2014

EXPLORATION LAKES RECHARGE STUDIES

141011-MBJ-RPT-001 | 8/26/2014
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ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
Baker	Michael Baker Jr., Inc.
CPAI	ConocoPhillips Alaska, Inc.
GPS	Global positioning system
NAD83	North American Datum of 1983
Mgal	Million gallons
TBM	Temporary benchmark
WSE	Water surface elevation

1.0 INTRODUCTION

ConocoPhillips Alaska Inc., (CPAI) builds and maintains ice roads and ice pads for access and transportation of people and equipment during the winter months. Each season, millions of gallons of fresh water and ice are withdrawn from lakes within the National Petroleum Reserve Alaska (NPRA) to meet winter construction and operation requirements. Additional fresh water is used for potable water supplies at temporary rig camps and make-up water for drilling operations. Water withdrawal for construction and operations may begin as early as December and continues into May.

To comply with stipulations of Alaska Department of Fish and Game (ADF&G) Fish Habitat Permits and Alaska Department of Natural Resources (ADNR) Temporary Water Use Permits, CPAI conducts studies at water withdrawal lakes to document seasonal recharge. Michael Baker Jr., Inc. (Baker) conducted spring lake recharge studies to monitor water levels and provide photo documentation for permit compliance. This report summarizes the hydrologic observations, measurements, and analyses undertaken for this project.

Baker was supported during field monitoring by CPAI Alpine Environmental Coordinators, Umiaq/LCMF, LLC, and Pathfinder Aviation. All Baker and support team crew members are recognized for their contribution to an incident-free field effort.

1.1 STUDY OVERVIEW

The objectives of the 2014 Exploration Lakes Recharge Studies include collection and analysis of spring breakup recharge data at thirteen water withdrawal lakes. Lake studies included observations and photos at all lakes and gage water surface elevation (WSE) measurements at Lake L9805. The 2014 Exploration Lakes are listed in Table 1.1 and the locations are shown in Figure 1.1.

Table 1.1: 2014 Exploration Lakes

L9803	L9804
L9805	L9817
L9826	L9911/R0061
M0024	M1301
M9914	M9915
M9922	M9923
R0062	

ConocoPhillips
Alaska

Miles
0 1.75 3.5

Date:	08/12/2014	Project:	141011
Drawn:	MEA	File:	Figure 1.1
Checked:	SME	Scale:	1 in = 1.75 miles

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2014 EXPLORATION LAKES RECHARGE STUDY

FIGURE: 1.1

(SHEET 1 of 1)

Lake recharge was determined using visual observations and photos focusing on key hydrologic features, including peak water levels, hydraulic connectivity with other bodies of water, and inflow/outflow locations. The existing staff gage at Lake L9805 was restored during spring breakup setup and data was collected when Baker field personnel were in the vicinity of this lake.

1.2 Lake Recharge Background

Annual recharge of lakes in the NPRA occurs as a result of three primary mechanisms: spring breakup flooding, snow melt, and precipitation. Of these, spring breakup flooding and snow melt (considered overland flow) were investigated. Lake elevation, proximity to streams, and local topography typically dictate the recharge mechanism. Lakes located within annually inundated stream floodplains or hydraulically connected areas recharge primarily from spring breakup flood flows. Lakes not inundated because of distance or topographical limitations depend solely on snowmelt runoff and precipitation for recharge.

The magnitude of spring breakup flooding fluctuates from year to year in terms of stage and discharge. If flood stage is relatively low, bankfull recharge may not occur depending on topography and elevation.

2.0 PERMITS AND WATER USE

CPAI requires water sources for building ice roads and ice pads, drilling, drinking water, and general operations. ADNR, ADF&G, or both agencies grant permits on the condition of CPAI compliance with temporary water use requirements to regulate water withdrawal and maintain conditions supportive of fish habitat. To maintain fish habitat, lakes must seasonally recharge water volumes borrowed during the winter season and lost naturally through evaporation. Fish Habitat and Temporary Water Use permits stipulate the water withdrawal quantities for each water year. Additionally, these permits specify the form of water that may be borrowed from each lake – liquid only, specific quantities of liquid and ice, or a total of both without designation of individual quantities. Ice aggregate removal is permitted over naturally grounded portions of the lake 4 feet deep or less. A water year is defined as one year beginning and ending with spring breakup (June through May). Actual withdrawal quantities are reported by CPAI per water year; these numbers are compared to the maximum water withdrawal allowed. If two permits are issued for one lake, the maximum water withdrawal by CPAI is less than or equal to the lesser allowable quantity.

All of the 2014 Exploration lakes were permitted for specific borrow quantities of liquid and ice. Water and ice was withdrawn from six of the thirteen study lakes during the 2013/2014 ice road construction season, including L9803, L9817, L9911/R0061, M0024, M1301, and M9923. During the 2013/2014 winter season, Lake M9923 was used as a water and ice source.

Table 2.1 summarizes the permits regulating water use, purpose, and permitted versus actual withdrawal volumes by form at the thirteen water withdrawal lakes. The permitted and actual withdrawal volumes are based on third and fourth quarter 2013 and first and second quarter 2014 water use reports (CPAI 2013a, 2013b, 2014a, and 2014b).

Table 2.1: Summary of Permitted and Actual Withdrawal Volumes

2014 Exploration Lakes Recharge Study										
Lake	Permit		Permit Expiration	Water Use Purpose	Permitted Volume[1]			Withdrawal Volume[3]		
	ADF&G	ADNR			Liquid	Ice	Total Water[2]	Liquid	Ice	Total Water
					(Mgal)					
L9803	FH13-III-0315	TWUP A2013-163	12/6/2018	Ice Road/Pad	0.44	33.75	34.19	0.00	0.50	0.50
L9804	FH12-III-0263	TWUP A2012-173	12/20/2017	:::	0.00	66.09	66.09	0.00	0.00	0.00
L9805	FH12-III-0264	TWUP A2012-173	12/20/2017	:::	0.01	99.82	99.83	0.00	0.00	0.00
L9817	FH12-III-0265	TWUP A2012-173	12/20/2017	Ice Road/Pad	5.49	3.42	8.91	5.14	0.00	5.14
L9826	FH13-III-0338	TWUP A2013-163	12/6/2018	:::	0.26	0.59	0.85	0.00	0.00	0.00
L9911/R0061	FH13-III-0384	TWUP A2013-198	12/9/2018	Ice Road/Pad	59.08	53.92	113.00	0.00	1.34	1.34
M0024	FH13-III-0391	TWUP A2013-198	12/9/2018	Ice Road/Pad	11.34	10.61	21.95	0.02	0.00	0.02
M1301	FH13-III0392	TWUP A2013-199	12/6/2018	Ice Road/Pad/ Drilling Make-Up	3.00	30.40	33.40	2.53	0.00	2.53
M9914	FH12-III-0262	TWUP A2012-174	12/20/2017	:::	0.00	14.99	14.99	0.00	0.00	0.00
M9915	FH13-III-0385	TWUP A2013-198	12/9/2018	:::	1.18	3.10	4.28	0.00	0.00	0.00
M9922	FH12-III-0270	TWUP A2012-175	12/9/2017	:::	1.32	18.71	20.03	0.00	0.00	0.00
M9923	FH12-III-0268	TWUP A2012-174	12/20/2017	Ice Road/Pad/ Camp Supply	4.69	35.23	39.92	4.29	2.56	6.85
R0062	FH13-III-0387	TWUP A2013-200	12/8/2018	:::	0.06	8.00	8.06	0.00	0.00	0.00
Notes	1 Per water year. Some permits do not stipulate specific liquid/ice volumes. 2 Total permitted withdrawal may be either ice, water, or a combination 3 Total withdrawal volume between June 1, 2013 and May 31, 2014. Specific liquid/ice withdrawal volumes not available when not stipulated in permit. ::: n/a									

3.0 STUDY METHODS

3.1 WATER SURFACE ELEVATIONS SURVEYS

Changes in WSE were measured at Lake L9805. This gage was rehabilitated for 2014 and WSE monitoring was conducted during the pre-breakup, breakup, and post-breakup periods.

Photo 3.1: Staff gage at Lake L9805, pre-breakup; May 11, 2014

A staff gage assembly consists of a metal gage faceplate mounted on a two-by-four timber. The timber is attached with U-bolts to a 1.5-inch wide angle iron driven approximately 2 feet into the ground. All gages installed are indirect-read staff gages; meaning, the values read on the gage faceplate do not directly correspond to a known elevation. Photo 3.1 shows the gage setup at Lake L9805. A tabulated list of gage and the temporary benchmark (TBM) location is included in Appendix A.

Standard differential leveling techniques were used to establish staff gage elevations with the local TBM. Elevation at Lake L9805 gage was based on a TBM established in 2013 with an arbitrary elevation of 100.00 feet. An arbitrary elevation of 100.00 feet is typically used to avoid confusion with actual British Petroleum Mean Sea Level (BPMSL) elevations which are much lower in the surrounding terrain.

WSE recorded at the staff gage was tied to the arbitrary elevation. A staff gage tied to an arbitrary elevation is used to illustrate a change in WSE for the specific lake, and does not provide a BPMSL elevation.

Pre-breakup WSE was recorded at Lake L9805 by using an electric drill to auger a 2-inch sampling hole in the ice covering the lake. Ice surface elevation was determined through differential leveling. WSE was calculated by subtracting measured freeboard from the ice surface elevation at the sample hole. Freeboard was measured using a pocket rod (Baker 2002).

Activities at Lake L9805 were limited to the pre-breakup survey, aerial photography during breakup, and post-breakup investigation. A high water mark was not evident throughout breakup.

When water levels were not sufficiently high to be recorded on the staff gage face plate, standard differential leveling techniques were used to measure WSE. The horizontal position of each staff gage and TBM was recorded using a handheld global positioning system (GPS) in North American Datum of 1983 (NAD83).

3.2 Lake Recharge Observations

Throughout breakup, aerial photographs were taken from a helicopter using a GPS camera. Photos were taken from various perspectives to capture the extent of snow melt, flow pattern, potential lake water recharge sources, and hydraulic connectivity with other water bodies. Written documentation of visual observations combined with time-stamped GPS photos support identification of the lake's recharge mechanism(s), extent, and timeline.

4.0 STUDY RESULTS

The WSE and lake recharge observations are presented in this section. Photographs of before, during, and after breakup of each lake are included in Appendix B.

4.1 WATER SURFACE ELEVATION

Baker installed a gage on Lake L9805 in May 2013; however, because of limited resources, Lake L9805 was not visited consistently throughout the monitoring program. The WSE data for Lake L9805 is presented in Table 4.1.

Table 4.1: WSE Data for Lake L9805

Date and Time	WSE[1] (feet)	Observations
5/11/14 10:00 AM	92.85	
7/11/14 11:45 AM	93.04	No hydraulic connections

Note:

1. Elevations are assumed based on TBM N193AL (100.00 feet), installed by Baker in May 2013

4.2 LAKE RECHARGE

Recharge of lakes L9803, L9804, L9817, L9826, L9911/R0061, M1301, and M9914 was determined by visual observation and aerial photographs. These seven lakes were observed to fully recharge over bankfull during the 2014 monitoring season. Bankfull recharge was determined through visual observations of outflow.

Lakes L9805, M0024, M9915, M9922, M9923, and R0062 primary recharge mechanism was from local melt. These lakes were not observed draining into nearby water bodies or tundra. Based on available observations, bankfull recharge could not be confirmed. Regular visits to each lake were not possible and outflow drainage may have occurred between observations.

4.3 SUMMARY

Observed hydraulic connections are likely seasonal and limited to an increase in stage conditions during spring breakup. The lakes should be considered hydraulically isolated during the remainder of the year. A compilation of 2014 hydrologic observations, including whether the lake recharged to bankfull, the primary recharge mechanism, additional hydraulic connections, and estimated bankfull WSE is provided provided in Table 4.2.

Table 4.2: Summary of 2014 Hydrologic Recharge Observations

Study Lake	Recharge to Bankfull	Primary Recharge Mechanism	Additional Hydraulic Connection[1]		Estimated Bankfull WSE [2] (feet BPMSL)
			Flow In	Flow Out	
L9803	√	Local melt	No channelized flow	Flow into wetland (northwest)	--
L9804	√	Local melt	No channelized flow	Sheet flow into the Clover Material Source area (northwest)	--
L9805	Not Confirmed	Local melt	No channelized flow	No channelized flow	93.0
L9817	√	Local melt	No channelized flow	Flow into wetlands (west)	--
L9826	√	Ublutuoch River overbank flow	Ublutuoch River overbank flow and channelized flow from lakes L9803 and L9804	Sheet flow into Ublutuoch River (north)	--
L9911/R0061	√	Local melt	Local melt	Channelized flow into wetland (north)	--
M0024	Not Confirmed	Local melt	Channelized flow from wetlands (southeast)	No channelized flow	--
M1301	√	Local melt	No channelized flow	Flow into wetlands (south)	--
M9914	√	Local melt	Channelized flow from wetlands (south)	Flow into wetlands (north)	--
M9915	Not Confirmed	Local melt	No channelized flow	No channelized flow	--
M9922	Not Confirmed	Local melt	No channelized flow	No channelized flow	--
M9923	Not Confirmed	Local melt	No channelized flow	No channelized flow	--
R0062	Not Confirmed	Local melt	No channelized flow	No channelized flow	--
Notes:	1. Observations between May 1 and July 12, 2014. Unless specified, hydraulic connections are likely seasonal only. 2. WSE estimated based on gage readings for all years available -- Visual observations only, WSE not available				

5.0 References

ConocoPhillips AK, Inc. (CPAI). 2013a. Alaska Department of Natural Resources Alpine 3rd Quarter 2013 Water Use Report.

——2013b. Alaska Department of Natural Resources Alpine 4th Quarter 2013 Water Use Report.

—— 2014a. Alaska Department of Natural Resources Alpine 1st Quarter 2014 Water Use Report.

—— 2014b. Alaska Department of Natural Resources Alpine 2nd Quarter 2014 Water Use Report.

Michael Baker Jr., Inc. (Baker). 2002. Alpine Facility and Vicinty 2002 Lake Monitoring and Recharge Study. Prepared for ConocoPhillips Alaska, Inc. 25288-MBJ-DOC-002. November 2002.

Appendix A Gage and TBM Locations

Monitoring Location	Site Name	Type	Latitude[1]	Longitude[1]
L9803	Lake 9803	Aerial Photos	70.2586°	-151.1895°
L9804	Lake 9804	Aerial Photos	70.2433°	-151.2129°
L9805	L9805-A	Gage	70.2333°	-151.1439°
	N193AL	TBM	70.2328°	-151.1437°
L9817	Lake 9817	Aerial Photos	70.2336°	-151.3400°
L9826	Lake 9826	Aerial Photos	70.2589°	-151.2364°
L9911/R0061	Lake 9911/R0061	Aerial Photos	70.1705°	-151.7898°
M0024	Lake M0024	Aerial Photos	70.2110°	-151.6511°
M1301	Lake M1301	Aerial Photos	70.2271°	-151.4245°
M9914	Lake M9914	Aerial Photos	70.2340°	-151.6336°
M9915	Lake M9915	Aerial Photos	70.2026°	-151.7624°
M9922	Lake 9922	Aerial Photos	70.2289°	-151.5876°
M9923	Lake 9923	Aerial Photos	70.2278°	-151.5239°
R0062	Lake R0062	Aerial Photos	70.1772°	-151.6155°

Note 1: Locations are referenced to NAD 83 datum in decimal degrees

Appendix B Photos

B.1 Lake L9803

Photo B.1: Lake L9803 pre-breakup, looking south; May 23, 2014

Photo B.2: Lake L9803 post-breakup, looking south; July 11, 2014

B.2 Lake L9804

Photo B.3: Lake L9804 pre-breakup, looking southwest; May 23, 2014

Photo B.4: Lake L9804 post-breakup, looking southwest; July 11, 2014

B.3 Lake L9805

Photo B.5: Lake L9805 pre-breakup, looking southeast; May 23, 2014

Photo B.6: Lake L9805 post-breakup, looking south; July 11, 2014

B.4 Lake L9817

Photo B.7: Lake L9817 pre-breakup, looking west; May 23, 2014

Photo B.8: Lake L9817 post-breakup, looking northwest; July 11, 2014

B.5 Lake L9826

Photo B.9: Lake L9826 pre-breakup, looking west; May 19, 2014

Photo B.10: Lake L9826 post-breakup, looking west; July 11, 2014

B.6 Lake L9911

Photo B.11: Lake L9911 pre-breakup, looking northwest; May 23, 2014

Photo B.12: Lake L9911 post-breakup, looking south; July 11, 2014

B.7 Lake M0024

Photo B.13: Lake M0024 pre-breakup, looking south; May 23, 2014

Photo B.14: Lake M0024 post-breakup, looking northeast; July 11, 2014

B.8 Lake M1301

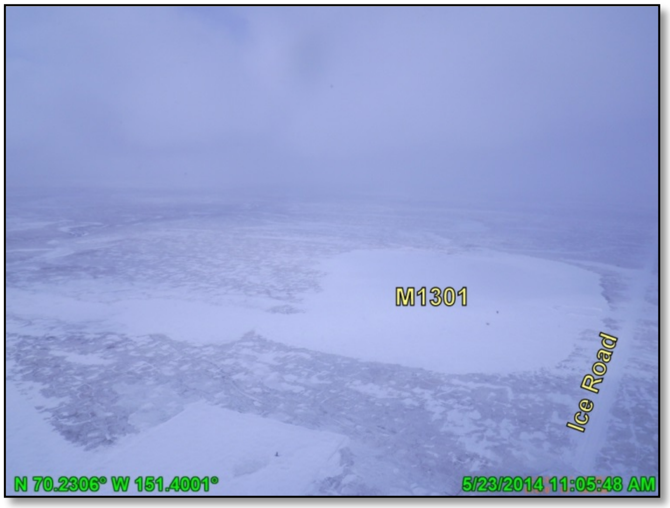

Photo B.15: Lake M1301 pre-breakup, looking southwest; May 23, 2014

Photo B.16: Lake M1301 during breakup, looking south; June 5, 2014

Photo B.17: Lake M1301 post-breakup, looking northwest; July 11, 2014

B.9 Lake M9914

Photo B.18: Lake M9914 pre-breakup, looking northwest; May 23, 2014

Photo B.19: Lake M9914 post-breakup, looking northwest; July 11, 2014

B.10 Lake M9915

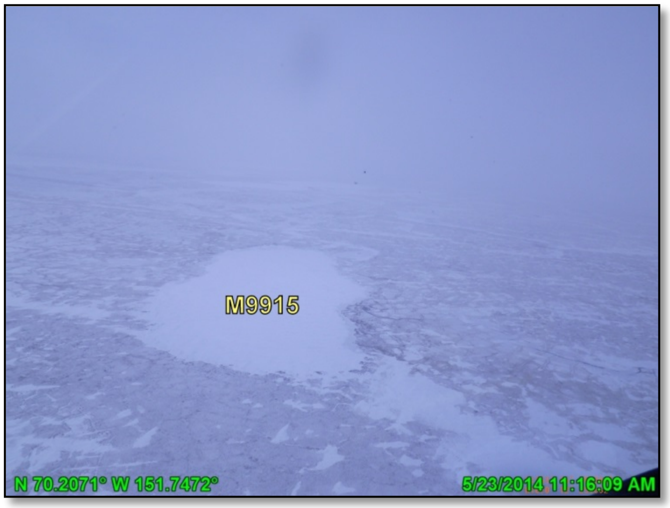

Photo B.20: Lake M9915 pre-breakup, looking southwest; May 23, 2014

Photo B.21: Lake M9915 post-breakup, looking northwest; July 11, 2014

B.11 Lake M9922

Photo B.22: Lake M9922 pre-breakup, looking west; May 23, 2014

Photo B.23: Lake M9922 post-breakup, looking west; July 11, 2014

B.12 Lake M9923

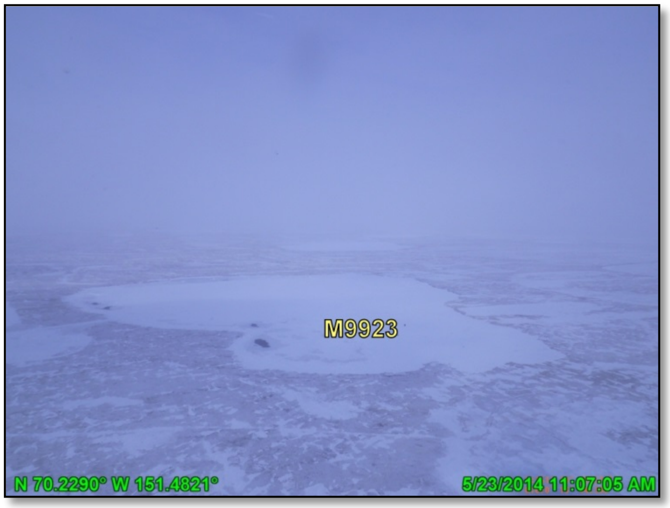

Photo B.24: Lake M9923 pre-breakup, looking west; May 23, 2014

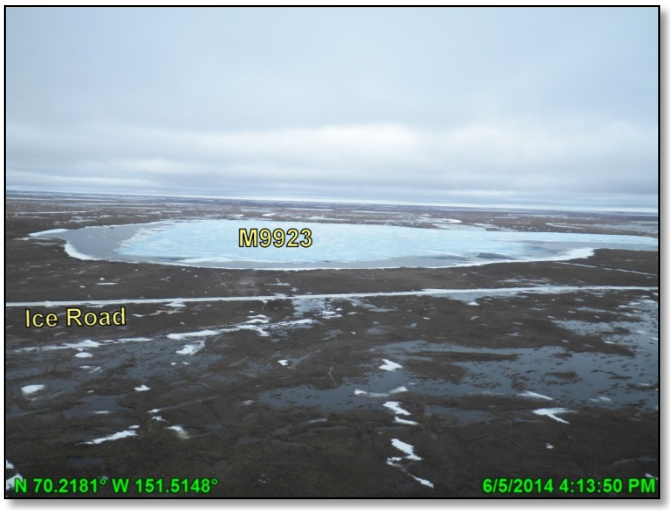

Photo B.25: Lake M9923 during breakup, looking north; June 5, 2014

Photo B.26: Lake M9923 post-breakup, looking north; July 11, 2014

B.13 Lake R0062

Photo B.27: Lake R0062 pre-breakup, looking northeast; May 23, 2014

Photo B.28: Lake R0062 post-breakup, looking northwest; July 11, 2014

2014 Exploration Lakes Recharge Studies

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