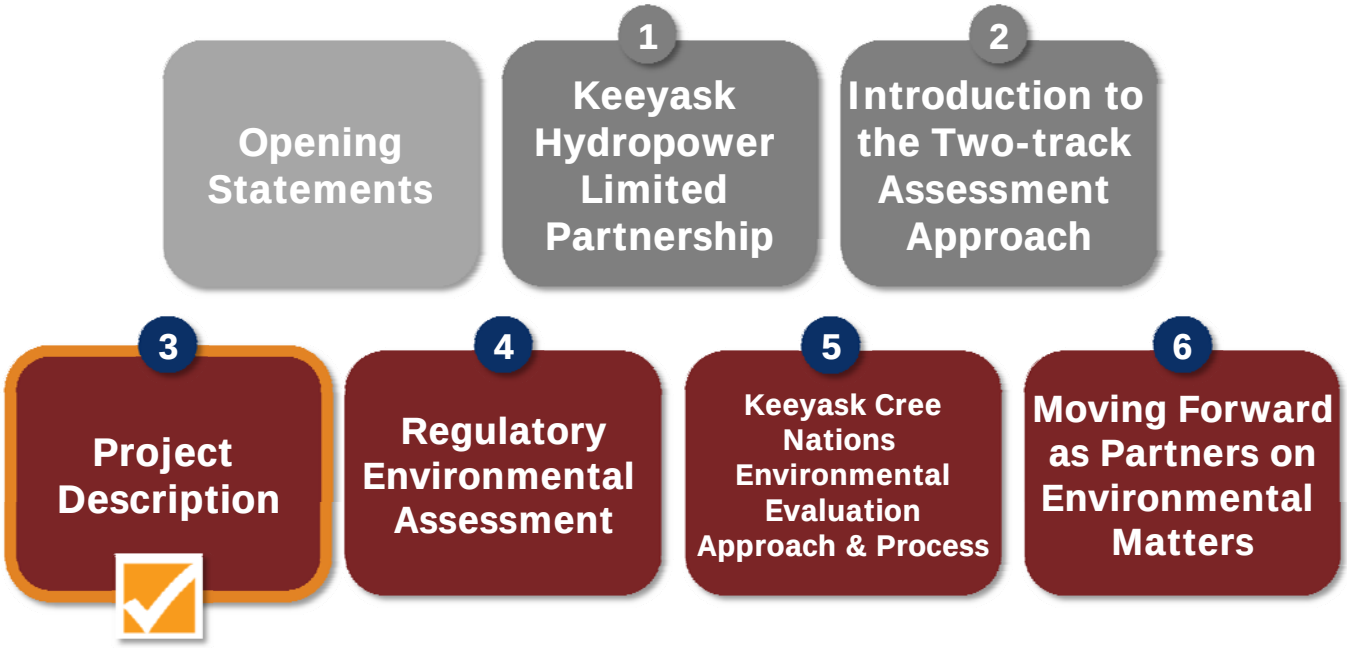
Panel and Presentation Guide



Keeyask Generation Project

CEC Hearings - Environmental Impact Statement

KEEYASK
Hydropower Limited Partnership

Project Description

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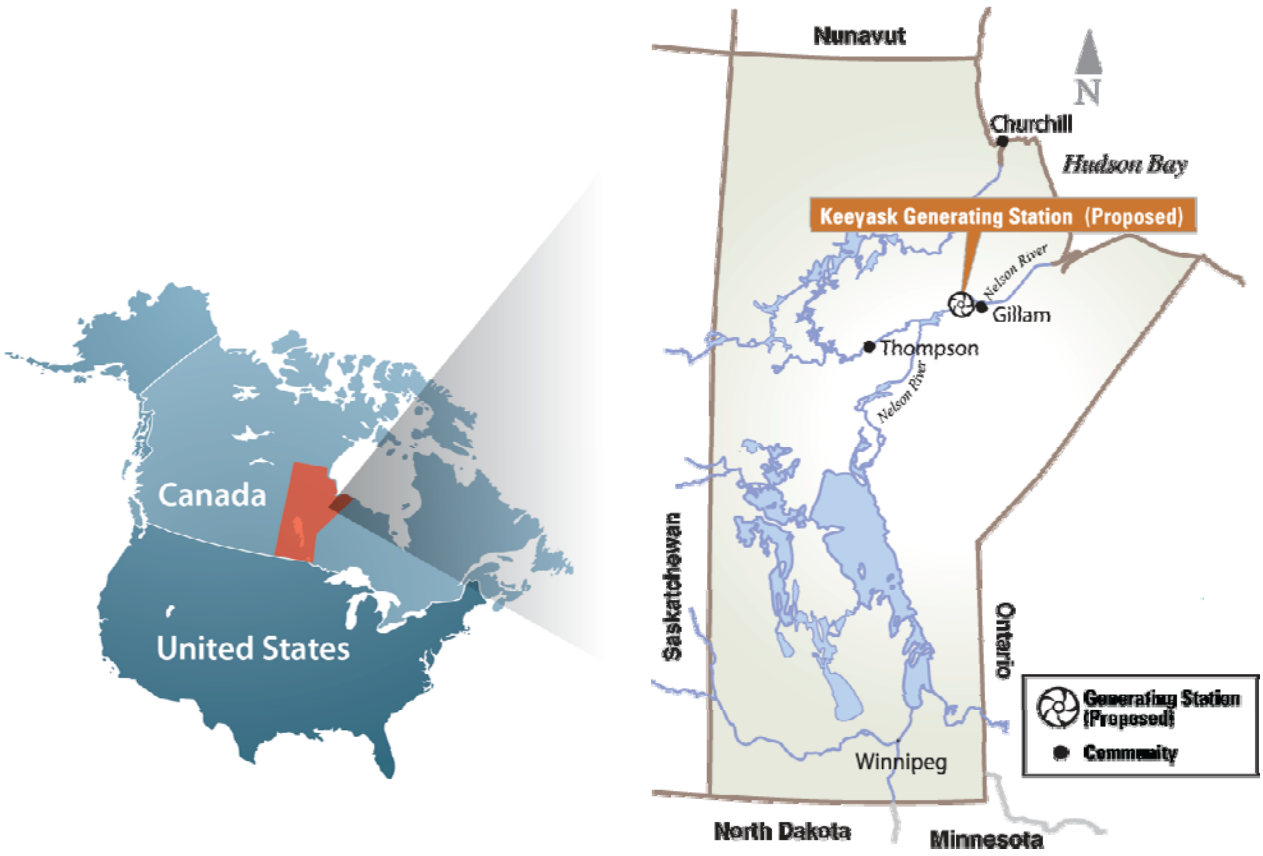
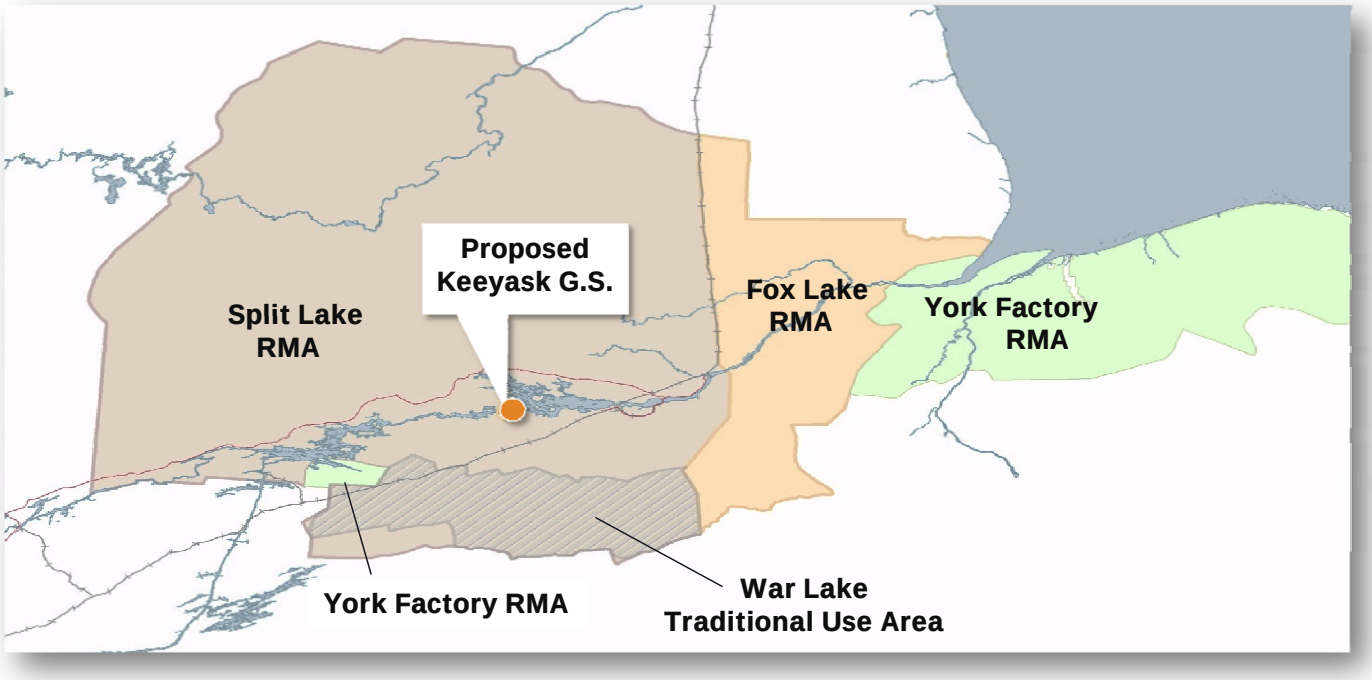
Project Description Panel

Marc St. Laurent	• Keeyask Planning Engineer, Manitoba Hydro • Preliminary Engineering, Planning, Physical Environment
Glen Schick	• Keeyask Engineering & Construction Dept Manager, Manitoba Hydro • Final Design and Construction
Jarrod Malenchak	• Hydrotechnical Engineer, Manitoba Hydro • Hydraulic Engineering Design, Water & Ice Regime Studies
Carolyne Northover	• Senior Environmental Specialist, Manitoba Hydro • Environmental Protection Program
Philip Pantel	• Geotechnical Engineering Dept Manager, HATCH • Design of Earth Structures, Construction

Outline

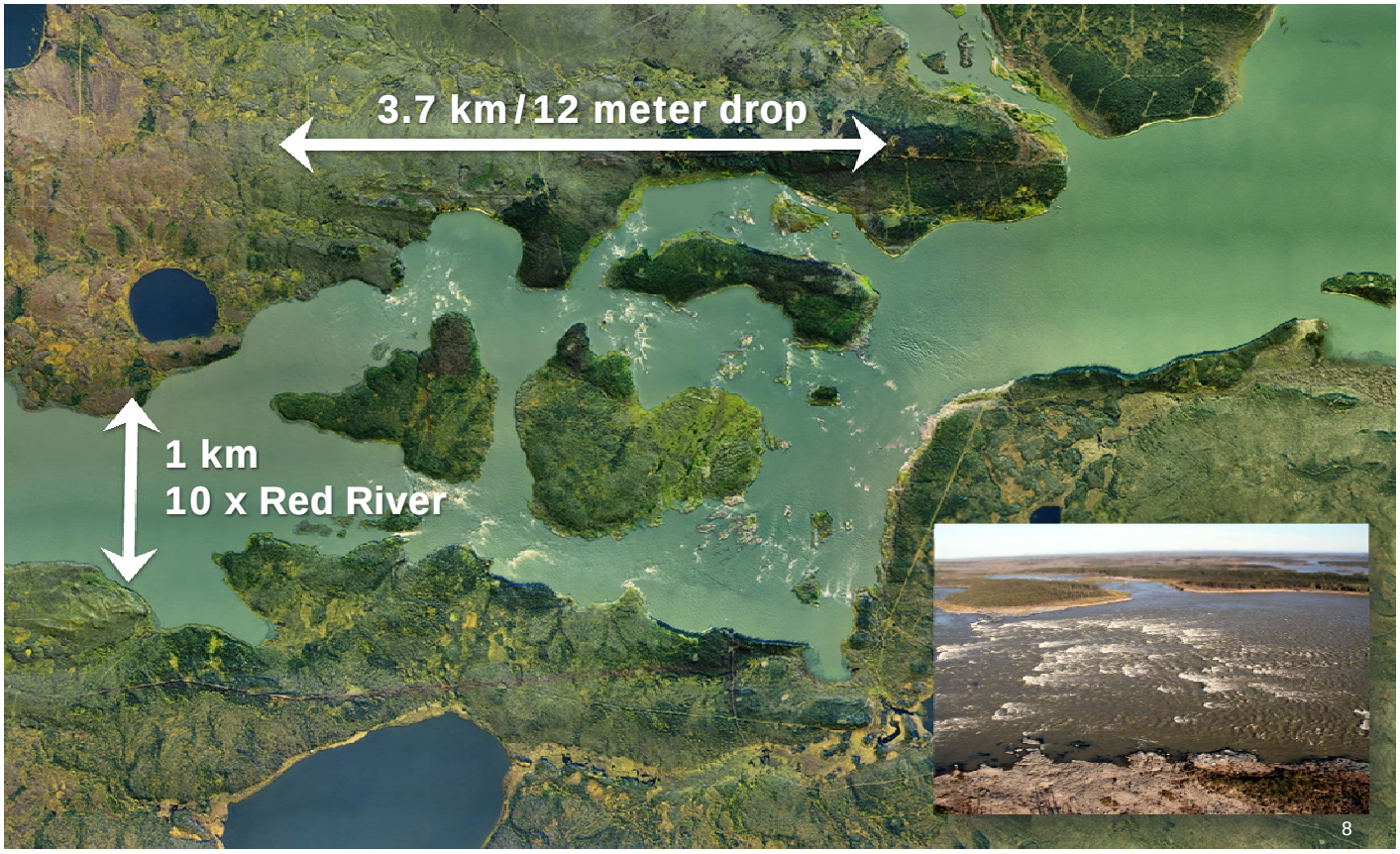
- Location
- Project Overview
- Manitoba Hydro System Overview
- Project Components and Land Requirements
- Project Planning Phase
- Project Construction Phase
- Project Operation Phase


Canada
United States
Nunavut
N
Churchill
Hudson Bay
Keeyask Generating Station (Proposed)
Nelson River
Gillam
Thompson
Nelson River
Saskatchewan
Ontario
Winnipeg
North Dakota
Minnesota
Generating Station (Proposed)
Community


Proposed
Keeyask G.S.
Split Lake
RMA
Fox Lake
RMA
York Factory
RMA
York Factory RMA
War Lake
Traditional Use Area

Project Location

Gull Rapids



Project Overview

- **Manitoba Hydro and TCN have worked together for over 20 years to plan this project to avoid, reduce and mitigate Project impacts and to address concerns raised about the Project. WLFN, FLCN and YFFN have worked with Manitoba Hydro for over 10 years.**

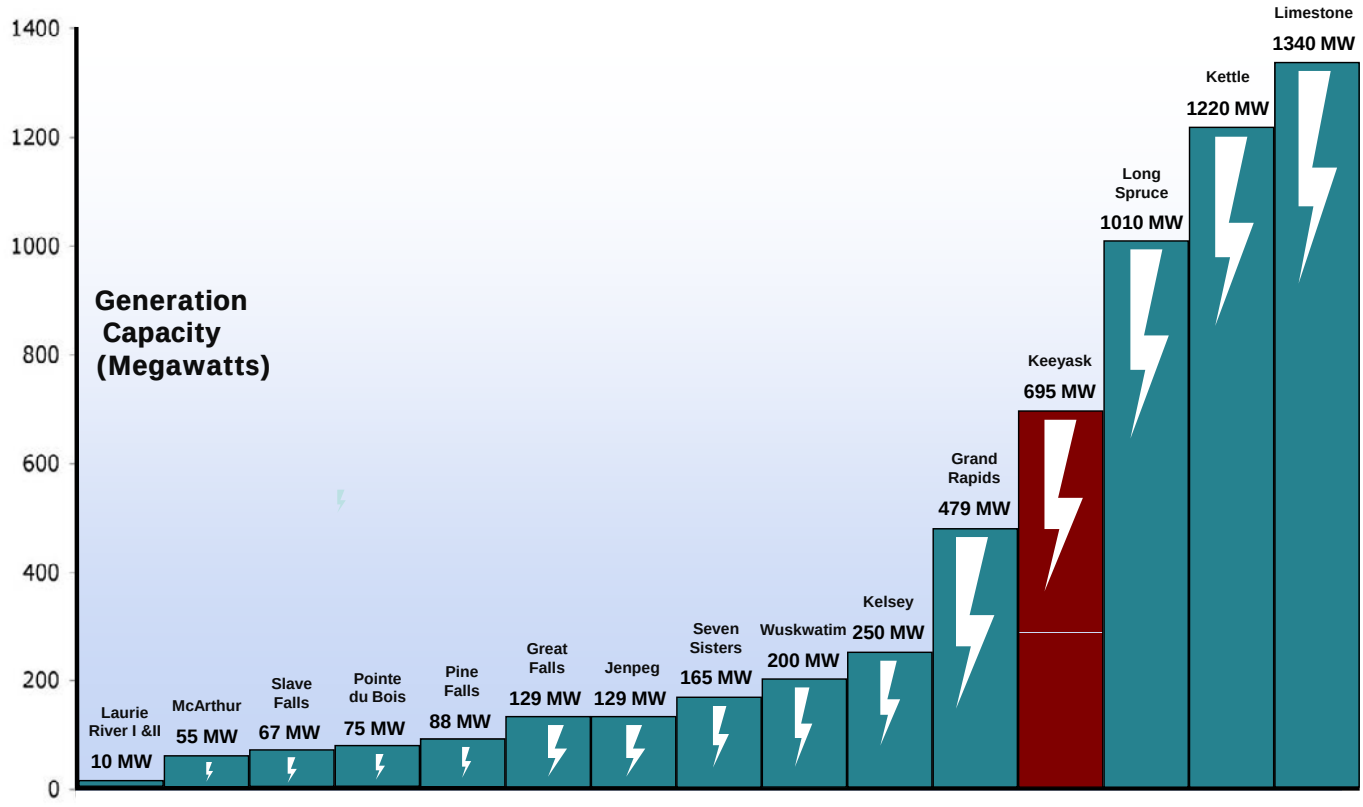
Project Overview

Would produce enough electricity to supply 400,000 homes

- **Large Station with Low Head (18m/60') and High Discharge (4000 m^3/s)**
- **Rated Capacity: 695 MW – will add 12% to Manitoba Hydro system capacity**
- **Average Annual Energy: 4,400 GWhr**
- **8.5 years to construct (2014-22)**
- **Create 4,225 person-years of employment at Keeyask**
- **A low head project was selected instead of high head project to minimize flooding and environmental impacts – resulting in less generation capacity**

Keeyask GS will produce renewable hydroelectric energy, which will be sold to Manitoba Hydro and integrated into its electric system for use in Manitoba and export markets

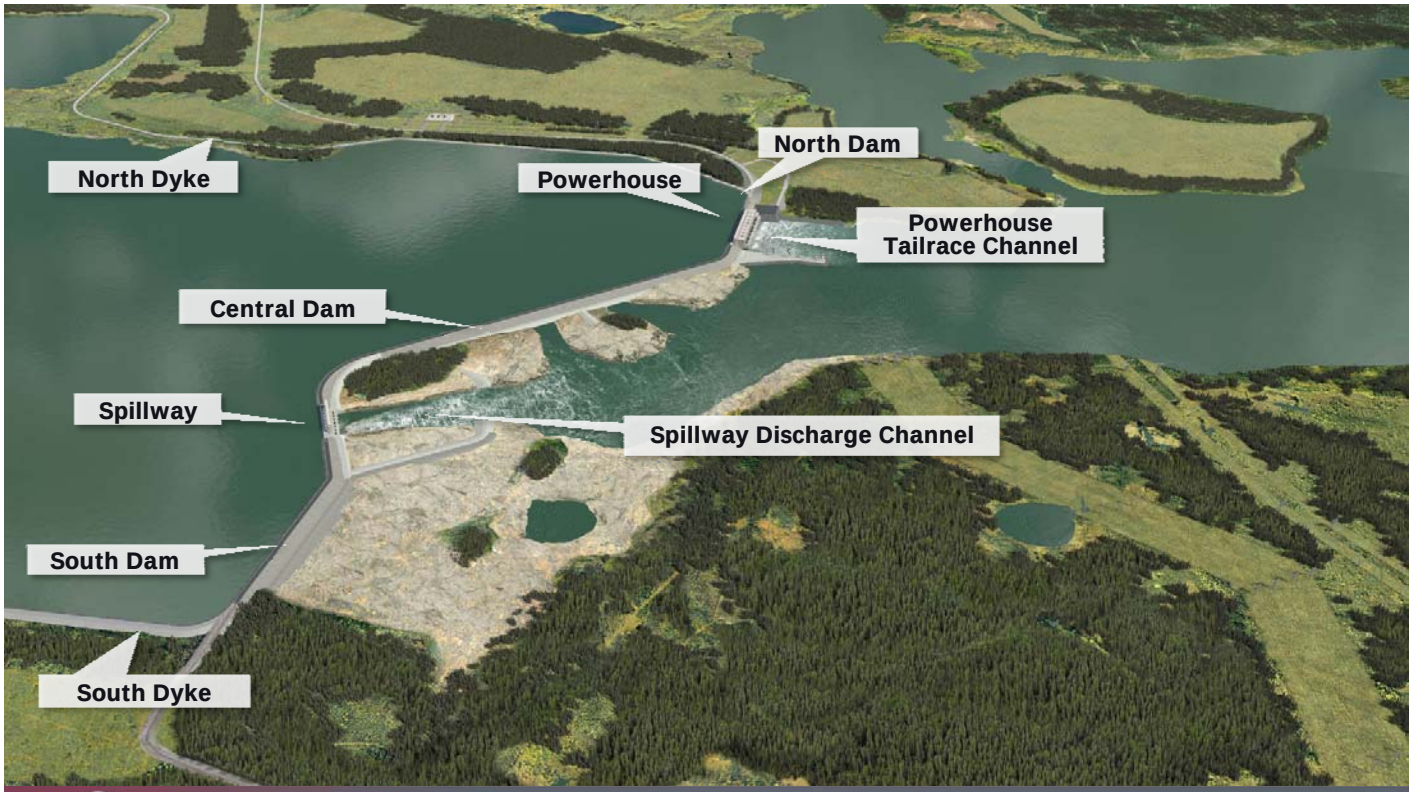
Project Comparison



KEEYASK

Project Components and Land Requirements

Principal Structures



KEEYASK

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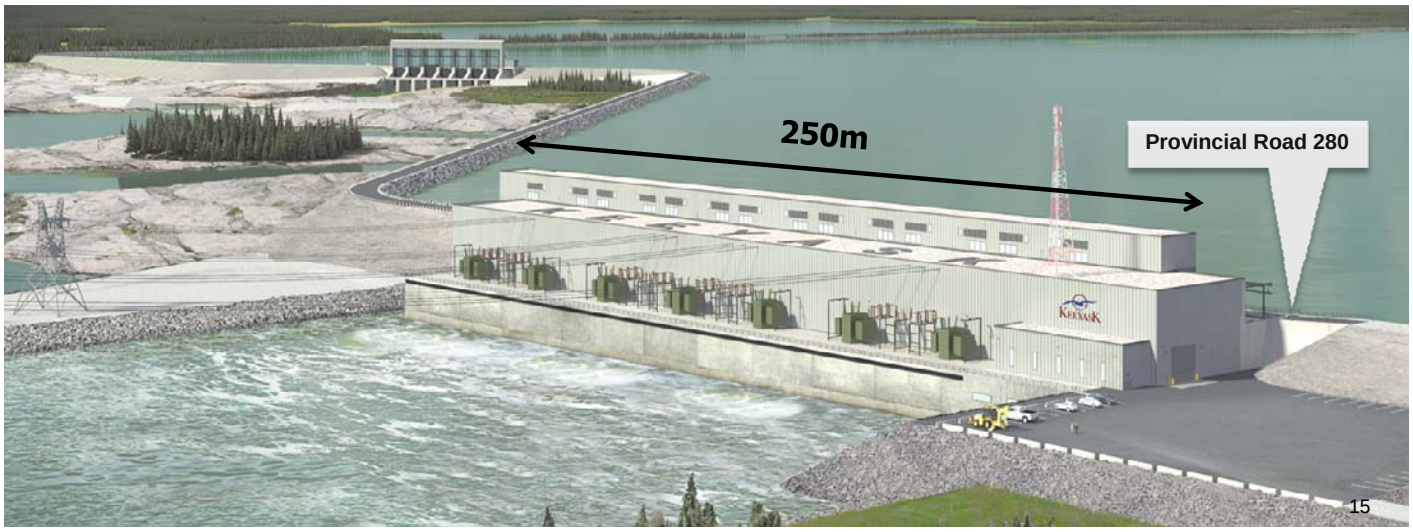
VIDEO

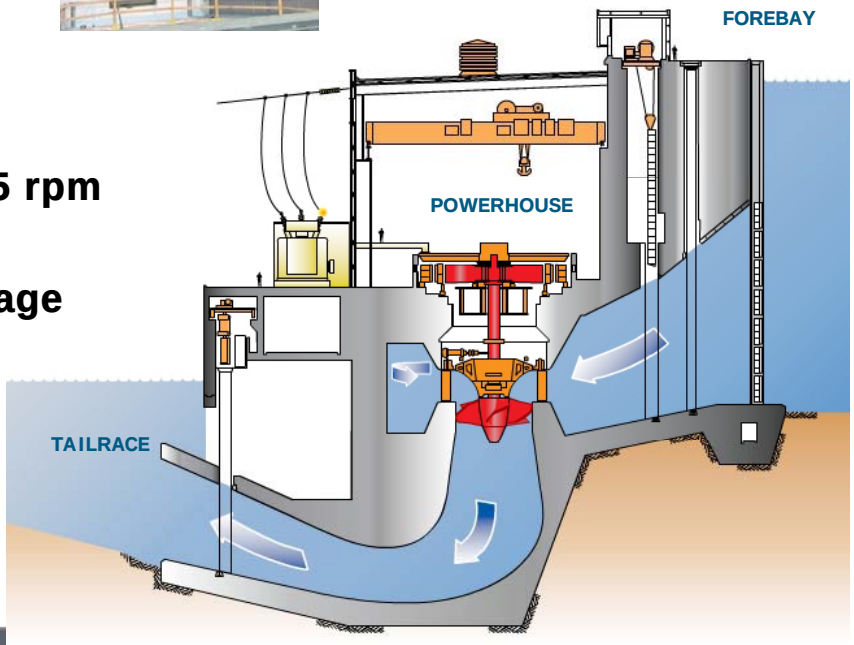
Powerhouse Complex

- **Contains 7 large turbines, generators and the control equipment used to generate power**
- **Head: 18 m (59 feet)**
- **Discharge Capacity: 4000 m^3/s**



Powerhouse Complex

- **Turbine Type:** Fixed Blade Vertical Propeller
- **Runner Diameter:** 8.85 metres /29 feet
- **Rotational Speed:** 65.5 rpm
- **Fish Passage:** Since downstream fish passage will be through the powerhouse, the turbines are being designed to minimize injury and mortality to fish



KEEYASK

Spillway

- **Used when Powerhouse reaches flow capacity**
- **Provides overflow discharge capacity of 8,700 m^3/s at reservoir Full Supply Level**
- **Concrete structure – 7 bays with motorized vertical lift gates**
- **Also provides a diversion channel during construction**

KEEYASK

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North, Central & South Dams

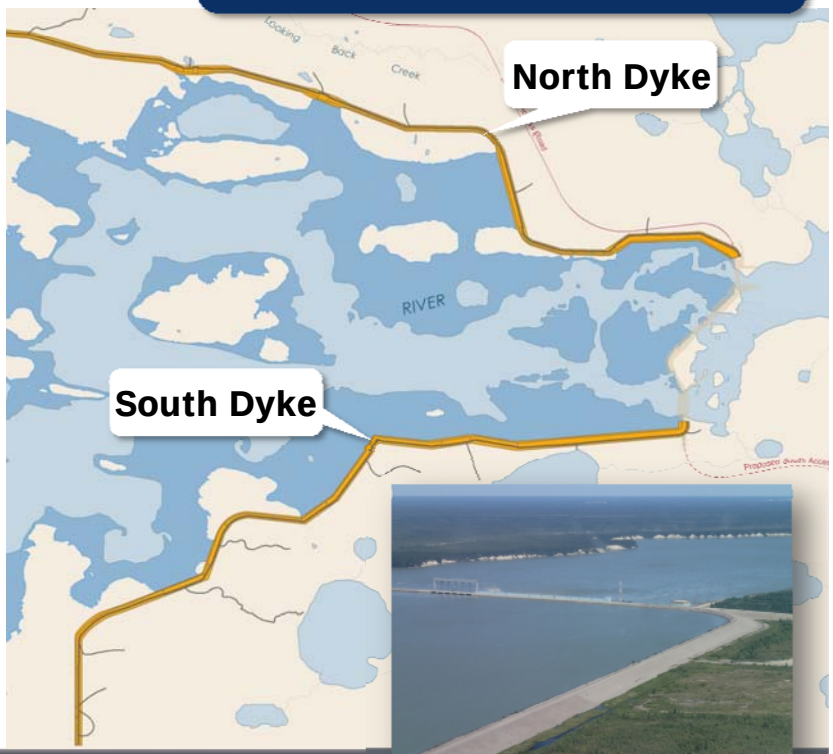
- **Dams constructed through Gull Rapids founded on bedrock**
- **Crest will be 3.0 to 3.6m (10'to 12') higher than reservoir level.**

North & South Dykes

Dykes will be founded on mineral soils

Design of dykes takes into account permafrost soils and melting of frozen foundation soils

- **23 km of earth fill dykes will contain the reservoir**
- **Crest will be 1.8-4.0m (6-13') higher than the reservoir level**
- **Dykes will have maximum heights of about 20m (66')**
- **Roadway will be constructed on top of the dykes and between the sections of dykes for inspection and maintenance**



KEEYASK

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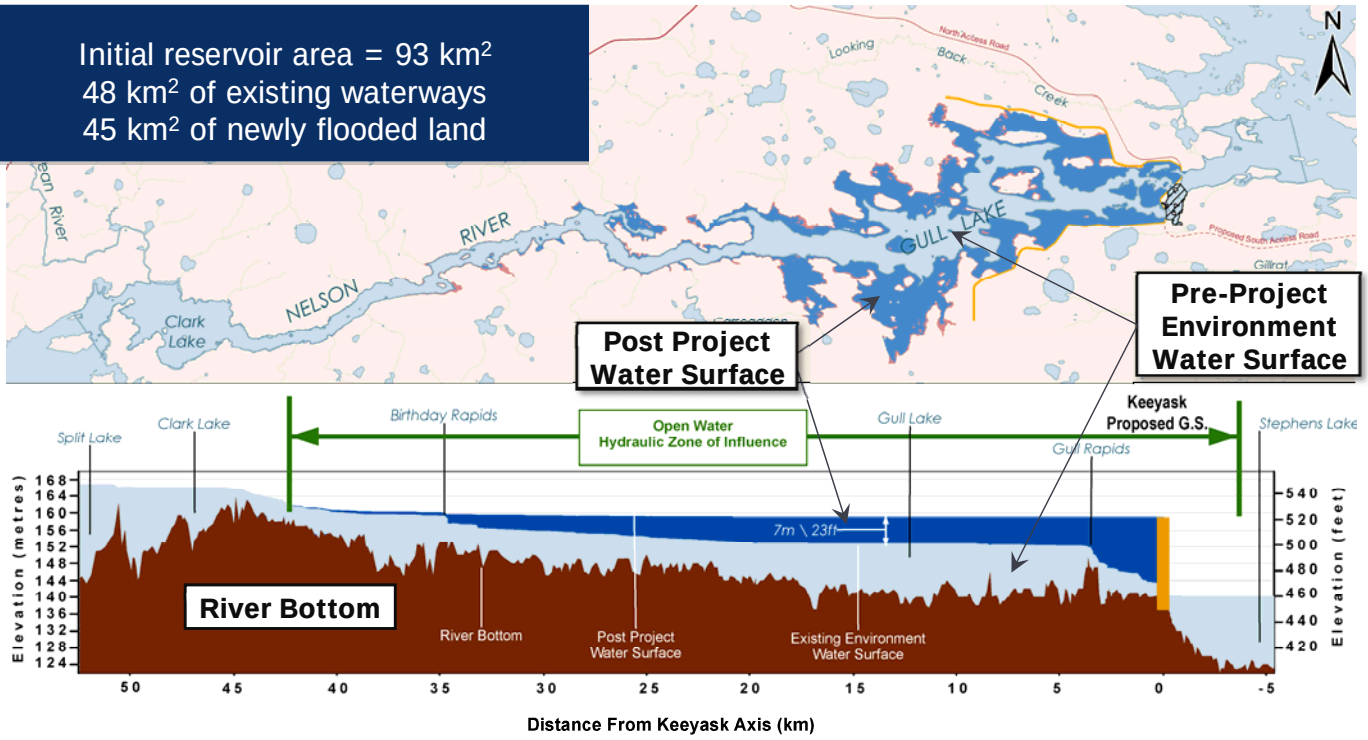
Reservoir

Initial reservoir area = 93 km²
48 km² of existing waterways
45 km² of newly flooded land



Reservoir predicted to expand 7-8 km² during the first 30 years after reservoir impoundment due to erosion of some mineral shorelines and disintegration of peatland

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Supporting Infrastructure

- **Project will require temporary and permanent infrastructure to support the construction and operation phases**

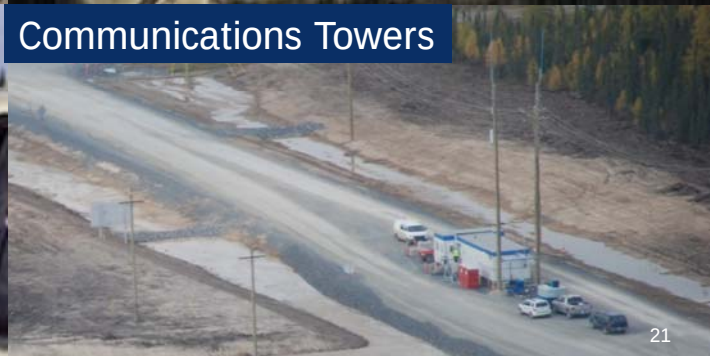
Temporary:

Roads and Borrow Sources

Construction Camp/Work Areas

Safety/Security Facilities

Communications Towers



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Supporting Infrastructure

Temporary:

Explosive magazines

Boat Launch, Cofferdams/Rock Groins

Waterways/Public Safety Measures

Ice/Safety Booms

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Supporting Infrastructure

Permanent:

Borrow Sources

Roads

Communications Tower

Excavated Materials Placement Areas

KEEYASK

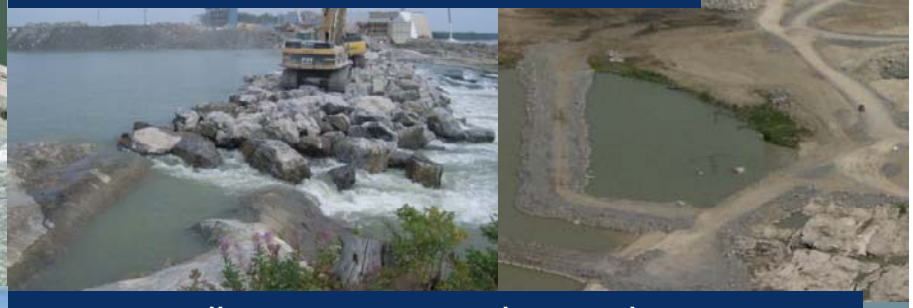
23

Supporting Infrastructure

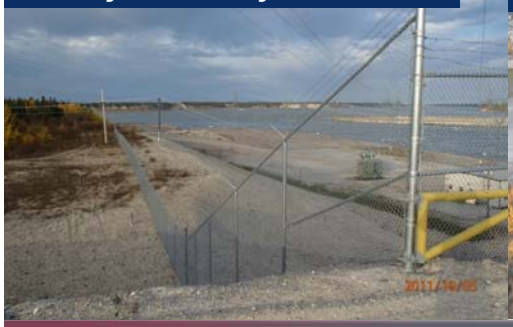
Permanent:

Transmission Tower Spur

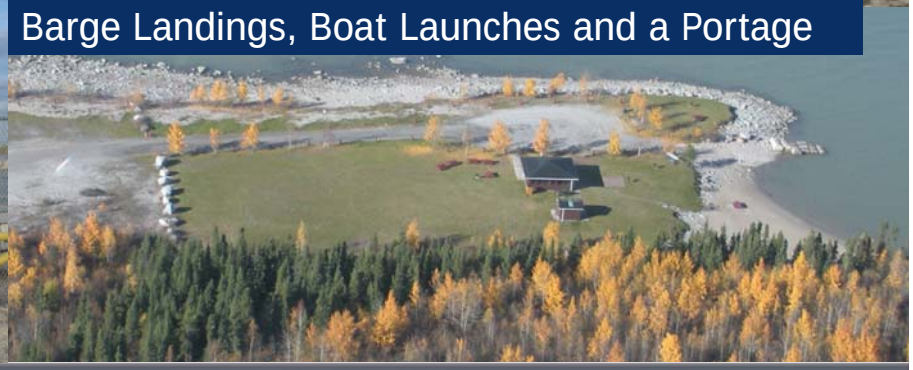
Some Cofferdams/Groins



Safety/Security Facilities



Barge Landings, Boat Launches and a Portage



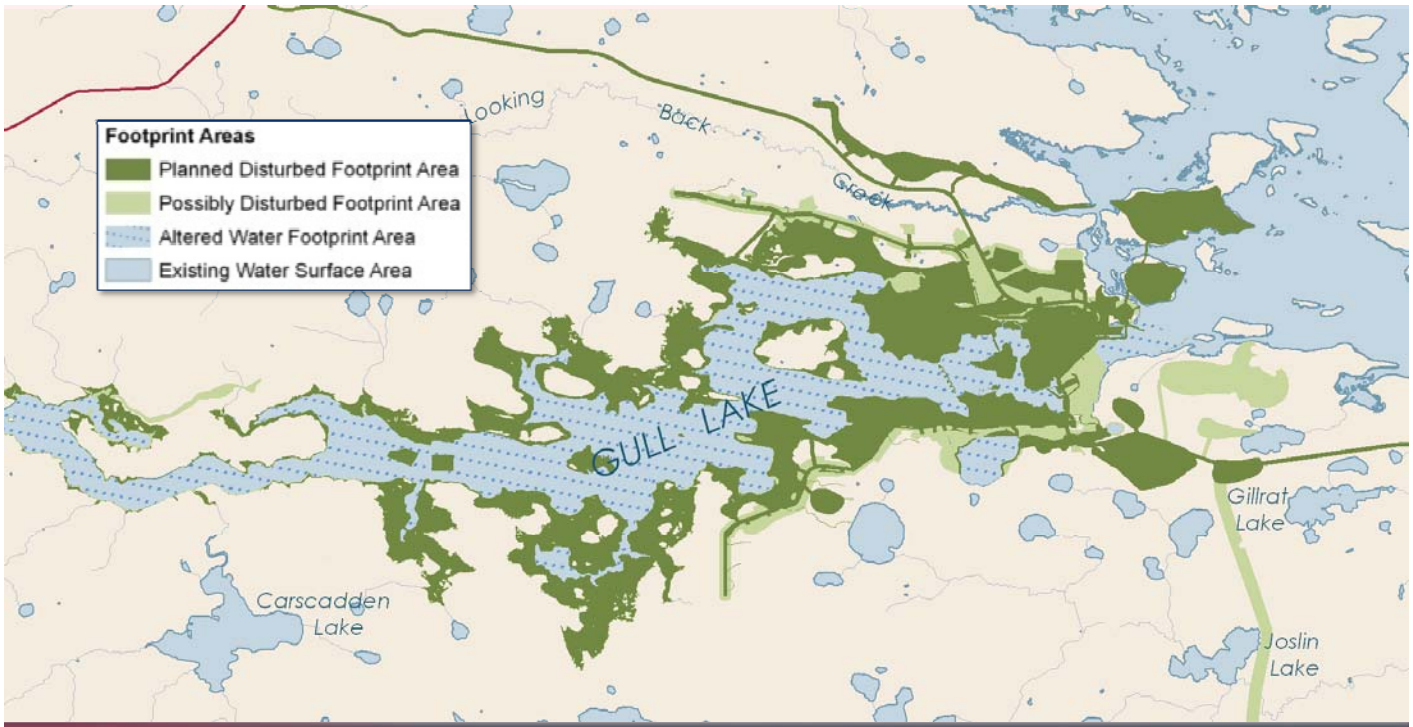
Infrastructure of Other Projects/Facilities

- **Infrastructure developed prior to start of the Project will be used to construct and operate Keeyask GS**

- **Keeyask Infrastructure Project**
  - Start-up camp, North access road, Phase 1 Main Camp, contractor work areas, potable water supply, wastewater treatment facility
  - Operation of these components is part of Keeyask Generation Project

- **Keeyask Transmission Project**
  - Construction power line and substation, generation outlet transmission lines & Switching Station
  - Power lines and substations will provide power for construction and transmit power from Keeyask during operation
  - Concurrent regulatory review

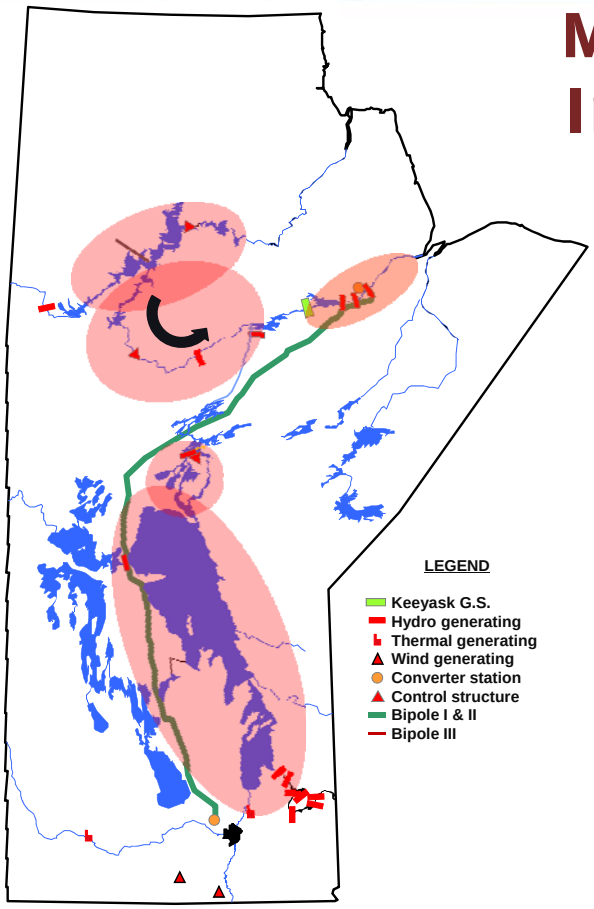
Total Project Footprint: 140 Square Kilometres



KEEYASK

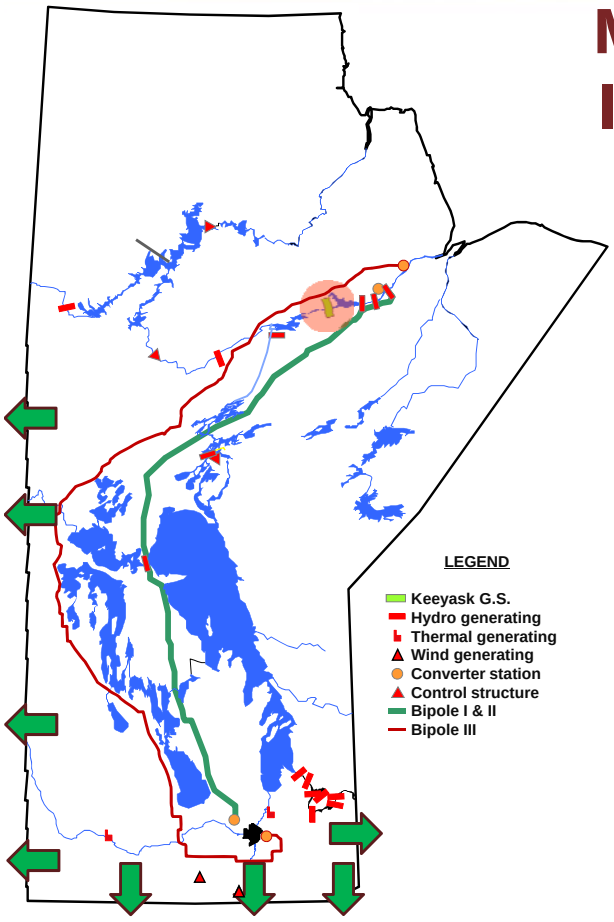
Manitoba Hydro Integrated Power System

Water Supply: Nelson & Churchill River Basins drain a 1.4 Million km² area



Manitoba Hydro Integrated Power System

- Total Installed Capacity 5700 MW
- 15 hydroelectric generating stations
- Lower Nelson Generating Stations – Kettle, Long Spruce & Limestone contribute 70% of system generation capacity
- Lake Winnipeg is largest reservoir – provides 50% of system storage
- Lake Winnipeg Regulation Project regulates outflows seasonally to meet energy demands
- Southern Indian Lake also stores water over seasons
- Churchill River Diversion (CRD) diverts water into the Lower Nelson River to increase hydropower generation



Manitoba Hydro Integrated Power System

- HVDC Lines Bipole I & II transmit power from Lower Nelson Plants to Southern MB
- Bipole III received regulatory approvals for construction
- Transmission lines interconnected to SK, ON, US enable power to be imported and exported
- Keeyask will add another 12% generation capacity to the system
- MH will operate Keeyask on behalf of KHLP
- Keeyask will operate as part of Manitoba Hydro's integrated system within the constraints of licences and approvals granted for each component including the Lake Winnipeg Regulation and Churchill River Diversion Projects.

KEEYASK

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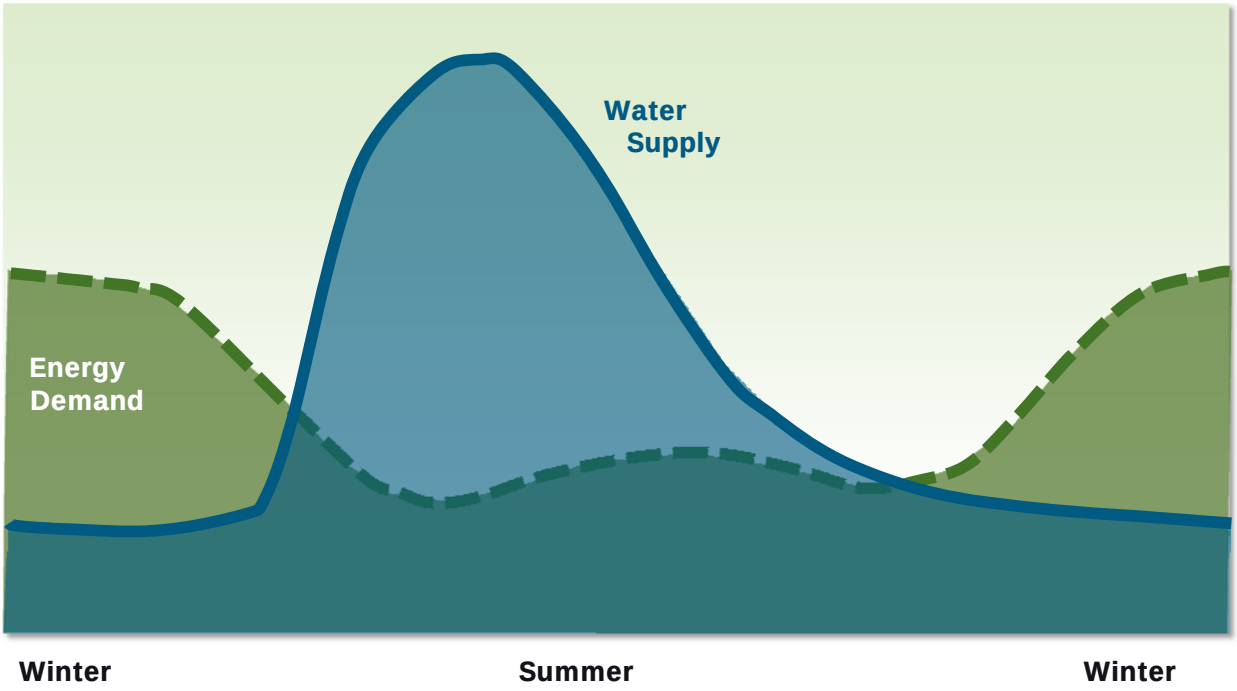
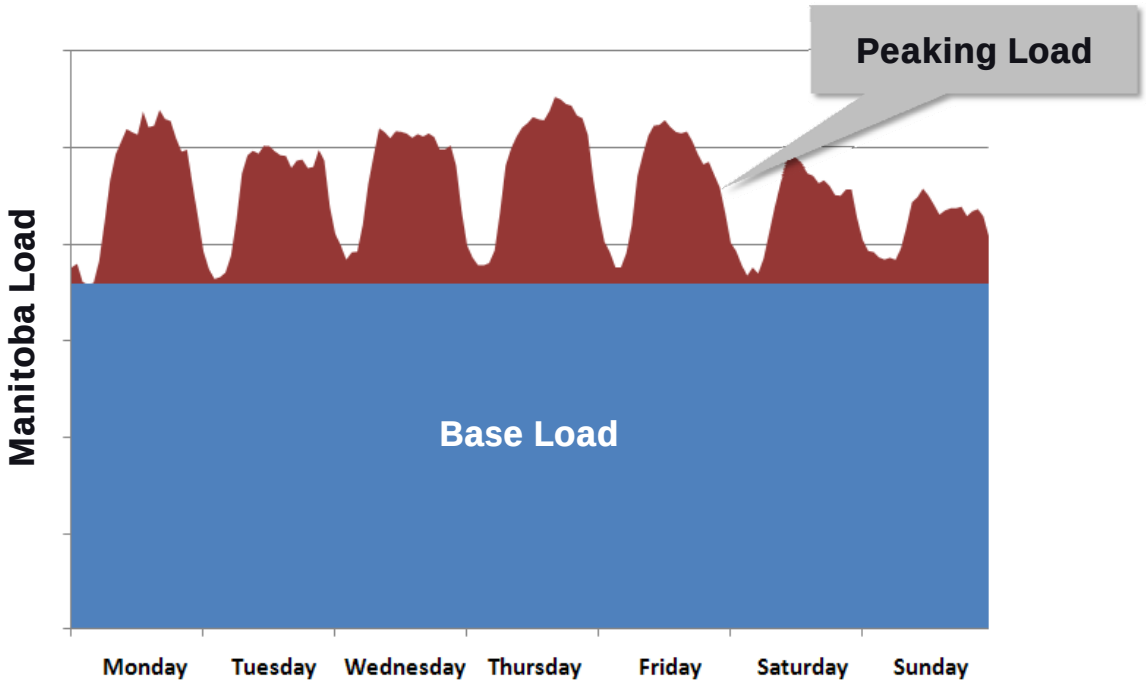
Manitoba Water Supply and Energy Demand



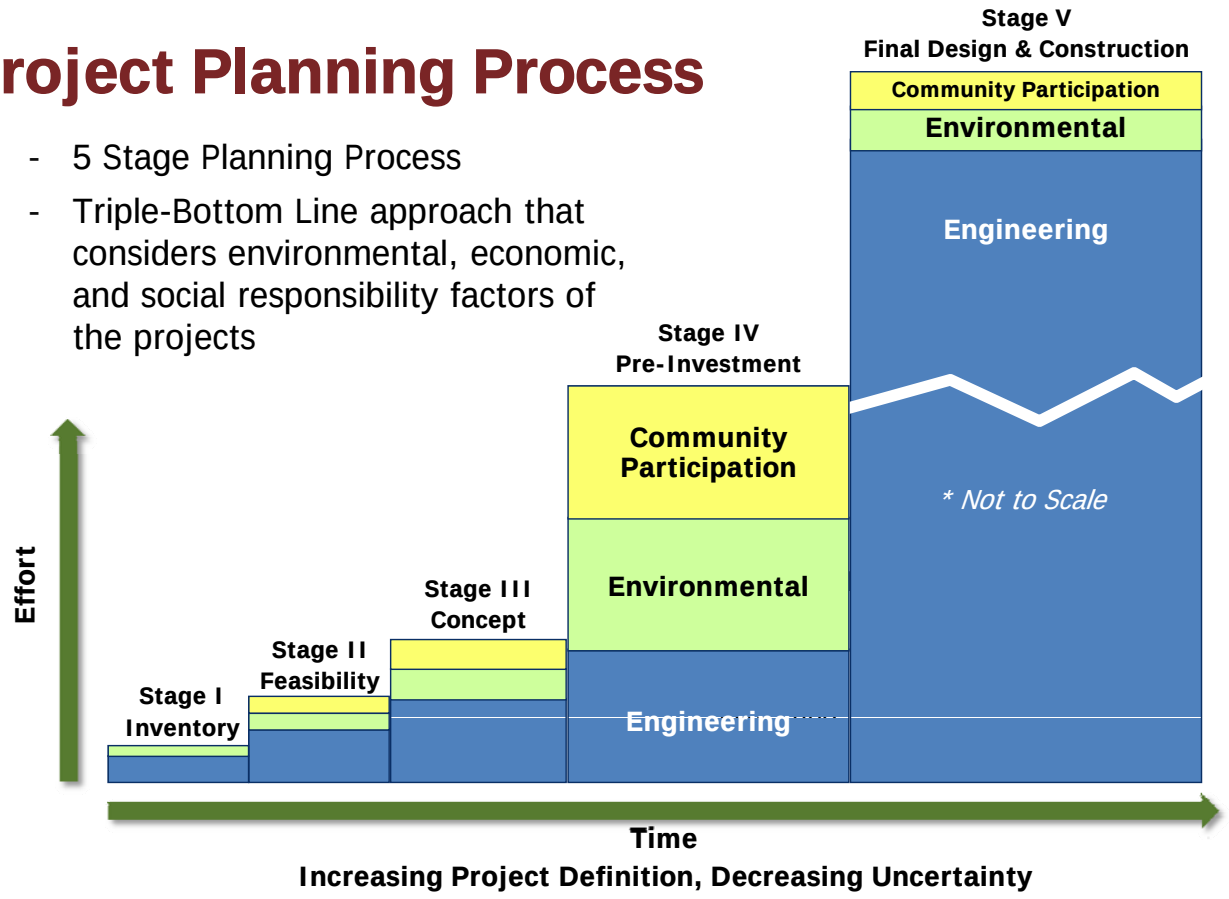
Example of Weekly Power Demand In Manitoba



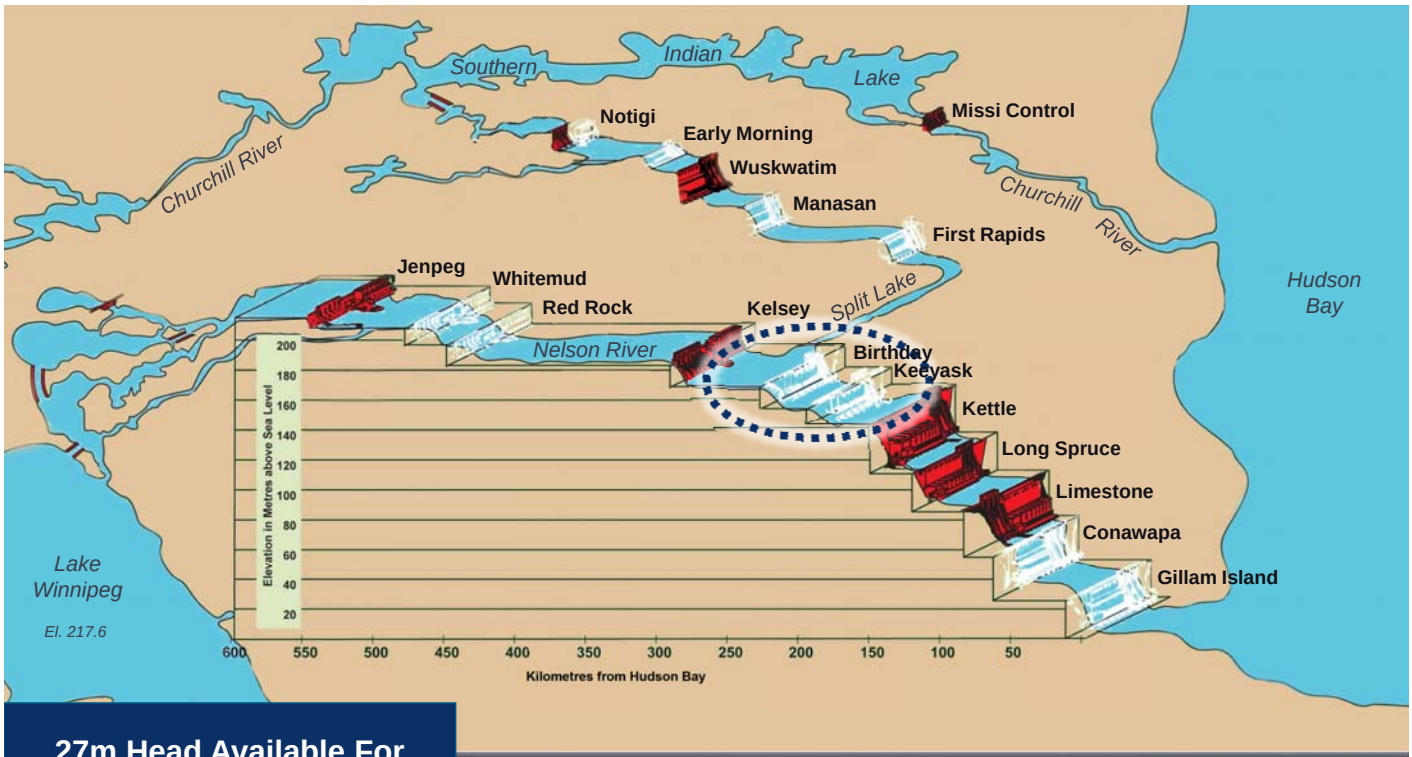
Project Planning Phase

Project Planning Process

- 5 Stage Planning Process
- Triple-Bottom Line approach that considers environmental, economic, and social responsibility factors of the projects



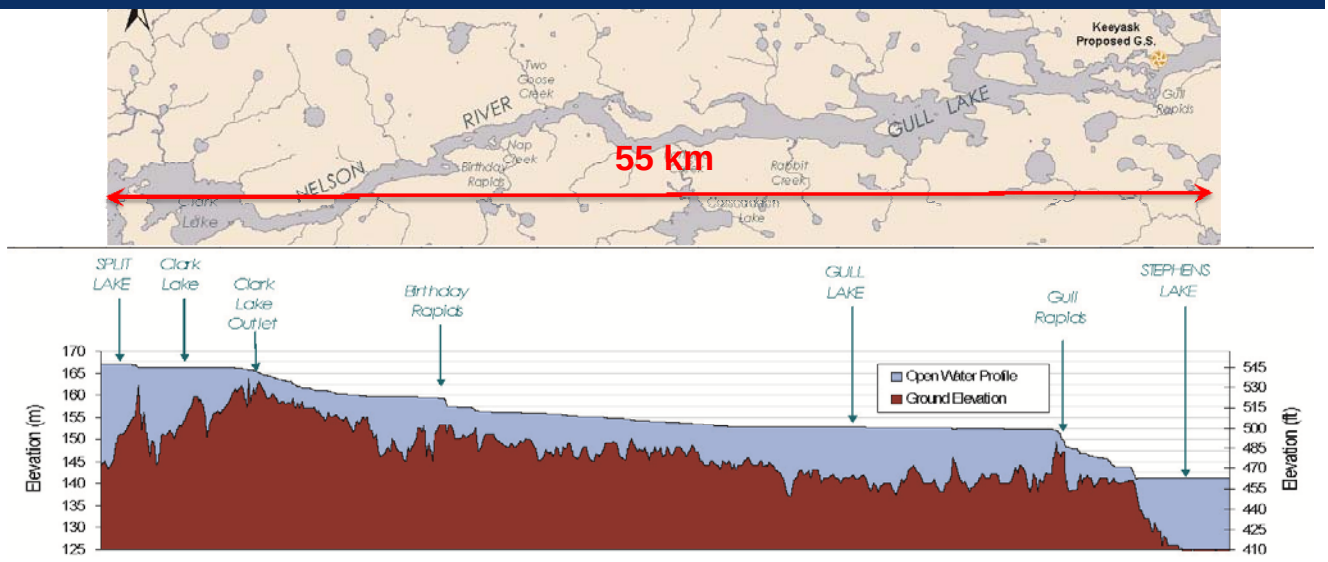
Reach Development



27m Head Available For Hydro Development

Reach Development

- Since the 1950s, Canada, Manitoba, Manitoba Hydro have studied options to develop hydro generating stations on this reach of river. Potential sites first identified in early 1900's.
- Since the early 1990s Manitoba Hydro has been working closely with the TCN through a **Joint Planning Process**

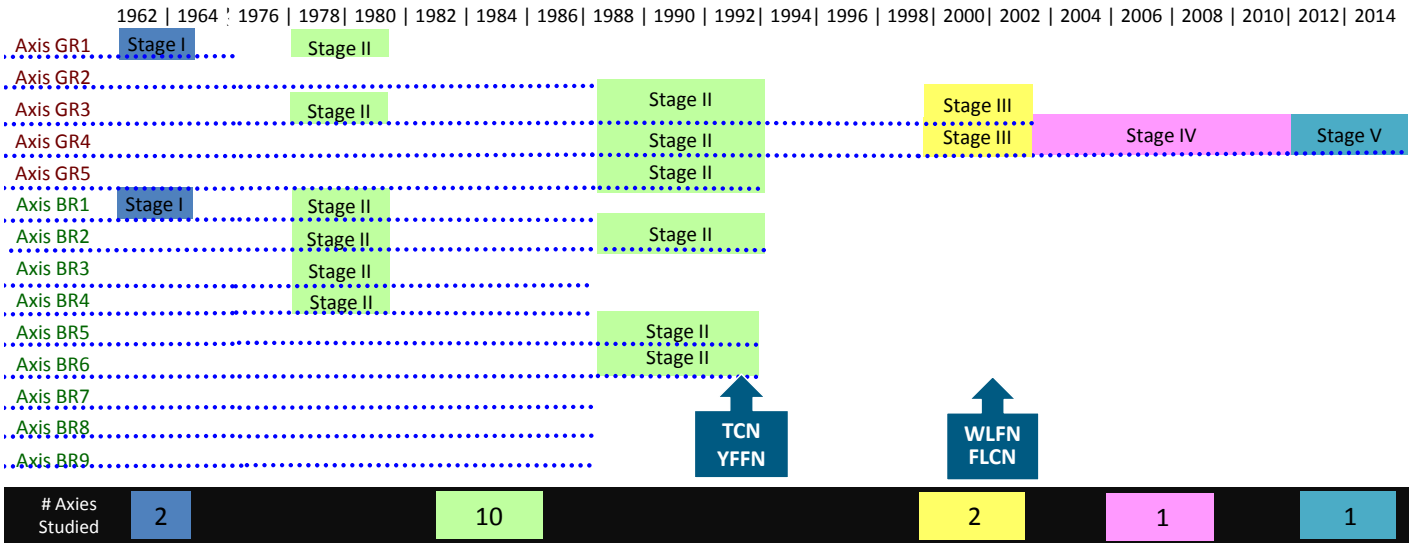


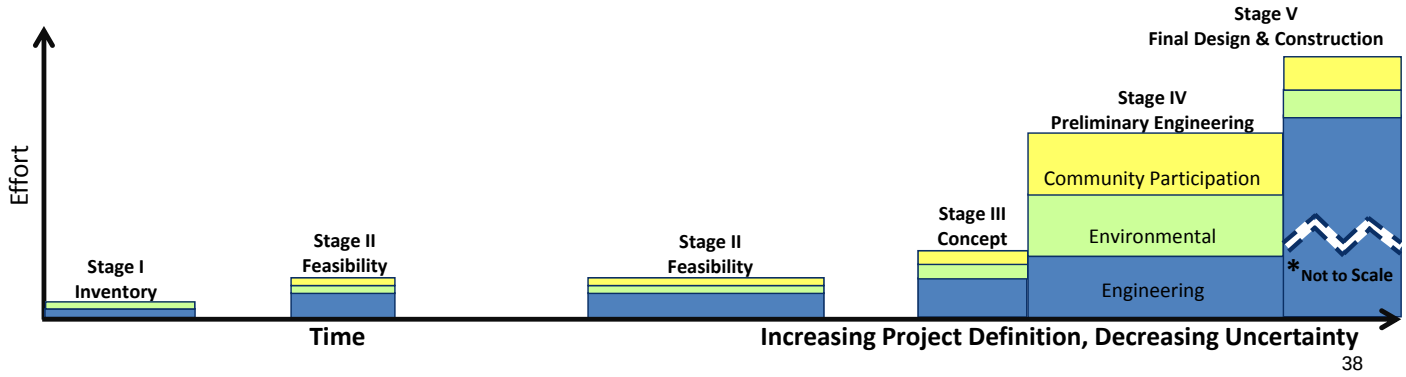
27m of available head between Split Lake and Stephens Lake (Kettle Reservoir) could be developed different ways

Location of Alternative Axes

- **Several alternative axes were considered to develop the river reach:**
  - Gull Rapids – 5 alternatives
  - Birthday Rapids – 9 alternatives

Planning History





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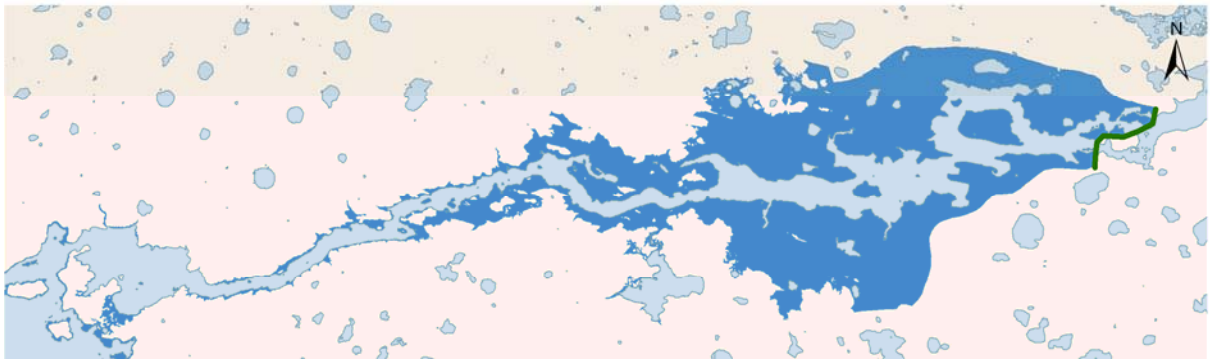
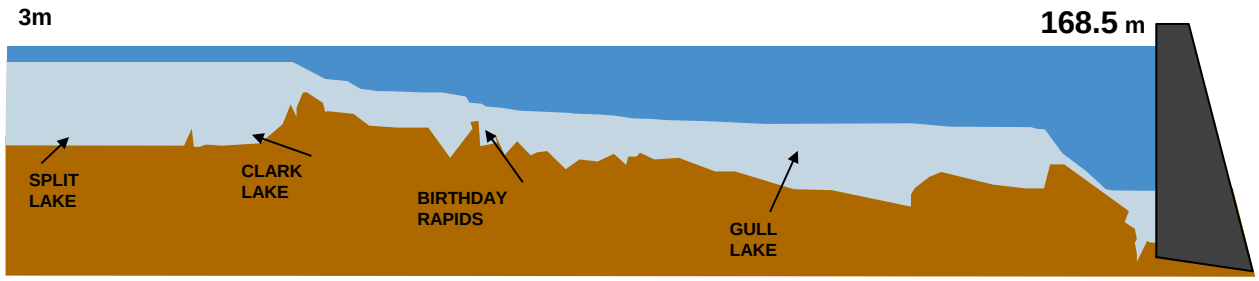
Option 1: High Head Single Site Development

- **Flooded Area = ~183 km² (includes flooding on Split Lake)**
- **Generation Capacity = 1,150 MW**





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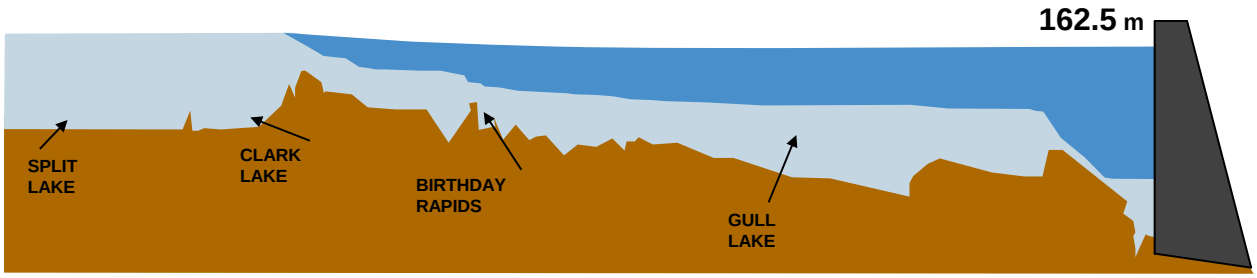
Option 2: Intermediate Head Single Site Development

- **Flooded Area = ~78 km² (no flooding on Split Lake)**
- **Generation Capacity = 900 MW**



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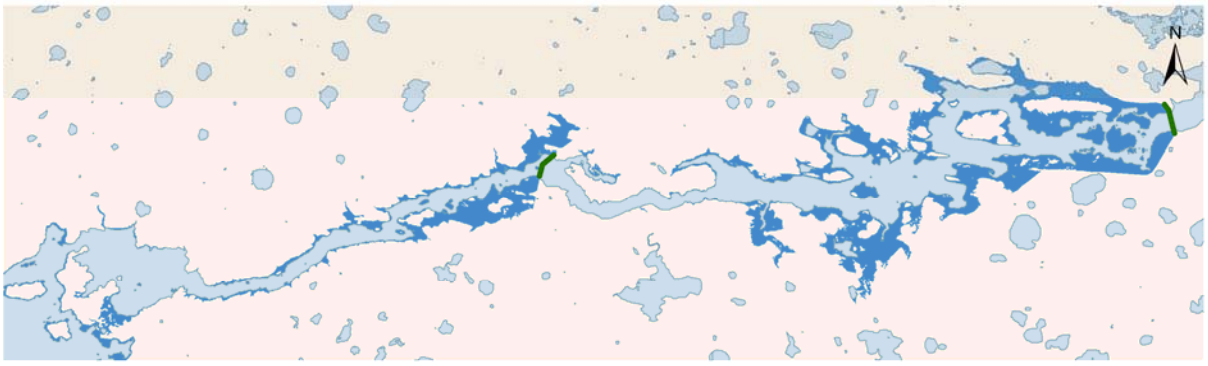
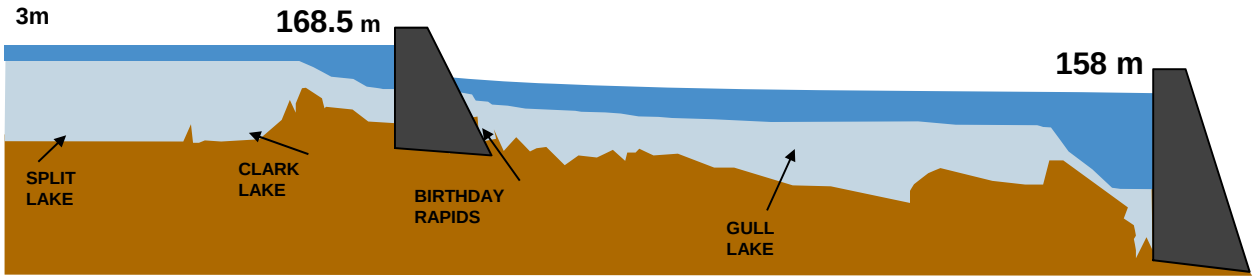
Option 3: Low Head Two Site Development

- **Flooded Area = ~106 km² (includes flooding on Split Lake)**
- **Generation Capacity = 510 MW + 640 MW**





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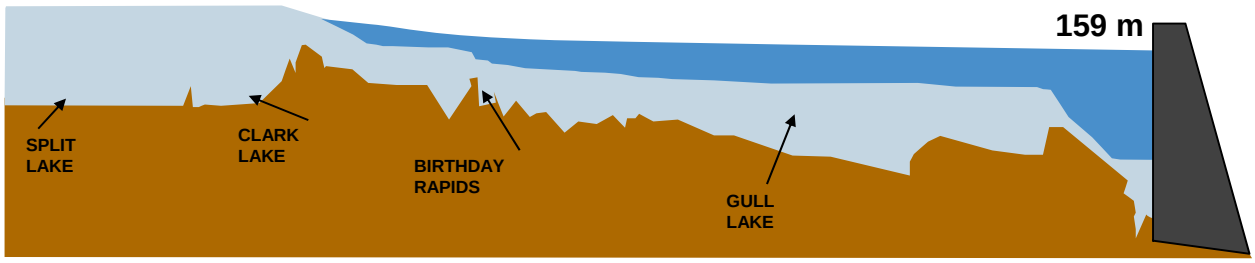
Option 4: Low Head Single Site Development

- **Flooded Area = ~45 km² (no flooding on Split Lake)**
- **Generation Capacity = 695 MW**



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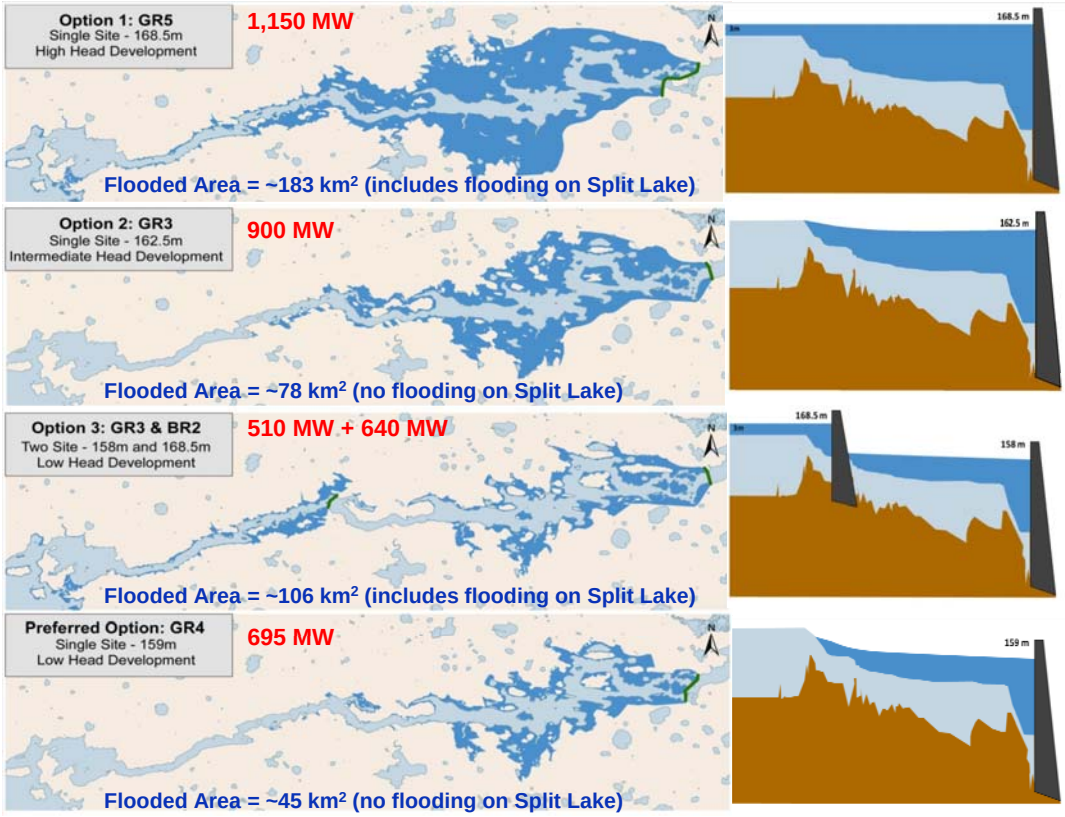
Reach Development Options



In 1996 High Head option eliminated because of concerns over environmental effects

In 1999 TCN and MH decided to pursue a single low head development at Gull Rapids
- Least Flooding
- Least Environmental Effects

Result is least Power Production

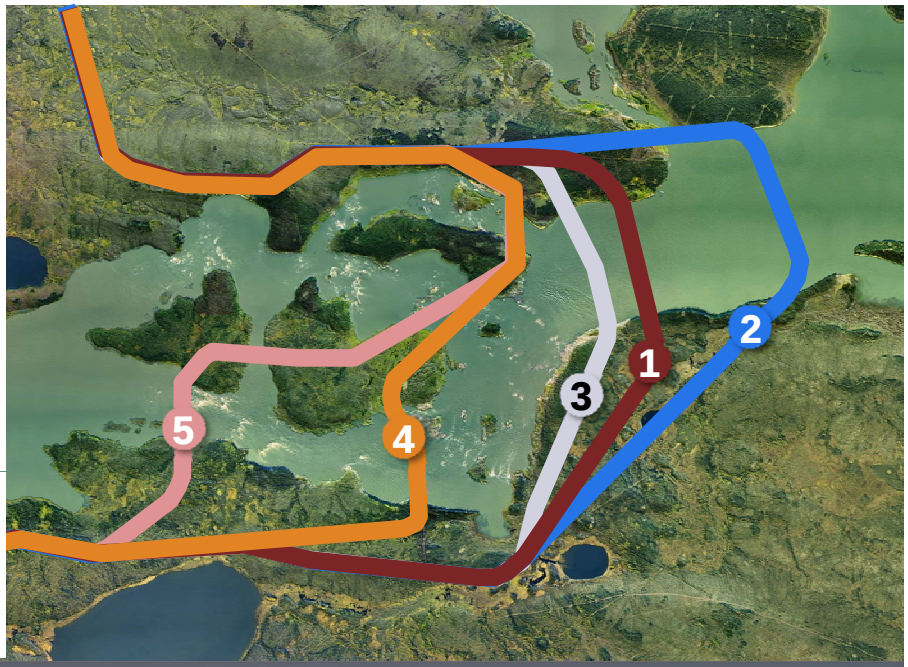
In 2002 axis with a Full Supply Level 159m was selected as the preferred option

Note: Estimates of flooded area are preliminary

Gull Rapids Alternative Axis

Axis 4 Selected Because:

- **Lowest capital-cost estimate**
- **Least construction risk**
- **Best material transport logistics**
- **Shorter construction schedule (1 year earlier than Axis 3)**
- **Fewer adverse effects and provides more potential for environmental mitigation**



Reservoir Level Optimization

- **Reservoir levels lower than 159m were considered**
- **Reservoir levels below 158m require upstream channel excavation resulting in a more expensive project**
- **Additional 1m above 158m required to ensure a stable ice cover forms upstream of the powerhouse**

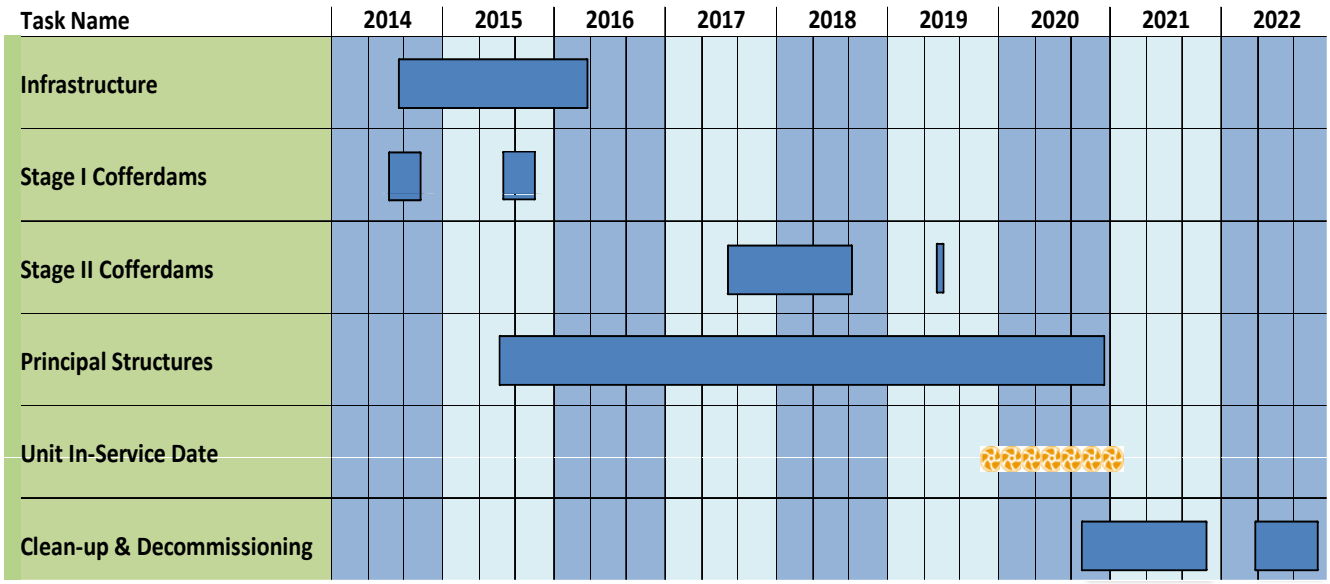
Fundamental Features

- **In 2009, the Joint Keeyask Development Agreement (JKDA) established fundamental construction and operating features of the Project that are of fundamental importance to TCN or YFFN and cannot be altered without their consent:**
  1. The north and south access roads routed within defined corridors
  2. Powerhouse in North Channel & Spillway in South Channel
  3. Main Construction camp on north side of Nelson River
  4. No change to the CRD or LWR Licences will be required to construct the Project
  5. The operation of the Project will not affect water levels on Split Lake during open water conditions
  6. The FSL=159m and MOL=158m; reservoir level may exceed the FSL or be drawn down below the MOL under special or emergency conditions.

Project Construction Phase

Construction Schedule

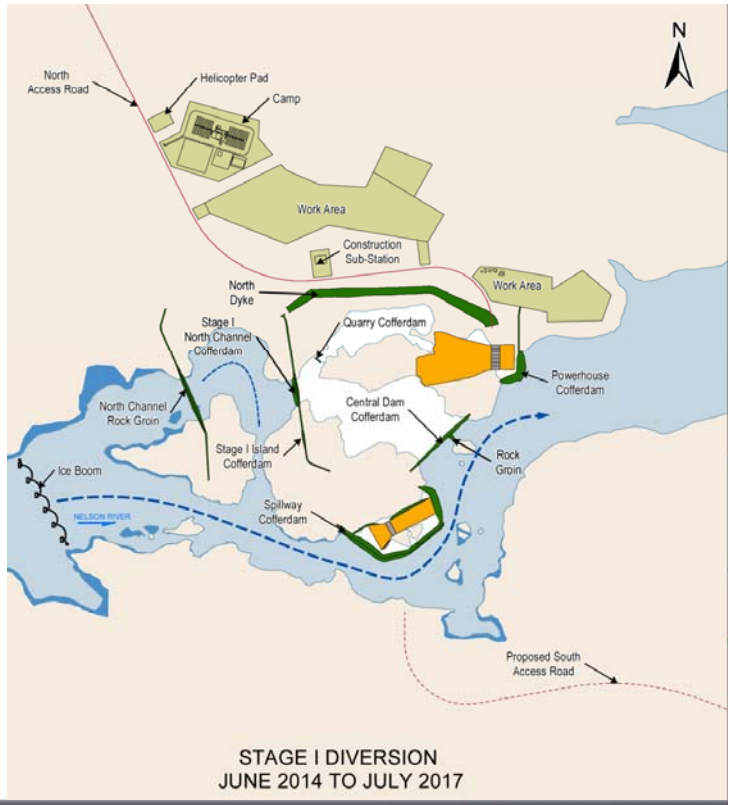
- **Construction schedule is based on results of the Stage IV Preliminary Engineering Design Phase**
- **Contractors may modify sequence and schedule**



The timelines above show the start and end dates of each activity, but do not reflect the downtime periods that may occur throughout the activity.

Construction Sequence: 2014-2017

- **Stage I River Diversion includes 6 cofferdams and 2 rock groins**
- **Entire river flows in south channel for 3 years (2014-2017)**
- **Cofferdams create dry work areas to construct powerhouse, spillway and dams**
- **Supporting Infrastructure completed 2014/15**
- **Construction of dykes started**
- **South access road completed**



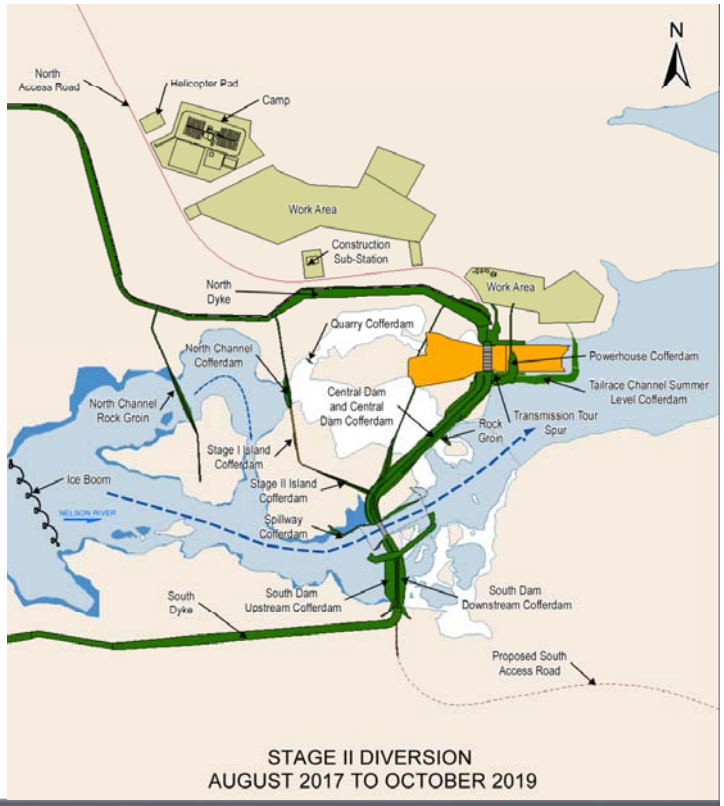
STAGE I DIVERSION
JUNE 2014 TO JULY 2017

Construction Sequence: 2014-2017

- **Example cofferdam at Limestone GS that creates dry work area**
- **Cofferdams constructed to withstand floods and extreme ice conditions**

Construction Sequence: 2017-2019

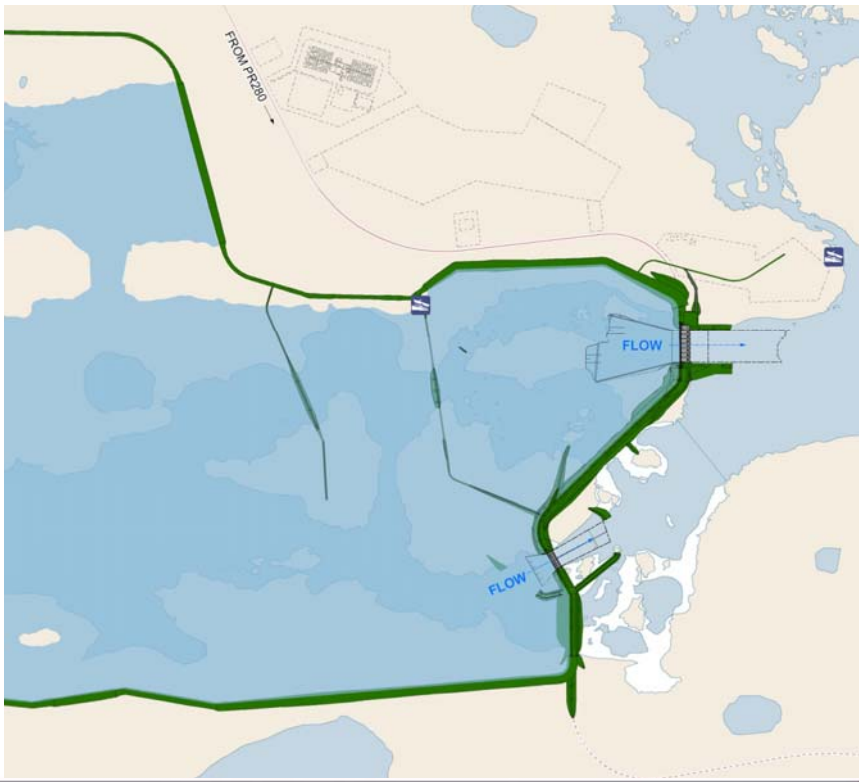
- **During Stage II River Diversion entire river flows through partially completed spillway for 2 years**
- **South Dam cofferdam**
- **Powerhouse summer level cofferdam**
- **Work continues on powerhouse, dams and dykes**



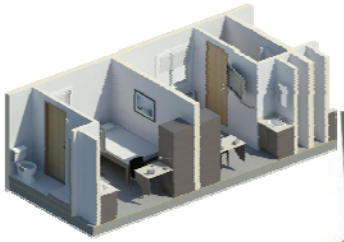
STAGE II DIVERSION
AUGUST 2017 TO OCTOBER 2019

Construction Sequence: 2019-2022

- **Reservoir impounded in 2019 once dykes and dams completed and powerhouse sufficiently completed**
- **7 Units commissioned in 2019 and 2020**
- **Spillway completed**
- **Supporting infrastructure decommissioned**
- **Disturbed sites rehabilitated**



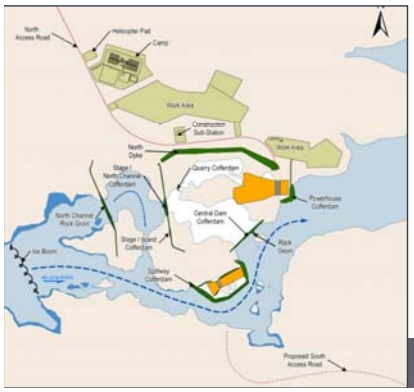
Main Construction Camp



Craft Dorms

Kitchen / Dining
Security / Emergency Response
Entertainment Centre
Reception / Check -in

Phase I Capacity (2014)
500 People
Phase II Capacity (2016)
2000 People



Licensed Lounge

Recreation Centre

Supervisor Dorms

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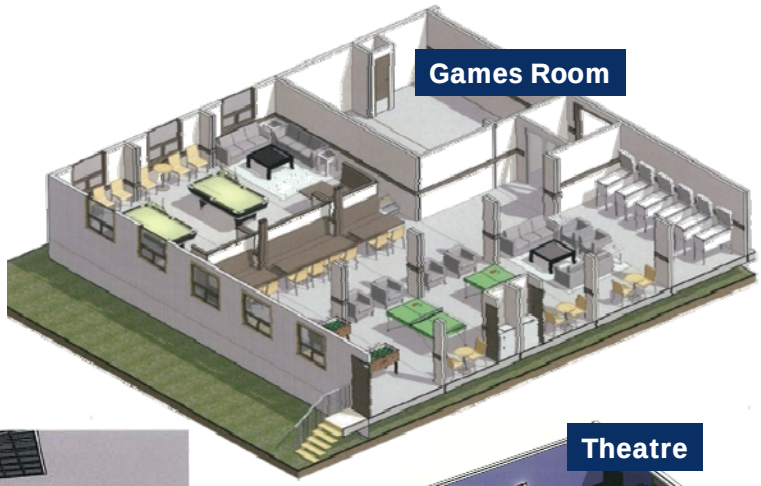
Construction Camp

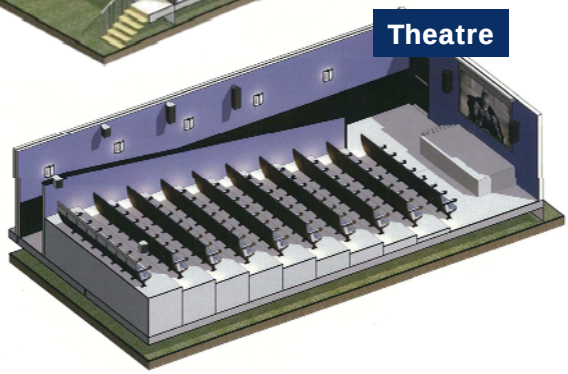
Dinning Hall

Games Room



Recreation Center

Theatre



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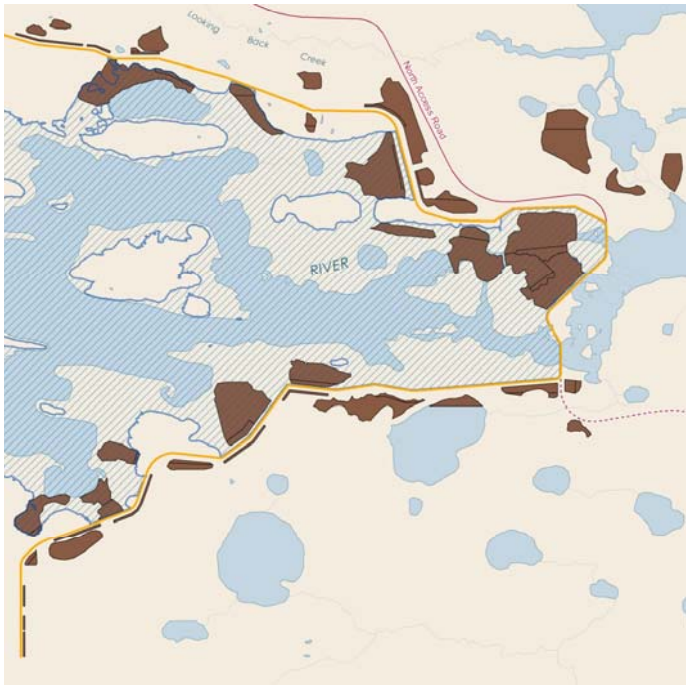
Earth and Rock Sources

- **Approximately 8.4 Million m^3 of rock, granular and impervious material will be required to construct the project**
- **Boundaries modified to avoid or reduce impacts on sensitive habitats**

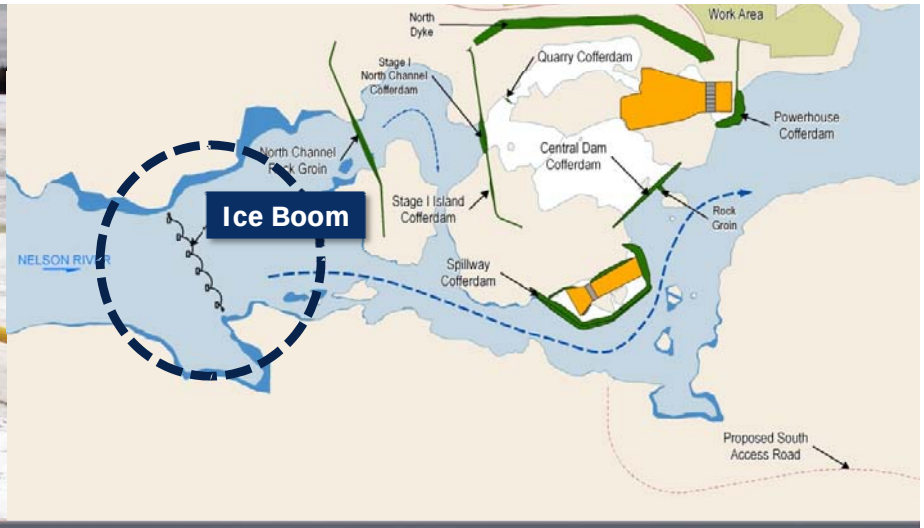
Excavated Material Placement Areas

- **Excavations for principal structures and removal of cofferdams will result in approximately 4.17 Million m^3 of earth materials that cannot be used for construction**
- **This material will be placed within 35 alternative excavated material placement areas (EMPAs)**
- **EMPAs within the reservoir reduce project impacts – designed not to erode and not to impact water quality**



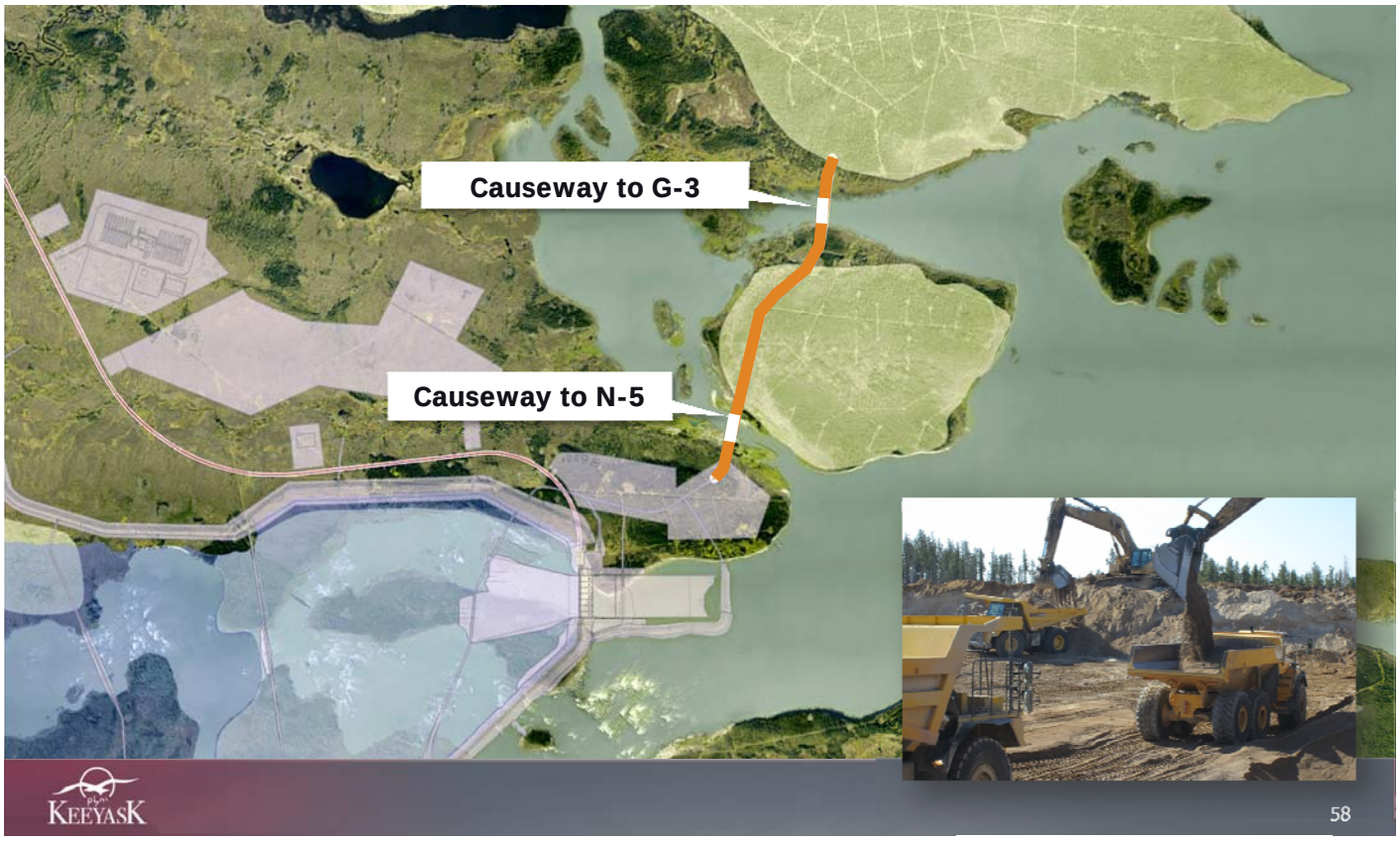
Ice Boom

- **Ice boom will reduce the accumulation of ice downstream of Gull Rapids reducing construction risks and construction costs**
- **Located 3 km upstream of the powerhouse**



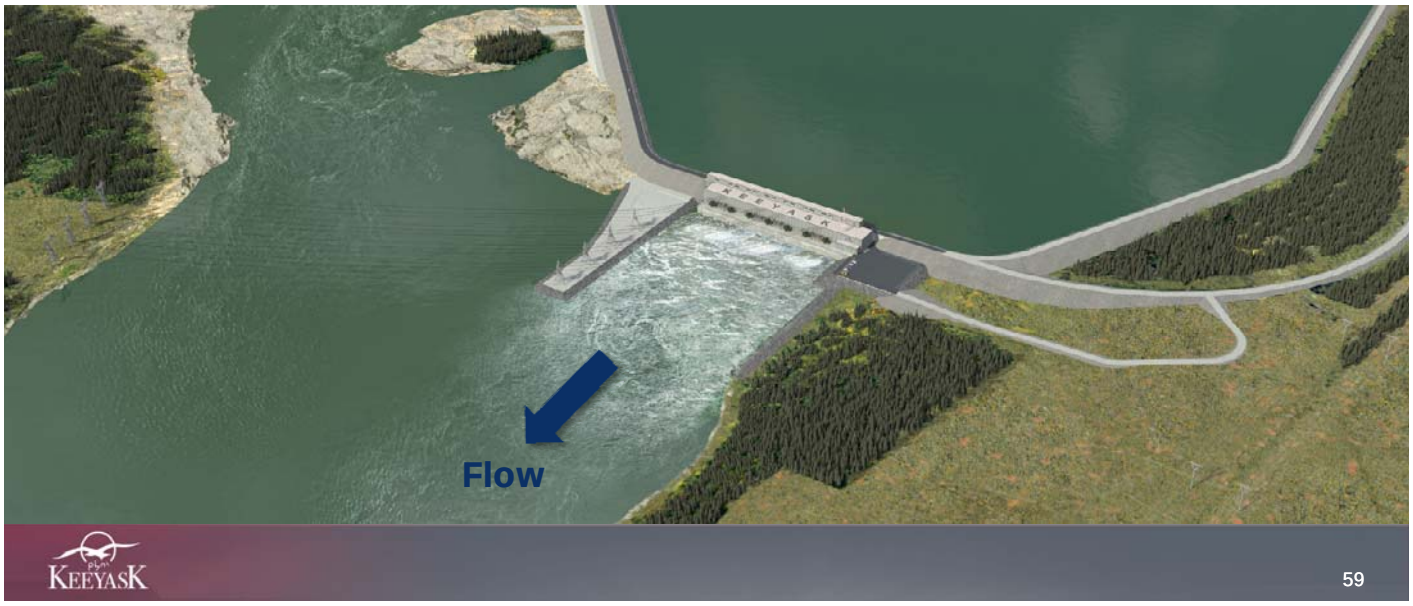
KEEYASK

Rock Fill Causeways



Transmission Tower Spur

- **The Keeyask GS would utilize a transmission tower spur to support the foundations for the first row of transmission towers beyond the downstream side of the generating station**



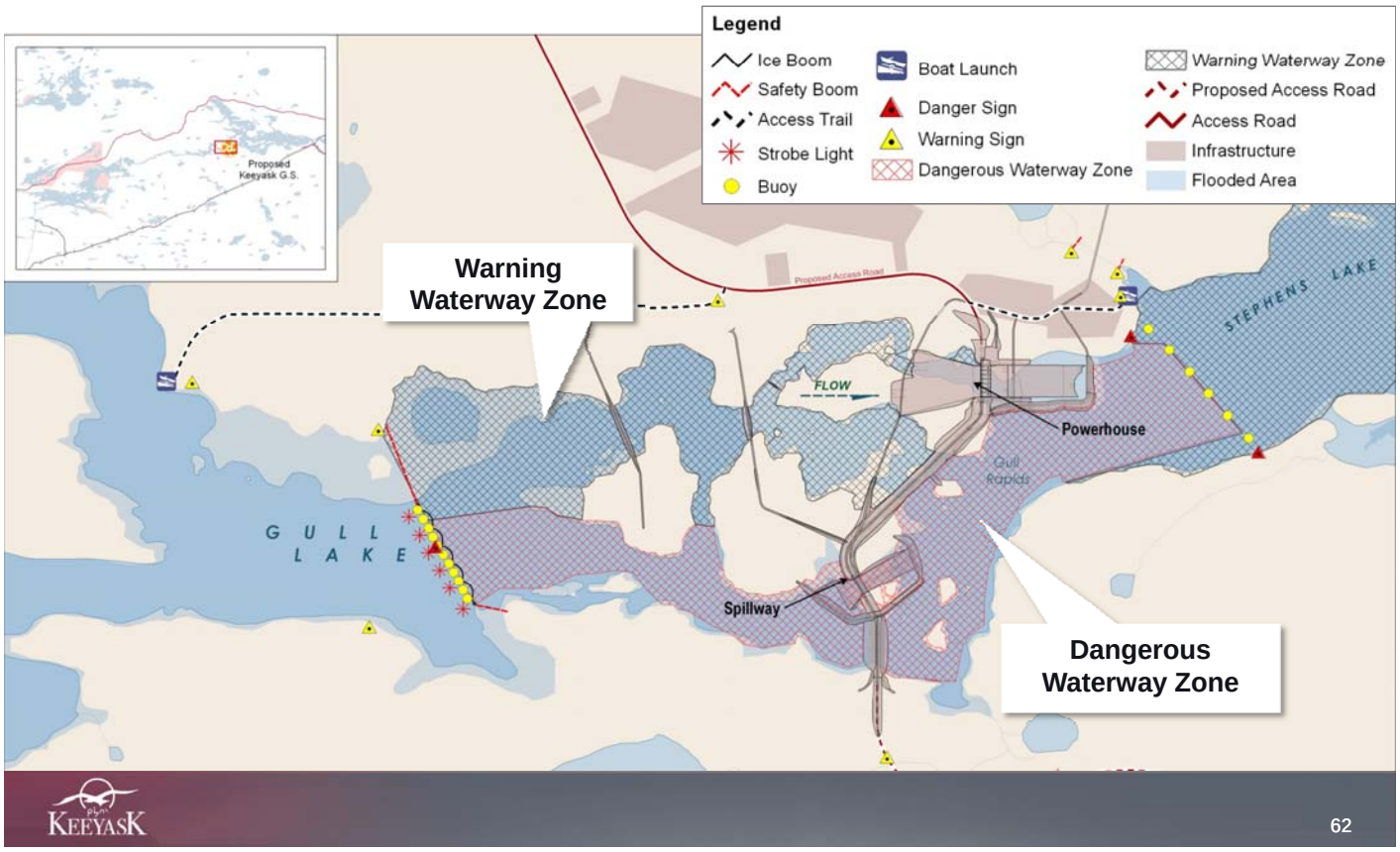
South Access Road

- **Would be built to support the operation of the Keeyask GS**
- **Will also be used to start construction of the south dyke during Stage I River Diversion.**

Reservoir Clearing

- **Key concern of the partner First Nations is the impact of floating debris on waterway travel, access and human safety**
- **Partner First Nations and Manitoba Hydro decided to clear timber from the reservoir prior to impoundment**

Public Safety During Construction



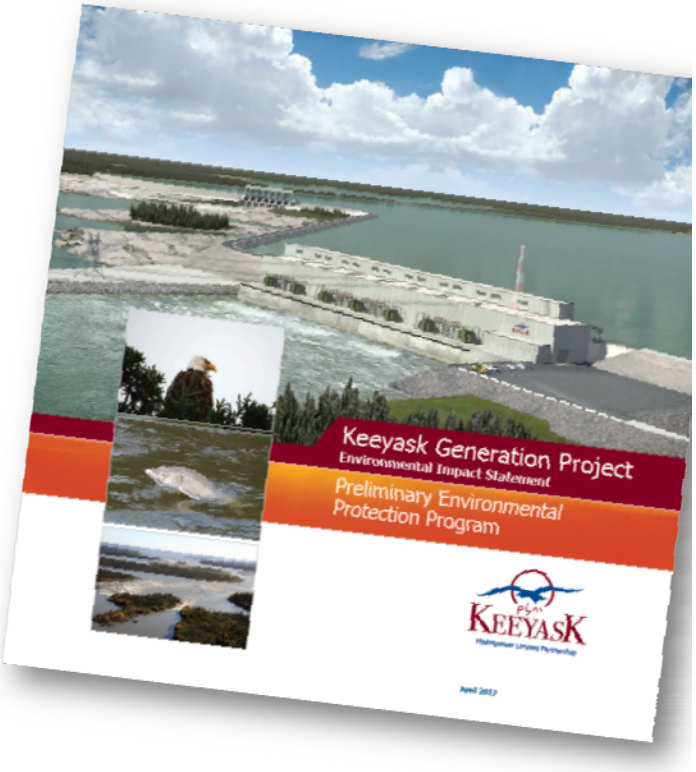
Environmental Protection Program

- **Will be a comprehensive program developed which contains three different types of plans:**

Environmental Protection Plans (EnvPPs)	• Measures to be implemented by contractors and staff to minimize effects of construction
Environmental Management Plans	• Mitigation focused on specific issues, such as sediment, site access, fish habitat and heritage resources
Environmental Monitoring Plans	• Procedures to monitor effects on aquatic, terrestrial, physical and socio-economic environments

Environmental Protection Plans

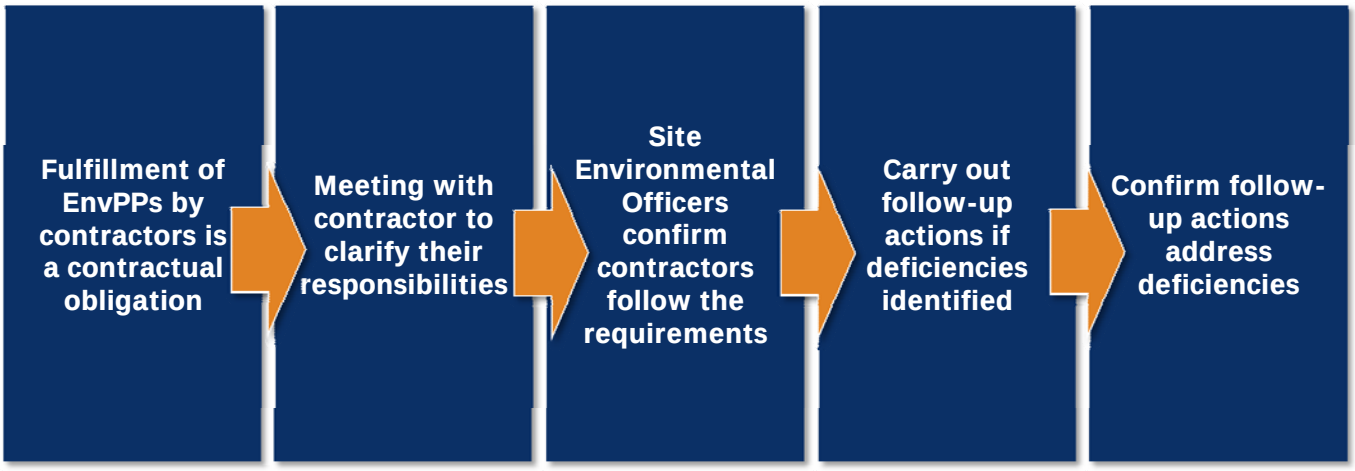
- **Two preliminary EnvPPs have been developed:**
  - Generating Station Construction
  - South Access Road Construction



Environmental Protection Plans

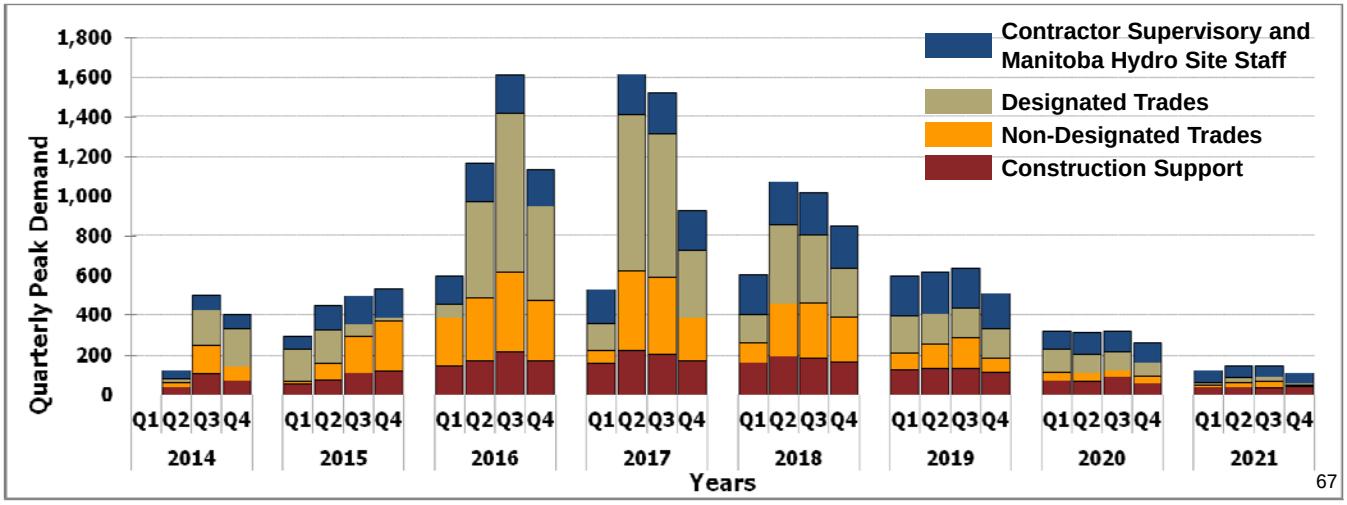
- **EnvPPs are organized by construction activity (e.g., tree clearing, drilling, cofferdam, in water work) with mitigation measures listed specific to the activity. EnvPPs also include:**
  - Detailed maps of the construction area that show setback distances from sensitive sites (e.g., caribou calving areas and rare habitat features)
  - Emergency response plan
  - Erosion and sediment control measures – specifications for materials and methods to be applied
  - Permits, licences, authorizations received

Implementation of the EnvPPs will include the following process:



Construction Employment

- **Peak workforce will be approximately 1,600 people**
- **Total project employment estimate at Keeyask is approximately 4,225 person years**
- **Opportunities available within construction support and service trades, non-designated trades, designated trades, contractor supervisory and Manitoba Hydro site staff**



Construction Work Packages

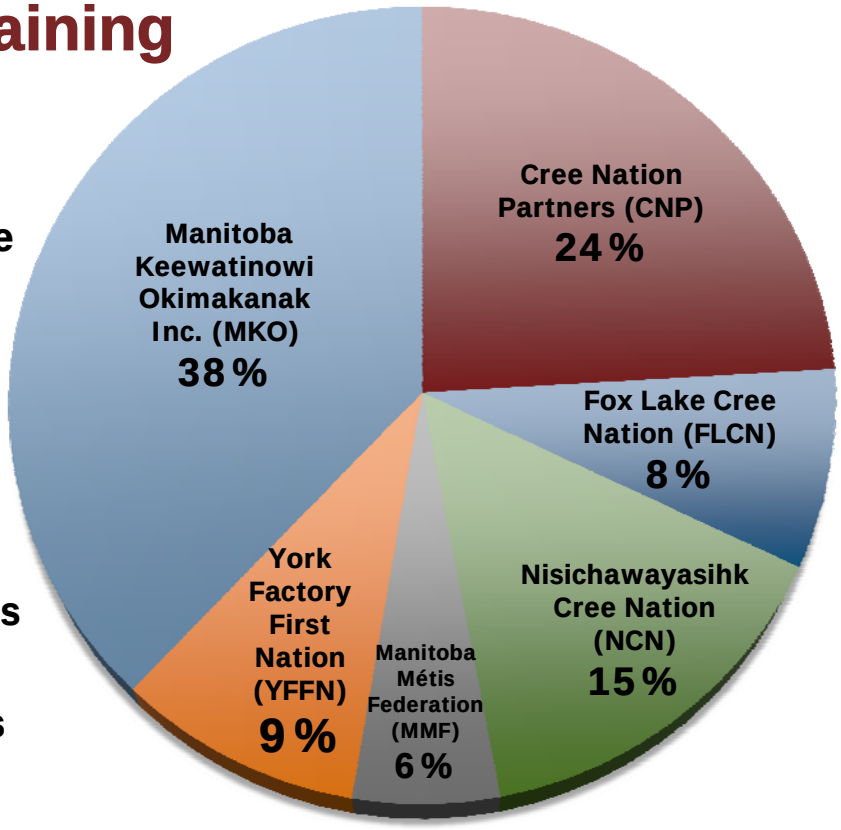
Direct Negotiated Contracts (DNCs)	• Several service and construction contracts will be directly negotiated with the partner First Nations • Examples include the south access road, catering and first aid
Tendered Contracts	• Several contracts will be publicly tendered – i.e. competitive process where contractors submit proposals with a price to complete the work • Examples include the general civil contract, turbines and generators

Construction Hiring

- **Direct Negotiated Contracts (DNCs)**
  - Employment opportunities are available for qualified KCN and northern Aboriginal residents through the direct hire provisions for DNCs:
    - **1st preference:** Members of the partner community awarded the contract
    - **2nd preference**: Members of the remaining partner communities
    - **3rd preference** - Aboriginal residents of northern Manitoba not covered above
- **Tendered Contracts**
  - Employment opportunities are available for the KCN and northern Aboriginal residents through the first preference in the hiring sequence outlined in the Burntwood Nelson Agreement

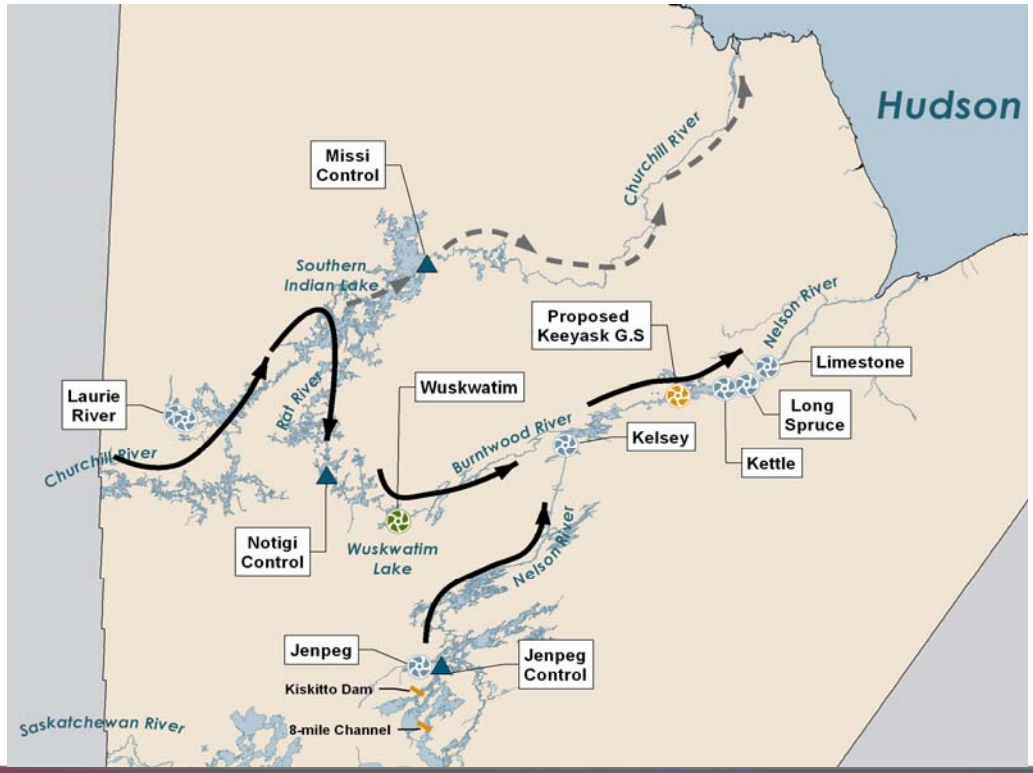
Construction Training

- The Hydro Northern Training and Employment Initiative was implemented to prepare Aboriginal northerners to participate in northern hydro construction employment and business opportunities
- Approximately 2,600 training opportunities were provided in the communities

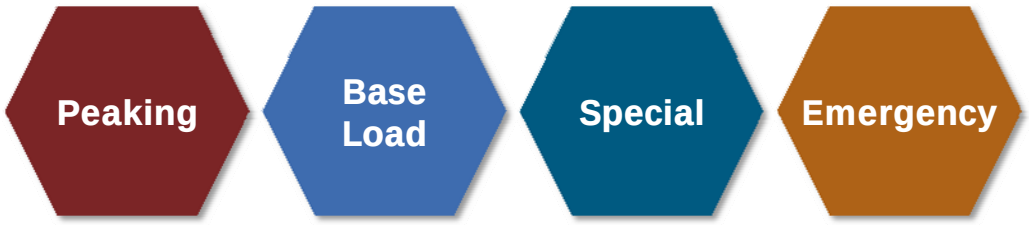


Project Operation Phase

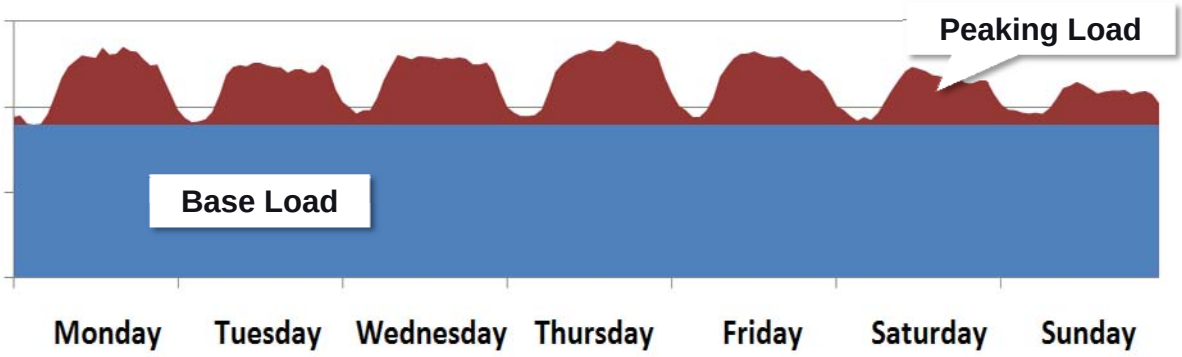
Inflow to Keeyask Reservoir



Four Modes of Operation



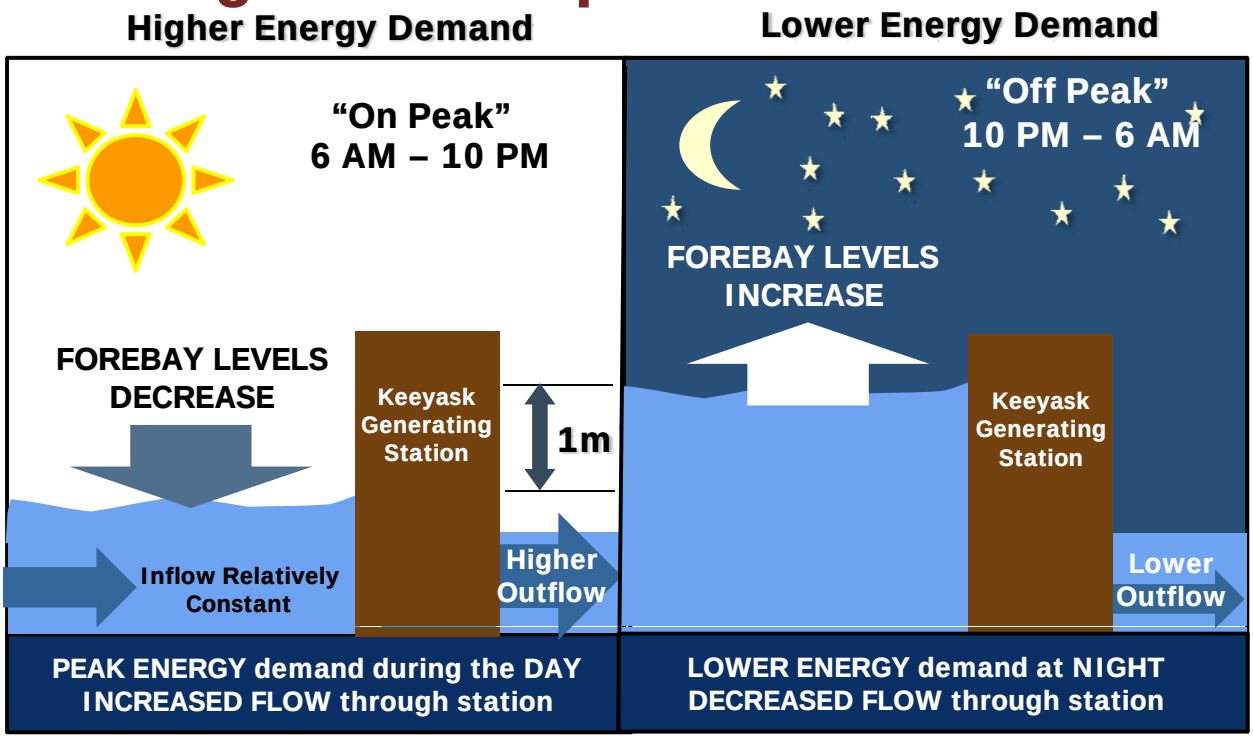
- Will operate in Peaking or Base load modes virtually all of the time
- Mode will depend on inflow conditions and the requirements of the Manitoba Hydro integrated generation and transmission system



Modes of Operation

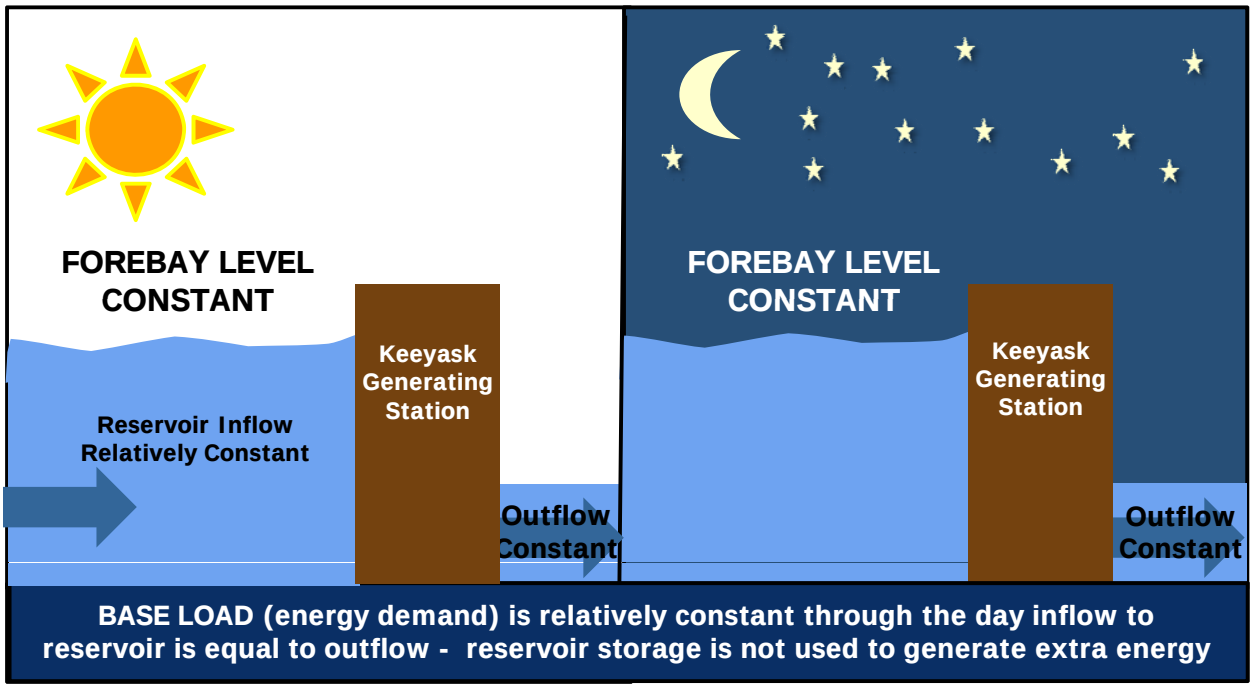
- **Reservoir will normally operate within a narrow 1m range**
- **Operate between 1 and 7 Units**
- **Will be some restrictions to operations during spring period to maintain lake sturgeon spawning habitat downstream of the generating station**

Peaking Mode of Operation



Based on historical flows from the CRD and LWR, Keeyask GS could potentially operate in a "Peaking Mode" 88% of the time or less.

Base Load Mode of Operation



Keeyask GS could operate in a "Base Load Mode" 100% of the time or less

Special Mode of Operation

- **Special conditions may cause the forebay to temporarily exceed the full supply level or draw down below the minimum operating level:**
  - Load Rejection (units tripping off due to mechanical, transmission or other problems)
  - Flood Management
  - Large rain events or high winds
  - Non Project hydraulic effects (ice, rapid spring runoff)
- **Keeyask GS would operate to return reservoir level within the designated 1m reservoir range.**

Emergency Mode of Operation

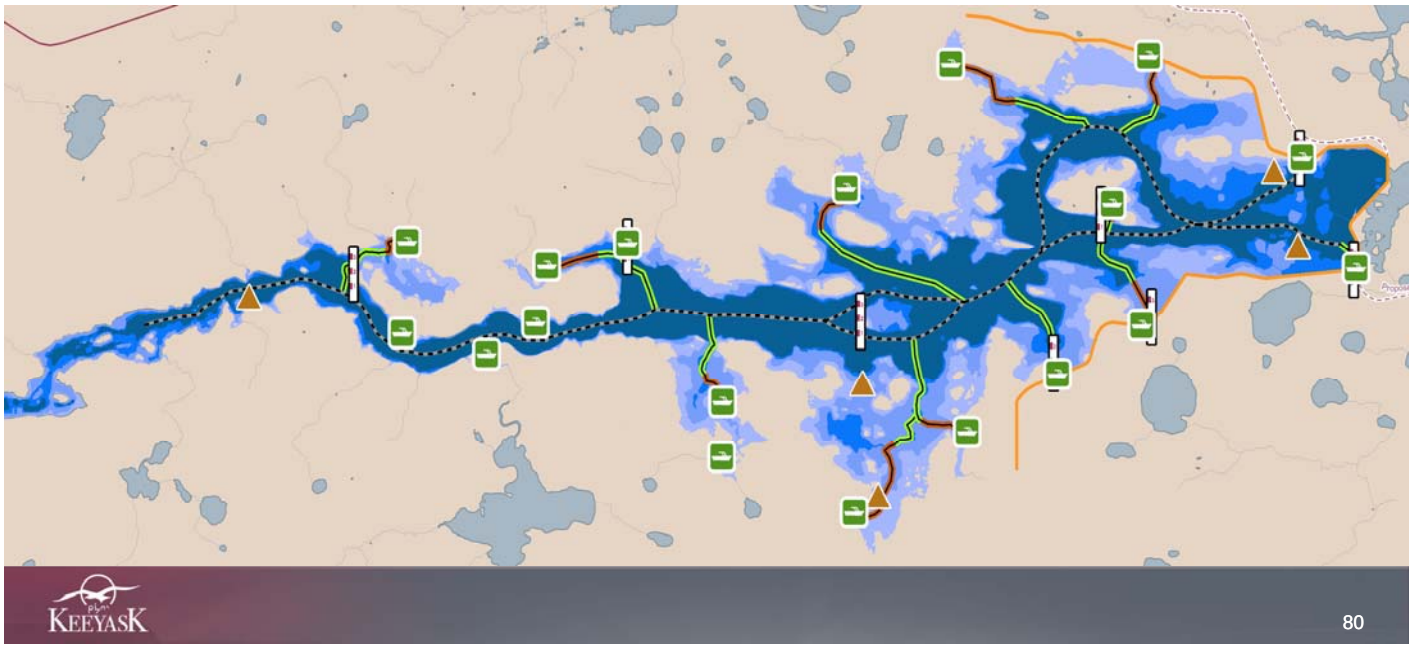
- **Emergency situations that are highly unlikely may require the Keeyask GS to operate in a mode different than all other modes:**
  - Risk of imminent failure of a dam or dyke
  - Downstream accident or event may require the outflow to be stopped temporarily

Waterways Management Program

- **Objective is to contribute to safe use and enjoyment of the waterway**
- **Boat patrols will monitor waterway and travel routes and remove debris that pose a risk to safe navigation and to maintain access routes**
- **Boat patrols will monitor waterway shorelines for trees that may become debris and work crews will remove them before they become debris**
- **Discussed further by Physical Environment Panel**

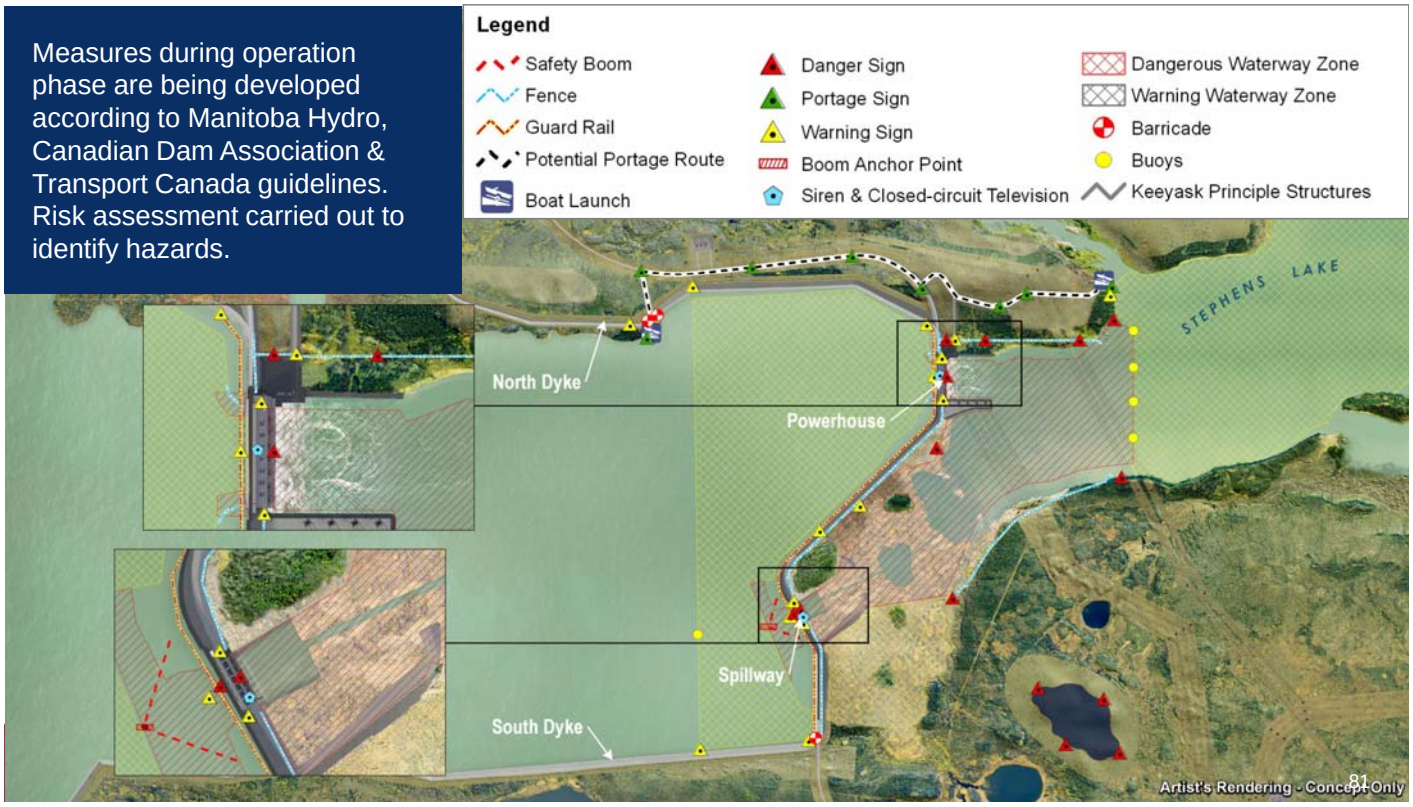
Safe Boating Routes and Landings

- **Safe boating routes & landing sites will be developed to maximize navigation safety**
- **Similarly safe winter trails will be established**



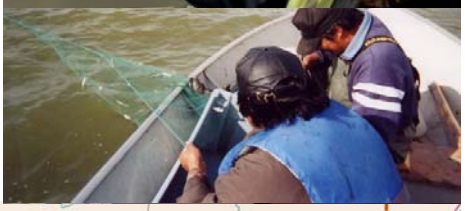
Waterways Public Safety Measures, Portage & Boat Launch

Measures during operation phase are being developed according to Manitoba Hydro, Canadian Dam Association & Transport Canada guidelines. Risk assessment carried out to identify hazards.



Operation Workforce

- **Staff working at Keeyask GS = 38**
  - station will be staffed 24 hrs/day, 7 days/week
- **Staff Along Lower Nelson River & Gillam**
  - Support staff in Gillam
  - Waterways Management Program
  - Environmental Monitoring



Road Network

PR 280 will be rerouted to use the access roads and the Keeyask Principal structures Reducing travel time from the turn off to Gillam by 45 minutes.

Current Road Network

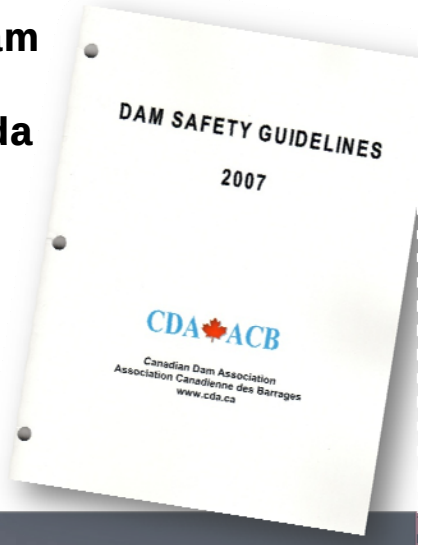
Future Road Network

Manitoba Infrastructure & Transportation plans to decommission this section from PR280 to a departmental road once Keeyask is built

KEEYASK

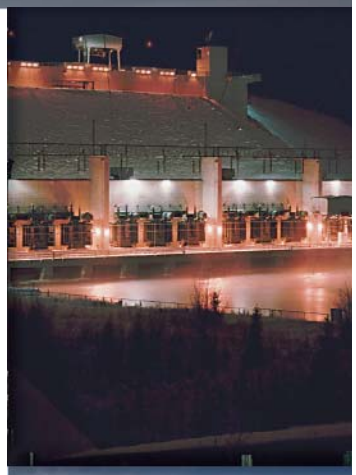
Dam Safety

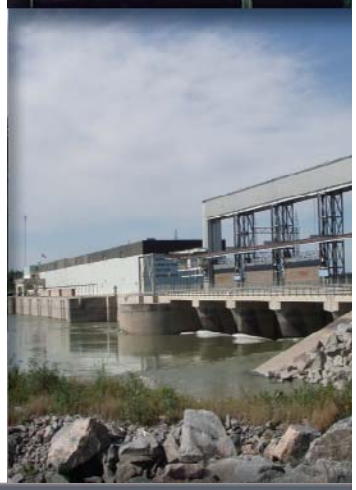
- **Manitoba Hydro's Dam Safety Program will be applied to Keeyask to manage the risk of a dam failure during the construction and operation phases**
- **Keeyask dams will be designed, monitored and maintained to minimize the risk of a dam failure**
- **Dam Safety Program based on Canadian Dam Association Dam Safety Guidelines (2007) which is the standard practice across Canada**
- **Some elements of the Dam Safety Program include:**
  - Site specific Dam Safety Reviews
  - Emergency Preparedness Plan
  - Emergency Response Training, Exercises and Simulations
  - Condition Assessments.



Dam Safety Program

- The risk of dam failure during a large flood has been mitigated by designing Keeyask to safely pass the Probable Maximum flood (PMF)
- PMF is an extremely large flood that has an exceptionally low probability of occurring with less than a 1:10,000-year frequency
- PMF for Keeyask is nearly twice as large as the largest flood of record
- Designing Keeyask to safely pass the PMF is in accordance with Canadian Dam Association Dam Safety Guidelines





Summary Remarks

- **Keeyask is a carefully planned project that has undergone decades of planning**
- **During the 1990's Manitoba Hydro and TCN worked together through a Joint Planning Process resulting in the selection of a low head project to avoid and reduce Project effects and address concerns raised by TCN**
- **Manitoba Hydro and the Partner First Nations worked together to continue planning the project for over 10 years resulting in Project features that reduce and mitigate environmental impacts**

Summary Remarks

- **Construction will take about 8.5 years requiring temporary and permanent supporting infrastructure**
- **Construction will have a peak workforce of 1600 people and generate significant employment and business opportunities for the KCN and northern Aboriginal residents**
- **Keeyask will produce energy for domestic and export markets using water which is a renewable resource**

Keeyask Generation Project

CEC Hearings - Environmental Impact Statement

KEEYASK
Hydropower Limited Partnership

Thank You

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