

Summary Report

For

2012/2013 Colville River Ice Bridge Monitoring

Submitted to:



Submitted by:

Baker

Michael Baker Jr., Inc.

1400 W. Benson Blvd. Suite 200

Anchorage, AK 99503

907.273.1600

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1.0 Introduction

ConocoPhillips Alaska, Inc. (CPAI) constructs a 2,000-foot long ice bridge each year across the Colville River. Alaska Department of Natural Resources (ADNR) Temporary Water Use Authorization (TWUP) A2009-23, amended in November 2009, and the Alaska Department of Fish and Game (ADF&G) Fish Habitat Permit FH04-III-0135 requires monitoring of specific conductance and velocity of the Colville River in the vicinity of the ice bridge. Michael Baker Jr., Inc. (Baker) conducted ice bridge monitoring during the 2012/2013 winter season.

The purpose of the ice bridge monitoring project is to document flow velocity, ice thickness, water depth, and water quality, including specific conductance (SC) and dissolved oxygen (DO).

2.0 2012/2013 Monitoring Locations

During each field monitoring event, in situ water quality parameters were sampled at six locations. The six sampling locations were established in the approximate center of the channel where maximum depth is observed at points 400, 800, and 1,200 feet upstream and downstream from the centerline of the Colville River ice bridge. During the first sampling event, monitoring locations were marked with a snow pole and coordinates were recorded with a handheld GPS unit. Snow poles were removed at the end of the season. Figure 1 shows the ice bridge and sampling locations with respect to existing facilities.



Date:	05/31/2013	Project:	132689
Drawn:	BTG	File:	Figure 1
Checked:	SME	Scale:	1 in = 0.75 miles

Legend	
●	Monitoring Location
—	Pipelines
■	Existing Facilities

3.0 Methods

A two-person Baker field crew conducted the first ice bridge sampling event on November 7, 2012 prior to ice bridge construction to establish baseline water quality conditions and to identify the extent of salt water intrusion. For each subsequent event, a one-person field crew completed the sampling with support from LCMF. LCMF provided transportation to the monitoring sites. Snow machine travel was required early in the sampling season because of the tundra travel conditions. Häggglunds were used at all other times.

Weekly site trips took place during active water withdrawal and during conditions with saline influence as determined by permit stipulation when SC values at any depths begin to exceed 500 microsiemens per centimeter ($\mu\text{S}/\text{cm}$). Bi-weekly monitoring events were conducted at all other times until the ice bridge was slotted. The final monitoring event of the ice road season occurred on April 24, 2013.

3.1 Measurements

Ice thickness, total water depth, freeboard, temperature, salinity, conductivity, and DO measurements were collected. Water velocities were obtained 1,200 feet downstream of the ice bridge centerline. SC was calculated using temperature and conductivity measurements.

Specific conductance at each sample depth was calculated using the following equation:

$$SC = \frac{\text{Conductivity}}{(1 + (0.0196 * (\text{Temperature} - 25^{\circ}\text{C})))}$$

In-situ water quality parameters were recorded using an YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of 2-foot intervals. The YSI-30 was calibrated by Baker prior to each sampling event. The YSI ProODO meter was calibrated prior to each trip by TTT Environmental.

3.2 Observations

At each location (400, 800, and 1,200 feet upstream and downstream), observations included:

- Total water depth (ft)
- Ice thickness (ft)
- Freeboard (ft)

At each sample depth (1 to 2 foot increments beneath the ice), recorded data included:

- Temperature ($^{\circ}\text{C}$)
- Conductivity ($\mu\text{S}/\text{cm}$)
- Dissolved Oxygen (mg/L and %)
- Salinity (ppt)
- Velocity (ft/sec)

4.0 2012/2013 Colville River Ice Bridge Monitoring Summary

Fifteen monitoring events were conducted between November 7, 2012 and April 24, 2013. Each monitoring event was summarized in a Project Trip Report transmitted electronically to CPAI within 24 hours of data collection. The dates of the 2012/2013 ice bridge monitoring events are shown below.

Month	Nov-12			Dec-12			Jan-13			Feb-13		Mar-13		Apr-13								
Week																						
Monitoring Event																						
	11/7/2012			11/20/2012	11/28/2012		12/6/2012	12/12/2012	12/19/2012			1/3/2013	1/16/2013	1/30/2013			2/13/2013	2/27/2013	3/13/2013	3/27/2013	4/10/2013	4/24/2013

Ice bridge monitoring Project Trip Reports are included in Attachment A. Photographs are included in Attachment B. Colville River ice bridge crossing profiles were provided by Lewellen Arctic Research. These are included in Attachment C.

For the season and all monitoring locations, the SC values ranged from a minimum of 279 $\mu\text{S}/\text{cm}$ (November 20) to a maximum of 21,454 $\mu\text{S}/\text{cm}$ (January 30). SC values generally increased with depth. Comparison of SC at sample locations is included in each Project Trip Report (see Attachment A).

The DO saturation ranged between 51.8 percent (April 24) and 94 percent (March 27). DO values generally decreased with depth.

Velocities at 1,200 feet downstream from the ice bridge centerline ranged from a minimum magnitude of 0.0 feet per second (ft/s) (November 28, December 6, January 3, January 16, and April 24) to a maximum magnitude of 0.39 ft/s (November 7). The accuracy of this measurement is +/- 0.05 ft/s. There was no correlation between velocity and depth.

Ice thickness ranged between 0.6 feet (November 7) to 6 feet (April 24) at all sample locations. Ice thickness generally increased as the monitoring season continued. Snow thickness ranged from 0.1 feet (November 28, December 6, and January 30) to 1.1 feet (April 24) at all sample locations.

Salinity ranged between 0.1 parts per thousand (ppt) (November 7, November 20, and December 12) to 12.2 ppt (January 30). Salinity generally increased with depth.

Attachment A Project Trip Reports

Project Trip Report

Baker

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: November 7, 2012
Project Code: 132689	Submitted By: Garrett Yager

Weather: 18° F, 10-25 mph wind

Garrett Yager arrived at Alpine on Tuesday, November 6, 2012 at 04:30 p.m. Upon arrival Mr. Yager met with LCMF to coordinate access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on November 7, Mr. Yager attended LCMF's daily health and safety meeting. Roy Baldwin of LCMF accompanied Mr. Yager to the Colville River Ice Bridge site via snowmobiles departing Alpine at approximately 10:00 a.m.

Ice thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI 30 meter was calibrated by Baker personnel the morning of the sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

SC ranged from a maximum of 319 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 1,200 feet downstream and at 400 feet upstream to a minimum of 314 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. SC values were relatively consistent with depth and below 500 $\mu\text{S}/\text{cm}$ at each sampling location. Low salinity and conductivity values indicate negligible saline influence at all monitoring locations. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 90.9 percent (%) and 89.7%, with an average of 90.3%. DO saturation values decreased slightly with depth at all monitoring locations. The DO saturation values were fairly consistent between monitoring locations.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.39 feet per second (ft/s) at a depth of 7 feet to a minimum of 0.23 ft/s at 4 feet. Average velocity was 0.29 ft/s.

Ice thickness ranged between 0.7 and 0.6 feet at all sample locations; average ice thickness was 0.68 feet.

The next sampling event is scheduled for November 21, 2012.

Table 1: Water Quality Parameters Upstream and Downstream of Proposed Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: November 7, 2012

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)	
400-ft Upstream N70°14'13.6" W150°50'10.0" 1:20 p.m.	13.0	0.7	0.0	1	-	-	-	-	-	-	-	
				2	0.1	162	316	13.3	90.5	0.1	-	
				3	-	-	-	-	-	-	-	-
				4	0.1	162	316	13.2	90.5	0.1	-	
				5	-	-	-	-	-	-	-	-
				6	0.2	163	316	13.2	90.4	0.1	-	
				7	-	-	-	-	-	-	-	-
				8	0.2	163	316	13.2	90.1	0.1	-	
				9	-	-	-	-	-	-	-	-
				10	0.2	163	318	13.1	90.0	0.1	-	
				11	-	-	-	-	-	-	-	-
				12	0.2	164	319	13.0	89.7	0.1	-	
800-ft Upstream N70°14'10.0" W150°50'06.4" 1:00 p.m.	13.2	0.7	0.0	1	-	-	-	-	-	-	-	
				2	0.1	161	315	13.2	90.5	0.1	-	
				3	-	-	-	-	-	-	-	-
				4	0.1	161	315	13.2	90.5	0.1	-	
				5	-	-	-	-	-	-	-	-
				6	0.1	162	316	13.2	90.3	0.1	-	
				7	-	-	-	-	-	-	-	-
				8	0.1	162	317	13.1	90.3	0.1	-	
				9	-	-	-	-	-	-	-	-
				10	0.1	162	317	13.1	90.0	0.1	-	
				11	-	-	-	-	-	-	-	-
				12	0.1	163	318	13.0	89.9	0.1	-	
1200-ft Upstream N70°14'06.0" W150°50'02.8" 12:45 p.m.	13.9	0.7	0.0	1	0.1	161	314	13.2	90.6	0.1	-	
				2	-	-	-	-	-	-	-	
				3	0.1	161	314	13.2	90.9	0.1	-	
				4	-	-	-	-	-	-	-	
				5	0.1	161	315	13.2	90.6	0.1	-	
				6	-	-	-	-	-	-	-	
				7	0.1	162	317	13.1	90.3	0.1	-	
				8	-	-	-	-	-	-	-	
				9	0.1	162	317	13.1	90.4	0.1	-	
				10	-	-	-	-	-	-	-	
				11	0.1	163	318	13.0	90.1	0.1	-	
				12	-	-	-	-	-	-	-	
				13	0.2	163	318	12.9	90.0	0.1	-	
				14	-	-	-	-	-	-	-	

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI-30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



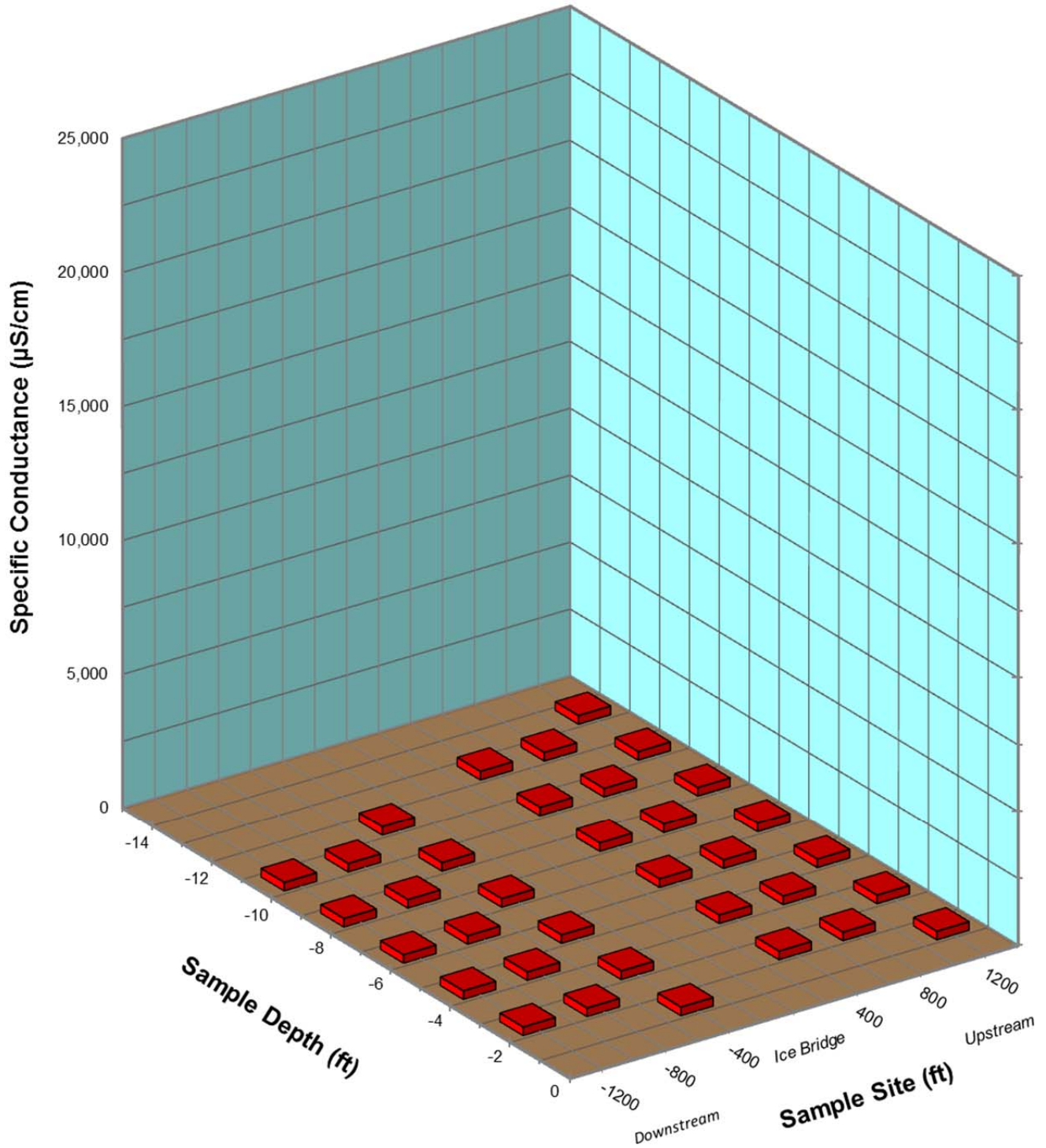
Sample Date: November 7, 2012

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)	
400-ft Downstream N70°14'21.1" W150°50'17.0" 1:40 p.m.	11.6	0.7	0.0	1	0.1	163	318	13.3	90.6	0.1	-	
				2	-	-	-	-	-	-	-	-
				3	0.1	162	317	13.3	90.6	0.1	-	
				4	-	-	-	-	-	-	-	
				5	0.2	163	316	13.2	90.4	0.1	-	
				6	-	-	-	-	-	-	-	
				7	0.2	163	316	13.2	90.3	0.1	-	
				8	-	-	-	-	-	-	-	
				9	0.2	163	316	13.2	90.2	0.1	-	
				10	-	-	-	-	-	-	-	
				11	0.2	163	317	13.1	90.0	0.1	-	
				12	-	-	-	-	-	-	-	
800-ft Downstream N70°14'25.0" W150°50'20.4" 1:50 p.m.	11.1	0.6	0.0	1	-	-	-	-	-	-	-	
				2	0.1	163	318	13.3	90.9	0.1	-	
				3	-	-	-	-	-	-	-	
				4	0.2	163	317	13.2	90.7	0.1	-	
				5	-	-	-	-	-	-	-	
				6	0.2	163	317	13.2	90.7	0.1	-	
				7	-	-	-	-	-	-	-	
				8	0.2	163	317	13.1	90.3	0.1	-	
				9	-	-	-	-	-	-	-	
				10	0.2	163	318	13.1	90.0	0.1	-	
				11	-	-	-	-	-	-	-	
				12	-	-	-	-	-	-	-	
1200-ft Downstream N70°14'28.8" W150°50'23.8" 2:45 p.m.	10.7	0.7	0.0	1	-	-	-	-	-	-	-	
				2	0.1	163	318	13.2	90.5	0.1	0.25	
				3	-	-	-	-	-	-	-	
				4	0.2	163	317	13.2	90.3	0.1	0.23	
				5	-	-	-	-	-	-	-	
				6	0.2	163	317	13.2	90.2	0.1	0.29	
				7	-	-	-	-	-	-	-	
				8	0.2	163	317	13.1	90.0	0.1	0.39	
				9	-	-	-	-	-	-	-	
				10	0.2	164	319	13.0	89.9	0.1	0.29	
				11	-	-	-	-	-	-	-	
				12	-	-	-	-	-	-	-	

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI-30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring November 7, 2012



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Proposed Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: November 20, 2012
Project Code: 132689	Submitted By: Garrett Yager

Weather: -8° F, 5 mph wind

Garrett Yager arrived at Alpine on Monday, November 19, 2012, at 12:00 p.m. Upon arrival Mr. Yager coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on November 20, Mr. Yager attended LCMF's health and safety meeting. Chris Zeimut of LCMF accompanied Mr. Yager to the Colville River Ice Bridge site via snowmobiles departing Alpine at approximately 9:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 351 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 1200 feet upstream and 800 feet downstream to a minimum of 279 $\mu\text{S}/\text{cm}$ at 800 feet upstream. At all sampling locations, SC was less than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Low salinity and conductivity values indicate negligible saline influence at all monitoring locations. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 88.6 percent (%) and 91.7%, with an average of 89.8%. DO values generally decreased with respect to depth with the exception of 1,200 and 800 feet downstream.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.19 feet per second (ft/s) at a depth of 5 feet to a minimum of 0.15 ft/s at 9 feet; average velocity was 0.17 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 1.1 to 1.3 feet at all sample locations; average ice thickness was 1.2 feet. Snow thickness ranged from 0.2 to 0.4 feet at all sample locations; average snow thickness was 0.3 feet.

LCMF provided the following additional information for this report. Ice thickness values of 1.1 feet and 1.0 to 1.3 feet were measured at the Nigliagvik Channel and Nigliq Channel exploration ice road crossings, respectively, on November 19, 2012.

The next sampling event is scheduled for November 28, 2012.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: November 20, 2012

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:10 a.m.	12.0	1.1	0.2	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.1	176	344	13.2	90.0	0.2	-
					4	-	-	-	-	-	-	-
					5	0.1	176	344	13.1	89.8	0.2	-
					6	-	-	-	-	-	-	-
					7	0.1	177	345	13.1	89.7	0.2	-
					8	-	-	-	-	-	-	-
					9	0.1	177	346	13.1	89.4	0.2	-
					10	-	-	-	-	-	-	-
					11	0.1	176	343	13.1	89.6	0.2	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:00 a.m.	13.0	1.3	0.4	0.0	1	-	-	-	-	-	-	-
					2	0.1	176	344	13.1	89.6	0.2	-
					3	-	-	-	-	-	-	-
					4	0.1	176	343	13.0	89.4	0.2	-
					5	-	-	-	-	-	-	-
					6	0.1	176	343	13.0	89.3	0.2	-
					7	-	-	-	-	-	-	-
					8	0.1	153	298	13.0	89.0	0.1	-
					9	-	-	-	-	-	-	-
					10	0.1	143	279	13.0	88.7	0.1	-
					11	-	-	-	-	-	-	-
					12	0.1	143	279	13.0	88.7	0.1	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 9:40 a.m.	13.0	1.2	0.3	0.1	1	-	-	-	-	-	-	-
					2	0.0	176	346	13.0	89.3	0.2	-
					3	-	-	-	-	-	-	-
					4	0.0	176	345	13.0	88.9	0.2	-
					5	-	-	-	-	-	-	-
					6	0.0	176	345	13.0	88.8	0.2	-
					7	-	-	-	-	-	-	-
					8	0.1	177	345	12.9	88.7	0.2	-
					9	-	-	-	-	-	-	-
					10	0.1	178	347	12.8	88.6	0.2	-
					11	-	-	-	-	-	-	-
					12	0.1	180	351	12.8	88.6	0.2	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Downstream of Bridge



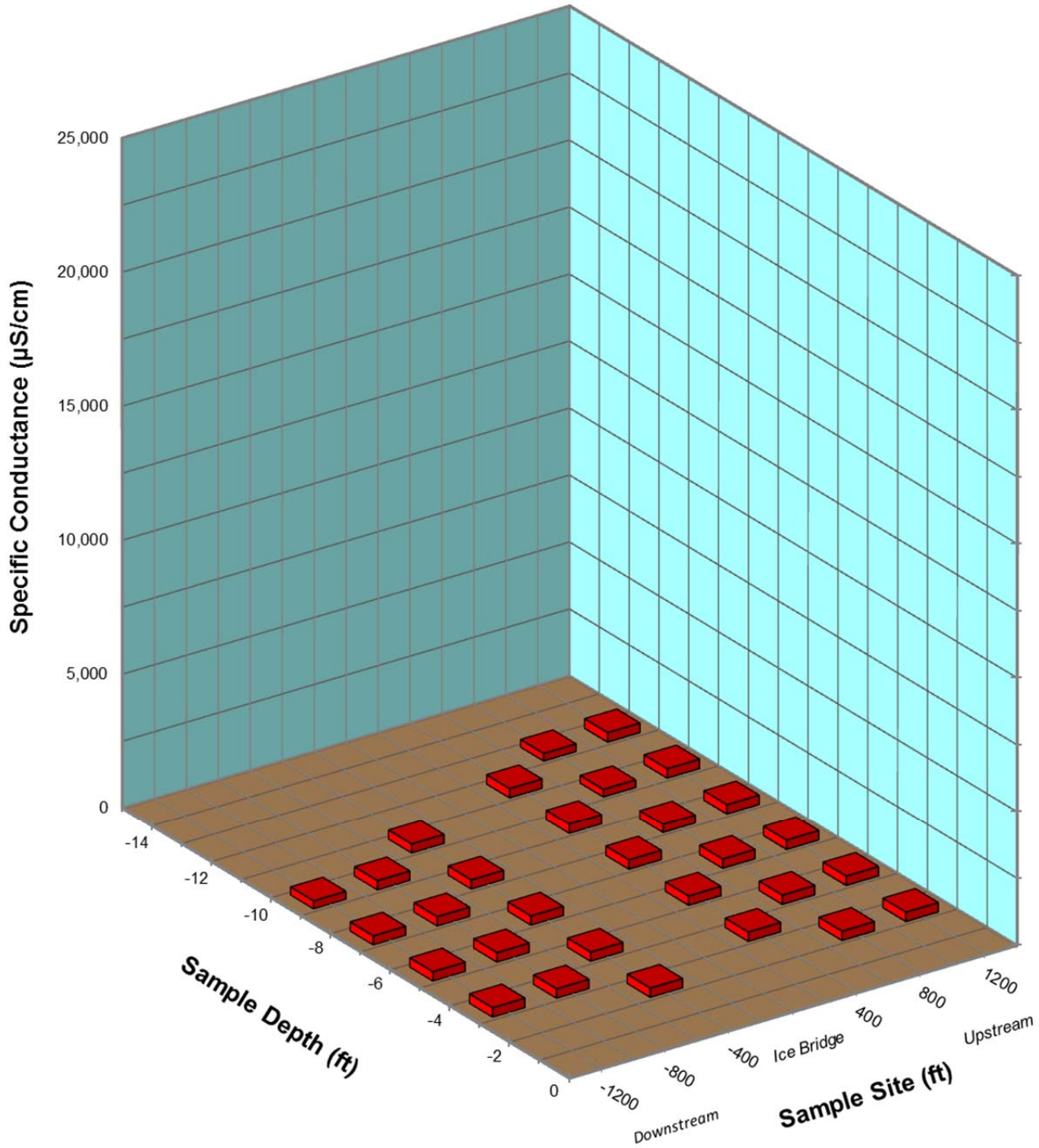
Sample Date: November 20, 2012

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:30 a.m.	10.7	1.1	0.2	0.1	1	-	-	-	-	-	-	-
					2	0.1	174	341	13.3	90.7	0.2	-
					3	-	-	-	-	-	-	-
					4	0.1	174	340	13.2	90.6	0.2	-
					5	-	-	-	-	-	-	-
					6	0.1	174	340	13.2	90.2	0.2	-
					7	-	-	-	-	-	-	-
					8	0.1	173	338	13.2	90.3	0.2	-
					9	-	-	-	-	-	-	-
					10	0.1	172	336	13.3	90.5	0.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:40 a.m.	10.3	1.1	0.2	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.2	179	348	13.3	90.8	0.2	-
					4	-	-	-	-	-	-	-
					5	0.1	180	351	13.2	90.5	0.2	-
					6	-	-	-	-	-	-	-
					7	0.1	177	346	13.2	90.5	0.1	-
					8	-	-	-	-	-	-	-
					9	0.1	176	344	13.4	90.8	0.1	-
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 10:50 a.m.	9.9	1.1	0.3	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.2	180	350	13.4	90.8	0.2	0.17
					4	-	-	-	-	-	-	-
					5	0.2	178	346	13.3	90.6	0.2	0.19
					6	-	-	-	-	-	-	-
					7	0.2	174	338	13.4	91.0	0.1	0.18
					8	-	-	-	-	-	-	-
					9	0.2	152	296	13.6	91.7	0.1	0.15
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (9) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring November 20, 2012



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: November 28, 2012
Project Code: 132689	Submitted By: Garrett Yager

Weather: -10° F, 15 mph wind

Garrett Yager arrived at Alpine on Tuesday, November 27, 2012, at 6:00 p.m. Upon arrival Mr. Yager coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on November 28, Mr. Yager attended LCMF's health and safety meeting. Tony Pogue of LCMF accompanied Mr. Yager to the Colville River Ice Bridge site via snowmobiles departing Alpine at approximately 10:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 375 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 1,200 feet upstream to a minimum of 350 $\mu\text{S}/\text{cm}$ at 800 feet downstream. At all sampling locations, SC was less than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Low salinity and conductivity values indicate negligible saline influence at all monitoring locations. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 72.0 percent (%) and 74.6%, with an average of 73.2%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.01 feet per second (ft/s) at a depth of 3, 5 and 7 feet to a minimum of 0.0 ft/s at 9 feet; average velocity was 0.01 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 1.4 to 1.5 feet at all sample locations; average ice thickness was 1.5 feet. Snow thickness ranged from 0.1 to 0.3 feet at all sample locations; average snow thickness was 0.2 feet.

The next sampling event is scheduled for December 5, 2012.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: November 28, 2012

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W 150°50'10.0" 11:50 a.m.	12.0	1.5	0.1	0.1	1	-	-	-	-	-	-	-
					2	0.1	183	357	10.7	73.2	0.2	-
					3	-	-	-	-	-	-	-
					4	0.2	183	355	10.7	73.0	0.2	-
					5	-	-	-	-	-	-	-
					6	0.2	183	355	10.7	72.9	0.2	-
					7	-	-	-	-	-	-	-
					8	0.2	185	360	10.7	72.8	0.2	-
					9	-	-	-	-	-	-	-
					10	0.2	185	361	10.7	72.8	0.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W 150°50'06.4" 11:30 a.m.	13.6	1.5	0.3	0.1	1	-	-	-	-	-	-	-
					2	0.1	183	357	10.7	72.8	0.2	-
					3	-	-	-	-	-	-	-
					4	0.1	183	357	10.7	72.7	0.2	-
					5	-	-	-	-	-	-	-
					6	0.1	182	356	10.7	72.6	0.2	-
					7	-	-	-	-	-	-	-
					8	0.1	183	357	10.7	72.5	0.2	-
					9	-	-	-	-	-	-	-
					10	0.2	186	362	10.7	72.7	0.2	-
					11	-	-	-	-	-	-	-
					12	0.2	188	367	10.7	73.0	0.2	-
1200-ft Upstream N70°14'06.0" W 150°50'02.8" 11:10 a.m.	13.4	1.4	0.2	0.0	1	-	-	-	-	-	-	-
					2	0.1	182	356	10.6	72.6	0.2	-
					3	-	-	-	-	-	-	-
					4	0.1	182	356	10.6	72.6	0.2	-
					5	-	-	-	-	-	-	-
					6	0.1	182	356	10.6	72.1	0.2	-
					7	-	-	-	-	-	-	-
					8	0.1	183	357	10.6	72.0	0.2	-
					9	-	-	-	-	-	-	-
					10	0.1	185	360	10.6	72.3	0.2	-
					11	-	-	-	-	-	-	-
					12	0.1	192	375	10.6	72.5	0.2	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



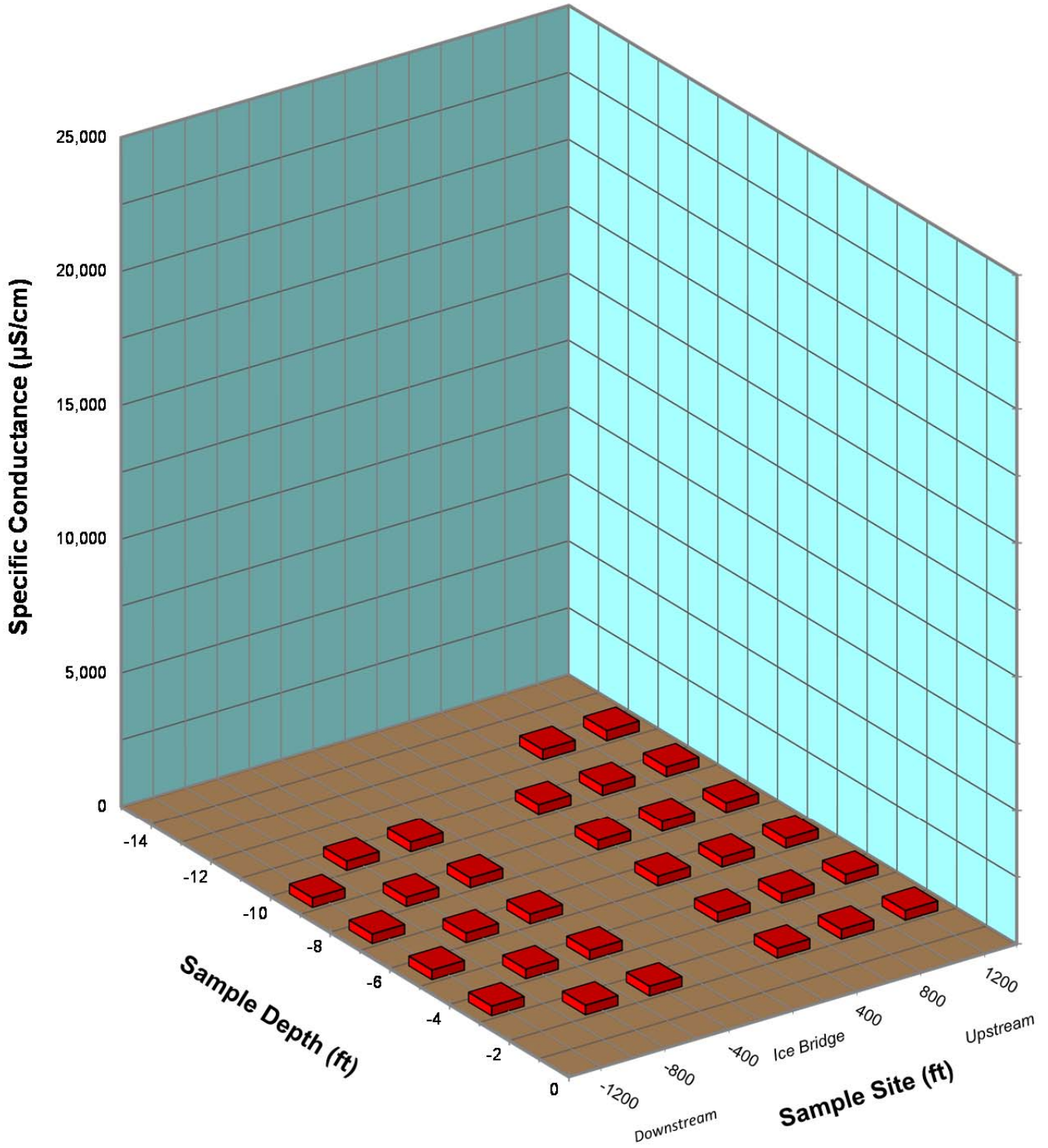
Sample Date: November 28, 2012

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 1:20 p.m.	11.3	1.5	0.2	0.1	1	-	-	-	-	-	-	-
					2	0.1	184	359	10.8	73.5	0.2	-
					3	-	-	-	-	-	-	-
					4	0.2	184	357	10.7	73.4	0.2	-
					5	-	-	-	-	-	-	-
					6	0.2	184	358	10.7	73.5	0.2	-
					7	-	-	-	-	-	-	-
					8	0.2	184	359	10.7	73.4	0.2	-
					9	-	-	-	-	-	-	-
					10	0.2	185	360	10.6	73.3	0.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 1:40 p.m.	11.0	1.4	0.2	0.1	1	-	-	-	-	-	-	-
					2	0.2	184	358	10.8	73.7	0.2	-
					3	-	-	-	-	-	-	-
					4	0.2	184	358	10.8	73.7	0.2	-
					5	-	-	-	-	-	-	-
					6	0.2	184	358	10.8	73.7	0.2	-
					7	-	-	-	-	-	-	-
					8	0.2	181	351	10.8	73.8	0.2	-
					9	-	-	-	-	-	-	-
					10	0.2	180	350	10.8	74.2	0.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 1:55 p.m.	10.6	1.4	0.3	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.2	184	358	10.9	74.3	0.2	0.01
					4	-	-	-	-	-	-	-
					5	0.2	184	357	10.9	74.3	0.2	0.01
					6	-	-	-	-	-	-	-
					7	0.2	183	356	10.9	74.2	0.2	0.01
					8	-	-	-	-	-	-	-
					9	0.2	183	356	10.9	74.6	0.2	0.00
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (9) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring November 28, 2012



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: December 6, 2012
Project Code: 132689	Submitted By: Bill Brooks

Weather: 0° F, 10-15 mph wind

Bill Brooks and Steven Clark arrived at Alpine on Tuesday, December 4, 2012, at 1:30 p.m. Upon arrival Mr. Brooks and Mr. Clark coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event. Ice bridge monitoring was coordinated to coincide with the December 6th Alpine Lakes monitoring at Lake L9312 and Lake L9313.

At 6:00 a.m. on December 5, Mr. Brooks and Mr. Clark attended LCMF's health and safety meeting. Roy Baldwin of LCMF accompanied Mr. Brooks and Mr. Clark to the Colville River Ice Bridge site via snow machines departing Alpine at approximately 11:00 a.m. Because of a malfunctioning water quality meter, monitoring was not completed. A new meter was shipped to the field crew from Anchorage, and Mr. Brooks, and Mr. Clark repeated the monitoring on December 6th. Chris Ziemut of LCMF accompanied Mr. Brooks and Mr. Clark on December 6th.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 363 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 800 feet upstream to a minimum of 354 $\mu\text{S}/\text{cm}$ at 1,200 feet downstream. At all sampling locations, SC was less than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Low salinity and conductivity values indicate negligible saline influence at all monitoring locations. Comparison of SC at sample locations between 1,200 feet upstream

and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 68.8 percent (%) and 74.1%, with an average of 70.3%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.02 feet per second (ft/s) at a depth of 9 feet to a minimum of 0.0 ft/s at 3 feet; average velocity was 0.01 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s. Velocities were measured on December 5th.

Ice thickness ranged between 1.5 to 1.9 feet at all sample locations; average ice thickness was 1.6 feet. Snow thickness ranged from 0.1 to 0.4 feet at all sample locations; average snow thickness was 0.3 feet.

The next sampling event is scheduled for December 12, 2012.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Upstream of Bridge



Sample Date: December 6, 2012

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 11:50 a.m.	11.7	1.9	0.2	0.1	1	-	-	-	-	-	-	-
					2	0.1	182	356	10.2	69.7	0.2	-
					3	-	-	-	-	-	-	-
					4	0.1	182	356	10.2	69.8	0.2	-
					5	-	-	-	-	-	-	-
					6	0.2	183	355	10.4	70.0	0.2	-
					7	-	-	-	-	-	-	-
					8	0.2	184	358	10.4	71.3	0.2	-
					9	-	-	-	-	-	-	-
					10	0.2	185	359	11.0	74.1	0.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 11:30 a.m.	12.3	1.6	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.1	182	355	10.1	69.1	0.2	-
					4	-	-	-	-	-	-	-
					5	0.1	182	356	10.1	69.2	0.2	-
					6	-	-	-	-	-	-	-
					7	0.1	183	357	10.1	69.0	0.2	-
					8	-	-	-	-	-	-	-
					9	0.2	186	362	10.1	68.8	0.2	-
					10	-	-	-	-	-	-	-
					11	0.1	186	363	10.2	69.6	0.2	-
					12	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 11:10 a.m.	13.0	1.5	0.4	0.0	1	-	-	-	-	-	-	-
					2	0.1	182	356	10.3	70.3	0.2	-
					3	-	-	-	-	-	-	-
					4	0.1	182	356	10.4	71.4	0.2	-
					5	-	-	-	-	-	-	-
					6	0.1	183	356	10.4	71.1	0.2	-
					7	-	-	-	-	-	-	-
					8	0.1	184	359	10.4	71.2	0.2	-
					9	-	-	-	-	-	-	-
					10	0.1	184	359	10.5	71.8	0.2	-
					11	-	-	-	-	-	-	-
					12	0.1	185	361	10.8	72.9	0.2	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Downstream of Bridge



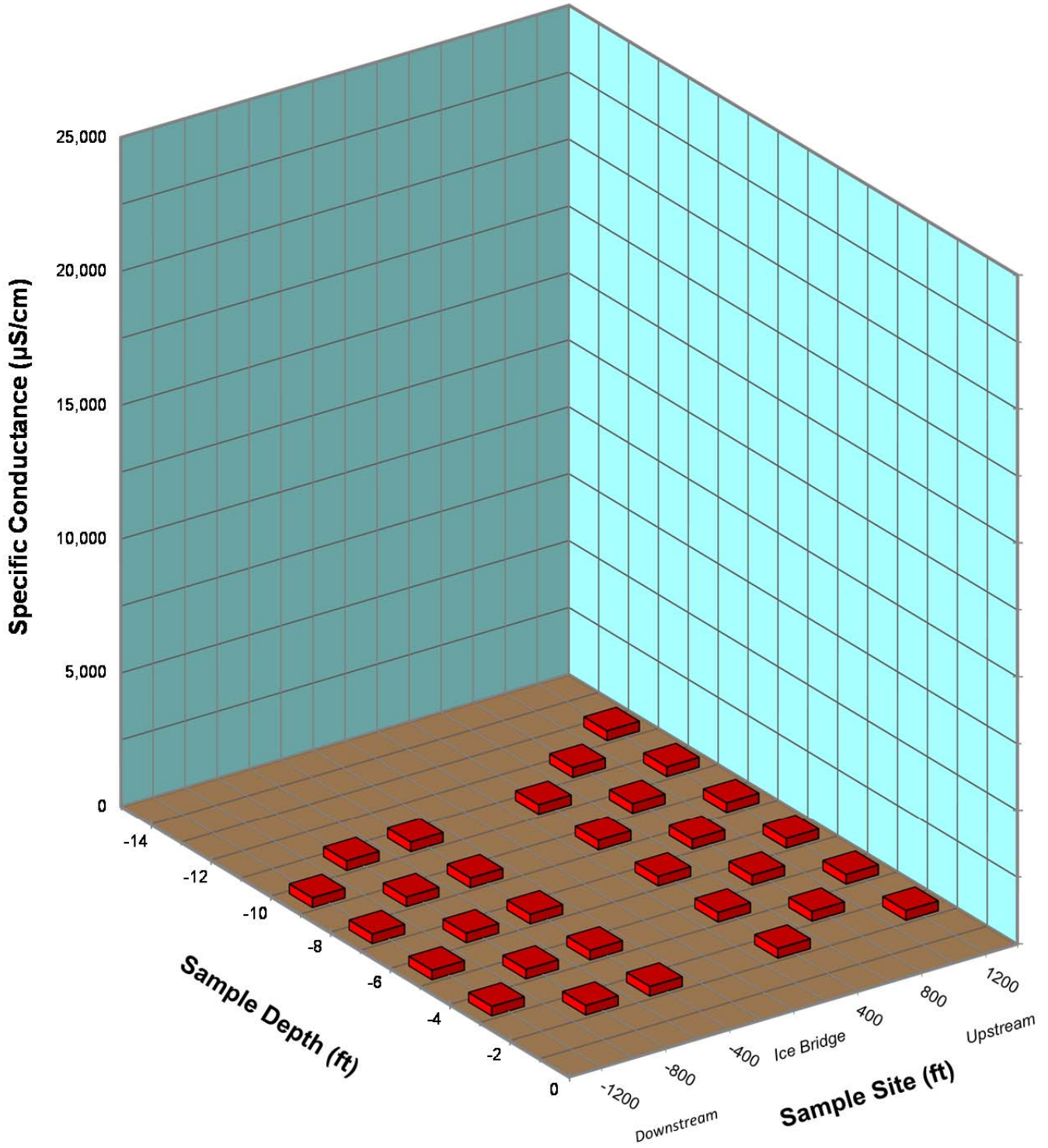
Sample Date: December 6, 2012

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)	
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:05 a.m.	11.1	1.6	0.2	0.1	1	-	-	-	-	-	-	-	
					2	0.2	183	356	10.2	69.8	0.2	-	
					3	-	-	-	-	-	-	-	-
					4	0.2	183	356	10.2	69.6	0.2	-	
					5	-	-	-	-	-	-	-	
					6	0.2	183	356	10.2	69.8	0.2	-	
					7	-	-	-	-	-	-	-	
					8	0.2	183	357	10.3	70.2	0.2	-	
					9	-	-	-	-	-	-	-	
					10	0.1	183	358	10.6	72.0	0.2	-	
					11	-	-	-	-	-	-	-	
					12	-	-	-	-	-	-	-	
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:20 a.m.	10.8	1.6	0.1	0.1	1	-	-	-	-	-	-	-	
					2	0.2	183	355	10.2	69.2	0.2	-	
					3	-	-	-	-	-	-	-	
					4	0.2	183	356	10.2	69.3	0.2	-	
					5	-	-	-	-	-	-	-	
					6	0.3	184	357	10.2	69.2	0.2	-	
					7	-	-	-	-	-	-	-	
					8	0.3	184	357	10.2	69.3	0.2	-	
					9	-	-	-	-	-	-	-	
					10	0.2	185	360	10.2	69.6	0.2	-	
					11	-	-	-	-	-	-	-	
					12	-	-	-	-	-	-	-	
1200-ft Downstream N70°14'28.8" W150°50'23.8" 10:30 a.m.	9.8	1.7	0.3	0.1	1	-	-	-	-	-	-	-	
					2	-	-	-	-	-	-	-	
					3	0.3	183	354	10.2	69.7	0.2	0.00	
					4	-	-	-	-	-	-	-	
					5	0.3	183	355	10.2	69.7	0.2	0.01	
					6	-	-	-	-	-	-	-	
					7	0.3	185	359	10.3	69.8	0.2	0.01	
					8	-	-	-	-	-	-	-	
					9	0.3	186	360	10.3	70.0	0.2	0.02	
					10	-	-	-	-	-	-	-	
					11	-	-	-	-	-	-	-	
					12	-	-	-	-	-	-	-	

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability. Measured December 5, 2012.
- (9) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring December 6, 2012



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: December 12, 2012
Project Code: 132689	Submitted By: Garrett Yager

Weather: -35° F, 10 mph South wind

Garrett Yager arrived at Alpine on Tuesday, December 11, 2012, at 5:30 p.m. Upon arrival Mr. Yager coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on December 12, Mr. Yager attended LCMF's health and safety meeting. Jack Tiepelman of LCMF accompanied Mr. Yager to the Colville River Ice Bridge site via Hagglund departing Alpine at approximately 9:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 386 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 1,200 feet downstream to a minimum of 321 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. At all sampling locations, SC was less than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Low salinity and conductivity values indicate negligible saline influence at all monitoring locations. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 71.9 percent (%) and 79.0%, with an average of 74.6%. DO values generally increased with respect to depth with the exception of 1,200 feet upstream.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.08 feet per second (ft/s) at a depth of 8 feet and 3 feet to a minimum of 0.06 ft/s at 6 feet; average velocity was 0.07 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 1.8 feet to 2.0 feet at all sample locations; average ice thickness was 1.9 feet. Snow thickness ranged from 0.2 to 0.4 feet at all sample locations; average snow thickness was 0.3 feet.

The next sampling event is scheduled for December 19, 2012.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: December 12, 2012

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:25 a.m.	12.8	1.9	0.2	0.1	1	-	-	-	-	-	-	-
					2	0.2	169	329	10.9	74.0	0.1	-
					3	-	-	-	-	-	-	-
					4	0.2	168	327	10.9	74.0	0.1	-
					5	-	-	-	-	-	-	-
					6	0.2	170	331	10.9	74.1	0.1	-
					7	-	-	-	-	-	-	-
					8	0.2	176	342	10.9	74.4	0.2	-
					9	-	-	-	-	-	-	-
					10	0.3	179	347	11.0	75.1	0.2	-
					11	-	-	-	-	-	-	-
					12	0.4	189	365	11.2	76.9	0.2	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:15 a.m.	13.8	1.8	0.4	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.1	166	324	10.8	73.6	0.1	-
					4	-	-	-	-	-	-	-
					5	0.1	166	324	10.9	73.9	0.1	-
					6	-	-	-	-	-	-	-
					7	0.2	167	324	10.9	74.0	0.1	-
					8	-	-	-	-	-	-	-
					9	0.2	169	329	10.9	74.4	0.1	-
					10	-	-	-	-	-	-	-
					11	0.2	176	341	11.0	75.2	0.2	-
					12	-	-	-	-	-	-	-
					13	0.3	181	350	11.1	76.5	0.2	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 10:00 a.m.	13.6	1.9	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.1	165	322	10.6	72.2	0.1	-
					4	-	-	-	-	-	-	-
					5	0.1	165	322	10.6	72.1	0.1	-
					6	-	-	-	-	-	-	-
					7	0.1	165	321	10.5	71.9	0.1	-
					8	-	-	-	-	-	-	-
					9	0.1	165	321	10.5	72.0	0.1	-
					10	-	-	-	-	-	-	-
					11	0.2	167	324	10.4	72.0	0.1	-
					12	-	-	-	-	-	-	-
					13	0.3	176	340	10.3	72.0	0.2	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



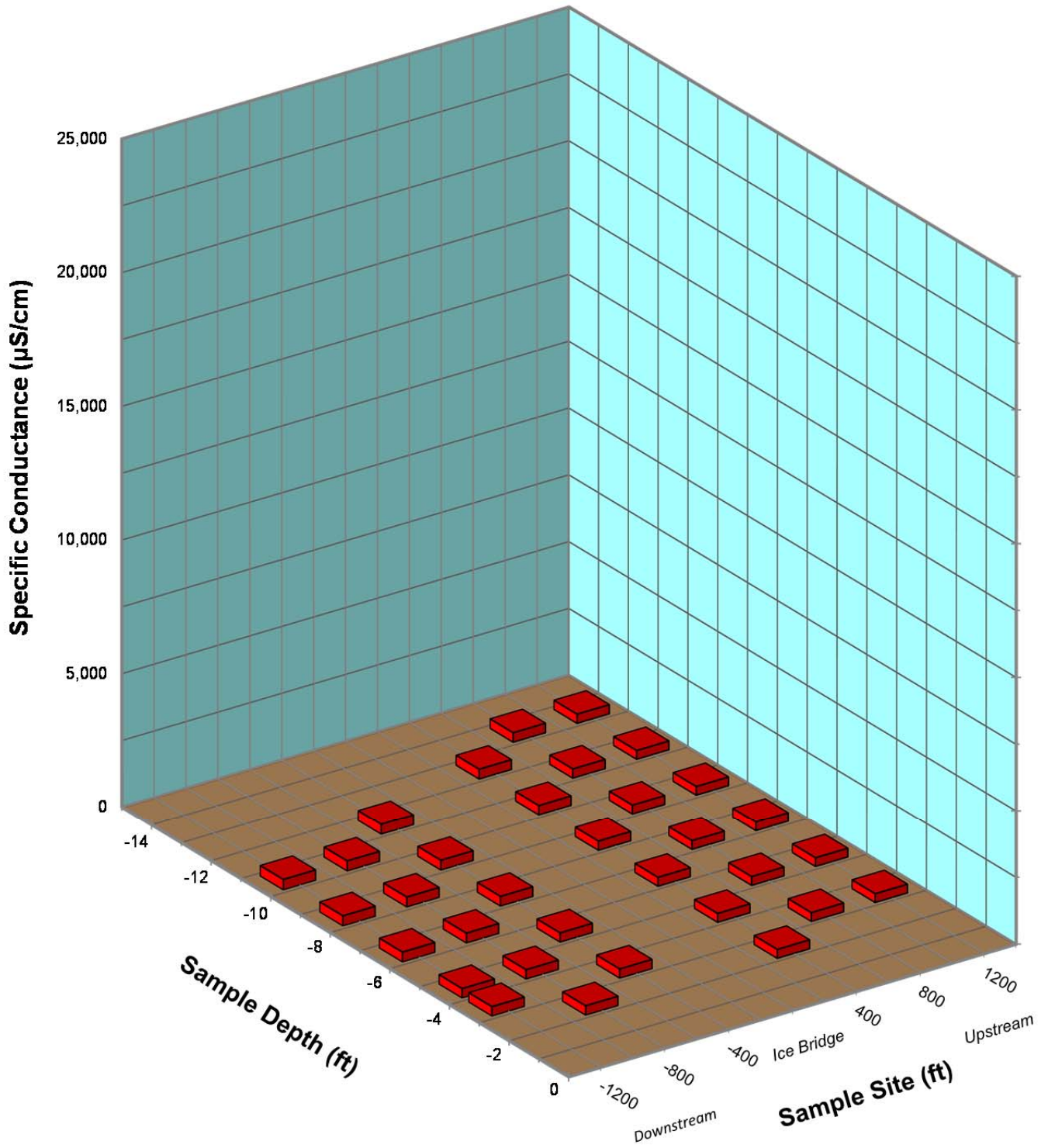
Sample Date: December 12, 2012

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:40 a.m.	11.5	1.8	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.2	175	341	10.9	74.2	0.2	-
					4	-	-	-	-	-	-	-
					5	0.2	176	343	10.9	74.3	0.2	-
					6	-	-	-	-	-	-	-
					7	0.2	185	360	10.8	74.2	0.2	-
					8	-	-	-	-	-	-	-
					9	0.3	188	363	10.9	74.5	0.2	-
					10	-	-	-	-	-	-	-
					11	0.3	192	371	10.7	75.7	0.2	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:55 a.m.	11.1	1.9	0.3	0.0	1	-	-	-	-	-	-	-
					2	0.2	178	346	11.0	74.7	0.2	-
					3	-	-	-	-	-	-	-
					4	0.2	179	348	11.0	75.2	0.2	-
					5	-	-	-	-	-	-	-
					6	0.2	188	366	11.0	75.5	0.2	-
					7	-	-	-	-	-	-	-
					8	0.3	191	369	11.2	76.6	0.2	-
					9	-	-	-	-	-	-	-
					10	0.4	193	372	11.3	77.8	0.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 11:05 a.m.	11.1	2.0	0.3	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.3	180	348	11.0	75.5	0.2	0.08
					4	0.3	180	349	11.0	75.3	0.2	0.07
					5	-	-	-	-	-	-	-
					6	0.3	189	366	11.0	75.6	0.2	0.06
					7	-	-	-	-	-	-	-
					8	0.3	193	374	11.2	76.6	0.2	0.08
					9	-	-	-	-	-	-	-
					10	0.5	201	386	11.5	79.0	0.2	0.07
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (9) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring December 12, 2012



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: December 19, 2012
Project Code: 132689	Submitted By: Bill Brooks

Weather: -22° F, 20 mph Southeast wind

Bill Brooks arrived at Alpine on Tuesday, December 18, 2012, at 12:30 p.m. Upon arrival Mr. Brooks coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event. This monitoring trip was combined with additional ice bridge crossing monitoring at the Nigliq, Nigliagvik, and Tamayayak rivers also performed on Wednesday, December 19, 2012.

At 6:00 a.m. on December 19, Mr. Brooks attended LCMF's health and safety meeting. Roy Baldwin of LCMF accompanied Mr. Brooks to the Colville River Ice Bridge site via Hagglund departing Alpine at approximately 8:50 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations on the Colville River, SC ranged from a maximum of 17,518 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 800 feet downstream to a minimum of 523 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. At all locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. At all upstream locations, SC was greater than 2,800 $\mu\text{S}/\text{cm}$ below 9 feet of depth; at all downstream locations SC was greater than 1,600 $\mu\text{S}/\text{cm}$ below 9 feet of depth. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 81.9 percent (%) and 71.3%, with an average of 74.6%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.20 feet per second (ft/s) at a depth of 11 feet to a minimum of 0.10 ft/s at 3 feet; average velocity was 0.14 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 2.0 feet to 2.4 feet at all sample locations; average ice thickness was 2.2 feet. Snow thickness ranged from 0.2 to 0.5 feet at all sample locations; average snow thickness was 0.3 feet.

The next sampling event is scheduled for December 27, 2012.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: December 19, 2012

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:54 a.m.	12.8	2.1	0.2	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.2	281	548	10.7	73.8	0.3	-
					4	-	-	-	-	-	-	-
					5	0.2	282	548	10.7	73.7	0.3	-
					6	-	-	-	-	-	-	-
					7	0.3	291	564	10.6	73.0	0.3	-
					8	-	-	-	-	-	-	-
					9	0.6	1497	2869	10.3	72.2	1.6	-
					10	-	-	-	-	-	-	-
					11	0.7	7630	14569	9.8	72.0	7.7	-
					12	1.3	8140	15201	9.7	73.0	8.5	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 11:08 a.m.	13.5	2.4	0.5	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.3	276	535	10.7	74.0	0.2	-
					4	-	-	-	-	-	-	-
					5	0.3	279	541	10.7	74.0	0.2	-
					6	-	-	-	-	-	-	-
					7	0.3	359	695	10.7	73.8	0.3	-
					8	-	-	-	-	-	-	-
					9	0.6	2038	3906	10.2	72.2	2.0	-
					10	-	-	-	-	-	-	-
					11	0.9	7740	14669	9.9	73.3	8.1	-
					12	-	-	-	-	-	-	-
					13	1.0	8860	16730	10.0	75.5	9.5	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 11:20 a.m.	14.0	2.2	0.4	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.2	269	523	10.7	73.7	0.2	-
					4	-	-	-	-	-	-	-
					5	0.2	271	527	10.7	73.5	0.2	-
					6	-	-	-	-	-	-	-
					7	0.3	319	618	10.6	73.3	0.3	-
					8	-	-	-	-	-	-	-
					9	0.6	1829	3505	10.2	71.8	2.0	-
					10	-	-	-	-	-	-	-
					11	0.7	7140	13633	9.7	71.3	7.5	-
					12	-	-	-	-	-	-	-
					13	0.9	8580	16261	9.8	73.0	9.0	-
					14	-	-	-	-	-	-	-

- Notes:
- (1) All sample location coordinates referenced to NAD83 datum.
 - (2) Freeboard is the distance from the top of ice to the water surface.
 - (3) Sample depth is measured from the water surface.
 - (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
 - (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
 - (6) Dissolved oxygen was measured using a YSI ProODO meter.
 - (7) Time shown indicates the start of the measurement.

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Downstream of Bridge



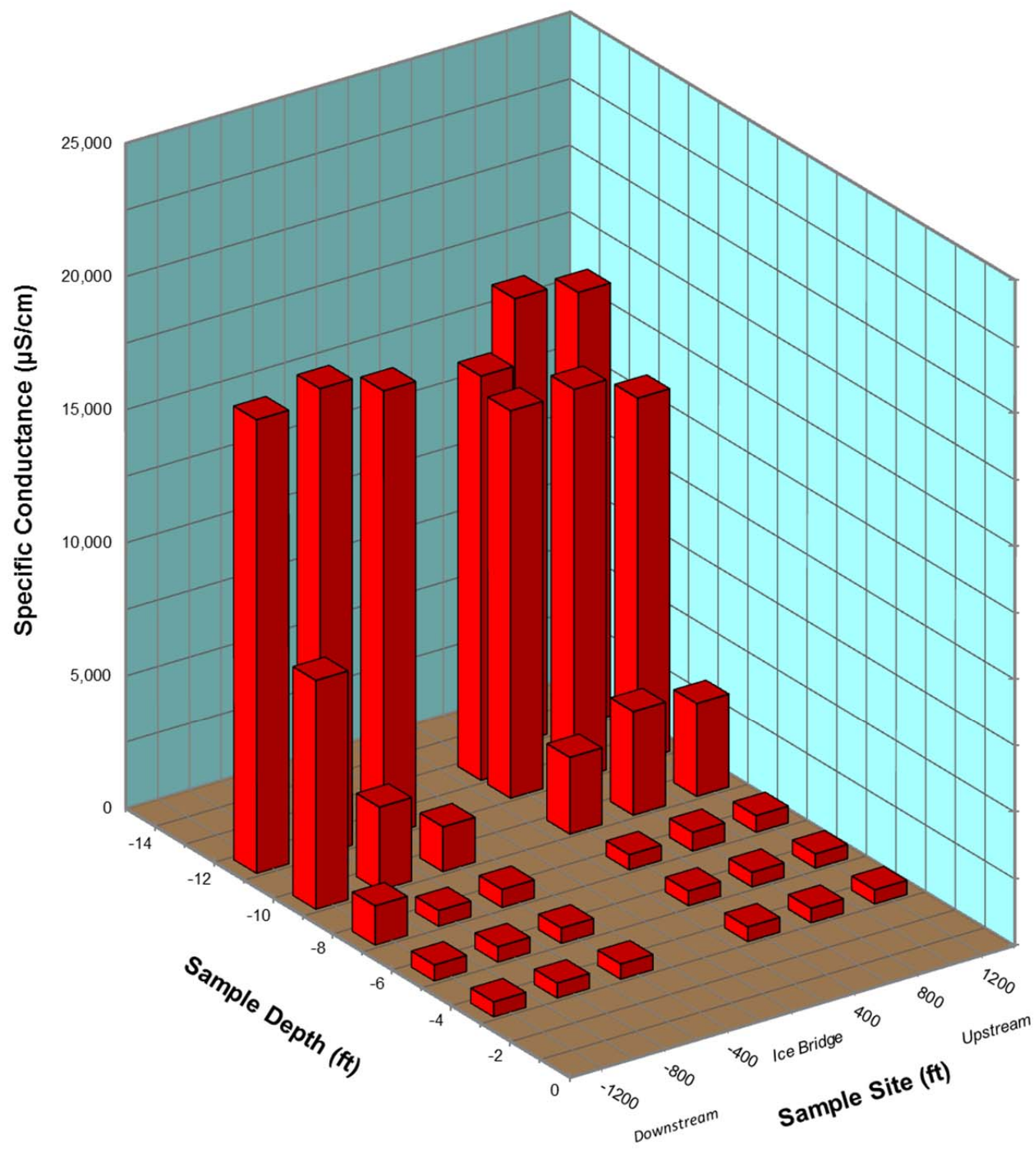
Sample Date: December 19, 2012

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:40 a.m.	12.8	2.1	0.2	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.1	291	568	10.9	74.6	0.3	-
					4	-	-	-	-	-	-	-
					5	0.1	294	573	10.9	75.0	0.3	-
					6	-	-	-	-	-	-	-
					7	0.1	346	676	10.9	74.9	0.3	-
					8	-	-	-	-	-	-	-
					9	0.3	865	1677	11.0	76.4	1.0	-
					10	-	-	-	-	-	-	-
					11	0.7	8760	16726	10.4	77.5	9.3	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:25 a.m.	12.0	2.2	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.0	286	560	11.0	75.5	0.3	-
					4	-	-	-	-	-	-	-
					5	0.1	295	576	11.0	75.7	0.3	-
					6	-	-	-	-	-	-	-
					7	0.1	302	589	11.0	75.5	0.3	-
					8	-	-	-	-	-	-	-
					9	0.3	1610	3121	11.0	76.7	1.3	-
					10	-	-	-	-	-	-	-
					11	0.6	9140	17518	10.6	79.1	9.8	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 9:40 a.m.	12.2	2.0	0.4	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.0	286	561	11.0	75.2	0.3	0.10
					4	-	-	-	-	-	-	-
					5	0.0	306	600	11.0	75.2	0.3	0.11
					6	-	-	-	-	-	-	-
					7	0.2	756	1471	10.9	75.3	0.7	0.14
					8	-	-	-	-	-	-	-
					9	0.3	4441	8609	10.7	76.9	5.8	0.15
					10	-	-	-	-	-	-	-
					11	0.7	8930	17051	11.0	81.9	9.6	0.20
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (9) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring December 19, 2012



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: January 3, 2013
Project Code: 132689	Submitted By: Garrett Yager

Weather: 3° F, 12 mph ENE wind

Garrett Yager arrived at Alpine on Wednesday, January 2, 2013, at 1:30 p.m. Upon arrival Mr. Yager coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on January 3, Mr. Yager attended LCMF's health and safety meeting. Chris Zeimut of LCMF accompanied Mr. Yager to the Colville River Ice Bridge site via Hagglund departing Alpine at approximately 9:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 19,075 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 800 feet upstream to a minimum of 404 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. At all sampling locations, SC was greater than 14,600 $\mu\text{S}/\text{cm}$ below 10 feet of depth with exception of 1,200 feet downstream which had a maximum of 14,225 $\mu\text{S}/\text{cm}$ at 9 feet of depth. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 65.5 percent (%) and 72.8%, with an average of 67.4%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum magnitude of 0.11 feet per second (ft/s) at a depth of 7 feet to a minimum magnitude of 0.00 ft/s at 5 and 9 feet; average velocity was 0.01 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 2.6 feet to 2.9 feet at all sample locations; average ice thickness was 2.7 feet. Snow thickness ranged from 0.2 to 0.5 feet at all sample locations; average snow thickness was 0.3 feet.

The next sampling event is scheduled for January 16, 2012.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: January 3, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:35 a.m.	12.2	2.8	0.2	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-0.1	210	414	9.7	66.5	0.2	-
					4	-	-	-	-	-	-	-
					5	-0.1	212	418	9.7	66.2	0.2	-
					6	-	-	-	-	-	-	-
					7	0.1	283	553	9.6	66.0	0.3	-
					8	-	-	-	-	-	-	-
					9	0.5	7630	14679	9.0	65.9	8.0	-
					10	-	-	-	-	-	-	-
					11	0.9	9330	17683	9.0	67.4	9.8	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:20 a.m.	13.6	2.6	0.5	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-0.1	210	413	9.9	67.6	0.2	-
					4	-0.1	212	417	9.8	67.0	0.2	-
					5	-	-	-	-	-	-	-
					6	-0.1	258	508	9.8	66.6	0.2	-
					7	-	-	-	-	-	-	-
					8	0.3	1924	3730	9.5	66.2	2.1	-
					9	-	-	-	-	-	-	-
					10	0.5	8800	16930	9.1	67.7	9.4	-
					11	-	-	-	-	-	-	-
					12	0.7	9990	19075	9.7	72.8	10.7	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 10:00 a.m.	13.3	2.6	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-0.1	205	404	9.8	67.1	0.2	-
					4	-0.1	205	404	9.8	67.2	0.2	-
					5	-	-	-	-	-	-	-
					6	-0.1	235	463	9.9	67.4	0.3	-
					7	-	-	-	-	-	-	-
					8	0.2	1909	3715	9.6	66.6	1.9	-
					9	-	-	-	-	-	-	-
					10	0.4	8820	17032	9.1	67.2	9.5	-
					11	-	-	-	-	-	-	-
					12	0.6	9660	18514	9.3	69.5	10.4	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C.

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Downstream of Bridge



Sample Date: January 3, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:50 a.m.	11.3	2.9	0.3	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-0.1	208	409	9.9	67.9	0.2	-
					4	-0.1	210	413	9.9	67.7	0.2	-
					5	-	-	-	-	-	-	-
					6	0.0	260	510	9.9	67.5	0.2	-
					7	-	-	-	-	-	-	-
					8	0.4	1769	3416	9.6	67.5	1.8	-
					9	-	-	-	-	-	-	-
					10	0.8	8670	16493	9.4	70.2	9.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 11:05 a.m.	11.0	2.6	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.0	207	406	9.8	67.4	0.2	-
					4	0.0	208	408	9.8	67.3	0.2	-
					5	-	-	-	-	-	-	-
					6	0.1	271	529	9.7	66.4	0.2	-
					7	-	-	-	-	-	-	-
					8	0.6	2342	4489	9.6	67.6	2.2	-
					9	-	-	-	-	-	-	-
					10	0.8	9900	18833	9.3	70.2	10.6	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 11:20 a.m.	10.6	2.6	0.5	0.0	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	0.0	208	408	9.8	67.0	0.2	-0.07
					4	-	-	-	-	-	-	-
					5	0.0	215	422	9.7	66.3	0.2	0.00
					6	-	-	-	-	-	-	-
					7	0.3	389	755	9.6	66.2	0.5	0.11
					8	-	-	-	-	-	-	-
					9	0.7	7450	14225	8.9	65.5	7.8	0.00
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

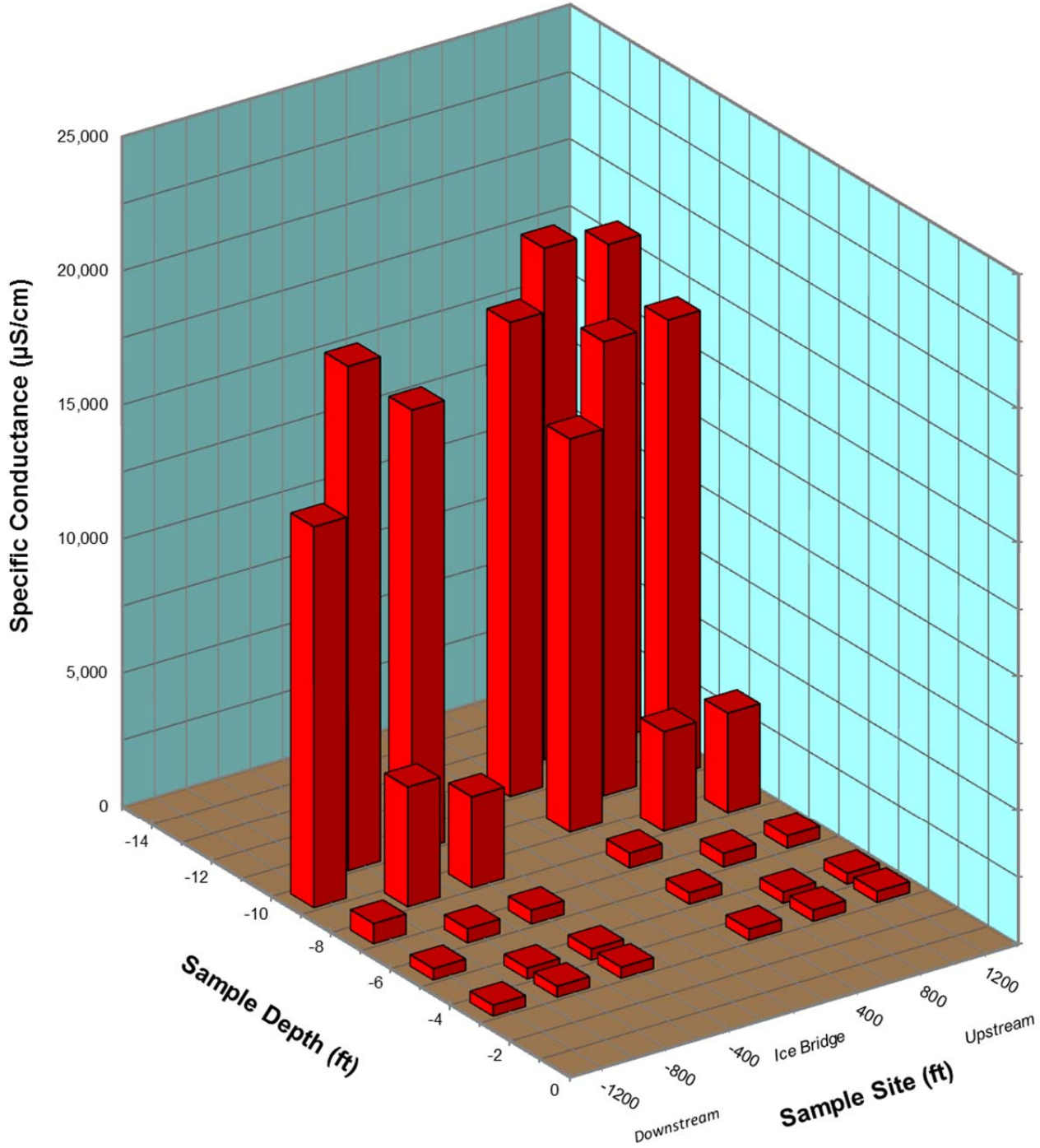
Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (10) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge



2012/2013 Colville River Ice Bridge Monitoring January 3, 2013



Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: January 16, 2013
Project Code: 132689	Submitted By: Kris Homerding

Weather: -19° F, 10 mph NE wind

Kris Homerding arrived at Alpine on Tuesday, January 15, 2013, at 12:00 p.m. Upon arrival Mr. Homerding coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event. This monitoring trip was combined with monitoring at the proposed CD5 bridge crossings at the Nigliq Channel, Lake L9341, and the Nigliagvik.

At 6:00 a.m. on January 16, Mr. Homerding attended LCMF's health and safety meeting. Mark Williams of LCMF accompanied Mr. Homerding to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 9:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 19,195 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 1,200 feet upstream to a minimum of 512 $\mu\text{S}/\text{cm}$ at 800 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. At all upstream locations, SC was greater than 4,000 $\mu\text{S}/\text{cm}$ below 9 feet of depth; at all downstream locations, SC was greater than 4,000 $\mu\text{S}/\text{cm}$ below 5 feet of depth. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 65.0 percent (%) and 73.6%, with an average of 68.0%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum magnitude of 0.02 feet per second (ft/s) at depths of 5 and 7 feet to a minimum magnitude of 0.0 ft/s at 9 feet; average velocity was 0.01 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 2.9 feet to 3.2 feet at all sample locations; average ice thickness was 3.1 feet. Snow thickness ranged from 0.4 to 0.8 feet at all sample locations; average snow thickness was 0.6 feet.

The next sampling event is scheduled for January 30, 2013.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

**Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Upstream of Bridge**



Sample Date: January 16, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W 150°50'10.0" 11:10 a.m.	12.7	3.2	0.4	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	289	569	10.4	71.1	0.3	-
					6	-	-	-	-	-	-	-
					7	0.1	796	1555	9.7	66.8	0.7	-
					8	-	-	-	-	-	-	-
					9	0.4	3114	6013	9.6	67.6	3.3	-
					10	-	-	-	-	-	-	-
					11	0.5	9780	18815	9.3	69.6	10.5	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W 150°50'06.4" 10:50 a.m.	12.8	2.9	0.8	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-0.1	260	512	10.2	69.5	0.2	-
					5	-	-	-	-	-	-	-
					6	0.0	512	1004	9.6	66.0	0.5	-
					7	-	-	-	-	-	-	-
					8	0.2	2062	4012	9.3	65.1	2.1	-
					9	-	-	-	-	-	-	-
					10	0.4	5300	10235	9.0	65.0	5.4	-
					11	-	-	-	-	-	-	-
					12	0.4	9910	19137	9.1	67.6	10.8	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W 150°50'02.8" 10:30 a.m.	13.3	3.0	0.7	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-0.1	264	520	10.2	70.0	0.2	-
					5	-	-	-	-	-	-	-
					6	-0.1	424	835	9.8	66.8	0.4	-
					7	-	-	-	-	-	-	-
					8	0.1	1490	2910	9.4	65.4	1.4	-
					9	-	-	-	-	-	-	-
					10	0.4	5060	9771	9.1	65.5	5.4	-
					11	-	-	-	-	-	-	-
					12	0.4	9940	19195	9.1	67.9	10.7	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



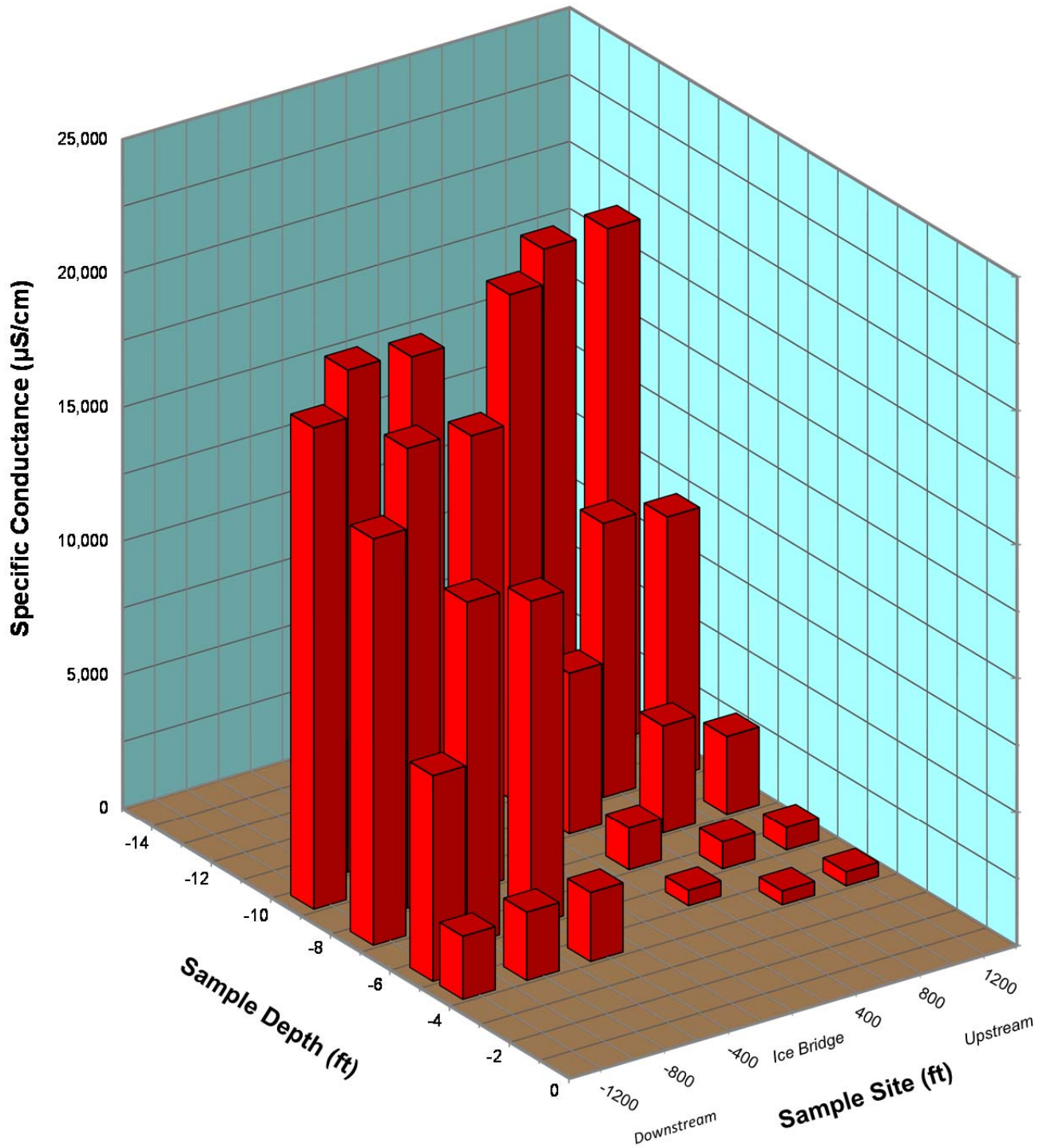
Sample Date: January 16, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W 150°50'17.0" 11:35 a.m.	11.2	3.2	0.8	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	0.1	1318	2574	9.9	68.5	1.4	-
					5	-	-	-	-	-	-	-
					6	0.3	6260	12135	9.1	65.9	6.4	-
					7	-	-	-	-	-	-	-
					8	0.5	8820	16968	9.2	67.8	9.4	-
					9	-	-	-	-	-	-	-
					10	0.6	9690	18572	9.4	70.0	10.5	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W 150°50'20.4" 11:50 a.m.	10.9	3.0	0.5	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	0.1	1303	2545	9.6	66.6	1.7	-
					5	-	-	-	-	-	-	-
					6	0.4	6630	12803	9.0	65.3	6.9	-
					7	-	-	-	-	-	-	-
					8	0.5	8940	17199	9.1	67.6	9.6	-
					9	-	-	-	-	-	-	-
					10	0.6	9800	18783	9.7	72.6	10.6	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W 150°50'23.8" 12:15 p.m.	10.5	3.1	0.5	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	0.2	1210	2354	10.0	69.6	1.4	-0.01
					5	0.4	3989	7703	9.5	67.5	4.0	0.02
					6	-	-	-	-	-	-	-
					7	0.5	7900	15198	9.4	69.4	8.5	0.02
					8	-	-	-	-	-	-	-
					9	0.6	9390	17997	9.9	73.6	10.0	0.00
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (10) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring January 16, 2013



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: January 30, 2013
Project Code: 132689	Submitted By: Steven Clark

Weather: -38° F, 2 mph S wind

Steven Clark arrived at Alpine on Tuesday, January 29, 2013, at 5:15 p.m. Upon arrival Mr. Clark coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on January 30, Mr. Clark attended LCMF's health and safety meeting. Tim Willman of LCMF accompanied Mr. Clark to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 9:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 21,454 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 400 feet downstream to a minimum of 508 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 60.0 percent (%) and 72.5%, with an average of 65.6%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.06 feet per second (ft/s) in the upstream direction at a depth of 9 feet to a minimum of 0.03 ft/s in the upstream direction at a depth of 5 feet; average velocity was 0.05 ft/s in the upstream direction. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 3.5 feet to 4.3 feet at all sample locations; average ice thickness was 3.8 feet. Snow thickness ranged from 0.1 to 0.5 feet at all sample locations; average snow thickness was 0.3 feet.

The next sampling event is scheduled for February 13, 2013.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: January 30, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 9:45 a.m.	12.1	4.0	0.2	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	270	531	10.5	71.9	0.2	-
					6	-	-	-	-	-	-	-
					7	-0.1	430	846	9.7	66.4	0.4	-
					8	-	-	-	-	-	-	-
					9	0.2	6250	12161	8.3	60.0	6.6	-
					10	-	-	-	-	-	-	-
					11	0.6	10110	19377	8.2	61.2	10.9	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:05 a.m.	13.0	4.3	0.1	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	-0.1	276	542	10.6	72.5	0.2	-
					7	-	-	-	-	-	-	-
					8	0.2	705	1372	9.1	62.8	0.8	-
					9	-	-	-	-	-	-	-
					10	0.4	9690	18712	8.3	61.5	10.5	-
					11	-	-	-	-	-	-	-
					12	0.7	10360	19782	8.4	63.3	11.1	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 10:20 a.m.	13.9	3.5	0.2	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	258	508	10.6	72.3	0.2	-
					6	-	-	-	-	-	-	-
					7	0.1	316	617	10.2	70.2	0.3	-
					8	-	-	-	-	-	-	-
					9	0.4	6800	13131	8.4	60.8	7.0	-
					10	-	-	-	-	-	-	-
					11	0.6	10150	19453	8.3	62.5	10.9	-
					12	-	-	-	-	-	-	-
					13	0.8	10400	19784	8.5	64.0	11.2	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of the ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



Sample Date: January 30, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:35 a.m.	12.3	3.7	0.2	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	0.1	1935	3780	9.3	64.7	2.0	-
					5	-	-	-	-	-	-	-
					6	0.3	3863	7488	8.9	63.3	3.9	-
					7	-	-	-	-	-	-	-
					8	0.6	8700	16674	8.6	63.9	9.5	-
					9	-	-	-	-	-	-	-
					10	0.9	11320	21454	8.7	66.4	12.2	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:50 a.m.	10.7	3.5	0.5	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	0.1	1928	3766	9.2	63.6	1.9	-
					6	-	-	-	-	-	-	-
					7	0.4	4013	7749	9.1	65.2	4.4	-
					8	-	-	-	-	-	-	-
					9	0.6	8460	16214	9.8	72.3	9.0	-
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 11:05 a.m.	10.4	3.5	0.4	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	0.2	2000	3892	9.5	66.1	2.1	-0.03
					6	-	-	-	-	-	-	-
					7	0.4	3941	7610	9.0	64.3	4.0	-0.05
					8	-	-	-	-	-	-	-
					9	0.7	8180	15619	9.4	69.5	8.9	-0.06
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

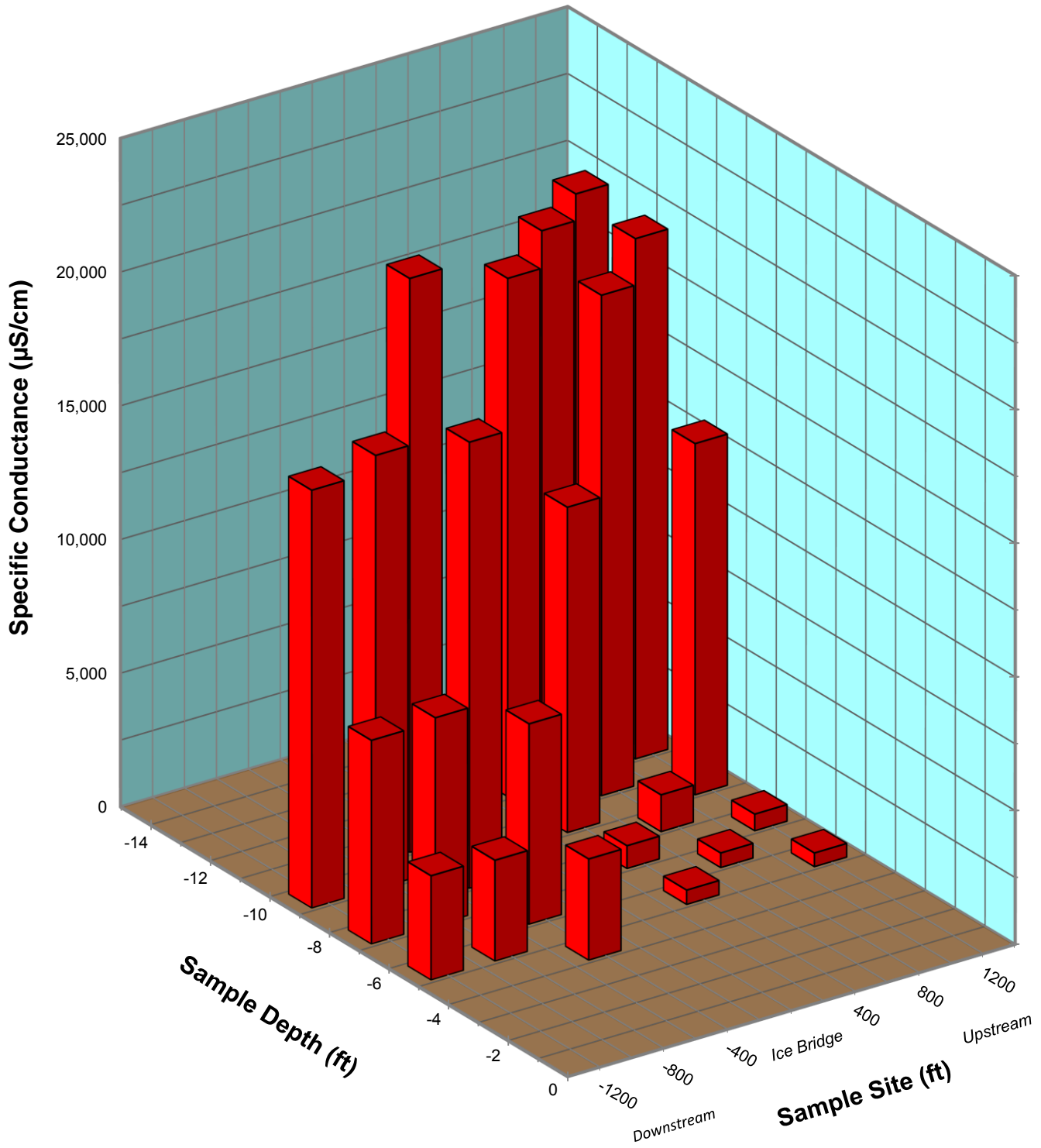
Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (10) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge



2012/2013 Colville River Ice Bridge Monitoring January 30, 2013



Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: February 13, 2013
Project Code: 132689	Submitted By: Garrett Yager

Weather: -19° F, 9.0 mph NE wind

Garrett Yager arrived at Alpine on Tuesday, February 12, 2013, at 5:00 p.m. Upon arrival Mr. Yager coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on February 13, Mr. Yager attended LCMF's health and safety meeting. Tim Willman of LCMF accompanied Mr. Yager to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 9:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Marsh McBirney Flo-Mate Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 20,772 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 400 feet upstream to a minimum of 605 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 60.8 percent (%) and 83.0%, with an average of 68.6%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.04 feet per second (ft/s) in the downstream direction at a depth of 6 feet to a minimum of 0.03 ft/s in the downstream direction at depths of 4, 8 and 10 feet; average velocity was 0.03 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 3.7 feet to 4.3 feet at all sample locations; average ice thickness was 4.0 feet. Snow thickness ranged from 0.2 to 0.6 feet at all sample locations; average snow thickness was 0.4 feet.

The next sampling event is scheduled for February 27, 2013.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: February 13, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:15 a.m.	12.8	4.3	0.2	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	0.0	344	674	11.6	79.7	0.3	-
					6	0.1	370	723	10.9	74.9	0.3	-
					7	-	-	-	-	-	-	-
					8	0.3	1550	3005	9.0	62.6	1.5	-
					9	-	-	-	-	-	-	-
					10	0.5	10300	19815	8.2	61.8	11.1	-
					11	-	-	-	-	-	-	-
					12	0.9	10960	20772	8.4	63.7	11.7	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:00 a.m.	13.0	3.9	0.5	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-0.1	317	623	11.7	79.7	0.3	-
					5	-	-	-	-	-	-	-
					6	0.0	343	673	11.2	76.7	0.3	-
					7	-	-	-	-	-	-	-
					8	0.2	2125	4135	8.7	60.8	2.2	-
					9	-	-	-	-	-	-	-
					10	0.4	10330	19948	8.2	61.5	11.2	-
					11	-	-	-	-	-	-	-
					12	0.7	10700	20431	8.2	62.1	11.6	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 9:45 a.m.	13.3	3.7	0.6	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-0.1	307	605	11.5	78.6	0.3	-
					5	-	-	-	-	-	-	-
					6	-0.1	353	695	11.2	76.8	0.4	-
					7	-	-	-	-	-	-	-
					8	0.2	2800	5448	8.7	61.2	2.6	-
					9	-	-	-	-	-	-	-
					10	0.4	10230	19755	8.1	60.8	11.1	-
					11	-	-	-	-	-	-	-
					12	0.8	10760	20469	8.2	62.4	11.6	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



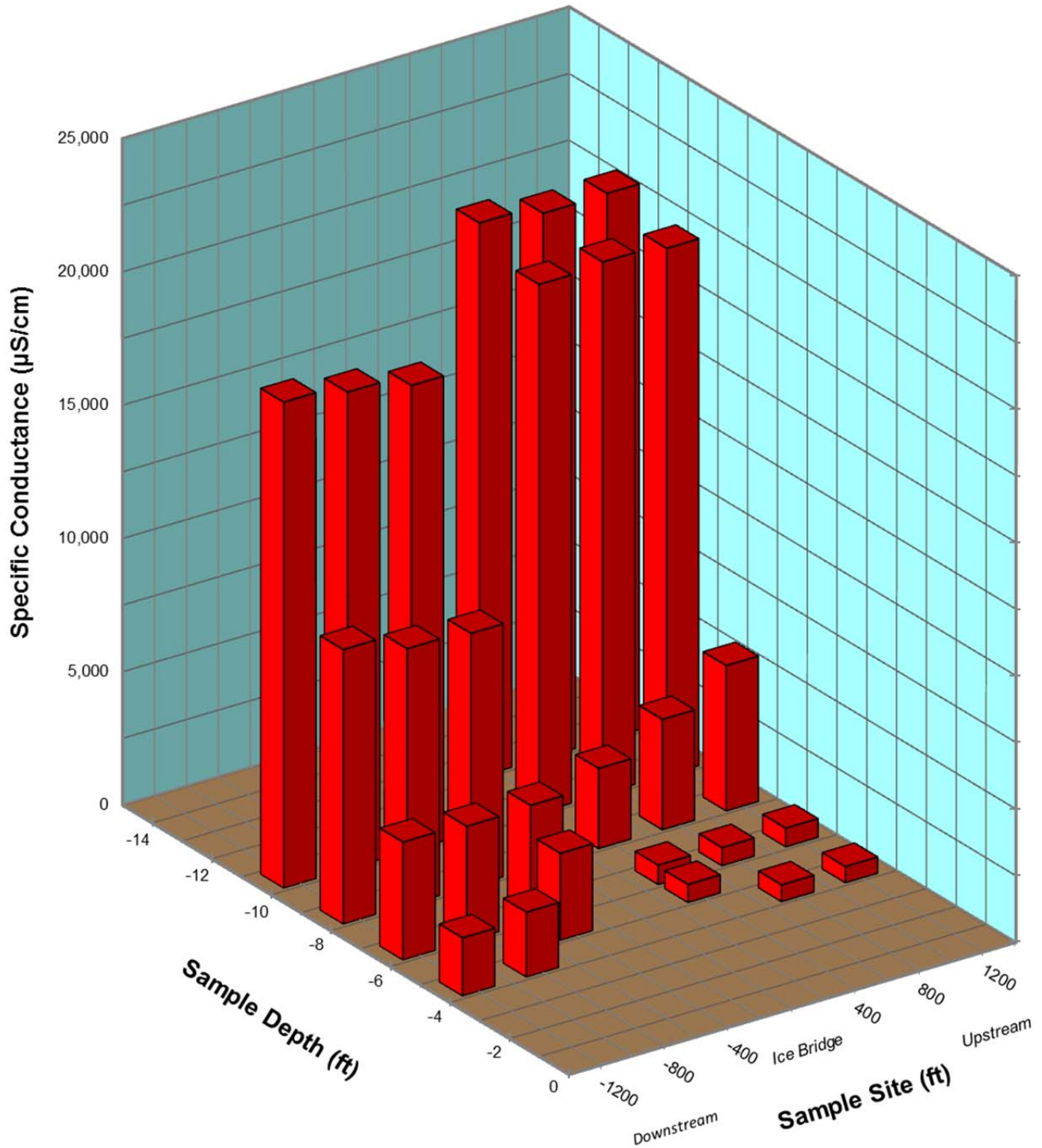
Sample Date: February 13, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:30 a.m.	11.3	4.1	0.4	0.4	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	0.0	1660	3255	11.8	82.0	1.7	-
					6	0.1	2242	4379	10.2	71.0	2.2	-
					7	-	-	-	-	-	-	-
					8	0.5	4930	9484	8.5	60.9	5.1	-
					9	-	-	-	-	-	-	-
					10	0.9	9200	17436	8.3	62.4	9.8	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:45 a.m.	11.0	3.9	0.4	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	0.0	1240	2431	12.0	83.0	1.2	-
					5	-	-	-	-	-	-	-
					6	0.2	2212	4304	9.6	66.9	2.2	-
					7	-	-	-	-	-	-	-
					8	0.5	5000	9619	8.6	61.6	5.1	-
					9	-	-	-	-	-	-	-
					10	0.7	9370	17891	8.8	66.0	10.0	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 11:00 a.m.	10.8	3.8	0.5	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	0.0	1110	2176	11.6	79.7	1.1	0.03
					5	-	-	-	-	-	-	-
					6	0.3	2280	4420	9.3	65.0	2.2	0.04
					7	-	-	-	-	-	-	-
					8	0.6	5370	10292	8.8	63.7	5.5	0.03
					9	-	-	-	-	-	-	-
					10	0.8	9580	18224	8.9	66.6	10.2	0.03
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity was measured using a Marsh-McBirney Model 2000, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (10) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring February 13, 2013



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: February 27, 2013
Project Code: 132689	Submitted By: Kris Homerding

Weather: -20° F, 15 mph E wind

Kris Homerding arrived at Alpine on Tuesday, February 26, 2013, at 2:00 p.m. Upon arrival Mr. Homerding coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on February 27, Mr. Homerding attended LCMF's health and safety meeting. AJ Griffin of LCMF accompanied Mr. Homerding to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:50 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 19,971 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 400 feet upstream to a minimum of 817 $\mu\text{S}/\text{cm}$ at 800 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. At all upstream locations, SC was greater than 4,000 $\mu\text{S}/\text{cm}$ below 9 feet of depth; at all downstream locations, SC was greater than 4,000 $\mu\text{S}/\text{cm}$ below 7 feet of depth. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 58.3 percent (%) and 79.2%, with an average of 66.2%.

Velocity measurements at 1,200 feet downstream from the proposed bridge centerline were not conducted because of equipment failure.

Ice thickness ranged between 4.1 feet to 4.8 feet at all sample locations; average ice thickness was 4.4 feet. Snow thickness ranged from 0.2 to 0.6 feet at all sample locations; average snow thickness was 0.4 feet.

The next sampling event is scheduled for March 13, 2013.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: February 27, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:15 a.m.	12.6	4.7	0.2	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	435	856	11.4	78.0	0.4	-
					6	-	-	-	-	-	-	-
					7	0.1	950	1856	9.5	65.7	0.9	-
					8	-	-	-	-	-	-	-
					9	0.3	7700	14926	8.7	64.0	8.7	-
					10	-	-	-	-	-	-	-
					11	0.6	10420	19971	9.2	69.0	11.2	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:05 a.m.	12.6	4.1	0.6	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	415	817	11.6	79.2	0.4	-
					6	-	-	-	-	-	-	-
					7	0.2	1212	2358	9.4	64.7	0.8	-
					8	-	-	-	-	-	-	-
					9	0.4	8280	15989	8.3	61.3	8.9	-
					10	-	-	-	-	-	-	-
					11	0.6	10180	19511	8.7	65.1	11.0	-
					12	-	-	-	-	-	-	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 9:45 a.m.	13.4	4.3	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	-0.1	640	1260	10.2	69.9	0.6	-
					7	-	-	-	-	-	-	-
					8	0.2	4170	8114	8.8	62.6	4.3	-
					9	-	-	-	-	-	-	-
					10	0.6	10090	19338	8.6	64.4	10.9	-
					11	-	-	-	-	-	-	-
					12	0.8	10440	19860	9.1	68.5	11.2	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



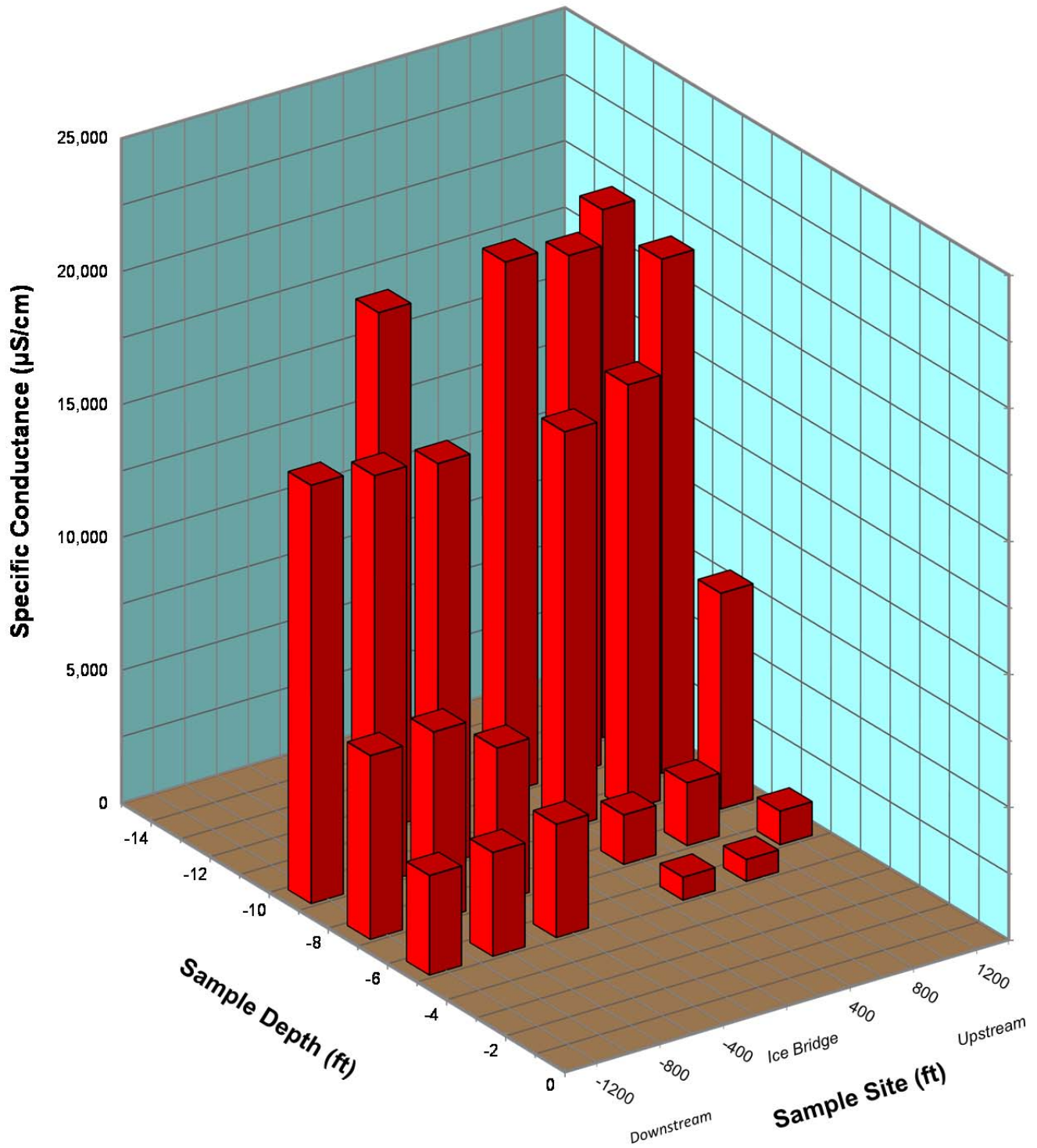
Sample Date: February 27, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W 150°50'17.0" 10:25 a.m.	12.3	4.8	0.2	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	2165	4261	10.3	71.5	2.2	-
					6	-	-	-	-	-	-	-
					7	0.1	2960	5782	8.9	62.3	3.0	-
					8	-	-	-	-	-	-	-
					9	0.6	7900	15141	8.1	60.0	8.6	-
					10	-	-	-	-	-	-	-
					11	0.7	10200	19476	7.7	58.3	11.0	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W 150°50'20.4" 10:35 a.m.	11.3	4.3	0.5	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	1983	3903	9.7	67.3	2.0	-
					6	-	-	-	-	-	-	-
					7	0.3	3660	7095	9.1	64.8	3.9	-
					8	-	-	-	-	-	-	-
					9	0.7	8060	15390	9.1	67.6	8.5	-
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W 150°50'23.8" 10:55 a.m.	10.6	4.3	0.6	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	0.0	1910	3745	9.5	65.9	2.1	-
					6	-	-	-	-	-	-	-
					7	0.3	3564	6909	8.9	62.9	3.6	-
					8	-	-	-	-	-	-	-
					9	0.7	8240	15734	8.5	62.7	8.7	-
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity measurements at 1,200 feet downstream from the proposed bridge centerline were not conducted because of equipment failure.

2012/2013 Colville River Ice Bridge Monitoring February 27, 2013



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: March 13, 2013
Project Code: 132689	Submitted By: Bill Brooks

Weather: -23° F, 10.0 mph E wind

Bill Brooks arrived at Alpine on Tuesday, March 12, 2013, at 6:00 p.m. Upon arrival Mr. Brooks coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on March 13, Mr. Brooks attended LCMF's health and safety meeting. Kevin Eischens of LCMF accompanied Mr. Brooks to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:25 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. DO measurements were only collected at 1,200 feet upstream due to a meter malfunction. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Hach FH950 velocity meter. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 19,501 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 1,200 feet upstream to a minimum of 1,106 $\mu\text{S}/\text{cm}$ at 400 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation at 1,200 feet upstream ranged between 60.7 percent (%) and 69.1%, with an average of 63.0%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.03 feet per second (ft/s) in the downstream direction at a depth of 7 feet to a minimum of 0.01 ft/s in the downstream direction at a depth of 9 feet; average velocity was 0.02 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 4.5 feet to 5.2 feet at all sample locations; average ice thickness was 4.7 feet. Snow thickness ranged from 0.2 to 0.5 feet at all sample locations; average snow thickness was 0.3 feet.

The next sampling event is scheduled for March 27, 2013.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: March 13, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W 150°50'10.0" 10:05 a.m.	12.6	5.2	0.2	0.5	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	562	1106	-	-	0.5	-
					6	-	-	-	-	-	-	-
					7	0.2	1605	3123	-	-	2.2	-
					8	-	-	-	-	-	-	-
					9	0.3	7720	14965	-	-	8.3	-
					10	-	-	-	-	-	-	-
					11	0.6	9900	18974	-	-	10.6	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W 150°50'06.4" 9:50 a.m.	12.6	4.6	0.5	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	660	1299	-	-	0.6	-
					6	-	-	-	-	-	-	-
					7	0.2	1822	3545	-	-	1.7	-
					8	-	-	-	-	-	-	-
					9	0.3	7810	15139	-	-	8.4	-
					10	-	-	-	-	-	-	-
					11	0.9	9990	18933	-	-	10.7	-
					12	-	-	-	-	-	-	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W 150°50'02.8" 9:20 a.m.	12.8	4.6	0.3	0.1	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	-0.1	777	1529	10.1	69.1	0.7	-
					7	0.1	1601	3127	8.9	61.6	1.8	-
					8	-	-	-	-	-	-	-
					9	0.3	8130	15759	8.3	60.7	8.6	-
					10	-	-	-	-	-	-	-
					11	0.3	10060	19501	8.2	60.7	10.8	-
					12	-	-	-	-	-	-	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Dissolved oxygen was only measured at 1,200 feet upstream due to an equipment malfunction.

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



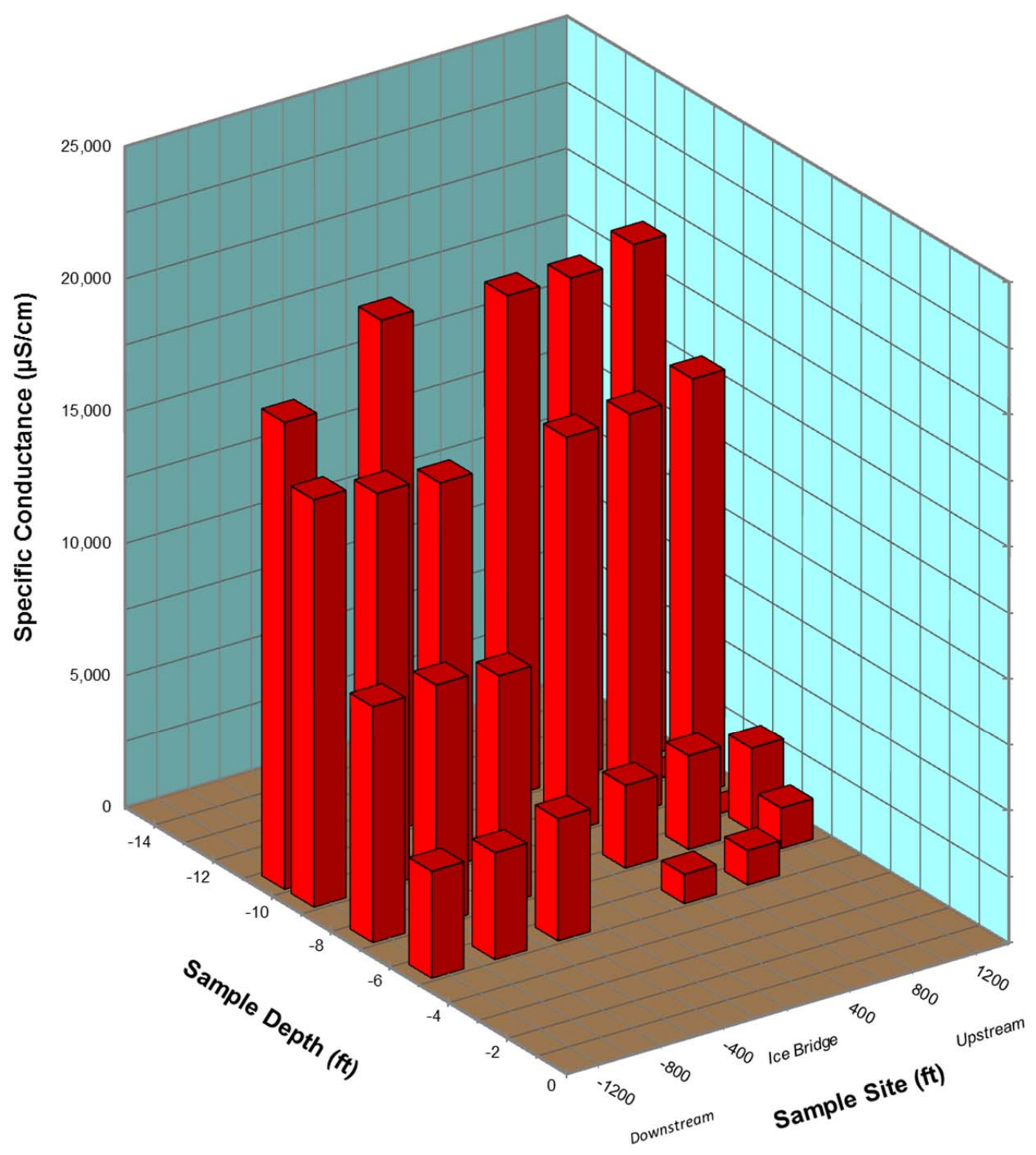
Sample Date: March 13, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:20 a.m.	12.3	5.0	0.2	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	2348	4622	-	-	2.6	-
					6	-	-	-	-	-	-	-
					7	0.4	4510	8709	-	-	4.8	-
					8	-	-	-	-	-	-	-
					9	0.9	7730	14650	-	-	8.1	-
					10	-	-	-	-	-	-	-
					11	1.2	10380	19456	-	-	10.9	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:35 a.m.	11.3	4.5	0.4	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	0.1	2068	4039	-	-	2.0	-
					6	-	-	-	-	-	-	-
					7	0.5	4710	9061	-	-	4.8	-
					8	-	-	-	-	-	-	-
					9	1.1	7950	14956	-	-	8.2	-
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 10:45 a.m.	10.6	4.5	0.3	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	2055	4045	-	-	2.2	0.02
					6	-	-	-	-	-	-	-
					7	0.6	4670	8950	-	-	4.8	0.03
					8	-	-	-	-	-	-	-
					9	0.9	8140	15427	-	-	8.5	0.01
					10	1.0	9360	17674	-	-	9.8	0.02
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Time shown indicates the start of the measurement.
- (7) Temperature measurements have an accuracy of +/- 0.2°C
- (8) Dissolved oxygen was only measured at 1,200 feet upstream due to an equipment malfunction.

2012/2013 Colville River Ice Bridge Monitoring March 13, 2013



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: March 27, 2013
Project Code: 132689	Submitted By: Garrett Yager

Weather: -9° F, 16 mph SW wind

Garrett Yager arrived at Alpine on Tuesday, March 26, 2013, at 6:15 p.m. Upon arrival Mr. Yager coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on March 27, Mr. Yager attended LCMF's health and safety meeting. Chris Ziemet of LCMF accompanied Mr. Yager to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 9:30 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Hach FH950 velocity meter. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 19,716 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 800 feet upstream to a minimum of 1,413 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 53.0 percent (%) and 94.0%, with an average of 66.4%.

Velocities at 1,200 feet downstream from the proposed bridge centerline were 0.01 feet per second (ft/s) in the downstream direction at depths of 9, 8 and 6 feet and 0.01 ft/s in the upstream direction at a depth of 5 feet; average velocity was 0.00 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 4.8 feet to 5.5 feet at all sample locations; average ice thickness was 5.1 feet. Snow thickness ranged from 0.3 to 0.7 feet at all sample locations; average snow thickness was 0.4 feet.

The next sampling event is scheduled for April 10, 2013.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: March 27, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:40 a.m.	12.8	5.5	0.4	0.4	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	0.0	905	1775	12.1	83.0	0.9	-
					7	-	-	-	-	-	-	-
					8	0.4	3990	7705	8.3	58.8	4.1	-
					9	-	-	-	-	-	-	-
					10	0.5	9010	17334	7.1	53.0	9.7	-
					11	-	-	-	-	-	-	-
					12	1.0	10420	19675	7.2	54.6	11.0	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:30 a.m.	13.3	4.8	0.7	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	747	1470	13.6	93.5	0.7	-
					6	0.1	900	1758	11.0	76.3	1.0	-
					7	-	-	-	-	-	-	-
					8	0.4	5130	9907	8.4	60.6	5.4	-
					9	-	-	-	-	-	-	-
					10	0.6	9370	17958	7.2	53.4	10.0	-
					11	-	-	-	-	-	-	-
					12	1.1	10480	19716	7.6	57.7	11.1	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 10:00 a.m.	13.5	4.8	0.6	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	718	1413	13.7	94.0	0.7	-
					6	0.0	830	1627	10.7	73.8	0.8	-
					7	-	-	-	-	-	-	-
					8	0.5	4940	9504	7.9	57.1	5.1	-
					9	-	-	-	-	-	-	-
					10	0.7	9370	17891	7.2	54.0	10.0	-
					11	-	-	-	-	-	-	-
					12	1.1	10470	19697	7.5	57.5	11.1	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



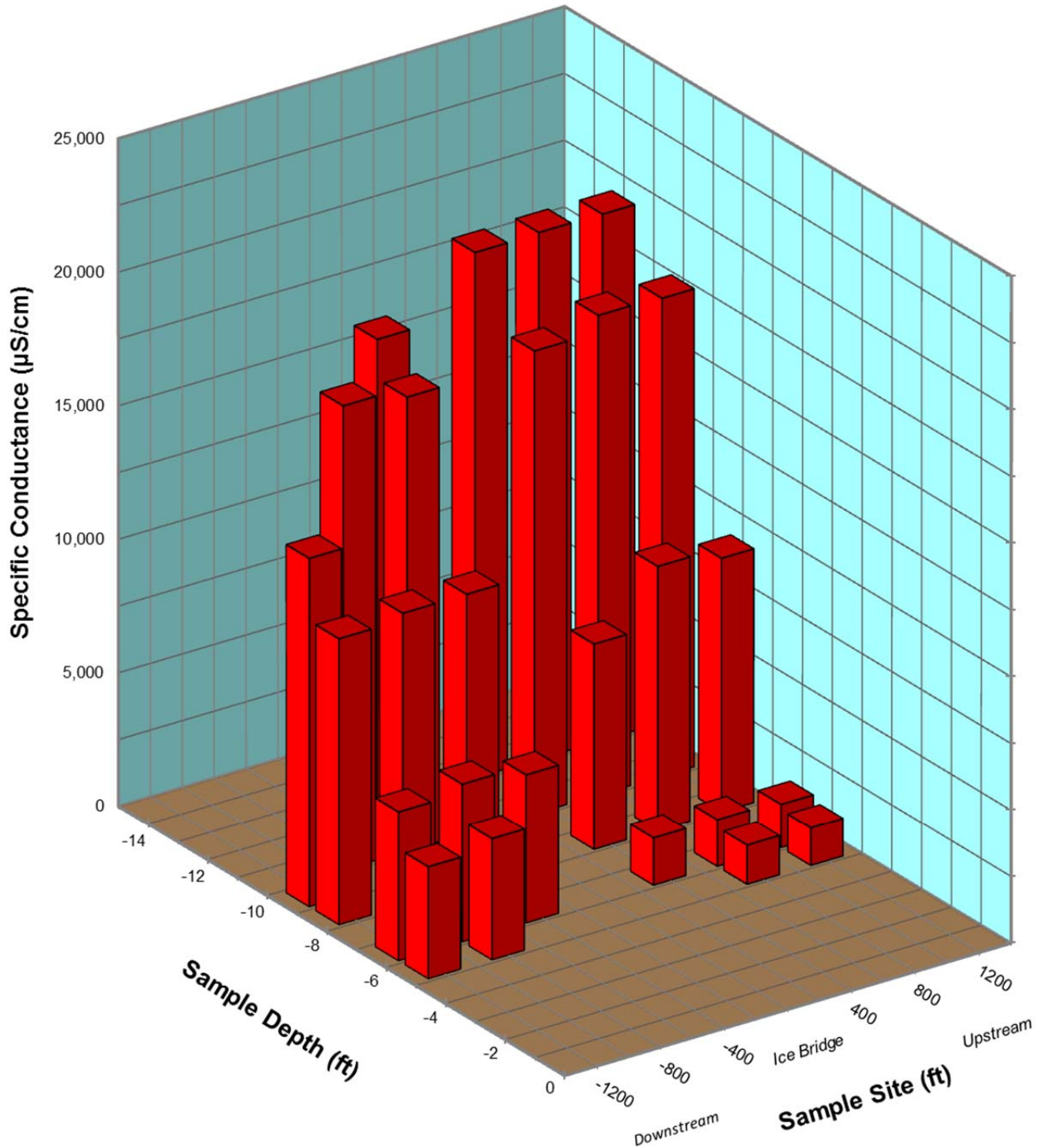
Sample Date: March 27, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:55 a.m.	12.2	5.2	0.3	0.5	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	-0.1	2830	5570	10.1	70.4	2.8	-
					7	-	-	-	-	-	-	-
					8	0.5	5710	10985	8.3	60.0	6.0	-
					9	-	-	-	-	-	-	-
					10	0.6	8880	17019	7.6	56.3	9.4	-
					11	0.5	9620	18507	8.7	64.6	10.3	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 11:05 a.m.	11.0	5.0	0.3	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	2308	4543	10.8	74.8	2.3	-
					6	0.1	3035	5928	10.1	71.1	3.1	-
					7	-	-	-	-	-	-	-
					8	0.6	5730	10982	8.6	62.2	6.0	-
					9	-	-	-	-	-	-	-
					10	0.9	9180	17398	7.7	57.6	9.8	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 11:30 a.m.	10.1	5.0	0.4	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-0.1	2130	4193	11.2	77.5	2.1	-0.01
					6	0.1	2864	5594	10.1	70.6	2.9	0.01
					7	-	-	-	-	-	-	-
					8	0.6	5600	10733	9.4	68.0	5.8	0.01
					9	0.8	6870	13069	9.0	66.0	7.1	0.01
					10	-	-	-	-	-	-	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity was measured using a Hach FH950, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.
- (10) A positive value for velocity indicates flow from the upstream side to the downstream side of the ice bridge.

2012/2013 Colville River Ice Bridge Monitoring March 27, 2013



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: April 10, 2013
Project Code: 132689	Submitted By: Bill Brooks

Weather: -5° F, 15.0 mph NW wind

Bill Brooks arrived at Alpine on Tuesday, April 9, 2013, at 1:30 p.m. Upon arrival Mr. Brooks coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on April 10, Mr. Brooks attended LCMF's health and safety meeting. Roy Baldwin of LCMF accompanied Mr. Brooks to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:25 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Hach FH950 velocity meter. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI-30 was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 18,087 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 1,200 feet upstream to a minimum of 2,348 $\mu\text{S}/\text{cm}$ at 800 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 53.4 percent (%) and 75.5%, with an average of 62.1%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a minimum of 0.01 feet per second (ft/s) in the downstream direction at depths of 6 and 7 feet to a maximum of 0.02 ft/s in the downstream direction at depths of 8 and 10 feet; average velocity was 0.01 ft/s. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 5.2 feet to 5.6 feet at all sample locations; average ice thickness was 5.4 feet. Snow thickness ranged from 0.4 to 0.8 feet at all sample locations; average snow thickness was 0.7 feet.

The next sampling event is scheduled for April 24, 2013.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: April 10, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 9:50 a.m.	12.4	5.4	0.7	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	-0.1	1215	2392	11.0	75.5	1.2	-
					7	0.2	1921	3738	8.8	61.1	2.1	-
					8	-	-	-	-	-	-	-
					9	0.5	6510	12524	8.3	58.6	6.7	-
					10	-	-	-	-	-	-	-
					11	0.9	9300	17626	8.4	64.4	9.8	-
					12	-	-	-	-	-	-	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 9:40 a.m.	12.3	5.2	0.8	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	-0.1	1193	2348	10.2	68.4	1.1	-
					7	0.1	2027	3959	8.8	60.0	2.3	-
					8	-	-	-	-	-	-	-
					9	0.4	6300	12166	8.2	56.6	6.6	-
					10	-	-	-	-	-	-	-
					11	0.7	9120	17414	8.3	59.5	9.7	-
					12	-	-	-	-	-	-	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 9:20 a.m.	12.8	5.2	0.7	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	0.2	1527	2971	9.2	63.8	1.2	-
					7	-	-	-	-	-	-	-
					8	0.3	4513	8748	8.7	59.2	4.8	-
					9	-	-	-	-	-	-	-
					10	0.6	8280	15869	7.5	53.4	8.7	-
					11	-	-	-	-	-	-	-
					12	1.2	9650	18087	7.7	55.6	10.2	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C

Colville River Ice Bridge Monitoring Program
Water Quality - Main Channel Downstream of Bridge



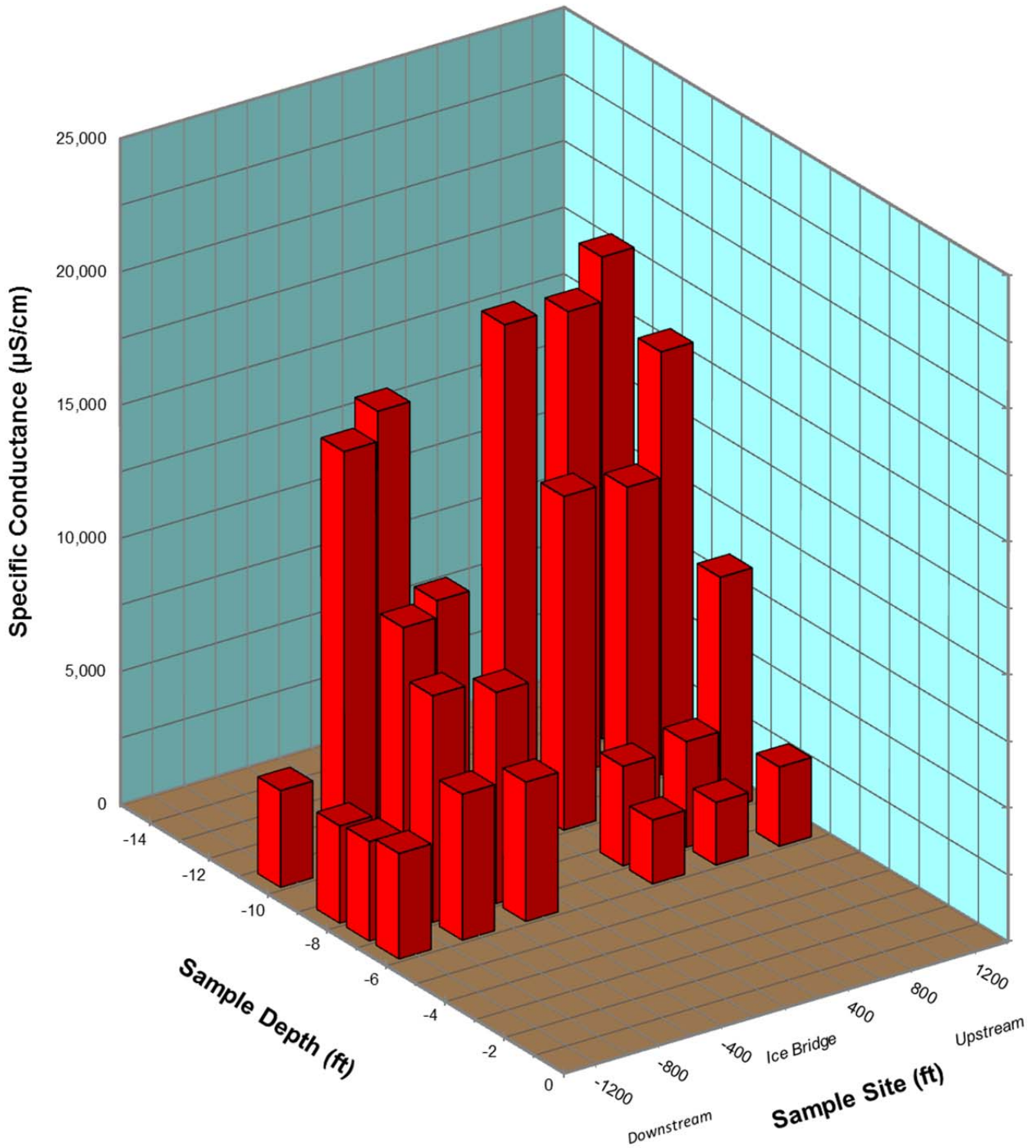
Sample Date: April 10, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)	
400-ft Downstream N70°14'21.1" W150°50'17.0" 9:55 a.m.	11.3	5.6	0.4	0.4	1	-	-	-	-	-	-	-	
					2	-	-	-	-	-	-	-	
					3	-	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-	-
					6	-0.1	2656	5228	9.8	66.1	2.7	-	
					7	0.2	4072	7923	8.9	62.1	4.3	-	
					8	-	-	-	-	-	-	-	
					9	0.5	5210	10023	8.2	58.1	5.3	-	
					10	-	-	-	-	-	-	-	
					11	0.8	8300	15789	7.9	57.7	8.8	-	
					12	-	-	-	-	-	-	-	
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:10 a.m.	11.3	5.2	0.8	0.4	1	-	-	-	-	-	-	-	
					2	-	-	-	-	-	-	-	
					3	-	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-	-
					6	-0.1	2784	5480	10.1	68.8	2.8	-	
					7	0.3	4386	8502	8.8	62.1	4.6	-	
					8	0.6	5420	10388	8.5	60.2	5.4	-	
					9	-	-	-	-	-	-	-	
					10	1.2	8350	15651	8.0	58.9	8.6	-	
					11	-	-	-	-	-	-	-	
					12	-	-	-	-	-	-	-	
1200-ft Downstream N70°14'28.8" W150°50'23.8" 10:25 a.m.	10.5	5.6	0.7	0.3	1	-	-	-	-	-	-	-	
					2	-	-	-	-	-	-	-	
					3	-	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-	-
					6	-0.1	2010	3956	10.1	69.7	2.0	0.01	
					7	0.2	1920	3736	9.4	65.7	1.9	0.01	
					8	0.9	1926	3650	8.6	63.1	1.9	0.02	
					9	-	-	-	-	-	-	-	
					10	1.0	1924	3633	8.4	61.3	1.8	0.02	
					11	-	-	-	-	-	-	-	
					12	-	-	-	-	-	-	-	

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a YSI 30 meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity was measured using a Hach EF950, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.

2012/2013 Colville River Ice Bridge Monitoring April 10, 2013



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Project Trip Report

Project Name: Colville River Ice Bridge Monitoring	Date of Trip: April 24, 2013
Project Code: 132689	Submitted By: Bill Brooks

Weather: -5° F, 15.0 mph NW wind

Bill Brooks arrived at Alpine on Tuesday, April 23, 2013, at 6:00 p.m. Upon arrival Mr. Brooks coordinated with UMIAQ (LCMF) to schedule access to the Colville River for the planned ice bridge monitoring event.

At 6:00 a.m. on April 24, Mr. Brooks attended LCMF's health and safety meeting. Jack Tiepelman of LCMF accompanied Mr. Brooks to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 9:00 a.m.

Ice thickness, snow thickness, total water depth, freeboard, temperature, salinity, conductivity, and dissolved oxygen (DO) measurements were collected. Sampling took place at 400, 800, and 1,200 feet intervals both upstream and downstream of the proposed ice bridge centerline. Water velocities were obtained at 1,200 feet downstream of the proposed bridge centerline. Specific conductance (SC) was calculated from observed temperatures and conductivity. Results are tabulated and graphed in the attached sheets.

In-situ water quality parameters were recorded using a YSI ProPlus meter (temperature, conductivity, and salinity). A YSI ProODO meter was used to measure DO. To determine the presence of flow, water velocities were measured using a Hach FH950 velocity meter. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The YSI ProPlus was calibrated by Baker prior to sampling. The YSI ProODO meter was calibrated prior to the trip by TTT Environmental. Water quality parameters between 1,200 feet upstream and downstream of the proposed ice bridge centerline are discussed below and included in Table 1.

At all sampling locations, SC ranged from a maximum of 18,645 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) at 800 feet upstream to a minimum of 3,158 $\mu\text{S}/\text{cm}$ at 1,200 feet upstream. At all sampling locations, SC was greater than 500 $\mu\text{S}/\text{cm}$ throughout the water column. Comparison of SC at sample locations between 1,200 feet upstream and downstream of the proposed ice bridge centerline is included in Graph 1.

The DO saturation ranged between 51.8 percent (%) and 68.6%, with an average of 58.7%.

Velocities at 1,200 feet downstream from the proposed bridge centerline ranged from a maximum of 0.00 feet per second (ft/s) at all depths. The accuracy of the velocity measurements is +/- 0.05 ft/s.

Ice thickness ranged between 5.0 feet to 6.0 feet at all sample locations; average ice thickness was 5.5 feet. Snow thickness ranged from 0.5 to 1.1 feet at all sample locations; average snow thickness was 0.7 feet.

There are no more sampling events planned for this project year.

Table 1: Water Quality Parameters Upstream and Downstream of Ice Bridge

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Upstream of Bridge



Sample Date: April 24, 2013

Upstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Upstream N70°14'13.6" W150°50'10.0" 10:25 a.m.	12.7	6.0	0.5	0.4	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	-	-	-	-	-	-	-
					7	0.7	2495	4764	8.3	57.2	2.5	-
					8	1.4	5345	9945	7.8	54.7	5.5	-
					9	-	-	-	-	-	-	-
					10	1.9	8975	16400	7.2	51.8	9.2	-
					11	-	-	-	-	-	-	-
					12	4.1	10722	18161.8	7.5	57.2	10.4	-
800-ft Upstream N70°14'10.0" W150°50'06.4" 10:15 a.m.	13.4	5.0	1.1	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	0.6	1853	3551	8.9	62.6	1.9	-
					7	-	-	-	-	-	-	-
					8	1.0	5735	10829	8.0	56.0	5.8	-
					9	-	-	-	-	-	-	-
					10	1.7	9341	17192	7.7	54.4	9.6	-
					11	-	-	-	-	-	-	-
					12	2.9	10569	18645	8.2	61.7	10.3	-
					13	-	-	-	-	-	-	-
1200-ft Upstream N70°14'06.0" W150°50'02.8" 10:00 a.m.	13.3	5.3	1.0	0.3	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	0.3	1629	3158	10.0	68.6	1.7	-
					7	-	-	-	-	-	-	-
					8	0.8	5608	10668	8.2	56.4	5.7	-
					9	-	-	-	-	-	-	-
					10	1.2	9129	17111	7.7	54.2	9.5	-
					11	-	-	-	-	-	-	-
					12	2.5	10278	18386	8.2	59.6	10.5	-
					13	-	-	-	-	-	-	-
					14	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a ProPlus meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C

Colville River Ice Bridge Monitoring Program
 Water Quality - Main Channel Downstream of Bridge



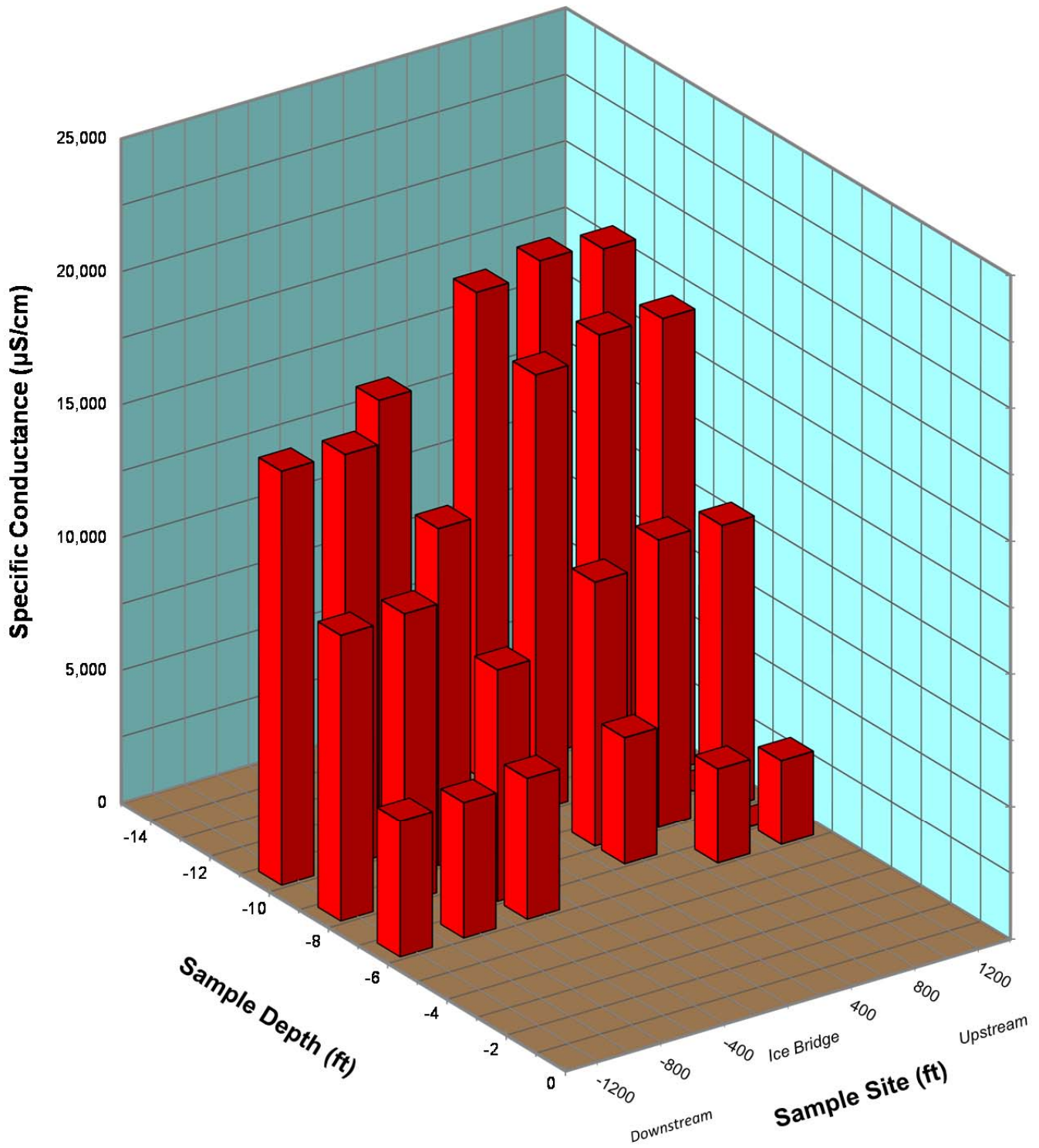
Sample Date: April 24, 2013

Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Snow Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
400-ft Downstream N70°14'21.1" W150°50'17.0" 10:35 a.m.	11.4	5.6	0.5	0.4	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	0.2	2733	5318	9.5	64.4	2.8	-
					7	0.9	4604	8726	7.9	55.5	5.0	-
					8	-	-	-	-	-	-	-
					9	1.8	6926	12702	7.6	54.7	7.0	-
					10	-	-	-	-	-	-	-
					11	3.8	9458	16182	7.5	56.7	9.6	-
					12	-	-	-	-	-	-	-
800-ft Downstream N70°14'25.0" W150°50'20.4" 10:45 a.m.	11.0	5.4	0.5	0.5	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	0.6	2666	5110	9.3	64.0	2.6	-
					7	-	-	-	-	-	-	-
					8	1.3	5822	10872	8.4	59.0	5.8	-
					9	-	-	-	-	-	-	-
					10	2.2	8586	15523	8.6	63.3	8.8	-
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-
1200-ft Downstream N70°14'28.8" W150°50'23.8" 10:55 a.m.	10.0	5.4	0.5	0.2	1	-	-	-	-	-	-	-
					2	-	-	-	-	-	-	-
					3	-	-	-	-	-	-	-
					4	-	-	-	-	-	-	-
					5	-	-	-	-	-	-	-
					6	0.7	2677	5112	9.4	64.4	2.7	0.00
					7	-	-	-	-	-	-	-
					8	2.1	5935	10768	8.0	57.4	5.8	0.00
					9	-	-	-	-	-	-	-
					10	3.9	9147	15598	7.6	57.5	8.5	0.00
					11	-	-	-	-	-	-	-
					12	-	-	-	-	-	-	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface.
- (3) Sample depth is measured from the water surface.
- (4) Temperature, salinity, and conductivity were measured using a ProPlus meter.
- (5) Specific conductance (referenced to 25°C) was obtained using a conversion coefficient of 0.0196 based on empirical data.
- (6) Dissolved oxygen was measured using a YSI ProODO meter.
- (7) Time shown indicates the start of the measurement.
- (8) Temperature measurements have an accuracy of +/- 0.2°C
- (9) Velocity was measured using a Hach EF950, which has a zero stability of +/- 0.05 ft/s and an accuracy of +/- 2% of reading + zero stability.

2012/2013 Colville River Ice Bridge Monitoring April 24, 2013



Graph 1: Comparison of Specific Conductance Upstream and Downstream of Ice Bridge

Attachment B Photographs



Photo B.1: Inserting meters into water for sampling; December 5, 2012



Photo B.2: Warm up tent; November 28, 2012



Photo B.3: Snow machine with gear attached in sled; November 28, 2012



Photo B.4: Personal Protective Equipment for cold conditions; November 28, 2012



Photo B.5: Drilling hole using ice auger; November 20, 2012



Photo B.6: Installing snow poles at 400, 800, and 1,200 feet upstream and downstream; November 7, 2012



Photo B.7: HDD warm up shack; November 7, 2012



Photo B.8: Recording data in field book; April 10, 2013



Photo B.9: Drilling hole using ice auger; March 13, 2013



Photo B.10: Ice road; February 27, 2013



N 70.2371° W 150.8364° 2/13/2013 11:19:29 AM

Photo B.11: Placing duck pond under Hägglund; February 13, 2013



1/30/2013 12:31:59 PM

Photo B.12: View from monitoring location; January 30, 2013



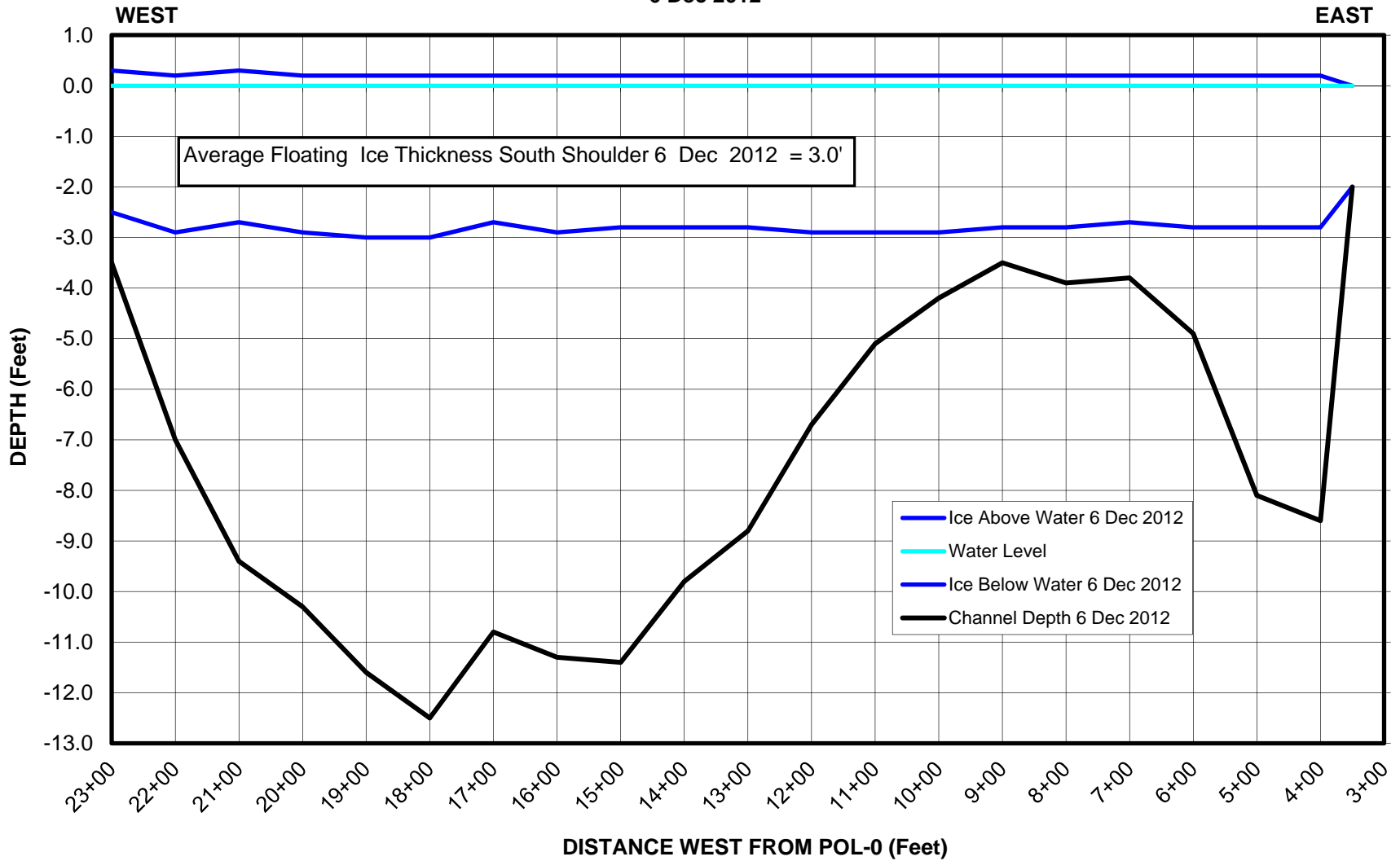
Photo B.13: Hägglund; January 16, 2013



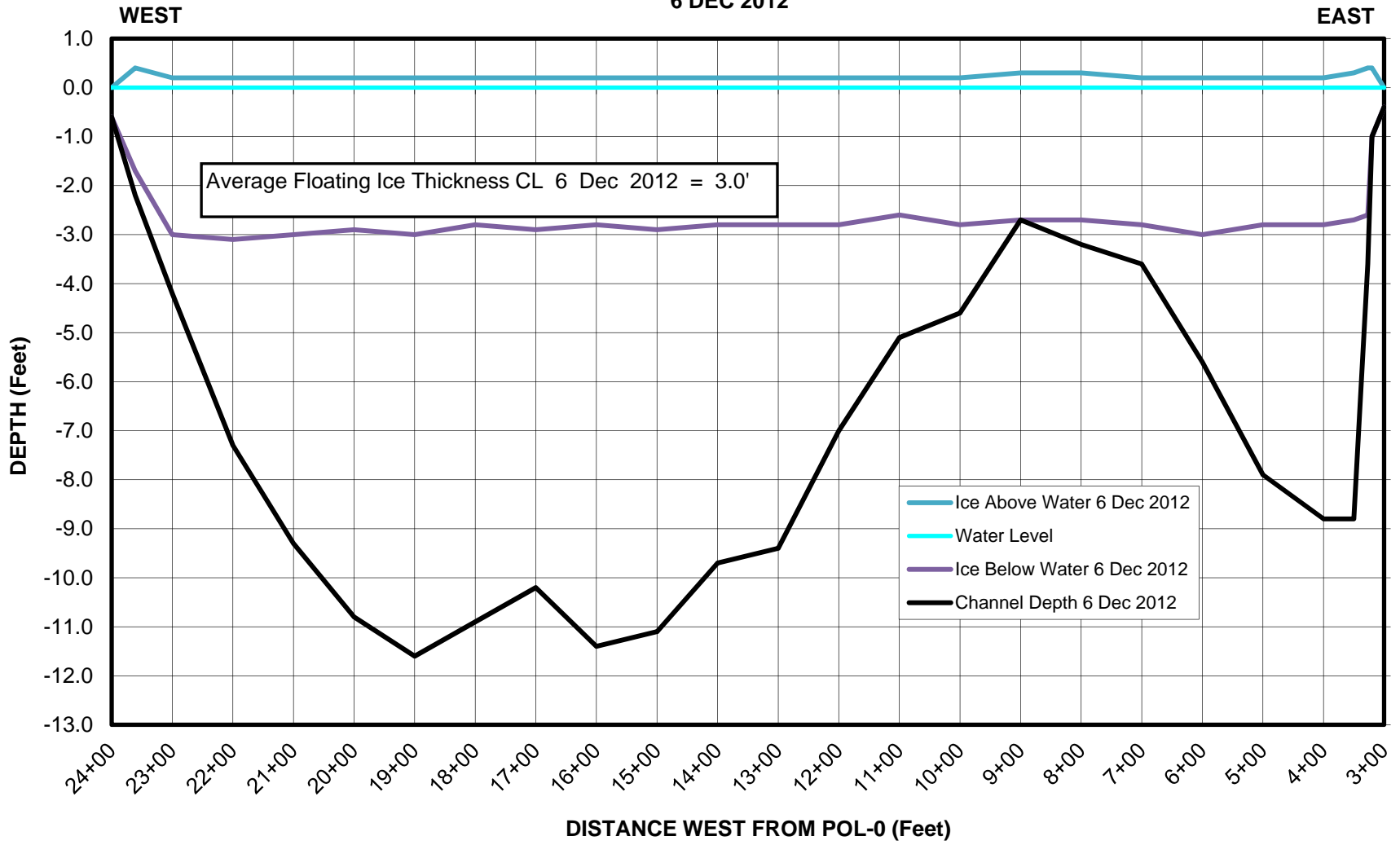
Photo B.14: Ice road; January 3, 2013

Attachment C Ice Bridge Crossing Profiles

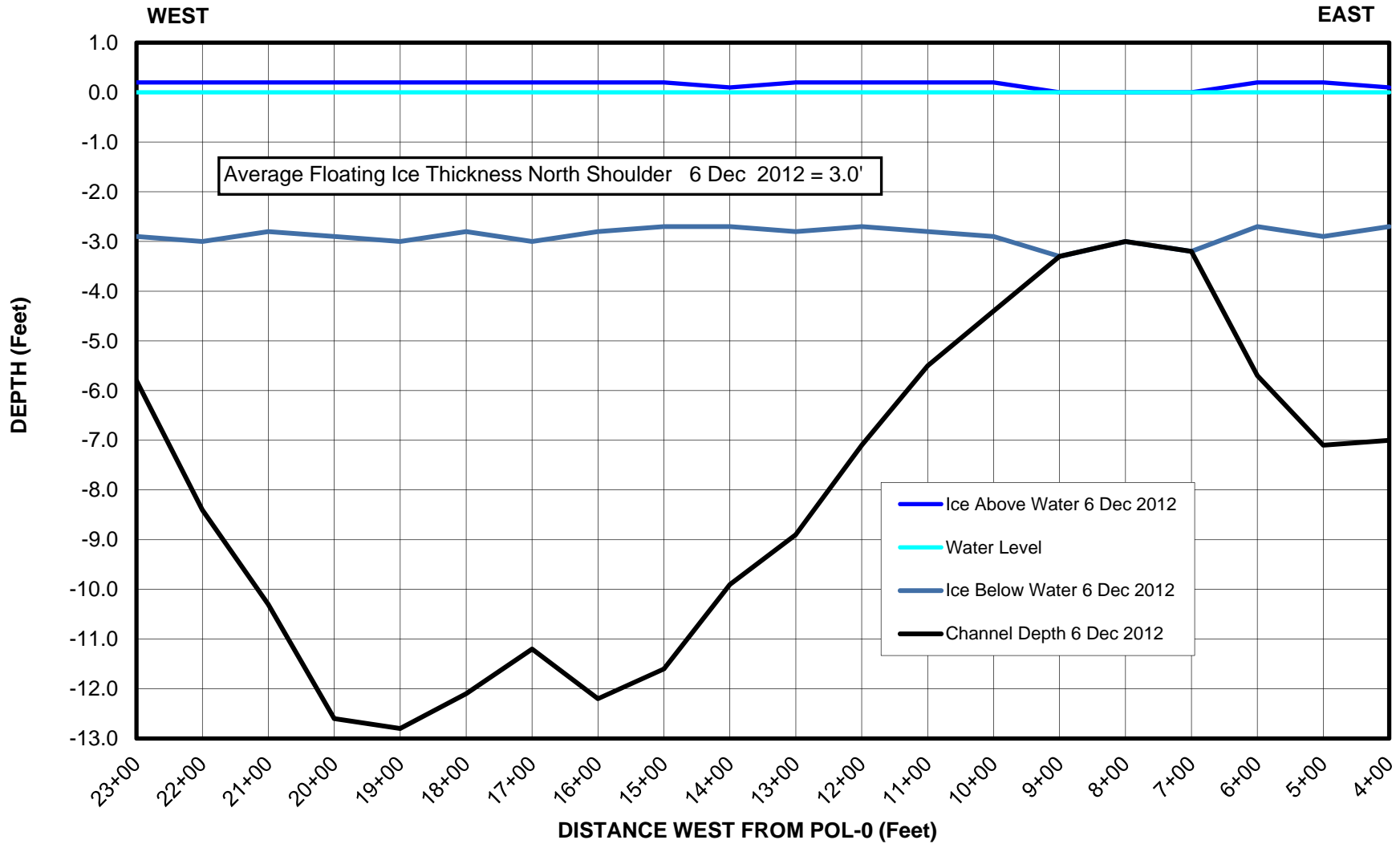
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ICE ROAD CROSSING
SOUTH SHOULDER
6 Dec 2012**



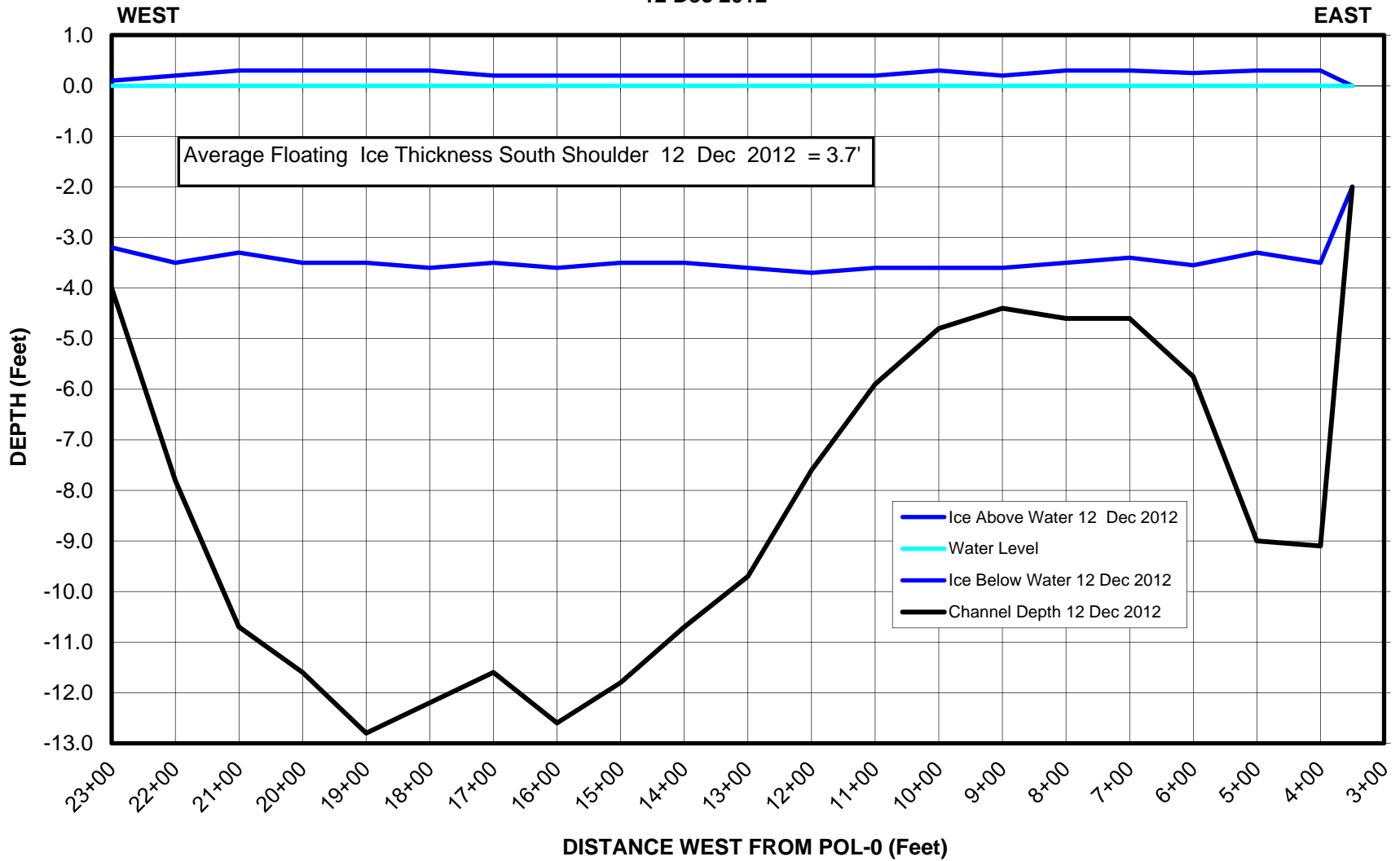
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ICE ROAD CROSSING
CENTER LINE
6 DEC 2012**



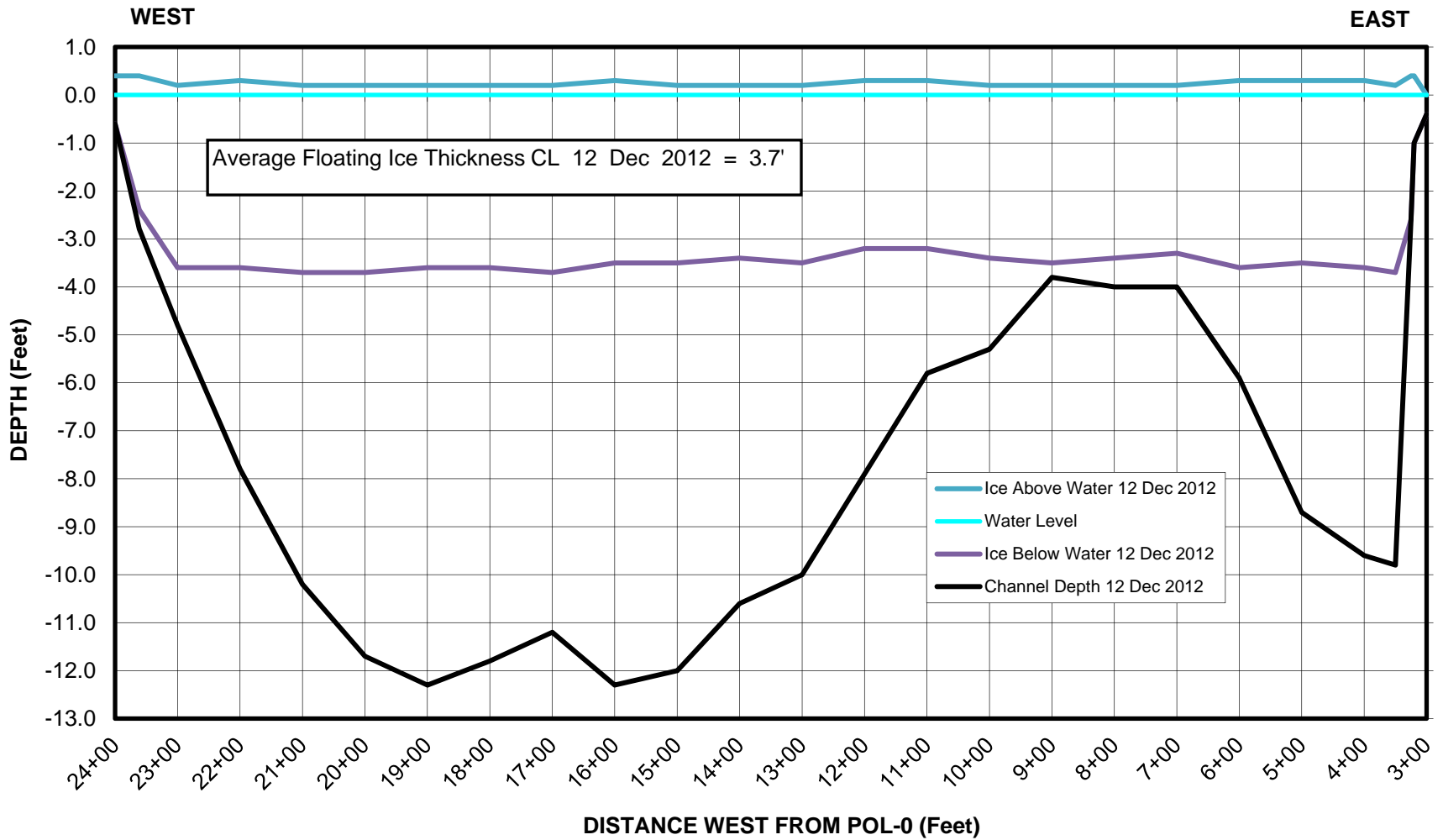
MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
6 DEC 2012



**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
12 Dec 2012**

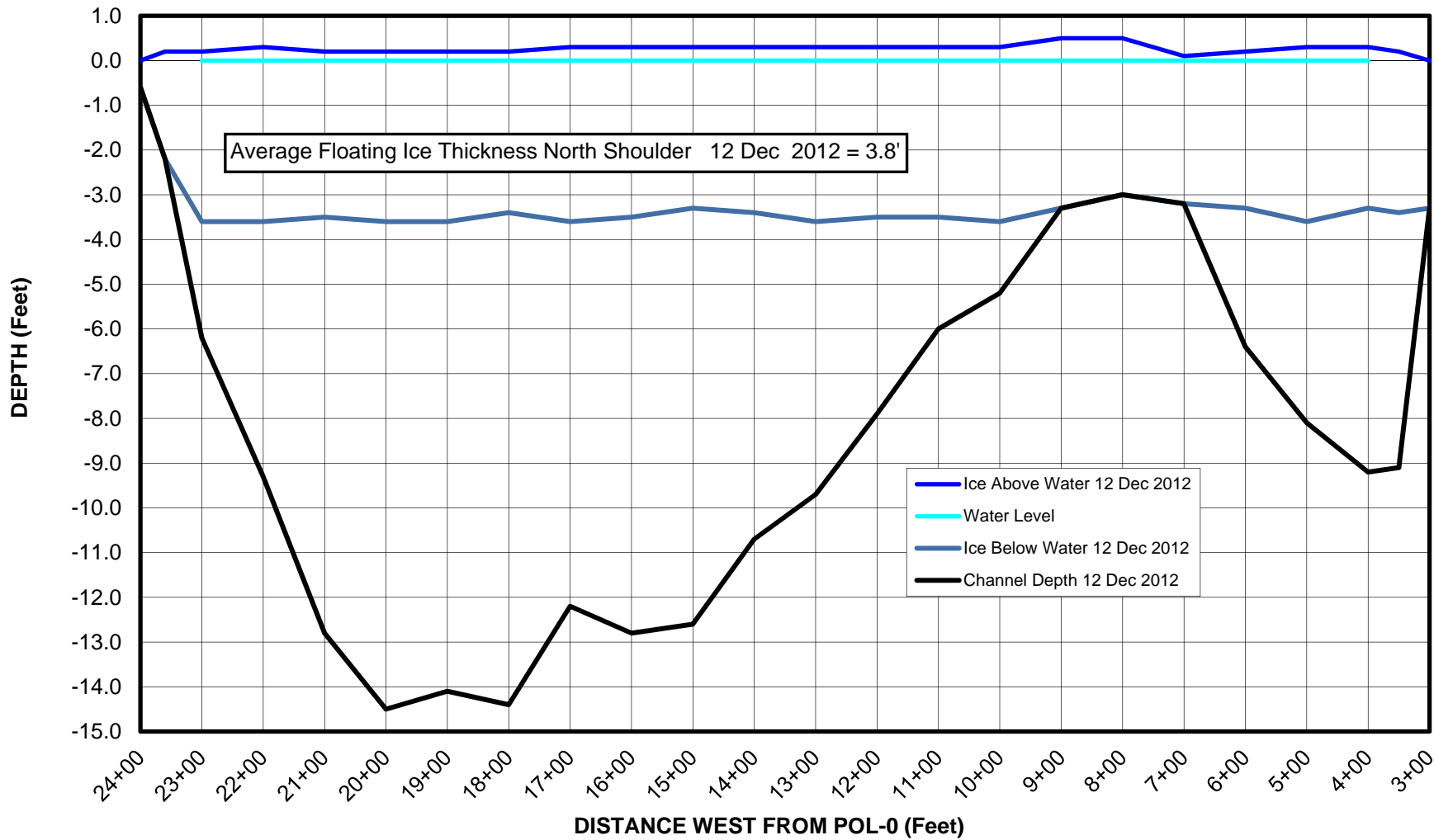


**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
12 DEC 2012**

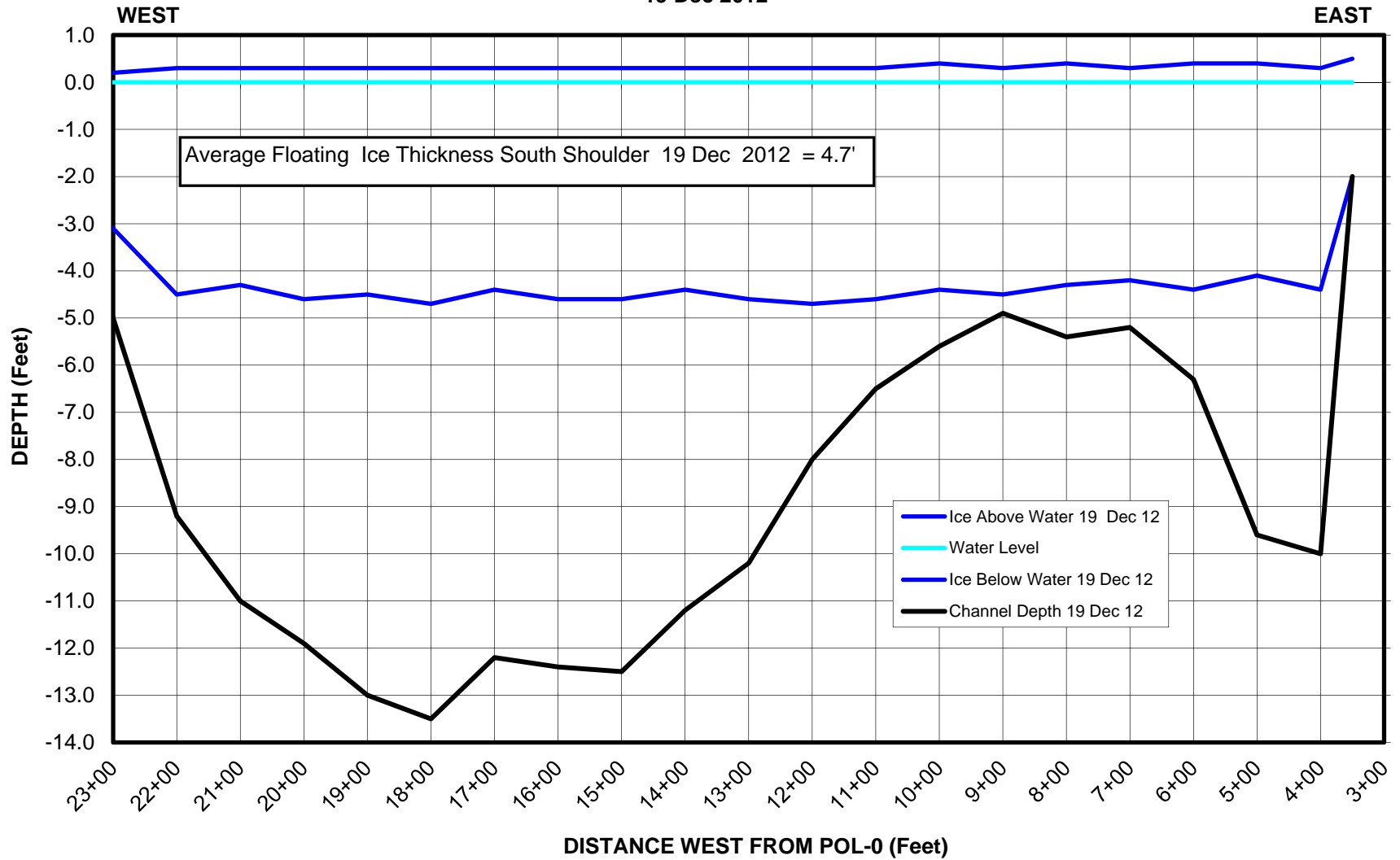


MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
12 DEC 2012

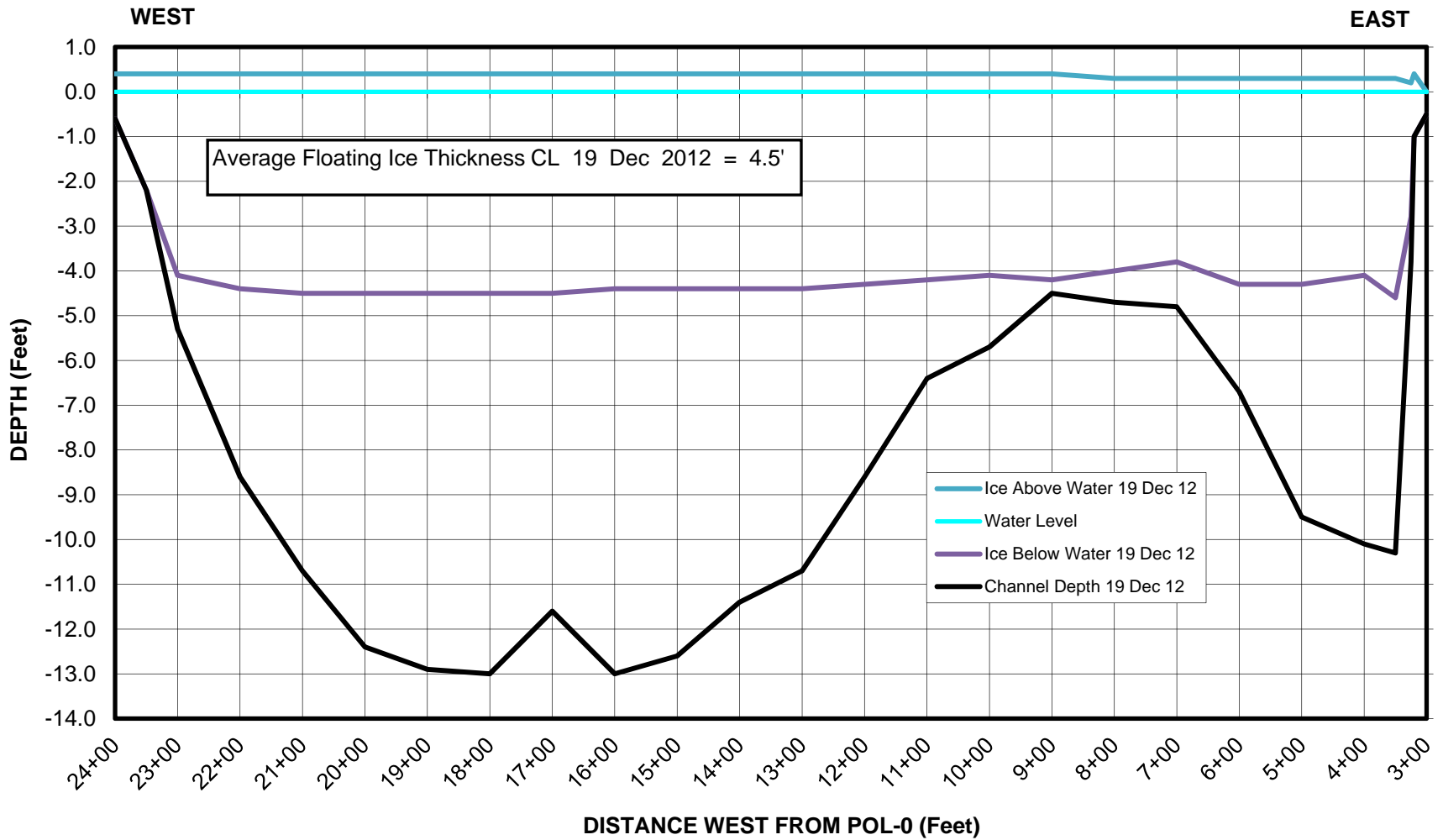
EAST



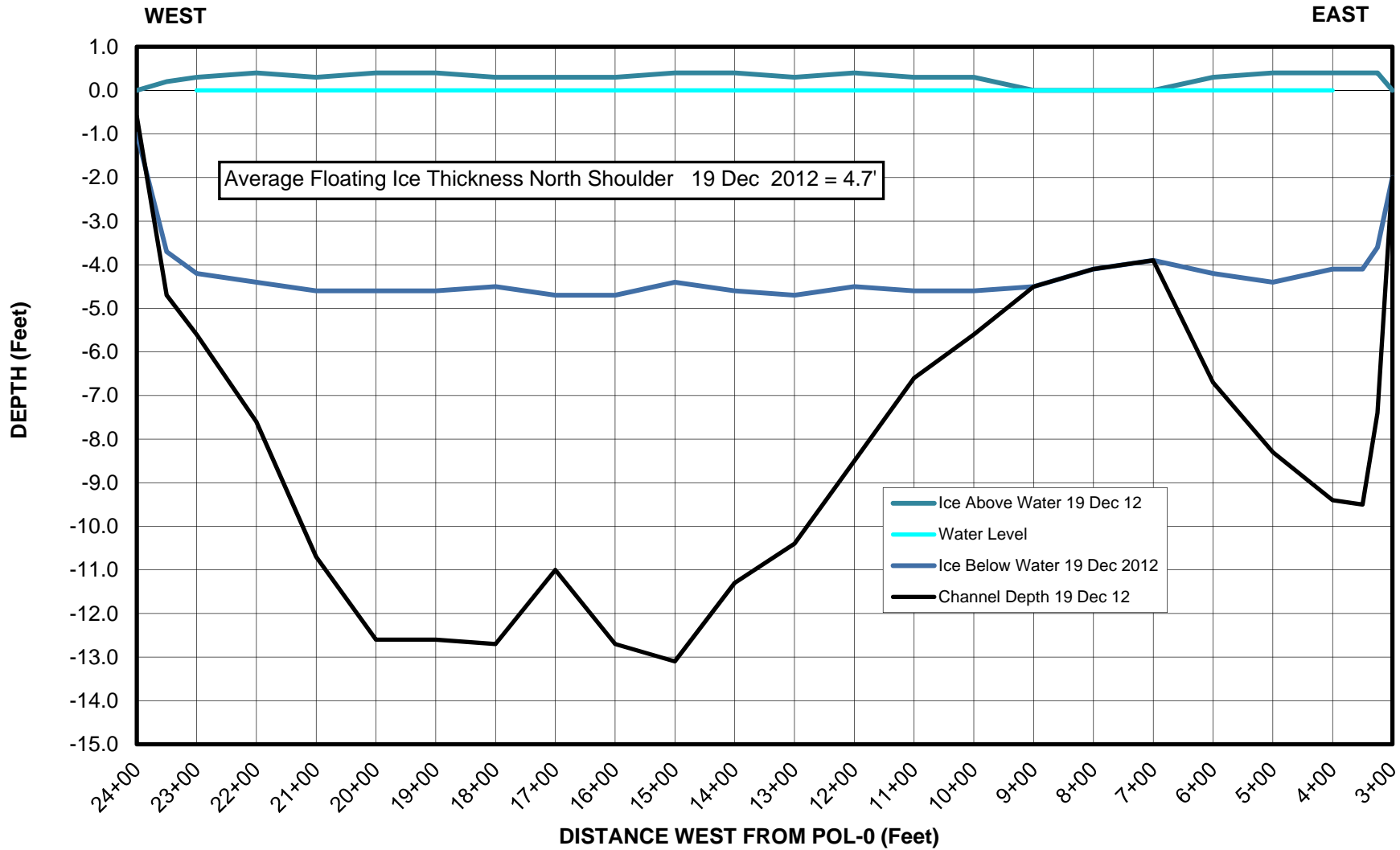
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
19 Dec 2012**



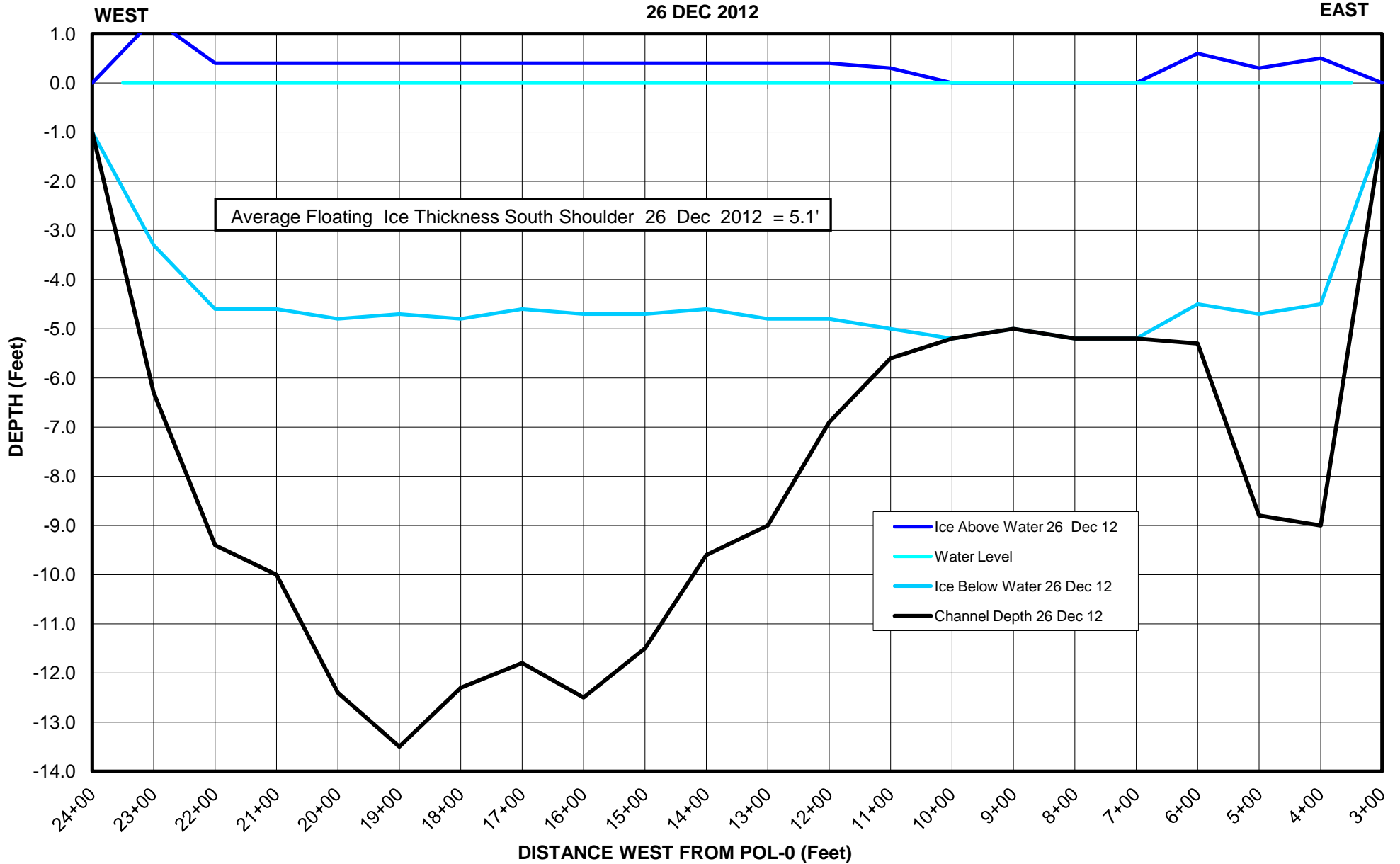
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
19 DEC 2012**



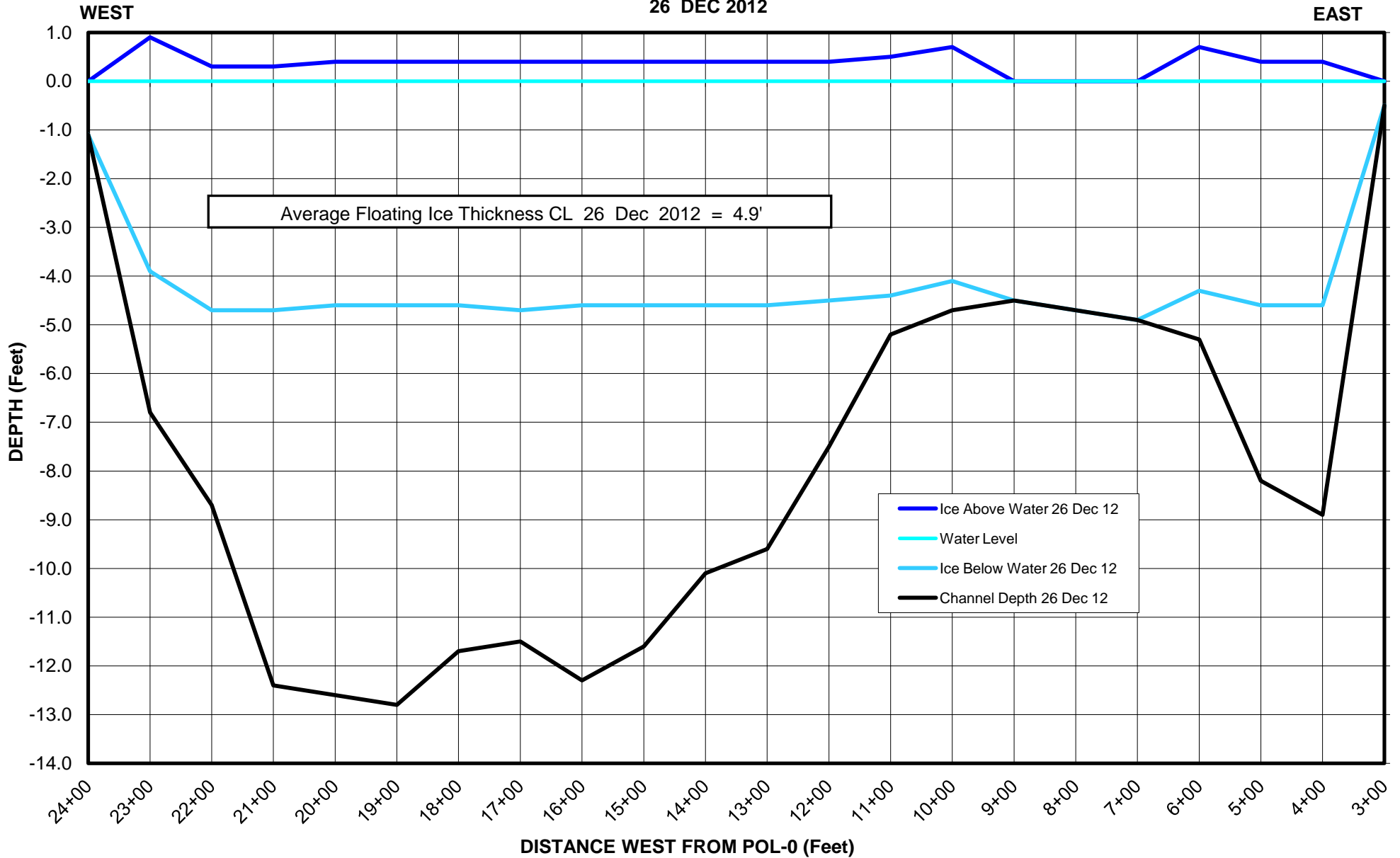
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
19 DEC 2012**



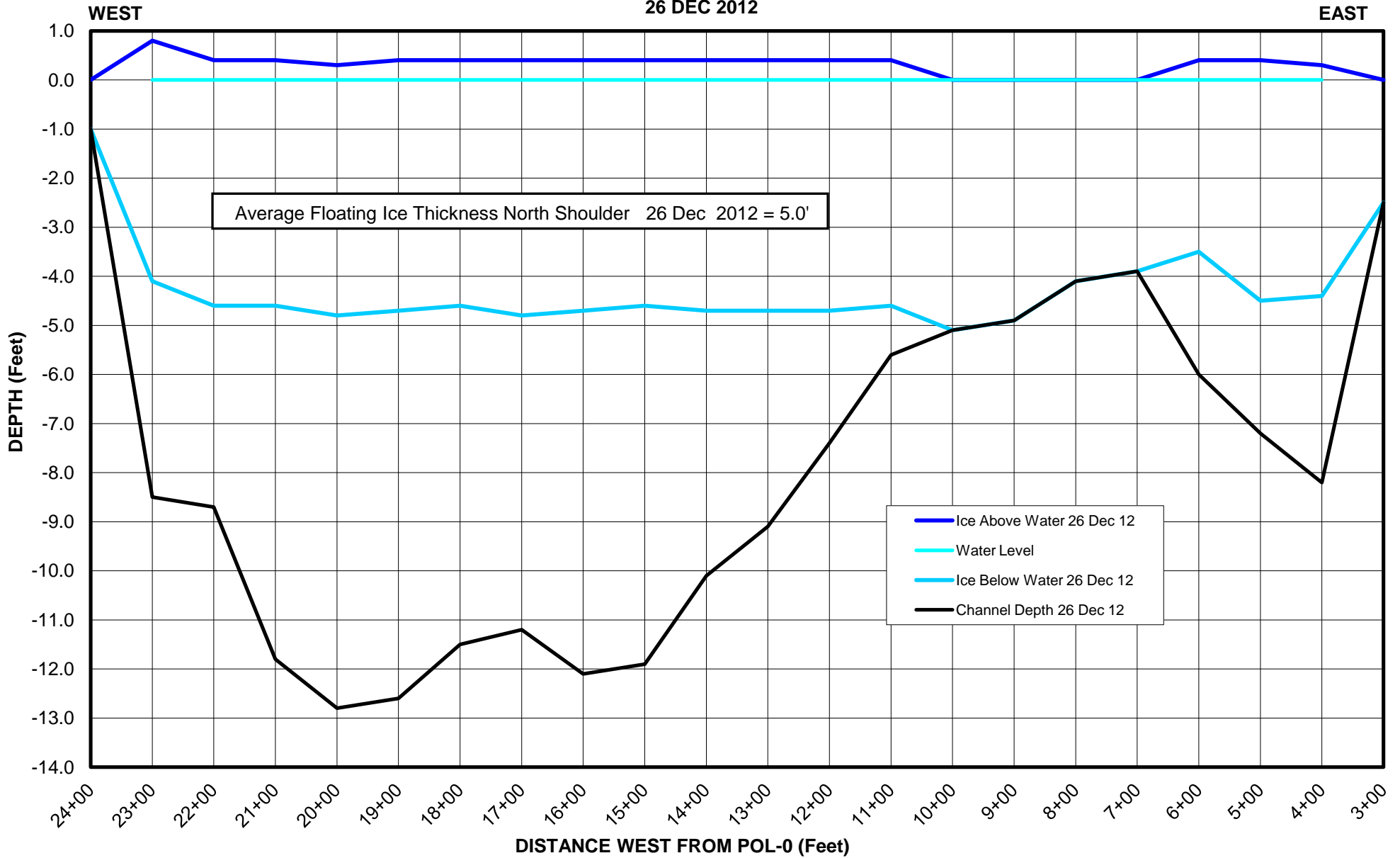
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
26 DEC 2012**



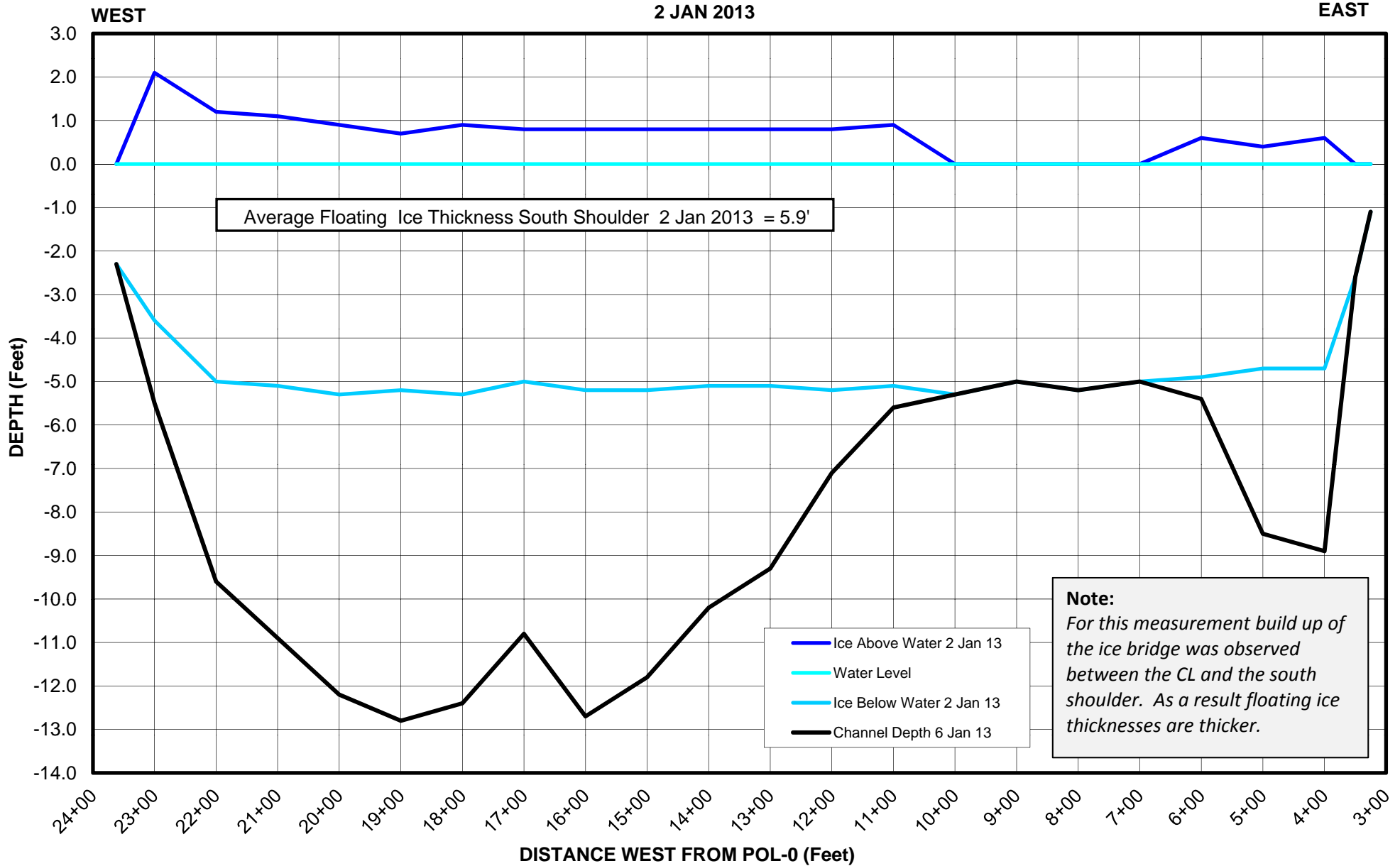
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
26 DEC 2012**



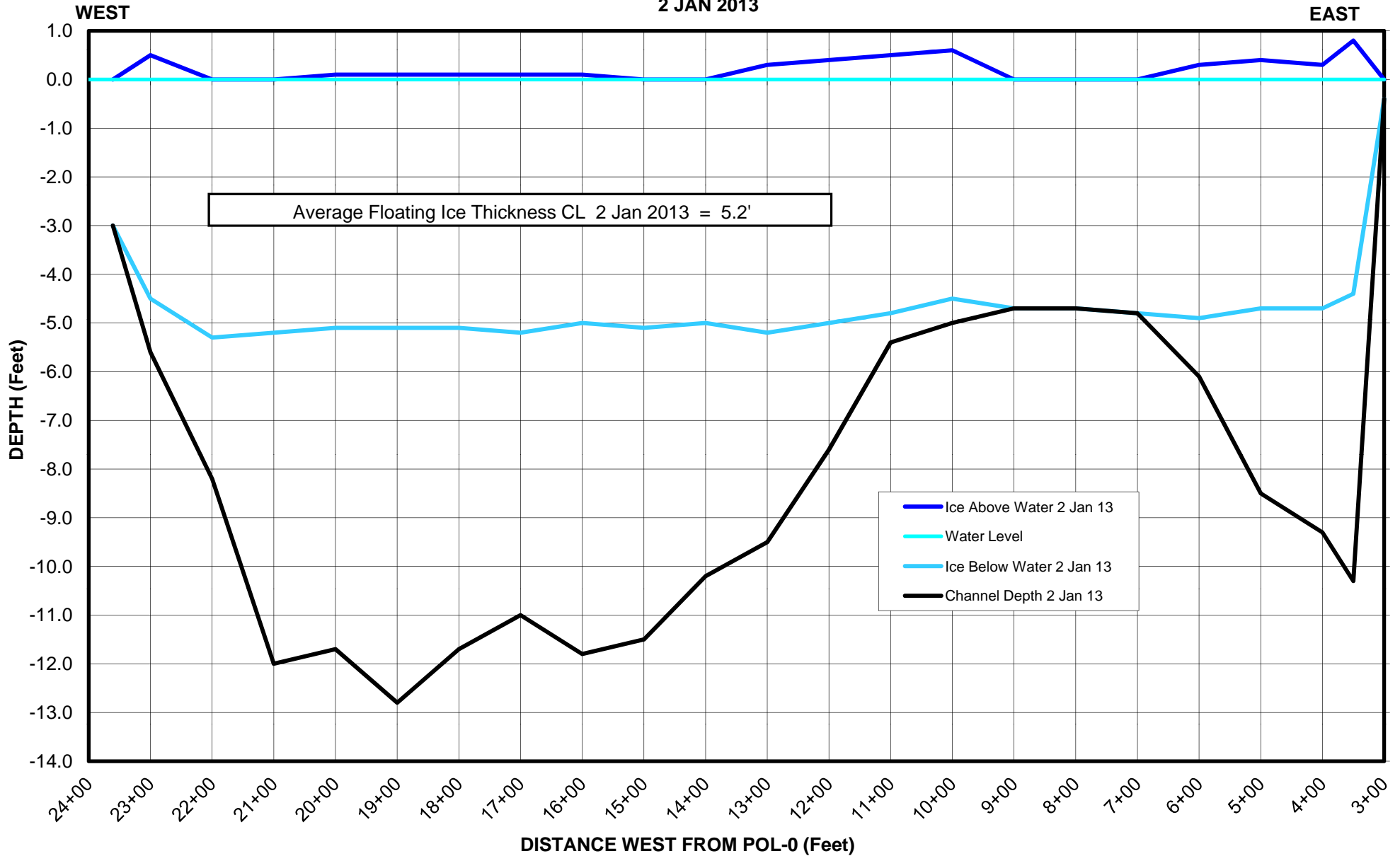
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
26 DEC 2012**



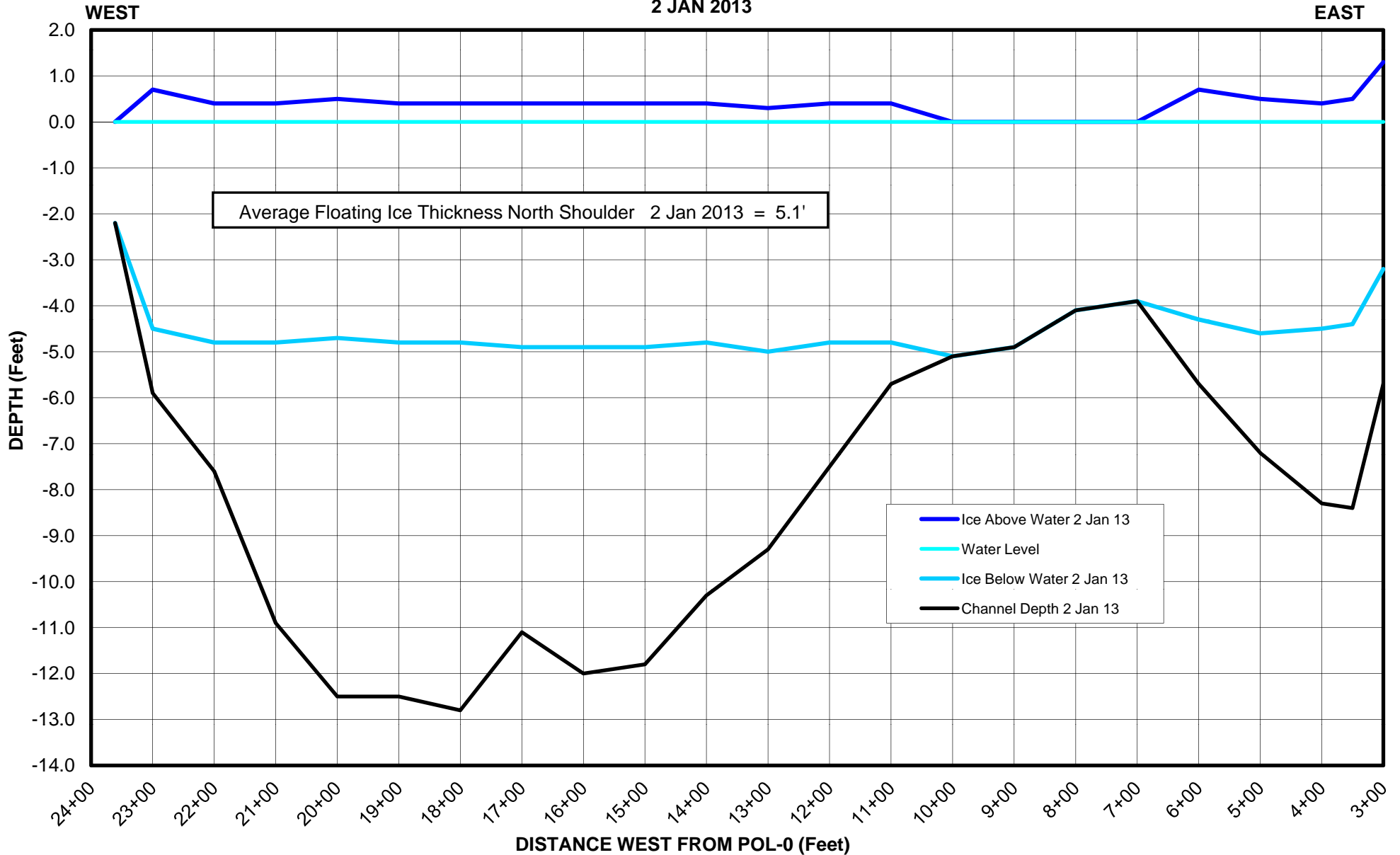
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
2 JAN 2013**



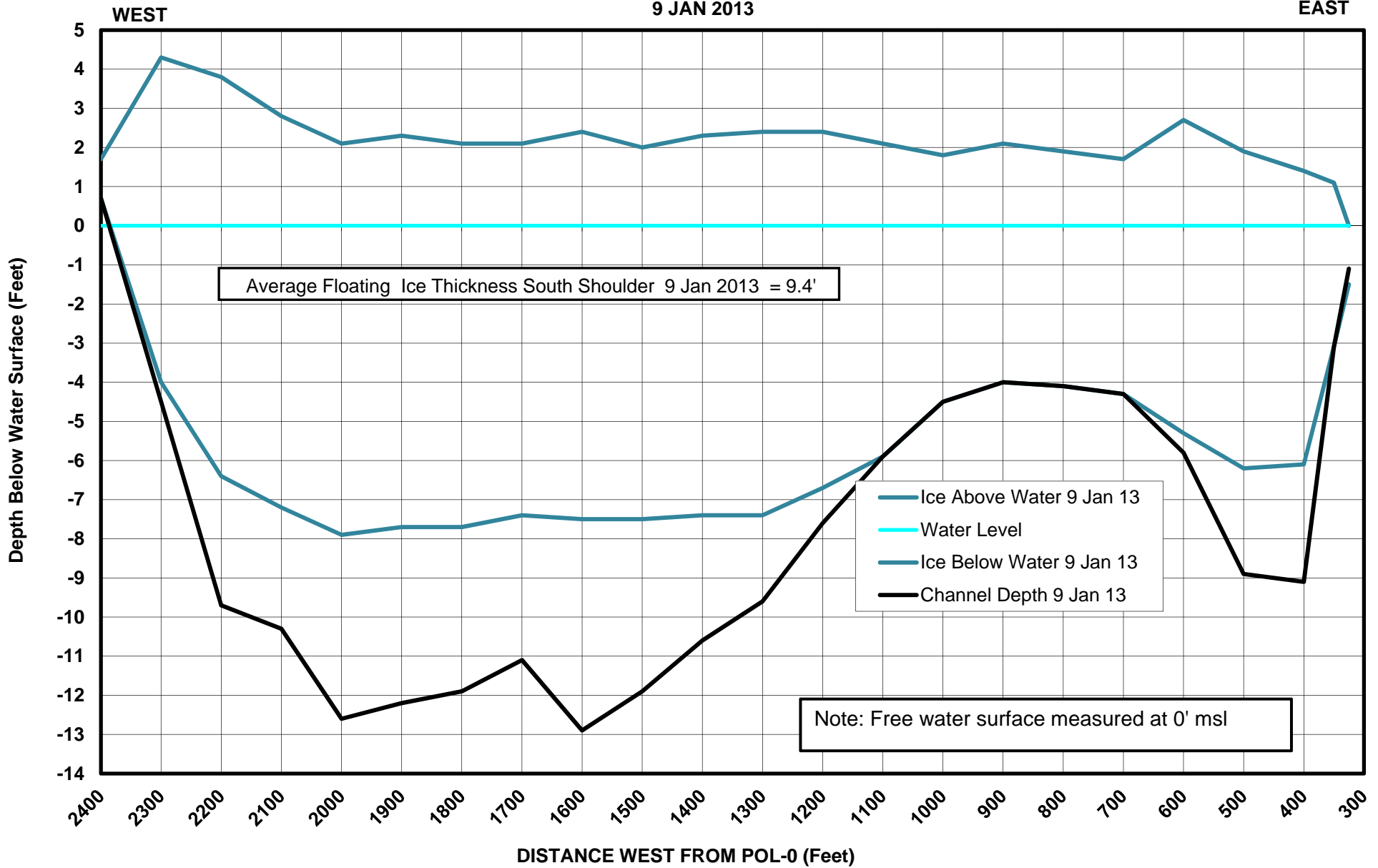
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
2 JAN 2013**



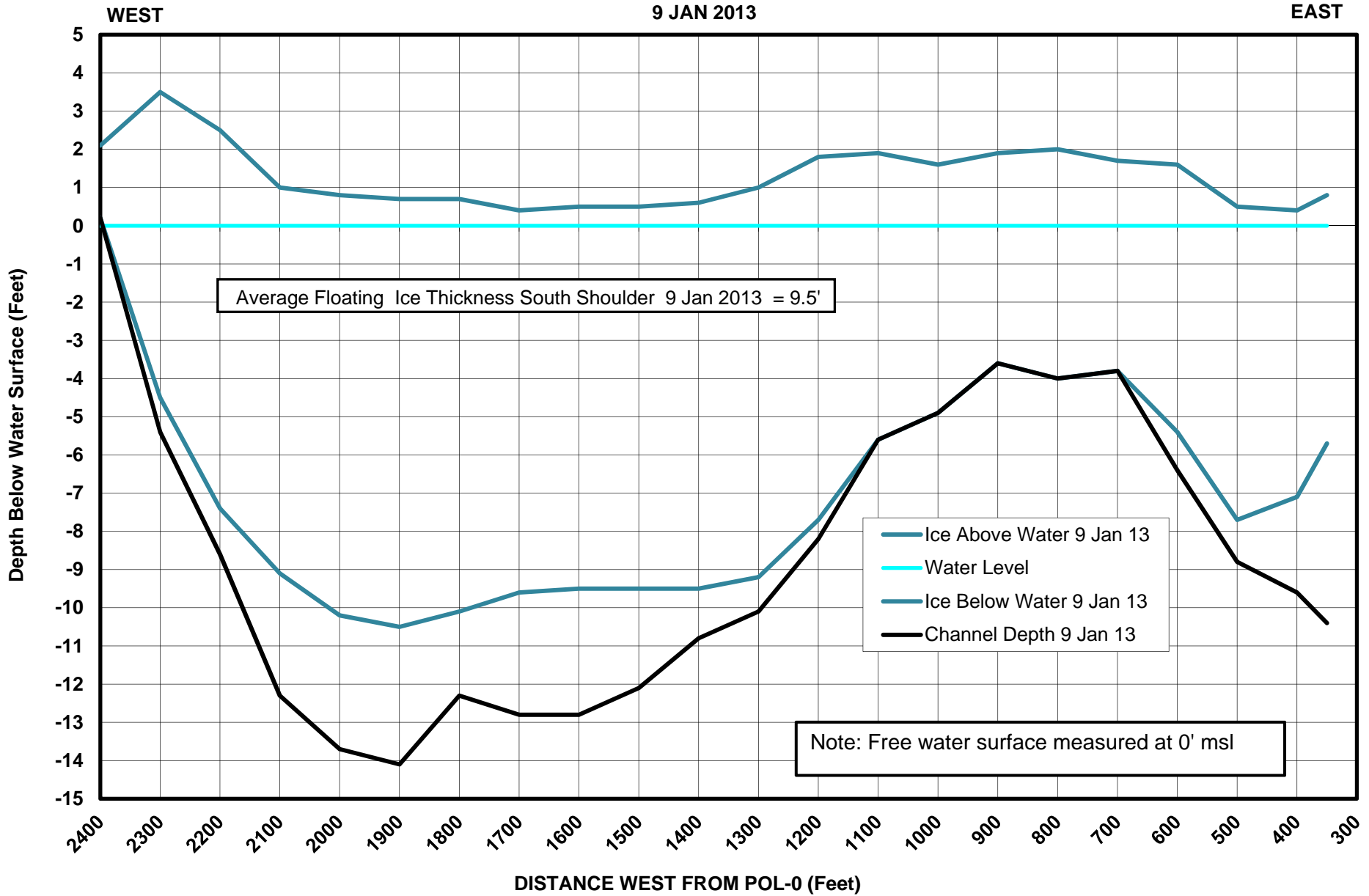
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
2 JAN 2013**



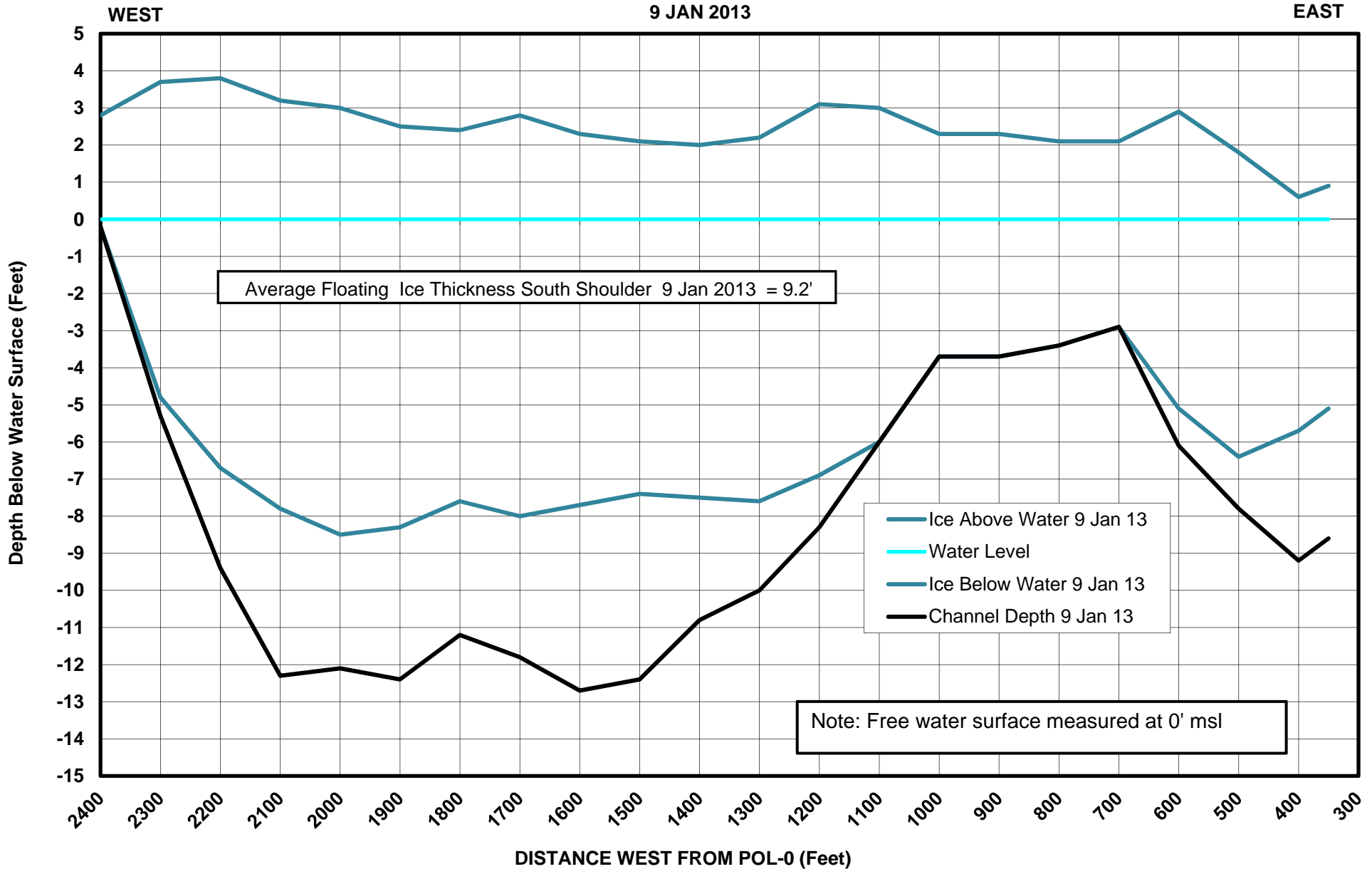
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
9 JAN 2013**



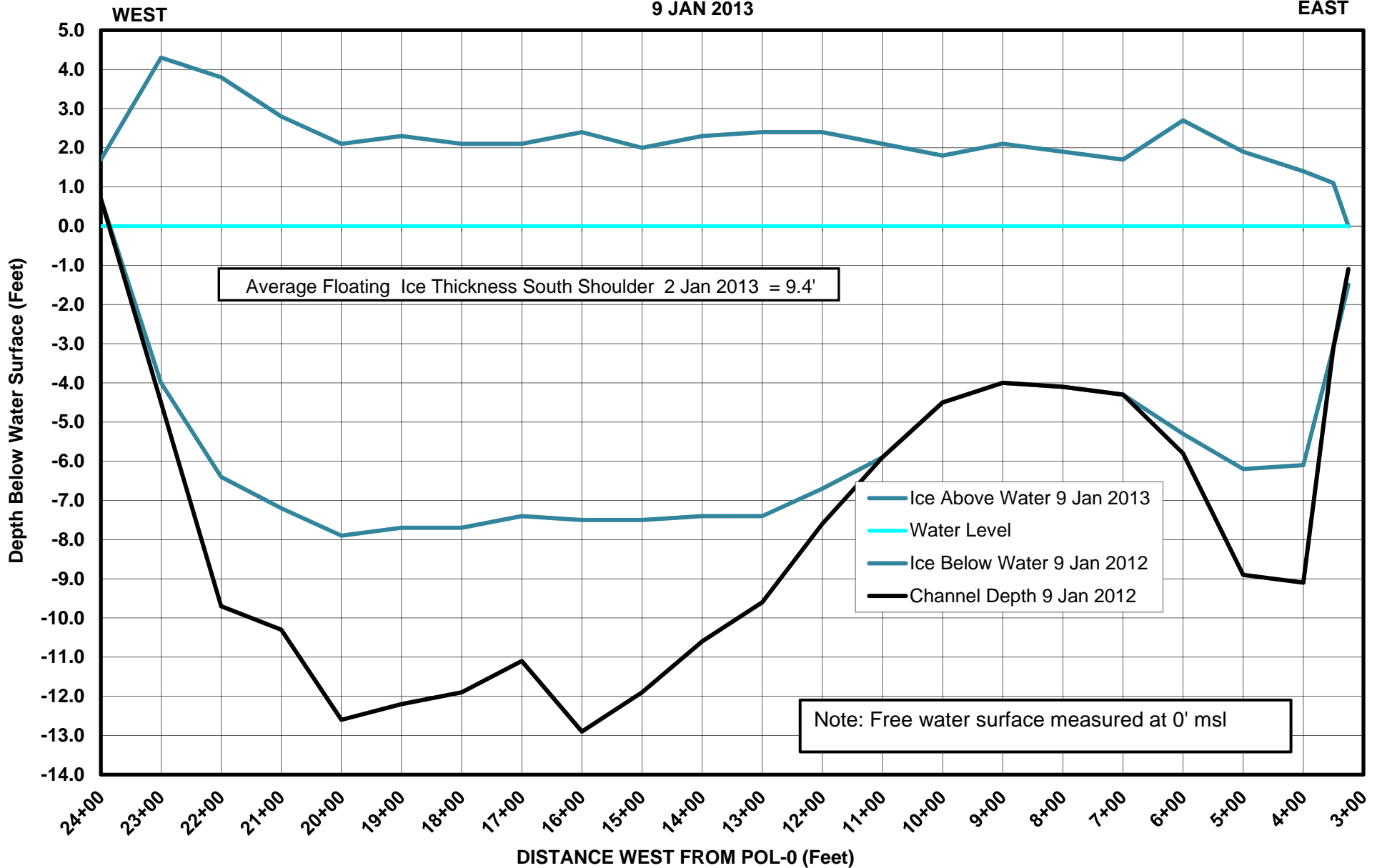
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
9 JAN 2013**



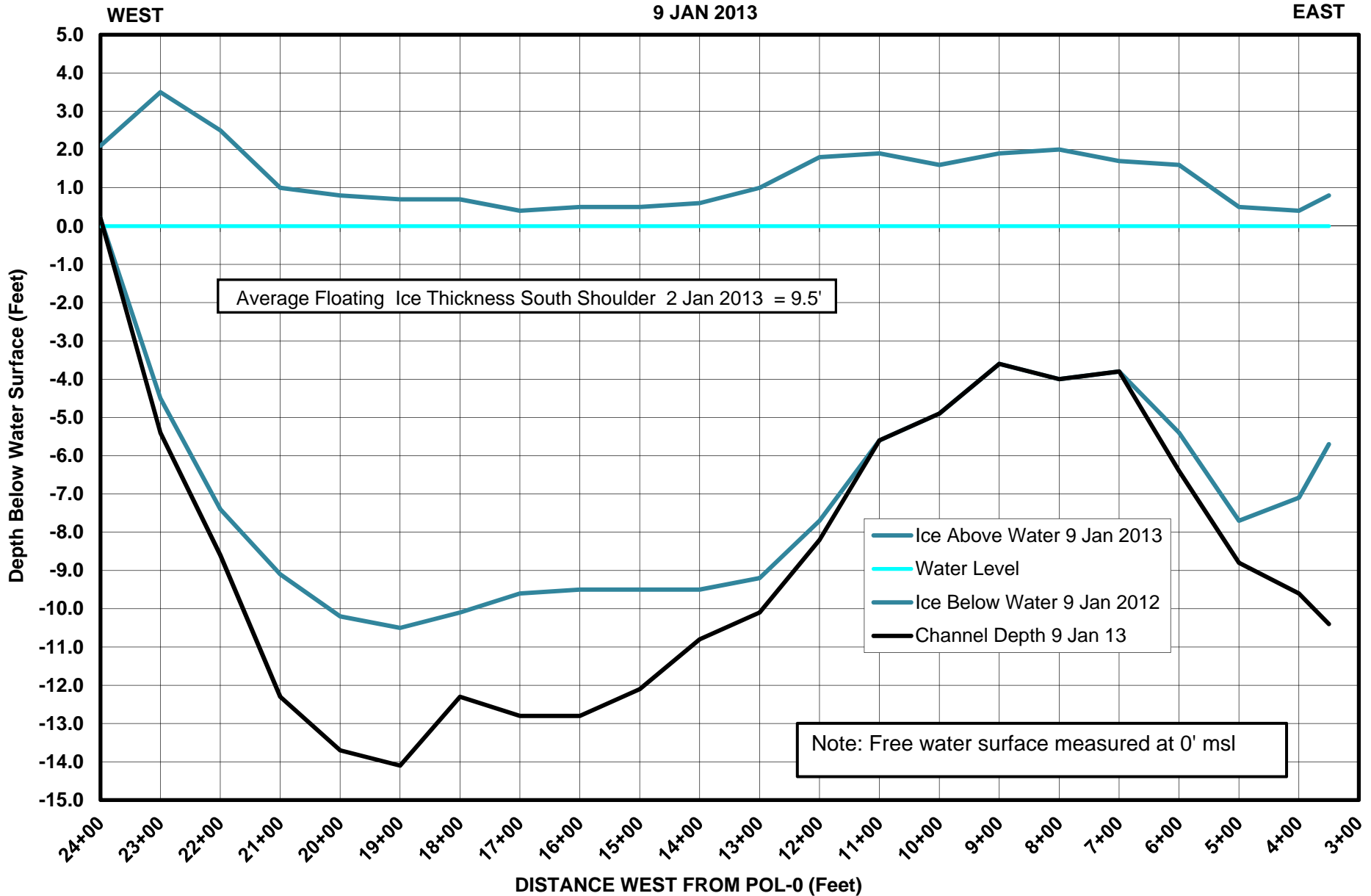
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
9 JAN 2013**



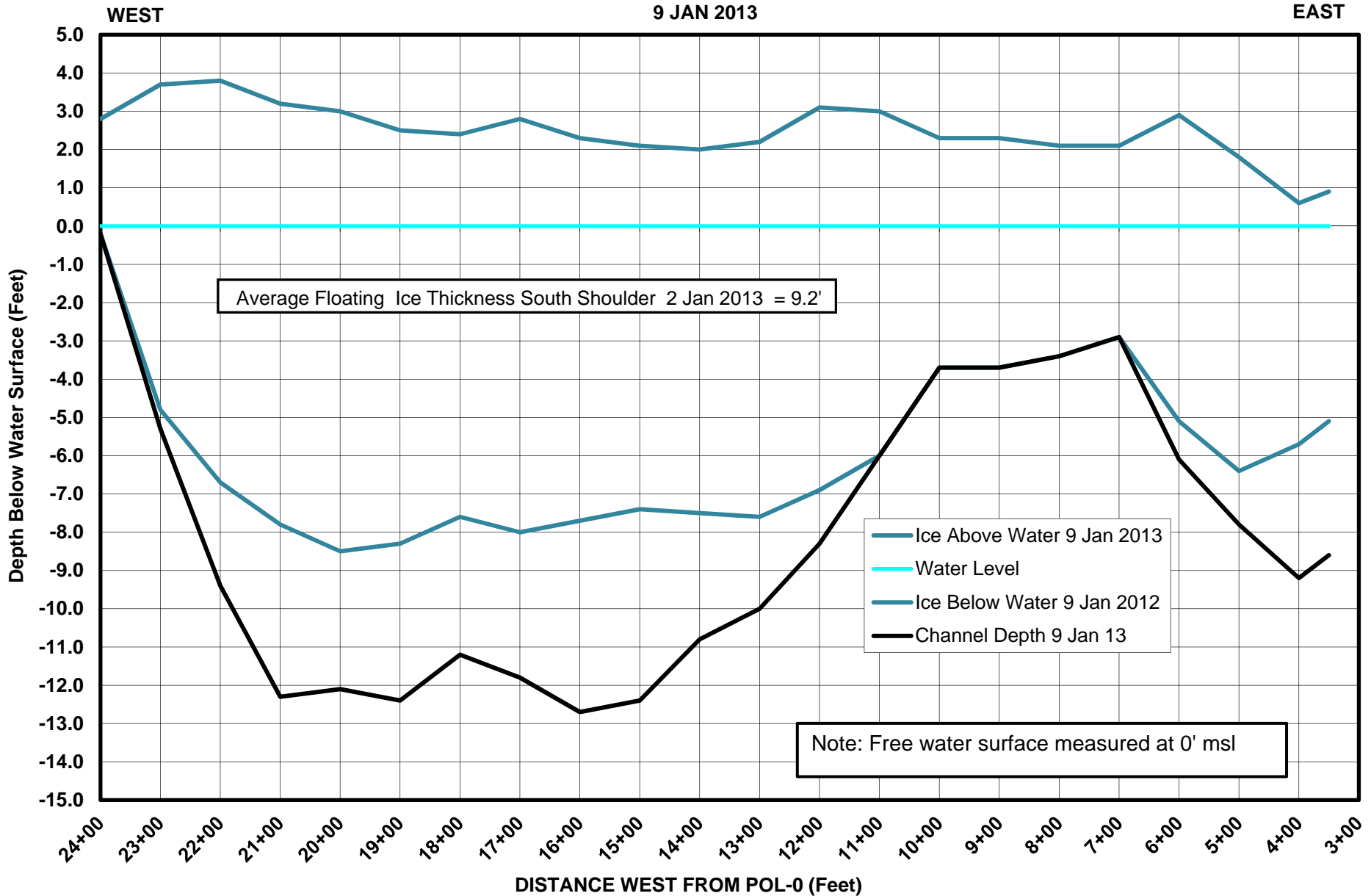
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
9 JAN 2013**



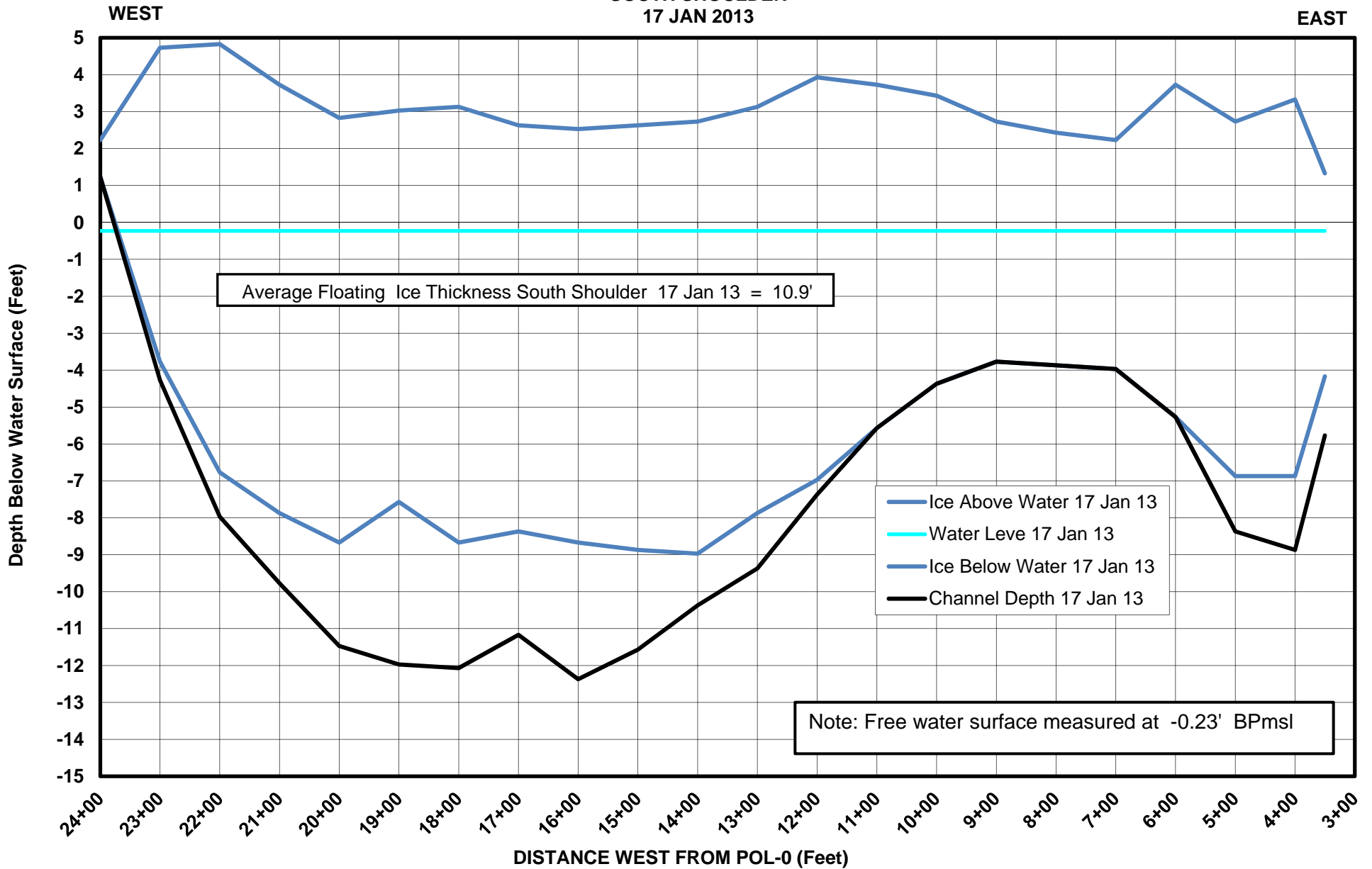
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
9 JAN 2013**



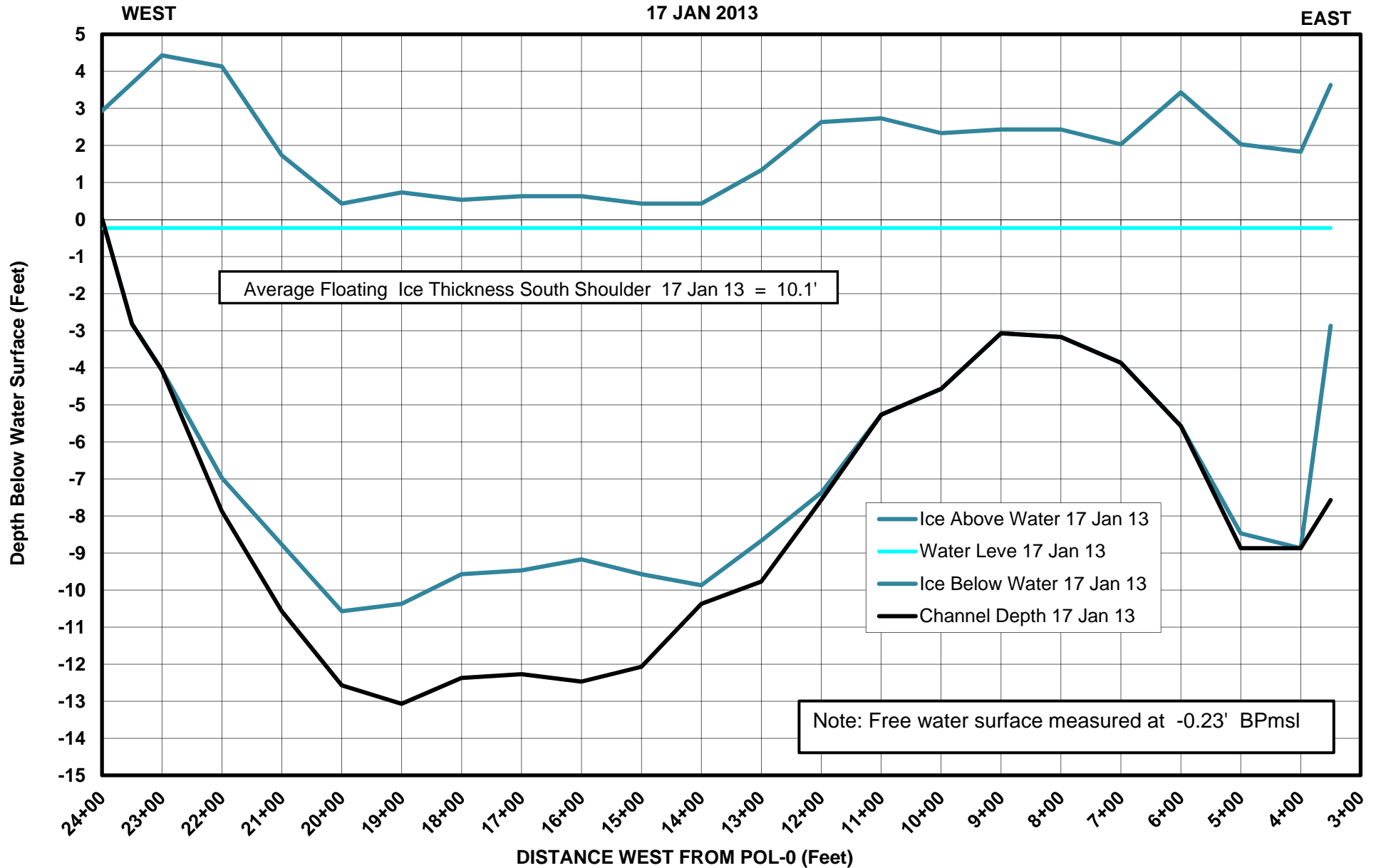
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
9 JAN 2013**



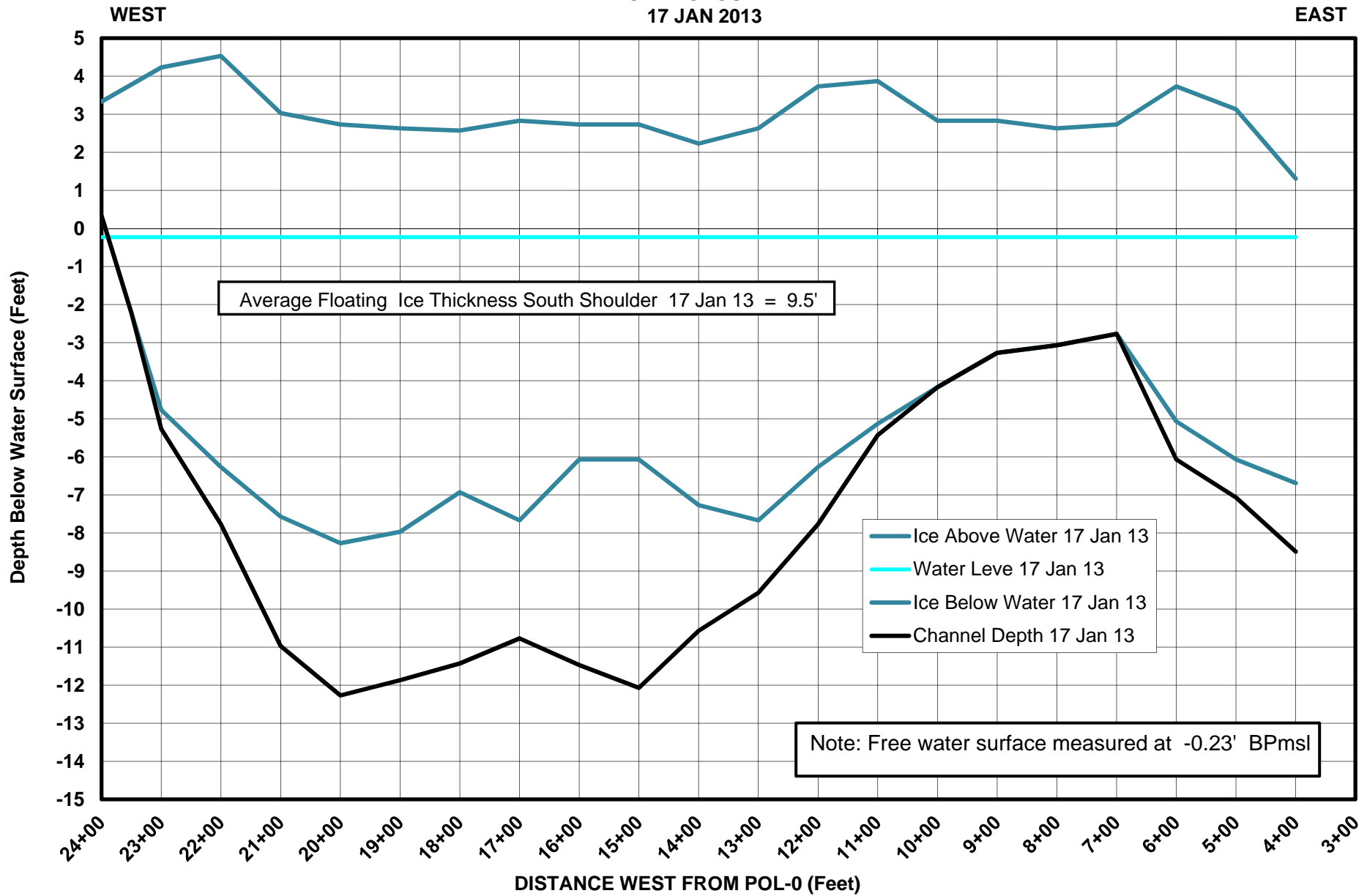
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
17 JAN 2013**



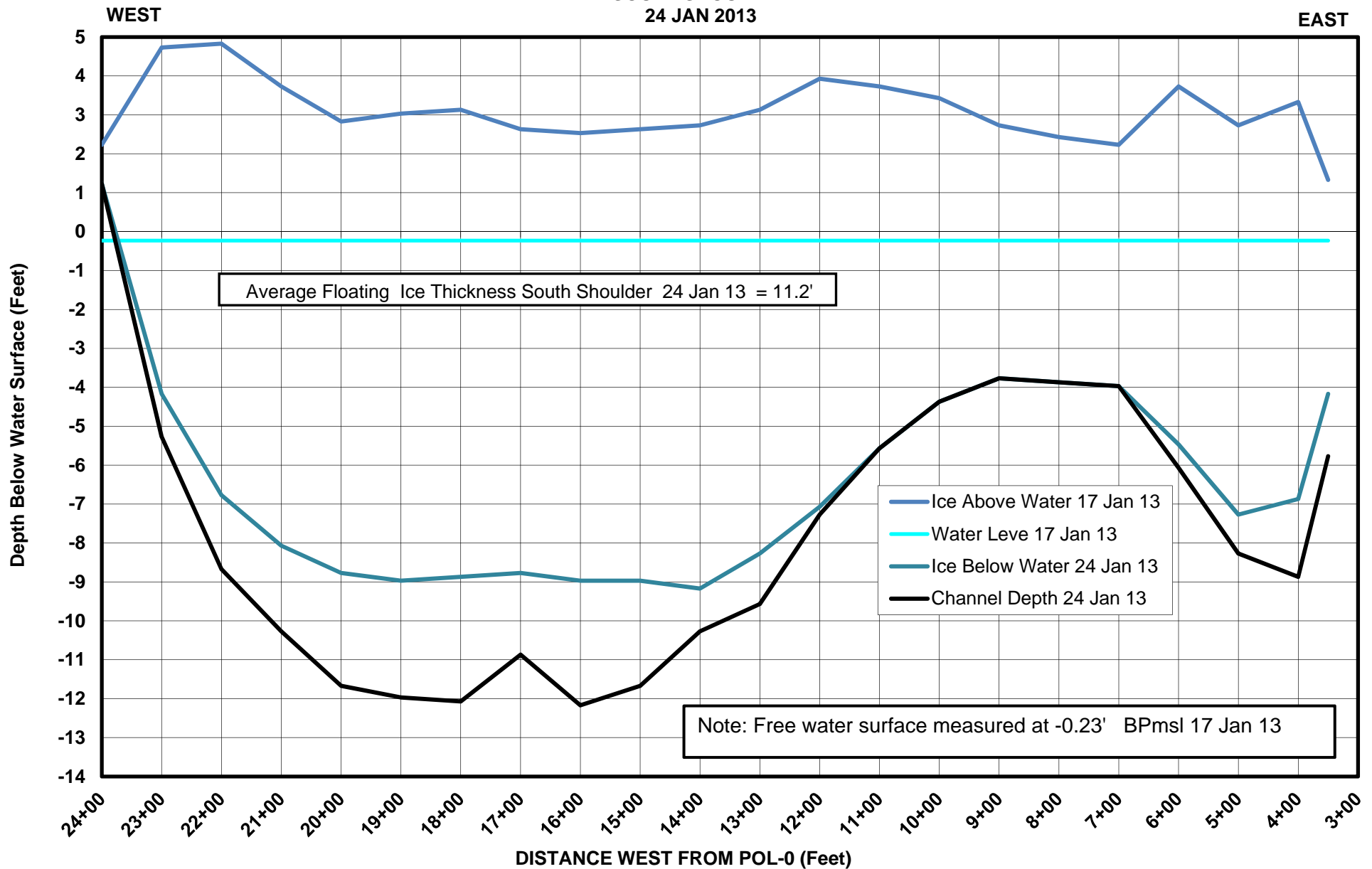
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
17 JAN 2013**



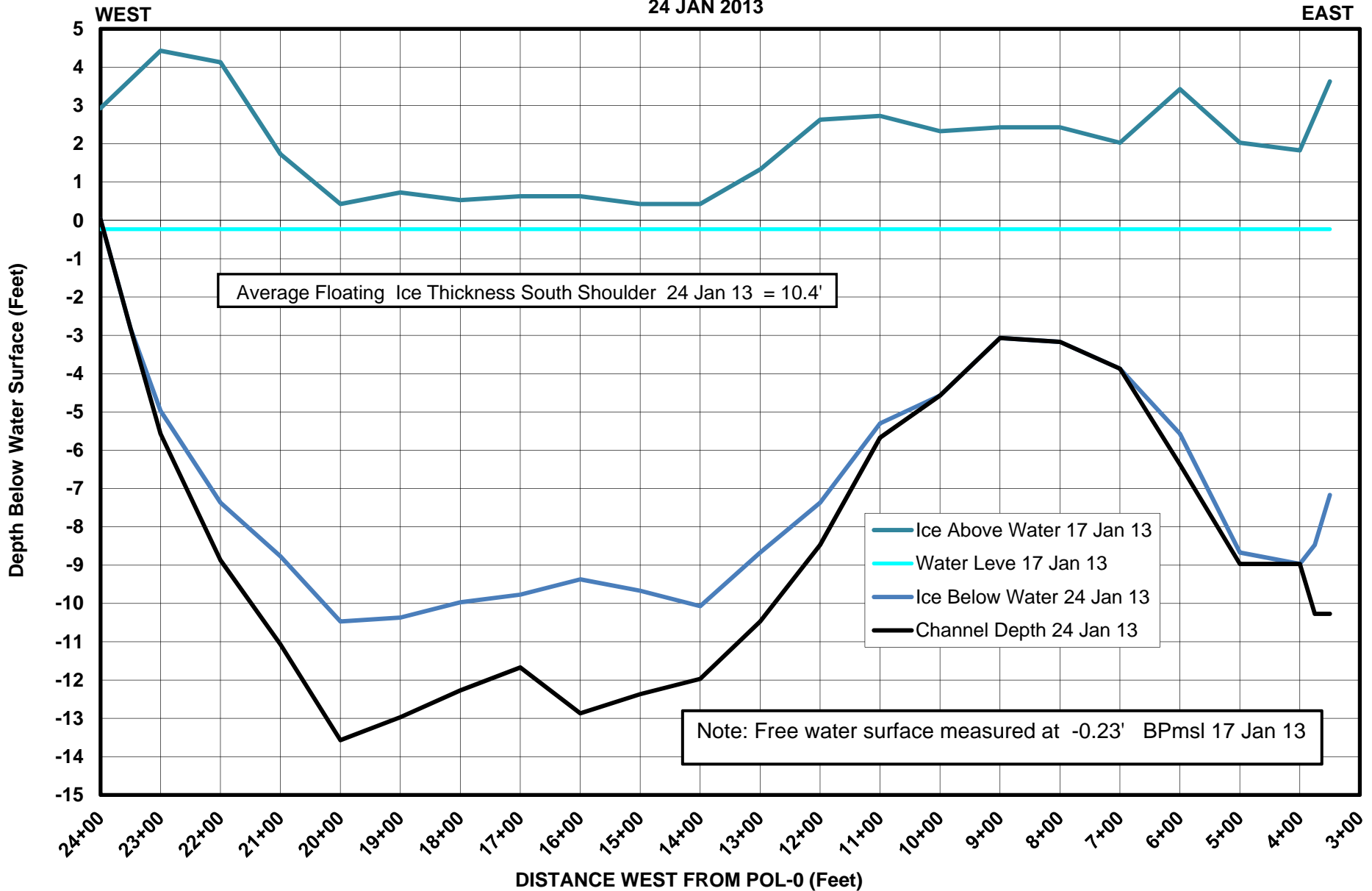
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
17 JAN 2013**



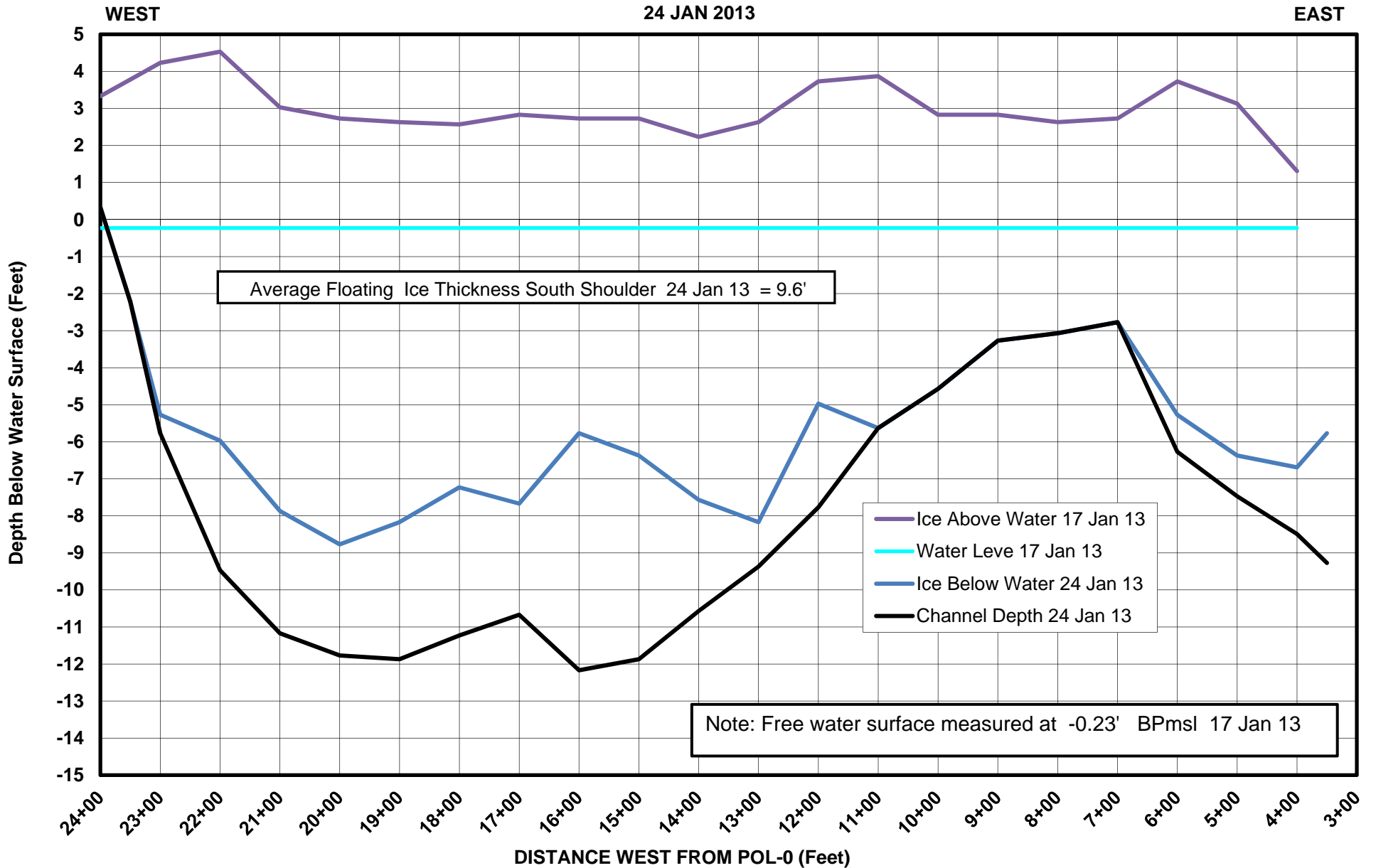
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
24 JAN 2013**



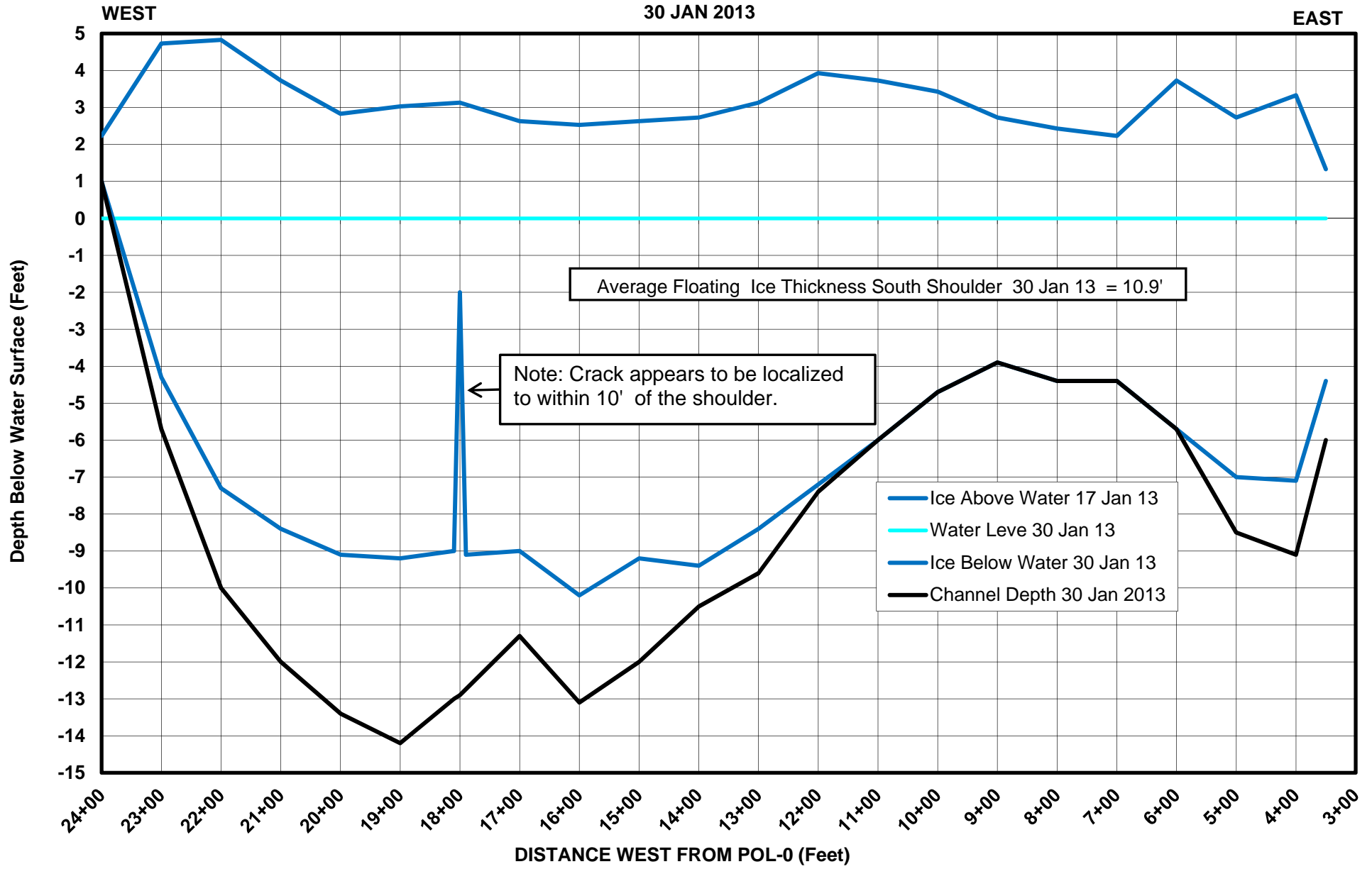
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
24 JAN 2013**



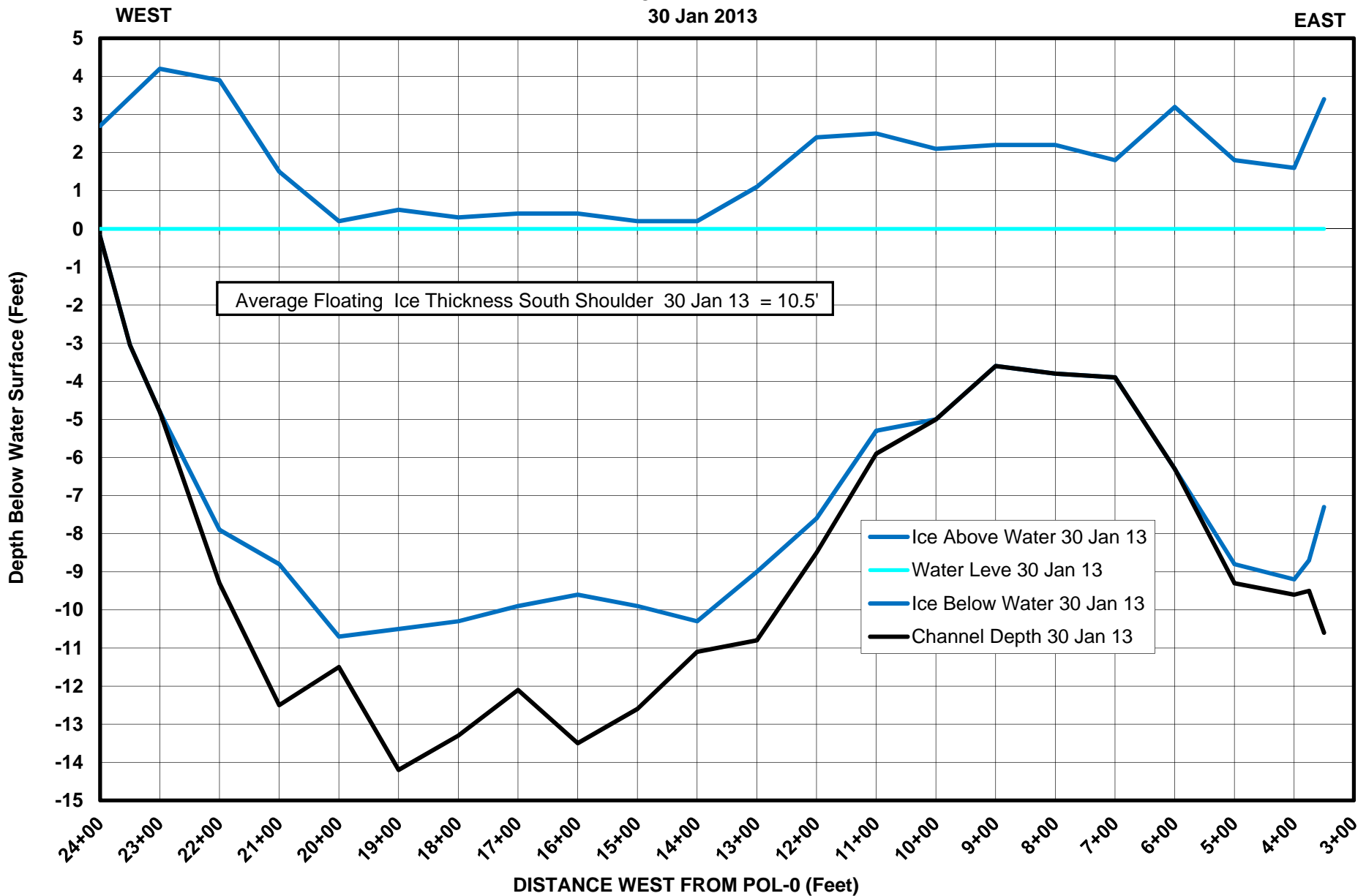
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
24 JAN 2013**



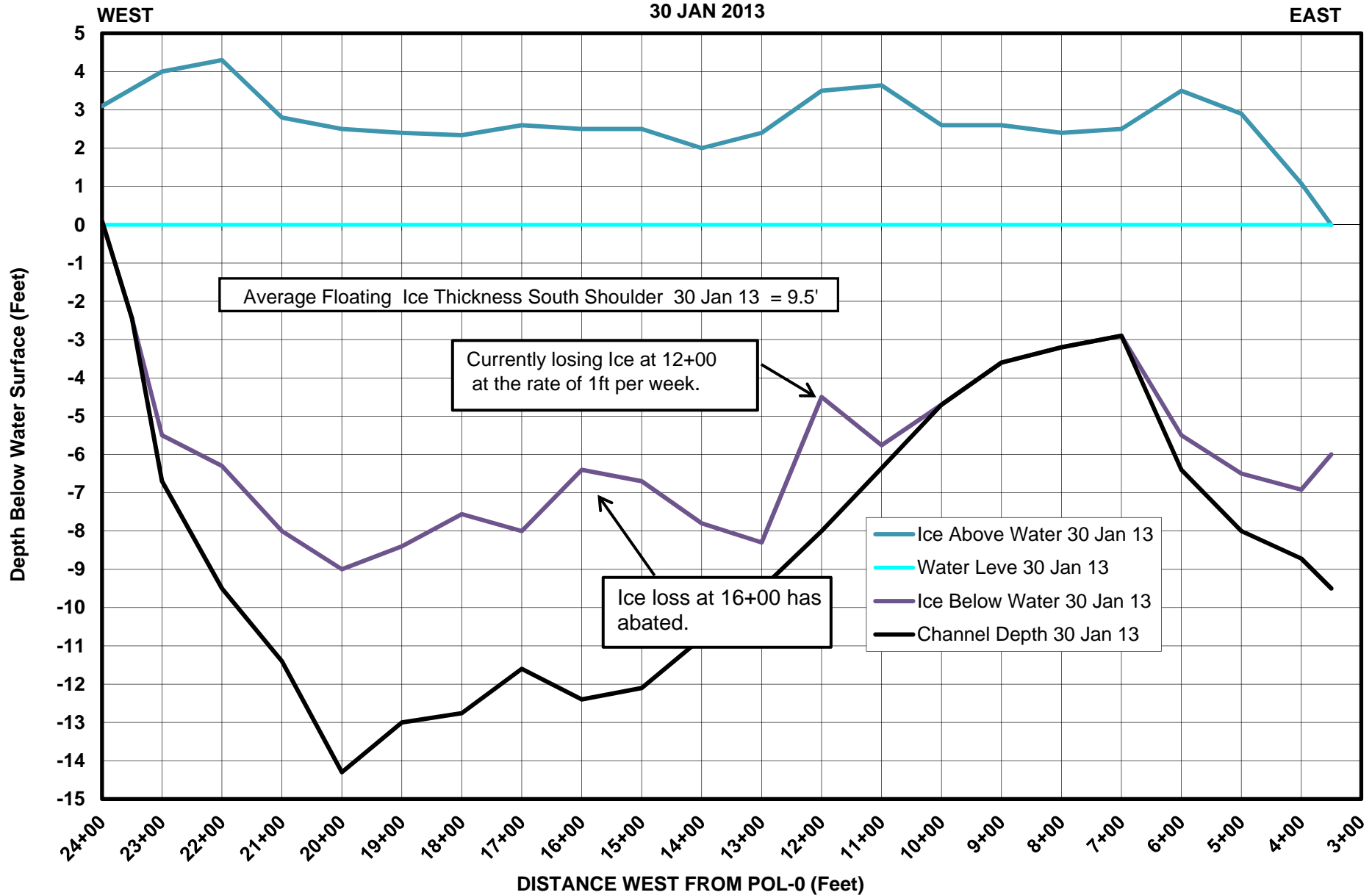
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
30 JAN 2013**



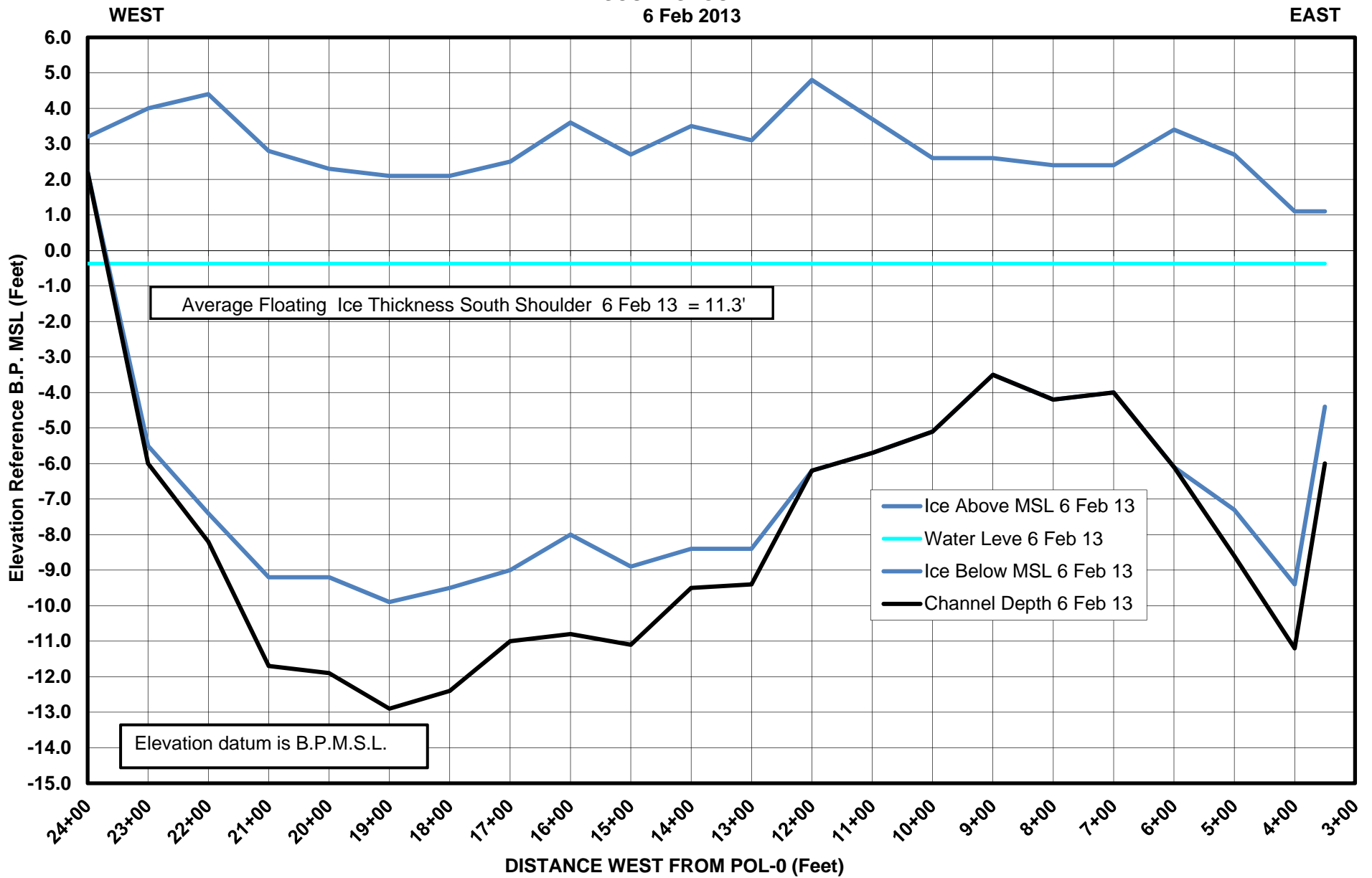
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
30 Jan 2013**



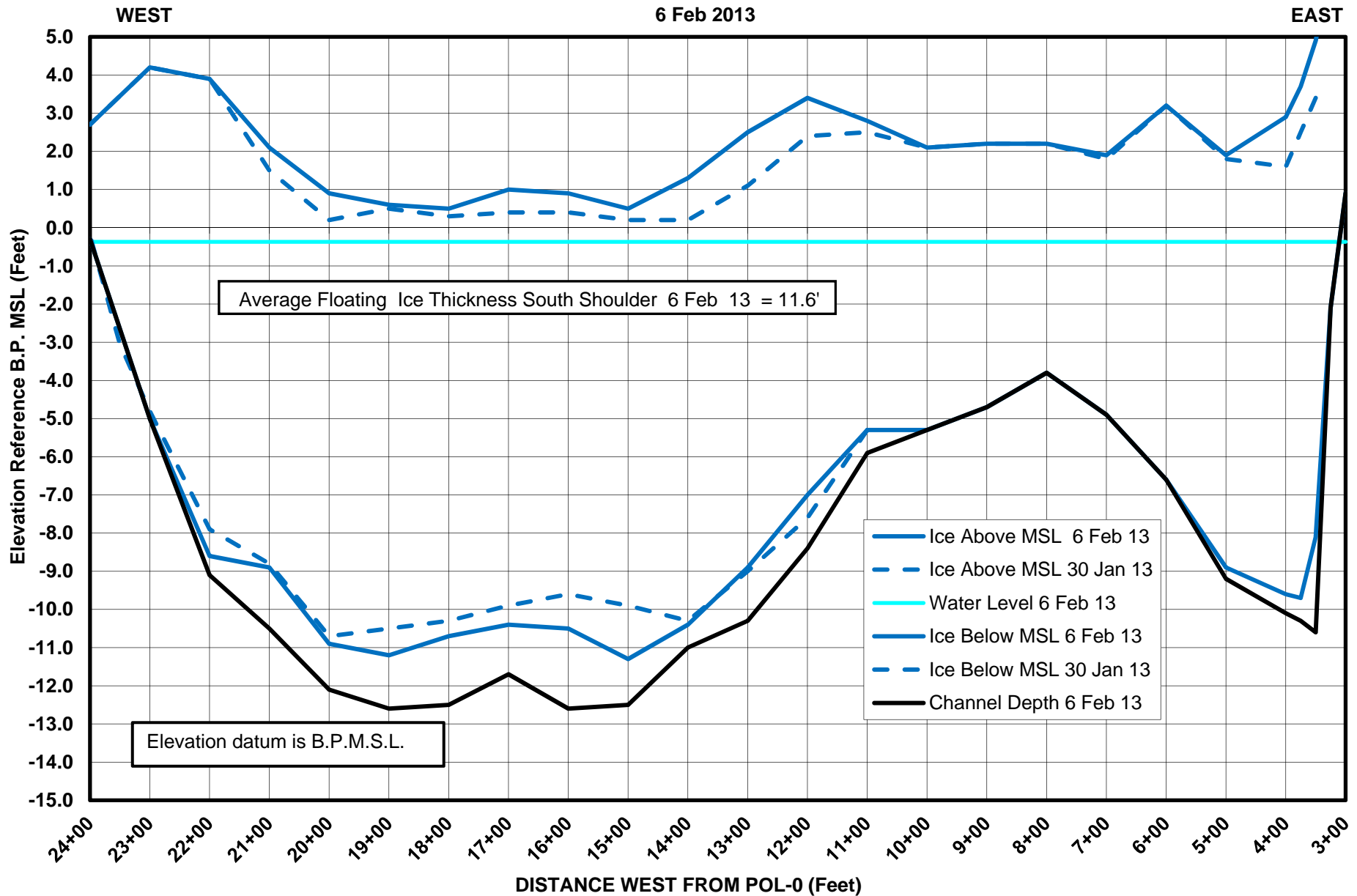
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
30 JAN 2013**



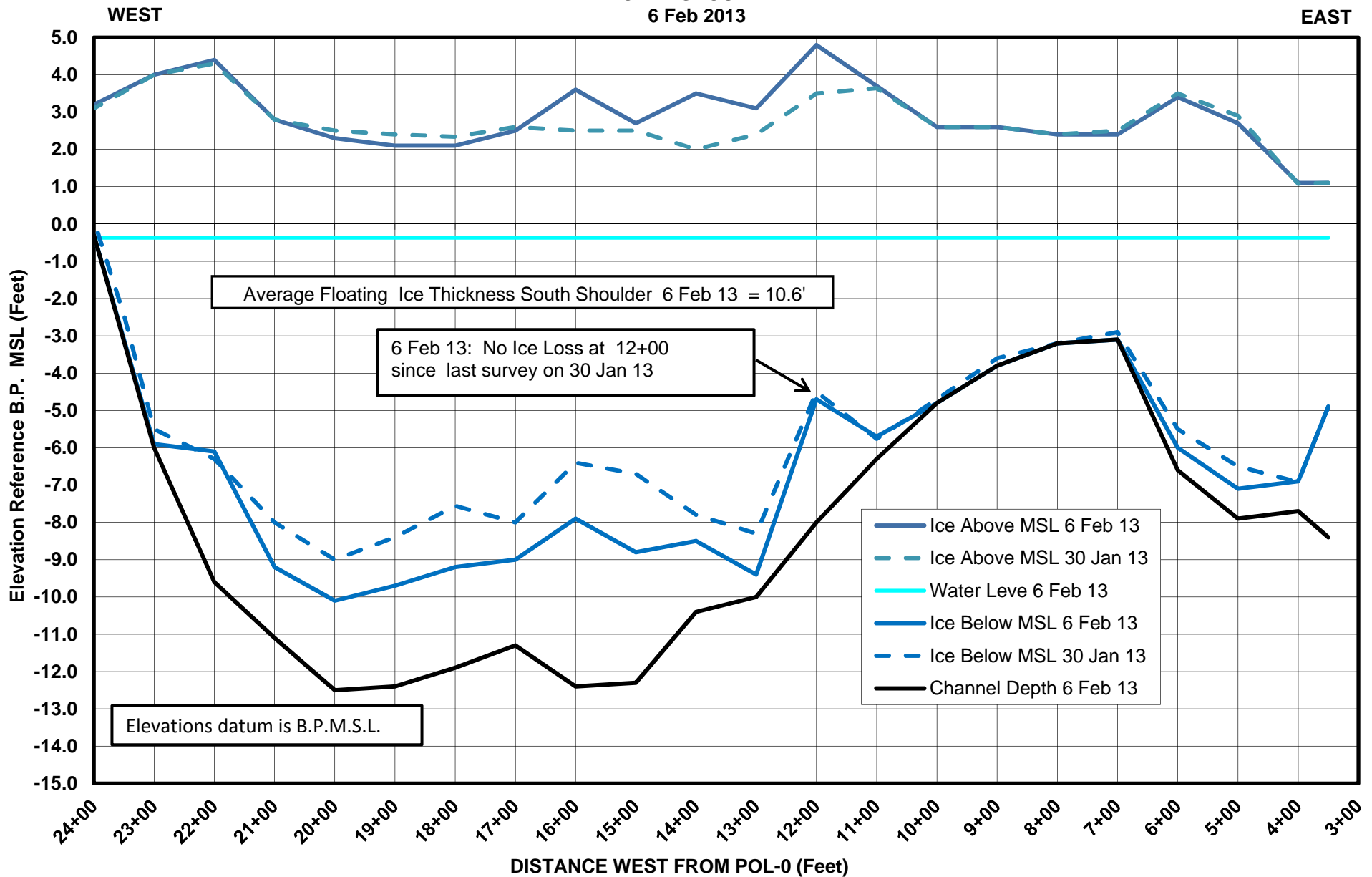
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
6 Feb 2013**



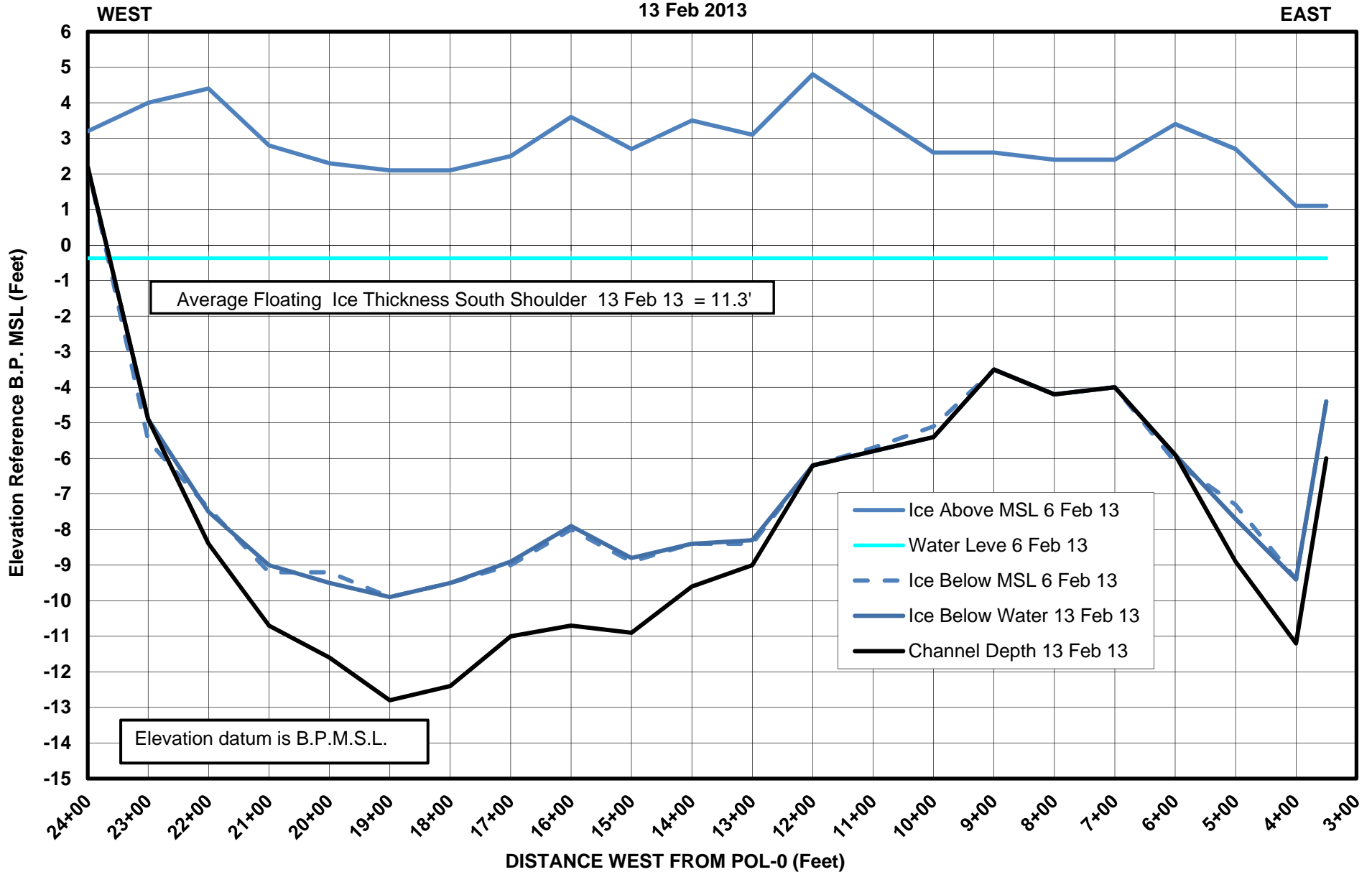
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
6 Feb 2013**



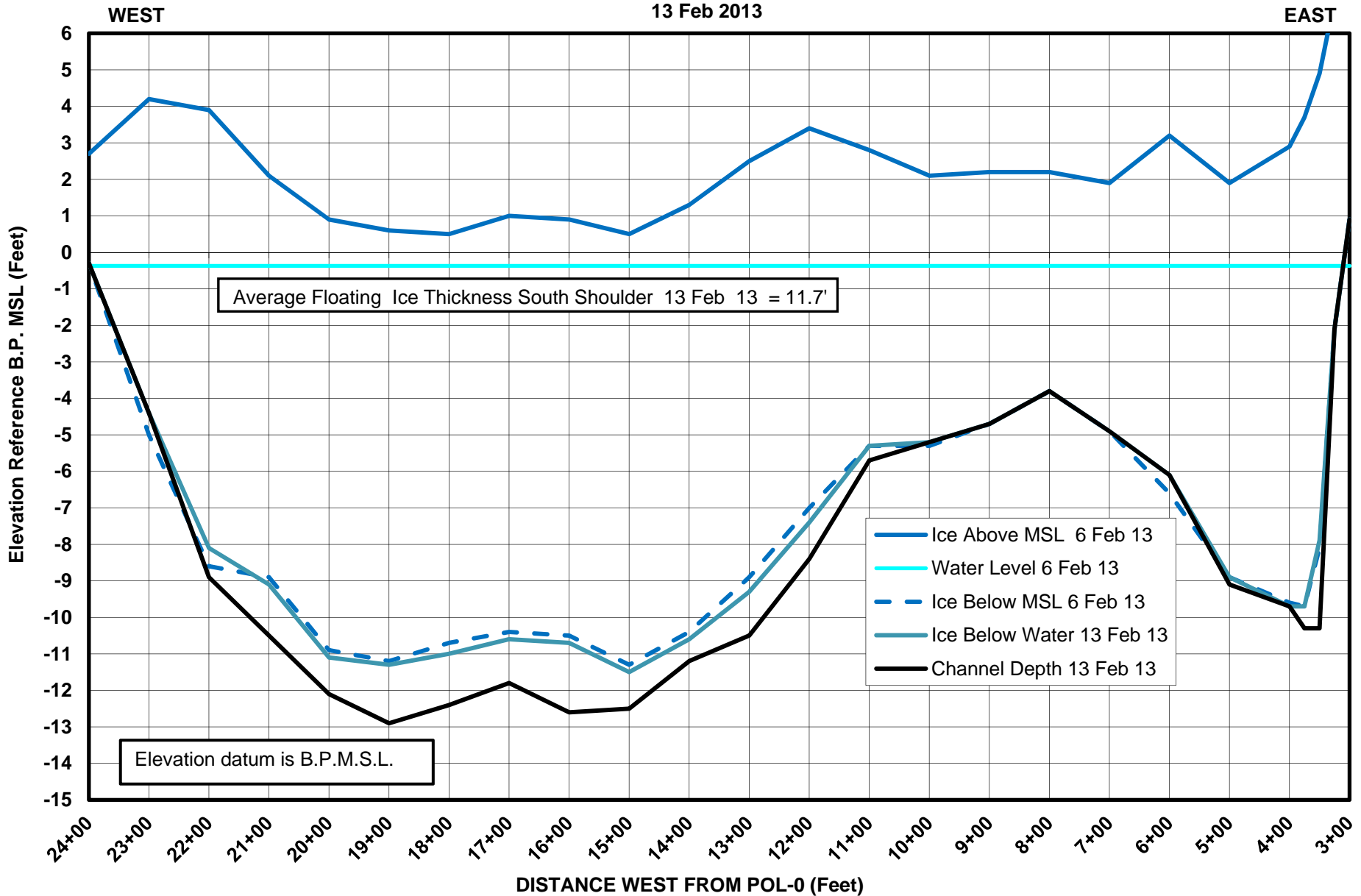
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
6 Feb 2013**



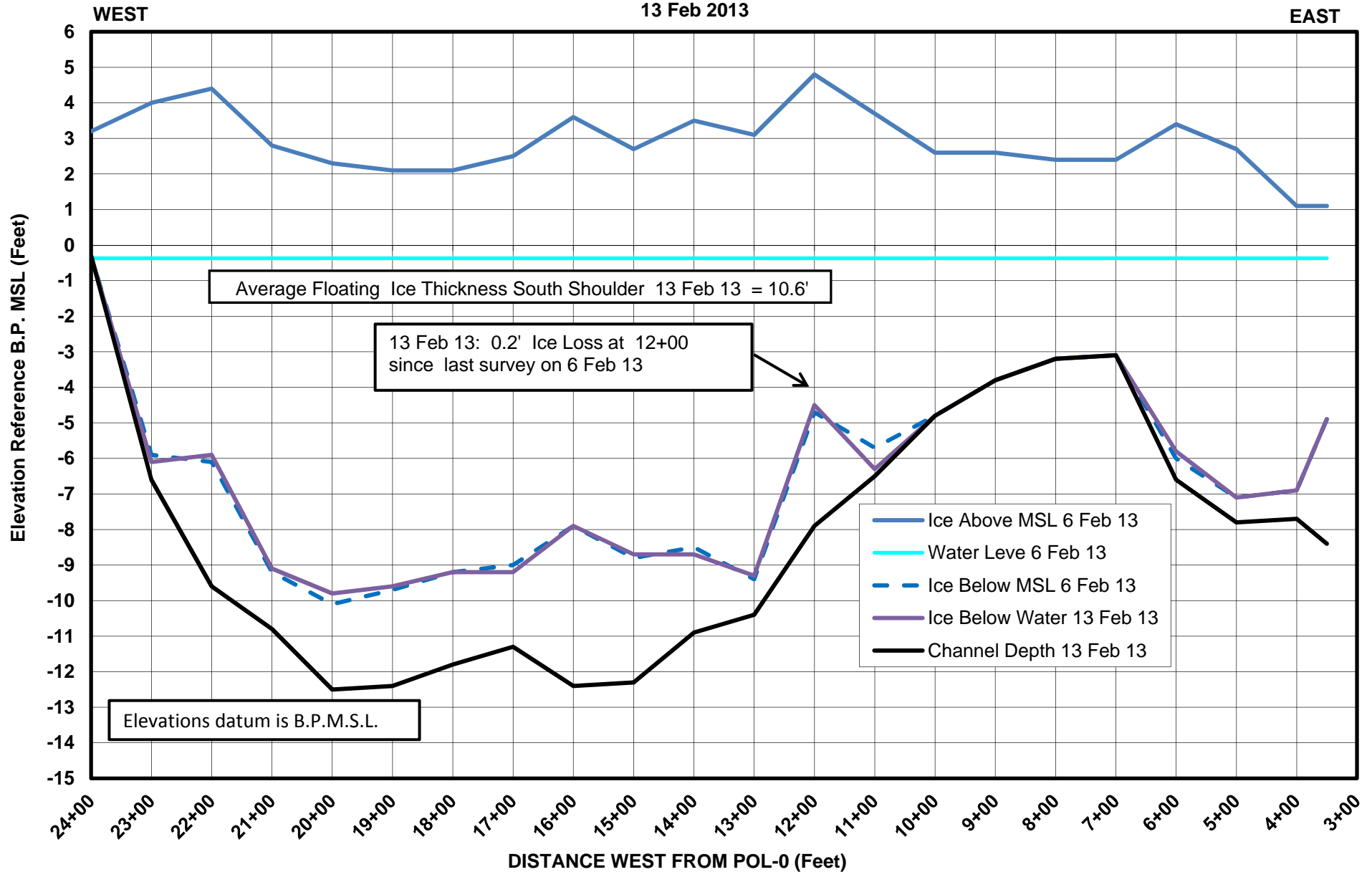
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
13 Feb 2013**



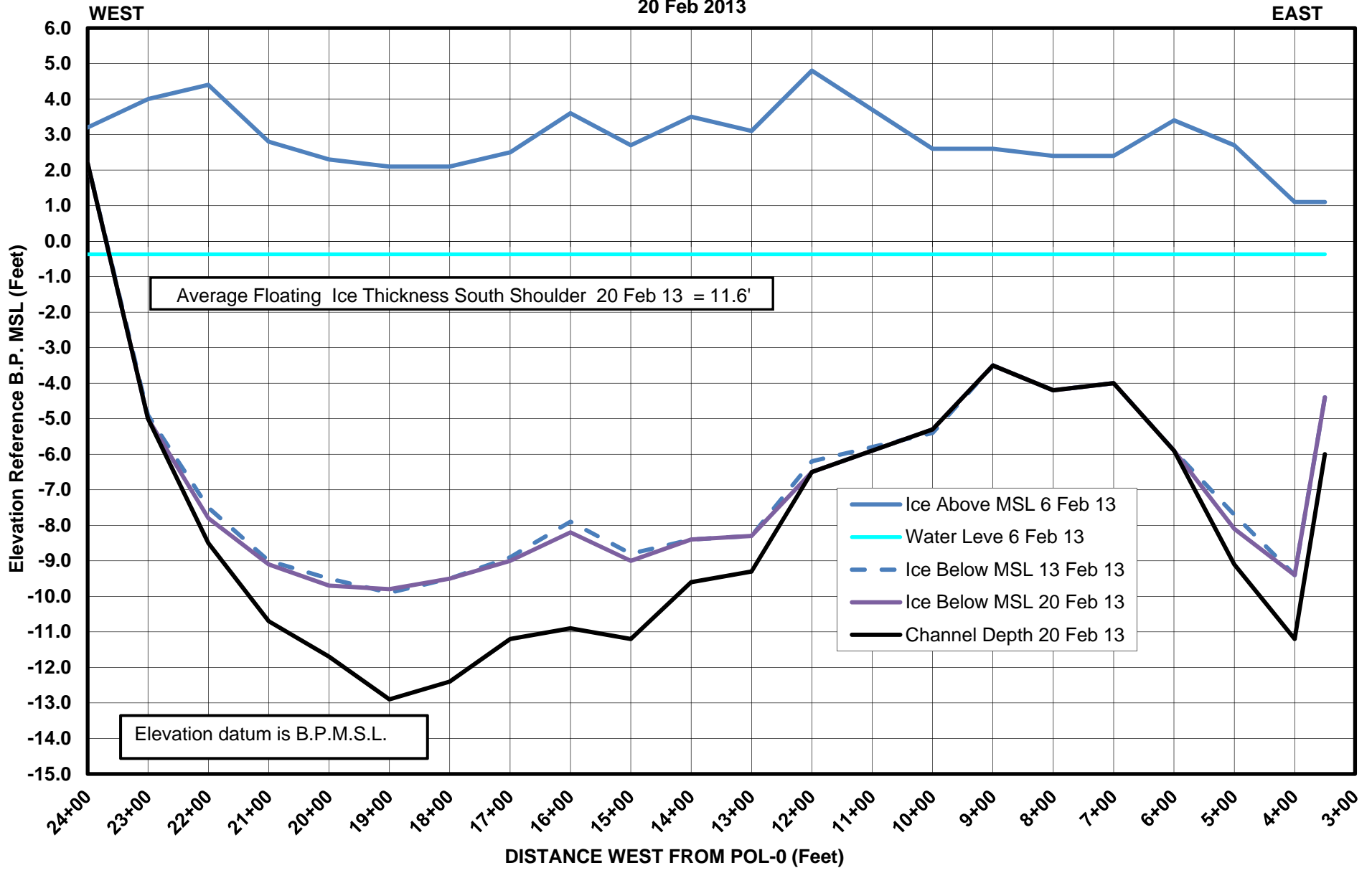
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
13 Feb 2013**



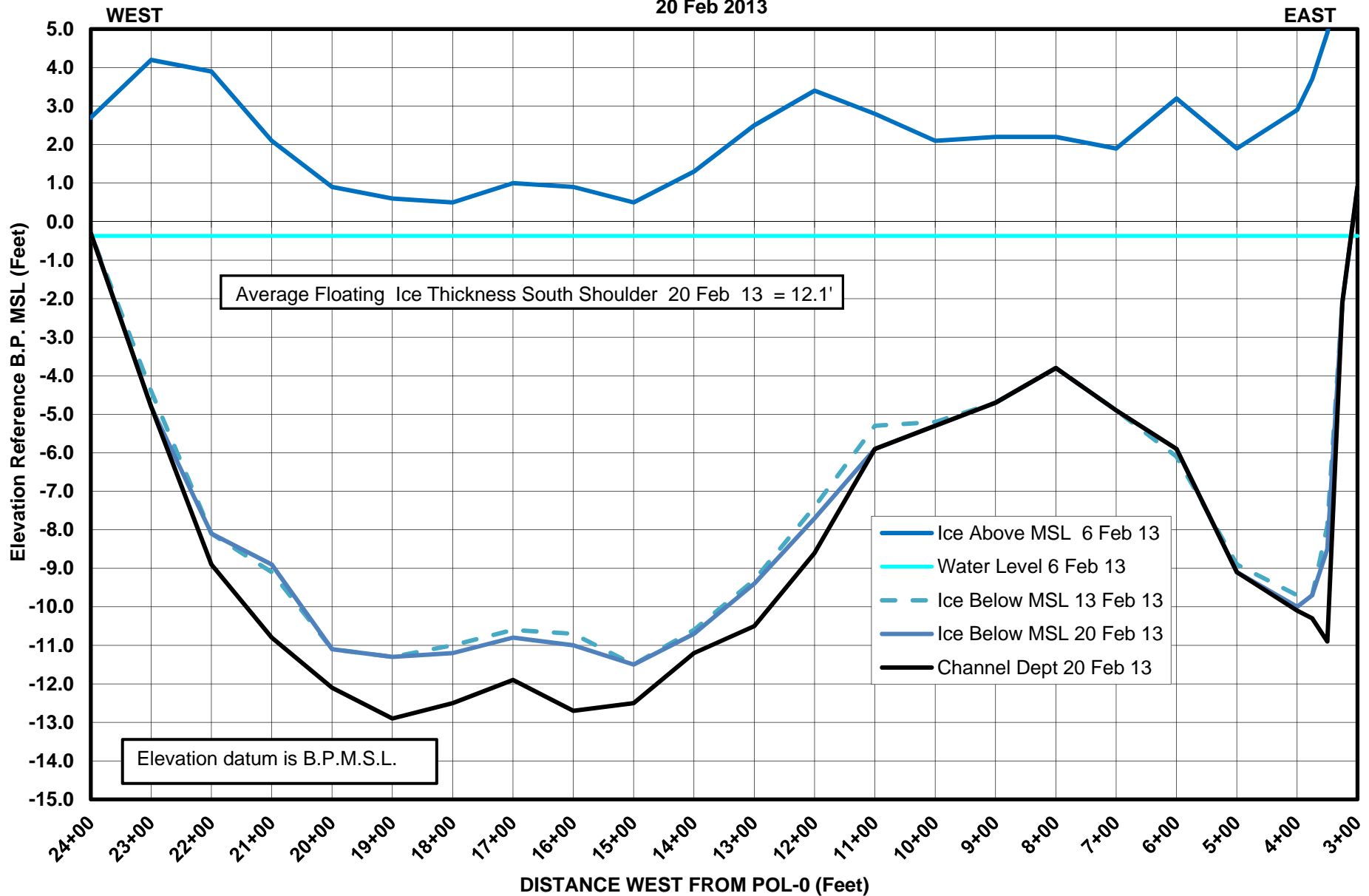
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
13 Feb 2013**



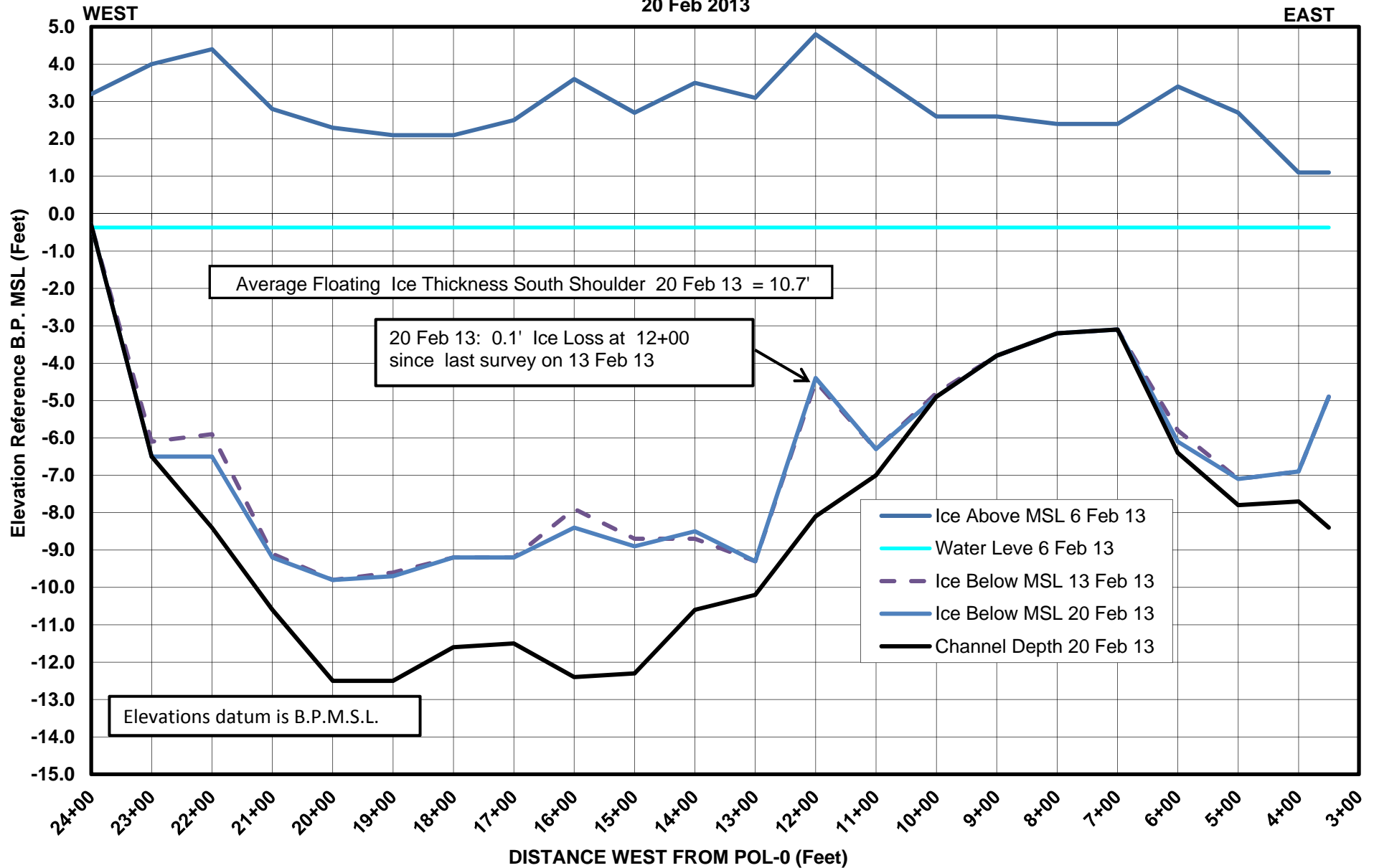
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
20 Feb 2013**



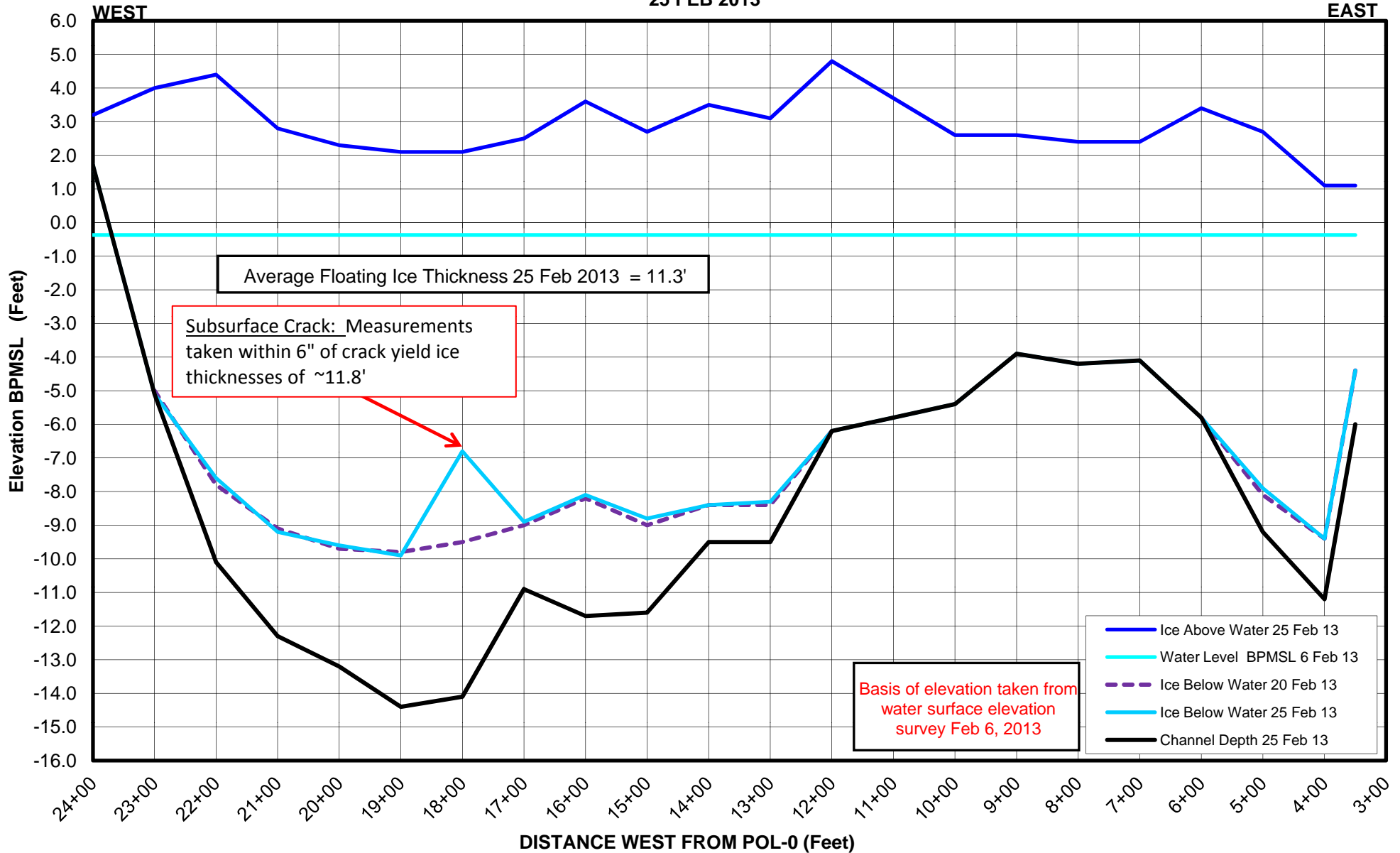
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
20 Feb 2013**



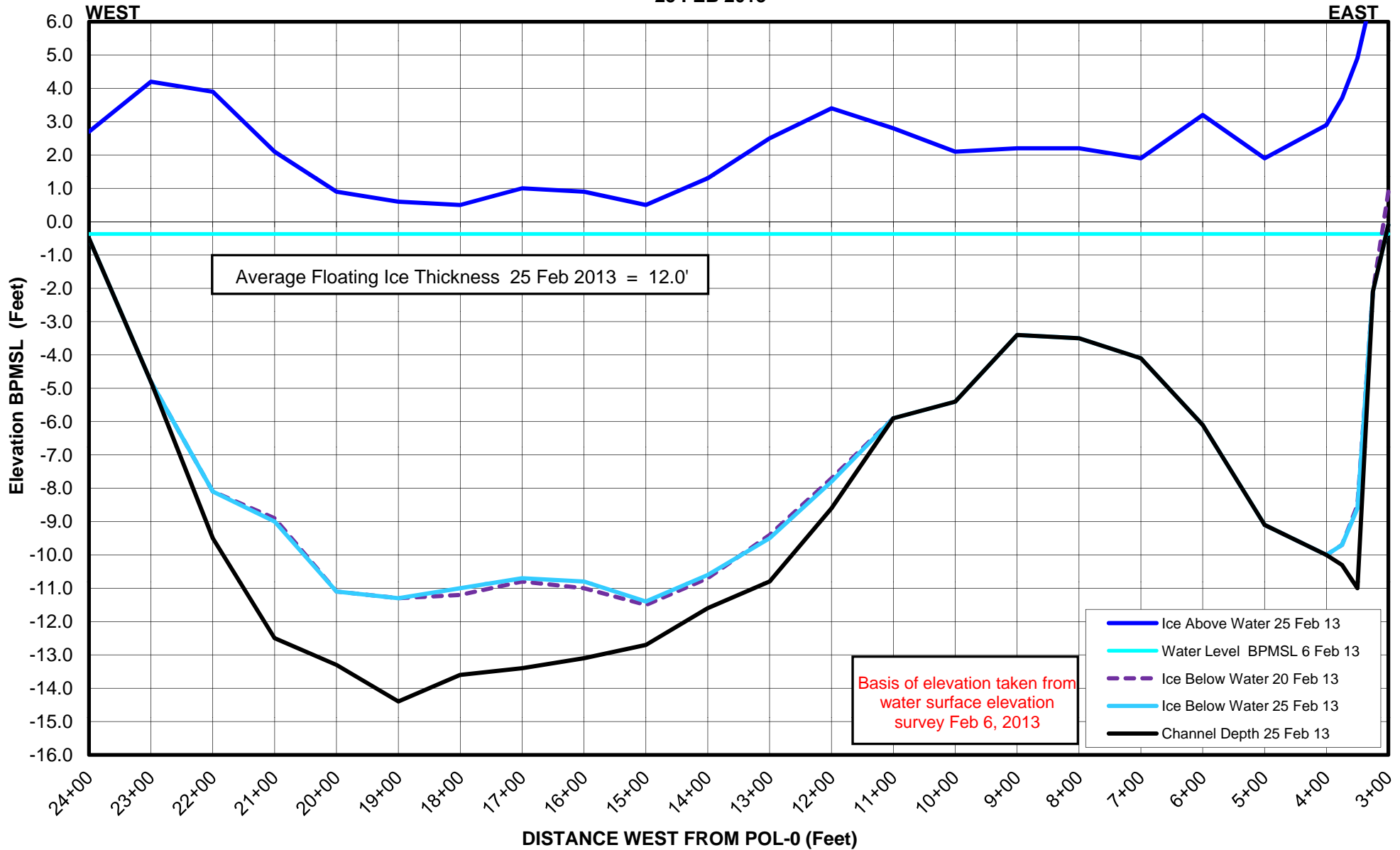
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
20 Feb 2013**



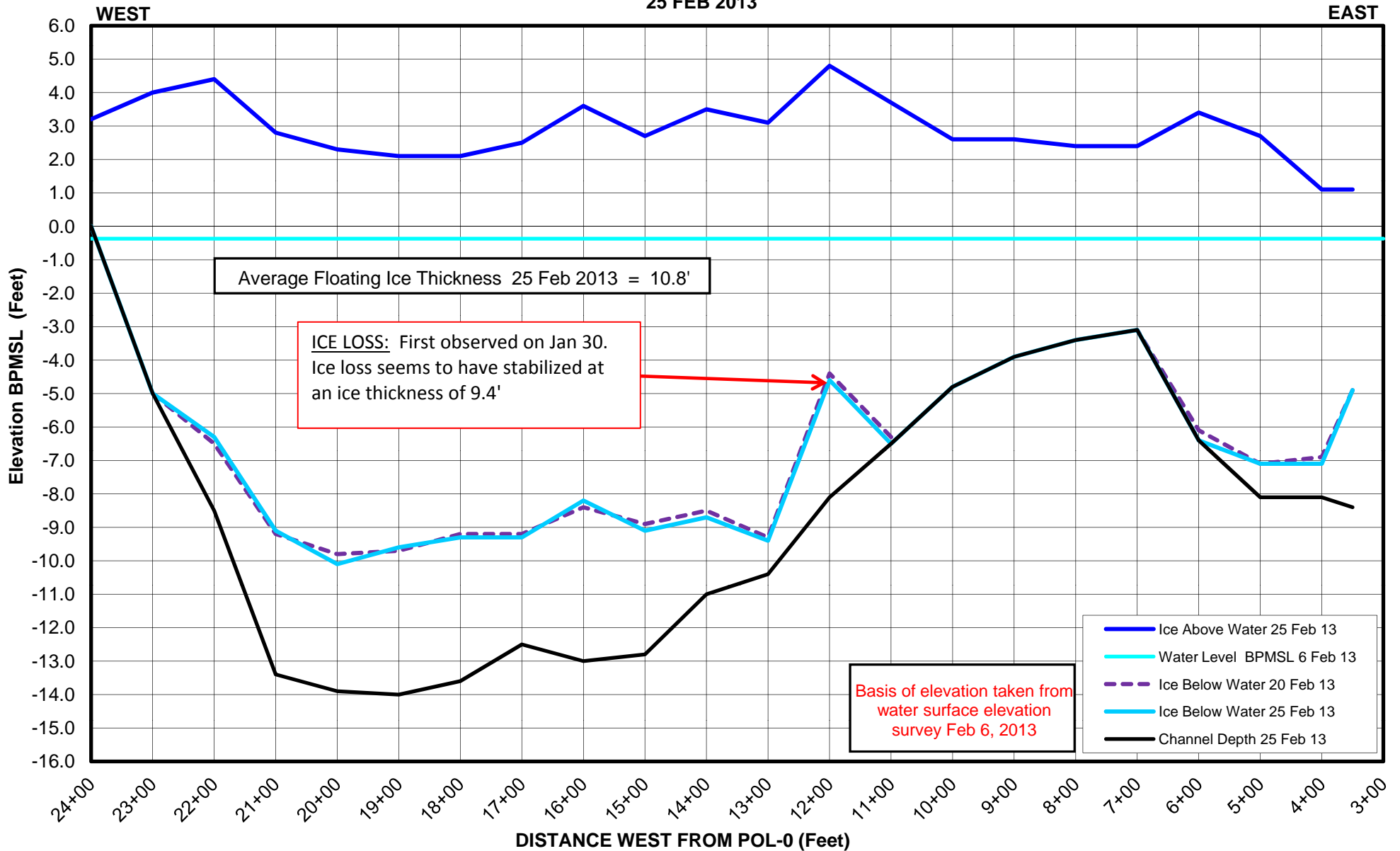
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
25 FEB 2013**



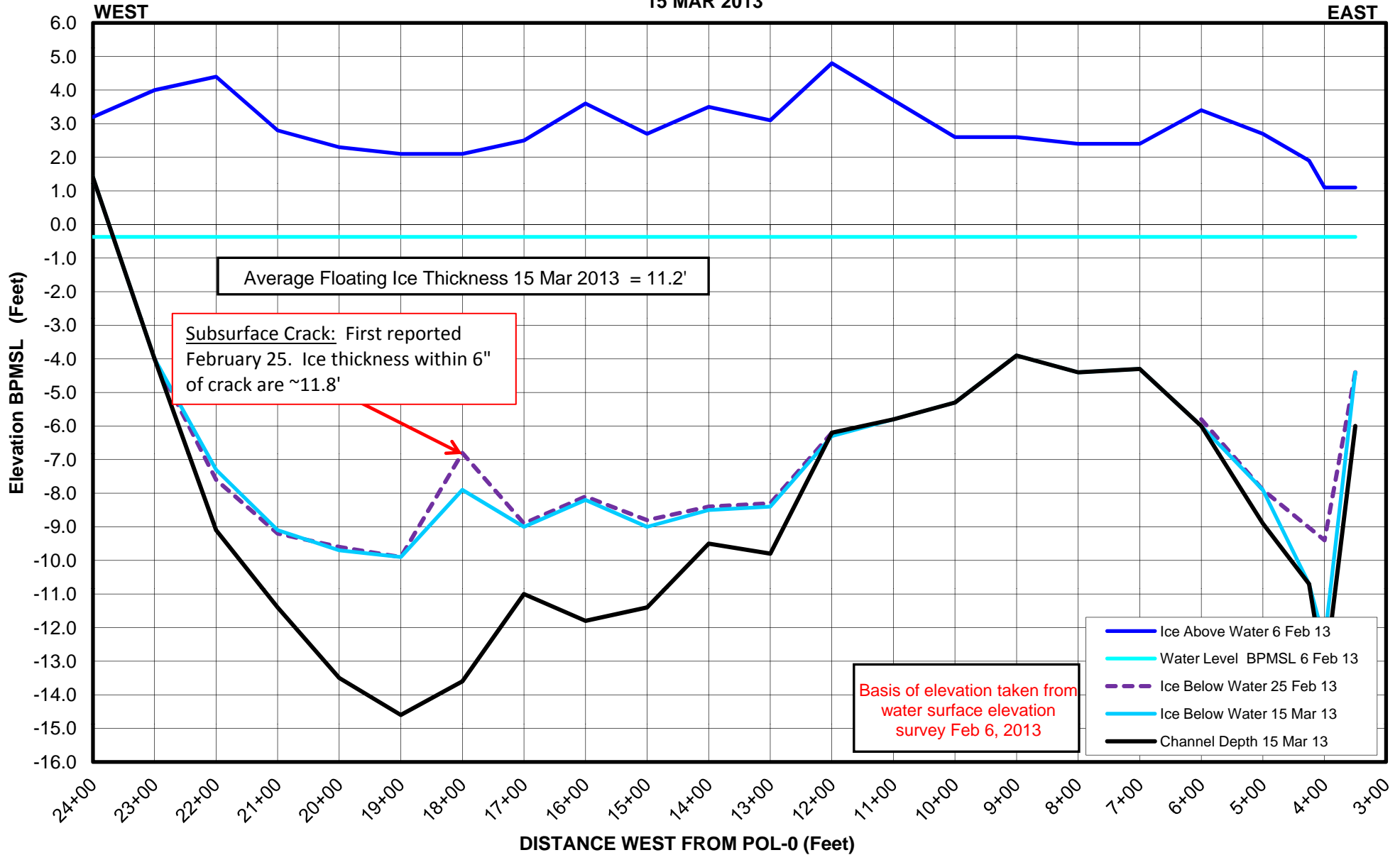
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
25 FEB 2013**



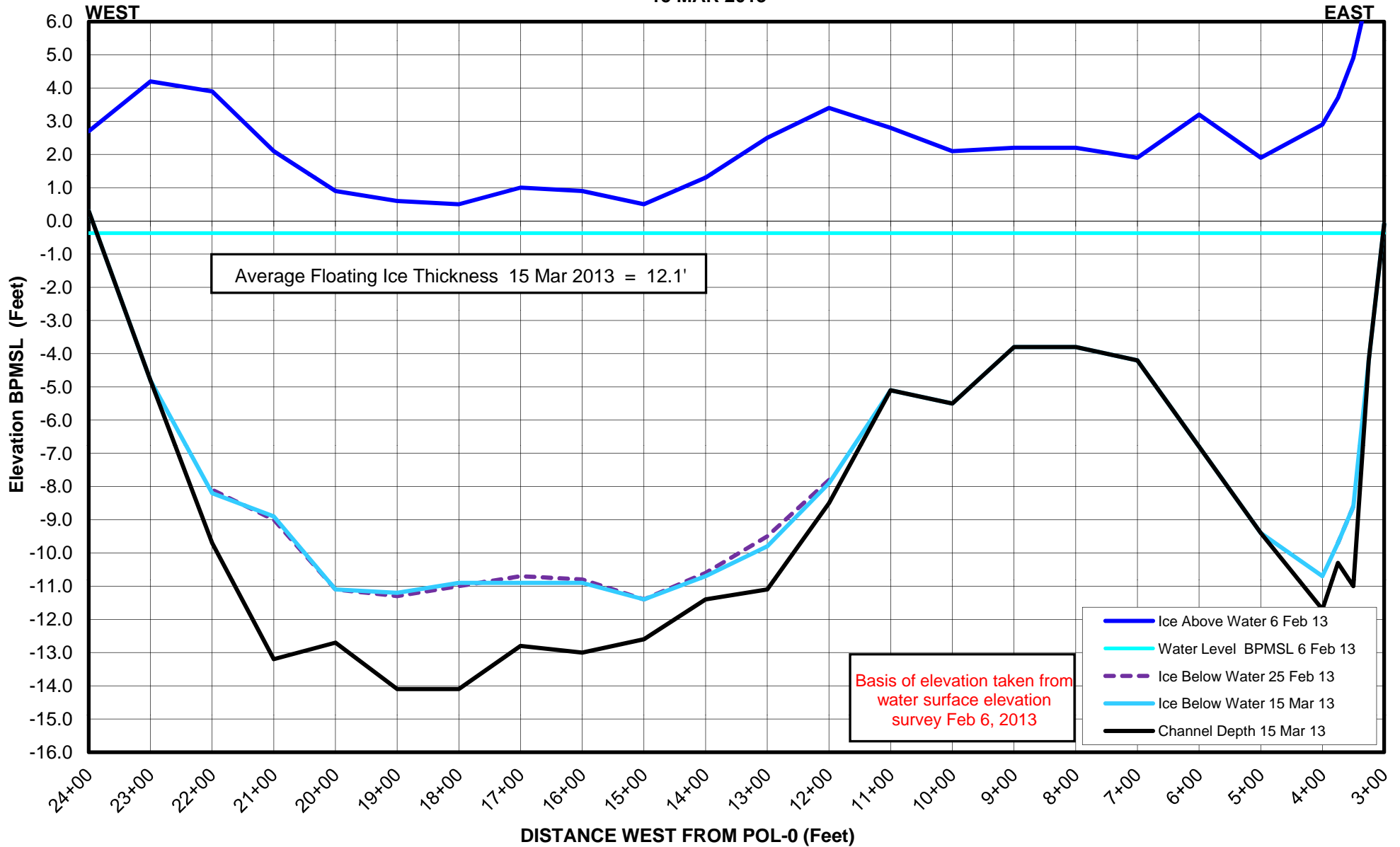
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
25 FEB 2013**



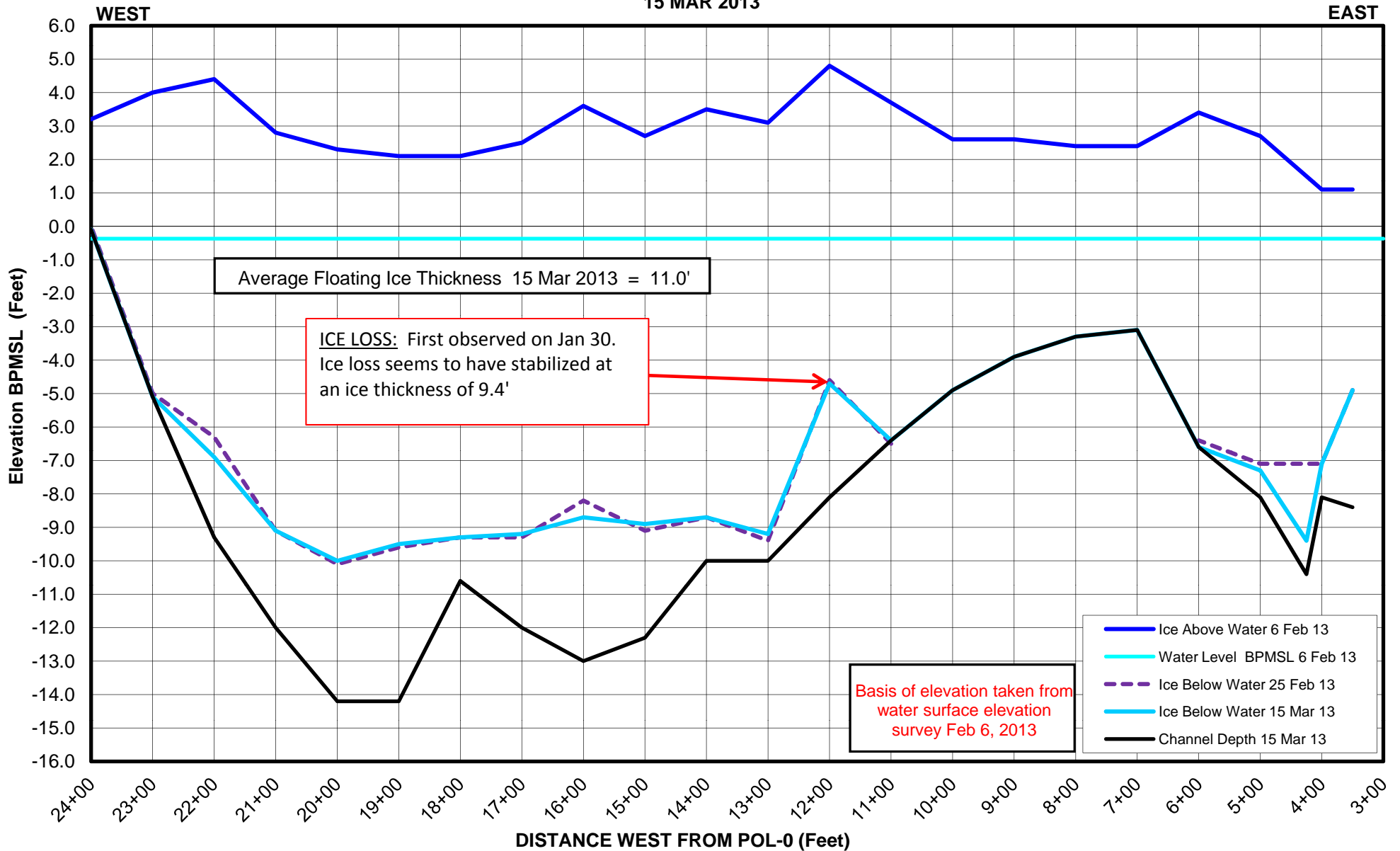
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
15 MAR 2013**



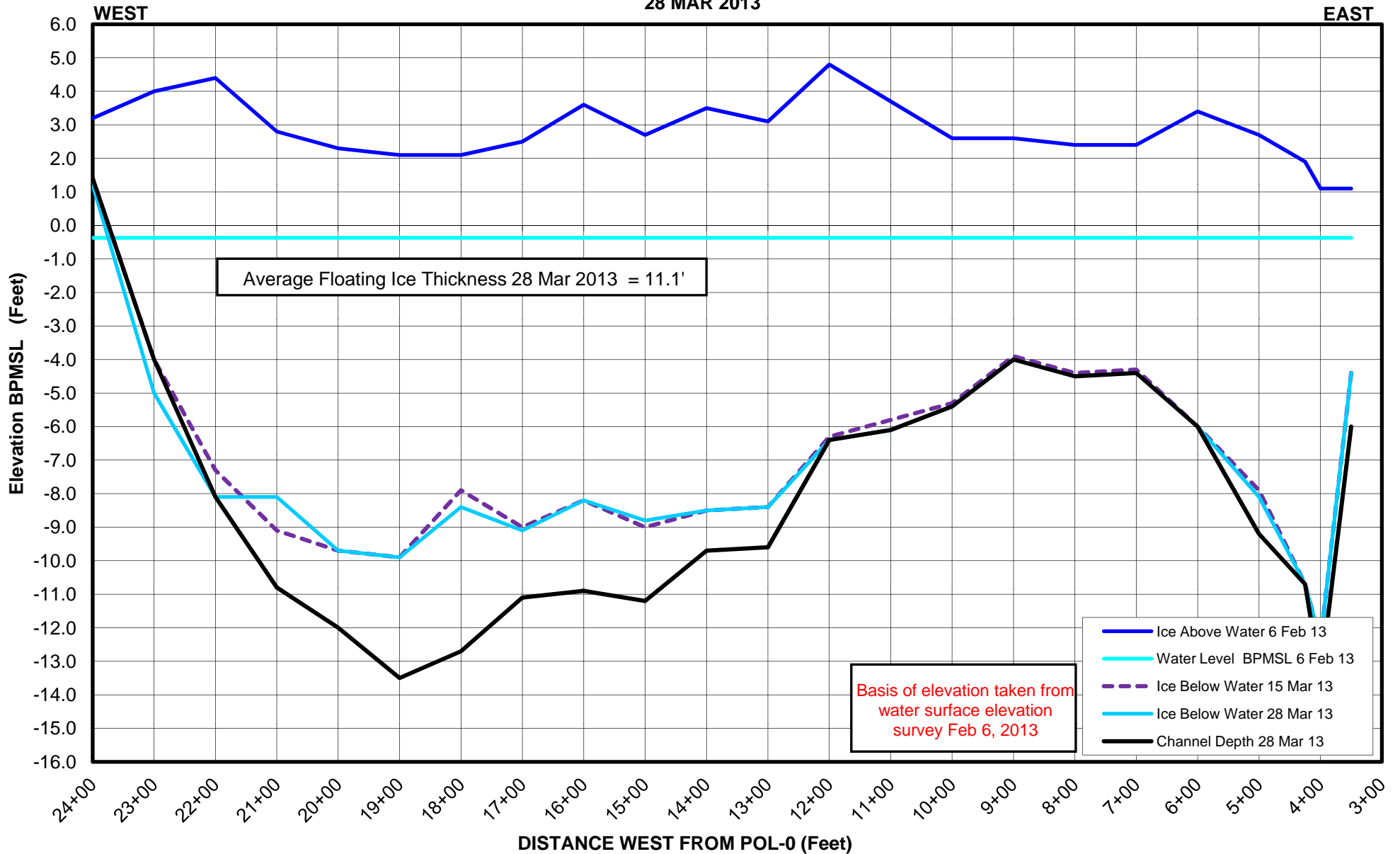
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
15 MAR 2013**



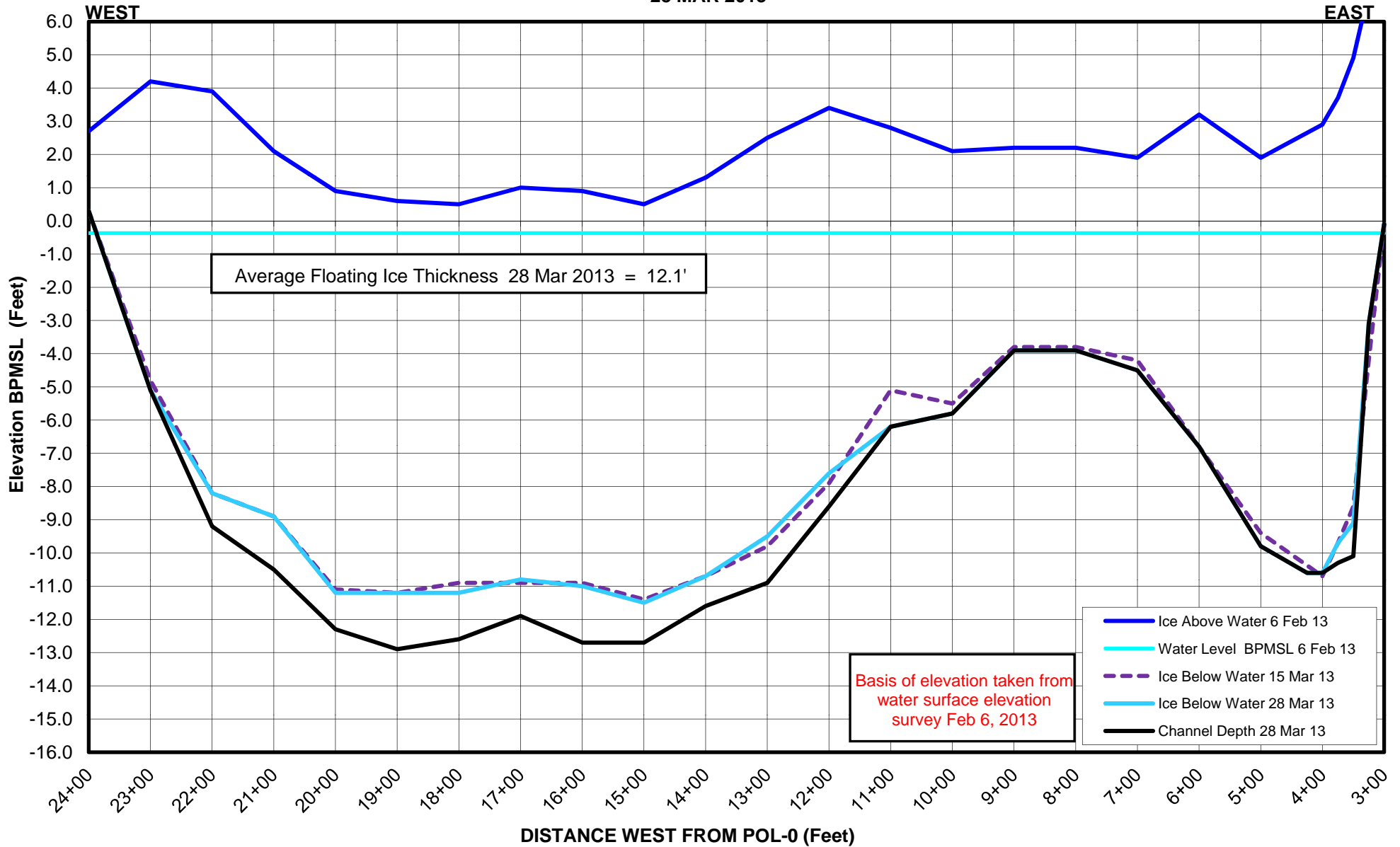
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
15 MAR 2013**



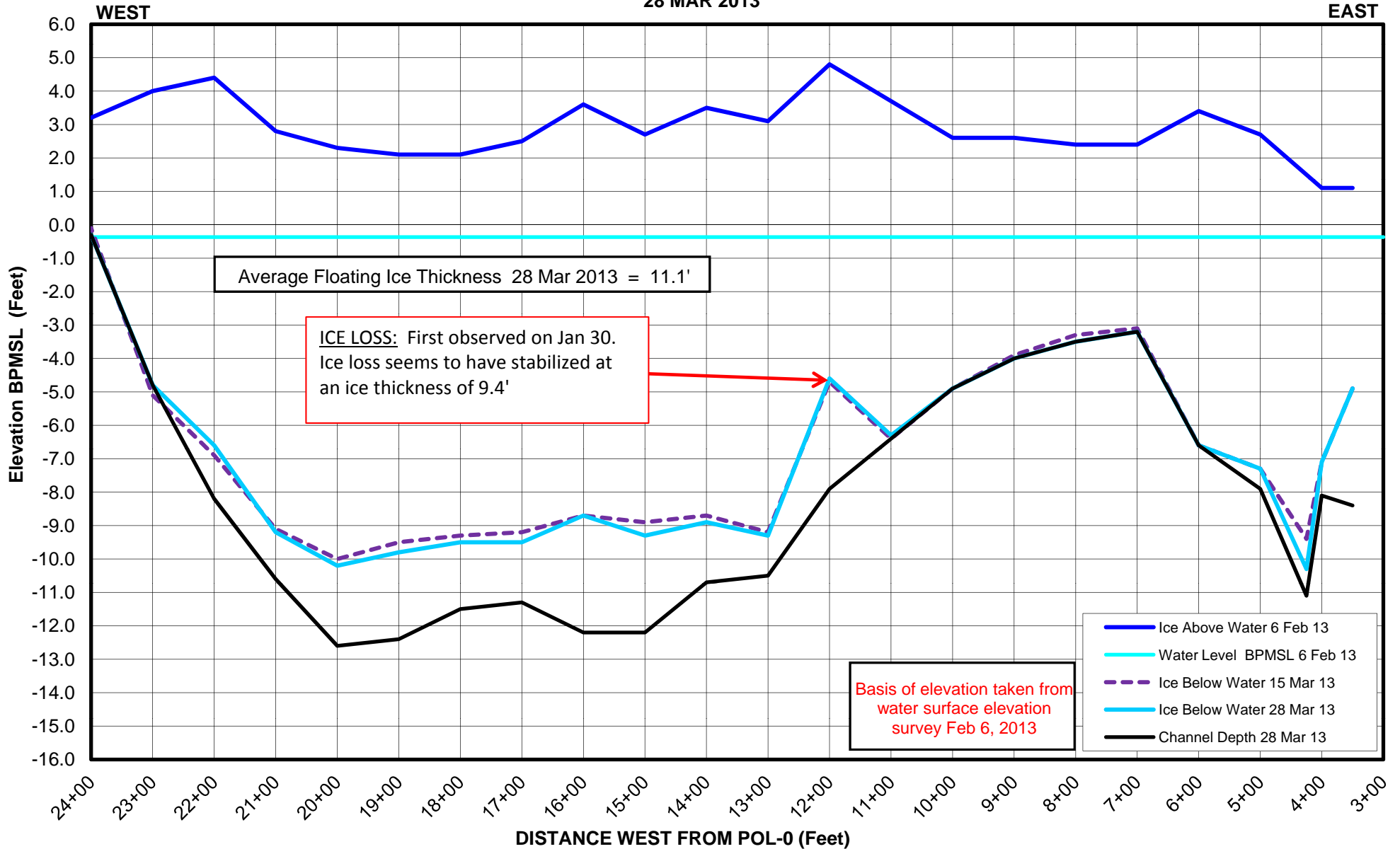
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
28 MAR 2013**



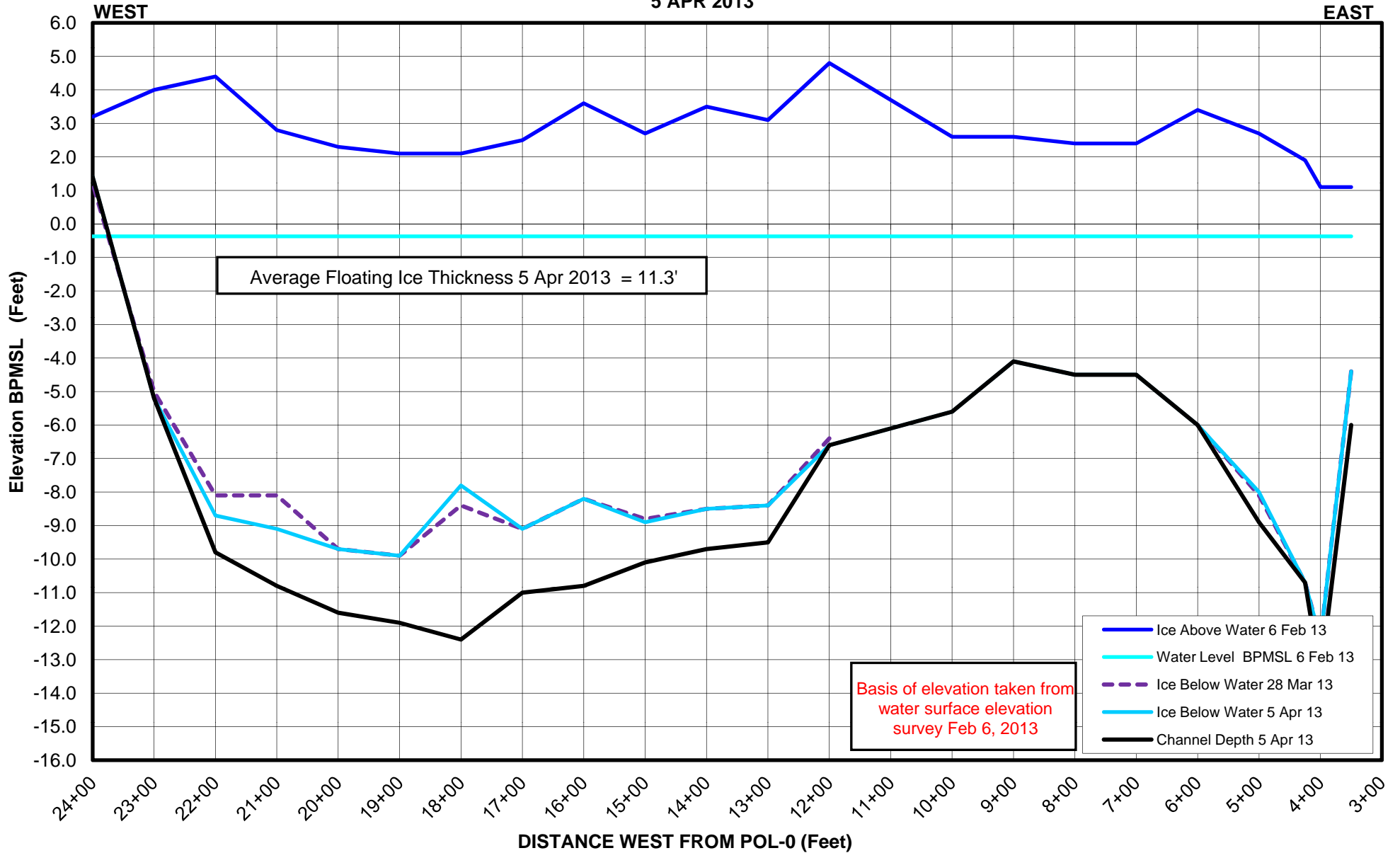
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
28 MAR 2013**



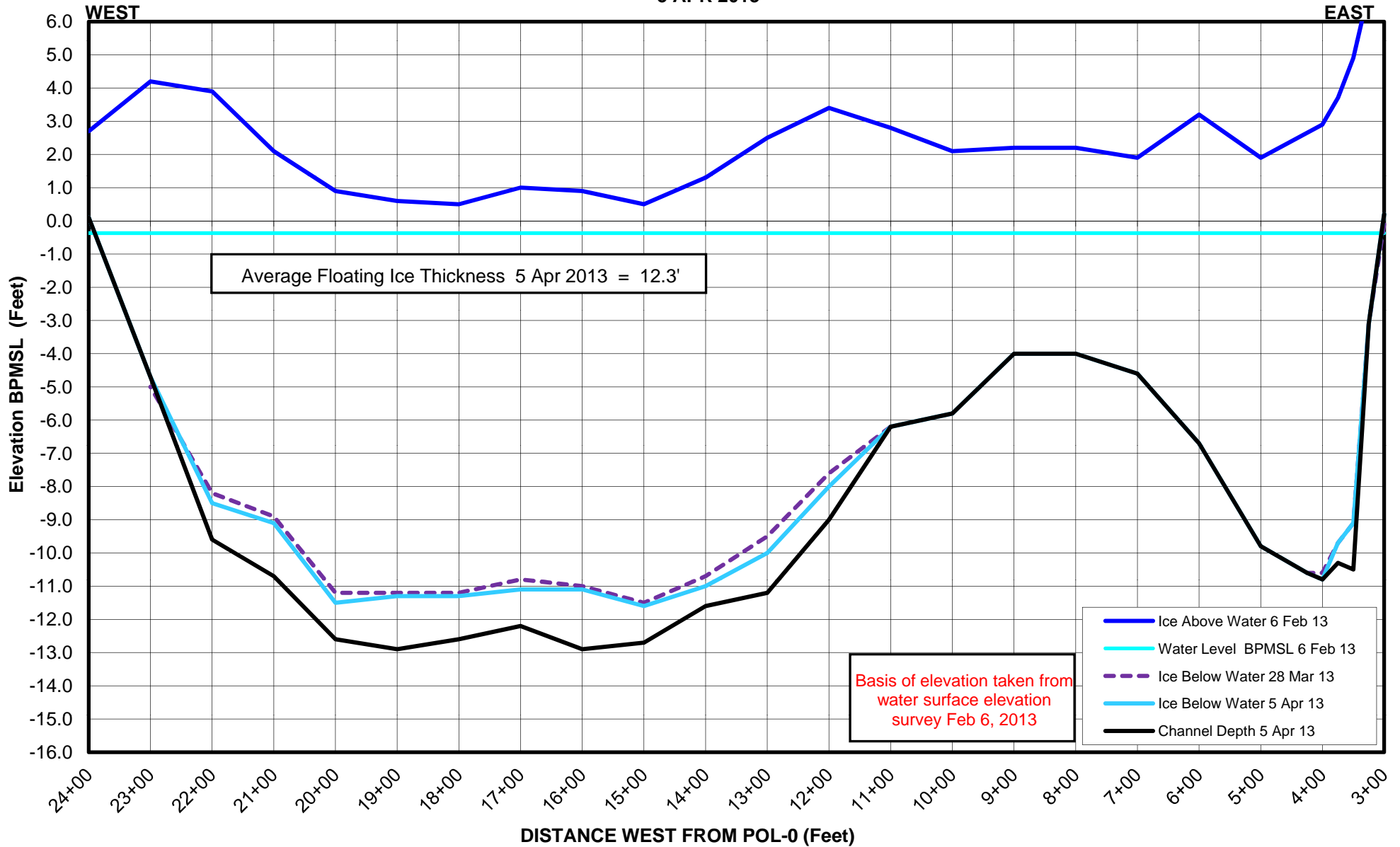
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
28 MAR 2013**



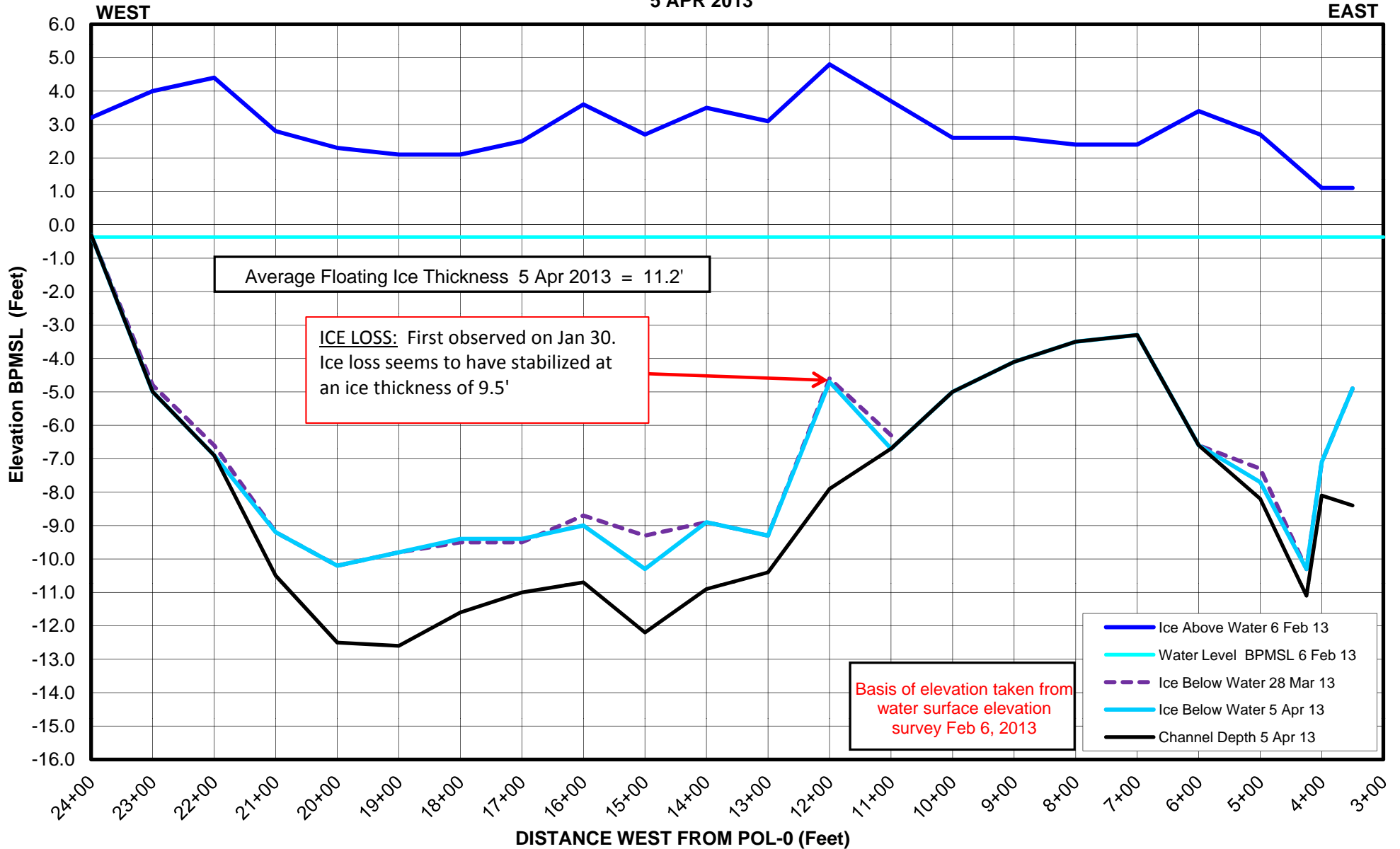
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
5 APR 2013**



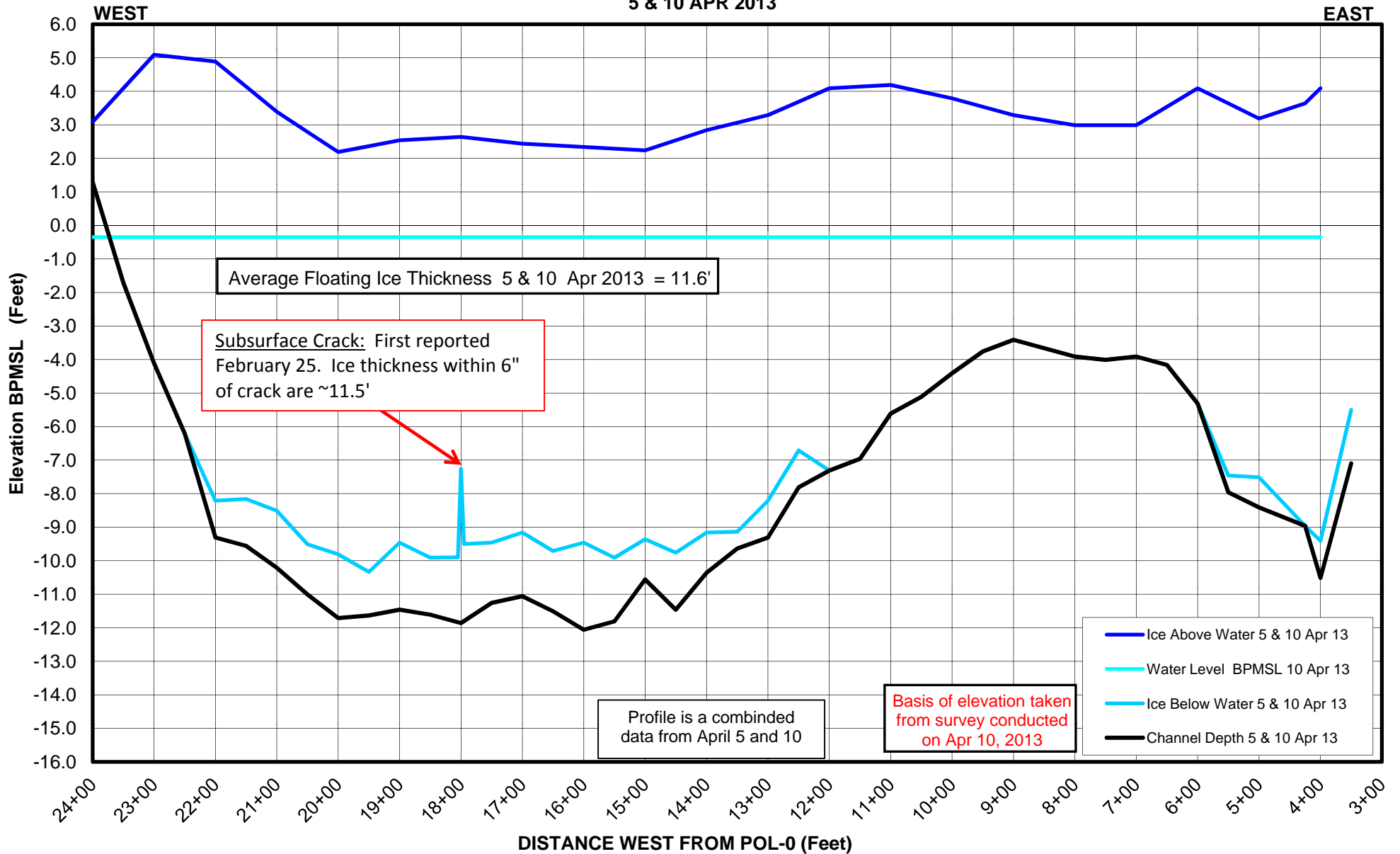
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
5 APR 2013**



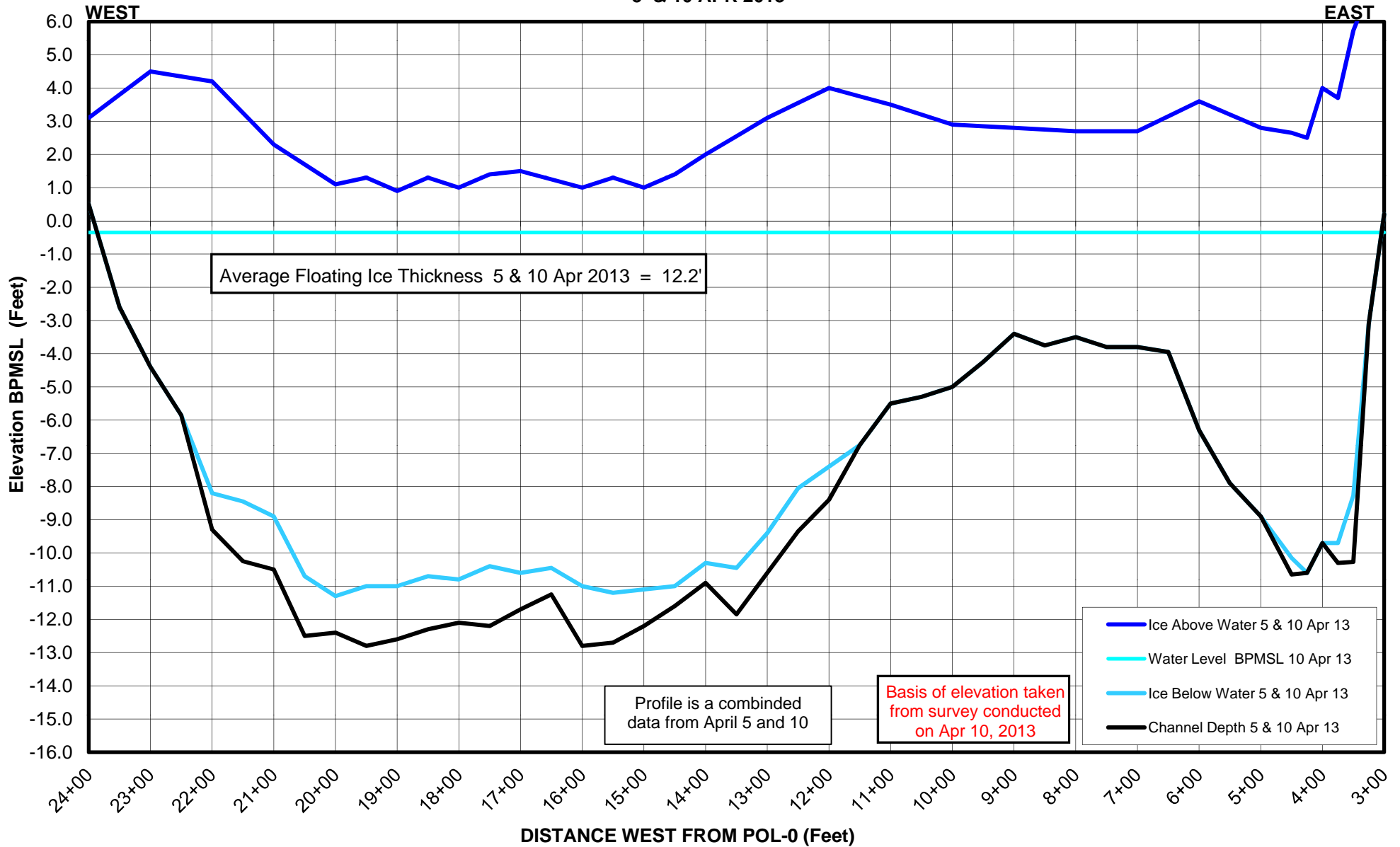
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
5 APR 2013**



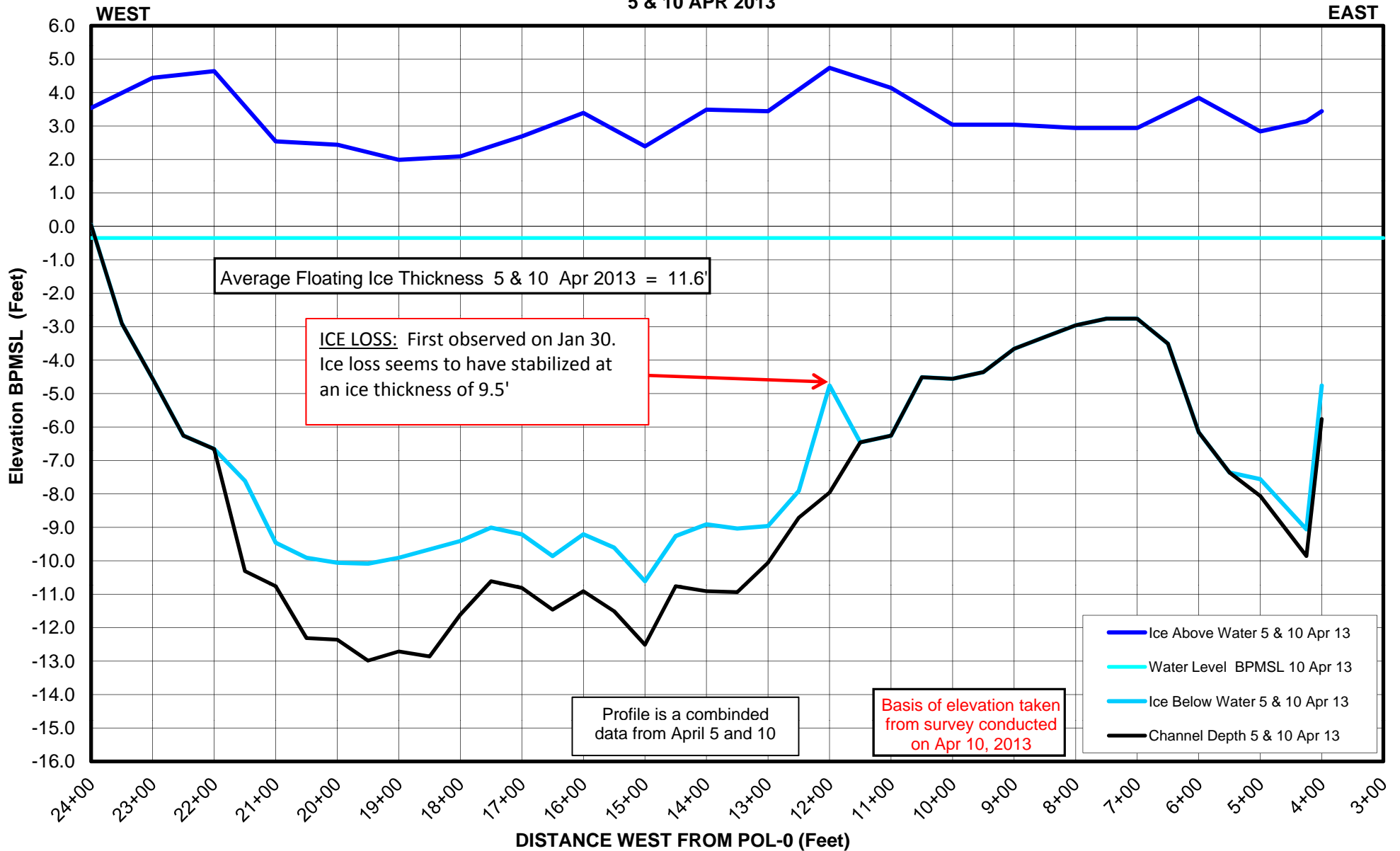
MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
5 & 10 APR 2013



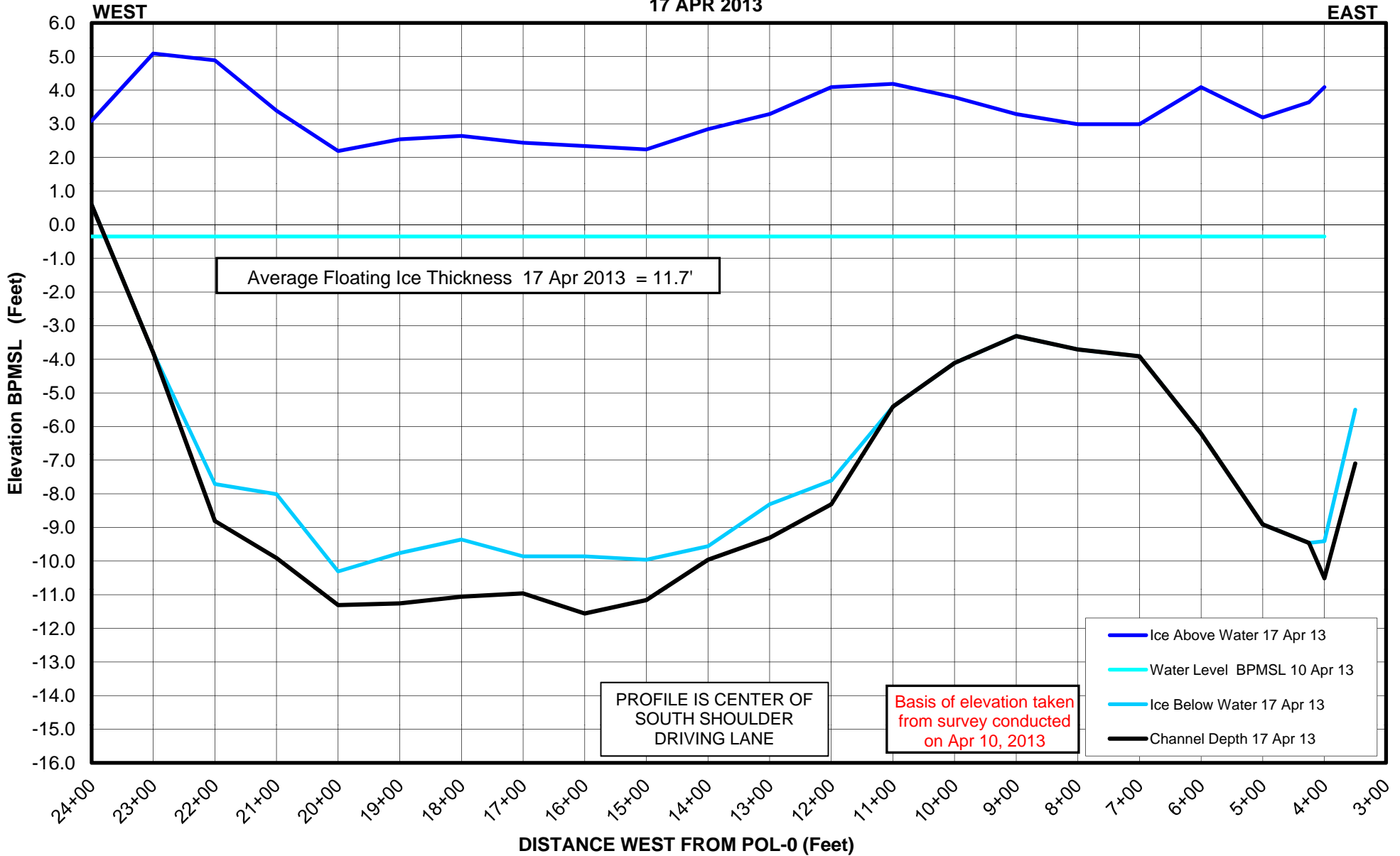
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
5 & 10 APR 2013**



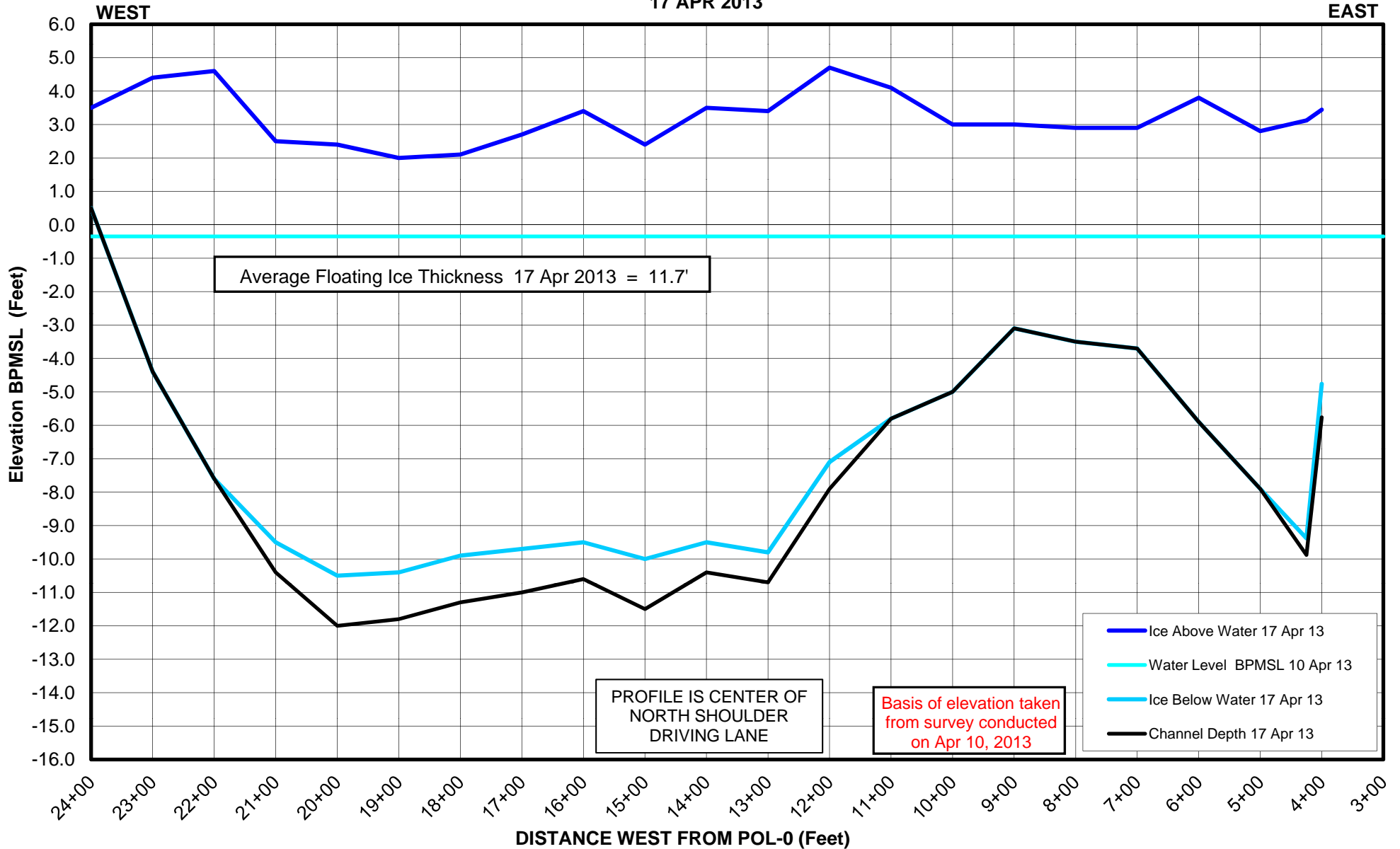
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
5 & 10 APR 2013**



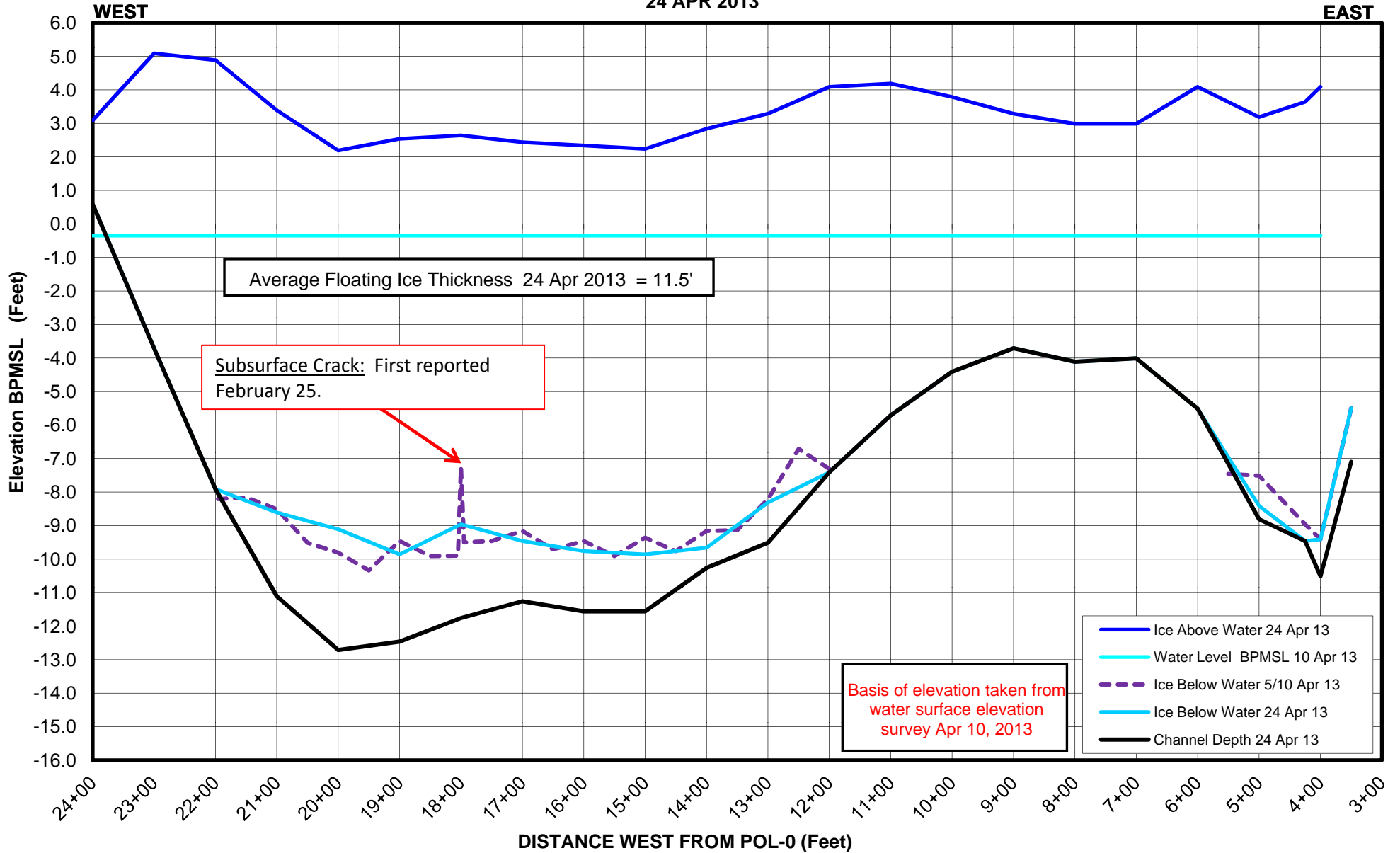
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER CENTER OF DRIVING LANE
17 APR 2013**



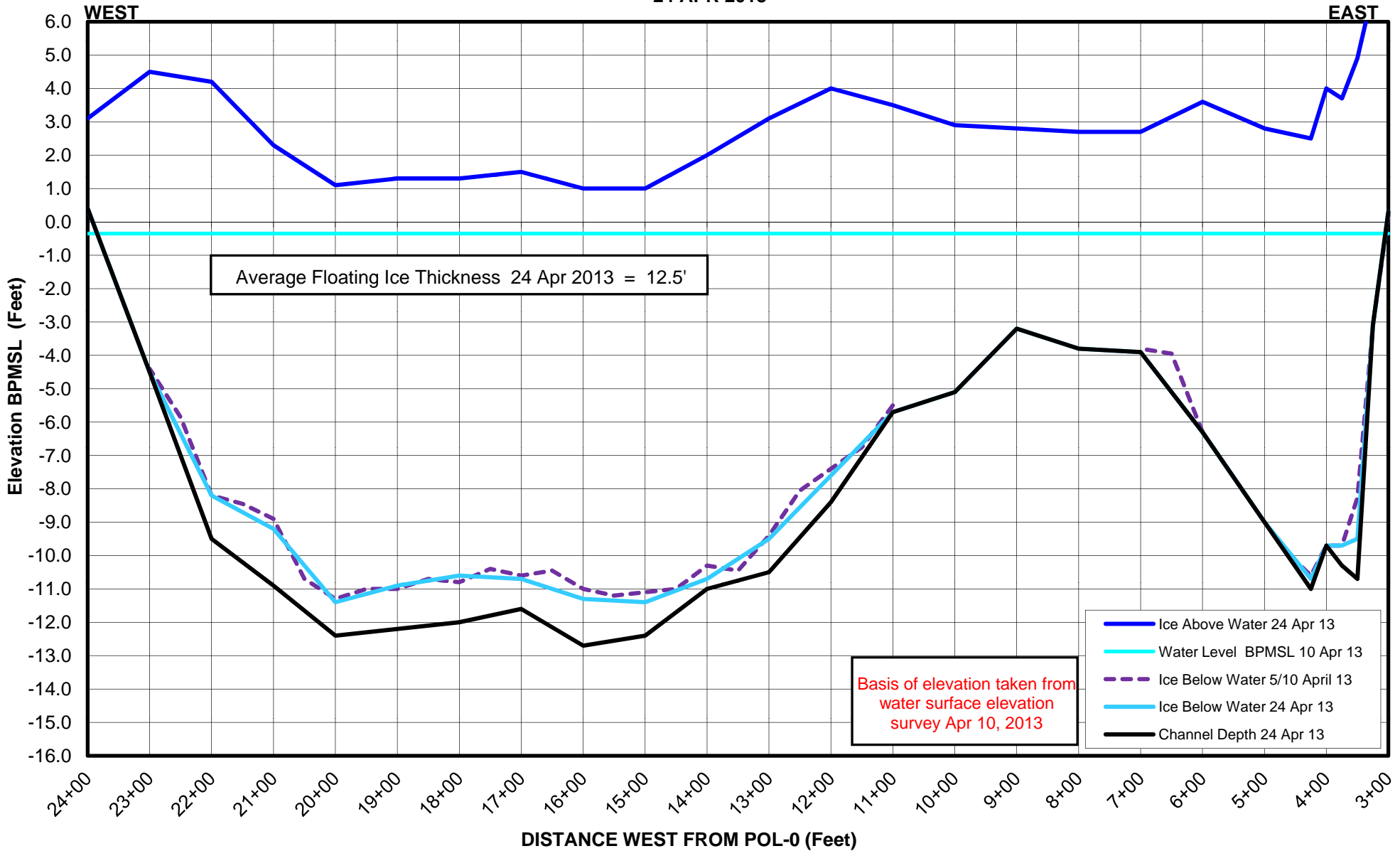
**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER CENTER OF DRIVING LANE
17 APR 2013**



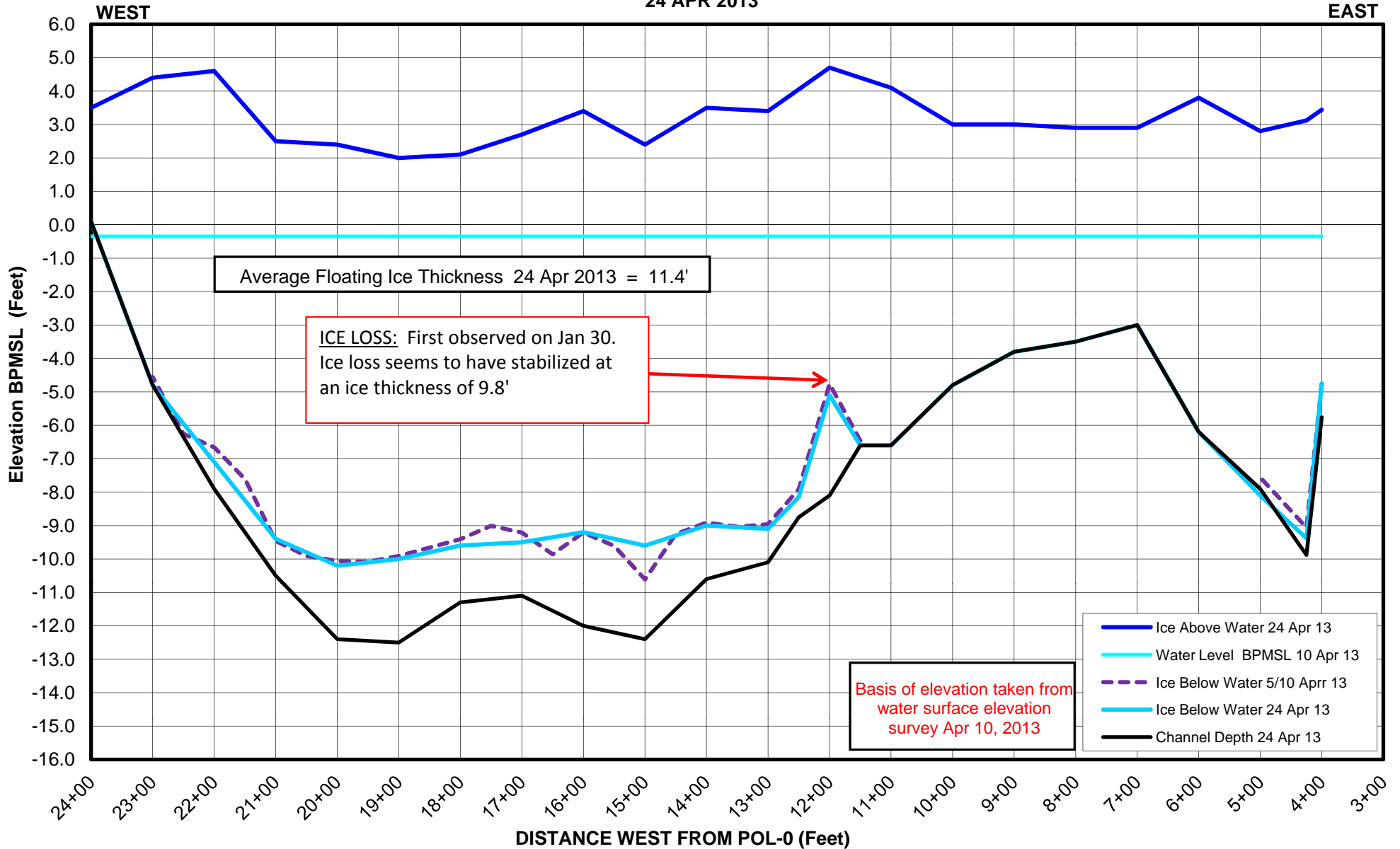
MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER
24 APR 2013



**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
CENTER LINE
24 APR 2013**



**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
NORTH SHOULDER
24 APR 2013**



**MAIN CHANNEL COLVILLE RIVER
ICE ROAD CROSSING
SOUTH SHOULDER BYPASS
24 APR 2013**

