



Keeyask Generation Project Socio-Economic Monitoring Plan

Socio-Economic Monitoring Report

SEMP-2022-01



KEEYASK GENERATION PROJECT

SOCIO-ECONOMIC MONITORING PLAN

REPORT #SEMP-2022-01

SOCIO-ECONOMIC MONITORING REPORT

APRIL 2021 TO MARCH 2022:

YEAR EIGHT CONSTRUCTION

Prepared by
Manitoba Hydro

2022

This report should be cited as follows:

Manitoba Hydro. *2022 Keeyask Generation Project Socio-Economic Monitoring Plan. # SEMP-2022-01. Socio-Economic Monitoring Report April 2021 to March 2022: Year 7 Construction, June 2022.*

SUMMARY

The Keeyask Generation Project (“the Project” or “KGP” or “Keeyask”) Environmental Impact Statement (EIS), completed in June 2012, provides a description of the existing environment, summary of predicted effects and planned mitigation for the Project. Technical supporting information for the socio-economic environment, including a description of the existing environment, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the Socio-Economic Environment, Resource Use and Heritage Resources Supporting Volume.

The environmental assessment for the KGP used both technical science and Aboriginal Traditional Knowledge (ATK). Mitigation measures were carefully planned and designed to prevent or reduce (to the extent practical), adverse effects from the Project. However, there were uncertainties associated with predicted effects and the effectiveness of planned mitigation measures. To address these uncertainties, many of the predictions and mitigation measures identified in the KGP EIS are supported by monitoring to enable testing of the predictions and timely response when actual results differ from the predictions.

The KGP Socio-economic Monitoring Plan (SEMP) is a commitment made by the Keeyask Hydropower Limited Partnership (KHLP) in Chapter 8 of the KGP EIS. The SEMP is intended to monitor changes over time for certain socio-economic Valued Environmental Components (VECs). The SEMP focuses on key pathways of effect to, and components of, the socio-economic environment, including:

- Economy;
- Population, Infrastructure and Services; and
- Personal, Family and Community Life.

This report focuses on SEMP monitoring activities for the Project to March 31, 2021. Key learnings of the SEMP Program over the 2021/22 period and next steps are presented below by monitoring topic area.

EMPLOYMENT AND TRAINING:

- The KGP EIS predicted employment levels for the partner First Nations’ members both at peak of construction and for the entire construction period. While a full comparison of person year outcomes cannot be made until the end of construction, total person years of employment to date are exceeding the range of what was predicted for the entire Project.
- Since the start of KGP construction to the end of March 2022, there were 27,148 hires on the Project. Total Manitoba hires represented 18,444 hires. Of this, 7,559 hires represented northern Manitoba (Indigenous and non-Indigenous) hires or 41% of total Manitoba hires.

- Since the start of KGP construction to the end of March 2022, the Project generated 16,986-person years of employment based on a 2000-hour person year. Of this, 10,588 represented Manitoba person years, and 3,782 represented total northern Manitoba (Indigenous and non-Indigenous) person years (36% of total Manitoba person years).
- Since the start of KGP construction to the end of March 2022, the cumulative turnover rate for the Project was 31% of total hires, 41% of Indigenous hires and 25% of non-Indigenous hires.
- Over the reporting period the Advisory Group on Employment (AGE) continued as a forum for addressing employment-related issues, in particular partner First Nation employment, related to the construction of the Keeyask Generation Project. As the project continues to ramp down, the AGE focused on maximizing Partner employment numbers and ensuring individuals in the On the Job Training (OJT) programs progress through their training.
- As of March 31, 2022, 1,880 Indigenous employees had training opportunities on the Project. 606 (32%) of these were filled by partner First Nation members.

BUSINESS OPPORTUNITIES:

- The KGP EIS predicted that Project construction would present direct and indirect business opportunities locally, regionally and across the province as a whole.
- Cumulatively, \$5,480.97 million has been spent on goods and services for the KGP. Of this, \$1,371.82 million were Manitoba purchases. Total northern Manitoba (Indigenous and non-Indigenous) purchases represent \$844.8 million or 64% of total Manitoba purchases.
- As of the end of March 2022, 28 KGP Direct Negotiated Contracts (DNCs), ranging from camp services to heavy construction, have been awarded to partner First Nations' businesses with a total value exceeding \$785 million. In addition, there have been four DNCs awarded for the Keeyask Transmission Project with a total value exceeding \$88 million. Partner First Nation businesses have also received contract work on the Keeyask Project through subcontract agreements; in total 5 subcontracts for a combined value exceeding \$24.5 million.

INCOME:

- Since the start of KGP construction to the end of March 2022, total labour income earned as a result of the KGP was approximately \$1,865.15 million. Of this, Manitoba labour income represented \$1,022.9 million.

KEEYASK WORKPLACE ENVIRONMENT

- Manitoba Hydro and the partner First Nations are continuing to work together at many levels to develop strategies to drive a positive and safe work environment at the Project site. Manitoba Hydro and the partner First Nations continue to collectively navigate through COVID-19 with regular dialogue on safety measures established at site and in the communities. A number of protocols were developed with guidance from Manitoba Public

Health to minimize the introduction of the COVID-19 virus at site and prevent transmission between site and the local communities.

CULTURE AND SPIRITUALITY:

- During this reporting period there were seven ceremonies held, as well as prayers and blessings to acknowledge each unit in service. A special ceremony was held for the final unit in service. Forty Indigenous awareness training workshops were held over this same period. Counseling services were available to employees on site on a voluntary basis. These efforts will continue throughout the remainder of construction.

WORKER INTERACTION:

- A Worker Interaction Subcommittee (under the Harmonized Gillam Development Committee) was established by Manitoba Hydro prior to the beginning of Keeyask construction as part of a corporate-wide initiative to address anticipated increases in the Gillam area workforce associated with several projects and activities.
- The Worker Interaction Subcommittee was suspended as a result of the wind down of large projects in the Gillam area and a focus on managing the spread of COVID-19 into and within Gillam and partner First Nation communities. Local efforts continued under the Harmonized Gillam Development process to address priority areas of focus such as the promotion of cultural awareness initiatives and wellness supports, and delivery of Gillam-FLCN community-based activities.

POPULATION:

- The changes in total population observed in 2021 for the partner First Nations and 2020 for Gillam are consistent with trends observed over time in each of the communities. The slight increases and decreases in population across the communities do not suggest a significant pattern of construction related in- or out-migration.

MERCURY AND HUMAN HEALTH:

- The KHLP prepared a Mercury and Human Health Risk Management Plan in consultation with provincial and federal regulators. This reporting period's key activities included: a review of 2021 fish monitoring results in comparison with fish mercury concentrations predicted for post-impoundment conditions; refinements to post-impoundment communication and associated materials; and community-based initiatives that support the goals of the risk management plan. There are ongoing efforts to have a 'Mercury Community Coordinator' role in each partner First Nation to implement mercury and human health program activities.

TRANSPORTATION INFRASTRUCTURE:

- While the KGP EIS predicted that existing transportation networks and plans for Provincial Road (PR) 280 upgrades would be able to accommodate the changes in road use associated

with Project construction, community concerns arose during construction regarding traffic safety and road conditions.

- In the period between April 2021 and March 2022, the PR 280 Joint Advisory Committee did not meet. The committee has now wrapped up activities.
- Mitigation measures have been adopted to reduce the impact of Project traffic on PR 280 including road reconstruction, increased maintenance efforts as well as operation of the Provincial Trunk Highway (PTH) 6 weigh station near Thompson.
- The segment of PR 280 with the highest traffic volumes is located between PR 391 and Split Lake. At this segment, from April 2021 to March 2022, the average traffic counts (northbound and southbound combined) were 227 vehicles per day. Of the 227 vehicles per day, 24 were large trucks.
- Collision rates along PR 280 and PR 290 have remained below the industry standard threshold of 1.50 MVKT. Spot grade improvements, localized design considerations, and other road safety improvements are being implemented to address ongoing concerns and to improve the driving experience for all road users.
- The Keeyask North Access Road connects PR 280 to the construction site. On average, 28 vehicles per day used the road between April 2021 and March 2022.
- The Keeyask South Access Road connects Gillam to the Keeyask construction site. On average, 23 vehicles per day used the road between April 2021 and March 2022. Data is reflective of all traffic types including daily construction activities such as hauling.
- Over the past year, traffic monitoring data indicate that Keeyask related construction traffic varied month to month accounting for between 15% to 52% of all traffic on PR 280 near the PR 280/Keeyask North Access Road intersection; with only three of those months greater than 40%.
- This will be the final submission of this section as funding from Manitoba Hydro to Manitoba Infrastructure for mitigation activities is now complete.

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1.0 INTRODUCTION

Manitoba Hydro, on behalf of the KHLP, received regulatory approval to commence construction of the KGP in July 2014.

The KGP follows the Keeyask Infrastructure Project (KIP), which included a start-up camp and associated infrastructure, a 25 kilometre (km) all weather North Access Road, and the first phase of the KGP main camp.

The KGP SEMP is intended to monitor changes over time for certain VECs. The SEMP focuses on key pathways of effect to, and components of, the socio-economic environment including:

- Economy;
- Population, Infrastructure and Services; and
- Personal, Family and Community Life.

The SEMP is part of an integrated and coordinated Environmental Protection Program that has been developed to facilitate an effective transition from planning and assessment to construction and operation of the KGP.

This report focuses on monitoring for the Project from the start of construction to March 31, 2022.

2.0 OVERVIEW OF PROJECT

The Keeyask Generation Project is a 695 megawatt (MW) hydroelectric generating station located approximately 180 km northeast of Thompson and 40 km southwest of Gillam at Gull Rapids on the lower Nelson River. The Project consists of four principal structures: a powerhouse complex, spillway, dams, and dykes. In 2020, a reservoir was created upstream of the principal structures. Supporting infrastructure consists of temporary facilities required to construct the principal structures and permanent facilities required to construct and operate the Project. Temporary infrastructure consists of work areas, cofferdams, rock groins, and an ice boom. Permanent supporting infrastructure consists of North and South Access Roads, a transmission tower spur, communications tower, some borrow areas, excavated-material placement areas, boat launches, and a portage to enable river traffic to bypass the dam.

3.0 OVERALL OBJECTIVES AND APPROACH

The KGP EIS identified primary effects to the socio-economic VECs and defined the process, scope, methods, documentation and application of the socio-economic monitoring for the Project. Overall, the intent of Manitoba Hydro and the partner First Nations has been to reduce adverse effects of the Project and to enhance project benefits to the extent feasible and practical. Monitoring information is intended to assist in this management task. The SEMP for the Project is intended to monitor changes over time for certain VECs to, where applicable:

- Test predicted effects in the EIS;
- Identify unanticipated effects related to the Project;
- Monitor the effectiveness of mitigation measures;
- Determine if adaptive management is required; and
- Confirm compliance with regulatory requirements, including terms and conditions in Project approvals.

The SEMP focuses on key pathways of effect to, and components of, the socio-economic environment. The SEMP builds on the assessment studies conducted for the EIS using established methods for data collection and analysis.

4.0 OVERALL SCHEDULE

Monitoring activities associated with the SEMP are more intensive during construction of the Project, but will also occur during the operation phase:

- **Construction Phase** – SEMP monitoring during construction is related to employment and training opportunities; business opportunities; income; population changes; housing; infrastructure and services; transportation infrastructure; public safety and worker interaction; travel, access and safety; and culture and spirituality. The 2022 SEMP report concludes the ‘construction phase’ monitoring phase. Some monitoring components in the programs noted above will be reported in the SEMP’s first year of the ‘operation phase’ report. These components are outlined in the SEMP (2015).
- **Operation Phase** – SEMP monitoring during operation is more limited and related to population change in Gillam during the first five years of operation; transportation infrastructure/travel safety at Split Lake; and mercury and human health.

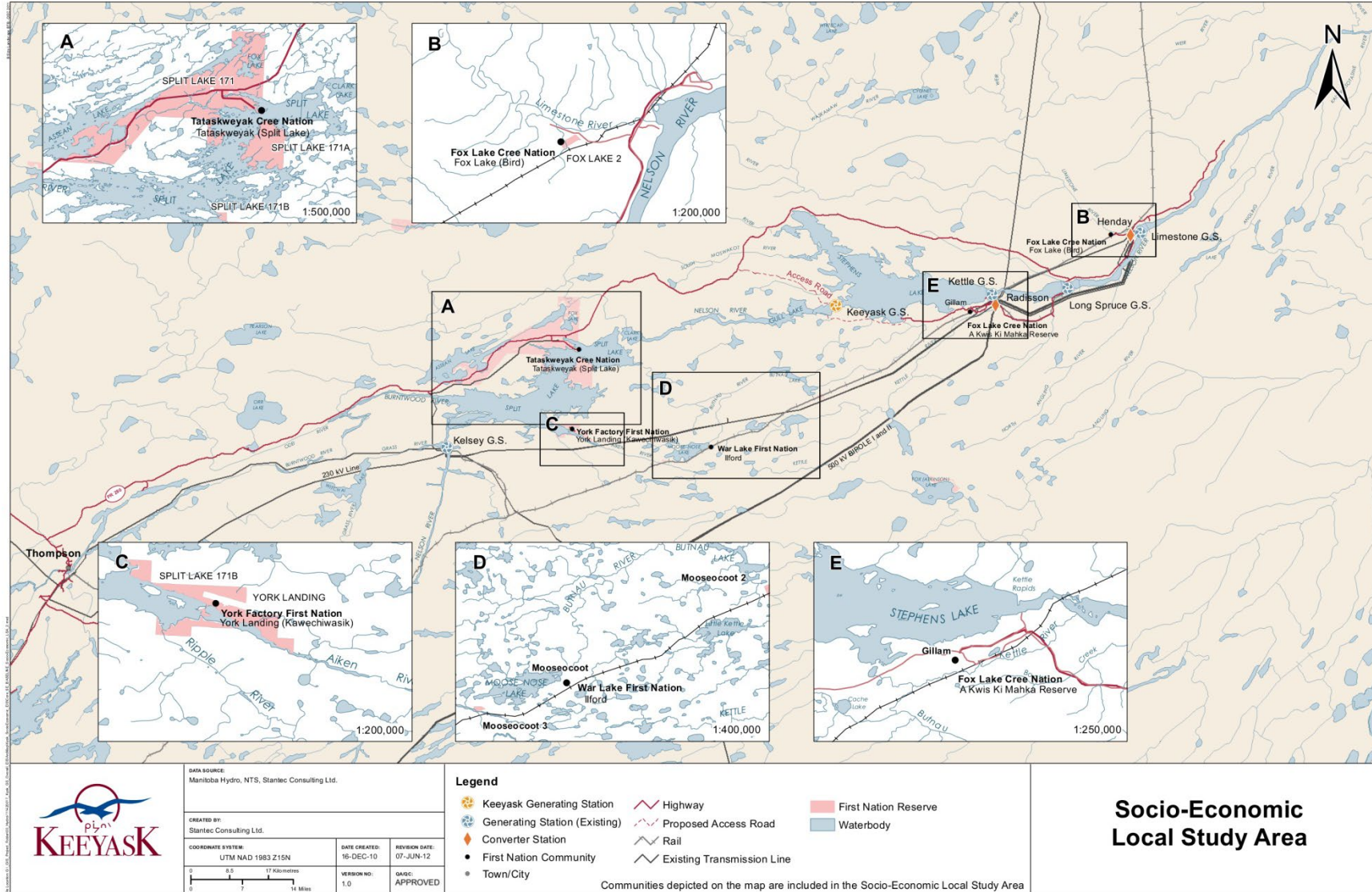
5.0 STUDY AREA

The Socio-Economic Local Study Area for the SEMP (see Map 1) incorporates the Project site and includes the partner First Nations' communities of Tataskweyak Cree Nation (TCN) at Split Lake, War Lake First Nation (WLFN) at Ilford, York Factory First Nation (YFFN) at York Landing and FLCN at Fox Lake/Gillam. The partner First Nations may be affected by the Project through the following pathways of effect:

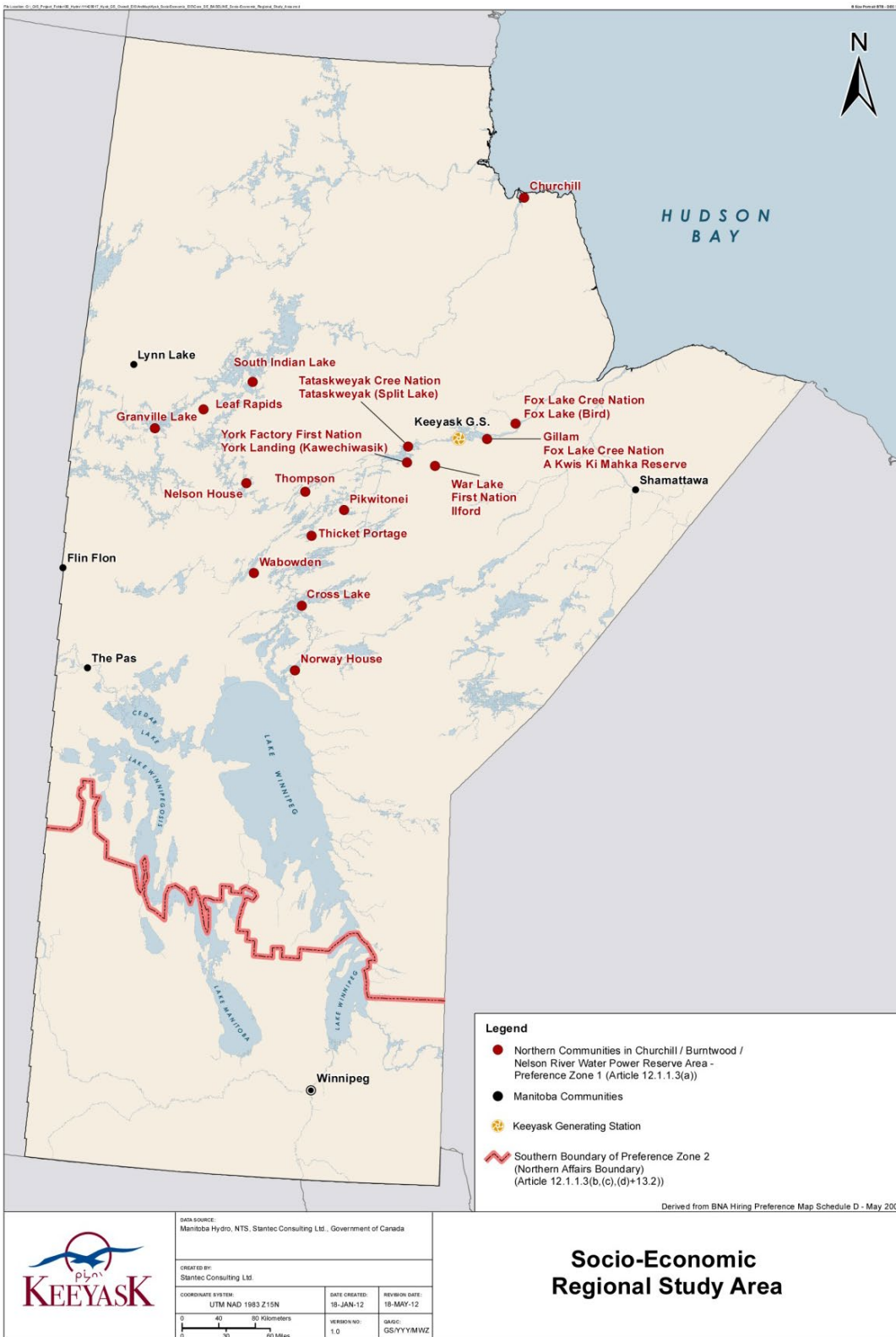
- Physical/biophysical changes to the way the landscape looks;
- Physical/biophysical effects on resource use/traditional use areas and heritage resources;
- Employment and business opportunities;
- Construction traffic;
- Interaction with non-local construction workers within the partner First Nations' home communities; and
- Investment income.

In addition to the partner First Nations' communities, the Town of Gillam and the City of Thompson are included in the Socio-Economic Local Study Area because of their proximity to the Project.

Certain project effects, in particular preferential hiring of northern Indigenous and other northern workers for construction employment, will extend beyond the Socio-Economic Local Study Area to all of northern Manitoba. For this reason, the Socio-Economic Regional Study Area has been defined as the area pertaining to northern hiring preference and using the boundary identified under Schedule D of the Burntwood Nelson Agreement (BNA) (see Map 2). This includes the Churchill-Burntwood-Nelson (CBN) communities identified in the BNA as part of hiring preference Zone 1.



Map 1: Socio-Economic Local Study Area



Map 2: Socio-Economic Regional Study Area

6.0 ECONOMIC MONITORING

Economic monitoring includes monitoring of all employment, training, business and income outcomes associated with the Project. Monitoring is conducted using a consistent methodology that Manitoba Hydro has used for other major capital projects.

All information regarding economic monitoring is provided from the start of generating station project activities (2014) to the end of March 2022.

Economic impacts can be direct, indirect or induced. Direct impacts result from project expenditures and include employment, purchases, and income generated by the Project. Indirect impacts refer to the employment, purchases and income created in other industries as the effects of project expenditures work their way through the economy. For example, there are indirect impacts on businesses supplying materials and equipment to companies in the direct impact segment. Induced impacts are created by the spending of additional income and profits earned by workers and company owners associated with the Project directly or indirectly. This includes additional spending on food, housing, entertainment, transportation, and all of the other expenses that make up a typical household budget. Adding up the direct, indirect and induced impacts, results in the total economic impact of the Project.

6.1 EMPLOYMENT AND TRAINING

The Project EIS analyzed and provided employment estimates for partner First Nations, the Indigenous workforce in the CBN area and the Indigenous workforce in the Socio-Economic Study Area as a whole (see SE SV Section 3.4.1) for the construction phase of the Project. The EIS also predicted that there would be northern participation in the operating jobs required to operate the facility.

Monitoring of employment and training is being undertaken, to determine the overall employment outcomes of the Project construction, with particular emphasis on Indigenous and northern resident participation. Monitoring is also intended to determine the extent to which recipients of Hydro Northern Training and Employment Initiative (HNTEI) pre-project training (PPT) participated in Keeyask construction jobs and received on-the-job training. It was estimated that the levels of participation would be influenced by several factors, including timing of the opportunities and the level of interest by potential workers in pursuing those opportunities.

Monitoring of employment outcomes provides data on overall success in attracting and retaining partner First Nations' members, Indigenous persons and Manitobans during Project construction.

As noted within the SEMP, the Project has an established AGE that is a forum to address employment-related issues related to the construction of the Project, and in particular Indigenous employment. The AGE is established to receive, review and find solutions to concerns and issues

and to monitor, report and make recommendations to the Project manager on employment-related matters, as required.

During construction, employment data is collected on site by contractors through an employee self-declaration form designed specifically for the Project. All completed forms are provided by on-site contractors to Manitoba Hydro and stored in a central database for the Project. Contractors also provide information to Manitoba Hydro on hours worked and labour income to enable calculations for person years and income during construction. Employment data is provided in the formats outlined below:

- Person years – When part-time and/or seasonal workers are used, it is useful to standardize the hires in terms of person years of employment. Person years of employment are defined as the amount of work that one worker could complete during twelve months of full-time employment. This usually means about 2,000 hours of work per year using a standard 40-hour work week in most industries; whereas for Keeyask construction work, a person year of employment represents 3,000 hours of work per year. The person years of employment presented below are shown both at 2,000 hours of work per year, for economic comparisons to other industries, as well as at 3,000 hours (identified in parentheses) of work per year.
- Hires – Refers to the number of times people were hired on the Project site for any duration.
- Employees – Refers to the number of individuals hired. The variance between Hires and Employees can be attributed to an individual being hired to the Project more than once.
- Type (job classifications) of work available.

Training data is collected by Manitoba Hydro through established methods utilizing contractor on-the-job reporting, and the completion of an employee self-declaration form. HNTEI PPTs are tracked by comparing self-declared Employee Report information to the Manitoba Hydro HNTEI database.

6.1.1 PERSON YEARS OF EMPLOYMENT

From the start of construction to March 31, 2022, direct employment on the Project totaled 16,986 (11,324) person-years. As shown below, 62%, or 10,588 (7,059) of these person-years, represent people already living in Manitoba.

Of the 62% of employees who are Manitobans:

- Northern Manitobans represent 36%, or 3,782 (2,521) person years;
- Other Manitobans represent 64%, or 6,806 (4,537) person years;
- Indigenous employment represents 48%, or 5,089 (3,393) person years; and
- Non-Indigenous employment represents 52%, or 5,498 (3,666) person years.

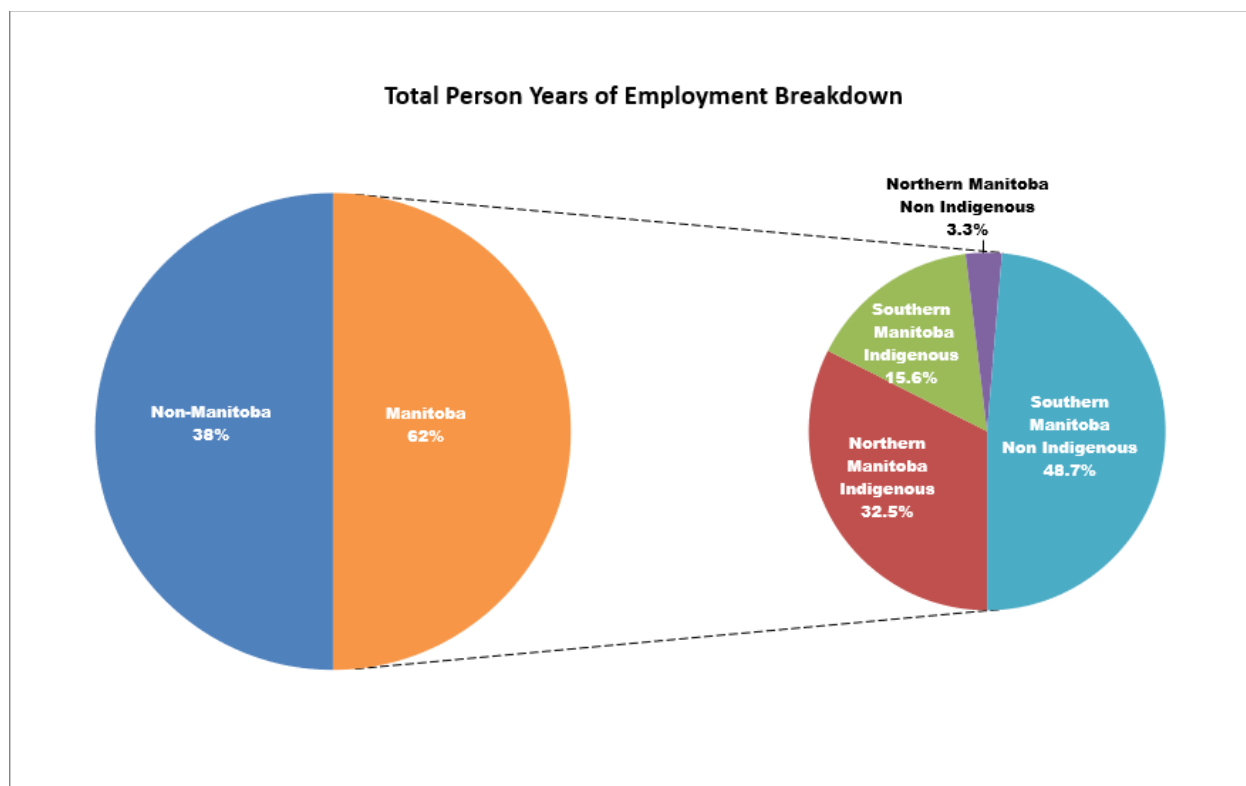


Figure 1: Person Years of Employment (Start of Construction to end of March 2022)

6.1.2 HIRES

From the start of construction to March 31, 2022, there were 27,148 hires on the work site. Of the total hires, 18,444 or approximately 68% were Manitobans:

- Total northern Manitoban hires represent 41% (7,559) of Manitoba hires;
- Indigenous hires represent 53% (9,765) of Manitoba hires; and
- Non-Indigenous hires represent approximately 47% (8,679) of Manitoba hires.

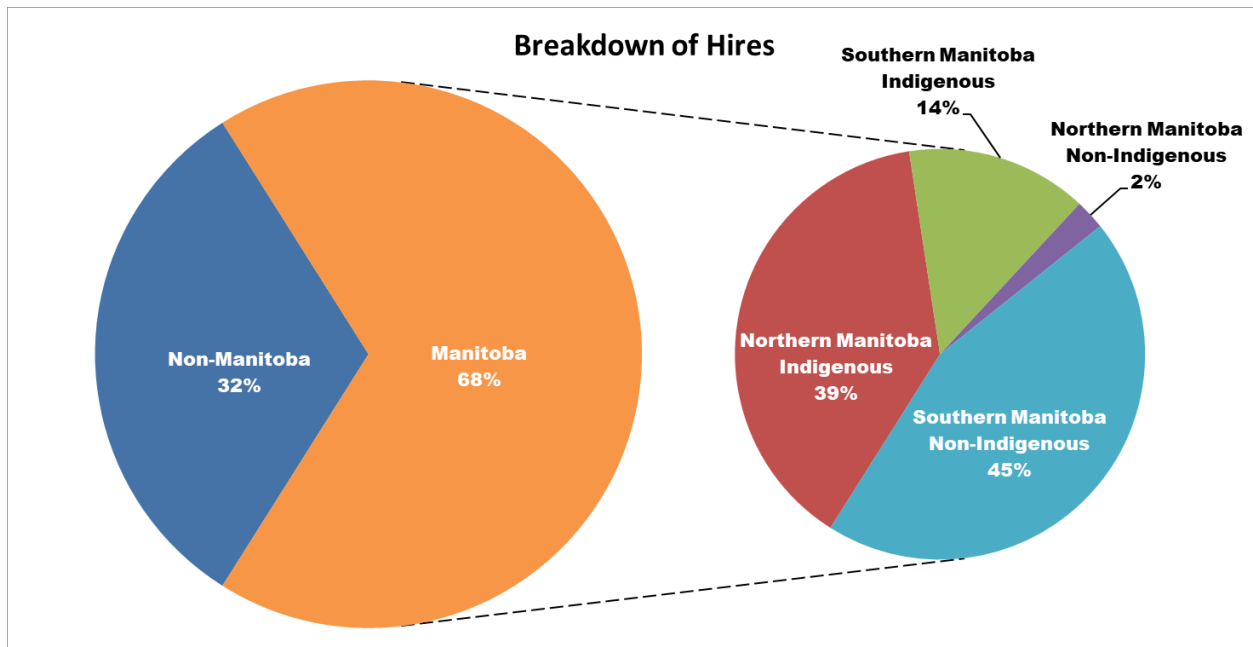


Figure 2: Number of Hires (Start of Construction to end of March 2022)

6.1.3 INDIVIDUAL EMPLOYEES

From the start of construction to March 31, 2022, a total of 11,086 individual employees were hired on the KGP. Of this, 58% (6,436 individual employee hires) were Manitobans:

- Total northern Manitoban employees represent 38% (2,466) of Manitoba hires;
- Indigenous employees represent 50% (3,229) of Manitoba employees; and
- Non-Indigenous employees represent approximately 50% (3,207) of Manitoba employees.

The total number of employees is less than the total number of hires (27,148) because the same individual may have been hired more than once. For example, an individual may have moved to work on a different contract or moved to a different job classification to improve their position. The difference of 16,062 identifies the number of re-hires at the Project site.

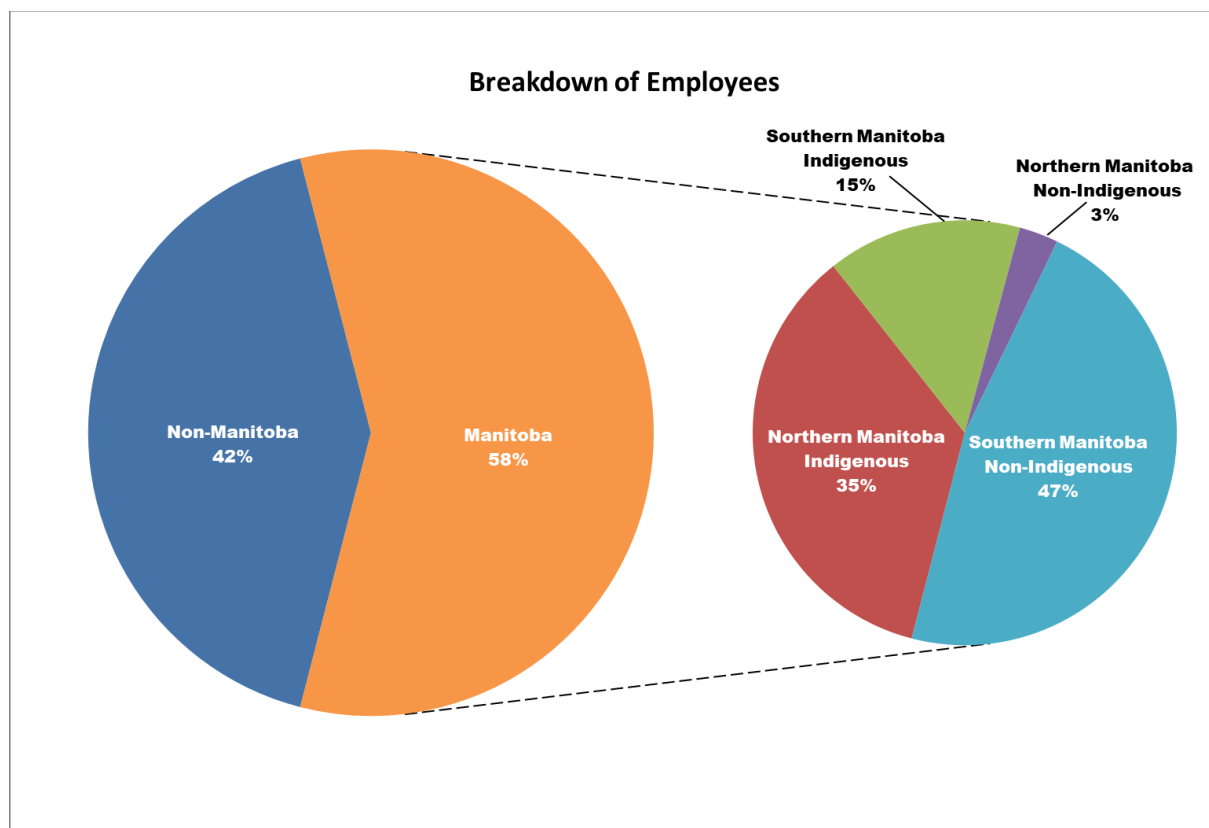


Figure 3: Total Individual Employees (Start of Construction to end of March 2022)

The number of individual employees to date does not reflect the number of employees on site at a given time. The number of employees on site at any given time varies depending on the work in progress and the time of year. The number of employees on site is usually highest during the period from late spring through early fall, which is typically the period with the highest level of construction activity and the largest workforce on site. The actual number of employees on site over the course of the year ultimately depends upon the work plans and schedules of the contractors for the various Project components, in conjunction with the provisions of the BNA, which is the collective bargaining agreement for the Project.

6.1.4 EMPLOYMENT IN THE PARTNER FIRST NATIONS

Construction of the KGP has resulted in the establishment of full- and part-time positions in each of the partner First Nations. While these positions have experienced temporary vacancies at times, overall the number of positions filled during the last reporting period (April 2021 to March 2022) included:

- Eleven positions at FLCN;
- Twelve positions at TCN;

- One positions at WLFN; and
- Five positions at YFFN.

These positions were created on the basis of community specific work plans for the implementation of governance, Aboriginal Traditional Knowledge monitoring, and other commitments in the Joint Keeyask Development Agreement (JKDA). Additional term or seasonal community-based positions have also been filled annually to help with technical science, ATK monitoring activities on the land and safe navigation, as required.

In addition, the partner First Nations also have a total of five positions available for members associated with the Job Referral Service (i.e., Job Seeker Manager staff) who work within their respective communities to assist community members in accessing Keeyask employment opportunities. As well, each partner First Nation has one Keeyask Site Representative whose employment is reported within the construction employment statistics because they work a portion of their time in the community and at the Project site.

6.1.5 TYPE OF WORK (JOB CLASSIFICATION) AVAILABLE

The total cumulative hires by job classification (to the end of March 2022) are provided in the table below. For employee privacy and confidentiality reasons, the numbers of hires by community cannot be disclosed, as the numbers are low for some of the classifications listed.

Table 1: Total Hires by Job Classification (Start of Construction to March 2021)

Job Classification	Total Hires	% of Total Hires	CBN	Indigenous	Non-Indigenous	Northern MB	Other MB	Non-MB
Labourers	3878	14%	1140	2101	1777	1605	1550	723
Security Guards	291	1%	27	105	186	72	219	<5
Crane Operators	446	2%	9	60	386	19	287	140
Equipment Operators	2237	8%	303	699	1538	478	829	930
Teamsters	2059	8%	480	994	1065	720	860	479
Carpenters	3953	15%	143	849	3104	368	917	2668
Millwrights	314	1%	10	57	257	21	217	76
Painters	114	<1%	<5	22	92	<5	58	55
Glass Workers	<5	<1%	<5	<5	<5	<5	<5	<5
Floor Covering Installers	13	<1%	<5	<5	12	<5	12	<5
Insulator Workers	135	<1%	<5	27	108	<5	113	20
Lathing and Drywall Workers	46	<1%	<5	8	38	<5	18	27
Plasterers	<5	<1%	<5	<5	<5	<5	<5	<5
Cement Masons	567	2%	<5	59	508	6	222	339
Bricklayers	38	1%	<5	<5	36	<5	38	<5
Sheet Metal Workers	47	<1%	<5	10	37	<5	43	<5
Roofers	81	<1%	13	19	62	18	59	<5
Sheeters, Deckers and Cladders	135	<1%	<5	36	99	<5	89	43
Boilermakers	83	<1%	<5	9	74	<5	74	9
Iron Workers	1228	5%	30	325	903	74	545	609
Rodmen	352	1%	<5	59	293	<5	59	290
Electrical Workers	1342	5%	77	266	1076	154	1125	63
Plumbers and Pipefitters	569	2%	26	126	443	54	417	98
Refrigeration Workers	44	<1%	<5	20	24	8	24	12
Sprinkler System Installers	40	<1%	<5	8	32	<5	32	8
Office and Professional Employees	2292	8%	257	812	1480	523	1357	412
Caterers	3060	11%	1895	2956	104	2863	137	60
Elevator Constructors	9	<1%	<5	<5	9	<5	9	<5
Other*	3772	14%	460	787	2985	565	1573	1634
Total Hires	27148	100%	4878	10417	16731	7559	10885	8704

*The "Other" category refers to hires in job classifications not covered by the BNA, i.e. "out of scope" positions. This would include managerial and supervisory staff (both Contractor and Manitoba Hydro), other Manitoba Hydro on-site staff and certain technical staff (engineers and technicians).

6.1.6 RATES OF TURNOVER

The cumulative rate of turnover is calculated as total incidents of separation, for discharges and resignations, divided by hires¹ from the start of construction to a given point in time. The cumulative rate of turnover does not include layoffs or transfers to other positions or contracts.

From the start of construction to March 31, 2022, the cumulative turnover rate for the Project is 31% for total hires, 41% for Indigenous hires and 25% for non-Indigenous hires.

¹ Hires for calculating turnover has been modified to exclude Contract 016125 (Emergency Medical Services), Contract 16180 (Nurse Practitioners) and all environmental monitoring contracts as hiring and work scheduling practices for these contracts can misrepresent the true turnover rate.

Table 2: Turnover

	Total Discharges	Total Resignations	Total Separations	Rate of Turnover
CBN	239	1915	2154	49%
Indigenous	437	3510	3947	41%
Non-Indigenous	406	3294	3700	25%
Northern Manitoba Indigenous	301	2719	3020	46%
Northern Manitoba Non-Indigenous	19	122	141	32%
Manitoba	646	4847	5493	34%
Non-Manitoba	197	1957	2154	25%

Note: Figures above are not additive

There have been instances where individuals have been discharged or resigned, but later returned to work on the Project. This occurred 3,191 times, approximately 42% of the total discharges and resignations.

It is also useful to look at the amount of turnover within certain time periods throughout the life of the Project. When looking at a specific period within the life of the Project, turnover is expressed as total incidents of separation (for discharges and resignations), divided by hires working on site within that specific time period. Since the start of construction, and as shown in Figure 4 below, the amount of turnover within a given quarter has ranged from 3.3% to 16.3%. Of this, turnover among Indigenous employees has ranged from 2.9% to 23.0% and among non-Indigenous employees from 2.5% to 12.5%. While there has been variation in the amount of turnover across each quarter, overall, the amount of turnover for the workforce in Q1, 2022 is lower than in Q3, 2014. Among Indigenous workers, the amount of turnover is lower than the Q1 turnover in previous years.

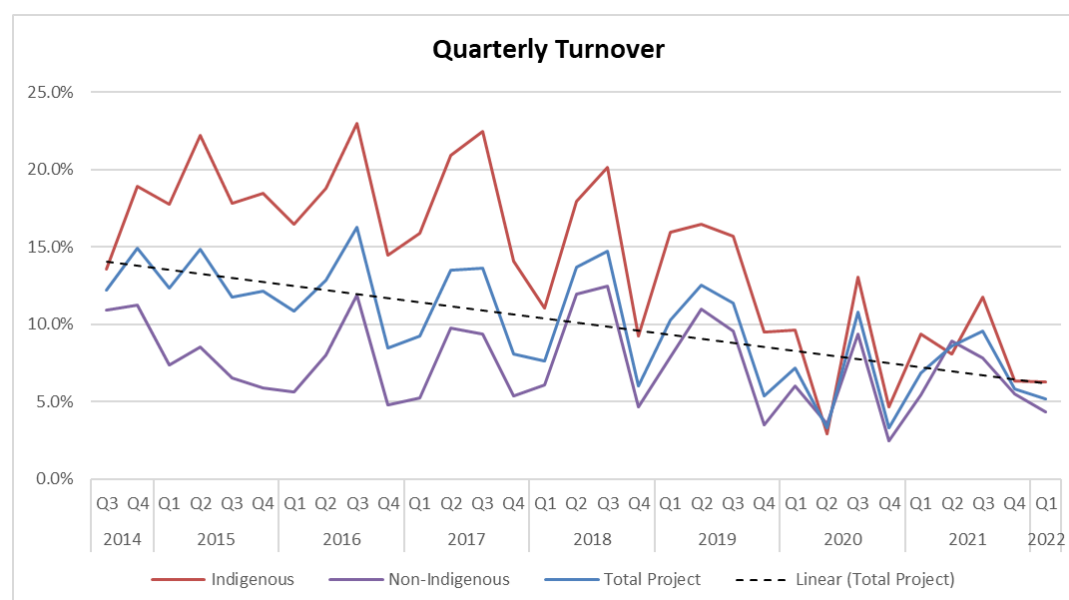


Figure 4: Quarterly Turnover (Start of Construction to end of March 2022)

6.1.7 EMPLOYMENT MITIGATION

6.1.7.1 THE ADVISORY GROUP ON EMPLOYMENT

The AGE is a forum for addressing employment-related issues, in particular Indigenous employment, related to the construction of the Project. The committee includes representatives from the Province of Manitoba, contractors, Manitoba Hydro, Hydro Projects Management Association, Allied Hydro Council and the partner First Nations.

Since the start of KGS construction, an emphasis has been placed on reaching skilled Indigenous workers in the partner First Nations, reducing the obstacles for northern Indigenous workers to enter apprenticeships and to fill open on-the-job training opportunities. The goal is to maximize the partner First Nations' employment numbers during the construction season and to have more Indigenous workers trained for future job opportunities beyond Keeyask. The AGE committee has created a collaborative environment for interaction, fact finding, and developing solutions to issues that are raised.

Job Seeker Managers (JSMs) are based in each of the four partner First Nations and are supported by the Province of Manitoba, Thompson Job Referral Service (JRS) team and Manitoba Hydro. Each JSM is responsible for developing an annual community employment plan. Each plan is unique to the community, but all plans have common goals including improving the ability for employers to make contact with members and ensuring that members' Job Seeker profiles are up to date. In addition, partner First Nations' Keeyask Site Representatives support the JSMs, and help contact community members referred for jobs or for open training opportunities.

The JSMs and Province, with support from Manitoba Hydro, continue to work on what the AGE committee has identified as a key factor to increasing the partner First Nations' workforce on the Project: reducing the number of job seekers who cannot be contacted. Several strategies are being used to ensure registration contact information is up to date such as: career counseling, community-based employment sessions, and assistance with updating candidate profiles. Additional methods of contacting candidates have been used including: emails; phone calls during weekends, holidays and the time preferred by job seekers; Facebook postings; and cellular text messages.

The Province of Manitoba, with community JSMs, continue to deliver career counseling through the Keeyask Employment Project (KEP) Referral List. The KEP Referral List identifies an individual's current trade and level as well as preferred trade(s) or area of interest and is used by contractors following the direct hire provisions under Letter of Agreement (LOA) 44² for on-the-job training opportunities.

² LOA 44, signed in 2016 as an amendment to the BNA, provides measures to remove barriers to the employment and retention of Indigenous apprentices and trainees.

The Keeyask Workplace Essential Skills Training (KWEST) Centre continued to operate on site until October 2nd, 2020. Since then the service has continued through a virtual platform. The goal of KWEST is to provide new and existing workers access to skill development support to enhance their capacity to participate in on-the-job training, to carry out workplace tasks effectively and efficiently, and to prepare for advanced training and employment opportunities. Essential skills assessment, administered by Workplace Education Manitoba, established the candidate's development plan for the trade they were in or were interested in pursuing. The tool allowed the trainer and student to address skill gaps through tutorials and small group sessions which are provided at the KWEST Centre. Contactors also used the service to deliver targeted training in support of skill development program for their workforce. These individuals benefited from the support and ongoing instruction offered through the Centre. Services are still available to Keeyask workers through an online platform.

6.1.8 TRAINING

On-the-job training programs were developed at site to hire individuals as trainees and apprentices and to enhance their qualifications for further career development. The programs offered during the last year were in the following areas:

- Catering, janitorial services and housekeeping
- Maintenance services
- General civil contract

From the start of construction to March 31, 2022, 1,880 Indigenous employees had participated in training opportunities on the Project (340 were in on-the-job training programs). 606 of the participants were partner First Nations' members (including 183 in on-the-job training programs). Apprenticeship opportunities were available in trade classifications such as Mechanics, Carpenters, Millwrights, Iron Workers, Plumbers & Pipefitters, Electricians, Refrigeration Workers, Water Treatment Operators, Heavy Equipment Operators, Construction Labourers, Dozer Operator, Loader and Rock Truck Drivers, Clerks, Fitness Leaders, and Red Seal Cooks.

Table 3: On-the-Job Training Programs

On-the-Job (OJT) Training Programs - by Labour Type									
Labour Type	Indigenous Hires other than KCN			KCN Hires			Indigenous & KCN GS Training Totals		
	Individuals Trained*	Training Hours^	Average Training Duration (Hours)^	Individuals Trained*	Training Hours	Average Training Duration (Hours)	Individuals Trained*	Training Hours	Average Training Duration (Hours)
Non-Designated Trades	3	2622	874	29	12918	445	32	15539	486
Designated Trades	135	273354	2025	89	186419	2095	224	459772	2053
Support & Service Trades	19	23264	1224	70	61881	884	89	85146	957
Staff & Supervisory	1	740	740	2	576	288	3	1316	439
Total GS Training^	157	299980	1911	183	261794	1431	340	561773	1652

*Total Individuals Trained is not additive; some individuals may have had training in multiple labour or contract types.

Outcomes to March 31, 2022

^Indigenous Hires other than KCN Total GS Training Hours and Total GS Training Average Duration for 2021-2022 SEMP decreased from what was reported in 2020-2021 SEMP due to formula error in 2020-2021. Corrected for 2021-2022 SEMP.

Three hundred and seventy one (371) partner First Nation members employed on the Project site were participants of the past HNTEI PPT Program. HNTEI PPT Program trainees have gained employment in craft trade positions as labourers, security guards, crane and equipment operators, teamsters, carpenters, iron workers, rodmen, electrical workers, plumbers and pipefitters, office and professional employees, caterers, cement masons, millwrights and painters. They have also gained employment in out-of-scope positions such as safety and environmental staff, employee retention and support staff and as trade supervisors. Of the 371 partner First Nation members who were past HNTEI participants, 25 remain active on the Project as of March 31, 2022.

6.1.9 KEEYASK WORKERS' OPPORTUNITY FUND

Through the generosity of Keeyask Project employees, this fund was created to provide opportunities to support education, training, and employment for members of the four partner First Nations.

Within the first six years of project construction, employees contributed \$243,203.87 to this fund by purchasing clothing at the on-site commissary. It is anticipated that additional donations will be added to the fund by Keeyask employees and site guests over the final year of construction. The funds are maintained by Manitoba Hydro in an interest-bearing account, and are dispersed during Keeyask Project construction, to a maximum of \$10,000 per year. Remaining funds will be transitioned into a legacy fund managed by the Fund Committee. once the Keeyask Project is in operation.

Since the start of construction, the Fund Committee has awarded 13 bursaries to partner First Nation members; three of these were awarded during the reporting period.

6.2 BUSINESS OPPORTUNITIES

Project construction presents direct and indirect business opportunities locally, regionally and across the province as a whole. Business outcomes of Project construction are being tracked, with a particular focus on Indigenous and northern Manitoba business participation.

Direct impacts result from Project expenditures and include employment, purchases, and income generated by the Project. Indirect impacts refer to the employment, purchases and income created in other industries as the effects of Project expenditures work their way through the economy. For example, there are indirect impacts on businesses supplying materials and equipment to companies in the direct impact segment.

6.2.1 DIRECT PROJECT EXPENDITURES

From the start of construction to March 31, 2022 there was \$5,480.97 million spent on goods and services for the Project. Of this, \$1,371.82 (25%) million were Manitoba purchases. Total northern Manitoba (Indigenous and non-Indigenous) purchases represent \$844.83 million or 64% of the total Manitoba purchases. This information reflects direct purchases of the Project for contractors and services. Indirect purchases made by contractors, in turn, would include purchases of goods and services from Manitoba based businesses. Figure 5 summarizes the breakdown of total purchases to date.

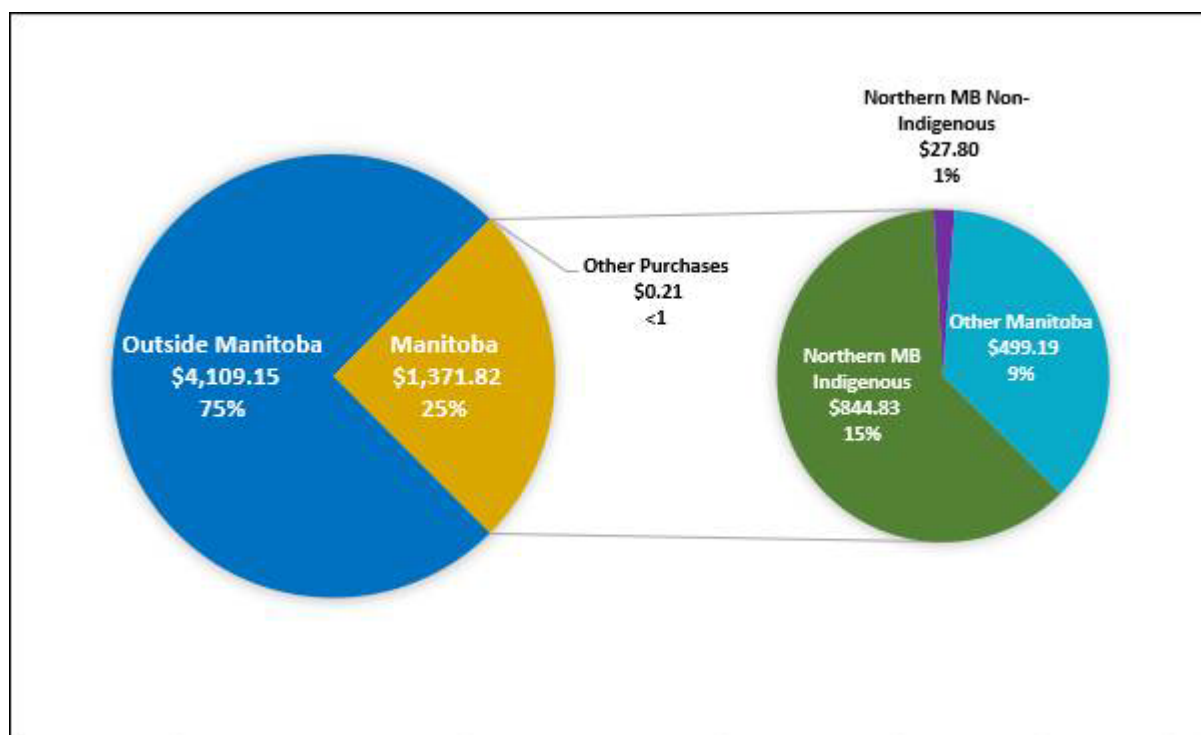


Figure 5: Direct Purchases

6.2.2 DIRECT NEGOTIATED CONTRACTS

As part of the JKDA, Manitoba Hydro and the partner First Nations committed to negotiate a series of business opportunities for the Project as DNCs with partner First Nations' businesses.

From the start of construction to March 31, 2022, 28 DNCs have been awarded to the partner First Nations, with a total value of exceeding \$785 million. Some of these DNCs were specific to the KGP, and some covered both the Keeyask Infrastructure Project and KGP. DNCs awarded to partner First Nations included work undertaken on the following components of the Project:

Services (throughout Infrastructure and Generation projects)

- Catering & janitorial services
- Security services
- Camp maintenance services
- Employee retention & support services
- Emergency medical services

Supporting Infrastructure

- PR 280
- North Access Road (Part A & B)
- Start-up camp and work areas site preparation
- Looking Back Creek bridge
- Work areas site development

Generation Station

- Southside containment dykes
- South Access Road
- Reservoir clearing
- Upstream and downstream boat launches
- Reservoir spawning shoals
- Ellis Esker Winter Trail
- Placement of North Access Road organics

In addition, there have been four DNCs awarded to TCN for the Keeyask Transmission Project with a total value exceeding \$88 million. The DNCs have been highly successful in providing significant employment opportunities for members of the partner First Nations.

Partner First Nations' businesses have also received work on the Keeyask Project through subcontract agreements: a total of 5 subcontracts for a combined value exceeding \$24.5M.

6.3 INCOME

Project construction has generated income from a number of sources including employment, business opportunities and payment of taxes. During the operation phase, the partner First Nations will receive equity income as a result of being partners in the Project.

Labour income is an important indicator of the economic impact of a project. It is the sum of wages and salaries earned by workers.

6.3.1 LABOUR INCOME³

From the start of construction to March 31, 2022, the KGP generated \$1,865.15. million in total labour income. Of this, Manitoba labour income represents \$1,022.9 million or approximately 55% of total labour income. Of total Manitoba labour income, Indigenous labour income represented approximately \$415.8 million (41%), northern Manitoba Indigenous labour income represented approximately \$248.8 million (24%), northern Manitoba non-Indigenous labour income represented approximately \$40.1 million (4%), and Manitoba non-Indigenous labour income represented \$607.1 million (59%). Partner First Nations' labour income represented approximately \$146.4 million (14% of total Manitoba labour income).

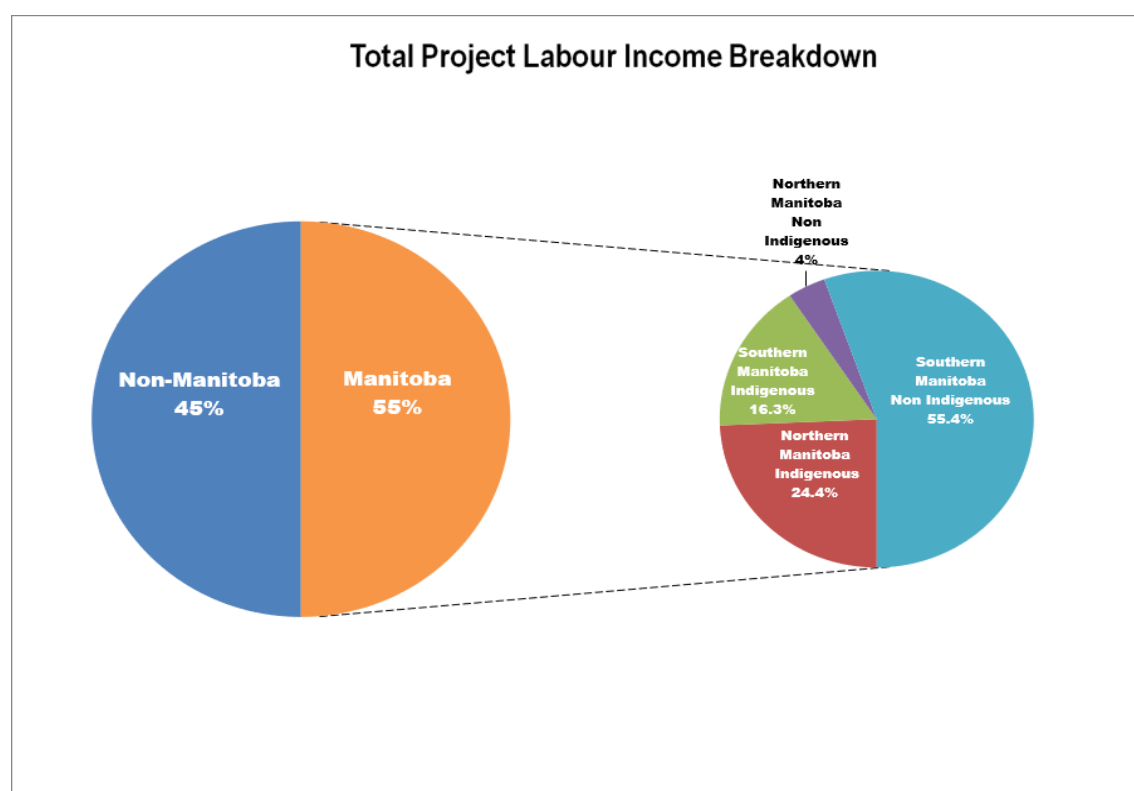


Figure 6: Labour Income

³ Labour income is calculated based on information provided by contractors and Manitoba Hydro.

7.0 SOCIAL MONITORING

7.1 KEEYASK WORKPLACE CULTURE

As predicted in the KGP EIS, construction of the Project has required a large temporary workforce comprised of both local and non-local workers. The Keeyask workforce includes individuals from other parts of Manitoba, Canada and other countries, with diverse cultures, perspectives and experiences. The KHLPP is committed to creating a respectful workplace culture for all employees at the Project site. A Harassment and Discrimination Free Standard has been implemented at the Project site. The Standard describes a strong vision for a workplace free from discrimination and harassment and emphasizes the importance of being respectful of different cultures. Achieving this goal is the responsibility of everyone involved in the Project.

Efforts to foster a positive workplace environment at the Project site are continuous and ongoing. Manitoba Hydro and the partner First Nations are continuing to work together at many levels to develop strategies to drive a positive work environment at the Project site. Forums where this work has occurred include:

- The KHLPP Board;
- An Issues Sub-Committee of the Board: a committee with representation from the partner First Nations and Manitoba Hydro. The mandate of this committee is to discuss and take action on concerns raised by the partner First Nations regarding drugs and alcohol and harassment and discrimination;
- The Keeyask Project Diversity and Inclusion Committee: a site-based committee with representation from the partner First Nations' Site Representatives, Project contractors, Employee Retention Services (ERS) and Manitoba Hydro labour relations. The mandate of this committee is to develop a Diversity and Inclusion Strategy for the Project. The committee also reviews past investigations involving complaints of harassment and discrimination, violence in the workplace, personal conduct cases, and any other significant events, to identify trends that could be addressed through diversity and inclusion initiatives and actions; and
- A Harassment and Discrimination Free Workplace Implementation Task Force (HDFWIT): an advisory group to the Site Support Manager with representation from the partner First Nations, Manitoba Hydro, the Allied Hydro Council and Employee Retention Services. The HDFWIT's mandate is to understand and make recommendations on the investigation process and course of action for workplace complaints under the Harassment and Discrimination Free Standard. This includes the process for receiving, investigating and taking action on workplace complaints under the Standard.

Due to the COVID-19 pandemic, the work of the Issues Sub-Committee of the Board as well as the Diversity and Inclusion Committee was suspended in 2020. The HDFWIT was suspended in 2020, but the Project continues to monitor compliance and harassment and discrimination data.

Since 2016, the number of complaints has reduced significantly, both as a result of addition of enhancement of practices over the years, and more recently, due to the reduced volume of people on site. Review of 2021 harassment and discrimination data indicates a similar level of complaints being filed as in 2020. Restorative Practices (healing circles) continue to be promoted as an option to addressing workplace conflict including non-compliance of the Harassment and Discrimination and Violence in the Workplace Standards. Compliance will continue to be monitored until the end of construction.

Conflict resolution training workshops are delivered regularly to supervisors and management. A Respect Campaign is also ongoing at site.

7.2 EMPLOYEE RETENTION AND SUPPORT PROGRAMS

Various measures have been in place for the KGP to support the retention of northern and Indigenous employees at the job site, and to ensure that sensitivity and respect for local culture are demonstrated throughout construction. These measures include establishing the ERS Services contract. The scope of this contract was developed jointly with the FLCN and YFFN Keeyask Joint Venture who endeavored to include all partner First Nations' interests. The ERS contractor began delivery of services during the KIP and continued into the KGP.

7.2.1 INDIGENOUS AWARENESS TRAINING

On-site Indigenous awareness training workshops are provided for staff working at the Keeyask site. Because of the dedicated team effort between Site Liaisons, ERS & project contractors, the overall site maintained 98% compliance between April 2021 and March 2022. During this period a total of 152 employees had completed awareness training, and 40 training workshops were held. The purposes of training workshops are to:

- Increase understanding and appreciation of the cultural differences, beliefs and values of individuals within the various parties/communities working at the site;
- Enhance comfort in living, working and/or doing business in a culturally diverse environment;
- Identify barriers and issues between the various parties working at the site;
- Identify common goals;
- Develop strategies and action plans for addressing issues/barriers, reaching common goals and developing and maintaining long-term harmonious relationships;
- Increase participants' understanding of contemporary issues facing Indigenous peoples;
- Challenge participants to re-think their assumptions and personal biases about Indigenous peoples;

- Provide participants with information that will promote understanding and respect of Indigenous cultures, enabling participants to work effectively with Indigenous peoples; and
- Increase participants understanding of what a harassment and discrimination free work environment means and what each individuals' responsibilities are to maintain a work environment that is safe for all.

7.2.2 ON-SITE COUNSELING

On-site counseling is available to help all employees, on a voluntary basis, deal with any issues experienced while working on the Project. This could include work adjustment problems, vocational/career issues, cultural adjustments, family stresses, money management, and substance use. The intent is to reduce attrition for all workers by assisting them in dealing with challenges directly affecting their work performance.

7.2.3 SITE LIAISON

The Site Liaison Team's main focus has been on engaging the partner First Nations on all KGP activities and functions. The team maintained its roster and consisted of the Site Liaison Lead, a Liaison Officer and a Site Representative from each of the partner First Nations. The Liaison Team continues to collaborate with the four partner First Nations and the site contractors with a high emphasis on employment and training opportunities, as well as cultural activities. The team works closely with the ERS team where the focus has been on providing support to all Keeyask workers.

The four partner First Nations' Site Representatives participated throughout this past reporting period. Over the past year, Site Liaison staff worked closely with the Site Representatives on the following activities:

- Engaging community members in employment and training opportunities;
- Assisting with communication between Keeyask Contractors and community JSMs; and
- Facilitating improved communication with partner First Nation workers at site.

Site Liaisons and partner First Nation Site Representatives are also members of the following committees:

- Construction Advisory Committee;
- Advisory Group on Employment;
- Monitoring Advisory Committee; and
- Keeyask Caribou Coordination Committee.

Engagement with these committees not only provides for direct input and feedback but it also allows the team to bridge networks and expand communications within the entire Project.

Due to pandemic measures no external visitor tours were held. Three tours were conducted during this past year for site personnel

7.2.4 EMPLOYEE SUCCESS GUIDE

The KGP Employee Success Guide was developed in 2019 and continues to be utilized to help prospective and new employees as well as their families learn more about living and working at Keeyask prior to applying or starting employment. The Guide is an online tool, available at Keeyask.com, and has been distributed in hard copy form at key locations including in the partner First Nations. The tool consists of the following seven modules:

- Is Keeyask right for you?;
- Preparing yourself and packing;
- Preparing with your family;
- Coming to Keeyask;
- Your room;
- Camp life; and
- Safety first.

7.3 CULTURE AND SPIRITUALITY

Since the start of construction, various measures were put in place to ensure that sensitivity and respect for local culture is maintained throughout construction of the Project.

7.3.1 CULTURAL SITE CEREMONIES

Site ceremonies have been held at key construction milestones to help mitigate the effect of the Project on partner First Nations' culture, and to demonstrate respect for the land and all that is supported by the land. Attendance at ceremonies is welcome and voluntary. Due to pandemic measures, this year's attendance only consisted of site workers including partner First Nation members, staff of the contractors and Manitoba Hydro. Prayers and Blessings are also held when needed and led by the ERS team.

Between April 2021 and March 2022, seven ceremonies were held. Prayers and blessings were held before each unit in service to give thanks to the water for its power and life sustainability also acknowledging the changes to the environment. In March 2022, a special prayer and blessing

ceremony was held for final in-service unit. Other ceremonies included: Spring Ceremonies, National Indigenous Peoples Day celebration, Grandmother Moon Ceremonies and National Day for Truth and Reconciliation Ceremony. On July 1, 2021 a Walk to Remember the Children was held, healing and sharing circles were offered and a feast concluded the walk.

7.3.2 SWEAT LODGE

A sweat lodge and teepee area were set up at the Keeyask site in September 2017. Since that time numerous sweat lodge ceremonies have been held which accommodate both night and day shift workers. The sweat lodge is a circular, dome-shaped structure used for many purposes in Indigenous culture. Through ceremonies, it offers a way of clearing, cleaning and freeing obstacles, obstructions and blockages to healing and well-being. During a purification ceremony, participants talk with and listen to the Creator and Grandfathers and Grandmothers for guidance. There are similarities between the physical body and the sweat lodge. Your skin is like the sweat lodge cover; ribs are like the willows; heartbeat is like the drumming; songs are your life lived. Between April 2021 and March 2022 four sweat ceremonies were held. Three sweats in the fall of 2021 occurred but suspended until end of March 2022 due to pandemic measures.

7.4 RESPONDING TO COMMUNITY CONCERNS

An important component of socio-economic monitoring is ongoing dialogue with communities to identify and address concerns or issues as they arise. Over the past year, a primary focus of the KHLP has been the global COVID-19 pandemic.

Considerable concern was expressed by the partner First Nations about the potential for the COVID-19 virus to enter their communities. In response, a comprehensive Pandemic Response Plan was developed by the Keeyask Project site, in consultation with communities, health officials and site representatives that outlines various actions to:

- Minimize the introduction of the COVID-19 virus at site;
- Prevent its spread; and
- Prevent transmission between site and the local communities.

Weekly pandemic update meetings with MH and community leadership commenced in April 2020 and continued until the parties agreed to meet on a biweekly basis starting in January 2022. Keeyask Daily News Briefs were developed to update Keeyask workers, partner First Nations Leadership and community members on the number of workers tested for COVID -19 at site, the results, and required pandemic safety protocols. In consultation with Manitoba Public Health, leadership in each partner First Nation community also developed their own pandemic response plans. Pandemic measures at site continue to be adapted as needed to operate with the safety and well-being of the entire workforce as a priority. This includes ongoing review and

enhancement of testing measures. As the Project Manager, Manitoba Hydro is committed to providing a safe and healthy work environment during the COVID-19 pandemic.

Concerns have also been raised by the partner First Nations that the Project has contributed to an increase in the presence and use of drugs and alcohol in the region (including at the Project site and in the communities), and regarding incidences of harassment, discrimination and gender-based violence at Keeyask. The Drug and Alcohol Standard continues at the Project site. The standard applies to all Manitoba Hydro employees, contractors, workers, subcontractors, and their respective employees working, living or attending the Project site. The Drug and Alcohol Standard is a component of Manitoba Hydro's commitment to providing a safe workplace for everyone on site. As part of the standard, drug and alcohol testing is conducted after:

- Safety incidents or high potential near miss;
- It is determined that there are reasonable grounds due to canine indication; or
- Information established by the direct observation of one's conduct.

Manitoba Hydro and each of the partner First Nations have had discussions on what supports can be provided at the community level to mitigate any potential increase of drugs and alcohol associated with the Project. Follow-up support by the substance abuse professional hired to support the Project site has occurred at the community level. The Project Drug and Alcohol Standard provides the opportunity for treatment where addiction is present. The treatment for addiction not only supports a safe working environment, but also improves the lives of individuals and their families.

The KHLP takes seriously any reports of discrimination, harassment or violence. Strong policies and processes are in place at the Project site aimed at preventing and addressing concerns of this nature. In planning for Keeyask, efforts occurred early on to reduce interactions between partner First Nations' members and the non-local Project workforce. In response to concerns during the Project, several committees have been established at the KHLP level and at site to continue efforts. Efforts will continue through the remainder of Project construction towards ensuring a safe and welcoming work environment for everyone at the Project site (see section 7.1 Keeyask Workplace Culture).

7.4.1 WORKER INTERACTION

A Worker Interaction Subcommittee (WIS) was established prior to Keeyask construction to deal with anticipated increases in the Gillam area workforce resulting from Keeyask, other Manitoba Hydro projects or related work occurring concurrently in the area. WIS was established as a forum for information sharing and communication to identify potential worker interaction concerns, prevent issues to the extent possible, and identify ways to work cooperatively to address issues as they arise. Representatives from Manitoba Hydro, FLCN, the Town of Gillam, the Royal Canadian Mounted Police (RCMP, Gillam Detachment), the Gillam Hospital and Northern Health Region, and the Gillam School served as regular members on this committee.

During peak construction periods of the KGP and Keewatinohk Converter Station, WIS focused on addressing project effects as they related to public safety, community services and infrastructure. WIS established an 'incident tracker' to monitor and respond to specific community concerns and incidents during this time. Several mechanisms and adaptive measures were established to respond in part, to issues raised at WIS such as a "PR 280/PR290 Taskforce", provision of on-site health care services at Keeyask, including nurse practitioner and emergency medical services, and ongoing cultural awareness programming for contractors working in the Gillam area.

With the wind down of projects in the region around 2018, WIS shifted its focus to identifying ways to prepare Gillam and FLCN residents for transition out of the Keeyask construction phase, including reduced economic opportunities, income and services associated with the Project.

WIS was suspended in 2020 due to the pandemic situation. Efforts to address priority areas of focus noted above continued at the local level through the Harmonized Gillam Development process (HGD) to the extent practicable. Activities included supporting the coordination of resources and services relating to counseling supports, traditional healing opportunities, delivery of FLCN history and cultural awareness workshops and shared cultural activities for both Gillam and FLCN community residents. Work will continue under the purview of HGD through a Wellness Action Working Group.

With the establishment of the Wellness Action Working Group under the purview of HGD, this is the final submission for the WIS section.

7.4.2 EMPLOYMENT TRANSITION TASK FORCE

The Employment Transition Task Force (ETTF), a joint initiative of MH and the partner First Nations, wound down its activities in 2020. The purpose of the ETTF was to explore potential opportunities related to employment of partner First Nations' members and northern Manitoba residents during the wind down of the Keeyask construction project. From 2018 to 2020, the Task Force members collectively identified resources and initiatives to support Keeyask workers transitioning out of project work, including a recommendation to assist laid off workers to find pathways to new employment in the region. In December 2020, the Keeyask Workforce Transition office opened its doors in Thompson. The Workforce Transition office is operated by the Northern Manitoba Sector Council under its mandate from Manitoba Workforce Training and Employment. These services will continue to be offered until the Fall of 2022.

7.5 POPULATION

The KGP EIS predicted the Project would not result in notable change in the number of people in the partner First Nations' communities or in Gillam. However, measuring levels of in- and out-migration is difficult, with limitations existing for all related data sources, and the partner First

Nations have noted that any in-migration to their communities could stress services that are already at capacity. Population is being monitored to confirm the extent of Project-induced migration in the partner First Nations' communities and Gillam.

The changes in total population observed in 2021 for the partner First Nations and 2020 for Gillam are consistent with trends observed over time in each of the communities. The slight increases and decreases in population across the communities do not suggest a significant pattern of construction related in- or out-migration.

7.5.1 PARTNER FIRST NATIONS' COMMUNITIES

Population data for the partner First Nations is based on data from Indigenous Services Canada for on-reserve and on-own-Crown⁴ land populations. As shown in the graph that follows, data for the partner First Nations from 2003 to 2021 shows periods of moderate population growth as well as moderate decline across years. In 2021, the FLCN population increased by 2 people and the WLFN population increased by 1. The TCN population decreased by 5 people and the YFFN population increased by 1 person.

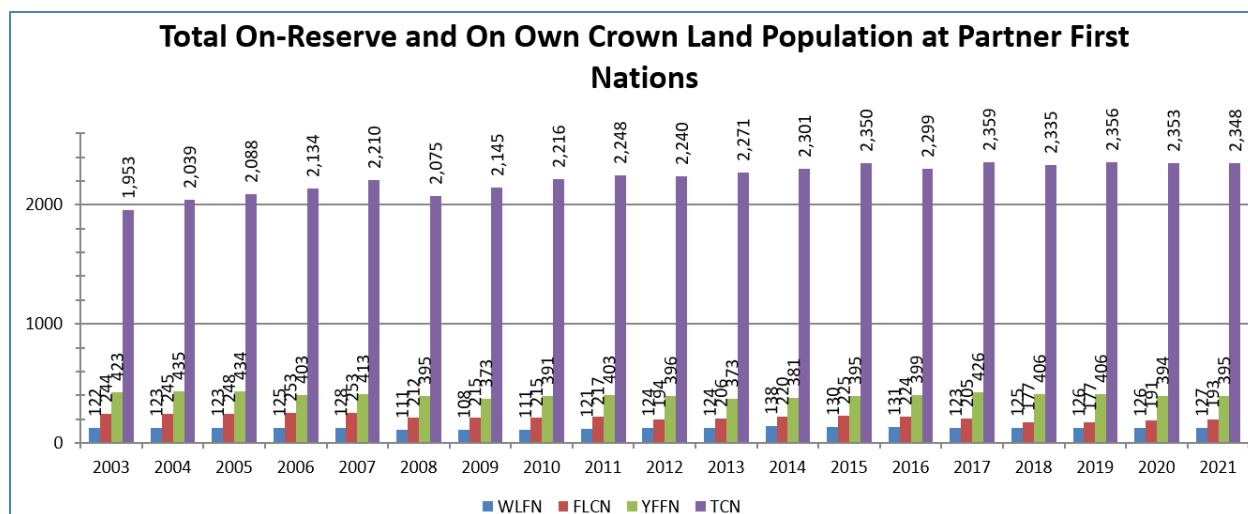


Figure 7: Total On-Reserve and On-Own-Crown Land Population at Partner First Nations (2003-2021)

7.5.2 TOWN OF GILLAM

Population data for the Town of Gillam is based on data from Manitoba Health's annual health statistics, which were available up to 2020. As shown in the graph below, the population of Gillam

⁴ On-own-Crown lands are those lands not classified as reserve lands but Crown lands that have been assigned to a particular First Nation.

experienced slight annual increases between 2008 and 2011, and, with the exception of a slight increase between 2012 and 2013, slight annual decreases between 2012 and 2020.

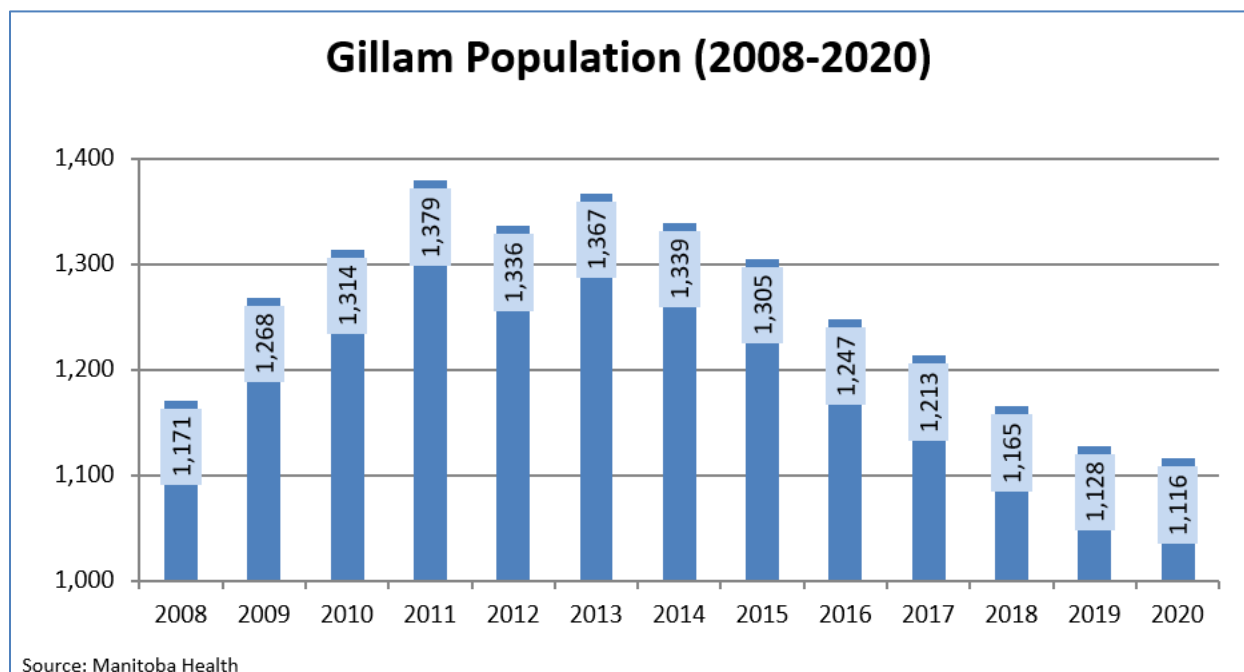


Figure 8: Gillam Population (2008-2020)

7.6 MERCURY AND HUMAN HEALTH

As a result of past experience with hydroelectric development, the partner First Nations raised the issue of mercury and human health as a primary concern in relation to the KGP. Manitoba Hydro and the partner First Nations have been working together since 2007 to study the issue and communicate information related to mercury and the Project. The KHLP, through the Mercury and Human Health Implementation Group (MHHIG), with advice from technical and health experts, developed a Mercury and Human Health Risk Management Plan. Key components of this plan include:

- a communication strategy about fish consumption for resource users in affected waterbodies;
- voluntary hair sampling;
- monitoring of mercury in fish, wildlife and plants; and
- periodic human health risk assessments.

Local implementation of mercury and human health programming is achieved through the hiring of Mercury Community Coordinators (or delegates) in each partner community.

Mercury is a metal found naturally in small amounts in rock, air, soil, water, and living organisms. It can be released into the environment through natural processes, but mainly as a result of human activity related to industrial development. When organic material such as peat is broken down by bacteria, mercury is converted to a more toxic form called methylmercury. Methylmercury becomes more concentrated as it moves up the food web from bugs to smaller fish to larger predatory fish. This process occurs in the natural environment and can be accelerated by processes such as flooding. It is most affected by unnatural causes, like the larger scale flooding caused by the creation of a hydroelectric reservoir. In addition, mercury levels are slowly increasing globally, in part due to industrial activity.

The creation of the Keeyask reservoir in 2020 is expected to raise mercury (methylmercury) levels in fish in Gull Lake and to a lesser extent, Stephens Lake. Mercury levels will increase, mostly due to the breakdown of peat in the reservoir. Fish mercury levels are estimated to peak 3-7 years after impoundment and gradually decrease over the next 20-30 years to levels similar to non-impacted waterbodies in the region.

People can be exposed to mercury (methylmercury) through eating fish. Larger, predatory fish, like pickerel and jackfish, generally have higher mercury levels than smaller fish. Too much mercury can cause human health problems, particularly for the developing brain (e.g., babies and children); however, all age groups are susceptible to some extent if mercury intake is too high.

Mercury in surface water does not become concentrated like it does in fish. Studies show that at current levels, drinking and recreational use of water is not a threat to human health as a result of mercury.

Because fish is an important part of a healthy traditional diet and offers many important health benefits, the MHHIG is working to build awareness and understanding in the partner First Nation communities about mercury and the risks and benefits of eating fish.

This section focuses on the key KHLF activities related to mercury and human health in 2021-2022.

7.6.1 MERCURY AND HUMAN HEALTH IMPLEMENTATION GROUP MEETINGS

The MHHIG normally meets quarterly for in-person meetings. To accommodate pandemic-related considerations, the MHHIG met virtually and more frequently, totalling 5 formal meetings over the course of the year. MHHIG discussions were supported by separate meetings with Mercury Community Coordinators, subject matter experts (toxicologist, aquatic biologist, hair monitoring consultant) and provincial health representatives (Medical Officer of Health [MOH], Public Health – Environment, Manitoba Health and Seniors Care and MOHs of the Northern Health Region and First Nation Inuit Health Branch). Key topics for discussion included:

- A review and preliminary human health risk assessment of fish mercury concentrations predicted for post-impoundment conditions and 2021 fish monitoring results.

- The refinement of post-impoundment communication materials (see Section 7.6.2).
- Anticipated plans for hair sampling and updates about community-based initiatives.
- Consideration of additional fish sampling in Stephens Lake (spring) to provide additional information to consumers of Stephens Lake fish, prior to summer / fall fishing season, while mercury levels are rising (see Sections 7.6.5 and 7.6.6), and
- Development of post-impoundment protocol outlining a process for timely communication of monitoring results, interpretation of data, and decision-making protocol for assessing currency of safe fish consumption recommendations (see Appendix 1: Post-Impoundment Fish Mercury Communication Process).

These issues and outcomes are described below.

7.6.2 COMMUNICATION STRATEGY

The Mercury and Human Health Risk Management Plan (RMP) commits to communicate potential risks to human health from increased methylmercury in the environment as a result of the Keeyask Project. Over the reporting period, the MHHIG refined select post-impoundment communication products, which were developed in 2020-2021. These products are intended to support community-based activities that promote RMP goals, such as to build understanding about mercury and human health and encourage safe harvesting, sharing and eating of healthy wild foods diet. Post-impoundment communication products include information related to predicted mercury concentrations in fish at peak, consumption advice for those consuming fish from the reservoir and downstream areas, and information about hair sampling and food survey program.

Partner First Nations experiences and knowledge and scientific / regulatory agency guidance were considered to develop accurate and meaningful messaging for partner First Nation community members and people who consume fish in the Project area. This included partner First Nation members' experiences with past hydroelectric development, the cultural importance of traditional harvesting practices and consumption of local wild foods, range of communication preferences, anticipated Project effects, fish mercury concentrations and hair sampling and food survey program information.

The suite of post-impoundment communication products is shown in Appendix 2 and includes⁵:

- "Mercury in Fish and Your Health" brochure which outlines Project effects as a results of reservoir creation, what to expect with mercury concentration in wild foods, monitoring activities and local information resources (issued in 2021).

⁵ The MHHIG also worked with provincial health representatives to develop a Manitoba government issued Public Notice for Mercury in Fish. Per discussions with the Manitoba government representatives, this notice will be distributed in conjunction with Safe Catch poster in each community and signage posted at Gull and Stephens lakes.

- “Safe Catch” posters for Gull Lake and Stephens Lake which provide fish consumption recommendations for sensitive and general populations under post-impoundment period (peak conditions) (revised 2022).
- Fish Tape for Gull Lake and Stephens Lake which visually categorizes post-impoundment (predicted peak) mercury concentrations and associated consumption categories for three fish species (i.e., very low to high mercury) (revised 2022)
- Postcard and equivalent poster which is intended to prompt interest in mercury and human health programming with an emphasis on consumers of fish in Stephens Lake (issued 2021).

Refinements to products were reviewed and approved by the MHHIG with input from provincial and federal health representatives. See Section 7.6.6 and Appendix 3: Wilson Scientific: Revisions to Post-Impoundment Communication Materials for additional discussion.

7.6.3 COMMUNITY BASED ACTIVITIES

Individuals fulfilling the role of Mercury Community Coordinators assisted in the implementation of mercury and human health related activities and organized mercury and human health events in each partner First Nation community. Despite limited opportunities due to pandemic restrictions, the following activities were achieved:

- Community events such as fishing derbies, youth camps, and education opportunities at cultural events to generate interest and understanding about fish, mercury and human health. Coordinators also worked with school and Indigenous traditional knowledge and land-based programs to deliver programming and share information,
- Mercury Community Coordinators began initiatives that integrate Indigenous knowledge and mercury and human health issues and support the goals of the RMP, such as the development of a joint calendar. YFFN developed a community calendar titled, *Fish is Good for the Soul / Kinoséw Minoskákéw*, which celebrates the role of wild fish harvest to maintain good health, support cultural practices and support knowledge transfer, and
- Mercury Community Coordinators utilized Safe Catch poster and Fish Tape in community-based activities and presentations to provide information and generate conversation about mercury and human health related Project effects due to impoundment.⁶

7.6.4 HAIR SAMPLING AND FOOD SURVEYS

The RMP provides for voluntary hair sampling and wild food surveys for partner First Nation community members, Gillam residents and other consumers of fish from Gull and Stephens

⁶ There will be an effort to replace distributed communication materials with revised versions.

Lakes. The goals and objectives of the voluntary hair sampling and food survey program are as follows:

- For individuals who choose to participate, to characterize, with reasonable certainty, maximum monthly exposures, and in conjunction with education and/or nutritional counselling, to understand mercury levels in their bodies and manage their fish consumption. Hair sampling provides the opportunity for individuals to make informed choices about whether they should adjust (increase or decrease) their fish consumption.
- To understand current consumption of wild foods with a focus on fish, as the main source of mercury exposure, to understand the primary sources and types of fish harvested from the study area.

In 2018, the MHHIG developed a “Know your Number” campaign to generate interest and awareness of this program in partner communities and undertook sampling in 2019 and 2020. In anticipation of holding additional events, the Project hair monitoring lead provided a hair sampling refresher to Mercury Community Coordinators. In addition, the MHHIG reviewed the food survey based on pre-impoundment experience which resulted in some minor refinements to clarify or simplify the questionnaire. A map was also developed as an insert and larger poster to assist in identifying lakes where participants source their wild fish.

Despite multiple attempts, the pandemic situation and associated lockdowns inhibited the ability to offer hair sampling events this year. There were efforts to communicate that individual hair sampling was available upon request, with no requests made. Hair sampling events were undertaken in Fox Lake Cree Nation (Bird) and Gillam in late March 2022. Individual results will be provided in a confidential letter; aggregate results will be shared with community and MHHIG in a timely fashion.

An overview of methodology, revised food survey and summary of post-impoundment sampling outcomes will be provided in the 2023 report.

Hair sampling and food surveys will continue to be offered to all four partner First Nation communities over the next decade, which will allow individuals to monitor their mercury exposure through repeat hair sampling. There is a focused effort to encourage more frequent hair testing (e.g., seasonal) for people who consume fish from Gull or Stephens lakes and promote the participation of individuals who are higher consumers of fish in this program. Hair sampling will continue to be available upon request via the participant’s local Mercury Community Coordinator, and nutritional counselling offered.

7.6.5 MONITORING OF MERCURY IN FISH, WILDLIFE AND PLANTS

The RMP outlines pre-and post-impoundment monitoring for mercury in fish, wildlife and plants in the Project area, including a voluntary sampling component, where partner First Nations’ members can submit plant, Lake Sturgeon, and wildlife samples for mercury analysis. The objectives of this monitoring program are to confirm predictions in the EIS, provide a timely

communication system if levels approach or exceed predictions, and to provide information for individuals to make informed consumption choices (from Gull and Stephens lakes in particular).

The following provides an overview of EIS predictions, scheduled monitoring and 2021 monitoring results of fish, wildlife, plants, and water. Available data was reviewed by the Project Toxicologist to assess risk from consumption of wild foods harvested in the Project area (see Section 7.6.6).

Fish: The Keeyask reservoir (Gull Lake) was impounded in September 2020. It is predicted the mercury concentrations in pickerel, jackfish, and whitefish will increase by three to five times in Gull Lake and by two times in Stephens Lake. Fish mercury concentrations are expected to peak between 2023 and 2027, and then gradually decline over the next thirty years. Scheduled monitoring of mercury in fish outlined in the Aquatics Effects Monitoring Plan (AEMP) occurs in early fall. In 2021, it occurred in Split Lake, the reservoir and Stephens Lake – these lakes will continue to be monitored annually. Sampling also occurred in the Aiken River; 2021 results indicate fish mercury concentrations have not changed as a result of the Project.

In consideration of the monitoring objectives noted above, the MHHIG identified there is an unavoidable lag between seasonal fishing (e.g., spring/fall) and reporting of sampling results (late winter) as mercury levels rise in fish from Gull and Stephens lakes. The time lag is an issue until peak concentrations are observed and concentrations begin to decline. To address this communication lag, there was a decision to undertake additional small-scale sampling (using non-lethal dermal punch samples) on Stephens Lake in June 2021. This sampling may provide an additional, early warning indicator, prior to the fall fishing period, about how fast the mercury concentrations are increasing and approaching the predicted peak concentrations. Samples collected in June 2021 showed that concentrations in pickerel and jackfish remained aligned with predictions.

The 2021 AEMP: Mercury in Fish Flesh from Keeyask Study Area results show that mercury concentrations in jackfish, pickerel and whitefish caught in the Gull Lake are, as expected, higher than values measured historically. Concentrations found in fish from Stephens Lake and Split Lake continue to fluctuate from year to year but are within historical levels. Average concentrations in fish from Gull Lake and Stephens Lake remain below the predicted peak values. Sampling also occurred in the Aiken River; 2021 results indicate fish mercury concentrations are within historical levels. Monitoring of fish in these waterbodies will continue into operations.

Wildlife & Plants: The scheduled 2021 sampling program for mercury in wildlife, as outlined in the Terrestrial Effects Monitoring Plan (TEMP) was completed in winter 2021/22. No plant samples were scheduled to be collected in 2021. No wildlife or plant samples were submitted for analysis through the voluntary sampling program in 2021.

Post-impoundment mercury levels are expected to remain low in wildlife (moose, beaver, muskrat, snowshoe hare) and plants (blueberries and Labrador tea) consumed by people. Mercury levels in waterfowl, such as ducks, are expected to remain low with levels similar to whitefish, with even lower concentrations predicted for Canada geese. The 2021 results, outlined in the TEMP Mercury in Wildlife annual report, show beaver and muskrat concentrations remain low, consistent

with EIS predictions. There was an increase in mercury levels in river otter tissue – this was expected, as river otter eat fish.

Monitoring for mercury in wildlife and plants will continue during the operation period. Data collected will be supplemented by any samples provided by partner First Nations through the voluntary sampling program.

Water: Mercury levels in water, post-impoundment, are expected to remain below mercury water quality guidelines as set by Manitoba and Canada for drinking and bathing. Water quality was monitored at locations upstream of the project, in Gull Lake/the Keeyask Reservoir and in Stephens Lake for a suite of parameters, including mercury. As expected, some water quality variables, including mercury, have changed since reservoir flooding. Most notably, an increase in total mercury was observed in the reservoir, under the ice, in isolated back bays that were flooded; however, all the results were well below mercury water quality guidelines noted above.

7.6.6 ASSESSMENT OF RISK TO HUMAN HEALTH

The Project toxicologist participates as a regular member on the MHHIG and met regularly with subject matter experts as well as with provincial health representatives to discuss issues informing the assessment of risk to human health (HHRA) from mercury exposure as a result of the Keeyask Project.

On an annual basis, the Project toxicologist interprets risk to human health risk through a review of available monitoring results of mercury in fish, wildlife, plants and water, compared to predictions provided in the EIS. Appendix 4: Wilson Scientific: Preliminary Human Health Risk Interpretation of 2021 Environmental Data) contains more detailed information on the human health risks from the consumption of fish, wild foods and water. Key 2021-22 HHRA conclusions and activities are as follows:

Fish: The Project toxicologist concluded, based on 2021 fish mercury results from the Keeyask reservoir (Gull Lake) and Stephens Lake, that post-impoundment consumption recommendations remained valid for standard length fish in these communication products.⁷

Post-impoundment consumption recommendations developed in 2021 are based on peak concentrations predicted for Gull and Stephens lakes, Health Canada and World Health Organization guidance on acceptable rates of intake of mercury, and Manitoba Government mercury in fish guidelines. As noted in Section 7.6.2, the Safe Catch poster (2021) presents

⁷There are no anticipated increases in fish mercury concentrations in Split Lake as a result of the Project. Nonetheless, to build understanding about mercury and promote healthy fish food consumption, safe fish consumption recommendations for Gull, Stephens and Split lakes were developed in the pre-impoundment phase; the Split Lake products, last issued in 2018, were refreshed in 2021 to reflect new product design. These products are currently under review to determine whether consumption recommendations reflect current monitoring results and will continue to be monitored on an annual basis. Consistent with the pre-and post-impoundment protocol, a 20% change threshold is considered to assess currency of fish consumption recommendations. Preliminary review indicates an exceedance of this threshold has occurred for Split Lake. This information will be reviewed promptly with MHHIG, including health regulators, to determine whether consumption recommendations issued in 2018 should be revised.

consumption recommendations based on standard length sizes for three fish species; the fish tape presents consumption and mercury level categories for pickerel and jackfish in standard length sizes, and whitefish in three class sizes.

After further review of 2021 monitoring results and discussion with regulators and subject matter experts, three key adjustments were supported by the MHHIG:

- All products were adjusted to reflect standard length fish, on the basis that there was more certainty with standardized length predictions (as presented in the EIS) rather than three class sizes.
- The Safe Catch Poster and fish tape were both revised to strengthen messaging reflected in Manitoba guidelines, about which fish sizes according to species, are not recommended for consumption by specific age groups. Appendix 3: Wilson Scientific: Revisions to Post-Impoundment Communication Materials provides explanation of and rationale for revisions.
- All products were adjusted to include adolescent males (between the age of 12 to 18 years) in the sensitive age category rather than the general population. Appendix 5: Wilson Scientific: Adolescents and Methylmercury, provides discussion on the rationale for this change in classification.
- To provide earlier information on increasing mercury concentrations to people who consume fish from Stephens Lake, there was a decision to undertake additional small-scale sampling on Stephens Lake in June 2021 (see 7.6.5 and Appendix 6: North South: Results Stephens Lake Spring 2021).

Wildlife: Concentrations provided in the 2021 TEMP report indicate that eating beaver and muskrat from the Project area (based on previously reported consumption rates) would not pose unacceptable risks to people. While samples were not available for other wild foods (e.g., moose, snowshoe hare, ducks), there is no information to suggest that persons should be avoiding these foods, based on predicted peak estimates.

Efforts will continue to encourage the voluntary submissions of wildlife samples. A wild foods workshop, in combination with review of food survey results, will be undertaken to update the findings from a pre-impoundment (2009) wild foods workshop to determine if identified foods and previously reported consumption rates (i.e., frequency and meal sizes) are still applicable.

Plants: Plants consumed by people (blueberries and Labrador tea) near the Keeyask reservoir are expected to remain low in mercury concentrations. The first post-impoundment sampling of plants is scheduled to occur in 2024 and continue into operations, which will provide more information on expected concentrations and interpretation of risk to human health. Partner First Nations are encouraged to submit plant samples from the area for mercury analysis.

Water: Mercury levels in water continue to remain below mercury water quality guidelines as set by Manitoba and Canada for drinking and bathing.

A formal Human Health Risk Assessment (HHRA) will be completed in approximately 2026 (upon determination of peak conditions).

7.7 TRANSPORTATION INFRASTRUCTURE, TRAVEL, ACCESS AND SAFETY

While the EIS predicted that existing transportation networks and plans for PR 280 upgrades would be able to accommodate the changes in road use associated with KGP construction, community concerns arose regarding traffic safety and road conditions.

In response to community concerns, the Province, which is responsible for maintenance and upgrades to PR 280, established the PR 280 Joint Advisory Committee in the fall of 2014. The committee was comprised of representatives from the Province of Manitoba, Manitoba Hydro, the Town of Gillam and the partner First Nations' communities to involve the latter directly in the planning of upgrades to PR 280. In the period between April 2021 and March 2022, the PR 280 Joint Advisory Committee did not meet.

Mitigation measures have been adopted to reduce the impact of project traffic on PR 280 including road reconstruction, increased maintenance efforts and operation of the PTH 6 weigh station near Thompson.

In the fall of 2016, Manitoba Hydro developed a comprehensive transportation management plan to reduce the impacts of project traffic on PR 280. The plan includes pre-hauling construction materials to site during the winter months, night hauling, reductions in Manitoba Hydro truck traffic and reductions in truck weights during periods when the road has deteriorated substantially.

Manitoba Hydro, in collaboration with Manitoba Public Insurance and the RCMP continued to monitor traffic volumes, speeds, and vehicle types on PR 280 and PR 290 in 2021/22.

This will be the final submission of the Transportation Infrastructure, Travel, Access and Safety section as funding from Manitoba Hydro to Manitoba Infrastructure for mitigation activities is now complete.

7.7.1 TRAFFIC VOLUMES

Traffic volume data is typically collected by Manitoba Infrastructure (MI) every two years. Traffic data for PR 280 is divided into three segments: PR 391 to Split Lake, Split Lake to the PR 280/PR 290 intersection, and PR 280/ PR 290 intersection to Gillam. Use of PR 280 and PR 290 steadily increased since 2003. Volumes are now declining as work on Bipole III and the Keewatinohk Converter Station are complete. The Keeyask Generating Station is now past peak construction and is winding down work force numbers and deliveries. COVID-19 has also had an impact on traffic volume declines.

To better understand traffic patterns during construction, Manitoba Hydro worked with MI to have five, permanent traffic counters installed on PR 280 and PR 290. The segment of PR 280 with the highest traffic volumes is between PR 391 and Split Lake where from April 2021 to March 2022,

the average traffic counts (northbound and southbound combined) were 227 vehicles per day. Of the 227 vehicles per day, 24 were large trucks.

Further details on traffic volumes are provided in Manitoba Hydro's Northern Road Traffic Monitoring Quarterly Data Collection Summary (Appendix 7).

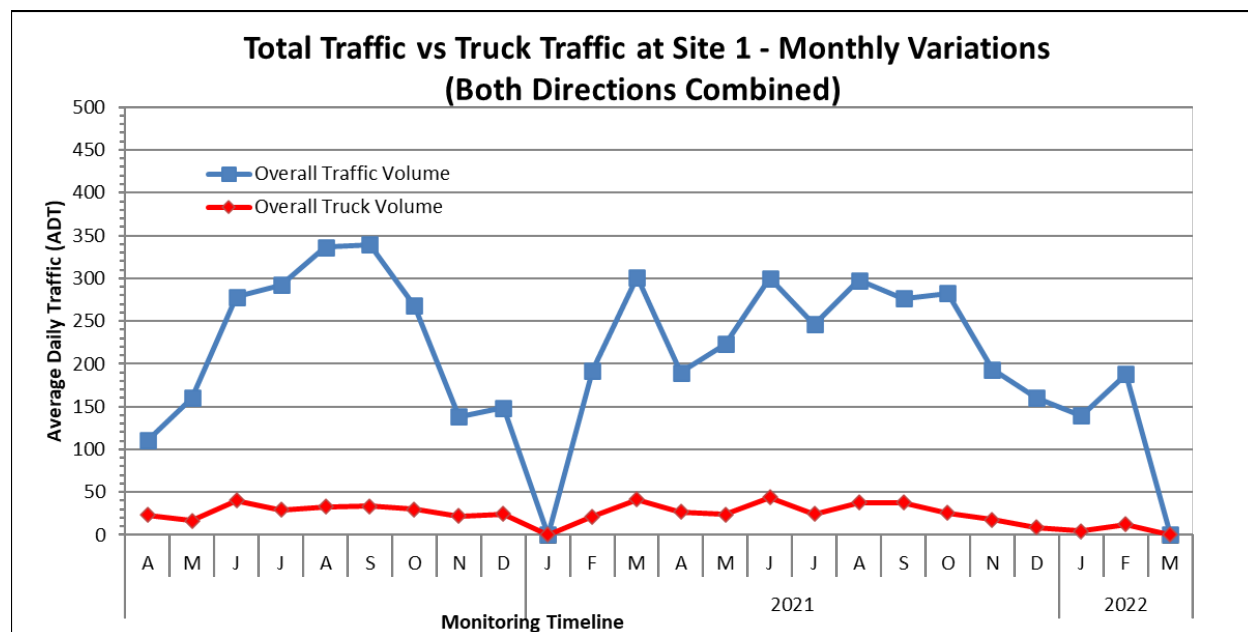


Figure 9: Monthly Variations: Overall Traffic Versus Truck Traffic⁸

7.7.2 COLLISION DATA

Collision rates along PR 280 and PR 290 have remained below the industry standard threshold of 1.50 million vehicle-kilometers of travel (MVKT). Collision rates are a factor of annual average daily traffic (AADT) volume, road length and reported collisions. Spot grade improvements, localized design considerations, and other road safety improvements are being implemented to address ongoing concerns and to improve the driving experience for all road users.

Further details on collisions are provided in Manitoba Hydro's Northern Road Traffic Monitoring Quarterly Data Collection Summary (see Appendix 5).

7.7.3 KEYYASK SITE ACCESS

The Keeyask North Access Road connects PR 280 to the construction site. It is a private road with restricted access, which is controlled by a security gate near the PR 280/North Access Road intersection. The gate office is staffed 24 hours per day, 7 days per week and security staff

document all authorized vehicles entering and exiting the road. On average, 28 vehicles per day used the road between April 2021 and March 2022.

Traffic counts from the monitoring station located at PR 280 Site 2, which is the closest station to the Keeyask North Access Road, allows construction related traffic to be compared to the overall traffic on PR 280. Over the past year, these two sets of traffic counts indicate that the percentage of Keeyask related construction traffic varies monthly and accounts for 15% to 52% of all traffic on PR 280 near the PR 280/Keeyask North Access Road intersection; with only three of those months greater than 40%.

The Keeyask South Access Road makes it possible to cross the Nelson River to access the south side construction area and Keeyask camp from Gillam resulting in a reduction of construction traffic on PR 280. Traffic is restricted to authorized construction and project vehicles only and all access is documented by gate security staff. On average, 23 vehicles per day used the road between April 2021 and March 2022. Data is reflective of all traffic types including daily construction activities such as hauling.

APPENDIX 1: POST-IMPOUNDMENT FISH MERCURY COMMUNICATION PROCESS

Subject: Communication Process of Mercury Fish Data Results and Consumption Recommendations, Keeyask Project PHASE 2 (Post-Impoundment)

Date: April 14, 2022

To: Mercury and Human Health Implementation Group

Purpose

The purpose of this memorandum (memo) is to outline a timely communication process with Mercury and Human Health Implementation Group (MHHIG) members on:

1. Keeyask Project related fish mercury monitoring activities and associated results.
2. Interpretation of fish mercury data for post-impoundment consumption recommendations; and the rationale for changes (or no change) to fish consumption recommendations.
3. Additional information and interpretation regarding hair sampling activities and plant and wildlife mercury concentrations.

Based on the Project assessment of risk to human health from potential mercury exposure, consumption recommendations are only prepared for fish consumption. Therefore, this memo focuses primarily on fish monitoring processes. The Project team will make every effort to present technical results and risk assessment interpretation to the MHHIG and Province for discussion in a timely manner. Timely analysis, interpretation and communication is of utmost importance in the assessment of whether consumption recommendations remain protective of human health, particularly until peak fish mercury levels have been determined.

Background

The Mercury and Human Health Implementation Group (MHHIG) developed a Mercury and Human Health Risk Management Plan to address the potential health effects from increased methylmercury in the environment (Gull and Stephens lakes) as a result of the Keeyask Project. Key components of this plan include:

- a communication strategy about fish consumption for resource users in affected waterbodies for pre- and post-impoundment conditions;
- monitoring of mercury in fish, wildlife and plants;
- voluntary hair sampling;
- periodic human health risk assessments (HHRAs)
 - Information obtained on biota, as available, will be reviewed and interpreted annually to assess whether changes to consumption guidance are required; and
- community-specific offsetting programs outlined in each partner First Nations Adverse Effects Agreements.

A suite of communication products related to Split, Gull and Stephens lakes was prepared for the operations phase. In addition, the government of Manitoba will issue a 'Public Notice' for Gull and

Stephens lakes (anticipated by early 2022) and has requested this notice be accompanied by corresponding Keeyask Project communication materials.

Monitoring Fish Mercury Concentrations for Consumption Recommendation Purposes

On an annual basis (January - March), the MHHIG will receive an update on the scheduled activities under the Keeyask Aquatic Effects Monitoring Plan (AEMP) for the upcoming season. Details would include month of sampling, which waterbodies, which fish species and approximate sample sizes. This includes monitoring in fish in Split, Gull and Stephens lakes and Aiken River (see Appendix A for more details).

Post-impoundment consumption recommendations prepared for Gull and Stephens lakes are based on predicted peak concentrations (outlined in the Project Environmental Impact Statement, 2012 and validated in 2021) and World Health Organization (WHO) and Health Canada guidance on acceptable rates of intake of mercury. Mercury concentrations in fish from these lakes will be reviewed annually to determine whether post-impoundment consumption recommendations reflect actual peak conditions. For Split Lake, consumption recommendations reflect existing conditions. No fish consumption recommendations are prepared for Aiken (Landing) River.

Mercury concentrations in fish may differ between sampling years because of chance events related to the relatively small sample size compared to the size of the fish population and natural year to year variation in concentrations. To avoid the potential for confusion created by frequent changes in consumption recommendations (and associated communication products) based on minor changes in fish concentrations, the MHHIG, in consultation with Provincial health representatives, outlined a process during the pre-impoundment phase to determine if and when consumption recommendations would need to be changed. General guidelines outlined below are adapted for the post-impoundment phase and consider balancing encouraging healthy fish consumption with providing timely information to communities of important changes to consumption recommendations.

Analytic and interpretive process of fish data

Mercury concentrations in whitefish, pickerel (Walleye), and jackfish (Northern Pike) from Split, Gull, and Stephens lakes will be a key source of information in determining whether fish consumption recommendations remain current or need to be revised. As mercury levels in fish from Gull Lake and, to a lesser extent, Stephens Lake rise as a result of impoundment of the Keeyask reservoir, there is an unavoidable lag between seasonal fish consumption / fish sampling and availability of preliminary sampling results. There is potential that people who consume fish from these lakes could unwittingly consume fish that exceed the acceptable mercury range, if model predictions underestimate peak fish concentrations. This is unlikely given the conservative estimate used to predict the peak concentrations, but the time lag remains an issue until peak conditions are observed and begin to decline. To enhance the information collected under the AEMP, the Aquatic team has committed to undertake supplemental sampling of pickerel and jackfish in spring (June) in Stephens Lake.¹

The MHHIG and the Province will have the opportunity to review and discuss preliminary and final monitoring results, HHRA interpretation as information becomes available, and in a timely fashion, to

¹ "Preliminary Results of 2021 Spring Mercury Sampling in Stephens Lake" (North / South, 2021) outlines the approach and rationale for June sampling.

assess the currency of consumption recommendations. Discussion will occur prior to finalization of memos or any communication products adjustments.

If fish mercury concentrations in Gull or Stephens lakes in any species reach predicted levels, the MHHIG and province will meet to review available information and assess whether consumption recommendations should be adjusted, in consideration of general guidelines outlined below.

Analysis of Fish Concentrations

- The Aquatic team will provide preliminary results from spring and fall fish sampling events, as soon as is practicable after each event is complete to the Project Toxicologist and MHHIG for review and discussion.²
- *Deliverables* include: A consolidated preliminary “*Fish Mercury Concentration*” memo describing the results of both the spring and fall sampling in a given year for comparison to predicted concentrations and for HHRA purposes (final, vetted results are typically available by February/March);
 - Fall fish monitoring results are also included in the Project’s *annual regulatory report* (submitted in June).
 - For fall program dataset, a statistical analysis will be conducted to determine if any of the mercury concentrations in the three species have changed significantly from the concentrations assumed to derive the consumption recommendations that are in place at the time of the sampling program.

KEY STEPS: Interpretation of consumption recommendations

- Project Toxicologist will prepare a draft “*Human Health Risk Assessment (HHRA)*” memo based on review and interpretation of “*Fish Mercury Concentration*” memo(s).
 - This *annual HHRA memo* will present an interpretation of the data and provide conclusions and recommendations on whether the communication products should be revised, including rationale for proposed changes.³
 - **Changes to communication products will be primarily based on a 20% change threshold (see below) and consideration of MHHIG and Province feedback.** If changes to consumption recommendations are considered after review of preliminary monitoring results, a meeting will be called in a timely manner to discuss results and next steps with the MHHIG and Province. In this case, an interim HHRA memo will be prepared for discussion.
- *Deliverable: a final HHRA Memo* will be prepared to reflect MHHIG discussion and submitted in partial fulfilment of annual regulatory reporting requirements.

² Timing will vary depending on sample size and receipt of analytic data from laboratory. Preliminary spring results may be available within 14 days, while preliminary fall results, due to larger sample size, may take up to 2 months.

³ If aggregate hair sampling results are available and considered to be representative of community members who eat the most fish at the peak time of year, the hair and fish data could be considered and cited to the MHHIG as part of a weight-of-evidence approach.

If changes to consumption recommendations are deemed necessary:

- Communication products will be promptly revised and reviewed by MHHIG and the Province. Once finalized and printed, Mercury Community Coordinators will recall previously distributed products and replace with most current.
- In 2013, Mercury concentrations in fish and other wild foods were considered in a formal Human Health Risk Assessment (HHRA) to represent the pre-Project environment. A formal HHRA will occur in approximately 2026 (or when peak concentrations have been determined by the Aquatic team) and every five years until fish mercury concentrations reach pre-Project or stable background levels.

General guidelines for determining whether communication products should be revised:

Post-Impoundment fish consumption recommendations prepared for fish from Gull and Stephens lakes,⁴ are based on predicted peak average concentrations of mercury. Predicted peak concentrations are outlined in Appendix B.

- Consumption recommendations may be revised if the measured average fish concentrations of standardized size fish exceed the predicted mercury concentrations by more than 20% (see Appendix B for threshold values and below for rationale).
- This '20% rule' would apply:
 - in the case of either increasing or decreasing fish mercury concentrations (e.g., after peak conditions have been reached in Gull and Stephens lakes) and
 - at any sampling event, subject to input from Project biologist on data quality (e.g., sample size, fish variability) and discussion with MHHIG, including provincial health representatives.
 - If changes in mercury concentrations are less than 20% for any fish species and length class, it is proposed there will be no need to revise fish consumption recommendations prior to peak conditions occurring.
- In addition to the 20% change threshold, the Aquatic team will attempt to determine whether the change in fish mercury concentrations is statistically significant.
- The MHHIG and Province will consider all relevant information in a timely manner to determine whether changes to fish consumption recommendations should be made.

Rationale for 20% threshold

The 20% threshold approach for fish mercury concentrations is applied for a variety of reasons:

- To avoid confusion by frequent updates and subsequent product recalls based on minor exceedances of the predicted mercury concentration used in these products.
- To account for variability that naturally occurs in fish.
- An increase in fish concentration of up to 20% is not expected to represent an appreciable difference in health risk.

⁴ Split Lake products reflect existing conditions and will be updated based on annual review of fish monitoring results. Protocol to determine currency of Split Lake consumption recommendations will follow the decision-making guidelines outlined in this memo (e.g., 20% threshold).

Health Canada (2021) and Province of Manitoba (2007) express the acceptable intake level of mercury for sensitive individuals to one significant figure (i.e., 0.2 µg/kg bw/d) while the World Health Organization (2007) provides a value equal to 0.23 µg/kg bw/d for sensitive individuals. Allowing up to a 20% increase in mercury concentrations will mean that a person who is consuming fish at exactly the maximum acceptable amount of fish but with 20% higher mercury concentrations than predicted will now have a mercury intake of 0.24 µg/kg bw/d which rounded to 1 significant figure is equal to the Health Canada acceptable intake level of 0.2 µg/kg bw/d and is only slightly greater than 0.23 µg/kg bw/d cited by the World Health Organization. These rates would be expected to be associated with hair concentrations in the range of 2.4 ppm rather than 2.0 ppm and are still well below known health effects.

Overall, by using a 20% value as the threshold for changing consumption recommendations, it is believed that health can be protected without unduly revising communication products every time new data are received.

Additional Monitoring

In addition to fish monitoring, hair sampling, in conjunction with a food survey will be available over the next decade. Hair sampling is a reliable way to measure and keep individuals informed of their mercury exposure so they can make informed choices about their fish consumption. While eating fish is the primary source of mercury exposure, an accompanying food survey may provide additional insight into sources of mercury exposure. Timing of sampling will be determined by community input (and upon individual request) in order to capture peak consumption (e.g., late fall / early winter hair sampling). The MHHIG will assess the need to continue hair sampling after fish mercury concentrations have stabilized.

Wildlife and Plant sampling will also occur as outlined in the Terrestrial Effects Monitoring Plan (TEMP), including scheduled collections (plants and aquatic furbearers) and through submission of samples by partner First Nation community members. Mercury concentrations are expected to remain low in plants and wildlife consumed by people; nonetheless, the voluntary submission of samples will assist in confirming predictions outlined in the Project Environmental Impact Statement. In addition to the scheduled monitoring outlined in the TEMP, voluntary samples will be collected for the first 10 years of operations, at which time the need to continue sampling each component will be assessed (see Appendix A for more details).

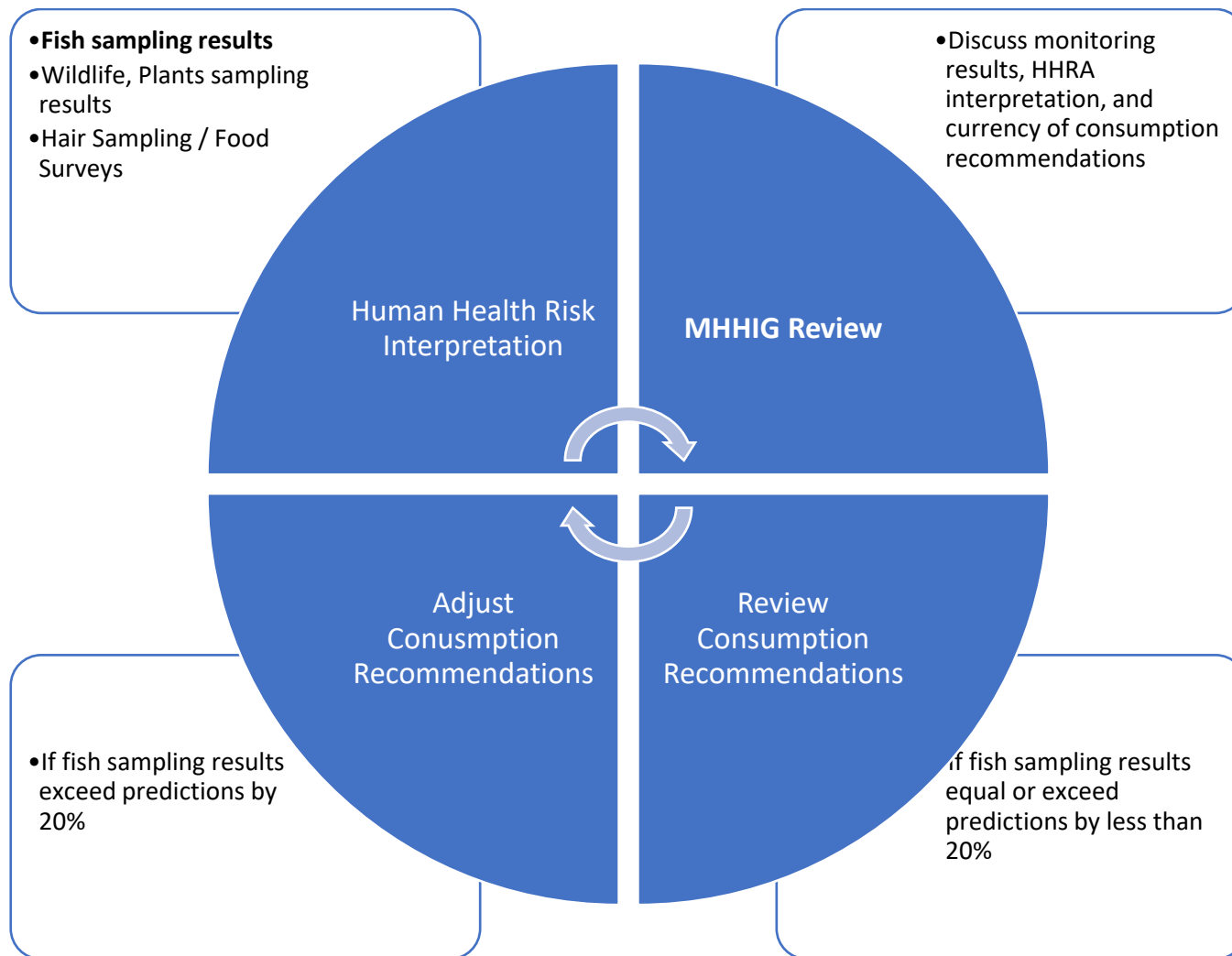
KEY STEPS

- The MHHIG will be provided a seasonal reminder about the voluntary sampling opportunity and for which plants (blueberries, Labrador tea, northern Labrador tea, and Seneca root) and wildlife (aquatic furbearers, waterfowl, and caribou/moose) samples can be submitted, from where, and the targeted sampling timeframe.
- The Mercury Community Coordinators (or delegate) and/or Manitoba Hydro representative will ensure plant and wildlife sampling protocols and collection kits are available to community members and work with the Project wildlife biologist to coordinate receipt of collected samples.
- The Mercury Community Coordinators (or delegate) and/or Manitoba Hydro representative will provide annual updates on plant and wildlife samples provided by community members for analysis of their mercury concentrations.
- Deliverables:

Memo: Keeyask Project Mercury and Human Health Risk Management Plan

- The Project 'Hair Monitoring' consultant (Golder Associates Ltd.) will provide *confidential, individual results* within 2-6 weeks with opportunity for individualized feedback. *Aggregate results* will be shared with MHHIG (and at community level) as available and will be compiled in annual regulatory report.
- Draft "*Plant and Wildlife Mercury Concentration*" memo(s) outlining plant and wildlife concentrations, pending receipt of voluntary samples, will be prepared by Project biologist (terrestrial) within 60 days of receiving the data.
- The Project toxicologist will prepare an HHRA memo based on review the "*Plant and Wildlife Mercury Concentration*" memo(s) and submit as part of the annual regulatory report.

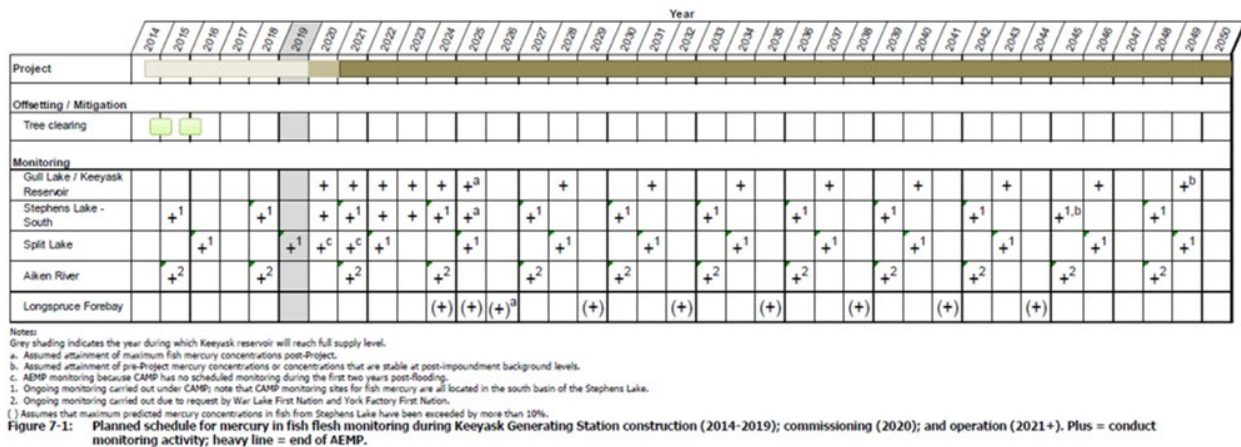
<p style="text-align: center;">HIGHLIGHTS OF COMMUNICATION PROCESS</p> <p style="text-align: center;">MHHIG and the Province will have the opportunity to review and discuss monitoring results, HHRA interpretation and currency of consumption recommendations prior to finalization of memos or possible communication products adjustments.</p> <p style="text-align: center;">Each memo will be prepared in a standalone manner and provide as much context as possible to assist in interpretation of results. Details such as field methods, laboratory data, and quality control will be included.</p>			
Information	Lead	Timeline / Targets	Purpose
Fish Monitoring Results / Memos for HHRA purposes	Aquatic Team (North South Consultants)	Annually: Preliminary spring results: by late July Preliminary fall results: by December Final results and memo: by March	To assess fish mercury concentrations in Gull, Stephens and Split lakes and Aiken (Landing) River. To assess validity of predicted post-impoundment peak concentrations in Gull and Stephens lakes.
HHRA Memo	Project Toxicologist, Wilson Scientific Consulting Inc.	Annually, upon receipt of available fish, wildlife and plants data. HHRA may reference aggregate hair sampling information.	Interpretation of fish concentrations to assess currency of consumption recommendations. Interim memo to be provided if consumption recommendations adjustments may be warranted after receipt of preliminary fish monitoring analysis.
HHRA (Full)	Project Toxicologist, Wilson Scientific Consulting Inc.	~2026 (after peak conditions have been confirmed to have occurred)	To assess risk to human health from consumption of wild foods harvested from the Project area.
Consumption Recommendations for Gull, Stephens and Split lakes	Project Toxicologist, Wilson Scientific Consulting Inc.	Annual review of data upon receipt (preliminary and final results); review of supplemental sampling data from Stephens Lake (~summer)	Post- Impoundment consumption recommendations for Gull and Stephens lakes reflect predicted peak conditions. Split Lake consumption recommendations reflect current conditions.
Wildlife and Plants Monitoring Results / Memos	Terrestrial Team	Annually (March), subject to monitoring schedule	To assess post-impoundment mercury concentrations in select wildlife and plant species
Hair Sampling Results / Memos	Project Hair Monitoring Consultant, Golder Associates, Ltd.	Individual results reported upon receipt of samples. Aggregate results and memo reported annually, or as available (timing and frequency determined by communities)	To understand mercury exposure in individuals to enhance informed decision making about their fish consumption.
Annual Regulatory Report	ALL	June	Submissions includes all noted reports and/or key highlights



Appendix A

Preliminary Fish, Plants and Wildlife Monitoring Schedules⁵

Fish Monitoring



Plants and Wildlife

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	Notes
5. Mercury in Plants and Wildlife Monitoring Studies																											
Plants: Collection of blueberries and Labrador tea leaves to analyze for Hg content in areas near the reservoir and in areas more than 1 km away from the reservoir and any roads. Voluntary sampling program for partner First Nations to submit samples also in place.				+			+						+														
Waterfowl: Voluntary sampling program for partner First Nations to submit waterfowl tissue samples for Hg analysis.	Voluntary submission of samples										+																
Aquatic Furbearers: Trapping program for beaver, muskrat, mink and otter, to collect tissue samples for Hg analysis in areas within 5 km of the Keeyask reservoir and Stephens Lake. Will be working with the RTL 15 trapline holder to collect samples.	+	+	+	+	+	+	+	+			+		+			+	Results to date will be reviewed to determine if continued sampling frequency (every 3 years) is appropriate, or if it needs to be adjusted.										+
Caribou and Moose: Voluntary sampling program for partner First Nations to submit caribou or moose tissue samples for Hg analysis.	Voluntary submission of samples										+																

⁵ Schedule is provided to represent general timeline. Actual sampling years may deviate slightly due to delayed impoundment, which occurred in 2020. Graph does not show additional Gull Lake sampling (2014, 2016) or supplemental annual sampling in Stephens Lake.

Appendix B

Predicted peak fish concentrations (average, standardized length) presented in Keeyask Environmental Impact Statement, 2012 and North/South (2021).

Stephens Lake Fish

- Stephans Lake whitefish, standardized size of 350 mm: 0.15 µg/g (wet weight)
- Stephans Lake pickerel, standardized size of 400 mm: 0.5 µg/g (wet weight)
- Stephans Lake jackfish, standardized size of 550 mm: 0.5 µg/g (wet weight)

Gull Lake Fish

- Gull Lake whitefish, standardized size of 350 mm: 0.19 µg/g (wet weight)
- Gull Lake pickerel, standardized size of 400 mm: 1.0 µg/g (wet weight)
- Gull Lake jackfish, standardized size of 550 mm: 1.0 µg/g (wet weight)

20% Change Threshold based on predicted peak fish mercury concentrations. An exceedance of the values below would prompt revisions to post-impoundment fish consumption recommendations, prepared in 2021, subject to MHHIG and provincial health regulator input.

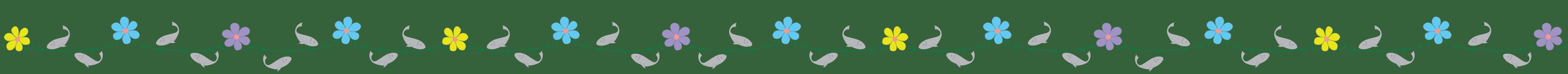
Stephens Lake Fish

- Stephans Lake whitefish, standardized size of 350 mm: 0.18 µg/g (wet weight)
- Stephans Lake pickerel, standardized size of 400 mm: 0.60 µg/g (wet weight)
- Stephans Lake jackfish, standardized size of 550 mm: 0.60 µg/g (wet weight)

Gull Lake Fish

- Gull Lake whitefish, standardized size of 350 mm: 0.23 µg/g (wet weight)
- Gull Lake pickerel, standardized size of 400 mm: 1.2 µg/g (wet weight)
- Gull Lake jackfish, standardized size of 550 mm: 1.2 µg/g (wet weight)

APPENDIX 2: POST-IMPOUNDMENT COMMUNICATION PRODUCTS



SAFE CATCH



A Mercury-Level Guide to eating fish from Stephens Lake

As a result of Keeyask reservoir impoundment, fish mercury concentrations are expected to rise 2x in predatory fish in Stephens Lake. Recommendations are based on the estimated maximum (average) concentrations for standardized lengths in each fish species shown below. Fish concentrations will gradually decline after reaching peak conditions (expected to occur between 2023-2027).

Recommendations in effect until approximately 2030.

VERY GOOD CHOICE

OCCASIONAL CONSUMPTION

RESTRICTED CONSUMPTION

Larger fish than shown are expected to be higher in mercury concentrations and not recommended for consumption. Smaller fish than shown are expected to have lower mercury concentrations.

Pickereel greater than 16 inches not recommended for consumption.

Jackfish greater than 21 inches are not recommended for consumption.






Fish are Good for You! Remember to eat fish that are low in mercury.






okáw Pickereel

For fish up to 16 inches, eat up to the monthly maximum total below

		
Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
13 oz	1 lb, 9 oz	3 lbs, 11 oz




onhchwápéw Jackfish

For fish up to 21 inches, eat up to the monthly maximum total below

		
Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
13 oz	1 lb, 9 oz	3 lbs, 11 oz

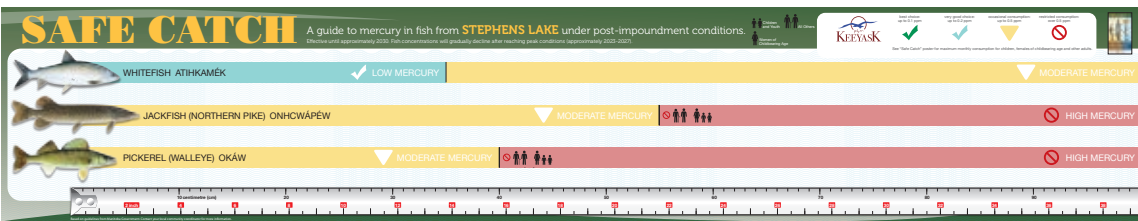
atihkamék Whitefish

For fish up to 14 inches, eat up to the monthly maximum total below

		
Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
2 lbs, 10 oz	5 lbs, 5 oz	12 lbs, 7 oz

Get your hair tested to
KNOW YOUR NUMBER!
The best indicator of mercury exposure

The chart shows maximum monthly fish consumption during peak conditions. Recommendations apply to total fish consumed. For example, if you eat half of the maximum monthly intake of whitefish, you can have half the recommended amount of pickereel or jackfish. Intake should be adjusted if people weigh more or less than noted here. For example, if an individual child weighs 33 lbs rather than the assumed 66 lbs, divide the maximum monthly intake by 2. Standardized lengths in each fish species are rounded to the nearest inch.

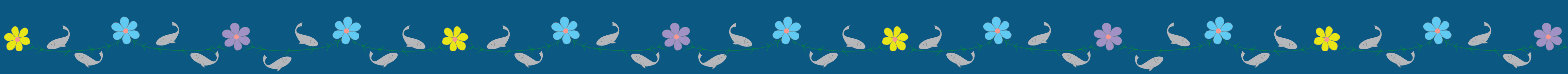


See fish tape for specific recommendations for various fish sizes.



To test your mercury levels through a hair sample contact:

STICKER TO BE PLACED HERE



SAFE CATCH

A Mercury-Level Guide to eating fish from Gull Lake



As a result of Keeyask reservoir impoundment, fish mercury concentrations are expected to rise 3-5x in predatory fish in Gull Lake. Recommendations are based on the estimated maximum (average) concentrations for standardized lengths in each fish species shown below. Fish concentrations will gradually decline after reaching peak conditions (expected to occur between 2023-2027).

Recommendations in effect until approximately 2030.

VERY GOOD CHOICE

OCCASIONAL CONSUMPTION

RESTRICTED CONSUMPTION

Larger fish than shown are expected to be higher in mercury concentrations and not recommended for consumption. Smaller fish than shown are expected to have lower mercury concentrations.

Pickereel greater than 16 inches not recommended for consumption.

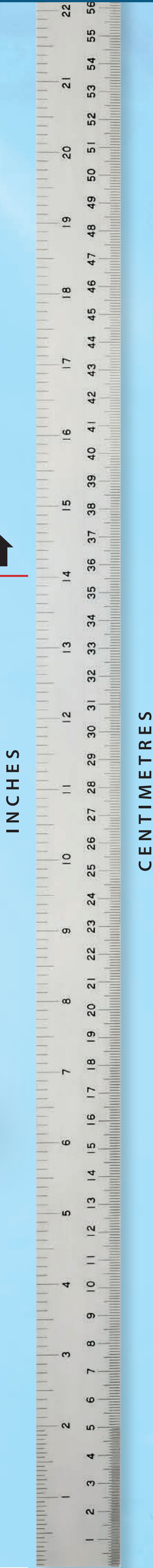


Jackfish greater than 21 inches are not recommended for consumption.



Fish are Good for You! Remember to eat fish that are low in mercury.

Whitefish greater than 14 inches are not recommended for consumption.



okáw Pickereel

For fish up to 16 inches, eat up to the monthly maximum total below

Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
Avoid	Avoid	1 lb, 14 oz

onhchwápéw Jackfish

For fish up to 21 inches, eat up to the monthly maximum total below

Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
Avoid	Avoid	1 lb, 14 oz

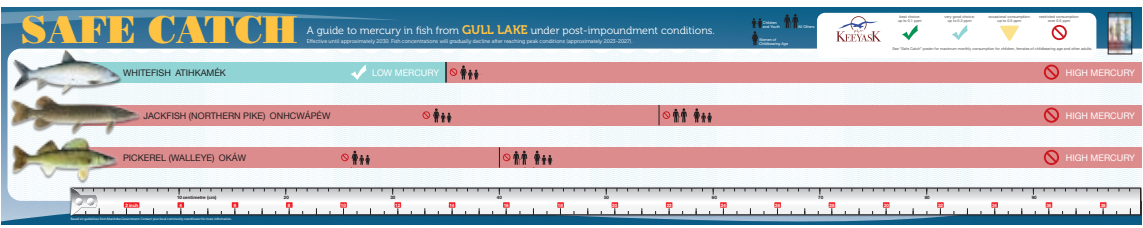
atihkamék Whitefish

For fish up to 14 inches, eat up to the monthly maximum total below

Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
2 lbs, 1 oz	4 lbs, 3 oz	9 lbs, 13 oz

Get your hair tested to
KNOW YOUR NUMBER!
The best indicator of mercury exposure

The chart shows maximum monthly fish consumption during peak conditions. Recommendations apply to total fish consumed. For example, if you eat half of the maximum monthly intake of whitefish, you can have half the recommended amount of pickereel or jackfish. Intake should be adjusted if people weigh more or less than noted here. For example, if an individual child weighs 33 lbs rather than the assumed 66 lbs, divide the maximum monthly intake by 2. Standardized lengths in each fish species are rounded to the nearest inch.



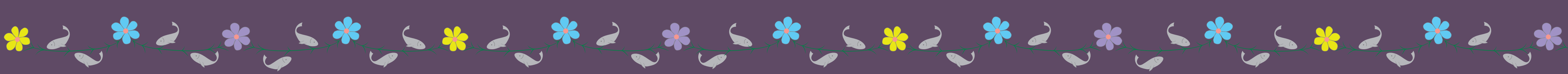
See fish tape for specific recommendations for various fish sizes.

Information provided in 2021 in collaboration with Manitoba Government.



To test your mercury levels through a hair sample contact:

STICKER TO BE PLACED HERE



SAFE CATCH

A Mercury-Level Guide to eating fish from Split Lake



Recommendations are based on average mercury concentrations under current conditions for standardized lengths in each fish species shown below.
Information provided in 2021.

BEST CHOICE

VERY GOOD CHOICE

OCCASIONAL CONSUMPTION

RESTRICTED CONSUMPTION

Larger fish than shown are expected to be higher in mercury concentrations. Smaller fish than shown are expected to have lower mercury concentrations.



Fish are Good for You!
Remember to eat fish that are low in mercury.



ᐃᑭᑦ okáw Pickerel

For fish up to 16 inches,
eat up to the monthly maximum total below

Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
1 lb, 8 oz	3 lbs	7 lbs, 3 oz

ᐃᑭᑦ onhchwápéw Jackfish

For fish up to 21 inches,
eat up to the monthly maximum total below

Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
1 lb, 6 oz	2 lbs, 8 oz	6 lbs, 11 oz

ᐃᑭᑦ atihkamék Whitefish

For fish up to 14 inches,
eat up to the monthly maximum total below

Children (under 12) 66 lbs (or ~30 kg)	Youth (ages 12-18) Females of Childbearing Age 132 lbs (or ~60 kg)	All Others 132 lbs (or ~60 kg)
6 lbs, 10 oz	13 lbs, 3 oz	31 lbs, 2 oz

Get your hair tested to
KNOW YOUR NUMBER!
The best indicator of mercury exposure

The chart shows maximum monthly fish consumption during current conditions. Recommendations apply to total fish consumed. For example, if you eat half of the maximum monthly intake of whitefish, you can have half the recommended amount of pickerel or jackfish. Intake should be adjusted if people weigh more or less than noted here. For example, if an individual child weighs 33 lbs rather than the assumed 66 lbs, divide the maximum monthly intake by 2. Standardized lengths in each fish species are rounded to the nearest inch.

See fish tape for specific recommendations for various fish sizes.

Information provided in 2021 in collaboration with Manitoba Government.



To test your mercury levels through a hair sample contact:

STICKER TO BE PLACED HERE

SAFE CATCH

A guide to mercury in fish from **GULL LAKE** under post-impoundment conditions.

Effective until approximately 2030. Fish concentrations will gradually decline after reaching peak conditions (approximately 2023-2027).



best choice:
up to 0.1 ppm



very good choice:
up to 0.2 ppm



occasional consumption:
up to 0.5 ppm



restricted consumption:
over 0.5 ppm



See "Safe Catch" poster for maximum monthly consumption for children, females of childbearing age and other adults.



WHITEFISH ATIHKAMÉK



LOW MERCURY



HIGH MERCURY



JACKFISH (NORTHERN PIKE) ONHCWÁPÉW



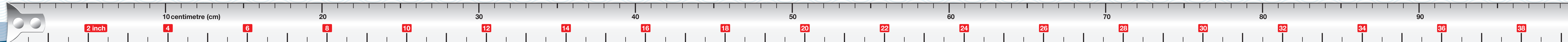
HIGH MERCURY



PICKEREL (WALLEYE) OKÁW



HIGH MERCURY



Based on guidelines from Manitoba Government. Contact your local community coordinator for more information.

SAFE CATCH

A guide to mercury in fish from **SPLIT LAKE** under existing conditions.
Information provided in 2021.



best choice:
up to 0.1 ppm



very good choice:
up to 0.2 ppm



occasional consumption:
up to 0.5 ppm



restricted consumption:
over 0.5 ppm



See "Safe Catch" poster for maximum monthly consumption for children, females of childbearing age and other adults.



WHITEFISH ATIHKAMÉK

✓ VERY LOW MERCURY

✓ LOW MERCURY



JACKFISH (NORTHERN PIKE) ONHCWÁPÉW

✓ LOW MERCURY

▼ MODERATE MERCURY

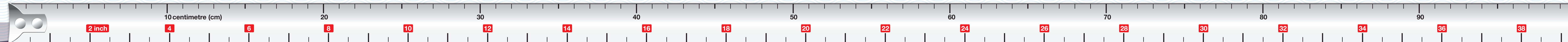
⊘ HIGH MERCURY



PICKEREL (WALLEYE) OKÁW

▼ MODERATE MERCURY

⊘ HIGH MERCURY



Based on guidelines from Manitoba Government. Contact your local community coordinator for more information.

SAFE CATCH

A guide to mercury in fish from **STEPHENS LAKE** under post-impoundment conditions.

Effective until approximately 2030. Fish concentrations will gradually decline after reaching peak conditions (approximately 2023-2027).



best choice:
up to 0.1 ppm



very good choice:
up to 0.2 ppm



occasional consumption:
up to 0.5 ppm



restricted consumption:
over 0.5 ppm



See "Safe Catch" poster for maximum monthly consumption for children, females of childbearing age and other adults.



WHITEFISH ATIHKAMÉK



LOW MERCURY



MODERATE MERCURY



JACKFISH (NORTHERN PIKE) ONHCWÁPÉW



MODERATE MERCURY



HIGH MERCURY



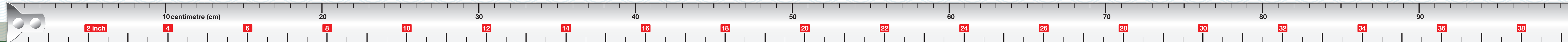
PICKEREL (WALLEYE) OKÁW



MODERATE MERCURY



HIGH MERCURY



Based on guidelines from Manitoba Government. Contact your local community coordinator for more information.

APPENDIX 3: REVISIONS TO POST- IMPOUNDMENT COMMUNICATION MATERIALS BY WILSON SCIENTIFIC.

Technical Memorandum

To: Manitoba Hydro

From: Ross Wilson, M.Sc., DABT, Wilson Scientific Consulting Inc.

Date: June 10, 2022

Re: Keeyask Mercury and Human Health: Suggested Revisions to Post-Impoundment Communication Products

Issue: People should be advised to not consume certain fish in Gull and Stephens lakes to avoid unacceptable exposure to mercury. Currently, prepared post-impoundment materials provide recommendations that are for specific sizes (i.e., fish up to standardized sizes) and species of fish according to population categories – sensitive and general, or non-sensitive, groups. There is concern that post-impoundment communication materials (issued in 2021) do not clearly indicate a recommendation to avoid certain fish sizes, such as pickerel and jackfish larger than ‘standardized length size’.

Revisions for Review: To address this issue, the terms “not recommended for consumption” or “restrict/avoid” have been added to the fish tapes and posters wherever fish are identified as “high mercury”. In addition, graphics have been added to the fish tapes instead of wording to communicate this message. Added graphics reflect messaging for specific population groups.

Key Messages:

- Revisions have been reviewed by the Mercury and Human Health Implementation Group (MHHIG). Final revisions are subject to input from the Manitoba Government and MHHIG approval.
- The interpretation of risk to human health and adjustments to communication materials is based on data provided by the Keeyask aquatic biologist (see North/South, 2021), including all references to fish mercury concentrations throughout this memo. Key information provided includes:
 - Peak average mercury concentrations for fish in Gull and Stephens lakes have been predicted for standardized sizes and for various fish size classes. North/South (2022; personal communications) has indicated that standardized size concentrations are considered more reliable indicators of concentrations than size classes and were therefore used as the primary source in the fish consumption recommendations.
 - Size class predictions were nevertheless useful and considered to determine the potential for concentrations in the largest fish classes to exceed the provincial thresholds of 0.5 and 1.5 ppm (e.g., largest size class of whitefish in Gull Lake was predicted by North/South [2021] to exceed 0.5 ppm and, thus, communication products used this information to recommend avoiding Gull Lake whitefish larger than standardized size; see

background supporting information). If a fish in the largest size class approached or exceeded provincial thresholds, it was assumed that all fish above standardized size should be treated similarly (uncertainty with size classes suggested no further use of these predictions beyond this application).

- The Province of Manitoba (2007) fish guidelines indicate that sensitive age groups should avoid fish with mercury greater than 0.5 ppm and all other age groups should avoid fish with mercury greater than 1.5 ppm. Although the Province of Manitoba (2007) considers sensitive age groups to include children under 12 years of age (in addition to women of childbearing age), the fish consumption recommendations provided in the Stephens and Gull lakes products considered children and youth who are 18 years and under to be in the sensitive age group (in addition to women of childbearing age).
- Based on the predicted peak average concentrations and application of Government of Manitoba consumption guidance, the following messages are recommended to be conveyed in the communication products:

Fish from Gull Lake:

- Sensitive age groups: recommended to not consume any size of pickerel or jackfish; and recommended to not consume whitefish greater than 350 mm (14 inches)
- Other age groups: recommended to not consume pickerel greater than 400 mm (16 inches) or jackfish greater than 550 mm (21 inches)

Fish from Stephens Lake:

- All age groups: recommended to not consume pickerel greater than 400 mm (16 inches) or jackfish greater than 550 mm (21 inches)

Revisions to Products:

FISH TAPES: The fish tapes have been adjusted as follows:

- Recommendations have been adjusted to reflect standardized lengths for all three fish species¹.
- The legend of the fish tape currently shows fish mercury concentrations as 'very low' (less than 0.1 ppm), 'low' (0.1 to 0.2 ppm), 'moderate' (0.2 to 0.5 ppm) and 'high mercury' (greater than 0.5 ppm). Reverted legend to corresponding pre-impoundment¹ consumption guidance labels as 'very good choice', 'good choice', 'occasional' and 'restrict' (same concentration ranges are used).

¹ Standardized size lengths are 14 inches for whitefish, 16 inches for pickerel and 21 inches for jackfish. Note, the largest size class of Gull Lake whitefish (greater than 18 inches) are predicted by North/South to be above 0.5 ppm but below the 1.5 ppm threshold for non-sensitive groups. Nonetheless, a generalized recommendation for all fish consumers to avoid Gull Lake whitefish larger than the standard length (14 inches) was added to simplify message for the poster. However, the fish tape provides more tailored advice with the recommendation for sensitive age groups only to not consume these larger whitefish in Gull Lake.

- Added graphics to indicate which age category should limit/restrict consumption vs ‘avoid’ for identified fish species and sizes (i.e., if predicted size class concentrations are between the provincial thresholds of 0.5 and 1.5 ppm).

Considerations:

- Non-sensitive groups are advised to limit consumption of fish between 0.5 and 1.5 ppm under Province of Manitoba (2007) guidelines. Inclusion of the message “not recommended for consumption” or “avoid” for all ‘high mercury’ (above 0.5 ppm but below 1.5 ppm) fish could create confusion, discourage the consumption of ‘viable’ fish for non-sensitive groups and generate additional fear about eating and sharing fish in general. This addition of graphics allows for population specific messaging and avoids word clutter.

POSTERS: The posters have been adjusted as follows:

Posters for Stephens Lake have been revised to include text that attempts to convey the following message:

Pickeral greater than 16 inches and jackfish greater than 21 inches are not recommended for consumption by any age group².

For the Gull Lake poster, revisions include text as a banner/stamp that attempts to convey the following message:

Whitefish greater than 14 inches, pickeral greater than 16 inches and jackfish greater than 21 inches are not recommended for consumption by any age group. (There was already text that indicates that pickeral and jackfish up to standardized size are to be avoided by sensitive age groups.)

Considerations:

- For whitefish greater than 14 inches in Stephens Lake, no consumption recommendations are provided in the poster. North/South (2021) has predicted peak average concentrations of 0.318 ppm for the largest whitefish size class (greater than 18 inches) in Stephens Lake; however, these predictions are not considered by North/South (2022; personal communications) to be as reliable as the standardized size concentration and so were not used in formal quantitative consumption recommendations. Nevertheless, it does create the void that people are not advised as to how much of the largest size whitefish can be consumed in Stephens Lake (i.e., the consumption recommendation in the poster is for people consuming whitefish less than or equal to 14 inches). If this causes a concern, it is suggested that wording could be added to the Stephens Lake poster

² The posters do not actually use the words “by any age group” and instead it is implied. If further clarity is desired, “by any age group” could be added to the poster. Note the fish tape demonstrates specific guidance based on age category.

that if people consume whitefish larger than 14 inches that a community representative be contacted.

Background Supporting Rationale for Recommendations

In Province of Manitoba (2007), sensitive age groups are advised to not consume fish with mercury concentrations greater than 0.5 ppm. Under peak conditions, North/South (2021) has predicted the following mercury concentrations:

- Gull Lake: pickerel and jackfish of all size categories and the largest size whitefish (i.e., greater than 450 mm [18 inches]) were predicted to have peak average mercury concentrations greater than 0.5 ppm. Thus, Gull Lake pickerel and jackfish of all sizes and whitefish greater than standard length were assumed in this memo to have mercury concentrations greater than 0.5 ppm—although North/South predicted that only the largest size class of Gull Lake whitefish would be above 0.5 ppm, it was conservatively assumed that Gull Lake whitefish greater than standardized size of 350 mm [14 inches] could have mercury concentrations greater than 0.5 ppm due to uncertainties in the size class predictions; and
- Stephens Lake: standardized size pickerel at 400 mm (16 inches) and standardized size jackfish at 550 mm (21 inches) were predicted to have peak average mercury concentrations equal to 0.5 ppm. Thus, Stephens Lake pickerel and jackfish greater than standardized size were assumed in this memo to have mercury concentrations greater than 0.5 ppm.

Accordingly, the communication products should advise sensitive age groups to avoid certain fish from Gull and Stephens lakes, that is those with predicted peak average mercury concentrations greater than 0.5 ppm.

Currently, the posters are based on the concept that people can eat certain amounts of fish up to the 'standardized length' sizes (14 inches for whitefish, 16 inches for pickerel and 21 inches for jackfish); however, the posters do not provide recommendations for fish greater than these lengths. Previous fish tapes for post-impoundment provide mercury concentration categories (rather than consumption recommendations) without the avoid recommendation.

In the case of non-sensitive age groups, the fish tapes and posters should ideally communicate that certain fish are recommended to not be consumed by this age group (i.e., those fish with mercury concentrations above 1.5 ppm are not recommended for consumption by even non-sensitive age groups). Under peak conditions, North/South (2021) has predicted the following mercury concentrations:

- Gull Lake: while standardized size pickerel at 400 mm (16 inches) and jackfish at 550 mm (21 inches) were predicted to have peak average mercury concentrations of 1.0 ppm, pickerel size classes of 400 to 550 mm (i.e., 2.38 ppm) and greater than 550 mm (i.e., 3.38 ppm) and jackfish size classes of 500 to 750 mm (i.e., 1.54 ppm) and greater than 750 mm (i.e., 3.55 ppm) were predicted to have peak average mercury concentrations that exceeded 1.5 ppm. Thus, Gull Lake pickerel greater than standardized size of 16 inches (400 mm) for pickerel and Gull Lake jackfish

greater than 21 inches (550 mm) were assumed in this memo to have the potential for peak average mercury concentrations greater than 1.5 ppm and were recommended to be avoided by non-sensitive age groups.

- Stephens Lake: while standardized size pickerel at 400 mm (16 inches) and jackfish at 550 mm (21 inches) were predicted to have peak average mercury concentrations of 0.5 ppm, pickerel greater than 550 mm (21 inches) (i.e., 1.48 ppm³) and jackfish greater than 750 mm (29 inches) (i.e., 1.85 ppm) were predicted to have peak average mercury concentrations that were equal to or exceeded 1.5 ppm. Although North/South (2021) did not predict the middle size classes of pickerel or jackfish as exceeding 1.5 ppm, these size class estimates were not considered to be as reliable as the standardized size estimates (North/South, 2022; personal communications). Instead, Stephens Lake pickerel greater than standardized size of 16 inches (400 mm) for pickerel and jackfish greater than standardized size of 21 inches (550 mm) were assumed in this memo to have the potential for peak average mercury concentrations greater than 1.5 ppm and were recommended to be avoided by non-sensitive age groups.

For persons who are not in the sensitive age groups, the Province of Manitoba (2007) indicates that fish above 1.5 ppm should not be consumed; however, as described above, the previous posters are focused on consumption of fish up to specified standardized lengths (e.g., Gull Lake poster advises “all others” that they can consume 1 lb, 14 oz per month for jackfish up to 21 inches but it does not indicate that “all others” should avoid jackfish larger than 21 inches). Thus, the posters and fish tapes were revised to provide advice on which fish are not recommended for consumption by non-sensitive individuals.

It is possible that some pickerel and jackfish caught in Stephens Lake may have migrated from Gull Lake. The largest class sizes of pickerel and jackfish from Gull Lake (i.e., pickerel greater than 21 inches and jackfish greater than 29 inches), are predicted to exceed 3 ppm as average concentrations under peak conditions. Inclusion of the “not recommended for consumption” message for Stephens Lake pickerel greater than 16 inches and jackfish greater than 21 inches will further reduce the likelihood that these largest Gull Lake fish will be inadvertently consumed in Stephens Lake.

A key drawback to this approach is that predictions for Stephens Lake size classes for pickerel between 16 and 21 inches (i.e., 0.922 ppm), pickerel over 21 inches (i.e., 1.48 ppm) and jackfish between 19 and 29 inches (i.e., 0.704 ppm) do not exceed the Province of Manitoba (2007) threshold of 1.5 ppm for non-sensitive age groups. As a result, this approach may be more restrictive than the provincial recommendations. Nevertheless, given the uncertainties of predicting mercury concentrations for size class and the unknown aspect of travel of fish from Gull Lake into Stephens Lake, it was considered to be prudent to recommend that all persons avoid Stephens Lake pickerel greater than 16 inches and Stephens Lake jackfish greater than 21 inches.

³ Although 1.48 ppm did not exceed 1.5 ppm, North/South (2022; personal communication) indicated that there is a higher degree of uncertainty in the size class predictions and, consequently, consumption of these fish was recommended to be avoided for the purposes of the communication materials (i.e., the predicted concentration was essentially treated as an exceedance of 1.5 ppm).

With the above in mind, the following approach was developed for determining when **recommendations to not consume** were applied on the communication materials (posters and fish tapes):

- No changes to recommendations when predicted concentrations for standardized size fish (and larger) were less than or equal to 0.5 ppm. If predicted concentrations for standardized size fish were less than or equal to 0.5 ppm but largest size class predictions for such fish were greater than 0.5 ppm, fish larger than standardized size should be designated as “not recommended for consumption by any age group” in the communication products (this approach was used for Stephens Lake pickerel and jackfish and Gull Lake whitefish).
- When predicted concentrations for standardized size fish exceeded 0.5 ppm but were less than 1.5 ppm, fish up to standardized size should be designated as “not recommended for consumption by sensitive age groups” while some restricted consumption can occur by non-sensitive age groups. For fish greater than standardized size, these should be designated as “not recommended for consumption by any age group” in the communication products (this approach was used for Gull Lake pickerel and jackfish).

The adjustments in messaging are intended to be more protective of human health and to clarify messaging that certain fish, as indicated above, are not recommended for consumption. The fish tape and poster products are subject to review and input from the MHHIG and health agencies.

Overall Review

After reviewing the posters and revised fish tapes, members of the MHHIG are asked to consider the following:

- Will community members use posters and fish tapes?
- Are recommendations, including proposed adjustments clear? What requires additional clarification, either through further adjustments, explanation or otherwise?
- Are there other communication products or methods that should be considered? Is there a way to test that these messages are received?

Statement of Limitations

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The information and conclusions contained in this report are based upon work undertaken by trained professional staff in accordance with generally accepted scientific practices current at the time the work was performed.

Any site-specific information provided by Manitoba Hydro, North/South Consultants Inc. or other parties has been assumed by Wilson Scientific to be accurate. Conclusions presented in this report should not be construed as legal advice.

This risk evaluation was undertaken exclusively for the purpose outlined herein and was limited to those contaminants, exposure pathways, receptors, and related uncertainties specifically referenced in the report. This work was specific to the site conditions and land use considerations described in the report. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations.

This report describes only the applicable risks associated with the identified environmental hazards, and is not intended to imply a risk-free site. Should any conditions at the site be observed or discovered that differ from those at the sample locations, or should the land use surrounding the identified hazards change significantly, Wilson Scientific requests that to be notified immediately to reassess the conclusions provided herein.

References

North/South. 2021. Predictions of Post-Impoundment Fish Mercury Concentrations for Application in the Mercury and Human Health Risk Management Plan Products. Prepared for Manitoba Hydro. Prepared by North/South Consultants Inc. April 23, 2021.

North/South. 2022. Personal communications; February 2, 2022 email from Jodi Holm to Manitoba Hydro.

Province of Manitoba. 2007. Mercury in Fish & Guidelines for the Consumption of Recreationally Angled Fish in Manitoba. Province of Manitoba, Winnipeg, MB. Available at:
https://www.gov.mb.ca/sd/pubs/fish_wildlife/fish/mercury_infish.pdf.

APPENDIX 4: PRELIMINARY HUMAN HEALTH RISK ASSESSMENT: INTERPRETATION OF 2021 ENVIRONMENTAL DATA BY WILSON SCIENTIFIC

Technical Memorandum

To: Manitoba Hydro

From: Ross Wilson, M.Sc., DABT, Wilson Scientific Consulting Inc.

Date: June 15, 2022

Re: Preliminary Human Health Risk Interpretation of 2021 Environmental Data

DRAFT FOR DISCUSSION

1.0 Introduction

The Keeyask Mercury and Human Health Risk Management Plan was prepared to fulfill the requirements of The Environment Act (Manitoba) License No. 3107 and outlines a range of commitments to monitor and mitigate the risks associated from increased methylmercury in the environment as a result of the operation of Keeyask Generation Project (the Project), including sampling of fish from Gull and Stephens Lakes. As part of this effort, Wilson Scientific Consulting Inc. (Wilson Scientific) has been retained by Manitoba Hydro to assist the Keeyask Hydropower Limited Partnership (KHLP) in meeting Keeyask monitoring and license commitments relating to mercury and human health. This includes conducting a human health risk interpretation of predicted peak concentrations of mercury in fish from Gull and Stephens lakes and other environmental data on mercury from the affected area.

On behalf of the KHLP, Manitoba Hydro has contracted various environmental professionals to estimate peak mercury concentrations (as a modelling effort) and then develop/implement monitoring plans to determine if predicted concentrations are exceeded. The modelled peak mercury concentration forms the basis of the consumption recommendations (i.e., it has been assumed that the modelled peak mercury concentrations for the various media are accurate and will persist until concentrations can be shown to be in decline). The monitoring programs were submitted by the KHLP in fulfillment of the license requirements. These programs are intended to verify that the predicted concentrations are not exceeded. The results of monitoring are used to determine whether the current consumption recommendations for fish (which are based on predicted peak concentrations) remain valid. The results of monitoring will be used in the HHRA that will be undertaken when mercury concentrations are shown to be in the decline phase.

As of the date of this memorandum, the following environmental monitoring reports have been received which have relevancy to the estimation of human health risks:

- fish mercury concentrations: North/South (2021) predicted fish concentrations in Gull and Stephens lake; North/South (2021b) provided mercury concentrations in fish sampled from Stephens Lake in June 2021; and North/South (2022) provided mercury concentrations in fish sampled from Gull and Stephens lakes in August/September 2021; and

- wildlife mercury concentrations: Wildlife Resource Consulting Services MB Inc. (WRCS) (2022) provided mercury concentrations in wildlife as both predictions and sampled from the Keeyask reservoir area in the winter of 2021/2022.

This memorandum provides a preliminary human health risk interpretation of these results and is intended to inform Manitoba Hydro (on behalf of the KHLP) and the Mercury and Human Health Implementation Group (MHHIG) regarding the preliminary interpretation of human health risks from the reported concentrations. In addition to ongoing consultations with partner First Nations, it will be important that health agencies concur with the risk interpretation. A consistent message from all experts will likely reduce confusion and skepticism regarding the safety of consuming fish, wild game and waterfowl. It is understood this memo, as well as related fish mercury data prepared by North/South and wildlife data prepared by WRCS, will be submitted as part of the 2021-22 Socio-Economic Monitoring Plan in fulfilment of annual regulatory reporting requirements. It is recommended that Manitoba Hydro and/or the MHHIG, on behalf of KHLP, continue to engage with and follow up with health agencies to discuss contents within these documents.

All risk interpretations provided in this memorandum should be considered preliminary. Nevertheless, the approach and results have been part of previous presentations with health agencies and partner First Nations and their representatives. Future dialogue with and feedback from the Partner First Nations and regulatory agencies should be considered prior to making more final conclusions are provided herein. The fish and wildlife sampling program is an ongoing effort and this risk interpretation reflect information provided to date, which may change over time, based on the future monitoring, which is ongoing and planned into operations.

Wilson Scientific has engaged in conversation with the Project biologists to clarify information provided, but a critical analysis of their methodologies and conclusions in the cited reports is beyond the scope of the HHRA. As such, all concentrations and predictions provided by North/South and WRCS have been assumed to be accurate and representative in the Keeyask Project Area.

2.0 Interim Assessment of Human Health Risks

2.1 Fish

The primary approach to interpreting human health risks from fish consumption involved a comparison of the measured fish concentrations in 2021 to the predicted peak average concentrations used in the fish consumption recommendations. Fish consumption recommendations were developed using the predicted peak average concentration for the various fish (see below) and calculating the consumption rate that would result in exposures to mercury that would equal Health Canada's Tolerable Daily Intakes (TDIs) for the various age groups that may consume fish from these lakes. The approach was generally consistent with the Province of Manitoba's (2007) approach for developing recreational fish consumption guidelines, Health Canada's fish consumption approach (Health Canada, 2007) and risk assessment advice from Health Canada (Health Canada, 2007; 2021). Based on this approach, the measured fish concentration was less than the predicted peak average concentration; no unacceptable risks were predicted from that fish species for a person following the fish consumption recommendations.

Summary of the Comparison of Measured Fish Data to Predicted Peak Average Concentrations

In development of the fish consumption recommendations, the following mercury concentrations for standardized fish from Gull and Stephens lakes provided by North/South (2021a) were assumed to be representative of peak average concentration:

- Gull Lake jackfish at 550 mm: 1.0 ppm
- Gull Lake pickerel at 400 mm: 1.0 ppm
- Gull lake whitefish at 350 mm: 0.19 ppm
- Stephens lake jackfish at 550 mm: 0.5 ppm
- Stephens lake pickerel at 400 mm: 0.5 ppm
- Stephens lake whitefish at 350 mm: 0.15 ppm

Based on the most recent fall fish sampling data collected in August and September 2021, North/South (2022) has indicated reasonable confidence that the concentrations are not likely to be exceeded as peak average concentrations for jackfish and pickerel up to various standardized lengths. For all fish other than Stephens Lake jackfish, the most likely estimates and the upper 95th percent confidence limits are less than the predicted peak average concentrations and, thus, there would seem to be high confidence that there are no exceedances. In the case of Stephens Lake jackfish, the most likely estimate is 0.448 ppm while the upper 95% confidence limit is 0.520 ppm which slightly exceeds the peak average concentration prediction; however, the 95% confidence limit is less than 0.6 ppm which is the plus 20% value for triggering a change in communication products. As a result, the North/South (2022) data indicates reasonable confidence from the fall 2021 sampling that there is unlikely an exceedance of predicted peak average concentration and high confidence there are no exceedance of the plus 20% value for triggering a change for consumption recommendations for jackfish and pickerel from Gull and Stephens lakes.

In addition to the fall sampling, jackfish and pickerel were also sampled from Stephens Lake in June 2021 (North/South, 2021b). This sampling dataset was appreciably smaller than the fall sampling dataset and North/South was not able to calculate a mercury concentration for standardized size fish for pickerel. In the case of jackfish, the mercury concentration for standardized size of 550 mm was estimated by North/South to be 0.45 ppm with an upper 95% confidence limit that was just under 0.6 ppm (i.e., the 95% confidence limit was slightly less than the trigger value of 0.6 ppm). North/South indicated reasonable confidence that this sampling effort indicated that their peak average predictions remain robust and valid.

In the case of whitefish from Gull and Stephens lakes, North/South (2022) was not able to estimate mercury concentrations for standardized size fish. In the case of Gull Lake whitefish, North/South (2022) indicated a bimodal distribution exists that prevent the calculation while for Stephens Lake whitefish, there was not sufficient number of whitefish caught. Using their best professional judgement, North/South (2022) has indicated confidence that their predictions for whitefish from Gull and Stephens lakes remain reasonable for standardized size fish.

Overall, North/South (2022) has concluded that they have reasonable confidence in their predictions of peak average concentrations for standardized jackfish, pickerel and whitefish from Gull and Stephens lakes. North/South (2022) has concluded the 2021 fish data indicates that there are no exceedances of the predicted peak average concentrations (the predicted peak average concentrations are a key aspect of the consumption recommendations).

Risk Interpretation for those Following Consumption Recommendations

In addition to no change in peak average mercury concentrations in fish, none of the other input parameters used to estimate consumption recommendations have changed. More specifically, the Health Canada Tolerable Daily Intakes for methylmercury remain applicable for the sensitive age groups (TDI = 0.2 µg/kg bw/day) and non-sensitive group (TDI = 0.5 µg/kg bw/day). The other input parameters body weights and amortization factor also remain valid and reasonable. Since the predicted peak average concentrations and human health risk assessment input assumptions have not changed, the Wilson Scientific (2021; revised 2022) consumption recommendations remain valid.

As a result, for those who do not consume fish larger than standardized size and do not consume at rates greater than specified in the fish consumption recommendations, the intake of mercury is estimated to be equal to the current TDIs specified by Health Canada and the World Health Organization (i.e., TDIs of 0.2 µg/kg bw/d for children up to 18 years of age and women of childbearing age and 0.5 µg/kg bw/d for all others).

With the above in mind, there are certain cautions that should be considered based on the recent fish data. Firstly, North/South (2021a) has predicted that certain fish will eventually have very high mercury concentrations. Gull Lake jackfish and pickerel larger than standardized size are of particular concern (e.g., the largest size classes of these fish in Gull Lake are predicted to eventually have average mercury concentrations that will exceed 3 ppm). While sensitive age groups are recommended to avoid all sizes of jackfish and pickerel, it is especially important that these larger fish are not consumed. The size and frequency that such meals are consumed would be important factors in predicting the consequences of eating such fish and so it is difficult to estimate the harm that could occur; however, information from Health Canada, World Health Organization and the Province of Manitoba would support the message that consumption of such high mercury fish should be avoided. If persons are consuming these fish on even an occasional basis (i.e., a large serving once per month), the Health Canada and WHO provisional TDIs will be exceeded, and elevated hair concentrations of mercury may be expected. It is emphasized that non-sensitive age groups are also of concern and are advised to not consume Gull Lake jackfish and pickerel larger than standard size.

The message of not consuming jackfish and pickerel larger than standardized size is also important for Stephens Lake. The mercury concentrations in Stephens Lake jackfish and pickerel are not expected to be as significantly elevated as Gull Lake; however, the largest size classes of these fish in Stephens Lake could approach or exceed 1.5 ppm according to North/South (2021a) predictions. In addition, it is possible that some jackfish and pickerel caught in Stephens Lake may have originated from Gull Lake and, thus, have mercury concentrations that are closer to the Gull Lake predictions. Consequently, it remains an important message that persons do not consume Stephens Lake jackfish or pickerel that are larger than standardized size.

It is also noted that North/South (2022) has reported high mercury concentrations in lake sturgeon from Gull Lake. As discussed in North/South (2022), lake sturgeon are not part of the formal monitoring program and only two lake sturgeon were sampled (they were inadvertently caught and died during the sampling program). The mercury concentrations in both of these lake sturgeon exceeded 0.5 ppm (0.69 and 0.70 ppm). Despite a limited dataset, the Project biologist has indicated these concentrations are likely representative of typical lake sturgeon. Therefore, it would be recommended that these fish are not

consumed by sensitive age groups (those under 18 years of age and women of childbearing age) and consumed only on a restricted basis by non-sensitive age groups. At the current time, it is recommended that the partner First Nations and agencies consider these results and meet in the near future to discuss, including the potential for voluntary sample submission.

North/South (2021a; 2022) provides information on mercury concentrations in fish from Split Lake, but because there are no predicted effects on Split Lake as a result of mercury, the risk interpretation and consumption recommendations for Split Lake are not evaluated as part of this assessment. In addition, tributaries to Stephens and Gull lakes are not part of this assessment. Although it is possible that some fish may migrate into these tributaries, there is no sampling program or estimates of mercury concentrations. Finally, fish migration from Gull Lake into Clark Lake was not evaluated as part of this assessment. It is recommended that the MHHIG be aware of the outcomes of fish movement studies undertaken to assess extent of movement from Gull Lake to Clark Lake or other waterbodies.

Overall, the North/South (2021a, b; 2022) fish dataset provides support for the current fish consumption recommendations for Stephens and Gull lakes being protective of human health; however, the dataset also illustrates the toxicological importance of consuming fish that are less than standardized size from both of these lakes.

2.2 Wild Game

In October 2009, representatives of the partner First Nations convened to provide the key wild game that were of primary concern to them from a mercury perspective. In addition, estimates of how often and how much of each food were consumed were provided by the Partner First Nations at the workshop. For persons who enjoy the above foods, the following foods and consumption rates were estimated (when the food was in season or available):

- beaver: consumed 3 times per week (57 g/serving for young child; 200 g/serving for adult);
- muskrat: consumed once per week (57 g/serving for young child; 200 g/serving for adult);
- snowshoe hare: consumed once per week (57 g/serving for young child; 200 g/serving for adult); and
- moose: consumed 5 times per week (100 g/serving for young child; 400 g/serving for adult).

As part of the planned monitoring outlined in the Terrestrial Effects Monitoring Plan, and the invaluable participation of a registered trapline holder and his assistants in the winter of 2021/2022, WRCS (2022) obtained and submitted 5 samples of muskrat (kidney, liver and muscle) and 5 samples of beaver (kidney, liver and muscle) from the Gull Lake area for total mercury analysis. In addition to these species, 2 samples of mink (kidney, liver and muscle) and 3 samples of river otter (kidney, liver and muscle) were received and submitted for total mercury analysis; however, there is no current knowledge of human consumption of mink or otter (these animals were not identified as foods people consume in the 2009 workshop or the 2020 food survey prepared in conjunction with hair sampling program). WRCS (2022) submitted these tissues for mercury analysis to confirm predicted effects (the EIS predicted an increase in mercury concentration in river otter as they consume fish).

WRCS (2022) reported low concentrations of mercury in beaver and muskrat and concluded that the mercury concentrations do not appear to have changed from prior to impoundment. Although WRCS (2022) does caution that the sample size for beaver and muskrat is low, WRCS (2022) also indicated that

their review of the information indicates that their predicted peak concentrations from the EIS remain valid and unchanged for these species. The mercury concentrations that were measured and the reaffirmed predictions are summarized in Table 1 below.

Table 1: Summary of Predicted Mercury Concentrations in Beaver and Muskrat Muscle Tissue from WRCS (2022)

Species	Range of Concentrations Reported for Winter 2021/22 Samples (mg/kg; wet weight) (n=5)	Arithmetic Mean Concentration Reported for Winter 2021/22 Samples (mg/kg; wet weight) (n=5)	WRCS Predicted Peak Concentration – Arithmetic Mean and Most-likely Range in Parentheses (mg/kg; wet weight)*
Beaver	<0.001 to 0.0159	0.006	0.01 (<0.01 to 0.05)
Muskrat	0.0041 to 0.0141	0.008	0.04 (<0.01 to 0.12)

*WRCS (2022) predicted peak concentrations are the same as those estimated for the previous EIS and used in Wilson Scientific (2013)

Since the concentrations of mercury in beaver and muskrat muscle remain below the concentrations assumed in the previous HHRA and none of the other input assumptions have changed (i.e., TRVs remain current positions of Health Canada and WHO; other input assumptions have not changed), the previous results of no unacceptable risks from consumption of these animals remain valid (3 meals per week of beaver muscle and 1 meal per week of muskrat were assumed in the previous HHRA).

In the case of the mercury concentrations in kidney and liver of beaver and muskrat, these organs were not indicated as consumed by people and so it is unlikely that these are a key concern from a mercury perspective. In addition, although the mercury concentrations in kidneys are higher than muscle, the maximum concentrations (i.e., 0.0447 mg/kg wet weight in beaver kidney and 0.052 mg/kg wet weight in muskrat kidney) are still relatively low and these organs represent likely only a small fraction of the animal even if they were consumed. As a result, it would seem that there is low toxicological risk from the organs of these animals.

As indicated above, there is no information suggesting that persons are consuming mink or river otter. With this in mind, the mercury concentrations reported by WRCS (2022) for mink and river otter is substantially higher than either beaver or muskrat and these animals would not be recommended for consumption by any age group but particularly not for the sensitive age group. As shown in WRCS (2022), the maximum muscle concentration was 0.659 mg/kg wet weight for mink (n=2) and 2.48 mg/kg wet weight for river otter (n=3). WRCS (2022) stressed that this is a very small sample size but that concentrations were in the range predicted in the EIS. Nevertheless, it may be prudent to determine this lack of consumption of mink and river otter remains the case and that people are aware that the mercury concentrations in mink and river otter is quite different from muskrat and beaver.

In the case of snowshoe hare and moose, WRCS (2022) has indicated that no samples have been submitted for mercury analysis by the First Nation partners at the current time but that they have confidence in their previous estimates of mercury tissue concentrations. Although WRCS (2022) has indicated that their conclusion remains that mercury concentrations in snowshoe hare and moose are

unlikely to change post-impoundment, the previous estimates were based on literature values and the actual tissue concentrations had greater uncertainty than other species. In addition, there was no previous estimate of mercury concentrations in liver or kidney of these animals. Consequently, any opportunity to obtain actual samples should be undertaken to improve the confidence in WRCS (2022) estimates are not being exceeded following impoundment. Nevertheless, WRCS (2022) has indicated their mercury concentration estimates remain valid for snowshoe hare and moose (see Table 2). Using the same concentrations as reported by WRCS (2022), no unacceptable risks were predicted in the previous HHRA for persons consuming 5 meals per week of moose muscle or 1 meal per week of snowshoe hare muscle.

Table 2: Summary of Predicted Mercury Concentrations in Moose and Snowshoe Hare Muscle Tissue from WRCS (2022)

Species	Predicted Range of Concentrations under Peak Conditions (mg/kg; wet weight)	Predicted Arithmetic Mean Concentration under Peak Conditions (mg/kg; wet weight)*	Predicted Change in Concentrations from Prior to Impoundment to Peak Conditions
Moose	<0.01 to 0.17	0.07	No change
Snowshoe hare	<0.01 to 0.12	0.05	No change

*WRCS (2022) predicted peak concentrations are the same as those estimated for the previous EIS

Overall, at the current time, there is no information to suggest that persons should be avoiding any of the wild game identified as frequently consumed by the partner First Nations (i.e., beaver, muskrat, snowshoe hare and moose). Nevertheless, as is discussed later in this memorandum, it is recommended that efforts be made to try to increase participation of submission of all wild foods for mercury testing.

2.3 Waterfowl

In October 2009, representatives of the Partner First Nations convened to provide the key waterfowl that were most likely to be consumed and of primary concern to them from a mercury perspective. In addition, estimates of how often and how much of each food were consumed were provided by the Partner First Nations at the workshop. For persons who enjoy consuming waterfowl, the following foods and consumption rates were estimated (when the food was in season or available):

- ducks: consumed once per week (57 g/serving for young child; 200 g/serving for adult); and
- gull eggs (no consumption rate was provided).

In the original EIS, the mercury concentration in ducks was estimated to be equal to or less than whitefish (based on modelling of present and current concentrations and not actual duck data) while no estimate of mercury concentrations in gull eggs was provided. In WRCS (2022), no new data on these wild foods have been provided. Nevertheless, WRCS (2022) has confirmed that they consider the duck estimates to remain valid and have provided an estimate for Canada goose muscle. Table 3 provides the mercury concentrations predicted peak concentrations for waterfowl provided in WRCS (2022).

Table 3: Summary of Predicted Mercury Concentrations in Ducks and Canada Goose Muscle Tissue from WRCS (2022)

Species	Predicted Range of Concentrations under Peak Conditions (mg/kg; wet weight)	Predicted Arithmetic Mean Concentration under Peak Conditions (mg/kg; wet weight)	Predicted Change in Concentrations from Prior to Impoundment to Peak Conditions
Canada goose	None provided	0.03 (approximate)	No change (approximately)
Mallard duck	None provided	<0.19	Up to a 5-fold change

*WRCS (2022) predicted peak concentrations are the same as those estimated for the previous EIS

In the HHRA completed for the EIS, no unacceptable risks from consumption of ducks was estimated when a mercury concentration of up to 0.19 mg/kg wet weight was assumed and one meal per week was assumed. Canada goose was not evaluated in the previous HHRA; however, with an appreciably lower predicted peak concentration of mercury, risks would be even lower for consumption of one meal per week of Canada goose (as compared to ducks). As a result, there is no current information to suggest that people should avoid consumption of mallard ducks or Canada geese.

As noted above, the October 2009 workshop with the Partner First Nations representatives indicated that consumption of gull eggs took place in the spring by some individuals. In the case of gull eggs, no measurements or predicted mercury concentrations are available and, thus, it is not possible to provide an estimate of risks from this food. Gull eggs will likely need to be submitted for mercury analysis if risk estimates are to be calculated for this food group.

3.0 Recommended Future Activities

3.1 Ongoing Dialogue with Partner First Nations and Agencies

Although the fish and wildlife monitoring programs were developed through detailed dialogue with the Partner First Nations, it is recommended that ongoing feedback from the Partner First Nations is received in the near future to ensure that the locations, types of animals and other aspects of the fish and wildlife sampling programs continue to meet the needs of the Partner First Nations. In addition, it is recommended that agency review of these fish and wildlife reports of mercury concentrations be completed to ensure that agencies are accepting of the sampling plan, methods and results. Through their involvement and discussion with MHHIG representatives, health agencies have had a chance to review the preliminary fish results in relation to consumption recommendations and messaging. Nevertheless, by receiving ongoing feedback, the sampling program will have the greatest likelihood of acceptance by the communities and agencies.

3.2 Environmental Monitoring

With respect to the information used from environmental monitoring programs, a detailed HHRA requires the following:

- a strong dataset;
- firm statements on certainty re: exceedance (or not) of predicted concentrations; and
- a mechanism to detect early, exceedances of predicted concentrations.

With this in mind, it is recognized that there are numerous constraints to this sampling and collection of a dataset and ideal statistical power may not be possible.

In the case of fish samples, the June 2022 fish sampling program has been expanded to include approximately double the number of fish that were collected in June 2021 and to attempt to get more fish that are less than standardized size (but greater than 200 mm length). While there is no indication of people eating fish (subsistence) from Gull Lake, there may be merit in future years to consider June sampling in Gull Lake. In the case of the fall (August/September) sampling program, analysis would ideally include a reasonable likelihood that standardized size fish are estimated for all fish.

To enhance the limited dataset of wildlife, exploring additional options to encourage the voluntary sampling programs of wildlife and plants would contribute to the feasibility of a detailed HHRA. Furthermore, it may be reasonable to attempt to obtain mercury concentrations in wild game for unaffected areas for comparative purposes through the voluntary sampling program.

3.2 Wild Foods Workshop

As discussed earlier, an important aspect of the interpretation of human health risks relies on the wild foods and consumption rates that were identified in the October 2009 workshop with the Partner First Nations. While the food survey, developed in conjunction with the hair sampling program provided information about commonly consumed local, wild and market foods, current information about consumption rates is lacking. It would be productive to revisit the results of this workshop with the Partner First Nations to determine if the wild foods remain the key concerns and if the consumption rates (i.e., frequency and meal sizes) are still applicable.

3.3 Testing of the Communication of Risk Messages

As noted earlier, it is important that the risk messages are communicated in an effective manner. In particular, there are certain fish sizes that need to be avoided. It would be helpful assess whether the messages are well understood and being followed in the larger communities. This would also involve listening to the communities for other methods to communicate the messages.

4.0 Conclusions

Overall, the North/South (2021a, b; 2022) fish dataset provides support for the current fish consumption recommendations for Stephens and Gull lakes being protective of human health; however, the dataset also illustrates the toxicological importance of consuming fish that are less than standardized size from both of these lakes. Although fish in Stephens Lake are predicted to have appreciably lower concentrations than in Gull Lake, ongoing communication efforts that there are fish in both Gull and Stephens lakes that people are advised to limit consumption or avoid altogether are important.

Based on environmental data and predictions provided in WRCS (2022), there is no information to suggest that persons should be avoiding any the wild game identified as frequently consumed by the Partner First Nations (beaver, muskrat, snowshoe hare and moose). Nevertheless, it is recommended that efforts be made to try to increase participation of submission of all wild foods for mercury testing.

Finally, reconvening a wild foods workshop with the Partner First Nations and testing that the communication messages are being received could be very beneficial.

Statement of Limitations

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The information and conclusions contained in this report are based upon work undertaken by trained professional staff in accordance with generally accepted scientific practices current at the time the work was performed.

Any site-specific information provided by Manitoba Hydro, North/South Consultants Inc., Wildlife Resources Consulting MB Inc. or other parties has been assumed by Wilson Scientific to be accurate. Conclusions presented in this report should not be construed as legal advice.

This risk evaluation was undertaken exclusively for the purpose outlined herein and was limited to those contaminants, exposure pathways, receptors, and related uncertainties specifically referenced in the report. This work was specific to the site conditions and land use considerations described in the report. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations.

This report describes only the applicable risks associated with the identified environmental hazards, and is not intended to imply a risk-free site. Should any conditions at the site be observed or discovered that differ from those at the sample locations, or should the land use surrounding the identified hazards change significantly, Wilson Scientific requests that to be notified immediately to reassess the conclusions provided herein.

References

- Health Canada. 2007. Human Health Risk Assessment of Mercury in Fish and Health Benefits of Fish Consumption. Health Canada, Ottawa, ON. ISBN: 978-0-662-47023-6.
- Health Canada. 2009. Prenatal Nutrition Guidelines for Health Professionals: Fish and Omega-3 Fatty Acids. Health Canada, Ottawa, ON. ISBN: 978-1-100-12445-2.
- Health Canada. 2021. Federal Contaminated Site Risk Assessment in Canada: Toxicological Reference Values (TRVs), Version 3.0. Health Canada, Ottawa, ON. ISBN: 978-0-660-36723-1.
- North/South. 2021a. Predictions of Post-Impoundment Fish Mercury Concentrations for Application in the Mercury and Human Health Risk Management Plan Products. Prepared for Manitoba Hydro. Prepared by North/South Consultants Inc. April 23, 2021.
- North/South. 2021b. Results of 2021 Spring Mercury Sampling in Stephens Lake. Prepared by North/South Consultants Inc. June 24, 2021 (revised 5 July, 2021; 6 August, 2021; 10 May, 2022; 1 June 2022).
- North/South. 2022. Mercury in Fish Flesh from the Keeyask Reservoir, Stephens Lake, and Split Lake: 2021. Prepared for Manitoba Hydro. Prepared by North/South Consultants Inc. June, 2022.
- Province of Manitoba. 2007. Mercury in Fish & Guidelines for the Consumption of Recreationally Angled Fish in Manitoba. Province of Manitoba, Winnipeg, MB. Available at: https://www.gov.mb.ca/sd/pubs/fish_wildlife/fish/mercury_infish.pdf (accessed June 8, 2022).
- WHO. 2007. Evaluation of Certain Food Additives and Contaminants: Sixty-seventh Report of the Joint FAO/WHO Expert Committee on Food Additives. WHO technical report series; no. 940).
- Wilson Scientific. 2013. Keeyask EIS Socio-Economic Environment, Resource Use and Heritage Resources Supporting Volume Appendix 5C: Human Health Risk Assessment of the Mercury from the Proposed Keeyask Generation Project. Prepared for InterGroup Consultants. Prepared by Wilson Scientific. April 2013 (revised).
- Wilson Scientific. 2021. Recommended Maximum Monthly Intake Rates for Post-impoundment Fish Consumption from Gull and Stephens Lakes. Prepared for Manitoba Hydro. Prepared by Wilson Scientific. June 7, 2021. Revised June 10, 2022.
- WRCS. 2022. Mercury Monitoring in Wildlife: 2021. Prepared for Manitoba Hydro. Prepared by Wildlife Resources Consulting Services MB Inc. June 2022.

APPENDIX 5: ADOLESCENTS AND METHYLMERCURY BY WILSON SCIENTIFIC

To: Susan Roberecki, Medical Officer of (Environmental) Health, Manitoba

Health From: Ross Wilson, M.Sc., DABT, Wilson Scientific Consulting Inc.

Date: June 16, 2021

Re: Adolescents and Methylmercury: Seeking advice on age classification relating to Keeyask Consumption Recommendations

8.0 Summary:

Based on a review of health agency guidance, discussion with you, Manitoba Hydro, Golder (Keeyask Hair Monitoring lead) and the Keeyask Mercury and Human Health Implementation Group, consumption recommendations developed for the Keeyask post-impoundment products currently consider male teenagers as members of the general population (non-sensitive group). In the absence of specific guidance for *adolescents*, there is a desire to re-evaluate which category male teenagers should be considered in order to be protective of health (from mercury exposure through eating fish) but also promote a healthy fish diet. We are seeking your advice and/or input on whether all adolescents should be considered to be part of the sensitive group in the fish consumption recommendations developed for the Keeyask Project and associated lakes.

9.0 Discussion:

In the development of recreational fish consumption guidelines, Province of Manitoba (2007) used the following tolerable daily intakes (TDIs) from Health Canada and World Health Organization (WHO) sources: 1) a value of 0.2 µg/kg bw/day for sensitive members of the population; and 2) a value of 0.47 µg/kg bw/day for non-sensitive members of the population (see page 5 of Province of Manitoba [2007]; both of these TDIs remain current and are presented in Health Canada [2021]). In defining sensitive versus non-sensitive groups, Province of Manitoba (2007) considered children under 12 years of age and women of childbearing age to be the sensitive group and all others to be in the non-sensitive group. The age cut-off in the Province of Manitoba (2007) approach is quite similar to that used by Health Canada (2007); the Health Canada interpretation only slightly differs by defining sensitive children as “up to 12 years of age” rather than “under 12 years”. On page 11 of Health Canada (2007), the rationale for the age cut-off for their provisional TDI (pTDI) is provided as follows:

"The age at which neurodevelopment would not be as sensitive to the effects of methylmercury and at which sensitivity would be considered equivalent to that of the general population is not clearly established. By default, BCS tends to apply the lower pTDI value to young children up to the age of 12 years."

In providing fish consumption advice on their website, Health Canada (2019a) seems to further suggest that children under 12 years of age and women of childbearing age represent the key sensitive group. Specifically, on this Health Canada website, fish consumption advice for the sensitive population is provided for women who may become pregnant or are breastfeeding,

children between 1 and 4 years of age and children between 5 and 11 years of age (i.e., children older than 11 years of age are not discussed).

In Health Canada (2021), toxicity reference values (TRVs) are provided for numerous substances including methylmercury; however, this report does not specifically address the approach recommended for adolescents. Specifically, on page 35 of Health Canada (2021), sensitive populations are defined as children under 12 years of age and women of childbearing age while non-sensitive populations are listed as adults who are not women of childbearing age (i.e., adolescents are not addressed in either group). Health Canada (2021) cites Health Canada (2007) as the source of the sensitive population TRV and WHO (2007) as the source of the non-sensitive TRV (but as pointed out below, these are in conflict over the age group where sensitivity stops and where non-sensitivity commences).

Notwithstanding the above, we have identified information from both WHO and other Health Canada sources which is suggestive that adolescents should be included in the sensitive group. WHO (2007) includes adolescents up to 17 years of age in the sensitive group; however, the rationale for including this expanded age group is brief and not specific to actual observed methylmercury effects in this age group. In providing their rationale, WHO (2007; pages 55-56) indicates that certain brain changes (such as neuronal myelination and re-modelling of brain cortex; and, synaptogenesis) occur into adolescence up to about 17 years of age. Conversely, on pages 58 and 76-77, WHO (2007) suggest including children up to 17 years could overestimate the potency of methylmercury (i.e., toxicological data used in the development of the TDI for the sensitive age group are from fetal exposures). However, WHO (2007) indicates firm data are missing to provide an alternate potency estimate and indicate that the approach and acceptable intake rates could be re-evaluated on a case-by-case basis, such as for populations where local fish consumption is a very important source of nutrition. This consideration is particularly relevant for the Keeyask partner First Nations communities.

The WHO (2007) approach of including adolescents in the sensitive age group for evaluation of methylmercury seems to be adopted by Legrand et al. (2010). Although not a formal Health Canada document, Legrand et al. (2010) is a commentary paper by five senior Health Canada scientists. Legrand et al. (2010) adopt the position that minors up to 18 years of age should be considered in the sensitive group; however, there is little supporting rationale provided aside from citing WHO (2007). One minor difference from the WHO approach is that Legrand et al. (2010) paper considers the sensitive group to include children up to 18 years of age (rather than up to 17 years assumed by WHO [2007]).

The age cut-off cited in Legrand et al. (2010) is also used in certain high-profile Canadian documents. In the Canadian Health Measures Survey (Health Canada, 2019b; see page 88), the Legrand et al. (2010) approach of including adolescents up to 18 years in the sensitive age group is adopted. A similar cut-off age is cited in the most recent versions of the First Nations Food, Nutrition and Environment Study (FNFNES) reports (Chan et al., 2019; see page 129). Although adolescents were not a key part of their evaluation (i.e., hair analysis was only completed for adults), the authors of the FNFNES reports are respected scientists from academia, the Assembly of First Nations, Health Canada and Indigenous Services Canada and, thus, their consideration of this adolescent age cut-off is noteworthy.

Under an approach where under 18 year-olds are considered 'sensitive', fish consumption recommendations for all adolescents 12 to 18 years of age would be equal to those for females of childbearing age (i.e., these are equal since a similar TDI of 0.2 µg/kg bw/day and body weight

of 60 kg would be used for both groups). Note that female adolescents are already in the group of females of childbearing age and so this primarily affects male adolescents; however, the inclusion of male adolescents in the sensitive group may produce clearer and simpler messaging.

If the MHHIG took this approach, consumption recommendations would be revised to include adolescents 18 years and under as part of the sensitive group. This approach would also be applicable to the hair analysis (i.e., 2 ppm in hair would be used as the upper bound target for all adolescents rather than just female adolescents).

In sum, the Province of Manitoba (2007) and Health Canada (2007) approaches differ from WHO and certain other Health Canada guidance. This is a complex issue and the benefits of eating fish versus the effects of methylmercury need to be balanced. On one hand, we see the benefit of being consistent with the Province of Manitoba (2007) approach of using an age cut-off of 12 years of age as we do not want to unnecessarily discourage healthy fish consumption given the known benefits (e.g., Marushka et al. (2017) has reported that diabetes is increased in adults eating less fish in a study with Manitoba First Nations communities). On the other hand, WHO and certain Health Canada guidance indicate that all adolescents should be considered to be in the sensitive group. Further discussion and your input are appreciated on this matter.

References

Chan, L, Batal, M, Sadik, T, Tikhonov, C, Schwartz, H, Fediuk, H, Ing, A, Marushka, L, Lindhorst, K, Barwin, L, Berti, P, Singh, K, Receveur, O. 2019. First Nations Food, Nutrition and Environment Study (FNFNES) Final Report for Eight Assembly of First Nations Regions: Draft Comprehensive Technical Report. Assembly of First Nations, University of Ottawa, Université de Montréal. Available at: www.fnfnes.ca/docs/FNFNES_draft_technical_report_Nov_2_2019.pdf

Health Canada. 2007. Human Health Risk Assessment of Mercury in Fish and Health Benefits of Fish Consumption. Health Canada, Ottawa, ON. ISBN: 978-0-662-47023-6. Available at: https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/merc_fish_poisson-eng.pdf

Health Canada. 2019a. Health Canada Website: Mercury in Fish - Questions and Answers. Health Canada, Ottawa, ON. Available at: <https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/chemical-contaminants/environmental-contaminants/mercury/mercury-fish-questions-answers.html>

Health Canada. 2019b. Fifth Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 5 (2016-2017). Health Canada, Ottawa, ON. ISBN: 2562-9360. Available at: <https://www.canada.ca/content/dam/hc-sc/documents/services/environmental-workplace-health/reports-publications/environmental-contaminants/fifth-report-human-biomonitoring/pub1-eng.pdf>

Health Canada. 2021. Federal Contaminated Site Risk Assessment in Canada: Toxicological Reference Values (TRVs), Version 3.0. Health Canada, Ottawa, ON. ISBN: 978-0-660-36723-1.

Legrand, M., Feeley, M, Tikhonov, C, Schoen, D, Li-Muller, A. 2010. Methylmercury blood guidance values for Canada. Can J Public Health 2010;101(1):28-31.

Marushka L, Batal M, Sharp D, Schwartz H, Ing A, Fediuk K, Black A, Tikhonov C, and Chan HM. 2017. Fish consumption is inversely associated with type 2 diabetes in Manitoba First Nations communities. FACETS 2: 795–818. doi:10.1139/facets-2017-0023. Available at: http://www.fnfnes.ca/docs/Lesya_facets-2017-0023.pdf

Province of Manitoba. 2007. Mercury in Fish & Guidelines for the Consumption of Recreationally Angled Fish in Manitoba. Province of Manitoba, Winnipeg, MB. Available at: https://www.gov.mb.ca/sd/pubs/fish_wildlife/fish/mercury_infish.pdf

WHO. 2007. Evaluation of Certain Food Additives and Contaminants: Sixty-seventh Report of the Joint FAO/WHO Expert Committee on Food Additives. WHO technical report series ; no. 940). Available at: https://apps.who.int/iris/bitstream/handle/10665/43592/WHO_TRS_940_eng.pdf?sequence=1&isAllowed=y

APPENDIX 6: RESULTS, STEPHENS LAKE, SPRING 2021 BY NORTH SOUTH CONSULTANTS

Results of 2021 Spring Mercury Sampling in Stephens Lake, prepared by North South Consultants

24 June, 2021 (revised 5 July, 2021; 6 August, 2021; 10 May, 2022; 1 June 2022)

Program Objectives:

- The validity of predictions about the magnitude and timing of peak mercury concentrations in fish due to the Keeyask Project are being assessed as part of the Keeyask Aquatic Effects Monitoring Program (Keeyask Hydropower Limited Partnership 2015). The Project biologist is confident that the annual monitoring plan identified in the AEMP is robust and sufficient to detect if the predicted peak standard size fish concentrations are exceeded.
 - Since 2009, and throughout the construction phase, monitoring for mercury in fish from Stephens Lake was conducted every three years in concert with the Coordinated Aquatic Monitoring Program, an ongoing program in which samples are collected from the south basin of the lake.
 - Since reservoir impoundment, sampling is conducted annually in Stephens Lake in the late summer/early fall, so that tracking increases in mercury over time, and comparing it with predictions is done more frequently.
- There is some food fishing on Stephens Lake, particularly by FLCN and TCN members, including cabin owners, although information to date indicates it does not serve as a primary domestic fishing source.
- To provide resource users who harvest fish from Stephens Lake information on mercury concentrations in pickerel and jackfish following impoundment, earlier in the year, additional mercury sampling was conducted in the spring 2021 concurrent with other AEMP monitoring programs. This additional monitoring event will continue annually for the next few years.
 - Developed as an early warning measure, the June sampling event is not intended to replace or replicate the AEMP monitoring study, which is required to compare the results against predictions (see above).
- Conducting the full AEMP monitoring study again in Stephens Lake in the spring will not provide more certainty about predictions.
- Spring mercury monitoring is not being conducted on the Keeyask reservoir as it is assumed that food fishing has been non-existent or very limited on Gull Lake prior to impoundment based on feedback received from MHHIG community members.

Study Design:

- Dermal punches were selected to sample tissue for mercury analysis in the spring rather than fillets to limit the number of mortalities for scientific studies.
- Dermal punch samples were to be collected from 8 pickerel and 8 jackfish captured in the reach of Stephens Lake below the Keeyask GS (i.e., south basin) as part of AEMP fish community monitoring studies.

- The number of samples was based on recommendations in Environment Canada's (2012, revised 2014) Metal Mining Technical Guidance for Environmental Effects Monitoring¹ (Section 3.11.4). The maximum number of samples that could be guaranteed by the lab for a 100% rush was also considered in the sample size.
- The size of the fish that can be sampled using a dermal punch is limited to those larger than 200 mm as per Environment Canada's (2012, revised 2014) Metal Mining Technical Guidance for Environmental Effects Monitoring (Section 3.11.4.1). Above 200 mm fork lengths, dermal plugs were to be collected from a variety of lengths to facilitate the calculation of a standard mean mercury concentration.
- Whitefish were not selected for mercury monitoring in the spring because mercury concentrations were predicted to be considerably lower than in the two piscivorous species and as a fall spawning species, whitefish are not expected to be present in the area in the spring.

Preliminary Results:

- Pickerel and jackfish were sampled for mercury on June 3 and 4, 2021 from Stephens Lake below the Keeyask dam.
- Plugs of tissue using a 6 mm dermal punch were collected from 6 pickerel and 8 jackfish.
- Fillets were collected from an additional 3 pickerel and 2 jackfish.
- The concentration of one of the pickerel fillets was considered suspect (low) and was revised by ALS – this revision has been incorporated into the data presented in this brief.
- The concentration of mercury in the plugs and fillets collected in 2021 are plotted against the length of the fish in Figure 1 along with similar data from fish sampled during the CAMP monitoring in 2018.
- Pickerel and jackfish sampled in the spring 2021 were of a narrower size range and generally longer than those captured in the fall as part of fish community monitoring programs for CAMP in 2018 (Figure 1). This was to be expected since these are spring spawning species (typically bigger fish) and fishing occurred in the vicinity of known spawning habitat.
- The concentrations of mercury in dermal plugs are comparable to concentrations in fillet samples² (Figure 1).
 - Figure 1 shows the samples collected in June 2021 fell within the range of mercury concentrations that have been observed historically. As such, there is no evidence that there has been an increase in mercury concentrations in the spring of 2021 compared to 2018.
 - An indicator that mercury concentrations were on the rise in Stephens Lake would have been if several of the biopsied fish results were higher than those collected in 2018.

¹ While the guidance provided by Environment Canada was developed to assist regulated facilities (metal and diamond mines), methodologies for environmental effects monitoring have been used in the design of monitoring programs for other industries (*e.g.*, Wuskwatim GS Aquatic Effects Monitoring Program, oil sand development Regional Aquatic Monitoring Program).

² Fillets and dermal plugs were collected from different rather than the same individual fish as per the protocol due to miscommunication with field staff.

- Fillet and plug tissue samples were pooled to calculate the standard mean. A linear regression of log transformed fork length and log transformed mercury concentration was not significant for pickerel. The range of pickerel lengths sampled in the spring may have been too narrow for the linear regression (Figure 1). Because the relationship was not significant, a standard mean could not be calculated for pickerel sampled in the spring 2021.
- The standard mean concentration of a 550 mm jackfish from Stephens Lake between 1999 and 2021 is plotted in Figure 2. The standard mean mercury concentration of a 550 mm jackfish from Stephens Lake in the spring following impoundment of the Keeyask reservoir was 0.45 ppm. This value is higher than the concentration observed in the same size of fish since 1999, but is below the predicted peak, and within the 95% confidence interval of the standard mean concentration measured in 1999 and the 95% confidence interval overlapped with those of several years post-1999.
- While a standard mean could not be calculated for pickerel, the concentrations of individual fish generally fall within the range of concentrations measured in 2018, before reservoir impoundment.
- Based on a preliminary review of mercury concentrations in pickerel and jackfish sampled in the vicinity downstream of the Keeyask GS in spring 2021, there is no indication that mercury concentrations exceeded the predicted peak mercury used to develop consumption recommendations.
- Mercury monitoring conducted as part of the AEMP in early September 2021 in Stephens Lake confirmed the results of the spring program. The standard mean mercury concentrations later in the season were 0.45 ppm in jackfish (the same concentration as observed in the spring) and 0.44 ppm in pickerel (Holm and Aiken 2022, in prep.). The similarities in the spring and fall programs provide evidence that monitoring under the AEMP program is robust and sufficient to detect if predicted peak mercury concentrations are exceeded and, in conjunction with supplementary Spring sampling, at the earliest possible time.

Next Steps:

The June sampling program will be repeated in 2022 but will attempt to double the sample size (i.e., 16 samples from each species) using the same methodology as in 2021.

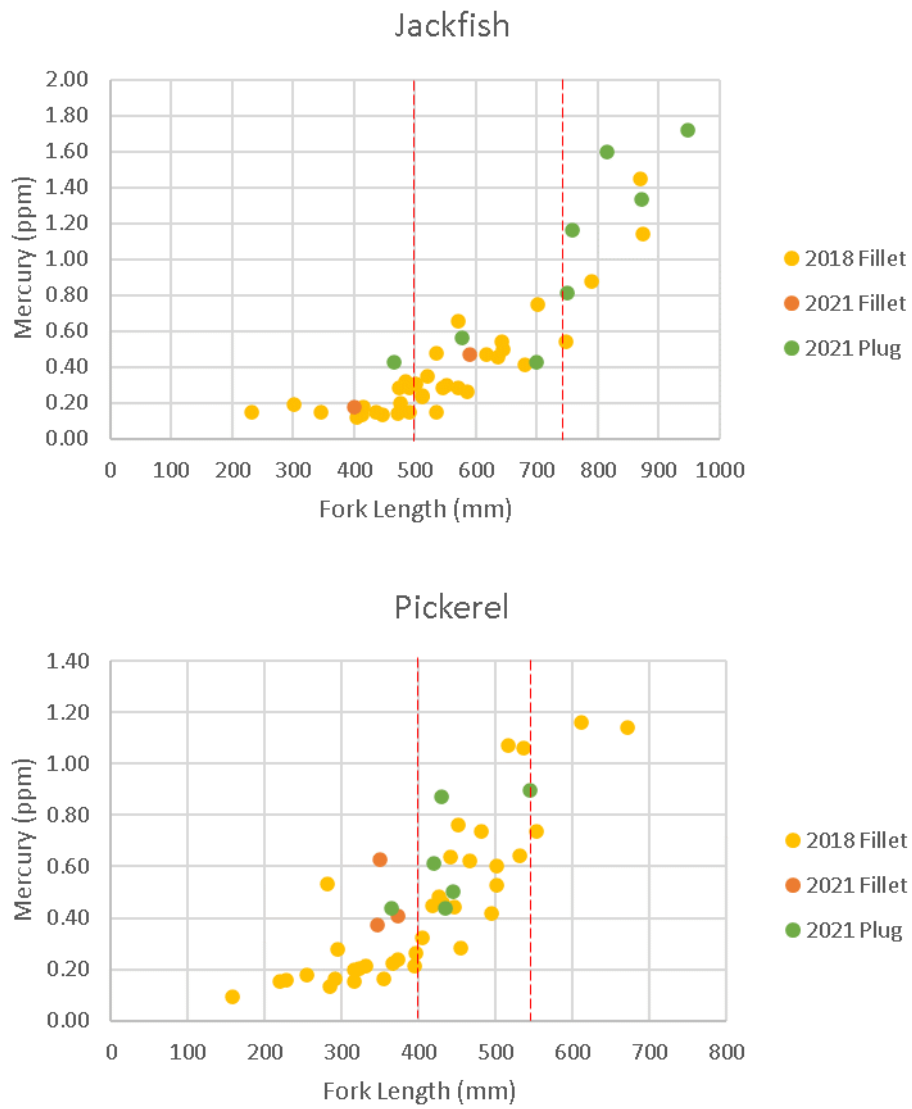


Figure 1. Concentration of total mercury in flesh samples from jackfish (top) and pickerel (bottom) collected from Stephens Lake in August/September 2018 and June 2021 versus fish length. The dashed red lines indicate the size ranges used for the Human Health Risk Assessment.

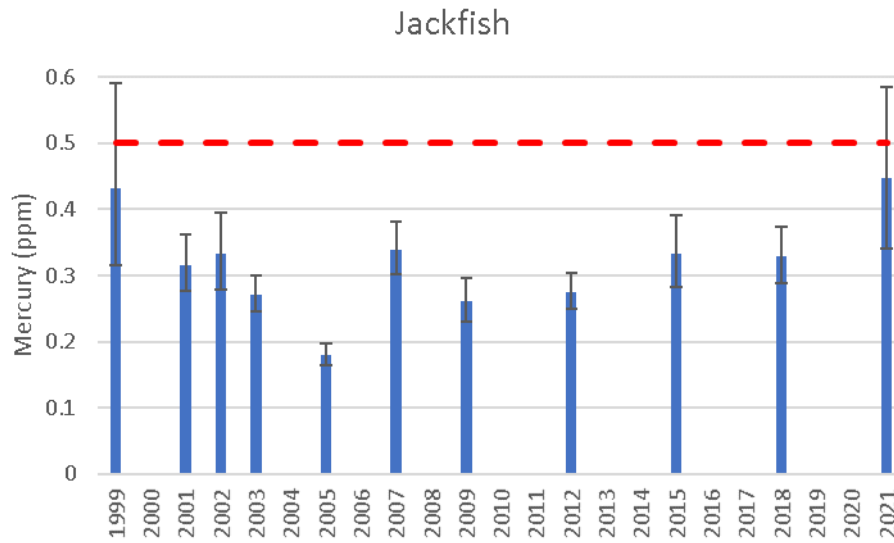


Figure 2. Standard mean mercury concentrations (\pm 95% confidence limits) of a 550 mm jackfish from Stephens Lake from 1999–2021. The red dashed line indicates the predicted peak mercury concentration post-impoundment.

APPENDIX 7: NORTHERN ROAD TRAFFIC MONITORING QUARTERLY DATA COLLECTION SUMMARY APRIL 2021

NORTHERN ROAD TRAFFIC MONITORING QUARTERLY DATA COLLECTION SUMMARY MARCH 2022



Traffic Monitoring Site 10

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Summary

Background

Construction-related activities associated with the development of the Keeyask Project, Keewatinohk Converter Station Project and Bipole III Transmission Project (BPIII) generated additional traffic on various segments of the Provincial Road (PR) network, in particular, on PR 280 and PR 290. Three types of traffic are being realized - local traffic, workforce traffic, and traffic generated from shipping materials and equipment for both local and site specific needs.

The Environmental Impact Statements (EIS) for both the Keeyask Project and the Bipole III Transmission Project (BPIII) contain requirements for continual traffic monitoring throughout the lifespan of these Projects. While the Environmental Impact Statements (EIS) for both the Keeyask and BPIII Projects predicted that existing transportation networks and plans for PR 280 upgrades would be able to accommodate the changes associated with Project construction, communities in the area expressed concerns regarding traffic safety and road conditions. Manitoba Infrastructure (MI) is responsible for the existing provincial highway system, including maintenance and upgrades to PR 280 and PR 290. Monitoring has been ongoing and continues with information from MI, Manitoba Public Insurance (MPI), and the Keeyask site access gates to assess EIS predictions and respond to community concerns.

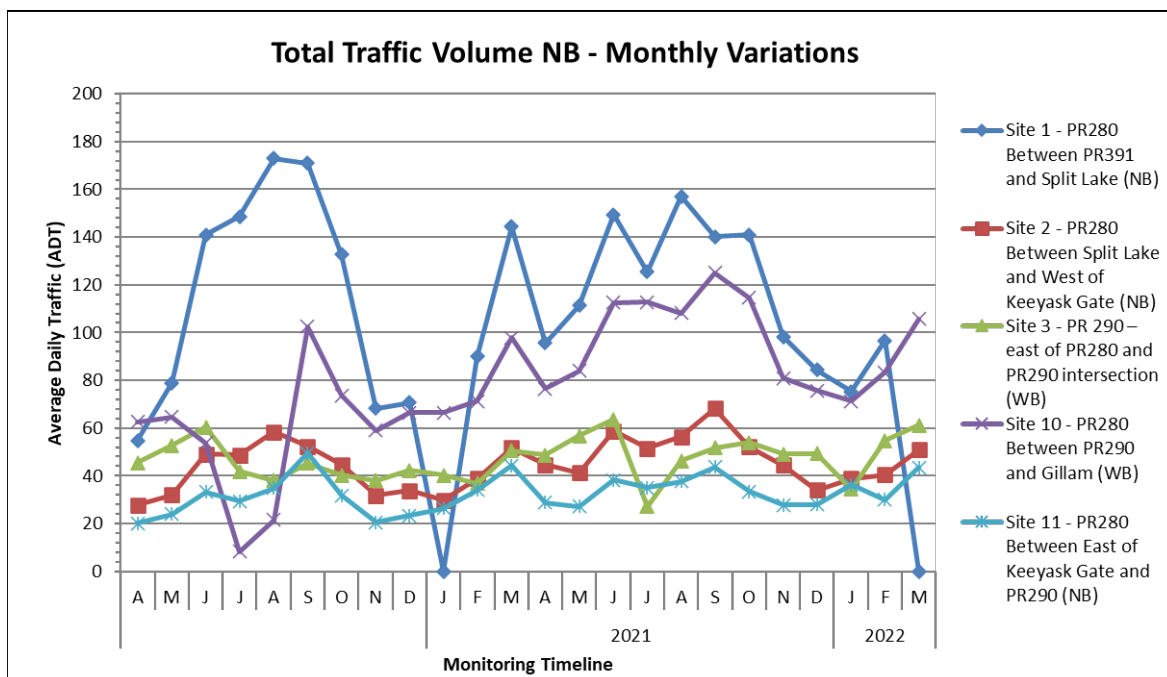
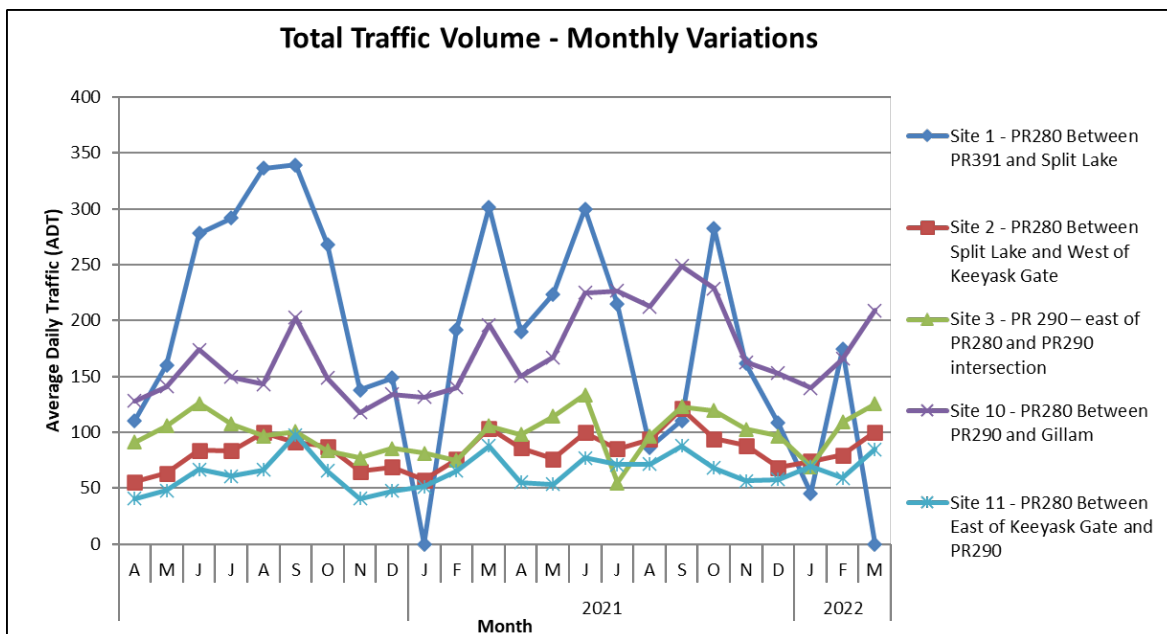
Traffic monitoring stations have been installed at five locations on PR 280 and PR 290 – Site 1, 2, 3, 10 and 11. Refer to **Appendix A** for a map of the traffic monitoring station locations and monitoring station failures. MI installed the stations in 2015 with funding provided by Manitoba Hydro (MH) and MI provides ongoing maintenance of the equipment. MI collects data from the stations and submits the information on a monthly basis to MH. Induction loops are able to differentiate various vehicle types based upon axle count and spacing. Vehicle classifications have been grouped into small, medium and large vehicles as shown in **Appendix B**.

Notable Quarterly Results:

Measures have been implemented to address the Covid-19 global pandemic since March 2020. These measures include the restriction of access on and off the site resulting in a reduction of traffic and gate counts during the quarterly reporting period. Construction activities have decreased due to the progress of the Keeyask Project which also contributes to the slow down of traffic and gate counts. However, the distribution between the restriction of access due to COVID-19 and slow down of construction activities cannot be determined with respect to the impacts on traffic reduction.

Data Collection Results

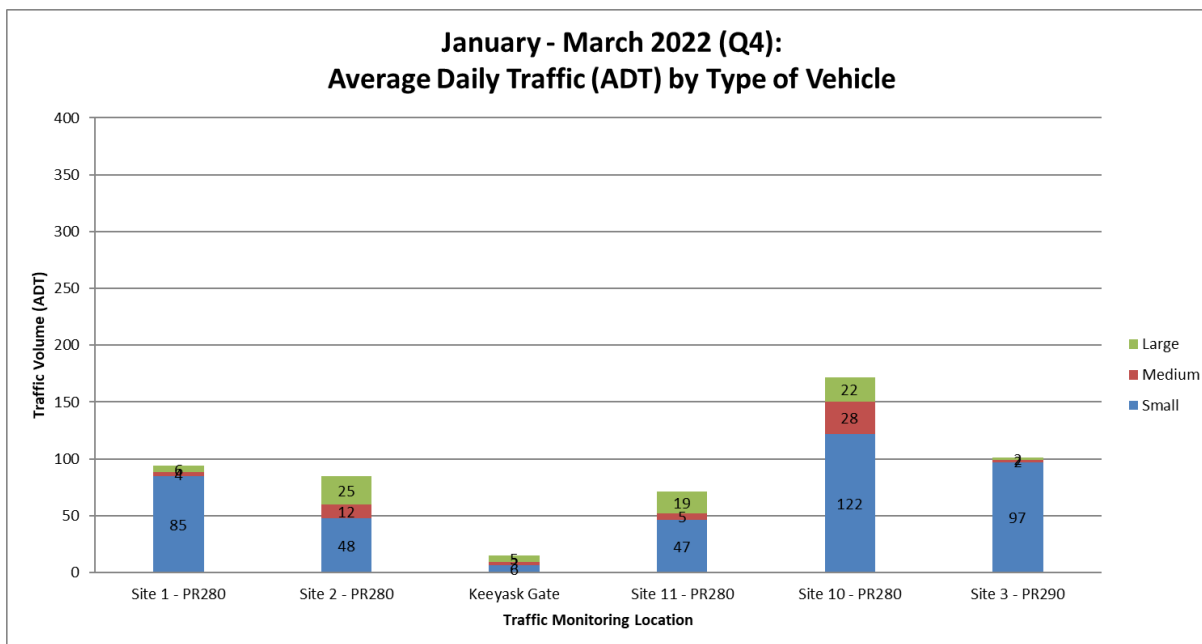
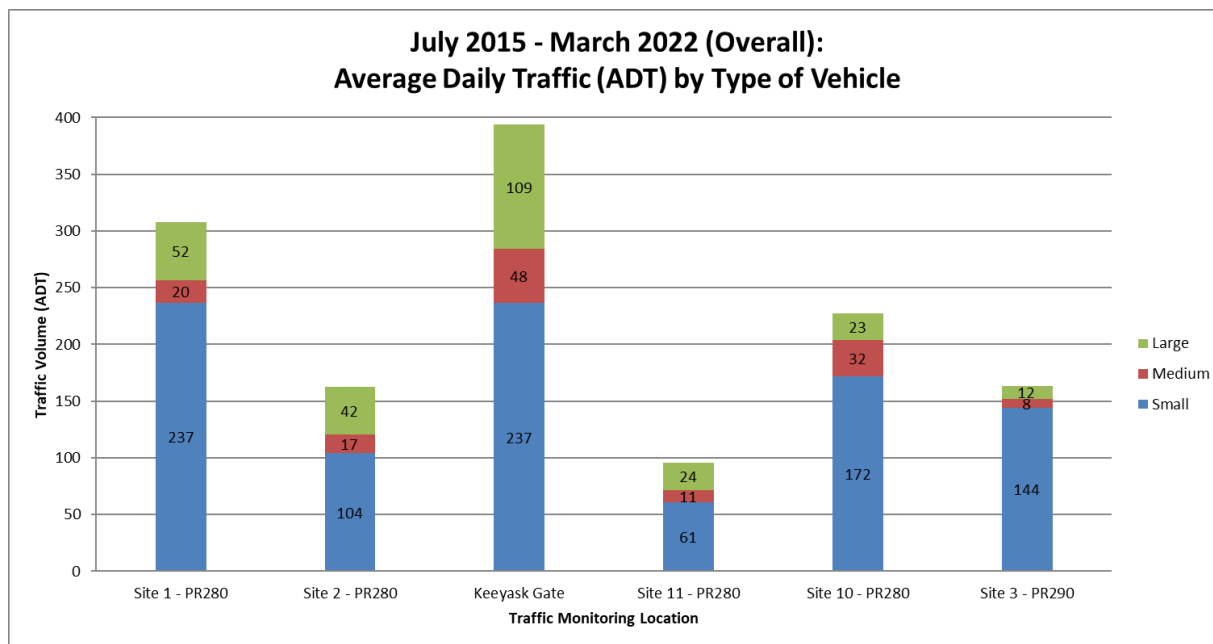
Total Traffic Volume – Monthly



Summary

- Traffic at all sites has reduced since the Feb 2020 COVID-19 time period however; the split between the reduction of project traffic and traffic as a result of COVID-19 cannot be determined.
- During the quarter, Site 1 had monitoring issues in March 2022.

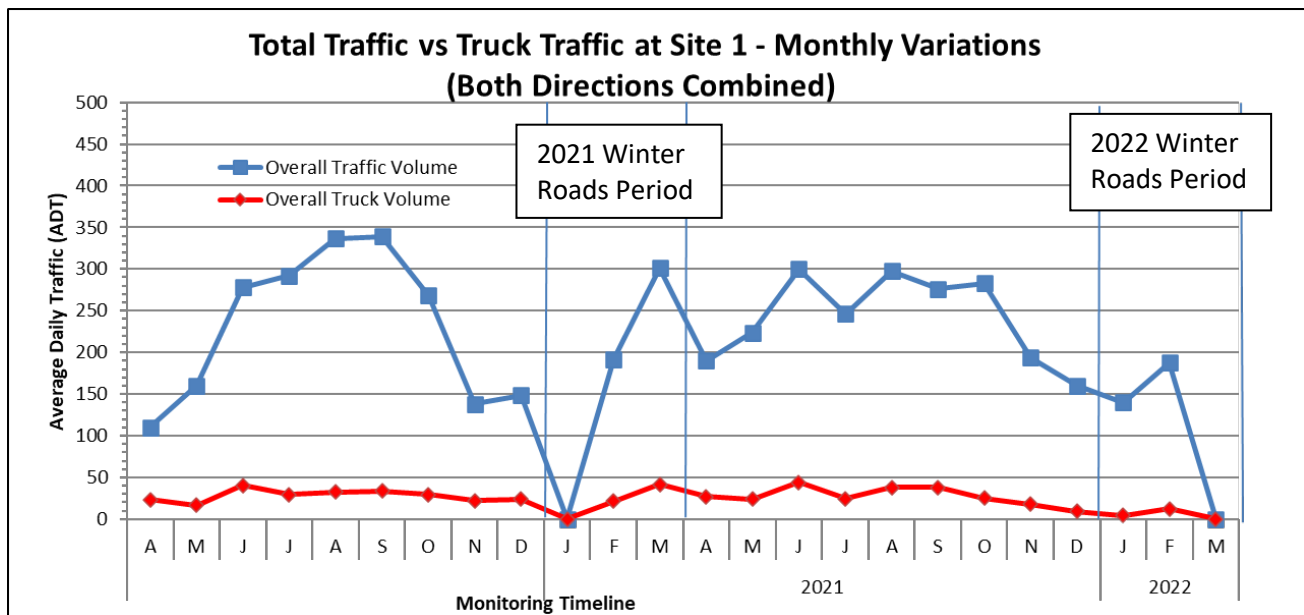
Average Daily Traffic (ADT) – by type of vehicle



Summary

- Small vehicles result in the highest percentage of vehicle type.
- ADT vs traffic type graphs by site location are given in **Appendix C**.

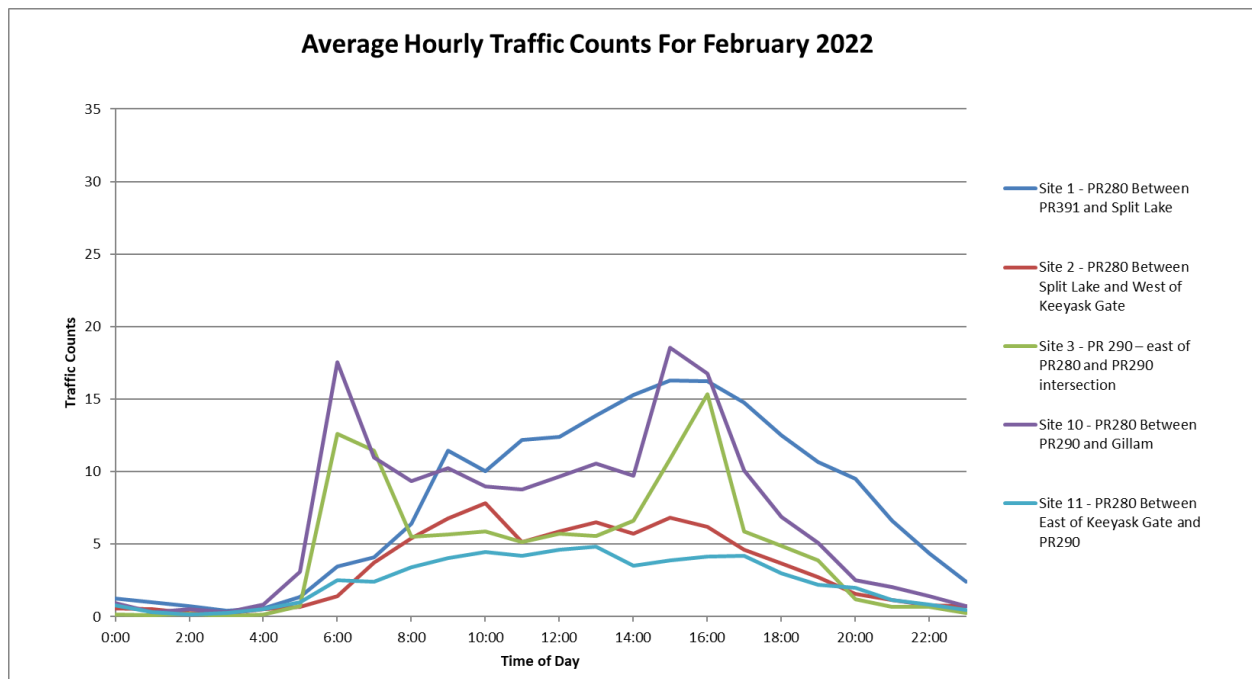
Total Traffic vs Truck Traffic



Summary

- Truck traffic (i.e. large vehicles) graphed against overall traffic does not indicate a correlation to increased volume.
- Truck traffic vs overall traffic graphs for other sites are given in **Appendix D**.
- During the quarter, Site 1 had monitoring issues in March 2022.

Average Hourly Traffic Count



Summary

- Peak travel time between 2 and 6 pm.

Keeyask Security Gate Records

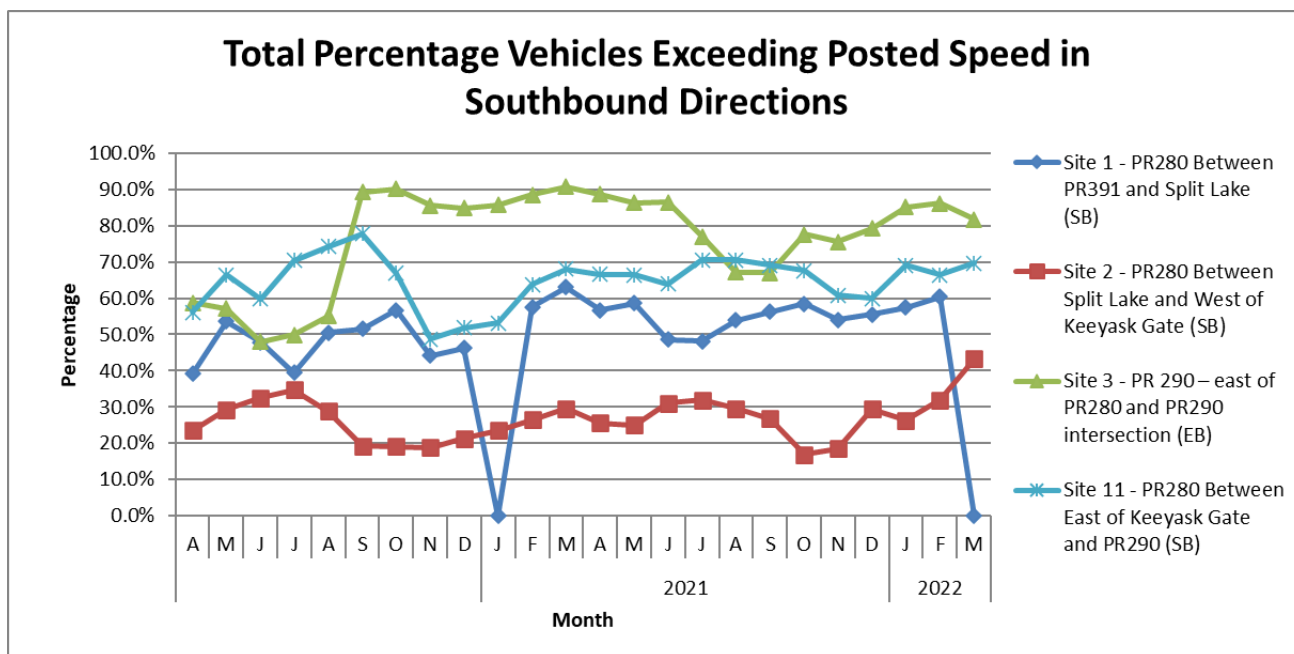
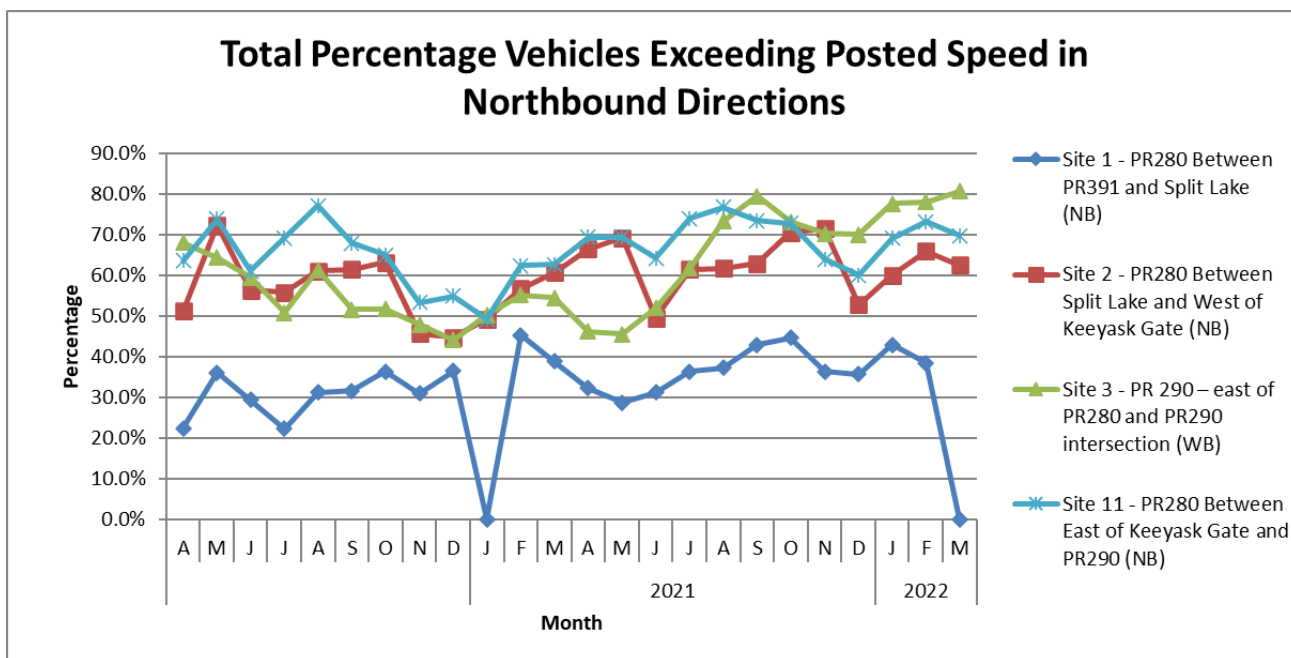
The security gates on the North Access Road and South Access Road into Keeyask collect data on vehicles entering the site. Security personnel located at the gate tracks the type and number of vehicles that enter and leave the site.

KEYYASK NORTH ACCESS ROAD SECURITY GATE				KEYYASK SOUTH ACCESS ROAD SECURITY GATE			
	Period	Gate Count Total	Daily Average		Period	Gate Count Total	Daily Average
2020	April	552	18	2020	April	43	1
	May	398	13		May	113	4
	June	768	26		June	318	11
	July	977	32		July	447	14
	August	1,479	48		August	287	9
	September	2,411	80		September	463	15
	October	2,299	74		October	470	15
	November	744	25		November	256	9
	December	488	16		December	212	7
2021	January	351	11	2021	January	210	7
	February	615	22		February	250	9
	March	698	23		March	871	28
	April	814	27		April	340	11
	May	842	27		May	361	12
	June	1,567	52		June	617	21
	July	1,050	34		July	441	14
	August	1,204	39		August	1,232	40
	September	1,214	40		September	1,322	44
	October	916	30		October	1,388	45
	November	860	29		November	808	27
	December	501	16		December	603	19
2022	January	351	11	2022	January	277	9
	February	460	16		February	268	10
	March	512	17		March	671	22

Summary

- Gate data continues to be consistent with the same time period of the previous fiscal year.
- Restricted access continues due to COVID-19 protocols.

Speeding Analysis



Summary

- Graphs are representative of vehicles exceeding the posted speed limit (>90 km/hr.) as recorded by monitoring stations.
- During the quarter, Site 1 had monitoring issues in March 2022.

Average Vehicle Speed

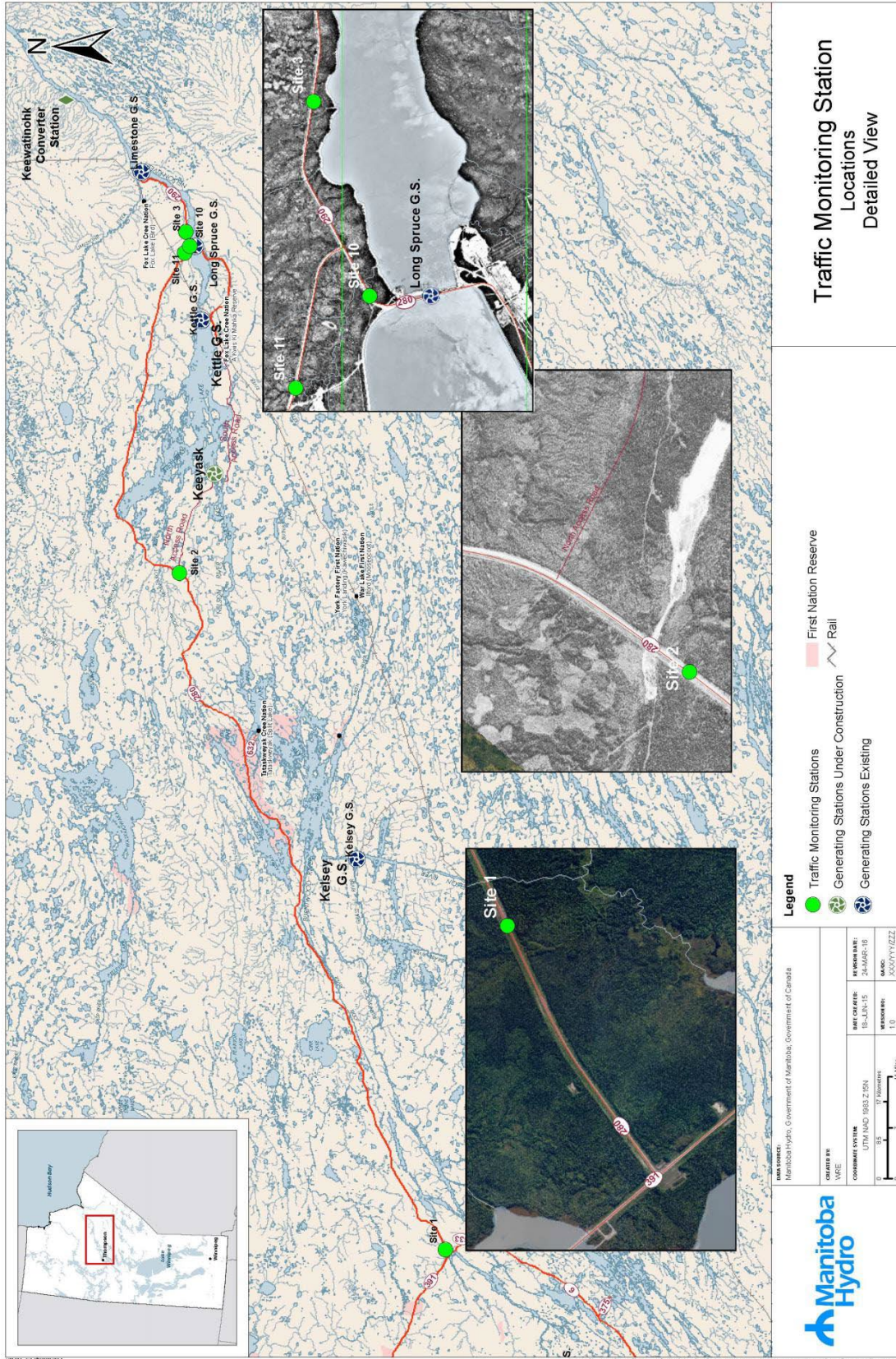
Average Vehicle Speed

Station	Posted Speed	Avg Speed (April to June 2021)			Avg Speed (July to Sept 2021)			Avg Speed (Oct to Dec 2021)			Avg Speed (Jan to March 2022)		
		Small	Medium	Large	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Site 1 – PR280 between PR391 and Split Lake	90 - NB	84	79	76	87	79	79	86	82	82	87	86	84
	90 - SB	91	85	83	91	83	83	92	81	80	91	93	87
Site 2 – PR280 between Split Lake and Keeyask	90 - NB	94	96	86	93	96	88	91	101	94	94	96	85
	90 - SB	80	73	67	80	77	79	77	69	63	84	76	75
Site 3 – PR290 east of PR280/290 intersection	90 - WB	89	85	83	96	100	106	97	90	89	99	88	85
	90 - EB	102	105	103	98	87	95	100	89	92	102	96	95
Site 11 – PR280 north of the PR280/290 intersection	90 - NB	96	87	85	99	93	90	94	87	86	95	93	88
	90 - SB	97	86	84	100	88	87	96	86	84	96	90	88

Summary

- Average Vehicle Speed data results in the small vehicle category averaging the highest speeds.
- Average speed has historically been higher in winter months which can be attributed to frozen road conditions that tend to be smoother and free of dust.
- Speeding has varied throughout the years with a decrease in spring and fall due an increased likelihood of poor road conditions related to weather, road reconstruction, or even to driver awareness initiatives being implemented by MH and MI.
- Monitoring locations give data related to that specific location only.
 - Site 1 station shows higher speeding rates for SB traffic compared to NB traffic due to the monitoring station being in close proximity to the PR 391 intersection.
 - Site 10 located at curve on north side of Long Spruce Generating Station. Vehicles are slowing down to navigate the curve or have just come out of the curve and are still speeding up; therefore speed data for Site 10 was not included in this analysis.
- Speeding information by vehicle type by Station is given in **Appendix E**.

Appendix A – Traffic Monitoring Locations and List of Failures






Monitoring Station Failures:

- Station 1: November 2015 approximately two weeks.
 - Average daily traffic was extrapolated based on the partial month's data collection.
- Station 1: June 2016 approximately three days.
 - Results have been based on a 27 day period rather than 30 days.
- Station 1: July 2016 approximately three weeks.
 - Results are skewed.
- Station 1: July 31, 2017.
 - Loss of data.
- Station 2: September 2017 approximately 2 weeks.
 - Loss of data.
- Station 11: September 2017 approximately 1 week.
 - Loss of data.
- Station 11: June and July 2018 for Station 11.
 - Loss of data due to a recording device error.
- Station 2: March 12 2019 approximately 2 weeks.
 - Loss of data due to recording device error.
- Station 1: March 2020
 - Loss of data due to recording device error.
- Station 1: December 2020 – January 2021
 - Loss of data from December 19- January 31 due to recording device error.
- Station 1: July 2021 – September 2021
 - Monitoring Station issues, will be replaced by Manitoba Infrastructure – date TBD.
- Station 1: November – December 2021
 - Monitoring Station issues.
- Station 1: January – March 2022
 - Monitoring Station issues.

Appendix B - Vehicle Classifications

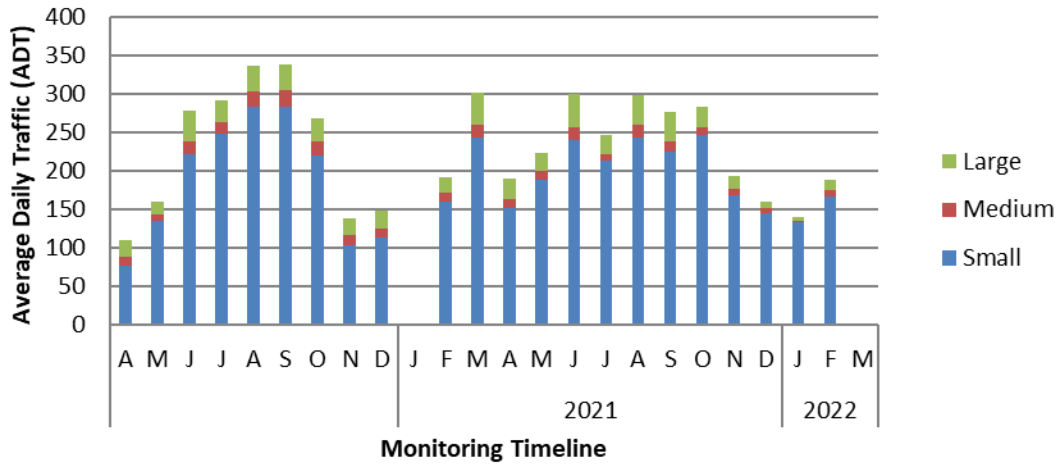
The induction loops that are buried within the roadway are spaced at a given interval. The time it takes for the front axle and rear axle to cross the loops gives an indication of the speed of the vehicle within an accuracy range of +/- 5 km/h. This information is reflective of vehicle speed tendencies at the traffic monitoring station location. The specific location of the traffic monitoring station may impact the speed tendencies dependent upon road geometry in each direction.

Vehicle Category		Vehicle Description	
Small			
Medium			
Large			
Bin 1	Class 1	Small	Cars, truck and vans
Bin 2	Class 2, 3, 4	Medium	Buses, single dual & tandem dual trucks, dual steering with tandem drive
Bin 3	Class 5 and 6	Large	Trucks 5 axles and up

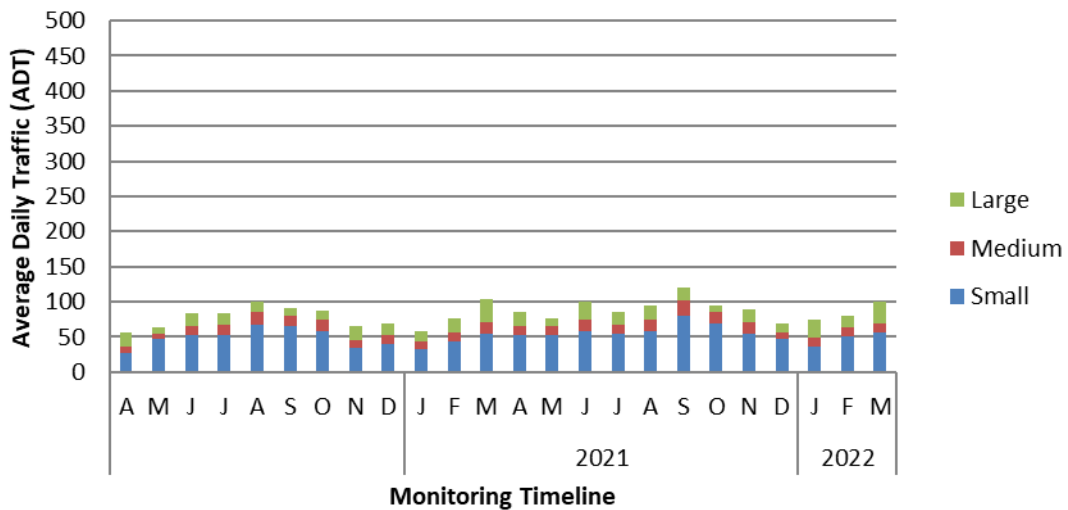
- Small vehicles are categorized as all passenger cars, trucks and vans.
- Medium vehicles are categorized as all buses and dual or tandem axle trucks.
- Large vehicles are categorized as all vehicles with five axles and more.

Appendix C – Monthly Traffic Counts

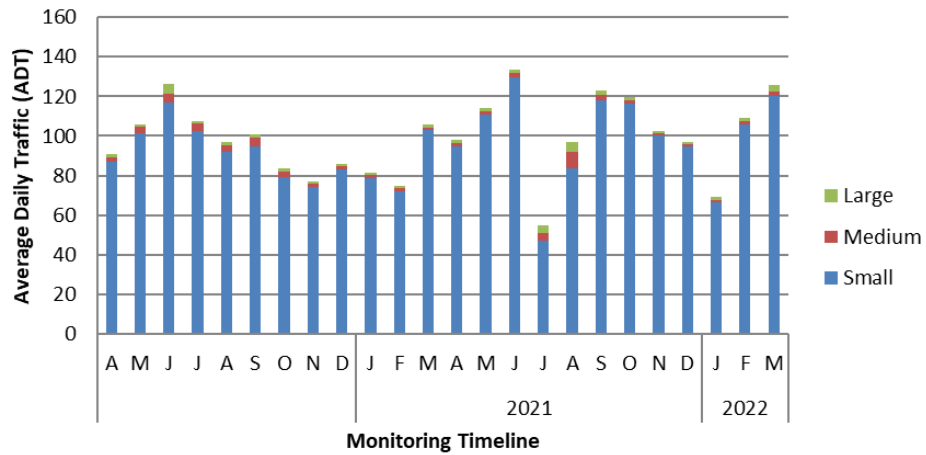
Site 1 - ADT by Traffic Types



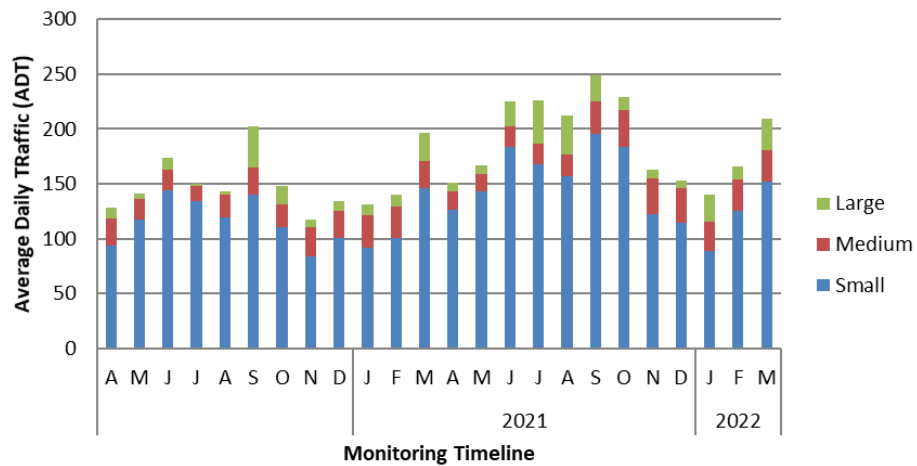
Site 2 - ADT by Traffic Types



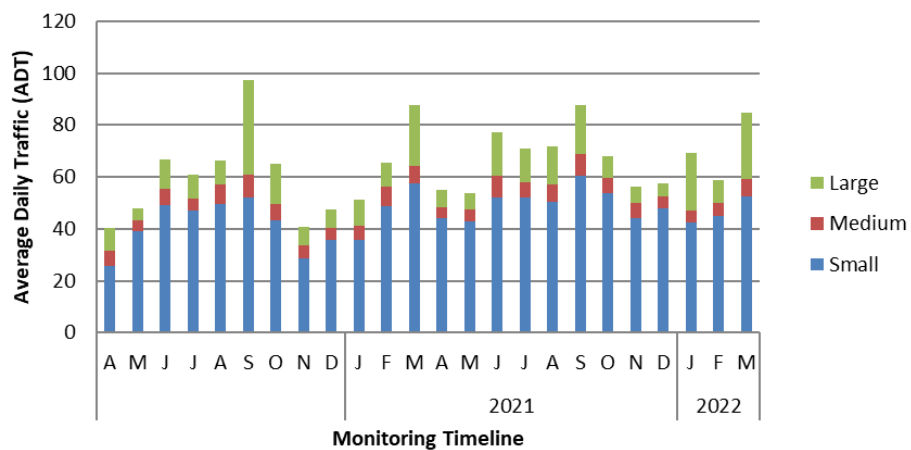
Site 3 - ADT by Traffic Types



Site 10 - ADT by Traffic Types

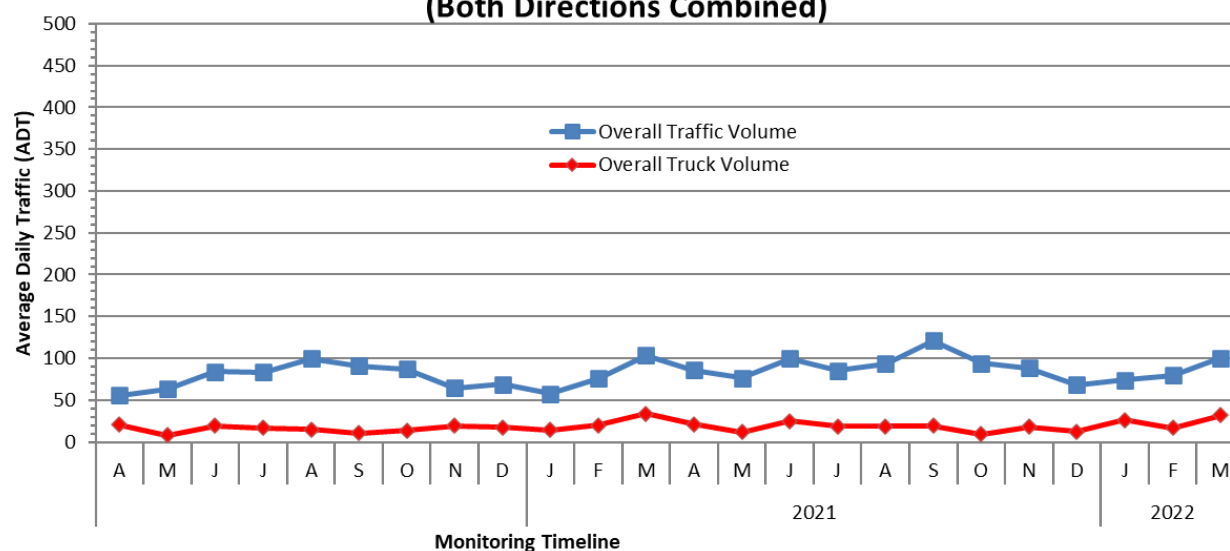


Site 11 - ADT by Traffic Types

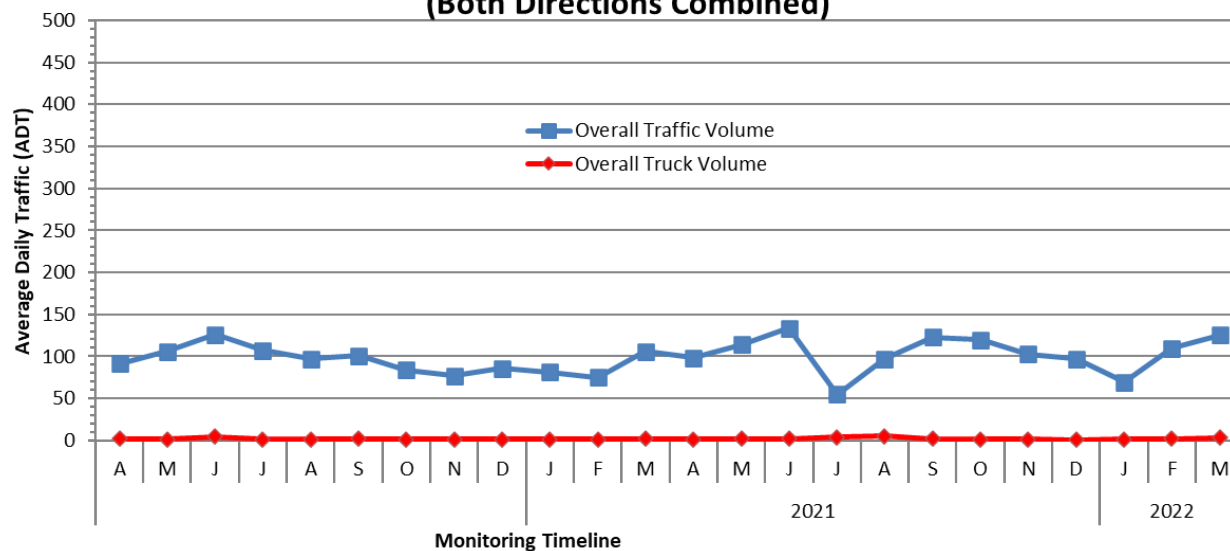


Appendix D – Truck Traffic vs Total Traffic

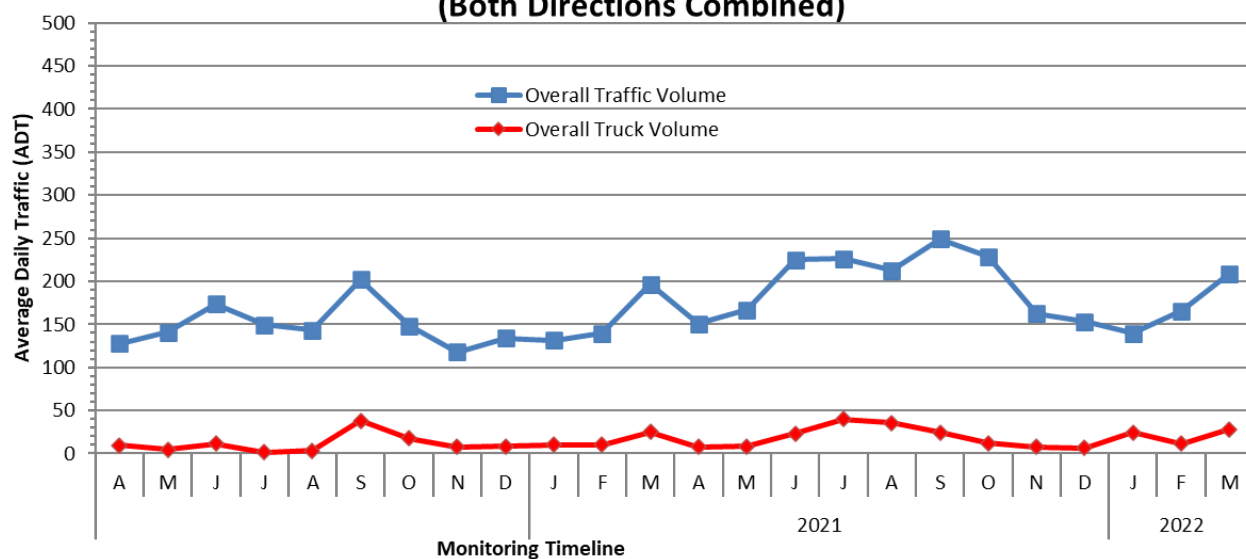
**Total Traffic vs Truck Traffic at Site 2 - Monthly Variations
(Both Directions Combined)**



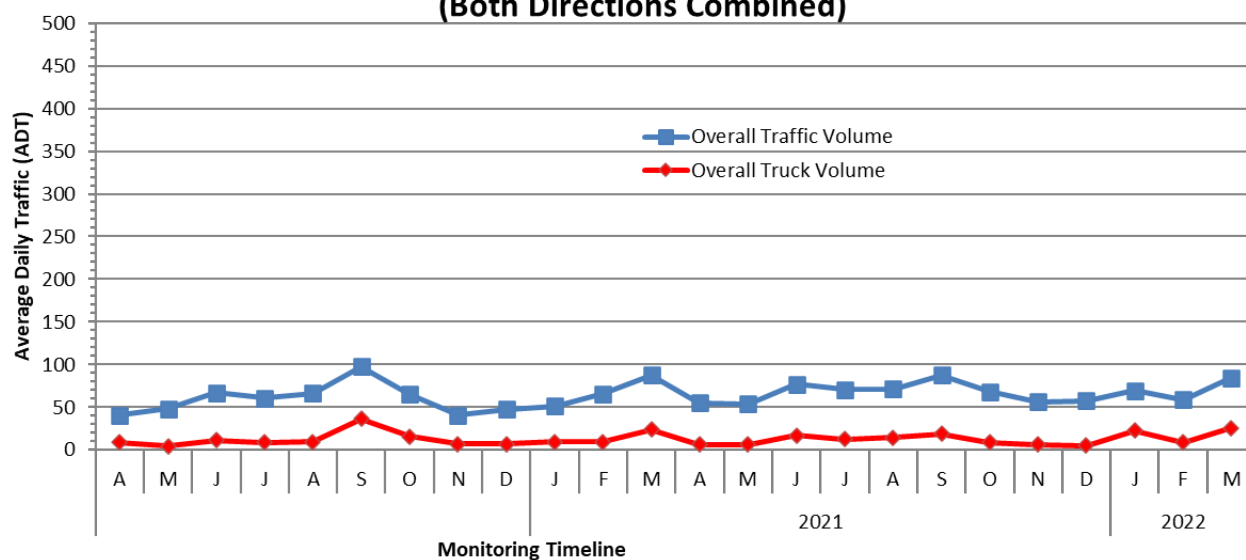
**Total Traffic vs Truck Traffic at Site 3 - Monthly Variations
(Both Directions Combined)**



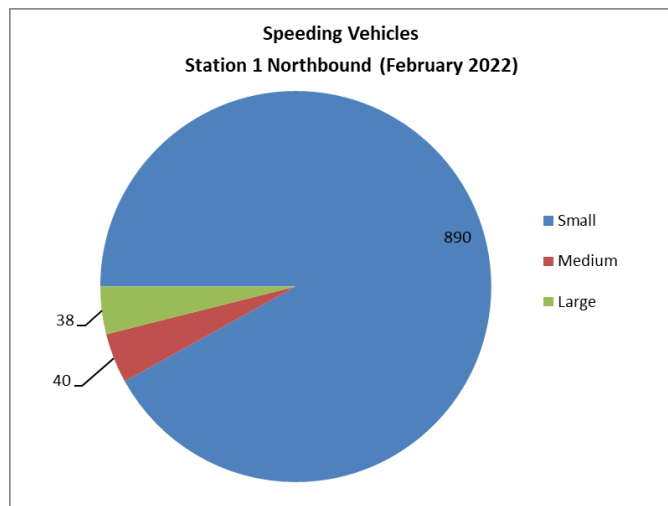
**Total Traffic vs Truck Traffic at Site 10 - Monthly Variations
(Both Directions Combined)**



**Total Traffic vs Truck Traffic at Site 11 - Monthly Variations
(Both Directions Combined)**

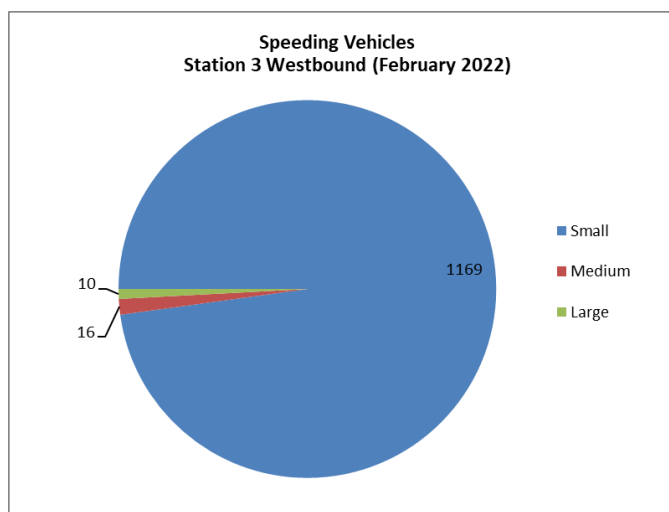


Appendix E – Speed Data by Vehicle Type



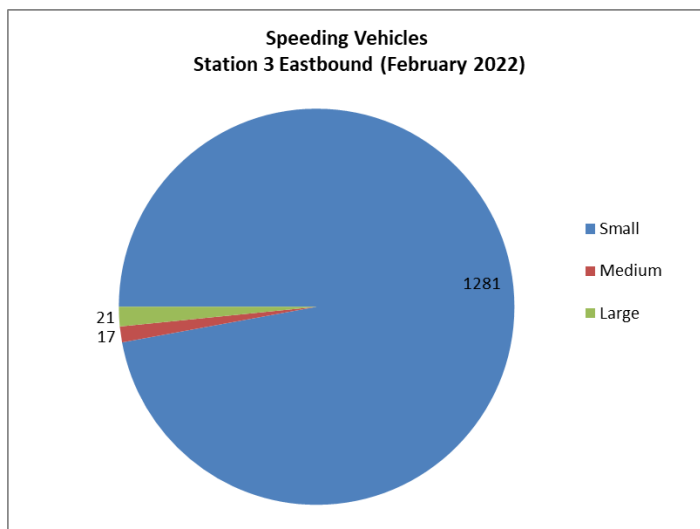
Speed Data				
Northbound - Station 1				
February 2022				
	Vehicle Length (cm)			Total
	Bin #1	Bin #2	Bin #3	
	0-702	703-1202	1203-3500	
<= 90 kph	1297	97	153	1547
	59.3%	70.8%	80.1%	61.5%
> 90 kph	890	40	38	968
	40.7%	29.2%	19.9%	38.5%
> 100 kph	356	12	10	378
	16.3%	8.8%	5.2%	15.0%
> 110 kph	93	2	3	98
	4.3%	1.5%	1.6%	3.9%
Total	2187	137	191	2515

Station 1 – PR 280 between PR 391 and Split Lake (Southbound)



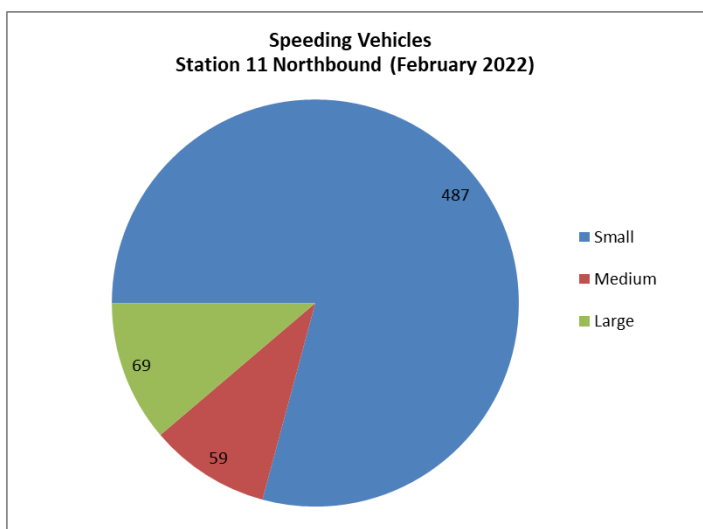
Speed Data				
Westbound - Station 3				
February 2022				
	Vehicle Length (cm)			Total
	Small	Medium	Large	
	0-702	703-1202	1203-3500	
<= 90 kph	308	15	13	336
	20.9%	48.4%	56.5%	21.9%
> 90 kph	1169	16	10	1195
	79.1%	51.6%	43.5%	78.1%
> 100 kph	625	4	1	630
	42.3%	12.9%	4.3%	41.1%
> 110 kph	251	1	0	252
	17.0%	3.2%	0.0%	16.5%
Total	1477	31	23	1531

Station 3 – PR 290 East of PR 280 and PR290 Intersection (Westbound)



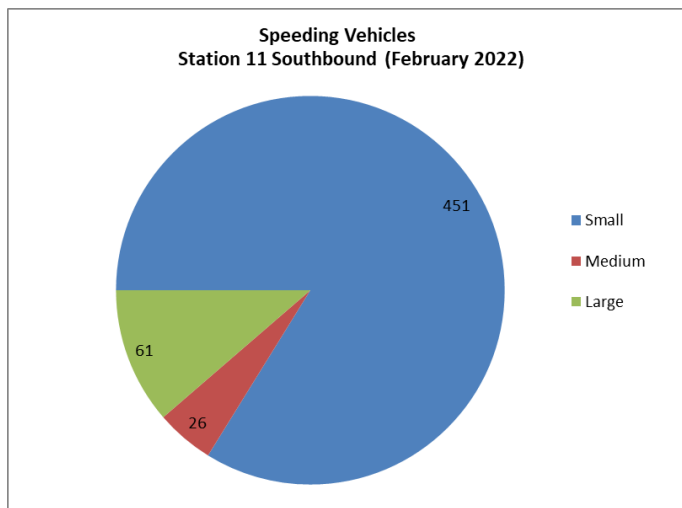
Speed Data				
Eastbound - Station 3				
February 2022				
	Vehicle Length (cm)			Total
	Small	Medium	Large	
	0-702	703-1202	1203-3500	
<= 90 kph	197	11	3	211
	13.3%	39.3%	12.5%	13.8%
> 90 kph	1281	17	21	1319
	86.7%	60.7%	87.5%	86.2%
> 100 kph	866	8	8	882
	58.6%	28.6%	33.3%	57.6%
> 110 kph	420	1	3	424
	28.4%	3.6%	12.5%	27.7%
Total	1478	28	24	1530

Station 3 – PR 290 East of PR 280 and PR290 Intersection (Eastbound)



Speed Data				
Northbound - Station 11				
February 2022				
	Vehicle Length (cm)			Total
	Small	Medium	Large	
	0-702	703-1202	1203-3500	
<= 90 kph	143	22	60	225
	22.7%	27.2%	46.5%	26.8%
> 90 kph	487	59	69	615
	77.3%	72.8%	53.5%	73.2%
> 100 kph	337	35	20	392
	53.5%	43.2%	15.5%	46.7%
> 110 kph	175	11	1	187
	27.8%	13.6%	0.8%	22.3%
Total	630	81	129	840

Station 11 – PR 280 between East of Keeyask Gate and PR 290 (Northbound)



Speed Data				
Southbound - Station 11				
February 2022				
	Vehicle Length (cm)			Total
	Small	Medium	Large	
	0-702	703-1202	1203-3500	
<= 90 kph	183	24	65	272
	28.9%	48.0%	51.6%	33.6%
> 90 kph	451	26	61	538
	71.1%	52.0%	48.4%	66.4%
> 100 kph	286	11	12	309
	45.1%	22.0%	9.5%	38.1%
> 110 kph	115	3	2	120
	18.1%	6.0%	1.6%	14.8%
Total	634	50	126	810

Station 11 – PR 280 between East of Keeyask Gate and PR 290 (Southbound)

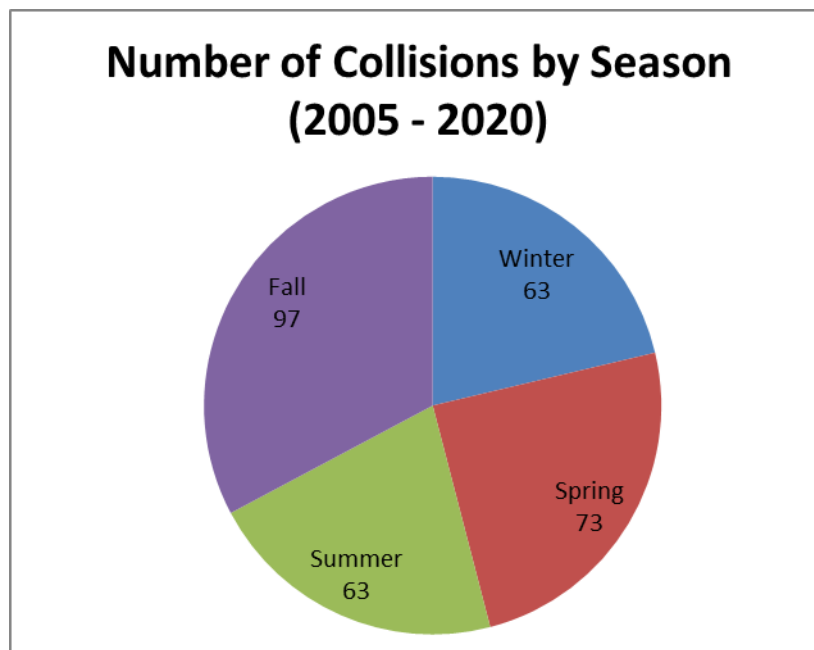
Appendix F – Annual Collision Summary

Reported collision data has been tracked by MPI up to the end of 2020. MPI is only able to log collisions that are reported and the details are limited to what is provided. In addition, the local RCMP detachment provides information on reported collisions.

Collision data is provided by MPI annually in January for PR 280. Collision data for PR 290 is very low and ranges from 0 collisions to a high of 2 collisions per year. For this reason, this data is not included in the following tables and graphs.

A collision is defined as any reported incident involving a personal injury or property damage to a vehicle. Property damage can be attributed to collisions with wildlife, running off the road into a fixed object, head on or side swipe collisions with other vehicles, overturned vehicles, and damage to vehicles as a result of hitting potholes/ruts. It does not include cracked or broken windshields from rocks kicked up by passing vehicles as this would not constitute a reportable collision.

PR 280 Number of Collisions by Season (2005-2020)



Summary

- There were a total of 296 collisions on PR 280 between 2005 and 2020.
- Average of 20 collisions per year.
- 25% of collisions occurred during the spring - March, April and May.
- 33% of collisions occurred during the fall - September, October and November.
- Single vehicle collisions accounted for approximately 93% percent of all collisions during the analysis period.

PR 280 Collision Severity and Contributing Factors

Year	Severity			Contributing Factor		
	Property Damage	Non-Fatal Injury	Fatality	Wildlife	Ran-off Road	Other/Unknown
2005	12	4	0	2	8	6
2006	11	6	0	3	13	1
2007	9	3	1	0	4	9
2008	6	2	0	1	4	3
2009	10	4	1	0	9	6
2010	8	1	0	1	3	5
2011	2	2	0	0	1	3
2012	2	0	0	0	1	1
2013	3	0	1	0	1	3
2014	26	4	0	6	3	21
2015	23	1	0	6	6	12
2016	34	3	0	7	8	22
2017	46	0	0	15	9	22
2018	28	1	0	8	6	14
2019	29	1	0	7	6	16
2020	13	3	0	5	1	7
Total	262	35	3	61	83	151

**Data available annually.*

Summary

- Approximately 89% of collisions along PR 280 were property damage.
- Running off the road was the contributing factor in 28% of collisions.
- Other factors, including collisions with other vehicles and overturning in the roadway accounted for approximately 51% of all reported collisions.
 - Typical causes are considered to be: loss of control, fatigue, speeding along curved sections or attempting to avoid another vehicle or wildlife.

PR 280 Collision Rate

Year	Collision Rate (incidents per MVKT)
2005	0.98
2007	0.79
2009	0.82
2011	0.19
2013	0.14
2015	0.66
2016	0.97
2017	1.14
2018	0.71
2019	0.80
2020	0.48
Average	0.70
MI Threshold	1.5

**2016 collision rate revised to correct previous reporting error.*

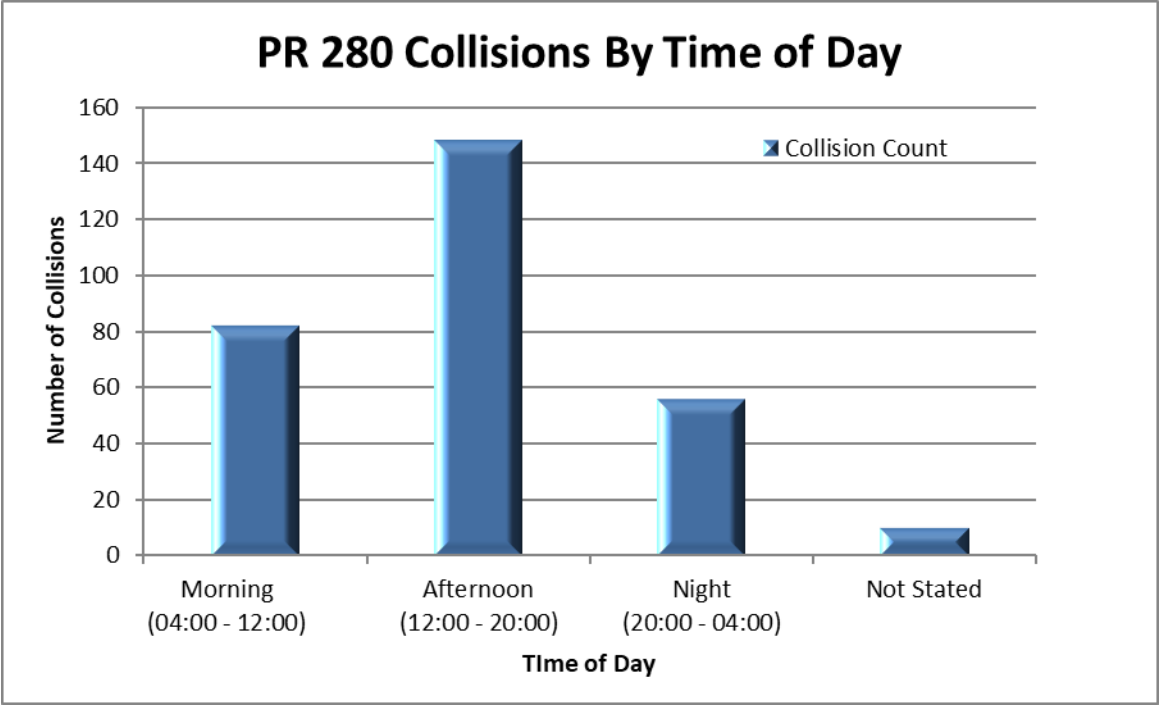
Calculation Notes:

- Collision rate (CR) is based on the number of collisions that occurred and the volume of traffic on a section of roadway during a specified period.
- CR is measured as the number of collisions per million vehicle-kilometres of travel (MVKT) on a section of roadway during the analysis period.
- Traffic volumes used in calculating the collision rate are the average of the annual average daily traffic (AADT) volume recorded each year over the eleven year period.
- Many agencies consider road sections with collision rates exceeding 1.5 incidents per MVKT as warranting further review.
- AADT counts used to calculate collision rate are based on a collection period of two weeks. Counts are extrapolated from two week count.

Summary:

- Based on the AADT and the number of collisions for 2005, 2007, 2009, 2011, 2013, 2015, 2016, 2017, 2018, 2019 and 2020 PR 280 has an average collision rate of approximately 0.70 incidents per MVKT over the study period.
- The collision rate of 0.70 remains below the industry standard threshold of 1.50 incidents per MVKT.

PR 280 Collisions by Time of Day



*January 1, 2005 – December 31, 2020
Data available annually.*

Summary:

- Approximately 50% of collisions occur in the afternoon.
- Approximately 28% of collisions occur in the morning.
- Daytime collisions are predominant.