Nelson-Churchill Water Resources Modelling in Manitoba

Integrated Modelling Program for Canada, Kick-off Workshop

Masoud Asadzadeh, Collaborator

15 September 2017

University of Manitoba

Content

Plan proposed in NSERC CRD

- Study area
- P1. Water supply scenario development and analysis
- P2. Integrated Water Management Modelling
- P3. Resource Planning

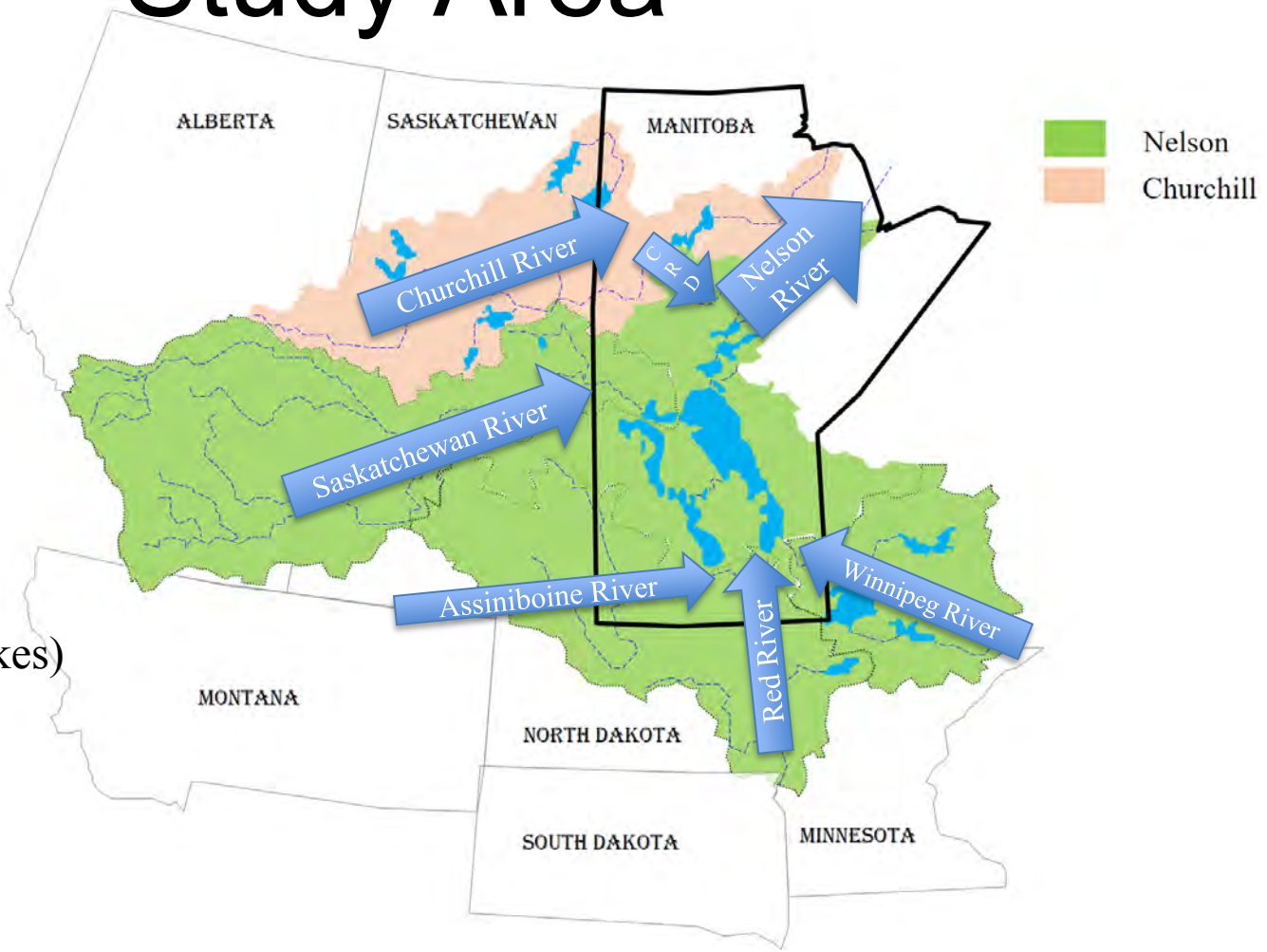
Objectives

- Predicting future water supply scenarios for the river-reservoir system in Manitoba
- Developing an integrated water management model of the system
- Evaluating and enhancing mid-term operation and long-term resource planning decisions

Study Area

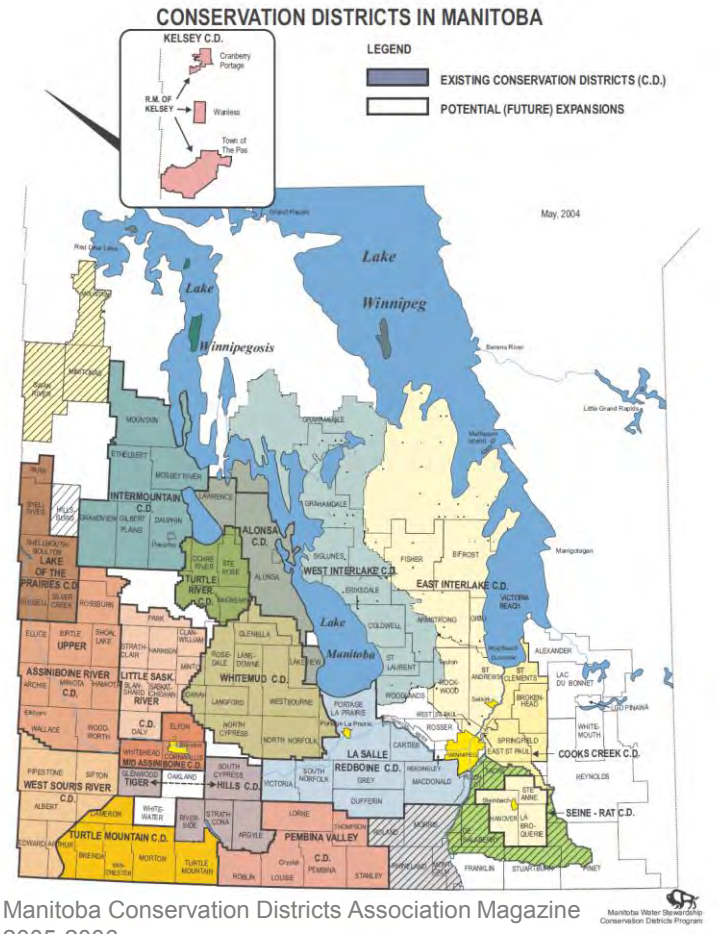
Highly controlled

- 15 current hydroelectric generating stations
- 5200 Megawatts
- 75% along Nelson downstream of LW
- MB, SK, ON, ND, MN
- Other control points (lakes)



Study Area

- Water Protection Act 2006
  - Non-government entities authorized to develop IWMP
  - IWMP needs provincial approval
- 18 conservation districts
- Based on watershed boundaries
- Manage 1500-7000 km^2
- 85% of agricultural areas in MB
- CDs
  - Are preferred water planning authorities in MB
  - Make the platform for developing and implementing of IWMPs
  - Perform source water protection
  - Develop and implement landuse management
  - Make watershed plans consistent with Planning Act
  - Plans with life-cycle of 10 yr
  - Strive to involve First Nations in IWMP



Manitoba Conservation Districts Association Magazine 2005-2006

Cuvelier and Greenfield 2017

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P1. Water supply scenario development and analysis (with IMPC modelers including Stadnyk)

- Key locations in the hydraulic system will be identified
  - Experts' opinion from MH will be considered
- Identify representative hydrologic model(s) of the study region
  - HYPE, MESH, VIC, WATFLOOD (MH's interest), HEC-HMS
- Model calibration and evaluation
  - Multi-model comparison
- Develop long-term water supply scenarios for the study region
  - Feed the selected hydrologic model with predicted climate data
    - High resolution climate data
    - Scenarios from BaySys (CMIP5)
    - Scenarios from Theme C
- Estimate the extent of changes in water supply in the study region

P2. Integrated Water Management Modelling (with Razavi and Stadnyk)

- Develop IWM model of river-reservoir system operated by MH
  - MODSIM-DSS and WEAP are considered
    - Mass balance
    - Nodes to simulate Source vs Demand
    - Arcs to simulate connecting channels and feedback loops in the system
    - Advanced user interface
    - Routing in short-term (daily) simulation is possible
    - Can be linked with hydrologic models
    - Transboundary waters can be modelled

P2. Integrated Water Management Modelling (cont'd)

- Develop IWM model of river-reservoir system operated by MH (cont'd)
  - River-reservoir network in MB will be modelled
    - As the first step, historical inflow to the system at key locations in the system will be used
    - Current mid-term (bi-weekly to monthly two-year) systems operation will be modelled
    - Baseline systems performance will be assessed and benchmarked
    - System performance will be compared with historical records, e.g. hydroelectricity production and flood protection
    - A particular focus on the past extreme events such as the 2005/06 flood and the early 2000s multi-year drought
    - Vision: model will be synced with the work by Razavi's group to simulate transboundary waters

P2. Integrated Water Management Modelling (cont'd)

- Link selected IWM and hydrologic models
  - Assess the system performance over the historical scenario against the baseline
- Evaluate the system performance under future climate conditions
  - Feed the hydrologic model with future climate variables
  - Assess the system performance with current operations in comparison with the baseline
  - Compare system performance with MH's current mid-term operation program
- Evaluate the system performance under future development plans
  - IWMP?

P2. Integrated Water Management Modelling (cont'd)

- Optimize mid-term operations
  - In IWM model, at key control points, current operation policies will be replaced by adjustable (parametric) rules
  - Potential policies derived from the Water Power Act and Environment Act
  - Expert's opinion will be considered to design/formulate new operations
  - Optimize new operations considering future climate conditions and future development plans

P3. Resource Planning Analysis

- Analyze the effectiveness of resource planning policies under future climate conditions
  - Long-term (more than 2 years)
  - Specific configurations of development plans
  - Alternative resources
  - Demand-side management programs and priorities

TRAILBLAZER CHALLENGER

CHALLENGER DEFENDER VISIONARY

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