BRITISH COLUMBIA | Ministry of Energy and Mines

Columbia River Treaty Review

Fauquier June 15, 2013

Strategic Decision Overview

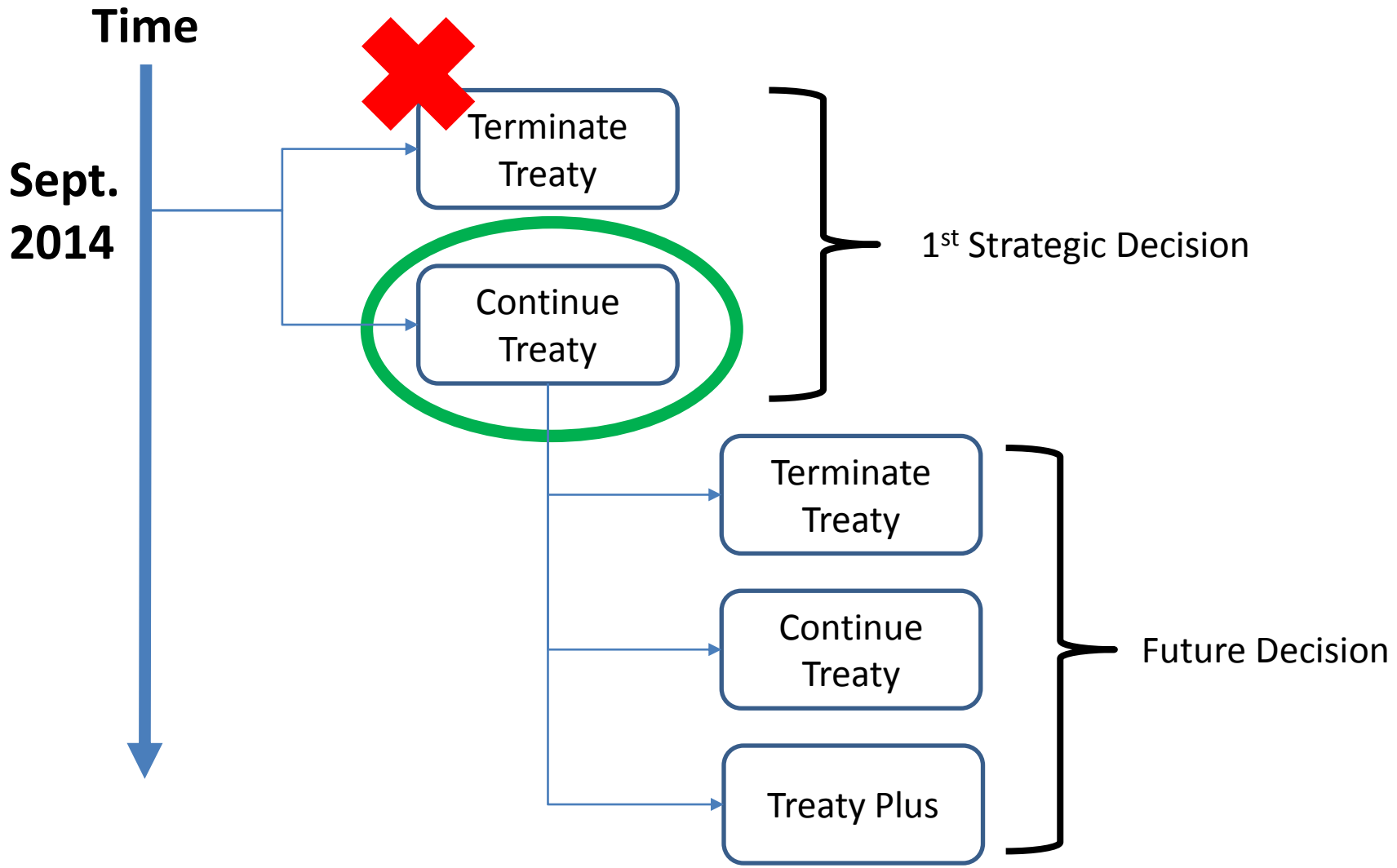
Columbia River Treaty

- Signed in 1964, the Columbia River Treaty coordinates flood control and optimizes power production in the US and Canada.

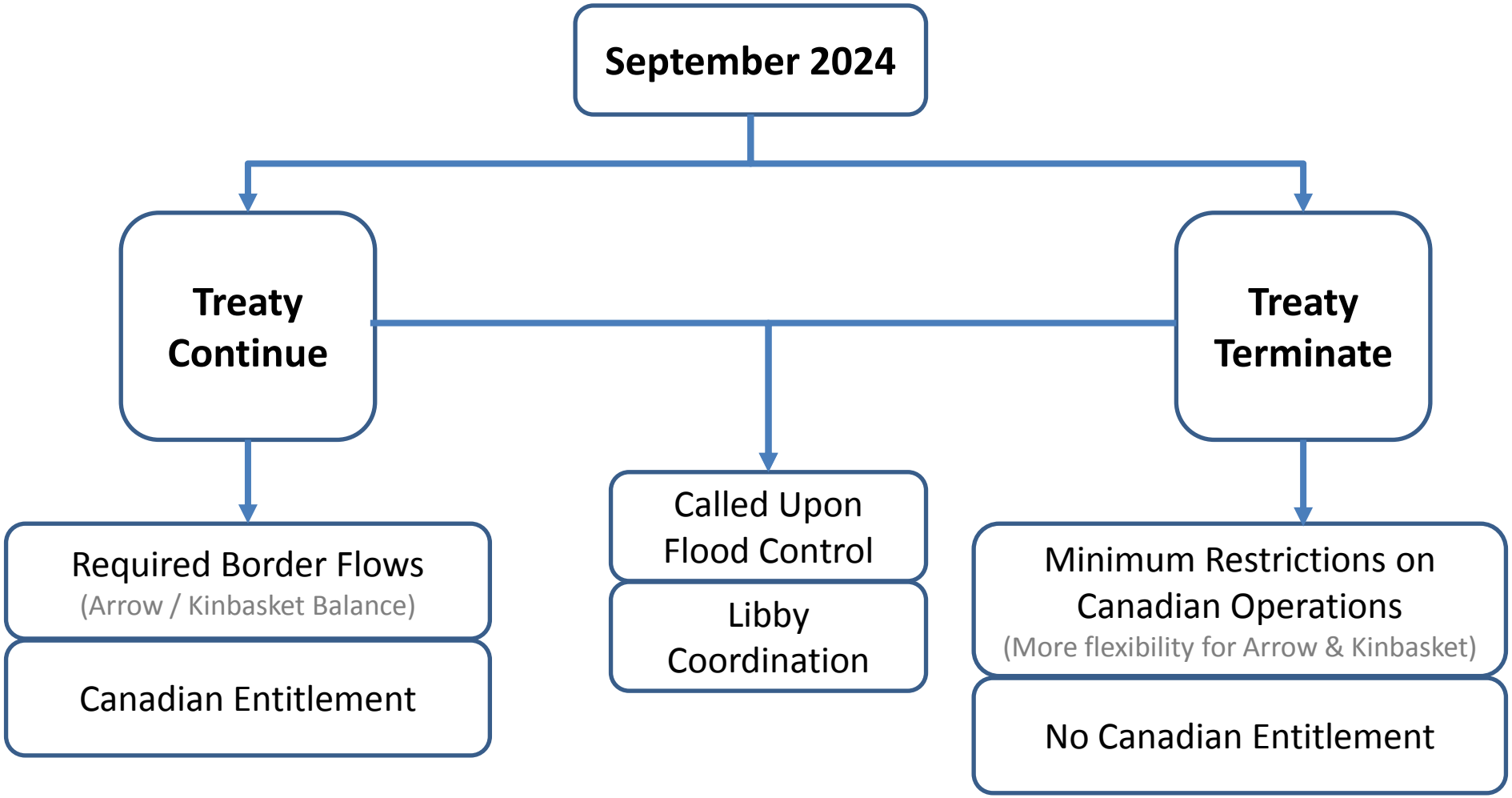
- The Treaty establishes border flows, reservoir storage and dam discharges at the 3 Canadian Treaty Dams – Mica, Hugh Keenleyside, and Duncan.

- At any point, the US and Canadian entities can agree to deviate from the original Treaty provisions for their mutual benefit, such as fisheries flows.

Strategic Decision Overview



Implications of Strategic Decision



Strategic Decision Scenarios - Columbia

Terminate

Possible Operating Alternatives

- Power
- Power + current fish operations
- (includes Arrow recreation)
- Arrow wildlife & vegetation
- Mica environmental/recreation
- Fisheries #1– below Arrow
- Fisheries #2– sturgeon

Treaty Continue

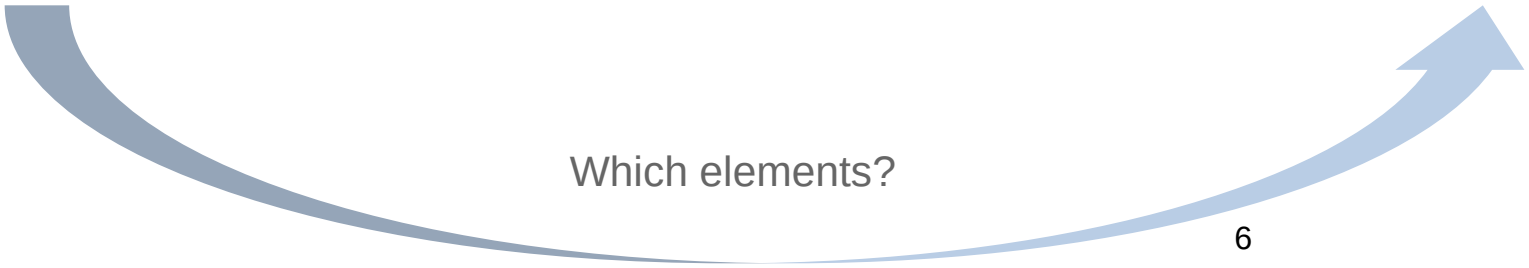
Possible Operating Alternatives

- Power
- Power + current fish operations
- Arrow wildlife & vegetation
- Mica environmental/recreation

Treaty Plus

Possible Operating Alternatives

- Future modelling



CRT Alternatives

Alternative	Description
Ref- TC (reference)	**Current Operating Constraints (TC)** • All current hard operating constraints and the Treaty power operations • Flows below Arrow to meet whitefish and rainbow trout spawning • Whitefish: Arrow discharge is reduced in January; excessive flow reductions are managed through March • Rainbow trout: increasing flow April through June.
Ref - TT (reference)	**Optimum Power (TT)** – • All current hard operating constraints but not constrained by the Treaty • To optimize power, Arrow reservoir is held close to full throughout the year • Trout spawning flows are met • Whitefish spawning flows are met in approximately 40% of years

CRT Alternatives

Alternative	Description
Alt 3 TC	**Arrow Wildlife/Vegetation (TC)** • Arrow Lakes Reservoir lower until mid-July • Allows vegetation to extend into lower elevations • Provides benefits to nesting birds • Increases the length of flowing river • Provides shore based recreation in the Revelstoke • This alternative: April (1427.2 ft/435 m) , May (1427.2 ft/435 m), June (1427.2 ft/435 m), July (1433.8 ft/437m), August (1433.8 ft/437m)
Alt 3 TT	**Arrow Wildlife/Vegetation (TT)** • same as above except no Treaty constraints

CRT Alternatives

Alternative	Description
Alt 4 TC	**Mica Environmental/Recreation** (TC) • Supports fish, navigation and recreation on Kinbasket Reservoir • Maintain a minimum elevation of 2395 ft (730 m) year round
Alt 4 TT	**Mica Environmental/Recreation** (TT) • same as above except no Treaty constraints

CRT Alternatives

Alternative	Description
Alt 5 TT	**Fisheries hydrograph #1- Flushing flow** (TT) • Provide flushing flows of 200 kcfs (5663.4 cms) at Birchbank for 5 days.
Alt 6 TT	**Fisheries hydrograph #2 – Sturgeon (TT)** • Provide flows of 185 kcfs (5238.6 cms) at Birchbank for 4 weeks starting ~ mid-June in at least 60 % of the years • Ramping up rate doubles the discharge in about 2 weeks • Ramping down rate reduces flows to 55% of the peak flow in 4 weeks

Columbia Performance Measures

- Example 1 - Kinbasket Reservoir
- Vegetation
  - # of 2m elevation bands between 735-755m that are inundated more than 18 weeks per year

- Example 2 – Arrow Reservoir
- Bull trout & Kokanee tributary access in Arrow Lakes Reservoir
  - # of days reservoir is > 1430 ft between 25 August to 15 November (spawning period)

- Example 3 – Lower Columbia River
- Frequency of Flood Flows
  - # of days per year flows > 165,000 kcfs (at Birchbank)
  - # of days per year flows > 177,000 kcfs (at Birchbank)

Examine uncertainties and trade-offs of alternatives

Mid-Columbia River

Objective	Performance Measure	Units	Dir	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT	PM
Mid Columbia River												
Veg & Wildlife - Veg Flooding	Hectares flooded > 18 wks	Hectares	L	2,352	1,388	1,388	3,234	2,352	3,426	3,234	1,871	(#11)
Veg & Wildlife - Nesting birds	% Useable habitat	Percent	H	20	48	40	-	17	-	0	70	(#13)
Veg & Wildlife - Fall Mig. Birds	% Useable habitat	Percent	H	15	87	71	-	55	-	0	34	(#13)
Aquatic - River Habitat	Functional large river habitat	Km	H	31	35	34	18	23	19	19	26	(#12)
Aquatic - Sturgeon	Larval habitat availability	Km	H	2.84	2.85	2.85	2.77	2.85	2.83	2.79	2.85	(#12)
Rec - Boat Access	Days > 1435	Days	H	64	2	21	153	26	153	145	59	(#10)
Rec - Shore Access	Days < 1435	Days	H	119	181	162	-	157	-	8	94	(#10)

Legend

Better than highlighted alt

Worse than highlighted alt

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Arrow Reservoir

Objective	Performance Measure	Units	Dir	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT	PM
Arrow Lakes												
Aquatic - Kok Trib. Access	Days > 1430'	Days	H	60	37	50	82	82	82	82	22	(#20)
Aquatic Productivity	Epilimnetic residence time	Days	H	107	101	98	95	93	84	94	70	(#7)
Heritage	Site erosion	Weighted Days	L	227	135	151	365	332	357	363	233	(#17)
Heritage	Site inundation	Weighted Days	H	190	56	95	763	524	750	735	430	(#17)
Recreation - General	1435 < days < 1440	Days	H	97	75	72	197	197	197	197	41	(#16)
Dust	days < 1410	Days	L	41	61	61	-	-	-	-	-	(#18)
Navigation	Weighted-Days	Days	H	219	226	219	211	248	211	226	248	(#15)

Legend

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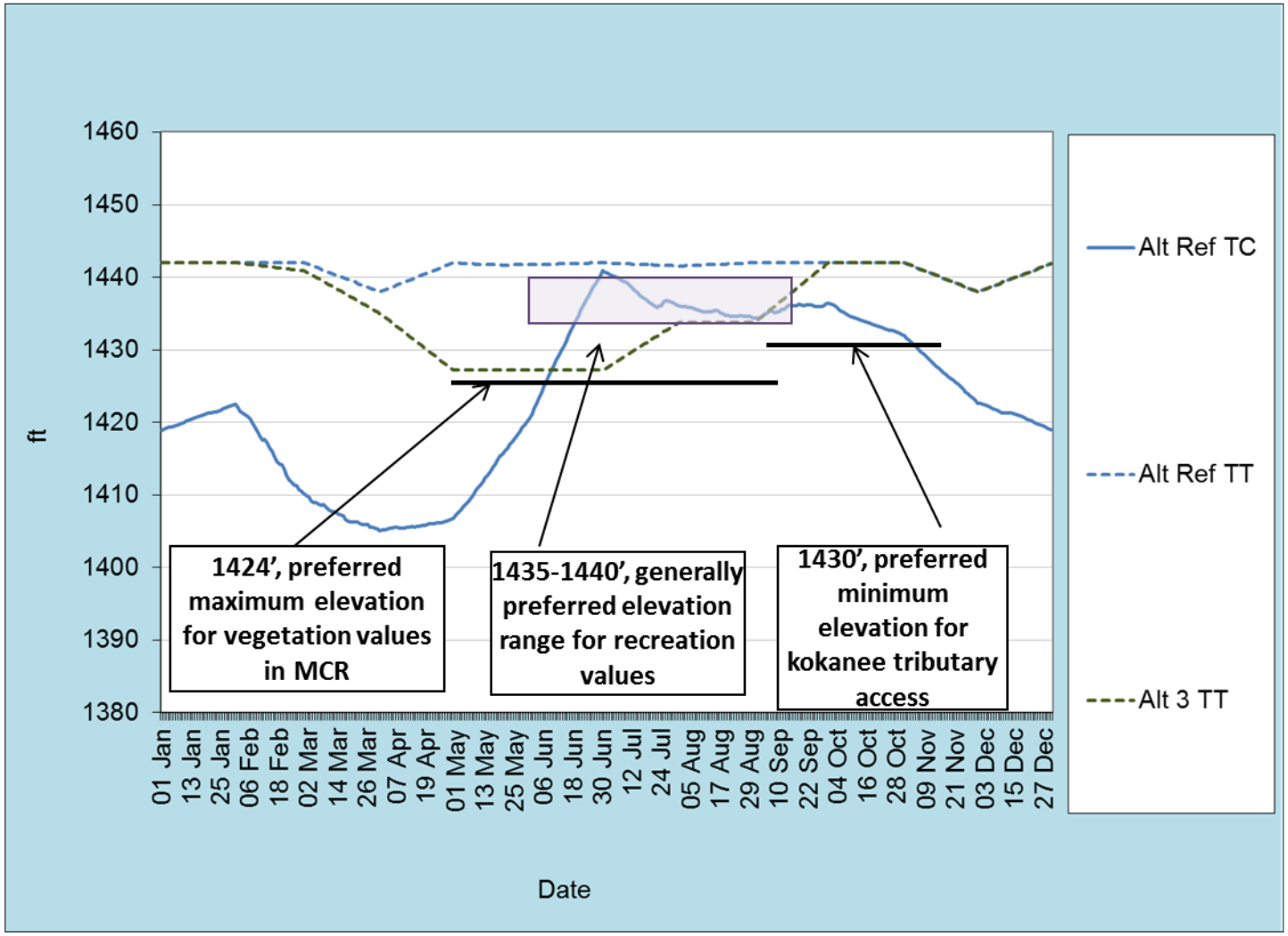
Key Findings – 3 – Arrow

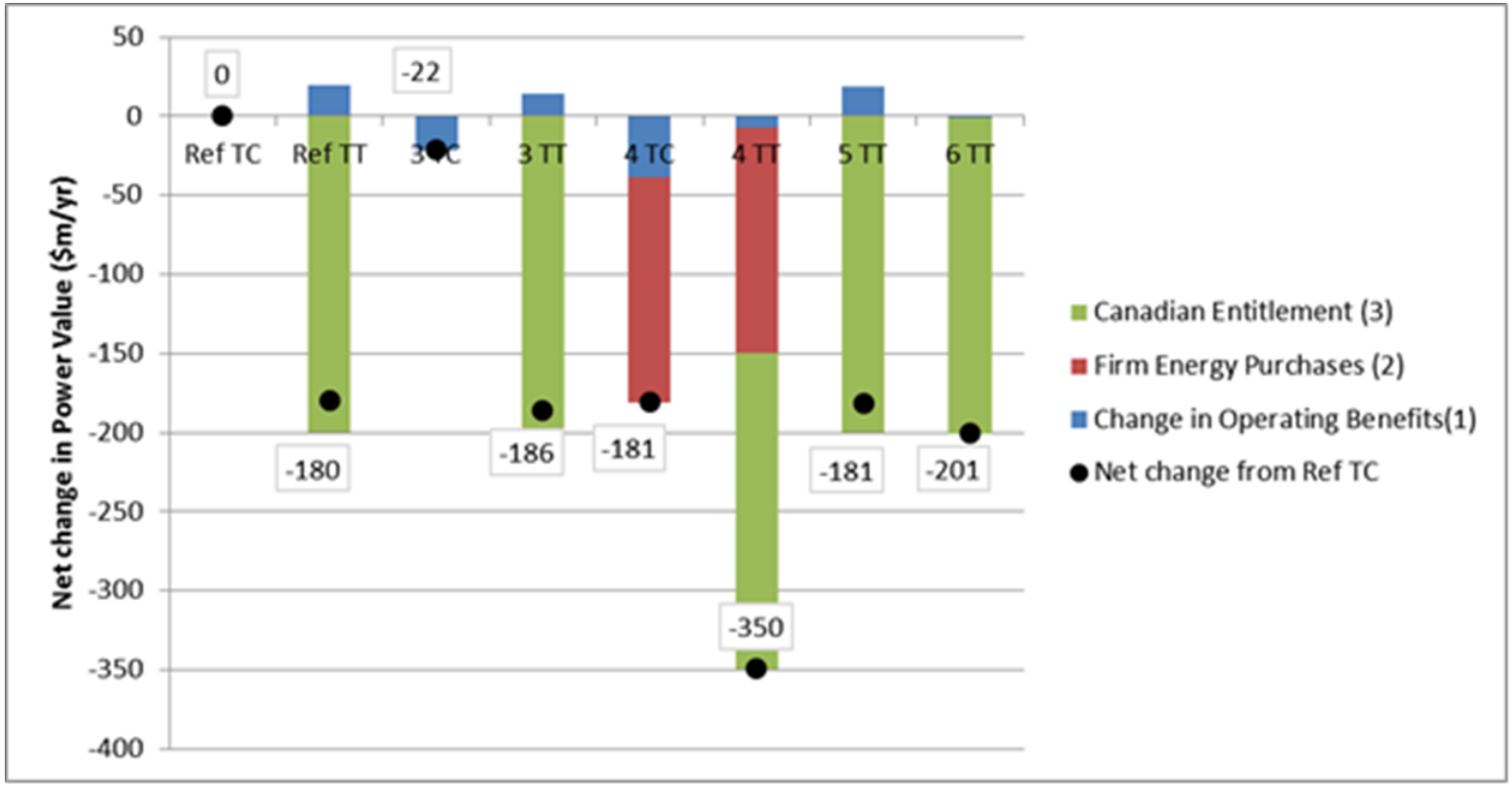
- Preferred ranges for vegetation, recreation, tributary access



Systemic Trade-offs

	Treaty Continue			Treaty Terminate				
	Ref TC	**3TC Veg/ Wildlife**	**4 TC Kinbasket Env/Rec**	**Ref TT Optimum Power**	**3 TT Veg/ Wildlife**	**4 TT Kinbasket Env/Rec**	**5 TT Fish Flow 5 days**	**6 TT Fish Flow 4 weeks**
Kinbasket Rec/ Nav / Dust	NA	Rec Days (+15-30%)	Rec Days (+5-30%)			Rec Days (+0-20%)		
Mid-Columbia River Veg / Wildlife/River Habitat		Veg Area (+40%) Bird Hab. (+>100%) River Hab (+12%)	Veg Area (+40%) Bird Hab. (+>100%)	Veg Area (-38%) All Bird Habitat Lost River Hab (-40%)	River Hab (-25%)	Veg Area (-46%) All Bird Habitat Lost River Hab (-40%)	Veg Area (-38%) All Bird Habitat Lost River Hab (-39%)	Veg Area (+70%) Bird Hab. (+>100%) River Hab (-17%)
Arrow Rec / Dust /Kokanee access		Rec Days (-23%) Kok Access (-38%)	Rec Days (-26%) Kok Access (-17%)	Rec range all season Full Kok Trib Access	Rec range all season Full Kok Trib Access	Rec range all season Full Kok Trib Access	Rec range all season Full Kok Trib Access	Res drops 60' in summer
LCR Fish				Possibly better for MW / RBT		Possibly better for MW / RBT		Major sturgeon pulse
LCR Flooding							Flow >177kcfs (5012 cms) every year	Flow >177kcfs (5012 cms) every year
Annual Power Value Change		-$22m	-$180m	-$180m	-$190m	-$350m	-$180m	-$200m

System Wide – Financial



Key Findings – 1

Operating constraints on Kinbasket reservoir have the highest costs (especially if firm energy is impacted), regardless of Treaty Termination
Improvements to recreation, navigation and potentially vegetation/wildlife and the operating cost and cost of building new sources of firm energy are similar whether the Treaty continues or is terminated.

Treaty Continue	Treaty Terminate
Due to the large generation capability at Mica and Revelstoke (5700 MW, ~50% of BC Hydro's capacity), changes at Mica are the most costly and provide limited gains for interests around the reservoir.	In Treaty Terminates, more radical changes to operations could be developed that could provide greater benefits to interests around the reservoir, but at an even higher cost. This domestic trade-off remains the same.

Key Findings – 2

With Treaty Termination, Arrow Lakes operational choices become less linked to choices made at Kinbasket	
Treaty Continue	Treaty Terminate
Under the Treaty Continue scenario, there will always be a need to balance between Kinbasket/Arrow as the *border flow* releases from Canadian storage are set by the Treaty operations. If Arrow is low, Kinbasket will be higher and vice versa.	Under a Treaty Terminate scenario, Arrow reservoir levels can change without having the same impact on Kinbasket reservoir, thereby creating more opportunity to operate Arrow for other interests.

Key Findings – 3

Regardless of the Treaty's future, value trade-offs at Arrow will remain **Further analysis and discussion at WUP 2020 review**	
Treaty Continue	Treaty Terminate
Alternative 3 demonstrates the trade-off at Arrow reservoir under a Treaty Continue scenario: • significant benefits to vegetation, bird and wildlife values in the Mid-Columbia River from a lower reservoir elevation • declines in kokanee tributary access and recreation days in Arrow Lakes Reservoir • loss of power revenue to CBT/CPC	The de-linking of Kinbasket and Arrow reservoirs enables different operations at Arrow reservoir: • different (and potentially better) balance between the high and low Arrow reservoir interests • however, several of the key interests in Arrow Lakes reservoir are mutually exclusive, and so tough trade-off choices will remain

Key Findings – 4

Treaty Terminate opens up new trade-off opportunities / constraints between Arrow and the Lower Columbia River	
Treaty Continue	Treaty Terminate
• able to meet Lower Columbia River spawning flows in the January through June period • result in high Arrow reservoir levels in the spring which impacts the Mid-Columbia interests that prefer lower levels in the spring • benefits reservoir based recreation.	• potential for different operations creates quite different trade-offs between Arrow reservoir and the downstream river section that were not investigated in the WUP

Key Findings – Columbia River System

- **Operating constraints on Kinbasket reservoir have the highest costs (especially if firm energy is impacted), regardless of Treaty Termination**
- **With Treaty Termination, Arrow Lakes operational choices become less linked to choices made at Kinbasket**
- **Regardless of the Treaty's future, value trade-offs at Arrow will remain**
- **Treaty Terminate opens up new trade-off opportunities / constraints between Arrow and the Lower Columbia River**