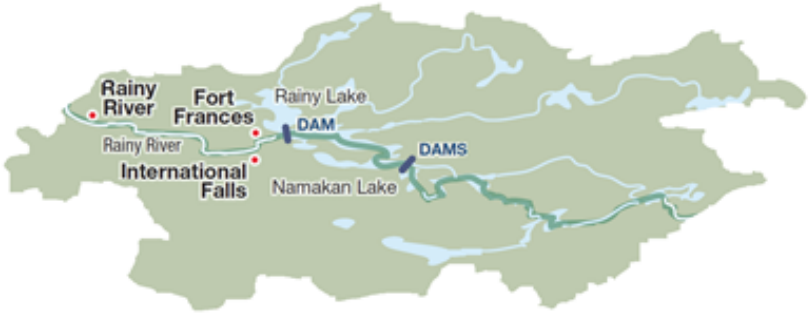
International Rainy and Namakan Lakes Rule Curves Study Board



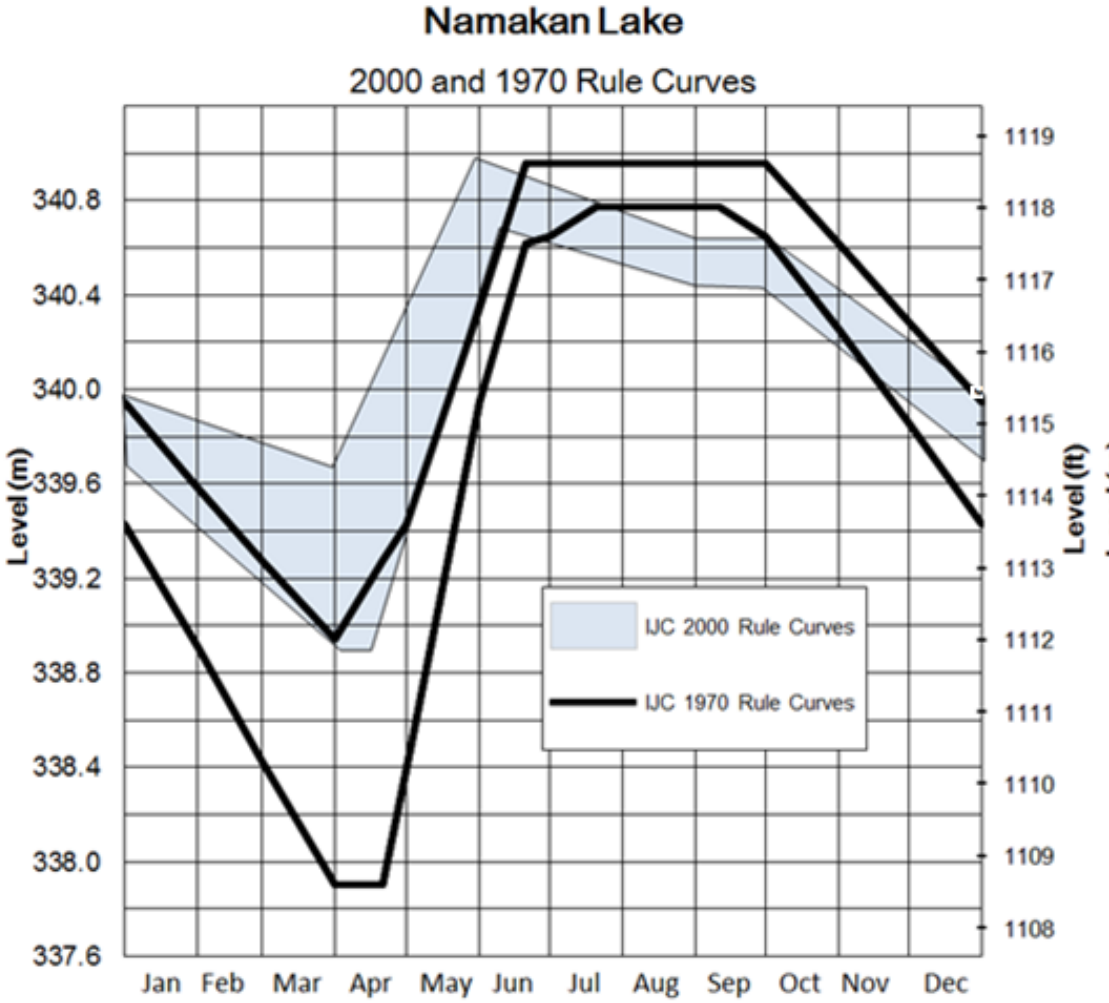
Study of 2000 Rule Curves for Namakan and Rainy Lakes

MARCH 2017

UPDATE

Current Rule Curve Regulation

- Current Rule Curves est. 2000 after extensive review in the 1990s.
- Replaced 1970 Rule Curves, with main changes aimed primarily at improved Namakan navigation, ecological conditions.
- IJC required review of performance after 15 years.
- The Study Board began the review in September, 2015, due to report to IJC in spring of 2017

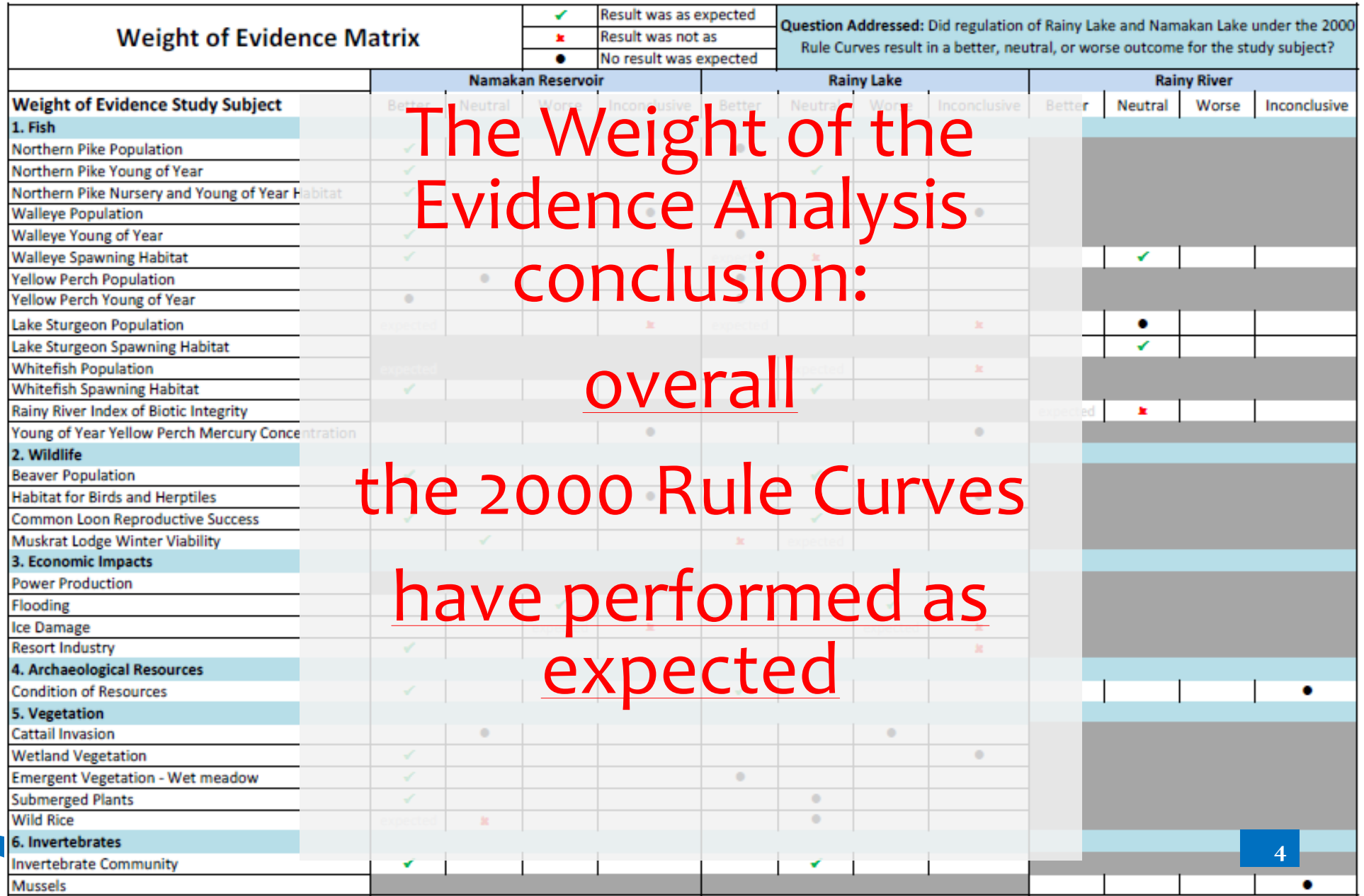


Aim 1: Did 2000 Rule Curve perform as expected?

Approach: Weight of Evidence Analysis

- Study Board has reviewed all available studies and monitoring data, prepared table showing the overall effect of the 2000 Rule Curves on these subjects.
- Presented Preliminary Results in July, draft in November, now finalized.
- Reviewed interpretation with study authors

Final WOE Matrix



Weight of Evidence Matrix	✓	Result was as expected
	✗	Result was not as
	●	No result was expected

Question Addressed: Did regulation of Rainy Lake and Namakan Lake under the 2000 Rule Curves result in a better, neutral, or worse outcome for the study subject?

	Namakan Reservoir				Rainy Lake				Rainy River			
Weight of Evidence Study Subject	Better	Neutral	Worse	Inconclusive	Better	Neutral	Worse	Inconclusive	Better	Neutral	Worse	Inconclusive
1. Fish												
Northern Pike Population	✓				✓							
Northern Pike Young of Year	✓				✓							
Northern Pike Nursery and Young of Year Habitat	✓				✓							
Walleye Population	✓				●							
Walleye Young of Year	✓				●							
Walleye Spawning Habitat	✓				✗					✓		
Yellow Perch Population	●				●							
Yellow Perch Young of Year	●				●							
Lake Sturgeon Population	expected			✗	expected			✗		●		
Lake Sturgeon Spawning Habitat										✓		
Whitefish Population	expected				expected			✗				
Whitefish Spawning Habitat	✓				✓							
Rainy River Index of Biotic Integrity									expected	✗		
Young of Year Yellow Perch Mercury Concentration				●				●				
2. Wildlife												
Beaver Population	✓				✓							
Habitat for Birds and Herptiles	●				●							
Common Loon Reproductive Success	✓				✓							
Muskrat Lodge Winter Viability	✓				✗				expected			
3. Economic Impacts												
Power Production	✓				✓							
Flooding	✓				✓							
Ice Damage	✗				✗							
Resort Industry	✓				✗							
4. Archaeological Resources												
Condition of Resources	✓				●							●
5. Vegetation												
Cattail Invasion	●				●							
Wetland Vegetation	✓				●							
Emergent Vegetation - Wet meadow	✓				●							
Submerged Plants	✓				●							
Wild Rice	expected	✗			●							
6. Invertebrates												
Invertebrate Community	✓				✓							
Mussels												●

The Weight of the Evidence Analysis conclusion:

overall

the 2000 Rule Curves

have performed as expected

Aim 2 : Can the 2000 Rule Curves be improved?

Approach 2: Shared Vision Planning Analysis

- Shared Vision Planning approach:
  - Transparent, participatory
  - Assisted by **computer models** to simulate effects of **alternative** rule curve options on a variety of subjects (e.g. fish, flooding)
  - Workshops with Rule Curve Public Advisory Group, Resource Advisory Group to review and weigh options.

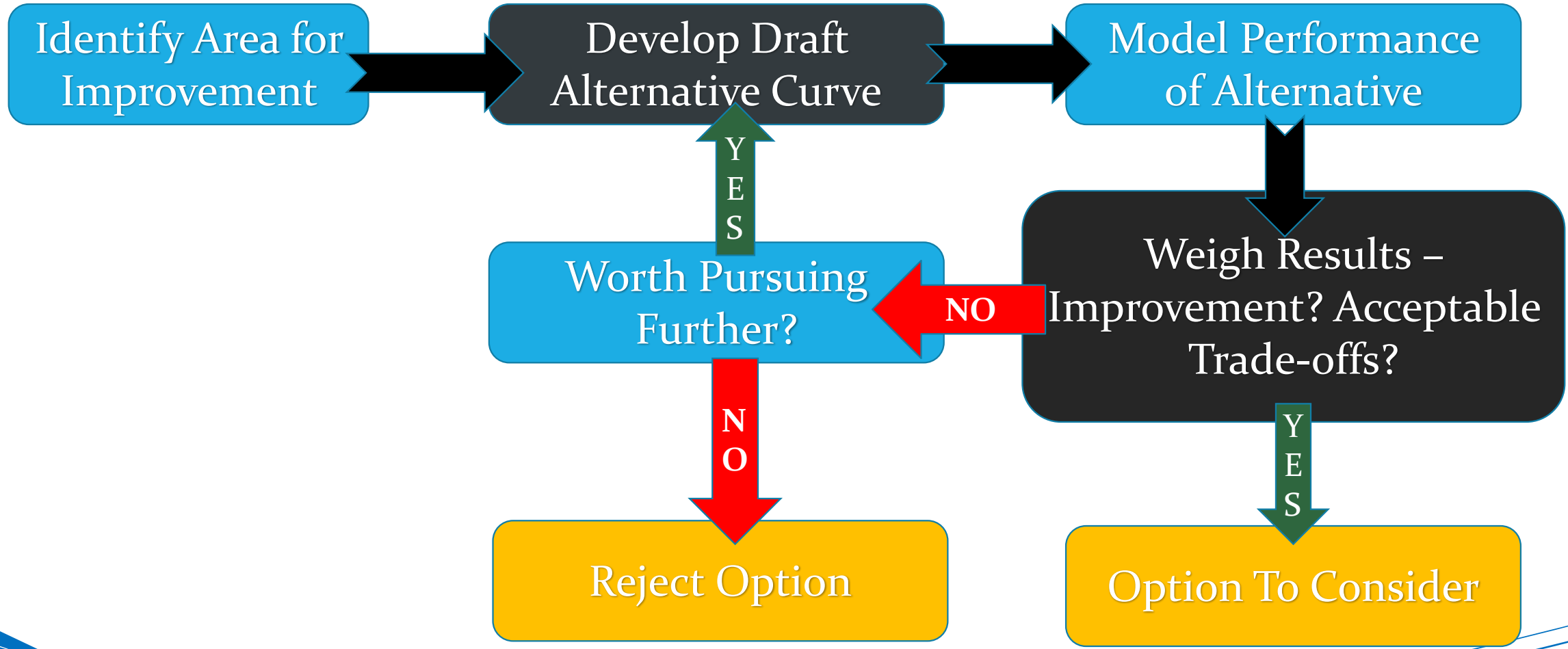
Alternative Development:

Main areas where 2000 Rule Curves could be improved:

1. Risk of spring flooding on Rainy Lake

2. Ecological subjects of concern:
   - Muskrat winter survival
   - Northern Pike spawning habitat
   - Wild rice
   - Spread of invasive hybrid cattail
   - Inter-annual variability

Alternative Development:



Alternative Development:

Identify Area for Improvement → Develop Draft Alternative Curve

Flooding

- Modelled extreme flood reduction to test limits – flooding unavoidable
- Next, targeted realistic approaches to modestly reduce flooding

Tested:

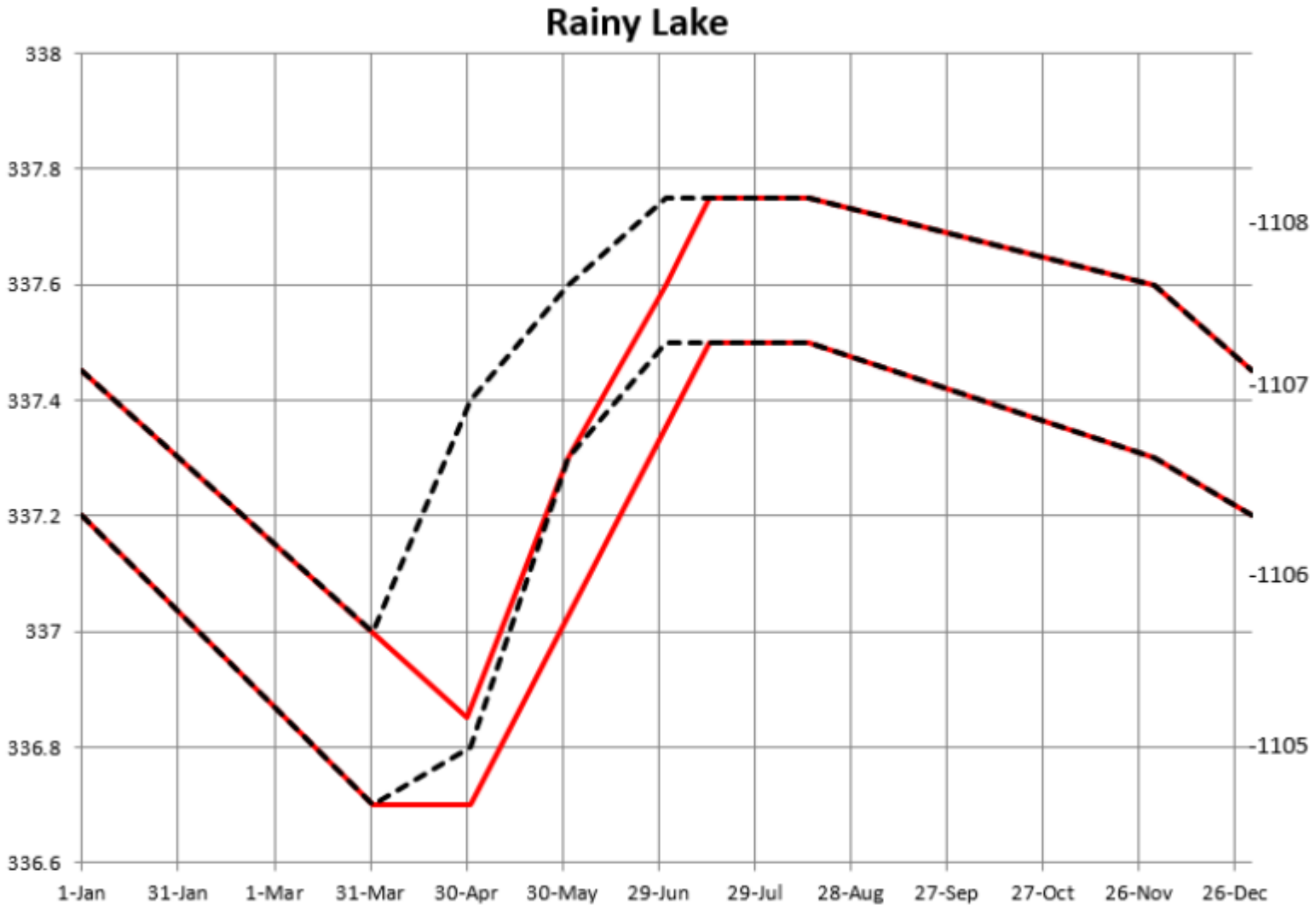
1. Lower targets in spring on Rainy Lake or both lakes
2. Delayed refill in spring on Rainy Lake or both lakes
3. Holding Namakan higher (no early drawdown)

Alternative Development:

Identify Area Improvemen

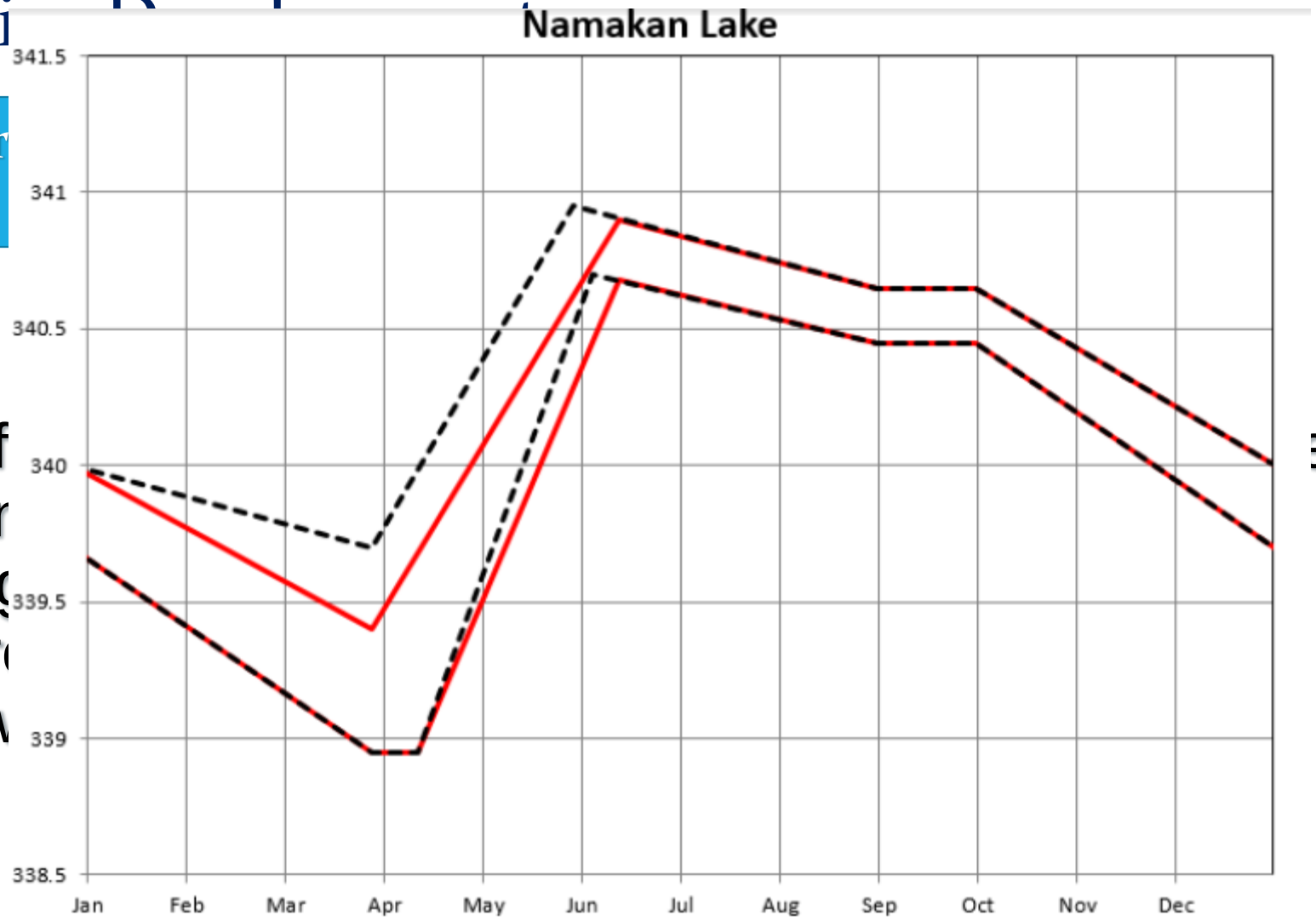
Flooding

- Make u e Rainy Lake peak du
- Lower t
- Delayed
- Use onl



Alternati

Identify Area for Improvement



Flooding

- Make up f e Rainy Lake peak durir
- Lower tarç
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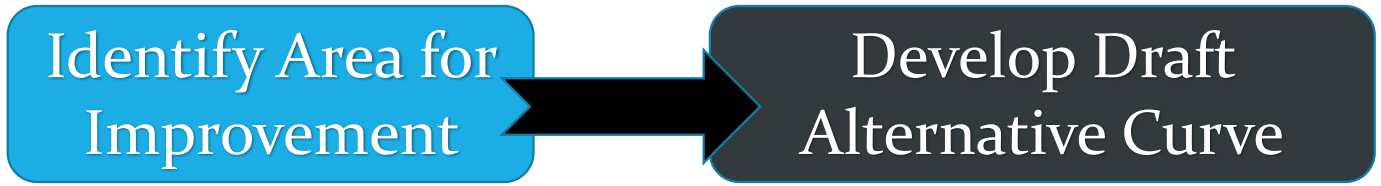
Alternative Development:



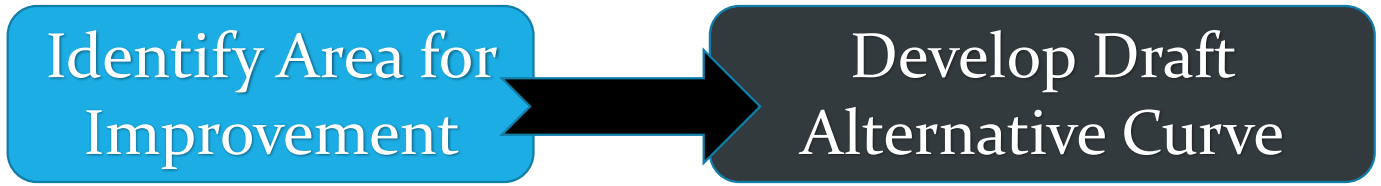
Risks of Flood Reduction Approach:

- Always lowering of the lakes lower, and delaying refill, harms some interests, risks not refilling lakes in drier years.

To Reduce these Risks:

- Study Board/ TWG sought method to identify higher risk of high water
- Developed test based on snowfall, 'La Nina' climate indicator on March 1.

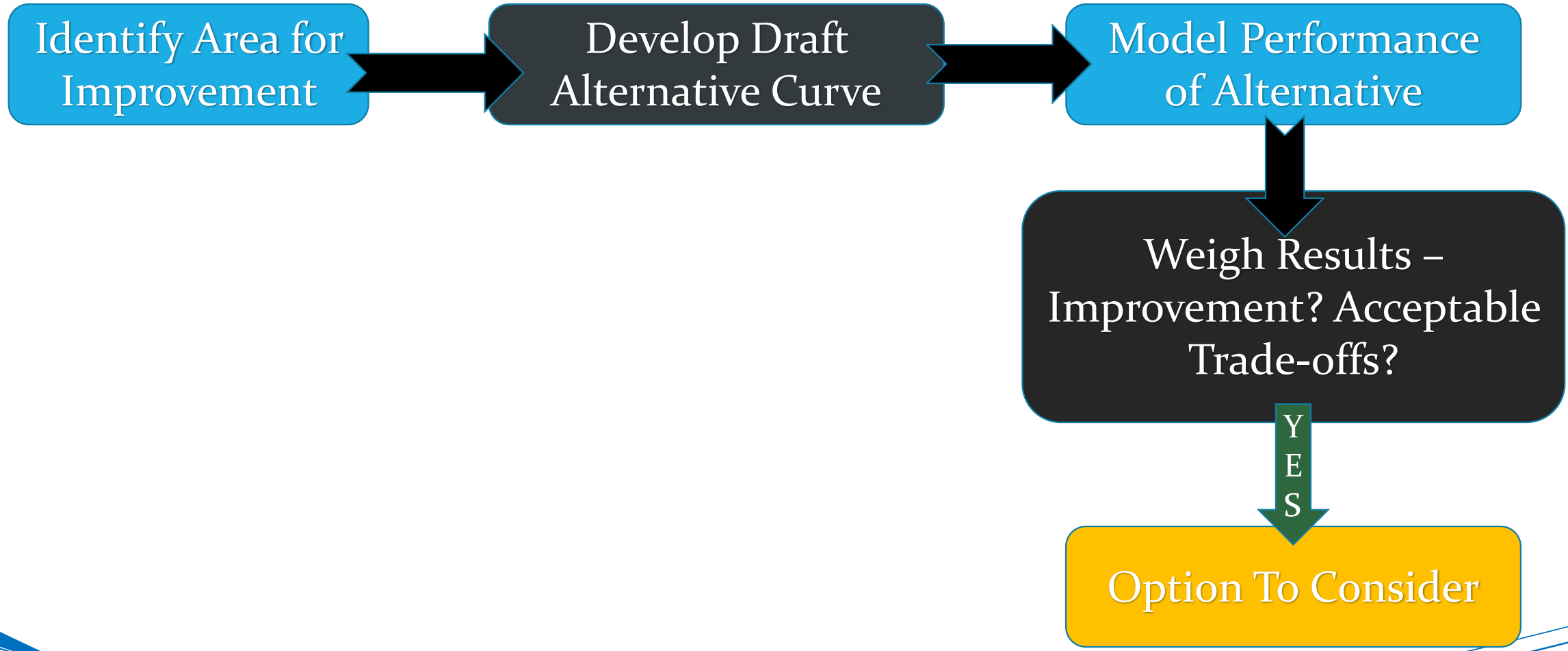
Alternative Development:



Conditional Use of this Alternative

- Using this test on all years since 1950:
  - Correctly predicted a flood 79% of the time
  - Correctly predicted no-flood 76% of the time

Alternative Development:



Menu

	All plans all metrics	Namakan											
		A	B	C	D	E	F	G	H	I	J	A	B
Net reduction in damages	Average Annual Flood Damage Reduction ($1000's)	$0	$0	-$6	$17	-$7	-$32	-$35	-$64	-$64	-$37	$0	$68
	1950 Flood damage reduction ($1000s)	$0	$0	$0	$561	$0	-$724	-$724	$975	$975	-$1,469	$0	$847
	2014 Flood damage reduction ($1000s)	$0	$0	$60	$217	$0	-$231	-$231	-$231	-$231	-$295	$0	$965
Bigger ratio is better	Boating Months with limited access (Rainy Lake)											1.00	0.98
	Archeological stress (residency time)	1.00	1.00	0.81	0.66	0.50	0.62	0.61	1.06	1.06	1.74	1.00	1.02
Not verified	Power production (maximum power)											1.00	1.00
	Average annual power production											1.00	1.00
	Minimum power production											1.00	1.16
	Average Spill											1.00	0.99
Ratio of total scores (1D) or average areas (2D) to Plan A, the 2000 RC	Wild Rice 1D	1.00	1.00	1.00	0.80	1.00	0.98	1.00	0.84	1.01	0.69	1.00	1.00
	Wild Rice 2D Suitable Growth Habitat	1.00	0.99	1.03	1.08	1.06	1.16	1.03	0.24	0.03	1.20	1.00	0.96
	Wild Rice 2D Suitable Growth Habitat (Cattail impact included)	1.00	0.99	1.03	1.33	1.03	1.25	1.07	0.32	0.03	1.79	1.00	1.01
	Wild Rice 2D Success (Survival & Cattail Effect)	1.00	0.98	1.00	1.11	0.99	1.27	1.09	0.33	0.04	1.72	1.00	0.99
	Cattails 1D	1.00	0.98	0.98	0.89	0.98	1.00	1.00	0.96	0.98	0.91	1.00	1.00
	Cattails (Floating) 2D	1.00	1.01	1.01	0.94	1.19	1.03	0.97	0.12	0.03	0.01	1.00	0.97
	Cattails (Not Floating) 2D	1.00	0.98	1.03	1.46	1.13	0.85	0.96	0.29	0.05	0.94	1.00	1.11
	Cattails (Total) 2D	1.00	0.99	1.02	1.21	1.16	0.94	0.97	0.21	0.04	0.50	1.00	1.03
	Wet meadow 2D	1.00	1.00	0.92	1.16	0.62	1.04	1.00	0.51	0.12	1.10	1.00	1.01
	Shrubby swamp 2D	1.00	1.00	0.95	0.73	0.72	1.09	1.02	0.28	0.13	1.75	1.00	0.96
	Emergent plants 2D	1.00	1.00	1.05	1.19	1.08	0.87	0.87	0.49	0.09	1.00	1.00	0.96
	Submerged Vegetation Low Density 2D	1.00	1.00	1.00	0.92	0.98	0.97	0.91	0.74	0.60	0.63	1.00	1.01
	Submerged Vegetation High Density 2D	1.00	1.00	0.97	1.15	1.01	0.49	0.50	0.68	0.57	0.34	1.00	1.04
	Loon Nest success 1D	1.00	1.00	1.00	0.70	1.00	1.03	1.05	0.71	1.03	0.48	1.00	0.93
	Walleye 1D	1.00	1.00	1.03	0.80	0.99	1.09	1.09	0.91	1.10	1.02	1.00	1.46
	Walleye Habitat 2D	1.00	1.00	1.07	0.51	1.00	1.36	1.36	1.01	1.57	1.24	1.00	0.86
	Walleye Success 2D	1.00	1.00	1.09	0.51	1.00	1.46	1.46	1.04	1.68	1.34	1.00	0.85
	Walleye Habitat 2D Rainy River											1.00	0.96
	Sturgeon Habitat 2D Rainy River											1.00	0.98
	Northern Pike Spawning 2D	1.00	1.01	0.89	0.86	0.99	1.06	1.10	0.13	0.00	1.27	1.00	0.91
	Northern Pike Larval 2D	1.00	1.00	0.70	0.76	1.04	0.58	0.64	0.10	0.00	0.26	1.00	0.96
	Northern Pike YoY Habitat 2D	1.00	1.01	0.83	0.99	1.10	0.80	0.76	0.12	0.00	0.59	1.00	1.00
	Whitefish 1D	1.00	1.00	1.09	0.11	1.00	1.00	1.02	0.73	1.16	0.00	1.00	0.98
	Whitefish Habitat 2D	1.00	0.98	0.99	0.71	0.97	1.00	1.00	0.25	0.00	0.87	1.00	1.03
	Whitefish Spawning Success 2D	1.00	0.98	0.96	0.45	0.96	1.09	1.06	0.20	0.00	0.85	1.00	1.01
raw scores	Muskrat 1D (raw scores, not a ratio to RC2000 Scores)	0.00	0.00	0.15	0.00	0.00	0.61	0.78	0.38	0.78	0.46	0.00	0.00

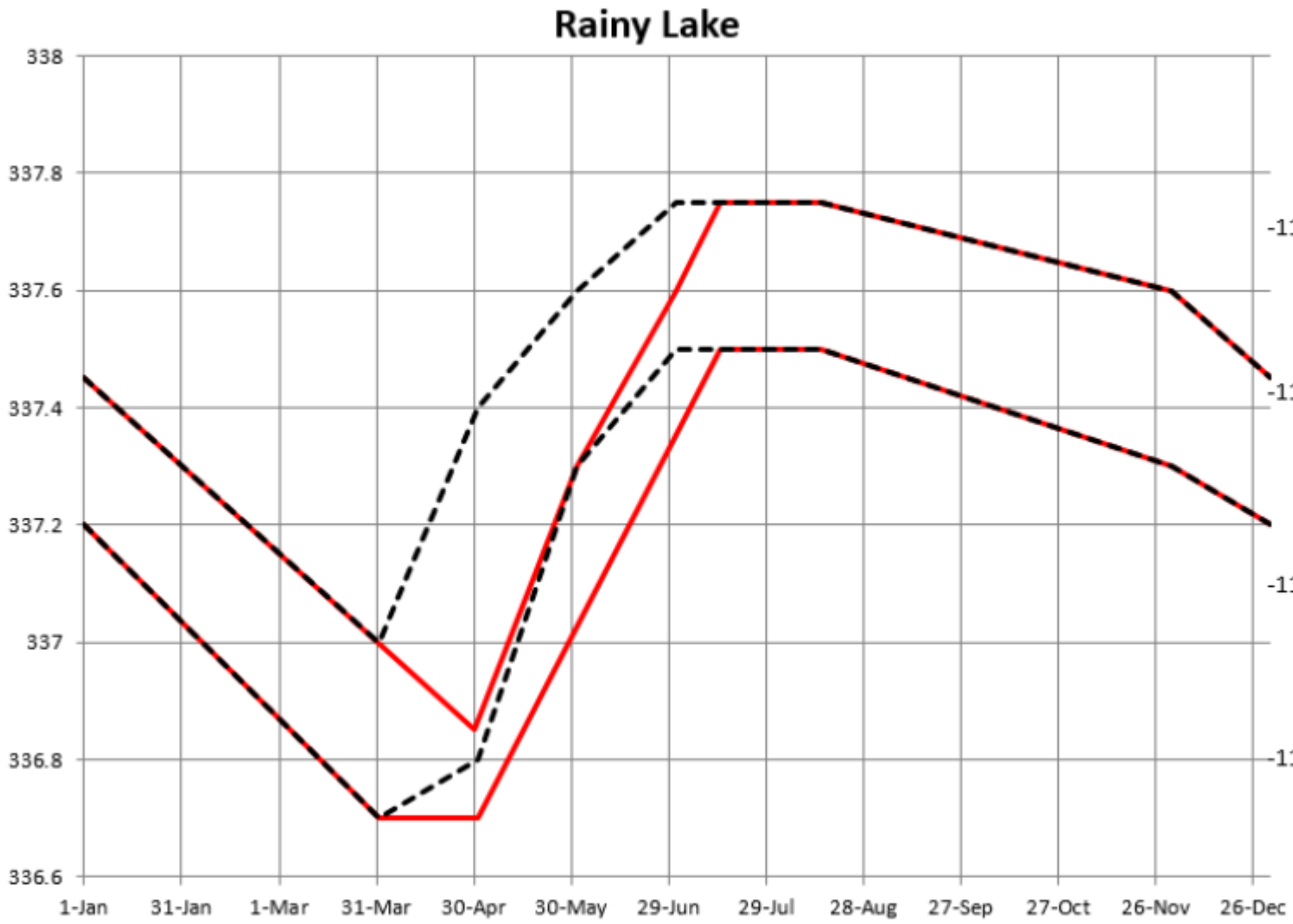
Alternative : Flood Risk Reduction

Pros

- In most flood years, flooding closer to that under 1970 RC
- Same as 2000 RC when not expecting flood

Cons

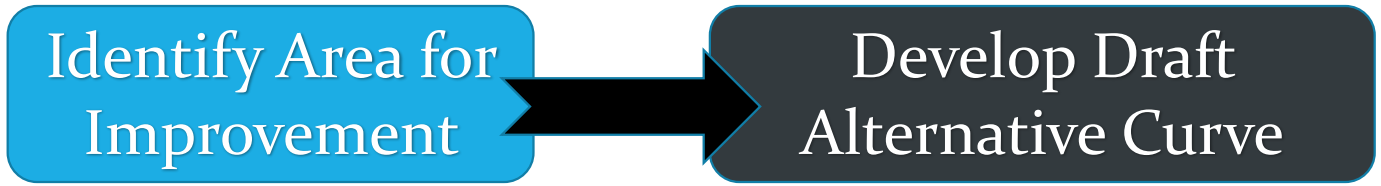
- Somewhat lower walleye population score than 2000



Alternative : Flood Risk Reduction vs 2000 RC

Year	cm lower if 1970	cm lower if Flood Red.	Difference (1970-Flood Red)
1950	4	2	2
1954	7	3	4
1968	4	4	0
1974	6	1	5
1985	1	6	-5
1996	7	2	5
2001	4	0	4
2005	8	0	8
2008	2	2	0
2009	3	1	2
2013	7	7	0
2014	4	4	0

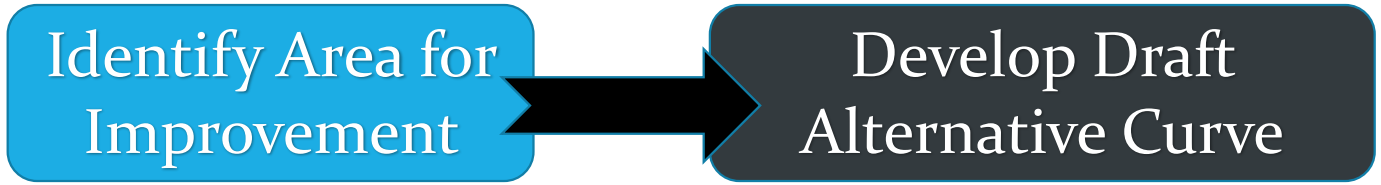
Alternative Development:



Ecological

- Improve muskrat over-winter survival
- Increase stress to cattail
- Increase access to Pike spawning grounds

Alternative Development:



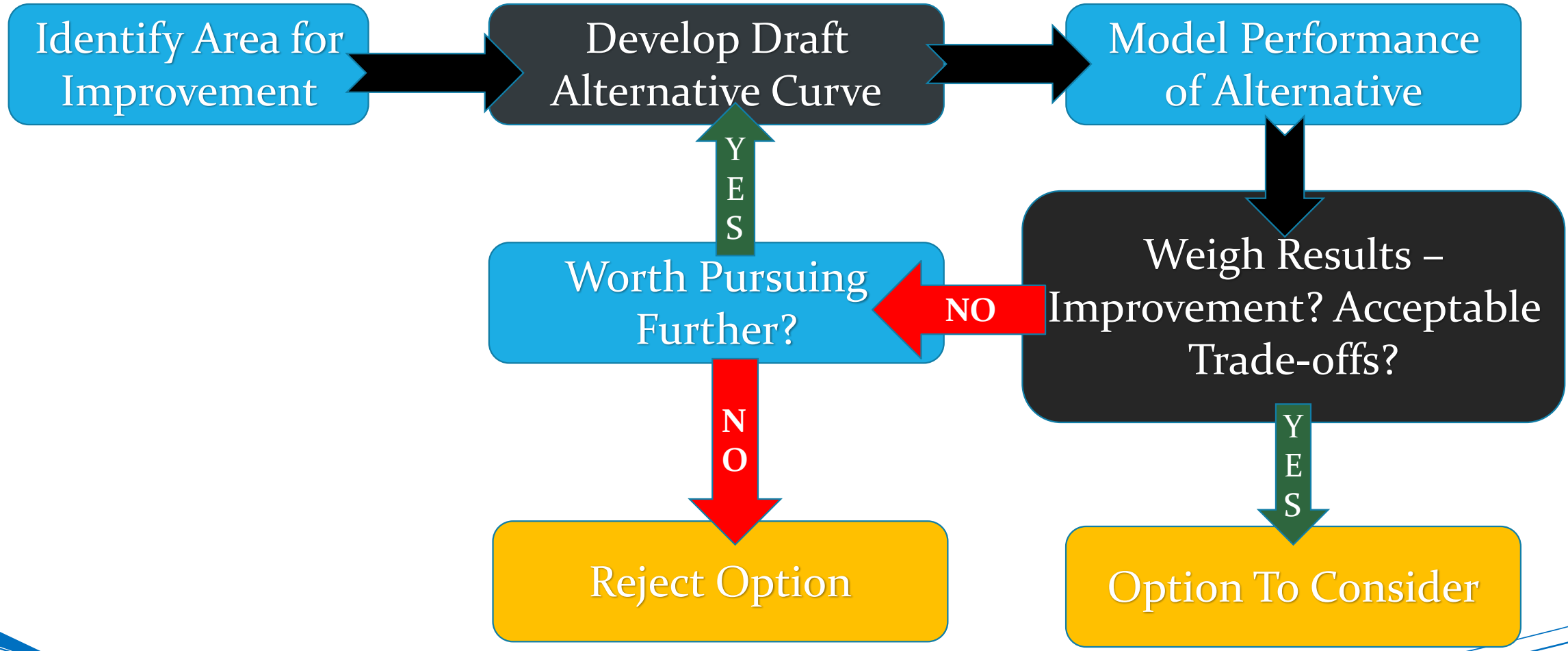
Ecological

- TWG developed individual ‘perfect’ Rule Curves for each subject as starting point.
- Some of these are quite different from 2000 Rule Curves
- Combined the individual curves into one, adjusted to respect flood and drought limits

What happened at the second practice decision today?

- About 35 members of the RAG and PAG participated
- The Study Board presented a preliminary weight of evidence table that showed that most evidence suggests that the 2000 Rule Curves performed as expected
- Two preliminary alternatives based on the 2000 Rule Curves were presented
  - The Adaptive Rule Curve which uses La Niña forecasts to reduce flood damages
  - The Environmental Rule Curve which adjusts the fall and winter levels to increase the percentage of muskrats that survive the winter
- The analysis used some performance indicators including flooding damages, but was not a full assessment
- Both alternatives provide benefits but also carry risks and participants offered their views on how to manage those risks

Alternative Development:



What happened at the second practice decision today?

- The Board practiced deciding by saying the 2000 Rule Curves had performed well and would form the basis for their recommendation
- But adjustments such as those suggested in the Adaptive and Environmental Rule Curves deserved more thorough investigation and might be part of their recommendation in some form.
- Participants supported the idea of more flexible rule curves and some sort of community involvement in the application of forecasting.

New Information Available Online

- Draft Weight of Evidence
- Story Map of Supporting Studies
- Fact Sheets
- 2 videos on Rainy Lake outflow

Website: http://ijc.org/en_/RNLRCSB

Look Ahead…

Early April– 1st Draft Report for Public Comment (30 Days)

Early May – Final Decision Workshop

Mid-May – Final Draft Report to Peer Reviewers

Mid-June – Final Report and Press Conference

Summer – IJC Holds Public Hearings