



University of  
**Strathclyde**  
Engineering

# **Harnessing Hydrokinetic Energy for Enhanced Energy Resilience in the Arctic Communities of Canada**

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**3<sup>rd</sup> Pan-American Marine Energy Conference  
21<sup>st</sup> -24<sup>th</sup> January 2024**

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# Background

## REMIROCaN aims to investigate energy resiliency and reduce diesel consumption in Arctic homes and shelters through the use of renewable energy resources around the Nunavut area

Prior to exploring any engineering solutions, it is of utmost importance to incorporate Inuit Qaujimajatuqangit (IQ) when collaborating with Nunavummiut in communities across Nunavut. IQ encapsulates eight fundamental values of Inuit culture, which include:

1. Inuuqatigiitsiarniq: Respect for other people
2. Tunnganarniq: Openness
3. Pijitsirniq: Acts of service
4. Aajiiqatigiinni: Decision making through discussion and consensus
5. Pilimmaksarniq: Development of skills
6. Ikajuqtigiinni: Working together for a common goal
7. Qanuqtuurniq: Being innovative and resourceful
8. Avatittinnik Kamatsiarniq: Respect for the land



- Approximate area of around 2.093 million km<sup>2</sup>
- Nearly 40,000 habitants live in the Nunavut territory.
- In 2018, the Nunavut was the lowest petroleum-based product consumer in Canada with 465 liter per capita
- However, in average the Nunavut residents consumed 79% more petroleum than the average Canadian for electricity, heat, transport and food

Add reference

## Representative Family Cabin near Iqaluit, NU



Representative dwelling  
Near Iqaluit, NU



**Representative Hunter/ Trapper  
Cabin near Iqaluit, NU**

# Sites of Interest Near Iqaluit, NU

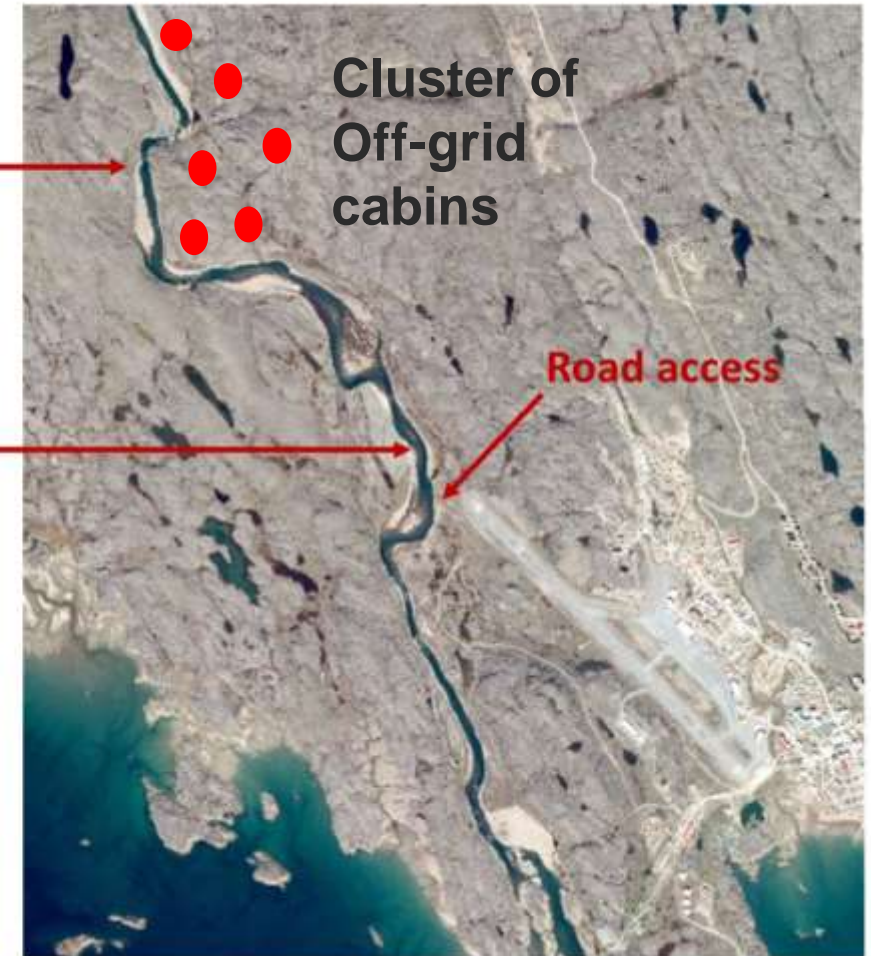


# Methods

1st interest area (most ideal conditions at this location)



2nd interest area



- Water flow in the Mecham River was insufficient given that it completely froze and/or dried up during the winter.
- The Apex River was observed to contain insufficient flow to produce a meaningful amount of hydrokinetic energy and insufficient depth to install a turbine.
- A successful visual inspection was carried out for the Sylvia Grinnell River.

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# Micro Hydrokinetic Feasibility (2)

Proposed sites & available flow data:

Loc. 1: Sylvia Grinnell and Apex Rivers



Loc. 2: Mecham River



Flow Level

Further need for community guidance

# Hydrokinetic Site, Sylvia Grinnell River Near Iqaluit, NU

**Early May 2023**



**Early July 2023**



Photo credit Katelyn Kirby



# Resource Assessment

Approvals and permits to collect field data

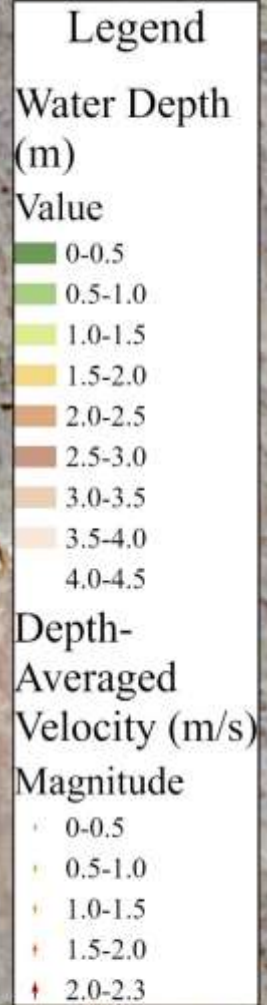
Field equipment transport  
July & August 2023

Field equipment assembly

Field data collection  
July & August 2023

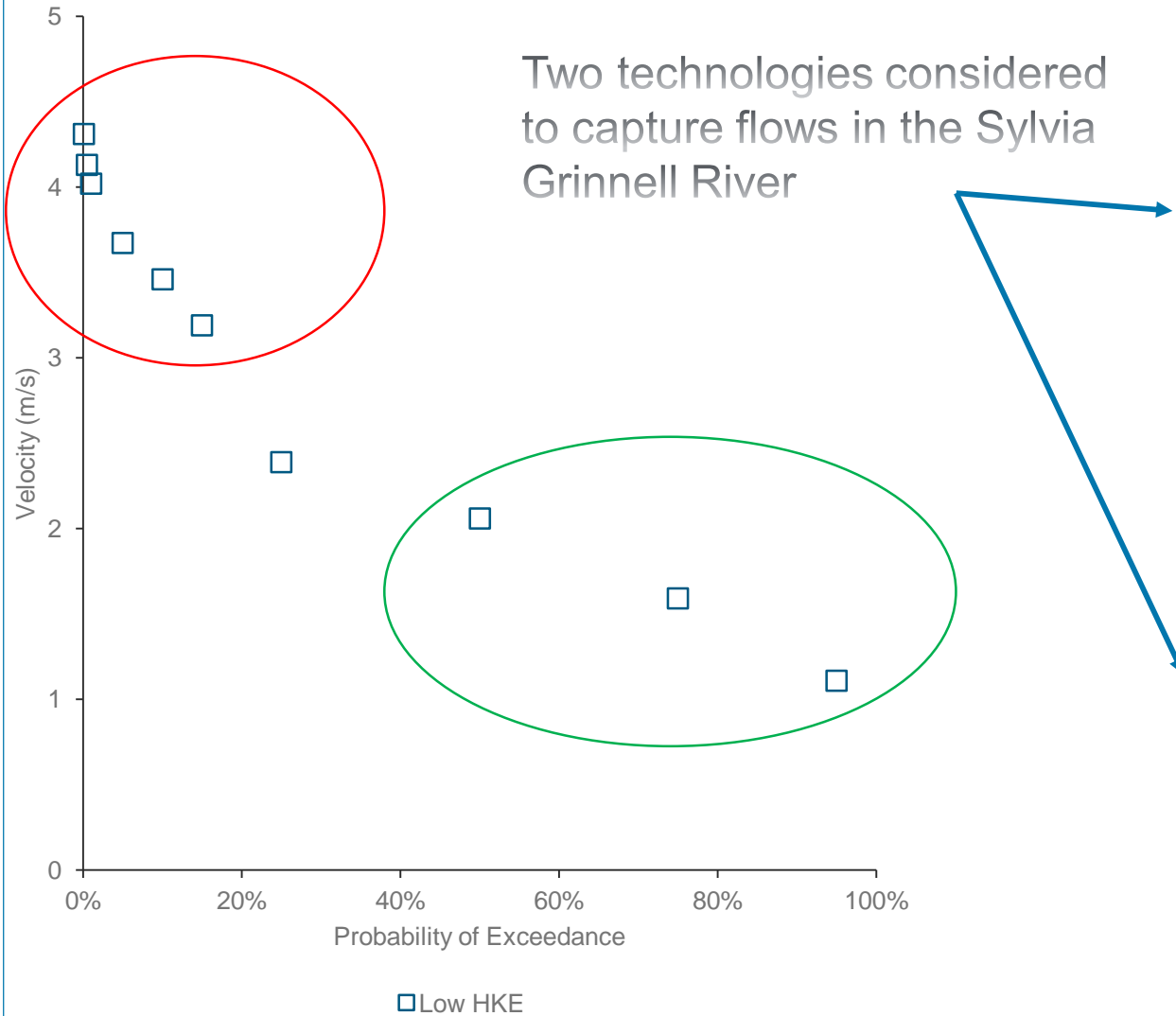
Field data transect  
July & August 2023

Field data results  
for August 2023



→ Field data used for hydrodynamic modelling & hydrokinetic power estimation

# Results



The RivGen Power System (taken from: RivGen Power System & Integrated Microgrid Solutions - ORPC)



Tocado Turbine, taken from Hydrowing

# Results

## Characteristics of cross flow turbine

D(m)	Rated power (kW)	Rated power (kW)	Cut-out speed (m/s)	Stream-wise length	Cross-stream width
1m	40 at 2.25m/s	80 at 3.5m/s	3.5	16.3m	15m

## Characteristics of horizontal axis turbine

D(m)	Rated power (kW)	Rated revs(rpm)	Cut-in speed (m/s)	Cut-out speed (m/s)	Survival speed (m/s)
3.1	98	64	0.9	6.8	9.0

**APG: 87 MWh**  
**CR: 46.8%**



**APG: 141.6 MWh**  
**CR: 15.5%**

The red area is where the systems supposed location to be installed. a) the location for RivGen, where shallowest water depth is above 3.5m in all seasons. b) the location for Tocardo T1,

# Conclusions and Future work

1. Great potential opportunities for the development of hydrokinetic project using rivers in Artic communities in Canada.
2. The work presented here illustrates the first hydrokinetic resource and technology ever proposed for the Sylvia Grinnell River in Nunavut, Canada.
3. Flow velocities in the order of 1 to 2 m/s were observed for most of the year in open water conditions.
4. By using a cross flow turbine, capacity factors in the order of 47% and 103 MWh/year could be obtained in this reach of the Sylvia Grinnell River.
5. Future work includes the assessment of the river when defrosting, accelerated flow patterns, quantification of energy demand- supply match when used as a local energy resource.



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