Consequences for Trial Alternatives under Interim Performance Measures

Main Table Meeting July 14, 2021



Outline

- Purpose of Sample Consequences
 Calculations
- Trial Alternatives and Interim Performance Measures
- PM Methods and Results



Purpose of Trial Alternatives

- Demonstrate how performance measures respond to flow management decisions
- Demonstrate some of the trade-offs that may be required in SDM process
- Provide a starting point to inform discussion of potential alternatives
- May not represent future hydrological conditions
 - climate change
- Not intended as a future operational regime



Performance Measure	Period L	Location	Units	Preferred	Scenario		
				Direction	Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0
Flushing flows – number of days where flow exceeds 468 m³/s	All	Nechako at Vanderhoof	Days Per Year	High	15.2	7.7	46.8
Salmon - Average daily flow	Jul 1 - Sep 30	Nechako at Vanderhoof	m³/s	High	229	176	291
Caribou - Days where reservoir elevation is less than 852 m	May 1 - Jun 30	Nechako Reservoir	Days per year	Low	48.7	38.4	???
Boat access - Average reservoir elevation	Mar 1 - Oct 31	Nechako Reservoir	m	High	851.7	851.7	???
Power Generation - Average daily flow	All	Kemano Powerhouse	m³/s	High	86.4	118	0.00

PM values calculated as average over all years of record

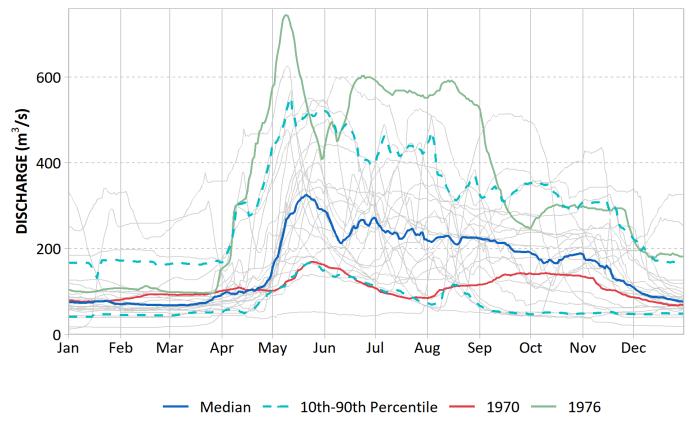
Values presented use interim PMs, and are subject to change

Trial Alternatives – Inputs / Methods

- Simplified calculations, based on data from:
 - Measured discharge at Nechako at Vanderhoof (pre/post 1981)
 - Modelled discharge at Nechako at Vanderhoof (100% flow to Nechako via SLS)
 - Nechako Reservoir elevation
 - Kemano powerhouse
- Calculations are completed for individual years and summarized
 - Figures show the distribution of PM values over years
 - Tables provide average across all years



Nechako at Vanderhoof Historic (Pre-1981)

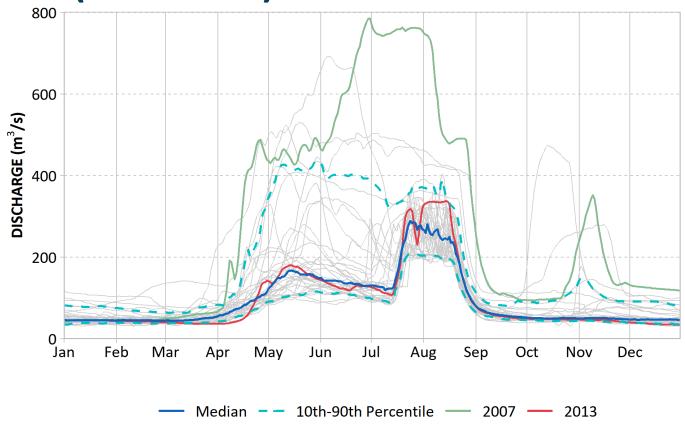


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Flow scenarios are for demonstration purposes and not intended as a future operational regim

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Nechako at Vanderhoof Historic (Post-1981)

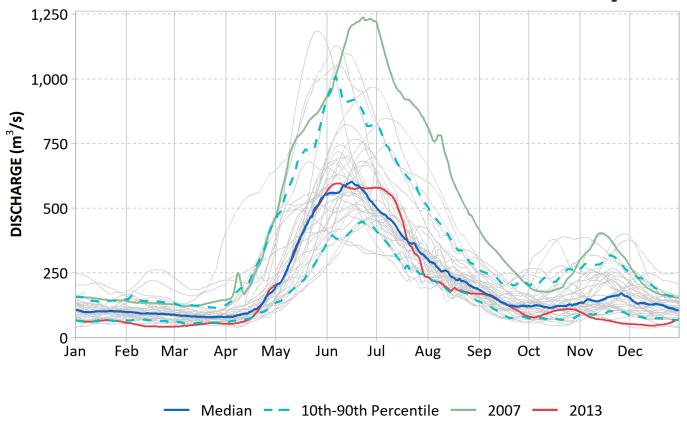


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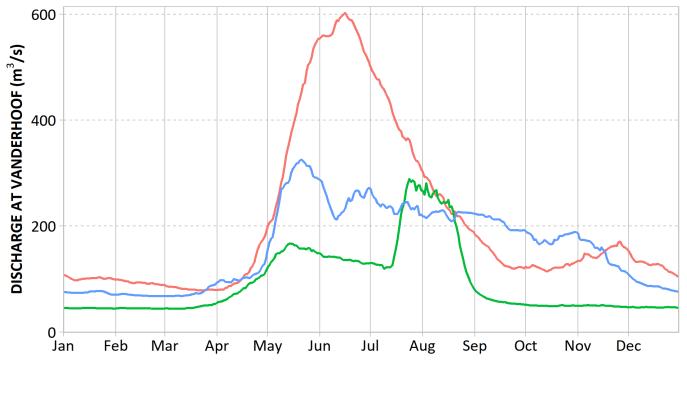
Nechako at Vanderhoof 100% Flow to Nechako via Skins Lake Spillway



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Flow scenarios are for demonstration purposes and not intended as a future operational regime Hydrograph is based on modelled data of hypothetical flow routing scenario

Nechako at Vanderhoof **Comparison of Median Flow**



Pre 1981 — Post 1981 — 100% Flow to Nechako via SLS

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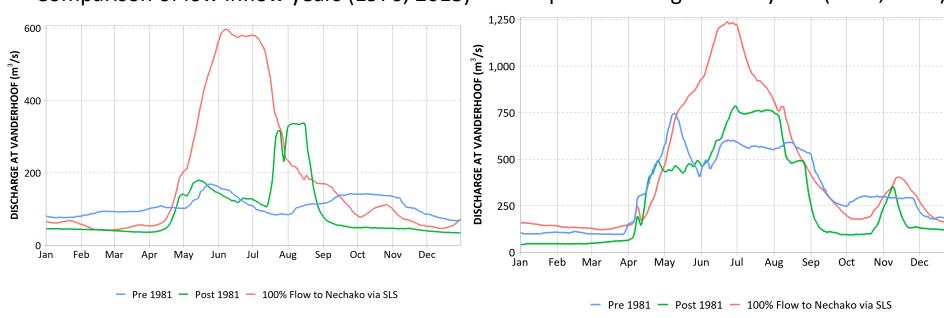
Flow scenarios are for demonstration purposes and not intended as a future operational reg all face to t

Thomas and

Nechako at Vanderhoof Specific Years

Comparison of low inflow years (1970, 2013)

Comparison of high inflow years (1976, 2007)



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Thomas .

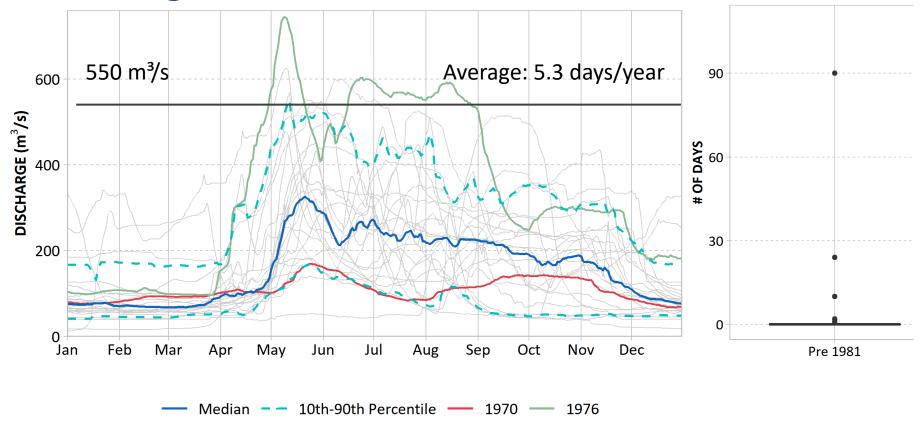
Performance Measures for Interim Calculations

Objective	Interim Performance Measure	Preferred Direction
Minimize open-water, overbank flooding	Number of days at Vanderhoof where flow exceeds 550 m ³ /s	Low
Maximize flushing flows	Number of days at Vanderhoof where flow exceeds 200% MAD	High
Minimize temperature effects on salmon migration	Average daily flow at Vanderhoof between July 1 and Sept 30	High
Minimize land connections to caribou calving islands	Days where reservoir elevation is less than 852 m (2795 ft) between May 1 and June 30	Low
Maximize access to boat docks and launches	Average reservoir elevation between March 1 and October 31	High
Maximize RTA power generation	Average Kemano Powerhouse flow	High

Objective: Minimize open-water, overbank flooding

Interim PM: Number of days where flow exceeds 550 m³/s

Nechako at Vanderhoof Flooding - Pre-1981



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Values presented use interim PMs, and are subject to change

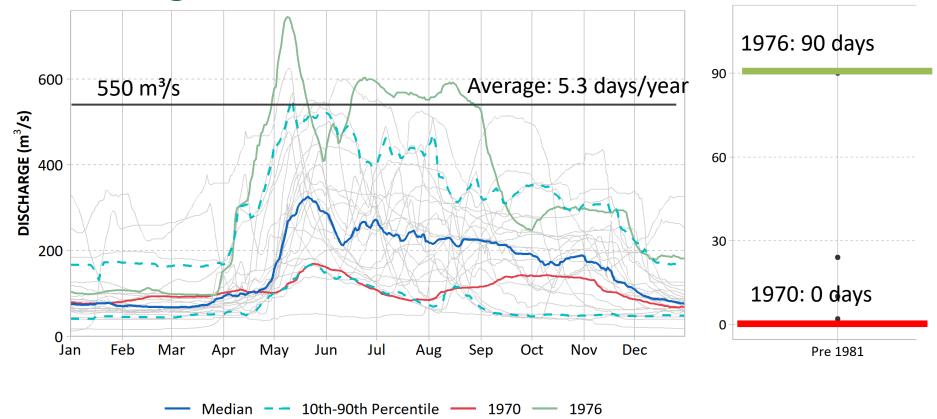
Box Plots

Largest value* 75th percentile Interquartile range Median / 50th percentile middle 50% of the values are within the box 25th percentile Smallest value within 1.5 times interquartile range below 25th percentile Outlier – value is farther than 1.5 times the

• interquartile range below the 25th percentile

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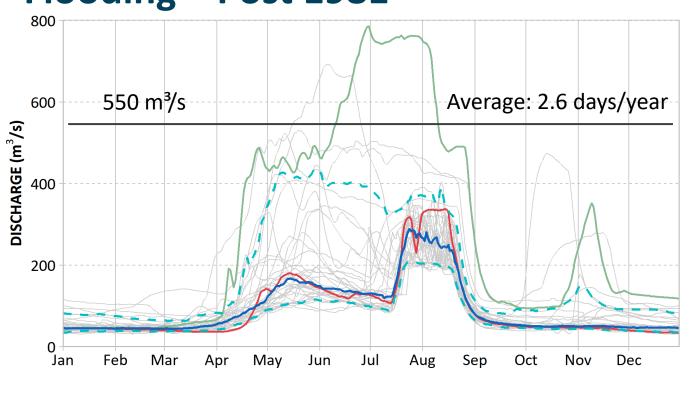
Nechako at Vanderhoof Flooding - Pre-1981

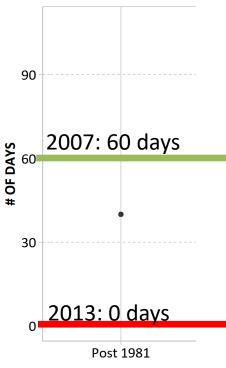


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Nechako at Vanderhoof Flooding – Post 1981





Median - 10th-90th Percentile - 2007 201

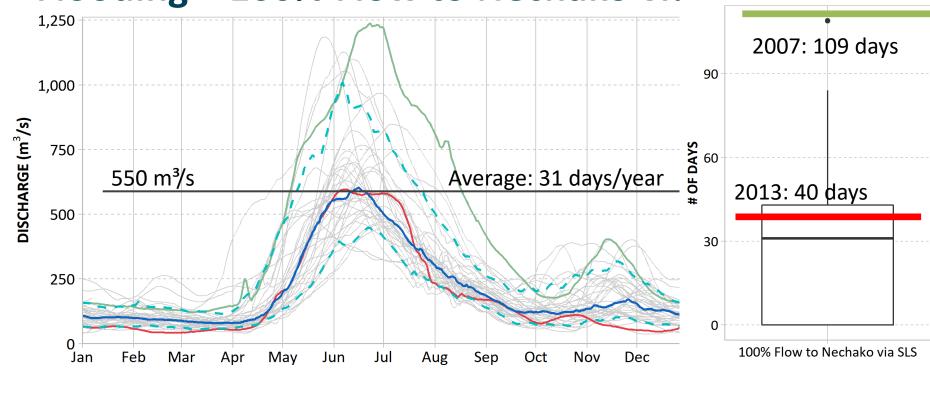
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Median – 10th-90th Percentile — 2007 — 2013

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Performance Measure	Period	Location	Units	Preferred	Scenario			
				Direction	Pre- 1981	Post- 1981	100% via SLS	
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0	

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PM values calculated as average over all years of record

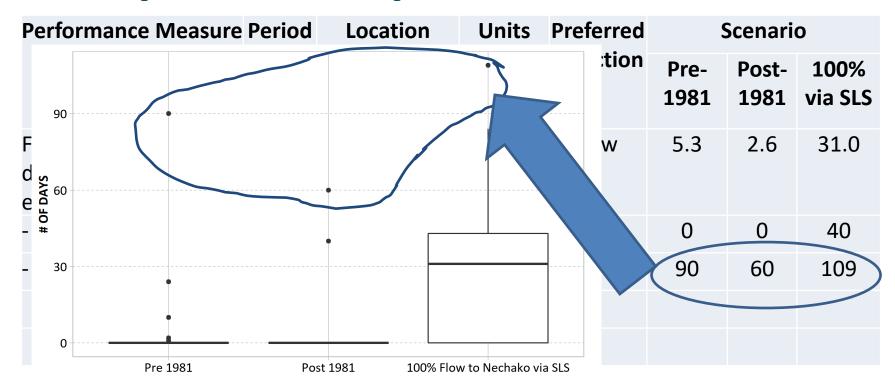
Values presented use interim PMs, and are subject to change

Performance Measure Period	Period	Location	Units	Preferred Direction	Scenario		
					Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0
- Low inflow year					0	0	40
- High inflow year					90	60	109

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PM values calculated as average over all years of record

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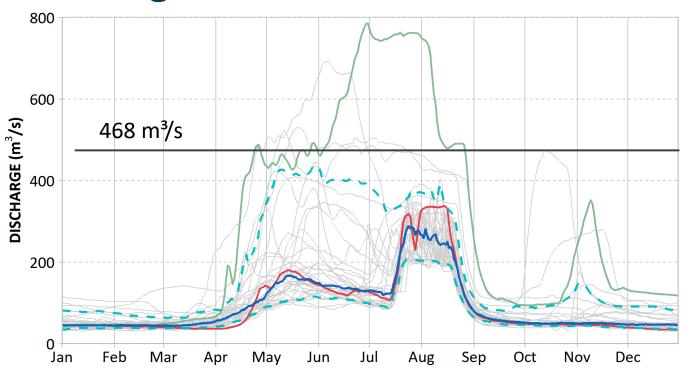
PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change

Objective: Maximize flushing flows

Interim PM: Number of days where flow exceeds 200% natural mean annual discharge (~468 m³/s)

Nechako at Vanderhoof Flushing Flows – Post-1981



Median - 10th-90th Percentile - 2007 -

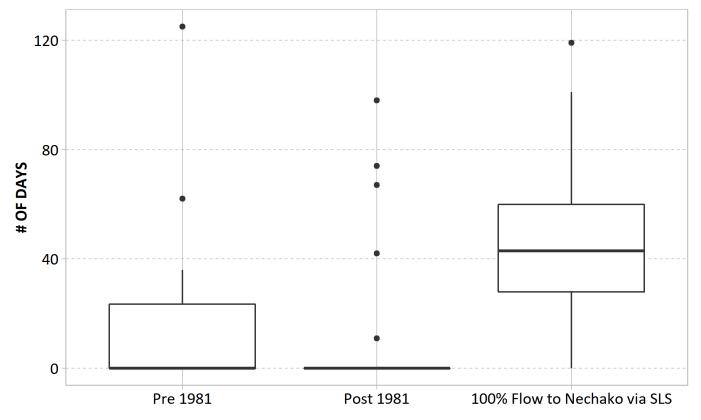
In contrast to flooding, preferred direction is high

Values presented use interim PMs, and are subject to change.

Flow scenarios are for demonstration purposes and not intended as a future operational regime.

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Nechako at Vanderhoof Flushing Flows



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Performance Measure	Period	Location	Units	Preferred	Scenario		
				Direction	Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0
Flushing flows – number of days where flow exceeds 468 m ³ /s	All	Nechako at Vanderhoof	Days Per Year	High	15.2	7.7	46.8

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PM values calculated as average over all years of record

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Performance Measure	Period	Location	Units	Preferred	Scenario		
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Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0
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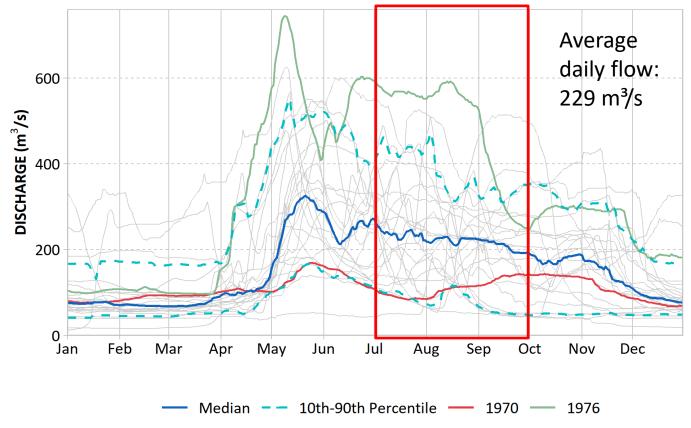
PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change

Objective: Minimize temperature effects on salmon migration

Interim PM – Average daily flow at Vanderhoof between July 1 and Sept 30 (proxy for temperature)

Nechako at Vanderhoof Salmon Migration - Pre-1981

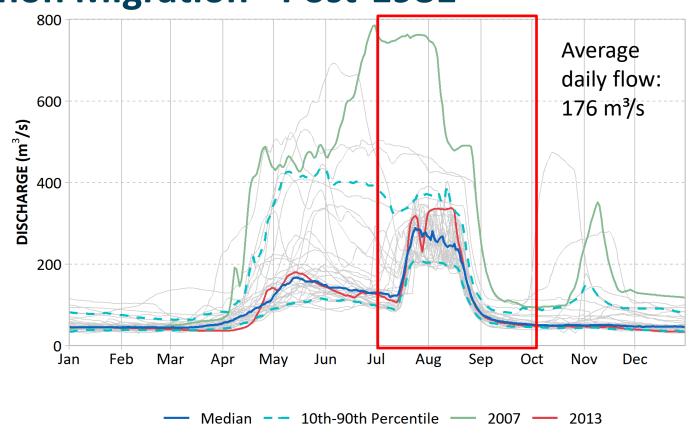


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Nechako at Vanderhoof Salmon Migration - Post-1981

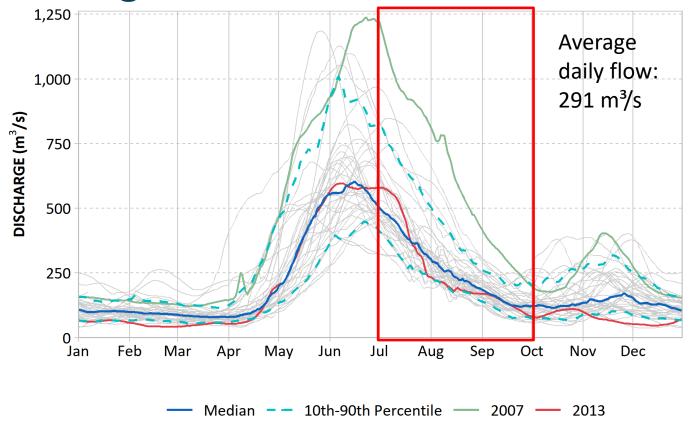


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Salmon Migration - 100% Nechako flow via SLS



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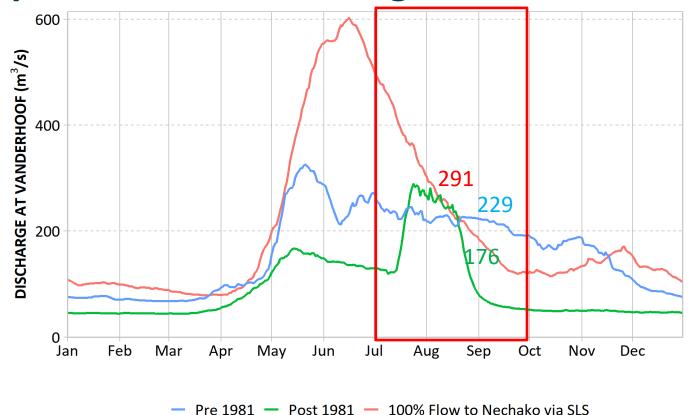
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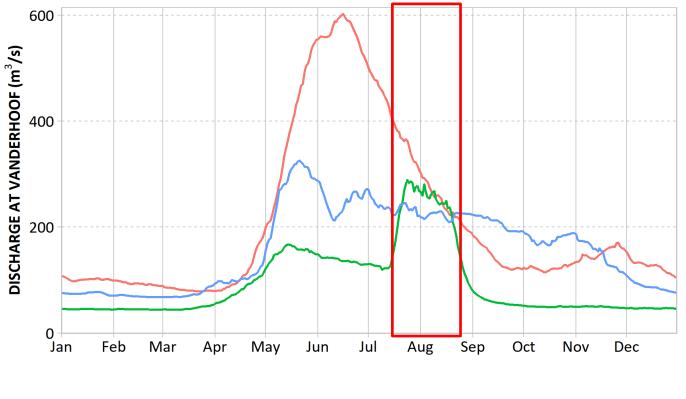
Comparison of Salmon Migration Flows



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Values presented use interim PMs, and are subject to change Flow scenarios are for demonstration purposes and not intend

Critical Timing of Salmon Migration Flows?

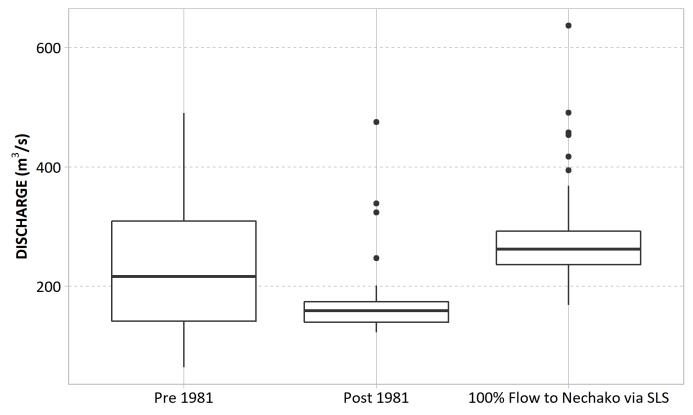


Pre 1981 — Post 1981 — 100% Flow to Nechako via SLS

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Nechako at Vanderhoof Salmon Migration Flows



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Performance Measure	Period L	Location	Units	Preferred	Scenario		
				Direction	Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0
Flushing flows – number of days where flow exceeds 468 m ³ /s	All	Nechako at Vanderhoof	Days Per Year	High	15.2	7.7	46.8
Salmon - Average daily flow	Jul 1 - Sep 30	Nechako at Vanderhoof	m³/s	High	229	176	291

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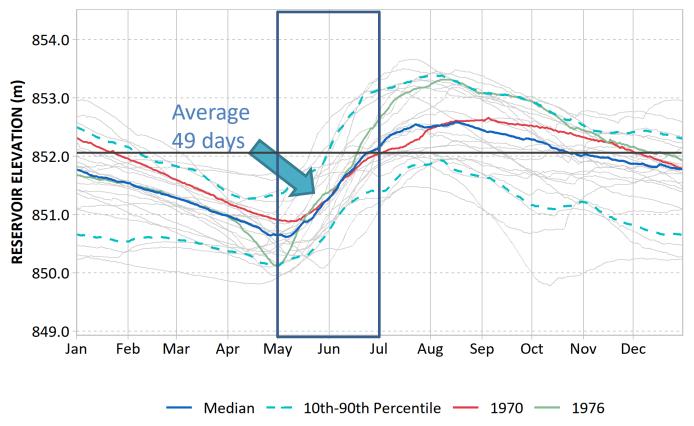
PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change and in

Objective: Minimize land connections to caribou calving islands

Interim PM – Days where reservoir elevation is less than 852 m (2795 ft) (May 1 – June 30)

Nechako Reservoir Elevation Caribou Calving Island Land Links - Pre-1981



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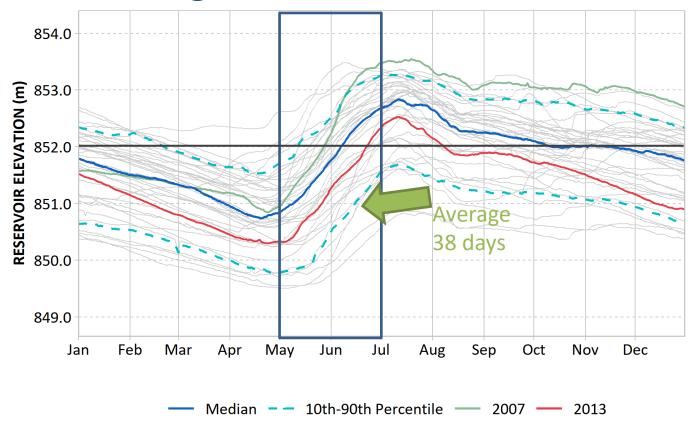
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Nechako Reservoir Elevation Caribou Calving Island Land Links - Post-1981



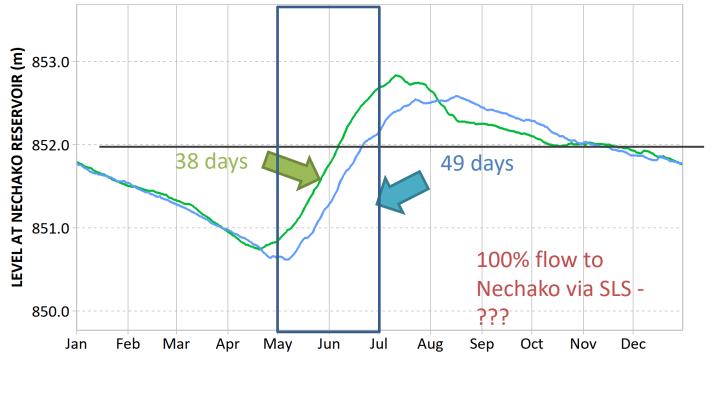
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Values presented use interim PMs, and are subject to change.

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Nechako Reservoir Elevation Caribou Calving Island Land Links - Comparison



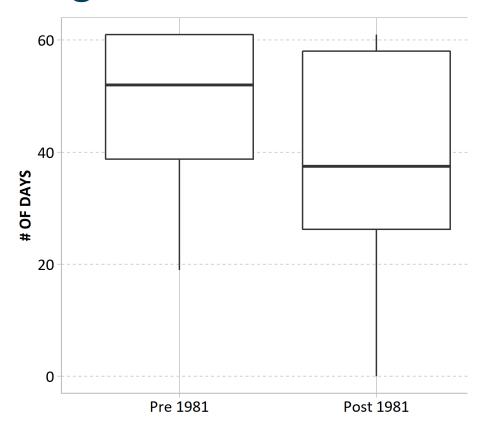
Pre 1981Post 1981

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Nechako Reservoir Elevation Caribou Calving Island Land Links



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Sample Consequences Table

Performance Measure	Period	Location	Units	Preferred	9	Scenari	0
				Direction	Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0
Flushing flows – number of days where flow exceeds 468 m ³ /s	All	Nechako at Vanderhoof	Days Per Year	High	15.2	7.7	46.8
Salmon - Average daily flow	Jul 1 - Sep 30	Nechako at Vanderhoof	m³/s	High	229	176	291
Caribou - Days where reservoir elevation is less than 852 m	May 1 - Jun 30	Nechako Reservoir	Days per year	Low	48.7	38.4	???

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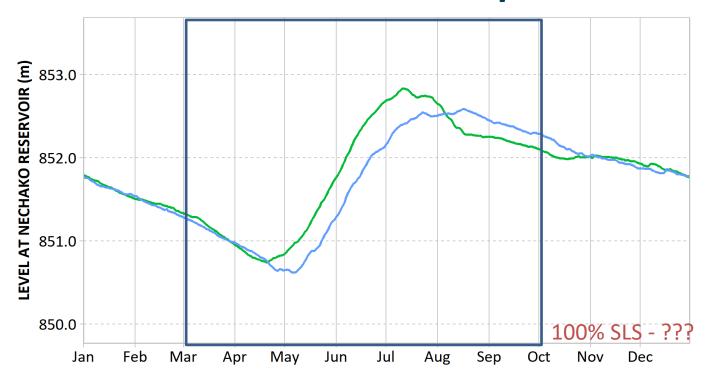
PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change and in

Objective: Maximize access to boat docks and launches

Interim PM – Average reservoir elevation March to October

Nechako Reservoir Elevation Boat Docks and Launches - Comparison

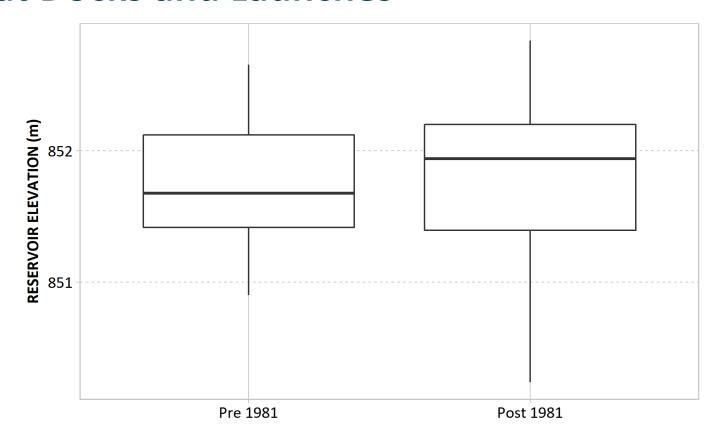


Pre 1981
 Post 1981

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Nechako Reservoir Elevation Boat Docks and Launches



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Sample Consequences Table

Performance Measure	Period	Location	Units	Preferred		Scenari	ost- 100% 981 via SLS			
				Direction	Pre- 1981	Post- 1981				
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0			
Flushing flows – number of days where flow exceeds 468 m ³ /s	All	Nechako at Vanderhoof	Days Per Year	High	15.2	7.7	46.8			
Salmon - Average daily flow	Jul 1 - Sep 30	Nechako at Vanderhoof	m³/s	High	229	176	291			
Caribou - Days where reservoir elevation is less than 852 m	May 1 - Jun 30	Nechako Reservoir	Days per year	Low	48.7	38.4	???			
Boat access - Average reservoir elevation	Mar 1 - Oct 31	Nechako Reservoir	m	High	851.7	851.7	???			

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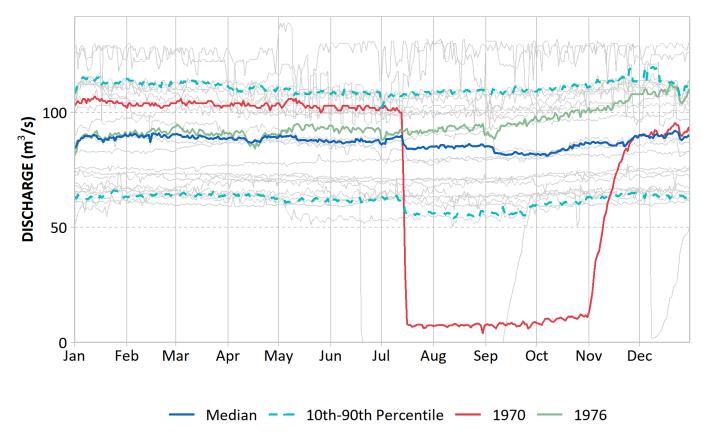
PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change

Objective: Maximize RT power generation

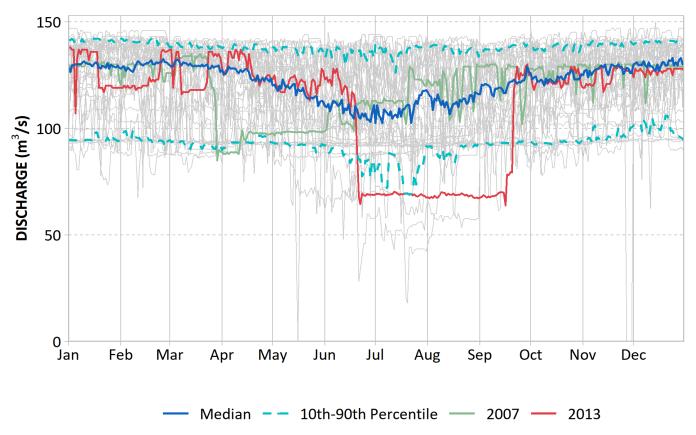
Interim PM – Average daily flow at Kemano Powerhouse

Kemano Powerhouse Power Generation – Pre-1981



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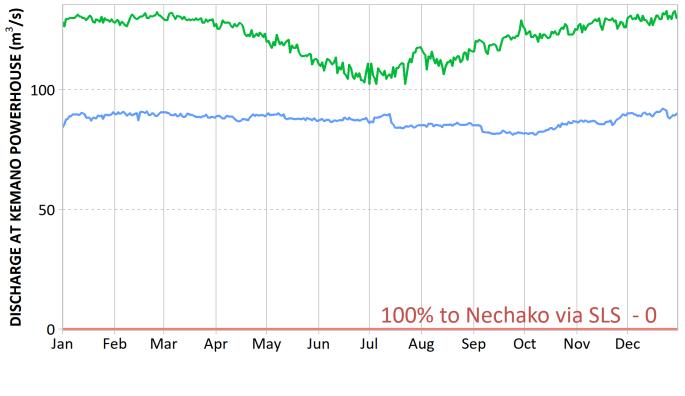
Kemano Powerhouse Power Generation – Post-1981



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Kemano Powerhouse Power Generation – Comparison



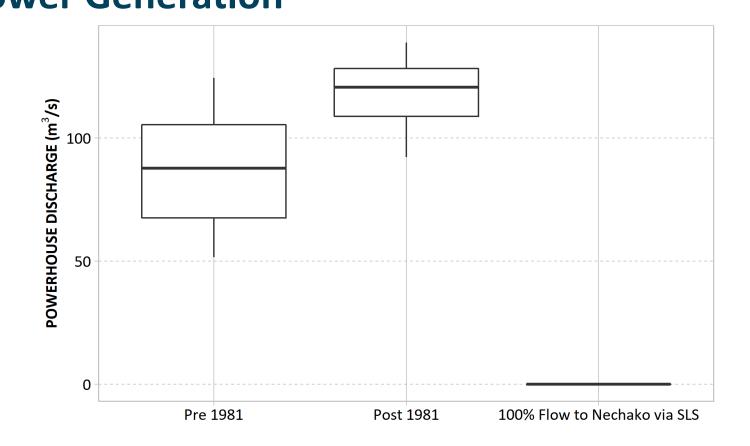
Pre 1981 — Post 1981 — 100% Flow to Nechako via SLS

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Kemano Powerhouse Power Generation



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Sample Consequences Table

Performance Measure	Period	Location	Units	Preferred	9	Scenari	0
					Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	5.3	2.6	31.0
Flushing flows – number of days where flow exceeds 468 m ³ /s	All	Nechako at Vanderhoof	Days Per Year	High	15.2	7.7	46.8
Salmon - Average daily flow	Jul 1 - Sep 30	Nechako at Vanderhoof	m³/s	High	229	176	291
Caribou - Days where reservoir elevation is less than 852 m	May 1 - Jun 30	Nechako Reservoir	Days per year	Low	48.7	38.4	???
Boat access - Average reservoir elevation	Mar 1 - Oct 31	Nechako Reservoir	m	High	851.7	851.7	???
Power Generation - Average daily flow	All	Kemano Powerhouse	m³/s	High	86.4	118	0.00

PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change

Sample Consequences Table Low inflow years

Performance Measure	Period	Location	Units	Preferred	9	Scenario	O
				Direction	Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	0	0	40
Flushing flows – number of days where flow exceeds 468 m ³ /s	All	Nechako at Vanderhoof	Days Per Year	High	0	0	54
Salmon - Average daily flow	Jul 1 - Sep 30	Nechako at Vanderhoof	m³/s	High	110	168	257
Caribou - Days where reservoir elevation is less than 852 m	May 1 - Jun 30	Nechako Reservoir	Days per year	Low	58	53	???
Boat access - Average reservoir elevation	Mar 1 - Oct 31	Nechako Reservoir	m	High	851.9	851.4	???
Power Generation - Average daily flow	All	Kemano Powerhouse	m³/s	High	71	111	0

PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change and in

Sample Consequences Table High inflow years

Performance Measure	Period	Location	Units	Preferred	9	Scenario	D
				Direction	Pre- 1981	Post- 1981	100% via SLS
Flooding - Number of days where flow exceeds 550 m ³ /s	All	Nechako at Vanderhoof	Days per year	Low	45	60	109
Flushing flows – number of days where flow exceeds 468 m ³ /s	All	Nechako at Vanderhoof	Days Per Year	High	62.5	98	119
Salmon - Average daily flow	Jul 1 - Sep 30	Nechako at Vanderhoof	m³/s	High	300	476	637
Caribou - Days where reservoir elevation is less than 852 m	May 1 - Jun 30	Nechako Reservoir	Days per year	Low	53	27	???
Boat access - Average reservoir elevation	Mar 1 - Oct 31	Nechako Reservoir	m	High	852.0	852.5	???
Power Generation - Average daily flow	All	Kemano Powerhouse	m³/s	High	83	119	0

PM values calculated as average over all years of record

Values presented use interim PMs, and are subject to change ————

Sample Consequences Table -

Discussion

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Performance Measure	Period	l Location	Units	Preferred Direction	9	Scenar	io	600
				Pre- 1981		100% via SLS	AT VANDERHOOF (m³/s) 009	
Flooding - Number of days where flow exceeds 550 m³/s	All	Nechako at Vanderhoof	•	Low	5.3	2.6	31.0	DISCHARGE AT VA
Flushing flows – number of days where flow exceeds 468 m³/s	All	Nechako at Vanderhoof	Days Per Year	High	15.2	7.7	46.8	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Salmon - Average daily flow		Nechako at Vanderhoof	m³∕s	High	229	176	291	852.0 ES 852.0
Caribou - Days where reservoir elevation is less than 852 m	May 1 - Jun 30	Nechako Reservoir	Days per year	Low	48.7	38.4	???	AT NECHAKO
Boat access - Average reservoir elevation	Mar 1 - Oct 31	Nechako Reservoir	m	High	851.7	851.7	???	850.0
Power Generation - Average daily flow	All	Kemano Powerhous e	m³/s	High	86.4	118	0.00	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec — Pre 1981 — Post 1981

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