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Attention: Dave Lasser, RPF, Operations Manager
Glen Bonderud, Chair, Board of Directors, Sunshine Coast Community Forest

Re: **Response to: Withholding Water flow Science in the Wilson Watershed – an examination of the Sunshine Coast Community Forest's Wilson Creek Watershed Assessments (2010-2012)**

This is in response to the above commentary by a member of the public that you forwarded to me on April 18, 2015. I refer to it herein as the Koop document. The date of the document is March 15, 2015.

The Koop document comments on the regulatory regime and Sechelt Community Projects Inc. (SCPI) business practices. My response is confined to the remarks he made on my report.

GENERAL COMMENTS

The Koop document focuses on Equivalent Clearcut Area (ECA) and planning-level preliminary indicators but gives no attention to field investigation of sediment sources, riparian condition or stream channels. This is odd, given that the value of concern to the Wilson watershed assessment is fish habitat. The Koop document does not demonstrate any understanding of physical watershed processes and their effects on stream channel condition or water quality. It does not discuss landforms, terrain behaviour, stream channel types, fluvial processes or channel sensitivity – essential components of any assessment of watershed condition and particularly one evaluating fish habitat; yet it declares that the watershed is "hydrologically unstable" and "in a state of stress" without any field examination of physical conditions. It makes definitive statements about watershed condition on the strength of small maps with most of the detail blotted out. It extracts information incorrectly from key references (TR032).

From the title it purports to examine "water flow science" but makes no mention of weather data, hydrometric data or climate trends relevant to the Wilson watershed – the most fundamental information for any understanding of "water flow science".

Appendix A purports to be a "primer" on Equivalent Clearcut Area. Despite the considerable length, it is incomplete as a literature review, relies on out of date information in Forest Practices Code guidebooks, misses many recent publications, and includes lengthy extracts from studies in the Interior that are not applicable to coastal watersheds. A reader would be well advised to disregard this appendix and look to more accurate, current and credible summaries of the state of the science.

My comments on specific statements in the Koop document follow.

RESPONSE COMMENTS

Some of the same statements are repeated multiple times in the document. Rather than follow the Koop document sequentially, I have grouped the comments to avoid repetition.

Equivalent Clearcut Area (ECA) value for Wilson watershed

Koop page RS-4: "Though Horel's watershed assessment (2012) fails to provide a hydrologic recovery ECA percentage grade for the Wilson watershed…"

Koop page RS-7: "The most likely reason why SCPI's second Wilson Creek Watershed Assessment of August 2012 failed to provide a science-based figure representing the state of hydrologic recovery is because it would have resulted in a cessation of logging for an undetermined period of time

Koop page RS-8: "SCPI's term of choice – perceptions – is a loaded word that explains why a concluding figure on the state of hydrologic recovery remained undisclosed in the August 2012 Wilson Creek Watershed Assessment.

Koop page 71: "The August 2012 Watershed Assessment report by G.M. Horel Engineering Ltd. concludes by way of vague, conditional language that the Wilson watershed has a "*high potential for hydrologic change.*" However, the Horel report, unlike the 2010 Dobson report, fails to interpret the hydrologic recovery data by way of a concluding figure, thereby avoiding a final prohibitive recommendation to SCPI about future logging: i.e., if it had been found and stated that the Wilson watershed has an Equivalent Clearcut Area (ECA) rating of about 50 percent or more. The forest hydrology literature suggests that a logging threshold for a small, sensitive salmon bearing watershed, such as the Wilson watershed, ranges from 20 to 25 percent of total disturbance."

Koop goes on to compare the Wilson Creek watershed assessment to a 2008 watershed assessment by Bill Grainger, P. Geo. for Chase Creek in the Interior.

ECA for the watershed is not "undisclosed". Table 5, page 12 in my report gives Equivalent Clearcut Area (ECA) percentages for each elevation band and for the total watershed (47%). Map 4 displays hydrologic recovery ranges spatially in the watershed. Table 4, page 11 gives the distribution of forest age ranges in the watershed. Together these illustrate the character of the forest as it is relevant to watershed assessment.

Page 12 of my report contains the following statement: "These ECAs indicate an overall high potential for hydrologic change." What that means is that field investigation is warranted to look for effects on stream channels of possible increased stream flows; and on other watershed processes such as erosion and terrain stability, of possible increased runoff. Subsequent sections of my report go on to describe these specific watershed processes and my findings.

As to the logging threshold, the ECA threshold above which peak flow change may start to occur is different for each watershed. The magnitude and significance of the peak flow change depends on watershed characteristics. Neither hydrologic recovery nor ECA is an indicator of the health of a watershed, as pointed out in the Forest Practices Board investigation into community watersheds (FPB/SIR/40, April 2014). Once we have arrived at an ECA figure for the watershed, we then look at physical watershed conditions to check for possible effects of increased runoff and stream flows.

We look <u>in the field</u> for evidence of channel scour, and increased sediment and debris transport. Are the stream channels erodible? If so, are they exhibiting signs of increased erosion? On floodplains and alluvial fans we look for evidence of increased channel instability and lateral migration. On steep slopes we look for increased landslide occurrence in logged cutblocks. We look for increase rates of erosion in road ditches and at culvert outlets, and sediment transport to streams.

In short, we look for evidence <u>in the field</u> that roads and harvest levels are having an impact on physical watershed processes and stream channel conditions; we consider the values that could be affected by these changes; and base our recommendations on what we find.

The Koop document contrasts my report with Mr. Bill Grainger's report in Chase Creek in the B.C. Interior. The comparison is not valid. Interior watersheds have completely different peak flow regimes than coastal watersheds. Interior forests have different characteristics than coastal forests.

Harvest restrictions

Koop page RS-3: "…It failed to provide an itemized polygon reference map (though partly completed as Map 4) and associated statistical tables to pinpoint the physical locations and detail the many components behind the hydrological state of the Wilson Watershed. Such standardized complex data is used to calculate hydrological thresholds, and <u>is the basis for a final recommendation on whether or not logging can continue."</u>

Koop page 56: "Following a 'key finding' comment in the Horel report on page 25 – "ECA's in Wilson watershed are high" – why is there no final recommendation in the 2012 Horel report prohibiting future harvesting in the Wilson watershed based on a current and thorough Wilson watershed tree height inventory on hydrologic recovery?"

Final recommendations for watershed management are not made on the basis of a compilation of office data, or on a numeral value of ECA.

Recommendations for rate of cut or harvest limits in watersheds may be made following a synthesis of information gathered from both office information (spatial data, imagery) and a field investigation of sediment sources including landslides and erosion; riparian condition; channel sensitivity and current trend (for example, if still unstable or recovering from legacy impacts); other sensitive features such as alluvial fans or floodplains exhibiting instability; and the type and possible scale of effects on values of concern. Depending on the outcome of this synthesis, the recommendations may have no specific harvest limits; or harvest limits over an entire drainage; or limits in certain areas such as steep slopes prone to landslides.

Recommendations on harvest restrictions would not be made purely on the basis of an ECA value, no matter how rigorously the tree heights were measured. Hydrologic recovery is only one component of a watershed assessment; every watershed is different and a thorough assessment must consider all aspects of physical watershed processes.

In the case of Wilson watershed, an assessment of stream impacts must consider not only the forest lands but also the more pressing threat to stream channels and fish habitat in the non-forest development in the lower watershed (where the greatest extent of channel disturbance has occurred).

ECA by land tenure

Koop page 33: "Though general land ownership statistics are provided in Table 9 and Figure 19 of the Horel report, there is no further breakdown analysis of these statistics. For instance, the total area in hectares of the upper private forest lands are not identified, making it impossible to understand the statistical relationship of private and Crown total forest cover in the Wilson main stem basin (see below), and the relationship of those private lands to the entire Wilson watershed. The same is true of the lower private managed forest lands that make up a large proportion of the East Wilson sub-basin. After all, ECA and hydrologic recovery analysis is all about crunching numbers and issues thoroughly, accurately, and transparently."

Parsing out ECA by land tenure as opposed to drainage unit has limited utility where land tenures do not follow drainage divides. ECA only has relevance within a total drainage area upstream of a selected point of interest.

Hydrologic recovery and ECA are determined by calculation. Caution must be applied when interpreting any numerical indicator that represents a physical process, especially in a complex system such as stream flow response in a watershed.

Koop alteration of Map 4

Koop page RS-4 – RS-6: He describes my Map 4 as having a "confusing medley of colours depicting interpretation of hydrologic recovery stages in terms of forest age and height"; and provides 2 maps that are modifications of my Map 4 to blot out the colour polygons with less than 70% hydrologic recovery.

He doesn't understand the recovery ranges?

Koop page RS 6: "The evidence, as depicted from Horel's findings on the map to the left (black dots and white zones within the red watershed boundaries), clearly shows that the Wilson Creek watershed is in a state of hydrological stress and needs to recover from past logging."

The Koop document uses terms like "hydrologically unstable" and "hydrologically stressed" but does not describe in what manner this "stress" and "instability" is manifesting; and makes no connection to stream condition. An assessment of the state of a watershed and the physical processes that determine its condition cannot possibly be made from a glance at a small map with most of the information blotted out. This blotted out map on page RS-6 (repeated from maps on pages 67-68) doesn't "clearly show" anything.

Calculating hydrologic recovery

Koop page RS-6. "According to a 2007 technical report (TR-032), which Horel co-authored with BC hydrologist Robert Hudson, 90% hydrologic recovery is equivalent to forest stands having reached 20 metres in height (information which is not stated or revealed in the Horel report.)"

Koop page 32, referring to TR032: "….where a 20 meter tree height is equivalent to about 90% hydrologic recovery".

Koop page 56: "Are the Hudson and Horel modelling assumptions in their 2007 TR-032 report reliable, whereby a 20 metre benchmark is the correct assumption of tree height for interpreting an early 90% stage of hydrologic recovery for logging clearcut sites on the South Coast of BC?"

That is quoting incorrectly from TR032**.** TR032 does not say that 90% recovery at 20 m stand height is a benchmark for hydrologic recovery on the south coast of BC. The 90% recovery at 20 m height was for a particular scenario analyzed at the Gray Creek research site. A 20 m stand at a different elevation could have a different hydrologic recovery value.

In the TR032 recovery curves there is no unique value of hydrologic recovery for an individual stand height. For a given stand height, recovery depends on where it is in the watershed (rain, rain-on-snow, snowpack), the elevation, the design storm, and the snow thresholds (if in the rain-on-snow or snow zone).

"Hydrologic recovery" is it is used here, in TR032 and generally in the research literature in B.C is the extent to which a regenerating stand compares to a reference stand , typically old growth, with respect to rainfall interception and snowpack recovery. At a certain stage, the canopy of second growth stands becomes denser than that of old growth stands and intercepts more rain. Stands at this stage are considered "over-recovered". Forest canopy characteristics are different in high elevation stands than in low elevation stands; hence, the shape of the recovery curves are different. Trees cannot begin to influence snowpack accumulation until they are higher than seasonal snow pack depths. Once trees are above the seasonal snowpack depth, they begin to affect snow depth quite quickly. There is no over-recovery effect with respect to snow accumulation.

To account for these different stand behaviours, TR032 has separate recovery curves for the rainfall zone, the rain-on-snow zone and the snow zone. In the rainfall zone, rainfall interception depends on the size of the storm as well as the height of the stand. In small storms on a dry canopy (such as a summer rainfall), a large percent of the rainfall may be intercepted in the canopy. In large winter storms on a wet canopy, most of the rainfall will go through the canopy. Thus, the hydrologic recovery for these two scenarios is different. In the TR032 methods, calculation of hydrologic recovery in the rainfall zone requires selection of a design storm to calculate the over-recovery effect.

In the snow zone, recovery depends on the depth of snowpack. This varies with snow zone and elevation, because snow depth varies with elevation.

Recovery in the rain-on-snow zone is calculated by blending the equations for rainfall recovery and snowpack recovery. The blending is factored to account for increase in the snowpack component with increasing elevation.

In the Wilson watershed (Regional Snow Zone 4), and accounting for over-recovery for the rainfall component with the design storm selected, 90% hydrologic recovery occurred as follows:

Rainfall zone (<300 m): 90% recovery at 21 m
Rain-on-snow zone (300-900 m): 90% recovery at 16 m (this is average: recovery varies with elevation in this zone)

Snow zone: (>900 m): 90% recovery at 11 m (also assuming an average snowpack depth).

In TR004, TR027 and TR032 the recovery equations are based on data from coastal research sites (including Gray Creek).

Watershed hydrology and hydrologic recovery is a specialized discipline and is an area of emerging science. As of my Wilson Creek report, TR032 represents the best available science for determining hydrologic recovery in coastal watersheds. It is quite likely that, as the science advances, new or revised methodologies will be developed in future for refining hydrologic recovery curves and for examination of more and different scenarios.

Koop page 43: "…without first reading, and then understanding, a highly technical and complicated TR-032 report, the reader will not understand what guides the underlying assumptions and findings concerning hydrologic recovery and ECA's in the August 2012 Horel report, which in turn fails to summarize or describe for the reader how the information from TR-032 is being applied.

Much of the scientific literature on hydrological recovery is highly technical. Any qualified professional with expertise in watershed analysis would be able to read and understand TR032 as the basis for my hydrologic recovery computations. Koop's errors in extracting information from TR032 show the dangers of pulling information out of a scientific source without sufficient expertise to understand the material.

Koop page 32: "In her assessment (discussed below), Horel unexplainably uses a new determination, using 300 – 900 meter, and > 900 meter elevation bands to interpret ECAs."

There are 5 regional snow zones delineated for the west coast, based on rather limited snow course data. See TR004. These are broad regional zones. Snow zone 1 is the wettest. Snow zones 4 and 5 are the driest, with the least snow. Wilson watershed is in snow zone 4.

The actual extent of the transient snow zone (the rain-on-snow zone) in a particular watershed will vary depending on the proximity to the ocean, predominant aspect of the watershed and local weather patterns. It will also vary year to year depending on the phase of the climate cycle and weather conditions during that year.

In our discussions, Dr. Rob Hudson indicated (personal communication) that he felt that the transition elevation (rain-on-snow to snowpack zone) may be more typically 900 m for Snow Zone 4 and 1000 m for Snow Zone 5. Since the full extent of Wilson watershed is in close proximity to the ocean and the predominant aspect is southwest, I chose to use 900 m as the transition elevation.

This increases the extent of the zone that has a rainfall component of recovery. Because rainfall recovery is initially slower, using 900 m instead of 800 m is more conservative; that is hydrologic recovery is less for rain-on-snow than for just snow.

Koop page 32: "Though not explained in Dobson's report, he adopted the 2007 methodologies and findings of the Hudson/Horel TR-032 report in his application of ECA's. Those findings include the following two methodologies:…" in reference to Dobson's legend for regeneration height: <3 m, 3-<5 m, 5-<7 m, 7-<9 m, >9 m etc.

These height/recovery categories are not from TR032, and are not represented by Dobson to have come from TR032. These tree height categories and the associated recoveries are from CWAP/IWAP 1999 (and the earlier 1995 version) and are a very simplistic method but still in common use. As discussed above, the recovery curves in TR032 and associated factors used to calculate hydrologic recovery are more complicated and include design storms for over-recovery for the rainfall component; and consideration of snowpack depth for the snow component.

Using old growth vs second growth as reference stand for hydrologic recovery calculations

Koop page 46: "Of note in the 2003 Hudson report, the author hypothetically challenges the criteria and relationship to "old-growth" as being / having the reference or threshold goal for hydrologic recovery: *It has been shown that old growth might not always be the most appropriate reference stand to use as a benchmark against which to measure recovery.*

In selecting whether to use a recovery curve based on old growth (most common) or second growth, one needs to consider whether the hydrology of the drainage unit has made a long-term re-adjustment to a second growth forest: That is to say, whether the condition of the stream channels now reflects an established condition under the altered hydrologic response. If watershed response is still in transition from old growth forest conditions to second growth forest conditions then the old growth reference is likely more appropriate. I judged that to be the case in Wilson watershed and so I used the recovery curves referenced to old growth.

It also depends on what question is being asked. Hudson's research suggests that the over-recovered state is likely to contribute to reduced summer low flows because of increased evapotranspiration in the denser second growth forest. If one is comparing the effects on low flows of a second growth forest to the pre-disturbance condition, then the old growth reference would be selected even though the hydrological response to a second growth forest may have stabilized.

Logged blocks taken into account in ECA

Koop page RS 6: "As shown, a percentage of both medium and dark green areas (90-100% recovered) have since been logged (black dots) following the release of the August 2012 Horel report (which relied on 2009 imagery), significantly reducing her estimated hydrologic recovery zones of 90% or greater."

Koop page 54 and 55 – in reference to ortho images overlaid by hydrologic recovery polygons:
"EW002, recently logged, is drawn overtop of area in Horel report now incorrectly identified as 70-90% and 100% hydrologically recovered"
"The solid yellow line hatched areas are the 4 cutblocks logged by SCPI, two of which have different or zero hydrologic recovery ratings than those shown in the Horel report: the Horel recovery percentages need to be reviewed."

With respect to the yellow hatched areas shown on Koop's ortho maps, my 2012 report included blocks that were logged up to the time of my assessment. Blocks that had not been logged at the time of my assessment were not included in ECA's. I used 2009 and 2010 imagery. Blocks that were logged after the imagery, up to the time of my report (2012), were added in to the harvest areas in calculating hydrologic recovery and ECA. These show as zero ("0") recovery on Map 4 in my report.

Block EW011 and the east part of EW0080A had been logged but do not appear on the ortho because they were logged after the date the imagery was flown. These blocks are included in the ECA's in my report, and show as zero recovery on Map 4.

Block EW002 and the west part of EW008a had not been logged at the time of my assessment and so were not included in the ECA's. The hydrological recoveries shown for these stands in my report were the state of the stands as they were at the time of my assessment.

In several places the Koop document mentions harvesting that has taken place after my report was completed and infers that this invalidates the report. A watershed assessment is a snapshot in time of the conditions in the watershed at the time of assessment, which is why monitoring and periodic re-assessment are usually recommended (as per Section 14 of my report). Watershed conditions are then compared to the conditions described in the earlier report.

Public meeting

Koop page 6: "Horel, however, made no final summary statement or conclusion at the public meeting from her report data on hydrologic recovery regarding the overall health or state of the entire Wilson watershed resulting from cumulative logging activities over the last 30 years on public and private forest lands, and therefore made no recommendations at the meeting about possibly curtailing future logging. No such conclusion / statement was made because nothing was stated about this critical component in Horel's report."

Overall watershed health is a function of the physical processes within it. In making a judgment on watershed health we look at sediment sources (landslides, erosion, channel bank and instream sources, roads, trails, pipelines, other development); stream flow effects and alteration of drainage patterns (such as by development); riparian condition; and stream channel condition. Arriving at conclusions about the health of a watershed involves considerably more investigation and assessment of all the physical processes in the watershed and how they interact to affect stream condition. The health of the watershed is judged by the physical condition of the stream channels and the processes that are affecting them, not by a hydrologic recovery or ECA number. I reported on all these things at the public meeting.

At the public meeting I also reported on the ECA and hydrologic recovery, as well as on the range of watershed processes investigated, and I did present my conclusions about the health of the watershed, as well as the key management concerns in order to maintain the health of the watershed going forward.

References

Koop page 5: "Though Dobson's 2010 assessment report is referenced three times in the August 2012 Horel report (pages 1, 2, and 20), the Dobson report is nevertheless omitted as a citation reference in *Appendix C, Information Sources*. Similarly, another report written by Dr. David Bates about fish populations and streamflow in Wilson Creek, which is referred to three times – with the report's title unnamed (on pages 8, 24, and 26) – is also not included as a draft reference in Appendix C."

The Dobson report is listed in my report in Section 3 Information Available. I usually list information specific to the project in this section, and general references in the Reference list. I do not have Dr. Bates' report listed because his report was submitted two months after mine was completed. I therefore did not have a title and date to reference. However, we had done some of our field work jointly and had discussed our findings prior to his report being submitted.

Peer reviews

Koop page 5: "According to SCPI's Minutes of January 30, 2012, the Horel Watershed Assessment was to undergo a formal *"peer review."* However, there is no follow-up mention of a peer review in the Horel report."

Mr. Denny Maynard, Dr. Dan Hogan and Mr. Allan Chapman reviewed my report as well as contributing to the assessment. This is noted in my report both in the Acknowledgments and in Section 2 Assessment Team.

Denny Maynard, P. Geo. is an eminent surficial geologist, who also provided terrain mapping and terrain interpretation in my report.

Dr. Dan Hogan, P. Geo., is a research fluvial geomorphologist and internationally recognized expert in stream morphology. He was with the BC Ministry of Environment at the time he provided the review; I think he may now be retired. Dr. Hogan did a field review with me of stream conditions as well as reviewing my report.

Allan Chapman, P. Geo., formerly BC's chief flood forecaster with the BC Ministry of Environment, is now a hydrologist with the BC Oil and Gas Commission where he developed a ground-breaking tool for public access to hydrological information in BC. For this work, in 2014 he won APEGBC's most prestigious award to a geoscientist, the Westerman award. Allan contributed to the hydrological analysis and interpretation as well as reviewing my report.

Gully sidewall failure adjacent to Block EW002

Koop Page 10. Photo description. "The edge of the cutblock is visible at the top of this photo, where a thin buffer of standing forest has exposed a steep escarpment composed of glacial lacustrine clay/silt materials deposited during the last ice age."

Not sure what "thin buffer has exposed…" is meant to imply. The "thin buffer" didn't expose; this gully sidewall failure predates the cutblock by several years. The escarpment is in glacial till, possibly with minor ice-marginal glaciofluvial inclusions, not "glacial lacustrine deposits". This feature is described in my report on page 19-20 and at Field Stop 30 in Appendix A. Map 2 shows surficial deposits in the watershed.

Topographic mapping

Koop page 10:
Map and Aerial Information Shortfalls
"Unlike the Dobson report, no contour map of the Wilson Creek drainage is included. Contour mapping is a simple and basic tool regularly used for showing slope gradients, water drainage courses, and tributary basin boundaries"

The Dobson report had only TRIM (20 m) contours for his assessment. I had LIDAR products for my assessment including bare-earth imagery. I used 1 m and 5 m LIDAR contours to refine the watershed boundaries, correct the positions of the major stream channels, determine channel gradients, revise road alignments, identify steep road grades; and other tasks intended to improve the accuracy of the information base. Features are visible on the LIDAR bare-earth imagery that are not apparent in the contours, especially in the 20 m contours in the Dobson report and in the Koop document. I chose to use the LIDAR bare-earth imagery to display watershed topography in my report because it allows a greater appreciation for details, including gullies and valley floors that are important features in this watershed.

Tributary basins

Koop page 10: "There is no map information, contour or otherwise, delineating the location area boundaries of the three primary drainages, catchments or sub-basins of the Wilson Creek watershed: Wilson Creek main stem, Hudson Creek, and East Wilson Creek"

Wilson watershed is a small drainage (2207 ha) and its tributary basins even smaller: East Wilson drainage is 453 ha; Husdon drainage is 684 ha. The management recommendations apply to SCPI's holdings in the entire Wilson watershed; they are not different for each tributary basin. If tenure or ownership were divided by drainage boundaries; or if the condition of the basins was sufficiently different that they required different management approaches, then it would make sense to delineate the smaller drainage units.

Use of airphoto series

Koop page 10: "There are no comparative, early aerial photograph overlays showing disturbance or land use activities in the Wilson Creek watershed. The only such information used repeatedly is recent Google Earth satellite imagery, dated 2009, which fails to show logging area locations after 2010 by the SCPI in the Hudson Creek and East Wilson sub-basins"

As indicated in Section 3 of my report, in addition to the 2009/2010 orthos, the following airphoto years were available and used in this assessment: 1972, 1985, 1994, 1996, 1998, 2003. Not all airphoto years covered the entire study area. Both Denny Maynard and I referred to these different photo series in our evaluation of the various aspects of watershed processes.

An author may choose to use airphotos to illustrate particular aspects of watershed characteristics or trends over time. For example, in large alluvial streams where the channels can clearly be seen on the airphotos, it is very useful to show channel change over time by displaying airphotos of different ages. The streams in Wilson watershed are too small to view on historic airphotos; the forest canopy obscures the channel in most airphotos.

Another example is to use airphotos to show changes in sediment production and/or landslide occurrence over time, especially when comparing historic logging practices to current practices. I agree that, for example, providing an airphoto comparison of the 1994 airphotos shown on page 23-24 to the 2009/2010 airphotos of the same area would be useful. In the 2009/2010 imagery, the preCode block logged in 1991 has greened up considerably and sediment production has noticeable declined – in other words, the airphoto comparison shows an improving trend in this harvest area.

Airphotos can also be used to construct a history of forest removal if there is no forest cover inventory available. In Wilson watershed the logging history is captured in the forest cover (provincial Vegetation Resource Inventory). I used the VRI, revised to the orthos and the LIDAR data.

The historic documents and airphotos on page 12-24 of the Koop document, while interesting, do not add new information to the harvest history necessary for the watershed assessment.

Koop page 33: "The aerial photos from 1980, 1994, and the 2009 Google Earth imagery in the March 2015 Koop report portray the progression of recent logging over a thirty year period in the Wilson watershed. These revelations are aided by showing boundaries of three primary watershed sub-basins, Wilson main stem, East Wilson, and Hudson, showing the progression of logging within each."

These aren't revelations. Stand age and stand height are a few of the dozens of attributes in the provincial Vegetation Resource Inventory, publicly available.

20 year plan blocks

Koop page 10: "Other than Map 11 showing 2 cutblocks, there is no map showing the locality and area of all proposed logging cutblocks from the SCPI's 20-year operational logging plan (2010-2030), information that had been posted and available on the SCPI website since about 2010."

To make a prediction with any confidence of the possible effects that SCPI's 20 year logging plan might have on watershed health, one would also have to know all of the other harvesting that would take place in the same time frame over the whole watershed on both crown and private lands; and the changes that would take place from non-forest development in the lower watershed.

Each of the SCPI blocks and the roads that access them, prior to harvest, must be considered individually <u>at the site level</u> against the management recommendations in my report with respect to windthrow, terrain stability (if adjacent to gullies or escarpments) and sediment management.

Snowpack in block at 900 m elevation

Koop page 26, in reference to top photograph: "April 2008 snowpack on upper block at 900 meter elevation. The <u>serious repercussions</u> concerning increased water runoff from rain-on-snow events during cool and warmer temperature conditions on this exposed extensive cutblock have been ongoing since the early 1990s."

The Koop document doesn't describe what these "serious repercussions" are.

Tabular stand data

Koop page 29: "There is no central reference map carefully detailing forest age / logging polygons and a corresponding table itemizing each polygon regarding area in hectares, tree height, <u>age class, tree species.</u> Nor is there a corresponding table itemizing road length / area per polygon. Nor is there a corresponding table estimating total areas of stream channel width. Nor is there a corresponding table itemizing private land information and areas, including harvesting and road construction. Without this information, the reader cannot understand or research how the author came to his conclusions about hydrologic recovery."

Koop page 33: "Missing in the Horel report is map and table data itemizing <u>logging history per cutblock: year of logging, area logged, seedling restocking year, and years for and length of road access construction.</u>"

"Horel report neglects to map-identify the three drainage sub-basins or catchments in the Wilson watershed, and neglects to provide statistics and evaluations within each. According to the April 1999 revised *Coastal Watershed Procedure Assessment Guidebook*, such sub-basin or catchment mapping and evaluation for fish bearing streams in watersheds greater than 1,000 hectares is a standard procedure. For instance, the gathering of:

- Statistics on the total length and density (area in hectares) of logging road access;
- Statistics and discussions on ECAs and hyrologic recovery;
- Statistics on private forest land and Crown land ownerships and conflicts."

Koop page 73. "…the August 2012 Horel Assessment did not include descriptive data cataloguing Crown and private forest land harvesting and road building data over time, critical for pinpointing and developing overall statistics for peak flow by way of ECA and complex water runoff attributes related to hydrologic recovery in regenerating forest stands: <u>cutblock year and area, reforestation date, accurate species re-forestation</u> tree height per block, etc. Fundamentally, no specific tree height values were identified in the August 2012 Horel Assessment which were used to determine hydrologic recovery modelling and assumptions, merely a reference given to a 2007, TR-032 government report, which Horel co-authored with R. Hudson.

None of the underlined attributes are used in determining hydrologic recovery or ECA. At this point, we do not have different recovery curves for different stand species.

I give total road length and road density in Section 9.8 of my report. Lengths of stream channel types are in Table 8, Section 11.1. Maps 8, 9 and 10 display stream gradients (by range), channel type and riparian condition. Road length and road density by themselves are not meaningful without consideration of the condition of the road network in the watershed and a field evaluation of roads and stream crossings. Map 7 displays road segments with grades steeper than 10% and potentially more susceptible to erosion. I discuss factors affecting the influence of roads in my report.

The forest attributes that Koop lists on page 29 are contained in the publicly available provincial Vegetation Resource Inventory. As indicated in my report, I used this VRI and corrected it to the ortho images and to the LIDAR tree height data for greater accuracy. Anyone could obtain the VRI coverage and do an independent check of my hydrologic recovery values.

I would provide my background data and hydrologic recovery computations to another registered professional with expertise in watershed assessment, if one were retained to review my report, and subject to my client's agreement. This did in fact happen; Ms. Laurie Bloom retained a recognized watershed specialist, Mr. Bill Grainger, P. Geo. to review my report (the same Mr. Grainger that completed the Chase Creek risk analysis that Koop extracts content from). With my client's permission, I offered to provide to him any background data or information that he cared to review. I would not make my data or analysis available to an individual that did not have the expertise to evaluate it.

The important attribute for calculation of hydrologic recovery is stand height. As described in my report, I used VRI stand polygons and adjusted the stand heights using LIDAR tree height data and visual comparison to the orthos. For recently logged blocks not shown on the imagery, I added these areas into the ECA's.

Private land boundary

Koop page 35: According to land ownership information from IMAP BC, and from A.J.B. Investments (Surespan holdings) website, which register the location boundaries of the private lands, as shown below, **those maps do not correspond with information in the Horel report.**

The ownership and tenure boundaries in my report are from spatial data obtained from government sources (and provided to me by Chartwell Consultants Ltd. on behalf of SCPI.) There appears to be an inconsistency between the two government sources. However, it does not affect the findings in my report.

Terms of reference

Koop page 75: "The problems underlying the failures in providing final recommendations concerning watershed threshold hydrologic recovery in SCPI's 2012 Assessment reports, as noted above, and other data most likely stem from poor or politically restrictive and constrained Terms of References (written or otherwise)."

Absolute rubbish.

CLOSING

The title page of my August 2012 Wilson Creek Watershed Assessment report contains the following statement: *This document is the property of Sechelt community Projects Inc. and may not be referred to in other publications, or reproduced in whole or in part without the written permission of Sechelt Community Projects Inc.* The reason for the statement on the title page is to prevent material from being extracted out of context, misinterpreted and used to mislead, as has been done in the Koop document. The statement is there because registered professionals have an obligation to protect their work from such misuse.

Glynnis Horel

Glynnis Horel, P. Eng.

PROFESSIONAL PROVINCE OF G. M. HOREL BRITISH COLUMBIA ENGINEER

April 30, 2015