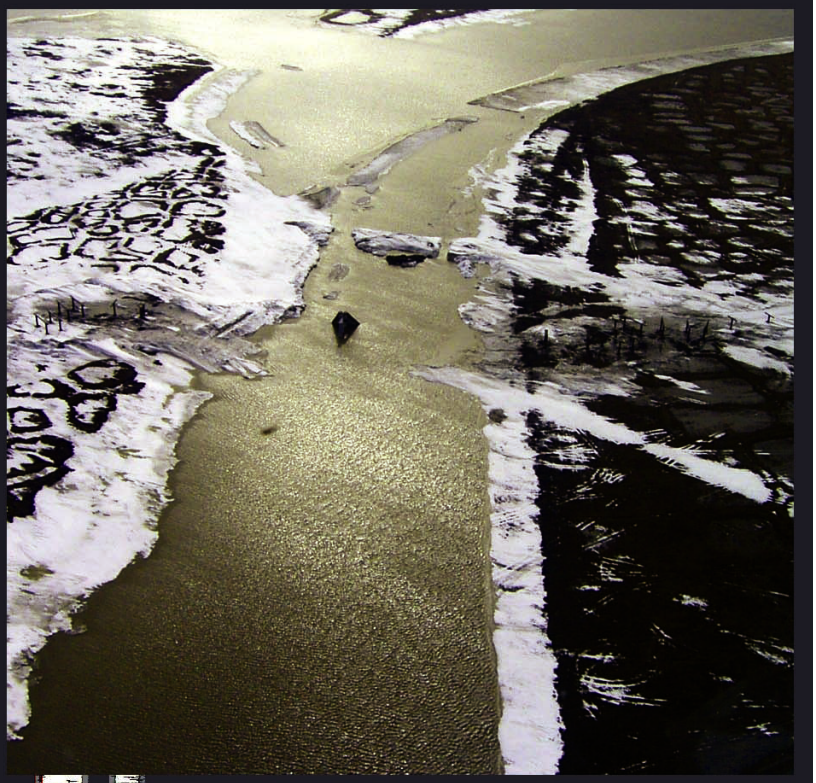

2005 Colville River Delta and Fish Creek Basin

Spring Breakup and Hydrological Assessment

Prepared for

ConocoPhillips

2005

Prepared by

Baker

ChallengeUs.

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105756-MBJ-RPT-001

December 2005

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Executive Summary

This report represents the fourteenth consecutive year of study for the Colville River Delta in support of the Alpine Oil Field (Alpine) and the fifth consecutive year of study for the Fish Creek basin in support of the proposed expansion into the National Petroleum Reserve-Alaska (NPRA). The Alpine Facilities are owned and operated by ConocoPhillips, Alaska (CPAI). Water surface elevations were monitored in 2005 at thirty-two locations in the Colville River delta and at eighteen locations in the Fish Creek basin. This season's breakup monitoring program represents the tenth consecutive year of Michael Baker, Jr., Inc. (Baker) involvement in Alpine development with respect to hydrological monitoring.

The start of the 2005 spring breakup at the United States Geological Survey (USGS) gage at Umiat began relatively early, but its arrival and advance in the delta was slowed due to cool temperatures and predominantly cloudy skies. In 2005, discharge was measured directly during spring breakup at Monument 1 at a water surface elevation near peak stage for the first time in ten years. The 2005 Colville River peak discharge at Monument 1 is estimated to have been 195,000 cubic feet per second (cfs) and represents the lowest recorded peak discharge since 1996. The CD3 and CD4 gravel facilities were of particular interest at Alpine during the 2005 breakup because this represented the first breakup season with these gravel facilities in place. All facilities withstood breakup floodwater without any erosion or damage.

The 2005 spring breakup flood within the Fish Creek drainage occurred during cool weather and predominantly cloudy skies that slowed the onset and advance of floodwaters on a basin-wide basis. The distribution of surface water during the 2005 spring breakup program in the Fish Creek basin was documented with particular attention to those gages located near proposed facilities. Breakup of Judy Creek, Fish Creek, and the Ublutuoch River were consistent with historical observations from prior years of study with respect to timing and the extent of flooding. Documentation of the breakup at the proposed drainage structures along the Alpine Satellite Development Program (ASDP) road was undertaken to continue to collect hydrologic data for use in designing these drainage structures.

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1.0 Introduction

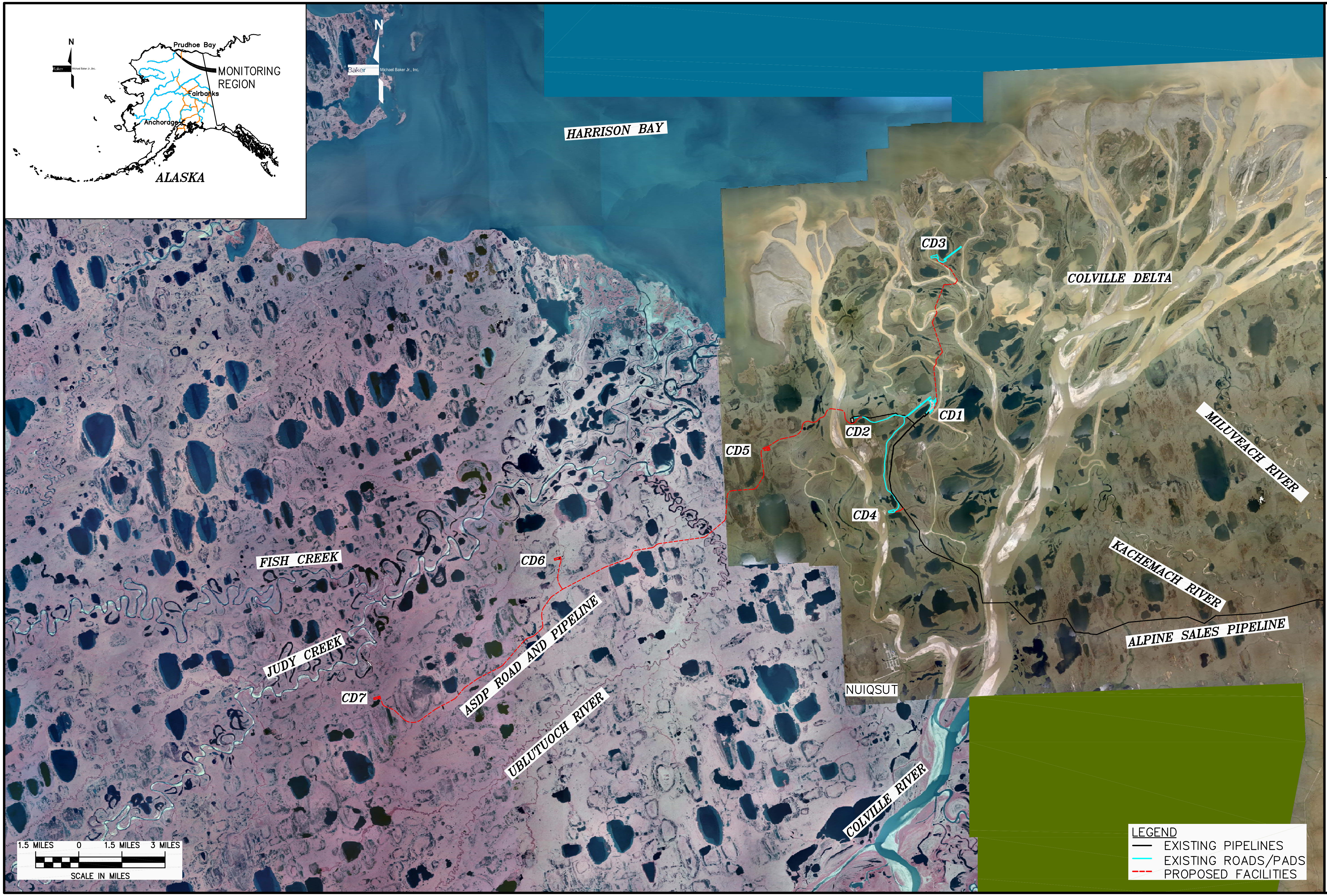
This report presents the results of the 2005 spring breakup monitoring activities conducted in the Colville River Delta (CD) and Fish Creek drainage basin by Baker. Fieldwork began on May 7 and was completed on June 15, 2005. Figure 1-1 identifies the Fish Creek Basin and Colville River Delta 2005 monitoring areas. Annual spring breakup monitoring is an important component in the ongoing program to further hydrological understanding in the region and provide information that can be used to maintain the continued safety of the environment and oilfield personnel and facilities during the region's annual spring flooding events.

1.1 Colville River Delta 2005 Monitoring Objectives

Located within the floodplain of the Colville River Delta on the North Slope of Alaska, the Alpine Facilities are owned and operated by ConocoPhillips, Alaska (CPAI). In this report, Alpine Facilities refers to the CD1 processing facility and CD2, CD3, and CD4 drilling pads. The spring breakup flooding is historically the largest annual flooding event in the North Slope region. For this reason, annual spring breakup monitoring activities have been conducted specifically for Alpine since 1992.

The primary objective of the 2005 spring breakup program in the Colville River Delta was to document the distribution of floodwater and measure water levels throughout the delta, including directly measuring discharge at Monument 1. Particular attention was given to locations of existing and proposed facilities as identified in Figure 1-2. CD1 and CD2 gravel facilities were constructed beginning in 1998 and the annual monitoring of spring breakup at these facilities was undertaken to satisfy U.S. Army Corps of Engineers (USACE) permit stipulations and in accordance with prudent operational monitoring. In 2005, a critical objective was to continue the spring breakup monitoring in and around the CD1 and CD2 facilities as identified in Figure 1-3. This included the documentation of breakup conditions at the Alpine drainage structures.

In addition, the 2005 spring breakup was of particular interest with respect to the CD3 and CD4 gravel facilities as 2005 was the first breakup season with these gravel facilities in place. The CD3 gravel pad and runway, the CD4 gravel pad and road, and the CD3 pipeline Vertical Support Members (VSM) and Horizontal Support Members (HSM) were constructed during the 2004/2005 winter construction season.



2005 BREAKUP MONITORING REGION

FIGURE 1-1 (SHEET 1 OF 1)

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COLVILLE RIVER DELTA
MONITORING SITES

FIGURE 1-2
(SHEET 1 OF 1)

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ALPINE FACILITIES
MONITORING SITES

FIGURE 1-3
(SHEET 1 OF 1)

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As part of the proposed CD5 development, CPAI has proposed the construction of the Nigliq Bridge, located to the west of CD2 and the Paleo Bridge located at the Nigliq Paleo Channel. For this reason, it was an objective of the 2005 program to emphasize the documentation of the distribution patterns of flow upstream, downstream, and at the site of the Nigliq Channel Bridge, as well as to measure discharge at this location.

Operation of Alpine currently relies on water withdrawal from local lakes L9312 and L9313. To help establish whether sufficient water is available, monitoring of the recharge of the lakes is conducted each spring breakup season. The 2005 monitoring of recharge to lakes L9312 and L9313 was completed to comply with State of Alaska Department of Fish and Game (ADF&G) permits FG99-111-0051-Amendment #5 and FG97-111-0190-Amendment #5, respectively.

The 2005 spring breakup program objectives also included documentation of the affects to flow and channel morphology caused by the ice bridges installed across the Kachemach River and the East and Nigliq channels of the Colville River.

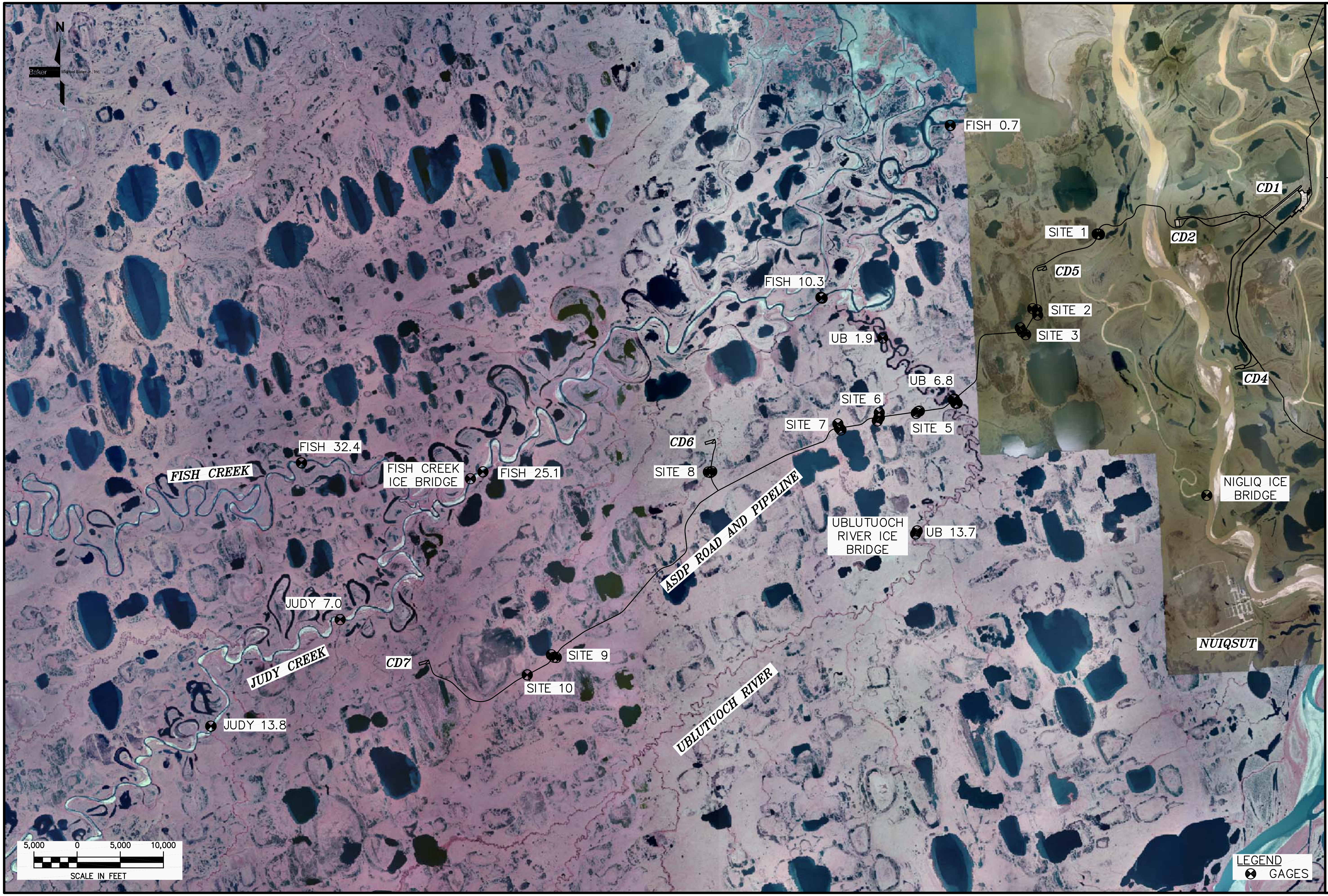
1.2 Fish Creek Basin 2005 Monitoring Objectives

CPAI has proposed the development of three satellite drilling pads in NPRA as part of the ASDP. The proposed drilling pads, designated CD5, CD6, and CD7, would be accessed by gravel road from CD2 via the Nigliq Bridge and Ublutuoch Bridge. The proposed pads and access roads are located within the Fish Creek Basin.

The primary objective of the 2005 spring breakup program in the Fish Creek basin was to document the distribution of surface water throughout the ASDP area with particular attention to the gage locations near proposed facilities as identified in Figure 1-4. The primary hydrological facilities associated with ASDP are the Ublutuoch Bridge located at River Mile (RM) 6.8 on the Ublutuoch River and the nine small streams drainage sites located along the proposed ASDP access road. The 2005 spring breakup program objectives also included documentation of the affects to flow and channel morphology caused by the Ublutuoch and Fish Creek ice bridges.

1.3 Acknowledgments

During hydrological documentation of spring breakup in 2005, Baker was pleased to have the steadfast support of Alaska Clean Seas, CPAI, Kuukpik/LCMF, Inc., and Maritime Helicopter. Their support was sincerely appreciated and contributed to another safe and successful breakup monitoring season.



FISH CREEK BASIN
MONITORING SITES

FIGURE 1-4
(SHEET 1 OF 1)

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2.0 2005 Spring Breakup Monitoring Program Methodology

The primary tasks associated with the 2005 spring breakup monitoring program were observations of the distribution of flow, measurement of water surface elevation, and documentation of discharge. The methods used in 2005 were based on standard techniques proven to be safe, reliable, efficient, and accurate for the conditions found on the North Slope of Alaska during the springtime and this year Acoustic Doppler Current Profiler (ADCP) technologies were introduced for measuring flow. In 2005 as in years past, safety, logistics, and weather were the factors that most affected the collection of data.

2.1 Visual Observations

One of the most valuable techniques for documenting spring breakup progression is visual observations. Observations in 2005 were made from the ground via Haggland tracked vehicles between May 7 and May 16, and continued from the air via helicopter between May 17 and June 15. Observations were made and recorded daily in field notebooks. In addition, daily digital photographs and video were collected to document the extent of breakup. A digital camera was also maintained at Monument 1 on May 7 and recorded pictures of the progression of breakup at 30-minute intervals through June 4. The video was compiled onto a Digital Video Disc (DVD), while the photographs have been organized by date and horizontal position into a Geographical Information System (GIS).

2.2 Water Surface Elevation Monitoring Methods

Water surface elevations were monitored at the various sites using permanent and temporary staff gages. The permanent staff gages are located at CD1 and CD2 and consist of permanently-mounted metal gage faceplates attached to drill steel. The temporary gage sets consisted of between two and five staff gage assemblies. Each gage assembly consisted of a metal gage faceplate mounted on a two-by-four timber attached with U-bolts to 1.5-inch angle iron posts driven into the ground. Installation of the temporary staff gages was completed prior to the arrival of breakup floodwater.

There were a total of eight permanent staff gages located at CD1 and CD2 which have been used during each of the six previous breakup programs. Ten new gage sites were added in 2005 around the CD3 and CD4 gravel facilities and three new gages near the CD3 pipeline river crossings. Baker proposes that theses gages be installed permanently using drill steel at a future date. In addition, gage sites were installed along the CD3 pipeline at each of the three river crossings. In 2005, there were a total of eleven temporary gages installed in the Colville River Delta and thirty-six temporary gages installed in the Fish Creek Basin.

The elevation of each gage was surveyed to benchmark elevations using optical level loop surveys. The surveys were completed in May 2005 just prior to breakup and were referenced to the British Petroleum Mean Sea Level (BPMSL) datum. Existing monuments were used for vertical control at all sites except for the NPRA small stream sites. In 2005, at the small streams sites, Kuukpik/LCMF established new vertical control using differential GPS techniques. Kuukpik/LCMF completed the level surveys of the permanent staff gages at Alpine and Baker completed the level surveys for all temporary staff gages.

The horizontal position of each gage was recorded using a handheld Garmin III Plus Global Positioning System (GPS) in North American Datum 83 (NAD 83). The horizontal position and elevation of the gages and survey monuments used in 2005 are tabulated in Appendix A. All elevations presented in this report are in feet and are based on BPMSL datum.

2.3 Discharge Measurement Methods

In 2005, discharge was measured indirectly using slope-area and slope-conveyance computations, and directly using ADCP technologies, standard USGS midsection techniques and using a single point velocity measurement. The method selected at each site depended on a variety of site-specific conditions including safety, location, depth of water, volume, and the nature and composition of the channel. Generally, discharge measurements were taken as close to the observed peak stage as possible.

Indirect discharge measurements at Monument 1 were completed using slope-area computations, and using slope-conveyance computations at the Nigliq Bridge site as outlined in Dalrymple and Benson (1984). Slope data were obtained from water surface elevations recorded from upstream and downstream gages at each site. Cross-section geometry was based on cross-sections surveyed by Kuukpik/LCMF, Inc. Hydraulic roughness values were calculated based on discharge measurements (ABR and Shannon & Wilson, 1994a) and have been evaluated annually based on site investigations of the channel bottom using methods outlined by the USGS (Arcement and Schneider, 1989).

Direct discharge measurements at Monument 1 and at the Nigliq Bridge site near Monument 23 were completed using an RD Instruments Workhorse Sentinel 600kHz ADCP. The 600 kHz Sentinel was selected based on the conditions of the Colville River during peak stage at Monument 1. The ADCP was mounted to an aluminum frame attached to the side of an inflatable boat. The ADCP discharge measurements were conducted within manufacturer's requirements and USGS specifications (Lipscomb, 1995).

Direct discharge measurements at the Fish Creek Basin small stream sites, Ublutuoch River 6.8, and CD2 452-foot bridge were completed using standard USGS midsection techniques. A tag line was used to define the cross-section and delineate the measurement subsections within the channel. Discharge measurements in the culverts located in CD2 access road and the NPRA small stream sites were recorded using a Marsh-McBirney Flow Mate 2000 velocity meter attached to a USGS wading rod. At the 452-foot CD2 swale bridge a Price AA current meter and wading rod were used to measure velocity. At Ublutuoch River 6.8, a Price AA current meter and sounding reel mounted on a boat-type boom was used to measure velocity, and a 30-pound Columbus-type lead sounding weight was used to stabilize the meter and measure depth. At Ublutuoch River 6.8, all measurements were made from a boat.

2.4 Flood Frequency Analysis Methods

The magnitude and frequency of peak discharge of the Colville River was estimated in 2002 (Baker and Hydroconsult 2002). The magnitude and frequency of peak discharge of the Ublutuoch River was estimated in 2002 (URS, 2002). The magnitude and frequency of peak discharge at selected Fish Creek Basin smalls stream sites was estimated in 2003 (PND, 2003).

In 2005, the magnitude and frequency of peak stream discharge was estimated by Baker for the Fish Creek Basin monitoring sites at the proposed locations of drainage structures. The analysis was based on the regression equations for Region 7 as published in the 2003 USGS Water Resources Investigation Report 03-4188, “Estimating the Magnitude and Frequency of Peak Streamflows for Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada” (Curran, Meyer, and Tasker, 2003). Two-meter contour mapping, field observations, and aerial photography were used to estimate the drainage area contributing flow into the proposed drainage structures.

3.0 Stream Basins Monitoring Sites Overview

The Colville River and Fish Creek Basin share common hydrologic and hydraulic characteristics due to the arctic climate and the continuous nature of regional permafrost. Groundwater influx is essentially nonexistent with shallow groundwater restricted to isolated zones beneath deep lakes and river channels. For most of the year, much of Fish Creek and its tributaries are frozen to their beds and cease flowing. While the Colville River may not freeze to its bed, flow has been documented to be non-existent during the winter months.

Spring snowmelt produces most of the annual flow that occur in these streams. Annual peak floods for the Colville River and Fish Creek occur in the spring during breakup. Summers are marked by generally declining low flow conditions with occasional temporary and relatively minor increases due to rainfall events.

In addition to the hydrological studies in support of Alpine and proposed ASDP, the USGS maintains independent records of streamflow and water quality for numerous sites along the Colville River and Fish Creek Basin and their tributaries. While much of the USGS data is limited to the 1970s, gages are currently maintained and operated on the Colville River at Umiat and on Fish Creek.

3.1 Colville River Delta

The Colville River drainage basin is situated within three physiographic provinces –Arctic Coastal Plain, Arctic Foothills, and Brooks Range. The bulk of the river's basin (64%) is located within the Arctic Foothills province (Walker, 1976). The 21,000 square mile Colville River Basin drains approximately 29% of the North Slope of Alaska (Walker, 1983) and is comprised of the Colville River and its tributaries (see Figure 3-1). The primary tributaries of the Colville River include the Itkillik River, Anaktuvuk River, Chandler River, and the Killik River.

Where the Colville River reaches the Beaufort Sea, it forms a delta more than 25 miles long that extends over an area of approximately 250 square miles. The East and Nigliq Channels account for 99% of the flow in the Colville Delta (Walker, 1983). The scars of two formerly active delta distributary channels are located between the Nigliq Channel and the far western margin of the Colville River Delta, and are referred to as the Nigliq Paleochannels. The proposed ASDP road between CD2 and the proposed CD5 facility will cross the Nigliq Channel Paleochannels.

COLVILLE RIVER AND FISH CREEK BASINS

FIGURE 3-1 (SHEET 1 OF 1)

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The 2005 Colville River monitoring sites extended from the head of the delta at Monument 1 to near the western downstream boundary of the delta at Monument 28 and at the Helmricks Homestead near Monument 35 at the eastern downstream boundary (see Figure 1-2). The Monument 1 gage location (Photo 3-1) represents the only reach of the Colville River where the flow from all of the primary contributors is confined in a single channel. Monuments 28 and Helmricks Homestead represent flooding conditions near the downstream boundary of the Colville River Delta.

Photo 3-1 Colville River at Monument 1, June 2, 2005

Monitoring of the East Channel was completed using the Monument 9 gage located downstream of the Putu Channel and upstream of the entrance to the Sakoonang Channel near the Horizontal Directional Drilled (HDD) crossing of the Alpine Sales Pipeline, thus it is positioned to represent the entire flow in the Colville River-East Channel. The gages in the Nigliq Channel included locations at Monuments 20, 22, and 23, which are located near CD2 and CD4.

Photo 3-2 CD3 and CD3 pipeline crossing Ulamnigiaq Channel, May 22, 2005

Monitoring sites that were established near existing and proposed facilities around Alpine are represented on Figure 1-3. CD1 and CD2 gages are positioned to monitor and record the water surface elevations upstream and downstream of the gravel facilities. Gage sets were installed at the locations where the CD3 pipeline route crosses the Sakoonang, Tamayayak, and Ulamnigiaq Channels (Photo 3-2).

Two gage sets were also monitored on the West and East Ulamnigiaq Channels to document water surface elevations at the southwest end of the CD3 pad and northeast of the CD3 runway (Photo 3-3). These gages are referred to as gages 11 and 12 respectively.

Eight gages were also monitored with respect to the CD4 road and pad (Photo 3-4) and are referred to as gages 13 through 20. In addition, two gage sets were also monitored near the Nigliq Paleochannels along the proposed ASDP road and are referred to as Nigliq PaleoEast and Nigliq PaleoWest (Figure 1-2).

3.2 Fish Creek Basin

The Fish Creek Basin drains 1,830 square miles and is comprised of Fish Creek and its primary tributaries, Ingok Creek, Judy Creek, and the Ublutuoch River (see Figure 3-1). Almost the entire Fish Creek Basin is situated within the Arctic Coastal Plain physiographic province with the exception of the upper portion of the Judy Creek Basin, which extends southward into the Arctic Foothills physiographic province (URS, 2003).

The 2005 Fish Creek Basin monitoring sites extended along Fish Creek, Judy Creek, and the Ublutuoch River. Monitoring site names are identified by the drainage and river mile from the mouth of the drainage. In addition, numerous smaller unnamed tributaries within the Fish Creek Basin were also monitored and are referred to as small stream sites (Photo 3-5).

Photo 3-3 CD3 pad and runway, July 8, 2005

Photo 3-4 CD4 pad and access road, May 30, 2005

Photo 3-5 Small Stream Site 8 in NPRA, June 8, 2005

The majority of the Fish Creek Basin monitoring sites were located adjacent to proposed facilities, including all of the small stream sites and the location of the proposed Ublutuoch Bridge. The other selected Fish Creek Basin monitoring sites extended throughout the northern portions of the basin (see Figure 1-4).

3.2.1 Fish and Judy Creeks

Fish Creek lies west of the Colville River Delta (Photo 3-6). The sinuous, relatively low-gradient channel flows northeast into Harrison Bay. Fish Creek channel banks and bed consist of silt and sand sized particles. Meander bends commonly have undercut banks and bank sloughing along their outer edges.

Photo 3-6 Flood waters on Fish Creek, June 6, 2005

In 2005, four monitoring sites were located along Fish Creek. Fish 0.7 was located on the south bank 0.7 river miles upstream of the mouth of Fish Creek near Harrison Bay. Fish 10.3 was located on the south bank approximately one mile upstream of the Ublutuoch River-Fish Creek confluence. Fish 25.1 was located approximately 1,000 feet downstream of the 2005 Fish Creek Ice Bridge on the northwest bank. At Fish 25.1, the sandy-silt riverbanks were found to be steep and sparsely populated by willows that form a dense bank before dissipating into tundra. Fish 32.4 was located approximately 4.5 river miles upstream of the Fish-Judy Creek confluence. Fish 32.4 had considerable sand and silt deposition to the inside of the bend and low-lying willows dominate sandy banks and shrubs intersperse with grass and sedge.

Judy Creek, a tributary to Fish Creek, is located approximately 26 river miles upstream of Harrison Bay. Judy Creek has a drainage area of approximately 666 square miles (URS, 2002), 18% of which is covered by lakes. The headwaters of Judy Creek are located in the Arctic foothills, while the remaining portion of the watershed falls within the Arctic Coastal Plain. Like Fish Creek, Judy Creek is a sinuous, low-gradient channel with channel banks and a bed consisting of silt and sand. Undercut banks and bank sloughing are common features along the outside of meander bends. In 2005, two gage sets were monitored at Judy Creek 7.0 and 13.8.

3.2.2 Ublutuoch River

Ublutuoch River lies southeast of Fish Creek and Judy Creek and is contained within the Fish Creek Basin. The sinuous, low-gradient channel (Photo 3-7) flows north into Fish Creek approximately 10 river miles upstream of Harrison Bay. Meander bends commonly have undercut banks and bank sloughing along their outer edges. Two monitoring stations on the Ublutuoch River in the vicinity of the proposed bridge crossing were renamed in 2005 to reflect their location in river mileage. Former site Ublutuoch 6.8 Upstream was renamed Ublutuoch 6.9 and former site Ublutuoch 6.8 Downstream was renamed Ublutuoch 6.7.

Photo 3-7 Flood waters on the Ublutuoch River, June 9, 2005

The Ublutuoch River bridge site is located at river mile 6.8 and has a drainage area equal to approximately 228 square miles. Ublutuoch 13.7 was installed near the location where the ice bridge crossed the channel and the existing site at Ublutuoch 1.9 was included in the monitoring program.

3.2.3 Small Stream Sites

A total of ten locations were identified as monitoring sites and are referred to as Small Stream Sites (Sites) 1 through 10, increasing in number from northeast to southwest (Figure 1-4). Site 4 of the small streams monitoring plan is otherwise referred to as the Ublutuoch 6.8 monitoring site. Due to the nature of the monitoring program and the size of the crossing on the Ublutuoch River, Ublutuoch 6.8 is discussed independently of the small streams. All but one of the small stream monitoring sites are located along the proposed ASDP access road. Site 8 is located on the proposed CD6 spur road. Each small stream site includes gages near the centerline, upstream and downstream of the proposed ASDP road. The only exception is small stream site 10 having only a centerline gage.

Site 1 is located approximately one mile west of the Nigliq Channel and CD2. The site drains a ponded marsh of approximately 0.9 square miles, flowing west to east into a moderate-sized lake, through a highly braided and shallow channel. The channel bed is dominated by dense, low-lying sedge and scattered willow. Ground surface is irregular with tussocks defining the braided channel banks.

Site 2 is located within one mile of Site 3 and approximately one mile south of the proposed CD5 pad. The drainage basin of Site 2 is relatively small at approximately 0.2 square miles; it is defined by a number of ponded marshes and small lakes. A low lying ridge running parallel to the proposed road bisects Site 2. Ground surface is highly irregular, dominated by tussocks of dense sedge resulting in highly braided channels and pooled basins that retain snow melt. The drainage basin area of Site 3 is approximately 2.4 square miles and contains lake L9308 of approximately 1.3 square miles. In 2003, no gages were installed at Site 3. Tussocks were most abundant along the toe of the slope defining the west side of the drainage channel.

Sites 5 and 7 are within a mile of Site 6, which is approximately four miles west of the proposed CD6 pad. The Site 5 2003 Middle gage was located approximately 200 feet northeast of the 2005 Site 5 centerline gage. Site 5 bisects a channel of connected pools draining a small sub-basin composed of approximately 0.7 square miles of ponds and marshes. Grassy swales of fairly uniform topography define the channel of connected pools draining northwest into the Ublutuoch River. Native grass dominates the area with the presence of tussocks limited to regions bordering the channel reach. The 3.6 square mile drainage basin of Site 6 drains into the Ublutuoch River via connected pools, small ponds, and lakes. The Site 6 2003 Upstream gage was located approximately 150 feet south of the 2005 Site 6 centerline gage. The drainage at Site 6 connects two smaller lakes and is uniform in cross-section, having a firm channel bed with underlying sedge and banks dominated by willows. Site 7 is located in a shallow recession of pooled marshland dominated by grasses and tussocks. The channel is oriented north-south connecting two lakes of varied size. The southern lake (L9819) is approximately 0.4 square miles defining much of the drainage basin of Site 7, while the northern lake is considerably smaller. The drainage area of Site 7 is approximately 0.9 square miles.

At Site 8, a well-defined channel crosses the proposed CD6 access road 0.7 miles south of the CD6 pad. This channel drains a basin of nearly 5.4 square miles and consists of a firm-bottom reach dominated by grass and bordered by willow. This channel ultimately drains a basin of marshlands and lakes from the west to Fish Creek. Channel flow initiates from a small lake to the southwest of the crossing and is confined to the channel before terminating into lake L9912 nearly two miles to the north.

Site 9 is located within one mile of Site 10 and is located approximately 3 miles east of the proposed CD7 pad. The Site 9 2003 Downstream gage was located approximately 150 feet west of the 2005 Site 9 centerline gage. Site 9 includes a defined channel feeding a shallow pond, which in turn drains north through the monitoring area to lake M0024. Scattered willows, grasses, and tussocks of short

sedge dominate the area. The drainage basin of approximately 1.6 square miles lies to the southeast and is predominantly composed of ponded marshland with a few lakes.

Site 10 drains a marshland with an area of approximately 2.3 square miles to the southwest via a small lake fed from the south by three well-defined channels. The lake drains to the north through the monitoring site where it passes through grass, willow, and sporadic sedge tussocks.

4.0 2005 Colville River Delta Breakup Overview

The Colville River Delta has been monitored annually in support of Alpine since 1992 primarily at Monument 1 and near the Alpine Facilities. The location and number of monitoring sites varied annually depending on the objectives of the hydrology program each season.

4.1 Colville River Delta Daily Observations

The start of the 2005 spring breakup at the USGS gage at Umiat began relatively early, but its arrival and advance in the delta was slowed due to cool temperatures and predominantly cloudy skies. Jim Helmricks observed the leading edge of floodwater on May 13 on the Colville River approximately 50 air miles upstream from Monument 1 (Photo 4-1).

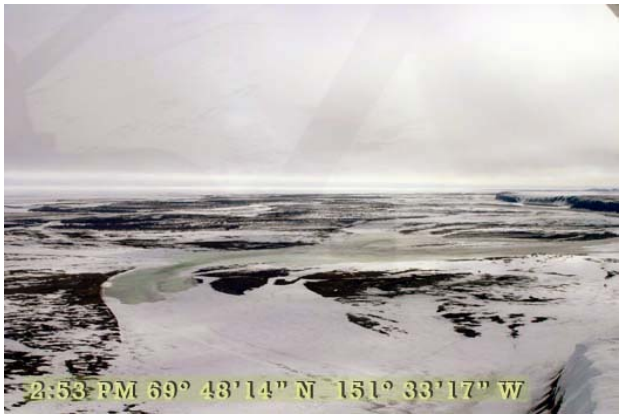


Photo 4-1 Leading edge of Colville River breakup, May 13, 2005

This early flow appeared to be originating from the main channel of the Colville River and did not contain flow from the tributaries downstream of Umiat. By May 16, the floodwater had reached the location of the 2005 ice bridge on the East Channel of the Colville River (Photo 4-2). On May 17 floodwater had entered the Nigliq Channel and was observed downstream of the 2005 Nigliq ice bridge location. Visual observations at both the East Channel and Nigliq ice bridges indicated that neither appeared to be impeding or in any way affecting the flood water levels.

Photo 4-2 East channel of Colville River at ice bridge, May 16, 2005

During the four-day period from May 17 through May 20, floodwater was slowed because of cold weather. On the afternoon of May 19, floodwater was observed in the Tamayayak Channel near the CD3 pipeline bridge (Photo 4-3).

Photo 4-3 Tamayayak channel pipe bridge on CD3 pipeline, May 25, 2005

At Monument 1, floodwater had yet to reach the gages. On May 20, flow under the ice from the Nigliq Channel into Nanuq Lake was observed.

An overflight of the Ocean Point area south of Monument 1 on the morning of May 21 showed significant broken ice in the channel. However, no significant ice jam formations were observed due to slow flow velocities. The channel upstream from Ocean Point appeared to be relatively more open with channel ice appearing to have lifted, but did not move much downstream, again due to slow water velocities. Subsequent flights to the Ocean Point area on May 24 and May 25 showed that though small ice jams were forming, they posed no impedance to flow and had caused no overbank flooding (Photo 4-4).

Photo 4-4 Ocean Point area, May 25, 2005

May 21 marked the first day that floodwater entered into the Ulamnigiaq Channel. On May 22, although floodwater had yet to enter the Sakoonang from the East Channel, water was observed in the Sakoonang Channel just downstream from Alpine (Photo 4-5).

Photo 4-5 Sakoonang channel pipe bridge on CD3 pipeline, May 22, 2005

The water observed in the Sakoonang Channel was backwater from the Tamayayak Channel. On May 23, the backwater had reached the pipeline crossing of Sakoonang Channel, and by May 26 had reached a point adjacent to the CD1 flare pits. In subsequent days, the backwater progressed steadily upstream. On the morning of May 29 floodwater was first observed to have entered the Sakoonang Channel from the East Channel.

May 30 was the first day that floodwater reached gages at Monument 1.

Floodwater at Monument 1 rose relatively quickly with the peak stage occurring two days later. On the morning of May 31, water from Nanuq Lake began flowing into the Alpine infield area and reached the CD2 road drainage structures (Photo 4-6).

The occurrence of the peak water surface elevation at Monument 1 on the afternoon of June 1 resulted in accelerated degradation of the floating ribbon ice still in place over the thalweg along the right bank (Photo 4-7). By June 2, all the floating ribbon ice had cleared the Monument 1 section and the stage began to decrease rapidly. The stage at Monument 1 and around Alpine continued to fall during the next several days.

On June 3 and June 4, the river stage of the Colville River at Umiat as measured by the USGS was noted to be rising. On June 6, the water surface elevation at Monument 1 also began to increase. A secondary peak water surface elevation occurred at Monument 1 on June 9 (Photo 4-8).

The secondary peak was not of sufficient magnitude to cause similar increases downstream in the Nigliq Channel or in the Alpine vicinity. Stage in those areas, as well as on the Colville River at Monument 1, continued to decrease steadily.

Photo 4-6 Nigliq channel flow reaching Nanuq Lake, May 31, 2005

Photo 4-7 Peak stage at Monument 1, June 1, 2005

Photo 4-8 Secondary peak at Monument 1, June 8, 2005

4.2 Colville River Water Surface Elevations

4.2.1 Colville River Delta Water Surface Elevations

Water was first noted in the Colville River Delta at Monument 9 on May 16 with gage readings at Monument 9 beginning on May 17. Due to flight restrictions caused by poor weather, it is not known when water first moved through the Monument 1 area; however, it likely preceded the time of first water at Monument 9 by no more than 12 hours. Freezing conditions slowed the movement of the floodwater further upstream. Water surface elevation measurements at Monument 1 did not begin until May 28. Gage readings began at Helmricks Homestead near Monument 35 on May 18 and continued until June 14. Gage readings at Monuments 1 and 9 continued until June 10 and June 9, respectively.

Staff gage measurements on the Nigliq Channel began on May 23 when floodwaters first reached the gages near Monument 23. Gage readings at Monument 20 began on May 30 when water first reached the gages. Measurements at each of the Nigliq Channel monitoring sites, with the exception of Monument 28, continued until June 9. Monument 28 measurements were discontinued on June 3 because peak stage had passed. Water surface elevation and observation records for temporary staff gages in the Colville River Delta for the East and Nigliq Channels are presented in Table 4-1 through Table 4-9, beginning on page 4-6.

The Monument 1 peak water surface elevation was recorded on June 1 at an elevation of 13.18 feet. A secondary peak occurred on the morning of June 9 at an elevation of 11.92 feet. While the stage of the secondary peak was more than one foot lower than the initial peak, it occurred with no floating ice in the channel under entirely open channel conditions.

A peak recorded stage at Monument 23 was 5.95 feet and occurred on the morning of June 1 with intact ice still floating along the left bank (Photo 4-9). However, a minor secondary peak stage occurred at Monument 23 on June 3 similar to observations at Monuments 20 and 22.

Photo 4-9 Peak stage on Nigliq channel at Monument 23, June 1, 2005

The peak water surface elevations at Monuments 20 and 22 occurred on June 3 at elevations of 8.42 and 7.65 feet, respectively (Photo 4-10). At the Monument 28 monitoring site, the peak stage occurred early on the morning of June 1 at an elevation of 3.60 feet (Photo 4-11).

The secondary peak at Monument 1 was not duplicated at any of the three monitoring sites along the Nigliq Channel. At Helmricks Homestead, numerous minor peaks on the falling limb of the stage hydrograph were recorded.

Floodwaters did not rise high enough to reach gages at Nigliq PaleoEast or Nigliq PaleoWest.

Photo 4-10 Nigliq channel at Monument 20, June 1, 2005

Photo 4-11 Peak stage on Nigliq channel at Monument 28, June 1, 2005

Table 4-1 Monument 1, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/28/05 10:00 AM	9.51	Water not yet on gages - surveyed WSE
5/29/05 1:00 PM	10.17	Water not yet on gages - surveyed WSE
5/30/05 11:25 AM	11.38	WSE +/- 0.02 ft due to high wind
5/31/05 11:10 AM	12.45	WSE +/- 0.02 ft due to high wind
6/1/05 9:08 AM	12.99	In-channel floating ice softening significantly
High Water Mark	13.18	High water occurred on the afternoon of June 1
6/2/05 9:55 AM	12.65	All floating ice has cleared, channel 100% open
6/2/05 5:05 PM	12.07	Chunk ice floating through the reach
6/3/05 11:10 AM	10.73	Significant drop in stage
6/4/05 11:10 AM	9.15	Stage continues to decrease
6/6/05 9:00 AM	8.87	Stage continues to decrease
6/7/05 9:00 AM	10.17	Significant increase in stage in previous 24 hours
6/8/05 12:04 PM	11.47	Stage continues to increase
6/9/05 9:36 AM	11.92	Secondary peak stage
6/10/05 9:10 AM	11.00	Reading prior to ADCP (doppler) discharge measurement
6/10/05 1:42 PM	10.84	Reading after doppler discharge measurement

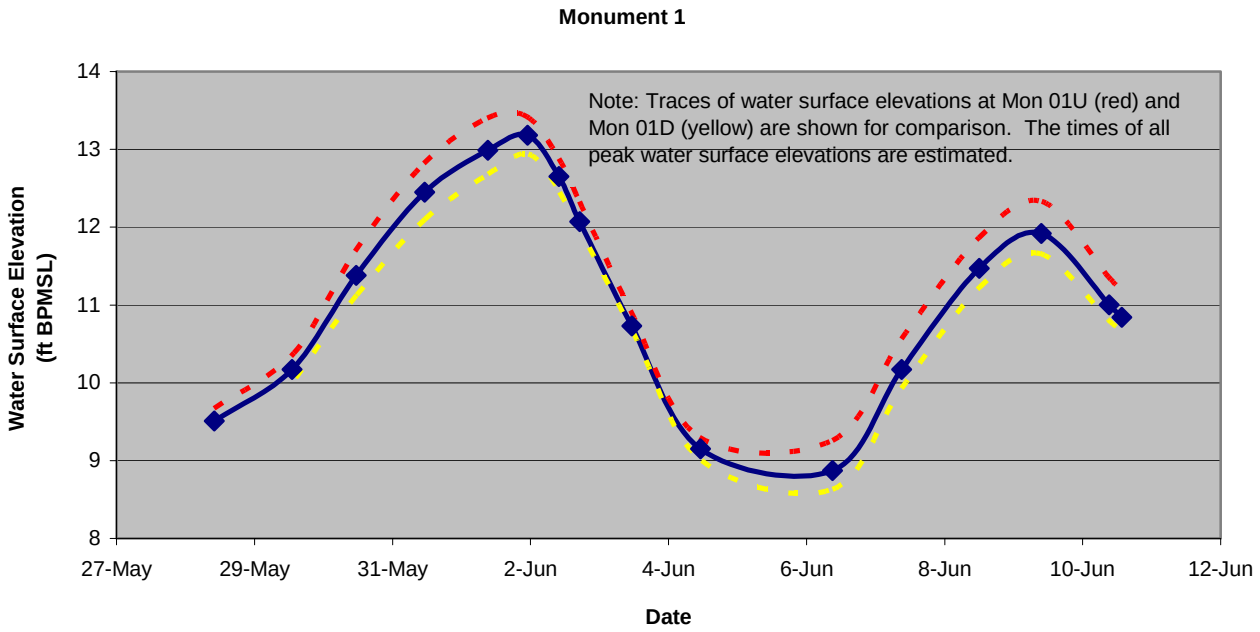


Table 4-2 Temporary Benchmark 1U, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/28/05 10:00 AM	9.67	Water not yet on gages - surveyed WSE
5/29/05 1:45 PM	10.38	Water not yet on gages - surveyed WSE
5/30/05 11:05 AM	11.69	WSE +/- 0.02 ft due to high wind
5/31/05 11:00 AM	12.82	WSE +/- 0.02 ft due to high wind
6/1/05 8:55 AM	13.40	In-channel floating ice softening significantly
High Water Mark	13.42	High water occurred on the afternoon of June 1
6/2/05 9:50 AM	12.88	All floating ice has cleared, channel 100% open
6/2/05 5:00 PM	12.33	Chunk ice floating through the reach
6/3/05 10:45 AM	10.93	Significant drop in stage
6/4/05 10:45 AM	9.30	Stage continues to decrease
6/6/05 9:00 AM	9.26	Stage continues to decrease
6/7/05 9:00 AM	10.56	Significant increase in stage in previous 24 hours
6/8/05 12:00 PM	11.86	Stage continues to increase
6/9/05 9:42 AM	12.33	Secondary peak stage
6/10/05 9:00 AM	11.36	Reading prior to ADCP (doppler) discharge measurement
6/10/05 1:36 PM	11.18	Reading after doppler discharge measurement

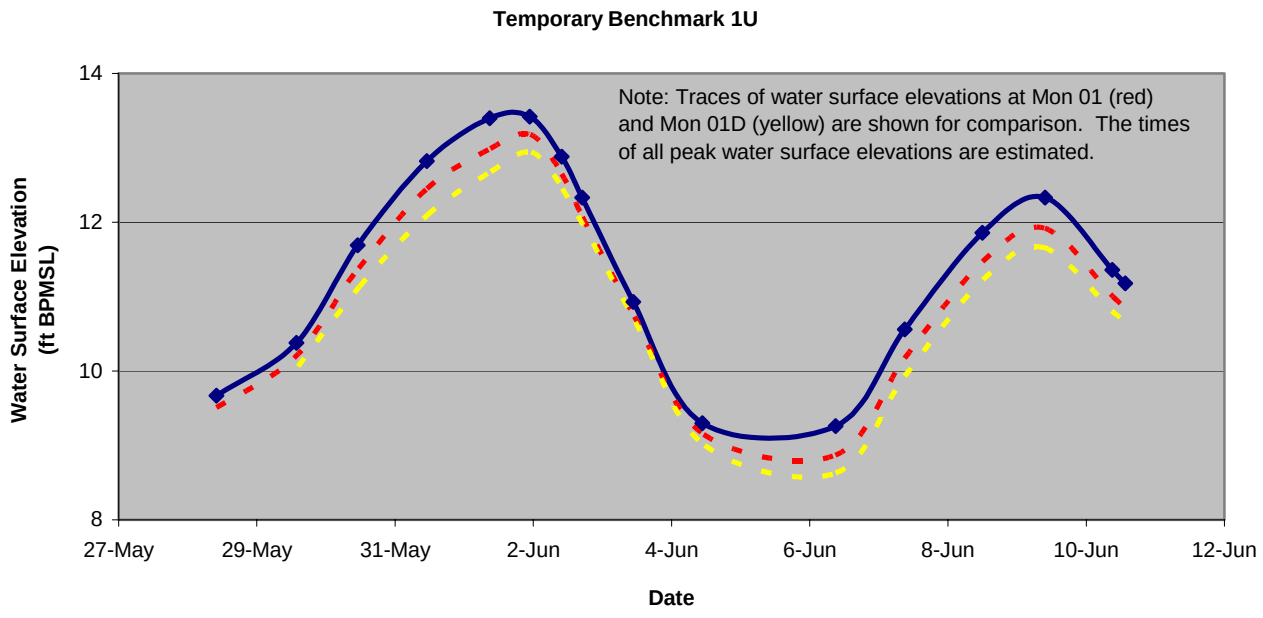


Table 4-3 Temporary Benchmark 1D, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/29/05 2:25 PM	10.06	Water not yet on gages - surveyed WSE
5/30/05 11:35 AM	11.13	WSE +/- 0.02 ft due to high wind
5/31/05 11:20 AM	12.10	WSE +/- 0.02 ft due to high wind
6/1/05 9:18 AM	12.68	In-channel floating ice softening significantly
High Water Mark	12.94	High water occurred on the afternoon of June 1
6/2/05 10:08 AM	12.45	All floating ice has cleared, channel 100% open
6/3/05 11:30 AM	10.66	Significant drop in stage
6/4/05 11:30 AM	9.00	Stage continues to decrease
6/6/05 9:00 AM	8.63	Stage continues to decrease
6/7/05 9:00 AM	9.93	Significant increase in stage in previous 24 hours
6/8/05 12:18 PM	11.23	Stage continues to increase
6/9/05 9:09 AM	11.66	Secondary peak stage
6/10/05 8:50 AM	10.81	Reading prior to ADCP (doppler) discharge measurement
6/10/05 1:55 PM	10.66	Reading after doppler discharge measurement

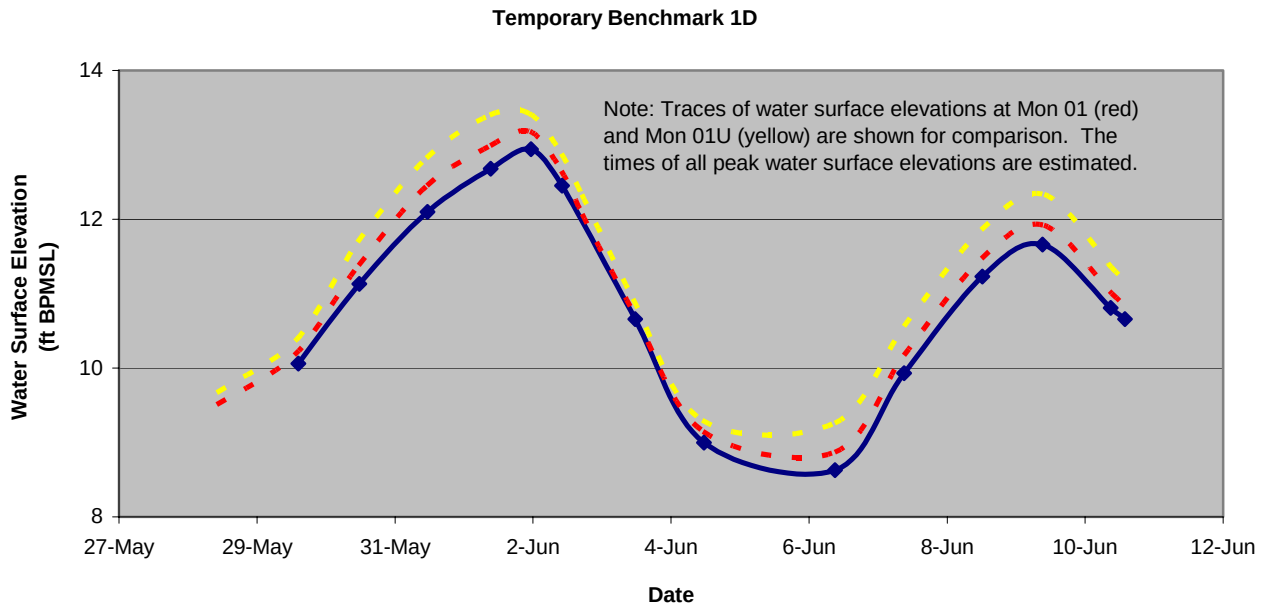


Table 4-4 Monument 9, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/17/05 9:10 AM	5.47	Floodwaters are bank to bank, appears all floodwater is frozen
5/17/05 5:15 PM	5.53	Floodwaters are bank to bank, appears all floodwater is frozen
5/18/05 9:02 AM	5.59	Floodwaters frozen w/ exception of a few small open leads, ice to 0.1-ft thick
5/18/05 5:55 PM	5.41	Floodwaters frozen w/ exception of a few small open leads, ice to 0.1-ft thick
5/19/05 9:50 AM	5.01	Floodwaters mostly frozen, broke through ice for gage reading
5/20/05 2:05 PM	4.38	Floodwaters mostly frozen, except immediately around gage
5/21/05 9:40 AM	4.10	Floodwaters mostly frozen, broke through ice for gage reading
5/22/05 3:15 PM	3.99	
5/23/05 3:40 PM	4.42	Floodwaters mostly frozen, broke through ice for gage reading
5/24/05 1:50 PM	5.23	Floodwaters mostly frozen, broke through ice for gage reading
5/25/05 9:45 AM	5.78	Chunk ice floating through the reach
5/25/05 3:13 PM	5.77	Chunk ice floating through the reach, TBM A hit by ice-reset
5/27/05 2:17 PM	6.39	
5/28/05 11:00 AM	7.35	Chunk ice floating through the reach
5/29/05 3:04 PM	7.71	
5/30/05 11:54 AM	8.96	WSE +/- 0.02 ft due to high wind
5/31/05 11:35 AM	9.81	WSE +/- 0.02 ft due to high wind
6/1/05 9:33 AM	10.31	Chunk ice floating through the reach
High Water Mark	10.51	High water occurred on the morning of June 2
6/3/05 12:03 PM	9.50	Significant drop in stage
6/9/05 9:55 AM	9.21	Stage continues to decrease

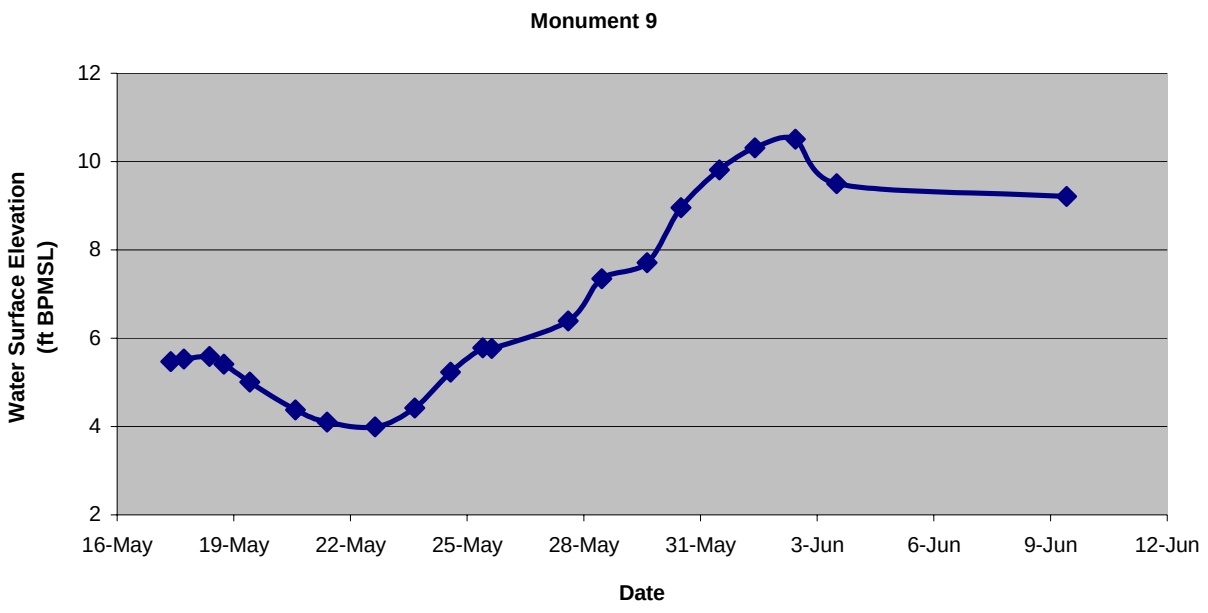


Table 4-5 Monument 20, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/30/05 11:10 AM	6.85	Floating ice on left bank
5/31/05 11:55 AM	7.82	WSE +/- 0.02 ft due to high wind
6/1/05 9:45 AM	8.04	WSE +/- 0.02 ft due to high wind
6/2/05 9:30 AM	7.75	
High Water Mark	8.42	High water occurred on the morning of June 3
6/3/05 12:13 PM	7.95	
6/4/05 4:34 PM	7.63	Decreasing stage
6/9/05 10:06 AM	6.29	Significant decrease in stage

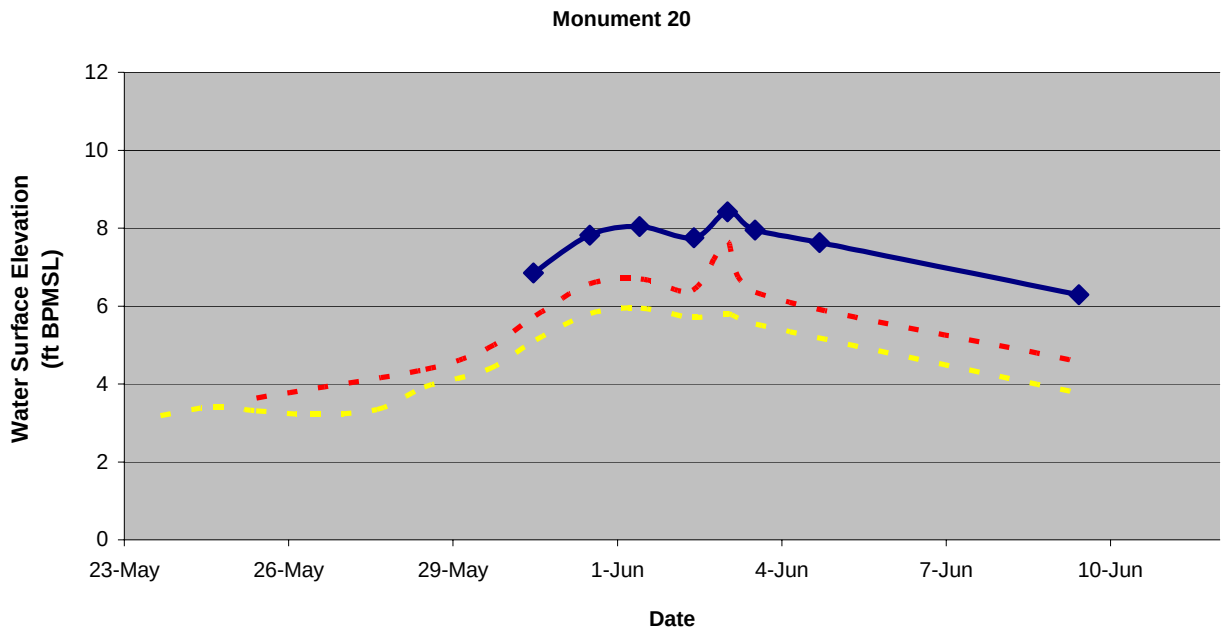


Table 4-6 Monument 22, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/25/05 10:00 AM	3.64	Floating ice on right bank
5/28/05 12:02 PM	4.38	No gages in water-survey WSE
5/29/05 3:00 PM	4.91	
5/30/05 12:15 PM	5.75	WSE +/- 0.02 ft due to high wind
5/31/05 12:05 PM	6.57	WSE +/- 0.02 ft due to high wind
6/1/05 10:13 AM	6.69	
6/2/05 9:00 AM	6.41	Moderate winds-good reading
High Water Mark	7.65	High water occurred on the morning of June 3
6/3/05 12:21 PM	6.35	
6/9/05 10:16 AM	4.57	Significant decrease in stage
6/11/05 9:20 AM	3.69	

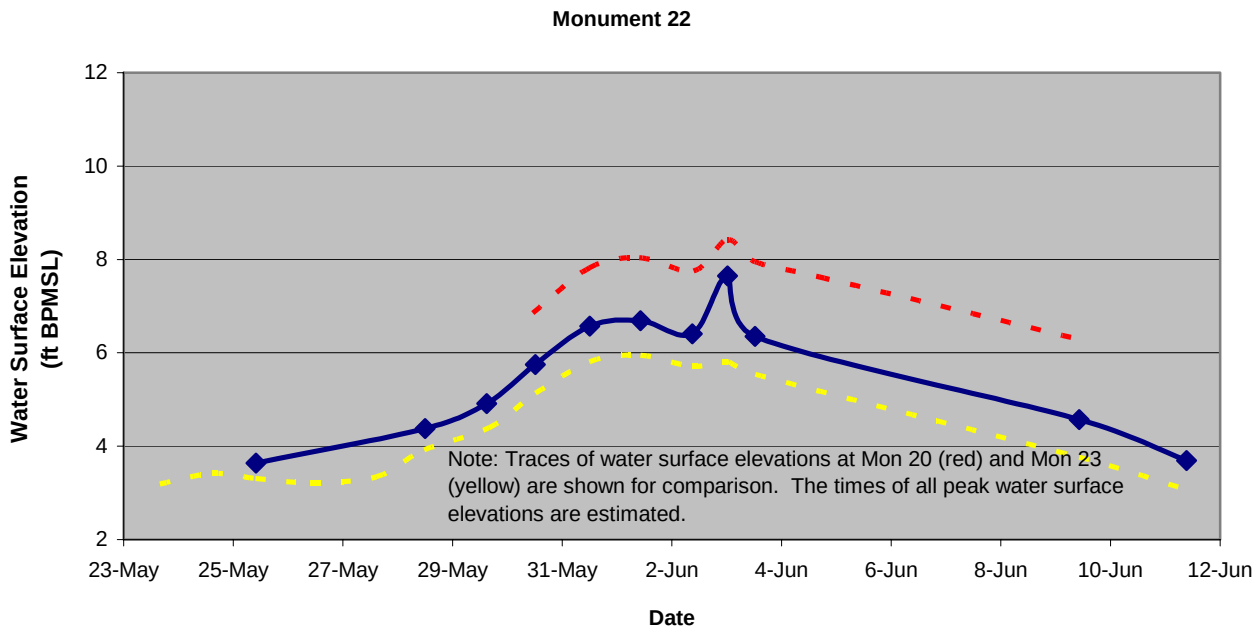


Table 4-7 Monument 23, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/23/05 4:01 PM	3.19	Reading through saturated snow-questionable communication
5/24/05 2:55 PM	3.42	Reading through saturated snow-questionable communication
5/25/05 9:40 AM	3.31	Reconfirm elevation at gages
5/26/05 9:35 AM	3.22	
5/27/05 2:42 PM	3.34	
5/28/05 11:29 AM	3.92	
5/29/05 3:55 PM	4.39	
5/30/05 12:20 PM	5.13	WSE +/- 0.02 ft due to high wind
5/31/05 12:20 PM	5.81	WSE +/- 0.02 ft due to high wind
High Water Mark	5.95	High water occurred on the morning of June 1, ice still floating along left bank
6/2/05 8:52 AM	5.71	
6/3/05 12:29 AM	5.81	
6/3/05 12:29 PM	5.54	Stage decreasing
6/9/05 10:21 AM	3.76	Significant decrease in stage
6/11/05 9:35 AM	3.06	

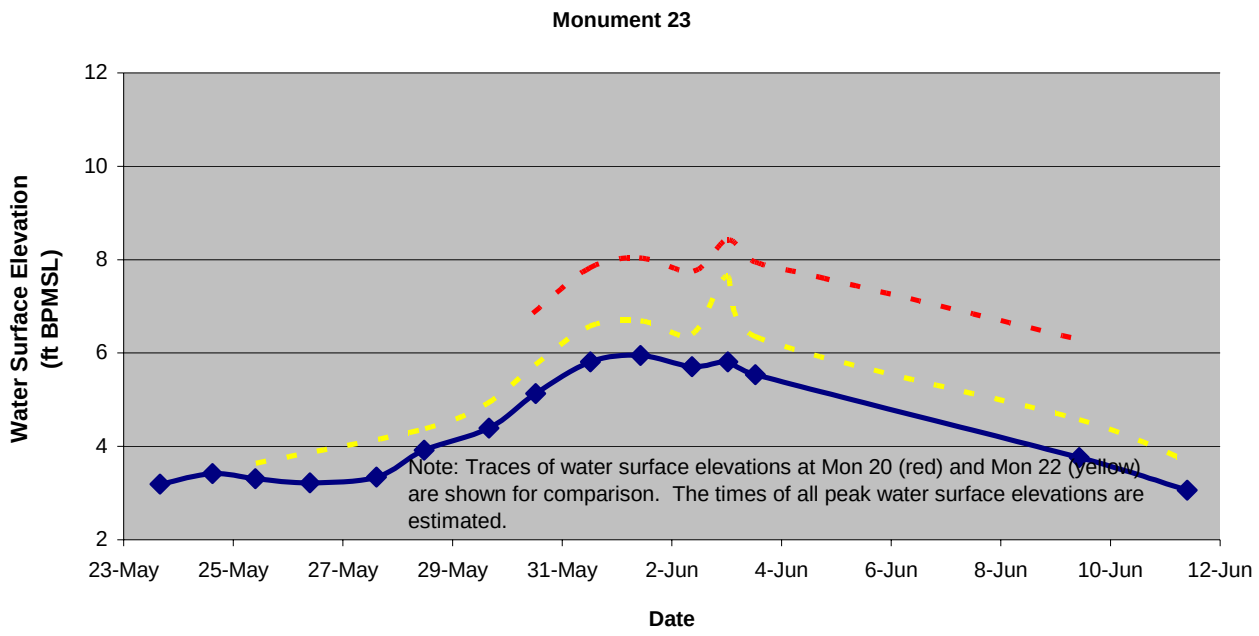


Table 4-8 Monument 28, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/29/05 4:33 PM	2.71	
5/30/05 12:40 PM	2.93	WSE +/- 0.02 ft due to high wind
5/31/05 12:37 PM	3.03	WSE +/- 0.02 ft due to high wind
High Water Mark	3.60	High water occurred on the morning of June 1
6/2/05 11:15 AM	3.31	
6/3/05 12:42 PM	2.98	

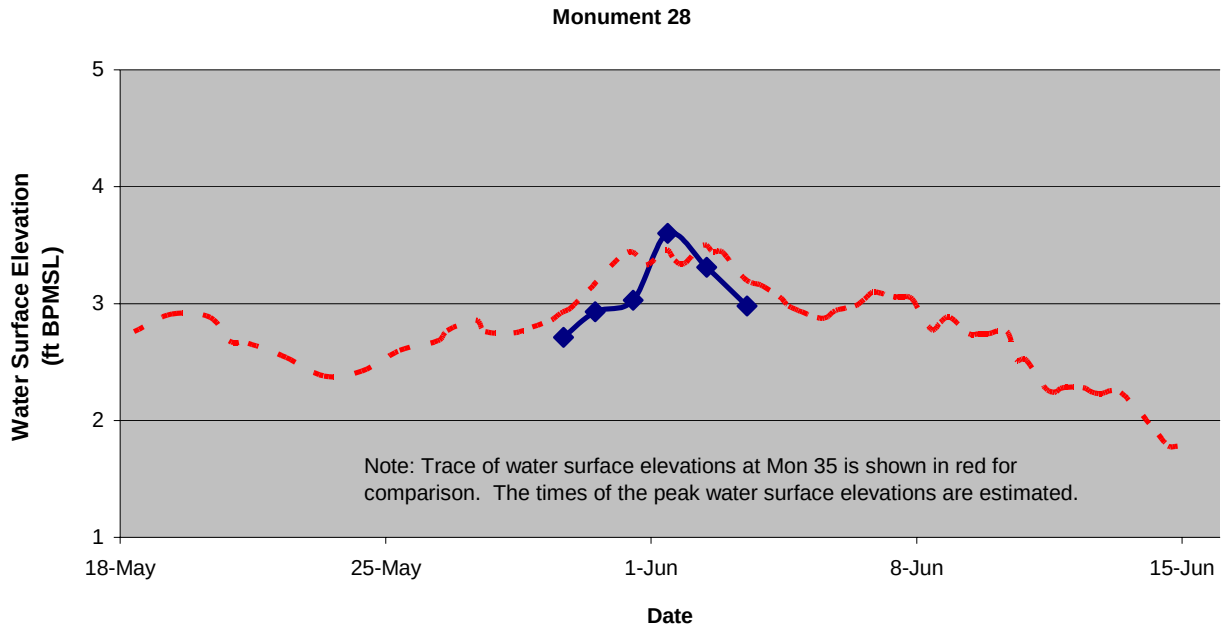
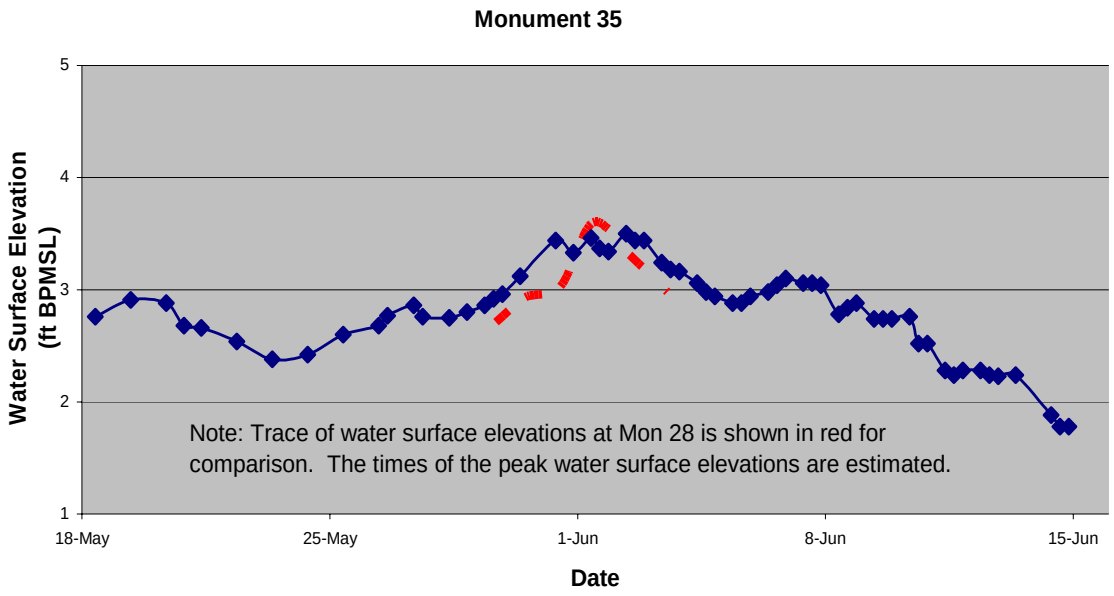


Table 4-9 Helmricks (near Monument 35), Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Date & Time	Water Surface Elevation (feet BPMSL)	Date & Time	Water Surface Elevation (feet BPMSL)
5/18/05 9:00 AM	2.76	6/1/05 9:00 AM	3.46	6/8/05 9:00 AM	2.78
5/19/05 9:00 AM	2.91	6/1/05 3:00 PM	3.37	6/8/05 3:00 PM	2.84
5/20/05 9:00 AM	2.88	6/1/05 9:00 PM	3.34	6/8/05 9:00 PM	2.88
5/20/05 9:00 PM	2.68	6/2/05 9:00 AM	3.50	6/9/05 9:00 AM	2.74
5/21/05 9:00 AM	2.66	6/2/05 3:00 PM	3.44	6/9/05 3:00 PM	2.74
5/22/05 9:00 AM	2.54	6/2/05 9:00 PM	3.44	6/9/05 9:00 PM	2.74
5/23/05 9:00 AM	2.38	6/3/05 9:00 AM	3.24	6/10/05 9:00 AM	2.76
5/24/05 9:00 AM	2.42	6/3/05 3:00 PM	3.18	6/10/05 3:00 PM	2.52
5/25/05 9:00 AM	2.60	6/3/05 9:00 PM	3.16	6/10/05 9:00 PM	2.52
5/26/05 9:00 AM	2.68	6/4/05 9:00 AM	3.06	6/11/05 9:00 AM	2.28
5/26/05 3:00 PM	2.77	6/4/05 3:00 PM	2.98	6/11/05 3:00 PM	2.24
5/27/05 9:00 AM	2.86	6/4/05 9:00 PM	2.94	6/11/05 9:00 PM	2.28
5/27/05 3:00 PM	2.76	6/5/05 9:00 AM	2.88	6/12/05 9:00 AM	2.28
5/28/05 9:00 AM	2.75	6/5/05 3:00 PM	2.88	6/12/05 3:00 PM	2.24
5/28/05 9:00 PM	2.80	6/5/05 9:00 PM	2.94	6/12/05 9:00 PM	2.23
5/29/05 9:00 AM	2.86	6/6/05 9:00 AM	2.98	6/13/05 9:00 AM	2.24
5/29/05 3:00 PM	2.92	6/6/05 3:00 PM	3.04	6/14/05 9:00 AM	1.88
5/29/05 9:00 PM	2.96	6/6/05 9:00 PM	3.10	6/14/05 3:00 PM	1.78
5/30/05 9:00 AM	3.12	6/7/05 9:00 AM	3.06	6/14/05 9:00 PM	1.78
5/31/05 9:00 AM	3.44	6/7/05 3:00 PM	3.06		
5/31/05 9:00 PM	3.33	6/7/05 9:00 PM	3.04		

Note: All gage readings made by Mr. Jim Helmricks



4.2.2 Alpine Facilities Water Surface Elevations

Water surface elevation measurements at the permanent staff gages at CD1 and CD2 pads began on May 31. These measurements were at Permanent Gages 9 and 10 and were attributed to local melt within drinking water lakes L9312 and L9313, respectively. Measurements on Permanent Gage 1 began on June 1 and were a result of Tamayayak backwater into the Sakoonang Channel. Measurements at gages 3 and 4 began on June 3. Floodwater did not rise high enough to register on Permanent Gages 6, 7, or 8. Measurements continued through June 4 on Permanent Gages 1, 3, and 4, at which point breakup flows had receded substantially.

Measurements continued at Permanent Gages 9 and 10 until June 13. After June 13, Kuukpik/LCMF recorded water levels at drinking water lakes L9312 and L9313.

Water surface elevation measurements at the CD3 pipeline crossing began on May 19 as flow passed through the slotted ice bridge on the Tamayayak Channel. Flow through ice bridge slots at the pipeline crossing on the Ulamnigiaq Channel began one day later on May 20 (Photo 4-12).

Floodwater did not rise high enough to reach Permanent Gage 11 on the West Ulamnigiaq; however, surface water reached Permanent Gage 12 on the East Ulamnigiaq on June 3 (Photo 4-13).

Photo 4-12 Ulamnigiaq channel at CD3 pipeline bridge, May 20, 2005

Photo 4-13 Peak stage at East Ulamnigiaq channel near CD3, June 2, 2005

Floodwaters did not rise high enough to reach any of the new CD4 gages 13 through 20 (Photo 4-15 and 4-15). Water surface elevation and observation records for staff gages at Alpine facilities CD1, CD2, and CD3 are presented in Table 4-10 through Table 4-18, beginning on page 4-17.

Peak water surface elevations in the Alpine vicinity at Permanent Gages 3 and 4 occurred on May 31 and June 1 at elevations of 6.48 and 6.28 feet, respectively (Photo 4-16 and 4-17).

The peak water surface elevation at Permanent Gage 1 occurred on the morning of June 2 at 4.46 feet. The peak water surface elevations at Permanent Gages 9 and 10 occurred on June 5 and June 10 at elevations of 8.0 and 6.1 feet, respectively. The maximum difference between water surface elevations on either side of the CD2 access road in 2005 was 0.12 feet and occurred between Permanent Gages 3 and 4. This maximum difference occurred on June 1.

Photo 4-14 Peak stage along CD4 road, June 1, 2005

Photo 4-15 CD4 pad near peak stage, June 1, 2005

Photo 4-16 CD2 pad near peak stage at, June 1, 2005

Photo 4-17 Peak stage at CD2 road and 452-foot swale bridge, May 31, 2005

Table 4-10 Permanent Staff Gage #1 - Sakoonang Channel, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Approx. Water Depth (feet)	Observations
6/1/05 10:00 AM	4.19	4.31	Backwater from Tamayayak Channel
High Water Mark	4.46	4.58	Peak backwater surface elevation occurred on June 2 at approximately 10:00 a.m.
6/3/05 8:33 AM	4.30	4.42	Backwater from Tamayayak Channel
6/4/05 8:49 AM	3.66	3.78	Backwater from Tamayayak Channel

Notes:
1. Water depth at the gage is based on ground elevation surveyed by Kuukpik/LCMF Inc. in 2002.

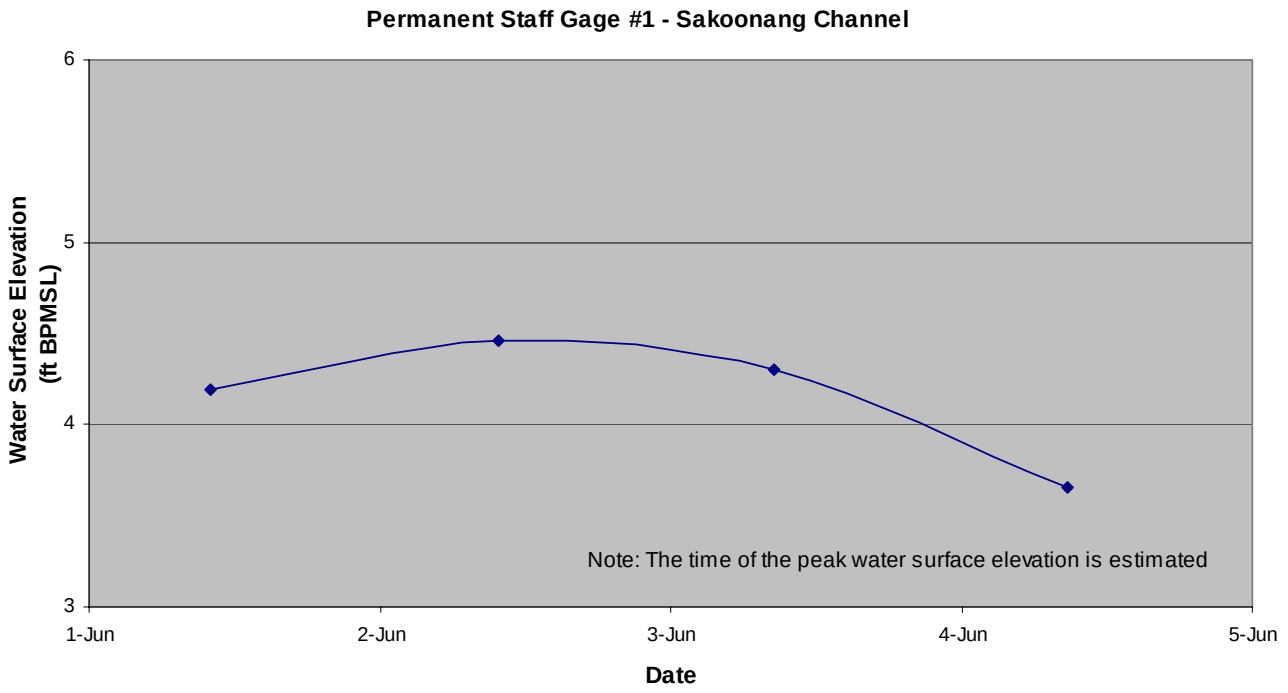


Table 4-11 Permanent Staff Gage #3, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Approx. Water Depth (feet)	Observations
High Water Mark	6.48	1.68	Peak water surface elevation occurred on May 31 at approximately 8:00 am
6/1/05 9:25 AM	6.40	1.60	Water surface elevation +/- 0.1' due to waves.
6/2/05 8:37 AM	6.13	1.33	Water surface elevation +/- 0.1' due to waves.
6/3/05 9:00 AM	6.07	1.27	Water surface elevation +/- 0.1' due to waves.
6/4/05 9:00 AM	5.57	0.77	

Notes:
1. Water depth at the gage is based on ground elevation surveyed by Kuukpik/LCMF Inc. in 2002.

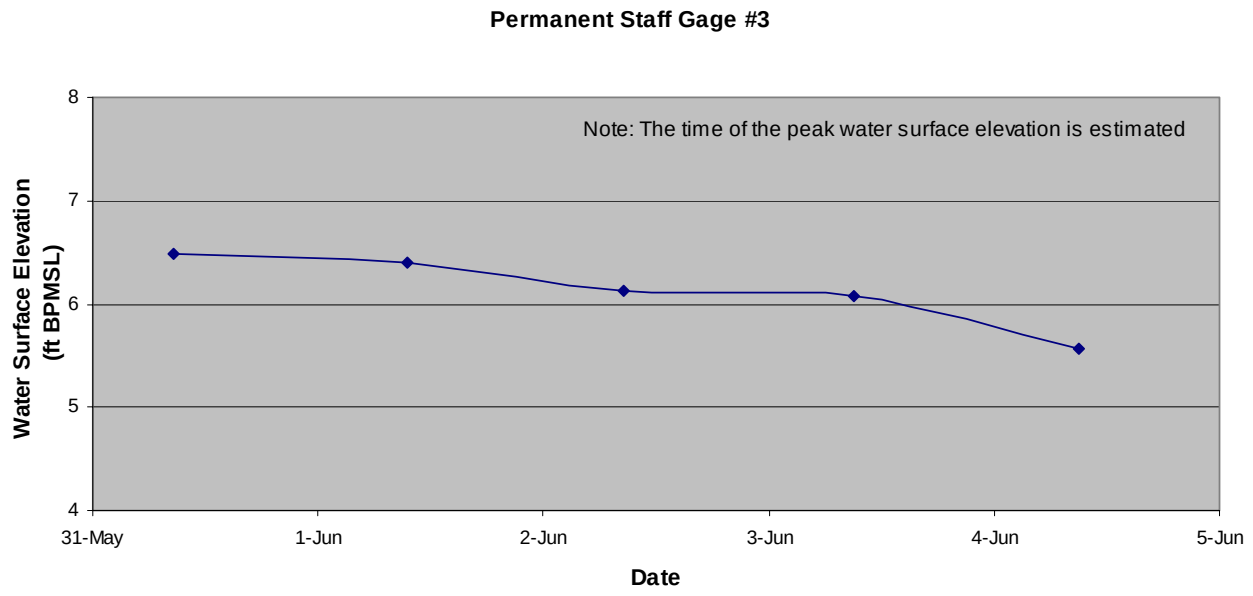


Table 4-12 Permanent Staff Gage #4, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Approx. Water Depth (feet)	Observations
High Water Mark	6.28	1.08	Peak water surface elevation occurred on June 1 at approximately 8:00 am
6/2/05 8:34 AM	6.05	0.85	Water surface elevation +/- 0.1' due to waves.
6/3/05 9:02 AM	5.98	0.78	
6/4/05 9:02 AM	Dry	0.00	No water on gage

Notes:

1. Water depth at the gage is based on ground elevation surveyed by Kuukpik/LCMF Inc. in 2002.

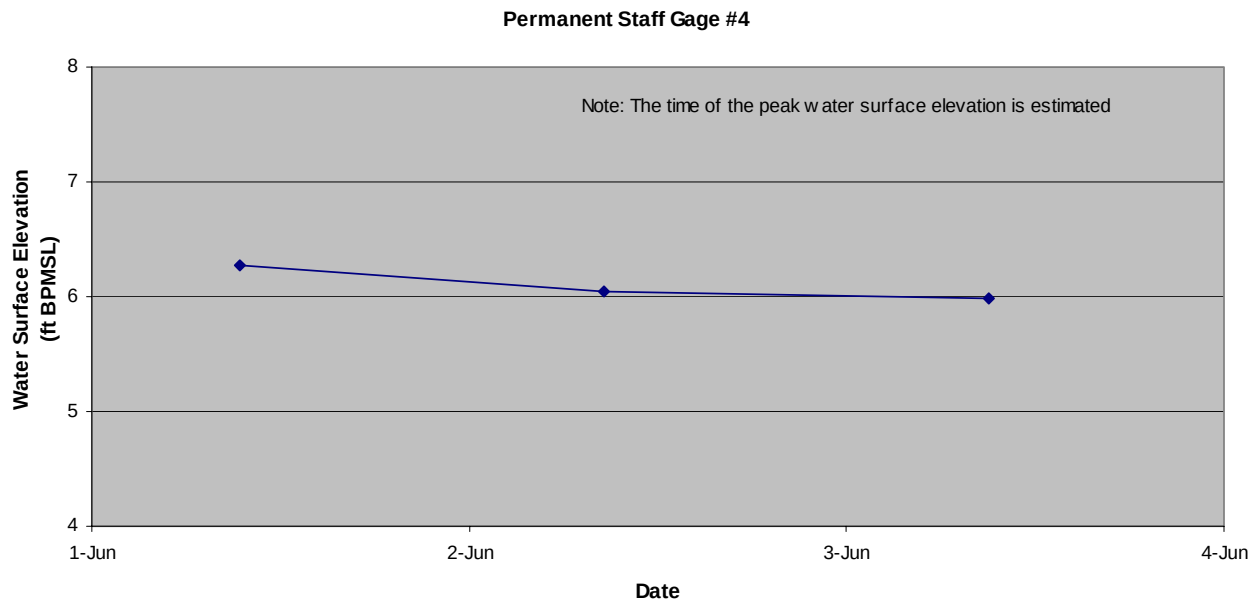


Table 4-13 Permanent Staff Gage #9-Lake L9312, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Approx. Water Depth (feet)	Observations
5/31/05 4:50 PM	7.95	2.85	Gage in ice surrounded by small open lead
6/2/05 11:26 AM	7.88	2.78	Gage in ice surrounded by small open lead
6/3/05 4:43 PM	7.88	2.78	Gage in ice surrounded by small open lead
6/4/05 5:10 PM	7.95	2.85	Gage in ice surrounded by small open lead
High Water Mark	8.00	2.90	Peak water surface elevation occurred on June 5 at approximately 6:00 pm
6/7/05 11:04 AM	7.88	2.78	Gage in ice surrounded by small open lead
6/9/05 12:30 AM	7.74	2.64	
6/10/05 5:53 PM	7.68	2.58	No indication that floodwaters will reach lake
6/11/05 1:53 PM	7.69	2.59	
6/13/05 1:53 PM	7.70	2.60	No indication that floodwaters will reach lake
7/1/05	7.75	2.65	
7/9/05	7.80	2.70	
8/1/05	7.67	2.57	
09/01/05	7.60	2.50	

Notes:
1. Water depth at the gage is based on ground elevation surveyed by Kuukpik/LCMF Inc. in 2002.
2. July and August readings were made by Kuukpik/LCMF

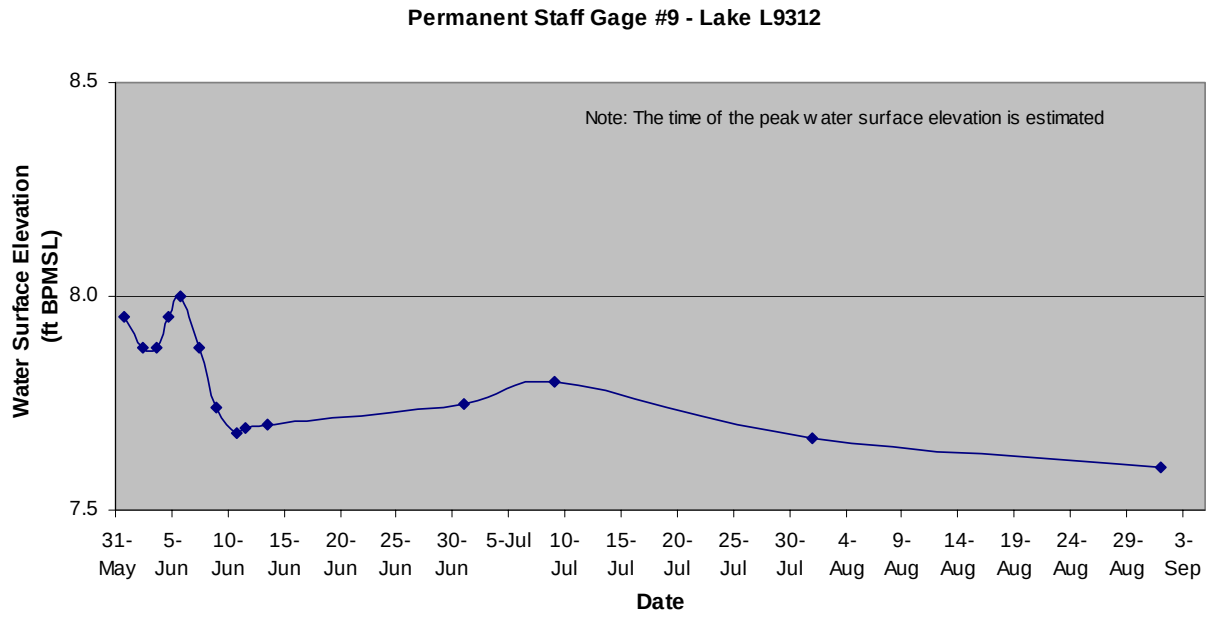


Table 4-14 Permanent Staff Gage #10-Lake L9313, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Approx. Water Depth (feet)	Observations
5/31/05 9:01 AM	6.48	1.38	Local melt only - disregard
6/1/05 9:45 AM	6.26	1.16	Local melt only - disregard
6/2/05 9:36 AM	–	–	Frozen water below gage plate
6/3/05 8:22 AM	–	–	Frozen water below gage plate
6/3/05 8:30 AM	–	–	Frozen water below gage plate
6/4/05 6:40 PM	6.08	0.98	Water on gage, frozen bottom
6/5/05 6:40 PM	6.08	0.98	Water on gage, frozen bottom
6/7/05 8:45 AM	6.09	0.99	Gage plate adjusted by LCMF personnel-no further elevation correction needed
6/8/05 7:45 AM	6.10	1.00	Frozen bottom
6/9/05 8:00 AM	6.10	1.00	Frozen bottom
High Water Mark	6.12	1.02	Preliminary peak water surface elevation occurred on June 10 at approximately 6:00 pm
6/11/05 8:22 AM	6.11	1.01	
6/13/05 5:15 PM	6.11	1.01	Frozen bottom
6/14/05 7:55 AM	6.10	1.00	
07/01/05	6.11	1.01	
08/01/05	5.95	0.85	
09/01/05	5.93	0.83	

Notes:
1. Water depth at the gage is based on ground elevation surveyed by Kuukpik/LCMF Inc. in 2002.
2. July and August readings were made by Kuukpik/LCMF

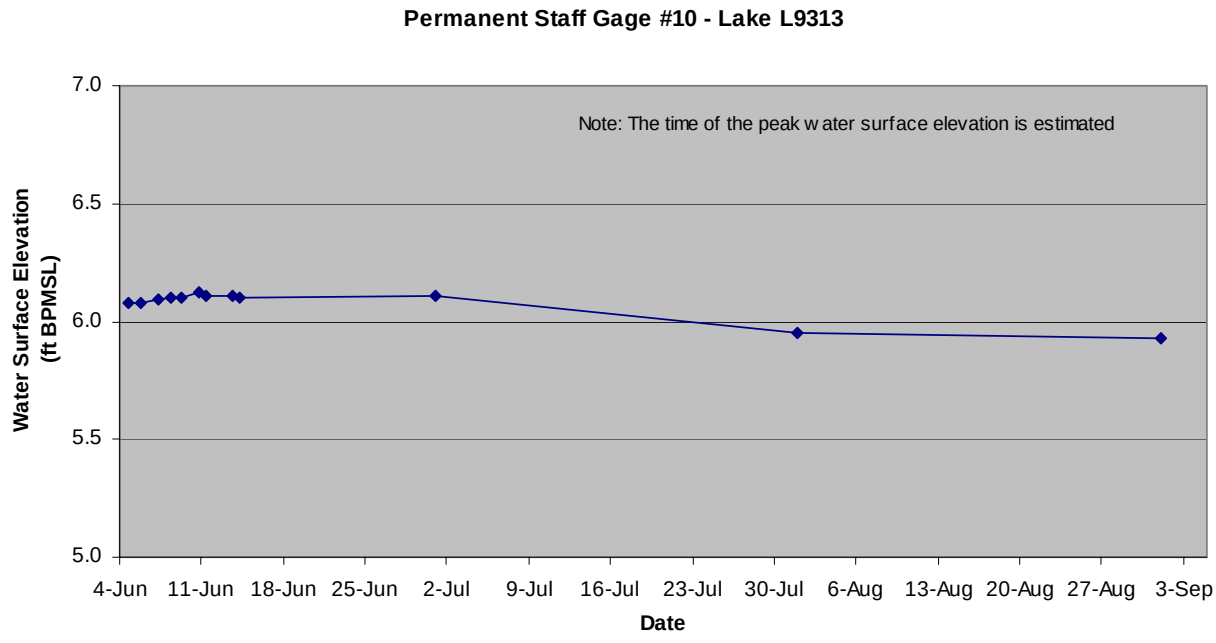


Table 4-15 Gage #12 - East Ulamnigiaq Channel, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
6/2/05 11:10 AM	4.38	Backwater from Harrison Bay
High Water Mark	4.40	Peak water surface elevation occurred early on the morning of June 3
6/3/05 11:10 AM	3.75	Potential backwater
6/9/05 3:19 PM	3.29	Potential backwater

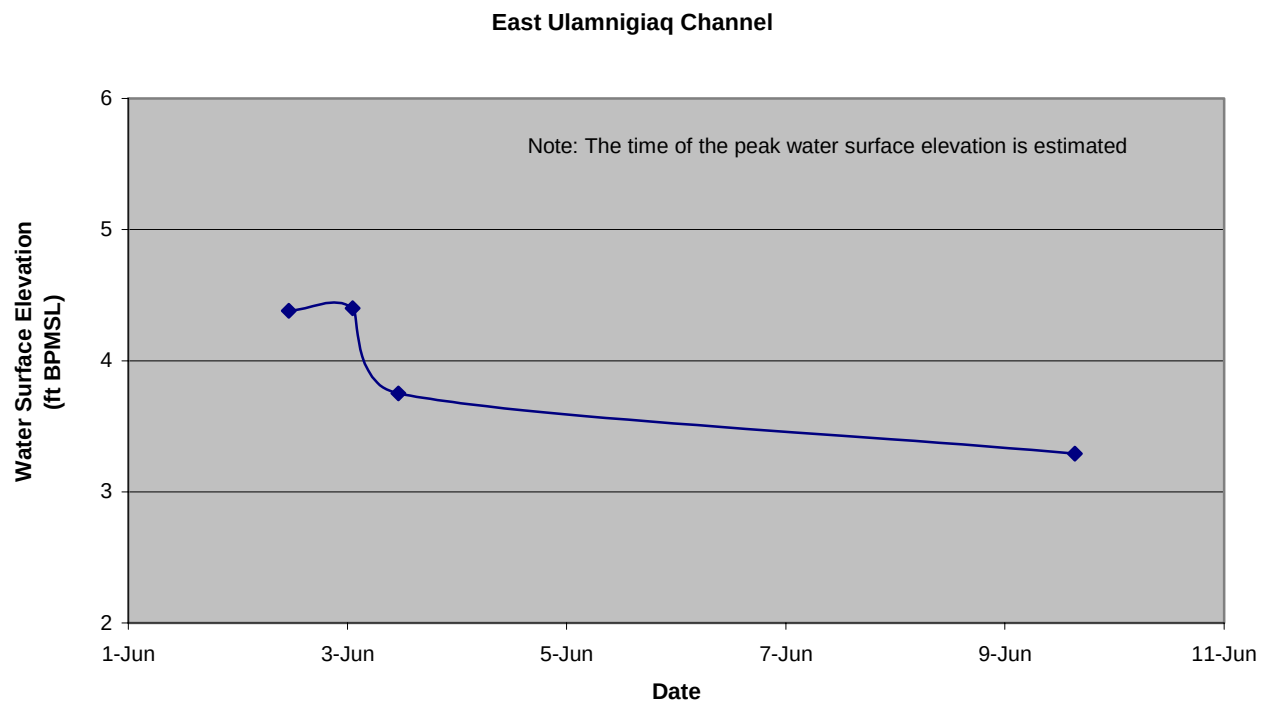


Table 4-16 Ulamnigiaq Channel at CD3 Pipeline, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/20/05 3:00 PM	3.00	Strong flow over ice, ice bridge flowing well
5/21/05 10:22 AM	3.22	Frozen water around gage
5/22/05 4:15 PM	3.28	Frozen water/snow around gage
5/23/05 4:25 PM	3.21	Frozen water around gage
5/24/05 3:10 PM	3.39	Strong flow over ice
5/25/05 11:17 AM	3.76	
5/26/05 10:00 AM	3.86	Frozen water around gage
5/27/05 3:00 PM	3.66	Frozen water around gage
5/28/05 11:48 AM	3.92	
5/29/05 4:42 PM	4.01	
5/30/05 12:48 PM	4.39	WSE +/- 0.02 ft due to high wind
5/31/05 12:49 PM	4.94	WSE +/- 0.02 ft due to high wind
6/1/05 10:48 AM	5.18	
6/2/05 11:00 AM	5.19	
High Water Mark	5.24	Peak water surface elevation occurred early on the morning of June 3
6/3/05 12:58 PM	4.51	Stage decreasing
6/9/05 12:58 PM	3.85	Significant decrease in stage

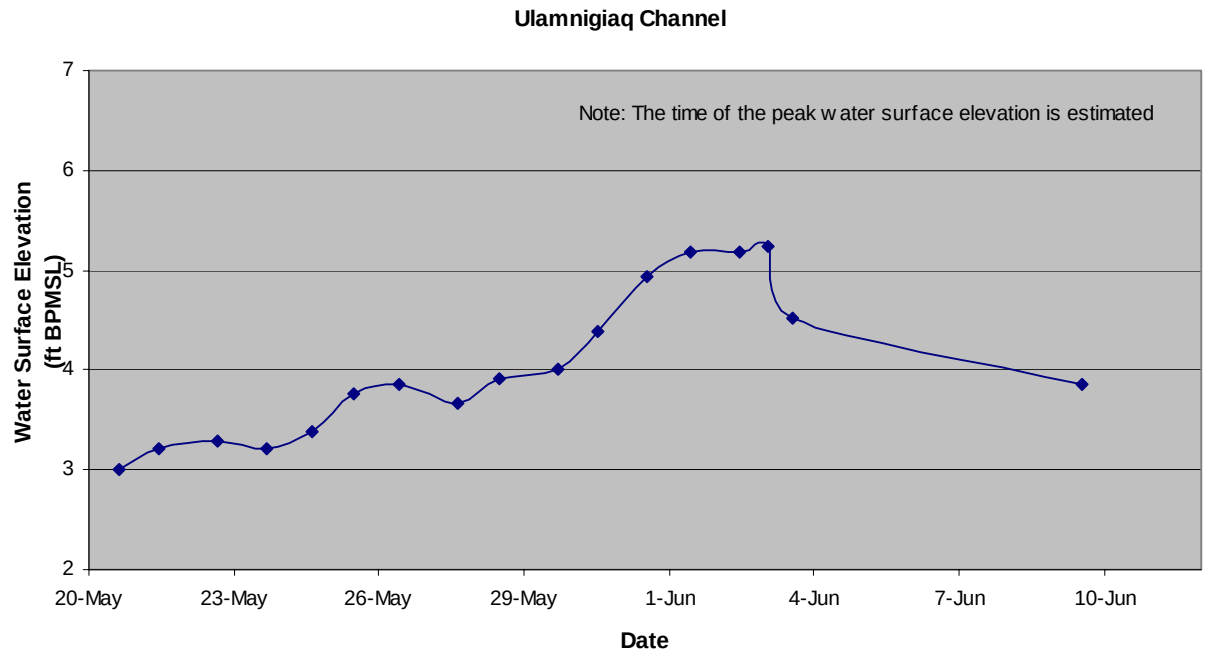


Table 4-17 Tamayagiaq Channel at CD3 Pipeline, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/19/05 4:17 PM	2.77	Flowing well, approx. 2 fps, very little floating ice
5/20/05 10:47 AM	3.13	Strong flow over ice, ice bridge flowing well
5/21/05 10:30 AM	3.30	Frozen water around gage
5/22/05 4:05 PM	3.31	Tamayagiaq backwater into Sakoonang Channel
5/23/05 4:30 PM	3.29	Frozen water around gage
5/24/05 3:00 PM	3.53	
5/25/05 11:13 AM	3.88	Frozen water around gage
5/26/05 9:55 AM	4.06	
5/27/05 2:53 PM	4.06	Tamayagiaq backwater into Sakoonang Channel as far as CD-1 pad
5/28/05 11:41 AM	4.32	
5/29/05 4:48 PM	4.59	
5/30/05 12:50 PM	5.01	WSE +/- 0.02 ft due to high wind
5/31/05 12:56 PM	5.52	WSE +/- 0.02 ft due to high wind
6/1/05 10:58 AM	5.72	
6/2/05 10:55 AM	5.74	
High Water Mark	6.13	Peak water surface elevation occurred early on the morning of June 3
6/3/05 1:03 PM	4.98	

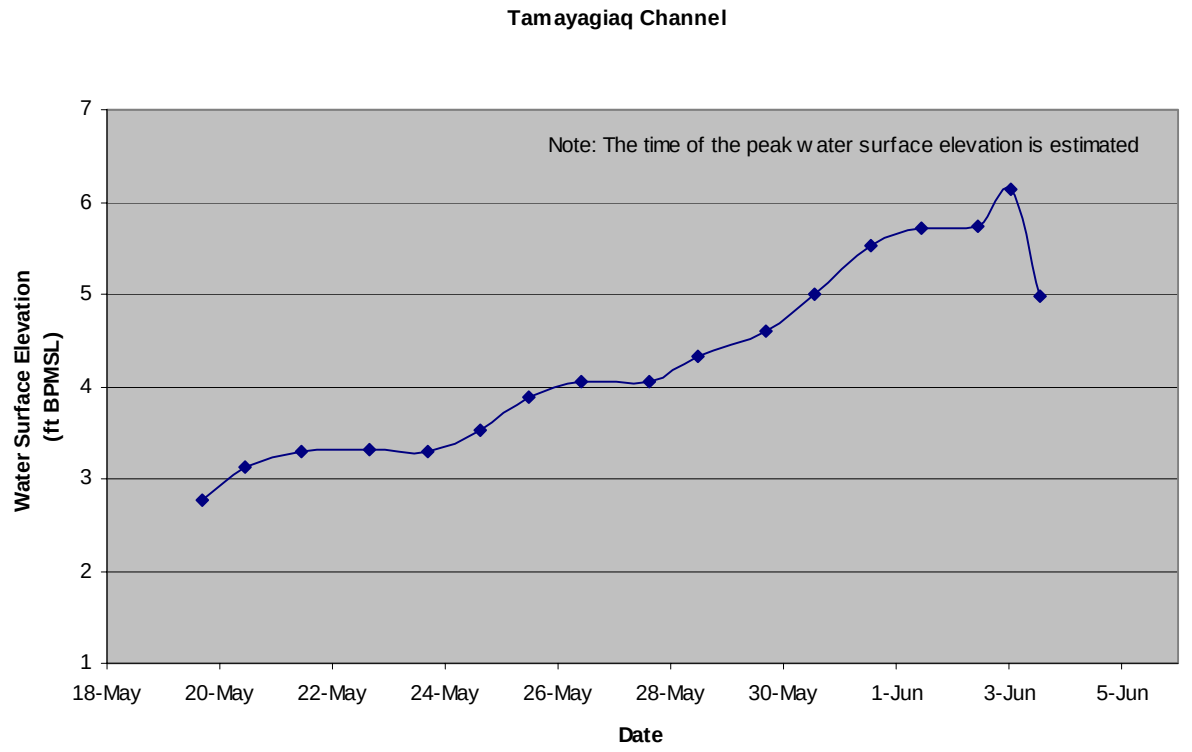
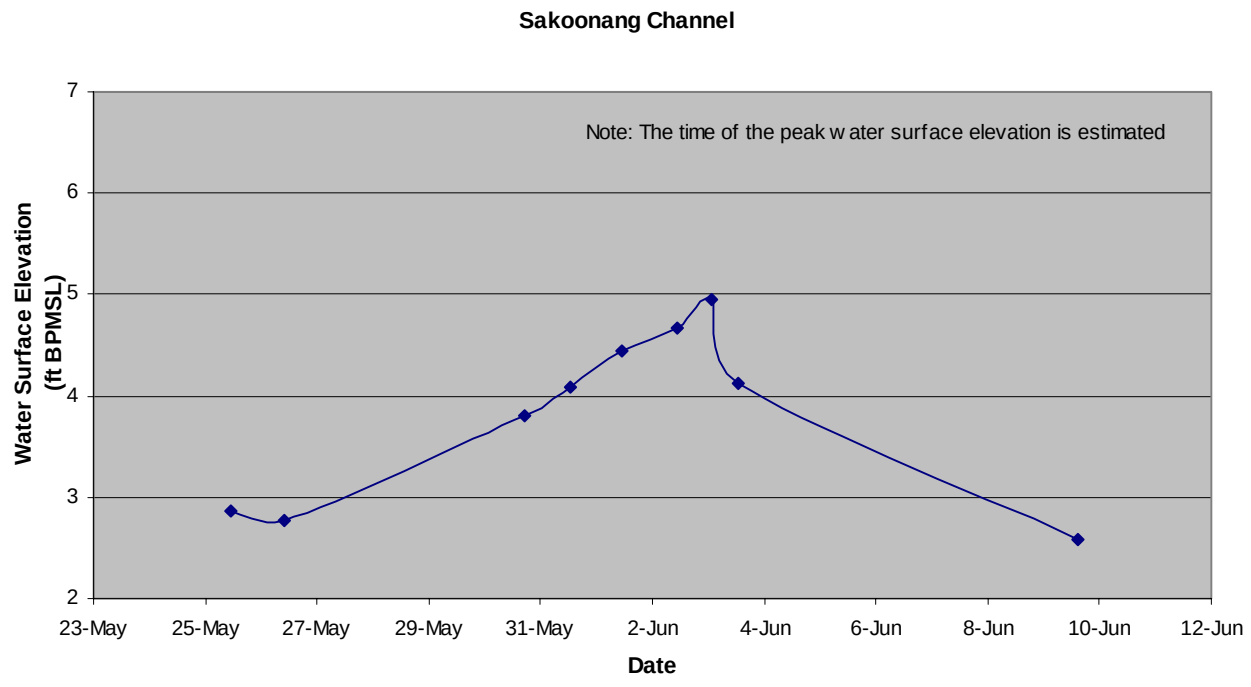


Table 4-18 Sakoonang Channel at CD3 Pipeline, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
5/25/05 11:07 AM	2.87	Backwater from Tamayayak Channel
5/26/05 9:50 AM	2.77	Backwater from Tamayayak Channel
5/30/05 5:12 PM	3.80	WSE +/- 0.02 ft due to high wind
5/31/05 1:02 PM	4.08	WSE +/- 0.02 ft due to high wind
6/1/05 11:06 AM	4.45	Backwater from Tamayayak Channel
6/2/05 10:45 AM	4.67	Backwater from Tamayayak Channel
High Water Mark	4.95	Peak water surface elevation occurred early on the morning of June 3
6/3/05 1:09 PM	4.12	Backwater from Tamayayak Channel
6/9/05 2:55 PM	2.58	Goof flow from the East Channel-no backwater



4.3 Colville River Discharges

4.3.1 Monument 1 Discharge

On June 10, four discharge transects were completed at Monument 1 (Figure 4-1) using ADCP techniques (Photo 4-18). The discharge measured by ADCP ranged from 158,190 to 160,658 cfs with a standard deviation of 0.995. Average discharge was 160,000 cfs with an average water surface elevation of 10.92 that plots well in relation to the historic Monument 1 rating curve.

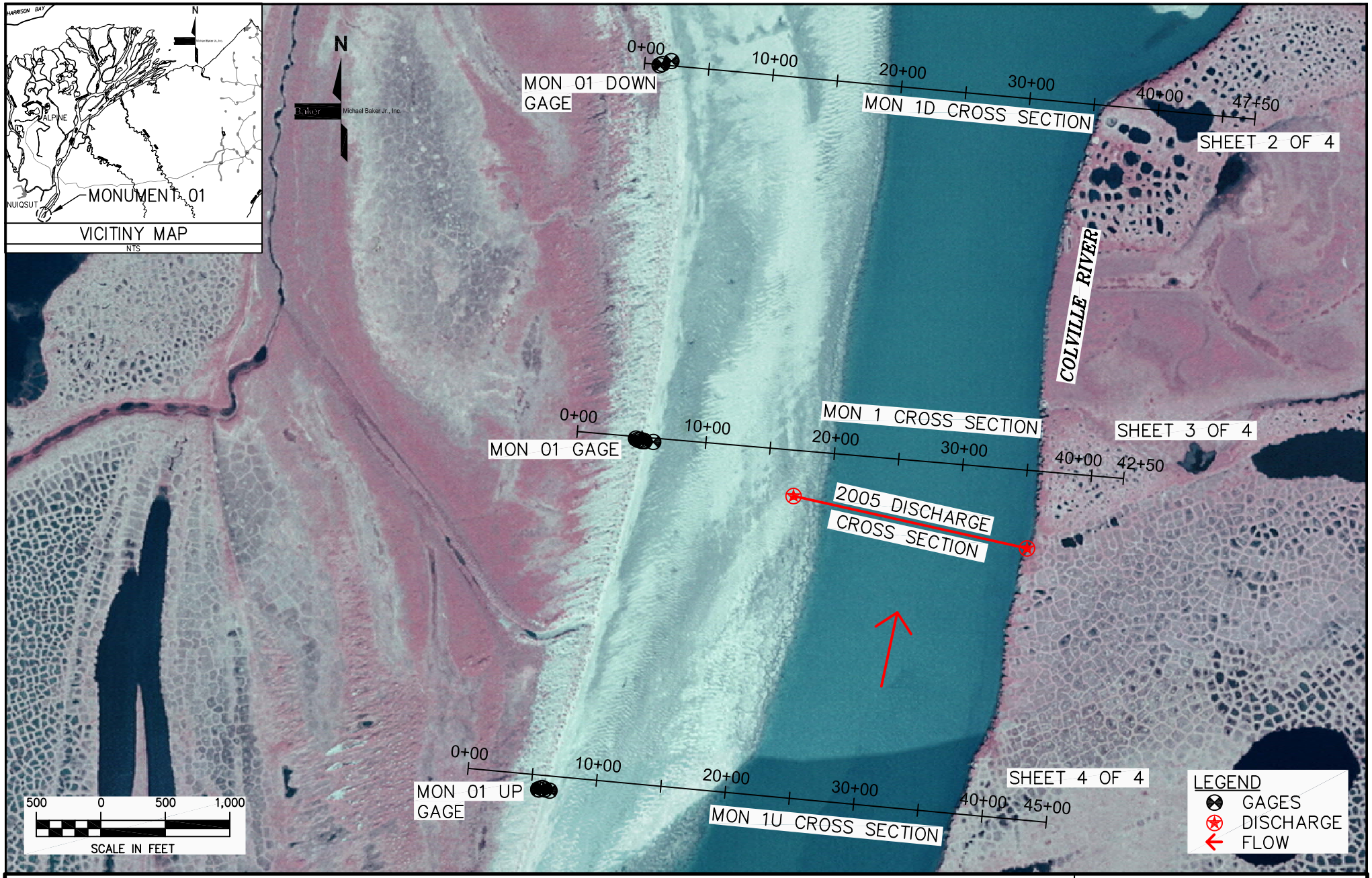
Table 4-19 summarizes the details of each discharge transect, Appendix C presents the WinRiver ADCP software Velocity Magnitude Contours and Ship Track output graphics for each of the four Monument 1 Transects. Due to conditions at Monument 1 at the time of the measurement, moving bed test results were inconclusive.

Photo 4-18 Direct discharge measurement at Monument 1, June 10, 2005

Table 4-19 ADCP Discharge Results at Monument 1

Start Time	Transect	Direction	Total Area (ft^2)	Width (ft)	Total Q (cfs)
June 10 12:26	0	R—> L	39,632	2,973	160,658
June 10 12:35	1	L—> R	41,709	3,126	159,667
June 10 12:47	2	R—> L	39,875	2,976	159,124
June 10 13:00	3	L—> R	40,702	3,002	158,190

Discharge at Monument 1 was also estimated using slope-area computations. Water surface elevation and slope data were obtained from the measurements made at gages located at Monument 1 Upstream and Monument 1 Downstream. Cross-section geometry was based on cross-sections surveyed by Kuukpik/LCMF in 2004 (Kuukpik/LCMF, 2004), presented in Figure 4-1. Based on these calculations and field data collected between May 29 and June 10, the peak discharge at Monument 1 is estimated to have occurred on June 9. The peak discharge was coincident with the secondary peak water surface elevation of 11.92 feet and with the steepest water slope measured under ice-free conditions. The peak discharge occurred after all ice had cleared from the channel, and thus is considered to have occurred under open-channel conditions. The 2005 Colville River peak discharge at Monument 1 is estimated to have been 195,000 cfs based on Table 4-20, Monument 1 Stage Discharge Curve. A historical tabulation of measured and estimated peak discharge of the Colville River is included in Table 4-21.



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DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	FIGURE_4_1
CHECKED:	MTA	SCALE:	1" = 1,000'

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MONUMENT 01

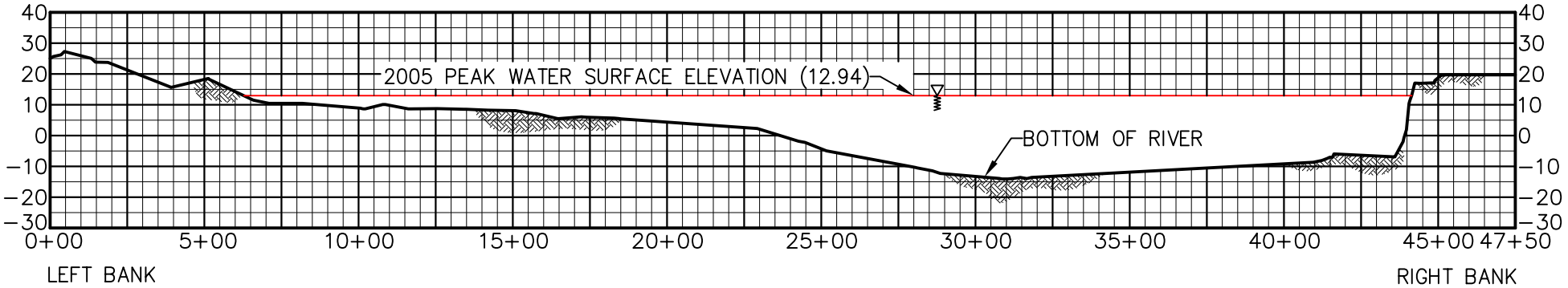
PLAN

FIGURE 4-1

(SHEET 1 OF 4)

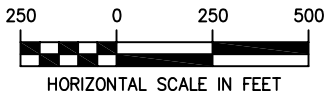
NOTES

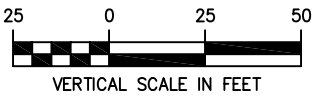
1. CHANNEL PROFILE MEASUREMENTS COMPLETED AUGUST 2004 BY KUUKPIK/LCMF INC.
2. ELEVATIONS SHOWN ARE REFERENCED TO BRITISH PETROLEUM MEAN SEA LEVEL DATUM.



1 COLVILLE RIVER CROSS SECTION AT MONUMENT 1 DOWNSTREAM

SCALE: HORZ. 1"= 500' / VERT. 1" = 50'





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MONUMENT 01

DOWNSTREAM

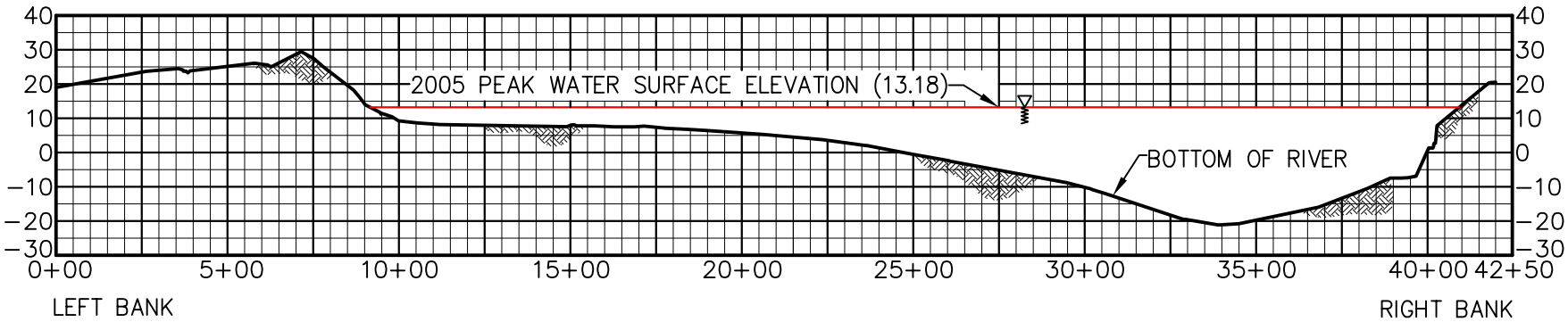
CROSS SECTION

FIGURE 4-1

(SHEET 2 OF 4)

NOTES

1. CHANNEL PROFILE MEASUREMENTS COMPLETED AUGUST 2004 BY KUUKPIK/LCMF INC.
2. ELEVATIONS SHOWN ARE REFERENCED TO BRITISH PETROLEUM MEAN SEA LEVEL DATUM.



2 COLVILLE RIVER CROSS SECTION AT MONUMENT 1

SCALE: HORZ. 1"= 500' / VERT. 1" = 50'

250 0 250 500

HORIZONTAL SCALE IN FEET

25 0 25 50

VERTICAL SCALE IN FEET

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MONUMENT 01

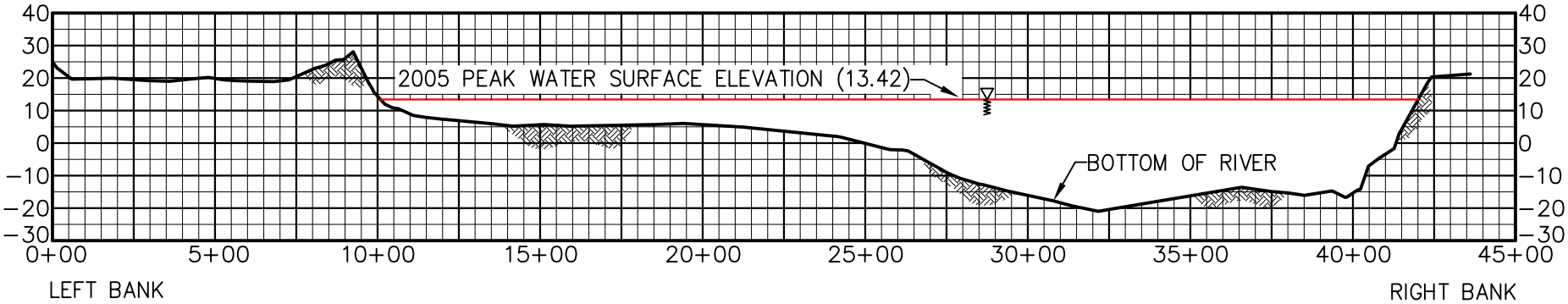
CROSS SECTION

FIGURE 4-1

(SHEET 3 OF 4)

NOTES

1. CHANNEL PROFILE MEASUREMENTS COMPLETED AUGUST 2004 BY KUUKPIK/LCMF INC.
2. ELEVATIONS SHOWN ARE REFERENCED TO BRITISH PETROLEUM MEAN SEA LEVEL DATUM.



3 COLVILLE RIVER CROSS SECTION AT MONUMENT 1 UPSTREAM

SCALE: HORZ. 1"= 500' / VERT. 1" = 50'

250 0 250 500

HORIZONTAL SCALE IN FEET

25 0 25 50

VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	FIGURE_4_1
CHECKED:	MTA	SCALE:	AS SHOWN

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MONUMENT 01

UPSTREAM

CROSS SECTION

FIGURE 4-1

(SHEET 4 OF 4)

Table 4-20 Monument 1 Stage Discharge Curve

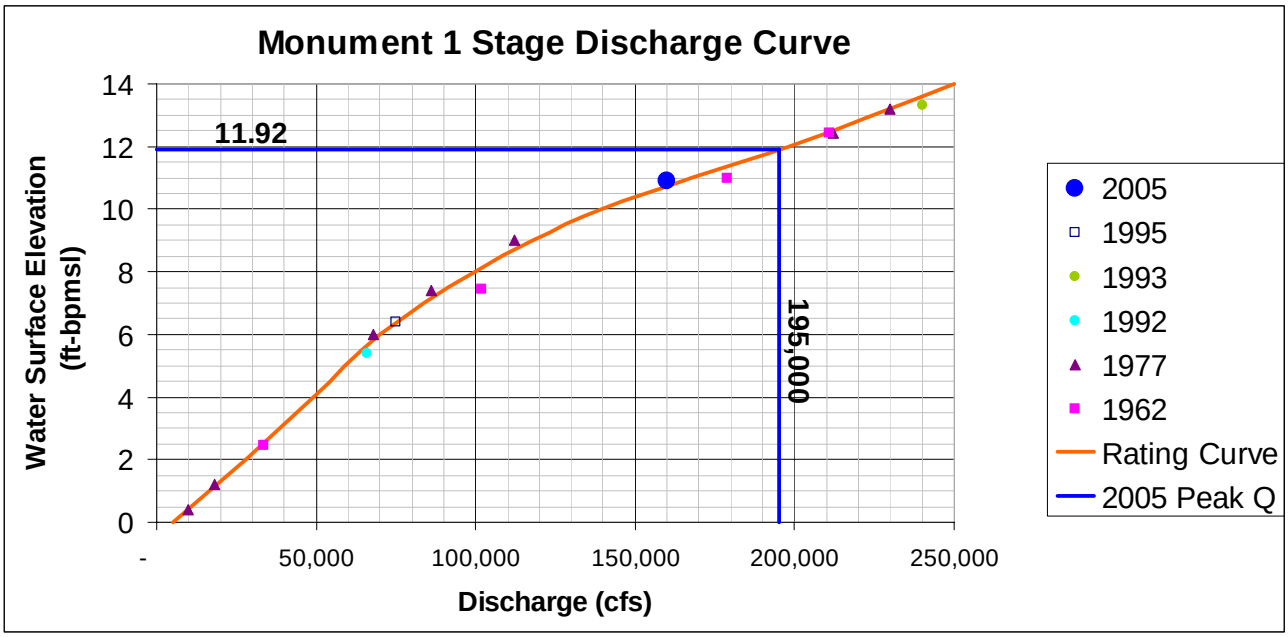


Table 4-21 Colville River Breakup Data Summary at Monument 1, 1992 - 2005

Year	Date of First Flowing Water	Peak WSE (ft)	Date of Peak WSE	Peak Breakup Q (cfs)	WSE @ Peak Q (ft)	Date of Peak Q	Datum
2005	16-May	13.18	1-Jun	195,000	11.92	9-Jun	BPMSL
2004	20-May	19.54	27-May	360,000	19.48	26-May	BPMSL
2003	27-May	13.76	5-Jun	350,000	13.3	11-Jun	BPMSL
2002	23-May	16.87	24-May	300,000	13.94	27-May	BPMSL
2001	5-Jun	17.37	10-Jun	300,000	14.18	11-Jun	BPMSL
2000	–	19.33	10-Jun	580,000	–	11-Jun	BPMSL
1999	Prior to May 24	13.97	30-May	203,000	13.38	30-May	BPMSL
1998	Prior to May 21	18.11	29-May	213,000	12.41	3-Jun	BPMSL
1997	–	15.05	29-May	230,000	–	–	BPMSL
1996	Prior to May 19	17.19	26-May	160,000	17.19	26-May	BPMSL
1995	Prior to May 11	15.87	16-May	233,000	–	–	USCGS "River"
1994	–	11.8	25-May	165,000	11.76	25-May	USCGS "River"
1993	–	19.16	31-May	379,000	18.69	31-May	NOAA "KNIK"
1992	–	13.4	–	164,000	13.4	–	NOAA "KNIK"

4.3.2 Monument 23 Discharge

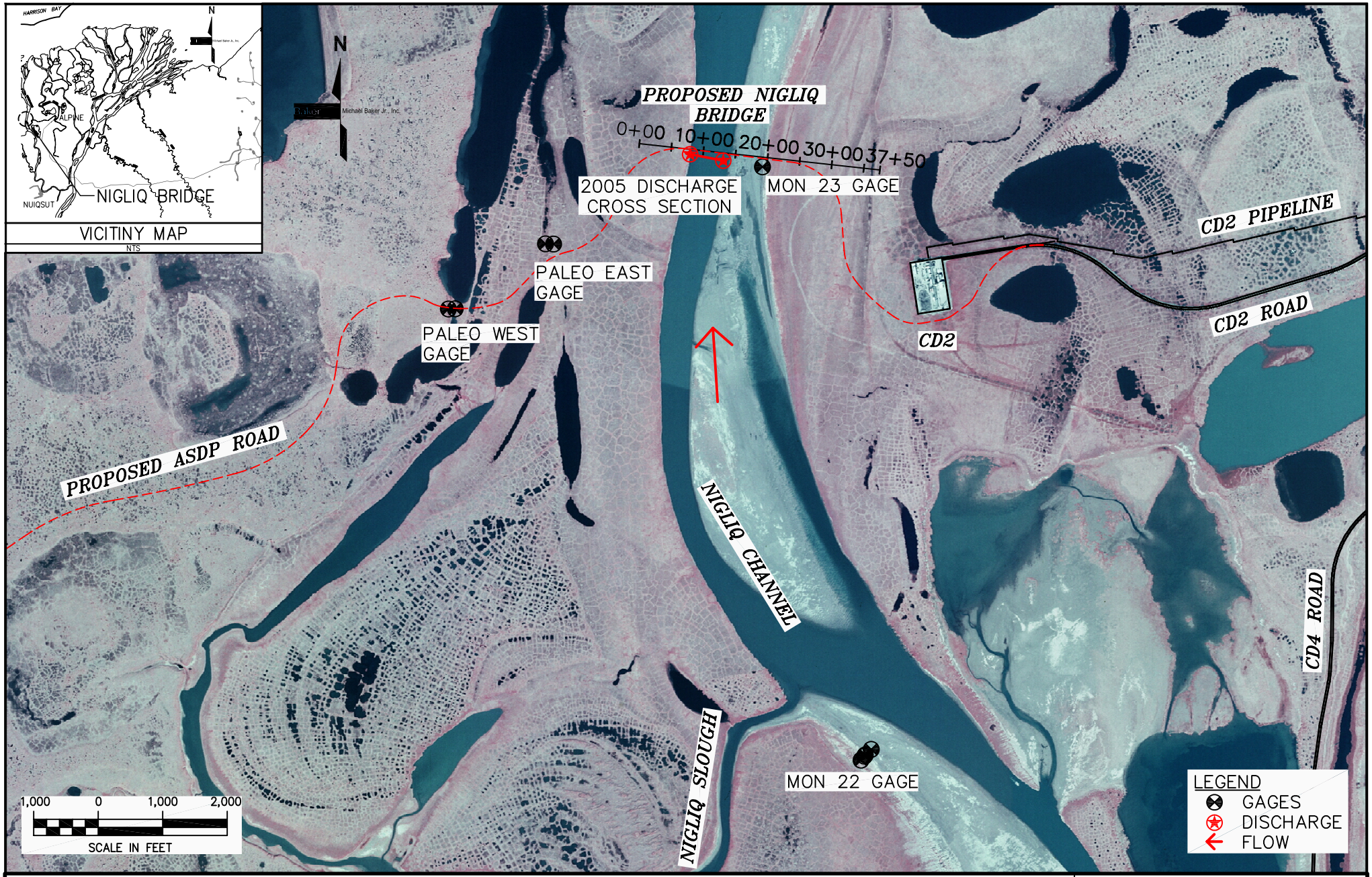
On June 11, six discharge transects were completed at Monument 23 (Figure 4-2) using the ADCP techniques. The average discharge was 29,000 cfs. Table 4-22 summarizes the details of each discharge transect, Appendix C shows the WinRiver ADCP software Velocity Magnitude Contours and Ship Track output graphics for each Monument 23 Transect. Due to conditions at Monument 23 at the time of the measurement, moving bed test results were inconclusive.

Table 4-22 ADCP Discharge Results at Monument 23

Start Time	Transect	Direction	Total Area (ft^2)	Width (ft)	Total Q (cfs)
June 11, 11:12	0	L—> R	13,237	1,157	28,592
June 11, 11:26	1	R—> L	13,697	1,157	29,517
June 11, 11:33	2	L—> R	13,525	1,158	29,153
June 11, 11:47	4	L—> R	12,647	1,161	27,765
June 11, 11:54	5	R—> L	13,783	1,152	29,471

Field data was collected at Monument 22 and Monument 23 between May 25 and June 11 in an effort to estimate discharge using slope-conveyance calculations. However, floating ribbon ice that spanned the entire channel between the Monument 22 and 23 monitoring locations between May 25 and June 4 rendered the water surface elevation data ineffective.

Water surface elevation and slope data were obtained under open-channel conditions on June 9 and June 11 based on field measurements, and cross-section geometry (Figure 4-2) of cross-sections surveyed by Kuukpik/LCMF in 2003 (Kuukpik/LCMF, 2003). Calculated discharge based on measurements at temporary gages Monument 22 and Monument 23 indicate that the discharge on June 9 was greater than that measured directly on June 11. However, the June 11 ADCP direct discharge measurement is considered the 2005 peak discharge for the Monument 23 reach due to the uncertainties associated with the water surface slope and channel roughness at the site during breakup on June 9. Therefore, in 2005 the flow in the Nigliq Channel represented approximately 15% of the Colville River Flow near peak discharge conditions.



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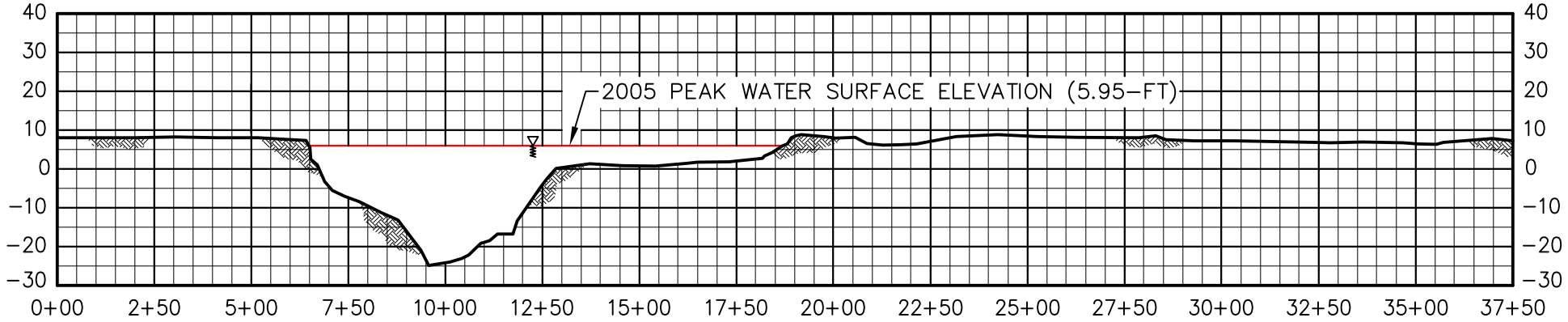
NIGLIQ BRIDGE

PLAN

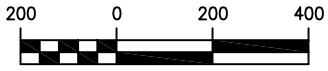
FIGURE 4-2

(SHEET 1 OF 2)

NOTES
1. CHANNEL PROFILE MEASUREMENTS COMPLETED BY KUUKPIK/LCMF INC.
2. ELEVATIONS SHOWN ARE REFERENCED TO BRITISH PETROLEUM MEAN SEA LEVEL DATUM.



1 NIGLIQ CHANNEL CROSS SECTION (AT BRIDGE)
SCALE: HORZ. 1"= 400' / VERT. 1" = 40'



ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	FIGURE_4_2
CHECKED:	MTA	SCALE:	AS SHOWN

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NIGLIQ BRIDGE
CROSS SECTION

FIGURE 4-2
(SHEET 2 OF 2)

4.3.3 Alpine Drainage Structures Discharge

Discharge was measured at the 452-foot bridge on June 2 at 1,140 cfs (Photo 4-19). The average velocity was 1.4 fps and the maximum water velocity was 2.0 fps. The peak flow through the 452-foot bridge is estimated to be 1,400 cfs and is assumed to have occurred at the time of the peak stage at permanent staff gage 3 on May 31. Flow of any significant quantity was not observed in the 62-foot bridge due to presence of snow beneath the bridge deck (Photo 4-20). Table 4-23 presents a tabulation of historical measured and estimated peak discharges at the Alpine swale bridges between 2000 and 2005.

Table 4-23 Measured and Estimated Peak Discharge – Alpine Swale Bridges 2000-2005

Year	452-Foot Bridge				62-Foot Bridge			
	Measured Discharge		Estimated Peak Discharge		Measured Discharge		Estimated Peak Discharge	
	Q (cfs)	Date	Q (cfs)	Date	Q (cfs)	Date	Q (cfs)	Date
2005	1,140	2-Jun	1,400	31-May	–[1]	–	–	–
2004	2,300	28-May	3,400	27-May	700	28-May	800	27-May
2003	420	8-Jun	730	7-Jun	–[1]	–	–	–
2002	3,200	25-May	4,000	26-May	430	25-May	500	26-May
2001	3,700	11-Jun	3,900	11-Jun	600	11-Jun	620	11-Jun
2000	3,780	9-Jun	7,085	12-Jun	577	10-Jun	975	12-Jun

Notes: 1. Bridge was obstructed with snow, no measurement made.

Photo 4-19 Conditions during direct discharge measurement at 452-foot swale bridge, June 2, 2005

Photo 4-20 Conditions during peak stage at 62-foot swale bridge, June 2, 2005

CD2 and CD4 road culvert water depths and velocities were measured on June 2 (Photo 4-21). On the CD2 road, water levels reached culverts CD2-21, CD2-22, CD2-23, and CD2-24 (Figure 4-3).

Photo 4-21 CD2 road culverts direct discharge measurement, June 2, 2005

The measured discharge is presented in Table 4-24 and ranged from 1.1 in culvert CD2-21 to 14.9 cfs in culvert CD2-24. Flow of any significant quantity was not observed in culvert CD2-22 due to snow inside the culvert. The estimated peak flow through the CD2 culverts is presented in Table 4-25 and is estimated to range from 1.5 cfs in culvert CD2-21 to 20 cfs in culvert CD2-24 and is assumed to have occurred at the time of the peak stage at permanent staff gage 4 on June 1. Floodwater did not reach culverts along the CD4 road (Photo 4-22 and Photo 4-23).

Photo 4-22 CD4 road southern Paleo culverts during peak stage, June 1, 2005

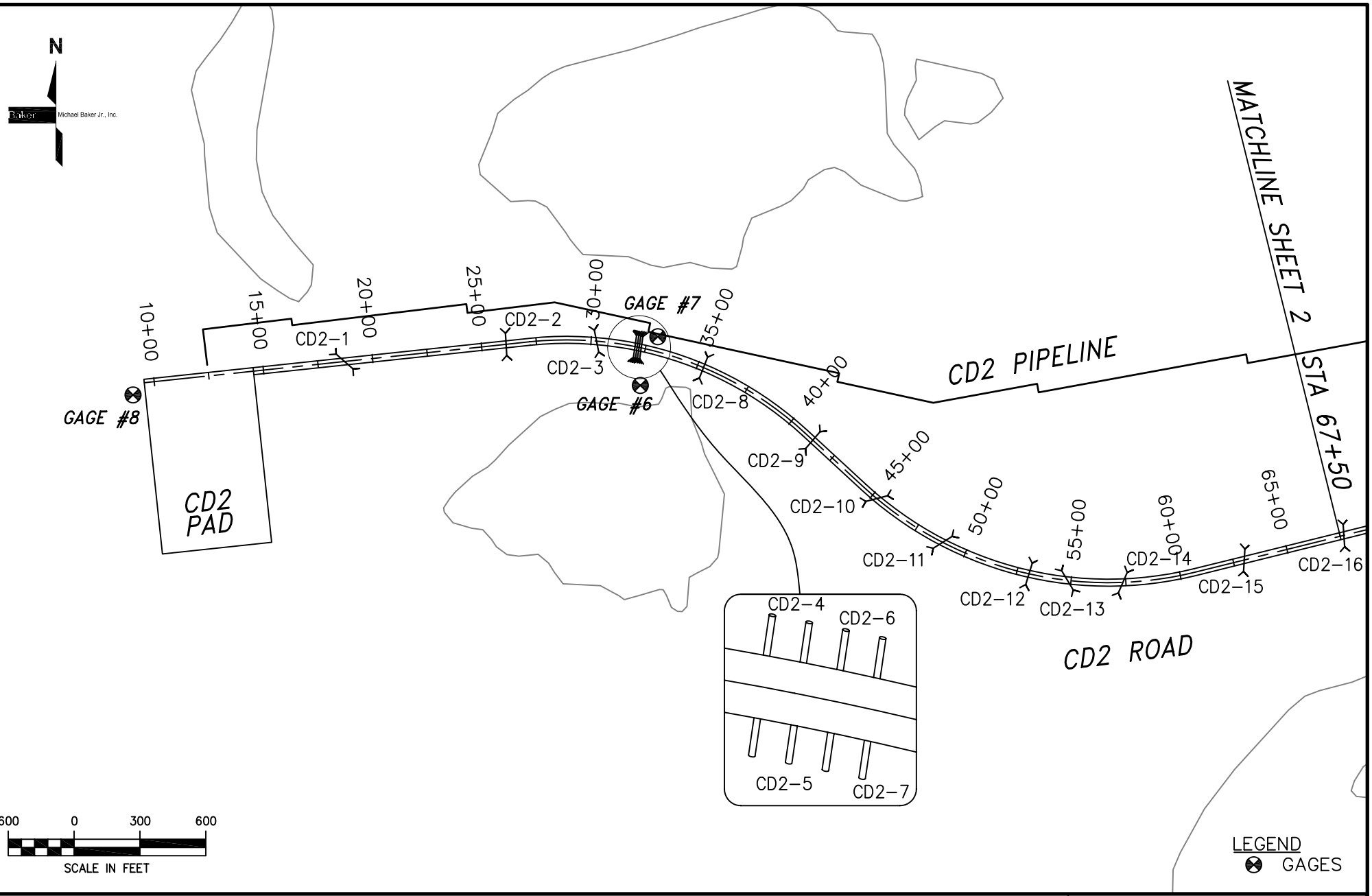
Photo 4-23 CD4 road northern Paleo culverts during peak stage, June 1, 2005

Table 4-24 Measured Discharge – Alpine Culverts

Field Measurements											
CD2 Culverts						CD4 Culverts					
Culvert Number	Diameter (in)	Date	Water Depth (ft)	Average Velocity (ft/s)	Discharge (cfs)	Culvert Number	Diameter (in)	Date	Water Depth (ft)	Average Velocity (ft/s)	Discharge (cfs)
CD2-1	48" Steel	No Flow				CD4-1	36" Steel	No Flow			
CD2-2	48" Steel	No Flow				CD4-2	36" Steel	No Flow			
CD2-3	48" Steel	No Flow				CD4-3	36" Steel	No Flow			
CD2-4	48" Steel	No Flow				CD4-4	36" Steel	No Flow			
CD2-5	48" Steel	No Flow				CD4-5	36" Steel	No Flow			
CD2-6	48" Steel	No Flow				CD4-6	36" Steel	No Flow			
CD2-7	48" Steel	No Flow				CD4-7	36" Steel	No Flow			
CD2-8	48" Steel	No Flow				CD4-8	36" Steel	No Flow			
CD2-9	60" CMP	No Flow				CD4-9	36" Steel	No Flow			
CD2-10	60" CMP	No Flow				CD4-10	36" Steel	No Flow			
CD2-11	60" CMP	No Flow				CD4-11	36" Steel	No Flow			
CD2-12	72" CMP	No Flow				CD4-12	36" Steel	No Flow			
CD2-13	60" CMP	No Flow				CD4-13	36" Steel	No Flow			
CD2-14	60" CMP	No Flow				CD4-14	36" Steel	No Flow			
CD2-15	48" Steel	No Flow				CD4-15	24" Steel	No Flow			
CD2-16	48" Steel	No Flow				CD4-16	24" Steel	No Flow			
CD2-17	48" Steel	No Flow				CD4-17	24" Steel	No Flow			
CD2-18	48" Steel	No Flow				CD4-18	24" Steel	No Flow			
CD2-19	48" Steel	No Flow				CD4-19	24" Steel	No Flow			
CD2-20	48" Steel	No Flow				CD4-20A	60" Steel	No Flow			
CD2-21	48" Steel	2-Jun	0.9	0.5	1.1	CD4-20	60" Steel	No Flow			
CD2-22	48" Steel	No Flow (blocked with snow)				CD4-21	60" Steel	No Flow			
CD2-23	48" Steel	2-Jun	1.1	4.0	11.3	CD4-22	60" Steel	No Flow			
CD2-24	48" Steel	2-Jun	1.1	5.3	14.9	CD4-23	60" Steel	No Flow			
CD2-25	48" Steel	No Flow				CD4-23A	60" Steel	No Flow			
CD2-26	48" Steel	No Flow				CD4-23B	60" Steel	No Flow			
						CD4-23C	48" Steel	No Flow			
						CD4-23D	48" Steel	No Flow			
						CD4-24	48" Steel	No Flow			
						CD4-25	48" Steel	No Flow			
						CD4-26	48" Steel	No Flow			
						CD4-27	48" Steel	No Flow			
						CD4-28	48" Steel	No Flow			
						CD4-29	48" Steel	No Flow			
						CD4-30	48" Steel	No Flow			
						CD4-31	48" Steel	No Flow			
						CD4-32	48" Steel	No Flow			
						CD4-33	48" Steel	No Flow			

Table 4-25 Estimated Peak Discharge – Alpine Culverts

Estimated Peak											
CD2 Culverts						CD4 Culverts					
Culvert Number	Diameter (in)	Date	Water Depth (ft)	Average Velocity (ft/s)	Discharge (cfs)	Culvert Number	Diameter (in)	Date	Water Depth (ft)	Average Velocity (ft/s)	Discharge (cfs)
CD2-1	48" Steel	No Flow				CD4-1	36" Steel	No Flow			
CD2-2	48" Steel	No Flow				CD4-2	36" Steel	No Flow			
CD2-3	48" Steel	No Flow				CD4-3	36" Steel	No Flow			
CD2-4	48" Steel	No Flow				CD4-4	36" Steel	No Flow			
CD2-5	48" Steel	No Flow				CD4-5	36" Steel	No Flow			
CD2-6	48" Steel	No Flow				CD4-6	36" Steel	No Flow			
CD2-7	48" Steel	No Flow				CD4-7	36" Steel	No Flow			
CD2-8	48" Steel	No Flow				CD4-8	36" Steel	No Flow			
CD2-9	60" CMP	No Flow				CD4-9	36" Steel	No Flow			
CD2-10	60" CMP	No Flow				CD4-10	36" Steel	No Flow			
CD2-11	60" CMP	No Flow				CD4-11	36" Steel	No Flow			
CD2-12	72" CMP	No Flow				CD4-12	36" Steel	No Flow			
CD2-13	60" CMP	No Flow				CD4-13	36" Steel	No Flow			
CD2-14	60" CMP	No Flow				CD4-14	36" Steel	No Flow			
CD2-15	48" Steel	No Flow				CD4-15	24" Steel	No Flow			
CD2-16	48" Steel	No Flow				CD4-16	24" Steel	No Flow			
CD2-17	48" Steel	No Flow				CD4-17	24" Steel	No Flow			
CD2-18	48" Steel	No Flow				CD4-18	24" Steel	No Flow			
CD2-19	48" Steel	No Flow				CD4-19	24" Steel	No Flow			
CD2-20	48" Steel	No Flow				CD4-20A	60" Steel	No Flow			
CD2-21	48" Steel	1-Jun	1.2	0.5	1.5	CD4-20	60" Steel	No Flow			
CD2-22	48" Steel	No Flow (blocked with snow)				CD4-21	60" Steel	No Flow			
CD2-23	48" Steel	1-Jun	1.4	4.0	15.2	CD4-22	60" Steel	No Flow			
CD2-24	48" Steel	1-Jun	1.4	5.3	20.0	CD4-23	60" Steel	No Flow			
CD2-25	48" Steel	No Flow				CD4-23A	60" Steel	No Flow			
CD2-26	48" Steel	No Flow				CD4-23B	60" Steel	No Flow			
						CD4-23C	48" Steel	No Flow			
						CD4-23D	48" Steel	No Flow			
						CD4-24	48" Steel	No Flow			
						CD4-25	48" Steel	No Flow			
						CD4-26	48" Steel	No Flow			
						CD4-27	48" Steel	No Flow			
						CD4-28	48" Steel	No Flow			
						CD4-29	48" Steel	No Flow			
						CD4-30	48" Steel	No Flow			
						CD4-31	48" Steel	No Flow			
						CD4-32	48" Steel	No Flow			
						CD4-33	48" Steel	No Flow			



ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756 - 2005 SPRING BREAKUP
DRAWN:	WAP	FILE:	ALPINE DRAINGE FIGURES
CHECKED:	MTA	SCALE:	1"= 600'

Baker

Michael Baker Jr., Inc.
A Unit of Michael Baker Corporation
1400 West Benson Blvd., Suite 200
Anchorage, Alaska 99503
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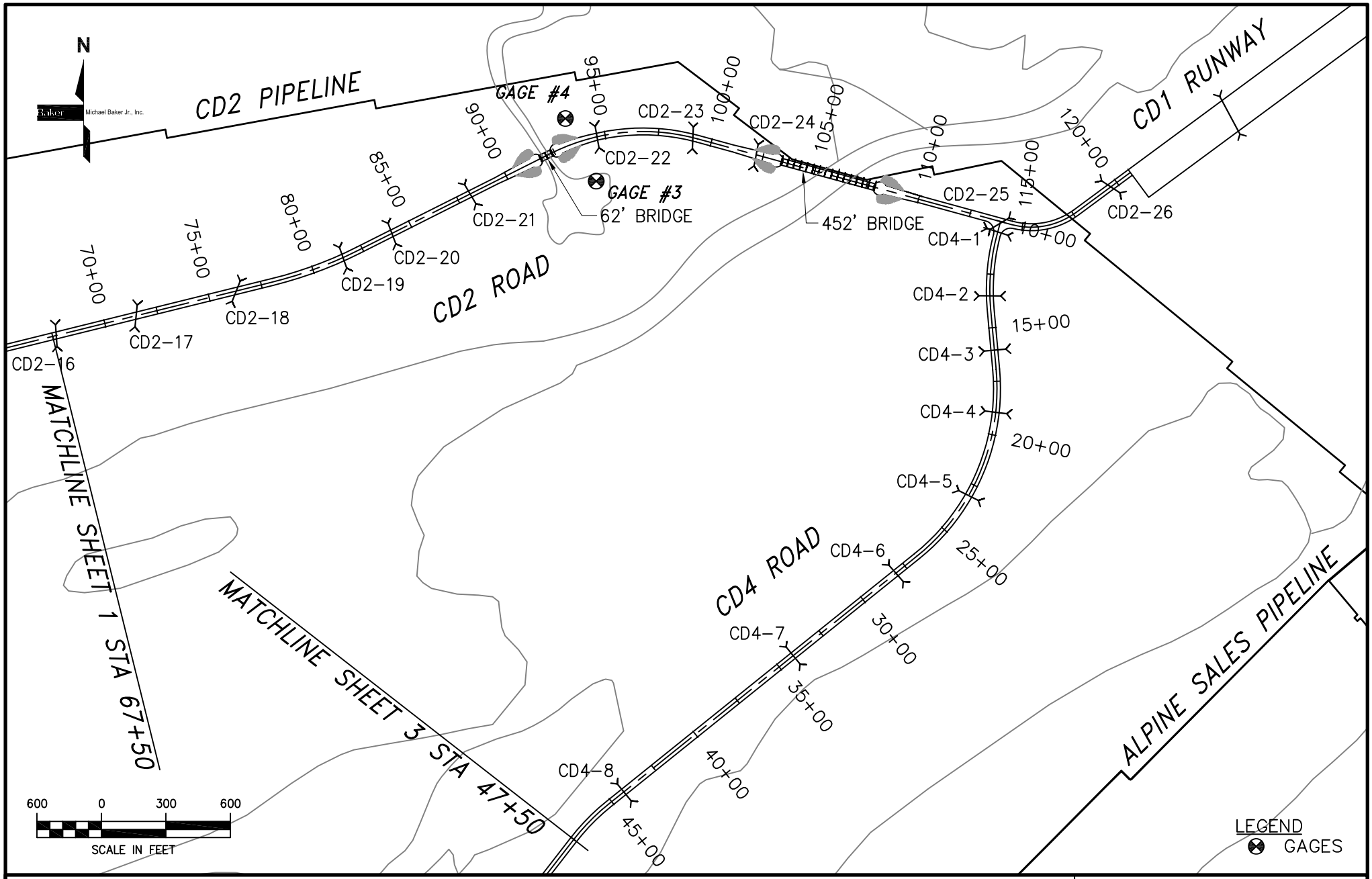
Fax: (907) 273-1699

ALPINE FACILITY

DRAINAGE STRUCTURE LOCATION AND NAMING CONVENTION

FIGURE 4-3

(SHEET 1 OF 5)



ConocoPhillips Alaska, Inc.

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DRAWN:	WAP	FILE:	ALPINE DRAINGE FIGURES
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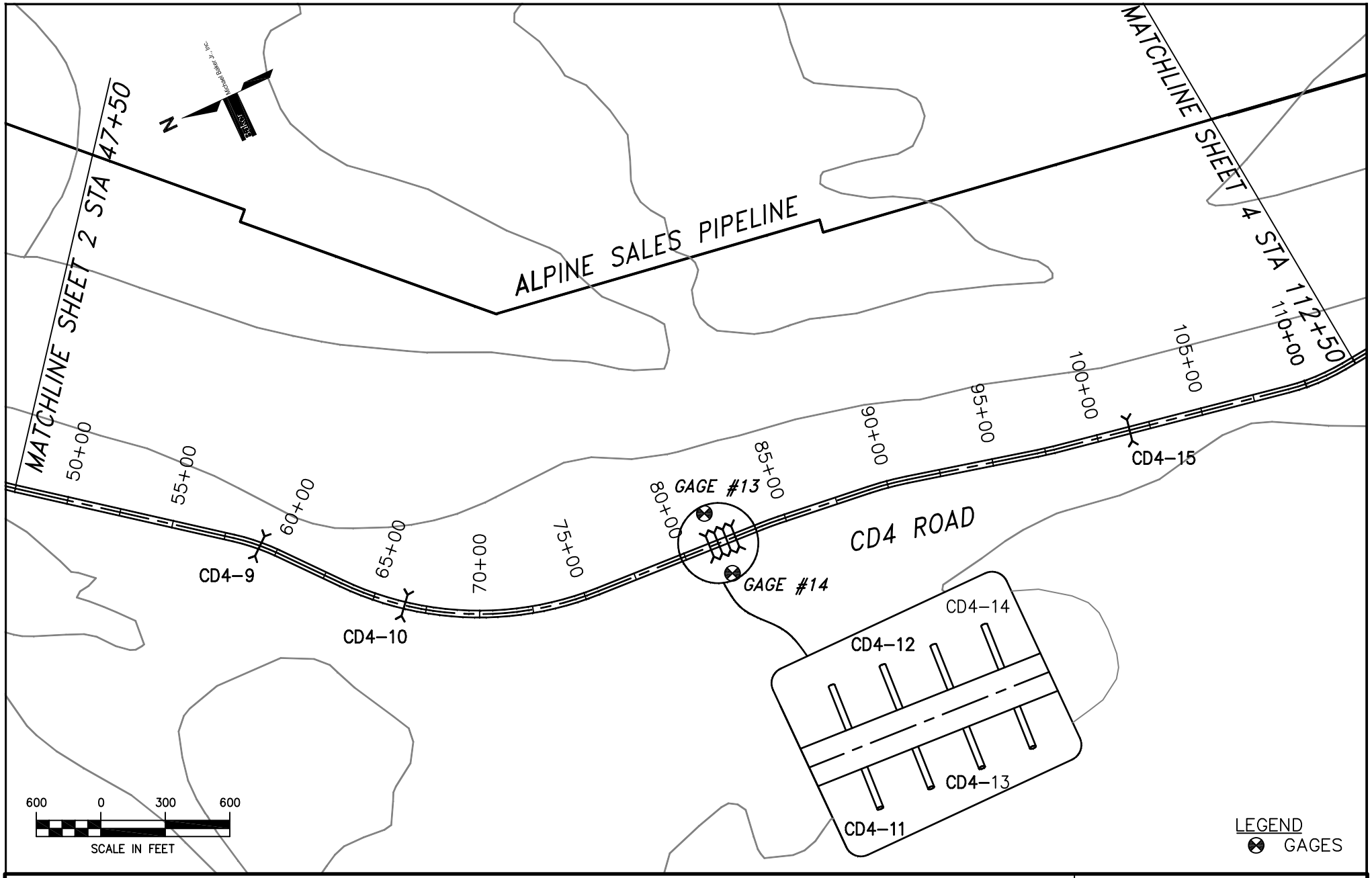
ALPINE FACILITY

DRAINAGE STRUCTURE LOCATION AND NAMING CONVENTION

FIGURE 4-3

(SHEET 2 OF 5)



ConocoPhillips Alaska, Inc.			
DATE:	12/16/05	PROJECT:	105756 - 2005 SPRING BREAKUP
DRAWN:	WAP	FILE:	ALPINE DRAINGE FIGURES
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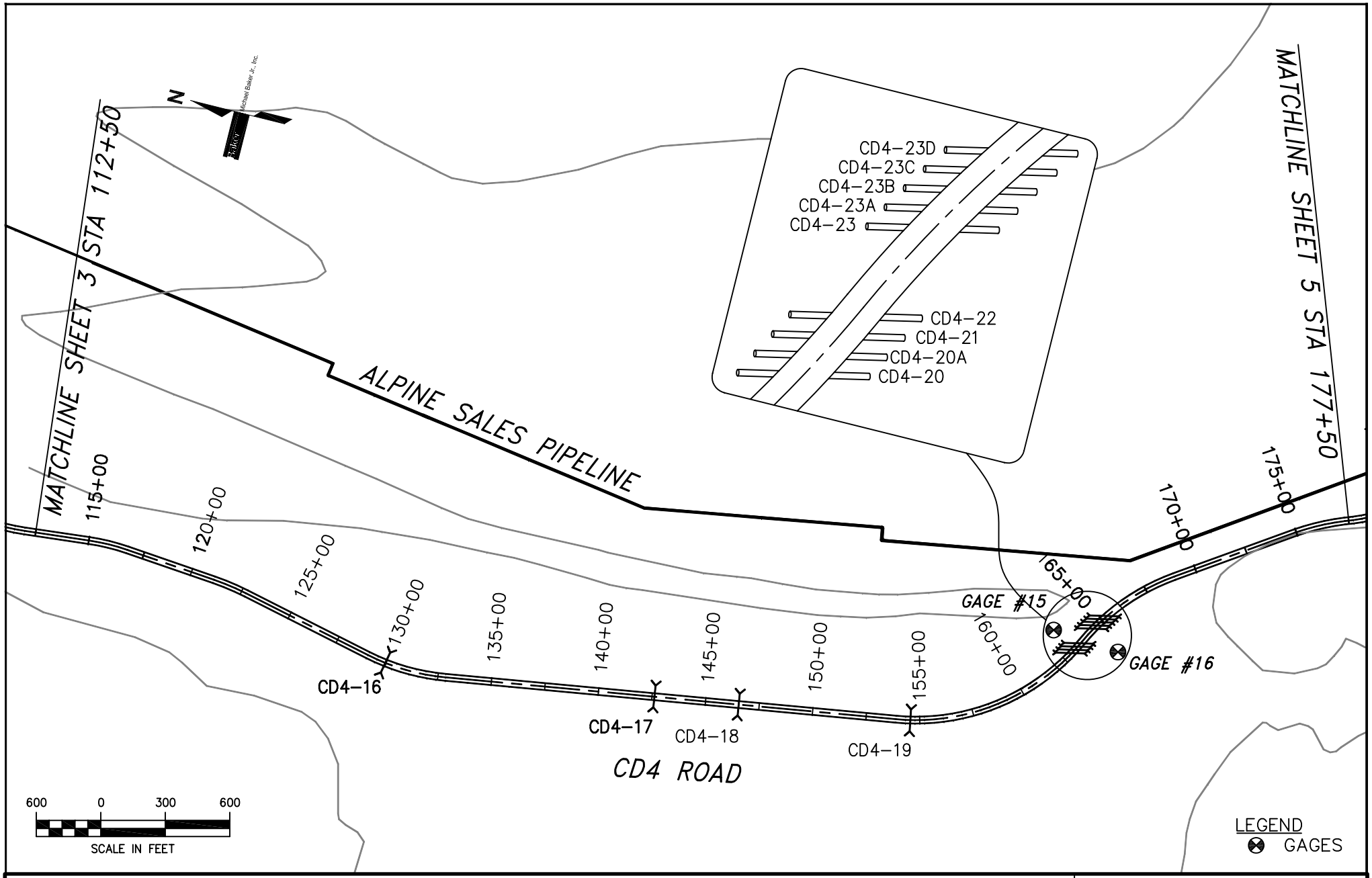
ALPINE FACILITY

DRAINAGE STRUCTURE LOCATION AND NAMING CONVENTION

FIGURE 4-3

(SHEET 3 OF 5)



ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756 - 2005 SPRING BREAKUP
DRAWN:	WAP	FILE:	ALPINE DRAINGE FIGURES
CHECKED:	MTA	SCALE:	1"= 600'

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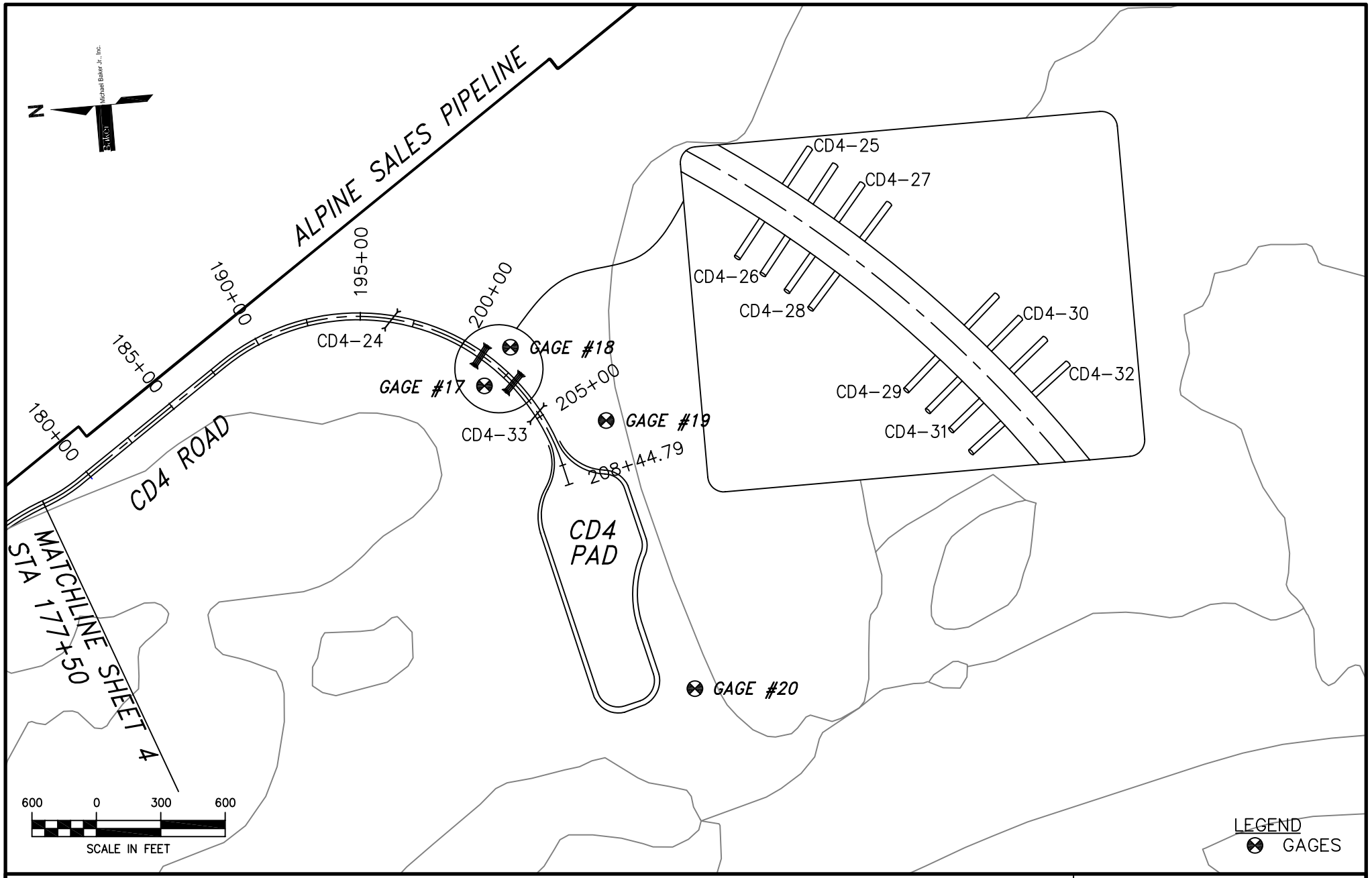
ALPINE FACILITY

DRAINAGE STRUCTURE LOCATION AND NAMING CONVENTION

FIGURE 4-3

(SHEET 4 OF 5)



ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756 - 2005 SPRING BREAKUP
DRAWN:	WAP	FILE:	ALPINE DRAINGE FIGURES
CHECKED:	MTA	SCALE:	1"= 600'

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ALPINE FACILITY

DRAINAGE STRUCTURE LOCATION AND NAMING CONVENTION

FIGURE 4-3

(SHEET 5 OF 5)

4.4 Alpine Roads and Pad Survey Results

The Alpine gravel pads and access roads were inspected for erosion before, during, and after breakup. Photographic documentation of the condition of the gravel facilities was recorded on July 9 and 10 (Photo 4-24 and Photo 4-25). Floodwater did not reach the gravel embankments at CD1, CD2, CD3, or CD4 pads or the CD4 gravel road.

Floodwater was observed along the CD2 road in the swale region and visual inspection of the CD2 road near the swale bridges revealed high water marks where breakup flows reached the low portions of the gravel structure (Photo 4-26).

High water marks were identified by debris stranded on the gravel side slopes or by noting where silts and fine-grained sands were washed form the road prism. No indications of significant erosion due to breakup floodwater was observed anywhere on the Alpine gravel facilities.

Photo 4-24 CD4 road alignment after recession of flood at the north Paleo culvert battery, July 10, 2005

Photo 4-25 CD4 road alignment after recession of flood at the south Paleo culvert battery, July 10, 2005

Photo 4-26 High water mark on CD2 road in the swale region, July 9, 2005

4.5 Colville River Delta Lake Recharge

4.5.1 Lake L9312 Recharge

Recharge flow into Lake L9312 from outside its own drainage sub-basin was not observed during the 2005 spring breakup because overflow via the Colville River did not reach the lake. Recharge to this lake was by means of local melt within the immediate sub-basin only (Photo 4-27).

Prior to breakup, the water surface elevation at Lake L9312 was 7.95 feet, measured on May 31. A peak water surface elevation of 8.00 feet was recorded on the evening of June 5. Measurements indicate that the water surface elevation in Lake L9312 increased approximately 0.05 feet due to recharge by localized melt. On September 1, Kuukpik/LCMF recorded the water surface elevation of 7.60 indicating a decrease of approximately 0.4 feet from the peak stage. Water surface elevations for Lake L9312 are presented in Table 4-13.

Photo 4-27 Lake L9312 near peak stage indicating lack of river recharge, June 7, 2005

Photo 4-28 Lake L9313 near peak stage indicating lack of river recharge, June 8, 2005

4.5.2 Lake L9313 Recharge

Recharge flow into Lake L9313 from outside its own drainage sub-basin was not observed during the 2005 spring breakup because overflow via the Colville River did not reach the lake. Recharge to this lake was by means of local melt within the immediate sub-basin only (Photo 4-28).

Prior to breakup, initial water surface elevation measurements at Lake L9313 recorded on May 31 and June 1 were determined to be localized melt and were disregarded. The first representative water elevation measurement at the lake was made on June 4 at an elevation of 6.08. The water surface elevation at Lake L9313 reached a peak of 6.12 feet on the evening of June 10, and maintained a similar elevation throughout the month of July. A water elevation measurement on September 1

revealed that the lake level had dropped to 5.93 feet representing a decrease of approximately 0.19 feet from the peak stage. Water surface elevations for Lake L9313 are presented in Table 4-14.

4.6 Colville River Delta Ice Bridge Monitoring

No erosion, scour, or significant increase in water surface elevation was observed during breakup at or near the ice bridges at the Colville River East Channel or Nigliq Channel crossings. The slotted portions of the bridges conveyed flow adequately and the decay of the ice bridge was relatively quick once floodwaters began their advance. Photo 4-29 and Photo 4-30 represent conditions of the East Channel of the Colville River at the ice bridge crossing during and after breakup. Photo 4-31 and Photo 4-32 represents conditions of the Nigliq Channel at the ice bridge crossing during and after breakup.

Photo 4-29 **Colville East Channel Ice Bridge during breakup with the ice road in place, June 1, 2005**

Photo 4-30 **Colville East Channel Ice Bridge after breakup without remnants of the ice bridge in place, July 8, 2005**

Photo 4-31 **Colville Nigliq Channel Ice Bridge during breakup with the ice road in place, May 23, 2005**

Photo 4-32 **Colville Nigliq Channel Ice Bridge after breakup without remnants of the ice bridge in place, July 8, 2005**

At the Kachemach River ice bridge crossing, the ice bridge appeared to have diverted a portion of the flow during breakup from the natural channel and directed it towards the east bank of the river as shown in Photo 4-33. At the ice bridge crossing, the east bank experienced erosion as a result of this diversion of flow.

Photo 4-33 Kachemach River Ice Bridge during breakup with the ice road in place, June 13, 2005

Photos 4-30 and 4-31 present the conditions of the Kachemach channel after breakup and once the ice bridge completely melted.

Photo 4-34 Kachemach River Ice Bridge after breakup with remnants of the ice road still in place, July 8, 2005

Photo 4-35 Kachemach River Ice Bridge location after breakup without remnants of the ice road, August 31, 2005

5.0 2005 Fish Creek Basin Breakup Overview

The Fish Creek Basin has been monitored in support of ASDP since 2001 primarily along Fish Creek, Judy Creek, and the Ublutuoch River. In 2003, PND, Inc. published the 2003 Breakup Monitoring Report for NPRA Small Stream Crossings (PND, 2003) and excluding the Ublutuoch River, this report represents the extent of available data on the small, unnamed tributaries along the proposed ASDP road. Of the nine small streams monitored along the road alignment in 2005, only Small Stream Sites 3, 5, 6, and 9 were previously monitored in 2003, all other 2005 small streams sites have no available data.

5.1 Fish Creek Basin Daily Observations

The 2005 spring breakup flood within the Fish Creek basin occurred during cool weather and predominantly cloudy skies that slowed the onset and advance of floodwaters on a basin-wide basis.

5.1.1 Fish and Judy Creeks Observations

Localized melt and standing water along Fish and Judy Creeks was first noted on May 25, but due to cool weather, floodwater was not observed for nine additional days. Judy Creek was the first channel to become active within the basin, with floodwater reaching the gages at Judy 13.8 on the evening of June 4 (Photo 5-1). Floodwater reached the gages at Judy 7.0 on the afternoon of June 5 (Photo 5-2).

Photo 5-1 Judy 13.8 near Peak stage, June 5, 2005

Photo 5-2 Peak stage at Judy 7.0, June 5, 2005

With the advance of floodwaters on Judy Creek, the Fish Creek gages below the Fish-Judy confluence also became active. Gages at Fish 25.1, located just downstream of the confluence, first saw measurable water on June 5 (Photo 5-3).

Water elevation was first recorded at Fish 10.3 on June 8. Monitoring at Fish 32.4, the only Fish Creek gage above the confluence, began on June 6 (Photo 5-4), and marked the beginning of flow in the main stem of Fish Creek at this site.

Water surface elevations at the Fish 0.7 monitoring site saw no inundation from Colville River backwater, and as a result the Fish 0.7 gages were the last gages in the Fish Creek Basin to see water on June 7 (Photo 5-5).

Photo 5-3 Water levels at Fish Creek 25.1, June 5, 2005

Photo 5-4 Water levels at Fish Creek 32.4, June 6, 2005

Photo 5-5 Water levels at Fish Creek 0.7, June 7, 2005

5.1.2 Ublutuoch River Observations

In 2005, the Ublutuoch River was the last study stream to break up within the Fish Creek basin. Similarly to Fish and Judy Creeks, localized melt and standing water along the Ublutuoch River was noted several days prior to occurrence of floodwater. The leading edge of the flood moved through the proposed bridge crossing location at the Ublutuoch 6.8 monitoring site on the afternoon of June 6 (Photo 5-6).

Photo 5-6 Leading edge of breakup flow at Ublutuoch River 6.8, June 6, 2005

The flow advanced relatively rapidly with surface velocities over the channel snow of approximately two to three feet per second (fps). Initially the leading edge appeared to follow the left bank at the bridge crossing site due to the deeper, higher snow in the thalweg area along the right bank. Flow eventually spread out to saturate snow across the entire channel. Bottomfast channel ice and snow was in place at Ublutuoch 1.9, 6.7, 6.8, 6.9 and 13.7 at the time the peak occurred and the peak water surface elevations were therefore considered to be ice-affected.

Backwater flooding from Fish and Judy Creeks was again noted at gages located in the lower portion of the Ublutuoch River at river mile 1.9 (Photo 5-7). Monitoring of the backwater at Ublutuoch 1.9 gages began on June 6 and continued through June 13. By the afternoon of June 8, Ublutuoch River was actively flowing from upstream.

Photo 5-7 Water levels at Ublutuoch River 1.9, June 7, 2005

5.1.3 NPRA Small Streams Observations

Monitoring on the nine small stream sites along the proposed ASDP road began on June 3 at Site 5, on June 5 at Sites 1, 2, and 3, on June 6 at Sites 7, 8, and 9, and on June 7 at Site 10 (Photos 5-8 through 5-14). In 2005 the timing of initiation of flow, and thus of monitoring appeared to follow the generalized breakup pattern relative to north-south orientation.

Initiation of flow in each of the small streams was controlled by upstream and local snow melt, with bottomfast channel ice, floating ice, and channel banks covered with saturated snow.

For the majority of the small stream sites, stage typically peaked two to three days after initiation of flow. In some cases, such as at Sites 2, 3, 6, and 10, the peak stage was recorded on the first day of water surface elevation measurements with stages steadily dropping thereafter.

In general, the rising and falling limbs of the stage hydrographs at the small streams could be characterized as gentle with relatively low slopes and rounded peaks. At Site 8, however, relatively confined channel conditions and a rapid breakup delivery to the active channel resulted in somewhat "flashy" conditions.

Photo 5-8 Aerial view of Site 1, July 8, 2005

Photo 5-9 Aerial view of Site 2, June 6, 2005

Photo 5-10 Aerial view of Site 5, June 5, 2005

Site 7 also experienced rapid and relatively significant water elevation rise and fall; however the site is composed of a broad, low-relief plain between two tundra lakes with the centerline gage likely on or close to the watershed divide.

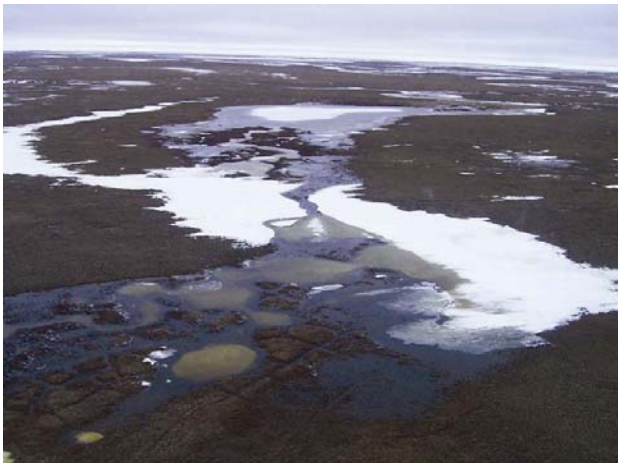


Photo 5-11 Aerial view of Site 6, June 6, 2005

Photo 5-12 Aerial view of Site 7, June 7, 2005

Photo 5-13 Aerial view of Site 9, June 7, 2005

Photo 5-14 Aerial view of Site 10, July 8, 2005

5.2 Fish Creek Basin Water Surface Elevations

5.2.1 Fish and Judy Creeks Water Surface Elevations

Water surface elevation measurements at Judy 13.8 began on June 4. By June 5 floodwater reached the gages at Judy 7.0 and Fish 25.1. All 2005 Fish Creek gaging locations were downstream of the Fish and Judy confluence with the exception of Fish 32.4. Flow at Fish 32.4 was not observed until June 6. Measurements on Fish and Judy Creeks continued until June 13. Table 5-1 through Table 5-6 present the water surface elevations and observations for the monitoring sites on the Fish and Judy Creeks.

A peak water surface elevation of 37.25 feet was recorded at Judy 13.8 on June 4 only about 12 hours after water was first noted on the gages. Floodwater elevation was affected by bottomfast ice and snow. The peak water surface at Judy 7.0 did not occur until three days later on June 7 at 28.64 feet. Peak water surface elevations at Fish 25.1 and Fish 10.3 occurred on June 8 and 10 at elevations of 19.98 feet and 7.59 feet, respectively. Several additional peaks on the falling limb of the hydrographs at Judy 13.8 and 7.0 and at Fish 32.4 were likely the result of the formation and subsequent release of localized ice jams. The peak stage of 7.59 feet measured at Fish 10.3 on June 10 was likely affected by a localized ice jam as well. The June 5 peak water surface elevation of 21.80 feet at Fish 32.4 occurred over intact ice and snow that affected its elevation.

The peak water surface elevation at Fish and Judy Creeks has historically occurred after the bottom fast channel ice has lifted. Several locations were an exception to that rule in 2005. At a minimum, peak water surface elevation at Fish 32.4 and Judy 13.8 occurred so rapidly that bottomfast channel ice was likely intact. It is possible too that the peak stage at Fish 25.1 and Judy 7.0 were similarly affected.

Table 5-1 Fish Creek - Mile 32.4, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
High Water Mark	21.80	High water occurred early on the morning of June 5 over intact snow/ice
6/6/05 11:52 AM	21.56	Snow around gage - good communication
6/7/05 12:58 PM	21.61	Snow/ice still in place
6/8/05 2:45 PM	21.57	
6/9/05 4:10 PM	21.66	Minor secondary peak
6/10/05 4:57 PM	20.45	Ice lifting/floating
6/11/05 3:15 PM	21.34	Secondary peak
6/12/05 9:28 AM	20.45	Read with hand level
6/13/05 3:21 PM	19.55	Stage dropping

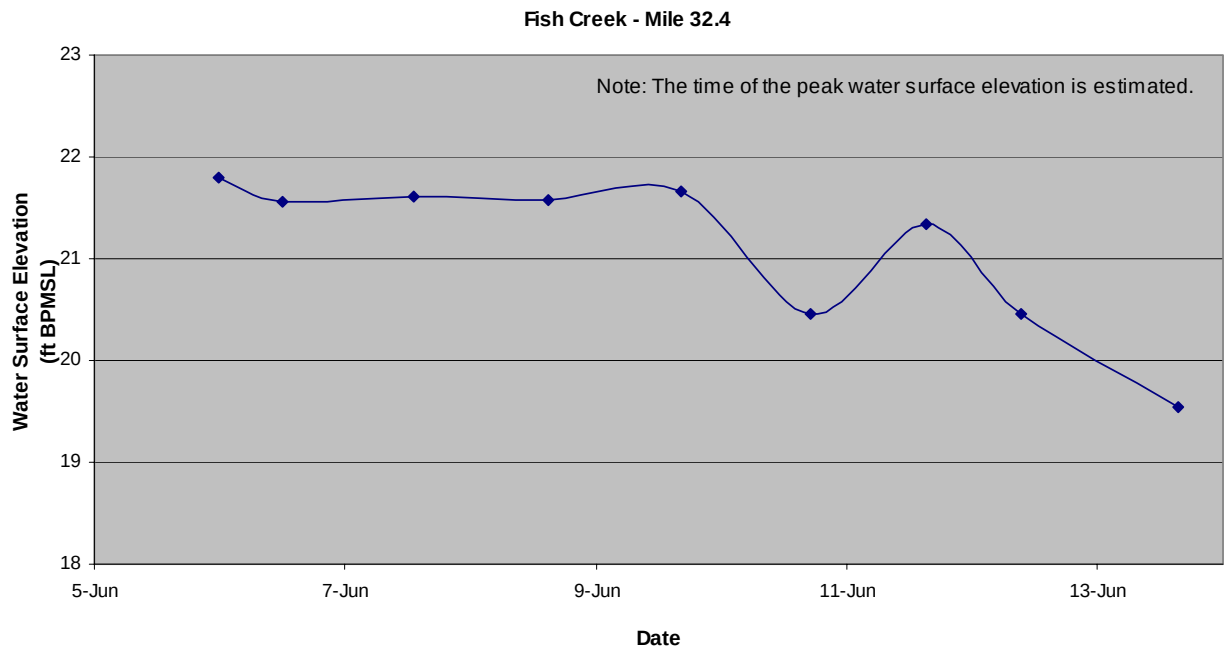


Table 5-2 Fish Creek - Mile 25.1, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
6/5/05 12:14 PM	14.14	Flow over ice
6/6/05 11:44 AM	16.32	Flow over ice
6/7/05 12:48 PM	19.57	
High Water Mark	19.98	High water occurred early on the morning of June 8
6/9/05 4:00 PM	18.36	Ice floating, moving through the section
6/10/05 4:38 PM	17.10	
6/11/05 3:10 PM	17.39	Secondary peak
6/12/05 9:19 AM	16.58	
6/13/05 3:15 PM	16.40	Read with hand level

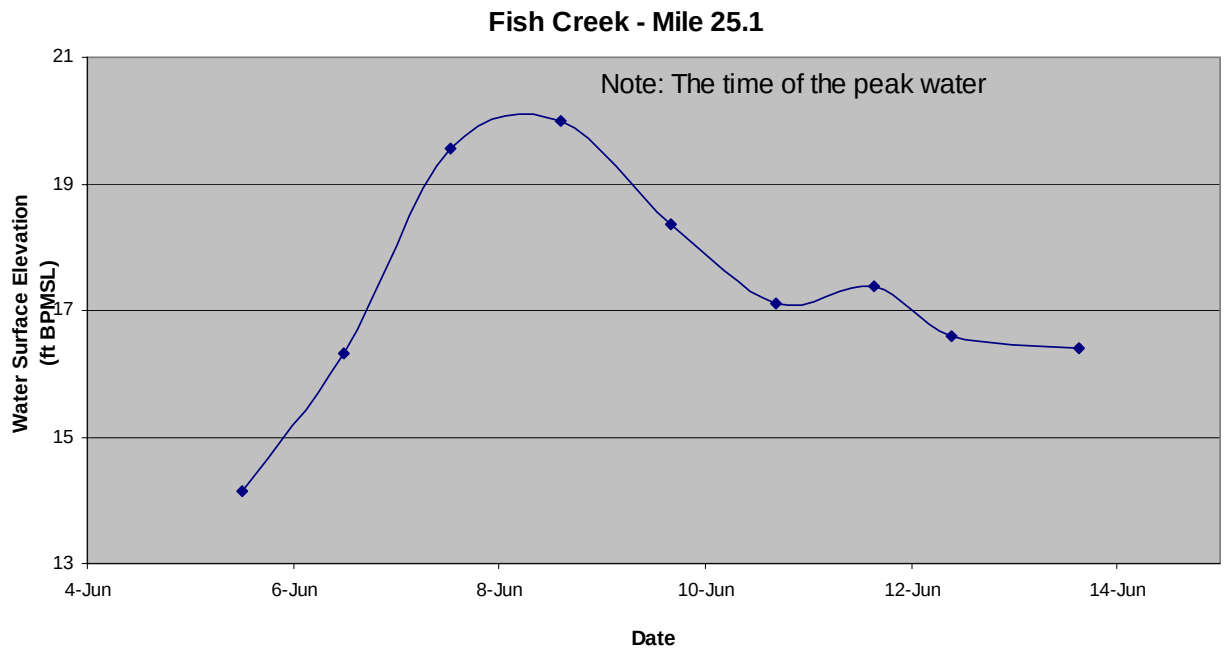


Table 5-3 Fish Creek - Mile 10.3, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
6/8/05 3:40 PM	7.28	Ice lifted/floating
6/9/05 3:47 AM	7.52	Preliminary peak
6/9/05 3:47 PM	7.40	
High Water Mark	7.59	High water occurred early on the afternoon of June 10
6/11/05 2:59 PM	6.95	
6/12/05 9:00 AM	6.57	Stage dropping
6/13/05 3:07 PM	5.89	Stage dropping

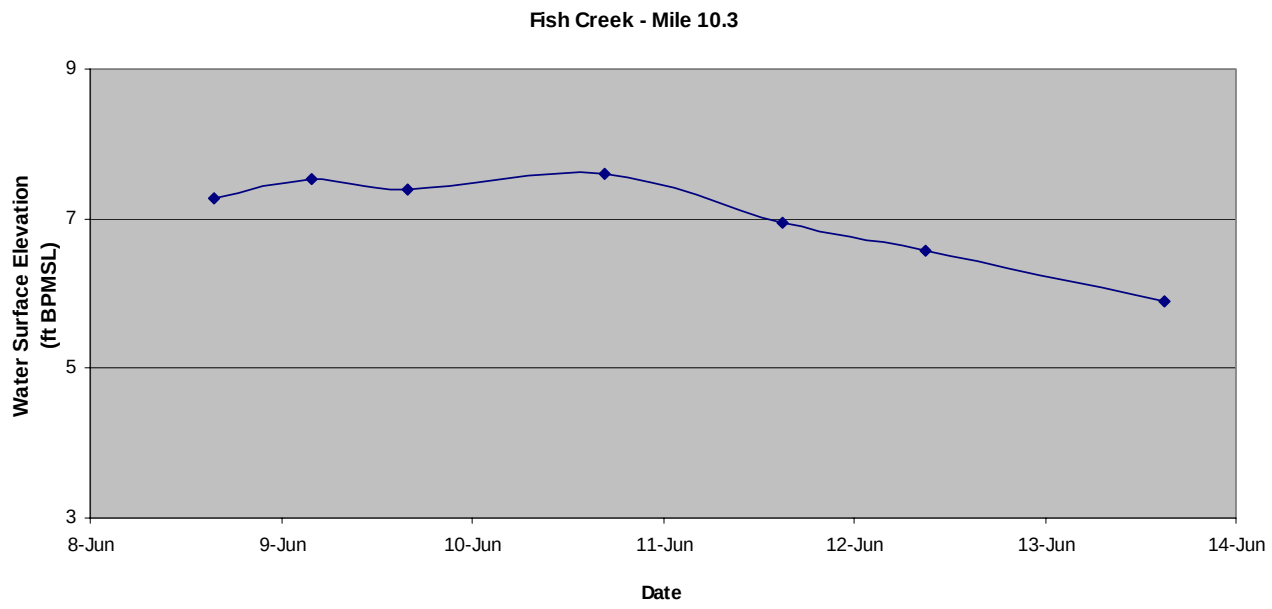


Table 5-4 Fish Creek - Mile 0.7, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
6/7/05 11:21 AM	2.93	No backwater from Nigliq, no water on gage - survey
6/8/05 3:50 PM	3.46	No backwater from Nigliq
High Water Mark	3.48	High water occurred on the afternoon of June 9
6/10/05 4:30 PM	3.27	
6/11/05 2:52 PM	3.16	No water on gage - measure down
6/12/05 9:02 AM	3.02	No water on gage - measure down
6/13/05 3:02 PM	2.76	No water on gage - measure down

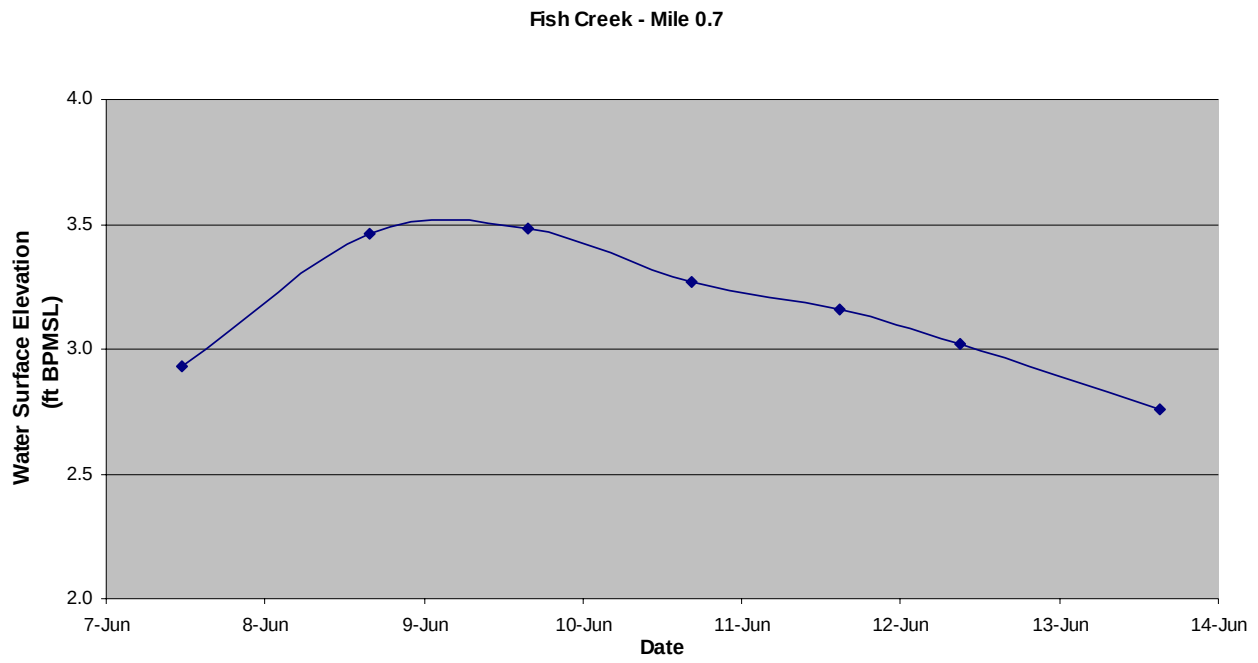


Table 5-5 Judy Creek - Mile 13.8, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
6/4/05 6:47 PM	36.88	Flow over ice/snow
High Water Mark	37.25	High water occurred on the evening of June 4 over intact channel ice
6/5/05 11:35 AM	34.97	Flow over ice/snow
6/6/05 12:10 PM	35.93	
6/7/05 1:33 AM	36.31	Minor secondary peak
6/7/05 1:33 PM	36.02	
6/8/05 1:55 AM	36.13	Minor secondary peak
6/8/05 1:55 PM	35.64	
6/9/05 4:19 AM	35.73	Minor secondary peak
6/9/05 4:19 PM	35.34	
6/10/05 5:06 PM	34.91	Stage dropping
6/11/05 3:23 PM	34.40	
6/12/05 9:37 AM	34.03	Stage dropping significantly
6/13/05 3:33 PM	33.53	

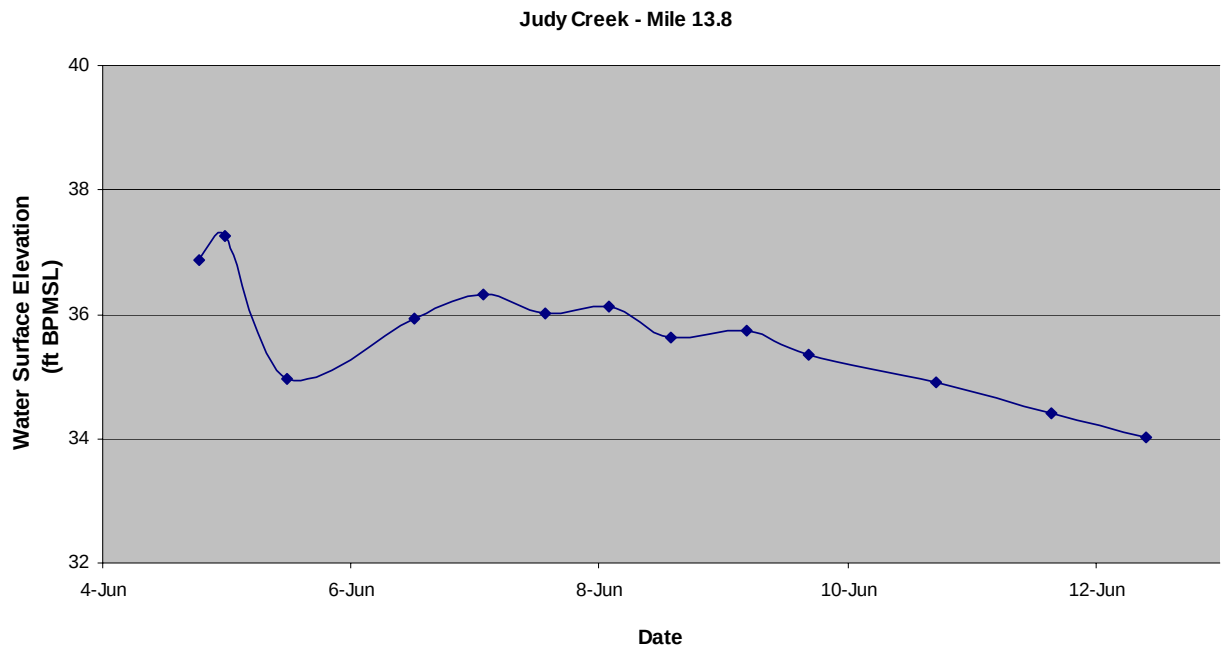
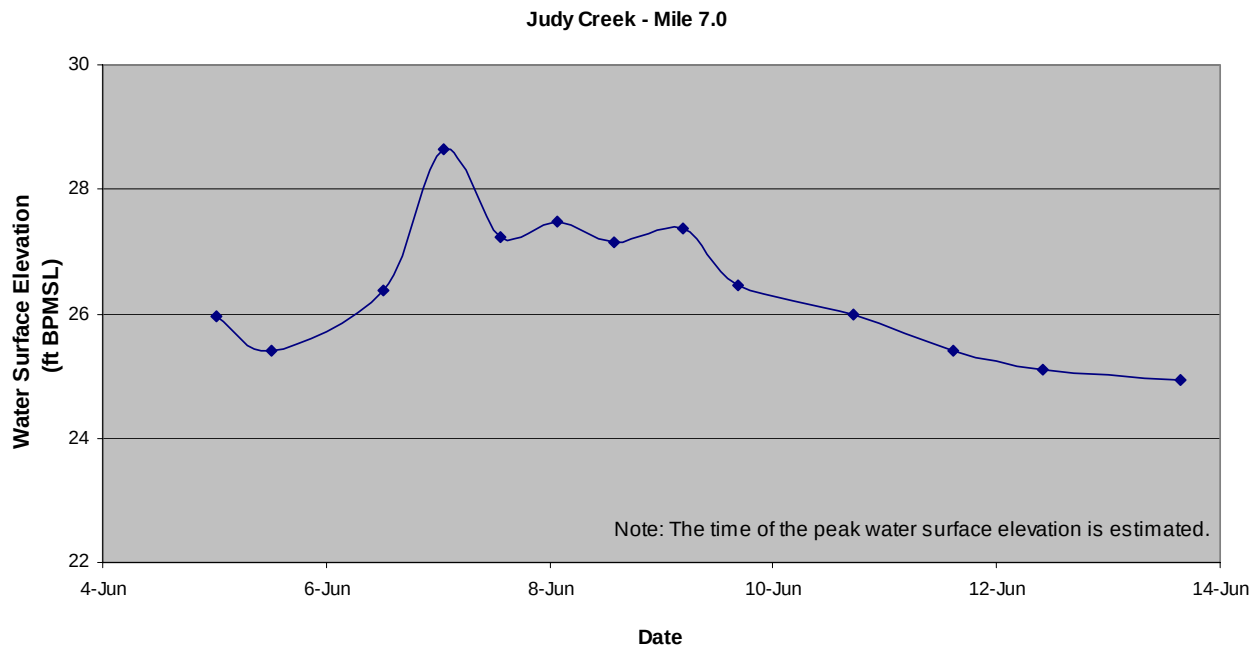


Table 5-6 Judy Creek- Mile 7.0, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
6/5/05 12:25 AM	25.96	Flow over ice/snow
6/5/05 12:25 PM	25.40	Flow over ice
6/6/05 12:22 PM	26.36	
High Water Mark	28.64	High water occurred early on the morning of June 7
6/7/05 1:15 PM	27.24	
6/8/05 1:40 AM	27.49	Secondary peak - ice jam release
6/8/05 1:40 PM	27.15	
6/9/05 4:29 AM	27.36	Secondary peak - ice jam release
6/9/05 4:29 PM	26.47	
6/10/05 5:15 PM	25.98	No water on gage - measure down
6/11/05 2:31 PM	25.41	No water on gage - measure down
6/12/05 9:44 AM	25.11	No water on gage - read with hand level
6/13/05 3:38 PM	24.93	Read with hand level



5.2.2 Ublutuoch River Water Surface Elevations

Water surface elevation monitoring on the Ublutuoch River began on June 6 at gages located at the southernmost and northernmost monitoring sites, Ublutuoch 13.7, and Ublutuoch 1.9, respectively. The water on the gages at Ublutuoch 1.9 was backwater from Fish Creek that had backed up into the lower Ublutuoch channel. On June 6, the leading edge of breakup floodwater on the Ublutuoch River was observed moving through the proposed bridge crossing site past Ublutuoch 6.9, 6.8, and 6.7. Water surface elevation measurements at these sites began June 7.

Table 5-7 through Table 5-11 present the water surface elevations and observations for the monitoring sites on the Ublutuoch River.

Peak stage at Ublutuoch 6.8 occurred on June 7, one day after the leading edge was observed flowing through the area at an elevation of 10.01 feet (Photo 5-15).

Photo 5-15 Ublutuoch River at 6.8 near peak stage, June 6, 2005

Between June 8 and June 9, two additional peaks occurred that were likely the result of the formation and subsequent release of localized ice jams and that were well-defined at all three bridge site monitoring locations.

At the Ublutuoch 13.7 site, peak recorded stage also occurred on the second day of observations, June 7, at an elevation of 18.87 feet. However, this may not represent the highest water surface elevation observed at Ublutuoch 13.7. On the morning of June 6, an attempt was made to record water elevation at the site however water levels were high enough that all gages and benchmarks were submerged such that no readings were recorded.

The peak water surface elevation at Ublutuoch 1.9 occurred approximately 24 hours before the peak water surface elevation at Fish Creek 10.3. It is likely that the flooding conditions on lower Fish Creek produced backwater effects on the lower Ublutuoch River that to some degree affected the timing and elevation of the peak water surface at Ublutuoch 1.9.

Bottomfast channel ice was intact at all Ublutuoch monitoring locations at the time the peak water surface elevation occurred and all peak water surface elevations were therefore considered ice-affected.

Table 5-7 Ublutuoch River Mile 13.7, Water Surface Elevations and Observations

Date	Water Surface Elevation (feet BPMSL)	Observations
6/6/05 10:10 AM	–	All gages submerged - no WSE reading possible
6/7/05 3:50 PM	18.87	All gages submerged - measure up from Monument UB US West
6/8/05 12:55 PM	18.26	
6/9/05 4:47 PM	17.17	TBM D slightly bent from ice impact - straightened
6/10/05 5:34 PM	16.02	
6/13/05 2:51 PM	13.34	Significant decrease in stage

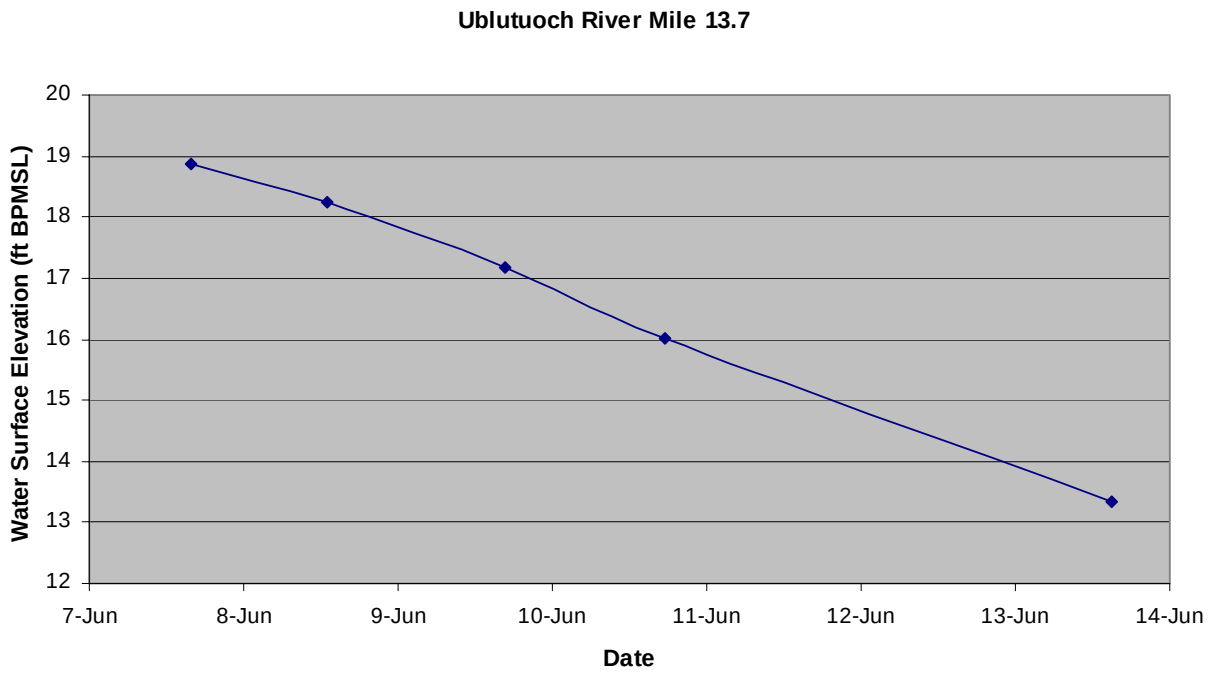


Table 5-8 Ublutuoch River Mile 6.9, Water Surface Elevations and Observations

Date	Water Surface Elevation (feet BPMSL)	Observations
6/7/05 10:00 AM	10.06	Flow over ice/snow in channel
High Water Mark	10.15	The peak water surface elevation occurred on June 7 at approximately noon.
6/7/05 6:00 PM	9.67	Flow over ice/snow in channel
6/8/05 12:08 AM	9.73	Possible minor secondary peak
6/8/05 12:08 PM	9.32	Measurement prior to 1st discharge measurement, flow over ice/snow
6/8/05 5:20 PM	9.20	Measurement after 1st discharge measurement, flow over ice/snow
6/8/05 9:15 PM	9.45	Possible secondary peak
6/9/05 9:15 AM	9.12	Measurement prior to 2nd discharge measurement, flow over ice/snow
6/9/05 11:32 AM	9.01	Measurement after 2nd discharge measurement, flow over ice/snow
6/10/05 8:58 AM	8.13	Measurement prior to 3rd discharge measurement, flow over ice/snow
6/10/05 11:58 AM	8.13	Measurement after 3rd discharge measurement, flow over ice/snow
6/11/05 9:50 AM	7.46	Measurement prior to 4th discharge measurement, flow over ice/snow
6/11/05 12:52 PM	7.35	Measurement after 4th discharge measurement, flow over ice/snow
6/13/05 1:27 PM	5.94	Measurement prior to depth sounding, flow over ice/snow
6/13/05 3:31 PM	5.86	Measurement after depth sounding, flow over ice/snow
6/14/05 11:01 AM	5.28	Measurement prior to depth sounding, flow over ice/snow
6/14/05 11:57 AM	5.26	Measurement after depth sounding, flow over ice/snow

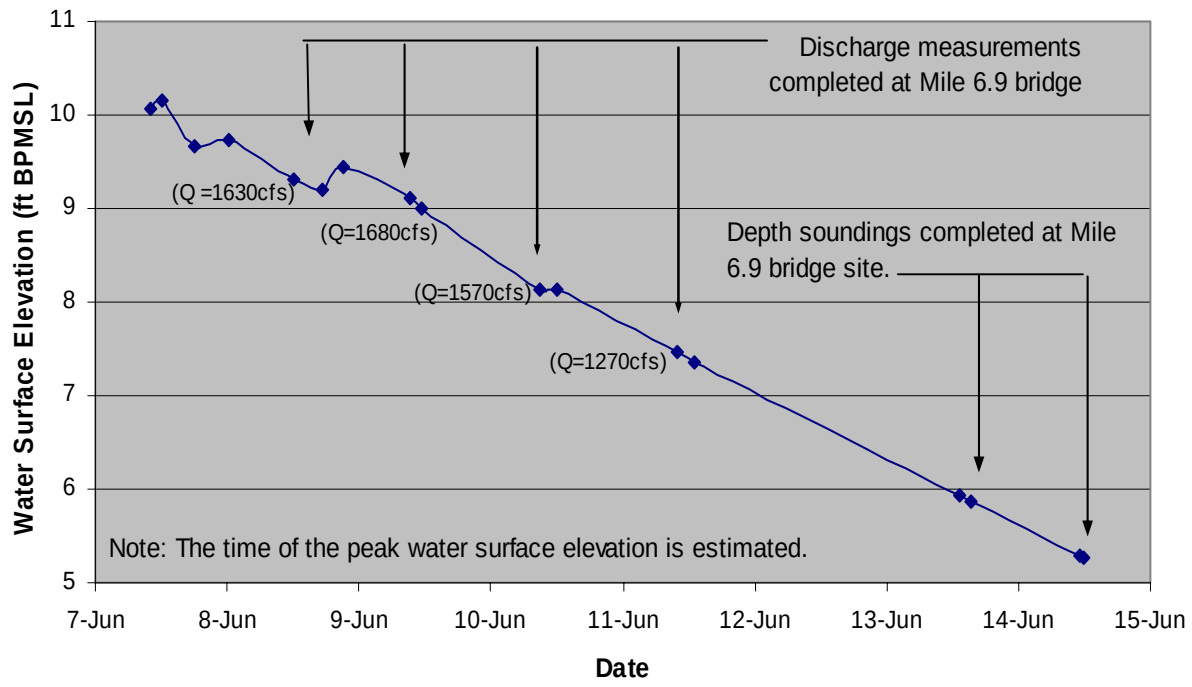


Table 5-9 Ublutuoch River Mile 6.8, Water Surface Elevations and Observations

Date	Water Surface Elevation (feet BPMSL)	Observations
6/7/05 10:05 AM	9.97	Flow over ice/snow in channel
High Water Mark	10.01	The peak water surface elevation occurred on June 7 at approximately noon.
6/7/05 6:04 PM	9.52	Flow over ice/snow in channel
6/8/05 12:00 AM	9.49	Possible minor secondary peak
6/8/05 12:00 PM	9.19	Measurement prior to 1st discharge measurement, flow over ice/snow
6/8/05 5:28 PM	9.11	Measurement after 1st discharge measurement, flow over ice/snow
6/8/05 9:10 PM	9.31	Possible secondary peak
6/9/05 9:10 AM	9.05	Measurement prior to 2nd discharge measurement, flow over ice/snow
6/9/05 11:34 AM	8.93	Measurement after 2nd discharge measurement, flow over ice/snow
6/10/05 8:48 AM	8.10	Measurement prior to 3rd discharge measurement, flow over ice/snow
6/10/05 12:03 PM	8.03	Measurement after 3rd discharge measurement, flow over ice/snow
6/11/05 9:27 AM	7.44	Measurement prior to 4th discharge measurement, flow over ice/snow
6/11/05 1:05 PM	7.30	Measurement after 4th discharge measurement, flow over ice/snow
6/13/05 1:43 PM	5.94	Measurement prior to depth sounding, flow over ice/snow
6/13/05 3:44 PM	5.90	Measurement after depth sounding, flow over ice/snow
6/14/05 10:54 AM	5.32	Measurement prior to depth sounding, flow over ice/snow
6/14/05 12:04 PM	5.29	Measurement after depth sounding, flow over ice/snow

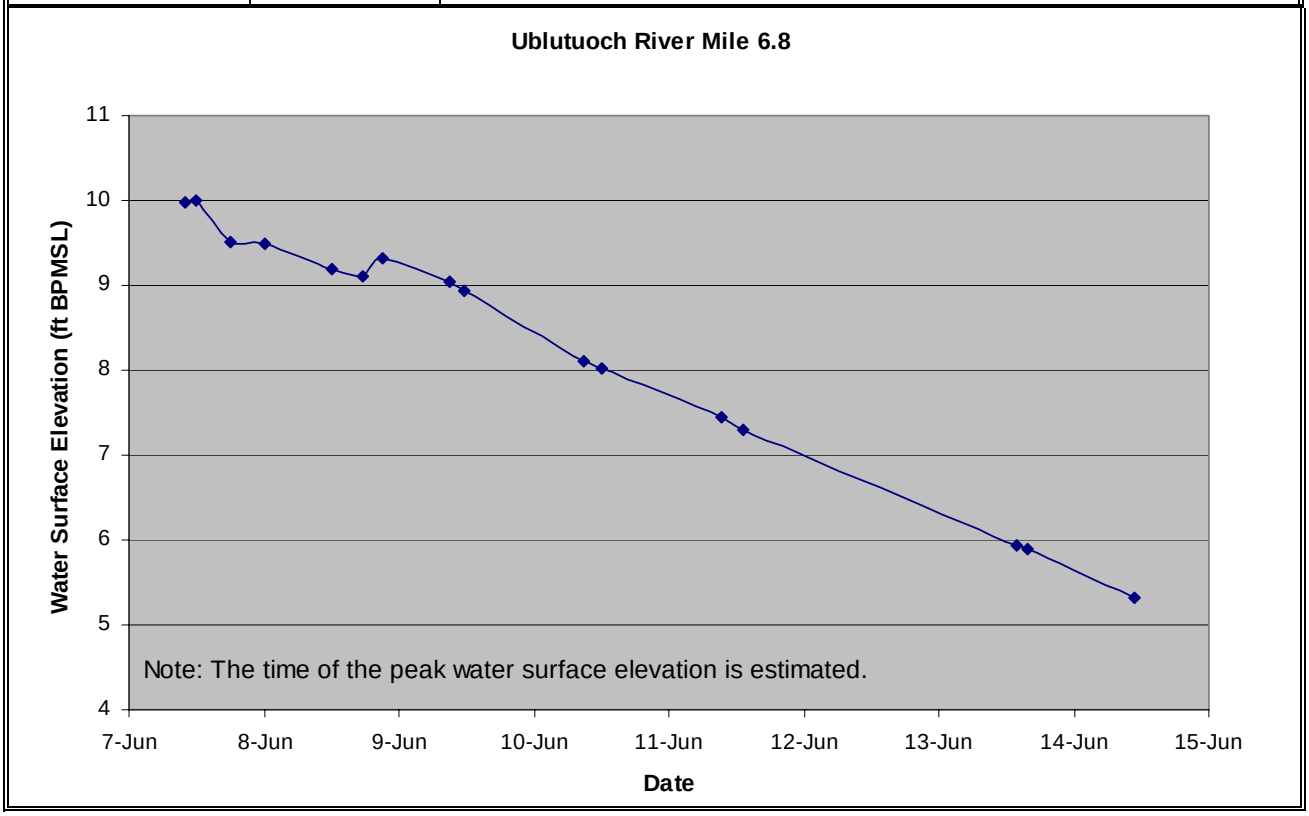


Table 5-10 Ublutuoch River Mile 6.7, Water Surface Elevations and Observations

Date	Water Surface Elevation (feet BPMSL)	Observations
6/7/05 10:08 AM	9.85	Flow over ice/snow in channel
High Water Mark	9.92	The peak water surface elevation occurred on June 7 at approximately noon.
6/7/05 6:06 PM	9.37	Flow over ice/snow in channel
6/8/05 12:01 PM	9.06	Measurement prior to 1st discharge measurement, flow over ice/snow
6/8/05 5:33 PM	8.98	Measurement after 1st discharge measurement, flow over ice/snow
6/8/05 9:00 PM	9.17	Possible secondary peak
6/9/05 9:00 AM	8.89	Measurement prior to 2nd discharge measurement, flow over ice/snow
6/9/05 11:36 AM	8.76	Measurement after 2nd discharge measurement, flow over ice/snow
6/10/05 8:42 AM	8.03	Measurement prior to 3rd discharge measurement, flow over ice/snow
6/10/05 12:05 PM	7.95	Measurement after 3rd discharge measurement, flow over ice/snow
6/11/05 9:23 AM	7.35	Measurement prior to 4th discharge measurement, flow over ice/snow
6/11/05 1:00 PM	7.23	Measurement after 4th discharge measurement, flow over ice/snow

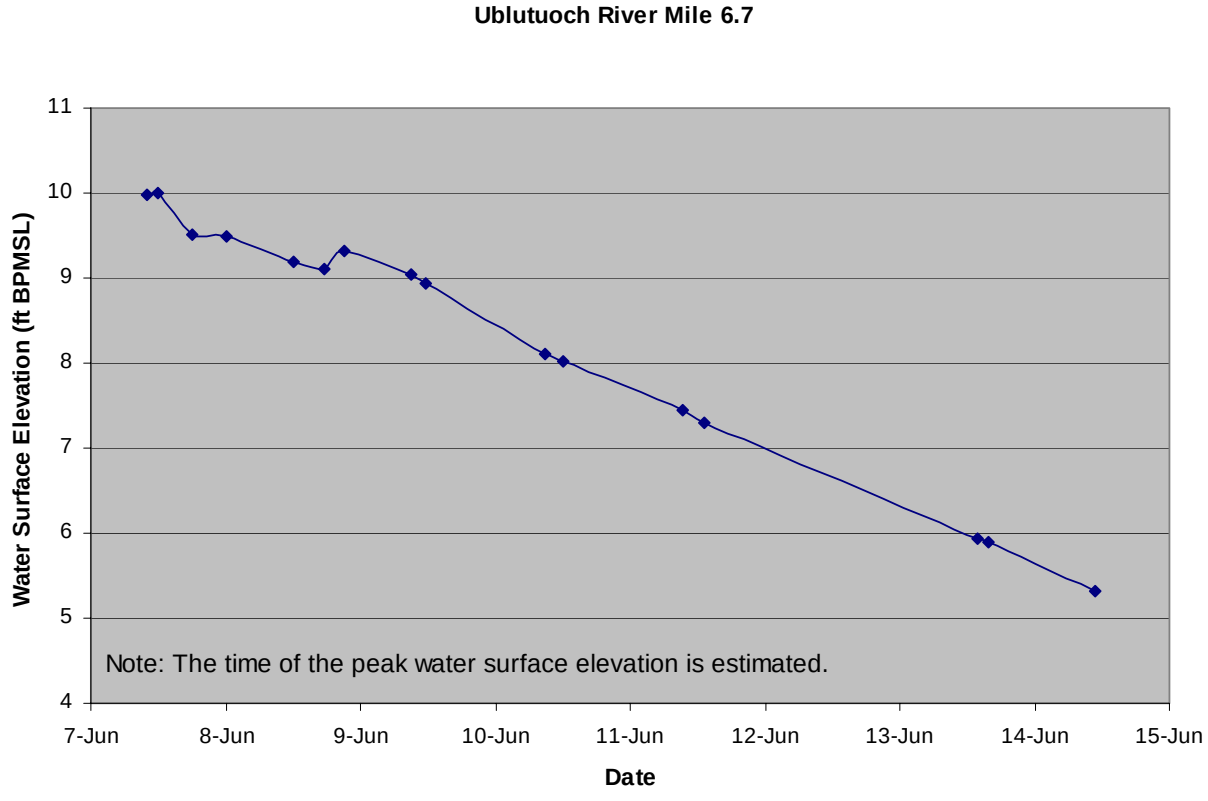
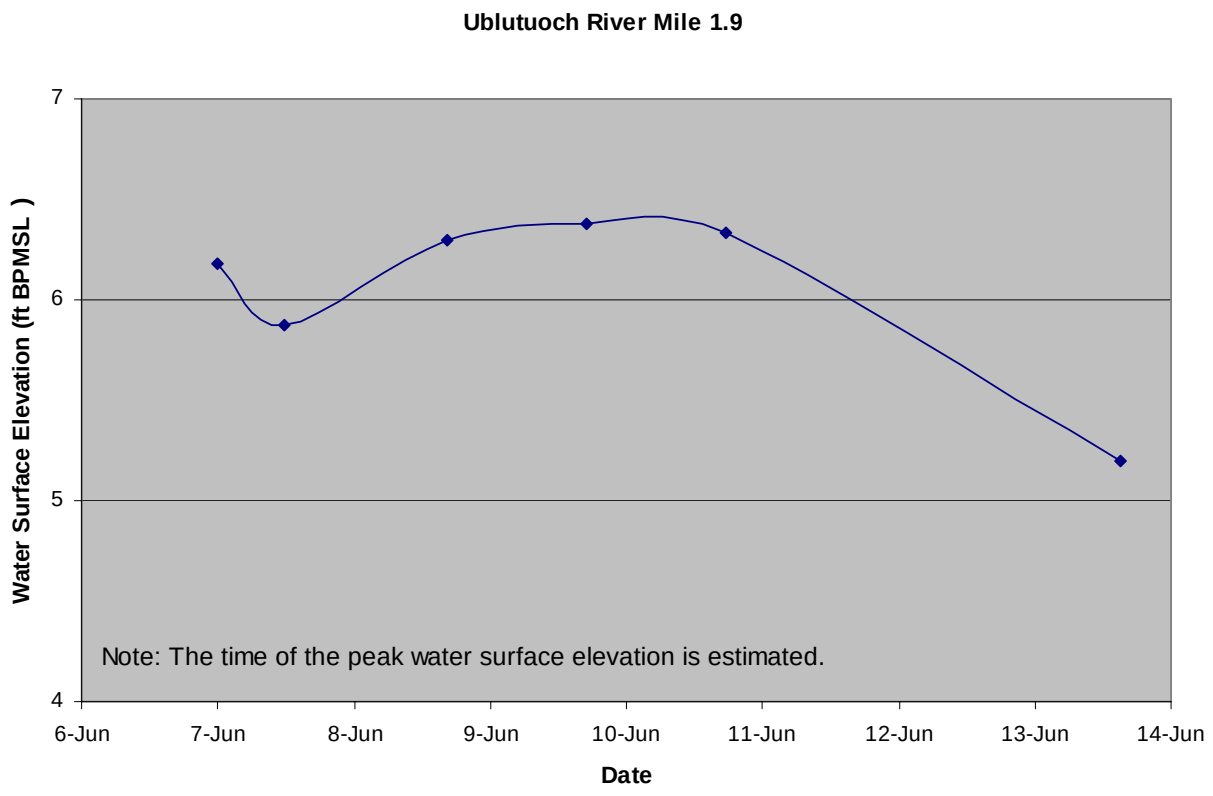


Table 5-11 Ublutuoch River Mile 1.9, Water Surface Elevations and Observations

Date	Water Surface Elevation (feet BPMSL)	Observations
6/6/05 11:49 PM	6.18	Preliminary peak - backwater from Fish Creek only
6/7/05 11:49 AM	5.87	Probable backwater from Fish Creek
6/8/05 4:30 PM	6.30	Good flow from upstream - little or no backwater
High Water Mark	6.38	The peak water surface elevation occurred on the afternoon of June 9.
6/10/05 5:42 PM	6.33	
6/13/05 2:55 PM	5.20	Significant decrease in stage



5.2.3 Small Streams Water Surface Elevations

Water surface elevation monitoring at the nine small stream sites at the potential ASDP road crossing locations began on June 3 at site 5 and continued until June 12 at site 10. The occurrence of peak stage at the small stream sites ranged from June 4 through June 7 at Site 5 and Site 7, respectively. Peak water surface elevations on centerline gages in the small streams network ranged from 10.38 feet at Site 1 to 66.51 feet at Site 10. The peak water surface elevations at the nine sites were affected by snow and/or ice.

At Site 1, a peak water surface elevation was recorded on June 6 at an elevation of 10.38 feet with little change recorded.

At Sites 2 and 7, surface water flow was not observed and water levels at each of these locations represents shallow local melt (Photo 5-16 and Photo 5-17, respectively). Peak water surface elevations at Site 2 and Site 7 were 19.62 feet and 24.44 feet, respectively.

Photo 5-16 Site 2 after breakup, July 8, 2005

Photo 5-17 Site 7 after breakup, July 8, 2005

At Site 3, a peak water surface elevation was recorded on June 5 at an elevation of 10.67 feet (Photo 5-18) with approximately 0.1 feet of change recorded between June 5 and June 8.

At Site 5, a peak water surface elevation was recorded on June 4 at an elevation of 15.13 feet and leveled off two days after peak water surface elevation.

Photo 5-18 Site 3 near peak stage, June 6, 2005

At Site 6 a peak water surface elevation was recorded on June 6 at an elevation of 19.61 feet and receded relatively quickly.

At Site 8, a peak water surface elevation was recorded on June 6 at an elevation of 26.13 feet (Photo 5-19) representing a relatively dramatic rise and fall of the hydrograph.

At Site 9, a peak water surface elevation was recorded on June 4 at an elevation of 63.38 feet and receded relatively quickly.

At Site 10, a peak water surface elevation was recorded on June 7 at an elevation of 66.51 feet with a steady drop in water surface elevation after the initial measurement.

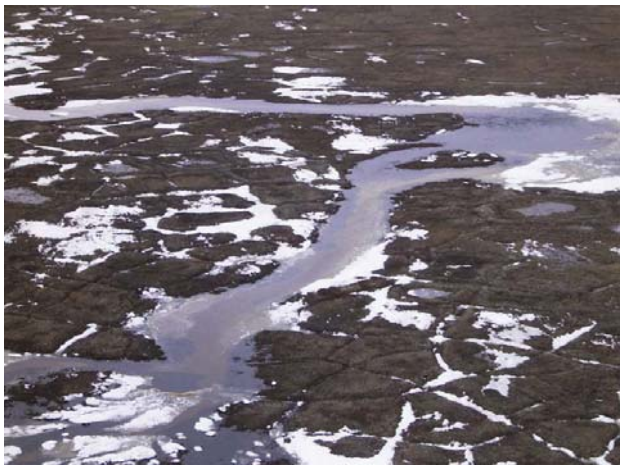


Photo 5-19 Site 8 near peak stage, June 7, 2005

Table 5-12 through Table 5-20 present the water surface elevations and observations for the small stream sites. Cross-section geometry at each small stream was surveyed by Baker in 2005 (Figure 5-1 through Figure 5-9, beginning on page 5-30).

Table 5-12 Small Stream Site 1, Water Surface Elevations And Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S1 Upstream		
6/5/05 3:49 PM	10.56	Water pooled within snow around gage
6/6/05 8:50 AM	10.61	No discernible flow, water frozen around gage
High Water Mark	10.67	High water occurred on the evening of June 6
6/7/05 9:33 AM	10.59	Flow noted at gage location
TBM S1 Centerline		
6/5/05 3:48 PM	10.18	Water pooled within snow around gage
6/6/05 8:50 AM	10.35	No discernible flow, water frozen around gage
High Water Mark	10.38	High water occurred on the evening of June 6
6/7/05 9:33 AM	10.23	Flow noted at gage location
6/8/05 4:10 PM	9.87	Flow mostly confined to single channel
6/8/05 6:40 PM	9.85	Discharge measurement completed
TBM S1 Downstream		
6/5/05 3:48 PM	9.35	Ice on gage, read ice level as WSE
6/6/05 8:50 AM	9.49	No discernible flow, water frozen around gage
High Water Mark	9.55	High water occurred on the evening of June 6
6/7/05 9:33 AM	9.37	Flow noted at gage location

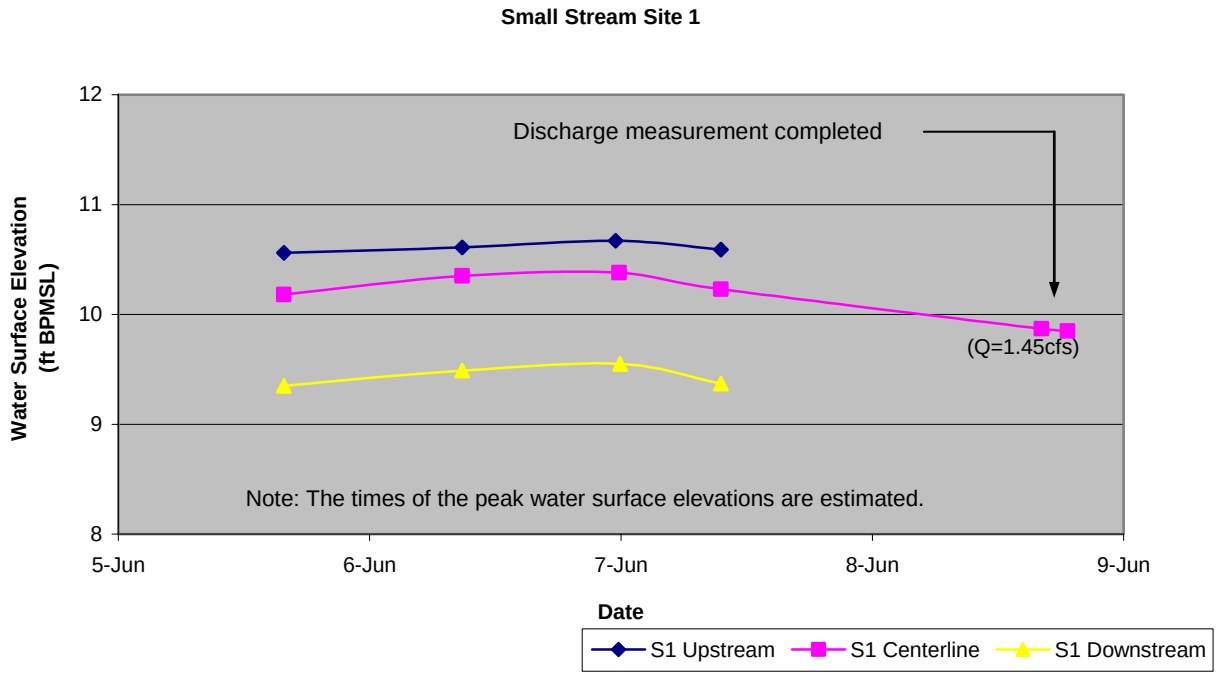


Table 5-13 Small Stream Site 2, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S2 North		
6/5/05 3:29 PM	–	Gage was dry due to its location on a tussock
6/6/05 11:15 AM	19.68	No water on gage plate - measure down from top of steel
6/7/05 4:31 PM	19.66	No water on gage plate - measure down from top of steel
TBM S2 Centerline		
6/5/05 3:29 PM	19.62	No water on gage plate - measure down from top of gage
6/6/05 11:29 AM	19.59	Completed cross-section of channel, WSE surveyed
6/7/05 4:41 PM	19.56	No water on gage plate - measure down from top of steel
6/8/05 4:15 PM	19.53	No discharge measurement required - water is static
TBM S2 South		
6/5/05 3:29 PM	–	Gage was dry due to its location on a tussock
6/6/05 11:00 AM	19.59	No water on gage plate - survey WSE
6/7/05 4:36 PM	19.55	No water on gage plate - measure down from top of steel

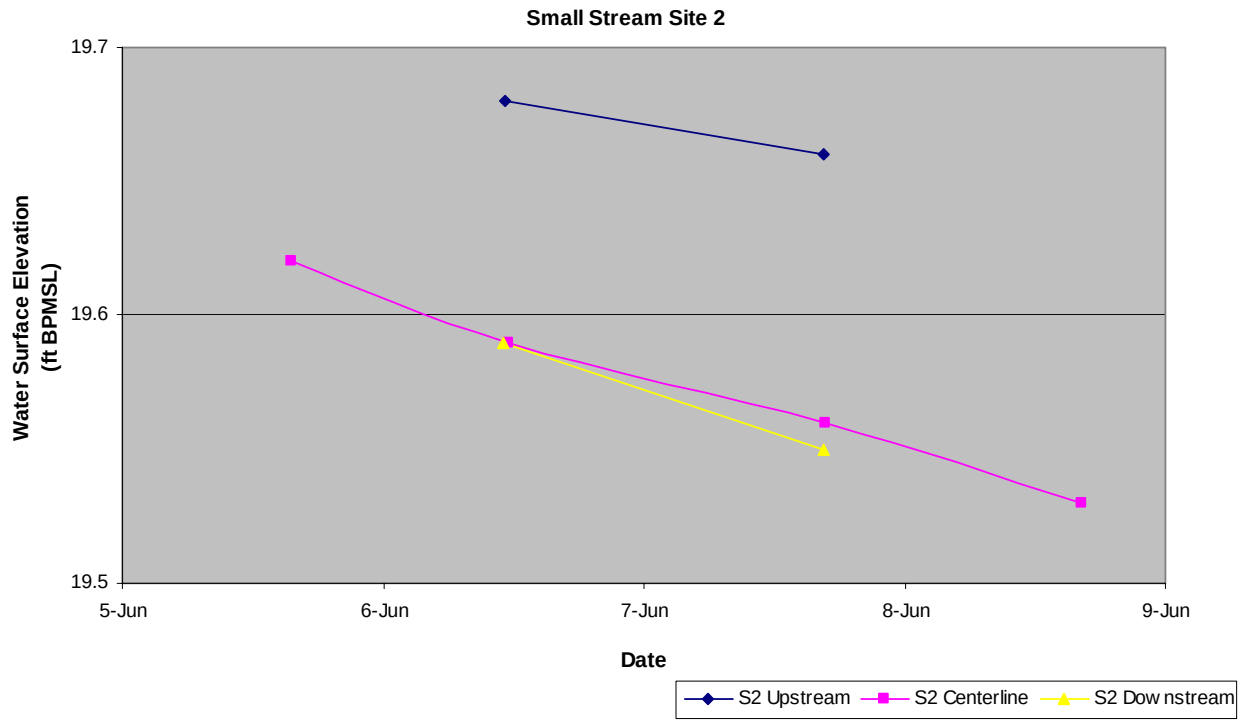


Table 5-14 Small Stream Site 3, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S3 Upstream		
6/5/05 3:13 PM	21.67	No water on gage plate - measure down from top of gage
6/6/05 1:00 PM	21.31	No water on gage plate - measure down from top of steel
6/7/05 4:18 PM	21.25	No water on gage plate - measure down from top of steel
TBM S3 Centerline		
6/5/05 3:13 PM	20.665	No water on gage plate - measure down from top of gage
6/6/05 1:00 PM	20.55	Channel cross section and discharge measurement completed
6/7/05 4:20 PM	20.50	No water on gage plate - measure down from top of steel
6/8/05 4:20 PM	20.51	No water on gage plate - measure down from top of gage
TBM S3 Downstream		
6/5/05 3:13 PM	–	Gage surrounded by snow - no water
6/6/05 1:00 PM	20.07	No water on gage - survey WSE
6/7/05 4:24 PM	20.13	No water on gage plate - measure down from top of steel

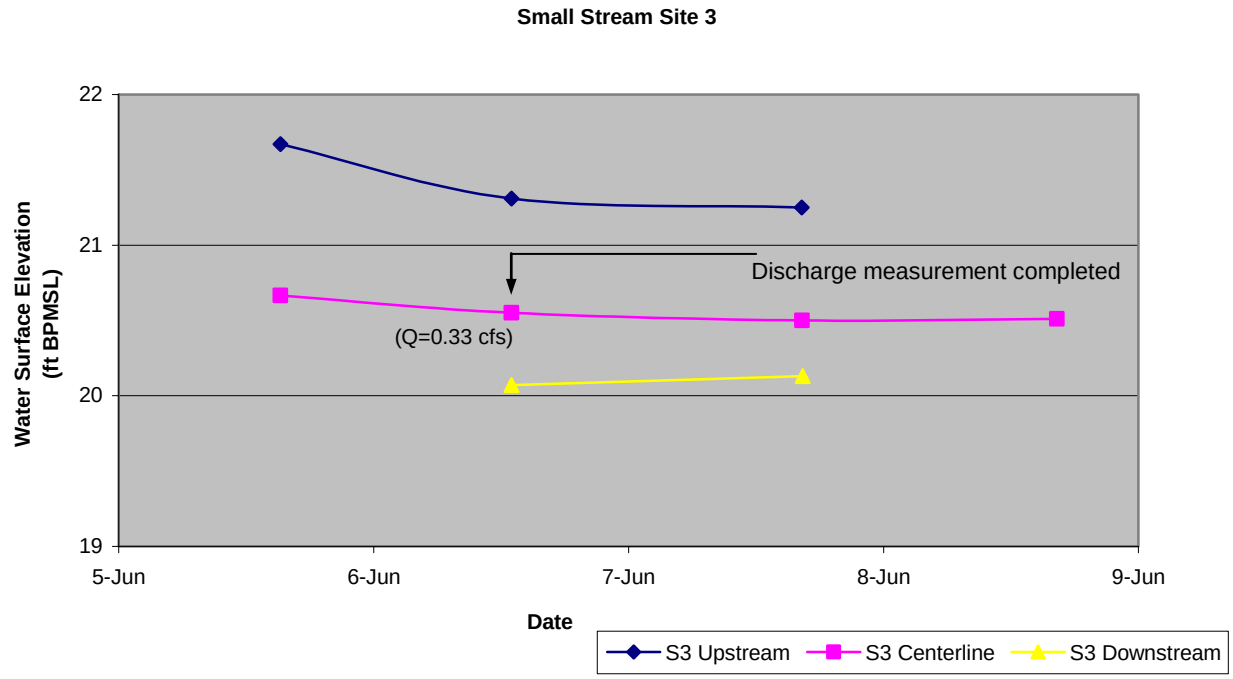


Table 5-15 Small Stream Site 5, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S5 Upstream		
6/3/05 3:47 PM	15.14	Flow over snow/ice
High Water Mark	15.20	High water occurred on the morning of June 4
6/4/05 7:17 PM	14.70	
6/5/05 7:17 PM	14.72	Good flow over grass-covered channel
6/6/05 3:21 PM	14.68	
6/7/05 11:59 AM	14.64	
TBM S5 Centerline		
6/3/05 3:49 PM	15.08	Flow over snow/ice
High Water Mark	15.13	High water occurred on the morning of June 4
6/4/05 7:15 PM	14.34	
6/5/05 7:15 PM	14.33	Channel cross section and discharge measurement completed
6/6/05 3:23 PM	14.19	
6/7/05 11:56 AM	14.13	
6/8/05 3:17 PM	14.09	No water on gage - measure down from top of gage
TBM S5 Downstream		
6/3/05 3:55 PM	15.03	Flow over snow/ice
High Water Mark	15.15	High water occurred on the morning of June 4
6/4/05 7:13 PM	13.84	
6/5/05 7:13 PM	13.62	Good flow over grass-covered channel
6/6/05 3:23 PM	12.95	
6/7/05 12:00 PM	12.8	

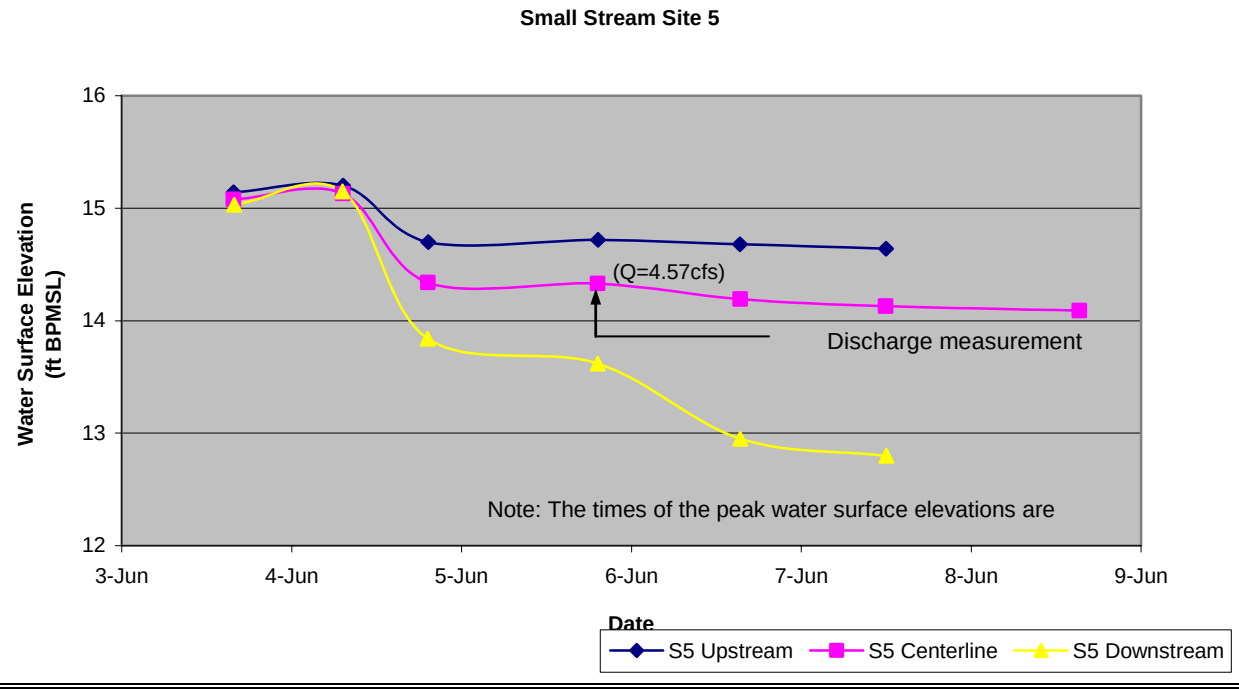


Table 5-16 Small Stream Site 6, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S6 Upstream		
High Water Mark	19.68	High water occurred on the morning of June 6
6/6/05 2:59 PM	18.53	
6/7/05 11:10 AM	18.25	
TBM S6 Centerline		
High Water Mark	19.61	High water occurred on the morning of June 6
6/6/05 3:00 PM	18.24	
6/7/05 11:03 AM	17.90	Discharge measurement completed
TBM S6 Downstream		
High Water Mark	16.85	High water occurred on the morning of June 6
6/6/05 3:11 PM	16.57	
6/7/05 10:54 AM	16.13	

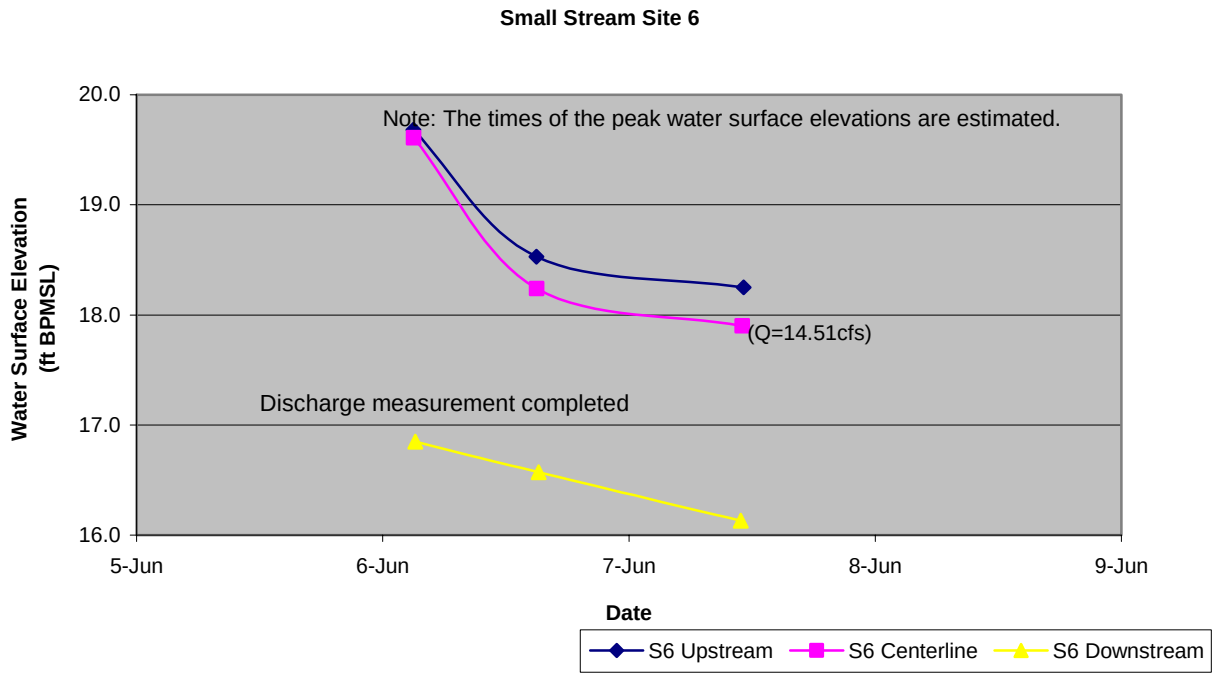


Table 5-17 Small Stream Site 7, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S7 North		
6/4/05 8:12 PM	24.23	No flow - static
6/5/05 1:08 PM	24.24	No flow - static
High Water Mark	24.34	High water occurred on the afternoon of June 5
6/5/05 5:40 PM	24.20	Evaluated for Q measurement - No apparent flow, no measurable velocity
6/6/05 2:37 PM	23.97	
6/7/05 2:34 PM	24.26	
TBM S7 Centerline		
6/4/05 8:11 PM	24.26	
6/5/05 1:12 PM	24.25	
6/5/05 3:00 PM	24.37	
6/5/05 5:40 PM	24.20	Evaluated for Q measurement - No apparent flow, no measurable velocity
6/6/05 2:33 PM	23.98	
6/7/05 2:29 PM	24.44	High water occurred on the afternoon of June 7
6/8/05 3:25 PM	24.27	
TBM S7 South		
6/5/05 5:40 PM	24.20	No water on gage - survey to WSE
6/6/05 2:20 PM	23.98	No water on gage - survey to WSE
6/7/05 2:10 PM	24.36	High water occurred on the afternoon of June 7

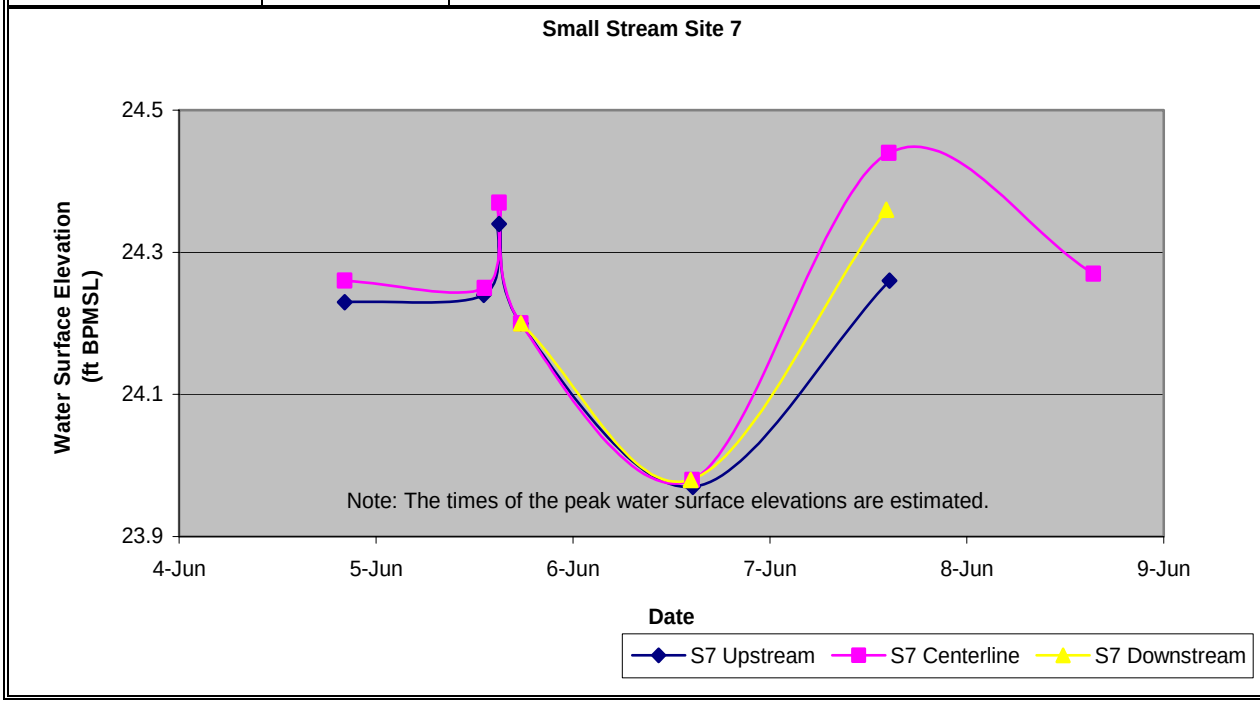


Table 5-18 Small Stream Site 8, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S8 Upstream		
6/4/05 7:56 PM	25.58	Water pooled, gage surrounded by snow, questionable hydraulic communication
6/5/05 12:57 AM	25.99	
6/5/05 12:57 PM	25.90	Flow over snow/ice, discharge measurement completed
6/5/05 3:21 PM	25.82	
6/5/05 5:00 PM	25.78	
6/6/05 1:36 AM	26.88	
6/6/05 1:36 PM	26.13	
6/7/05 1:48 PM	25.27	Flow velocity estimated at approx. 3 fps
TBM S8 Centerline		
6/4/05 7:52 PM	25.53	
6/5/05 1:00 AM	25.69	
6/5/05 1:00 PM	25.60	Flow over snow/ice, first discharge measurement completed
6/5/05 3:16 PM	25.55	
6/5/05 5:02 PM	25.47	
6/6/05 1:48 AM	26.13	
6/6/05 1:48 PM	25.59	
6/7/05 1:51 PM	24.96	Flow velocity estimated at approx. 3 fps
6/8/05 3:33 PM	24.62	Channel clear of ice/snow, second discharge measurement completed
TBM S8 Downstream		
6/4/05 7:55 PM	25.14	
6/5/05 12:58 AM	25.38	
6/5/05 12:58 PM	25.26	Flow over snow/ice, discharge measurement completed
6/5/05 3:11 PM	25.08	
6/5/05 5:03 PM	25.06	
6/6/05 1:46 AM	25.33	
6/6/05 1:46 PM	24.67	
6/7/05 1:57 PM	24.26	Flow velocity estimated at approx. 3 fps

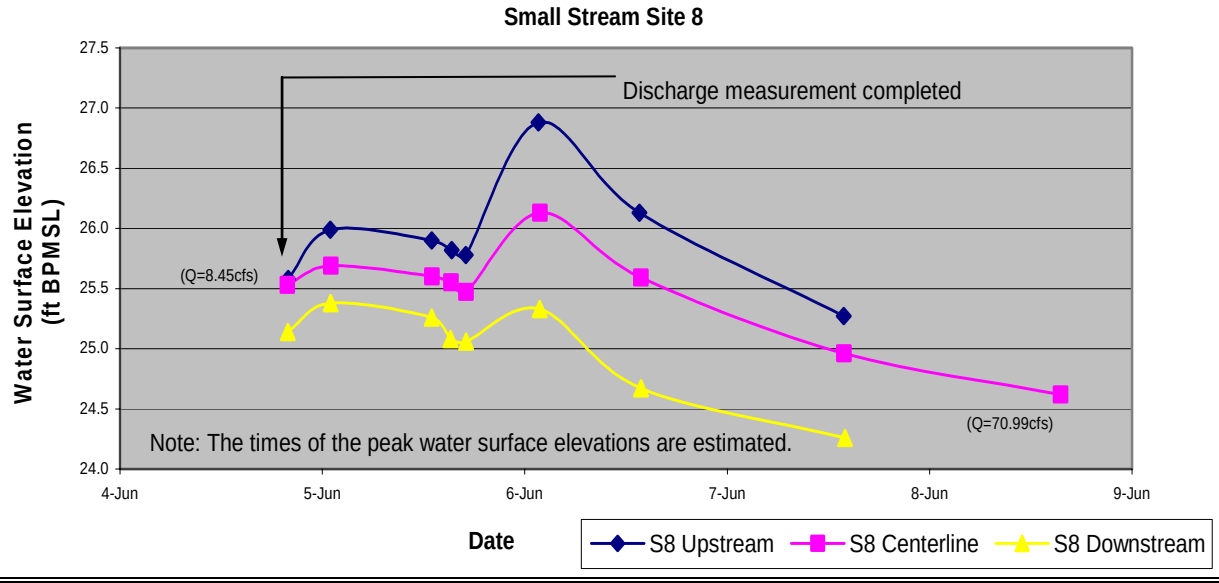


Table 5-19 Small Stream Site 9, Water Surface Elevations and Observations

Date & Time	Water Surface Elevation (feet BPMSL)	Observations
TBM S9 Upstream		
6/4/05 7:40 AM	63.05	
6/4/05 7:40 PM	62.84	
6/5/05 12:44 AM	63.39	
6/5/05 12:44 PM	63.27	
6/6/05 1:18 PM	61.62	
6/7/05 12:50 PM	60.98	
TBM S9 Centerline		
6/4/05 7:34 AM	63.38	WSE likely biased high due to poor hydraulic communication to the gage
6/4/05 7:34 PM	62.85	WSE likely biased high due to poor hydraulic communication to the gage
6/5/05 12:40 PM	63.28	WSE likely biased high due to poor hydraulic communication to the gage
6/6/05 1:18 PM	61.67	WSE likely biased high due to poor hydraulic communication to the gage
6/7/05 1:45 PM	60.18	Discharge measurement completed, WSE surveyed
TBM S9 Downstream		
6/7/05 1:55 PM	59.92	Gage buried in snow prior to this reading

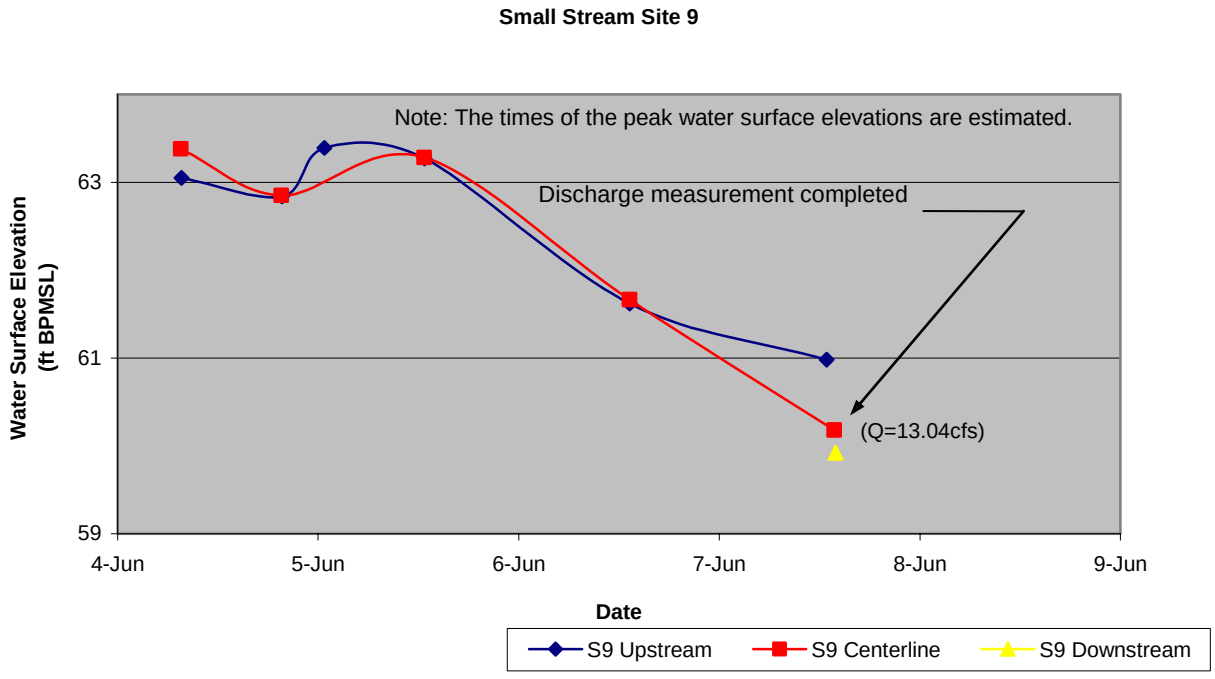
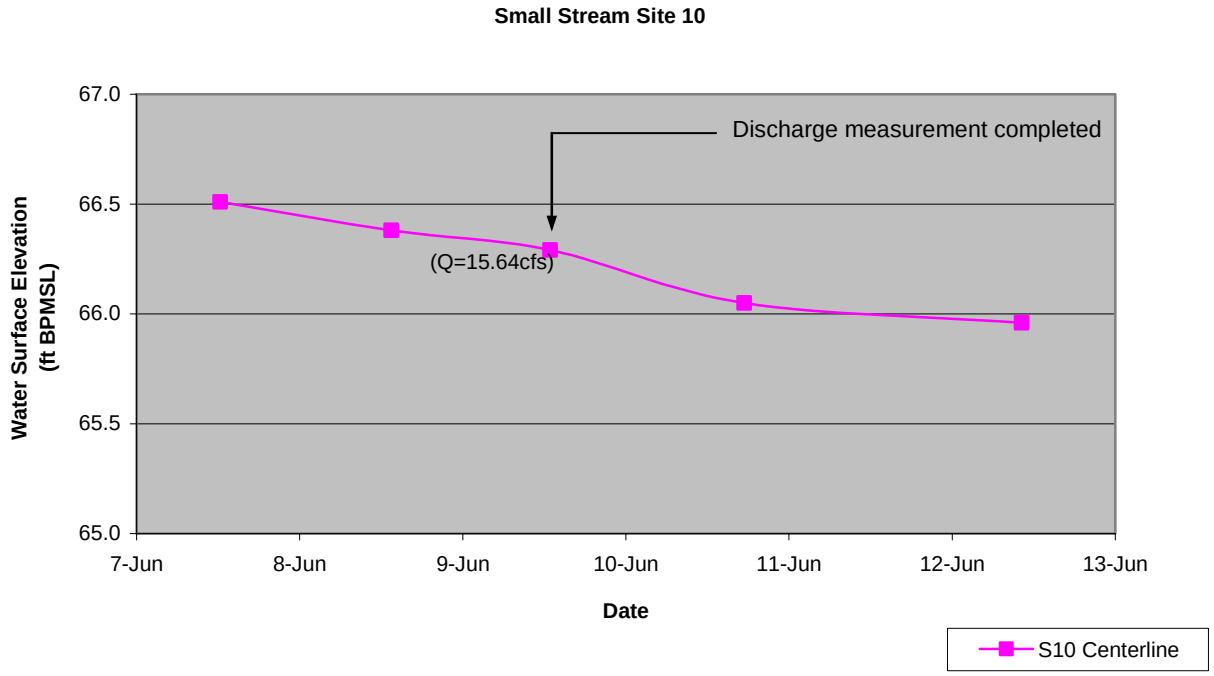


Table 5-20 Small Stream Site 10, Water Surface Elevations and Observations

TBM S10 Centerline		
Date & Time	**Water Surface Elevation (feet BPMSL)**	**Observations**
6/7/05 12:18 PM	66.51	Entire upstream area still full of snow
6/8/05 1:30 PM	66.38	Large amounts of ice still in the section
6/9/05 12:50 PM	66.29	Channel cross section and discharge measurement completed
6/10/05 5:24 PM	66.05	Flow over frozen channel
6/12/05 10:12 AM	65.96	



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DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	SMALL STREAM FIGURES
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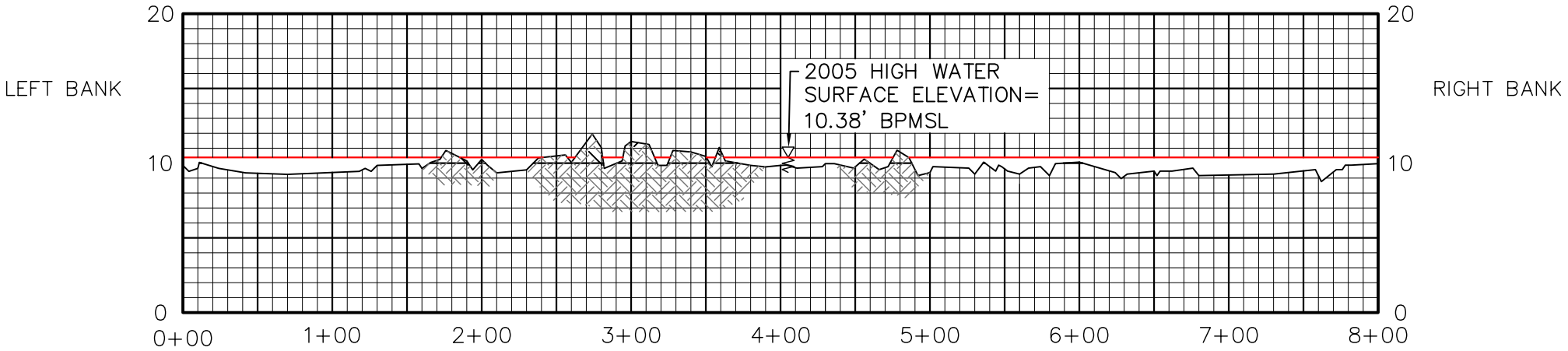
SMALL STREAM SITE 1

PLAN

FIGURE 5-1

(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMENT NPRA3.
2. LOCATION OF STA 0+00, 70°20'12.2"N 151°07'05.9"W.
3. LOCATION OF STA 8+00, 70°20'04.7"N 151°07'12.6"W.



1 CROSS SECTION @ S-1
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
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CHECKED:	MTA	SCALE:	1" = 100'

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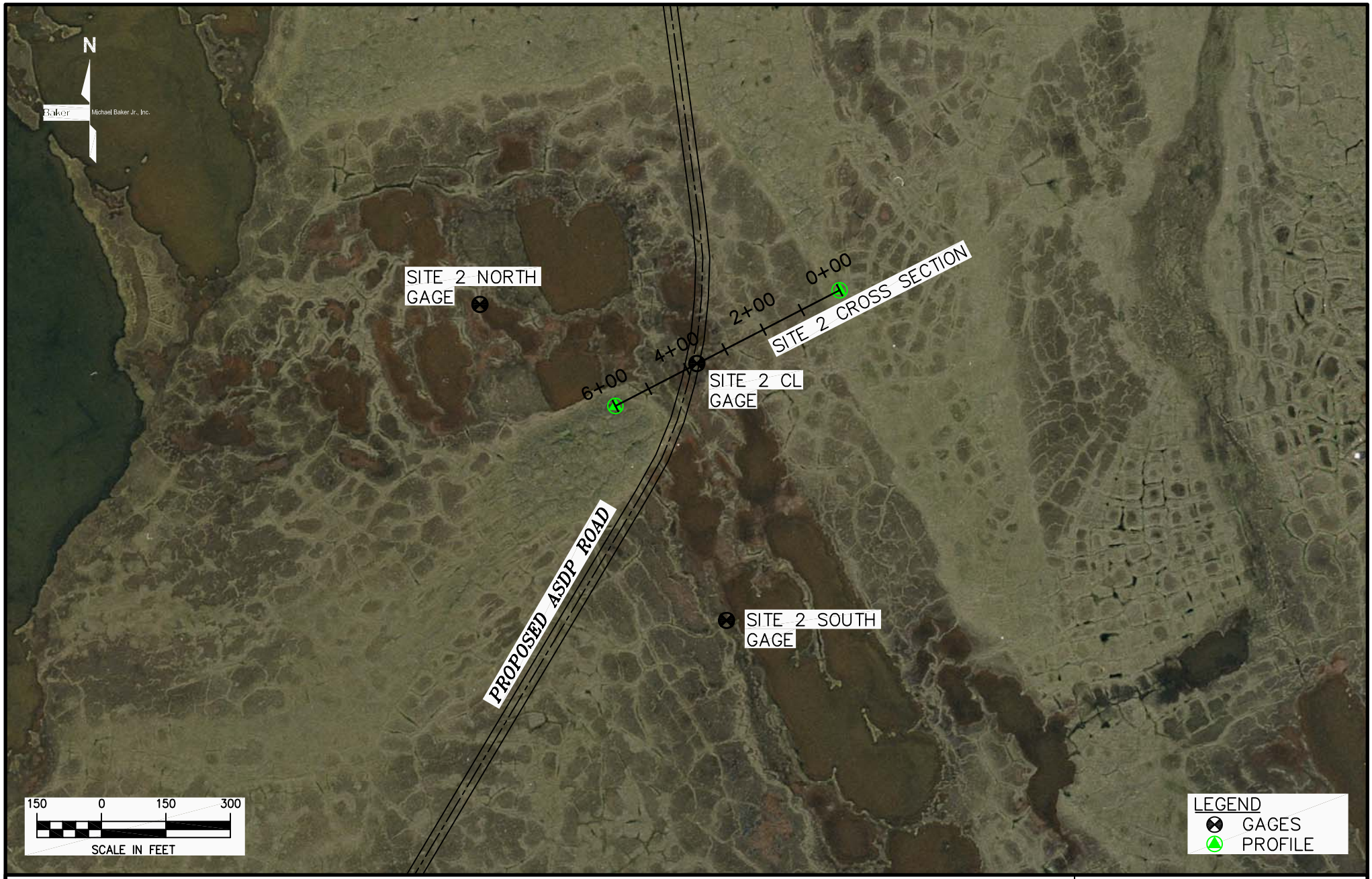
SMALL STREAM SITE 1

CROSS SECTION

FIGURE 5-1
(SHEET 2 OF 2)



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CHECKED:	MTA	SCALE:	1" = 300'

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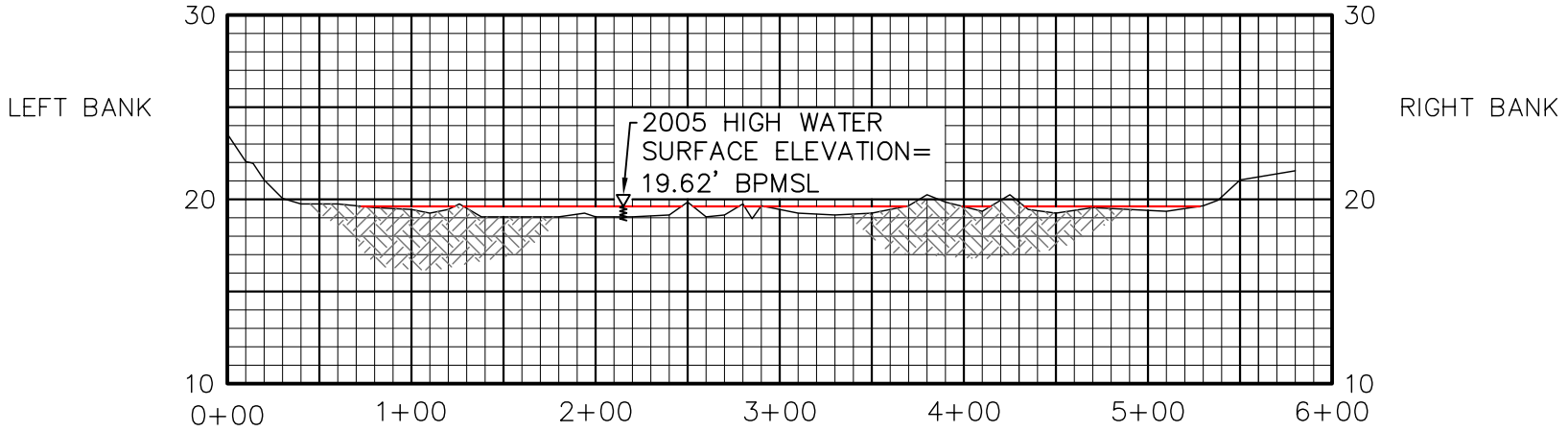
SMALL STREAM SITE 2

PLAN

FIGURE 5-2

(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMENT CDW.
2. LOCATION OF STA 0+00, 70°8'43.1"N 151°10'50.7"W.
3. LOCATION OF STA 5+80, 70°18'45.6"N 151°10'35.3"W.



2 CROSS SECTION @ S-2
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	EJK	FILE:	S2.DWG
CHECKED:	MTA	SCALE:	1" = 100'

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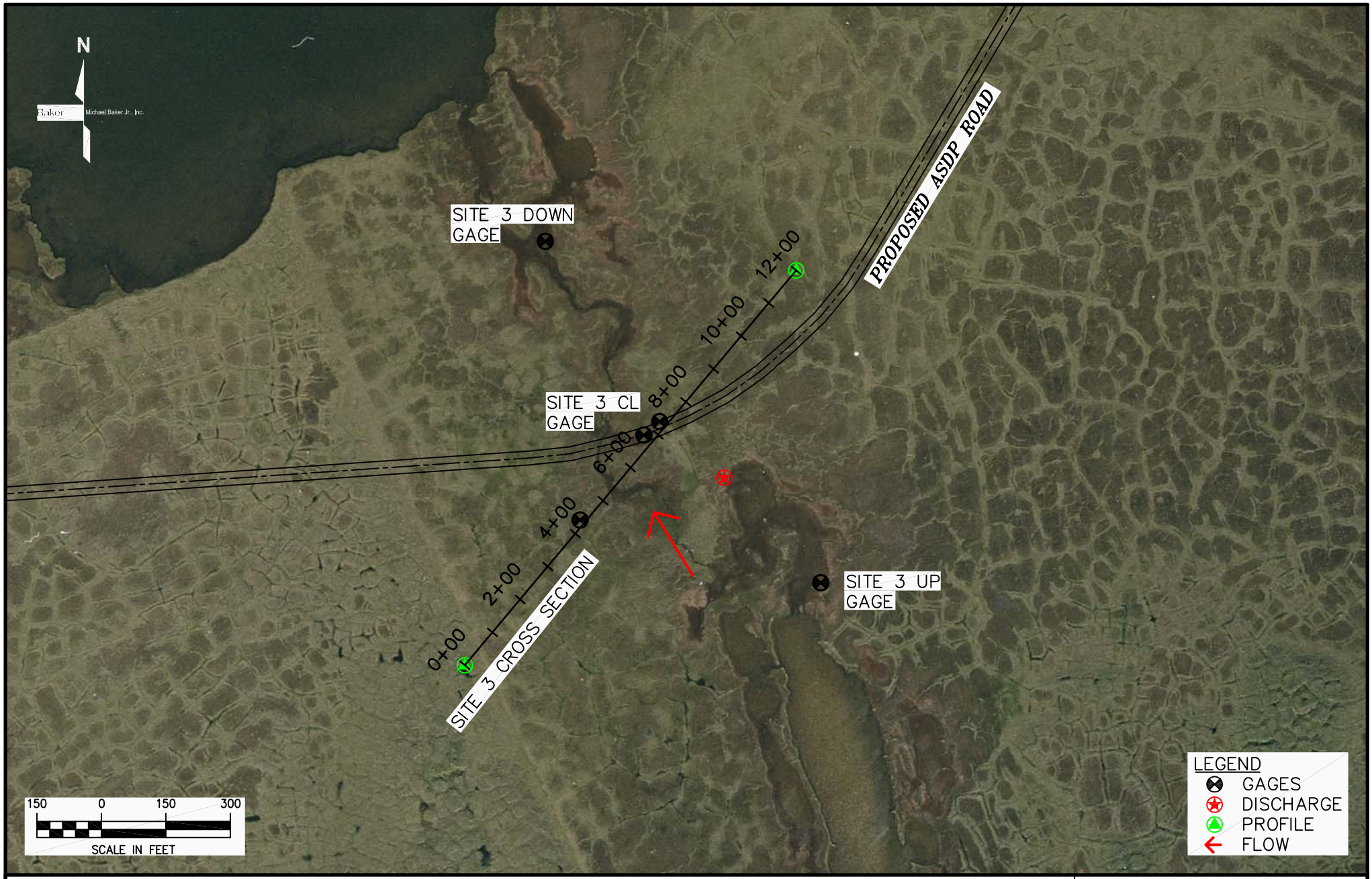
SMALL STREAM SITE 2
CROSS SECTION

FIGURE 5-2
(SHEET 2 OF 2)



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DRAWN:	WAP	FILE:	SMALL STREAM FIGURES
CHECKED:	MTA	SCALE:	1" = 300'

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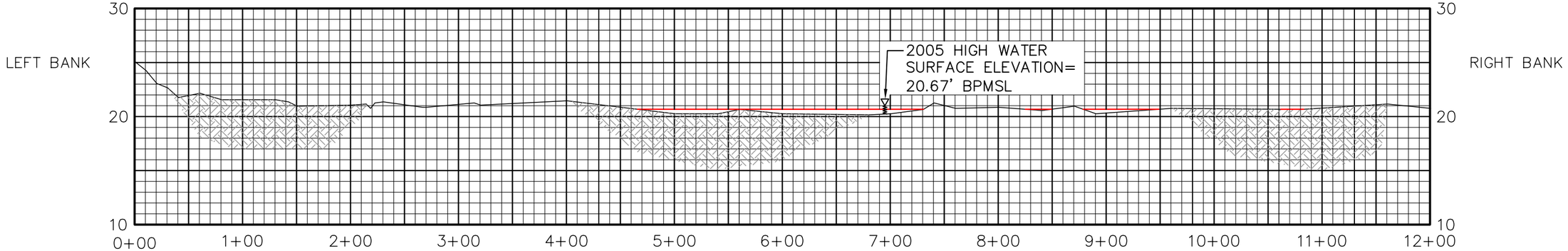
SMALL STREAM SITE 3

PLAN

FIGURE 5-3
(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMENT AMYLEE.
2. LOCATION OF STA 0+00, 70°18'14.5"N 151°115'0.2"W.
3. LOCATION OF STA 12+00, 70°18'23.3"N 151°11'26.9"W.



3 CROSS SECTION @ S-3
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

SMALL STREAM SITE 3
CROSS SECTION

FIGURE 5-3
(SHEET 2 OF 2)

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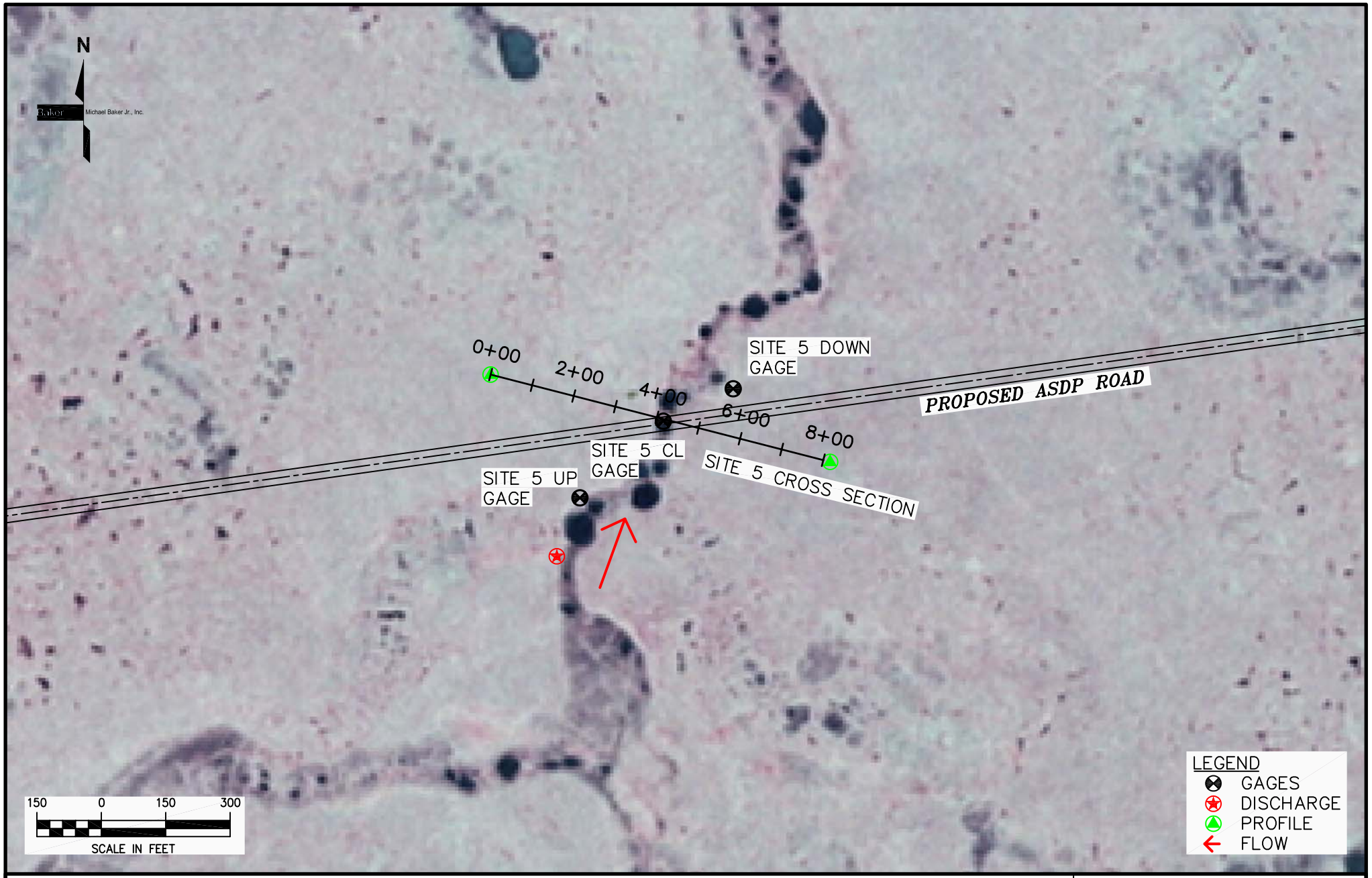
DATE:	12/16/05
DRAWN:	EJK
CHECKED:	MTA
PROJECT:	105756
FILE:	S6.DWG
SCALE:	1" = 100'



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DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	SMALL STREAM FIGURES
CHECKED:	MTA	SCALE:	1" = 300'

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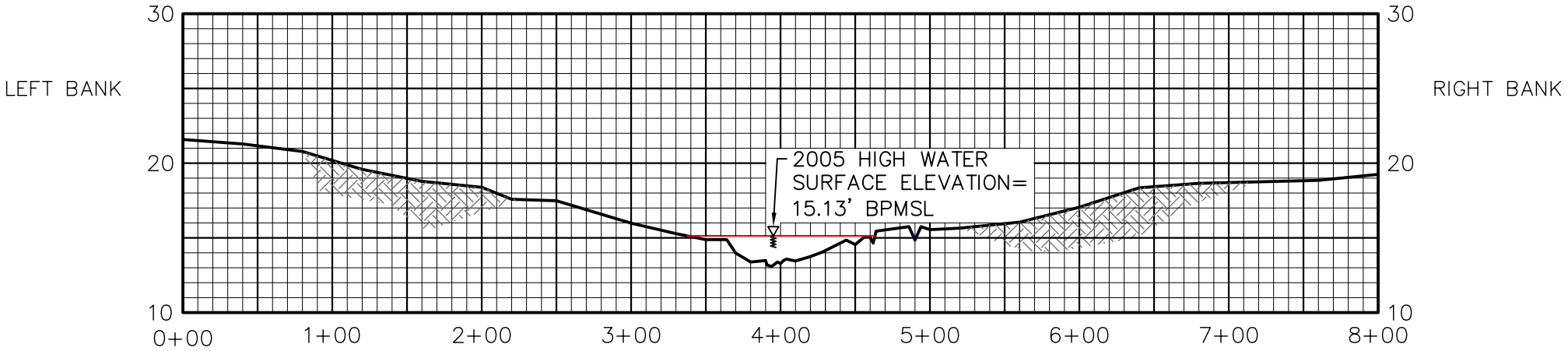
SMALL STREAM SITE 5

PLAN

FIGURE 5-4

(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMENT CHAR.
2. LOCATION OF STA 0+00, 70°16'53.0"N 151°17'48.8"W.
3. LOCATION OF STA 8+00, 70°16'50.8"N 151°17'26.0"W.



5 CROSS SECTION @ S-5
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	EJK	FILE:	S5.DWG
CHECKED:	MTA	SCALE:	1" = 100'

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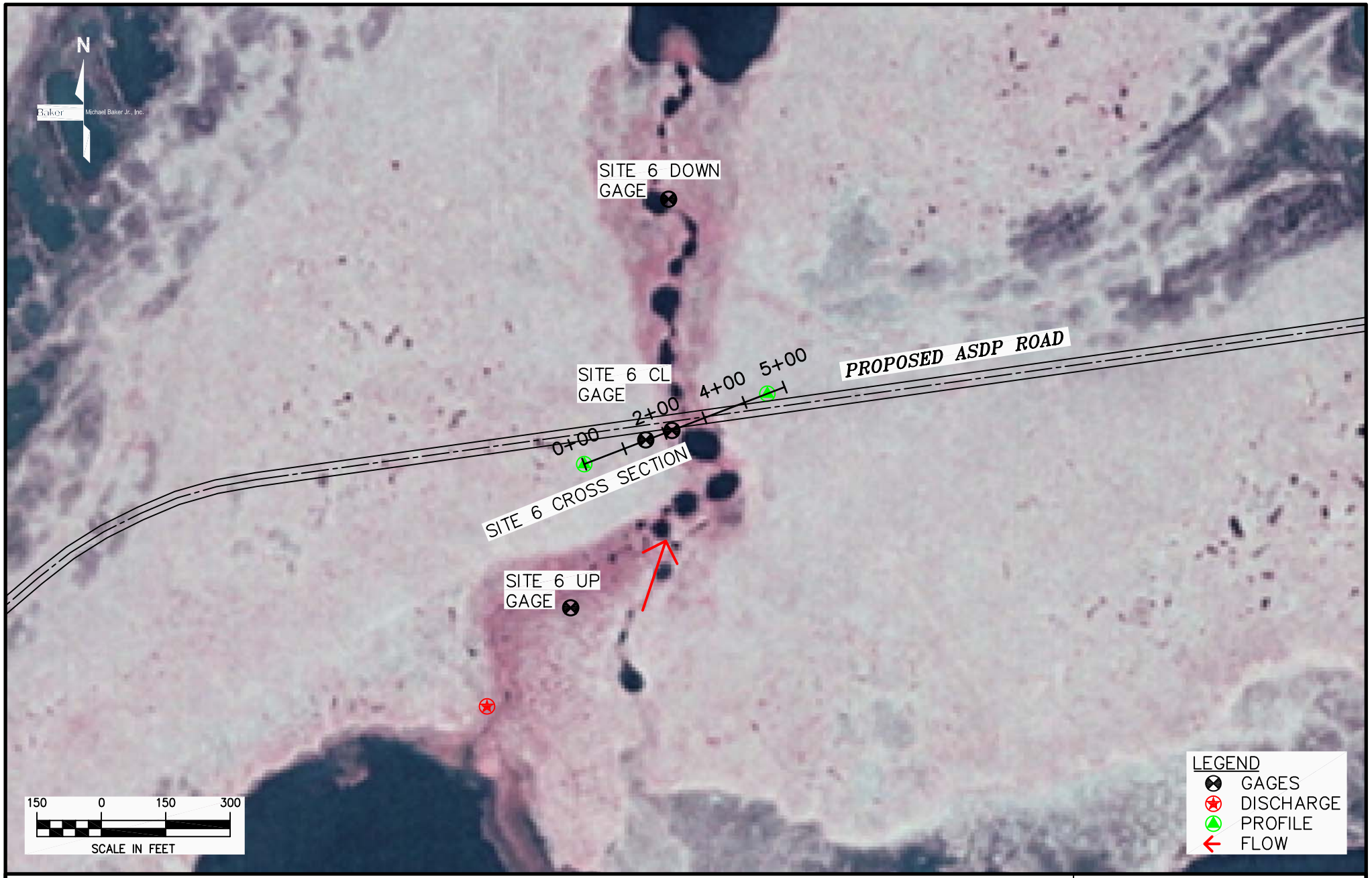
SMALL STREAM SITE 5

CROSS SECTION

FIGURE 5-4
(SHEET 2 OF 2)



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DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	SMALL STREAM FIGURES
CHECKED:	MTA	SCALE:	1" = 300'

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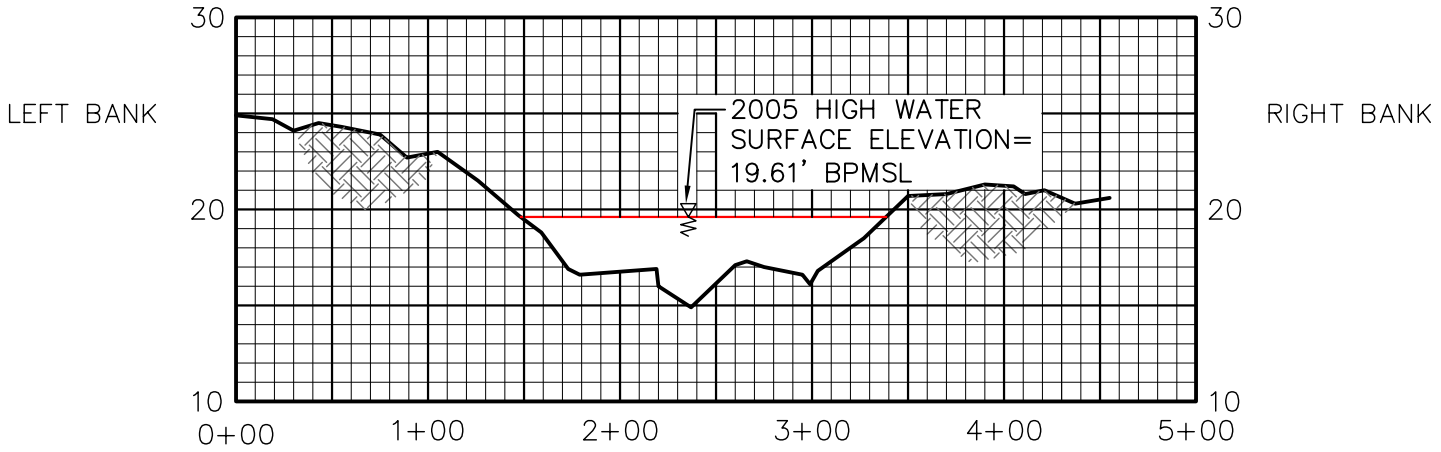
SMALL STREAM SITE 6

PLAN

FIGURE 5-5
(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMENT ALMA.
2. LOCATION OF STA 0+00, 70°16'45.9"N 151°19'53.9"W.
3. LOCATION OF STA 4+55, 70°16'47.4"N 151°19'41.4"W.



6 CROSS SECTION @ S-6
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	EJK	FILE:	S6.DWG
CHECKED:	MTA	SCALE:	1" = 100'

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SMALL STREAM SITE 6
CROSS SECTION

FIGURE 5-5
(SHEET 2 OF 2)

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CHECKED:	MTA	SCALE:	1" = 300'

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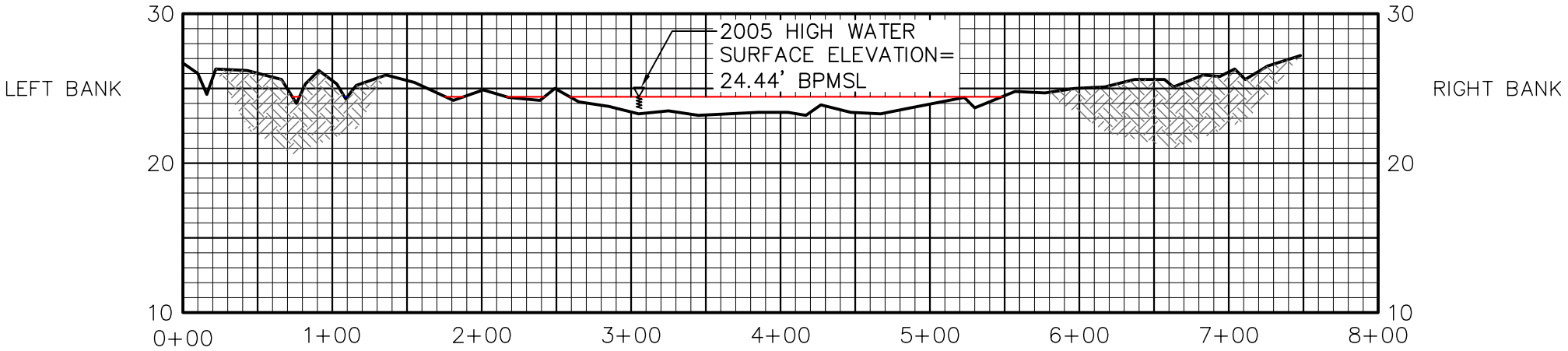
SMALL STREAM SITE 7

PLAN

FIGURE 5-6

(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMNET BRAD.
2. LOCATION OF STA 0+00, 70°16'37.7"N 151°21'55.8"W.
3. LOCATION OF STA 7+48, 70°16'35.9"N 151°22'16.9"W.



7 CROSS SECTION @ S-7
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	EJK	FILE:	S7.DWG
CHECKED:	MTA	SCALE:	1" = 100'

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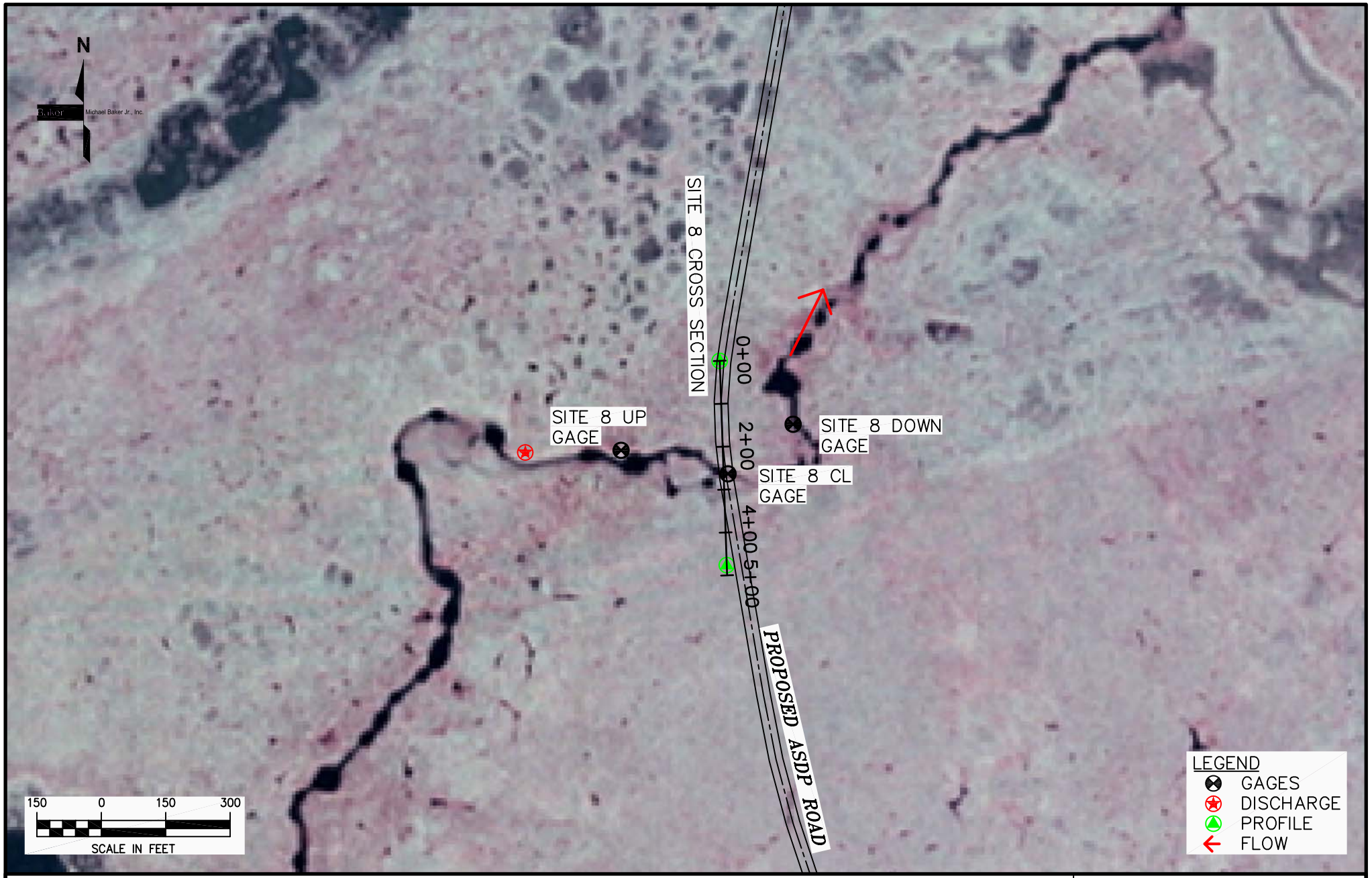
SMALL STREAM SITE 7

CROSS SECTION

FIGURE 5-6
(SHEET 2 OF 2)



ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	SMALL STREAM FIGURES
CHECKED:	MTA	SCALE:	1" = 300'

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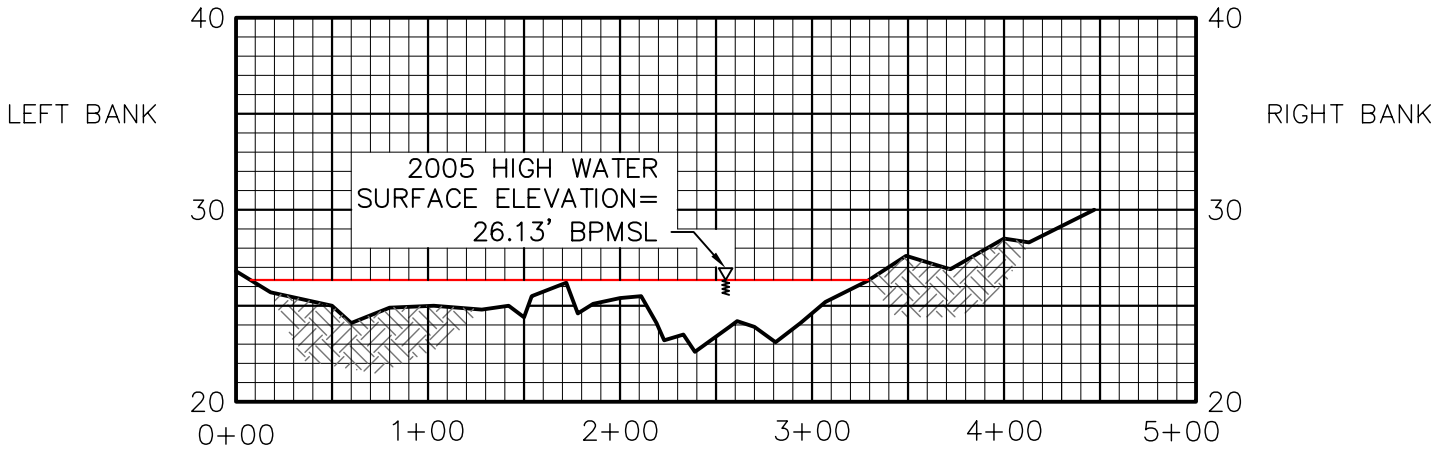
SMALL STREAM SITE 8

PLAN

FIGURE 5-7

(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION MONUMENT KELLY.
2. LOCATION OF STA 0+00, 70°15'51.3"N 151°29'22.8"W.
3. LOCATION OF STA 4+50, 70°15'46.6"N 151°29'22.6"W.



8 CROSS SECTION @ S-8
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	EJK	FILE:	S8.DWG
CHECKED:	MTA	SCALE:	1" = 100'

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SMALL STREAM SITE 8
CROSS SECTION

FIGURE 5-7
(SHEET 2 OF 2)

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DRAWN:	WAP	FILE:	SMALL STREAM FIGURES
CHECKED:	MTA	SCALE:	1" = 300'

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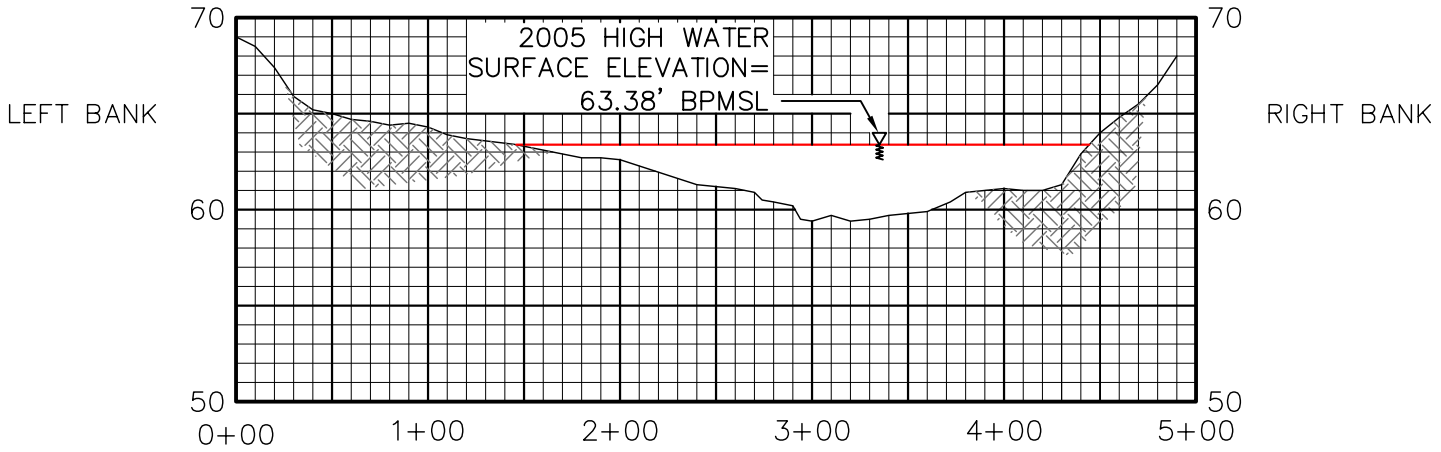
SMALL STREAM SITE 9

PLAN

FIGURE 5-8
(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMENT PATTY.
2. LOCATION OF STA 0+00, 70°12'19.3"N 151°38'22.1"W.
3. LOCATION OF STA 4+90, 70°12'24.1"N 151°38'20.0"W.



9 CROSS SECTION @ S-9
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	EJK	FILE:	S9.DWG
CHECKED:	MTA	SCALE:	1" = 100'

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SMALL STREAM SITE 9
CROSS SECTION

FIGURE 5-8
(SHEET 2 OF 2)

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DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	SMALL STREAM FIGURES
CHECKED:	MTA	SCALE:	1" = 300'

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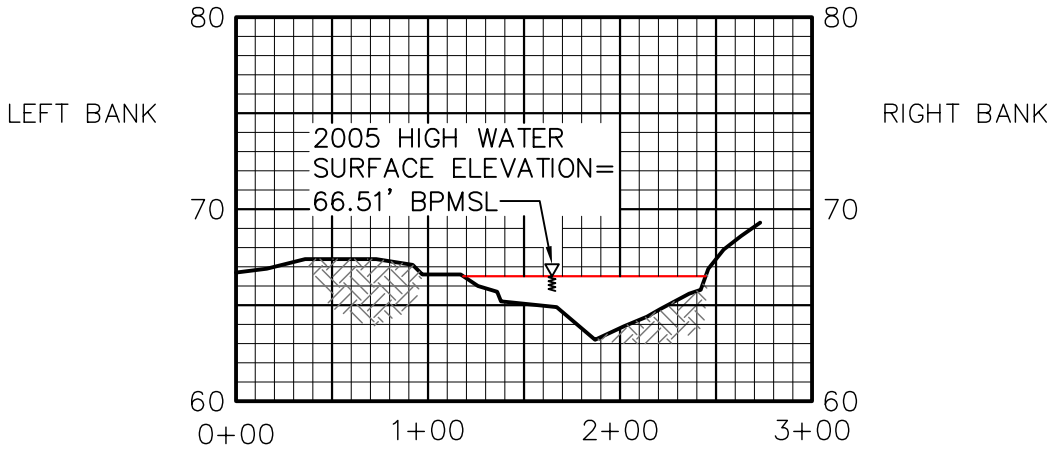
SMALL STREAM SITE 10

PLAN

FIGURE 5-9
(SHEET 1 OF 2)

NOTES:
1. BASIS OF ELEVATION, MONUMENT MECKEL.
2. LOCATION OF STA 0+00, 70°12'02.0"N 151°39'59.9"W.
3. LOCATION OF STA 3+00, 70°12'02.8"N 151°39'52.2"W.



10 CROSS SECTION @ S-10
SCALE: HORZ. 1"= 100' / VERT. 1" = 10'

50 0 50 100
HORIZONTAL SCALE IN FEET

5 0 5 10
VERTICAL SCALE IN FEET

ConocoPhillips Alaska, Inc.

DATE:	12/16/05	PROJECT:	105756
DRAWN:	EJK	FILE:	S10.DWG
CHECKED:	MTA	SCALE:	1" = 100'

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SMALL STREAM SITE 10
CROSS SECTION

FIGURE 5-9
(SHEET 2 OF 2)

5.3 Fish Creek Basin Discharges

5.3.1 Ublutuoch River Discharge

Discharges were measured directly at Ublutuoch 6.9 on June 8, June 9, June 10, and June 11 and are summarized in Table 5-21. The peak discharge was recorded in the morning of June 9 to be 1,680 cfs with an average velocity of 1.2 fps (Photo 5-20). Refer to Appendix B for complete field measurement notes. Discharge between June 8 and June 11 was measured over a frozen channel with intact low-water bottomfast snow and ice. Soundings conducted during discharge measurements documented the degradation of the snow and ice concluding a continuous change in channel geometry.

Discharge at Ublutuoch 6.8 using Normal-Depth computations was compared with the direct discharge results.

Table 5-21 Ublutuoch 6.8 – 2005 Daily Discharge Measurement Results

Date of Discharge Measurement	WSE (ft)	Discharge (cfs)
8-Jun	9.2	1,630
9-Jun	8.9	1,680
10-Jun	8.0	1,570
11-Jun	7.3	1,270

Photo 5-20 Ublutuoch River discharge measurement, June 9, 2005

It was found that due to the continuously changing cross-sectional geometry and varying conditions of the channel bottom, the correlation between the direct and indirect discharge measurement was poor. It was also determined that the assumptions used in the 2003 and 2004 Normal-Depth discharge computations were not valid. Because of this uncertainty at Ublutuoch 6.8, the 2003 and 2004 discharge values have been revised to include only the direct discharge measurements as presented in Table 5-22. Cross-section geometry (Figure 5-10) was based on cross-sections surveyed by Kuukpik/LCMF in 2003 (2003b).

Table 5-22 Ublutuoch River Breakup Data Summary, 2001 – 2005

Year	Date of First Flowing Water	Peak WSE (ft)	Date of Peak WSE	Peak Q (cfs)	Date of Peak Q	Location	Notes
2005	6-Jun	10.01	7-Jun	1,680	9-Jun	RM 6.8	
2004	2-Jun	10.5	6-Jun	2,800	5-Jun	RM 6.8	
2003	5-Jun	10.14	6-Jun	1,300	9-Jun	RM 6.8	Discharge was measured 2 days after peak WSE
2002	21-May	18.22	22-May	2,000	22-May	RM 13.7	
2001	8-Jun	18.09	10-Jun	2,200	10-Jun	RM 13.7	

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DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	FIGURE_5_1
CHECKED:	MTA	SCALE:	1" = 300'

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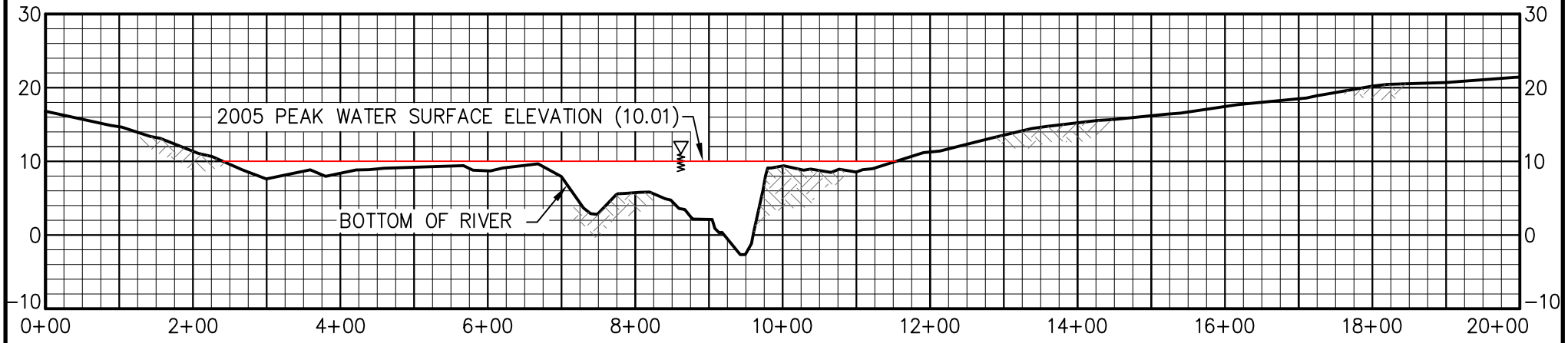
UBLUTUOCH 6.8 BRIDGE

PLAN

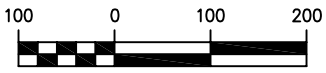
FIGURE 5-10

(SHEET 1 OF 2)

NOTES
1. TOPOGRAPHIC CHANNEL PROFILE MEASUREMENTS COMPLETED BY KUUKPIK/LCMF INC.
2. ELEVATIONS SHOWN ARE REFERENCED TO BRITISH PETROLEUM MEAN SEA LEVEL DATUM.



1 UBLUTUOCH RIVER CROSS SECTION AT RM 6.8
SCALE: HORZ. 1"= 200' / VERT. 1" = 20'



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DATE:	12/16/05	PROJECT:	105756
DRAWN:	WAP	FILE:	FIGURE_5_1
CHECKED:	MTA	SCALE:	AS SHOWN

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UBLUTUOCH 6.8 BRIDGE
CROSS SECTION

FIGURE 5-10
(SHEET 2 OF 2)

5.3.2 Small Streams Discharge

Discharges were measured at seven sites and determined to be too low to be measurable at two sites in 2005. Appendix B presents the complete field measurement notes and Table 5-23 summarizes the discharge results at each site. At all of the small stream sites, every attempt was made to obtain discharge from a single channel with concentrated flow. In the event that flow splits resulted in significant bifurcated flows, multiple discharges were taken on the various channels. If bifurcated flows were minor, the discharge in the channel that was conveying the majority of flow was measured. In one instance at Site 10, a very small volume of water likely circumvented the discharge cross-section due to overland flow. In numerous cases, surface ice was broken by field crews and removed from the area in order to improve the measurement section.

Table 5-23 NPRA Small Streams Discharge Measurement Results

Observation Site	Date of Discharge Measurement	Discharge (cfs)	WSE day of Discharge Measurement (ft)	Date of Peak WSE (ft)	Peak WSE (ft)
NPRA Site 1	8-Jun	1.5	9.87	6-Jun	10.38
NPRA Site 2	6-Jun	0	19.59	5-Jun	19.62
NPRA Site 3	6-Jun	0.3	20.55	5-Jun	20.67
NPRA Site 3	8-Jul	4	N/A	–	–
NPRA Site 5	5-Jun	4.6	14.33	3-Jun	15.13
NPRA Site 6	7-Jun	15	17.90	6-Jun	19.61
NPRA Site 7	5-Jun	0	24.25	7-Jun	24.44
NPRA Site 8	5-Jun	8.5	25.60	5-Jun	26.34
NPRA Site 8	8-Jun	71	24.62	–	–
NPRA Site 9	7-Jun	13	60.18	4-Jun	63.28
NPRA Site 10	9-Jun	16	66.29	7-Jun	66.51

At Site 1, discharge was 1.5 cfs with approximately 90–95% of flow confined to a single 30-foot wide channel having an average velocity of less than 0.1 fps (Photo 5-21).

Photo 5-21 Measurement of discharge at Site 1, July 8, 2005

Surface water flow was not observed or measured at Site 2 or Site 7; these locations represented stagnant surface water.

The discharge at Site 3 of 0.3 cfs and an average velocity less than 0.1 fps was measured downstream from the lake outlet, running south to north, over grasses and moderately irregular ground through the 17-foot wide channel (Photo 5-22).

The discharge at Site 5 was 4.6 cfs with an average velocity of 0.3 fps across a channel width of 22 feet (Photo 5-23).

At Site 6, discharge across the 25 foot channel was 15 cfs with an average velocity of 0.4 fps.

Two measurements were completed during breakup at Site 8 because changing channel physiology due to bottomfast ice and slush degradation resulted in significant variance in the flow regime and an increase in discharge from 8.5 to 71 cfs over a three-day period. The highest recorded discharge at Site 8 was measured at 71 cfs with an average velocity of 1.6 fps and a channel width of 27 feet (Photo 5-24).

At Site 9, discharge was 13 cfs with an average velocity of 0.3 fps across the 51-foot channel.

Photo 5-22 Measurement of discharge at Site 3, July 8, 2005

Photo 5-23 Measurement of discharge at Site 5, June 5, 2005

Photo 5-24 Measurement of discharge at Site 8, July 8, 2005

At Site 10 discharge was 16 cfs and average flow velocity was 0.3 fps (Photo 5-25).

In addition to the collection of discharge and tabulation of stage data during breakup, general observations and discharge measurements were collected at the small stream sites on July 8.

Photo 5-25 Measurement of discharge at Site 10, June 9, 2005

No discharge was measured at small stream sites 2, 5, and 7 on July 8 as flow conditions were too low to be measurable. At small stream sites 1, 9, and 10 flow was visually estimated to be less than 1 cfs. At small stream sites 3, 6, and 8, discharge was measured using a single point velocity measurement to be approximately 4 cfs, 3 cfs, and 2 cfs respectively. The July 8 discharge at Site 3 represents the highest recorded discharge measured at this location in 2005.

5.4 Fish Creek Basin Ice Bridge Monitoring

No erosion, scour, or significant increase in water surface elevation was observed during breakup at or near the 2005 ice bridge locations at the Ublutuoch River (Photos 5-26, 5-27, and 5-28) or Fish Creek (Photos 5-29 and 5-30) crossings.

The slotted bridge conveyed flow adequately and the decay of the ice bridge was relatively quick once floodwaters began their advance.

Photo 5-26 Ublutuoch River Ice Bridge prior to breakup with the ice road essentially removed from the drainage channel, May 12, 2005

Photo 5-27 Ublutuoch River Ice Bridge during breakup with the ice road remnants in place, June 6, 2005

Photo 5-28 Ublutuoch River Ice Bridge after breakup with the ice road remnants still in place, July 8, 2005

Photo 5-29 Fish Creek Ice Bridge during breakup with the ice road in place, June 8, 2005

Photo 5-30 Fish Creek Ice Bridge location after breakup, July 8, 2005

6.0 Flood Frequency Analysis

6.1 Colville River Flood Frequency Analysis

The results of the flood frequency analysis for the Colville River are presented in Table 6-1. Baker and Hydroconsult EN3 Services, Ltd. performed the updated flood frequency analysis in 2002 in order to provide recommended flood frequency values for the design of facilities within the delta (Baker and Hydroconsult, 2002).

Table 6-1 Colville River Flood Frequency Analysis Results

Recurrence Interval	Flood Peak Discharge [cfs]
2-year	240,000
5-year	370,000
10-year	470,000
25-year	610,000
50-year	730,000
100-year	860,000
200-year	1,000,000

6.2 Colville River Delta 2D Model Observed and Predicted Water Surface Elevations

The 2005 observed peak water surface elevations in the Colville River Delta are presented in Table 6-2 and were compared to water surface elevations predicted by the two-dimensional surface water model developed for the Colville River Delta (Baker, 2002a). The recurrence interval estimates are based on a linear interpolation between the water surface elevations predicted for the 2-, 10-, and 50-year floods as determined in 2002 (Baker and Hydroconsult, 2002). Because recurrence interval relationships are not linear, recurrence interval estimates should be considered as approximate.

At or near the time that peak water surface elevations within the delta were recorded, the discharge of the Colville River at Monument 1 was estimated to have a flood recurrence interval equal to or less than a 2-year event. Based on observed water surface elevations at Monument 1, the recurrence interval was less than a 2-year event when compared with the surface water models predictions.

For the five gage locations around CD1 and CD2 that were used to record water surface elevations in 2005 (gages 1, 3, and 4 and Monuments 22 and 23), the average difference between the observed and the predicted water surface elevation was +0.8 feet. For the three gages along the CD3 pipeline bridge crossings, the average difference between the observed and the predicted water surface elevation was +0.4 feet.

Table 6-2 Comparison of Observed and Predicted Water Surface Elevations

Observation Site	2005 Observed Peak WSE (ft)	Predicted 2-yr WSE (ft)	Predicted 10-yr WSE (ft)	Predicted 50-yr WSE (ft)	Observed and Predicted WSE Differential (ft)	Approximate Recurrence Interval of Observed Peak WSE (yrs)
Staff Gage 1	4.46	5.5	8.4	11.2	-1.0	< 2
Staff Gage 3	6.48	5.7	8.6	11.8	0.8	4
Staff Gage 4	6.28	5.1	7.6	9.9	1.2	6
Sak Bridge	4.95	4.9	8.4	11.1	0.0	2
Tam Bridge	6.13	5.8	8.3	9.2	0.3	3
Ulam Bridge	5.24	4.4	7.1	7.9	0.8	5
Gage 12 East Ulam	4.40	4.5	6.2	6.8	-0.1	<2
Monument 01	13.18	13.8	19	23.0	-0.6	< 2
Monument 20	8.42	7.8	11.3	14.4	0.6	3
Monument 22	7.65	5.9	8.6	11.8	1.8	7
Monument 23	5.95	4.9	7	10.1	1.1	6
Monument 28	3.60	3.1	3.3	3.7	0.5	40
Helmricks	3.50	3.8	5.3	5.9	-0.3	<2

For that region of Alpine that can generally be considered as the upstream side of CD1 and CD2 (gage 3 and Monument 22), the estimate of the recurrence interval of the 2005 flood was 5 years. For the region of Alpine that can generally be considered as the downstream side of CD1 and CD2 (gage 4 and Monument 23), the estimate of the recurrence interval of the 2005 flood was 6 years. For the region of Alpine that is impacted by flow from the Sakoonang Channel (staff gage 1), the estimate of the recurrence interval of the 2005 flood was less than 2 years. For the region of Alpine that can generally be considered as the CD3 pipeline alignment, the estimate of the recurrence interval of the 2005 flood was 3 years.

The two-dimensional surface water model was constructed to predict conditions during low frequency, high magnitude flood events such as the 50-, 100-, and 200-year recurrence interval floods. The model is based on open water, steady state conditions and does not account for snow, channel ice or ice jams. Thus, the water surface elevation predictions of the model will generally under-predict water surface elevations during small flood events when channel ice and snow are present in the delta. For this reason, observed water surface elevations during small flood events, such as 2005, are typically higher than the model predictions.

6.3 Fish Creek Basin Flood Frequency Analysis

6.3.1 Ublutuoch Bridge Site Flood Frequency Analysis

In 2005 the area of the drainage basin contributing to flow at Ublutuoch 6.8 was used to estimate the peak stream flow using 2003 USGS regression equations (Curran, Meyer, and Tasker, 2003). In addition to the estimated annual peak discharges based on the 2003 USGS regression equations, URS estimated peak stream discharges at Ublutuoch 8.0 using a drainage area of 233 square miles in 2002. The resulting peak stream flows are presented in Table 6-3. Based on these analyses, the mean annual peak discharge, at or near the location of the proposed Ublutuoch Bridge site, ranges from 2,400 cfs to 3,560 cfs. Considering that the average annual peak recorded discharge of the Ublutuoch River near the location of the proposed Ublutuoch Bridge site is 2,000 cfs based on five years of measurements, the lower range of the mean annual estimated peak discharge is likely more accurate. However, additional data collected in the future will help in refining the regression equations used in estimating the peak annual discharges at this location.

Table 6-3 Ublutuoch River Flood Frequency Analysis Results

Recurrence Interval	Flood Peak Discharge [ft^3/sec] (Based on USGS 2003 Regression Equations)	Flood Peak Discharge [ft^3/sec] (Based on URS at RM 8.0, 2002)
2-year	3,560	2,400
5-year	5,330	3,800
10-year	6,470	4,800
25-year	7,860	6,300
50-year	8,860	7,600
100-year	9,820	8,900
200-year	10,750	10,400

6.3.2 Small Stream Sites Flood Frequency Analysis

The peak stream flow estimates using the 2003 USGS regression equations (Curran, Meyer, and Tasker, 2003) and the area of the drainage basins contributing to flow at the locations of the proposed drainage structures were determine by Baker in 2005 and are presented in Table 6-4.

A comparison was made between the Baker 2005 flood frequency analysis and the PND 2003 flood frequency analysis for Site 5, Site 6, and Site 9. Both analyses were completed using the 2003 USGS regression equations for Region 7. The difference between the PND and Baker estimated drainage areas and resulting peak streamflow were less than 25% for Sites 6 and 9. However, for Site 5, the PND estimated drainage areas and resulting peak streamflow were nearly three times greater than those estimated by Baker in 2005. The difference in the results can be attributed to the size of the

drainage area, the limited topographic relief at the site, the interpretation of topographic data that is available, and the methods used in the analysis.

The drainage areas of Sites 1, 2, 5, and 7 were found to be less than the minimum applicable drainage area of 1.13 square miles, while the remaining Sites drainage areas were within the applicable range. In 2005 at Sites 2 and 7, where flow was too small to be measurable, the drainage area was less than the minimum applicable range for the regression equations used. In 2003 and 2005 at Site 5, the highest measured discharge was less than the mean annual peak streamflow determined in 2005 by Baker using the USGS regression equations. This review of the 2003 and 2005 discharge measurements suggests that for breakup conditions for these years, the USGS regression equations overestimate the discharge for the drainage areas which are less than the minimum applicable range. Therefore, the design flood values for the drainage areas less than the minimum applicable range are accepted for design purposes.

Based on the 2005 results tabulated in Table 6-4, the mean annual peak estimated discharge at the locations of the nine proposed drainage structures range from 8 to 127 cfs. In all cases in 2003 and 2005 at the small stream sites where discharge was measured, the highest measured discharge was less than the estimated mean annual peak discharge. At the seven sites where flow was measurable in 2005, the highest measured discharge was found on average to represent less than a quarter of the mean annual peak discharge estimated based on Bakers 2005 analysis.

Considering the methods in developing the drainage areas and that for most sites only a single year of data is available, the 2005 estimated peak discharge values represent acceptable and conservative estimates based on the existing data.

Table 6-4 Fish Creek Basin Small Streams Flood Frequency Analysis Results

		Site 1	Site 2	Site 3	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Drainage Area (mi^2)		0.9	0.2	2.4	0.7	3.6	0.9	5.4	1.6	2.3
Return Interval	2-year	25	8	62	21	87	24	127	43	59
	5-year	43	14	103	35	144	42	206	73	99
	10-year	55	18	132	45	182	53	260	93	125
	25-year	71	24	167	58	231	69	329	119	160
	50-year	83	28	194	68	267	80	379	138	185
	100-year	95	32	220	78	303	92	429	157	210

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Appendix A Summary of 2005 Gage Locations and Survey Control

Table A-1: Summary of 2005 Vertical Control Monuments

Monument	Elevation (BPMSL - Feet)	Latitude (NAD83)	Longitude (NAD83)	Monument	Reference
05-01-18A	7.75	N 70° 19' 35.1"	W 150° 59' 37.0"	Rebar	LCMF CD4 TBM, 1-23-2005
05-01-21A	12.17	N 70° 17' 46.4"	W 150° 58' 46.5"	Rebar	LCMF CD4 TBM, 1-26-2005
05-01-21D	12.44	N 70° 17' 27.7"	W 150° 59' 37.0"	Rebar	LCMF CD4 TBM, 1-26-2005
ALMA	25.06	N 70° 16' 45.7"	W 151° 19' 53.2"	Alcap	LCMF static gps, 5-11-2005
AMYLEE	27.50	N 70° 18' 17.1"	W 151° 11' 56.8"	Alcap	LCMF static gps, 5-12-2005
BRAD	25.78	N 70° 16' 37.4"	W 151° 22' 10.5"	Alcap	LCMF static gps, 5-11-2005
C2	12.30	N 70° 18' 38.6"	W 151° 25' 31.3"	Rebar	Lounsbury 2002
CDW	30.69	N 70° 18' 41.7"	W 151° 10' 54.1"	-	LCMF, 10-2003
CHAR	24.05	N 70° 16' 54.9"	W 151° 17' 41.8"	Alcap	LCMF static gps, 5-11-2005
Clear 1951	25.50	N 70° 20' 16.1"	W 151° 06' 24.0"	BC	LCMF levels, 8-8-2002
D1A South	3.90	N 70° 22' 17.7"	W 151° 15' 17.9"	Rebar	Lounsbury 2002
FIORD 01	9.30	N 70° 24' 27.7"	W 150° 52' 40.2"	Alcap	LCMF, 11-2004
FIORD 15	6.53	N 70° 25' 06.0"	W 150° 54' 22.3"	Alcap	LCMF, 3-2005
FIORD 17	8.31	N 70° 25' 10.9"	W 150° 55' 11.7"	Alcap	LCMF, 3-2005
JACK	23.45	N 70° 16' 55.4"	W 151° 15' 52.6"	Alcap	LCMF levels, 8-2003
KELLY	27.36	N 70° 15' 49.4"	W 151° 29' 19.7"	Alcap	LCMF static gps, 5-11-2005
Line 3S1	36.62	N 70° 13' 09.7"	W 151° 50' 20.1"	Alcap	Lounsbury 2001
Line 3S2	21.44	N 70° 16' 09.7"	W 151° 52' 20.6"	Alcap	Lounsbury 2001
Line 4BW	40.87	N 70° 11' 11.9"	W 151° 57' 43.1"	Alcap	Lounsbury 2001
Line 2S	21.44	N 70° 15' 55.1"	W 151° 42' 07.6"	Rebar	Lounsbury 2001
MECKEL	70.19	N 70° 12' 00.6"	W 151° 39' 57.6"	Alcap	LCMF static gps, 5-12-2005
Mon 01	27.74	N 70° 09' 57.2"	W 150° 56' 23.8"	Alcap	Lounsbury 1996
Mon 09	25.03	N 70° 14' 40.6"	W 150° 51' 29.6"	Alcap	Lounsbury 1996
Mon 20	19.17	N 70° 16' 48.0"	W 151° 00' 41.7"	Alcap	Lounsbury 1996
Mon 22	10.13	N 70° 19' 05.2"	W 151° 03' 21.9"	Alcap	Lounsbury 1996
Mon 23	9.53	N 70° 20' 40.0"	W 151° 03' 40.7"	Alcap	Lounsbury 1996 (9.523 LCMF 6-26-2005)
Mon 28	3.66	N 70° 25' 31.9"	W 151° 04' 01.2"	Alcap	Lounsbury 1996
Mon 35	5.57	N 70° 25' 57.0"	W 150° 23' 00.4"	Alcap	Lounsbury 1996
NAN2	13.31	N 70° 18' 14.9"	W 150° 59' 50.6"	-	LCMF, 3-2005
NPRA 2	7.67	N 70° 20' 22.6"	W 151° 05' 41.7"	Alcap	LCMF, 3-2005
NPRA 3	16.94	N 70° 20' 04.3"	W 151° 07' 19.9"	Alcap	LCMF, 3-2005
PATTY	68.79	N 70° 12' 21.6"	W 151° 38' 29.1"	Alcap	LCMF static gps, 5-12-2005
SAK-LT	10.17	N 70° 21' 49.5"	W 150° 55' 34.0"	Alcap	LCMF, 12-2004
STM RT	10.07	N 70° 23' 37.7"	W 150° 54' 54.4"	Alcap	LCMF, 11-2004
UBN 01	12.09	N 70° 18' 11.8"	W 151° 19' 48.6"	Rebar	LCMF static gps, 7-27-2003
UBUSW	17.50	N 70° 14' 36.4"	W 151° 17' 51.7"	Alcap	Lounsbury 2001

Table A-2: Summary of 2005 Gage Locations

Gage Site	Gage	Latitude (NAD83)	Longitude (NAD83)	Gage Bottom Elevation (BPMSL - Feet)	Basis of Elevation
CD 1	PG1	N 70° 20' 34.3"	W 150° 55' 15.3"	NA	Mon 19
	PG9	N 70° 20' 01.2"	W 150° 57' 07.2"	NA	Mon 19
	PG10	N 70° 20' 32.6"	W 150° 55' 57.8"	NA	Mon 19
CD 2	PG3	N 70° 20' 24.1"	W 150° 58' 58.7"	NA	Mon 12
	PG4	N 70° 20' 25.5"	W 150° 59' 00.0"	NA	Mon 12
	PG6	N 70° 20' 22.7"	W 151° 01' 45.3"	NA	Mon 12
	PG7	N 70° 20' 24.2"	W 151° 01' 44.4"	NA	Mon 12
	PG8	N 70° 20' 21.0"	W 151° 02' 52.2"	NA	Mon 12
SAK Pipe Bridge	TBM A	N 70° 21' 52.9"	W 150° 55' 17.4"	2.12	SAK-LT
	TBM B	N 70° 21' 52.5"	W 150° 55' 18.0"	3.68	
	TBM C	N 70° 21' 52.2"	W 150° 55' 19.1"	5.64	
	TBM D	N 70° 21' 52.2"	W 150° 55' 19.3"	8.04	
ULAM Pipe Bridge	TBM A	N 70° 24' 24.1"	W 150° 53' 01.3"	1.51	FIORD 1
	TBM B	N 70° 24' 24.4"	W 150° 53' 00.6"	2.66	
	TBM C	N 70° 24' 24.6"	W 150° 52' 59.9"	4.78	
	TBM D	N 70° 24' 24.7"	W 150° 52' 59.8"	6.83	
TAM Pipe Bridge	TBM A	N 70° 23' 30.4"	W 150° 54' 42.6"	2.02	STM RT
	TBM B	N 70° 23' 29.8"	W 150° 54' 41.2"	2.76	
	TBM C	N 70° 23' 29.4"	W 150° 54' 40.4"	4.93	
	TBM D	N 70° 23' 29.2"	W 150° 54' 40.1"	7.16	
	TBM E	N 70° 23' 28.5"	W 150° 54' 38.8"	NA	
West ULAM (CD3)	Gage 11 TBM A	N 70° 25' 06.6"	W 150° 55' 19.8"	3.02	FIORD 17
	Gage 11 TBM B	N 70° 25' 06.8"	W 150° 55' 18.6"	5.14	
	Gage 11 TBM C	N 70° 25' 07.5"	W 150° 55' 16.2"	5.69	
	Gage 11 TBM D	N 70° 25' 08.1"	W 150° 55' 14.7"	NA	
East ULAM (CD3)	Gage 12 TBM A	N 70° 25' 20.3"	W 150° 52' 21.3"	3.17	FIORD 15
	Gage 12 TBM B	N 70° 25' 20.4"	W 150° 52' 22.6"	4.53	
	Gage 12 TBM C	N 70° 25' 20.5"	W 150° 52' 24.3"	NA	
CD 4	Gage 13	N 70° 19' 24.3"	W 150° 59' 43.4"	10.25	05-01-18A
	Gage 14	N 70° 19' 24.4"	W 150° 59' 47.4"	10.07	05-01-18A
	Gage 15	N 70° 18' 07.8"	W 150° 59' 34.6"	6.50	NAN2
	Gage 16	N 70° 18' 05.7"	W 150° 59' 33.5"	6.55	NAN2
	Gage 17	N 70° 17' 35.9"	W 150° 58' 57.9"	10.24	05-01-21A
	Gage 18	N 70° 17' 34.8"	W 150° 58' 54.4"	9.99	05-01-21A
	Gage 19	N 70° 17' 28.8"	W 150° 59' 10.1"	9.38	05-01-21A
	Gage 20	N 70° 17' 28.1"	W 150° 59' 41.6"	10.70	05-01-21D

Gage Site	Gage	Latitude (NAD83)	Longitude (NAD83)	Gage Bottom Elevation (BPMSL - Feet)	Basis of Elevation
Mon 01U	TBM A - 1	N 70° 09' 30.4"	W 150° 56' 43.3"	9.25	Mon 01
	TBM A	N 70° 09' 30.5"	W 150° 56' 44.4"	11.22	
	TBM B	N 70° 09' 30.6"	W 150° 56' 45.5"	13.61	
	TBM C	N 70° 09' 30.7"	W 150° 56' 45.9"	15.97	
	TBM D	N 70° 09' 30.7"	W 150° 56' 46.2"	18.6	
	TBM E	N 70° 09' 30.6"	W 150° 56' 46.8"	21.13	
	TBM F	N 70° 09' 30.6"	W 150° 56' 47.0"	23.67	
Mon 01	TBM A - 1	N 70° 09' 56.7"	W 150° 56' 17.7"	9.32	Mon 01
	TBM A	N 70° 09' 56.8"	W 150° 56' 18.5"	10.52	
	TBM B	N 70° 09' 56.9"	W 150° 56' 20.5"	13.21	
	TBM C	N 70° 09' 56.9"	W 150° 56' 21.1"	15.62	
	TBM D	N 70° 09' 57.0"	W 150° 56' 21.4"	17.84	
	TBM E	N 70° 09' 57.0"	W 150° 56' 21.9"	20.19	
	TBM F	N 70° 09' 57.1"	W 150° 56' 22.4"	22.78	
Mon 01D	TBM A - 1	N 70° 10' 26.4"	W 150° 55' 58.3"	9.41	Mon 01
	TBM A	N 70° 10' 26.0"	W 150° 56' 10.2"	12.44	
	TBM B	N 70° 10' 25.8"	W 150° 56' 11.5"	14.68	
	TBM C	N 70° 10' 25.6"	W 150° 56' 13.7"	16.45	
	TBM D	N 70° 10' 25.5"	W 150° 56' 14.2"	18.97	
Mon 9	TBM A	N 70° 14' 40.2"	W 150° 51' 23.7"	3.79	Mon 09
	TBM B	N 70° 14' 40.1"	W 150° 51' 26.2"	5.91	
	TBM C	N 70° 14' 40.0"	W 150° 51' 27.1"	7.69	
	TBM D	N 70° 14' 39.9"	W 150° 51' 28.2"	9.73	
	TBM E	N 70° 14' 40.1"	W 150° 51' 28.5"	11.13	
Mon 20	TBM A	N 70° 16' 42.5"	W 150° 59' 58.6"	NA	Mon 20
	TBM B	N 70° 16' 42.8"	W 150° 59' 55.4"	3.56	
	TBM C	N 70° 16' 42.8"	W 150° 59' 55.0"	6.61	
	TBM D	N 70° 16' 42.7"	W 150° 59' 54.6"	8.93	
Mon 22	TBM A	N 70° 19' 06.0"	W 151° 03' 19.9"	4.23	Mon 22
	TBM B	N 70° 19' 06.6"	W 151° 03' 18.3"	4.85	
	TBM C	N 70° 19' 06.8"	W 151° 03' 17.9"	7.10	
	TBM D	N 70° 19' 07.6"	W 151° 03' 15.2"	8.41	
Mon 23	TBM A	N 70° 20' 37.0"	W 151° 03' 59.1"	2.5	Mon 23
	TBM B	N 70° 20' 37.0"	W 151° 03' 56.0"	4.65	
	TBM C	N 70° 20' 37.0"	W 151° 03' 54.9"	7.02	
	TBM D	N 70° 20' 36.9"	W 151° 03' 53.5"	NA	
Mon 28	TBM A	N 70° 25' 32.0"	W 151° 04' 01.2"	2.65	Mon 28
	TBM B	N 70° 25' 32.5"	W 151° 04' 11.3"	NA	
Mon 35	TBM A	-	-	-0.01	Mon 35

Gage Site	Gage	Latitude (NAD83)	Longitude (NAD83)	Gage Bottom Elevation (BPMSL - Feet)	Basis of Elevation
Nigliq Paleo West	TBM A	N 70° 20' 16.8"	W 151° 06' 17.2"	8.41	Clear 1951
	TBM B	N 70° 20' 16.8"	W 151° 06' 20.2"	11.2	
Nigliq Paleo East	TBM A	N 70° 20' 26.3"	W 151° 05' 35.3"	7.83	NPRA 2
	TBM B	N 70° 20' 26.2"	W 151° 05' 31.7"	8.15	
UB13.7	TBM A	N 70° 14' 35.9"	W 151° 17' 51.1"	9.33	UBUSW
	TBM B	N 70° 14' 36.0"	W 151° 17' 51.1"	10.24	
	TBM C	N 70° 14' 36.1"	W 151° 17' 51.1"	11.41	
	TBM D	N 70° 14' 36.2"	W 151° 17' 51.1"	14.41	
UB6.9	TBM A	N 70° 17' 00.2"	W 151° 15' 23.9"	2.69	Jack
	TBM B	N 70° 17' 00.3"	W 151° 15' 24.5"	4.77	
	TBM C	N 70° 17' 00.1"	W 151° 15' 28.9"	8.33	
UB6.8	TBM A	N 70° 17' 05.1"	W 151° 15' 33.1"	4.65	Jack
	TBM B	N 70° 17' 04.7"	W 151° 15' 35.8"	6.52	
	TBM C	N 70° 17' 04.3"	W 151° 15' 37.5"	8.29	
	TBM D	N 70° 17' 03.6"	W 151° 15' 40.5"	10.09	
UB6.7	TBM A	N 70° 17' 07.9"	W 151° 15' 45.3"	2.07	Jack
	TBM B	N 70° 17' 07.8"	W 151° 15' 45.6"	3.65	
	TBM C	N 70° 17' 07.6"	W 151° 15' 46.0"	6.19	
	TBM D	N 70° 17' 06.6"	W 151° 15' 47.8"	9.31	
UB1.9	TBM A	N 70° 18' 15.7"	W 151° 19' 40.8"	1.93	UBN 1
	TBM B	N 70° 18' 15.1"	W 151° 19' 41.5"	4.42	
	TBM C	N 70° 18' 13.4"	W 151° 19' 43.6"	8.66	
Judy 7.0	TBM A	N 70° 13' 11.0"	W 151° 50' 19.3"	23.83	Line 3S1
	TBM B	N 70° 13' 10.2"	W 151° 50' 20.5"	26.18	
	TBM C	N 70° 13' 10.2"	W 151° 50' 20.2"	29.64	
Judy 13.8	TBM A	N 70° 11' 11.2"	W 151° 57' 38.9"	32.55	Line 4BW
	TBM B	N 70° 11' 11.3"	W 151° 57' 40.8"	34.04	
	TBM C	N 70° 11' 11.4"	W 151° 57' 42.20"	38.09	
Fish 32.4	TBM A	N 70° 16' 10.0"	W 151° 52' 21.4"	17.18	Line 3S2
	TBM B	N 70° 16' 09.8"	W 151° 52' 20.8"	19.59	
	TBM C	N 70° 16' 09.7"	W 151° 52' 20.4"	22.03	
Fish 25.1	TBM A	N 70° 15' 56.0"	W 151° 42' 10.5"	14.44	Line 2S
	TBM B	N 70° 15' 55.5"	W 151° 42' 09.4"	16.97	
	TBM C	N 70° 15' 55.4"	W 151° 42' 09.3"	19.74	
Fish 10.3	TBM A	N 70° 19' 04.2"	W 151° 22' 52.0"	2.86	C-2
	TBM B	N 70° 19' 04.5"	W 151° 22' 51.4"	5.19	
	TBM C	N 70° 19' 05.1"	W 151° 22' 53.4"	5.88	
	TBM D	N 70° 19' 05.3"	W 151° 22' 54.5"	NA	
Fish 0.7	TBM A	N 70° 22' 17.2"	W 151° 15' 20.7"	2.85	D1A South
	TBM B	N 70° 22' 17.0"	W 151° 15' 20.5"	5.79	

Gage Site	Gage	Latitude (NAD83)	Longitude (NAD83)	Gage Bottom Elevation (BPMSL - Feet)	Basis of Elevation
Site 1	S1U	N 70° 20' 08.4"	W 151° 07' 14.2"	10.23	NPRA 3
	S1	N 70° 20' 08.4"	W 151° 07' 09.2"	10.07	
	S1D	N 70° 20' 07.8"	W 151° 07' 06.3"	9.21	
Site 2	S2U	N 70° 18' 45.5"	W 151° 10' 59.8"	20.13	CDW
	S2	N 70° 18' 44.0"	W 151° 10' 45.2"	19.72	
	S2D	N 70° 18' 38.1"	W 151° 10' 43.7"	20.12	
Site 3	S3U	N 70° 18' 16.1"	W 151° 11' 26.0"	21.79	AMYLEE
	S3	N 70° 18' 19.6"	W 15° 11' 37.7"	20.82	
	S3D	N 70° 18' 24.1"	W 15° 11' 44.0"	20.52	
	PND-A	N 70° 18' 19.9"	W 151° 11' 36.6"	NA	
	PND-B	N 70° 18' 17.7"	W 151° 11' 42.2"	NA	
Site 5	S5U	N 70° 16' 50.1"	W 151° 17' 43.1"	14.52	CHAR
	S5	N 70° 16' 51.8"	W 151° 17' 37.3"	14.13	
	S5D	N 701° 65' 32.5"	W 151° 17' 32.5"	12.78	
Site 6	S6U	N 70° 16' 42.6"	W 151° 19' 55.2"	18.07	ALMA
	S6A	N 70° 16' 46.6"	W 151° 19' 48.0"	17.44	
	S6B	N 70° 16' 46.4"	W 151° 19' 49.8"	20.09	
	S6D	N 70° 16' 51.9"	W 151° 19' 47.8"	16.50	
Site 7	S7U	N 70° 16' 40.4"	W 151° 22' 08.5"	23.94	BRAD
	S7	N 70° 16' 35.6"	W 151° 22' 03.9"	23.95	
	S7D	N 70° 16' 33.4"	W 151° 21' 58.6"	24.87	
Site 8	S8U	N 70° 15' 49.3"	W 151° 29' 29.6"	23.81	KELLY
	S8	N 70° 15' 48.7"	W 151° 29' 22.4"	23.47	
	S8D	N 70° 15' 49.8"	W 151° 29' 17.9"	23.06	
Site 9	S9U	N 70° 12' 21.9"	W 151° 38' 15.9"	60.39	PATTY
	S9	N 70° 12' 22.3"	W 151° 38' 23.8"	60.68	
	S9D	N 70° 12' 25.1"	W 151° 38' 32.6"	60.03	
Site 10	S10	N 70° 12' 02.8"	W 151° 39' 55.1"	66.64	MECKEL

Appendix B Discharge Measurement Notes

DISCHARGE MEASUREMENT NOTES

LOCATION: 452-foot Bridge, CD 2 Road

Date: June 2, 2005 **Party:** JPM, MDC, EJK

Width: 445 **ft** **Area:** 841 **ft²** **Ave. Vel:** 1.37 **fps** **G.H.:** NA **Discharge:** 1144 **cfs**

Start Time: 1820 **End Time:** 1905

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
See Tables			
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: No.622 Price AA Current Meter

Date rated: Standard

Meter: NA **ft. above bottom of weight.**

Spin before measurement: 2+ minutes **After:** 2+ minutes

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes, before and after

Measurement rated: Good **Rating based on the following conditions:**

Cross section: Consistant grass and mud, uniform depth

Flow: Uniform and steady **Weather:** Overcast **Air Temp.** 26°F

Gage: Permanent staff gages 3 & 4 Snow Squalls **Water Temp.** NR

Other:

Record Removed: N/A **Intake flushed:** NA

Observer N/A

Control Channel downstream constricted by snowbanks on edges and stationary floating ice causing backwater

Remarks Measurements collected at 0.6 depth due to presence of grass at cross section. Velocity from rating curve reduced 2% to account for rod measurements.

LOCATION:	452-foot Bridge, CD 2 Road	Date:	2-Jun-05	Party:	JPM, MDC, EJK

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)			
70	0	15.0	2.0	0.6	1.2	38	40	2.08	2.08	0.94	1.95	30.0	58.6	
75	30	30.0	2.3	0.6	1.38	29	40	1.59	1.59	0.97	1.54	69.0	106.1	
75	60	30.0	1.8	0.6	1.08	28	40	1.54	1.54	0.97	1.49	54.0	80.3	
85	90	30.0	1.5	0.6	1.08	28	40	1.54	1.54	1.00	1.53	45.0	69.0	
88	120	30.0	1.8	0.6	1.08	15	40	0.84	0.84	1.00	0.84	54.0	45.2	
88	150	30.0	1.7	0.6	1.08	26	40	1.43	1.43	1.00	1.43	51.0	72.9	
85	180	30.0	1.6	0.6	0.96	28	40	1.54	1.54	1.00	1.53	48.0	73.6	
80	210	30.0	1.8	0.6	0.96	33	40	1.81	1.81	0.98	1.78	54.0	96.2	
77	240	25.0	2.6	0.6	1.56	22	40	1.22	1.22	0.97	1.18	65.0	77.0	
70	260	20.0	2.5	0.6	1.56	17	40	0.95	0.95	0.94	0.89	50.0	44.4	
70	280	20.0	1.9	0.6	1.14	24	40	1.32	1.32	0.94	1.24	38.0	47.2	
70	300	20.0	2.1	0.6	1.14	24	40	1.32	1.32	0.94	1.24	42.0	52.2	
65	320	20.0	1.4	0.6	0.84	32	40	1.75	1.75	0.91	1.59	28.0	44.5	
65	340	20.0	1.5	0.6	0.84	31	40	1.70	1.70	0.91	1.54	30.0	46.2	
65	360	20.0	2.1	0.6	1.26	23	40	1.27	1.27	0.91	1.15	42.0	48.3	
65	380	20.0	1.9	0.6	1.26	23	40	1.27	1.27	0.91	1.15	38.0	43.7	
65	400	20.0	2.0	0.6	1.20	25	40	1.38	1.38	0.91	1.25	40.0	49.9	
80	420	20.0	1.8	0.6	1.20	25	40	1.38	1.38	0.98	1.36	36.0	48.8	
75	440	12.5	1.7	0.6	1.02	29	40	1.59	1.59	0.97	1.54	21.3	32.7	
75	445	2.5	2.3	0.6	1.02	22	40	1.22	1.22	0.97	1.17	5.8	6.7	
SUBTOTAL		**445.0**										**841**	**1144**	**Page 2 of 2**

DISCHARGE MEASUREMENT NOTES

LOCATION: Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"

Date: June 8, 2005 **Party:** J. Meckel, J. Wolf, M. McBroom

Width: 290 **ft** **Area:** 1261 **ft²** **Ave. Vel:** 1.29 **fps** **G.H.:** **Discharge:** **1630 cfs**

No Secs. 41 **G.H. change:** **in.:** **hrs.:** **Susp.:**

Method coef.: **Hor. Angle coef.** **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
See Tables			
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price "AA"

Date rated:

Meter: **ft. above bottom of weight.**

Spin before measurement: 2+ minutes **After:** 2+ minutes

Method: Soundings using 30 lb weight
Velocities by rod suspension

Levels obtained:

Measurement rated: Fair **Rating based on the following conditions:**

Cross section: Uniform, firm - some willows on LEW, some slush and willows on REW

Flow: **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: **Intake flushed:** N/A

Observer

Control Ice floating, but stationary, affecting stage 800-1500 ft downstream

Remarks STA 70-100 measured by 30 lb weight and reel. Station 105 to 365: depths from sounding weight, velocities by meter suspended by rod due to reel problem losing circuit conductivity.

G.H. of zero flow: **ft.**

Page 1 of 4

LOCATION:	Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"			**Date:** June 8, 2005				**Party:** J. Meckel, J. Wolf, M. McBroom						
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	75	2.5	0.3					0.00				0.8	0.0	REW
90	80	5.0	0.6	S	0.1			0.290	0.29	1.00	0.26	3.0	0.8	velocity read w/ digimeter
90	85	5.0	1.6	0.6	1.0			0.79	0.79	1.00	0.8	8.0	6.3	velocity read w/ digimeter
90	90	5.0	2.2	0.6	1.3			1.33	1.33	1.00	1.3	11.0	14.6	velocity read w/ digimeter
90	95	5.0	2.9	0.6	1.7			2.10	2.10	1.00	2.1	14.5	30.5	velocity read w/ digimeter
90	100	5.0	3.2	0.2	0.6			2.35	2.23	1.00	2.2	16.0	35.6	velocity read w/ digimeter
				0.8	2.6			2.10		0.00				
90	105	5.0	3.4	S	0.1	40	43	2.07	2.07	1.00	1.9	17.0	31.7	velocity read w/ price meter
90	110	5.0	3.9	S	0.1	40	42	2.12	2.12	1.00	1.91	19.5	37.2	surface velocities
90	115	5.0	3.9	S	0.1	40	40	2.22	2.22	1.00	2.00	19.5	39.0	surface velocities
90	120	5.0	4.1	S	0.1	40	48	1.86	1.86	1.00	1.67	20.5	34.2	surface velocities
90	125	5.0	4.3	S	0.1	40	48	1.86	1.86	1.00	1.67	21.5	35.9	surface velocities
90	130	5.0	4.6	S	0.1	40	47	1.89	1.89	1.00	1.70	23.0	39.2	surface velocities
90	135	5.0	4.8	S	0.1	40	43	2.07	2.07	1.00	1.86	24.0	44.7	surface velocities
90	140	5.0	4.8	S	0.1	50	47	2.36	2.36	1.00	2.13	24.0	51.0	surface velocities
90	145	5.0	4.8	S	0.1	50	45	2.47	2.47	1.00	2.22	24.0	53.3	surface velocities
90	150	5.0	4.8	S	0.1	50	46	2.41	2.41	1.00	2.17	24.0	52.1	surface velocities
90	155	5.0	4.8	S	0.1	50	46	2.41	2.41	1.00	2.17	24.0	52.1	surface velocities
90	160	5.0	4.6	S	0.1	50	46	2.41	2.41	1.00	2.17	23.0	50.0	surface velocities
														Page 2 of 4

LOCATION:	Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"							Date: June 8, 2005			Party: J. Meckel, J. Wolf, M. McBroom			
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	165	5.0	4.7	S	0.1	50	47	2.36	2.36	1.00	2.13	23.5	50.0	surface velocities
90	170	5.0	4.6	S	0.1	40	42	2.12	2.12	1.00	1.91	23.0	43.8	surface velocities
90	175	5.0	4.6	S	0.1	40	43	2.07	2.07	1.00	1.86	23.0	42.8	surface velocities
90	180	7.5	4.7	S	0.1	40	42	2.12	2.12	1.00	1.91	35.3	67.2	surface velocities
90	190	10.0	4.8	S	0.1	40	44	2.022	2.02	1.00	1.82	48.0	87.4	surface velocities
90	200	10.0	4.9	S	0.1	40	47	1.894	1.89	1.00	1.70	49.0	83.5	surface velocities
90	210	10.0	5.4	S	0.1	40	49	1.818	1.82	1.00	1.64	54.0	88.3	surface velocities
90	220	10.0	4.7	S	0.1	30	54	1.243	1.24	1.00	1.12	47.0	52.6	surface velocities
90	230	10.0	4.4	S	0.1	30	46	1.456	1.46	1.00	1.31	44.0	57.6	surface velocities
90	240	10.0	4.1	S	0.1	20	45	0.998	1.00	1.00	0.90	41.0	36.8	surface velocities
90	250	10.0	4.3	S	0.1	20	45	0.998	1.00	1.00	0.90	43.0	38.6	surface velocities
90	260	10.0	3.9	S	0.1	20	49	0.918	0.92	1.00	0.83	39.0	32.2	surface velocities
90	270	10.0	4.8	S	0.1	20	47	0.956	0.96	1.00	0.86	48.0	41.3	surface velocities
90	280	10.0	5.2	S	0.1	20	50	0.900	0.90	1.00	0.81	52.0	42.1	surface velocities
90	290	10.0	5.2	S	0.1	15	51	0.666	0.67	1.00	0.60	52.0	31.2	surface velocities
90	300	10.0	5.2	S	0.1	15	54	0.630	0.63	1.00	0.57	52.0	29.5	surface velocities
90	310	10.0	5.3	S	0.1	20	46	0.976	0.976	1.00	0.88	53.0	46.6	surface velocities
90	320	10.0	5.3	S	0.1	20	40	1.120	1.120	1.00	1.01	53.0	53.4	surface velocities
														Page 3 of 4

LOCATION:		Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"						Date: June 8, 2005		Party: J. Meckel, J. Wolf, M. McBroom				
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	330	10.0	5.5	0.6	3.3	20	54	0.834	0.834	1.00	0.83	55.0	45.9	
90	340	10.0	5.4	0.6	3.2	15	54	0.630	0.630	1.00	0.63	54.0	34.0	
90	350	10.0	4.9	0.2	1.08	5	40	0.293	0.278	1.00	0.28	49.0	13.6	
				0.8	4.3	10	90	0.263		0.00				
90	360	7.5	0.8	S	0.1	15	60	0.569	0.569	1.00	0.51	6.0	3.1	surface velocities
90	365	2.5	0.0					0.000	0.000			0.0	0.0	
SUBTOTAL		**290.0**										**1261**	**1630**	**Page 4 of 4**

DISCHARGE MEASUREMENT NOTES

LOCATION: Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"

Date: June 9, 2005 **Party:** J. Meckel, M. Cox, M. McBroom

Width: 291 **ft** **Area:** 1379 **ft²** **Ave. Vel:** 1.22 **fps** **G.H.:** **Discharge:** 1677 **cfs**

No Secs. 34 **G.H. change:** **in.:** **hrs.:** **Susp.:**

Method coef.: **Hor. Angle coef.** **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**

See Tables

Weighted M.G.H.		
G.H. corrections		
Correct M.G.H.		

Type of meter: Price "AA"

Date rated:

Meter: **ft. above bottom of weight.**

Spin before measurement: 2+ minutes **After:** 2+ minutes

Method: Soundings using 30 lb weight

Velocity using boom and reel

Levels obtained:

Measurement rated: **Rating based on the following conditions:**

Cross section: Uniform, firm - some willows on LEW, some slush and willows on REW

Flow: **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: **Intake flushed:** N/A

Observer

Control Ice floating, but stationary, affecting stage 800-1500 ft downstream

Remarks

G.H. of zero flow: **ft.**

Page 1 of 3

LOCATION:	Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"			Date: June 9, 2005				Party: J. Meckel, M. Cox, M. McBroom						
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	72	4.0										0.0		REW
90	80	6.5	1.1	S	0.1	10	45	0.508	0.457	1.00	0.5	7.2	3.3	
90	85	6.5	3.0	0.8	2.4	30	49	1.37	1.27	1.00	1.3	19.5	24.7	
				0.2	0.6	25	48	1.17		0.00				
90	93	7.5	3.9	0.8	3.1	30	66	1.02	1.01	1.00	1.0	29.3	29.5	
				0.2	0.8	20	45	0.998		0.00				
90	100	8.5	4.6	0.8	3.7	25	44	1.27	1.31	1.00	1.3	39.1	51.0	
				0.2	0.9	30	50	1.34		0.00				
90	110	10.0	4.8	0.8	3.8	25	45	1.24	1.24	1.00	1.2	48.0	59.6	
				0.2	1.0	25	45	1.24		0.00				
90	120	10.0	5.1	0.8	4.1	25	47	1.19	1.41	1.00	1.4	51.0	72.0	
				0.2	1.0	30	41	1.63		0.00				
90	130	10.0	5.4	0.8	4.3	40	47	1.89	1.94	1.00	1.9	54.0	104.5	
				0.2	1.1	40	45	1.98		0.00				
90	140	10.0	5.8	0.8	4.6	45	44	2.27	2.32	1.00	2.3	58.0	134.4	
				0.2	1.2	50	47	2.36		0.00				
90	150	7.5	5.6	0.8	4.5	40	46	1.94	2.08	1.00	2.1	42.0	87.3	
				0.2	1.1	40	40	2.22		0.00				
90	155	5.0	5.6	0.8	4.5	50	56	1.99	2.08	1.00	2.1	28.0	58.2	
				0.2	1.1	40	41	2.17		0.00				
90	160	5.0	5.4	0.8	4.3	40	44	2.02	2.30	1.00	2.3	27.0	62.1	
				0.2	1.1	50	43	2.58		0.00				
90	165	5.0	5.3	0.8	4.2	40	44	2.02	1.77	1.00	1.8	26.5	46.9	
				0.2	1.1	30	44	1.52		0.00				
90	170	5.0	5.1	0.8	4.1	40	43	2.07	2.22	1.00	2.2	25.5	56.5	
				0.2	1.0	50	47	2.36		0.00				
90	175	5.0	5.4	0.8	4.3	40	41	2.17	2.33	1.00	2.3	27.0	63.0	
				0.2	1.1	45	40	2.50		0.00				
90	180	5.0	5.4	0.8	4.3	40	43	2.07	2.27	1.00	2.3	27.0	61.2	
				0.2	1.1	50	45	2.47		0.00				
90	185	5.0	5.4	0.8	4.3	40	47	1.89	2.21	1.00	2.2	27.0	59.6	
				0.2	1.1	50	44	2.52		0.00				
90	190	5.0	5.4	0.8	4.3	40	47	1.89	1.98	1.00	2.0	27.0	53.5	
				0.2	1.1	40	43	2.07		0.00				
90	195	5.0	5.4	0.8	4.3	40	43	2.07	2.22	1.00	2.2	27.0	59.8	
				0.2	1.1	50	47	2.36		0.00				
														Page 2 of 3

LOCATION:	Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"							Date: June 9, 2005		Party: J. Meckel, M. Cox, M. McBroom				
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)			
90	200	5.0	5.6	0.8	4.5	40	42	2.12	2.27	1.00	2.3	28.0	63.4	
				0.2	1.1	50	46	2.41		0.00				
90	205	5.0	5.8	0.8	4.6	40	47	1.89	2.01	1.00	2.0	29.0	58.2	
				0.2	1.2	40	42	2.12		0.00				
90	210	5.0	6.4	0.8	5.1	40	56	1.59	1.49	1.00	1.5	32.0	47.8	
				0.2	1.3	30	48	1.40		0.00				
90	215	7.5	5.0	0.8	4.0	15	41	0.824	1.01	1.00	1.0	37.5	37.9	
				0.2	1.0	30	56	1.20		0.00				
90	225	10.0	4.6	0.8	3.7	3	48	0.156	0.55	1.00	0.5	46.0	25.1	
				0.2	0.9	20	48	0.936		0.00				
90	235	10.0	3.9	0.8	3.1	5	61	0.199	0.58	1.00	0.6	39.0	22.5	
				0.2	0.8	20	47	0.956		0.00				
90	245	10.0	4.0	0.8	3.2	10	61	0.379	0.51	1.00	0.5	40.0	20.4	
				0.2	0.8	15	53	0.642		0.00				
90	255	10.0	4.1	0.8	3.3	5	48	0.247	0.55	1.00	0.5	41.0	22.5	
				0.2	0.8	20	53	0.850		0.00				
90	265	12.5	4.0	0.8	3.2	3	41	0.179	0.49	1.00	0.5	50.0	24.6	
				0.2	0.8	15	42	0.805		0.00				
90	280	15.0	5.1	0.8	4.1	15	58	0.588	0.60	1.00	0.6	76.5	46.2	
				0.2	1.0	15	55	0.619		0.00				
90	295	15.0	5.2	0.8	4.2	10	43	0.531	0.50	1.00	0.5	78.0	39.3	
				0.2	1.0	10	48	0.477		0.00				
90	310	15.0	5.3	0.8	4.2	20	62	0.729	0.79	1.00	0.8	79.5	62.6	
				0.2	1.1	15	40	0.845		0.00				
90	325	12.5	5.6	0.8	4.5	15	45	0.753	0.80	1.00	0.8	70.0	55.9	
				0.2	1.1	15	40	0.845		0.00				
90	335	12.5	5.7	0.8	4.6	15	55	0.619	0.67	1.00	0.7	71.3	47.8	
				0.2	1.1	15	47	0.721		0.00				
90	350	12.5	4.9	0.8	3.9	10	84	0.280	0.22	1.00	0.2	61.3	13.6	
				0.2	1.0	5	75	0.165		0.00				
90	360	6.5	1.6	0.6	1.0	4	70	0.144	0.144	1.00	0.1	10.4	1.5	
	363	1.5												
SUBTOTAL		**291.0**										**1379**	**1677**	**Page 3 of 3**

DISCHARGE MEASUREMENT NOTES

LOCATION: Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"

Date: June 10, 2005 **Party:** J. Meckel and A. Gibson

Width: 288 **ft** **Area:** 1314 **ft²** **Ave. Vel:** 1.19 **fps** **G.H.:** **Discharge:** 1567 **cfs**

No Secs. 40 **G.H. change:** **in.:** **hrs.:** **Susp.:**

Method coef.: **Hor. Angle coef.** **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**

See Tables

Weighted M.G.H.		
G.H. corrections		
Correct M.G.H.		

Type of meter: Price "AA"

Date rated:

Meter: 0.6 **ft. above bottom of weight.**

Spin before measurement: 2+ minutes **After:** 2+ minutes

Method: 0.6, 0.2 - 0.8

Levels obtained:

Measurement rated: Good/Fair **Rating based on the following conditions:**

Cross section: Firm bottom, some willow on REW - Section

Flow: Falling Stage **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: **Intake flushed:** N/A

Observer

Control Heavy ice lodged in channel 800-1500 feet downstream causing backwater

Remarks

G.H. of zero flow: **ft.**

Page 1 of 4

LOCATION:	Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"			Date: June 10, 2005				Party: J. Meckel and A. Gibson						
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	72	4.0	0.0									0.0		REW
90	80	6.0	1.8	est				0.400	0.400	1.00	0.4	10.8	4.3	velocity estimated due to willows
90	84	5.0	5.6	0.8	4.5	20	52	0.87	1.13	1.00	1.13	28.0	31.7	
				0.2	1.1	30	48	1.40		0.00				
90	90	5.5	5.0	0.8	4.0	30	40	1.67	1.78	1.00	1.8	27.5	49.0	
				0.2	1.0	40	47	1.894		0.00				
90	95	5.0	5.1	0.8	4.1	40	52	1.71	1.87	1.00	1.9	25.5	47.6	
				0.2	1.0	40	44	2.02		0.00				
90	100	5.0	5.0	0.8	4.0	40	48	1.86	1.99	1.00	2.0	25.0	49.7	
				0.2	1.0	40	42	2.12		0.00				
90	105	5.0	4.8	0.8	3.8	40	50	1.78	1.90	1.00	1.9	24.0	45.6	
				0.2	1.0	40	44	2.02		0.00				
90	110	5.0	4.9	0.8	3.9	30	44	1.52	1.75	1.00	1.7	24.5	42.9	
				0.2	1.0	40	45	1.98		0.00				
90	115	5.0	4.8	0.8	3.8	30	44	1.52	1.73	1.00	1.7	24.0	41.5	
				0.2	1.0	40	46	1.94		0.00				
90	120	5.0	4.9	0.8	3.9	25	40	1.40	1.53	1.00	1.5	24.5	37.6	
				0.2	1.0	30	40	1.67		0.00				
90	125	5.0	5.2	0.8	4.2	30	41	1.63	1.69	1.00	1.7	26.0	43.9	
				0.2	1.0	40	51	1.75		0.00				
90	130	5.0	5.2	0.8	4.2	30	47	1.43	1.55	1.00	1.6	26.0	40.4	
				0.2	1.0	40	53	1.68		0.00				
90	135	5.0	5.5	0.8	4.4	30	43	1.56	1.67	1.00	1.7	27.5	45.9	
				0.2	1.1	40	50	1.78		0.00				
90	140	5.0	5.6	0.8	4.5	30	41	1.63	1.72	1.00	1.7	28.0	48.3	
				0.2	1.1	40	49	1.82		0.00				
90	145	5.0	5.8	0.8	4.6	40	51	1.75	1.80	1.00	1.8	29.0	52.2	
				0.2	1.2	40	48	1.86		0.00				
90	150	5.0	5.5	0.8	4.4	40	47	1.89	1.94	1.00	1.9	27.5	53.2	
				0.2	1.1	40	45	1.98		0.00				
90	155	5.0	5.6	0.8	4.5	40	46	1.94	2.08	1.00	2.1	28.0	58.2	
				0.2	1.1	40	40	2.22		0.00				
90	160	5.0	5.5	0.8	4.4	30	40	1.67	2.02	1.00	2.0	27.5	55.5	
				0.2	1.1	50	47	2.36		0.00				
														Page 2 of 4

LOCATION: Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2" **Date:** June 10, 2005 **Party:** J. Meckel and A. Gibson

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)			
90	165	5.0	5.4	0.8	4.3	40	44	2.02	2.14	1.00	2.1	27.0	57.9	
				0.2	1.1	50	49	2.27		0.00				
90	170	5.0	5.3	0.8	4.2	40	42	2.12	2.27	1.00	2.3	26.5	60.0	
				0.2	1.1	50	46	2.41		0.00				
90	175	5.0	5.4	0.8	4.3	40	47	1.89	2.21	1.00	2.2	27.0	59.6	
				0.2	1.1	50	44	2.52		0.00				
90	180	5.0	5.5	0.8	4.4	40	51	1.75	2.14	1.00	2.1	27.5	58.7	
				0.2	1.1	50	44	2.52		0.00				
90	185	5.0	5.6	0.8	4.5	40	48	1.855	2.19	1.00	2.2	28.0	61.3	
				0.2	1.1	50	44	2.52		0.00				
90	190	5.0	5.6	0.8	4.5	40	49	1.818	2.23	1.00	2.2	28.0	62.4	
				0.2	1.1	50	42	2.643		0.00				
90	195	5.0	5.5	0.8	4.4	40	51	1.747	2.11	1.00	2.1	27.5	58.0	
				0.2	1.1	50	45	2.468		0.00				
90	200	5.0	5.8	0.8	4.6	40	48	1.855	2.08	1.00	2.1	29.0	60.5	
				0.2	1.2	50	48	2.314		0.00				
90	205	5.0	6.1	0.8	4.9	40	52	1.714	1.97	1.00	2.0	30.5	60.0	
				0.2	1.2	50	50	2.223		0.00				
90	210	5.0	5.8	0.8	4.6	30	46	1.456	1.66	1.00	1.7	29.0	48.0	
				0.2	1.2	40	48	1.855		0.00				
90	215	7.5	4.6	0.8	3.7	20	52	0.866	1.15	1.00	1.1	34.5	39.5	
				0.2	0.9	30	47	1.425		0.00				
90	225	12.5	3.7	0.8	3.0	5	48	0.247	0.47	1.00	0.5	46.3	21.7	
				0.2	0.7	15	49	0.693		0.00				
75	240	15.0	3.2	0.8	2.6	5	53	0.226	0.46	0.97	0.4	48.0	21.3	
				0.2	0.6	15	49	0.693		0.00				
50	255	15.0	2.9	0.8	2.3	5	48	0.247	0.52	0.77	0.4	43.5	17.2	
				0.2	0.6	15	43	0.787		0.00				
40	270	15.0	3.8	0.8	3.0	5	46	0.257	0.48	0.64	0.3	57.0	17.7	
				0.2	0.8	15	48	0.707		0.00				
50	285	15.0	4.5	0.8	3.6	15	53	0.642	0.68	0.77	0.5	67.5	35.2	
				0.2	0.9	15	47	0.721		0.00				
45	300	12.5	4.5	0.8	3.6	10	52	0.442	0.49	0.71	0.3	56.3	19.3	
				0.2	0.9	10	43	0.531		0.00				
														Page 3 of 4

LOCATION:	Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"							Date: June 10, 2005		Party: J. Meckel and A. Gibson				
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
40	310	12.5	4.8	0.8	3.8	10	55	0.419	0.43	0.64	0.3	60.0	16.8	
				0.2	1.0	10	51	0.450		0.00				
40	325	15.0	5.3	0.8	4.2	10	56	0.412	0.44	0.64	0.3	79.5	22.7	
				0.2	1.1	10	48	0.477		0.00				
35	340	12.5	5.0	0.8	4.0	5	51	0.234	0.28	0.57	0.2	62.5	10.2	
				0.2	1.0	7	49	0.333		0.00				
70	350	10.0	4.6	0.8	3.7	5	51	0.234	0.26	0.94	0.2	46.0	11.1	
				0.2	0.9	5	42	0.280		0.00				
	360	5.0	0.0			0	0	0.00						
SUBTOTAL		288.0										1314	1567	Page 4 of 4

DISCHARGE MEASUREMENT NOTES

LOCATION: Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"

Date: June 11, 2005 **Party:** J. Meckel and A. Gibson

Width: 285 **ft** **Area:** 1186 **ft²** **Ave. Vel**: 1.07 **fps** **G.H.:** **Discharge:** **1271 cfs**

No Secs. 34 **G.H. change:** **in.:** **hrs.:** **Susp.:** 30 lb

Method coef.: 1 **Hor. Angle coef.** noted **Sus. Coef.:** 1 **Meter No.**

Type of meter: Price "AA"

Date rated:

Meter: 0.6 **ft. above bottom of weight.**

Spin before measurement: 3:45 **After:** 3:45

Method: 0.6, 0.2 - 0.8

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
See Tables			
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Levels obtained:

Measurement rated: fair to good **Rating based on the following conditions:**

Cross section: well-defined, firm some willow near REW & Station 212 to 330.

Flow: minor surges **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: **Intake flushed:** N/A

Observer

Control heavily ice affected from ice jam 1200 to 2000 feet downstream

Remarks

G.H. of zero flow: **ft.**

LOCATION:	Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2"			**Date:** June 11, 2005				**Party:** J. Meckel and A. Gibson						
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	73	1.0	0.0									0.0		REW
90	75	5.5	1.1					0.000	0.000			6.1		
90	84	7.5	4.7	0.8	3.8	3	55	0.14	0.33	1.00	0.33	35.3	11.8	
				0.2	0.9	10	43	0.53		0.00				
90	90	6.5	5.6	0.8	4.5	30	44	1.52	1.71	1.00	1.7	36.4	62.2	
				0.2	1.1	40	47	1.894		0.00				
90	97	7.0	5.6	0.8	4.5	30	43	1.56	1.81	1.00	1.8	39.2	71.0	
				0.2	1.1	40	43	2.07		0.00				
90	104	7.0	4.9	0.8	3.9	30	44	1.52	1.59	1.00	1.6	34.3	54.4	
				0.2	1.0	40	54	1.65		0.00				
90	111	7.0	4.4	0.8	3.5	40	55	1.62	1.74	1.00	1.7	30.8	53.5	
				0.2	0.9	40	48	1.86		0.00				
90	118	7.0	4.5	0.8	3.6	30	46	1.46	1.39	1.00	1.4	31.5	43.9	
				0.2	0.9	25	42	1.33		0.00				
90	125	7.0	5.2	0.8	4.2	25	41	1.36	1.42	1.00	1.4	36.4	51.9	
				0.2	1.0	30	45	1.49		0.00				
90	132	7.0	5.0	0.8	4.0	25	42	1.33	1.35	1.00	1.3	35.0	47.1	
				0.2	1.0	25	41	1.36		0.00				
90	139	7.0	5.2	0.8	4.2	30	47	1.43	1.64	1.00	1.6	36.4	59.7	
				0.2	1.0	40	48	1.86		0.00				
90	146	6.5	5.4	0.8	4.3	25	44	1.27	1.58	1.00	1.6	35.1	55.5	
				0.2	1.1	40	47	1.89		0.00				
90	152	6.0	5.2	0.8	4.2	30	44	1.52	1.69	1.00	1.7	31.2	52.7	
				0.2	1.0	40	48	1.86		0.00				
90	158	6.0	5.2	0.8	4.2	25	40	1.40	1.71	1.00	1.7	31.2	53.3	
				0.2	1.0	40	44	2.02		0.00				
90	164	6.0	5.1	0.8	4.1	40	49	1.82	1.92	1.00	1.9	30.6	58.7	
				0.2	1.0	40	44	2.02		0.00				
90	170	5.5	5.1	0.8	4.1	40	49	1.82	1.94	1.00	1.9	28.1	54.5	
				0.2	1.0	40	43	2.07		0.00				
90	175	5.0	5.1	0.8	4.1	40	50	1.78	1.90	1.00	1.9	25.5	48.5	
				0.2	1.0	40	44	2.02		0.00				
90	180	5.0	5.3	0.8	4.2	40	46	1.94	2.03	1.00	2.0	26.5	53.7	
				0.2	1.1	40	42	2.12		0.00				
90	185	5.0	5.4	0.8	4.3	30	44	1.52	1.84	1.00	1.8	27.0	49.8	
				0.2	1.1	40	41	2.17		0.00				
														Page 2 of 3

LOCATION: Ublutuoch River Mile 6.8, N 70° 17' 01.8" W 151° 15' 25.2" **Date:** June 11, 2005 **Party:** J. Meckel and A. Gibson

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)			
90	190	5.0	5.4	0.8	4.3	30	40	1.67	1.99	1.00	2.0	27.0	53.8	
				0.2	1.1	50	48	2.31		0.00				
90	195	5.0	5.4	0.8	4.3	25	40	1.40	1.65	1.00	1.6	27.0	44.4	
				0.2	1.1	40	47	1.89		0.00				
90	200	5.0	5.7	0.8	4.6	40	52	1.71	1.75	1.00	1.7	28.5	49.8	
				0.2	1.1	40	50	1.78		0.00				
90	205	6.0	5.5	0.8	4.4	25	46	1.216	1.37	1.00	1.4	33.0	45.2	
				0.2	1.1	30	44	1.52		0.00				
90	212	7.5	4.3	0.8	3.4	25	43	1.300	1.33	1.00	1.3	32.3	42.9	
				0.2	0.9	25	41	1.362		0.00				
90	220	14.0	3.3	0.8	2.6	5	53	0.226	0.51	1.00	0.5	46.2	23.4	
				0.2	0.7	15	43	0.787		0.00				
80	240	15.0	2.6	0.6	1.6	5	79	0.157	0.16	0.98	0.2	39.0	6.0	
60	250	15.0	2.3	0.6	1.4	7	57	0.289	0.29	0.87	0.2	34.5	8.6	
60	270	20.0	3.0	0.6	1.8	5	63	0.193	0.19	0.87	0.2	60.0	10.0	
60	290	20.0	3.8	0.8	3.0	10	48	0.477	0.47	0.87	0.4	76.0	30.8	
				0.2	0.8	10	50	0.459		0.00				
60	310	20.0	4.0	0.8	3.2	10	43	0.531	0.54	0.87	0.465	80.0	37.2	
				0.2	0.8	10	42	0.543		0.00				
75	330	17.5	4.6	0.8	3.7	5	52	0.230	0.28	0.97	0.3	80.5	21.6	
				0.2	0.9	7	50	0.326		0.00				
80	345	10.0	4.2	0.8	3.4	5	70	0.175	0.23	0.98	0.2	42.0	9.6	
				0.2	0.8	5	41	0.287		0.00				
50	350	6.5	3.7	0.8	3.0	5	46	0.257	0.27	0.77	0.2	24.1	5.0	
				0.2	0.7	5	41	0.287		0.00				
	358	4.0	0.0			0	0	0.00						
SUBTOTAL		**285.0**										**1186**	**1271**	**Page 3 of 3**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 1, N 70° 20' 08.6" W 151° 07' 11.7"

Date: June 8, 2005 **Party:** M.Cox, A.Gibson

Width: 30 **ft** **Area:** 13 **ft²** **Ave. Vel:** 0.09 **fps** **G.H.:** NA **Discharge:** **1.45 cfs**

Start Time: 1824 **End Time:** 1840

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
		See Tables	
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes, before and after

Measurement rated: Fair **Rating based on the following conditions:** NA

Cross section:

Flow: **Weather:** Partly cloudy **Air Temp.** ~35°F

Gage: 5-10 mph wind **Water Temp.** ~33°F

Other:

Record Removed: N/A **Intake flushed:** NA

Observer N/A

Control

Remarks Flow spread out into many channels at S1 area. Discharge location conducted in an area where ~90-95% of water flow was confined to a single channel. Grass

Page 1 of 2

LOCATION:	Small Stream Site 1, N 70° 20' 08.6" W 151° 07' 11.7"	Date:	June 8, 2005	Party:	M.Cox, A.Gibson

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (mps)	Converted (fps)	Adjust for Angle Coef.	Adjusted (fps)			
90	0	1.5	0.20	0.6	0.12	NA	40	0.01	0.03	1.00	0.03	0.30	0.01	LEW - Grass - mostly local melt
90	3	3.0	0.20	0.6	0.12	NA	40	0.00	0.00	1.00	0.00	0.60	0.00	Grass - mostly local melt
90	6	3.0	0.15	0.6	0.09	NA	40	0.00	0.00	1.00	0.00	0.45	0.00	Grass - mostly local melt
90	9	3.0	0.00	0.6	0.00	NA	40	0.00	0.00	1.00	0.00	0.00	0.00	Grass - mostly local melt
90	12	3.0	0.30	0.6	0.18	NA	40	0.02	0.07	1.00	0.07	0.90	0.06	Grass - mostly local melt
90	15	2.5	0.55	0.6	0.33	NA	40	0.01	0.03	1.00	0.03	1.38	0.05	Grass w/ <5% ice on bottom
90	17	1.5	0.85	0.6	0.51	NA	40	0.01	0.03	1.00	0.03	1.28	0.04	Grass w/ <5% ice on bottom
90	18	1.0	1.15	0.6	0.69	NA	40	0.11	0.36	1.00	0.36	1.15	0.42	Grass w/ <5% ice on bottom
90	19	1.0	1.20	0.6	0.72	NA	40	0.08	0.26	1.00	0.26	1.20	0.31	Grass w/ <5% ice on bottom
90	20	1.0	1.10	0.6	0.66	NA	40	0.07	0.23	1.00	0.23	1.10	0.25	Grass w/ <5% ice on bottom
90	21	1.0	0.95	0.6	0.57	NA	40	0.06	0.20	1.00	0.20	0.95	0.19	Grass w/ <5% ice on bottom
90	22	1.5	0.80	0.6	0.48	NA	40	0.01	0.03	1.00	0.03	1.20	0.04	Grass w/ <5% ice on bottom
90	24	2.5	0.55	0.6	0.33	NA	40	0.01	0.03	1.00	0.03	1.38	0.05	Grassy area
90	27	3.0	0.45	0.6	0.27	NA	40	0.01	0.03	1.00	0.03	1.35	0.04	Grassy area
90	30	1.5	0.00	0.6	0.00	NA	40	0.00	0.00	1.00	0.00	0.00	0.00	REW - Grassy area
SUBTOTAL		**30.0**										**13**	**1.45**	**Page 2 of 2**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 3, N 70° 18' 18.6" W 151° 11' 32.3"

Date: June 6, 2005 **Party:** M.McBroom, J.Meckel, M.Cox

Width: 17 **ft** **Area:** 4 **ft²** **Ave. Vel:** 0.07 **fps** **G.H.:** NA **Discharge:** **0.33 cfs**

Start Time: 1350 **End Time:** 1413

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
		See Tables	
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes, before and after

Measurement rated: Fair to poor **Rating based on the following conditions:** NA

Cross section: Shallow - bottom soft mud ~0.1 ft, long grass on edges, uniform

Flow: Steady **Weather:** Clear **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: NA **Intake flushed:** NA

Observer NA

Control

Remarks Broke surface ice to improve the section. Small ice chunks floating through the section, intact surface ice present across channel upstream from cross section

LOCATION:	Small Stream Site 3, N 70° 18' 18.6" W 151° 11' 32.3"	Date:	June 6, 2005	Party:	M.McBroom, J.Meckel, M.Cox

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (cfs)	Discharge	Description
								At Point (fps)	Adjust for Angle Coef.	Adjusted (fps)	(s.f.)			
90	1.0	0.50	0.00	0.6	0	NA	40	0.00	1.00	0.00	0.00	0.00	LEW	
90	2.0	1.00	0.10	0.6	0.06	NA	40	0.00	1.00	0.00	0.10	0.00		
90	3.0	1.00	0.15	0.6	0.09	NA	40	0.05	1.00	0.05	0.15	0.01		
90	4.0	1.00	0.25	0.6	0.15	NA	40	0.11	1.00	0.11	0.25	0.03		
90	5.0	1.00	0.25	0.6	0.15	NA	40	0.07	1.00	0.07	0.25	0.02		
90	6.0	1.00	0.30	0.6	0.18	NA	40	0.05	1.00	0.05	0.30	0.02		
90	7.0	1.00	0.30	0.6	0.18	NA	40	0.12	1.00	0.12	0.30	0.04		
90	8.0	1.00	0.30	0.6	0.18	NA	40	0.13	1.00	0.13	0.30	0.04		
90	9.0	1.00	0.30	0.6	0.18	NA	40	0.17	1.00	0.17	0.30	0.05		
90	10.0	1.00	0.25	0.6	0.15	NA	40	0.12	1.00	0.12	0.25	0.03		
90	11.0	1.00	0.30	0.6	0.18	NA	40	0.02	1.00	0.02	0.30	0.01		
90	12.0	1.00	0.30	0.6	0.18	NA	40	0.03	1.00	0.03	0.30	0.01		
90	13.0	0.75	0.35	0.6	0.21	NA	40	0.06	1.00	0.06	0.26	0.02		
90	13.5	0.50	0.35	0.6	0.21	NA	40	0.23	1.00	0.23	0.18	0.04		
90	14.0	0.75	0.25	0.6	0.15	NA	40	0.03	1.00	0.03	0.19	0.01		
90	15.0	1.00	0.25	0.6	0.15	NA	40	0.04	1.00	0.04	0.25	0.01		
90	16.0	1.00	0.20	0.6	0.12	NA	40	0.06	1.00	0.06	0.20	0.01		
90	17.0	1.00	0.15	0.6	0.09	NA	40	0.08	1.00	0.08	0.15	0.01		
18	18.0	0.50	0.00	0.6	0	NA	40	0.00	1.00	0.00	0.00	0.00	REW	
SUBTOTAL		**17.0**										**4**	**0.33**	**Page 2 of 2**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 5, N 70° 16' 48.8" W 151° 17' 44.7"

Date: June 5, 2005 **Party:** J.Wolf, J.Meckel, M.Cox

Width: 22 **ft** **Area:** 15 **ft²** **Ave. Vel:** 0.28 **fps** **G.H.:** NA **Discharge:** **4.57 cfs**

Start Time: 1145 **End Time:** 1210

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
		See Tables	
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes, before and after

Measurement rated: Fair **Rating based on the following conditions:** NA

Cross section: Fairly uniform, grass swale, fast ice on bottom, long grass, snow edges

Flow: Steady **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: NA **Intake flushed:** NA

Observer NA

Control

Remarks Grassy, snow riffles 75 - 100 ft downstream

LOCATION:	Small Stream Site 5, N 70° 16' 48.8" W 151° 17'	Date:	June 5, 2005	Party:	J.Wolf, J.Meckel, M.Cox

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	At Point (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	5	0.5	0.40	0.6	0.24	NA	0.00	1.00	0.00	0.20	0.00	LEW
90	6	1.0	0.40	0.6	0.24	NA	0.27	1.00	0.27	0.40	0.11	
90	7	1.0	0.60	0.6	0.36	NA	0.18	1.00	0.18	0.60	0.11	
90	8	1.0	0.70	0.6	0.42	NA	0.22	1.00	0.22	0.70	0.15	
90	9	1.0	0.70	0.6	0.42	NA	0.13	1.00	0.13	0.70	0.09	
90	10	1.0	0.75	0.6	0.45	NA	0.28	1.00	0.28	0.75	0.21	
90	11	1.0	0.75	0.6	0.45	NA	0.29	1.00	0.29	0.75	0.22	
90	12	1.0	0.70	0.6	0.42	NA	0.28	1.00	0.28	0.70	0.20	
90	13	1.0	0.75	0.6	0.45	NA	0.31	1.00	0.31	0.75	0.23	
90	14	1.0	0.80	0.6	0.48	NA	0.48	1.00	0.48	0.80	0.38	
90	15	1.0	0.90	0.6	0.54	NA	0.33	1.00	0.33	0.90	0.30	
90	16	1.0	1.00	0.6	0.6	NA	0.57	1.00	0.57	1.00	0.57	
90	17	1.0	0.90	0.6	0.54	NA	0.61	1.00	0.61	0.90	0.55	
90	18	1.0	0.80	0.6	0.48	NA	0.37	1.00	0.37	0.80	0.30	
90	19	1.0	0.85	0.6	0.51	NA	0.39	1.00	0.39	0.85	0.33	
90	20	1.0	0.80	0.6	0.48	NA	0.23	1.00	0.23	0.80	0.18	
90	21	1.0	0.75	0.6	0.45	NA	0.17	1.00	0.17	0.75	0.13	
90	22	1.0	0.60	0.6	0.36	NA	0.23	1.00	0.23	0.60	0.14	
90	23	1.0	0.50	0.6	0.3	NA	0.16	1.00	0.16	0.50	0.08	
90	24	1.0	0.50	0.6	0.3	NA	0.22	1.00	0.22	0.50	0.11	
90	25	1.0	0.35	0.6	0.21	NA	0.24	1.00	0.24	0.35	0.08	
90	26	1.0	0.30	0.6	0.18	NA	0.29	1.00	0.29	0.30	0.09	
90	27	0.5	0.25	0.6	0.15	NA	0.12	1.00	0.12	0.13	0.02	REW
SUBTOTAL		**22.0**								**14.7**	**4.57**	**Page 2 of 2**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 6, N 70° 16' 40.4" W 151° 20' 01.1"

Date: June 7, 2005 **Party:** J.Wolf, J.Meckel, M.Cox

Width: 25 **ft** **Area:** 32 **ft²** **Ave. Vel:** 0.37 **fps** **G.H.:** NA **Discharge:** **14.51 cfs**

Start Time: 1050 **End Time:** 1112

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
		See Tables	
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes, before and after

Measurement rated: Good **Rating based on the following conditions:** NA

Cross section: Uniform, sedge with firm bed, willow on banks

Flow: Steady **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: NA **Intake flushed:** NA

Observer NA

Control

Remarks Some ice & snow effect

LOCATION:	Small Stream Site 6, N 70° 16' 40.4" W 151° 20' 01.1"			Date:	June 7, 2005	Party:	J.Wolf, J.Meckel, M.Cox					
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	6	1.0	0.60	0.6	0.36	NA	40	0.00	1.00	0.00	0.60	0.00	LEW - Willow
90	8	2.0	0.50	0.6	0.3	NA	40	0.10	1.00	0.10	1.00	0.10	Willow
90	10	2.0	0.85	0.6	0.51	NA	40	0.06	1.00	0.06	1.70	0.10	Willow
90	12	1.5	1.05	0.6	0.63	NA	40	0.11	1.00	0.11	1.58	0.17	Grass
90	13	1.0	1.10	0.6	0.66	NA	40	0.18	1.00	0.18	1.10	0.20	Grass
90	14	1.0	1.10	0.6	0.66	NA	40	0.29	1.00	0.29	1.10	0.32	Grass
90	15	1.0	1.25	0.6	0.75	NA	40	0.34	1.00	0.34	1.25	0.43	Grass
90	16	1.0	1.35	0.6	0.81	NA	40	0.31	1.00	0.31	1.35	0.42	Grass
90	17	1.0	1.40	0.6	0.84	NA	40	0.26	1.00	0.26	1.40	0.36	Grass
90	18	1.0	1.50	0.6	0.9	NA	40	0.36	1.00	0.36	1.50	0.54	Grass
90	19	1.0	1.55	0.6	0.93	NA	40	0.46	1.00	0.46	1.55	0.71	Grass
90	20	1.0	1.60	0.6	0.96	NA	40	0.42	1.00	0.42	1.60	0.67	Grass
90	21	1.0	1.70	0.6	1.02	NA	40	0.16	1.00	0.16	1.70	0.27	Grass
90	22	1.0	1.70	0.6	1.02	NA	40	0.95	1.00	0.95	1.70	1.62	Grass
90	23	1.0	1.80	0.6	1.08	NA	40	1.11	1.00	1.11	1.80	2.00	Grass
90	24	1.0	2.00	0.6	1.2	NA	40	1.09	1.00	1.09	2.00	2.18	Grass
90	25	1.0	2.10	0.6	1.26	NA	40	1.04	1.00	1.04	2.10	2.18	Grass
90	26	1.0	2.05	0.6	1.23	NA	40	0.67	1.00	0.67	2.05	1.37	Grass
90	27	1.0	1.90	0.6	1.14	NA	40	0.32	1.00	0.32	1.90	0.61	Grass
90	28	1.0	1.30	0.6	0.78	NA	40	0.11	1.00	0.11	1.30	0.14	Grass
90	29	1.0	0.90	0.6	0.54	NA	40	0.07	1.00	0.07	0.90	0.06	Grass
90	30	1.0	0.40	0.6	0.24	NA	40	0.12	1.00	0.12	0.40	0.05	Willow
90	31	0.5	0.05	0.6	0.03	NA	40	0.00	1.00	0.00	0.03	0.00	REW - Willow
SUBTOTAL		**25.0**									**31.6**	**14.51**	**Page 2 of 2**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 8, N 70° 15' 49.3" W 151° 29' 36.1"

Date: June 5, 2005 **Party:** J.Wolf, J.Meckel, M.Cox

Width: 42 **ft** **Area:** 54 **ft²** **Ave. Vel:** 0.16 **fps** **G.H.:** NA **Discharge:** **8.45 cfs**

Start Time: 1556 **End Time:** 1646

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings

Time	Recorder	Inside	Outside
		See Tables	
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6, 0.8 & 0.2 depth

Levels obtained: Yes, before and after

Measurement rated: Poor **Rating based on the following conditions:** NA

Cross section: Fairly uniform, firm bottom, ice in grass, snow & slush

Flow: Steady **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: NA **Intake flushed:** NA

Observer NA

Control

Remarks Snow occluded channel, slush, willow. Cross section occluded by slush in Sta 20-42 segement

Page 1 of 3

LOCATION:	Small Stream Site 8, N 70° 15' 49.3" W 151° 29' 36.1"			Date:	June 5, 2005		Party:	J.Wolf, J.Meckel, M.Cox						
								Velocity						
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth	(ft)	Revo-lutions	Time (sec)	At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	0	1.0	0.00	0.6	0	NA	40	0.00	0.00	1.00	0.00	0.00	0.00	LEW
90	2	2.0	0.30	0.6	0.18	NA	40	0.02	0.02	1.00	0.02	0.60	0.01	
90	4	2.0	0.40	0.6	0.24	NA	40	0.04	0.04	1.00	0.04	0.80	0.03	
90	6	2.0	0.40	0.6	0.24	NA	40	0.05	0.05	1.00	0.05	0.80	0.04	
90	8	1.5	0.95	0.6	0.57	NA	40	0.44	0.44	1.00	0.44	1.43	0.63	
90	9	1.0	1.20	0.6	0.72	NA	40	0.13	0.13	1.00	0.13	1.20	0.16	
90	10	1.0	1.20	0.6	0.72	NA	40	0.18	0.18	1.00	0.18	1.20	0.22	
90	11	1.0	1.30	0.6	0.78	NA	40	0.41	0.41	1.00	0.41	1.30	0.53	
90	12	1.0	1.60	0.6	0.96	NA	40	0.25	0.25	1.00	0.25	1.60	0.40	
90	13	1.0	1.80	0.6	1.08	NA	40	0.30	0.30	1.00	0.30	1.80	0.54	
90	14	1.0	1.80	0.6	1.08	NA	40	0.54	0.54	1.00	0.54	1.80	0.97	
90	15	1.0	1.70	0.6	1.02	NA	40	0.15	0.15	1.00	0.15	1.70	0.26	
90	16	1.0	1.70	0.2	0.34	NA	40	1.01	0.54	1.00	0.54	1.70	0.91	
90				0.8	1.36	NA	40	0.06						
90	17	1.0	1.80	0.2	0.36	NA	40	0.66	0.35	1.00	0.35	1.80	0.62	
90				0.8	1.44	NA	40	0.03						
90	18	1.5	1.80	0.2	0.36	NA	40	0.36	0.20	1.00	0.20	2.70	0.53	
90				0.8	1.44	NA	40	0.03						
90	20	2.0	1.80	0.2	0.36	NA	40	0.46	0.23	1.00	0.23	3.60	0.83	Slush
90				0.6	1.08	NA	40	0.00						
90				0.8	1.44	NA	40	0.00						
90	22	2.0	1.80	0.2	0.36	NA	40	0.18	0.09	1.00	0.09	3.60	0.32	Slush
90				0.8	1.44	NA	40	0.00						
90	24	2.0	1.70	0.2	0.34	NA	40	0.33	0.17	1.00	0.17	3.40	0.58	Slush
90				0.8	1.36	NA	40	0.01						
90	26	2.0	1.90	0.2	0.38	NA	40	0.01	0.01	1.00	0.01	3.80	0.02	Slush
90				0.8	1.52	NA	40	0.00						
90	28	2.0	1.90	0.2	0.38	NA	40	0.02	0.01	1.00	0.01	3.80	0.04	Slush
90				0.8	1.52	NA	40	0.00						
90	30	2.0	1.60	0.2	0.32	NA	40	0.33	0.17	1.00	0.17	3.20	0.54	Slush
90				0.8	1.28	NA	40	0.01						
90	32	2.0	1.80	0.2	0.36	NA	40	0.00	0.01	1.00	0.01	3.60	0.04	Slush
90				0.8	1.44	NA	40	0.02						
90	34	2.0	1.80	0.2	0.36	NA	40	0.01	0.03	1.00	0.03	3.60	0.11	Slush
90				0.8	1.44	NA	40	0.05						
90	36	2.0	1.40	0.2	0.28	NA	40	0.02	0.03	1.00	0.03	2.80	0.08	Slush
90				0.8	1.12	NA	40	0.04						

LOCATION:	Small Stream Site 8, N 70° 15' 49.3" W 151° 29' 36.1"	Date:	June 5, 2005	Party:	J.Wolf, J.Meckel, M.Cox

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (fps)	Mean in-vertical (fps)	Adjust for Angle Coef.	Adjusted (fps)			
90	38	2.0	0.70	0.6	0.42	NA	40	0.01	0.01	1.00	0.01	1.40	0.01	Slush
90	40	2.0	0.40	0.6	0.24	NA	40	0.04	0.04	1.00	0.04	0.80	0.03	Slush
90	42	1.0	0.20	0.6	0.12	NA	40	0.00	0.00	1.00	0.00	0.20	0.00	REW - Slush
SUBTOTAL		**42.0**										**54.2**	**8.45**	**Page 3 of 3**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 8, N 70° 15' 49.3" W 151° 29' 36.1"

Date: June 8, 2005 **Party:** M.Cox, A.Gibson

Width: 27 **ft** **Area:** 37 **ft²** **Ave. Vel:** 1.60 **fps** **G.H.:** NA **Discharge:** **70.99 cfs**

Start Time: 1707 **End Time:** 1743

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings

Time	Recorder	Inside	Outside
		See Tables	
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes

Measurement rated: Good - channel free of snow/slush **Rating based on the following conditions:** NA

Cross section:

Flow: **Weather:** Partly cloudy **Air Temp.** ~38°F

Gage: 5-10 mph wind **Water Temp.** ~33°F

Other:

Record Removed: NA **Intake flushed:** NA

Observer NA

Control

Remarks Bottom of channel holds grass - no ice

Page 1 of 2

LOCATION:	Small Stream Site 8, N 70° 15' 49.3" W 151° 29' 36.1"						Date:	June 8, 2005		Party:	M.Cox, A.Gibson			
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (mps)	Converted (fps)	Adjust for Angle Coef.	Adjusted (fps)			
90	0.0	1.00	0.00	0.6	0.00	NA	40	0.00	0.00	1.00	0.00	0.00	0.00	LEW
90	2.0	1.50	1.05	0.6	0.63	NA	40	0.08	0.26	1.00	0.26	1.58	0.41	
90	3.0	1.00	1.15	0.6	0.69	NA	40	0.18	0.59	1.00	0.59	1.15	0.68	
90	4.0	1.00	1.20	0.6	0.72	NA	40	0.17	0.56	1.00	0.56	1.20	0.67	
90	5.0	1.00	1.35	0.6	0.81	NA	40	0.18	0.59	1.00	0.59	1.35	0.80	
90	6.0	1.00	1.30	0.6	0.78	NA	40	0.24	0.79	1.00	0.79	1.30	1.02	
90	7.0	1.00	1.45	0.6	0.87	NA	40	0.40	1.31	1.00	1.31	1.45	1.90	
90	8.0	1.00	1.60	0.6	0.96	NA	40	0.54	1.77	1.00	1.77	1.60	2.83	
90	9.0	1.00	1.60	0.6	0.96	NA	40	0.62	2.03	1.00	2.03	1.60	3.25	
90	10.0	1.00	2.00	0.6	1.20	NA	40	0.63	2.07	1.00	2.07	2.00	4.13	
90	11.0	1.00	1.75	0.6	1.05	NA	40	0.67	2.20	1.00	2.20	1.75	3.85	
90	12.0	1.00	1.75	0.6	1.05	NA	40	0.84	2.76	1.00	2.76	1.75	4.82	
90	13.0	1.00	1.80	0.6	1.08	NA	40	0.83	2.72	1.00	2.72	1.80	4.90	
90	14.0	1.00	1.80	0.6	1.08	NA	40	0.85	2.79	1.00	2.79	1.80	5.02	
90	15.0	1.00	1.85	0.6	1.11	NA	40	0.81	2.66	1.00	2.66	1.85	4.92	
90	16.0	1.00	1.90	0.6	1.14	NA	40	1.06	3.48	1.00	3.48	1.90	6.61	
90	17.0	1.00	1.90	0.6	1.14	NA	40	0.95	3.12	1.00	3.12	1.90	5.92	
90	18.0	1.00	1.80	0.6	1.08	NA	40	1.01	3.31	1.00	3.31	1.80	5.96	
90	19.0	1.00	1.75	0.6	1.05	NA	40	0.95	3.12	1.00	3.12	1.75	5.45	
90	20.0	1.00	1.60	0.6	0.96	NA	40	0.62	2.03	1.00	2.03	1.60	3.25	
90	21.0	1.00	1.50	0.6	0.90	NA	40	0.56	1.84	1.00	1.84	1.50	2.76	
90	22.0	1.00	1.35	0.6	0.81	NA	40	0.15	0.49	1.00	0.49	1.35	0.66	
90	23.0	1.00	1.00	0.6	0.60	NA	40	0.23	0.75	1.00	0.75	1.00	0.75	
90	24.0	1.50	0.90	0.6	0.54	NA	40	0.09	0.30	1.00	0.30	1.35	0.40	
90	26.0	1.50	0.50	0.6	0.30	NA	40	0.00	0.00	1.00	0.00	0.75	0.00	
90	27.0	0.50	0.00	0.6	0.00	NA	40	0.00	0.00	1.00	0.00	0.00	0.00	REW
SUBTOTAL		**27.0**										**37.1**	**70.99**	**Page 2 of 2**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 9, N 70° 12' 22.4 W 151° 38' 08.2"

Date: June 7, 2005 **Party:** J.Wolf, J.Meckel, M.Cox

Width: 51 **ft** **Area:** 30 **ft²** **Ave. Vel:** 0.33 **fps** **G.H.:** NA **Discharge:** **13.04 cfs**

Start Time: 1247 **End Time:** 1315

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
See Tables			
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Measurement rated: Fair **Rating based on the following conditions:** NA

Cross section: Fairly uniform, dense sedge, embedded bottom ice as noted

Flow: Steady **Weather:** **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: NA **Intake flushed:** NA

Observer NA

Control

Remarks Ice and snow in channel downstream

LOCATION:	Small Stream Site 9, N 70° 12' 22.4 W 151° 38' 08.2"					Date:	June 7, 2005	Party:	J.Wolf, J.Meckel, M.Cox				
Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	At Point (fps)	Adjust for Angle Coef.	Adjusted (fps)	Area (s.f.)	Discharge (cfs)	Description
90	55.0	0.50	0.10	0.6	0.06	NA	40	0	1.00	0.00	0.05	0.00	REW
90	54.0	1.00	0.45	0.6	0.27	NA	40	0.05	1.00	0.05	0.45	0.02	
90	53.0	1.00	1.00	0.6	0.6	NA	40	0.44	1.00	0.44	1.00	0.44	
90	52.0	1.50	1.00	0.6	0.6	NA	40	0.63	1.00	0.63	1.50	0.95	
90	50.0	2.00	0.90	0.6	0.54	NA	40	0.57	1.00	0.57	1.80	1.03	
90	48.0	2.00	0.85	0.6	0.51	NA	40	0.37	1.00	0.37	1.70	0.63	
90	46.0	2.00	0.85	0.6	0.51	NA	40	0.71	1.00	0.71	1.70	1.21	Ice
90	44.0	2.00	0.75	0.6	0.45	NA	40	0.46	1.00	0.46	1.50	0.69	Ice
90	42.0	2.00	0.75	0.6	0.45	NA	40	0.52	1.00	0.52	1.50	0.78	Ice
90	40.0	2.00	0.70	0.6	0.42	NA	40	0.56	1.00	0.56	1.40	0.78	Ice
90	38.0	2.00	0.75	0.6	0.45	NA	40	0.44	1.00	0.44	1.50	0.66	Ice
90	36.0	2.00	0.75	0.6	0.45	NA	40	0.62	1.00	0.62	1.50	0.93	Ice
90	34.0	2.00	0.75	0.6	0.45	NA	40	0.62	1.00	0.62	1.50	0.93	Ice
90	32.0	2.00	0.65	0.6	0.39	NA	40	0.62	1.00	0.62	1.30	0.81	Ice
90	30.0	2.00	0.70	0.6	0.42	NA	40	0.64	1.00	0.64	1.40	0.90	Ice
90	28.0	2.00	0.60	0.6	0.36	NA	40	0.63	1.00	0.63	1.20	0.76	Ice
90	26.0	2.00	0.55	0.6	0.33	NA	40	0.43	1.00	0.43	1.10	0.47	Ice
90	24.0	2.00	0.60	0.6	0.36	NA	40	0.34	1.00	0.34	1.20	0.41	Ice
90	22.0	2.00	0.55	0.6	0.33	NA	40	0.17	1.00	0.17	1.10	0.19	Ice
90	20.0	2.00	0.60	0.6	0.36	NA	40	0.23	1.00	0.23	1.20	0.28	Ice
90	18.0	2.00	0.50	0.6	0.3	NA	40	0.13	1.00	0.13	1.00	0.13	Ice
90	16.0	2.00	0.40	0.6	0.24	NA	40	0.04	1.00	0.04	0.80	0.03	Grass
90	14.0	2.00	0.40	0.6	0.24	NA	40	0.04	1.00	0.04	0.80	0.03	Grass
90	12.0	2.00	0.30	0.6	0.18	NA	40	0	1.00	0.00	0.60	0.00	Grass
90	10.0	2.00	0.30	0.6	0.18	NA	40	0	1.00	0.00	0.60	0.00	Grass
90	8.0	2.00	0.30	0.6	0.18	NA	40	0	1.00	0.00	0.60	0.00	Grass
90	6.0	2.00	0.10	0.6	0.06	NA	40	0	1.00	0.00	0.20	0.00	Grass
90	4.0	1.00	0.00	0.6	0	NA	40	0	1.00	0.00	0.00	0.00	LEW - Grass
SUBTOTAL		**51.0**									**30.2**	**13.04**	**Page 2 of 2**

DISCHARGE MEASUREMENT NOTES

LOCATION: Small Stream Site 10, N 70° 12' 02.8" W 151° 39' 55.1"

Date: June 9, 2005 **Party:** J.Wolf, A.Gibson

Width: 134 **ft** **Area:** 76 **ft²** **Ave. Vel:** 0.33 **fps** **G.H.:** NA **Discharge:** **15.64 cfs**

Start Time: 1306 **End Time:** 1350

Method coef.: Noted **Hor. Angle coef.** Noted **Sus. Coef.:** **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
		See Tables	
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Marsh-McBirney Flow Mate 2000

Date rated:

Meter: NA **ft. above bottom of weight.**

Spin before measurement: NA **After:** NA

Method: Wading w/ wading rod @ 0.6 depth

Levels obtained: Yes, before and after

Measurement rated: Poor **Rating based on the following conditions:** NA

Cross section: Shallow over intact ice, grass & frozen mud.

Flow: Steady but irregular across section **Weather:** Clear **Air Temp.**

Gage: **Water Temp.**

Other:

Record Removed: NA **Intake flushed:** NA

Observer NA

Control

Remarks Broke surface ice to improve the section. Small ice chunks floating through the section, intact surface ice present across channel upstream from cross section

Page 1 of 2

LOCATION:	Small Stream Site 10, N 70° 12' 02.8" W 151° 39' 55.1"	Date:	June 9, 2005	Party:	J.Wolf, A.Gibson

Angle Coef. (deg)	Distance From Initial Point (ft)	Width (ft)	Total Depth (ft)	Observed Depth (ft)		Revo-lutions	Time (sec)	Velocity				Area (s.f.)	Discharge (cfs)	Description
								At Point (mps)	Converted (fps)	Adjust for Angle Coef.	Adjusted (fps)			
90	18	2.5	0.45	0.6	0.27	NA	40	0.23	0.75	1.00	0.75	1.13	0.85	REW - Grass & short willows
90	23	5.0	0.60	0.6	0.36	NA	40	0.45	1.48	1.00	1.48	3.00	4.43	Grass & short willows
90	28	5.0	0.65	0.6	0.39	NA	40	0.17	0.56	1.00	0.56	3.25	1.81	Grass & short willows
90	33	5.0	0.40	0.6	0.24	NA	40	0.09	0.30	1.00	0.30	2.00	0.59	Grass & short willows
90	38	5.0	0.40	0.6	0.24	NA	40	0.24	0.79	1.00	0.79	2.00	1.57	Grass & short willows
90	43	5.0	0.35	0.6	0.21	NA	40	0.11	0.36	1.00	0.36	1.75	0.63	Grass & short willows
90	48	7.5	0.55	0.6	0.33	NA	40	0.16	0.52	1.00	0.52	4.13	2.17	Grass & short willows
90	58	10.0	0.70	0.6	0.42	NA	40	0.00	0.00	1.00	0.00	7.00	0.00	On ice
90	68	10.0	1.10	0.6	0.66	NA	40	0.00	0.00	1.00	0.00	11.00	0.00	On ice
90	78	10.0	1.00	0.6	0.6	NA	40	0.00	0.00	1.00	0.00	10.00	0.00	On ice
90	88	10.0	0.80	0.6	0.48	NA	40	0.05	0.16	1.00	0.16	8.00	1.31	On ice
90	98	10.0	0.75	0.6	0.45	NA	40	0.00	0.00	1.00	0.00	7.50	0.00	On ice
90	108	10.0	0.40	0.6	0.24	NA	40	0.03	0.10	1.00	0.10	4.00	0.39	On ice
90	118	10.0	0.30	0.6	0.18	NA	40	0.01	0.03	1.00	0.03	3.00	0.10	On ice
90	128	7.5	0.25	0.6	0.15	NA	40	0.03	0.10	1.00	0.10	1.88	0.18	Grass
90	133	5.0	0.35	0.6	0.21	NA	40	0.06	0.20	1.00	0.20	1.75	0.34	Grass
90	138	5.0	0.25	0.6	0.15	NA	40	0.09	0.30	1.00	0.30	1.25	0.37	Grass
90	143	5.0	0.35	0.6	0.21	NA	40	0.04	0.13	1.00	0.13	1.75	0.23	Grass
90	148	4.5	0.30	0.6	0.18	NA	40	0.06	0.20	1.00	0.20	1.35	0.27	Grass
90	152	2.0	0.30	0.6	0.18	NA	40	0.20	0.66	1.00	0.66	0.60	0.39	LEW - Grass
SUBTOTAL		**134.0**										**76**	**15.64**	**Page 2 of 2**

Appendix C WinRiver ADCP Output Graphics

Station No.: Monument 01 Meas. No: 001

Station Name: Colville River Date: 06/10/2005

Party:	JWW/MDC	Width:	3,020 ft	Processed by:	JWW
Boat/Motor:	Achilles w/ 25hp outboard	Area:	40,500 ft²	Mean Velocity:	3.94 ft/s
Gage Height:	0.00 ft	G.H.Change:	0.00	Discharge:	159,000 ft³/s

Area Method:	Avg. Course	ADCP Depth:	1.10 ft	Index Vel.:	0.00 ft/s	Rating No.:1
Nav. Method:	Bottom Track	Shore Ens.:	10	Adj.Mean Vel:	0.00 ft/s	Qm Rating:E
MagVar Method:	Nearby Site (25.0°)	Top Est:	Power (0.1667)	Rated Area:	0.000 ft²	% Diff: 0.0%
Depth Sounder:	Not Used	Bottom Est:	Power (0.1667)	Control:	Clear	

Screening Thresholds:

BT 3-Beam Solution:	ON	Max. Vel.:	8.92 ft/s
WT 3-Beam Solution:	OFF	Max. Depth:	34.5 ft
BT Error Vel.:	0.33 ft/s	Mean Depth:	13.4 ft
WT Error Vel.:	3.50 ft/s	% Meas.:	72.71%
BT Up Vel.:	1.00 ft/s	Water Temp.:	None
WT Up Vel.:	5.00 ft/s	ADCP Temp.:	40.0 °F

ADCP:

Type/Freq.:	Workhorse / 600 kHz		
Serial #:	0	Firmware:	16.21
Bin Size:	50 cm	Blank:	25 cm
BT Mode:	5	BT Pings:	1
WT Mode:	1	WT Pings:	1
WV:170			

Diag. Test:

Moving Bed Test:

Compass Test:

Meas. Location: Adjacent to Mon01 monitoring location

Filename Prefix: DATA_mon01

Software: 1.06.00

Tr.#		Edge D.		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad		
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins	
000	R	1161	10	340	24302	116666	16409	3288	-5.90	160659	2974	39632	12:26	12:32	4.91	4.05	13	1	U
001	L	1161	13	566	24160	115828	16040	3655	-15.8	159667	3126	41710	12:35	12:46	3.06	3.83	26	1	U
002	R	1161	13	534	23755	116618	16314	2453	-15.6	159124	2976	39875	12:47	12:58	3.06	3.99	13	1	U
003	L	1161	13	684	23572	114501	16406	3725	-13.8	158191	3003	40703	13:00	13:14	2.50	3.89	14	1	U
Mean		1161	12	531	23947	115903	16292	3280	-12.8	159410	3020	40480	**Total**	00:47	3.38	3.94	16	1	
SDev		0	1	143	341	1011	174	584	4.68	1032	72	939			1.05	0.10			
R/M%		0	24	64.8	3.0	1.9	2.3	38.8	77.6	1.5	5.1	5.1			71.40	5.73			

Remarks:

U - transect is unlocked

Station No.: Monument 23 Meas. No: 001

Station Name: Nigliq Channel, Colville River Date: 06/11/2005

Party:	JWW/MDC	Width:	1,160 ft	Processed by:	JWW
Boat/Motor:	Achilles w/ 25hp outboard	Area:	13,400 ft²	Mean Velocity:	2.16 ft/s
Gage Height:	0.00 ft	G.H.Change:	0.00	Discharge:	28,900 ft³/s

Area Method:	Avg. Course	ADCP Depth:	1.10 ft	Index Vel.:	0.00 ft/s	Rating No.:	1
Nav. Method:	Bottom Track	Shore Ens.:	10	Adj.Mean Vel:	0.00 ft/s	Qm Rating:	G
MagVar Method:	Nearby Site (25.0°)	Top Est:	Power (0.1667)	Rated Area:	0.000 ft²	% Diff:	0.0%
Depth Sounder:	Not Used	Bottom Est:	Power (0.1667)	Control:	Clear		

Screening Thresholds:

BT 3-Beam Solution:	ON	Max. Vel.:	6.01 ft/s
WT 3-Beam Solution:	OFF	Max. Depth:	26.1 ft
BT Error Vel.:	0.33 ft/s	Mean Depth:	11.6 ft
WT Error Vel.:	3.50 ft/s	% Meas.:	62.56%
BT Up Vel.:	1.00 ft/s	Water Temp.:	None
WT Up Vel.:	4.00 ft/s	ADCP Temp.:	40.0 °F

ADCP:

Type/Freq.:	Workhorse / 600 kHz		
Serial #:	0	Firmware:	16.21
Bin Size:	50 cm	Blank:	25 cm
BT Mode:	5	BT Pings:	1
WT Mode:	1	WT Pings:	1
WV:	170		

Diag. Test:

Moving Bed Test:

Compass Test:

Meas. Location: Adjacent to Mon 23 monitoring site/proposed bridge

Filename Prefix: DATA_nigliq20050611111221

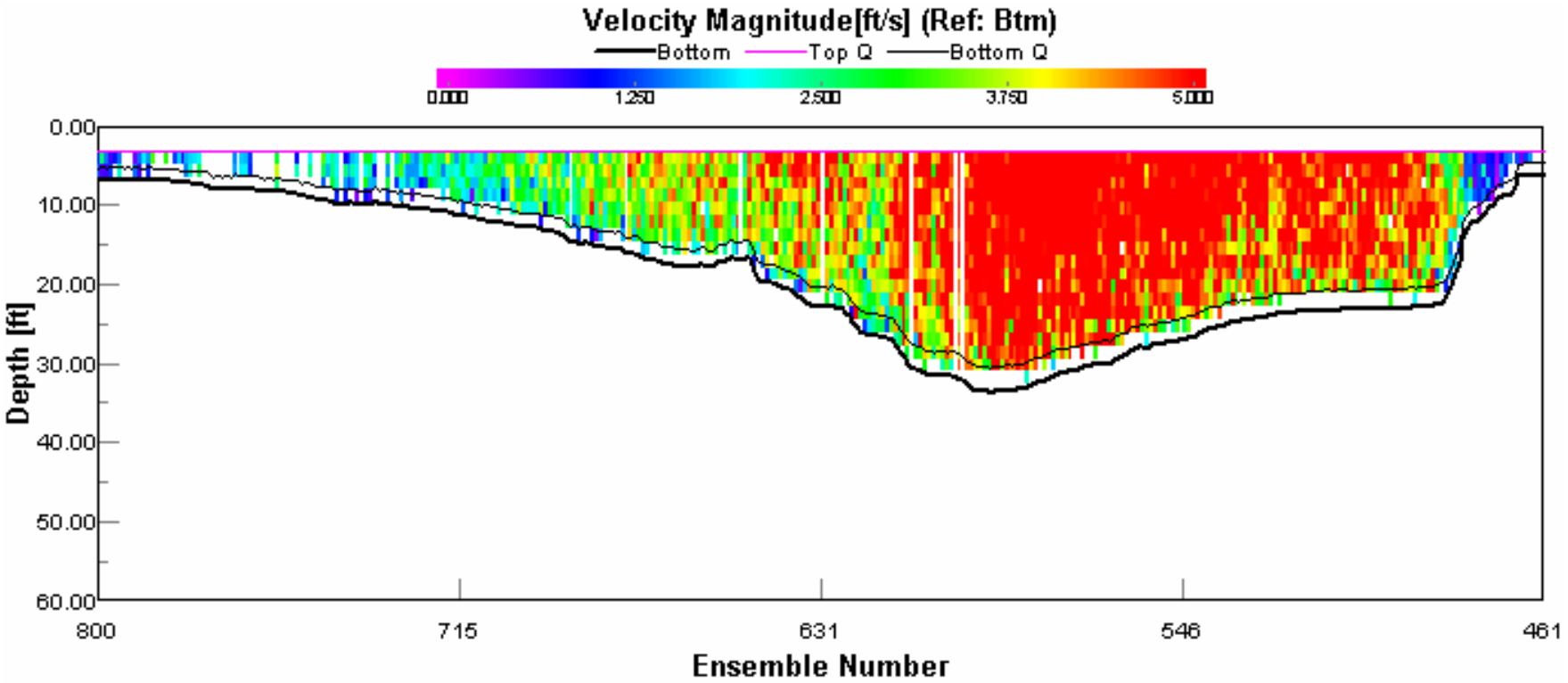
Software: 1.06.00

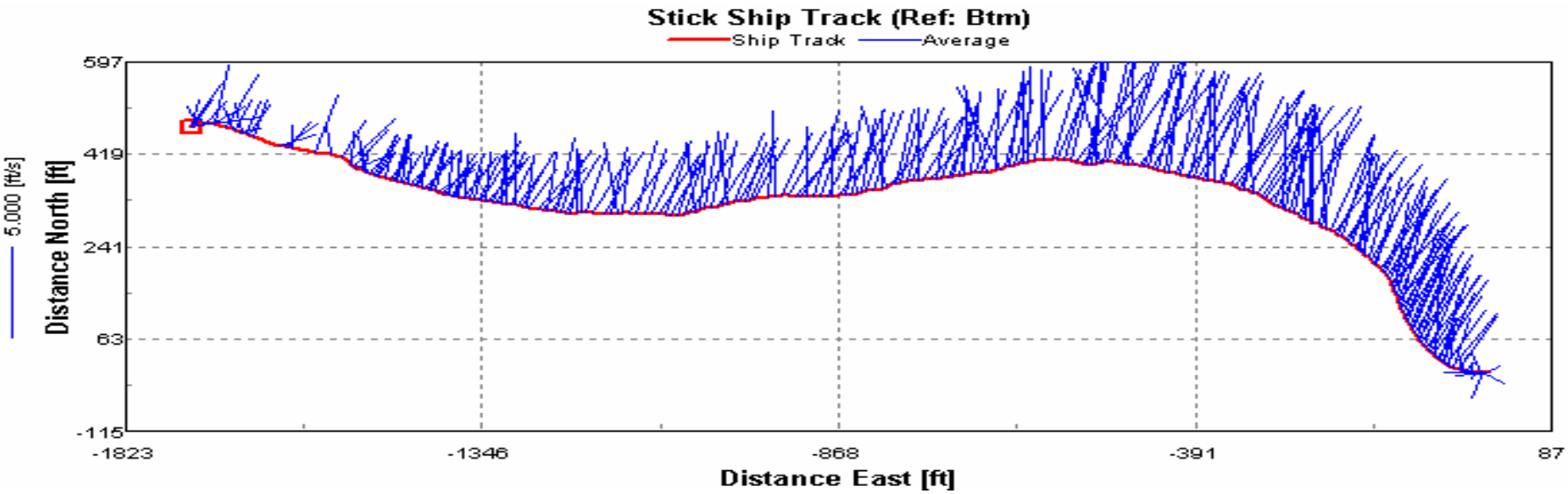
Tr.#		Edge D. L	Edge D. R	#Ens.	Discharge Top	Discharge Middle	Discharge Bottom	Discharge Left	Discharge Right	Discharge Total	Width	Area	Time Start	Time End	Mean Vel. Boat	Mean Vel. Water	% Bad Ens.	% Bad Bins	
000	L	26	580	126	4995	18406	3112	83.8	1996	28593	1157	13238	11:12	11:18	1.84	2.16	32	1	U
000	R	25	580	122	5068	18120	3151	111	3067	29517	1157	13697	11:26	11:32	1.93	2.15	11	1	U
000	L	26	580	77	4965	18027	3108	129	2924	29153	1158	13526	11:33	11:36	2.66	2.16	0	2	U
000	L	25	580	87	4967	17874	3240	112	1571	27765	1161	12674	11:47	11:51	2.67	2.19	1	2	U
000	R	25	580	126	4942	17968	3030	160	3372	29471	1153	13784	11:54	12:00	1.72	2.14	2	1	U
Mean		25	580	108	4988	18079	3128	119	2586	28900	1157	13384	**Total**	00:47	2.16	2.16	9	1	
SDev		1	0	24	49.0	203	76.4	28.0	765	734	3	448			0.46	0.02			
R/M%		4	0	45.5	2.5	2.9	6.7	63.8	69.6	6.1	0.7	8.3			43.63	2.44			

Remarks:

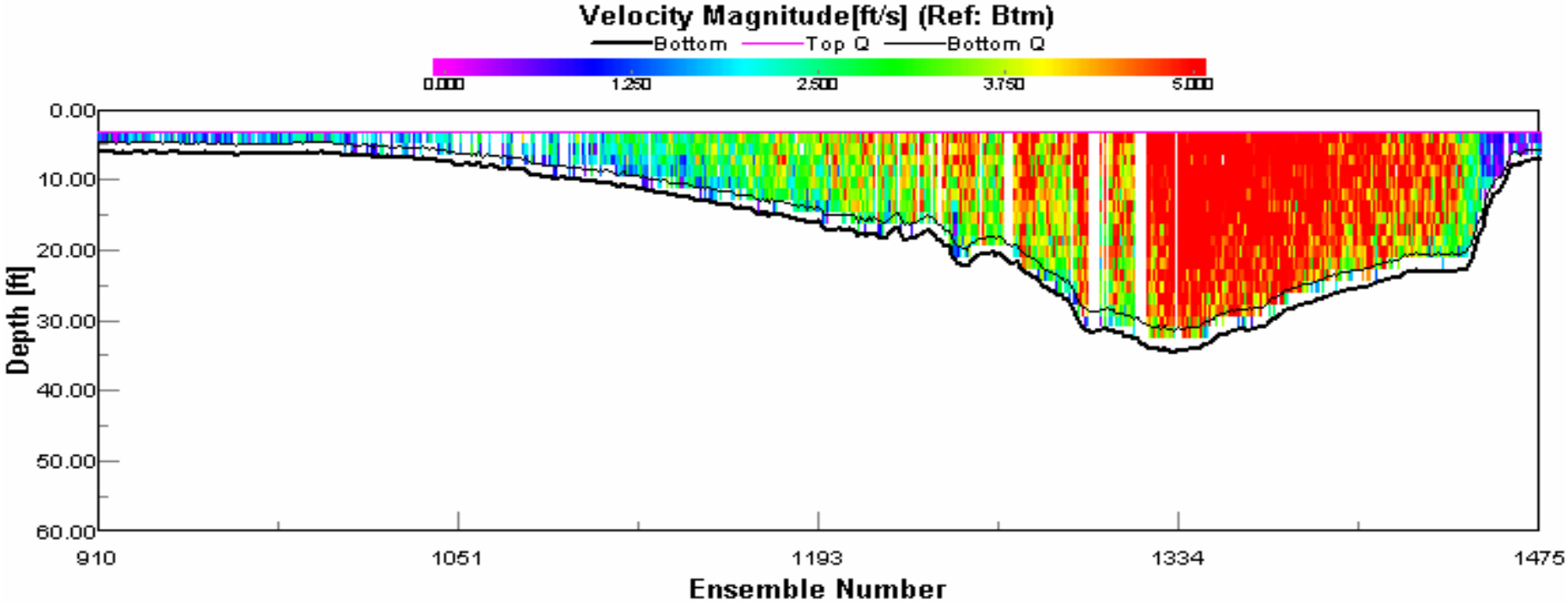
U - transect is unlocked

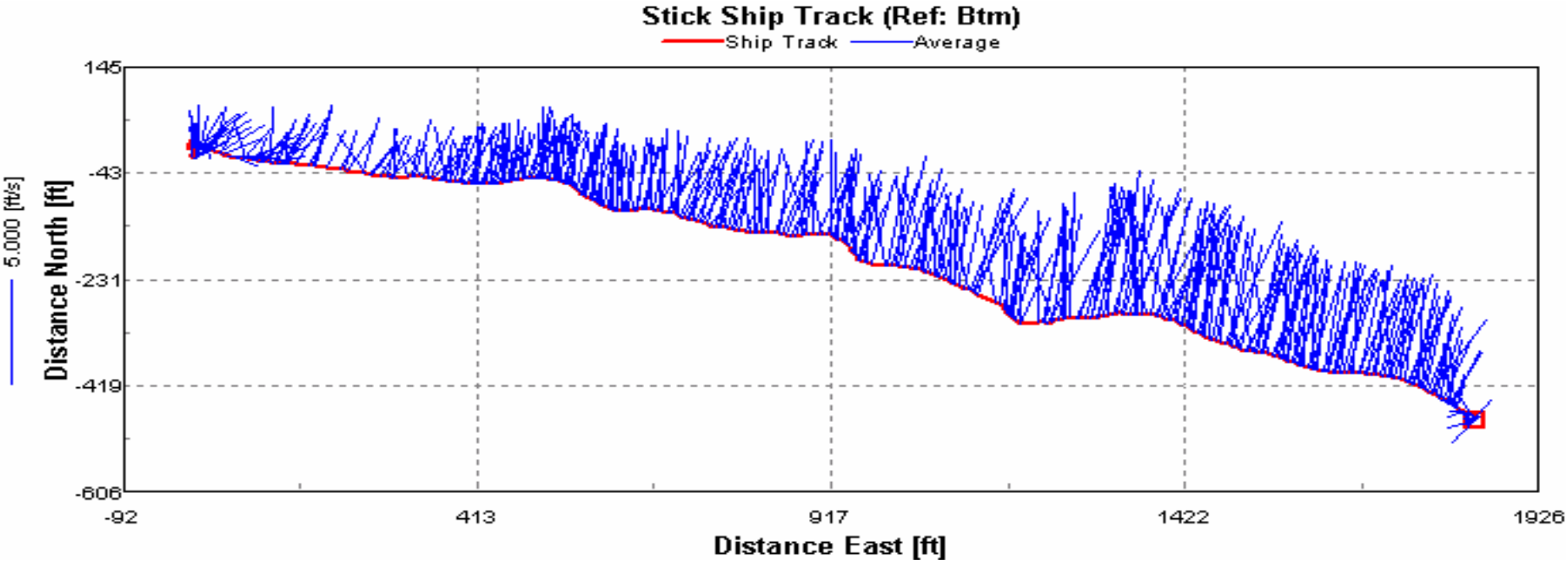
Monument 01 Discharge Transect 0, WinRiver Velocity and Ship Track Plots



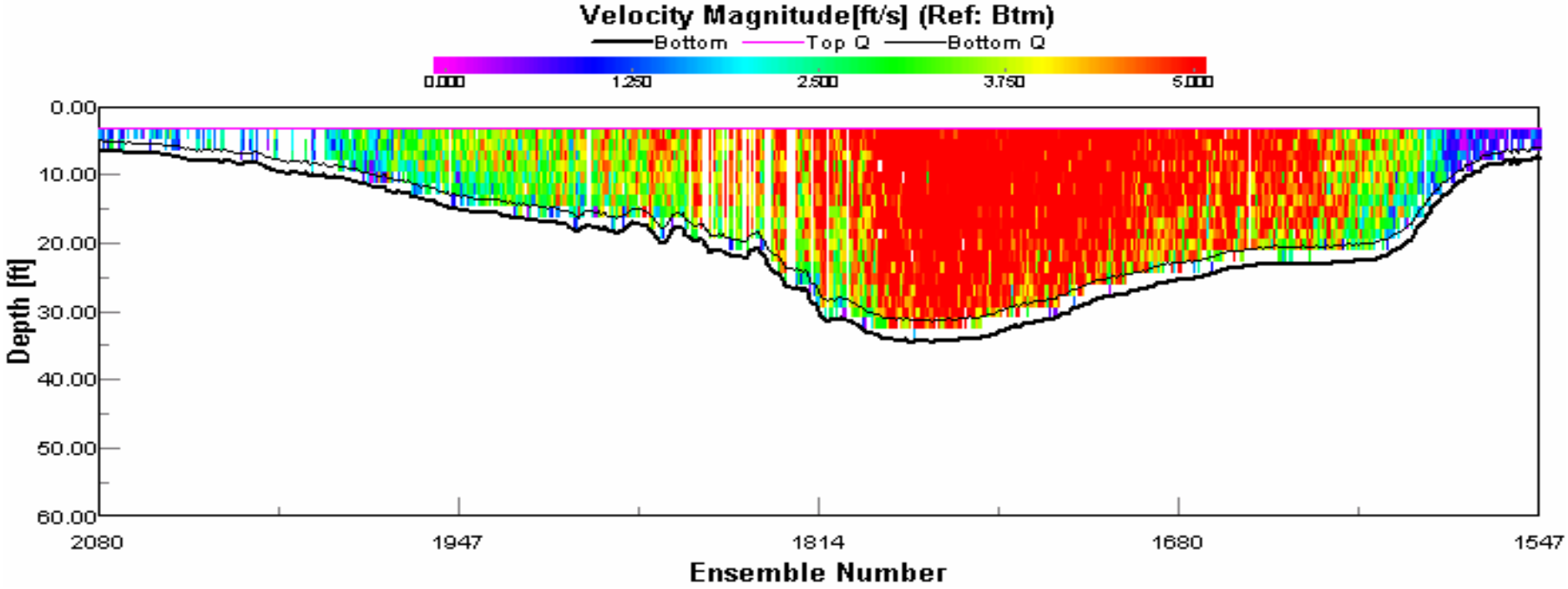


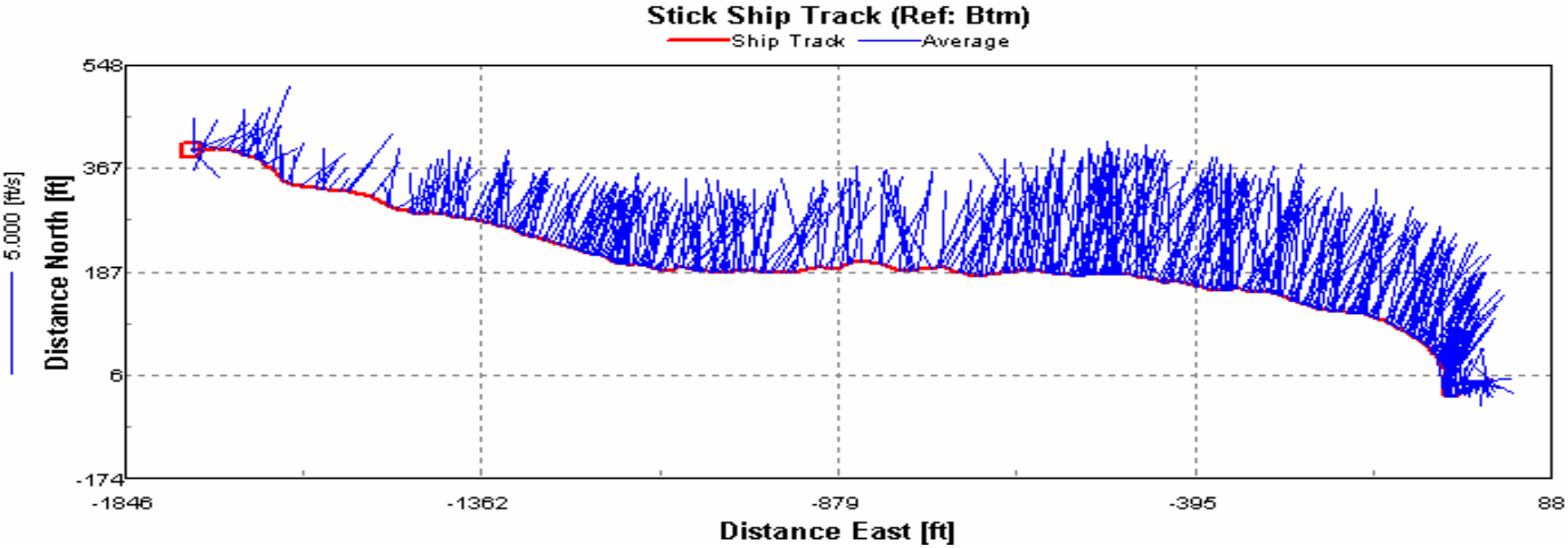
Monument 01 Discharge Transect 1, WinRiver Velocity and Ship Track Plots



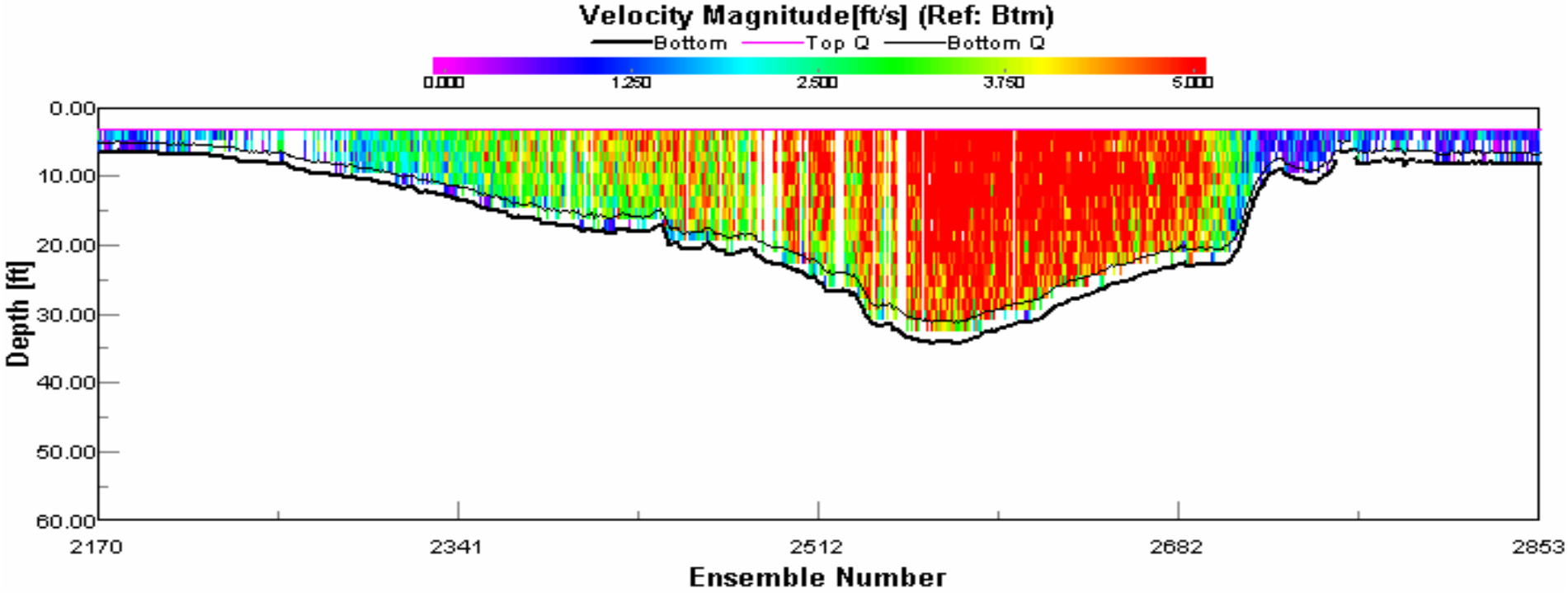


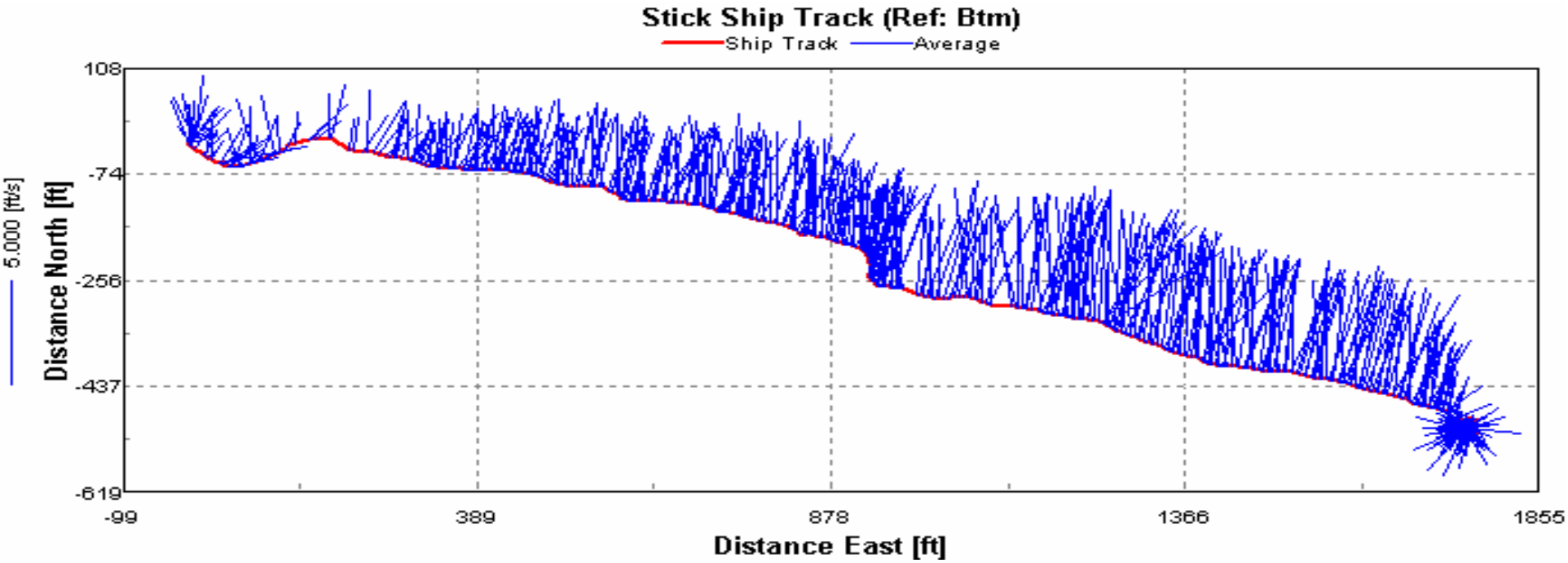
Monument 01 Discharge Transect 2, WinRiver Velocity and Ship Track Plots



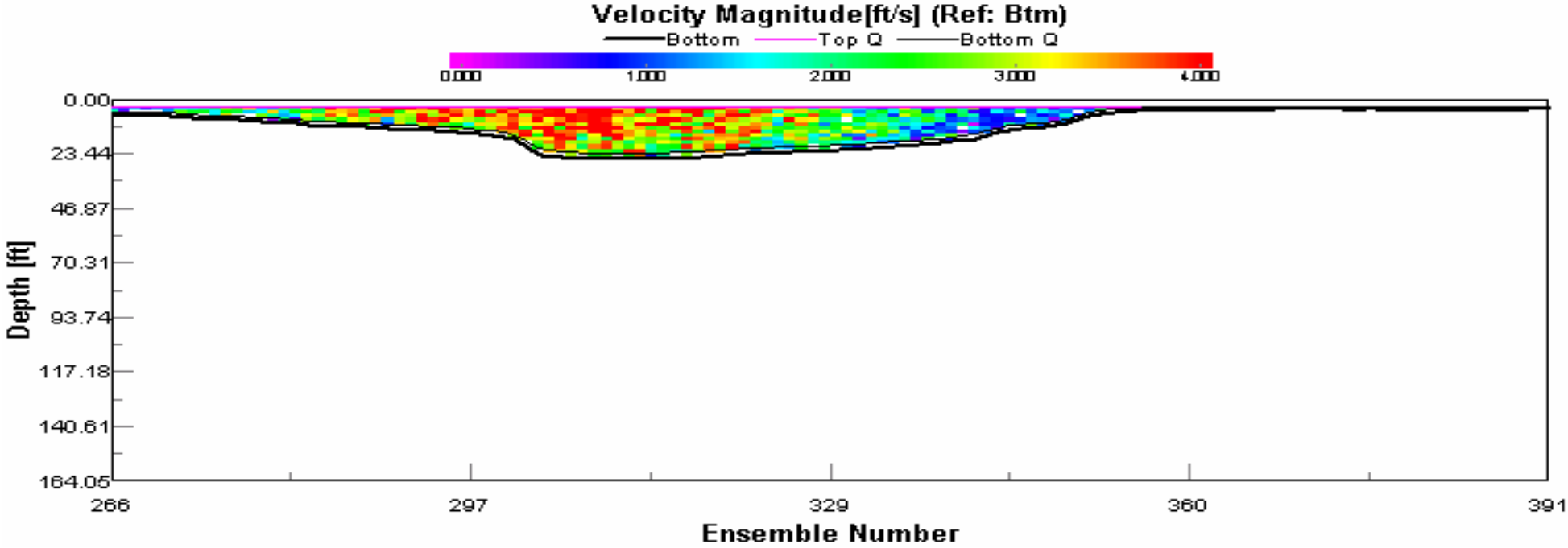


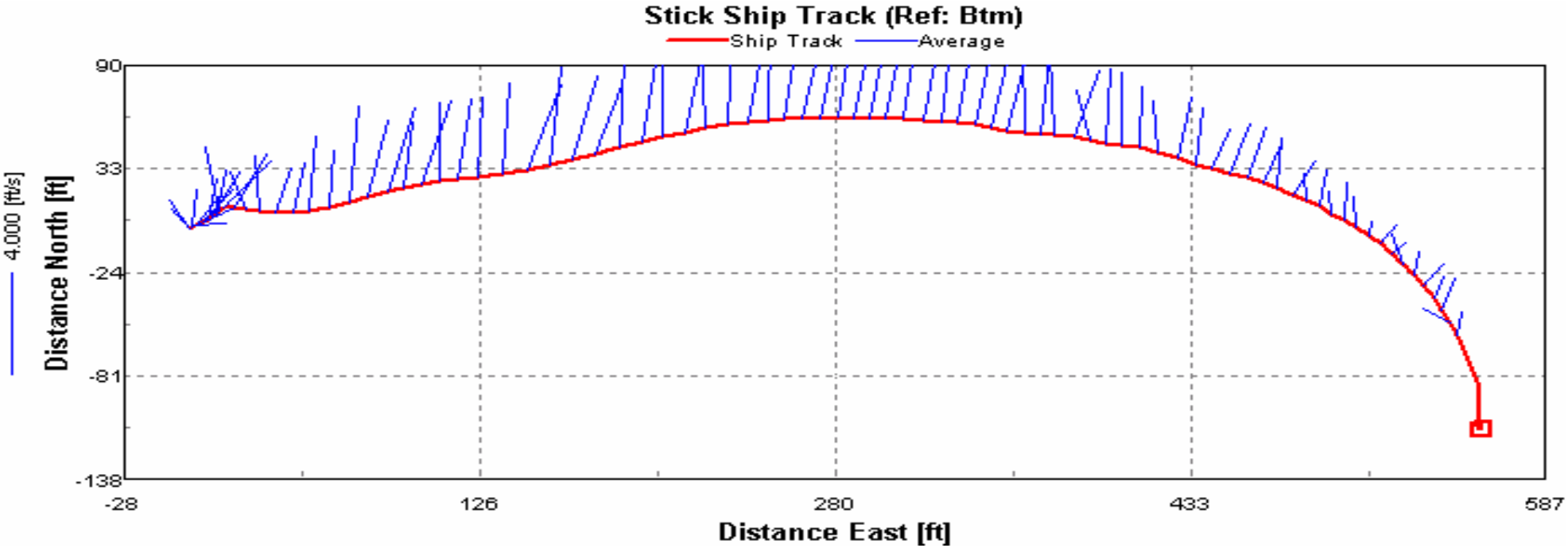
Monument 01 Discharge Transect 3, WinRiver Velocity and Ship Track Plots



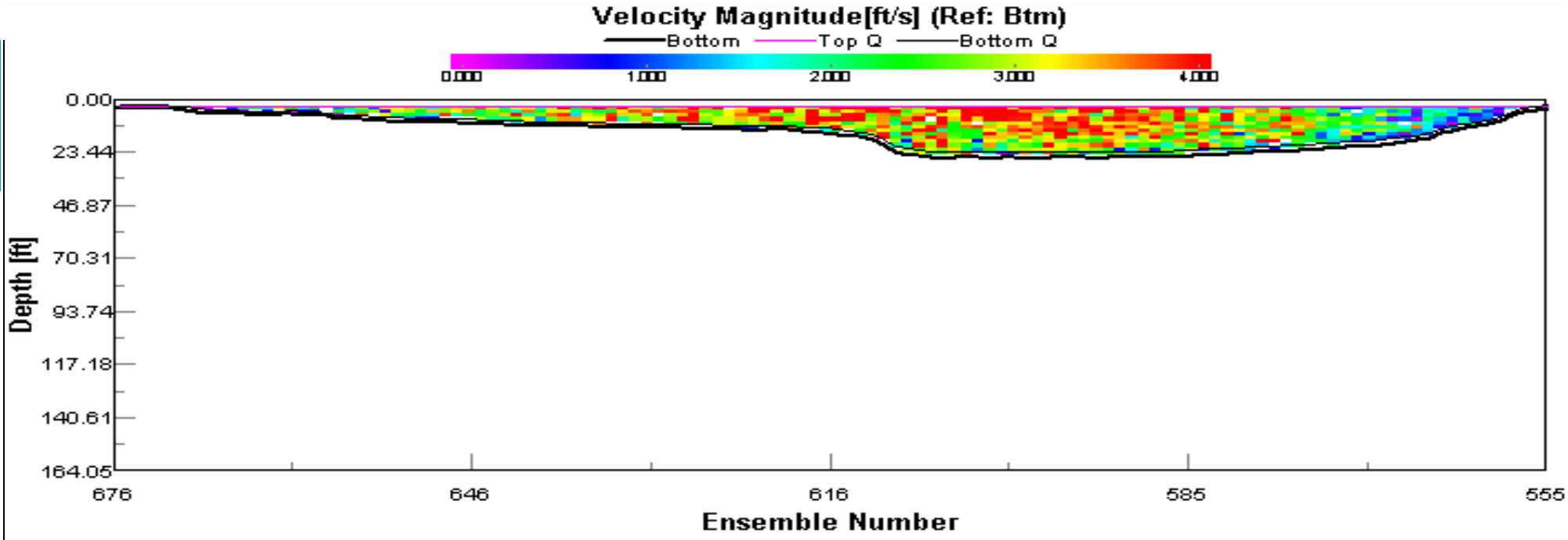


Monument 23 Discharge Transect 0, WinRiver Velocity and Ship Track Plots

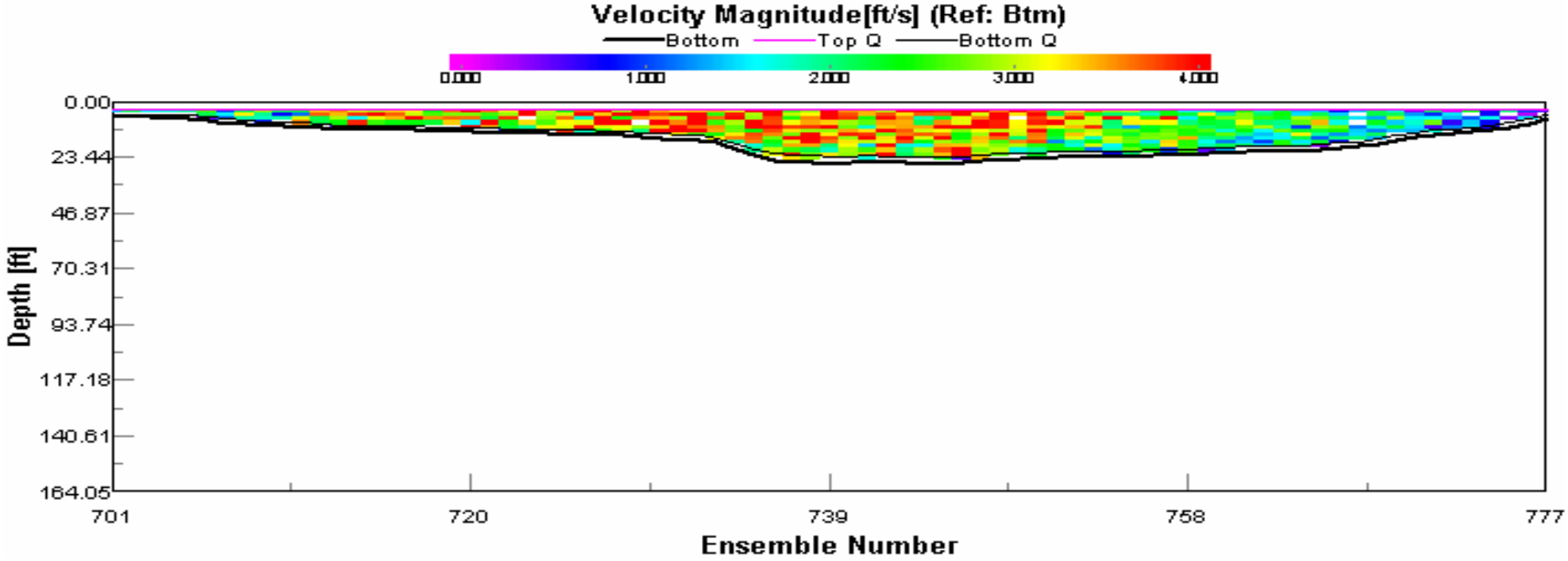


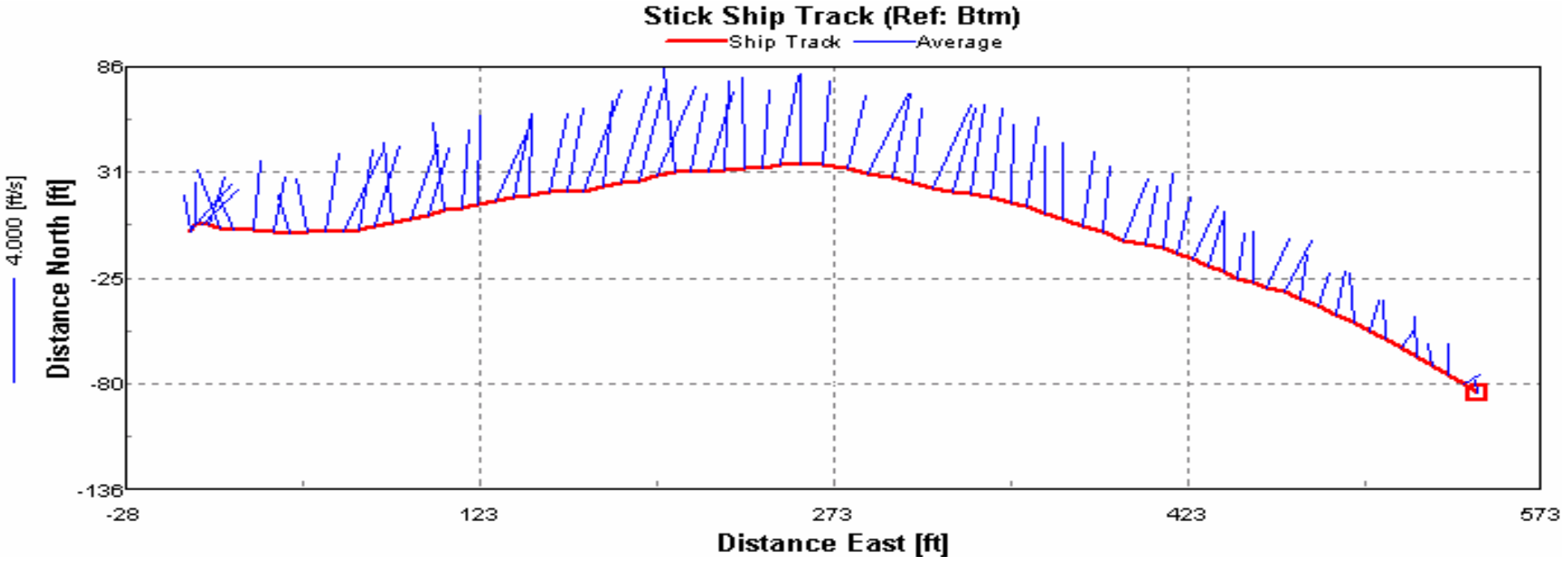


Monument 23 Discharge Transect 1, WinRiver Velocity and Ship Track Plots

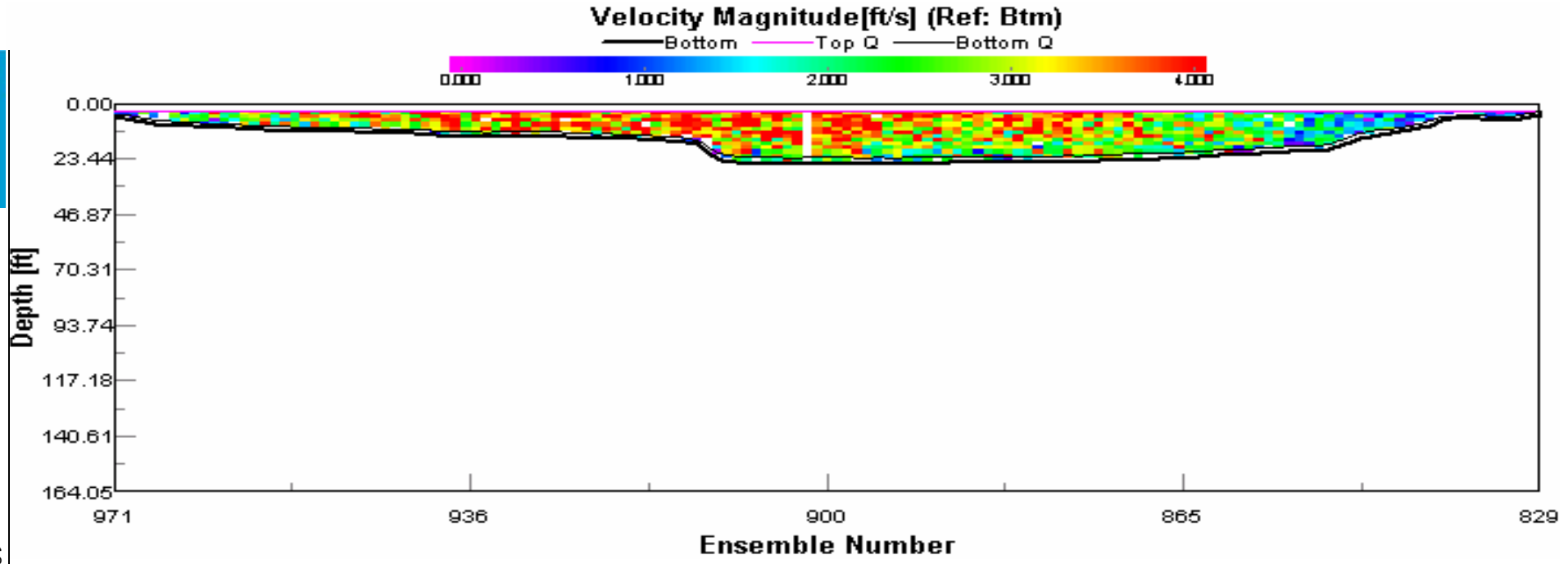


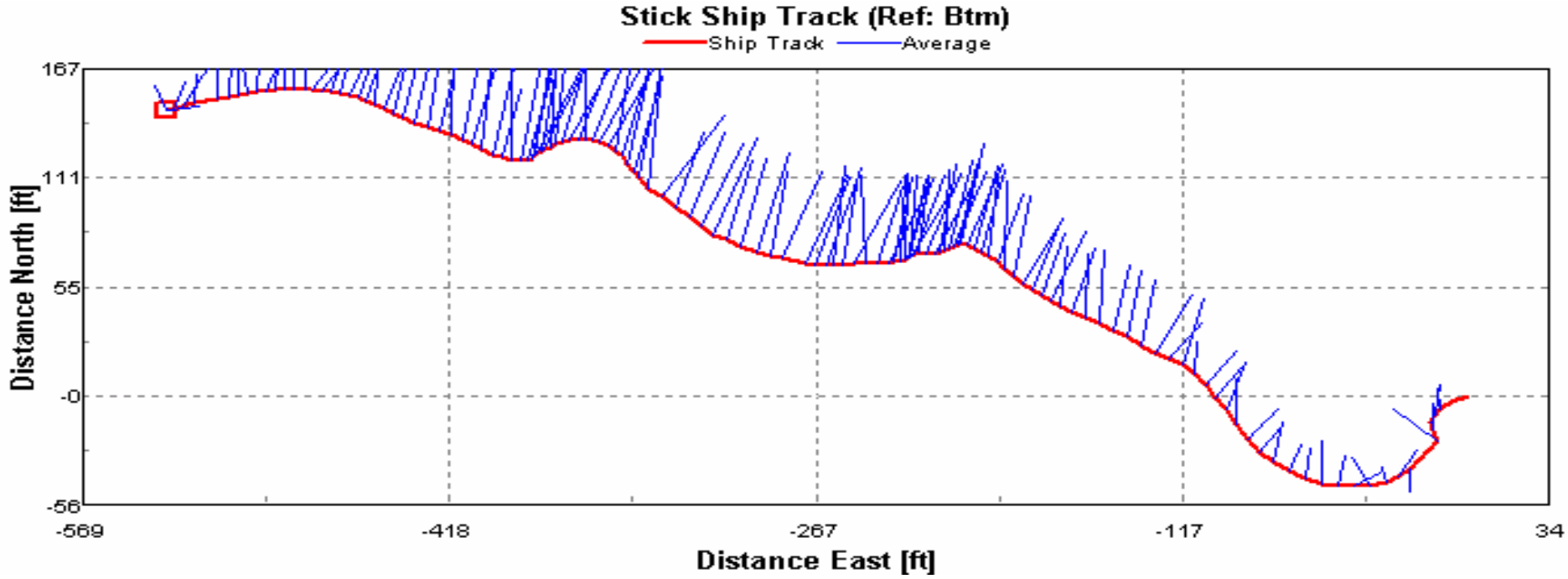
Monument 23 Discharge Transect 2, WinRiver Velocity and Ship Track Plots



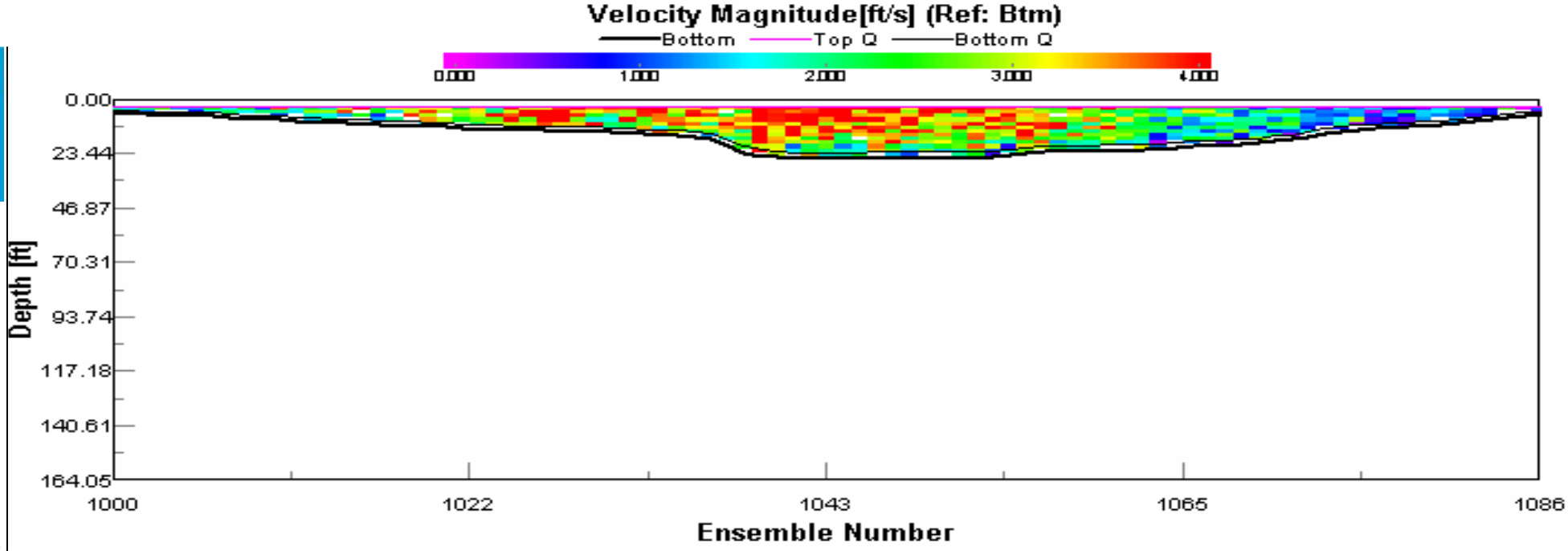


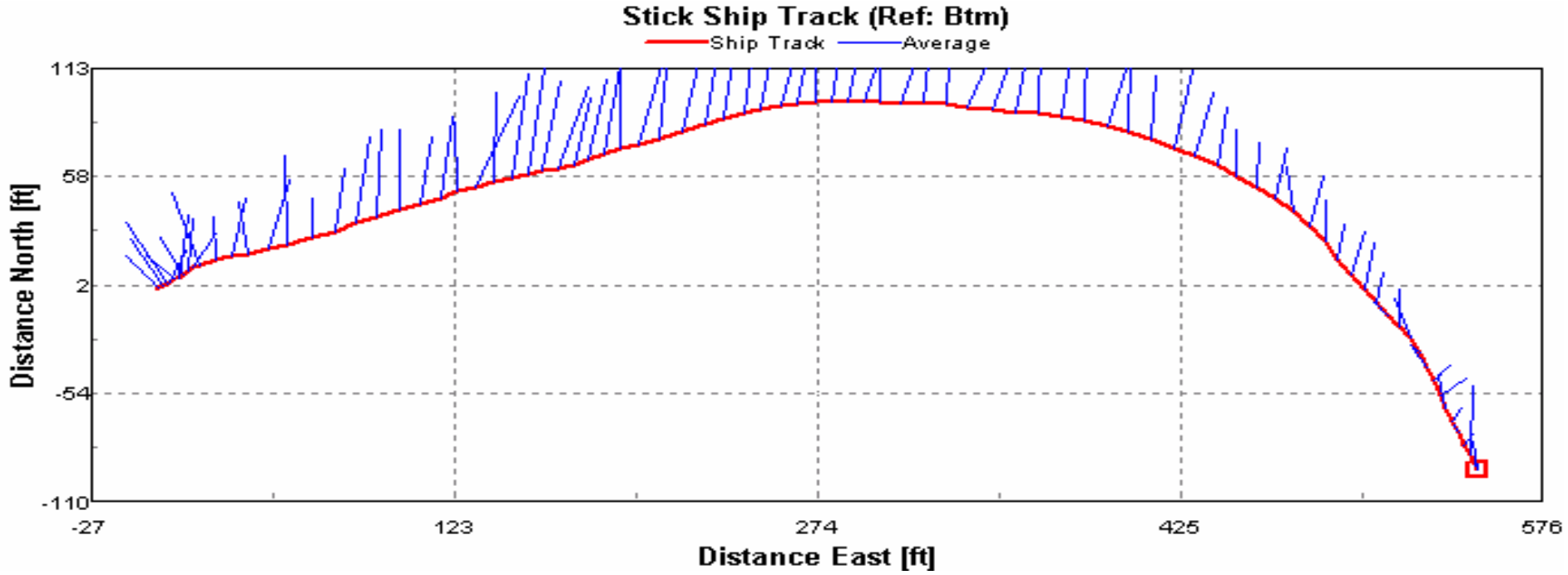
Monument 23 Discharge Transect 3, WinRiver Velocity and Ship Track Plots



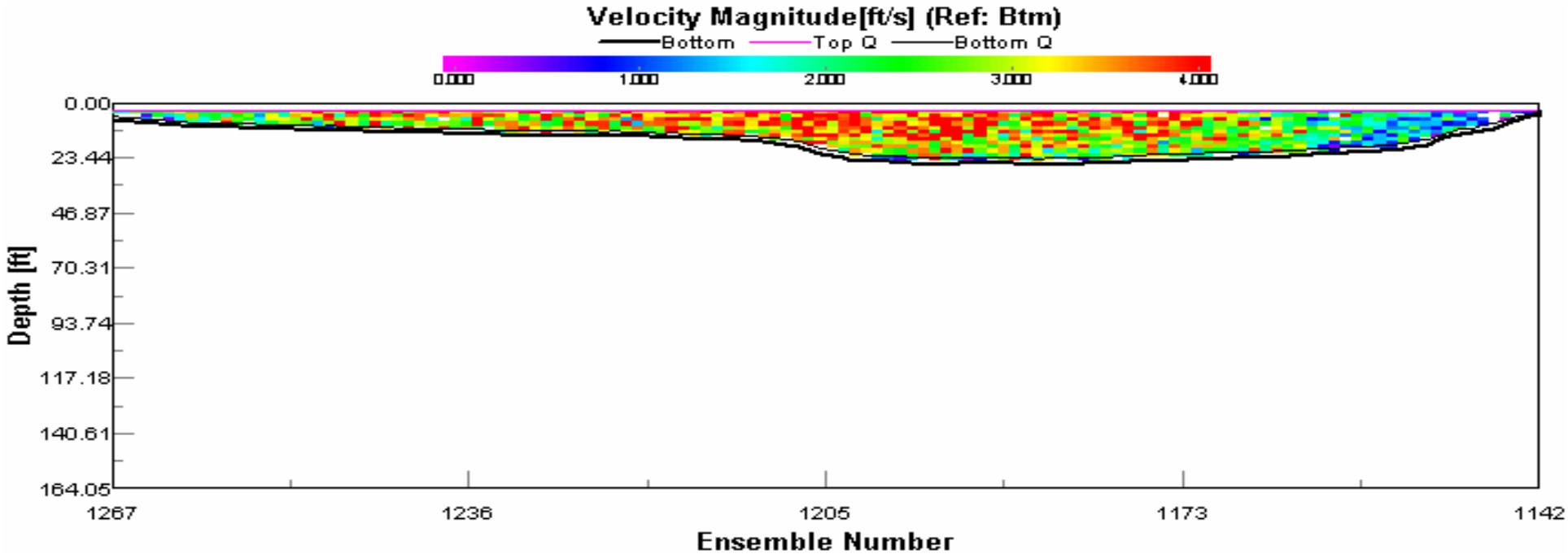


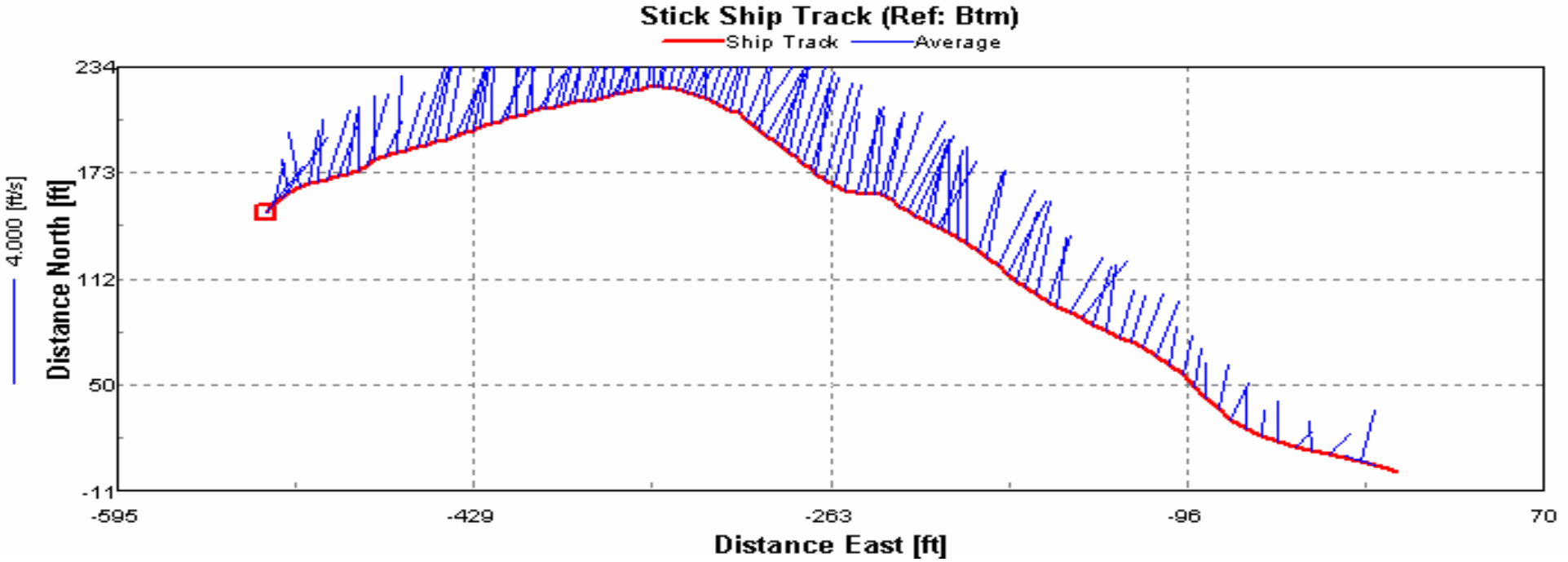
Monument 23 Discharge Transect 4, WinRiver Velocity and Ship Track Plots





Monument 23 Discharge Transect 5, WinRiver Velocity and Ship Track Plots





2005
Colville River Delta
and
Fish Creek Basin

Spring Breakup
and
Hydrologic Assessment

December 2005

105756-MBJ-RPT-001

ChallengeUs.