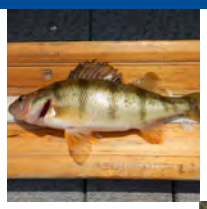
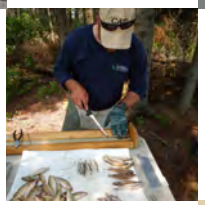
CAMP

Coordinated Aquatic Monitoring Program





Annual Activity Report

2018/2019

Submitted to:

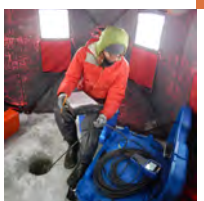
Minister of Sustainable Development

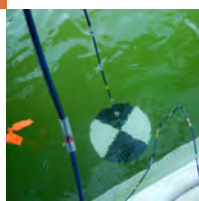
President/CEO Manitoba Hydro

Submitted by:

MOU Working Group

September 2019





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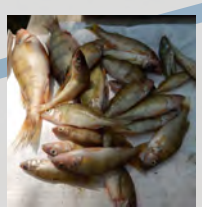


Cross Lake

1.0 Executive Summary

The 2018/19 Coordinated Aquatic Monitoring Program (CAMP, the Program) marks the eleventh year of monitoring since implementation in 2008/09. The program was initiated to address comments received from communities and the Clean Environment Commission about the need for system-wide monitoring to better understand the effects of hydroelectric operations on the aquatic environment. In 2006, Manitoba and Manitoba Hydro signed a Memorandum of Understanding (MOU) and the CAMP partnership was established. The MOU outlines the objectives of the program and requires an annual summary of activities, which is provided in this report.

The Coordinated Aquatic Monitoring Program is an ecosystem-based monitoring program that samples key biological/chemical/physical parameters at different levels of the food web. These variables, along with hydrometric data are used to describe the ecological condition and status of aquatic ecosystem health in the waterways in which Manitoba Hydro operates. The selected parameters were determined based on the best advice of scientists and regulators that participated in annual CAMP workshops that started in November 2007. Attendees included representatives from Manitoba Conservation and Water Stewardship, Manitoba Hydro, Fisheries and Oceans Canada, University of Manitoba, Environment Canada and North/South Consultants Inc.

The program is assessed annually and adjusted to ensure it maintains scientific credibility and is on scope for meeting the objectives of the Memorandum of Understanding.

The past year was successful and most of the fieldwork was accomplished as planned and the program goals were met overall.

Recent developments to the program include:

- Testing the feasibility of installing water quality data loggers in generating stations
- Increasing communication products and plain-language documents
- Completion of the 6-Year Technical Reports and Summary Document
- Implementation of ArcGIS Online to view the CAMP data
- Increasing collaborations with communities
- Exploration of the addition of shoreline health monitoring

Additional items to be developed over the next few years include:

- Development of a pilot program for shoreline health monitoring
- Continuation of community participation
- Investigating opportunities for citizen science to complement the CAMP data

2.0 Background

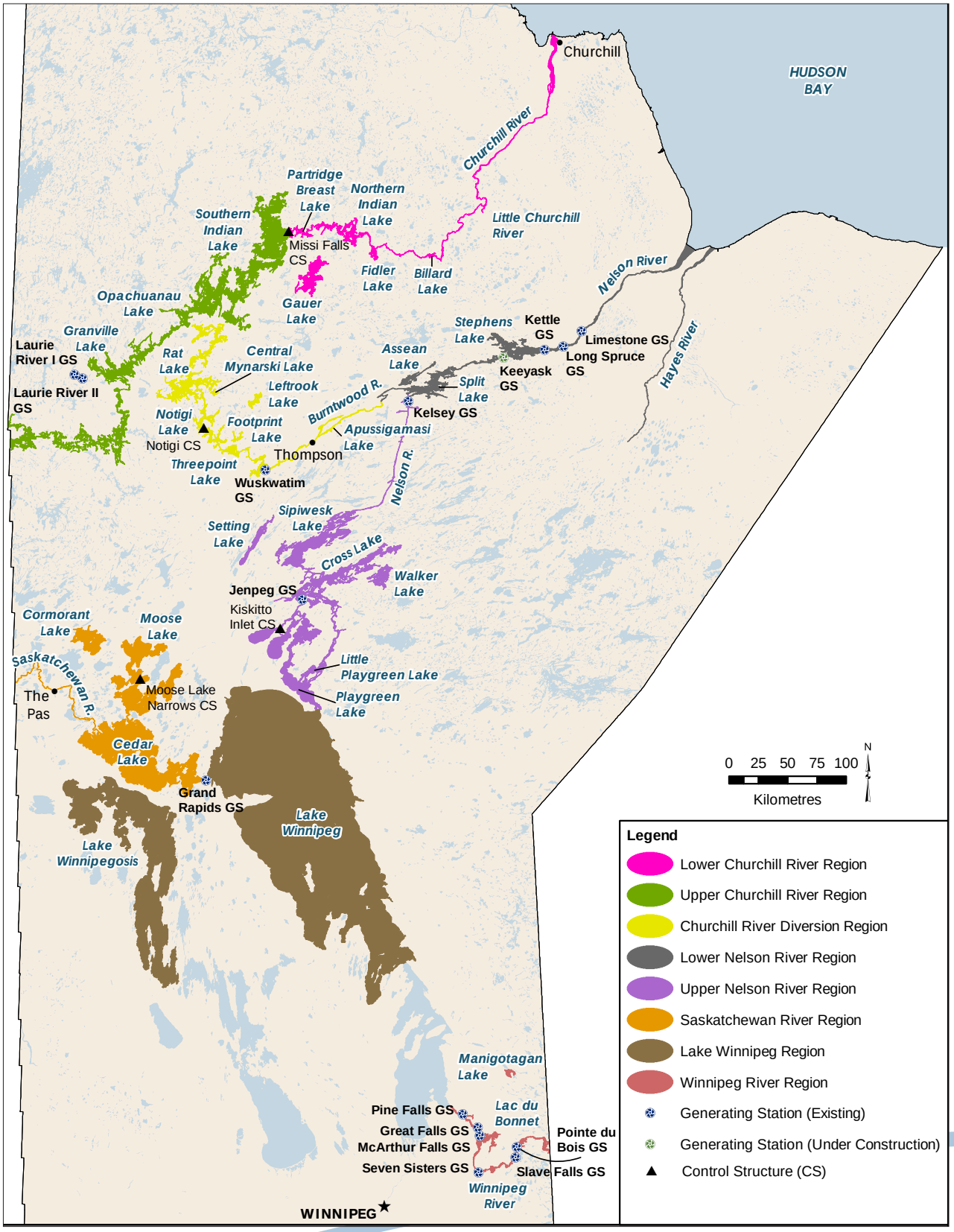
The purpose of this report is to provide the signatories of the "Memorandum of Understanding about the Program of LWR/CRD Monitoring Activities" with a summary of the 2018/19 Coordinated Aquatic Monitoring Program. The MOU, signed in 2006 by the Province of Manitoba and Manitoba Hydro (Appendix 1), outlines the need to develop a system-wide aquatic monitoring program to address concerns related to potential effects associated with Manitoba Hydro operations.

The Coordinated Aquatic Monitoring Pilot Program was developed and implemented in 2008/09 and operated for the first three years to test sampling methodologies. This 2018/19 annual activity report represents the eighth year of a fully implemented, post-pilot phase, Coordinated Aquatic Monitoring Program (CAMP).

129

Sampling events occurred for CAMP in 2018

Collecting water samples - Lower Churchill River - March 2019



CAMP Study Regions

3.0 Program Management

The CAMP is a large program that has a broad geographic and topic scope. It comprises waterways across Manitoba (from the Winnipeg River to the Churchill River) and a multitude (hundreds) of monitoring parameters that are sampled on an annual or rotational basis. To accomplish the goals of the program, many different groups (i.e., Manitoba government, Manitoba Hydro, environmental consultants, technical experts, lab technicians and community members) perform various duties to:


Southern Indian Lake - Area 1 - Spring 2018

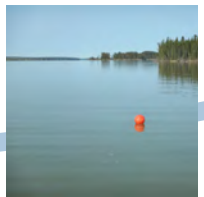
- Plan and direct the work
- Manage and budget effectively
- Acquire resources
- Conduct field sampling
- Ensure legislative compliance
- Process and analyze results
- Report results and progress in various formats
- Manage data
- Ensure safety
- Communicate, share information, and receive feedback
- Collaborate and develop relationships
- Strive for continuous improvement

The Program supports *Water Power Act* licensing, and a Working Group composed of individuals from Manitoba Hydro and Manitoba Sustainable Development oversees the program. Smaller subcommittees, with subject matter experts from Manitoba Hydro, Manitoba Sustainable Development, Fisheries and Oceans Canada, Environment and Climate Change Canada, environmental consultants, and other research scientists, are also brought together occasionally to address specific topics and issues. Day to day administration, budgeting, and management of the program are conducted by Manitoba Hydro. Monitoring activities (i.e., data collection and fieldwork) are performed by Manitoba Hydro, Manitoba Sustainable Development, and North/South Consultants Inc. (on behalf of Manitoba Hydro). Manitoba Sustainable Development performs CAMP water quality sampling in a few locations in the north basin of Lake Winnipeg, from Lake Winnipeg Research Consortium's large research vessel, the M.V. *Namao*.

More detailed information about the program, sampling parameters, monitoring sites, and results can be found on the website at www.campmb.com.

3.1 Working Group

On May 16, 2018, a draft workplan for the 2018/19 program was presented to the MOU Working Group, which is the oversight committee identified in the MOU. Items that were presented and discussed at the meeting include:



- Review of the 2017/18 Coordinated Aquatic Monitoring Program
- Update on the CAMP reporting and data management (i.e., updates on the 6-Year Report, the Data Integration Strategy, website, plain language documents)
- Presentation and discussion of the proposed 2018/19 CAMP workplan (i.e., ecosystem monitoring schedule, sedimentation monitoring plans)
- Update on community dialogue efforts

No significant concerns or issues were raised by the Working Group members and the 2018/19 workplan was subsequently accepted as presented. A summary of the CAMP meetings is provided in Appendix 2.

3.2 Subcommittees

The subcommittees are composed of groups of technical experts from Manitoba Hydro, Manitoba, North/South Consultants Inc., and other experts as needed for each of the specific parameters sampled in the Program. There were no specific technical subcommittee meetings during 2018/19.

3.3 Annual Workshop

Usually one annual CAMP workshop is held with approximately 30 people representing federal and provincial agencies, private consultants, research groups, and Manitoba Hydro staff. The intent of the workshop is to disseminate information related to the CAMP activities and receive feedback on future directions. This year, the workshop, held on February 20th, 2019, was extended to a larger group than in the past with a specific focus for discussing the development of a shoreline health monitoring component.

Invitees included Nisichawayasihk Cree Nation, Manitoba Sustainable Development, Manitoba Hydro, consultants, academics, advisors, and other subject matter experts.

In oder to asses what is important to the participants regarding shoreline monitoring and to hear suggestions on how to implement the monitoring, the following three main questions were posed to the group:

1. What is happening on the hydro-affected shorelines?
2. What do you want to know about shorelines and riparian areas?
3. How can we get there?

A positive discussion took place and it is anticipated that with Manitoba's lead, similar meetings will occur with other communities to hear their input and ideas regarding the CAMP shoreline health monitoring. A pilot program will be drafted after the initial round of meetings and discussions. To date, the meetings with communities have not occurred as Manitoba considers who will replace their Manitoba CAMP lead who has recently retired.

4.0 Ecosystem Monitoring

The following summary documents the major activities undertaken by the CAMP in 2018/19 (i.e., April 1, 2018 to March 31, 2019).

Water quality, benthic macroinvertebrates (BMI), and fish community were sampled in up to 30 lakes (or areas of lakes) or riverine reaches (21 on-system and 9 off-system) during the 2018/19 CAMP (adjacent map and Appendix 3). In addition, water quality was sampled at the outlets of Lake Winnipeg (Two-Mile Channel and the upper Nelson River near Warren Landing). Mercury in fish monitoring was conducted in 2018/19 at four waterbodies, including two lakes (Leftrook and Threepoint lakes) that are monitored annually. No aquatic habitat (bathymetry and substrate type) surveys were undertaken in 2018/2019.

Overall, the program goals were achieved; however, a few sites were missed or changed, mainly due to inclement weather and equipment issues.

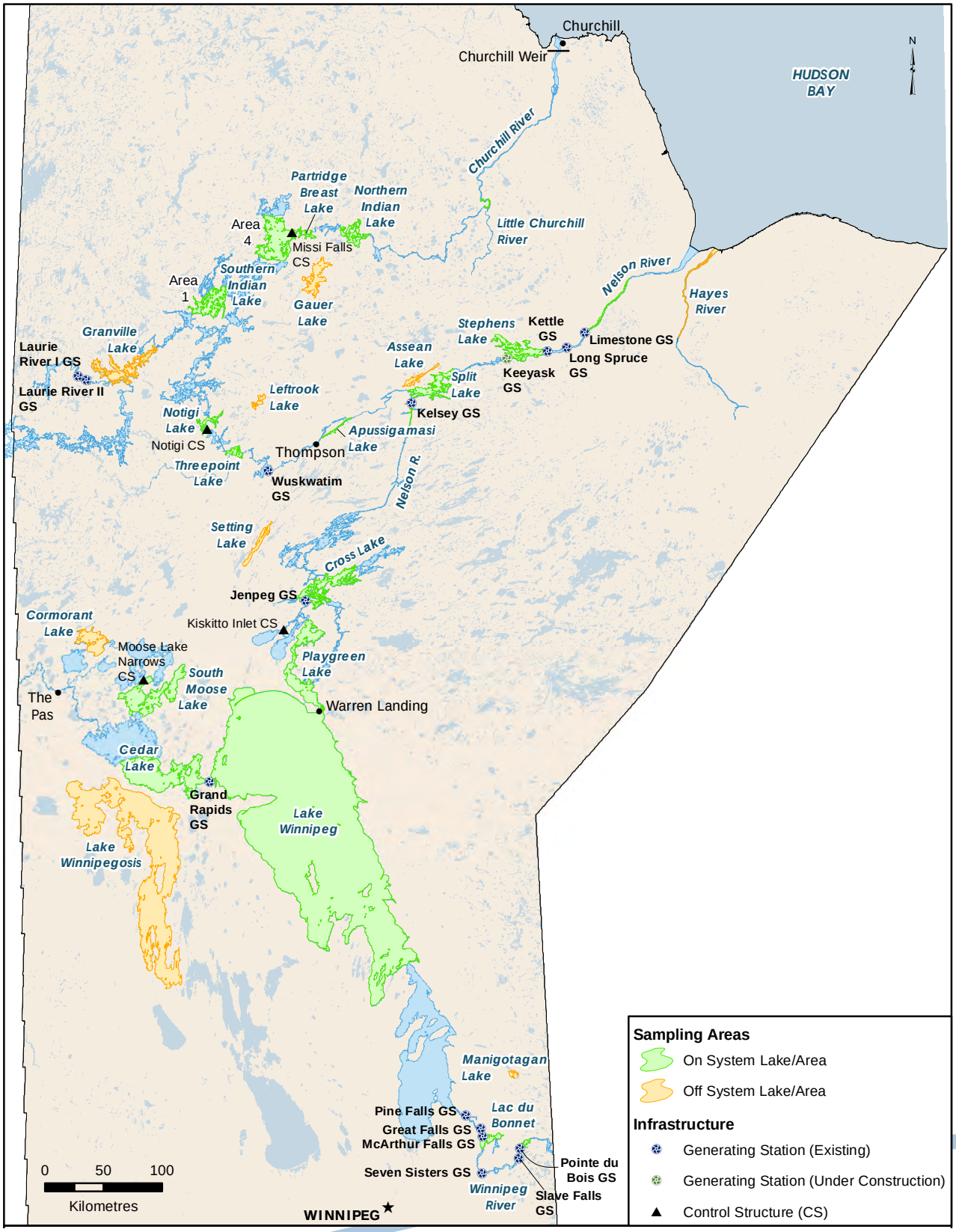
4.1 Changes

Continuous water quality monitoring was initiated at several sites under the Physical Environment Program. Details about this can be found in Section 4.9. No other substantive changes were made to the program.

4.2 Aquatic Habitat

Characterizing the aquatic habitat of a waterbody helps inform our understanding of the ecosystem components, such as invertebrates and fish. The CAMP aquatic habitat surveys are done using boat based hydroacoustic equipment to produce lake bathymetry and substrate/bottom habitat typing. Surveys are conducted each year in a different waterbody as budget allows to build an inventory of maps over time to assist with interpreting monitoring results.

No aquatic habitat surveys were conducted in 2018/2019 as efforts were focused on processing data from previous years to create communication products. For example, Cedar Lake data was collected in the previous two years and the data was analyzed and processed in 2018/19 to create maps and posters.



On and Off System 2018/2019 Sampling Areas

4.3 Water Quality

Water quality is sampled four times a year in annual and rotational water bodies. Three samples are collected during the open-water season (spring, summer, fall) and one is collected during winter, under ice conditions. Over 50 parameters are analyzed in the water quality samples through in-situ (i.e., on site) or lab analysis. With a few exceptions, water quality sampling was completed at all sites as planned in 2018/19. Sampling site locations were adjusted at some sites over the course of the sampling program due to inclement weather/site conditions, such as high wind or cloud cover, which affects site access and safety when sampling from a float plane; these sites included:

- **Spring:** Gauer and Leftrook lakes (high winds/waves);
- **Summer:** Lake Winnipegosis – Site 1 (sampling completed at a shallow area near Site 1); Southern Indian Lake - Areas 1 and 4 (high wind/waves); and
- **Fall:** Cedar Lake –Southeast and Lake Winnipegosis - Site 3 (low cloud).

Water quality sampling at the Lake Winnipeg CAMP sites did not occur during spring 2018 due to the M.V. *Namao* being in dry dock for repairs. The table below summarizes the Lake Winnipeg water quality sampled by Manitoba Sustainable Development.

Collecting representative samples in the Lake Winnipeg outlet area (i.e., Warren Landing and 2-Mile Channel) was challenging due to turbidity plumes from eroding shorelines. Sampling within the sedimentation plume will provide vastly different results than sampling outside the sedimentation plume. Although both conditions represent the outflow of Lake Winnipeg, it is difficult to characterize conditions in one sample or even an average of several samples from these two locations; both represent different water quality conditions that are simultaneously present (i.e., water at the outlets is not always well mixed).

Summary of Lake Winnipeg Water Quality Sampling

Site	Spring	Summer #1	Summer #2	Fall
Two-Mile Channel (Inlet)	Not sampled[1]	18 July 2018	12 August 2018	08 October 2018
Two-Mile Channel (Outlet)			14 August 2018	
Nelson River @ Warren Landing				
Big Mossy Point		Not sampled[2]	12 August 2018	
Site 22			11 August 2018	07 October 2018

[1] Sampling period did not occur due to the Namao being in drydock.

[2] The north basin sampling was limited because of the delayed start to the season so there was concern that the July sampling would further delay Summer #2 and Fall sampling; therefore, Big Mossy Point and Site 22 were not sampled in July.

79
parameters are measured for each water sample

Measuring in situ water quality variables at Setting Lake - winter 2019

4.4 Sediment Quality

Sediment quality is monitored on a rotational basis every six years. 2018/19 was not a sampling year so no sediment quality data was collected. The next round of sediment quality monitoring will occur in 2023/2024.

4.5 Benthic Macroinvertebrates

Benthic macroinvertebrates (BMI) (i.e., bugs in the sediment) monitoring is conducted once per year at annual and rotational sites. BMI are often used as indicators of ecosystem health as they are a food source (i.e., lower trophic level) for higher-level consumers, such as fish. Some BMI are more susceptible to environmental changes and can reveal trends that may be occurring in areas of a waterbody over time.

Benthic macroinvertebrate sampling was not conducted at the lower Churchill River at the Little Churchill River site because of high water levels and flows at the time of sampling. Benthic macroinvertebrate sampling was completed, as planned, at all other sites; however, additional time and effort were required during sampling to comply with new Aquatic Invasive Species regulations that require thorough decontamination of gear that is moved between waterbodies.

Benthic macroinvertebrate samples were sorted, identified, and enumerated in the laboratory over the winter.

To date, the invasive spiny waterflea (*Bythotrephes longimanus*) has been identified from nearshore samples from the Winnipeg River (Eaglenest Lake, Pointe du Bois reservoir, and Lac du Bonnet), Lake Winnipeg (Mossy Bay), and Playgreen Lake; and from offshore samples from the Winnipeg River (Pointe du Bois reservoir, and Lac du Bonnet), Lake Winnipeg (Grand Rapids and Mossy Bay), and Playgreen Lake. The spiny waterflea was not found at any other CAMP site in 2018.

240,000
benthic invertebrates were identified in 2018

Benthic macroinvertebrates sampling in Assean Lake - 2018

4.6 Phytoplankton

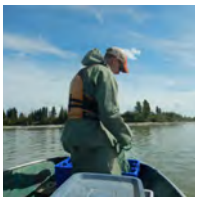
Phytoplankton are microscopic, plant-like organisms in the water column that make up the base of the food web (i.e., they are primary producers). They are an important food source and provide oxygen in the aquatic environment. An over-abundance of phytoplankton (called blooms, which occur when nutrients are plentiful) can be a detriment to the environment; oxygen can be depleted from decomposition after they die, they can prevent sunlight from penetrating into the water column, or some (e.g., blue-green algae) contain toxins. Sampling for phytoplankton helps us understand how the primary producers are contributing to the health of the ecosystem, as well as the nutrient levels in the water.

Samples for phytoplankton analysis (i.e., community composition and biomass) were collected from all sites during the open-water and ice-cover season; samples from the four routine annual monitoring sites (Cross, Setting, Split and Assean lakes) were submitted for analysis as planned.

In addition to the annual site sampling, the CAMP analyses any water samples with chlorophyll *a* concentrations exceeding 10 µg/L to monitor for algal toxins. During the open-water season, 28 samples were submitted for the algal bloom monitoring.

108
types of phytoplankton were identified in 2018

Collecting water samples in Stephens Lake north - summer 2018



4.7 Fish Community

Fish community sampling is conducted once per year during open water as compared to water quality which is sampled four times per year. Some fish community sites are sampled annually while others are sampled on a three- year rotational basis. The intent of the analysis is to estimate fish abundance and diversity, and to collect information on fish condition (e.g., size, weight, condition factor, etc.). Ageing structures are also collected for target species (i.e., Walleye, Northern Pike, Lake Whitefish, Sauger and on any incidental Lake Sturgeon mortalities). Otoliths (ear bones) or cleithra (jaw bones) are collected and analyzed for age in a way similar to counting tree rings. Knowing the age of a fish and the abundance of that age class within a particular species provides information on fish growth and the relative strength of a particular year class.

Fish community sampling was completed at all locations and sites as planned. As per usual, fish ageing structures were collected during fish community sampling; those ageing structures were analyzed in the lab over the winter.

The Manitoba Sustainable Development (Northeast Region) fish sex and maturity monitoring protocol was revised and is now a stand-alone document.

303
sites were sampled in 31 waterbodies in 2018

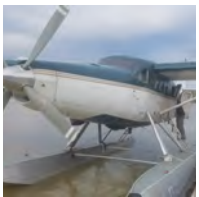
Small mesh gillnet catch - Stephens Lake - fall 2018

4.8 Mercury in Fish

Mercury in fish is monitored in the CAMP waterbodies every three years, except for two sites that are monitored annually (Threepoint and Leftrook lakes). Fish tissue samples (i.e., muscle) were collected during fish community monitoring at each of the four waterbodies that were scheduled to be sampled in 2018 (Threepoint, Leftrook, Playgreen, and Stephens Lake - south). After collection, mercury samples were analyzed over the winter in the laboratory. In addition, extra samples collected from Cormorant Lake in 2017 in error were also analyzed.

36
fish species were identified for CAMP in 2018

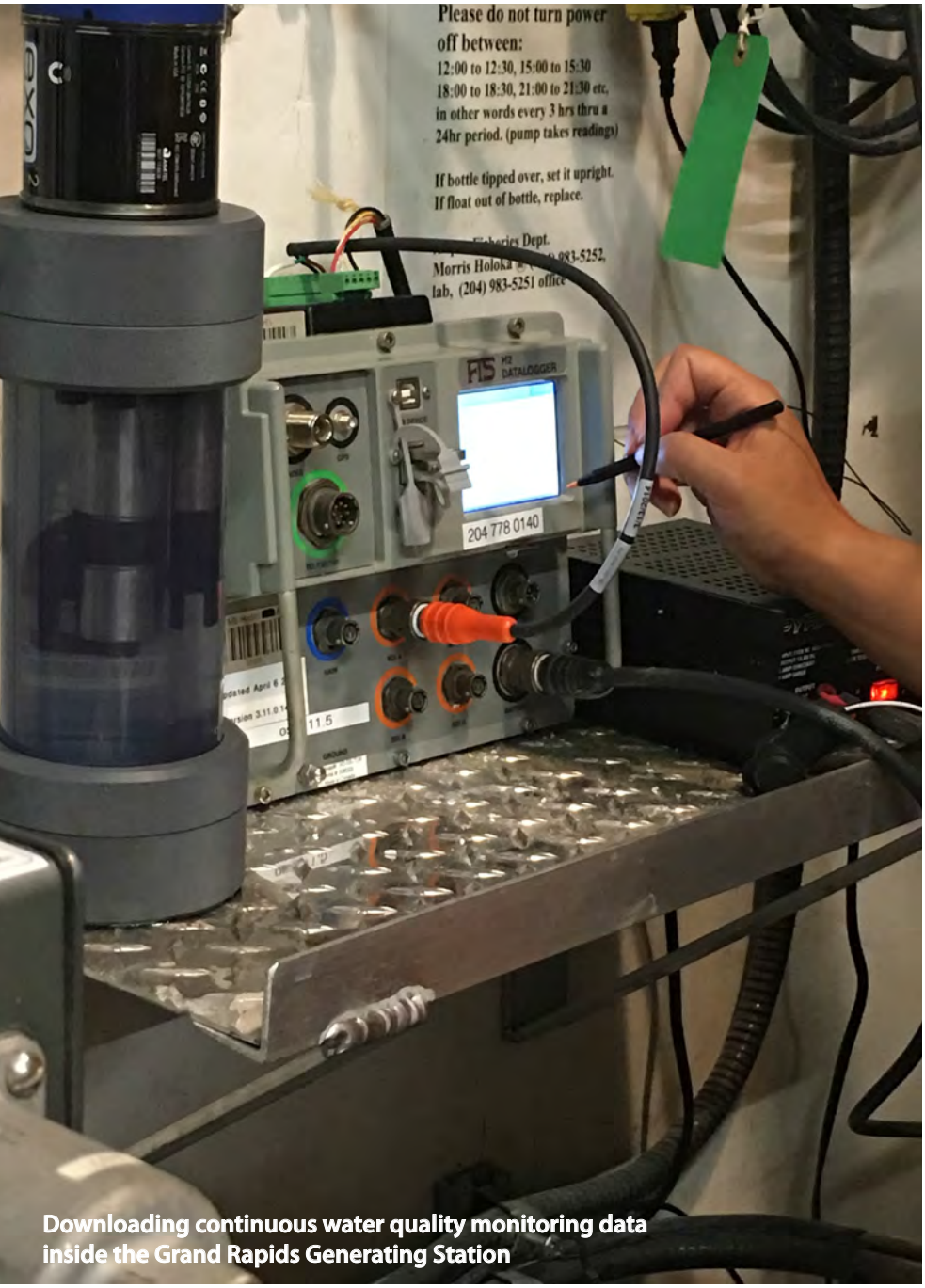
Preparing to set a gill net on Apussagamasi Lake - summer 2018



4.9 Physical Environment

4.9.1 Sedimentation Monitoring

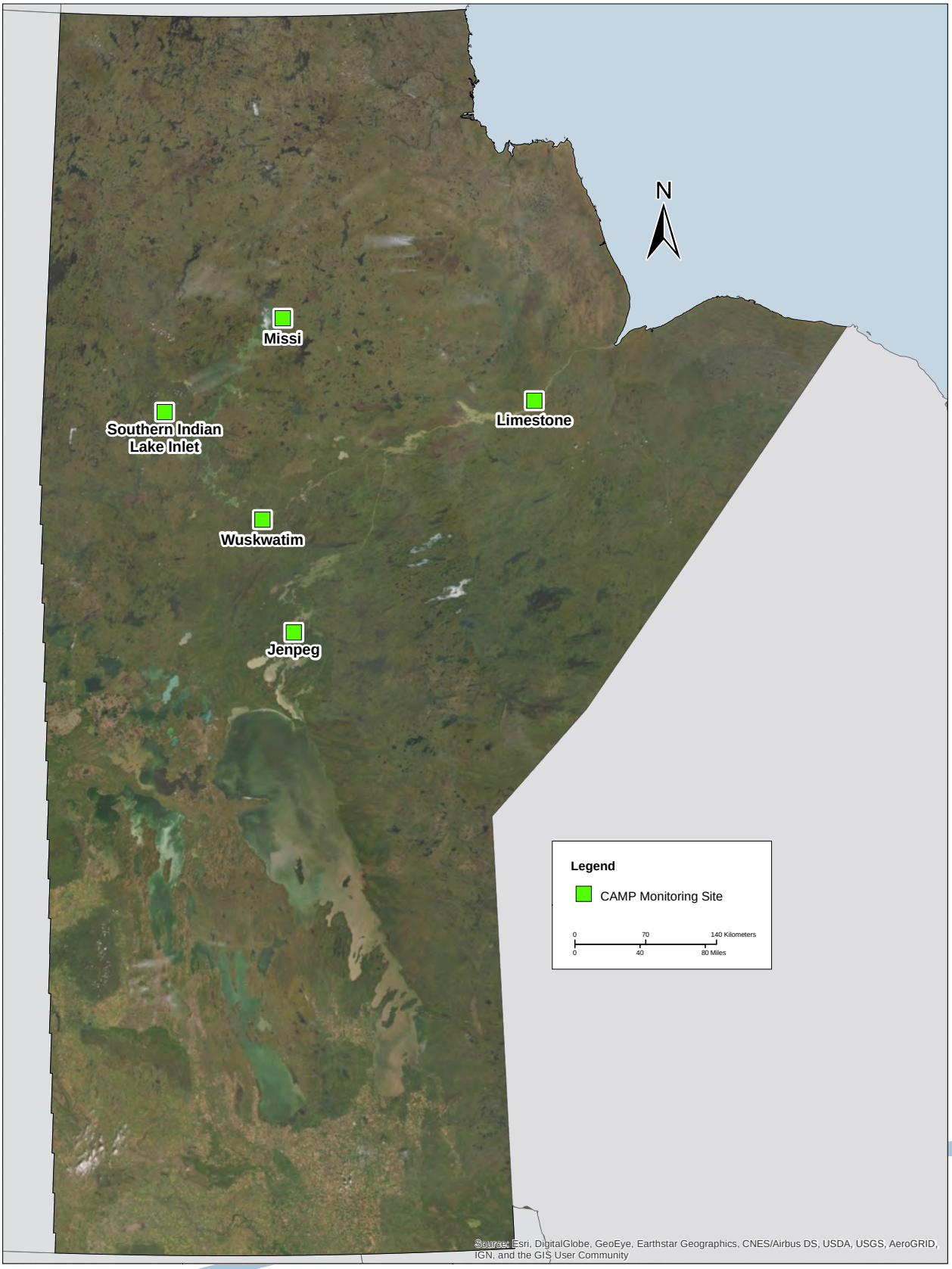
The 2018 season saw a concerted effort put into establishing long-term continuous monitoring sites inside Manitoba Hydro structures (e.g., generating stations) that will allow for year-round monitoring of turbidity, water temperature, conductivity, and dissolved oxygen. The goal for the 2018 summer season was to test four to five sites (see adjacent map) depending on time and resources.



Downloading continuous water quality monitoring data inside the Grand Rapids Generating Station

Each of the sites was investigated for suitable permanent long-term monitoring locations that could operate year round with safe access without the need for boats. Sites were identified and testing commenced at the Jenpeg, Wuskwatim, and Limestone generating stations and the Missi Falls Control Structure. Investigations into a suitable site on the Churchill River near Leaf Rapids did not find a suitable site for year round monitoring.

Results to date show that monitoring inside generating stations is possible by tapping into untreated water supply lines. The internal data has shown good correlations with samples collected outside; however some of the in-station results showed periods of time with unreliable data (e.g., temperature differences between internal and external data which may be due to water flow being turned off in the station inadvertently). Testing will continue at the sites and sampling locations will be refined as needed.



2018/2019 long-term continuous monitoring sites

South Moose Lake - Spring 2018

5.0 Communications

Increasing awareness of the Program and sharing information and results have become priorities for the program. The program has evolved from establishing the technical parameters of the program, to sampling and collecting data, into now focusing more on communicating what we are learning from the data. The CAMP data and information are shared in several venues and formats and we are continuing to work to provide plain language documents and materials that are accessible to wider audiences.

5.1 Meetings

5.1.1 Community Meetings

5.1.1.1 Tataskweyak Creek Nation

CAMP representatives attended a few meetings with Tataskweyak Cree Nation to provide information on data availability in the Lower Churchill River Region. The information was being sought to help understand effects from high water events in 2017.

5.1.1.2 Opaskwayak Cree Nation

There was an opportunity to present the CAMP information to members of Opaskwayak Cree Nation. Basic CAMP information was shared to build awareness of the Program and answer questions.

5.1.2 Other Meetings

5.1.2.1 Manitoba Hydro Waterways Crews

Members of the CAMP Working Group presented an overview of the Program and the data to the Manitoba Hydro waterways crews at their annual wrap-up meeting in Thompson on October 25, 2018. The presentations helped build awareness and understanding of the CAMP and was a first step toward building a relationship with the group. Since they are on the water frequently, they were invited to share any information they may have regarding

the aquatic environment (for example, presence of unusual fish, eroding shorelines, noticeable environmental changes, etc.) The crews were most interested in the bathymetry posters as they could relate to the information.

5.1.2.2 Shoreline Health Monitoring Workshop

The annual CAMP workshop was held on February 20th, 2019. It was the first meeting working with stakeholders to develop a shoreline health monitoring component. Knowledge holders from Nisichawayasihk Cree Nation (NCN) were present, along with members from Manitoba Sustainable Development, Manitoba Hydro, consultants, ecologists, academics, and other non-governmental organizations. The intent is to have similar meetings with other communities to obtain their ideas about how best to monitor the health of the shorelines.

5.1.2.3 ALS Laboratories

CAMP representatives from Manitoba Water Stewardship, Manitoba Hydro, and North/South Consultants Inc. presented the CAMP information to ALS Laboratories at their Winnipeg office. The Program uses ALS as a contractor for laboratory services to analyze a variety of CAMP parameters, such as water and sediment quality. The information about the CAMP helped the ALS staff understand the context of their work in the Program and why and how samples are collected. The meeting was useful to help build the relationship and understanding between the CAMP and ALS participants.

5.1.2.4 Lake Winnipeg Foundation

The CAMP information was presented to the Lake Winnipeg Foundation and the CAMP data sharing was discussed. The Lake Winnipeg Foundation invited CAMP to contribute data to an open-access water data hub called DataStream that is administered by the Gordon Foundation (https://lakewinnipegdatastream.ca). The CAMP is working with the Lake Winnipeg Foundation and the Gordon Foundation to ensure that the CAMP data can be shared securely through DataStream and risks are minimized.

5.1.2 Conferences

5.1.2.1 National Water Quality Monitoring Conference

Two CAMP members (Jennifer Van de Vooren and Russ Schmidt) attended the National Water Quality Monitoring Conference in Denver, Colorado in March 2019. The conference brings together practitioners, scientists and regulators in the water quality monitoring field to share knowledge and advance industry practices. Both CAMP members made presentations and received valuable feedback regarding the Program. In many areas the CAMP is quite advanced in monitoring techniques and data management. As well, the collaborative foundation of the Program is very unique and many other jurisdictions are striving to attain effective partnerships such as this.

5.2 Reporting

The Six-Year Technical Report covering 2008 to early 2014 of the Program has been completed. The report reviewed all the data from that period and identifies trends in key aquatic indicators. A Plain Language Summary document of the 6-Year Report was also prepared, which follows a "Pathways of Effects" format. The International Institute for Sustainable Development – Experimental Lakes Area (IISD-ELA) is currently conducting a peer review to identify potential areas of improvement for the program and reporting.

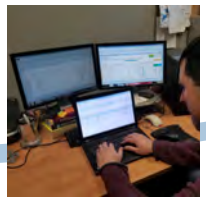
The CAMP website (www.campmb.com) will continue to be updated with data as it is collected, and made available to the public. Reports, posters and other news are also being added, as available.

5.3 Data Sharing

Requests for the CAMP data continue to be received from the public. Ten requests for data were received in 2018/19, and included universities, Indigenous communities, students, and consultants. Currently, data must be manually extracted from the database and forwarded to the requester. To streamline this process and make all the data available to the public on a self-serve basis, we are working on implementing a map-based interface on the website (i.e., ArcGIS Online).

6.0 Data Management

Starlims is the new database system for the CAMP that was implemented in 2017. The 2017 data were checked and uploaded to Starlims. Some database issues with the data were identified and are being resolved. The 2018 data are under review and will be uploaded to the database once the quality assurance process is complete. Once the data is checked it will be analyzed and uploaded to summary graphs on the CAMP website.



7.0 Emerging Items

7.1 Sediment and Erosion Monitoring

The sediment and erosion monitoring component is continuing to be reviewed and adjusted to meet the CAMP's objectives. Remote sensing will likely be used to monitor shoreline erosion to be able to analyze broad areas for large-scale areas of erosion.

7.2 Shoreline Health Monitoring

Currently, the Program monitors only the aquatic environment below the water line, however, many of the changes from hydroelectric operations are observed near and above the shoreline. Adding a shoreline monitoring component to the CAMP would provide a greater understanding of the health of the environment. The Working Group decided that the development of a shoreline health monitoring component was an opportunity to increase external participation in the program. As such, the initial steps in this endeavour involved the multi-party meeting on February 20, 2019 to start to collect ideas, concerns, and recommendations for how to best implement shoreline monitoring.

Aquatic macrophytes - Stephens Lake - fall 2018

The next steps include continuing the collection of feedback with other communities along Manitoba Hydro-affected waterways. This portion of the Program has been delayed due to retirements and staff transitions with Manitoba Sustainable Development. The community meetings are still anticipated after a new CAMP lead from Manitoba Sustainable Development is identified (likely in the fall of 2019).

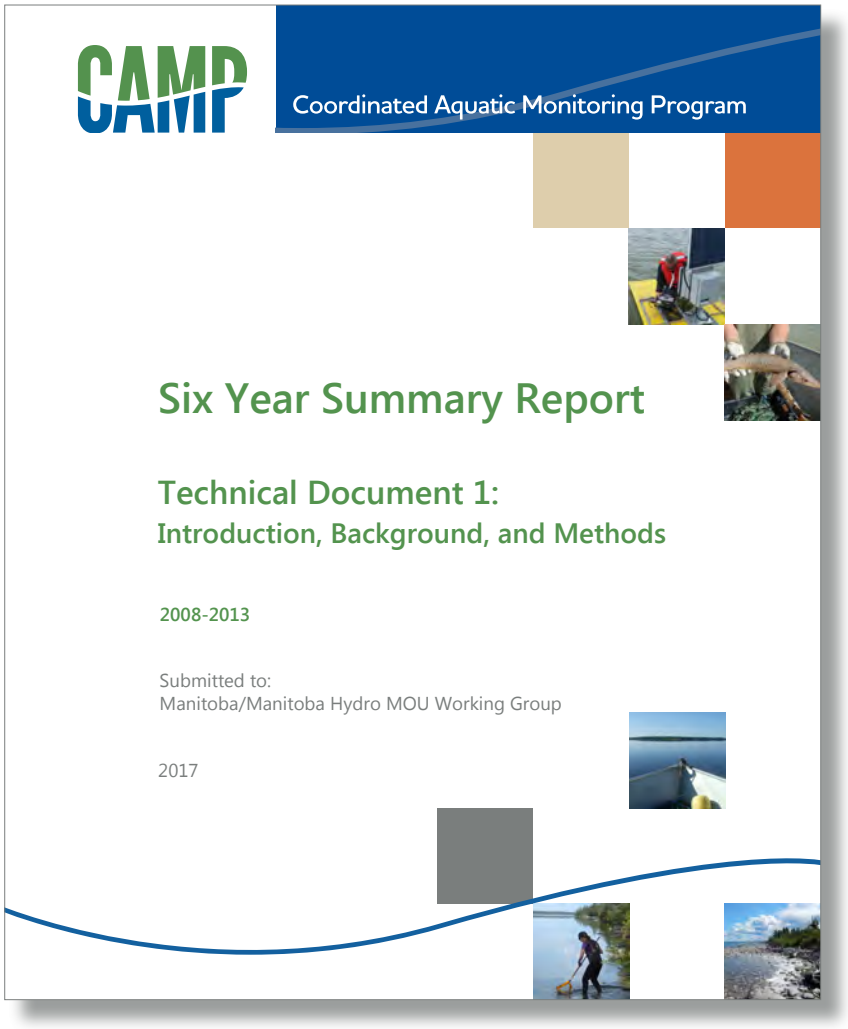
After the series of community meetings are complete, a pilot program will be drafted and tested prior to full implementation.

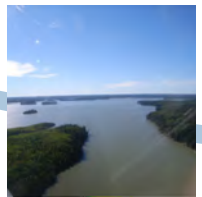
7.3 Increasing Communication

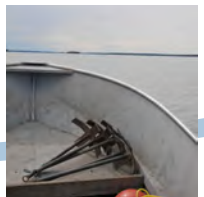
As per the CAMP Communications Strategy (endorsed by the Working Group) CAMP continues to increase its outreach. Increasing numbers of plain language documents are being generated to communicate the technical information to a broader audience and social media has started to be used to share the information, including news, data updates, recent findings, photos, technical methods, and basic monitoring information.

7.4 Research and Development Project – Photons to Phish

Over the past three years the CAMP has sponsored a Research and Development project with IISD-ELA. The project is called Photons to Phish and it focuses on identification of productivity drivers in the aquatic environment. The research was conducted at the Experimental Lakes Area and includes Ph.D. and Masters level students. The research will help identify indicators to estimate productivity up the food chain. This information is useful to help characterize the health of the ecosystem and understanding hydroelectric generation impacts.







8.0 Conclusion

The CAMP is a successful ecosystem monitoring program. It continues to grow and evolve and currently has a larger focus on increasing communications. Plain language documents, website updates, public meetings and easier data sharing are a few of the ways that the Working Group is making the Program information more accessible. The value of the program continues to increase as data are acquired; however, the true benefit lies in usage of the data and not just its collection.

The next monitoring milestone for the CAMP is to establish a new component focusing on the shoreline. This will be a collaborative endeavour and will be developed with the inclusion of Indigenous communities, subject matter experts, regulators, Manitoba, and Manitoba Hydro.

The CAMP will continue to provide information to support decision-making processes at various levels. Regulators use the information to contribute to licence conditions and recommendations and the CAMP data can be used to support provincial broad-area planning in the future (as recommended in the Clean Environment Commission's "A Review of the Regional Cumulative Effects Assessment" (2018).

Overall, the CAMP is a positive, high-profile environmental monitoring project that is expected to continue to grow in usefulness and support decision making in the coming years.

Pelicans on Cedar Lake

6.0 Appendices

Appendix 1: Memorandum of Understanding

Memorandum of Understanding about Program of LWR/CRD Monitoring Activities, dated October 16 , 2006.

The Government of Manitoba and Manitoba Hydro are committed to work together on matters relating to monitoring of hydrometric (water level and stream flow) and environmental data in certain areas in the Lake Winnipeg Regulation and Churchill River Diversion system.

Manitoba and Manitoba Hydro have the common objective of developing a program of activities ("the activities"), building on the existing monitoring program of Manitoba Hydro, that would provide objective information about hydrometric and environmental effects of hydro-electric development on agreed rivers and lakes comprising the Lake Winnipeg Regulation and Churchill River Diversion systems ("the system"). The information from the activities could be of benefit to Manitoba, Manitoba Hydro and other interested parties, including communities in the area of the Lake Winnipeg Regulation/Churchill River Diversion project. Objectives of the program of activities would include:

(a) assisting in evaluating whether and to what extent the water regime in areas of the system is or will be affected by the addition of additional hydro-electric facilities;

(b) assisting in identifying adverse effects and positive effects resulting from effects on the water regime; and

(c) assisting in considering measures that may be undertaken to address any identified adverse effects.

Manitoba and Manitoba Hydro may establish additional objectives of the activities.

Manitoba and Manitoba Hydro recognize that Manitoba Hydro has made commitments to monitoring and follow up programs as part of the environmental licensing process for the Wuskwatim Generating Station. These commitments will be considered in developing the activities.

The program of activities will be reviewed each year and annual workplans will developed by Manitoba and Manitoba Hydro to assist in achieving the program of activities. The agreed workplan for the fiscal year ending March 31, 2007 is attached as Appendix A to this Memorandum.

Manitoba and Manitoba Hydro will consider methods of making information from the activities available to interested parties.

It is intended that the nature and scope of activities will be developed starting in Fiscal Year 2006-07 (starting April 1, 2006) and will continue until Manitoba and Manitoba Hydro agree to no longer proceed with a program of activities.

As part of the development of the annual program of activities, Manitoba and Manitoba Hydro will consider the resources each will provide in order to carry out the activities

It is intended that Manitoba and Manitoba Hydro personnel will prepare an Annual Report to be delivered to the Minister of Water Stewardship and the Minister of Conservation, on behalf of Manitoba and to the President and CEO of Manitoba Hydro. Additional reports may be prepared as Manitoba and Manitoba Hydro determine to be appropriate. The Annual Report may include:

- a description of the activities for that year;
- a description of any information determined as a result of the activities;
- information about any circumstances where water levels or flows were outside of ranges provided for in licences;
- methods of making the information available to interested parties and to the public;
- any other matters that are considered appropriate. It is expected that Manitoba and Manitoba Hydro will make the Annual Reports available to the public.

Manitoba and Manitoba Hydro may amend this Memorandum from time to time by further Memorandum.

for Manitoba

Oct. 16, 2006
Date

for Manitoba Hydro

06 09 06
Date

Appendix 2: Summary of 2018/19 CAMP Meetings

Various meetings and workshops occur throughout the year to share CAMP information with different audiences. Regular administrative monthly meetings are held with CAMP participants from Manitoba Fisheries, Manitoba Water Stewardship, Manitoba Hydro, and consultants. The purpose of these meetings is to discuss day-to-day progress, planning, budget, and to address any issues that arise. In addition to the internal monthly meetings, Working Group meetings and workshops are held for specific purposes, as needed. Those meetings that occurred over the past year are described below.

Spring MOU Working Group Meeting – May 16, 2018

Objective: To review and endorse the 2018/19 workplan with the Working Group

Attendees: CAMP Working Group (members from Manitoba Sustainable Development and Manitoba Hydro)

AGENDA

- Review of 2017 Working Group meeting summary and action items
- Review the 2017/18 CAMP
- Activity and Reporting Review
    - 6-Year Report & Plain Language Summary
    - Communications products
    - Data Integration Strategy & Website
    - New contract for monitoring consultant
- Discussion of proposed 2018/19 CAMP work plan
    - Proposed 2018/19 sedimentation & erosion monitoring
    - Additional items for consideration
        - Habitat mapping/bathymetry (no sampling, just products)
        - Community participation (photos)
    - Update on the system-wide community dialogue
    - Review of R.L. Harris Hydroelectric Project Website
    - Other Business

Shoreline Health Monitoring Workshop – February 20, 2019

Objective: To gather perspectives and ideas from various stakeholders on how to develop a riparian monitoring program as part of CAMP

Attendees: Manitoba Sustainable Development, Manitoba Hydro, Nisichawayasihk Cree Nation, consultants, academics, subject matter experts

AGENDA

- Opening Prayer
- Welcome and Introductions
- Overview presentations on:
  - CAMP, Workshop Objectives, Riparian
  - NCN Perspectives
  - Physical Environment shoreline monitoring
- Group discussion on:
  - What is happening on the hydro-affected shorelines? (i.e. your experience/ observations)
  - What do we want to know about shorelines/riparian areas?
  - How do we get there? (methods and processes)
- Breakout sessions into small groups to discuss each question above. Reconvene with large group to discuss each question individually. (Each group to record and present ideas)
- Breakout: Question 1: What is happening on the shorelines?
  - Reconvene and each group presents answers
- Breakout: Question 2: What do we want to know?
  - Reconvene and each group presents answers
- Breakout: Question 3: How do we get there?
  - Reconvene and each group presents answers
- Plenary and group discussion on ideas and recommendations to move forward
- Closing Remarks

Shoreline Health Monitoring Workshop Participants

Appendix 3: 2018/19 CAMP Sampling Schedule

Region	Site	On-system	Off-system	Fish Community
Winnipeg River	Upstream of Pointe du Bois	X		Annual
	Lac du Bonnet	X		Annual
	Manigotagan Lake		X	Annual
	Eaglenest Lake		X	16/17 & 19/20
	Pine Falls Reservoir	X		17/18 & 20/21
Saskatchewan River	Cedar Lake - southeast	X		Annual
	Cormorant Lake		X	Annual
	Moose Lake	X		18/19 & 21/22
	Cedar Lake - west	X		17/18 & 20/21
	Saskatchewan River	X		16/17 & 19/20
Lake Winnipeg	Lake Winnipeg - Mossy Bay	X		Annual
	Lake Winnipeg - Site 22	X		
	Lake Winnipeg - Grand Rapids	X		Annual
	Lake Winnipeg - Sturgeon Bay	X		Annual
	Lake Winnipegosis		X	Annual
Upper Churchill River	Southern Indian Lake (Area 4)	X		Annual
	Granville Lake		X	Annual
	Southern Indian Lake (Area 1)	X		18/19 & 21/22
	Southern Indian Lake (Area 6)	X		16/17 & 19/20
	Opachuanau Lake	X		17/18 & 20/21
Lower Churchill River	Northern Indian Lake	X		Annual
	Churchill R. at Little Churchill R.	X		Annual
	Gauer Lake		X	Annual
	Partridge Breast Lake	X		18/19 & 21/22
	Billard Lake	X		16/17 & 19/20
	Fidler Lake	X		17/18 & 20/21
	Churchill R. at Churchill Weir	X		17/18 & 20/21
Churchill River Diversion	Threepoint Lake	X		Annual
	Leftrook Lake		X	Annual
	Notigi Lake	X		18/19 & 21/22
	Rat Lake	X		16/17 & 19/20
	West/Central Mynarski Lake	X		17/18 & 20/21
	Apussigamasi Lake	X		18/19 & 21/22
	Wuskwatim	X		
	Footprint Lake	X		16/17 & 19/20
Upper Nelson River	Cross Lake - West basin	X		Annual
	Setting Lake		X	Annual
	Playgreen Lake	X		18/19 & 21/22
	Little Playgreen	X		16/17 & 19/20
	Walker Lake		X	16/17 & 19/20
	Sipiwesk Lake	X		17/18 & 20/21
	Nelson River: d/s Sipiwesk Lake to Kelsey GS	X		17/18 & 20/21
	2-Mile Channel	X		
	Warren Landing	X		
Lower Nelson River	Split Lake	X		Annual
	Assean Lake		X	Annual
	Nelson R. Mainstem - d/s Limestone GS	X		Annual
	Hayes River		X	Annual
	Stephens Lake - north arm	X		18/19 & 21/22
	Stephens Lake - south	X		18/19 & 21/22
	Limestone Reservoir	X		16/17 & 19/20
	Burntwood River - First Rapids to Split Lake	X		17/18 & 20/21

Water Quality	Benthic Invertebrate	Hg in Fish	Sediment Quality	Phytoplankton	Sedimentation
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
Annual	Annual		17/18 & 23/24		
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
16/17 & 19/20	16/17 & 19/20				
17/18 & 20/21	17/18 & 20/21				
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
18/19 & 21/22	18/19 & 21/22				
17/18 & 20/21	17/18 & 20/21				
16/17 & 19/20	16/17 & 19/20				
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
Annual					
Annual (site W2)	Annual		17/18 & 23/24		
Annual	Annual		17/18 & 23/24		
Annual	Annual	16/17 & 19/20	17/18 & 23/24		Continuous (Missi)
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
18/19 & 21/22	18/19 & 21/22				
16/17 & 19/20	16/17 & 19/20	16/17 & 19/20			
17/18 & 20/21	17/18 & 20/21				
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
18/19 & 21/22	18/19 & 21/22				
16/17 & 19/20	16/17 & 19/20				
17/18 & 20/21	17/18 & 20/21				
17/18 & 20/21	17/18 & 20/21	17/18 & 20/21			
Annual	Annual	Annual	17/18 & 23/24		
Annual	Annual	Annual	17/18 & 23/24		
18/19 & 21/22	18/19 & 21/22				
16/17 & 19/20	16/17 & 19/20	16/17 & 19/20			
17/18 & 20/21	17/18 & 20/21				
18/19 & 21/22	18/19 & 21/22				
					Continuous (Wuskwatim)
16/17 & 19/20	16/17 & 19/20				
Annual	Annual	16/17 & 19/20	17/18 & 23/24	Annual	
Annual	Annual	16/17 & 19/20	17/18 & 23/24	Annual	
18/19 & 21/22	18/19 & 21/22	18/19 & 21/22			
16/17 & 19/20	16/17 & 19/20	16/17 & 19/20			Continuous (Jenpeg)
16/17 & 19/20	16/17 & 19/20				
17/18 & 20/21	17/18 & 20/21	17/18 & 20/21			
17/18 & 20/21	17/18 & 20/21				
Annual					
Annual					
Annual	Annual	16/17 & 19/20	17/18 & 23/24	Annual	
Annual	Annual	16/17 & 19/20	17/18 & 23/24	Annual	
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
Annual	Annual	16/17 & 19/20	17/18 & 23/24		
18/19 & 21/22	18/19 & 21/22				
18/19 & 21/22	18/19 & 21/22	18/19 & 21/22			
16/17 & 19/20	16/17 & 19/20	16/17 & 19/20			Continuous (Limestone)
Annual	17/18 & 20/21				

Sampling conducted by Manitoba Hydro, MSD - Water Quality Section, MSD - Fisheries Branch, and Consultants

CAMP

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