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# 2008-2009 COLVILLE RIVER ICE BRIDGE MONITORING



## SUMMARY REPORT

Submitted to

  
**ConocoPhillips**  
Alaska

Submitted by

  
**Baker**

**Michael Baker, Jr., Inc.**

1400 West Benson Blvd., Suite 200  
Anchorage, Alaska 99503

May 4, 2009  
115721-MBJ-RPT-001

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# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> November 5, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Mark McBroom, Elijah Keib

**Weather:** 0° F, 0-5 mph wind

Mark McBroom and Elijah Keib arrived at Alpine on Tuesday, November 4, 2008 at 7:45 PM. Upon arrival Mr. McBroom met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on November 5, Mr. McBroom and Mr. Keib attended LCMF's daily health and safety meeting. At 6:30 AM equipment was assembled, calibrated and prepared for transport. Gene Diamond of LCMF accompanied Mr. McBroom and Mr. Keib to the Colville River Ice Bridge site via snow machine departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on November 5 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 22,800 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 540 uS/cm at 1 foot of depth to 22,000 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 94.4%, and averaging 88.8%. Measured velocities suggested slight downstream flow with a maximum measured velocity of 0.2 ft/s. The next monitoring event is scheduled for November 19, 2008.

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



Sample Date: November 5, 2008

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:35 a.m.	12.8	0.9	0	1	-	-	-	-	-	-	-
				2	0.4	276	534	13.6	93.9	0.2	-
				3	-	-	-	-	-	-	-
				4	0.4	277	535	13.8	94.2	0.2	-
				5	-	-	-	-	-	-	-
				6	0.4	291	563	13.7	93.3	0.3	-
				7	-	-	-	-	-	-	-
				8	0.6	295	566	12.9	88.4	2.9	-
				9	-	-	-	-	-	-	-
				10	1.0	10920	20619	11.8	81.4	11.7	-
				11	-	-	-	-	-	-	-
				12	1.0	11760	22205	11.8	81.8	12.7	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 10:00 a.m.	13.8	1.0	0	1	0.4	279	539	13.9	94.7	0.2	-
				2	-	-	-	-	-	-	-
				3	0.4	274	528	13.8	94.2	0.2	-
				4	-	-	-	-	-	-	-
				5	0.4	274	529	13.9	94.8	0.2	-
				6	-	-	-	-	-	-	-
				7	0.6	381	731	13.6	92.9	0.3	-
				8	-	-	-	-	-	-	-
				9	0.8	9460	17996	11.9	81.9	10.1	-
				10	-	-	-	-	-	-	-
				11	1.1	11750	22105	12.0	82.4	12.6	-
				12	-	-	-	-	-	-	-
				13	1.0	11940	22545	12.1	83.3	12.8	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 10:30 a.m.	13.5	1.1	0.1	1	0.4	271	522	13.8	94.2	0.2	-
				2	-	-	-	-	-	-	-
				3	0.4	271	523	13.8	94.0	0.2	-
				4	-	-	-	-	-	-	-
				5	0.4	274	528	13.7	93.2	0.2	-
				6	-	-	-	-	-	-	-
				7	0.5	575	1106	13.5	92.2	0.7	-
				8	-	-	-	-	-	-	-
				9	0.7	9160	17490	12.1	83.4	9.8	-
				10	-	-	-	-	-	-	-
				11	1.0	11770	22224	12.1	83.2	12.7	-
				12	-	-	-	-	-	-	-
				13	0.8	11990	22809	12.4	85.3	13.1	-

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface (negative values represent freeboard above ice surface).
- (3) Sample depth is measured from the water surface.
- (4) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO

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



Sample Date: November 5, 2008

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)	
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:05 a.m.	11.1	1.0	0	1	0.3	288	558	13.8	94.3	0.3	-	
				2	-	-	-	-	-	-	-	-
				3	0.4	287	554	13.8	94.0	0.3	-	
				4	-	-	-	-	-	-	-	
				5	0.3	314	608	13.6	93.1	0.3	-	
				6	-	-	-	-	-	-	-	
				7	0.4	728	1406	13.2	90.4	0.7	-	
				8	-	-	-	-	-	-	-	
				9	0.7	9560	18254	11.7	81.0	10.2	-	
				10	-	-	-	-	-	-	-	
				11	0.8	11190	21287	11.7	81.2	12.1	-	
				12	-	-	-	-	-	-	-	
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 8:45 a.m.	13.6	0.8	- 0.1	1	0.2	284	553	13.8	94.4	0.3	-	
				2	-	-	-	-	-	-	-	
				3	0.2	285	554	13.8	94.3	0.3	-	
				4	-	-	-	-	-	-	-	
				5	0.1	299	583	13.7	93.6	0.3	-	
				6	-	-	-	-	-	-	-	
				7	0.2	724	1409	13.4	91.9	0.7	-	
				8	-	-	-	-	-	-	-	
				9	0.5	9680	18623	11.6	80.7	10.4	-	
				10	-	-	-	-	-	-	-	
				11	0.6	10990	21063	11.6	80.8	11.9	-	
				12	-	-	-	-	-	-	-	
				13	0.6	11310	21677	11.5	81.1	12.3	-	
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 10:45 a.m.	12.5	0.9	0	1	-	-	-	-	-	-	-	
				2	0.4	283	546	13.8	94.2	0.3	0.18	
				3	-	-	-	-	-	-	-	
				4	0.4	283	547	13.9	94.6	0.3	0.19	
				5	-	-	-	-	-	-	-	
				6	0.4	284	548	13.8	93.8	0.3	0.20	
				7	-	-	-	-	-	-	-	
				8	0.7	303	578	12.0	82.5	3.1	-0.03	
				9	-	-	-	-	-	-	-	
				10	0.9	10840	20544	11.9	82.3	11.6	0.07	
				11	-	-	-	-	-	-	-	
				12	1.0	11200	21148	12.1	83.0	12.0	0.08	

Notes:

- (1) All sample location coordinates referenced to NAD83 datum.
- (2) Freeboard is the distance from the top of ice to the water surface (negative values represent freeboard above ice surface).
- (3) Sample depth is measured from the water surface.
- (4) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) Velocity was measured using a Marsh-McBirney Model 2000



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> November 13, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** 5° F, 0-5 mph wind, light snow

Elijah Keib arrived at Alpine on Wednesday, November 12, 2008 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on November 13, Mr. Keib attended LCMF's daily health and safety meeting. At 6:30 AM equipment was assembled, calibrated and prepared for transport. Gene Diamond of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via snow machine departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance was calculated from observed temperatures and conductivity. Results are tabulated in the attached sheets.

In-situ water quality parameters were recorded using a YSI-30 meter (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on November 13 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 24,000 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 600 uS/cm at 1 foot of depth to 24,000 uS/cm at 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 95.6%, and averaging 87.7%. Measured velocities suggested slight downstream flow with a maximum measured velocity of 0.2 ft/s. The next monitoring event is scheduled for November 20, 2008.

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



Sample Date: November 13, 2008

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)	
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 8:50 a.m.	12.6	1.1	0	1	-	-	-	-	-	-	-	
				2	0.2	322	627	13.5	95.3	0.3	-	
				3	-	-	-	-	-	-	-	-
				4	0.2	327	636	13.4	94.9	0.3	-	
				5	-	-	-	-	-	-	-	-
				6	0.3	800	1551	13.2	94.1	0.8	-	
				7	-	-	-	-	-	-	-	-
				8	1.0	10440	19713	11.1	80.1	11.2	-	
				9	-	-	-	-	-	-	-	-
				10	1.0	11990	22640	11.3	81.5	12.9	-	
				11	-	-	-	-	-	-	-	-
				12	1.0	12510	23622	11.5	82.8	13.5	-	
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 8:30 a.m.	13.3	1.3	0	1	0.2	312	607	13.4	95.2	0.3	-	
				2	-	-	-	-	-	-	-	
				3	0.2	313	608	13.3	94.8	0.3	-	
				4	-	-	-	-	-	-	-	-
				5	0.2	337	655	13.1	93.8	0.3	-	
				6	-	-	-	-	-	-	-	-
				7	0.4	3860	7454	11.1	80.1	3.9	-	
				8	-	-	-	-	-	-	-	-
				9	1.0	11050	20865	11.3	81.5	11.8	-	
				10	-	-	-	-	-	-	-	-
				11	1.0	12160	22961	11.5	83.2	13.2	-	
				12	-	-	-	-	-	-	-	-
				13	1.0	12550	23697	11.6	83.9	13.6	-	
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:10 a.m.	13.5	1.2	0	1.5	0.1	301.5	589	13.34	95.6	0.3	-	
				2	-	-	-	-	-	-	-	
				3	0.1	303	591	13.3	95.3	0.3	-	
				4	-	-	-	-	-	-	-	-
				5	0.1	366	716	13.1	94.2	0.3	-	
				6	-	-	-	-	-	-	-	-
				7	0.3	1730	3353	11.7	84.9	2.0	-	
				8	-	-	-	-	-	-	-	-
				9	0.9	11110	21056	11.1	81.6	12.0	-	
				10	-	-	-	-	-	-	-	-
				11	1.0	12200	23036	11.2	82.5	13.2	-	
				12	-	-	-	-	-	-	-	-
				13	1.0	12730	24037	11.2	84.5	13.8	-	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO



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



Sample Date: November 13, 2008

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)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:10 a.m.	10.5	1.2	0.1	1	-	-	-	-	-	-	-
				2	0.3	321	623	13.5	95.5	0.3	-
				3	-	-	-	-	-	-	-
				4	0.3	333	645	13.4	95.1	0.3	-
				5	-	-	-	-	-	-	-
				6	0.3	723	1401	13.3	94.4	0.9	-
				7	-	-	-	-	-	-	-
				8	0.9	10190	19312	11.1	79.9	10.9	-
				9	-	-	-	-	-	-	-
				10	1.1	11870	22330	11.1	90.1	12.7	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 9:30 a.m.	13.1	1.2	0	1.5	0.3	328	635	13.4	95.0	0.3	-
				2	-	-	-	-	-	-	-
				3	0.3	328	636	13.4	94.7	0.3	-
				4	-	-	-	-	-	-	-
				5	0.3	380	737	12.6	89.8	0.6	-
				6	-	-	-	-	-	-	-
				7	0.8	8300	15789	11.1	80.0	9.2	-
				8	-	-	-	-	-	-	-
				9	1.0	10760	20317	11.2	80.9	11.5	-
				10	-	-	-	-	-	-	-
				11	1.1	11880	22349	11.3	81.4	12.7	-
				12	-	-	-	-	-	-	-
				13	1.3	12050	22503	11.3	81.7	12.9	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 9:55 a.m.	12.5	1.2	0	1	-	-	-	-	-	-	-
				2	0.3	330	640	13.4	94.9	0.3	0.24
				3	-	-	-	-	-	-	-
				4	0.3	334	648	13.3	94.5	0.3	0.23
				5	-	-	-	-	-	-	-
				6	0.3	800	1551	11.3	80.3	0.9	0.18
				7	-	-	-	-	-	-	-
				8	0.8	10400	19784	11.2	80.8	11.2	-0.04
				9	-	-	-	-	-	-	-
				10	1.1	11570	21766	11.3	81.3	12.4	0.02
				11	-	-	-	-	-	-	-
				12	1.1	11810	22218	11.5	82.3	12.7	0.07

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) Velocity was measured using a Marsh-McBirney Model 2000

# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> November 20, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -15° F, 0-5 mph wind

Elijah Keib arrived at Alpine on Wednesday, November 19, 2008 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on November 20, Mr. Keib attended LCMF's daily health and safety meeting. At 6:30 AM equipment was assembled, calibrated and prepared for transport. Chris Zieman of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via snow machine departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on November 20 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 23,000 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 680 uS/cm at 2 foot of depth to 23,000 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 85.2%, and averaging 81.8%. Measured velocities suggested slight downstream flow with a maximum measured velocity of 0.2 ft/s. The next monitoring event is scheduled for November 27, 2008.

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



Sample Date: November 20, 2008

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:15 a.m.	12.5	1.1	0	1	-	-	-	-	-	-	-
				2	0.0	383	750	11.9	85.0	0.3	-
				3	-	-	-	-	-	-	-
				4	0.0	417	817	11.8	85.2	0.4	-
				5	-	-	-	-	-	-	-
				6	0.3	4770	9246	11.2	81.3	4.9	-
				7	-	-	-	-	-	-	-
				8	0.5	9020	17353	11.0	81.6	9.6	-
				9	-	-	-	-	-	-	-
				10	0.6	11760	22539	10.8	81.0	12.8	-
				11	-	-	-	-	-	-	-
				12	0.7	11890	22703	10.9	82.8	12.9	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:20 a.m.	13.0	1.4	0	1	-	-	-	-	-	-	-
				2	0.3	356	690	11.9	83.3	0.3	-
				3	-	-	-	-	-	-	-
				4	0.3	390	756	11.9	83.3	0.3	-
				5	-	-	-	-	-	-	-
				6	0.5	1680	3232	11.4	80.2	1.6	-
				7	-	-	-	-	-	-	-
				8	0.7	9060	17299	11.3	80.1	9.6	-
				9	-	-	-	-	-	-	-
				10	0.9	10850	20563	11.2	80.0	11.7	-
				11	-	-	-	-	-	-	-
				12	1.1	11880	22349	11.4	81.3	12.8	-
				13	-	-	-	-	-	-	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:55 a.m.	12.5	1.4	0	1	-	-	-	-	-	-	-
				2	0.1	352.4	688	11.9	83.7	0.3	-
				3	-	-	-	-	-	-	-
				4	0.1	368	718	11.8	83.2	0.3	-
				5	-	-	-	-	-	-	-
				6	0.2	555	1080	11.4	80.9	1.0	-
				7	-	-	-	-	-	-	-
				8	0.5	9330	17949	11.3	80.7	9.9	-
				9	-	-	-	-	-	-	-
				10	0.6	10200	19549	11.3	80.6	11.0	-
				11	-	-	-	-	-	-	-
				12	0.7	11900	22722	11.3	82.0	12.9	-
				13	-	-	-	-	-	-	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO

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



Sample Date: November 20, 2008

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)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 10:40 a.m.	10.5	1.5	0.1	1	-	-	-	-	-	-	-
				2	0.1	400	781	12.1	85.0	0.4	-
				3	-	-	-	-	-	-	-
				4	0.1	400	781	12.0	84.6	0.4	-
				5	-	-	-	-	-	-	-
				6	0.2	3000	5837	11.7	82.8	3.1	-
				7	-	-	-	-	-	-	-
				8	0.1	8600	16798	11.3	80.7	9.6	-
				9	-	-	-	-	-	-	-
				10	0.3	10830	20993	11.3	80.9	12.1	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 11:25 a.m.	12.9	1.2	0	1	-	-	-	-	-	-	-
				2	0.3	410	794	12.0	84.4	0.4	-
				3	-	-	-	-	-	-	-
				4	0.3	565	1095	11.9	84.0	0.5	-
				5	-	-	-	-	-	-	-
				6	0.5	3339	6424	11.3	80.1	3.3	-
				7	-	-	-	-	-	-	-
				8	0.8	8910	16949	11.3	80.4	9.5	-
				9	-	-	-	-	-	-	-
				10	0.8	12000	22828	11.1	79.4	13.0	-
				11	-	-	-	-	-	-	-
				12	0.8	12160	23132	11.3	80.2	13.2	-
				13	-	-	-	-	-	-	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 12:15 a.m.	11.7	1.2	0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.4	427	825	11.9	84.0	0.4	-0.02
				4	-	-	-	-	-	-	-
				5	0.4	562	1085	11.4	80.8	0.5	0.01
				6	-	-	-	-	-	-	-
				7	0.7	7660	14626	11.3	80.1	8.0	-0.01
				8	-	-	-	-	-	-	-
				9	0.9	9960	18877	10.9	78.7	10.8	0.02
				10	-	-	-	-	-	-	-
				11	1.0	12060	22772	11.0	79.0	13.0	0.01
				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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) Velocity was measured using a Marsh-McBirney Model 2000



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> November 25, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** 0° F, 0-5 mph wind

Elijah Keib arrived at Alpine on Monday, November 24, 2008 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on November 25, Mr. Keib attended LCMF's daily health and safety meeting. At 6:30 AM equipment was assembled, calibrated and prepared for transport. Chris Ziemet of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via snow machine departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on November 25 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 25,000 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 540 uS/cm at 3 feet of depth to 23,500 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 82.6%, and averaging 79.0%. Measured velocities suggested slight downstream flow with a maximum measured velocity of 0.22 ft/s. The next monitoring event is scheduled for November 27, 2008.

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



Sample Date: November 25, 2008

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)	
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:00 a.m.	12.8	1.3	0	1	-	-	-	-	-	-	-	
				2	0.2	279	542	11.5	81.6	0.2	-	
				3	-	-	-	-	-	-	-	-
				4	0.2	281	546	11.5	81.3	0.3	-	
				5	-	-	-	-	-	-	-	-
				6	0.4	2050	3959	11.4	81.2	2.0	-	
				7	-	-	-	-	-	-	-	
				8	0.7	9170	17509	11.1	79.7	9.7	-	
				9	-	-	-	-	-	-	-	
				10	1.0	11780	22243	10.9	78.6	12.7	-	
				11	-	-	-	-	-	-	-	
				12	1.1	11980	22537	11.0	79.6	12.9	-	
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:35 a.m.	13.0	1.4	0	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	0.1	275	537	11.5	81.6	0.2	-	
				4	-	-	-	-	-	-	-	
				5	0.2	276	536	11.5	81.3	0.4	-	
				6	-	-	-	-	-	-	-	
				7	0.5	7620	14659	11.2	79.9	8.3	-	
				8	-	-	-	-	-	-	-	
				9	0.8	10100	19213	10.9	78.2	10.7	-	
				10	-	-	-	-	-	-	-	
				11	0.9	11840	22440	10.9	78.7	12.8	-	
				12	-	-	-	-	-	-	-	
				13	0.9	12060	22856	11.2	80.7	13.0	-	
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:15 a.m.	13.4	1.5	0	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	0.1	271.2	530	11.5	81.8	0.2	-	
				4	-	-	-	-	-	-	-	
				5	0.1	272	531	11.5	81.6	0.3	-	
				6	-	-	-	-	-	-	-	
				7	0.4	7650	14773	11.1	79.9	8.2	-	
				8	-	-	-	-	-	-	-	
				9	0.7	9920	18941	11.0	79.3	10.7	-	
				10	-	-	-	-	-	-	-	
				11	0.9	11820	22402	11.0	79.6	12.8	-	
				12	-	-	-	-	-	-	-	
				13	0.9	12070	22875	11.2	81.7	13.1	-	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO

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



Sample Date: November 25, 2008

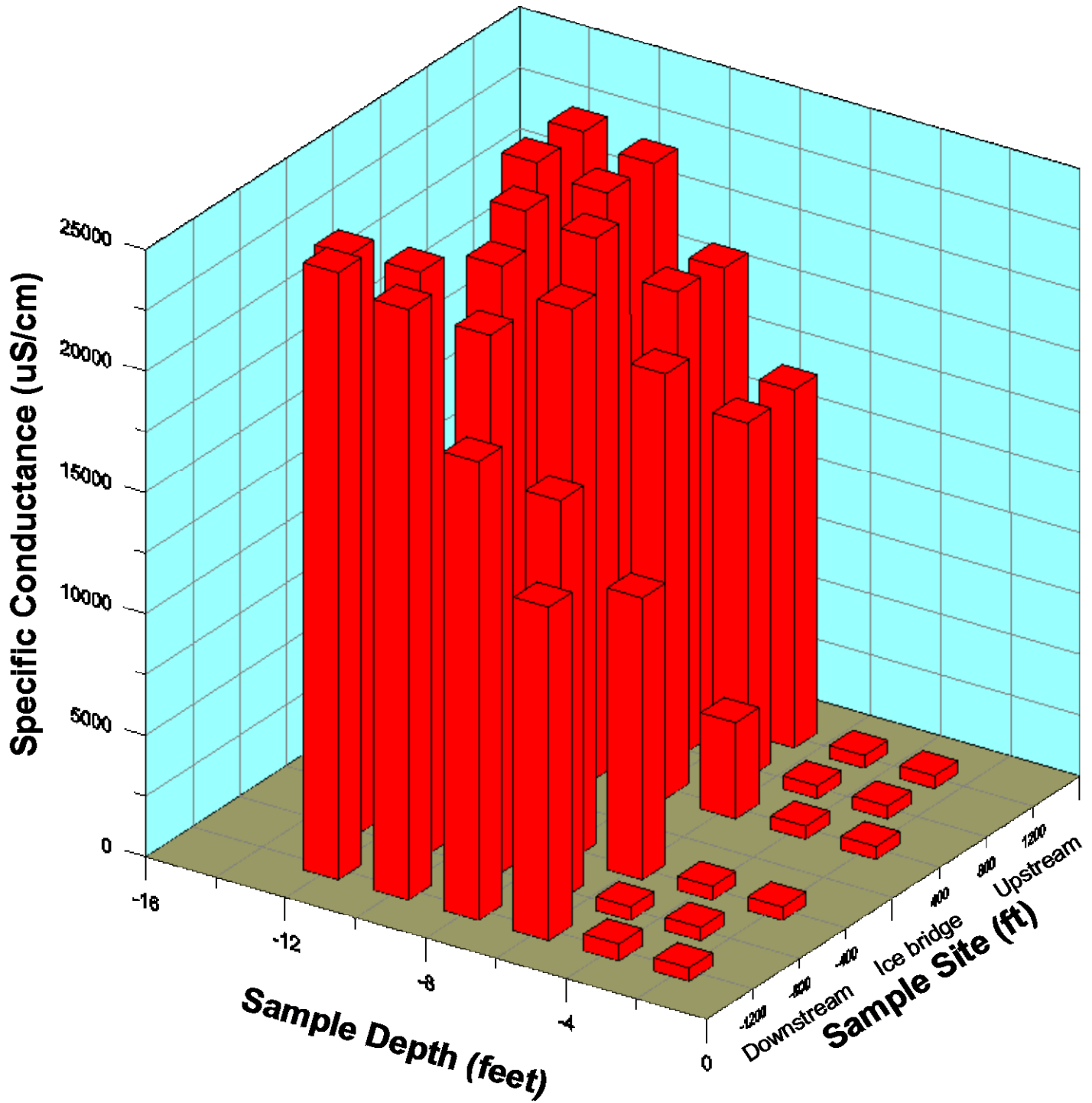
Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 11:00 a.m.	11.0	1.6	0	1	-	-	-	-	-	-	-
				2	0.0	284	557	11.4	82.6	0.3	-
				3	-	-	-	-	-	-	-
				4	0.0	290	569	11.4	82.4	0.3	-
				5	-	-	-	-	-	-	-
				6	0.2	5950	11578	11.0	81.0	6.1	-
				7	-	-	-	-	-	-	-
				8	0.8	11910	22656	9.9	76.5	12.9	-
				9	-	-	-	-	-	-	-
				10	1.4	12690	23612	9.4	77.5	13.5	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 11:20 a.m.	13.8	1.3	0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.1	283	552	11.5	82.0	0.3	-
				4	-	-	-	-	-	-	-
				5	0.1	289	565	11.5	81.7	0.3	-
				6	-	-	-	-	-	-	-
				7	0.5	8530	16410	11.1	79.8	9.1	-
				8	-	-	-	-	-	-	-
				9	0.8	11790	22428	10.7	77.3	12.8	-
				10	-	-	-	-	-	-	-
				11	0.8	12710	24178	10.4	75.3	13.8	-
				12	-	-	-	-	-	-	-
				13	0.8	12650	24064	10.5	76.0	13.8	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 11:50 a.m.	12.3	1.3	0	1	-	-	-	-	-	-	-
				2	0.1	283	552	11.5	81.5	0.3	0.12
				3	-	-	-	-	-	-	-
				4	0.1	360	703	11.4	81.2	0.4	0.17
				5	-	-	-	-	-	-	-
				6	0.5	7120	13698	11.1	79.5	7.5	0.22
				7	-	-	-	-	-	-	-
				8	0.8	9930	18890	10.8	77.7	10.7	0.03
				9	-	-	-	-	-	-	-
				10	0.9	12830	24316	10.4	75.3	13.9	0.16
				11	-	-	-	-	-	-	-
				12	0.9	13190	24998	10.5	75.6	14.4	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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) Velocity was measured using a Marsh-McBirney Model 2000



# 2008/2009 Colville River Ice Bridge Monitoring November 25, 2008



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> December 2, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -26° F, 10-30 mph wind

Elijah Keib arrived at Alpine on Monday, December 1, 2008 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on December 2, Mr. Keib attended LCMF's daily health and safety meeting. At 6:30 AM equipment was assembled, calibrated and prepared for transport. Jack Tippleman of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hagglund departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on December 2 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 28,000 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 800 uS/cm at 3 feet of depth to 27,500 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 81.3%, and averaging 78.1%. Measured velocities suggested a mixed flow with a maximum measured velocity of 0.08 ft/s. The next monitoring event is scheduled for December 9, 2008.

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



Sample Date: December 2, 2008

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:25 a.m.	12.7	1.4	+0.1	1	-	-	-	-	-	-	-
				2	0.0	411	806	10.9	79.4	0.4	-
				3	-	-	-	-	-	-	-
				4	0.0	533	1045	10.9	79.1	0.5	-
				5	-	-	-	-	-	-	-
				6	0.3	6530	12658	10.6	78.0	6.9	-
				7	-	-	-	-	-	-	-
				8	0.6	10600	20316	10.6	78.0	11.4	-
				9	-	-	-	-	-	-	-
				10	0.8	14170	26956	10.3	77.3	15.6	-
				11	-	-	-	-	-	-	-
				12	1.0	14500	27379	10.4	78.6	16.0	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 10:15 a.m.	13.6	1.7	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	416	816	10.9	79.5	0.4	-
				4	-	-	-	-	-	-	-
				5	0.1	670	1309	10.7	78.8	0.7	-
				6	-	-	-	-	-	-	-
				7	0.5	9110	17526	10.4	77.8	9.7	-
				8	-	-	-	-	-	-	-
				9	0.8	12260	23322	10.3	77.6	13.3	-
				10	-	-	-	-	-	-	-
				11	0.9	14360	27216	10.2	77.9	15.8	-
				12	-	-	-	-	-	-	-
				13	1.0	15000	28323	10.0	79.1	16.4	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:55 a.m.	13.7	1.6	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	416	816	10.9	78.3	0.4	-
				4	-	-	-	-	-	-	-
				5	0.1	680	1328	10.7	77.5	0.7	-
				6	-	-	-	-	-	-	-
				7	0.5	9450	18180	10.5	76.8	10.5	-
				8	-	-	-	-	-	-	-
				9	0.7	12200	23295	10.3	76.3	13.3	-
				10	-	-	-	-	-	-	-
				11	0.8	14270	27146	10.2	76.9	15.7	-
				12	-	-	-	-	-	-	-
				13	0.8	14450	27488	10.3	77.9	15.9	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) A positive value for freeboard indicates water measured above the surface of the ice.

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



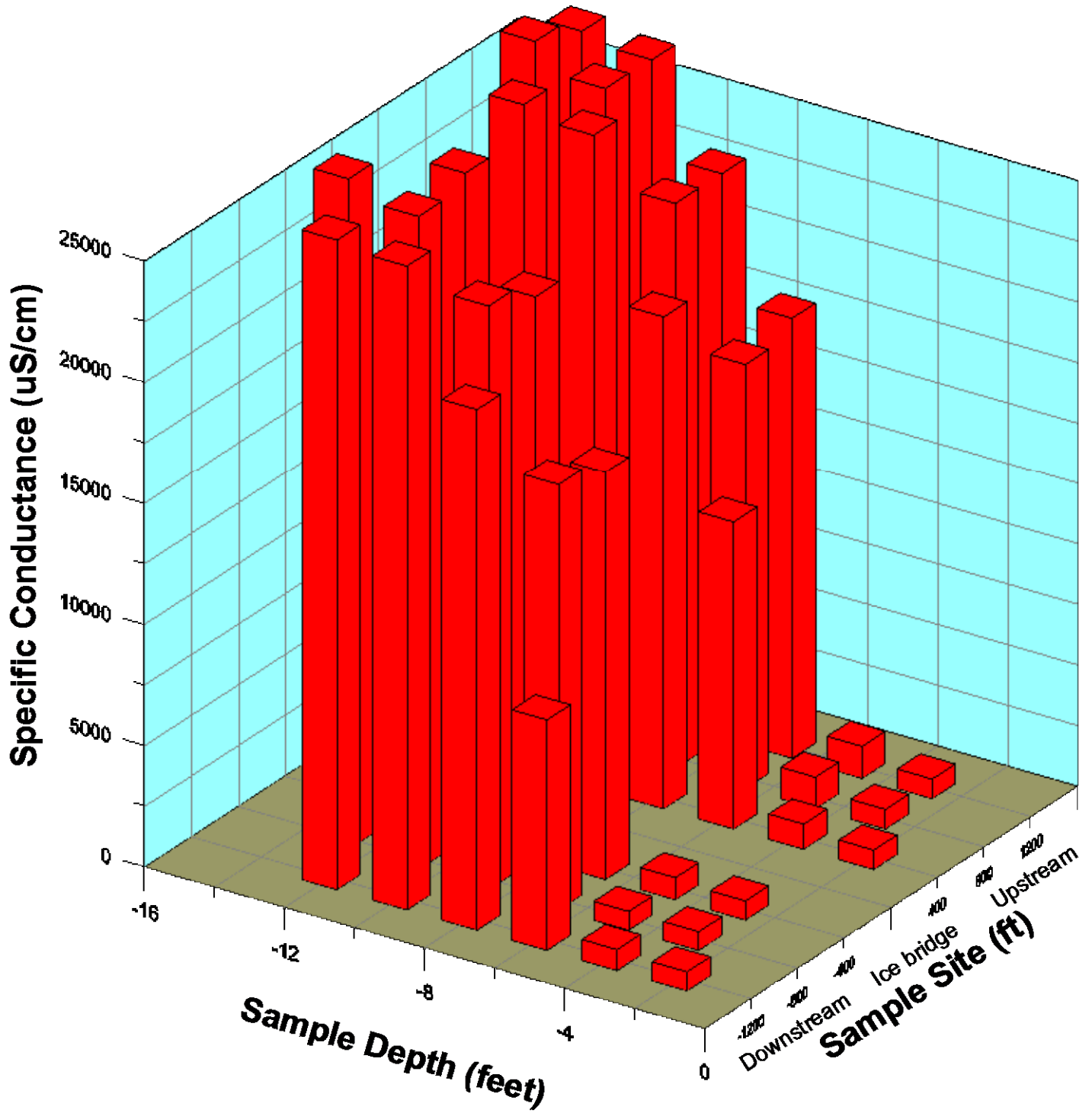
Sample Date: December 2, 2008

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)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 10:40 a.m.	11.1	1.9	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	405	794	11.0	81.3	0.4	-
				4	-	-	-	-	-	-	-
				5	0.1	469	916	10.9	80.9	0.7	-
				6	-	-	-	-	-	-	-
				7	0.4	8710	16820	10.4	78.6	9.3	-
				8	-	-	-	-	-	-	-
				9	0.8	12210	23227	10.1	77.4	13.4	-
				10	-	-	-	-	-	-	-
				11	0.9	14500	27481	9.6	76.2	15.9	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 10:50 a.m.	13.6	1.6	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	394	772	10.9	80.6	0.4	-
				4	-	-	-	-	-	-	-
				5	0.1	397	775	10.7	79.9	0.4	-
				6	-	-	-	-	-	-	-
				7	0.5	9120	17545	10.2	77.4	9.7	-
				8	-	-	-	-	-	-	-
				9	0.8	12670	24102	9.8	76.0	13.9	-
				10	-	-	-	-	-	-	-
				11	0.9	14220	26950	9.6	75.5	15.5	-
				12	-	-	-	-	-	-	-
				13	1.0	14650	27662	9.4	76.1	15.9	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 11:00 a.m.	13.0	1.5	0.0	1	-	-	-	-	-	-	-
				2	0.0	402	788	11.0	80.7	0.4	0.05
				3	-	-	-	-	-	-	-
				4	0.0	445	872	10.9	80.3	0.5	0.08
				5	-	-	-	-	-	-	-
				6	0.3	4900	9498	10.3	77.7	5.0	0.05
				7	-	-	-	-	-	-	-
				8	0.7	11260	21500	10.3	77.8	12.2	0.00
				9	-	-	-	-	-	-	-
				10	0.9	14020	26571	9.7	76.1	15.4	-0.04
				11	-	-	-	-	-	-	-
				12	1.0	14200	26813	9.5	76.9	15.5	-0.04

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) A positive value for freeboard indicates water measured above the surface of the ice.
- (8) Velocity was measured using a Marsh-McBirney Model 2000

# 2008/2009 Colville River Ice Bridge Monitoring December 2, 2008



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> December 9, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Ozzy Orwick

**Weather:** -14° F, 25-35 mph wind

Ozzy Orwick arrived at Alpine on Tuesday, December 9, 2008 at 11:00 AM. Upon arrival Mr. Orwick met with Gene Diamond of LCMF and coordinated access to the Colville River for that days planned ice bridge monitoring event. At 1:00 PM equipment was assembled, calibrated and prepared for transport. Jack Tippleman of LCMF accompanied Mr. Orwick to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 1:45 PM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on December 9 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 26,600 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 440 uS/cm at 2 feet of depth to 25,600 uS/cm at the maximum depth of each sample location. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 75.2%, and averaging 72.5%. Measured velocities suggest no flow. The next monitoring event is scheduled for December 15, 2008.

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



Sample Date: December 9, 2008

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 12:50 p.m.	12.2	1.6	0.1	1	-	-	-	-	-	-	-
				2	0.0	221	433	10.2	74.2	0.2	-
				3	-	-	-	-	-	-	-
				4	0.0	321	629	10.1	74.4	0.3	-
				5	-	-	-	-	-	-	-
				6	0.4	8620	16646	9.9	74.1	9.2	-
				7	-	-	-	-	-	-	-
				8	0.7	10870	20755	9.8	74.5	11.7	-
				9	-	-	-	-	-	-	-
				10	1.0	13480	25453	8.9	69.6	14.7	-
				11	-	-	-	-	-	-	-
				12	1.6	13940	25750	8.5	69.9	14.9	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 2:35 p.m.	13.0	2.0	0.1	1	-	-	-	-	-	-	-
				2	0.1	222	433	10.2	74.3	0.2	-
				3	-	-	-	-	-	-	-
				4	0.0	291	571	10.2	74.8	0.3	-
				5	-	-	-	-	-	-	-
				6	0.4	8680	16762	10.1	75.1	9.3	-
				7	-	-	-	-	-	-	-
				8	0.6	10480	20086	9.9	74.3	11.3	-
				9	-	-	-	-	-	-	-
				10	1.0	13360	25227	9.3	70.7	14.5	-
				11	-	-	-	-	-	-	-
				12	1.1	13770	25905	9.2	71.1	15.0	-
				13	1.2	13880	26016	9.1	72.3	15.0	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 2:20 p.m.	13.2	1.9	0.1	1	-	-	-	-	-	-	-
				2	0.0	219	428	10.2	73.8	0.2	-
				3	-	-	-	-	-	-	-
				4	0.0	276	541	10.2	74.5	0.2	-
				5	-	-	-	-	-	-	-
				6	0.4	8750	16897	10.2	75.0	9.4	-
				7	-	-	-	-	-	-	-
				8	0.7	10400	19858	10.2	75.2	11.2	-
				9	-	-	-	-	-	-	-
				10	0.9	13250	25112	9.6	71.9	14.5	-
				11	-	-	-	-	-	-	-
				12	1.1	13750	25867	9.6	72.2	14.9	-
				13	1.1	13790	25943	9.4	73.3	15.0	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) A positive value for freeboard indicates water measured above the surface of the ice.

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



Sample Date: December 9, 2008

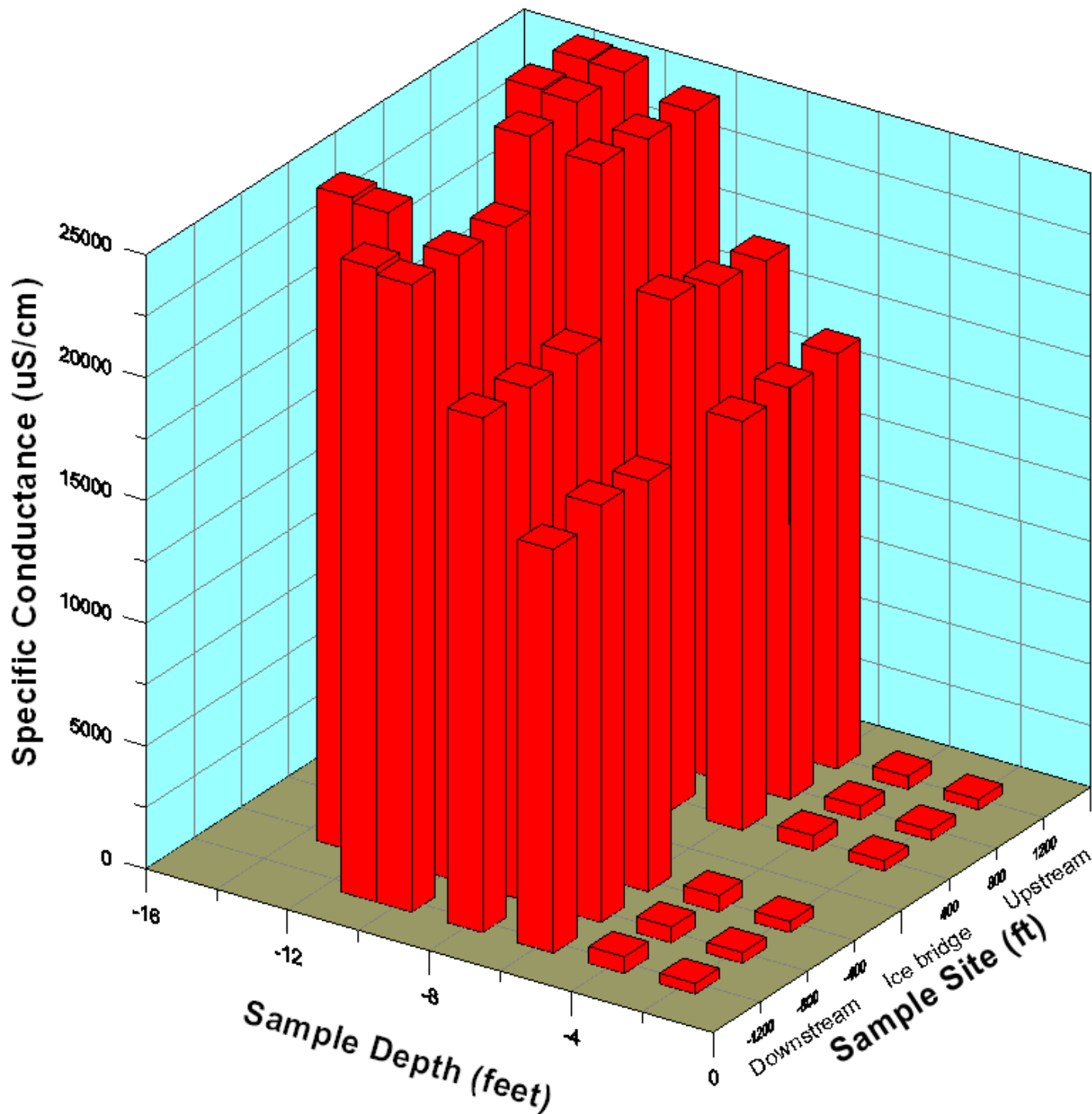
Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 3:05 p.m.	10.2	1.9	0.1	1	-	-	-	-	-	-	-
				2	0.0	235	460	10.2	74.5	0.2	-
				3	-	-	-	-	-	-	-
				4	0.0	341	669	10.0	74.4	0.3	-
				5	-	-	-	-	-	-	-
				6	0.4	8660	16723	9.8	74.1	9.2	-
				7	-	-	-	-	-	-	-
				8	0.8	11060	21039	9.5	73.0	11.9	-
				9	-	-	-	-	-	-	-
				10	1.3	13590	25379	8.9	71.5	14.6	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 3:20 p.m.	13.1	1.6	0.0	1	-	-	-	-	-	-	-
				2	0.0	226	443	10.2	74.1	0.2	-
				3	-	-	-	-	-	-	-
				4	0.0	332	651	10.1	73.9	0.3	-
				5	-	-	-	-	-	-	-
				6	0.4	8790	16974	10.0	74.1	9.4	-
				7	-	-	-	-	-	-	-
				8	0.7	10960	20927	9.7	72.5	11.8	-
				9	-	-	-	-	-	-	-
				10	1.0	13490	25472	8.9	67.3	14.7	-
				11	-	-	-	-	-	-	-
				12	1.2	14080	26391	8.4	64.0	15.3	-
				13	1.6	14400	26600	8.3	65.6	15.4	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 3:35 p.m.	11.6	1.9	0.1	1	-	-	-	-	-	-	-
				2	0.0	222	435	10.2	73.8	0.2	-
				3	-	-	-	-	-	-	-
				4	0.0	352	690	10.1	74.0	0.3	-0.08
				5	-	-	-	-	-	-	-
				6	0.4	8510	16434	10.0	74.7	9.1	-0.07
				7	-	-	-	-	-	-	-
				8	0.7	10970	20946	9.7	72.9	11.8	-0.06
				9	-	-	-	-	-	-	-
				10	1.0	13530	25548	8.9	68.4	14.7	-0.04
				11	1.3	13820	25809	8.5	67.4	15.0	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) A positive value for freeboard indicates water measured above the surface of the ice.
- (8) Velocity was measured using a Marsh-McBirney Model 2000



# 2008/2009 Colville River Ice Bridge Monitoring December 9, 2008



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> December 15, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Ozzy Orwick

**Weather:** 25° F, 25-35 mph wind

Ozzy Orwick arrived at Alpine on Sunday, December 14, 2008 at 6:00 PM. Upon arrival Mr. Orwick met with LCMF and coordinated access to the Colville River for the next day's ice bridge monitoring event. At 6:00 AM on December 15, Mr. Orwick attended LCMF's daily health and safety meeting. At 7:00 AM equipment was assembled, calibrated and prepared for transport. Chris Zeimet of LCMF accompanied Mr. Orwick to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on December 15 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 30,600 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 1600 uS/cm at 2 feet of depth to 30,300 uS/cm at the maximum depth of each sample location. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 81.0%, and averaging 72.2%. Measured velocities suggest no flow. The next monitoring event is scheduled for December 23, 2008.

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



Sample Date: December 15, 2008

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:45 a.m.	13.5	1.8	0.0	1	-	-	-	-	-	-	-
				2	0.0	819	1606	10.6	76.1	0.8	-
				3	-	-	-	-	-	-	-
				4	0.0	1525	2990	10.4	75.0	1.5	-
				5	-	-	-	-	-	-	-
				6	0.6	11180	21427	9.9	72.2	11.7	-
				7	-	-	-	-	-	-	-
				8	0.6	14420	27637	10.3	75.4	16.0	-
				9	-	-	-	-	-	-	-
				10	0.5	15430	29684	10.6	77.7	17.3	-
				11	-	-	-	-	-	-	-
				12	0.5	15640	30088	10.7	77.8	17.5	-
				13	0.5	15680	30165	10.8	79.1	17.6	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:30 a.m.	14.1	2.0	0.0	1	-	-	-	-	-	-	-
				2	0.0	819	1606	10.6	76.3	0.8	-
				3	-	-	-	-	-	-	-
				4	0.0	1503	2947	10.4	74.9	1.5	-
				5	-	-	-	-	-	-	-
				6	0.6	11540	22117	9.9	72.4	12.5	-
				7	-	-	-	-	-	-	-
				8	0.5	14410	27722	10.4	76.3	16.0	-
				9	-	-	-	-	-	-	-
				10	0.5	15260	29357	10.6	77.7	17.0	-
				11	-	-	-	-	-	-	-
				12	0.5	15640	30088	10.7	78.2	17.5	-
				13	-	-	-	-	-	-	-
				14	0.5	15720	30242	10.7	78.9	17.6	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:15 a.m.	13.8	2.0	0.0	1	-	-	-	-	-	-	-
				2	0.0	800	1569	10.6	77.0	0.8	-
				3	-	-	-	-	-	-	-
				4	0.0	1408	2761	10.4	75.6	1.4	-
				5	-	-	-	-	-	-	-
				6	0.6	11430	21907	9.8	72.8	12.4	-
				7	-	-	-	-	-	-	-
				8	0.6	14280	27369	10.1	75.1	15.8	-
				9	-	-	-	-	-	-	-
				10	0.5	15030	28915	10.3	77.2	16.7	-
				11	-	-	-	-	-	-	-
				12	0.5	15580	29973	10.3	77.6	17.4	-
				13	0.6	15760	30205	10.1	78.4	17.6	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) A positive value for freeboard indicates water measured above the surface of the ice.

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



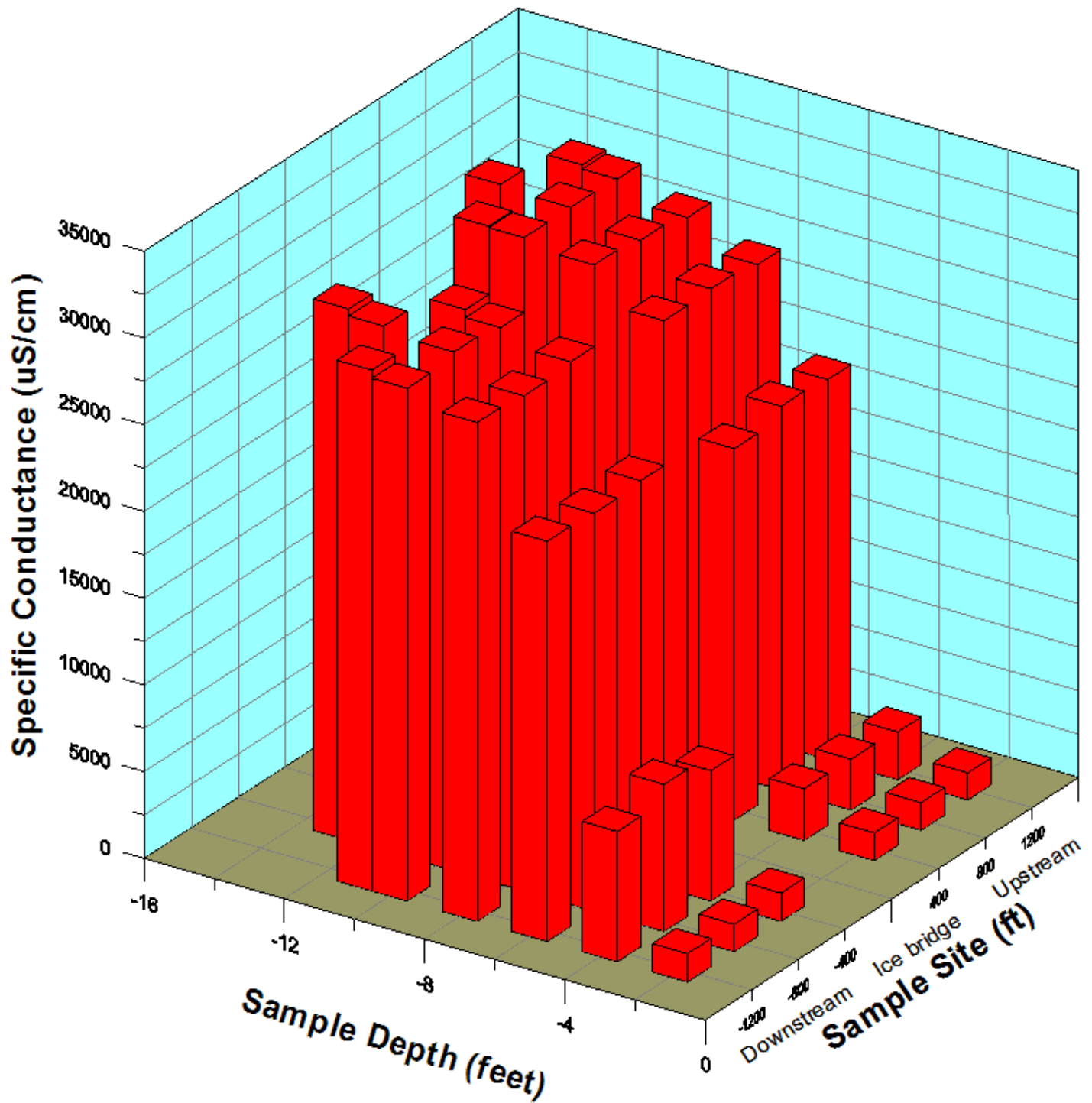
Sample Date: December 15, 2008

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)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 10:00 a.m.	11.7	2.0	0.0	1	-	-	-	-	-	-	-
				2	0.0	836	1639	10.5	75.5	0.8	-
				3	-	-	-	-	-	-	-
				4	0.1	3850	7520	10.4	74.9	3.9	-
				5	-	-	-	-	-	-	-
				6	0.6	12040	23076	10.0	73.1	13.1	-
				7	-	-	-	-	-	-	-
				8	0.5	14950	28761	10.6	77.1	16.7	-
				9	-	-	-	-	-	-	-
				10	0.5	15370	29569	10.8	78.3	17.2	-
				11	0.5	15610	30031	11.1	81.0	17.5	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 10:15 a.m.	13.8	1.8	0.0	1	-	-	-	-	-	-	-
				2	0.0	810	1588	10.4	75.2	0.8	-
				3	-	-	-	-	-	-	-
				4	0.2	4361	8486	10.3	74.7	4.5	-
				5	-	-	-	-	-	-	-
				6	0.6	11970	22942	10.1	73.5	13.0	-
				7	-	-	-	-	-	-	-
				8	0.5	14840	28549	10.6	76.9	16.5	-
				9	-	-	-	-	-	-	-
				10	0.5	15550	29915	10.6	77.3	17.4	-
				11	-	-	-	-	-	-	-
				12	0.5	15720	30242	10.7	77.6	17.6	-
				13	0.5	15930	30646	11.0	79.9	17.8	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 10:30 a.m.	13.0	2.0	0.0	1	-	-	-	-	-	-	-
				2	0.0	832	1631	10.6	76.4	0.8	-
				3	-	-	-	-	-	-	-
				4	0.1	3826	7473	10.4	75.0	3.9	-0.02
				5	-	-	-	-	-	-	-
				6	0.6	11770	22558	10.0	72.8	12.8	-0.02
				7	-	-	-	-	-	-	-
				8	0.6	14770	28308	10.6	76.8	16.4	-0.19
				9	-	-	-	-	-	-	-
				10	0.5	15650	30108	10.7	77.5	17.5	-0.19
				11	-	-	-	-	-	-	-
				12	0.5	15850	30492	10.9	79.0	17.8	-0.20
				13	0.5	15910	30608	10.9	79.3	17.8	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) A positive value for freeboard indicates water measured above the surface of the ice.
- (8) Velocity was measured using a Marsh-McBirney Model 2000

# 2008/2009 Colville River Ice Bridge Monitoring December 15, 2008



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> December 23, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -5° F, 0-5 mph wind

Elijah Keib arrived at Alpine on Monday, December 22, 2008 at 6:45 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on December 23, Mr. Keib attended LCMF's daily health and safety meeting. At 6:30 AM equipment was assembled, calibrated and prepared for transport. Roy Baldwin of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on December 23 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 32,000 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 840 uS/cm at 3 feet of depth to 32,000 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 73.5%, and averaging 69.8%. Measured velocities suggested a mixed flow with a maximum measured velocity of 0.09 ft/s. The next monitoring event is scheduled for December 30, 2008.

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



Sample Date: December 23, 2008

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:20 a.m.	13.7	1.9	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	520	1020	8.7	61.1	0.6	-
				4	-	-	-	-	-	-	-
				5	0.1	4600	8985	9.3	65.4	5.0	-
				6	-	-	-	-	-	-	-
				7	0.4	15340	29623	10.1	72.1	17.2	-
				8	-	-	-	-	-	-	-
				9	0.4	16290	31458	10.1	72.5	18.3	-
				10	-	-	-	-	-	-	-
				11	0.4	16510	31882	10.1	72.9	18.6	-
				12	-	-	-	-	-	-	-
				13	0.6	16850	32295	9.8	73.5	19.1	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:05 a.m.	14.4	2.3	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	0.0	1200	2353	8.8	62.4	1.3	-
				5	-	-	-	-	-	-	-
				6	0.2	10720	20859	9.9	70.1	11.7	-
				7	-	-	-	-	-	-	-
				8	0.4	15600	30125	10.2	72.5	17.5	-
				9	-	-	-	-	-	-	-
				10	0.4	16240	31361	10.2	72.5	18.3	-
				11	-	-	-	-	-	-	-
				12	0.4	16430	31728	10.2	72.8	18.5	-
				13	-	-	-	-	-	-	-
				14	0.6	16460	31547	9.8	73.2	18.1	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:50 a.m.	13.8	2.2	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	430.0	843	8.8	62.0	0.4	-
				4	-	-	-	-	-	-	-
				5	0.1	4450	8692	9.8	69.9	4.6	-
				6	-	-	-	-	-	-	-
				7	0.5	14560	28011	10.0	71.6	16.2	-
				8	-	-	-	-	-	-	-
				9	0.5	16050	30877	10.2	72.8	18.1	-
				10	-	-	-	-	-	-	-
				11	0.4	16390	31651	10.0	72.1	18.4	-
				12	-	-	-	-	-	-	-
				13	0.5	16700	32128	9.8	72.1	18.8	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO

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



Sample Date: December 23, 2008

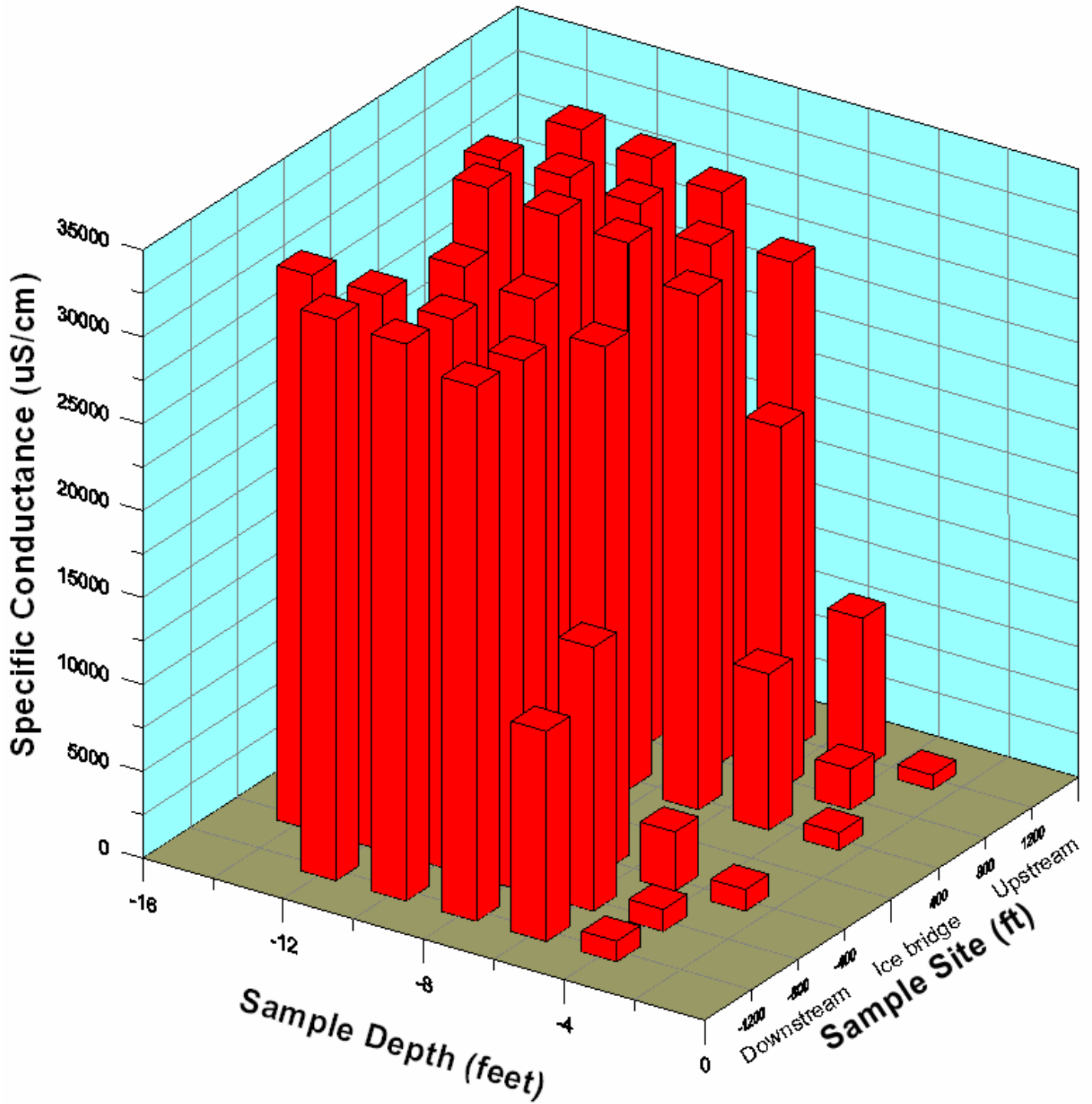
Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)	
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:30 a.m.	11.7	2.2	0.0	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	-
				3	0.0	640	1255	8.6	60.7	0.7	-	
				4	-	-	-	-	-	-	-	
				5	0.1	1740	3399	8.8	62.7	1.9	-	
				6	-	-	-	-	-	-	-	
				7	0.3	15550	30143	10.0	71.9	17.5	-	
				8	-	-	-	-	-	-	-	
				9	0.4	16420	31709	10.0	72.5	18.5	-	
				10	-	-	-	-	-	-	-	
				11	0.5	16840	32397	9.2	70.9	18.8	-	
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 9:40 a.m.	14.2	2.2	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-	
				4	0.0	650	1275	8.8	61.8	0.8	-	
				5	-	-	-	-	-	-	-	
				6	0.2	7800	15177	10.1	71.7	8.3	-	
				7	-	-	-	-	-	-	-	
				8	0.4	15800	30511	10.2	72.8	17.8	-	
				9	-	-	-	-	-	-	-	
				10	0.4	16430	31728	10.1	72.8	18.5	-	
				11	-	-	-	-	-	-	-	
				12	0.4	16550	31960	9.9	72.5	18.7	-	
				13	-	-	-	-	-	-	-	
				14	0.7	16720	31925	9.8	72.3	18.8	-	
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 10:00 a.m.	13.0	2.2	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-	
				4	0.0	610	1196	8.7	61.4	0.8	0.00	
				5	-	-	-	-	-	-	-	
				6	0.2	6220	12103	9.7	69.1	6.6	0.09	
				7	-	-	-	-	-	-	-	
				8	0.4	15930	30762	10.0	72.7	18.0	0.09	
				9	-	-	-	-	-	-	-	
				10	0.4	16600	32056	9.7	72.5	18.7	-0.03	
				11	-	-	-	-	-	-	-	
				12	0.6	16860	32314	9.0	71.9	19.0	-0.01	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) Velocity was measured using a Marsh-McBirney Model 2000



# 2008/2009 Colville River Ice Bridge Monitoring December 23, 2008



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> December 30, 2008
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -20° F, 0-5 mph wind

Elijah Keib arrived at Alpine on Monday, December 29, 2008 at 8:45 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on December 30, Mr. Keib attended LCMF's daily health and safety meeting. At 6:30 AM equipment was assembled, calibrated and prepared for transport. Roy Baldwin of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:30 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on December 30 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 33,000 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 590 uS/cm at 3 feet of depth to 32,000 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 69.9%, and averaging 64.9%. Measured velocities suggested a reverse flow with a maximum measured velocity of -0.10 ft/s. The next monitoring event is scheduled for January 13, 2009.

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



Sample Date: December 30, 2008

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:00 a.m.	12.5	2.2	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-0.1	319	628	8.4	57.1	0.3	-
				5	-	-	-	-	-	-	-
				6	0.1	602	1176	8.8	59.7	0.8	-
				7	-	-	-	-	-	-	-
				8	0.5	16120	31012	10.1	69.4	18.1	-
				9	-	-	-	-	-	-	-
				10	0.5	16560	31858	10.0	68.9	18.6	-
				11	-	-	-	-	-	-	-
				12	0.8	16960	32263	9.8	68.6	18.9	-
				13	-	-	-	-	-	-	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:45 a.m.	13.2	2.6	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-0.1	303	597	8.3	56.1	0.3	-
				4	-	-	-	-	-	-	-
				5	0.0	350	686	8.4	57.1	0.4	-
				6	-	-	-	-	-	-	-
				7	0.5	14800	28472	9.8	68.0	16.5	-
				8	-	-	-	-	-	-	-
				9	0.5	16320	31397	9.8	68.9	18.3	-
				10	-	-	-	-	-	-	-
				11	0.5	16650	32032	9.5	67.3	18.7	-
				12	-	-	-	-	-	-	-
				13	1.1	17500	32922	8.3	65.3	19.6	-
				14	-	-	-	-	-	-	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:15 a.m.	13.6	2.4	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-0.1	301	592	8.3	56.2	0.3	-
				4	-	-	-	-	-	-	-
				5	0.0	400	784	8.4	56.9	0.4	-
				6	-	-	-	-	-	-	-
				7	0.5	14940	28742	9.8	67.0	17.1	-
				8	-	-	-	-	-	-	-
				9	0.5	16400	31551	10.1	69.9	18.4	-
				10	-	-	-	-	-	-	-
				11	0.5	16710	32147	9.8	68.3	18.8	-
				12	-	-	-	-	-	-	-
				13	0.7	16960	32384	9.5	67.2	19.0	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO

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



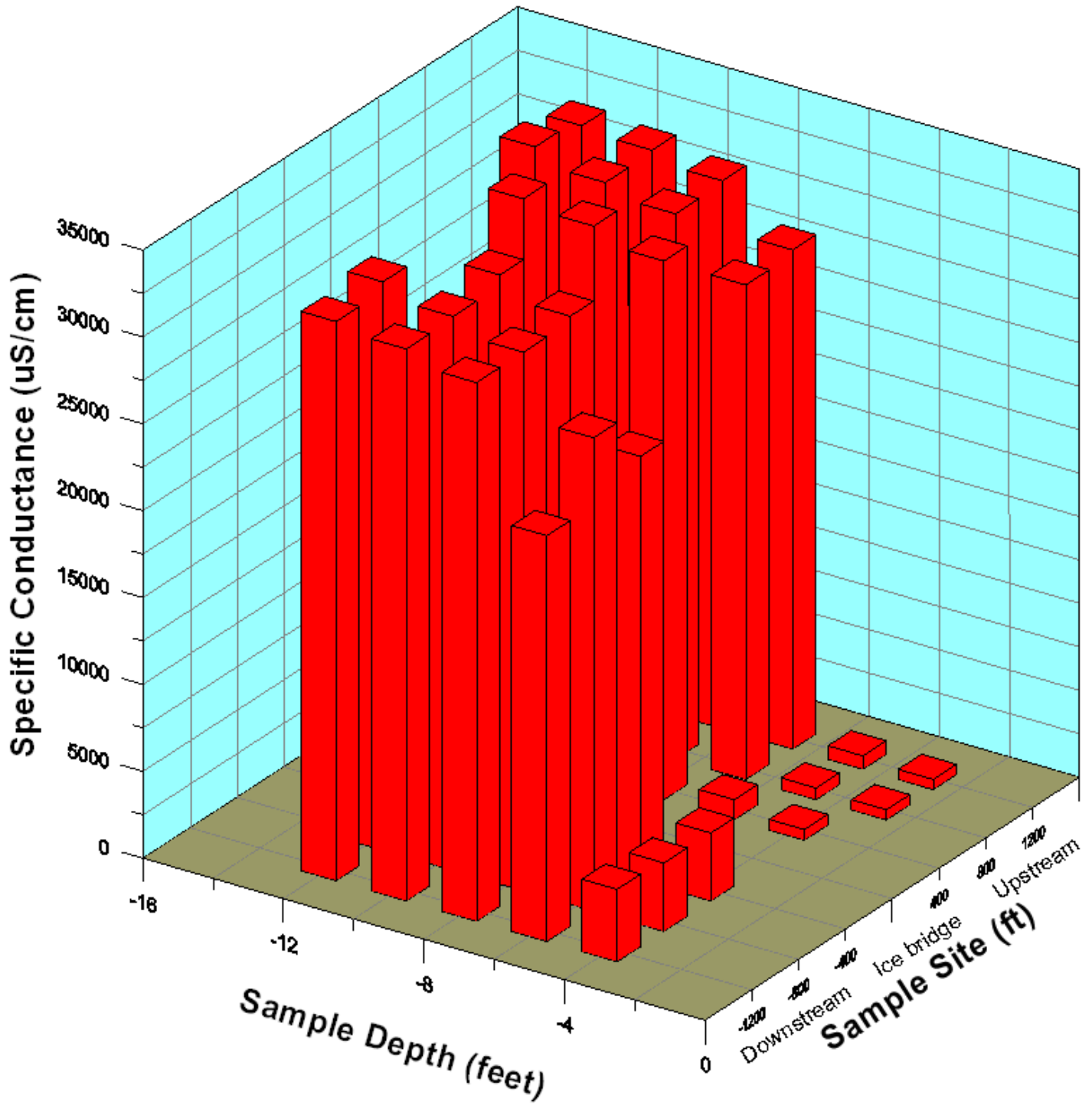
Sample Date: December 30, 2008

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)		
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 10:15 a.m.	10.7	2.6	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	0.2	2015	3921	8.5	58.3	2.3	-		
				5	-	-	-	-	-	-	-		
				6	0.4	12650	24428	9.4	66.1	14.0	-		
				7	-	-	-	-	-	-	-		
				8	0.6	16350	31336	9.5	68.0	18.2	-		
				9	-	-	-	-	-	-	-		
				10	1.1	17300	32546	9.1	68.1	19.1	-		
				11	-	-	-	-	-	-	-		
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 10:25 a.m.	12.9	2.1	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-		
				4	0.1	2022	3950	8.6	58.6	2.0	-		
				5	-	-	-	-	-	-	-		
				6	0.4	14110	27248	9.6	66.2	15.7	-		
				7	-	-	-	-	-	-	-		
				8	0.5	16120	31012	9.8	68.3	18.1	-		
				9	-	-	-	-	-	-	-		
				10	0.7	16710	31906	9.6	67.8	18.7	-		
				11	-	-	-	-	-	-	-		
				12	0.9	17270	32731	9.0	66.1	19.2	-		
				13	-	-	-	-	-	-	-		
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 10:35 a.m.	12.8	2.1	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-		
				4	0.1	2140	4180	8.6	58.6	2.1	-0.10		
				5	-	-	-	-	-	-	-		
				6	0.4	12100	23366	9.6	65.5	13.0	-0.07		
				7	-	-	-	-	-	-	-		
				8	0.5	16120	31012	10.1	69.2	18.1	-0.07		
				9	-	-	-	-	-	-	-		
				10	0.6	16580	31777	10.0	69.3	18.7	-0.07		
				11	-	-	-	-	-	-	-		
				12	0.7	16860	32193	10.1	69.9	18.9	-0.08		

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO
- (7) Velocity was measured using a Marsh-McBirney Model 2000
- (8) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.

# 2008/2009 Colville River Ice Bridge Monitoring December 30, 2008



# Project Trip Report



<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> January 6, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -37° F, 0-5 mph wind

Elijah Keib arrived at Alpine on Monday, January 6, 2009 at 6:30 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on January 6, Mr. Keib attended LCMF's daily health and safety meeting. At 7:00 AM equipment was assembled, calibrated and prepared for transport. Chris Zeimet of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on January 6 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 33,500 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 620 uS/cm at 3 feet of depth to 33,500 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 76.1%, and averaging 70.1%. Measured velocities were not indicative of flow. The next monitoring event is scheduled for January 20, 2009.

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



Sample Date: January 6, 2009

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:00 a.m.	12.8	2.3	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	0.1	315	615	8.9	64.7	0.3	-
				5	-	-	-	-	-	-	-
				6	0.3	880	1706	9.2	67.4	0.9	-
				7	-	-	-	-	-	-	-
				8	0.6	16240	31125	10.0	73.4	18.2	-
				9	-	-	-	-	-	-	-
				10	0.6	16670	31950	10.1	74.0	18.7	-
				11	-	-	-	-	-	-	-
				12	0.7	17160	32766	10.4	76.1	19.3	-
				13	-	-	-	-	-	-	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 8:50 a.m.	13.4	2.7	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	319	625	9.0	65.0	0.4	-
				4	-	-	-	-	-	-	-
				5	0.1	500	977	9.0	65.4	0.6	-
				6	-	-	-	-	-	-	-
				7	0.5	14690	28261	9.9	71.9	16.7	-
				8	-	-	-	-	-	-	-
				9	0.6	16560	31739	10.0	73.0	18.6	-
				10	-	-	-	-	-	-	-
				11	0.6	16780	32160	10.1	73.3	18.8	-
				12	-	-	-	-	-	-	-
				13	0.5	17130	32955	10.1	73.8	19.4	-
				14	-	-	-	-	-	-	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:30 a.m.	13.8	2.7	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	0.0	315	617	9.0	64.6	0.3	-
				4	-	-	-	-	-	-	-
				5	0.0	448	878	9.0	64.9	0.4	-
				6	-	-	-	-	-	-	-
				7	0.5	14930	28723	9.8	71.4	16.6	-
				8	-	-	-	-	-	-	-
				9	0.6	16570	31758	9.8	72.2	18.6	-
				10	-	-	-	-	-	-	-
				11	0.7	16820	32116	9.8	73.2	18.9	-
				12	-	-	-	-	-	-	-
				13	0.8	17370	33043	10.1	75.4	19.4	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.

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



Sample Date: January 6, 2009

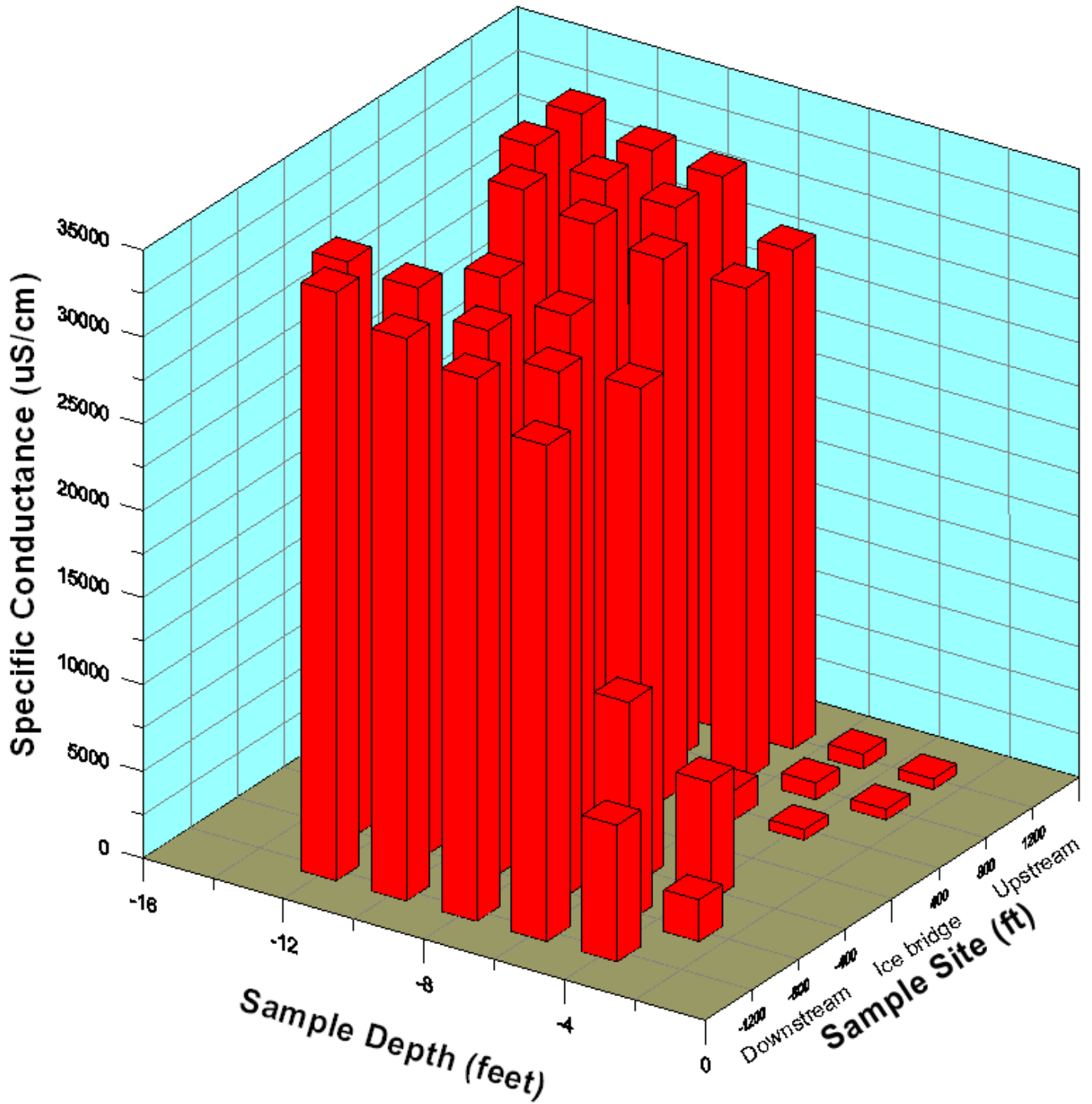
Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)		
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:15 a.m.	10.7	2.6	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	0.2	3515	6840	8.7	63.6	2.3	-	-	
				5	-	-	-	-	-	-	-	-	-
				6	0.5	14740	28357	9.3	69.0	14.0	-	-	
				7	-	-	-	-	-	-	-	-	-
				8	0.6	16360	31355	9.6	71.5	18.2	-	-	
				9	-	-	-	-	-	-	-	-	-
				10	0.7	16950	32365	9.5	71.6	19.1	-	-	
				11	-	-	-	-	-	-	-	-	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 9:30 a.m.	13.3	2.4	0.1	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	0.0	1229	2410	9.2	66.4	1.3	-	-	
				4	-	-	-	-	-	-	-	-	-
				5	0.3	6500	12600	8.8	64.1	6.9	-	-	
				6	-	-	-	-	-	-	-	-	-
				7	0.5	15820	30435	9.7	71.0	17.7	-	-	
				8	-	-	-	-	-	-	-	-	-
				9	0.6	16520	31662	9.8	71.5	18.5	-	-	
				10	-	-	-	-	-	-	-	-	-
				11	0.6	17190	32946	9.9	72.2	19.3	-	-	
				12	-	-	-	-	-	-	-	-	-
				13	0.7	17430	33281	10.2	74.5	19.6	-	-	
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 9:50 a.m.	12.9	2.4	0.1	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	0.1	4025	7862	8.6	62.8	4.2	-0.01	-	
				5	-	-	-	-	-	-	-	-	-
				6	0.5	14840	28549	9.3	69.8	16.8	-0.05	-	
				7	-	-	-	-	-	-	-	-	-
				8	0.6	16300	31240	9.5	71.7	18.3	-0.05	-	
				9	-	-	-	-	-	-	-	-	-
				10	0.6	16890	32371	9.5	72.2	18.9	-0.08	-	
				11	-	-	-	-	-	-	-	-	-
				12	0.8	17800	33861	9.2	71.4	19.9	0.02	-	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.



# 2008/2009 Colville River Ice Bridge Monitoring January 6, 2009



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> January 21, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -28° F, 20-25 mph wind

Elijah Keib arrived at Alpine on Monday, January 20, 2009 at 7:30 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on January 21, Mr. Keib attended LCMF's daily health and safety meeting. At 7:30 AM equipment was assembled, calibrated and prepared for transport. Darren Saxosky of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on January 20 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 33,500 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 900 uS/cm at 3 feet of depth to 33,500 uS/cm at 12 to 13 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 76.8%, and averaging 62.3%. Measured velocities were not indicative of flow. The next monitoring event is scheduled for February 4, 2009.

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



Sample Date: January 21, 2009

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)	
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:05 a.m.	13.2	2.7	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	-
				3	0.0	460	902	10.1	67.5	0.4	-	
				4	-	-	-	-	-	-	-	
				5	0.1	900	1758	8.6	57.9	1.0	-	
				6	-	-	-	-	-	-	-	
				7	0.4	14230	27480	8.6	59.0	15.9	-	
				8	-	-	-	-	-	-	-	
				9	0.6	15690	30071	8.8	60.9	17.5	-	
				10	-	-	-	-	-	-	-	
				11	0.6	16580	31777	8.6	60.8	18.5	-	
				12	-	-	-	-	-	-	-	
				13	0.8	17690	33652	8.0	63.5	19.8	-	
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:30 a.m.	14.0	3.1	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	
				5	0.1	810	1582	8.9	60.0	1.1	-	
				6	-	-	-	-	-	-	-	
				7	0.4	14310	27634	8.9	60.4	15.9	-	
				8	-	-	-	-	-	-	-	
				9	0.5	15420	29665	9.0	62.0	17.2	-	
				10	-	-	-	-	-	-	-	
				11	0.8	16580	31540	8.7	62.6	18.4	-	
				12	-	-	-	-	-	-	-	
				13	1.2	17510	32820	7.9	62.5	19.4	-	
				14	-	-	-	-	-	-	-	
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:00 a.m.	13.5	2.9	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	0.1	486	949	10.1	67.6	0.4	-	
				4	-	-	-	-	-	-	-	
				5	0.1	1001	1955	8.8	59.5	1.2	-	
				6	-	-	-	-	-	-	-	
				7	0.3	14330	27778	8.9	60.7	16.1	-	
				8	-	-	-	-	-	-	-	
				9	0.5	15490	29800	9.1	62.9	17.4	-	
				10	-	-	-	-	-	-	-	
				11	0.6	16300	31240	9.2	63.9	18.2	-	
				12	-	-	-	-	-	-	-	
				13	0.6	16500	31624	9.1	65.5	18.5	-	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.

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



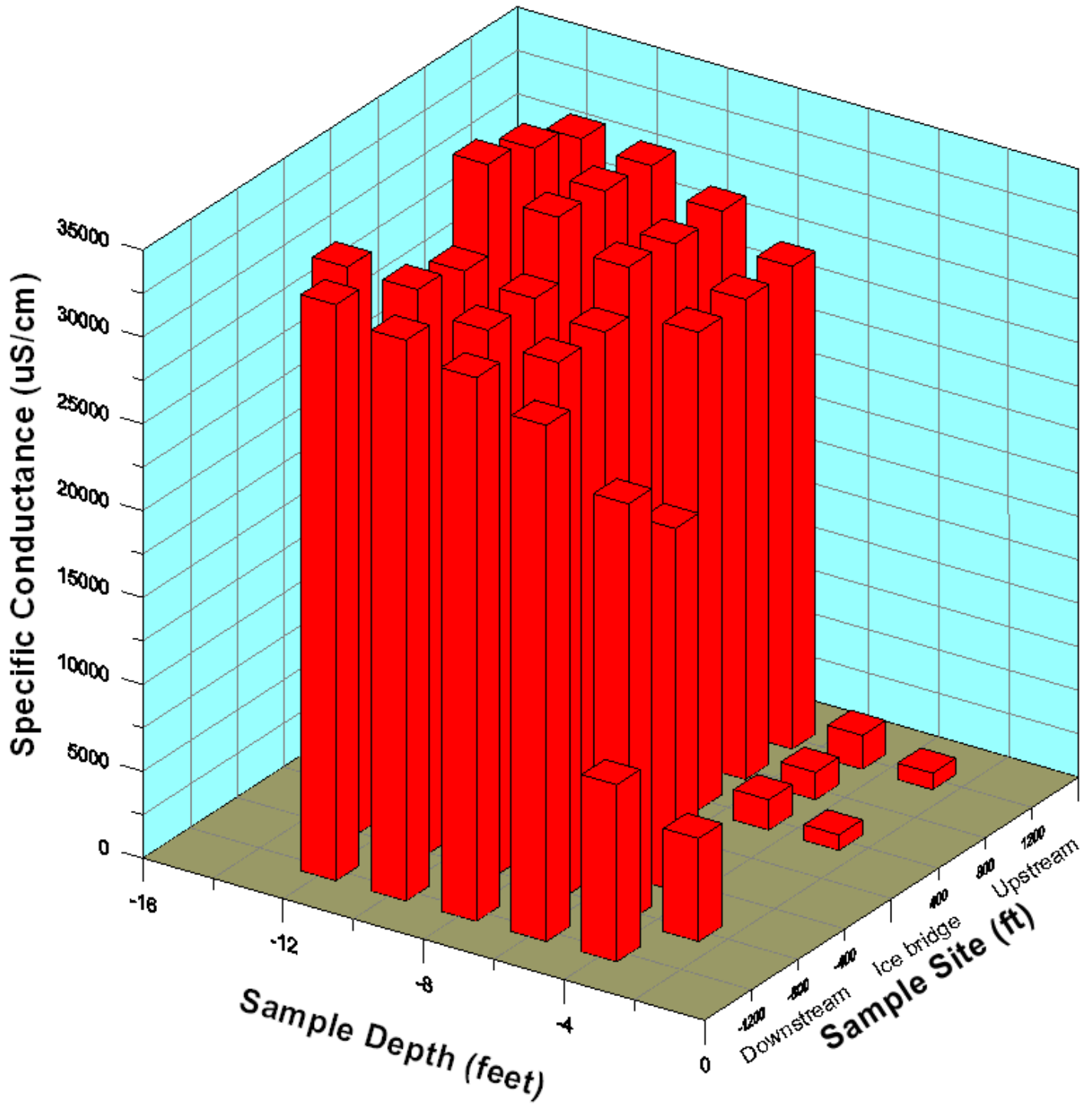
Sample Date: January 21, 2009

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)	
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 10:20 a.m.	11.4	3.2	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-
				5	0.1	10680	20861	9.1	61.7	11.8	-	
				6	-	-	-	-	-	-	-	
				7	0.3	15990	30996	9.3	64.1	18.0	-	
				8	-	-	-	-	-	-	-	
				9	0.5	16510	31762	9.5	66.5	18.5	-	
				10	-	-	-	-	-	-	-	
				11	1.3	17230	32177	9.3	68.7	18.9	-	
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 10:35 a.m.	13.8	2.8	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	-0.1	3017	5939	11.5	76.8	3.3	-	
				4	-	-	-	-	-	-	-	
				5	0.2	12350	24031	8.5	57.8	13.6	-	
				6	-	-	-	-	-	-	-	
				7	0.3	15990	30996	8.9	61.0	18.0	-	
				8	-	-	-	-	-	-	-	
				9	0.5	16470	31685	8.8	60.9	18.5	-	
				10	-	-	-	-	-	-	-	
				11	0.5	17080	32859	8.5	60.2	19.1	-	
				12	-	-	-	-	-	-	-	
				13	0.9	17410	32996	8.3	60.8	19.5	-	
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 11:00 a.m.	12.3	3.1	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	
				4	0.0	5200	10196	8.6	58.4	5.7	-0.02	
				5	-	-	-	-	-	-	-	
				6	0.2	15270	29713	8.8	61.0	17.2	-0.02	
				7	-	-	-	-	-	-	-	
				8	0.4	16200	31284	8.8	61.5	18.3	-0.02	
				9	-	-	-	-	-	-	-	
				10	0.5	16780	32282	8.5	61.5	18.9	-0.04	
				11	-	-	-	-	-	-	-	
				12	1.0	17560	33157	8.1	61.5	19.6	-0.05	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.

# 2008/2009 Colville River Ice Bridge Monitoring January 21, 2009



# Project Trip Report



<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> February 3, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -38° F, 0 mph wind

Elijah Keib arrived at Alpine on Monday, February 2, 2009 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on February 3, Mr. Keib attended LCMF's daily health and safety meeting. At 7:30 AM equipment was assembled, calibrated and prepared for transport. Chris Ziemet of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on February 3 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 35,500 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 1500 uS/cm at 3.5 feet of depth to 35,500 uS/cm at 13 to 14 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 83.1%, and averaging 60.8%. Measured velocities were not indicative of flow. The next monitoring event is scheduled for February 18, 2009.

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



Sample Date: February 3, 2009

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)	
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:15 a.m.	13.3	3.2	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	-
				3.5	0.0	755	1480	12.1	83.1	0.7	-	
				4	-	-	-	-	-	-	-	
				5	0.1	1024	2000	9.7	67.5	0.9	-	
				6	-	-	-	-	-	-	-	
				7	0.4	14400	27808	7.9	56.0	16.1	-	
				8	-	-	-	-	-	-	-	
				9	0.6	16750	32103	8.3	59.1	18.8	-	
				10	-	-	-	-	-	-	-	
				11	0.6	17480	33502	8.1	58.0	19.7	-	
				12	-	-	-	-	-	-	-	
				13	0.9	18660	35365	7.9	57.9	20.8	-	
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:00 a.m.	14.0	3.6	0.2	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	
				5	0.1	1010	1973	9.0	62.5	1.4	-	
				6	-	-	-	-	-	-	-	
				7	0.4	14000	27035	8.2	57.7	15.8	-	
				8	-	-	-	-	-	-	-	
				9	0.6	16600	31815	8.4	59.5	18.6	-	
				10	-	-	-	-	-	-	-	
				11	0.6	17330	33215	8.2	58.9	19.5	-	
				12	-	-	-	-	-	-	-	
				13	1.0	18530	34989	8.5	61.5	20.8	-	
				14	-	-	-	-	-	-	-	
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:50 a.m.	14.3	3.5	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	
				4	0.0	806	1580	11.9	82.1	0.8	-	
				5	-	-	-	-	-	-	-	
				6	0.3	4533	8787	8.2	56.8	4.7	-	
				7	-	-	-	-	-	-	-	
				8	0.4	15840	30589	8.5	59.0	17.8	-	
				9	-	-	-	-	-	-	-	
				10	0.7	17020	32498	8.5	59.3	19.1	-	
				11	-	-	-	-	-	-	-	
				12	0.6	17520	33579	8.4	59.0	19.7	-	
				13	-	-	-	-	-	-	-	
				14	0.7	18290	34923	8.6	60.6	20.6	-	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.

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



Sample Date: February 3, 2009

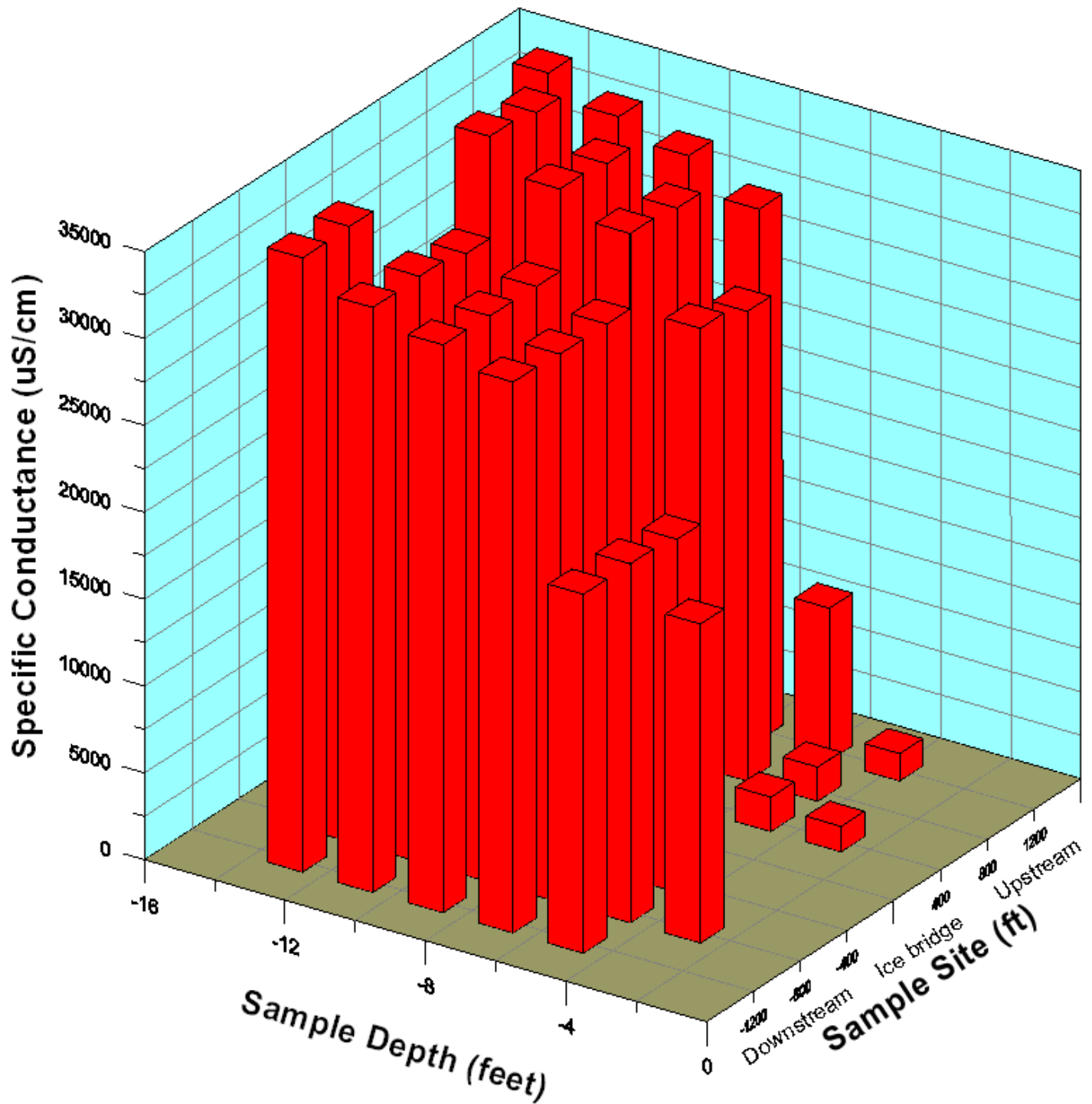
Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:35 a.m.	11.2	3.6	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.2	10290	20333	8.9	61.5	11.3	-
				6	-	-	-	-	-	-	-
				7	0.3	16280	31558	8.1	57.2	18.4	-
				8	-	-	-	-	-	-	-
				9	0.5	16920	32551	8.1	58.0	19.1	-
				10	-	-	-	-	-	-	-
				11	0.7	17430	33281	8.4	60.1	19.6	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 9:45 a.m.	13.7	3.0	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3.5	-0.5	9190	18373	TOR	TOR	10.2	-
				4	-	-	-	-	-	-	-
				5	-0.1	10500	20668	8.3	57.8	11.6	-
				6	-	-	-	-	-	-	-
				7	0.4	16350	31573	8.2	61.0	18.4	-
				8	-	-	-	-	-	-	-
				9	0.6	17010	32601	8.3	60.9	19.2	-
				10	-	-	-	-	-	-	-
				11	0.7	17660	33720	8.2	60.2	19.8	-
				12	-	-	-	-	-	-	-
				13	0.9	18690	35422	8.3	60.8	21.0	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 10:00 a.m.	13.4	3.6	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.1	10500	20668	8.3	57.4	11.6	-0.04
				6	-	-	-	-	-	-	-
				7	0.3	16360	31713	8.3	57.5	18.5	-0.03
				8	-	-	-	-	-	-	-
				9	0.5	16990	32686	8.3	58.1	19.2	-0.03
				10	-	-	-	-	-	-	-
				11	0.6	17570	33674	8.2	58.0	19.8	-0.06
				12	-	-	-	-	-	-	-
				13	0.7	18520	35362	8.2	58.2	20.9	-0.08

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.
- (10) TOR = Temperature out of Range for Hach HQ-40d LDO



# 2008/2009 Colville River Ice Bridge Monitoring February 3, 2009



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> February 18, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -28° F, 20-25 mph wind

Elijah Keib and Julie Shewman arrived at Alpine on Monday, February 2, 2009 at 6:00 PM. Upon arrival Mr. Keib and Mrs. Shewman met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on February 3, Mr. Keib and Mrs. Shewman attended LCMF's daily health and safety meeting. At 8:00 AM equipment was assembled, calibrated and prepared for transport. Mark Williams of LCMF accompanied Mr. Keib and Mrs. Julie Shewman to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:30 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on February 18 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 32,000  $\mu\text{S}/\text{cm}$ . Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 2800  $\mu\text{S}/\text{cm}$  at 5.0 feet of depth to 32,000  $\mu\text{S}/\text{cm}$  at 13 to 14 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 71.2%, and averaging 51.8%. Measured velocities suggest a slight flow downstream with an average velocity of 0.12 ft/sec. The next monitoring event is scheduled for March 4, 2009.

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



Sample Date: February 18, 2009

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:30 a.m.	13.3	3.5	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	0.1	1458	2848	10.5	71.2	1.4	-
				6	-	-	-	-	-	-	-
				7	0.4	12690	24506	7.3	49.9	13.9	-
				8	-	-	-	-	-	-	-
				9	0.3	15050	29173	7.2	49.4	16.9	-
				10	-	-	-	-	-	-	-
				11	0.5	15800	30396	7.1	50.0	17.7	-
				12	-	-	-	-	-	-	-
				13	0.9	16780	31802	7.1	51.4	18.6	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 10:05 a.m.	14.3	4.4	0.2	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-	-	-	-	-	-	-
				6	0.3	4279	8295	7.1	49.0	4.1	-
				7	-	-	-	-	-	-	-
				8	0.2	14360	27942	7.1	49.1	16.2	-
				9	-	-	-	-	-	-	-
				10	0.3	15540	30123	7.0	48.8	17.5	-
				11	-	-	-	-	-	-	-
				12	0.6	16260	31164	6.9	49.1	18.2	-
				13	-	-	-	-	-	-	-
				14	0.9	16810	31859	6.8	49.9	18.6	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:40 a.m.	13.6	3.8	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	0.0	1510	2961	9.5	64.2	1.4	-
				6	-	-	-	-	-	-	-
				7	0.4	12890	24892	7.6	51.8	14.2	-
				8	-	-	-	-	-	-	-
				9	0.3	15000	29077	7.4	50.8	16.8	-
				10	-	-	-	-	-	-	-
				11	0.5	15770	30339	7.4	51.3	17.7	-
				12	-	-	-	-	-	-	-
				13	0.7	16500	31505	8.2	57.5	18.5	-
				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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.

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



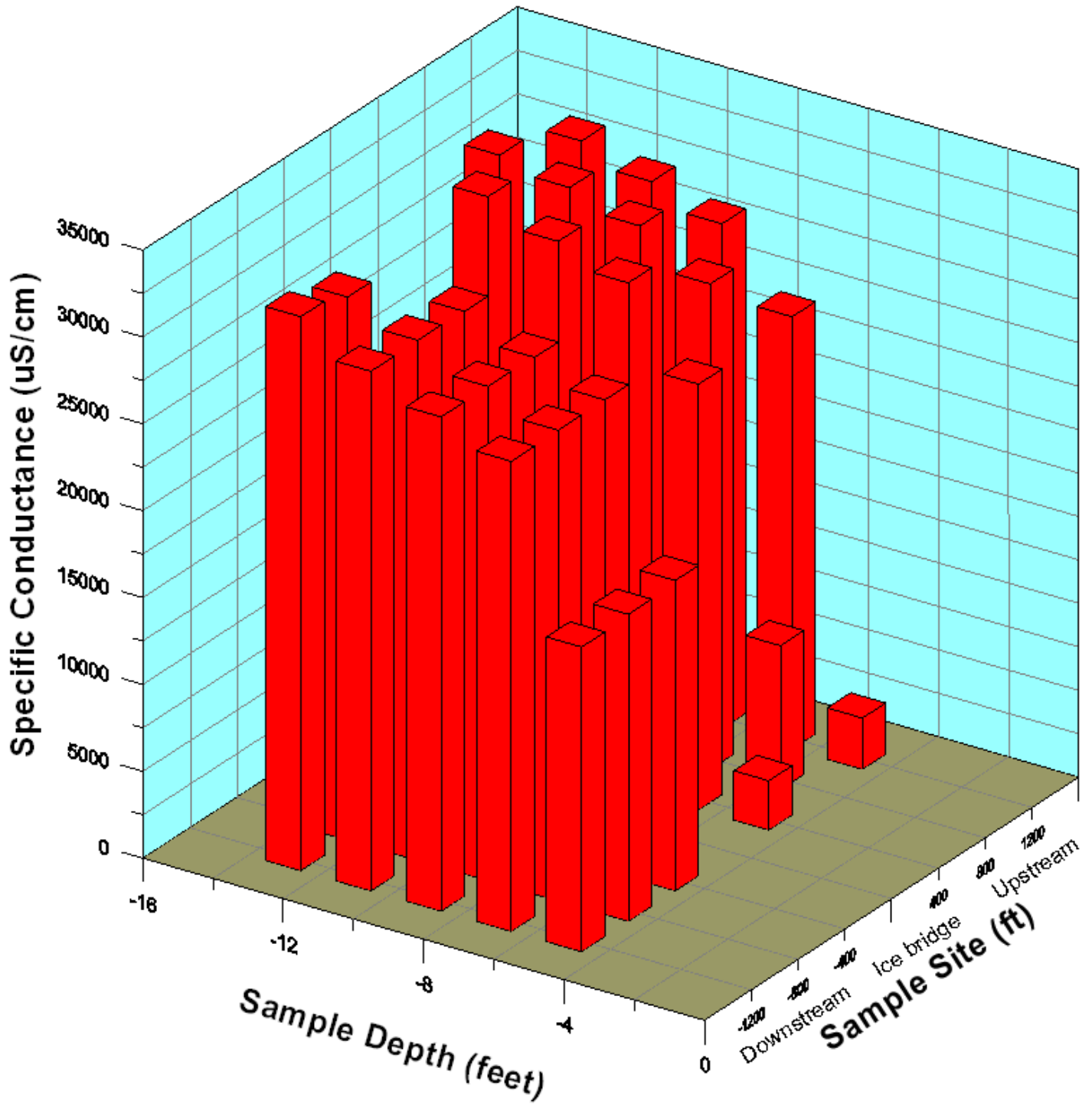
Sample Date: February 18, 2009

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)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:35 a.m.	11.3	4.0	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	0.3	9220	17872	7.3	49.6	10.2	-
				6	-	-	-	-	-	-	-
				7	0.2	13930	27105	7.1	49.1	15.6	-
				8	-	-	-	-	-	-	-
				9	0.4	14700	28387	7.0	48.6	16.4	-
				10	-	-	-	-	-	-	-
				11	0.6	15580	29860	7.0	48.8	17.4	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 11:17 a.m.	13.8	3.5	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	0.3	9120	17679	7.7	52.4	10.0	-
				6	-	-	-	-	-	-	-
				7	0.2	13930	27105	7.2	49.6	15.6	-
				8	-	-	-	-	-	-	-
				9	0.4	14740	28464	7.2	49.5	16.5	-
				10	-	-	-	-	-	-	-
				11	0.5	15570	29954	7.3	50.5	17.4	-
				12	-	-	-	-	-	-	-
				13	1.1	16620	31266	7.2	50.7	18.3	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 11:38 a.m.	13.5	3.6	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.1	8910	17538	7.4	50.9	9.7	0.09
				6	-	-	-	-	-	-	-
				7	0.3	13960	27061	7.3	50.7	15.6	0.11
				8	-	-	-	-	-	-	-
				9	0.5	14790	28453	7.3	51.0	16.5	0.12
				10	-	-	-	-	-	-	-
				11	0.5	15550	29915	7.6	53.1	17.4	0.14
				12	-	-	-	-	-	-	-
				13	0.6	16640	31892	7.8	55.7	18.7	0.12

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.

# 2008/2009 Colville River Ice Bridge Monitoring February 18, 2009



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> March 4, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -30° F, 0 mph wind

Elijah Keib arrived at Alpine on Tuesday, March 3, 2009 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on March 4, Mr. Keib attended LCMF's daily health and safety meeting. At 7:30 AM equipment was assembled, calibrated and prepared for transport. Chris Zeimet of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:00 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on March 4 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 36,200 uS/cm. Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 4100 uS/cm at 5.0 feet of depth to 36,200 uS/cm at 13 to 14 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 84.5%, and averaging 52.2%. Measured velocities were not indicative of flow. The next monitoring event is scheduled for March 18, 2009.

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



Sample Date: March 4, 2009

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)		
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:15 a.m.	13.3	3.2	0.1	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-	-
				5	-0.1	2070	4074	9.0	61.8	2.1	-	-	-
				6	-	-	-	-	-	-	-	-	-
				7	0.0	15360	30118	6.9	47.2	17.5	-	-	-
				8	-	-	-	-	-	-	-	-	-
				9	0.4	17430	33659	7.1	49.1	19.8	-	-	-
				10	-	-	-	-	-	-	-	-	-
				11	0.3	18140	35163	7.5	52.2	20.7	-	-	-
				12	-	-	-	-	-	-	-	-	-
				13	0.2	18530	36056	8.1	56.2	21.2	-	-	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:05 a.m.	14.1	4.5	0.2	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-	-
				5	-	-	-	-	-	-	-	-	-
				6	0.1	5790	11309	6.8	46.6	6.3	-	-	-
				7	-	-	-	-	-	-	-	-	-
				8	0.3	16220	31441	6.8	46.8	18.4	-	-	-
				9	-	-	-	-	-	-	-	-	-
				10	0.5	17950	34533	7.0	48.6	20.3	-	-	-
				11	-	-	-	-	-	-	-	-	-
				12	0.4	18490	35706	7.4	50.8	21.1	-	-	-
				13	-	-	-	-	-	-	-	-	-
				14	0.5	18620	35821	7.5	51.4	21.2	-	-	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:50 a.m.	14.3	4.0	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-	-
				5	-0.1	2140	4212	12.4	84.5	2.2	-	-	-
				6	0.2	7460	14516	6.8	46.8	7.9	-	-	-
				7	-	-	-	-	-	-	-	-	-
				8	0.4	16520	31902	6.9	47.8	18.7	-	-	-
				9	-	-	-	-	-	-	-	-	-
				10	0.6	18050	34594	7.1	49.8	20.4	-	-	-
				11	-	-	-	-	-	-	-	-	-
				12	0.5	18410	35417	7.3	51.4	20.9	-	-	-
				13	-	-	-	-	-	-	-	-	-
				14	0.5	18750	36072	7.6	53.6	21.3	-	-	-

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.

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



Sample Date: March 4, 2009

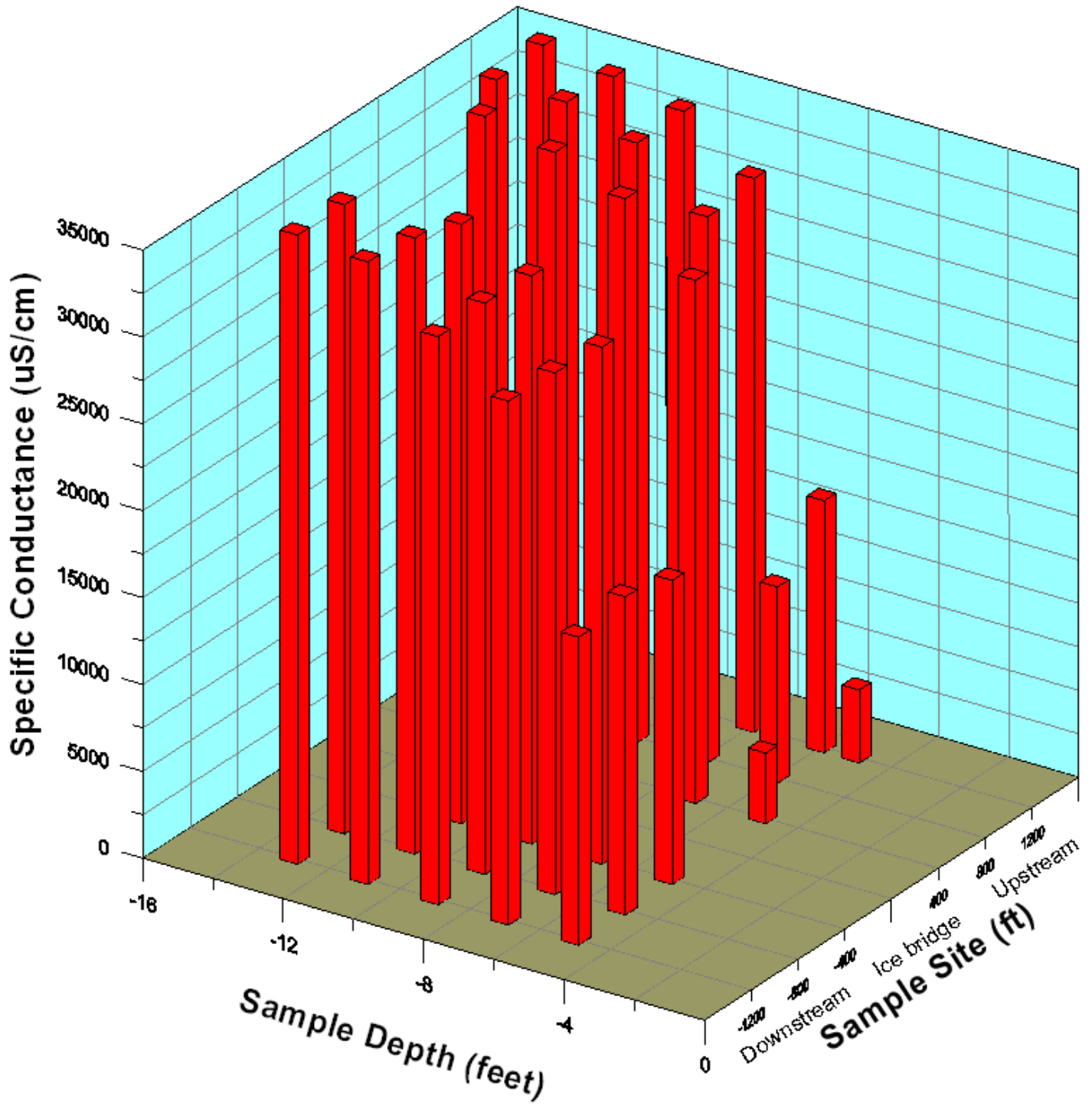
Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)		
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:35 a.m.	11.6	4.1	0.1	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-	-
				5	-0.3	8830	17516	TOR	TOR	9.8	-	-	
				6	-	-	-	-	-	-	-	-	-
				7	0.2	15300	29771	6.9	47.3	17.4	-	-	
				8	-	-	-	-	-	-	-	-	-
				9	0.4	16940	32713	7.0	48.5	19.2	-	-	
				10	-	-	-	-	-	-	-	-	-
				11	0.4	17870	34509	7.3	50.6	20.4	-	-	
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 9:50 a.m.	13.1	3.5	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	-	-
				5	-0.2	9270	18317	7.7	52.3	10.3	-	-	
				6	-	-	-	-	-	-	-	-	-
				7	0.2	15440	30044	6.9	47.3	17.4	-	-	
				8	-	-	-	-	-	-	-	-	-
				9	0.4	17030	32887	7.1	48.9	19.3	-	-	
				10	-	-	-	-	-	-	-	-	-
				11	0.3	18300	35473	7.9	54.7	20.9	-	-	
				12	-	-	-	-	-	-	-	-	-
				13	0.5	18830	36225	8.0	55.9	21.4	-	-	
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 10:05 a.m.	13.6	3.8	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	-	-
				5	-0.2	8980	17744	8.3	56.3	10.0	-0.06	-	
				6	-	-	-	-	-	-	-	-	-
				7	0.2	15500	30160	6.9	47.8	17.5	-0.08	-	
				8	-	-	-	-	-	-	-	-	-
				9	0.4	16940	32713	7.1	48.8	19.3	-0.08	-	
				10	-	-	-	-	-	-	-	-	-
				11	0.3	18490	35842	8.0	55.0	21.2	-0.11	-	
				12	-	-	-	-	-	-	-	-	-
				13	0.5	18830	36225	8.1	56.5	21.4	-0.12	-	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.
- (10) TOR = Temperature out of Range for Hach HQ-40d LDO



# 2008/2009 Colville River Ice Bridge Monitoring March 4, 2009



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> March 18, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -35° F, 5-10 mph wind

Elijah Keib and Haley Runa arrived at Alpine on Tuesday, March 17, 2009 at 8:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on March 17, Mr. Keib and Ms. Runa attended LCMF's daily health and safety meeting. At 8:00 AM equipment was assembled, calibrated and prepared for transport. A.J. Griffen of LCMF accompanied Mr. Keib and Ms. Runa to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:15 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on March 18 by Baker prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 37,000  $\mu\text{S}/\text{cm}$ . Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. The average specific conductance ranged from approximately 5,720  $\mu\text{S}/\text{cm}$  at 5.0 feet of depth to 37,000  $\mu\text{S}/\text{cm}$  at 13 to 14 feet of depth. Dissolved oxygen saturation remained consistent with respect to depth and distance downstream, having values as high as 98.5%, and averaging 50.4%. Measured velocities were not indicative of flow. The next monitoring event is scheduled for April 1, 2009.

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



Sample Date: March 18, 2009

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:15 a.m.	13.8	4.0	0.3	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.1	2906	5720	14.6	98.5	3.0	-
				6	-	-	-	-	-	-	-
				7	0.4	12560	24255	6.3	43.3	13.9	-
				8	-	-	-	-	-	-	-
				9	0.6	17430	33406	6.0	41.7	19.6	-
				10	-	-	-	-	-	-	-
				11	0.4	18400	35532	6.7	46.5	21.0	-
				12	-	-	-	-	-	-	-
				13	0.7	19340	36928	6.7	47.7	21.9	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 10:00 a.m.	14.5	4.6	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-	-	-	-	-	-	-
				6	0.2	6080	11831	7.5	51.3	6.5	-
				7	-	-	-	-	-	-	-
				8	0.6	16140	30934	6.4	44.2	18.1	-
				9	-	-	-	-	-	-	-
				10	0.8	18390	34983	6.3	43.3	20.7	-
				11	-	-	-	-	-	-	-
				12	0.5	18520	35629	6.8	47.0	21.0	-
				13	-	-	-	-	-	-	-
				14	0.6	19120	36645	6.9	47.9	21.7	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:25 a.m.	13.8	4.1	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.1	3004	5913	14.6	98.4	3.0	-
				6	-	-	-	-	-	-	-
				7	0.4	11980	23135	6.7	45.9	13.1	-
				8	-	-	-	-	-	-	-
				9	0.8	17280	32872	5.9	40.9	19.3	-
				10	-	-	-	-	-	-	-
				11	0.7	18470	35267	6.8	46.7	20.8	-
				12	-	-	-	-	-	-	-
				13	0.5	18420	35437	7.4	50.8	20.9	-
				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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.

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



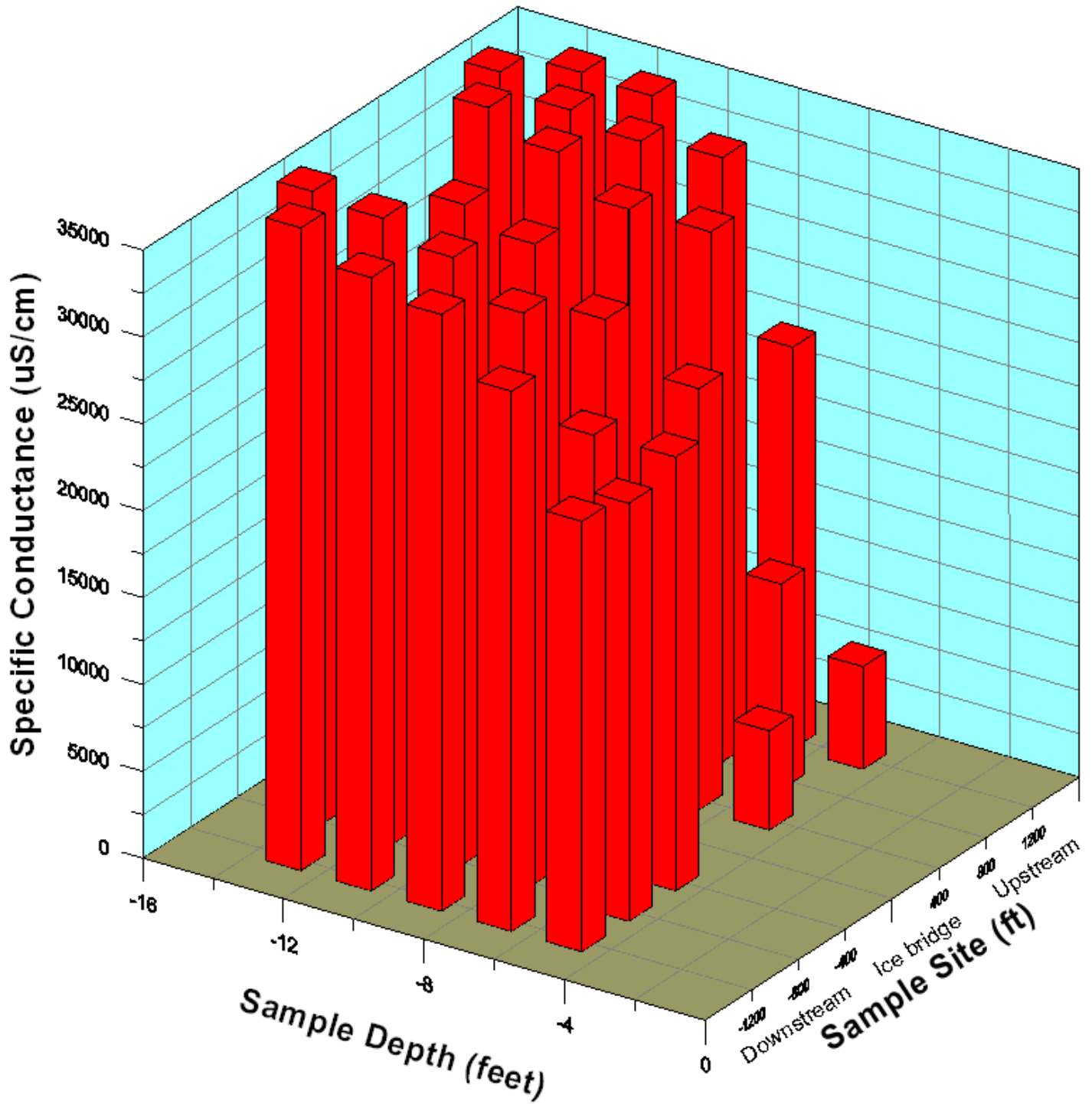
Sample Date: March 18, 2009

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)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 10:54 a.m.	11.8	4.3	0.3	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.5	12490	24970	8.0	54.1	14.4	-
				6	-	-	-	-	-	-	-
				7	0.3	16370	31732	6.4	44.7	18.5	-
				8	-	-	-	-	-	-	-
				9	0.4	18070	34895	6.3	45.3	20.5	-
				10	-	-	-	-	-	-	-
				11	1.3	19280	36005	6.6	50.1	21.5	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 11:11 a.m.	14.3	4.1	0.0	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	0.5	12510	24067	TOR	TOR	14.2	-
				6	0.1	14030	27404	6.6	44.8	15.9	-
				7	-	-	-	-	-	-	-
				8	0.3	17160	33264	6.7	45.5	19.4	-
				9	-	-	-	-	-	-	-
				10	0.4	18280	35300	6.9	47.3	20.8	-
				11	-	-	-	-	-	-	-
				12	0.6	18990	36396	6.7	46.4	21.6	-
				13	-	-	-	-	-	-	-
				14	0.6	19180	36760	6.9	48.3	21.7	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 11:27 a.m.	13.0	4.5	0.3	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.5	12390	24770	7.6	50.9	14.0	-0.03
				6	-	-	-	-	-	-	-
				7	0.2	15980	31094	6.6	45.1	18.1	-0.04
				8	-	-	-	-	-	-	-
				9	0.5	17850	34340	6.8	47.1	20.3	-0.05
				10	-	-	-	-	-	-	-
				11	0.6	18420	35304	6.9	48.9	20.9	-0.05
				12	-	-	-	-	-	-	-
				12.5	0.8	19450	37000	6.6	48.8	22.0	-0.07

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.
- (10) TOR = Temperature out of Range for Hach HQ-40d LDO

# 2008/2009 Colville River Ice Bridge Monitoring March 18, 2009



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> April 1, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -20° F, 0 mph wind

Elijah Keib arrived at Alpine on Tuesday, March 31, 2009 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on April 1, Mr. Keib attended LCMF's daily health and safety meeting. At 8:00 AM equipment was assembled, calibrated and prepared for transport. Chris Zeimet of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:10 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. The YSI-30 was calibrated on April 1 by Mr. Keib prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 33,800  $\mu\text{S}/\text{cm}$ . Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. Overall, specific conductance increased with increasing depth. The average specific conductance ranged from approximately 8,440  $\mu\text{S}/\text{cm}$  at 5.0 feet of depth to 33,800  $\mu\text{S}/\text{cm}$  at 12 to 13 feet of depth.

Dissolved oxygen saturation remained fairly consistent with respect to depth and distance downstream, having a single value as high as 67.6%, with all other values less than 50%. The average dissolved oxygen saturation was 45.1%. Dissolved oxygen generally increased very slightly with depth.

Measured velocities were not indicative of flow.

The next monitoring event is scheduled for April 14, 2009.

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



Sample Date: April 1, 2009

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)
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:20 a.m.	13.3	4.5	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.2	4272	8441	TOR	TOR	4.4	-
				6	-	-	-	-	-	-	-
				7	0.3	10550	20450	5.6	39.3	11.5	-
				8	-	-	-	-	-	-	-
				9	0.3	15500	30046	6.3	44.4	17.4	-
				10	-	-	-	-	-	-	-
				11	0.4	16480	31825	6.3	45.0	18.6	-
				12	-	-	-	-	-	-	-
				13	0.7	17480	33377	6.3	46.8	19.6	-
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 9:00 a.m.	14.3	5.2	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-	-	-	-	-	-	-
				6	-0.1	4465	8789	9.8	67.6	4.6	-
				7	-	-	-	-	-	-	-
				8	0.3	13960	27061	5.9	41.0	15.6	-
				9	-	-	-	-	-	-	-
				10	0.2	16090	31308	6.4	44.9	18.2	-
				11	-	-	-	-	-	-	-
				12	0.6	16670	31950	6.4	45.3	18.7	-
				13	-	-	-	-	-	-	-
				14	0.7	17360	33147	6.3	44.9	19.5	-
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:40 a.m.	13.7	4.5	0.2	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.2	4300	8497	TOR	TOR	4.5	-
				6	-	-	-	-	-	-	-
				7	0.3	8880	17213	6.3	44.2	9.6	-
				8	-	-	-	-	-	-	-
				9	0.3	15410	29871	6.3	44.1	17.4	-
				10	-	-	-	-	-	-	-
				11	0.5	16460	31666	6.5	45.6	18.5	-
				12	-	-	-	-	-	-	-
				13	0.6	16710	32026	7.1	49.7	18.7	-
				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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) TOR = Temperature out of Range for Hach HQ-40d LDO

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



Sample Date: April 1, 2009

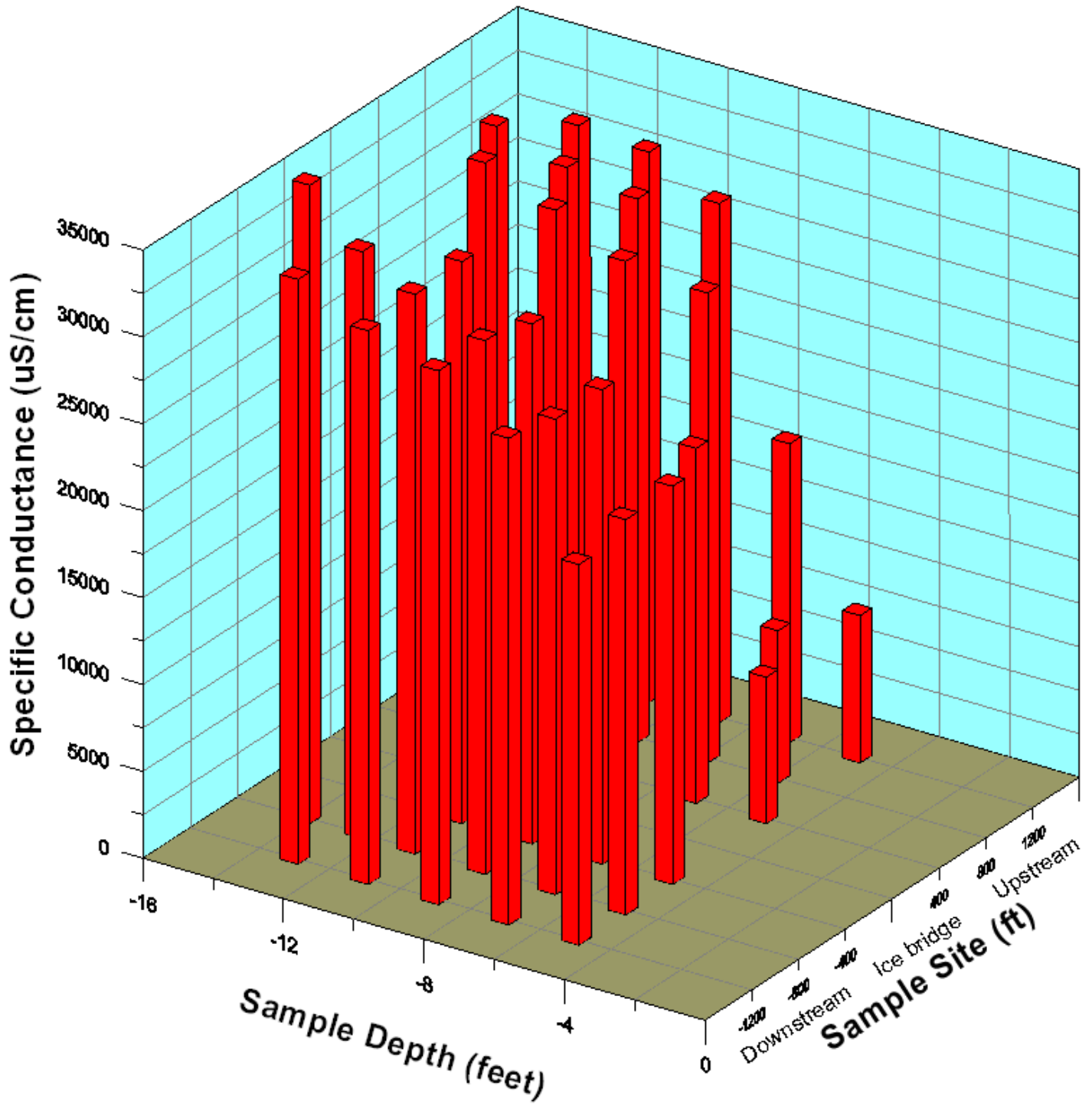
Downstream Location Time	Water Depth (ft)	Ice Thickness (ft)	Free Board (ft)	Sample Depth (ft)	Temp (°C)	Conductivity (µS/cm)	Specific Conductance (µS/cm)	DO (mg/L)	DO (Percent Saturation)	Salinity (ppt)	Velocity (ft/sec)		
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:35 a.m.	11.7	4.9	0.2	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-	-
				5	-0.7	11380	22931	TOR	TOR	12.9	-		
				6	-	-	-	-	-	-	-		
				7	-0.1	13880	27321	5.8	40.4	15.7	-		
				8	-	-	-	-	-	-	-		
				9	0.4	15500	29932	5.9	42.2	17.4	-		
				10	-	-	-	-	-	-	-		
				11	0.5	16820	32359	6.0	43.6	19.1	-		
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 9:55 a.m.	13.0	4.0	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	-	
				5	-0.4	11430	22762	6.0	41.4	13.0	-		
				6	-	-	-	-	-	-	-		
				7	0.5	14230	27376	6.0	42.1	16.2	-		
				8	-	-	-	-	-	-	-		
				9	0.3	15850	30724	6.3	44.5	17.8	-		
				10	-	-	-	-	-	-	-		
				11	0.4	16690	32230	6.5	46.2	18.8	-		
				12.5	0.6	17640	33809	6.4	46.3	19.8	-		
				13	-	-	-	-	-	-	-		
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 11:27 a.m.	13.0	4.5	0.3	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-		
				4	-	-	-	-	-	-	-		
				5	-0.7	10880	21923	TOR	TOR	12.3	-0.05		
				6	-	-	-	-	-	-	-		
				7	0.2	14400	28020	6.1	42.7	16.1	-0.05		
				8	-	-	-	-	-	-	-		
				9	0.5	15980	30743	6.3	44.7	17.9	-0.05		
				10	-	-	-	-	-	-	-		
				11	0.6	16630	31873	6.2	45.2	18.6	-0.03		
				12	-	-	-	-	-	-	-		
				13	0.8	17700	33671	6.1	46.3	19.9	-0.04		

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.
- (10) TOR = Temperature out of Range for Hach HQ-40d LDO



# 2008/2009 Colville River Ice Bridge Monitoring April 1, 2009



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> April 15, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** -10° F, 15 mph wind

Elijah Keib arrived at Alpine on Tuesday, April 14, 2009 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on April 15, Mr. Keib attended LCMF's daily health and safety meeting. At 7:45 AM equipment was assembled, calibrated and prepared for transport. AJ Griffen of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:15 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet both upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. Mr. Keib calibrated the YSI-30 on April 15 prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 37,300  $\mu\text{S}/\text{cm}$ . Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. Overall, specific conductance increased with increasing depth. Specific conductance ranged from approximately 12,700  $\mu\text{S}/\text{cm}$  at 5.0 feet of depth to 37,300  $\mu\text{S}/\text{cm}$  at 13 feet of depth.

Dissolved oxygen saturation remained fairly consistent with respect to depth and distance downstream from bridge centerline. With the exception of a single dissolved oxygen high value of 68.8%, all other values were less than 45%. The average dissolved oxygen saturation was 41.9%. Overall there was little change in dissolved oxygen values with depth.

Measured velocities were not indicative of flow.

The next and final monitoring event is scheduled for April 29, 2009.

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



Sample Date: April 15, 2009

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)		
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 9:05 a.m.	13.5	4.8	0.2	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-	-
				5	-0.3	6400	12695	TOR	TOR	6.8	-		
				6	-	-	-	-	-	-	-		
				7	0.1	9560	18673	5.7	39.2	10.6	-		
				8	-	-	-	-	-	-	-		
				9	0.2	17220	33507	5.8	40.3	19.6	-		
				10	-	-	-	-	-	-	-		
				11	0.5	18560	35706	5.8	40.8	21.1	-		
				12	-	-	-	-	-	-	-		
				13	0.8	19600	37285	5.8	42.3	22.1	-		
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 8:40 a.m.	14.3	5.3	0.7	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	-	
				5	-	-	-	-	-	-	-	-	
				6	-0.3	6460	12814	7.6	51.2	6.9	-		
				7	-	-	-	-	-	-	-		
				8	0.3	15630	30298	5.7	38.5	17.6	-		
				9	-	-	-	-	-	-	-		
				10	0.4	18050	34856	5.9	40.2	20.5	-		
				11	-	-	-	-	-	-	-		
				12	0.4	18820	36343	5.9	40.4	21.5	-		
				13	-	-	-	-	-	-	-		
				14	0.6	18920	36262	6.5	44.3	21.5	-		
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 8:25 a.m.	14.5	4.8	0.2	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-		
				3	-	-	-	-	-	-	-		
				4	-	-	-	-	-	-	-		
				5	-	-	-	-	-	-	-		
				6	-0.1	6450	12696	10.2	68.8	6.9	-		
				7	-	-	-	-	-	-	-		
				8	0.4	15960	30820	5.9	40.2	18.0	-		
				9	-	-	-	-	-	-	-		
				10	0.6	18130	34748	6.0	41.7	20.5	-		
				11	-	-	-	-	-	-	-		
				12	0.6	18540	35534	6.1	42.8	21.0	-		
				13	-	-	-	-	-	-	-		
				14	0.6	19170	36741	6.2	43.7	21.8	-		

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) TOR = Temperature out of Range for Hach HQ-40d LDO.

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



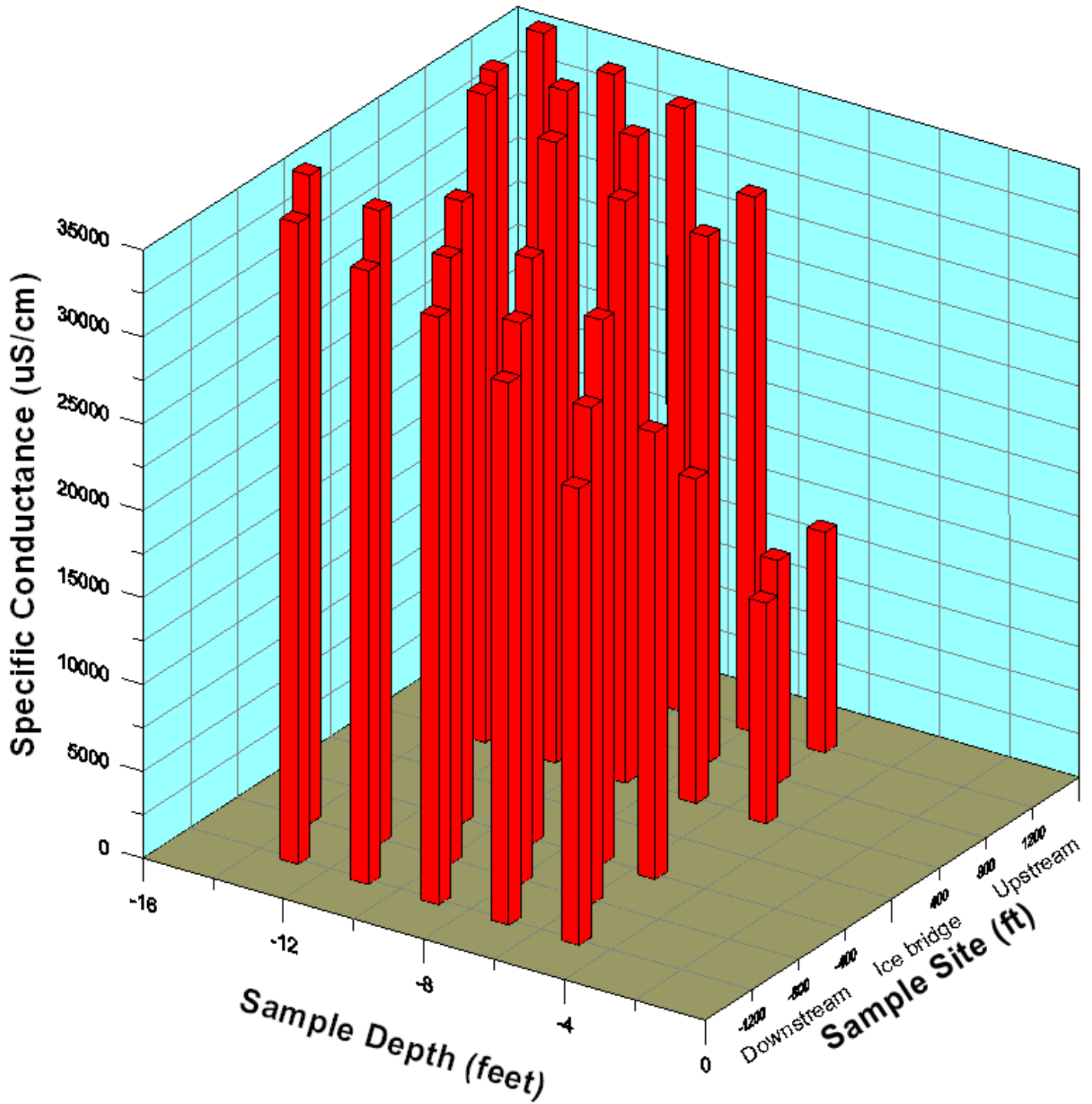
Sample Date: April 15, 2009

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)	
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 9:25 a.m.	11.6	5.0	0.3	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-
				5.5	-0.7	12760	25711	5.7	38.5	14.6	-	
				6	-	-	-	-	-	-	-	
				7	-0.1	15910	31316	5.1	35.9	18.2	-	
				8	-	-	-	-	-	-	-	
				9	0.4	17450	33698	5.3	38.2	19.8	-	
				10	-	-	-	-	-	-	-	
				11	0.8	18830	35820	5.1	39.6	21.3	-	
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 9:45 a.m.	14.3	4.4	0.2	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	
				5	-	-	-	-	-	-	-	
				6	-0.4	14370	28616	5.7	38.5	16.4	-	
				7	-	-	-	-	-	-	-	
				8	0.1	16540	32307	5.5	37.8	18.8	-	
				9	-	-	-	-	-	-	-	
				10	0.3	18010	34911	6.0	40.9	20.6	-	
				11	-	-	-	-	-	-	-	
				12	0.4	18870	36440	5.8	40.3	21.6	-	
				13	-	-	-	-	-	-	-	
				14	0.6	19470	37316	5.3	40.7	22.1	-	
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 10:00 a.m.	13.7	4.7	0.1	1	-	-	-	-	-	-	-	
				2	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	
				5	-0.6	13090	26272	TOR	TOR	15.0	0.01	
				6	-	-	-	-	-	-	-	
				7	0.1	15970	31194	5.7	38.8	18.1	0.01	
				8	-	-	-	-	-	-	-	
				9	0.3	17440	33806	6.0	41.1	19.8	-0.07	
				10	-	-	-	-	-	-	-	
				11	0.3	18210	35299	6.5	44.3	20.8	-0.02	
				12	-	-	-	-	-	-	-	
				13	0.6	19250	36894	6.2	43.3	21.9	-0.02	

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.
- (10) TOR = Temperature out of Range for Hach HQ-40d LDO

# 2008/2009 Colville River Ice Bridge Monitoring April 15, 2009



# Project Trip Report

Baker

<b>Project Name:</b> Colville River Ice Bridge Monitoring	<b>Date of Trip:</b> April 29, 2009
<b>Project Code:</b> 115721	<b>Submitted By:</b> Elijah Keib

**Weather:** 25° F, 0-3 mph wind

Elijah Keib arrived at Alpine on Tuesday, April 28, 2009 at 6:00 PM. Upon arrival Mr. Keib met with LCMF and coordinated access to the Colville River for the planned ice bridge monitoring event. At 6:00 AM on April 29, Mr. Keib attended LCMF's daily health and safety meeting. At 7:45 AM equipment was assembled, calibrated and prepared for transport. Chris Zeimet of LCMF accompanied Mr. Keib to the Colville River Ice Bridge site via Hägglund departing Alpine at approximately 8:35 AM. Ice thickness, total depth, freeboard, temperature, salinity, conductivity, dissolved oxygen (DO), and water velocities were collected at predetermined locations. Sampling took place at 400, 800, and 1200 feet both upstream and downstream of the proposed ice bridge centerline. Specific conductance 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 (conductivity, salinity, and temperature). Dissolved oxygen was measured using a Hach HQ40 LDO meter. Water velocities were measured at one location (1200 feet downstream) to determine the presence of flow using a Marsh McBirney Model 2000. All measurements were made from below the ice surface to the river bottom at a maximum of two-foot intervals. The DO meter was calibrated prior to the trip by TTT Environmental. Mr. Keib calibrated the YSI-30 on April 29 prior to sampling.

The maximum specific conductance calculated near the ice bridge was approximately 37,500  $\mu\text{S}/\text{cm}$ . Specific conductance values were relatively consistent at each sampling location with an evident stratification of salt and fresh water. Overall, specific conductance increased with increasing depth. Specific conductance ranged from approximately 15,000  $\mu\text{S}/\text{cm}$  at 5.0 feet of depth to 37,500  $\mu\text{S}/\text{cm}$  at 13 feet of depth.

Dissolved oxygen saturation remained fairly consistent with respect to depth and distance downstream from bridge centerline; all values were less than 45%. The average dissolved oxygen saturation was 37.1%. Overall there was little change in dissolved oxygen values with increasing depth.

Measured velocities were not indicative of flow.

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



Sample Date: April 29, 2009

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)		
<b>400-ft Upstream</b> N70°14'14.4" W150°50'09.5" 10:20 a.m.	13.8	4.8	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-	-	-
				5	-0.4	7520	14975	TOR	TOR	8.2	-		
				6	-	-	-	-	-	-	-		
				7	0.1	10100	19728	5.1	35.0	11.1	-		
				8	-	-	-	-	-	-	-		
				9	0.2	17150	33371	5.4	37.0	19.6	-		
				10	-	-	-	-	-	-	-		
				11	0.3	18250	35376	5.3	36.7	20.8	-		
				12	-	-	-	-	-	-	-		
				13	0.5	19210	36957	4.9	33.7	22.0	-		
<b>800-ft Upstream</b> N70°14'10.7" W150°50'06.5" 10:05 a.m.	13.8	5.3	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-	-	
				3	-	-	-	-	-	-	-	-	
				4	-	-	-	-	-	-	-	-	
				5	-	-	-	-	-	-	-	-	
				6	-	-	-	-	-	-	-	-	
				7	-0.1	8040	15826	6.6	44.9	8.7	-		
				8	-	-	-	-	-	-	-		
				9	0.0	16710	32765	5.5	37.5	19.1	-		
				10	-	-	-	-	-	-	-		
				11	0.3	18220	35318	5.5	37.8	20.8	-		
				12	-	-	-	-	-	-	-		
				13	0.5	18710	35995	5.4	37.2	21.5	-		
				14	-	-	-	-	-	-	-		
<b>1200-ft Upstream</b> N70°14'06.6" W150°50'03.4" 9:50 a.m.	14.0	5.3	0.0	1	-	-	-	-	-	-	-		
				2	-	-	-	-	-	-	-		
				3	-	-	-	-	-	-	-		
				4	-	-	-	-	-	-	-		
				5	-	-	-	-	-	-	-		
				6	-0.4	7410	14756	TOR	TOR	8.0	-		
				7	-	-	-	-	-	-	-		
				8	0.2	15700	30550	5.2	35.6	17.7	-		
				9	-	-	-	-	-	-	-		
				10	0.1	17880	34925	5.5	37.8	20.5	-		
				11	-	-	-	-	-	-	-		
				12	0.5	18400	35398	5.4	37.7	20.9	-		
				13	-	-	-	-	-	-	-		
				13.5	0.5	19300	37130	5.0	35.3	22.0	-		

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) TOR = Temperature out of Range for Hach HQ-40d LDO.

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



Sample Date: April 29, 2009

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)
<b>400-ft Downstream</b> N70°14'21.2" W150°50'18.9" 10:35 a.m.	11.8	5.1	0.3	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5.5	-0.7	12550	25288	TOR	TOR	14.3	-
				6	-	-	-	-	-	-	-
				7	-0.2	15180	29995	5.8	39.5	17.4	-
				8	-	-	-	-	-	-	-
				9	0.2	17000	33079	5.2	35.9	19.3	-
				10	-	-	-	-	-	-	-
				11	0.1	18070	35296	5.7	39.2	20.7	-
<b>800-ft Downstream</b> N70°14'24.5" W150°50'19.6" 10:45 a.m.	13.8	5.1	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.6	11940	23964	TOR	TOR	13.5	-
				6	-	-	-	-	-	-	-
				7	-0.1	15680	30864	TOR	TOR	17.9	-
				8	-	-	-	-	-	-	-
				9	0.2	17250	33566	5.2	35.5	19.7	-
				10	-	-	-	-	-	-	-
				11	0.3	18300	35473	5.3	36.3	20.9	-
				12	-	-	-	-	-	-	-
				13	0.4	19360	37386	4.8	33.1	22.2	-
				14	-	-	-	-	-	-	-
<b>1200-ft Downstream</b> N70°14'29.1" W150°50'20.3" 11:05 a.m.	13.3	5.1	0.1	1	-	-	-	-	-	-	-
				2	-	-	-	-	-	-	-
				3	-	-	-	-	-	-	-
				4	-	-	-	-	-	-	-
				5	-0.3	13380	26541	TOR	TOR	15.1	-0.04
				6	-	-	-	-	-	-	-
				7	-0.1	15520	30549	5.8	39.6	17.7	-0.06
				8	-	-	-	-	-	-	-
				9	0.3	17220	33380	5.7	39.5	19.5	-0.05
				10	-	-	-	-	-	-	-
				11	0.4	18260	35262	5.4	37.3	20.8	-0.05
				12	-	-	-	-	-	-	-
				13	0.4	19440	37541	5.0	34.4	22.2	-0.05

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) Salinity, conductivity, and temperature 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 Hach HQ-40d LDO.
- (7) Time shown indicates the start of the measurement.
- (8) Velocity was measured using a Marsh-McBirney Model 2000.
- (9) A negative value for velocity indicates flow from the downstream side to the upstream side of the ice bridge.
- (10) TOR = Temperature out of Range for Hach HQ-40d LDO



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