International Rainy and Namakan Lakes Rule Curves Study Board

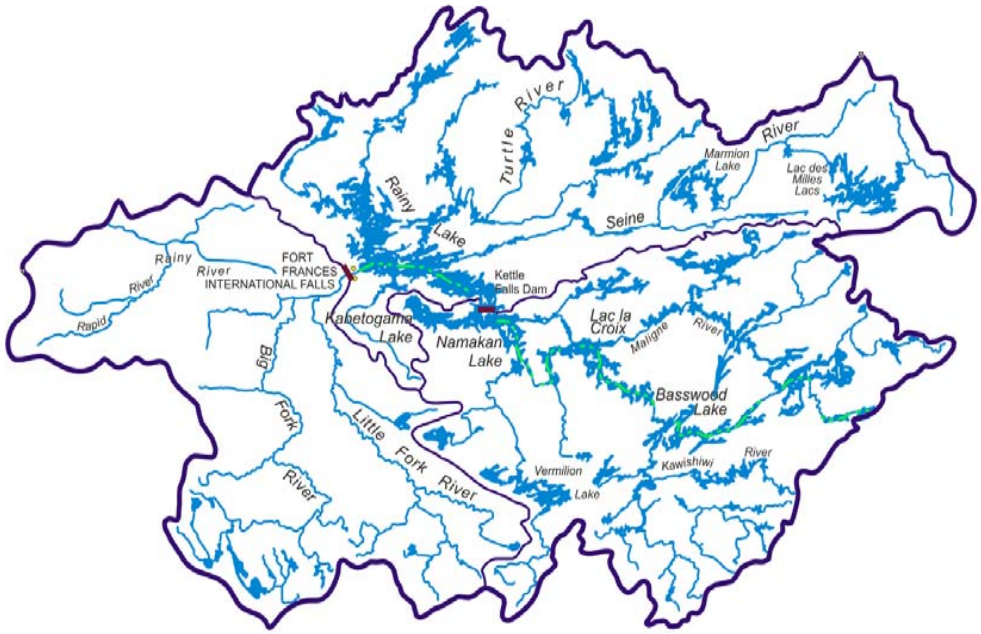
Overview of Study Strategy

Presented to the RCPAG

Feb 17, 2016

Outline

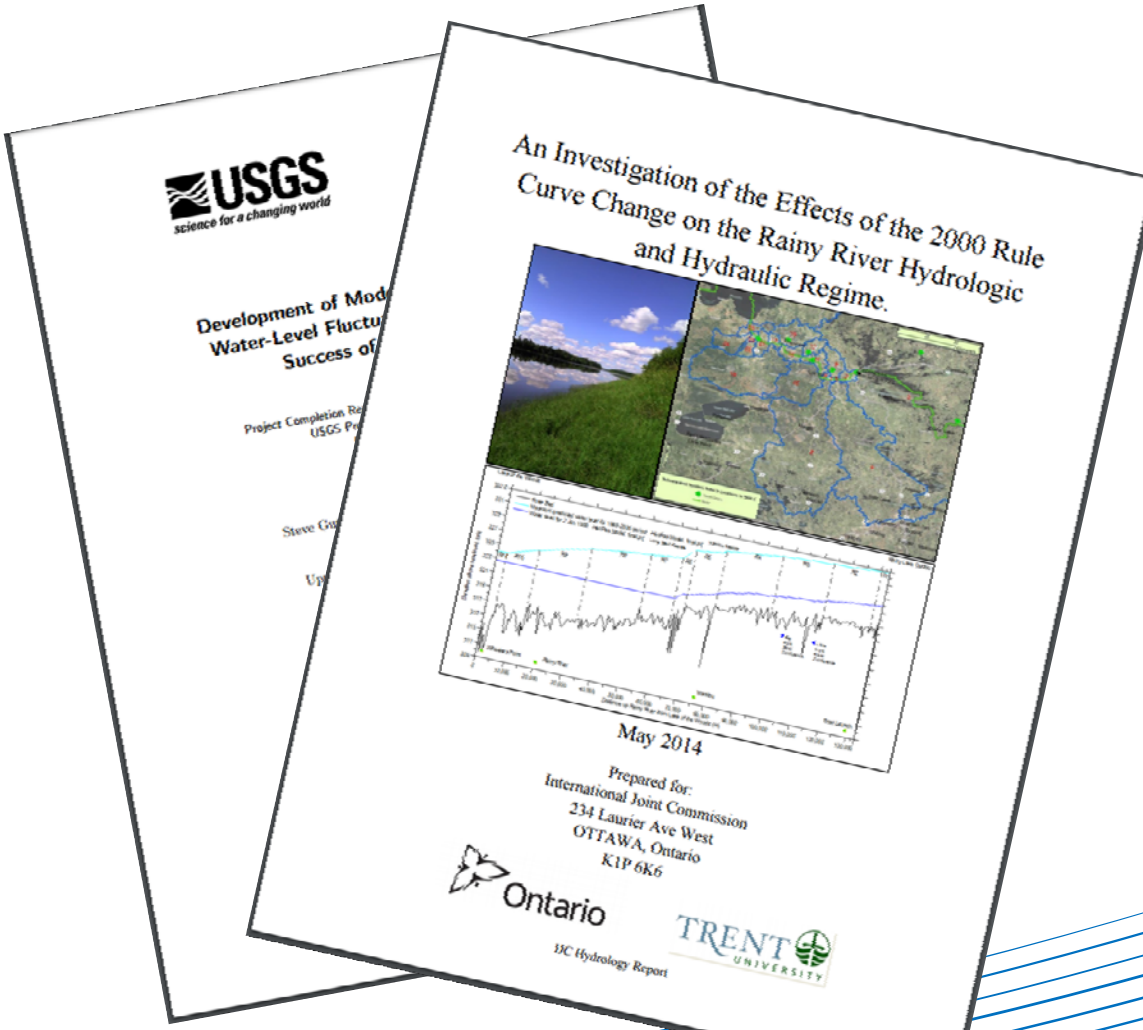
- Key Elements of Strategy
- Schedule and Deliverables
- Public Comment Period
- March 2016 Meetings



Key Elements of Study Strategy

1. Supporting Studies
2. Weight of Evidence Analysis
3. Shared Vision Planning
4. Integrated Environmental Response Model
5. Shared Vision Model
6. Regulation and Water Supply Alternatives
7. Decision Workshops
8. Peaking and Ponding

1. Supporting Studies



Supporting Studies

"The objective of this rule curve evaluation study is to provide to the IJC with scientifically supported recommendations for the modification or retention of the 2000 Rainy and Namakan Lakes Rule curves."

- **2009 Plan of Study** – addressed gaps in knowledge on particular 'risk factors': hydraulics, environmental, cultural
  - 21 Studies funded. Final reports on website, several nearing end
- **International Watersheds Initiative (IWI)**-funded studies
  - 4 studies
- Non-IJC studies
  - 14 studies, many by USGS/ NPS/ Universities
- **Total to Date: 39 Studies**

Categories of Supporting Studies

Categories of Study:

- Fish spawning and habitat
- Hydraulics and hydrology
- Bird, herpetile and mammal habitat and breeding
- Macroinvertebrates and Mussels
- Flooding and Ice damage
- Tourist resorts
- Cultural Resources
- Water Quality, temperature

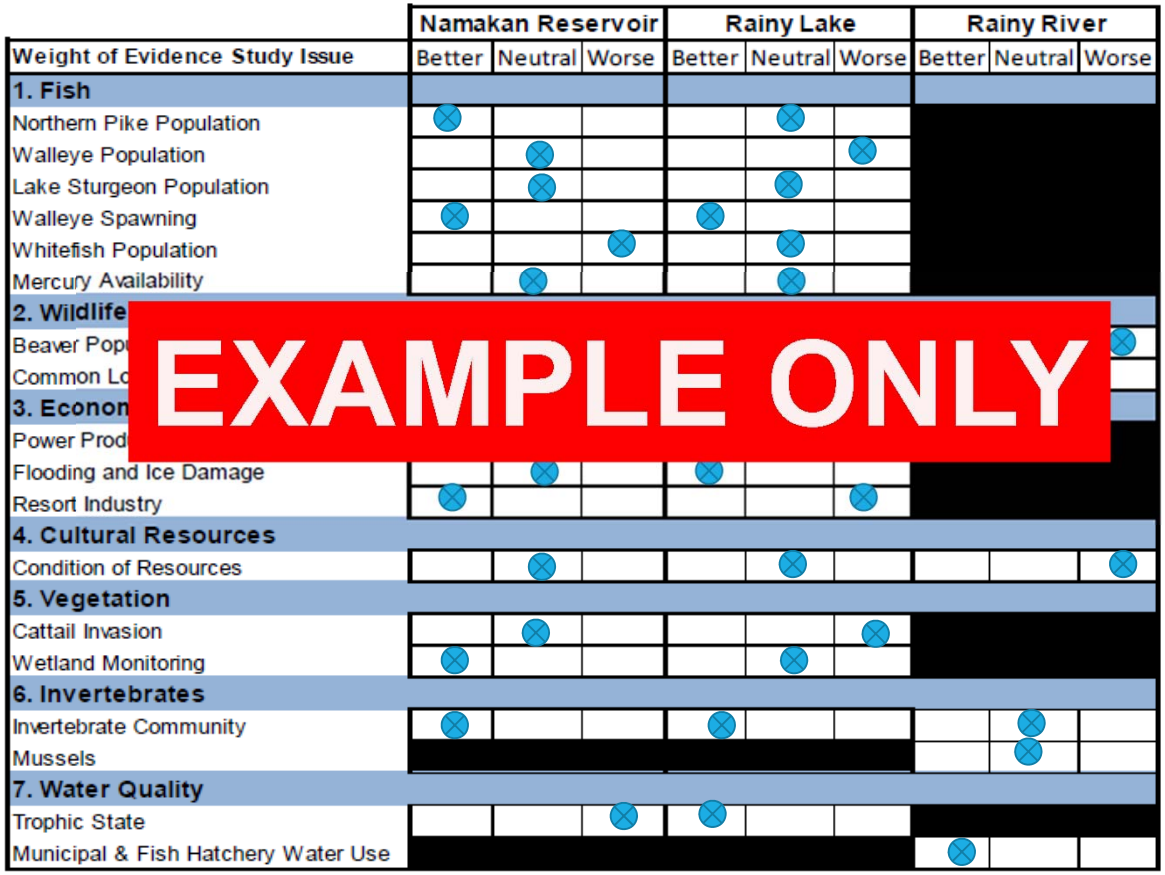
2.Weight of Evidence

	Namakan Reservoir			Rainy Lake			Rainy River		
Weight of Evidence Study Issue	Better	Neutral	Worse	Better	Neutral	Worse	Better	Neutral	Worse
1. Fish									
Northern Pike Population									
Walleye Population									
Lake Sturgeon Population									
Walleye Spawning									
Whitefish Population									
Mercury Availability									
2. Wildlife									
Beaver Population									
Common Loon Reproductive Success									
3. Economic Impacts									
Power Production									
Flooding and Ice Damage									
Resort Industry									
4. Cultural Resources									
Condition of Resources									
5. Vegetation									
Cattail Invasion									
Wetland Monitoring									
6. Invertebrates									
Invertebrate Community									
Mussels									
7. Water Quality									
Trophic State									
Municipal & Fish Hatchery Water Use									

Weight of Evidence Approach

- Original approach considered for Rule Curve Review
- Matrix of results from all studies gives an overall view of the changes since 2000.
- **Benefit**:
  - Relies on actual data from studies
- **Drawbacks:**
  - Not all studies consider pre- and post-2000
  - Not all studies separate out hydrology
  - Does not allow consideration of other options

Weight of Evidence Approach Example



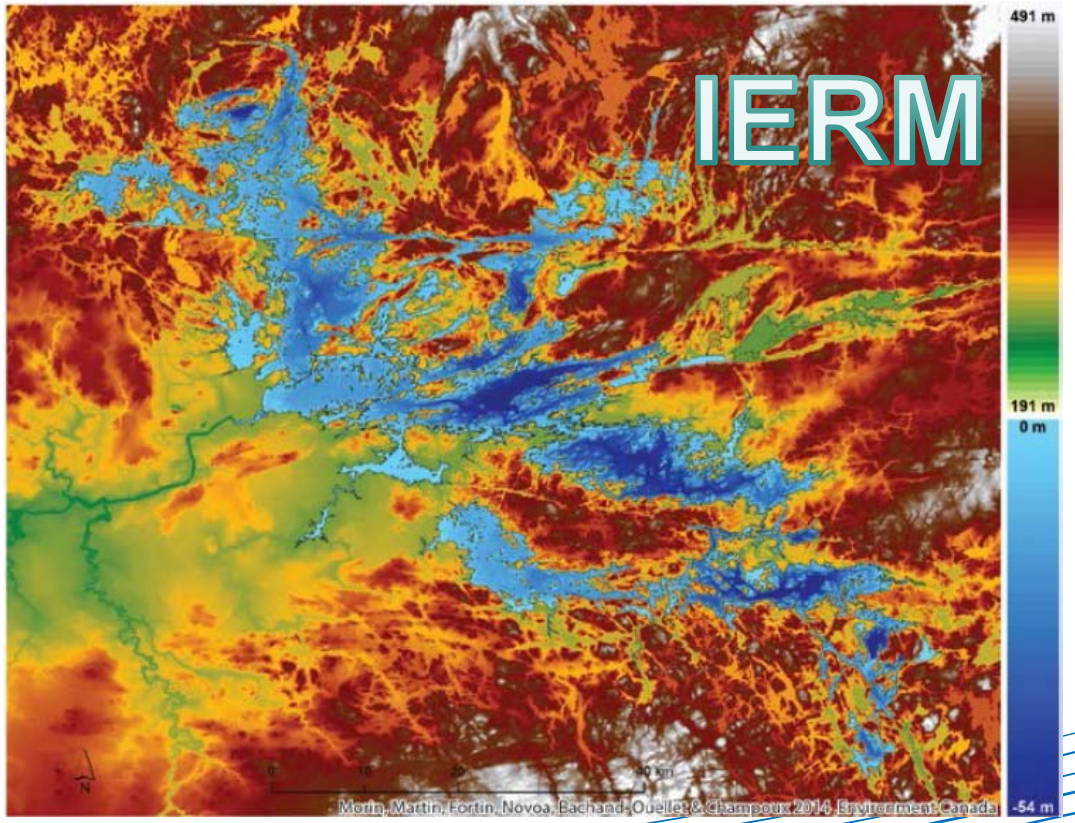
Weight of Evidence Study Issue	Namakan Reservoir			Rainy Lake			Rainy River		
	Better	Neutral	Worse	Better	Neutral	Worse	Better	Neutral	Worse
1. Fish									
Northern Pike Population	⊗				⊗				
Walleye Population		⊗				⊗			
Lake Sturgeon Population		⊗			⊗				
Walleye Spawning	⊗			⊗					
Whitefish Population			⊗		⊗				
Mercury Availability		⊗			⊗				
2. Wildlife									
Beaver Popu									⊗
Common Lo									
3. Econon									
Power Prod									
Flooding and Ice Damage		⊗		⊗					
Resort Industry	⊗					⊗			
4. Cultural Resources									
Condition of Resources		⊗			⊗				⊗
5. Vegetation									
Cattail Invasion		⊗				⊗			
Wetland Monitoring	⊗				⊗				
6. Invertebrates									
Invertebrate Community	⊗			⊗				⊗	
Mussels								⊗	
7. Water Quality									
Trophic State			⊗	⊗					
Municipal & Fish Hatchery Water Use							⊗		

3. Shared Vision Planning

Shared Vision Planning

- Approach added by IJC in Directive to expand on WOE
- Allows consideration of 1970, 2000 Rule Curves in comparison to other alternatives for a range of basin water supply conditions
- Relies on many of the same studies as WOE, but not limited to historic data
- Is the basis for a comprehensive, participatory and transparent evaluation process

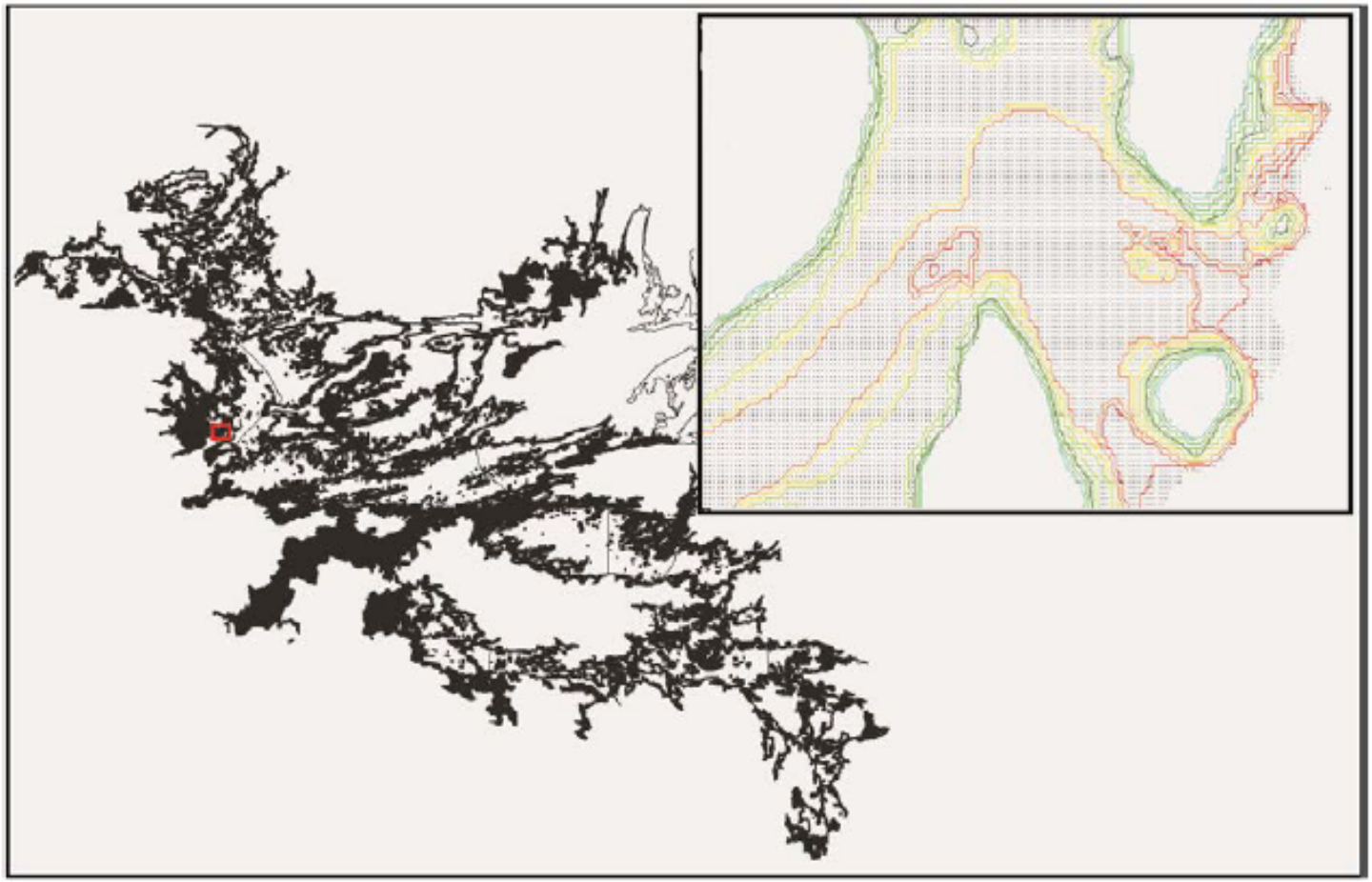
4. Integrated Environment Response Model



Integrated Environmental Response Model

- Able to model the spatially distributed physical variables of the system (e.g., water levels and waves for main lakes, flows in the Rainy River, currents, water level, depth, etc.)
- Able to simulate over period of years at a quarter-month timestep under various rule curve alternatives and water supplies
- Models the response of a number of ecological variables to these hydraulic conditions to build habitat models.
- Allows for a ranking of rule curves in terms of their impacts on the different components of the ecosystem.

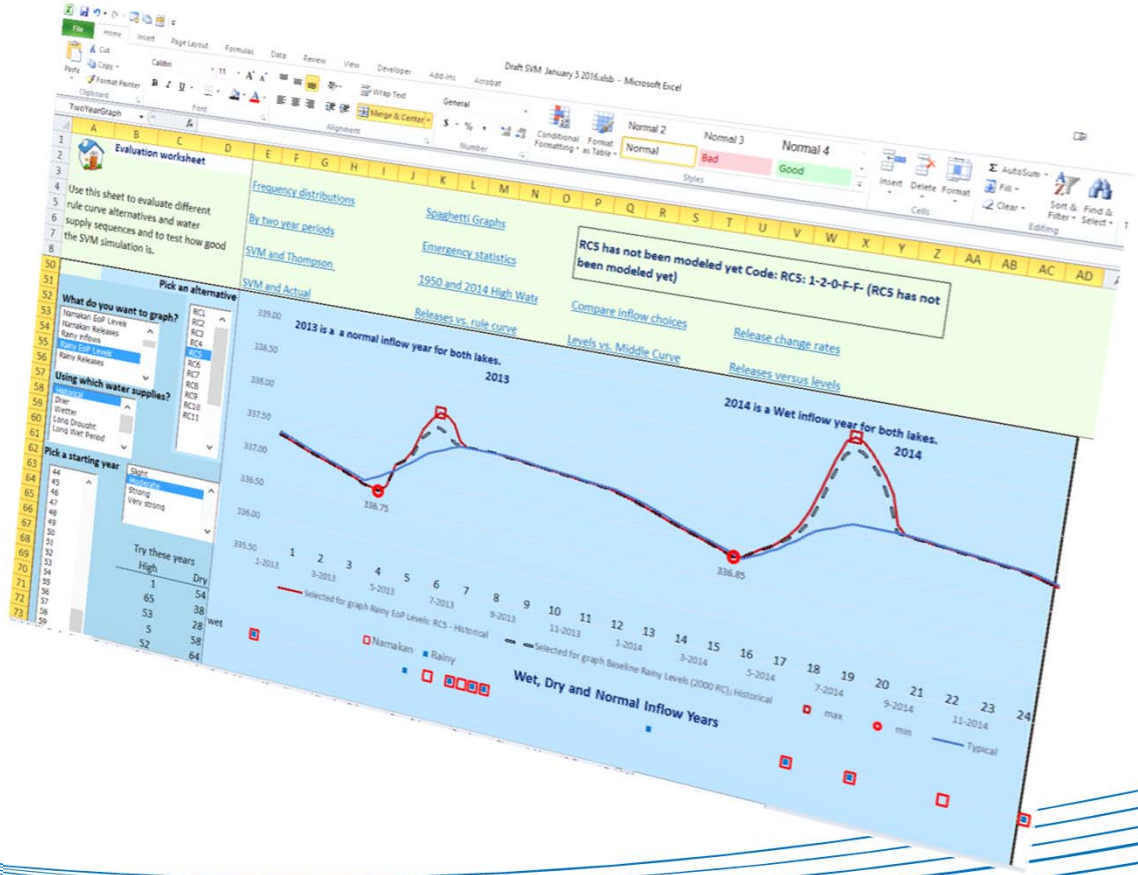
Integrated Environmental Response Model



Integrated Environmental Response Model

- For the lakes, includes several 1-D models to simulate effect of water level changes on wild rice, common loon muskrat, and walleye.
- More complex 2-D models were developed for lakes to quantify habitat area for wild rice, cattails, submerged and emergent plants, wet meadows, shrubby swamps as well as northern pike and walleye spawning grounds.
- For Rainy River, 2-D models for sturgeon and walleye based on flow characteristics (e.g. bottom slope, shear stress)

5. Shared Vision Model



Shared Vision Model

- Designed to:
  - Interpret results from the IERM
  - Integrate results from other studies
  - Develop evaluation metrics that can be used to compare rule curve alternatives
- Each Model Simulation will:
  - Produce water levels and flows for specific water supply and rule curve alternative
  - Automatically interpret water levels and flows against a set of pre-defined **Performance Indicators** and **Hydrologic Metrics**

Shared Vision Model

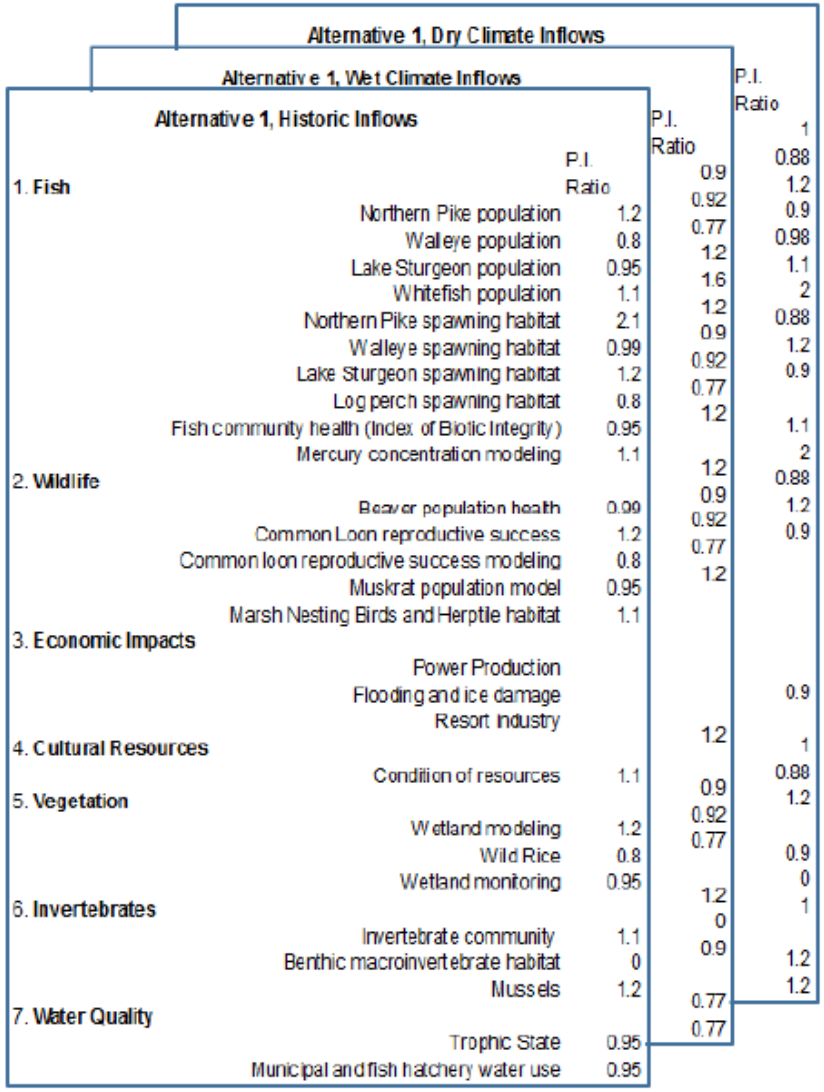
- **Performance Indicators and Hydrologic Metrics**
  - Pre-defined, based on studies, IERM output
  - Represent a quantitative, science-based understanding of the study and model subjects
  - Will form the basis for comparison of different rule curve alternatives under the SVP approach.
  - The Study Board and TWG will examine the results of all supporting studies for possible PIs that are amenable to being integrated into the SVM or the IERM, including those used in the WOE analysis.
  - In cases where there are no existing studies to support the development of needed PIs, the Study Board will attempt to develop the required information.

Hydrologic Metrics

- Statistics on measurable water data
- Examples:
  - Frequency of water level > Emergency level
  - % of time within Rule Curve range
- First Draft of SVM will focus solely on Hydrologic Metrics

Performance Indicators

- Used to quantify non-hydrologic outcomes of water levels and flows
- E.g. % of years where good wild rice production expected
- *Quantitative relationship* between PI and water level or flow



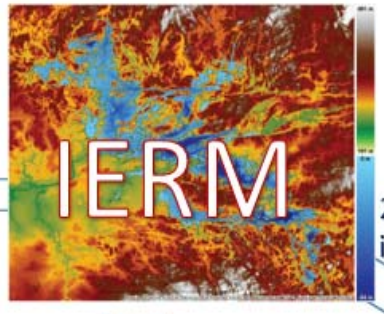
		Alternative 1, Historic Inflows P.I. Ratio	Alternative 1, Wet Climate Inflows P.I. Ratio	Alternative 1, Dry Climate Inflows P.I. Ratio
1. Fish			0.9	1
	Northern Pike population	1.2	0.92	0.88
	Walleye population	0.8	0.77	1.2
	Lake Sturgeon population	0.95	1.2	0.9
	Whitefish population	1.1	1.6	0.98
	Northern Pike spawning habitat	2.1	1.2	1.1
	Walleye spawning habitat	0.99	0.9	2
	Lake Sturgeon spawning habitat	1.2	0.92	0.88
	Log perch spawning habitat	0.8	0.77	1.2
	Fish community health (Index of Biotic Integrity)	0.95	1.2	0.9
	Mercury concentration modeling	1.1		
2. Wildlife				1.1
	Beaver population health	0.99	1.2	2
	Common Loon reproductive success	1.2	0.9	0.88
	Common loon reproductive success modeling	0.8	0.92	1.2
	Muskrat population model	0.95	0.77	0.9
	Marsh Nesting Birds and Herptile habitat	1.1	1.2	
3. Economic Impacts				
	Power Production			0.9
	Flooding and ice damage		1.2	
	Resort industry			1
4. Cultural Resources				
	Condition of resources	1.1	0.9	0.88
5. Vegetation			0.92	1.2
	Wetland modeling	1.2	0.77	
	Wild Rice	0.8		0.9
	Wetland monitoring	0.95	1.2	0
6. Invertebrates			0	1
	Invertebrate community	1.1	0.9	
	Benthic macroinvertebrate habitat	0		1.2
	Mussels	1.2	0.77	1.2
7. Water Quality			0.77	
	Trophic State	0.95		
	Municipal and fish hatchery water use	0.95		

6. Regulation and Water Supply Alternatives

- SVM will allow for choice of Regulation Alternative and Water Supply set for each model run.
- Regulation Alternatives:
  - 1970 RC, 2000 RC
  - State of Nature
  - At least 3 other alternatives
- Water Supply Alternatives:
  - Historic, simulated current, possible future climate

Weight of evidence results

Performance Indicator Algorithms

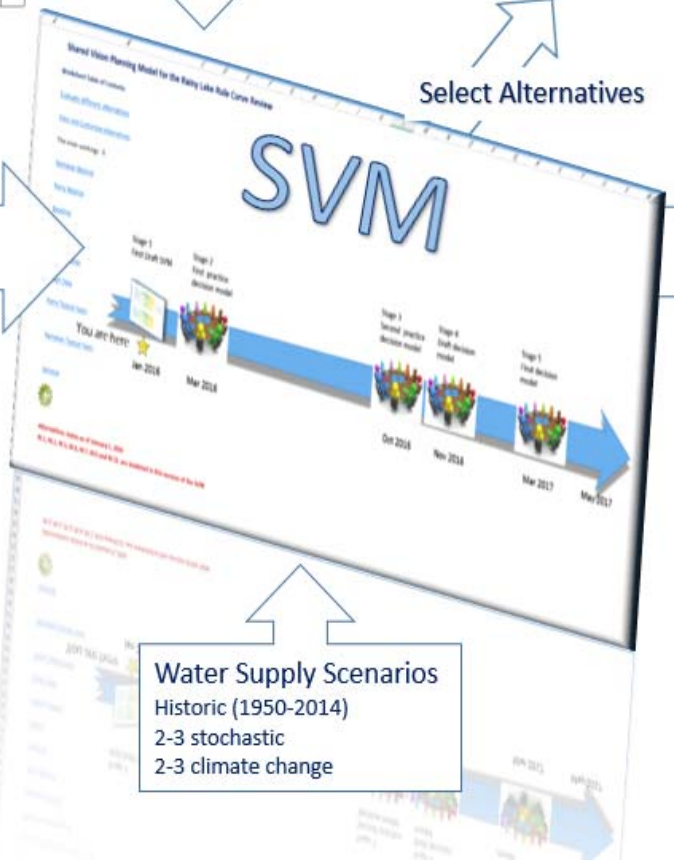


2D Performance indicators

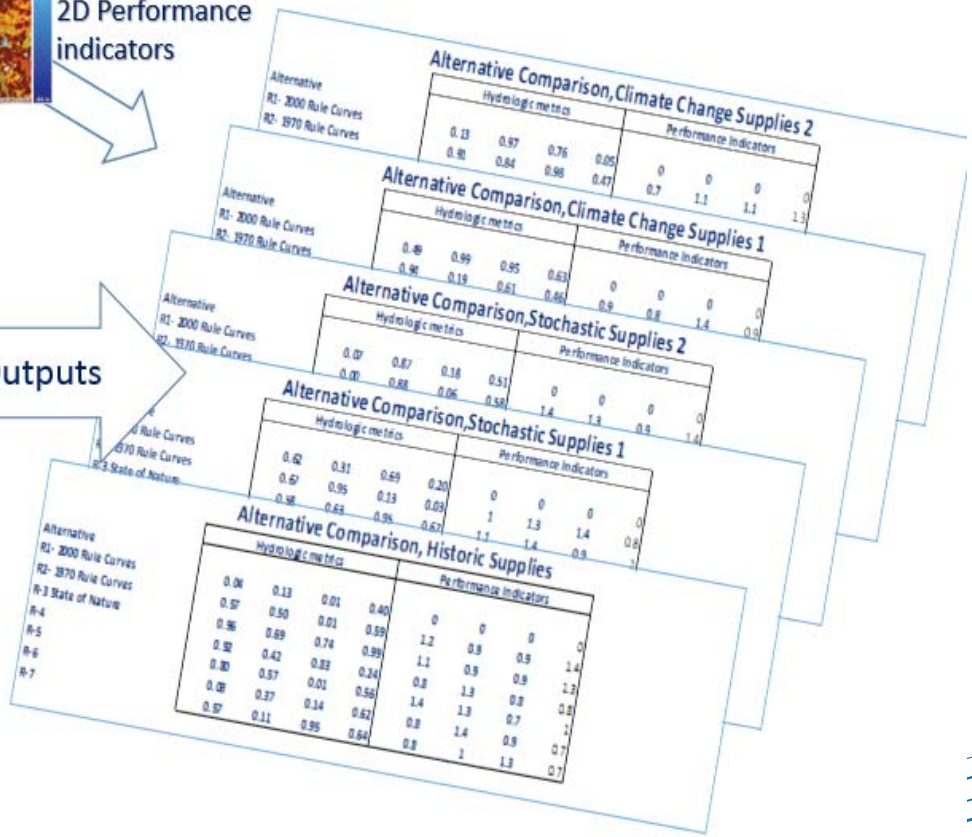
Study Board will rank alternatives in practice, draft and final decisions

Regulation Alternatives Scenarios
2000 Rule Curves
1970 Rule Curves
State of Nature
3 other alternatives

Select Alternatives

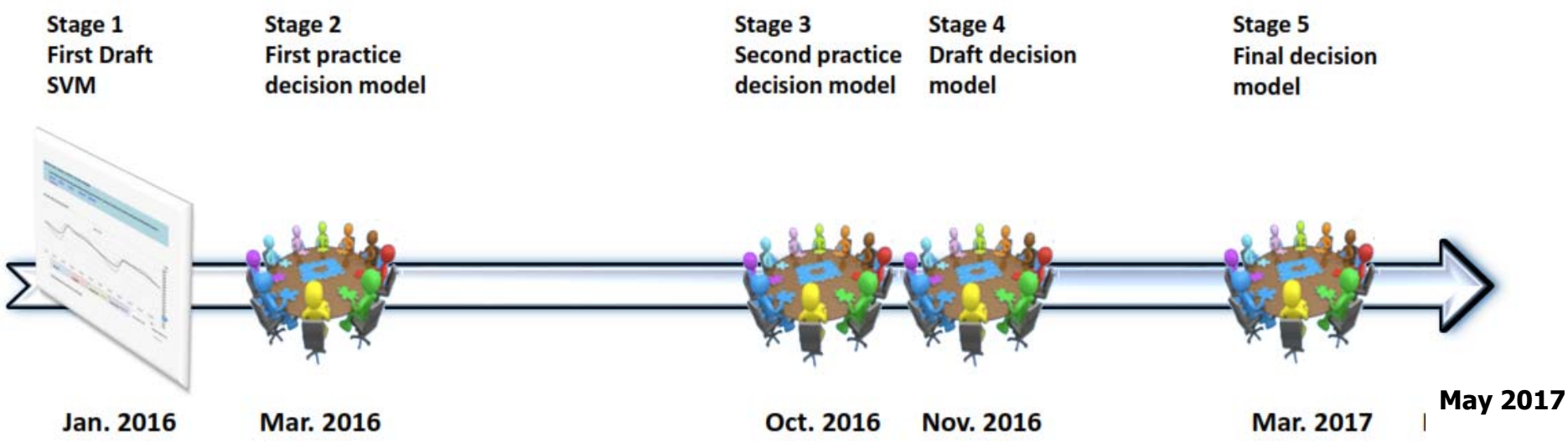


Outputs



Water Supply Scenarios
Historic (1950-2014)
2-3 stochastic
2-3 climate change

7. Decision Workshops



Evaluation worksheet

Use this sheet to evaluate different rule curve alternatives and water supply sequences and to test how good the SVM simulation is.

Frequency distributions | Spaghetti Graphs

By two year periods | Emergency statistics

SVM and Thompson | 1950 and 2014 High Wate | Compare inflow choices | Release change rates

SVM and Actual | Releases vs. rule curve | Levels vs. Middle Curve | Releases versus levels

RC3 (State of nature) is modeled. It's simulated now with Historical supplies . Code: RC3: 1-2-0-F-F- (RC3 is modeled)

What do you want to graph?

- Namakan EoP Levels
- Namakan Releases
- Rainy inflows
- Rainy EoP Levels
- Rainy Releases

Alternative: RC1, RC2, RC3, RC4, RC5, RC6, RC7, RC8, RC9, RC10, RC11

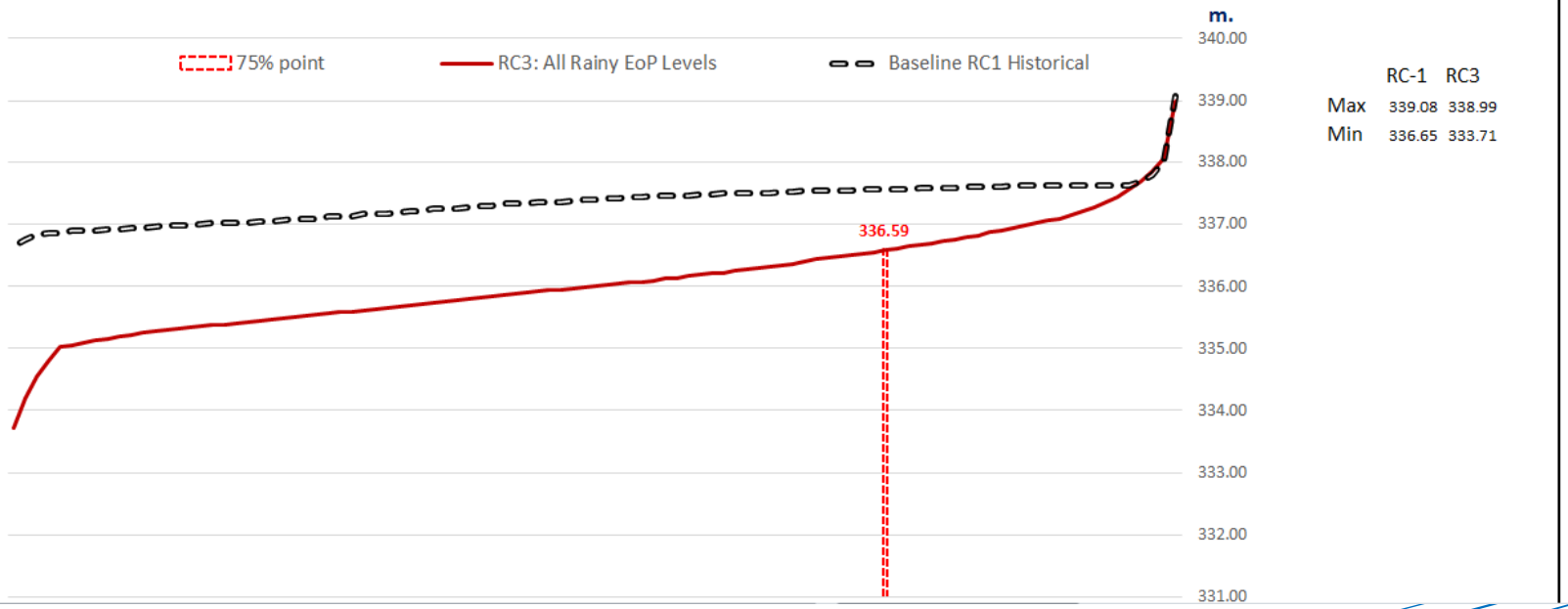
Using which water supplies?

- Historical
- Drier
- Wetter
- Long Drought
- Long Wet Period

No options for RC3

Pick: **Start QM** 43, 44, 45, 46, 47, 48 | **End QM** 24, 25, 26, 27, 28

RC3 - Historical is 9 m3/s lower than RC2000 (black outlined dashes) for the maximum Rainy EoP Levels. For the lowest flows, it averages 130 m3/s lower for the lowest 98%.

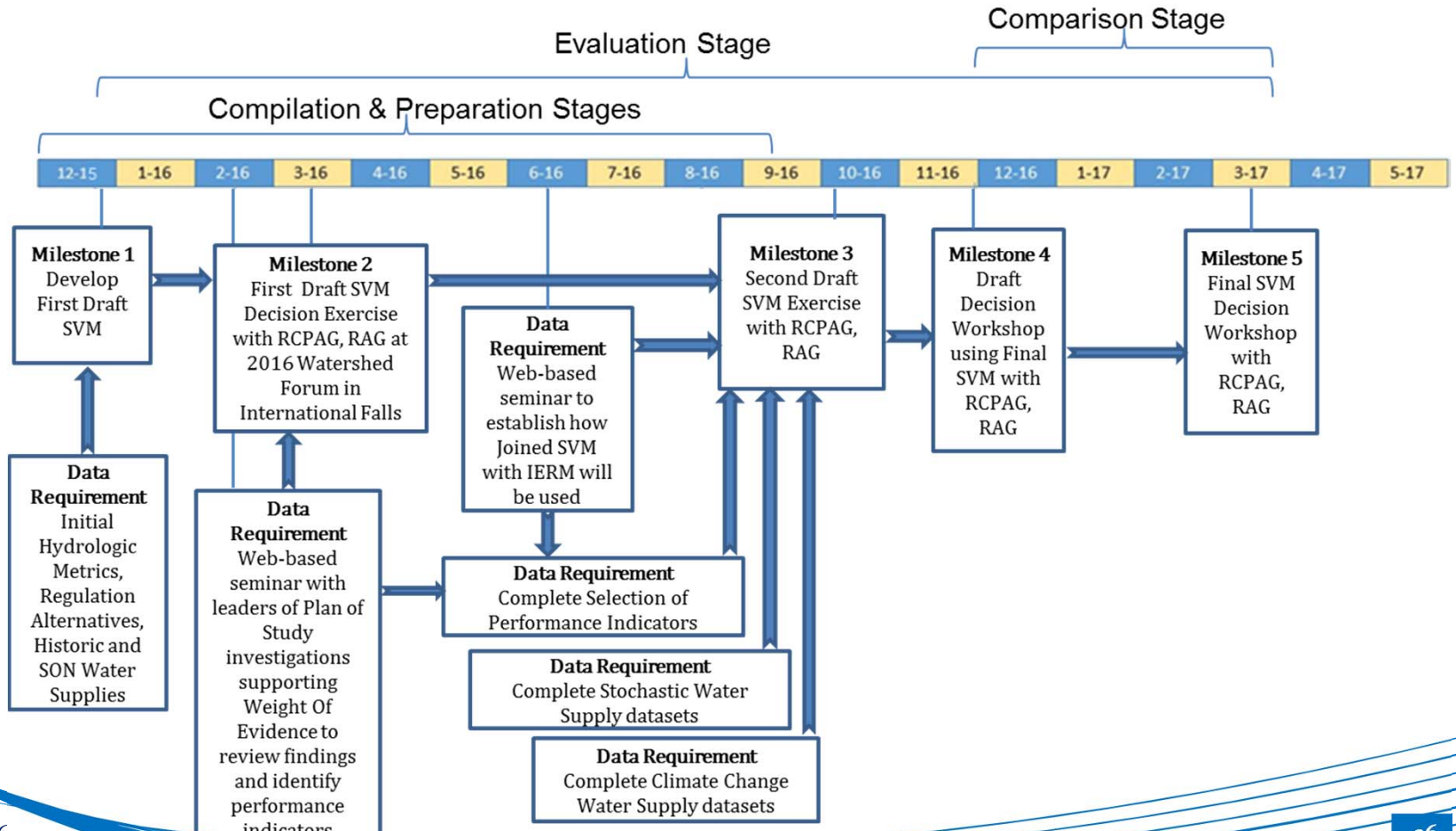


	RC-1	RC3
Max	339.08	338.99
Min	336.65	333.71

8. Peaking and Ponding

- Intra-day fluctuations in outflow from powerhouses in Fort Frances/I. Falls to maximize value of energy generated
- Generally not a concern for Rainy Lake levels, but may have impact on ecological and property interests along lower Rainy River
- Sub-committee examining

7. Schedule and Deliverables



Study Milestones

- **February, 2016** – Start of Public Comment Period for Draft Study Strategy
- **March 2016** – International Rainy-Lake of the Woods Watershed Forum – Study Board public information meetings, Practice Decision Workshop
- **Summer 2016** – Public Meetings throughout basin
- **Late 2016** – Further Practice Decision Workshops, updates
- **March 21, 2017** – Draft report submitted to the IJC
- **May 31, 2017** – Final draft report submitted to the IJC; Public hearings to be held as required

Study Strategy Public Comment Period

- Draft Strategy soon to be publically released by IJC, available on website
- Will be a public comment period, normally 30-days

March 2016 Meetings in International Falls

Tuesday March 8

- 1:00-2:00: RCPAG – Study Board meeting, R.R. Community College
- 2:00-4:30 Practice Decision Workshop:
  - Study Board, TWG, RCPAG, RAG, IRLWWB, also by webinar
  - Evening – IJC Public Open House, 6:30-8:00 pm

Wednesday March 9

Watershed Forum - Side meetings for Study Board with stakeholders

Thursday March 10

Watershed Forum – 1pm: Water Level Regulation Session,
Study Board Presentation

Questions ….

Further Information

http://ijc.org/en_/RNLRCSB