Benefit-Cost Analysis of the Yakima River Basin Integrated Plan Projects

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Legislative charge

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- The State of Washington Water Research Center (WRC) is to prepare separate benefit-cost (B-C) analyses for each proposed project in the Yakima Basin Integrated Plan (IP).
- Use existing studies to the greatest extent possible, supplemented by primary research.
- Focus on benefits from:
  - fish abundance increases,
  - Irrigation water reliability,
  - Municipal/domestic water supply reliability.

FAA as a precursor to WRC study

- The WRC relied heavily on the 2012 Four Accounts Analysis (FAA), which is an indication of its substantial value.
- I thank the FAA research team for their valuable indirect contribution to the WRC study.
- As always in scientific inquiry, we strove to build upon methods and use new data and models when possible, so the studies differ in several respects.

Methods

- Agricultural benefits: Crop-water response model like FAA.
- Integrated hydrologic/climate model (not available for FAA).
  - Three benchmark market regimes.
  - 4 climate scenarios.
- Municipal/domestic benefits: Avoided purchase cost method following FAA, with modification.
- Fish benefits: Fish abundance estimates and valuation methods are the same as in FAA, with some differences in data interpretation and use.

Results overview

- Compare WRC and FAA aggregate results.
- Discuss the source of differences.
- Summary of individual project B/C outcomes.
- Additional detail (time permitting).

Benefits of the IP: WRC and FAA results

- FAA results
  - Agricultural benefits: $800 million.
  - Municipal benefits: $400 million.
  - Fish benefits: $5–$7.4 billion.
- WRC results with moderate climate change & markets:
  - Agricultural benefits: $117 million.
  - Municipal benefits: $32 million.
  - Fish benefits: $1–$2 billion.

Differences: Agriculture

Basic differences: Climate and market assumptions.

- Climate/curtailment assumptions.
  - WRC uses cutailment simulations based on historic climate and 3 climate forecasts.
  - Climate/curtailment models were not available for FAA.
  - Difference in average curtailment reduction due to IP is 8 times higher given FAA assumptions used.
- Market assumptions:
  - FAA relies on arguably restrictive market assumptions in their market analysis.
  - WRC provides a range of potential future market scenarios, ranging from extremely restricted to extremely effective.

Differences: Municipal/domestic

Basic differences: Water prices and their use.

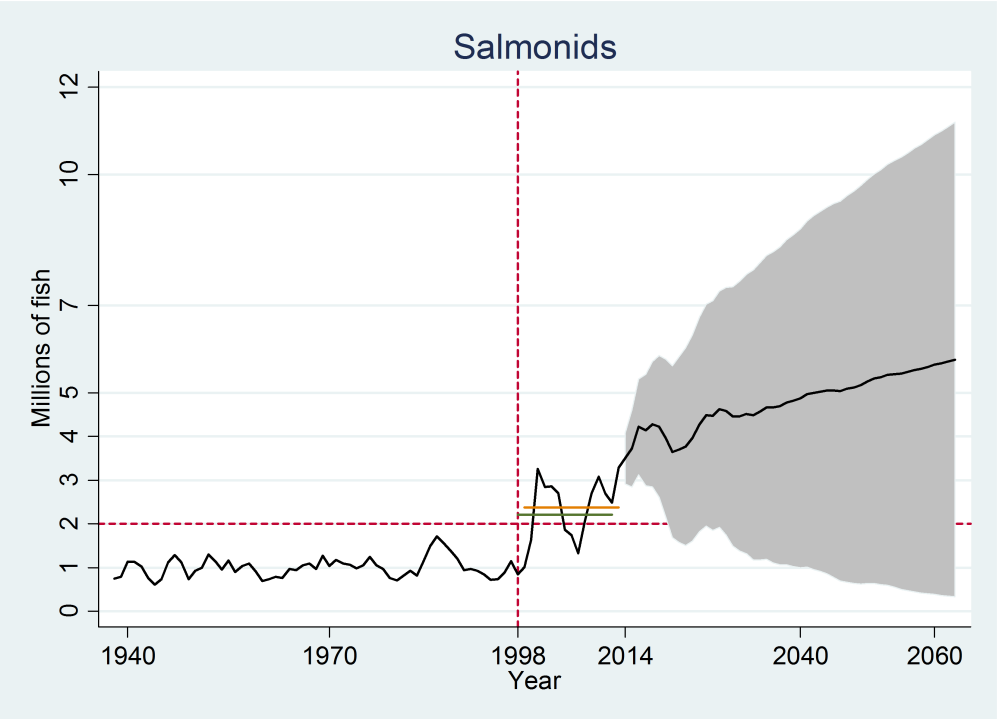
- Water security for existing users
  - We contend that assumed prices are too high relative to market lease prices.
  - FAA Doesn't account for the value of existing junior rights held by municipalities.
- Water for demand growth
  - FAA uses a wholesale water price, but it includes treatment and conveyance costs, accrued regardless of the IP.
  - The opportunity cost of water to agriculture is a more defensible price to use.

Differences: Fish benefits

Basic differences: Fish population growth and baseline fish population assumptions.

- FAA assumptions consistent with long-term fish growth rates of approximately 40%/year.
- Only 14% of populations have growth rates of 5% or more (McClure et al. 2003). WRC study assumes 5% growth.
- FAA assumes flat baseline salmonid populations in the Columbia River.
- The baseline assumption matters a lot economically.

Baseline fish populations



- FAA assumes no increase in Columbia River salmonid fish abundance since 1998.
- Avg. increase from 1998 is $> 200K$ fish (but high variance).
- Baseline & growth rates are the source of difference in results.

Individual projects: summary

- No storage project passes a B/C test as part of full IP implementation.
- Storage projects fail B-C test when implemented alone, with two exceptions:
  - Cle Elum Pool Raise approaches B-C viability *alone* in the most adverse climate scenario.

outdated KKC+KDRPP alone borderline, but with more caveats.

  - New KDRPP costs reported in DEIS almost double: B/C ratios with new B/C ratios max = 0.66.
- Fish passage projects are the most likely to satisfy a B-C test.
- Proposed IP instream flows less costly (based on opportunity cost of ag. water) if purchased than "built" with storage.
- Water market gains from trade are potentially substantial with active market development.

Questions?

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Additional detail: Time permitting

- Interpreting individual project results.
- Out-of-stream benefits
- Instream flow: break even and opportunity costs.
- Individual project net benefits
  - Alone (with no other projects implemented)
  - Implemented along with full IP
- Fish passage
- Instream flows and habitat restoration

Interpreting B-C of individual projects in an IWRM

- One reason the IP is "integrated" is because functionality of one project may depend on implementation of another.
- The WRC was careful to account for these interdependencies to the extent possible.
- Example: The value of a storage project differs depending on whether other storage projects are implemented.
- Results therefore must be interpreted in the appropriate implementation context.

Out of stream benefits

Out of stream benefits of water storage and conservation (incl. municipal). $Millions.

run	Cost	Benefits	Net benefits	B/C
IP, CGCM climate	2,850	123	-2,727	0.04
IP, HADGEM climate	2,850	351	-2,499	0.12

Estimated instream + restoration benefits combined of $50 to $300 million cannot cover these out-of-stream losses of around $2.5 billion.

Cost of purchasing instream flows

The cost of proposed IP instream flows in terms of agricultural production value. Present value, $ millions.

run	Climate	$m	diversion reduction
Base+Instream	CGCM	128	71,604
Base+Instream	HADGEM	490	114,043

Less expensive to purchase instream flows than to "build them" for around $2.5 billion (in terms of opportunity cost of water).

Each project implemented alone. Out-of-stream net benefits.

		moderate climate			adverse climate		
Project	Cost	TB	NB	B/C	TB	NB	B/C
KKC+KDRPP**	334	98	-236	0.29	340	5.5	1.02
CEPR	16	10	-6	0.62	21	5.5	1.34
ASR	126	45	-82	0.35	112	-13.9	0.89
Conservation	257	11	-246	0.04	0̃	-268	0.00
Bumping	452	81	-371	0.18	293	-159	0.65
Wymer	1,331	115	-1,217	0.09	524	-808	0.39

**Outdated. New cost estimates higher.max B/C for KKC+KDRPP is 0.84.

Individual project benefits as part of the full IP, most adverse climate (HADGEM).

Project	NB	B/C
KKC+KDRPP**	-188	0.44
CEPR	-16	0.00
ASR	-19	0.85
Conservation	-243	0.05
Bumping	-348	0.23
Wymer	-1,106	0.17

**Outdated. Now lower.

- Net benefits & B/C ratios lower for other climate scenarios.
- How to allocate instream flow benefits? Difficult to answer, but can't double count.

Potential gains from trade for with and without the IP. $ millions.

run	intra-district	+inter-district	Full trade	Net of TC
Baseline, CGCM	287	153	439	317
Full IP, CGCM	189	110	299	216
Baseline, HADGEM	1,212	787	1,999	1,436
Full IP, HADGEM	946	639	1,585	1,138

Fish passage benefits

Fish passage benefits by reservoir.

	Contribution to total		Cost $mill	Benefits $mill		B/C	
Reservoir	low	high		low	high	low	high
Keechelus	12	16	79.9	114	205	1.43	2.56
Kachess	29	31	79.9	276	495	3.46	6.19
Cle Elum	27	23	81.5	257	461	3.15	5.65
Tieton	13	17	79.9	124	222	1.55	2.78
Bumping	18	14	26.3	171	307	6.52	11.68
Total	100	100	347.5	952	1,706	2.74	4.91