

COWICHAN WEIR START-UP, OPERATION AND SEASONAL PROTOCOLS

Goals:

1. Maintain full storage behind the weir until July 9th if possible
2. Maintain an optimum 25 cms prior to May 1 if conditions allow
3. Maintain a minimum 15 cms in Cowichan River prior to June 15
4. Maintain a minimum 7 cms from June 15 to end of weir control period typically around Nov 1

Note: There may be provisions for possible spring and fall pulse flows for fish conservation.

A) Weir Startup Considerations:

1. Do not start-up weir earlier than Feb 28th due to the risk of a “rain on snow” flood event.
2. Schedule initial spring meeting to discuss/determine weir startup at 162.6 m GSC declining lake level which allows about 10 days before crest of weir is reached – avoid going below the crest.
3. Avoid lake level dropping below crest of weir in a year with below normal snowpack by April 15
4. Review snowpack level (currently measured at Jump Cr. – Nanaimo watershed) and assess prediction of snow water inflows to Cowichan (not currently available)
 - a. Note: Estimated that about 10 to 20% of total inflow to the lake from April to June 30 is contributed by snowmelt runoff, the remainder is precipitation
5. Review likelihood of precipitation
 - a. Early spring vs. late spring – likelihood of late spring rainfall vs. risk/cost of early start-up (cost to man and operate weir, risk of impact to fish resource of less than 15 cms flows)
 - b. Weather forecast and long range precipitation/inflow trends

B) Weir Start-up Triggers:

Start up weir if either of the two triggers below are met.

Trigger #1: There is low snowpack, the lake level is at the crest of weir at 162.37 GSC m, and it is past Feb 28th

OR:

Trigger #2: There is average snowpack and the lake level is 17 cm below the weir crest (162.20 GSC m).

Note: Trigger #2 is based on a rule curve of 25 cms to May 1, 15 cms to June 15, then 7 cms to season end – ie. a rule curve that improves the ability to rebuild and sustain storage to July 9th and recapture of occasional summer season precipitation inflows.

C) *Weir Start-up Ramp-down Protocol (Run of river to 25 cms)*

* Catalyst Paper will issue one press release for the entire weir operating season, and carry out pulse(s) in-season as directed by MOE.

* River flows will be measured using the Catalyst Paper static gauge and can be cross checked with Water Survey of Canada on-line automated Cowichan Lake river gauge.

Assessment Notice: Starting in 2006, an examination of the two tier spring river minimum flow (25 cms and 15 cms) will be done with the view that in drought situations, one tier 15 cms may be used to conserve storage. Significant fish conservation and sport fishery impacts may or may not occur based on the study's findings.

Weir Start-up Protocol:

- 1) Close boat lock over the course of half a day. (This will drop river flow typically from run of river 48 cms to 45cms over 48 hours, however, river flow will recover to run of river flow again as velocity of flow through the 4 spill gates increases to compensate for the Boat Lock closure).
- 2) Make no adjustments to spill gates for 2 days after the Boat Lock is closed.
- 3) Natural uncontrolled river flows >30cms need to be ramped down slowly as would occur when a high pressure system prevails – reduce the river flows no more than 3 cms/day and gradually adjust flows down to maintain 25 cms until May 1.

D) *First Spring Ramp-down Protocol: (25 cms to 15 cms)*

On April 28 (3 days ahead of the May 1 rule curve minimum target of 15 cms to allow for a gradual decline), start reducing the river flow from 25 cms to 15 cms by gradually closing the spill gates to achieve a river flow reduction rate of no greater than 2 cms/day.

E) Second Spring Ramp-down Protocol: (15 cms to 7 cms)

This is the most sensitive fisheries period when flow ramping must be gradual due to side-channel stranding of salmonid fry, juveniles and alevins still in the river gravels.

1. An acceptable ramp down rate if conservation of storage need is urgent: June 13 to June 17, reduced by 2 cms per day.
2. An ideal ramp down rate is over a longer period from June 11 to June 19, with a reduction of flow by 1 cms per day.
3. In ideal conditions, ramp down only at dusk or at night to minimize stranding risk of newly emerged fry.

F) Spring Spilling Protocol (if required): Prior to July 9

If, after going on control, but before June 15 (the beginning of the summer river rule curve flow of 7 cms), the lake level begins to approach Full Storage Level (FSL) due to increasing inflows, open the spillgates to spill water and maintain the lake level as close to FSL as possible, without going more than 15cm above FSL.

As the lake level approaches FSL, begin increasing the river flow gradually by up to 5 cms/day, as required to meet the target FSL of 162.38 GSC m (maximum 162.53 GSC m). Continue operating the spillgates to achieve inflow = outflow and a target FSL lake level until June 15. This will be a balancing act as inflows into the lake (snowmelt and precipitation) vary depending upon the weather.

G) Summer Maintenance Flows June 15 – Fall (7 cms)

Maintain 7 cms throughout the summer period

H) Falls pulse flows: (7 cms to 18 cms) Sept 17 to Oct 11

Pulse flows released at the weir in the fall are a conservation measure used to stimulate chinook upstream migration from the estuary.

1. Trigger for a pulse flow is based on available storage and lake level. If lake level is below the rule curve, a decision may be made not to initiate a pulse flow, or it may be initiated based on an acceptable probability of rainfall.
2. Optimum pulse flow conditions
 - a. Fishery is closed.
 - b. Timing window set by fisheries management committee
 - c. Pulse window: Sept 17 to Oct 11

- d. Optimum flow pulse is 18 cms (maximum for counting fence is 22 cms, maximum for Somenos backwatering/agricultural constraints is 24 cms)
 - e. Ramp-up from 7 to 18 cms over 6 hours, hold for 30 hours, ramp down from 18 cms to 7 cms over 12 hours)
3. Backwatering affect into Somenos sub-basin does not begin until flow exceeds 24 cms – therefore this is not a constraint to pulse flows.
 4. Process for obtaining a pulse flow(s):
 - a. The fisheries management committee will discuss and agree on pulse size and release timing.
 - b. One week in advance of pulse, a request is to be co-ordinated by a DFO stock assessment staff member to Catalyst Paper, and then reviewed/approved by MOE's Water Stewardship Division based on criteria above,
 5. Using the Water Survey Canada online river flow measurement at Lake Cowichan and at the Silver Bridge in Duncan shows that a pulse at the weir in Lake Cowichan takes about 12 hours to reach the estuary.

1) End of Year Weir Shutdown

1. Target the shut down of weir operation for on/about Oct 31st, providing the lake level remains below the crest of the weir. The weir's operation in the fall assists the Canada/US International salmon counting fence with a target river flow of 20cms. These flows also assist Somenos Basin agriculturists. Weir shutdown and flow ramp-up to be co-ordinated so that the counting fence is removed from the river in advance of opening the weir's gates.
2. If lake level has not reached the crest of the weir, maintain weir operation into November until fall rains begin to rebuild storage.

When going off control, the ramp-up flow rate will depend on the current flow, as it is the difference between current flow and “run of river” that will determine the ramp-up rate strategy. If the current flow is low (ie. 20 cms as the weir has been maintained in support of the fish counting fence operation and agricultural constraints in Somenos), then ramp up will be longer (over 5 days). If the current flow is high (~40 cms) ramp-up can proceed faster (approx 2 days) to run of river at which time the weir can be shut down for the season.

At an approximate flow about about 57 cms, it has been noted that the weir's spillgates do not dictate river flow but rather it is the pinch point downstream of the weir which controls the flowrate in the river.

Catalyst Paper Cowichan Lake level and Cowichan River flow data, Jump Creek snow pack and Duncan weather forecast available at:

http://www.catalystpaper.com/communities/communities_crofton_results_waterlevel.xml

On-Line Water Survey of Canada (Cowichan River at Lake Cowichan (discharge and temp.))

<http://scitech.pyr.ec.gc.ca/waterweb/formnav.asp?lang=0>

J) Other information

River kayaking is negatively impacted at flows below 7 cms. At around 6 cms it is still navigable but bumpy. At 5 cms or lower, it is very bumpy and tours may be cancelled at these kind of low flow rates.

The District of North Cowichan operated “Joint Utility Board” sewage lagoons in Duncan require a 40:1 dilution ratio, which equates to a minimum Cowichan River flow requirement of 5.1 cms (downstream of the Silver Bridge).

Broodstock collection typically occurs starting September 1 until the end of October. The fishing crews can safely handle a maximum flow of 18 cms.

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Also, with input from Craig Sutherland, UMA Engineering

L) Revision History

Revision Date	Change	Acknowledgements
May 12, 2008	Addition of spring spilling protocol	Michelle Vessey
Oct 17, 2008	Broodstock max flow restrictions	Michelle Vessey
Oct 21, 2008	Infor re: downstream pinch point at 57 cms added	Michelle Vessey

Appendix 1

Minimum Cowichan Lake Levels required to achieve various river discharges – provided by Craig Sutherland, UMA Engineering

These are for "uncontrolled" conditions with the boat lock closed and the gates fully open. Also included are daily lake level drops for the various discharges. These assume constant flow for the 24-hr period and zero net inflow (lake inflow = lake evaporation).

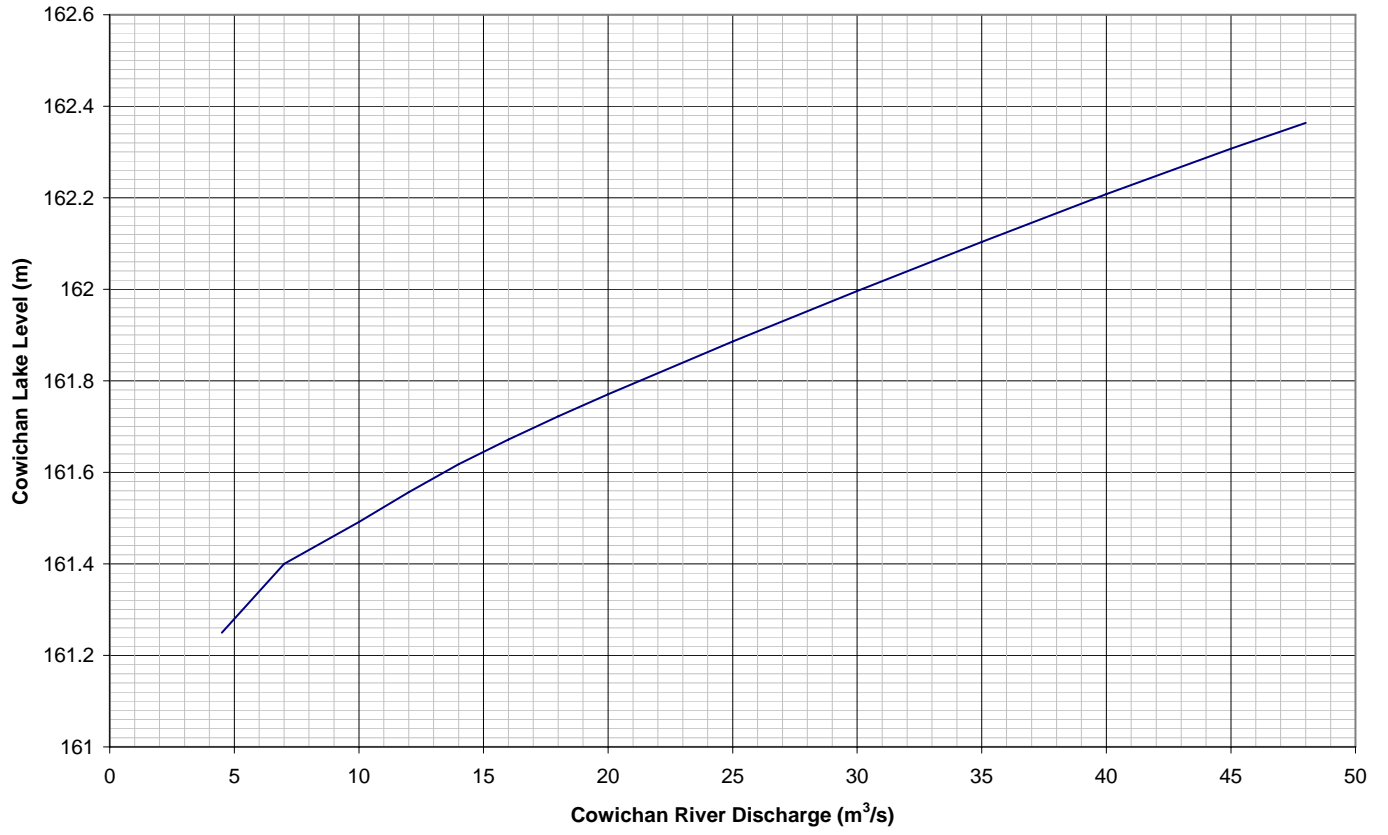
Cowichan Lake Level versus Cowichan River at Lake Cowichan Discharge

Discharge (m ³ /s)	Minimum Lake Level ¹ (m)	24-hr Volume (million m ³)	24-hr Lake Level Drop ² (cm)
4.5	161.25	0.39	0.6
7	161.40	0.60	1.0
10	161.49	0.86	1.4
12	161.56	1.04	1.7
14	161.62	1.21	2.0
16	161.67	1.38	2.2
18	161.72	1.56	2.5
20	161.77	1.73	2.8
25	161.89	2.16	3.5
30	162.00	2.59	4.2
35	162.10	3.02	4.9
40	162.21	3.46	5.6
45	162.31	3.89	6.3
48	162.36	4.15	6.7

Note: 1 - Minimum Lake level at which discharge can be released (equivalent to Zero Storage Elevation)

2 - Drop in lake level assuming constant discharge during the day and zero net inflow (ie: Inflow = Evaporation)

Cowichan Lake Level versus River Discharge



Appendix 2

From: Wightman, Craig ENV:EX [mailto:Craig.Wightman@gov.bc.ca]
Sent: Wednesday, October 11, 2006 12:26 PM
To: Sutherland, Craig; XT:Harper, David Westland Resource Group EAO:IN; TuttyB@pac.dfo-mpo.gc.ca; Vessey, Michelle (Crofton); Tom Anderson
Cc: Ptolemy, Ron ENV:EX; McCulloch, Mike ENV:EX; Harlan Wright; kpellett@bccf.com
Subject: Proposed Cowichan River Rule Curve Changes

Based on direct field observations by fisheries technicians of the BC Conservation Foundation this past spring, we are prepared to make several recommendations with respect to the "rule curve" governing flows downstream of the Catalyst Paper Corp. weir. These are predicated on observations of side-channel connectivity and wetted perimeter of steelhead spawning areas at sites above/below Skutz Falls. Observations were carried out from April 8-13 at 50.5cms; May 24 at 26.5cms; June 19 at 21.5cms; and, June 21 at 15.8cms. The BCCF report is now in a second draft which we hope to finalize by early November.

Existing "rule curve" conditions:

- (1) When lake under weir control, maintain minimum of 25cms until May 1;
- (2) When lake under weir control, maintain minimum of 15cms from May 2 to June 15; and,
- (3) When lake under weir control, maintain minimum of 7cms from June 16 until lake storage is replenished by fall rains and weir is deactivated for the season.

Proposed rule curve amendments based on 2006 field observations:

- (1) Maintain minimum of 20cms and optimum of 30cms until May 1;
- (2) Maintain minimum of 15cms and optimum of 30 cms from May 2 to June 15; and
- (3) Maintain minimum of 7cms from June 16 until lake storage is replenished by fall rains and the weir is deactivated for the season.
- (4) In severe droughts, reduce incrementally to 4.5cms when storage will not support 7cms target.
- (5) In very wet summers, increase incrementally to 9cms (or more) to maintain target storage levels relative to peak lakeshore property use.
- (6) Pulse flows for chinook salmon migration in late September and mid-October will be dependent on lake inflow/storage conditions annually.

Rationale:

Observations by BCCF and testimonials by licenced freshwater angling guides this past spring have reinforced the 30cms "optimum" for spawning by steelhead/rainbow trout and side-channel connectivity throughout the river's length. The 30cms also provides excellent angling and drift boating conditions for guides and clients, and is probably well-suited for kayaking as well.

However, in dry springs with low-negligible snowpack, it may be prudent to go "on control" earlier than May 1 to ensure there is enough storage in the lake to meet the rule curve minimums. Observations indicated a minimum flow of 20cms prior to May 1 is sufficient to keep mainstem spawning riffles largely wet, and most side-channels connected with "adequate" wetted widths.

If low lake inflows are forecast, going to 20cms before May 1 could pay dividends by forcing steelhead/trout to spawn in more central areas of the mainstem's cross-section, where redd desiccation is less of a threat later as flows decrease. For the record, spawning by winter steelhead can start in late January and extend until mid April. Peak spawning probably varies somewhat between years depending

on water temperature trends, but likely occurs in March. A large number of adfluvial rainbow trout also migrate from Cowichan Lake in the early spring to spawn in the upper river (mainly upstream from 70.2 Mile Trestle). Peak spawning by these fish is likely mid-March to early April. Most (if not all) steelhead and trout fry emergence is complete by June 15, based on field observations and calculations of Accumulated Temperature Units from the time of initial egg deposition (354 ATU's to 50% hatch for steelhead/rainbow trout; Clarke 1997). Hence, ramping to the 7cms summer minimum can safely occur after June 15 following the spring protocol below:

Spring Ramp-Down Protocol - 15cms to 7cms (Ramping Protocol Sub-Committee, March 9/06)

1. Acceptable ramp-down rate if conservation of storage is urgent: June 13 to June 17, drop flows by 2cms per day.
2. Ideal: June 11 to June 19, drop flows by 1cms per day.
3. Ideal: Ramp only at dusk or at night to minimize stranding risk of newly emerged fry.

A minimum of 15cms from May 2 to June 15 is considered critical for maintaining some flow (i.e., 10-15% of what was observed at a river discharge of 50.5cms) in moderate-sized side-channels, and in providing reasonable riffle coverage for successful fry emergence. 15cms is not as good as the 20cms "threshold" described above, but would be acceptable given the need to maintain lake storage for later release during forecasted dry summer and early fall conditions.

I may be prudent to have the CBWMP Steering Committee meet to discuss these recommendations or arrange a conference call for next week. It would be also useful to have the "20cms minimum before May 1" recommendation modelled in terms of its possible contribution to meeting the other conservation flow objectives outlined above.

Craig.