

Assessment of Canada's River Current Power Potential

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Outline

- Overview and Scope
- Background
- Previous Studies
- Current Study by Phase
- Deliverables

Canada's River Current Power Potential

- As a nation with extensive water resources, Canada has a substantial **river current potential energy** resource which remains largely untapped.
- The size of this national resource is unknown.
- Natural Resources Canada has identified a need to assess the gross theoretical potential of river current power as a national renewable resource.

Purpose and Scope

- The main objective is to assess the national potential in Canada for river current power production.
- The project scope will be limited to assessment of river kinetic energy at a regional scale.
- The challenge is to determine an accurate method of assessment of the current-potential of river reaches at a regional or watershed scale.

“Are there techniques that can provide a reasonable pre-reconnaissance estimate of river current potential and can we apply those techniques on a regional or national scale?”



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Background

- River Current Power

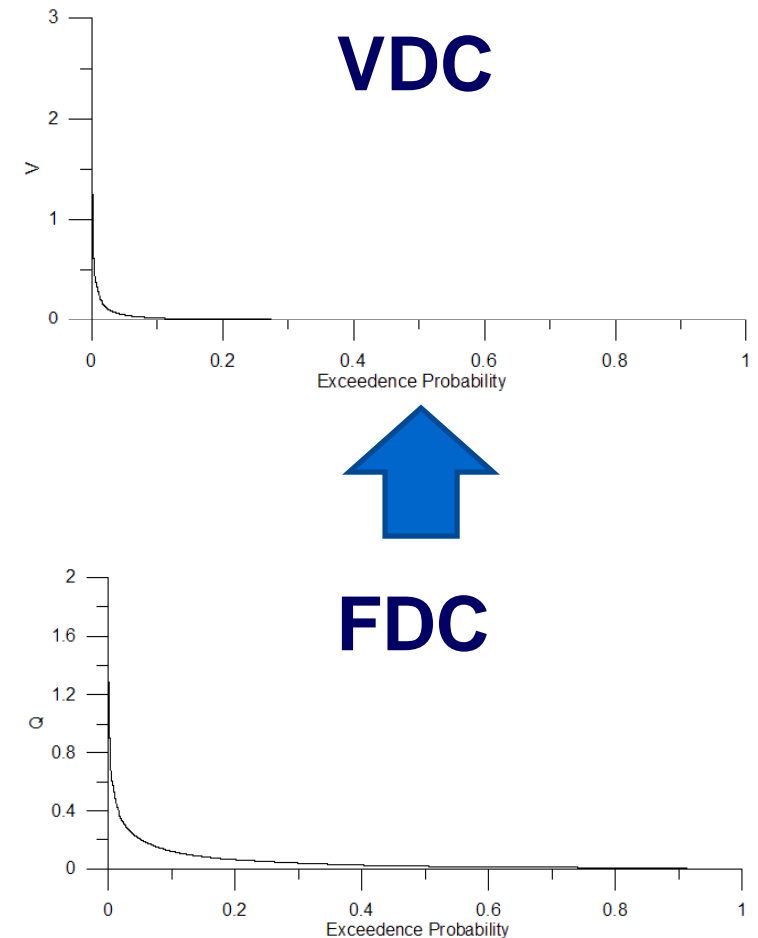
$$P_K = \eta \frac{\rho}{2} AV^3$$

- Velocity Estimation in River Systems

$$V = f(Q, R, n, S_0)$$

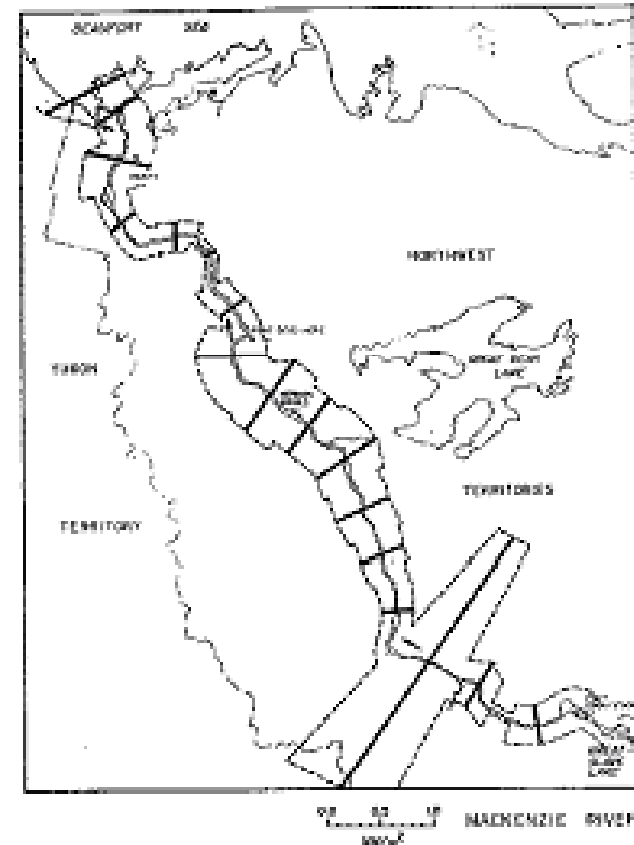
- Regional Flow Estimation

$$Q = f(A_D, P, \dots)$$



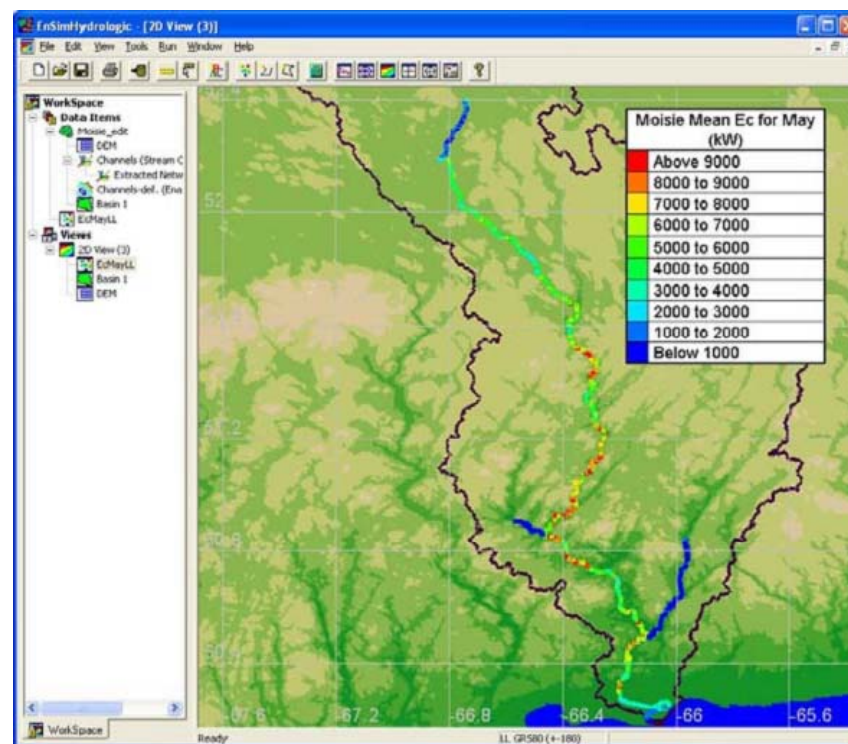
Previous Studies

- 1980 – UMA Group for NRC-CHC
 - Canadian national assessment study (first and only)
 - limited to a few major rivers in Canada
 - Coarse resolution – reaches order of 100km
 - Extensive use of physical map data – limited by technology of the day
 - Mean flows, assumed and constant roughness



Previous Studies

- 2008 – NRC-CHC
 - developed a methodology for the assessment of river current potential at the watershed scale using the **Green Kenue™** hydrological modelling system
 - Used DEM and NHN data to determine geographic characteristics
 - Monthly mean flow values translocated from station on same river
 - Only demonstrated, applied to single watersheds



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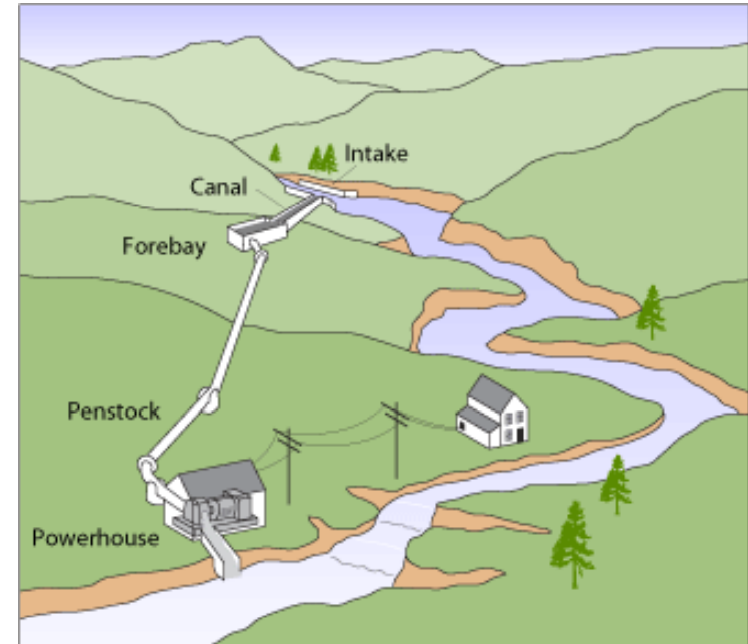
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Previous Studies

- Other Studies
 - Few other studies conducted for river current potential
 - Some studies examining run-of-river/small hydro on regional or national scales eg. USDOE (2004,2006); KWL (2008) and others.
 - Simpler analysis (less uncertainty) as only Q and H are required



Study Phases

The study has been divided into three phases:

1. Literature Review and Data Review

- Review of the methodologies, techniques and available data
- Selection of proposed methodologies and validation datasets and locations

2. Methodology Validation

- Implementation of a recommended set of methodologies against the validation datasets
- Sensitivity/uncertainty analysis

3. National Resource Assessment

- Application of the recommended methodology to produce a national river current assessment product

Phase I: Literature Review

1. Regional Channel Current Estimation Studies
2. Hydrologic Characteristics/Data Estimation Techniques
 - Channel Geometry
 - Slope
 - Flow Frequency
 - Roughness
3. Data Uncertainty and Uncertainty Analysis Techniques

Phase I: Data Review

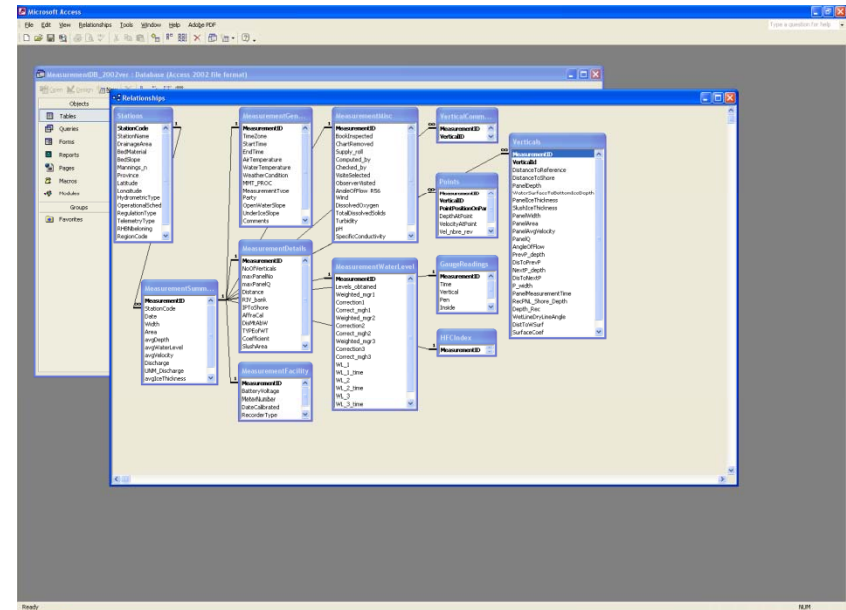
Methodology Dataset

- The final methodologies employed will be selected in part based on available national datasets
- Availability of associated uncertainty information will also be reviewed
- Provincially maintained datasets may be incorporated into the validation phase or final resource assessment

Phase I: Data Review

Validation Dataset

- Examination of datasets for validation conducted in cooperation with **EC-WSC**
- Locations across Canada selected to provide regional physiographic and hydrologic representation for both smaller and larger rivers
- Sites also chosen based on data availability and adequate information to fully characterize the validation reach (cross section, slope, roughness and velocity measurements)



Water Survey of Canada Measurement Database

- Hundreds of Stations
- Decades of Data (at some stations)
- Flow, Width, Depth, Velocity (mean and profiles)



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Phase II: Methodology Validation

- Implementation of recommended methodologies from Phase I
- Development of validation datasets to produce a series of data and channel power estimates that can be compared to the river current potential methodology output
- Application of methodologies to validation datasets in the test watersheds
- Uncertainty analysis of validation watersheds



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Phase III: National Resource Assessment

- Implementation of final recommended methodology from Phase II to assess the national potential in Canada for river current power production
- Intended to provide aggregated national/ regional level estimates
- Final reports of all three phases will be made available to stakeholders in the industry and the general public via website access



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Project Deliverables

- **Phase I Report – Literature and Data Review:**
December 31, 2009
- **Phase II Report – Methodology Validation:**
June 30, 2010
- **Phase III – Resource Assessment:**
TBD

Thank You!

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