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Watershed Assessment of the Kitseguekla Community Watershed.

(Kispiox Forest District)

Prepared For:

Skeena Cellulose Inc, Carnaby Division.

By

Freshwater Resources

January 2001

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Watershed Assessment for the Kits Creek Watershed (Kispiox Forest District)

1.0) Introduction:

At the request of Skeena Cellulose Inc. (SCI), Carnaby Division a Watershed Assessment of the Kits Creek watershed was conducted by Freshwater Resources of Smithers, B.C.. The Assessment was conducted because the Kits creek watershed is the Community Watershed for the village of Kitseguecla and as such is mandated a Watershed Assessment under the Forest Practices Code. Proposed forest development in the watershed was planned using the best available information at the time. This information included a Community Watershed boundary taken from the Kispiox LRMP. The Community Watershed boundary from the LRMP mapping was in error and did not indicate that the proposed blocks (9, 20 and 30, CP 099) were within the Community Watershed. When SCI became aware of the error they proceeded to conduct this assessment in order to rectify the oversight. The goal of the assessment is to assess the current hydrologic state of the watershed, review any proposed forest development and identify the possible hydrologic implications of that proposed development.

A thorough field evaluation of the watershed was conducted by Patrick Hudson (Freshwater Resources) and Shawn Munson (SCI) on November 27, December 1st and December 5th. The majority of the watershed was walked including the main stem of Kits creek from the headwaters down to the water treatment plant. This inspection allowed for the clarification of the Community Watershed boundary. The Community Watershed boundary referred to during this assessment reflects the adjusted boundary.

In addition to the field work the following photos, documents and assessments were reviewed:

- aerial photographs 30BCC97154 #s 38, 39 and 40, 30 BCB92077 #s 295, 206 and 207, and BC7809 #s 204 and 275.
- Terrain Stability, Soil Erosion and Sediment Delivery Risk Assessments for Cutting Permit 99, Block 9, 20 and 30 conducted by Jacques Whitford, Consulting Engineers, December 2000.
- Terrain Stability / Erosion Potential mapping assembled by Madrone Consulting, 1994.
- Silvicultural Prescriptions for blocks 9, 20 and 30 of CP 99 prepared by Silverwood Consulting in July of 2000.
- The B.C. Ministry of Forests "Community Watershed Guidebook", 1996 edition.
- The B.C. Ministry of Forests "Hazard Assessment Keys for Evaluating Site Sensitivity to Soil; Degrading Processes Guidebook", 1995 edition.
- 1:5000 scale logging plan maps.
- 1:20,000 scale forest cover map of the project area.
- Tree height information from SCI.
- Terrain Stability Assessment for CP 99 Block 9 completed by Madrone Consultants, May 2000.

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2.0) Background Information:

2.1) Physical Characteristics

Kits Creek is a small (approximately 380.5 ha.) watershed located approximately 15 km. southwest of Hazelton B.C.. The watershed has a predominantly northern aspect. The watershed is located in the Coastal Western Hemlock (CWH) Biogeoclimatic zone, Wet Submaritime subzone, Montane Variant (ws2). Minor higher elevation areas of the watershed are classified as the Mountain Hemlock (MH) Biogeoclimatic zone.

For the purposes of this assessment the watershed can be divided into three main terrain units (see map 1). Unit 1 contains the headwaters of Kits creek, the proposed block 20, minor amounts of proposed block 30 and extends to the slope break below block 20. Unit 2 is the mid-elevation slopes from the bottom of unit 1 to the toe of the slope north of the Indian Reserve boundary. This unit includes block 9 and the existing road grade. Unit 3 is the remainder of the watershed north of unit two. This unit includes the lower reaches of Kits creek, the Indian Reserve and the water treatment plant.

Bedrock geology in the area is comprised of Lower to Upper Cretaceous-aged rock of the Skeena Group. These rocks generally contain interbedded conglomerate, greywacke, siltstone, shale, sandstone, volcanic breccia and argillites. The local bedrock is weathered and highly fractured, a condition that provides pipes and interstitial spaces conducive to the storage and transmission of shallow groundwater.

Surficial materials in the project area reflect their glacial origin as well as the character of the local bedrock. Relatively erodible and weatherable parent materials (shales, sandstones and siltstones) have resulted in till textures that are matrix dominated (low coarse fragment content). The watershed is a complex assemblage of till veneers, colluvial deposits and glaciofluvial sediments. More recent fluvial reworking of these materials has resulted in the discontinuous deposition of alluvial gravels and fine textured overbank deposits.

The climate of the project area is intermediate between the West Coast Marine climate and the High Latitude Continental climate. The unique climate of the area results from its location in the lee of the Coast Range which has the effect of moderating the influence of onshore pacific weather systems. Fall and winter flows of marine air are funneled up the Skeena and Nass River basins spilling into the Kispiox and exerting a pronounced coastal effect on the local climate. In the winter, strong Arctic high-pressure systems can travel down those same rivers to exert a pronounced interior effect. The result is a climate that is dryer than coastal areas and warmer than typical interior wintertime climes.

The hydrology of the Kits Creek watershed reflects the local climate (high precipitation factor), topography (steep headwater gradients) and stream channel morphology (low channel storage capacity). The result is a discharge regime that is decidedly "flashy". Frequent rain-on-snow events serve to magnify this flashy discharge regime. The north aspect of the watershed serves to moderate radiative snowmelt, a factor that lengthens the springtime snowmelt period and maintains base flows.

Previous Forest Development:

Terrain Unit 1 has no previous harvesting. Terrain unit two was selectively harvested in the upper sections (circa 1970) above the Andimaul extension and two small sections of clearcut (circa 1970) are evident at the bottom (south) of the unit. Terrain unit 3 has been completely clearcut with the exception of a narrow strip of mature wood from the water treatment plant to the southern extent of the unit and two small leave patches at the north end of the unit.

Road building in the watershed is restricted to terrain units 2 and 3. Terrain unit 2 contains the Andimaul Extension, an access road that was built in the 1970's in anticipation of further forest development. The harvesting there was not approved and the road has remained. Terrain unit 3 has a network of roads and stream crossings resulting from forest harvesting in the 1970s. This road system remains in place and has not received any deactivation attention.

2.2) Water use History:

Two water use permits exist for Kits Creek. These licenses are held by the Kitseguecla Band and serve to permit the supply of municipal water. Early (1970s) municipal water was supplied from a check dam/storage tank system located just above the village. The Band has recently upgraded it's water system with a state of the art water treatment plant built on the bench above the village and upstream of the old water intake.

3.0) Methods:

The Kits creek watershed is a very small community watershed with a total watershed area of approximately 380.5 hectares. The Watershed Assessment Procedure, (WAP) as set out in the guidebook, is designed to assess watershed condition based on the average value of a number of key indicators. These factors relate climate, topography, vegetation, roadage, equivalent clearcut area (ECA), and other factors to the quality, timing and quantity of watershed discharge and discharge dependant processes. Average areal indices generated for such a small watershed are not likely to produce reliable estimates of watershed condition because they will be based by a small number of inputs. A field based, site specific assessment relying on professional judgement, landscape/process interpretation and selected WAP indices was chosen as the most appropriate method for this project.

The assessment detailed below is therefore largely based on a thorough field examination of the watershed and an interpretation of the relevant processes occurring there. The main WAP index used here is the ECA. The ECA was selected because it is a useful measure of the vegetation structure of the entire watershed which can be related to several hydrologic parameters of interest. Hydrologic parameters such as peak flow, snowmelt and accumulation, canopy interception and their effects on the timing, quality and quantity of watershed discharge will be discussed. Site specific assessments of the three terrain units identified above will be used to rationalize the recommendations listed at the end of this report.

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4.0) Assessment:

4.1) Equivalent Clearcut Area (ECA)

The ECA analysis conducted here is a simplified version of the procedure detailed in the WAP guidebook. The small size of the watershed and the uniformity of snowmelt and precipitation effects makes the delineation and weighting of distinct hydrologic elevational bands redundant. Instead, all of the canopy opening areas are delineated and appropriate weighting factors are applied based on tree heights and opening type (i.e. clear-cut or partial-cut). Table 1 (below) is a summary of the ECA analysis broken into existing and proposed ECAs. Weight factors are based on the hydrologic recovery owing to regeneration (tree heights) and the hydrologic benefit from partial cuts or small opening size. Refer to Table A2.1 and A2.2 in the WAP guidebook for an explanation of these factors.

Table 1: ECA Summary

Opening	Area (ha)	Regen. Height (m)	Weight factor	ECA (ha)
I.R. #3	40.9	0 / 6.9*	1 / 0.5*	40.9 / 20.5*
17A	16.8	6.9	0.5	8.4
17B	42.5	6.9	0.5	21.3
17C	16.0	6.9	0.5*0.6 (select. cut)	4.8
110-10	8.1	4.3	0.75	6.1
Andimaul Ext.	1.8	0	1	1.8
Current Total	124.3			83.3 (22%) /62.9 (16.6%)*
Block 099-09	38.3	0.0	1	38.3
Block 099-20	32.7	0.0	1	32.7
Block 099-30	3.6	0.0	1	3.6
Proposed total	74.6			74.6 (19.6 %)
Grand total	198.9			157.9 (41.6%)/137.5(36.2%)*

****There is some uncertainty as to whether the I.R. is sufficiently restocked. Numbers with an asterix indicate that they have been calculated with the assumption of tree heights similar to the adjacent cuts (6.9 m and a weight factor of 0.5) and assuming NSR with zero recovery (weight factor of 1).***

The current ECA for the Kits Creek watershed is between 22 and 17 percent. The projected ECA rises to 41.6% (36.2%) if the proposed harvesting proceeds. These estimates should be interpreted with caution because small changes in the delineation of the watershed boundary can have a large effect on the resultant ECA. Estimating tree heights and areal extents of high graded areas (opening 17C) is also not particularly exact given the quality of the current information (no information is available from the I.R.). They are useful numbers nonetheless because they are the best available estimates of the current areal extent that is in an equivalent to clear-cut state. The current areal extent of harvested ground (without considering recovery

factors) represents approximately 33% of the watershed. This number represents an estimate of the percentage of the watershed that has experienced some level of site disturbance and has remnant roads and stream crossings that have not been deactivated. This number rises to 52.3% if the proposed harvesting proceeds as is.

4.2) Road Assessments:

Roads are present in terrain units 2 and 3. A complete inventory, assessment and detailed prescription development of the roads in these areas is beyond the scope of this project but some comment is warranted on the roads that were field checked.

Terrain Unit 2

The main road in this unit is the Andimaul extension. This grade was built in the 1970s to access timber in the area but was not used at that time. The road traverses approximately half of terrain unit 2 with a slight favorable grade. The grade is located on steep ground (20 to 70%) below a major slope break. The method of construction for the road was side-cast. The side-cast material is partially retained by right of way wood that was not taken to the mill (see photo 1, below). Stream, gully and NCD crossings have not been deactivated and do not have adequate drainage structures but minimal erosion has occurred to this point.

Photo 1: The Andimaul Extension. Major portions of the road are constructed with side-cast material behind the right of way wood. This is the section with the tallest right of way wood and side-cast that was field checked and represents the "worst case example".

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One major stream crossing occurs at the west end of the road (stream crossing 1, see map 1) This crossing has not been deactivated. The structure is a log crib / earth fill type with significant volumes of fine-grained road surface material remaining (see photo 2, below).

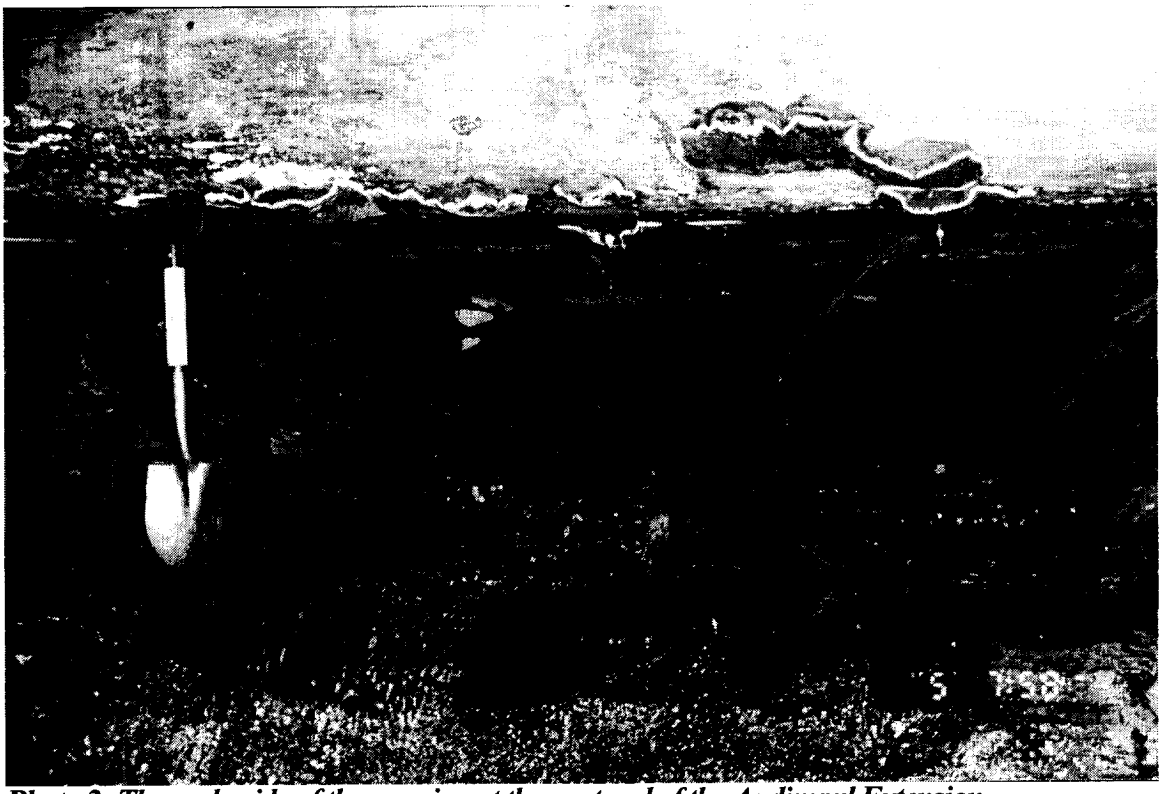

Photo 2: The underside of the crossing at the west end of the Andimaul Extension.

Terrain Unit 3

This unit has been extensively harvested and has a remnant road network that does not appear to have been deactivated to any extent. One section of road was field checked. This road begins near the beaver dam in the northeast of the unit and traverses in a southwest direction to a stream crossing (crossing 2, map1, photo 3, below) at Kits creek. This crossing is found within the Indian Reserve boundary and is a log stringer / earth fill type that has not been deactivated. This site is not currently eroding stringers and sill logs are decayed. A failure of this crossing has the potential to generate a significant volume of fine-grained sediment and could redirect the channel. The road grade east of this crossing is eroding, has not been deactivated and is intercepting streamflow from several small tributaries and diverting it to the beaver dam. The beaver dam is then diverting a portion of its discharge from the Kits creek watershed and into the adjacent (eastern) watershed.

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Photo 3: Stream Crossing 2. This crossing is within the Indian Reserve boundary.

4.3)Channel Assessments:

Channel assessments were conducted by walking as many of the streams as weather and budgetary constraints allowed. All of the streams in the watershed were not assessed but the highest priority channels in each terrain unit were walked.

Terrain Unit 1

Terrain unit 1 is the headwater of the watershed. Stream network density in this unit is the highest of the three units. The general pattern of the network is dendritic but broken, hummocky surfaces and bedrock control have resulted in a somewhat disorganized array of tributaries and dis-tributaries. Channel morphologies found here are predominantly step-pool types for lower gradient reaches and cascade / step-pool for higher gradient reaches. The step - pool morphology of these lower gradient reaches is a result of the recruitment and incorporation of Large Woody Debris (LWD) from the riparian forest. The steps are formed when LWD backwaters the stream thus trapping sediment and organic material. Large volumes of fine-grained sediments are stored in these reaches (see photo 4, below). The north west corner of the unit has a levee (likely a debris flow levee that predates the current forest cover) that is directing stream flow to the east.

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Photo 4: An example of the stream type found in terrain unit 1.

Terrain Unit 2

This unit contains the steepest potentially operable ground in the watershed. The mainstem of Kits creek flows across the western edge of the unit. The channel is very steep at the top of the unit (step pool cascade with multiple waterfalls) and grades to step-pool/cascade (30% grade) beyond the slope break at the bottom of the unit. This reach is bedrock controlled and is not displaying any channel disturbance.

Moving east across to the midpoint of this unit (below the Andimaul extension and up to stream A), three gullies and NCDs are encountered on slopes from 75 to 50 percent. The gullies are well vegetated and are not displaying serious erosion or debris loading. At the eastern end of the unit is a gully (stream B) that has been classified as class 5 terrain on the Terrain Stability mapping completed by Madrone Consulting.

Terrain Unit 3

The mainstem of Kits creek turns abruptly east at the bottom of terrain unit 2 and traverses to the middle of unit 3 where it again heads north. With the exception of two mature leave blocks at the top of the unit the stream has been logged to the edge on both sides with little retention. The riparian zone of Kits creek in this unit lacks mature wood and has lost most of its ability to supply mature wood to the channel. The channel itself is severely disturbed as a result of previous harvesting and more recently from over aggressive LWD removal (stream "cleaning") conducted by the Kitseguecla band (anecdotal information). Disturbance indicators include channel down cutting, a lack of functional woody debris, floodplain

abandonment, channel straightening and minimal sediment storage capacity. Several actively eroding nick points (vertical steps on erodible substrate) occur in this unit (see photo 5). These nick points are a result of the lack of functional large woody debris and represent a serious vertical instability in the channel. Unless they are complexed and armored they will produce chronic and episodic inputs of fine sediment upstream of the water treatment plant intake.

Photo 5: Nick point on the lower reaches of Kits Creek within or adjacent to the Indian Reserve boundary.

A groundwater return zone is evident at the toe of the slope at the south end of this unit. Several springs arise in this area as shallow bedrock forces interflow and groundwater to the surface. These springs are significant producers of water for the watershed. Upslope areas serve as the groundwater recharge area for the springs as rainfall and snowmelt percolate through the soil and travel down through soil macropores and rock fissures.

4.4) Peak Flow Implications:

Peak flow analysis involves assessing the potential and existing effects of forest harvesting and road building on stream channels and sediment routing. Vegetation removal during harvesting has been shown to increase annual and single event peak flows by increasing snowmelt rates (loss of shade) and by reducing the canopy-mediated interception and storage of rainfall. Roads and ditches also contribute to increases in peak flows because they intercept soil water and rainfall and convey it to receiving streams faster than would be the case in their absence.

The ECA estimate for the watershed (22% - 16.6%) implies that at least moderate increases in peak flows may be evident at the current time. Increasing the ECA to 42% or 36% will certainly increase peak flows. Ditchline interception and concentration of runoff is currently a factor in terrain units 2 and 3 further contributing to the peak flow effects. The north aspect of the watershed may moderate the peak flow increases somewhat due to its influence on radiative snowmelt. The acceptability of increases in peak flows must, however, be assessed in the context of the stream channels in the watershed. The lower reaches of Kits creek are severely disturbed and will respond poorly to any increase in peak flows. Increases in peak flows here can be expected to increase the rate of upstream migration of the nick points in terrain unit 3 and increase channel degradation with the result being an increase in fine sediment production.

4.5)Surface Erosion and Sediment Sources:

Surface Erosion Potential and Sediment Delivery Potential

The surface erosion potential and sediment delivery potential assessment for the three proposed blocks follows the method outlined in the Ministry of Forests Guidebook " Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Processes". The following table outlines the assessment scores and hazard ratings for the three proposed blocks. Surface erosion potential numbers were taken from the Silvicultural Prescriptions for the proposed blocks and were verified using Terrain Hazard / Sediment Delivery mapping conducted by Madrone Consulting. Sediment Delivery Potential estimates are based on the criteria listed in Appendix 2 of the guidebook.

Table 2: Surface Erosion Potential and Sediment Delivery Potential Summary

Block	Surface Erosion Potential	Sediment Delivery potential
30	High	low
20	High	high
09	High	moderate

The sediment delivery potential for block 30 is based on the portion of that block that is within the Community Watershed.

5.0) Risk Assessment:

Risk assessment for each of the proposed blocks is detailed below. The assessment is based on the hazard ratings detailed above and on the field assessment results. Consequence ratings for this Community watershed are high because of its small size, minimal stream channel sediment storage potential of Kits Creek (any sediment generating event will likely reach the water intake) and existing water quality issues. Risk ratings are defined as follows:

Risk = (Likelihood of Hazardous event) X (consequence)

Block 30

This block has a "Low" sediment delivery potential and a "High" surface erosion potential. This combination of hazard ratings combined with a high consequence rating translates to a

High Sediment Risk Rating for that portion of Block 30 that is within the Community Watershed. The peak flow implications for this block relate to ditchline interception and increases in snowmelt rates following harvesting. The terrain in this portion of unit 3 does not benefit from the north aspect and consequent topographic shading that the rest of the unit does.

Block 20

This bock has a "high" hazard rating for both Surface Erosion Potential and Sediment Delivery Potential. This combination of hazard ratings combined with the "High" consequence rating translates to a "Very High" Sediment Risk Rating. The Peak flow implications of this block are related to ditchline interception and increased snowmelt rates. The very high drainage network density in this unit is also cause for concern as the number of stream crossings required rises with increasing stream length thus increasing the risk. The levy at the northwest corner of the unit is effectively capturing stream flow that may otherwise enter the adjacent watershed. Excavating a road grade across this levy increases the risk of diverting flow and channel relocation. The channels in this unit rely on the recruitment of woody debris to stabilize their step pool morphology. Reductions or elimination of recruitable debris may eventually lead to the mobilization of large volumes of sediment stored in wedges behind each log step. The risk of channel disturbance following harvesting of this block is "Very High".

Block 9

Block 9 has a "High" Surface Erosion Potential and a "Moderate" Sediment Delivery Potential. This combination of hazard ratings combined with the "High" Consequence rating translates to a "Very High" Risk rating for Surface Erosion Potential and a "High" Risk rating for Sediment Delivery Potential. The Peak Flow Implications of this block are related to ditchline interception of interflow, loss of canopy interception and increased snowmelt rates. A considerable risk is involved in harvesting the west side of this block, as this is the source area for the springs at the toe of the slope and into unit 3. The west side also contains the steepest ground in the block (up to 75% grade). Previous harvesting in the 1970s resulted in a failure near where the Andimaul Extension crosses Kits Creek. Sediment from this failure traveled down Kits Creek and entered the water supply system for the village. The risk of harvesting this block can be diminished considerably by excluding the west side of the block. Re-activating the Andimaul Extension involves considerable risk due to the failure potential of the log cribbing and the sediment it is retaining. Re-activating the Andimaul crossing of Kits Creek involves a "High" risk of chronic sediment inputs from logging traffic and minor failures from the steep sidewalls in this area.

6.0) Conclusion:

The Kits Creek watershed is a very small Community Watershed. Were it not for the very high precipitation factor and high unit area runoff it would not produce enough water to service the needs of the village. Previous harvesting in the watershed has resulted in an ECA that suggests that some level of peak flow increase is currently occurring. This ECA does not emulate a natural disturbance regime for the watershed because fire is very rare in the CWH and natural levels of mass movement are low.

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Risks associated with forest harvesting are considerable due to the predominantly fine textured nature of area soils, small watershed size, steep slopes, channel disturbance and existing water quality issues. The remnant roads and crossings pose a further risk to the water quality of the watershed. Considerable Watershed Restoration opportunities exist in the watershed and if successfully implemented they have the potential to reduce the risk of any future forest harvesting. The implementation of Watershed Restoration activities will likely generate some level of impact to water quality in the watershed.

Since this is a Community Watershed the primary watershed management goal is the provision of potable water to meet the obligations of the water licenses held by the Kitseguecla Band. Other watershed management activities (forestry, recreation, etc.) should be designed to be consistent with the main watershed management goal of the production of potable water. This is clearly articulated in the Forest Practices Code.

7.0) Recommendations:

The following recommendations are designed to meet the watershed management goals of the Kits Creek Community Watershed.

7.1) Forest Harvesting:

1) Do not proceed with the development of block 20, CP 99.
2) Adjust the boundary of Block 30, CP 99 to pull it out of the Community watershed.
3) Re-design Block 9, CP 99 to exclude that portion of the block that is west of a line drawn one tree length east of the top of the gully of stream A.
4) Adjust the southern boundary of the block to exclude ground mapped as class 4 by Madrone Consulting
5) Develop access to block 9 from the northeast.

A number of high priority watershed management activities can be undertaken to mitigate the current state of the Kits Creek watershed. These activities generally fall within the Watershed Restoration Program and Water Management Branch (MOE) envelopes. Completing this work will facilitate the harvesting in Block 9 by mitigating the current hydrological impacts and water quality risks. These activities are:

6) Secure "Sensitive Area Status" for Terrain Unit 1, the western portion of Terrain Unit 2, the northern portion of Terrain Unit 3 and a corridor along the lower reaches of Kits Creek.
7) Deactivate the existing roads.
8) Develop and implement a restoration / Source Water Protection Plan for the watershed.
9) Determine and survey the watershed boundary.

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This report represents an assessment conducted using the best available information and thorough field verification to estimate current and projected hydrological conditions. Professional opinions stated within the report are for that purpose only.

I trust that this report meets your requirements. Should you have any further comments or inquiries please feel free to contact me.

Sincerely,

Patrick Hudson, P.Ag.