Overview of
Columbia & Kootenay operations

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Columbia River Treaty – why?

U.S.– has flood control needs and large hydroelectric plants
Canada – has good storage dam sites (and flood control & hydro needs)

- Canada has 15% of the basin area
- Canadian basin is mountainous, with much snow … produces 30-35% of the runoff for the entire basin
- During flood times, this can be 50%
- most hydropower production, and need for flood control, is in the U.S.
- best storage dam sites are in Canada

Columbia River – 4th largest in N. America
Duncan (1968)  
Created the Duncan Reservoir

Keenleyside (1969)  
Created the Arrow Reservoir

Mica (1973)  
Created the Kinbasket Reservoir
Major storage licences: Arrow and Kootenay system

- Arrow Reservoir: 7.1 MAF storage (BCH has storage licence)
  - 1446 ft maximum level, but need CWR permission to use top 2 ft (i.e. normal full pool level is 1444 ft)
  - licenced operating range is ~66 ft, but typical annual use is ~30 to 50 ft

- Duncan Reservoir: 1.4 MAF storage (BCH has storage licence)
  - full pool level is 1892 ft
  - licenced operating range is ~98 ft, and this full range is used in most years

- Koocanusa (Libby) Reservoir:
  - 5 MAF storage (no BC water licence)
  - full pool level (specified by CRT) is 2459 ft

- Kootenay Lake: storage licences held by FBC & CPC, power diversion licences held by BCH & others
  - regulated by IJC Kootenay Lk Board of Control (FBC holds Order)
  - behaves like natural lake during freshet period
Arrow reservoir levels, inflows, & outflows
July 2011 to Sep 2012

ARROW
Elevation and Streamflow Hydrographs
July 1, 2011 to September 30, 2012

Drainage Area = 14,100 Square Mile

Maximum Achieved Pool Elevation 1,445.5 Feet

- Flood Control Rule Curve
- Observed Elevation
- Observed Outflow
- Regulated Inflow
- Unregulated Inflow

Peak Statistics
Date - Flow
7/24/12 - 115.15
7/21/12 - 130.89
6/24 - 226.3

Minimum Achieved Pool Elevation 1,402.8 Feet

Columbia River at Arrow Project, British Columbia
Water Use Plans: Columbia & Duncan

Objectives of Water Use Plan process:

• review water licences in light of changing public values and environmental needs
• improve management of BC’s water resources through collaborative review
• all interests represented in the discussion

2001-04: BC Hydro undertook the Columbia & Duncan WUP processes

WUPs resulted in:

• several discharge and reservoir level constraints for Revelstoke and Duncan
• no hard constraints for Mica or Arrow; however some soft constraints were agreed on, and BC Hydro’s commitment to downstream fish protection were confirmed

Numerous monitoring studies and other capital works are now being implemented in addition to the operational changes.

Water Use Plans will undergo regular review
## Issues raised during WUP process (and since)

### KINBASKET, REV & MCR
- Navigation
- Recreation
- Heritage
- Erosion
- Vegetation
- Dust
- Fish (Pelagic)
- Entrainment
- REV Productivity
- MCR Recreation
- MCR Aquatics
- MCR Wetlands

### ARROW
- Navigation
- Recreation
- Heritage
- Vegetation
- Wildlife
- Dust
- Pelagic Productivity
- Entrainment
- Soft Constraints
  - Recreation
  - Fish
  - Heritage
  - Erosion
  - Vegetation
  - Wildlife

### LOWER COL RIVER
- LCR Recreation
- LCR Flooding
- TGP
- Whitefish

### SYSTEM WIDE
- Power (Cost)
- GHG
CRT supplemental operating agreements

If both sides can agree on changes to the default Treaty operation:

e.g.: annual Non-Power Uses Agreement

• adjusts Arrow outflows during Jan-Mar for whitefish spawning, and during April-June for trout spawning (Canadian fish benefit)

• helps smooth the refill of Treaty reservoirs (in Canada)

• enables storage for salmon flow augmentation and helps meet downstream minimum fish flows (U.S. fish benefit)
Duncan reservoir levels, inflows, & outflows
July 2011 to Sep 2012

Duncan
Elevation and Streamflow Hydrographs
July 1, 2011 to September 30, 2012

Drainage Area = 925 Square Mile

Maximum Achieved Pool Elevation 1,892.9 Feet

- Flood Control Rule Curve
- Observed Elevation
- Observed Outflow
- Unregulated Inflow

Minimum Pool Elevation 1794.2 Feet

Peak Statistics
Date - Flow
7/24/12 - 13.01
6/24 - 23.34

Duncan River at Duncan Project, British Columbia
Duncan WUP - issues

Known issues, with performance measures:

- Cultural resource protection
- Fish – in reservoir & downstream
- Flood management & erosion protection
- Power generation
- Quality of life – mosquitoes
- Recreation
- Wildlife – around reservoir & downstream
Kootenay Lake - 2012
Flood control benefits of upstream CRT dam operation
Kootenay Lake – issues

Known issues include:

- Agriculture – diking infrastructure, farming equipment handling, pumping costs
- Cultural resources
- Fish – within lake & downstream
- Flood management & erosion protection
  - Grohman Narrows restriction
- Power generation
- Recreation
- Transportation – ferry navigation
- Wildlife
Columbia River at Castlegar/Trail
Flood Event of 2012

COLUMBIA RIVER AT BIRCHBANK AVERAGE DAILY DISCHARGE
(Brilliant Project + Brilliant Expansion + Brilliant Spill + Arrow Lakes Hydro + Hugh Keenleyside)
Summary 1937 - 2012 (unregulated) & Summary 1964 - 2012 (regulated) and Actual 2012

- Highest pre-dam recorded discharge = 374 kcf/s (10600 m³/s) on 9 Jun 1961
- 2012 calculated peak discharge (no dams) = 365 kcf/s (10340 m³/s) on 26 Jun
- 2012 recorded peak discharge (with dams) = 213 kcf/s (6040 m³/s) on 22 Jul
- Start of major regional flooding, 280 kcf/s (7929 m³/s)
- Start of minor regional flooding, 225 kcf/s (6371 m³/s)
- Start of localized minor flooding, 165 kcf/s (4672 m³/s)
Extra slides
What does the Treaty Do?

- The Treaty required Canada to:
  - construct the Mica, Arrow, & Duncan reservoirs
  - operate these reservoirs for optimum power & flood control in both countries
- Canada did not turn over control of its reservoirs to the U.S.
  Rather, the Treaty requires specific operations under specific conditions.
- The Treaty required the U.S. to:
  - pay Canada 50% of the value of future flood control benefits in the U.S.
  - deliver to Canada 50% of the increased power capability at downstream U.S. plants
- The Treaty permitted the U.S. to:
  - construct and operate the Libby project on the Kootenai River … flooding some Canadian land, but also providing power & flood control benefits for Canada
Treaty priorities for water usage

1. **Domestic & consumptive uses** (e.g. drinking water)

2. **Flood control**

3. **Energy production - firm**

4. **Reservoir refill**

5. **Energy production – non-firm**

Other values (e.g. fisheries, recreation) are not mentioned in the Treaty and are managed by each country
Both countries realize significant flood control and power benefits from the Treaty.

Canada received lump sum payments for its share of the U.S. flood control benefits (to 2024) and for the first 30 years of U.S. power benefits (to 2003).

Canada will continue to receive its 50% share of electricity benefits until at least 2024.

Treaty has a minimum term of 60 years … can be terminated in 2024 by either country with 10 years notice.

Canada must continue to provide some flood protection (“Called Upon”) for the U.S. as long as the dams exist.
Mica (Kinbasket) reservoir levels, inflows, & outflows
July 2011 to Sep 2012

MICA
Elevation and Streamflow Hydrographs
July 1, 2011 to September 30, 2012

Drainage Area = 8,200 Square Mile

- Flood Control Rule Curve
- Observed Elevation
- Observed Outflow
- Unregulated Inflow

Maximum Achieved Pool Elevation 2,476.1 Feet
Minimum Achieved Pool Elevation 2,368.8 Feet

Peak Statistics
Date - Flow
7/27/12 - 58.13
6/25 - 113.41

Columbia River at Mica Project, British Columbia