

**HORSEFLY RIVER WATERSHED**  
**Watershed Restoration Program - Cariboo Region**

**RIPARIAN, WETLAND AND TERRESTRIAL ASSESSMENT**  
**AIR PHOTO INTERPRETATION RESULTS (PART A)**

**DRAFT REPORT**

**APRIL 1996**

## **1.0 Introduction**

Under a Ministry of Environment, Lands & Parks (MOELP) contract through the Watershed Restoration Program (WRP), AIM Ecological Consultants Ltd. and their associates undertook a comprehensive assessment of the Horsefly River Watershed. The project included:

- Level 1 Watershed Assessment
- Sediment Source Inventory and Mapping
- Review of Sediment and Water Temperature Monitoring Program
- Trend Analysis of Hydrometric Records
- Riparian, Wetland and Terrestrial assessment

This report addresses the Riparian, Wetland and Terrestrial component, and includes three parts. **Part A** details the results of the extensive air photo interpretation to assess loss or damage to riparian, wetland and terrestrial habitats as a result of forest harvesting, range use, silviculture and recreation activities. A catalogue of roads, their UTM coordinates and listing of those roads which border riparian and wetland areas, extend into high elevation basins and alpine areas, or cross wildlife winter ranges is included in this section.

**Part B** consists of the Biodiversity Assessment, based on seral stage analysis (GIS) of Ministry of Forests data.

**Part C** is a synthesis of the analyses from Parts A and B, which identifies and recommends potential restoration options, as well as discusses potential conflicts or amalgamation with other Watershed Restoration projects.

## 2.0 Objectives

The objectives to this portion of the watershed assessment program were to “evaluate access and loss or damage to riparian, wetland and terrestrial habitats as a result of forest harvesting, range use, silviculture and recreation activities, with particular emphasis on biodiversity.

The terms of reference for the Riparian, Wetland and Terrestrial assessment in the Horsefly River Watershed identified the following major focus of the study:

*Complete a detailed evaluation of access and loss or damage to wildlife habitat in riparian and terrestrial areas in the Horsefly River Watershed as result of human related activities including forest harvesting, range use, silviculture and recreation. The emphasis of this evaluation will be directed towards identifying access concerns, areas of high wildlife visibility in relation to access and habitat loss, in relation to the habitat attributes of mainly Red and Blue listed species and regionally important species such as Moose, Mule Deer and Mountain Goats.*

In order to accomplish these objectives, a number of tasks were identified to assess the total area impacted by logging practices, roads and grazing activities which border sensitive wildlife habitats. These tasks, described in the methods section resulted in a cataloging, assessment and ranking of high impact areas.

### **3.0 Approach and Methodology**

The Riparian, Wetland and Terrestrial assessment focused on the identification of disturbance and access to sensitive wildlife habitats. Mapping of sensitive areas included all of those areas which could be discerned from recent airphotos. Areas where logging activity appeared to be having a high impact on wildlife resources were identified, total area affected was estimated, and areas where restoration activities could be undertaken were listed. Private land was in general not mapped for this report except to note the amount of wetland which had been converted to agricultural use.

Air photos at a scale of 1:15,000 were provided to AIM by the Ministry of Environment for the purposes of this assessment. The lower two-thirds of the Horsefly basin were photographed in September 1994, while the remaining upper third was flown in 1995 (flight lines are included as Appendix 1). Air photo interpretation could not be undertaken in the southern portions of sub units 9, 10 and 21, which were not covered by 1994 air photos.

In addition to conventional stereoscopic airphoto analysis, this project used computer enhancement of the airphotos to provide detail regarding proximity of roads and logging activity to sensitive wildlife habitats. Approximately 350 air photos were digitized by high resolution scanner, then enlarged and enhanced using image manipulation software to provide maximum interpretive ability. Study areas were delineated on each photo to ensure complete area coverage and to avoid overlap. The digitized images were mapped using a computerized drafting program which allowed the calculation of areas, linear distances and highlighting of problem areas. Features assessed included: road lengths, riparian lengths, wetland areas, cutblock areas and landing areas. Landings were considered to be unrehabilitated when their reflectance pattern (in the recent aerial photographs) was easily distinguishable from the adjacent logged areas. Road assessments emphasized those roads which border riparian and wetland areas, extend into high elevation basins and alpine areas, or cross wildlife winter ranges. Road condition was assessed from the aerial photographs, and field verification needs were identified. All roads which bordered or entered areas where wildlife visibility concern were identified. Candidate areas for rehabilitation were defined and prioritized so that preliminary remedial works programs can be developed.

Sub-basin boundaries, based on the hydrological boundaries identified for the level 1 IWAP, were confirmed with topographic maps and by stereoscopic analysis of the air photos, using the height of land to determine drainage basins. If a photo contained more than one sub-basin, the information was separated for each specific sub-basin in the photo. Topographic and forest cover maps were used in conjunction with the aerial photos to confirm areal calculations.

Numerical data generated from the photos was transferred to, tabulated and synthesized within a spreadsheet format. Biogeoclimatic data, draft landscape units and mule deer winter ranges provided to AIM by MOE were incorporated into the database for each photo. Information was then summarized by sub-basin and by biogeoclimatic zone within the database. Interpreted images were printed, in order to provide a permanent visual record of the assessments (Appendix 2).

Recent aerial photography provides the most current information available for interpretation of landscape scale change. The interpretation and measurement of areas conducted for the purposes of this study provided an excellent graphic display of human related impacts and allowed for very good estimates of the areas involved. Although actual area calculations were made, they should be considered estimates due to the amount terrain variability throughout the watershed.

There are two sources of error inherent in using numeric values obtained from photographs:

- 1) image displacement

Objects above or below the horizontal plane of the ground, appear increasingly displaced with distance from the centre of the photo. This is primarily a problem with large scale photos and with vertical objects such as tall buildings or trees. It was generally not a problem in evaluating features on the surface of the ground and was in part compensated for by using the central portions of the images.

2) scale change with topography.

The scale of the aerial photographs is an average for the area over which they were flown. With higher terrain, the scale is larger, conversely at lower elevations the scale is smaller. During the course of the interpretation, adjustments were made to ensure calculations occurred at the correct scale and measurements were verified with topographic maps. However, in very steep terrain it is difficult to compensate between peaks and valley bottoms on the same image.

One of the advantages recent aerial photographs offer is to provide the most recent data available, a means to assess the degree of impact and means to evaluate the completeness of previous mapping. As an example, we found instances where cutblocks had been omitted from forest development plans. On the other hand, the Level 1 IWAP analysis assumes that if cutblocks are located adjacent to streams or straddle streams “then no riparian buffers were left”<sup>1</sup>. However, the air photo analysis revealed numerous instances where this assumption was not valid. The interpreted images appended to this report provide an opportunity to verify interpretations or to re-visit areas of interest.

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<sup>1</sup> IWAP Level 1 Procedures Manual

#### **4.0 Watershed Characteristics**

The Horsefly River is tributary to the Quesnel River and is located on the eastern edge of the Interior Plateau, south of Quesnel Lake and east of Williams Lake. The eastern boundary of the watershed abuts the Clearwater River watershed on the western flank of the Rocky Mountain Range. The 2183 ha project area includes that portion of the Horsefly River watershed above the Little Horsefly River. The Horsefly River is a very important rainbow trout stream, and supports an important salmon fishery.

Based on the Interior Watershed Assessment Procedure (IWAP), conducted by Dobson Engineering Ltd. as part of the overall Cottonwood River Assessment Project, the watershed has been divided into 21 sub-basins (Table 1, Figure 1).

For the purposes of the Riparian, Wetland and Terrestrial assessment all 21 sub-units were used for the biodiversity -seral stage analysis but were pooled into 9 larger sub-basins (Table 2) for the photo interpretation and analysis of impacts.

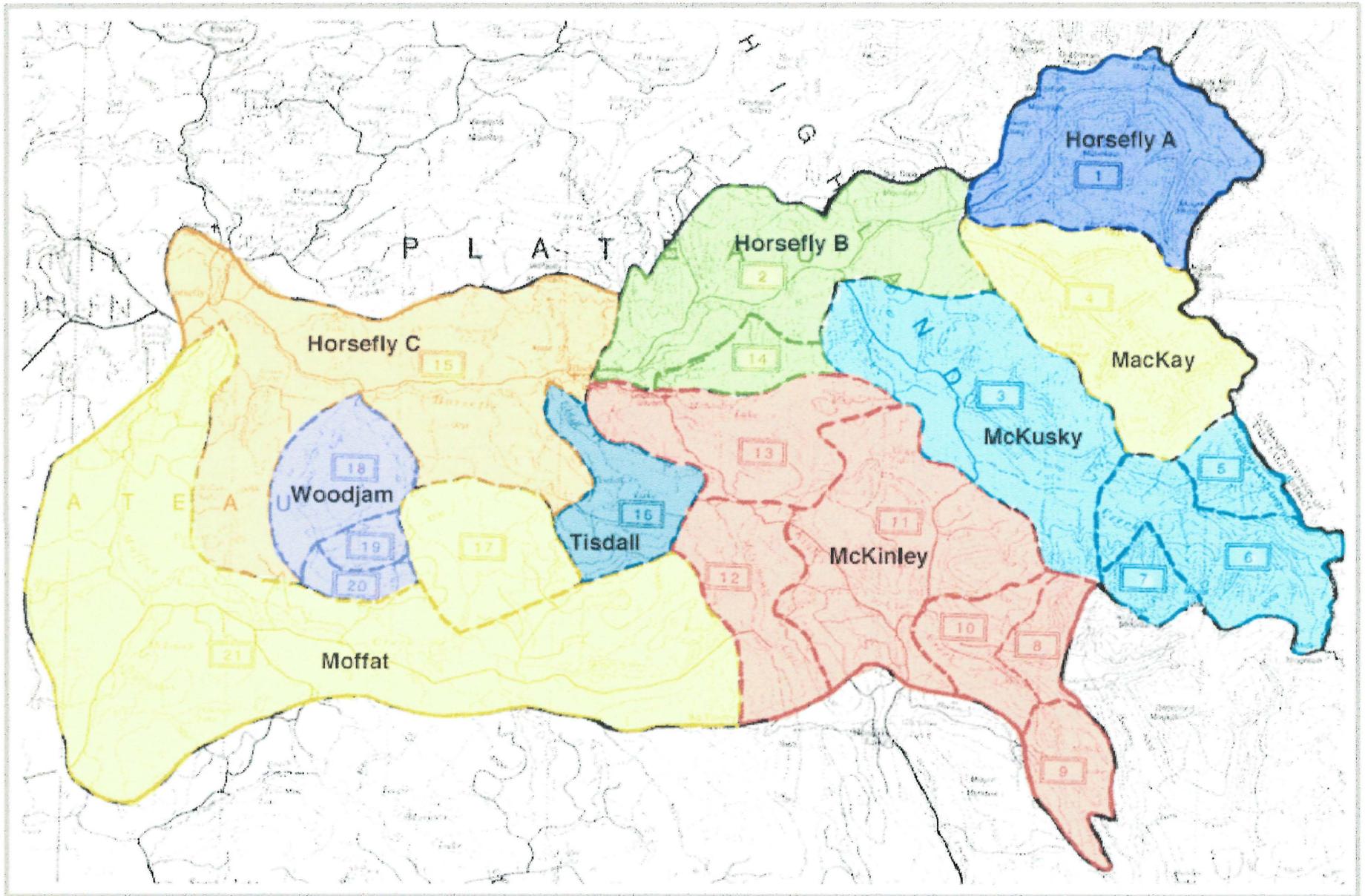
**Table 1. Horsefly River Watershed Sub-unit Areas**

<b>Sub-Basin</b>	<b>Area (sq. km)</b>	<b>Sub-Basin</b>	<b>Area (sq. km)</b>
1	145	12	80
2	169	13	77
3	184	14	20
4	144	15	238
5	29	16	71
6	74	17	74
7	20	18	64
8	26	19	13
9	40	20	13
10	42	21	483
11	180	<b>Total</b>	<b>2183</b>

**Table 2. Horsefly River Watershed Sub-basin Areas**

<b>Sub-basin</b>	<b>Sub-units</b>	<b>Area (sq. km)</b>
<b>Horsefly A</b>	1	145
<b>Horsefly B</b>	2	189
<b>Horsefly C</b>	15	237
<b>MCKINLEY</b>	8, 9, 10, 11, 12, 13	443
<b>MCKUSKY</b>	3,,5,6,7	307
<b>MACKAY</b>	4	144
<b>MOFFAT</b>	17, 21	557
<b>TISDALL</b>	16	71
<b>WOODJAM</b>	18, 19, 20	90

The lowlands in the western part of the watershed are mostly private land that has been developed for agricultural purposes. Large areas of the Mofat and Horsefly riparian zones have been converted from riparian wetlands to agricultural use. The upper elevations and most of the eastern portion of the drainage is Crown land and part of the provincial Forest. These Crown lands form part of the forest licenses for a number of major forest licensees, as well as the Small Business Forest Enterprise Program. Placer mining has been active in the watershed for the past 100 years, with a number of claims still active. This activity has had and is still having significant impact on the stream systems within the watershed.



**Horsefly River Watershed Sub-basins**

## **5.0 Results and Discussion**

Aerial photo interpretation focussed on determination of impacts on riparian, wetland and terrestrial habitats. Where human related activities were seen to have an impact on the natural environment, quantification of these impacts was undertaken. This resulted in data on the amount of area logged, the length of roads and the number of unrehabilitated landings, the lengths of cleared riparian environments, cleared lake shore and wetland borders for each sub-basin. Of the 2183 sq. km study area, 1,769 has been identified as forested. Nineteen percent of the total study area, or 24 percent of the forested area has been logged. Five percent of the study area consists of wetland (Figure 2).

The Horsefly watershed had an overall average of 0.08 km/km<sup>2</sup> of missing buffers. This was comprised of 81 kilometers of riparian buffers, 93 km of wetland buffers and 14 km of lake buffers. Two sub-basins, Horsefly A and Tisdall were found to have virtually no impacts on wetland and riparian habitats. The Woodjam and Horsefly C sub-basins had low forest-related impact with values of 0.04 km/km<sup>2</sup> of missing buffers for riparian and wetland areas. In contrast, the McKinley (0.24) and Horsefly B (0.22) had high densities of missing buffers (Figure 3).

A total of 828 unrehabilitated landings resulted in an average density of 0.37 landings per sq km for the watershed. The greatest density occurred in the McKinley sub-basin (1.15) followed by Horsefly B (0.67). The average road density for the watershed was determined to be 0.47 with the greatest densities occurring in Horsefly B (1.03) and McKinley (1.0).

Agricultural development was greatest in the Moffat and Horsefly C watersheds with relatively large areas of wetlands and riparian habitats converted to agricultural use. A total of 8.33 km<sup>2</sup> of converted wetland was identified for the Moffat sub-basin and 7.71 km<sup>2</sup> in Horsefly C.

**Table 3: Horsefly Watershed Sub-basin Summary**

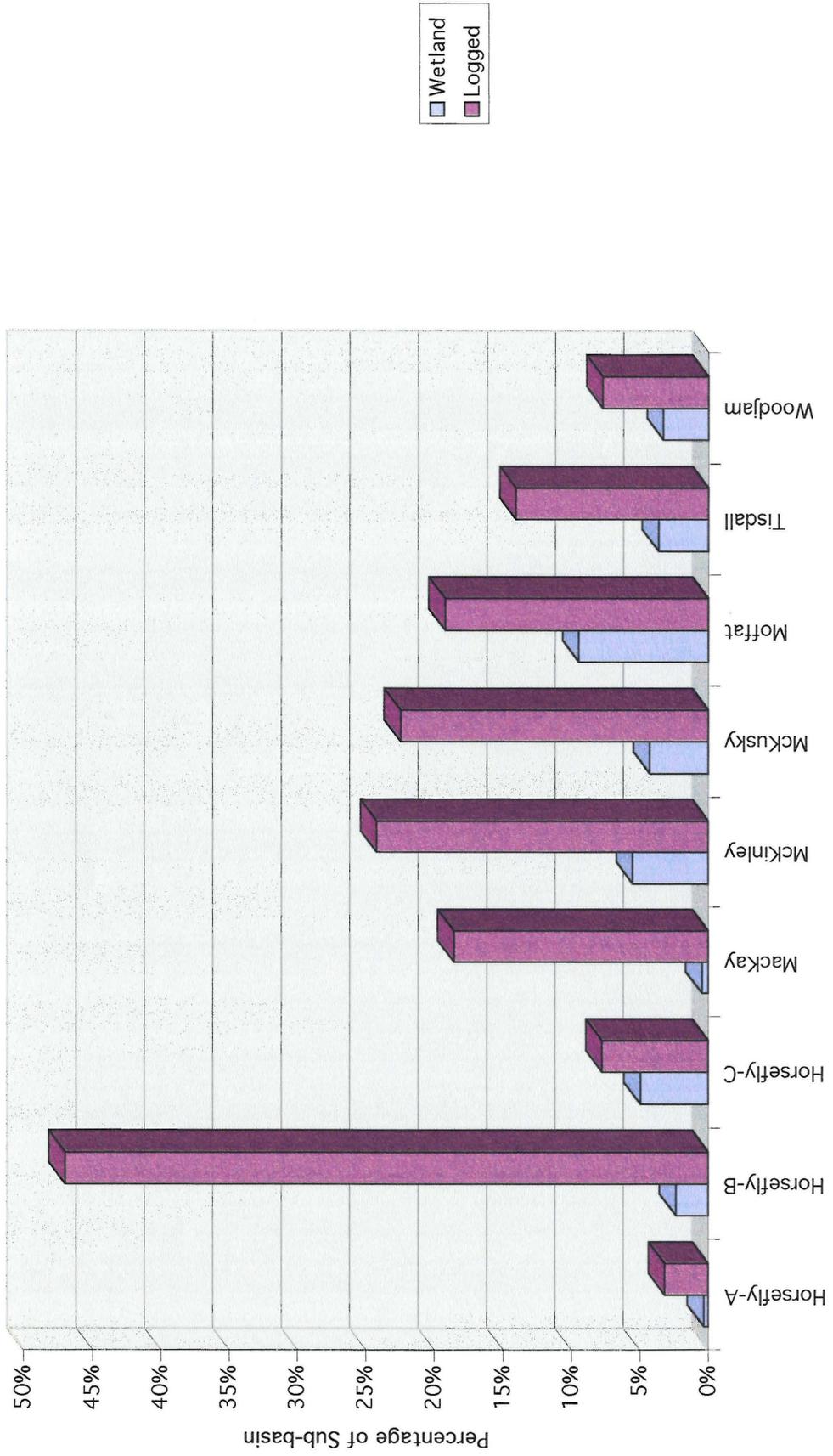
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	% Logged	% Wetland	Missing Riparian Buffer (km)	Missing Lake Buffer (km)	Missing Wetland Buffer (km)	# of Landings	Road Length (km)
<b>HORSEFLY A</b>	3	<1				21	30
<b>HORSEFLY B</b>	47	2	21		20	127	194
<b>HORSEFLY C</b>	8	5	9	<1	4	47	156
<b>MCKINLEY</b>	24	6	10	10	31	247	212
<b>MCKUSKY</b>	22	4	15		1	72	129
<b>MACKAY</b>	19	<1	12			42	73
<b>MOFFAT</b>	19	9	11	3	34	207	196
<b>TISDALL</b>	14	4		<1		32	27
<b>WOODJAM</b>	8	5	2	0	3	33	31

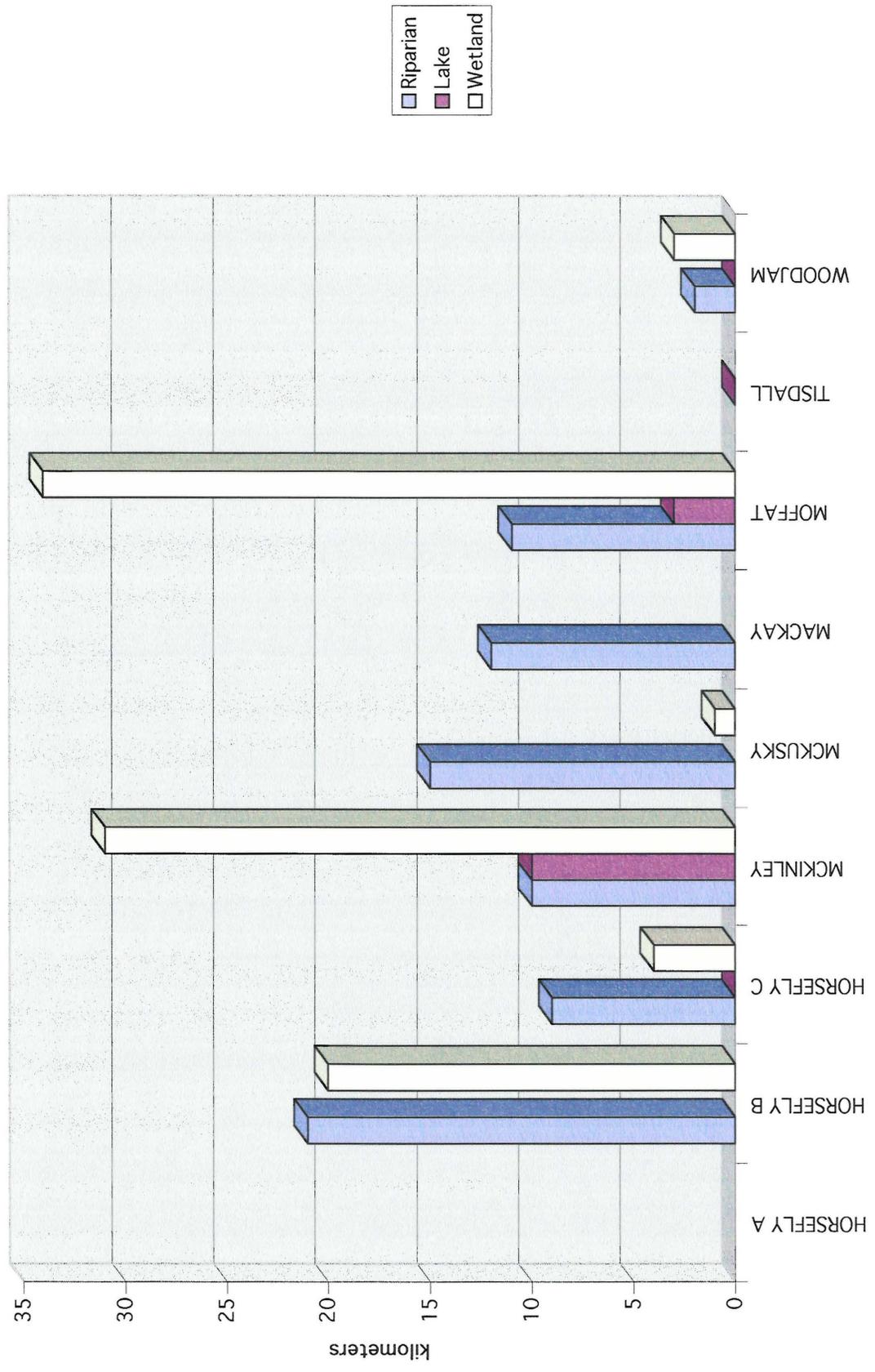
**Table 4: Density of Forestry Related Activity**

	landings # per sq. km	road density km/sq. km	missing buffers km/sq. km
<b>HORSEFLY A</b>	0.11	0.16	0
<b>HORSEFLY B</b>	0.67	1.03	0.22
<b>HORSEFLY C</b>	0.16	0.52	0.04
<b>MCKINLEY</b>	1.15	1.00	0.24
<b>MCKUSKY</b>	0.17	0.30	0.04
<b>MACKAY</b>	0.26	0.45	0.07
<b>MOFFAT</b>	0.37	0.35	0.08
<b>TISDALL</b>	0.42	0.36	0.00
<b>WOODJAM</b>	0.29	0.27	0.04
Total	0.37	0.47	0.08

Horsefly River Watershed - Proportions of Logged and Wetland Areas  
According to Sub-basin



Forestry Related Impacts on Riparian and Wetland Areas -  
Absence of Buffers in the Horsefly Watershed Sub-basins



## 5.1 Horsefly A (Sub-unit 1)

**Horsefly A (Sub-unit 1)** is located in the northeastern part of the watershed centered along the upper Horsefly River above McKay Creek (Figure 1). The area of Sub-basin #1 was determined by GIS analysis to be 142 km<sup>2</sup>.

Aerial photo analysis revealed that approximately 3% of the subbasin has been logged. Cutblocks occurred in two biogeoclimatic zones, 37% in ICHwk2 and 63% in ESSFwk1. Road distribution was concentrated in ESSFwk1 (81%) with only 19% in ICHwk2. The total road length was determined to be 30km with a density of 0.16 km/sq. km. A total of 21 unrehabilitated landings were enumerated for these logged areas resulting in an estimated area of 0.11 sq. km.

A total of 11 wetlands with a total area of approximately 0.61sq. km were identified in this sub-basin. The wetlands were concentrated in two subbasins; 69% in AT and 31% in ESSFwk1. Riparian lengths as determined from aerial photo interpretation totalled 79 km. No wetland or riparian areas appeared to have been disrupted by logging activity.

## 5.2 HORSEFLY B (Sub-unit #2 and 14)

The Horsefly B Sub-basin is comprised of two Sub-units; #2 covers an area of 169 km<sup>2</sup> and is located in the north central portion of the watershed centered along the Horsefly River from McKay Creek to McKinley Creek. Sub-unit #14 covers an area of 20 km<sup>2</sup> and is located in the north central part of the watershed encompassing Doreen Lake (Figure 1).

Aerial photo analysis revealed that approximately 47% of the subbasin has been logged. Cutblocks occurred in four biogeoclimatic zones; but the majority occurred in two zones, 40% in ICHwk2 and 36% in ESSFwk1. Road distribution followed a similar pattern with 44% in ICHwk2 and 35% in ESSFwk1. The total road length was determined to be 194 km with a density of 1.03 km/sq. km.

A total of 127 unrehabilitated landings resulting in an area of 0.64 sq. km were enumerated for this sub-basin.

A total of 139 wetlands occur in this sub-basin with a total area of approximately 15 sq. km. The wetlands were concentrated in two subbasins; 68% in ICH wk2 and 32% in ESSFwk1. Eighteen instances of missing wetland buffers were observed for a total of 19.5 km in length. Two wetland areas, totalling 0.32 sq. km have been isolated by logging activity.

Riparian lengths as determined from aerial photo interpretation totalled 96 km. Of this length, 21.4 km (22%) had been logged and had no buffer strips present. Over half of these occurrences (54%) were in ICH wk2, with the remainder divided between ESSFwc3 (24%) and ESSFwk1 (20%).

### 5.3 Horsefly C (Sub-unit #15)

The Horsefly C Sub-basin (Sub-unit #15) covers an area of 238 km<sup>2</sup> in the north west part of the watershed, including the western Horsefly River from Black Creek to Horsefly townsite (Figure 1). Aerial photo analysis revealed that approximately 8% of the subbasin has been logged. Cutblocks occurred in five biogeoclimatic zones; but the majority occurred in three zones, 41% in SBSdw1, 31% in ESSFwc3 and 21% in SBPSmk.. Road distribution was concentrated in SBSdw1 (81%) . The total road length was determined to be 156 km with a density of 0.52 km/sq. km.

A total of 47 unrehabilitated landings resulted in an estimated area of 0.31 sq. km in this sub-basin.

A total of 139 wetlands occur in this sub-basin with a total area of approximately 14 sq. km. The wetlands were concentrated in two subbasins; 65% in SBSdw1 and 25% in SBPSmk. Eleven instances of missing wetland buffers were observed for a total of 4.38 km in length. Two wetland areas, totalling 0.5 sq. km have been isolated by logging activity. Agricultural modification of wetlands was identified in 13 locations for a total of 4.86 sq. km.

Riparian lengths as determined from aerial photo interpretation totalled 171 km. Of this length, 9.41 km (5.5%) had been logged and had no buffer strips present. Over half of these occurrences (52%) were in SBSdw1, with the remainder divided between ESSFwc3 (23%) and SBPSmk (25%). One location of a missing buffer adjacent to a lake (0.43) was identified.

#### 5.4 McKusky (Sub-units #3, 5, 6, and 7)

The McKusky Sub-basin consists of 4 sub-units totalling 307 km<sup>2</sup> (Figure 1). Sub-unit #3 encompasses Crooked Lake and lower McKusky Creek and covers an area of 184 km<sup>2</sup>. Sub-basin #5 covers an area of 30 km<sup>2</sup> and encompasses the northern headwaters of McKusky. Sub-basin #6 covers an area of 74 km<sup>2</sup> and includes the headwaters of McKusky Creek south east of Crooked Lake. Sub-basin #7 covers an area of 20 between Boss Mountain and Mt. Beisig in the southeastern part of the watershed,.

Aerial photo analysis revealed that approximately 21% of the subbasin has been logged. Cutblocks occurred in five biogeoclimatic zones; the majority occurred in two zones, 38% in ICHwk2 and 28% in ESSFwc3. Roads occurred predominantly in ICHwk2 (54%) with lower proportions in the remaining four biogeoclimatic zones. The total road length was determined to be 130 km with a density of 0.75km/sq. km.

A total of 72 unrehabilitated landings were enumerated resulting in an estimated area of 0.36 sq. km in this sub-basin.

A total of 70 wetlands occur in this sub-basin with a total area of approximately 6.93 sq. km. The wetlands were concentrated in two subbasins; 55% in ICH wk2 and 21% in ESSFwc3. Four instances of missing wetland buffers were observed for a total of 1.49 km in length. One wetland area, 2.55 sq. km had been isolated by logging activity.

Riparian lengths as determined from aerial photo interpretation totalled 143 km. Of this length, 14.7 km (10%) had been logged (16 instances) and had no buffer strips present. Over half of these occurrences (54%) were in ESSFwc3 with the bulk of the remainder (42%) in ICH wk2.

## 5.5 MacKay (Sub-unit #4)

The MacKay Sub-basin (sub-unit #4) covers an area of 144 km<sup>2</sup> and encompasses McKay Creek in the eastern part of the watershed (Figure 1).

Aerial photo analysis revealed that approximately 19% of the subbasin has been logged. Cutblocks occurred in three biogeoclimatic zones; the majority in ESSFwk1 (65%) with most of the remainder in ESSFwc3 (25%). Roads occurred approximately evenly divided between ESSFwk1 and ESSFwc3. The total road length was determined to be 72 km with a density of 0.34 km/sq. km.

A total of 42 unrehabilitated landings were enumerated resulting in an estimated area of 0.21 sq. km in this sub-basin.

A total of 16 wetlands occur in this sub-basin with a total area of approximately 1 sq. km. The wetlands were concentrated in two subbasins; 55% in ESSFwc3 and 38% in AT. No instances of missing wetland buffers were observed.

Riparian lengths as determined from aerial photo interpretation totalled 94 km. Of this length, 12.1 km had been logged (17 instances) and had no buffer strips present. Over half of these occurrences (61%) were in ESSF wk1 with the remainder (39%) in ESSFwc3.

## 5.6 McKinley (Sub-units #8, 9, 10, 11, 12, and 13)

The McKinley Sub-basin consists of 6 sub-units totalling 443 km<sup>2</sup> (Figure 1). Sub-unit #8 covers an area of 26 km<sup>2</sup> and is located east of Gotchen Lake. Sub-basin #9 covers an area of 40 km<sup>2</sup> (encompasses McNeil Lake). Sub-basin #10 covers an area of 42 km<sup>2</sup> and is located south of McKinley Lake and west of Gotchen Lake. Sub-basin #11 covers an area of 180 km<sup>2</sup> (encompasses Elbow and Bosk Lakes and Bassett and McKinley Creeks). Sub-basin #12 covers an area of 80 km<sup>2</sup> and is along Molybdenite Creek with the Moffat sub-basin to the west. Sub-basin #13 encompasses McKinley Creek covering an area of 77 km<sup>2</sup> and bordered by the Tisdall sub-basin to the west; Horsefly B to the north and McKusky to the east.

Aerial photo analysis revealed that approximately 35% of the subbasin has been logged. Cutblocks occurred in five biogeoclimatic zones; the majority in ICHmk3 (43%) and ESSFwc3 (33%). The majority of roads in ICHmk3 (63%). The total road length was determined to be 216 km with a density of 0.51 km/sq. km.

A total of 292 unrehabilitated landings were enumerated resulting in an estimated area of 1.46 sq. km in this sub-basin.

A total of 122 wetlands occur in this sub-basin with a total area of approximately 23 sq. km. Over half of the wetlands occurred in ICHmk3 (51%) with the remainder divided between ESSFwc3 (22%) and ICHwk2 (17%). Missing wetland buffers were observed in 38 locations for a total of over 31km. Three instance of wetlands surrounded by cutblocks totalled 0.36 sq. km.

Riparian lengths as determined from aerial photo interpretation totalled 126 km. Of this length, 8.5 km had been logged (15 instances) and had no buffer strips present. Most of these occurrences (70%) were in ICHmk3. Fifteen instances of missing lake buffers were assessed, totalling 10.1 km.

## 5.7 Tisdall (Sub-unit #16)

The Tisdall Sub-basin (Sub-unit #16) covers an area of 71 km<sup>2</sup> and is located in the central part of the watershed, encompassing Tisdall Lake and Tisdall Creek (Figure 1).

Aerial photo analysis revealed that approximately 12% of of the subbasin has been logged. Cutblocks occurred in four biogeoclimatic zones; the majority in ESSFwk1 (50%) with the remainder in SBSdw1 (27%) and ESSFwc3 (19%). The majority of roads occurred in SBSdw1 (40%) with the remainder found in ESSFwk1 (34%) and ICHmk3 (26%). The total road length was determined to be 27 km with a density of 0.29 km/sq. km.

A total of 32 unrehabilitated landings were enumerated resulting in an estimated area of 0.16 sq. km in this sub-basin.

A total of 39 wetlands occur in this sub-basin with a total area of approximately 3.5 sq. km. Over 95% of the wetlands occurred in SBSdw1. Missing wetland buffers were not observed. One instance of a wetlands surrounded by a cutblocks accounted for 0.02 sq. km.

Riparian lengths as determined from aerial photo interpretation totalled 44 km. No instances of missing buffer strips were detected. .. One instance of a missing lake buffer accounted for 0.33 km.

## 5.8 Moffat (Sub-units #17 and 21)

The Moffat Sub-basin consists of two sub-units #17 and #21 covers a total area of 557 km<sup>2</sup> ( Figure 1). Sub-unit #17, a forested, rolling plateau, encompasses 74 km<sup>2</sup> in the central part of the watershed. Sub-unit #21 covers an area of 483 km<sup>2</sup> and encompasses the bulk of the south western part of the Horsefly watershed along Moffat Creek.

Aerial photo analysis revealed that approximately 19% of of the subbasin has been logged. Cutblocks occurred in five biogeoclimatic zones; the majority in ESSFwk1 (39%) and SBPSmk (36%). The majority of roads occurred in SBPSmk (57%). The total road length was determined to be 196 km with a density of 0.35 km/sq. km.

A total of 202 unrehabilitated landings were enumerated resulting in an estimated area of 1.01 sq. km in this sub-basin.

A total of 361 wetlands occur in this sub-basin with a total area of approximately 89 sq. km. The wetlands were concentrated in two subbasins; 45% in ESSFwc3 and 27% in SBPSmk. Forty-six instances of missing wetland buffers, totalling 30.4 km were observed. Eight instances of wetlands surrounded by a cutblocks accounted for 2.47 sq. km. Agricultural modification of wetlands was identified in 22 locations for a total of 8.33 sq. km.

Riparian lengths as determined from aerial photo interpretation totalled 133 km. Of this length, 10.9 km had been logged (15 instances) and had no buffer strips present. The majority of these occurrences (41%) were in SBPSmk with the remainder divided between SBSmc (26%) and ESSFwk1(25%).

Air photo interpretation revealed that a portion of sub unit 15, containing Cossack Lake, should correctly belong in sub unit 21. However, since all other reports had placed this area in sub unit 15, the area was retained as a portion of sub-unit 15, in order to maintain consistency between reports. As well, the original maps had identified the western boundary for sub unit 21 too far to the west . The western boundary was adjusted for this report.

## 5.9 Woodjam (Sub-units #18, 19 and 20)

The Woodjam Sub-basin includes three small sub-units and covers a total area of 90 ha as determined by GIS analysis. Sub-unit #18, covering 64 km<sup>2</sup>, is the largest unit within the Woodjam basin and includes the mouth of Woodjam Creek where it enters the Horsefly River (Figure 1). Sub-basin #19 covers an area of 13 km<sup>2</sup> immediately upstream of sub-unit #18. Sub-basin #20 covers an area of 13 km<sup>2</sup> and is located in the headwaters of Woodjam Creek

Aerial photo analysis revealed that approximately 11% of the subbasin has been logged. Cutblocks occurred in four biogeoclimatic zones; the majority in ICHmk3 (43%) and ESSFwc3 (33%). The roads occurred in SBSdw (40%), ESSFwk1 (34%) and ICHmk3 (26%). The total road length was determined to be 31 km with a density of 0.31 km/sq. km.

A total of 38 unrehabilitated landings were enumerated resulting in an estimated area of 0.19 sq. km in this sub-basin.

A total of 58 wetlands occur in this sub-basin (5%) with a total area of approximately 5.1 sq. km. The majority of wetlands occurred ESSFwk1 (40%), SBPS mk (33%) and SBSdw1 (25%). Missing wetland buffers were observed in 7 locations for a total of approximately 5 km. Three instance of wetlands surrounded by cutblocks totalled 0.39 sq. km.

Riparian lengths as determined from aerial photo interpretation totalled 111 km. Of this length, 1.8 km had been logged (5 instances) and had no buffer strips present. Most of these occurrences were in SBPS mk (52%) and SBSdw1 (27%).

The calculated area for the Woodjam sub-basin is greater than provided from GIS analyses. From close examination of the air photos of the area, it appears that the sub-basin is larger than shown on the map. According to information from the air photos, the basin should extend more southerly and westerly, in order to be geographically correct.

## 5.10 HORSEFLY WATERSHED ROAD SUMMARY

Major road lengths in the Horsefly Watershed were measured from the 1995 1:50,000 scale Horsefly Forest District Silviculture Plan map. In the Horsefly Watershed there are a total of 299 km. of Forest Service Roads (FSR) and major public roads. Air photo interpretation and GIS analysis revealed an additional 900 km of roads throughout the watershed. The major named and numbered roads are identified below and are listed together with UTM coordinates in Table 5.

The Horsefly B Sub-Basin contains 5 km. of road, the Horsefly Prairie FSR and the Horsefly-Bouldery FSR, both of which are found in Sub-Unit 2. Small portions of these roads continue into the Horsefly A Sub-Basin (Sub-Unit 1).

The Horsefly C Sub-Basin contains 121.5 km. of road. Sub-Unit 13 accounts for 1.5 km. and Sub-Unit 15 for 120 km.. Sub-Unit 15 contains the Corner Lake FSR which forms a loop. Two roads in Sub-Unit 15 continue into adjacent sub-units. The Horsefly FSR continues into the Horsefly B Sub-Basin (Sub-Unit 2) and the Black Cr.-Bosk Lk. FSR continues into the Horsefly C Sub-Basin (Sub-Unit 13).

The MacKay Sub-Basin (Sub-Unit 4) contains 20.5 km. of road.

The McKinley Sub-Basin contains 36.5 km. of road; 0.5 km. is located in Sub-Unit 9, 14.5 km. in Sub-Unit 10 and 21.5 km in Sub-Unit 11.

The McKusky Sub-Basin contains 17 km. of road. This is contained in Sub-Unit 3.

The Moffat Sub-Basin contains 89 km. of road. This is located in Sub-Unit 21. The Deerhorn FSR continues into the Horsefly C Sub-Basin (Sub-Unit 15).

The Tisdall Sub-Basin (Sub-Unit 16) contains 9.5 km. of road.

No major roads are located in the Woodjam Sub-Basin.

**TABLE 5: Horsefly Watershed Sub-basin Road Lengths**

<b>Watershed Sub-Basin (Sub-Unit)</b>	<b>Length (km.)</b>	<b>Watershed Sub-Basin (Sub-Unit)</b>	<b>Length (km.)</b>
Horsefly B (2)-Horsefly A (1)	5.00	Moffat (21)	79.00
Horsefly C (13)	1.50	Moffat (21)-Horsefly C (15)	10.00
Horsefly C (15)	65.50	McKinley (9)	0.50
Horsefly C (15)-Horsefly B (2)	35.00	McKinley (10)	14.50
Horsefly C (15)-Horsefly C(13)	19.50	McKinley (11)	21.50
MacKay (4)	20.50	Tisdall (16)	9.50
McKusky (3)	17.00	<b>TOTAL</b>	<b>299.00</b>

The UTM coordinates for each road are shown in Table 6. The coordinates for each road were determined at the intersection with a major road, at branch points, or where the road entered a Sub-Basin.

**TABLE 6: Horsefly Watershed Road Names and UTM Coordinates**

Road	Number	UTM (N)	UTM (E)
Horsefly Prairie FSR	1242.05	58 00 000	6 37 900
Horsefly-Bouldery FSR	1242.04	58 06 250	6 53 700
Black Cr.-McKinley FSR	1253.04	57 94 000	6 35 250
Corner Lk. FSR	8571.01	57 96 400	6 09 300
Woodjam FSR	9531.01	57 94 700	6 10 450
Sucker Cr. FSR	8891.01	57 94 450	6 16 600
Sucker Cr. FSR	8891.02	57 96 550	6 18 750
Sucker Cr. FSR	8891.03	57 96 700	6 19 400
Road north/south of Horsefly		57 97 750	6 06 100
Road from Horsefly to Little Horsefly R.		57 99 050	6 08 050
Road from Horsefly to Sucker Cr. FSR		57 99 050	6 08 050
Road from Sucker Cr. FSR to Horsefly R.		57 94 450	6 16 600
Road from highway to China Cabin Cr. FSR		57 98 100	6 07 250
Horsefly River FSR	1242.01	57 95 300	6 31 600
Black Cr.-Bosk Lk. FSR	1253.01	57 95 300	6 31 600
Black Cr.-Tisdall Lk FSR	1253.03 Sec A	57 89 700	6 40 000
Black Cr.-Tisdall Lk FSR	1253.03 Sec B	57 88 450	6 38 400
Horsefly-MacKay	1242.03	58 06 200	6 54 800
Gotchen Lk FSR	9173.01	57 81 700	6 52 800
Gotchen West FSR	9173.02	57 80 500	6 54 100
Gotchen-McKinley FSR	9173.03	57 79 150	6 54 600
Spanish-Deception	8611.04	57 69 900	6 63 600
Black Cr.-Cruiser	1253.05	57 87 900	6 48 350
	1253.08	57 86 750	6 49 550
Hendrix-McKinley	5382.03	57 82 450	6 48 250
Hendrix-Molybdenite	5382.02	57 80 300	6 51 150
Hendrix Cr. FSR	5382.01 Sec. B	57 76 850	6 51 800
Horsefly-McKusky FSR	1242.02	58 02 350	6 46 800
Moffat 'Branches'	7986.02-.04	57 78 500	6 15 950
Cossack Lk FSR	9239.01	57 83 150	6 06 350
Moffat Lk FSR	7968.01 Sec. B	57 60 550	6 99 000
Caribou Meadows FSR	9551.01	57 84 500	6 00 250
Branched road near Moffat (21) boundary		57 80 050	6 97 750
Deerhorn FSR	9286.01-.03	57 89 350	6 08 150

### Horsefly annotations

SUBBASIN	PHOTO #	COMMENTS				
HORSEFLY A	95068.164	alpine. avalanche				
HORSEFLY A	95068.166	Cutblock is approximately 1.5 km from alpine				
HORSEFLY A	95068.192	98 cutblock proposed adjacent to riparian area				
HORSEFLY A	95068.194	98 cutblock proposed adjacent to riparian area				
HORSEFLY A	95068.196	Cutblock is approximately 1.5 km from alpine				
HORSEFLY A	95087.034	Cutblock is approximately 2 km from alpine				
HORSEFLY B	94096.256	MDWR BORDERED BY LARGE CUTBLOCK; two separate roads (0.68 and 1.7 km through MDWR				
HORSEFLY B	95068.156	cutblock proximity (approx. 2 km) to alpine				
HORSEFLY B	95068.158-160	cutblock proximity (approx. 1 km) to alpine (this alpine area appears to be surrounded by cutblocks)				
HORSEFLY B	95087.004	cutblock borders alpine & extends down to riparian				
HORSEFLY B	95087.046	Proximity to alpine				
HORSEFLY B	95087.042	96 cutblock borders small wetland area 0.02				
HORSEFLY B	95087.064	old cutblock borders subalpine; logged riparian				
HORSEFLY B	95087.072	extensive logging with several missing buffers				
HORSEFLY B	95087.118	2 large cutblocks less than 1 km sw and nw of alpine				
Horsefly C	94096.008	Cossack L. several cutblocks proposed adjacent to wetlands and lake				
Horsefly C	94096.102	95 cutblock adjacent to wetland				
Horsefly C	94096.244	MDWR-3.15 km of road through				
Horsefly C	94096.246	MDWR-3.22 km of road through; 3.82 road between MDWR and agricultural area				
Horsefly C	94096.248	MDWR-3.26 km of road through; 3.2 road in agricultural area				
Horsefly C	94096.250	MDWR-3.61km road between MDWR and agricultural area; 2 cutblocks (0.18, 0.12km <sup>2</sup> )				
Horsefly C	94096.252	MDWR-3.34 & 2.53 km road				
Horsefly C	94096.254	MDWR-3.81; 0.95 & 1.47 km road				
Horsefly C	94096.256	MDWR-1.11km road				
MACKAY	94096.276	Proximity of cutblock to alpine ridge (<1km).				
MACKAY	95087.034	Cutblock is approximately 2 km from alpine				
MACKAY	95087.076	entire photo area logged -no buffers				
MACKAY	95087.084	Cutblock is approximately 1.5 km from alpine				
MACKAY	95087.082	Cutblock is <1 km from alpine				
MACKAY	95087.109	cutblocks border alpine & extends down to riparian				
MACKAY	95087.114	Cutblock is approximately 1.5 km from alpine				
MACKAY	95087.158	Cutblock is approx 0.5 km from alpine				
MACKAY	95087.160	Cutblock is approximately 1.5 km from alpine				
MACKAY	95087.162	Cutblock is approximately 1.5 km from alpine				

### Horsefly annotations

SUBBASIN	PHOTO #	COMMENTS				
McKinley	94095.167	Bosk L. buffer				
McKinley	94095.213	Cutblock is approximately 0.75 km from sub-alpine ridge				
McKinley	94095.215	lake buffer 1.7 km				
McKinley	94095.221	wetland buffers				
McKinley	94096.028	riparian/cutblock border 1.37				
McKinley	94096.030	large wetland complex border (1 & .47 km) adjacent to cutblock				
McKinley	94096.032	large wetland complex border adjacent to cutblock continued from #130 (see also #86)				
McKinley	94096.036	road/wetland buffer 0.54				
McKinley	94096.038	lake & wetland buffers				
McKinley	94096.042	Cutblock is approximately 1 km from alpine				
McKinley	94096.080	Wildlife visibility concern - lack of wetland buffers in large wetland complex (see also #38)-Molybdenite Cr.				
McKinley	94096.082	missing Elbow lake buffer - logged area not shown on FC map				
McKinley	94096.084	missing Elbow lake buffer - logged area not shown on FC map				
McKinley	94096.086	Wildlife visibility concern - lack of wetland buffers in large wetland complex (see also #32) Molybdenite Cr.				
McKinley	94096.088	Wildlife visibility concern - lack of wetland buffers in large wetland complex (see also #30) Molybdenite Cr.				
McKinley	94096.090	Wildlife visibility concern - lack of wetland buffers in large wetland complex (see also #30) Molybdenite Cr.				
McKinley	94096.148	road/wetland buffers 0.33				
McKinley	94096.202	large wetland adjacent to cutblock - buffer 2.1 km				
McKinley	94096.208	MDWR-1.15 km from cutblock (see#260)				
McKinley	94096.210	MDWR- road length 1.06				
McKinley	94096.254	MDWR - road length 1.47				
MCKUSKY	94096.190	Guide/outfitter trail (4.05, 0.4 & 2.81 through alpine				
MCKUSKY	94096.192	Guide/outfitter trail (3.76) through alpine				
MCKUSKY	94096.194	Guide/outfitter trail (3.43) through alpine				
MCKUSKY	94096.196	Guide/outfitter trail (3.52) through sub-alpine				
MCKUSKY	94096.200	Cutblock borders several large wetlands				
MCKUSKY	94096.202	Cutblock borders large wetland complex (buffer 2.1)				
MCKUSKY	94096.267	road borders large wetland complex				
MCKUSKY	95087.118	Cutblocks are <1 km from alpine				
MCKUSKY	95087.148	large riparian wetland bordered by cutblocks - wildlife visibility concerns				
MCKUSKY	95087.154	Cutblock is <1 km from alpine				

### Horsefly annotations

SUBBASIN	PHOTO #	COMMENTS				
Moffat	94095.025	cutblocks at either end of large wetland - wildlife visibility concerns				
Moffat	94095.115	cutblock adjacent to large wetland complex (buffer 2.93)				
Moffat	94095.119	98 cutblock proposed for wetland complex area				
Moffat	94095.121	98/99 cutblocks adjacent to large wetland complex				
Moffat	94095.123	98 cutblock close to Moffat Cr and large wetland				
Moffat	94095.125	Road crosses wetland (0.41 km); 99 cutblock adjacent to Moffat Cr.				
Moffat	94095.133	large area of converted wetland (1.05) near McIntosh lakes				
Moffat	94095.137	large wetland area at north end of McIntosh Lakes; road length 1.5 km through, ag. mod. wetland 0.68				
Moffat	94095.141	extensive agricultural modification and clearing around wetlands				
Moffat	94095.143	cutblock extends to Moffat creek, no buffer - wildlife visibility concerns				
Moffat	94095.157	large wetland lake complex, proposed cutblocks border - potential wildlife visibility concerns				
Moffat	94095.155	continuation of wetland complex from #155 proposed cutblocks border - potential wildlife visibility concerns				
Moffat	94095.235	extensive wetland complex - proposed cutblocks border - potential wildlife visibility concerns				
Moffat	94095.237	continuation of wetland complex from #235 -lack of buffer zones (2.13; 1.69)				
Moffat	94095.247	large wetland complex south of Cossack Lake - cutblocks proposed - potential for wildlife visibility concerns				
Moffat	94095.253	numerous wetlands - one large modified agricultural wetland - several proposed cutblocks				
Moffat	94096.002	numerous wetlands - one large modified agricultural wetland - several proposed cutblocks				
Moffat	94096.004	wetland - one large modified agricultural wetland - several proposed cutblocks adjacent				
Moffat	94096.020	top end of large wetland complex - proposed cutblocks adjacent -potential for wildlife visibility concerns				
Moffat	94096.112	wetland complex area- proposed cutblocks adjacent -potential for wildlife visibility concerns				
Moffat	94096.118	wetland complex area-road crosses one corner - proposed cutblocks adjacent -potential for wildlife visibility concerns				
Moffat	94096.120	wetland complex area- proposed cutblocks adjacent				
Moffat	94096.124	wetland complex area- extensive agricultural modification along Moffat Cr.				
Moffat	94096.126	wetland complex area- extensive agricultural modification along Moffat Cr.				
Moffat	94096.228	wetland cutblock complex area -road access into this area -potential for wildlife visibility concerns				
Moffat	94096.230	wetland cutblock complex area -road access into this area -potential for wildlife visibility concerns				
Moffat	94096.232	wetland cutblock complex area - several agric. converted wetlands				
Moffat	95018.086	extensive area of converted riparian wetland				
Tisdall	94096.092	cutblock 0.36 not shown on FC map				
Woodjam	94095.237	large cutblock borders 2.25 km riparian				
Woodjam	94095.147	wetland cutblock complex area - lack of wetland buffers (2.13, 1.69)				
Woodjam	94095.243	wetland complex area - several proposed cutblocks				
Woodjam	94096.224	large area of converted riparian/wetland				



## Horsefly comments

Sub-Basin	Photo #	Area	Comments
Horsefly A	95068-164		Proximity to alpine
Horsefly A	95068-166		Cutblock proximity to alpine ?
Horsefly A	95068-192	0.68	98 cutblock borders rip
Horsefly A	95068-194	0.38	98 cutblock borders rip
Horsefly A	95068-196		Cutblock proximity to alpine
Horsefly B	95087-040		Cutblock proximity to alpine
Horsefly B	95087-042		Proximity to alpine ?
Horsefly B	95087-046	0.02	96 cutblock borders wetland
Horsefly C	94096-008	0.61	97 cutblock borders wetland
Horsefly C	94096-008	0.61	98 cutblock borders/covers wetland and pond
Horsefly C	94096-008		3-98 cutblocks border Cossack Lake
Horsefly C	94096-096	1.63	Cutblock covers rip
Horsefly C	94096-096	0.28	Cutblock covers rip
Horsefly C	94096-102	0.13	95 cutblock borders wetland
Horsefly C	94096-102	0.05	95 cutblock borders wetland
Horsefly C	94096-110	0.01	95 cutblock borders wetland
Horsefly C	94096-110	0.04	95 cutblock borders wetland
Horsefly C	94096-110	0.27	98 cutblock borders wetland
Horsefly C	94096-110	0.05	98 cutblock borders wetland
Horsefly C	94096-112	0.89	98 cutblock covers wetland
Horsefly C	94096-112	0.1	98 cutblock covers wetland
Horsefly C	94096-112	0.31	98 cutblock covers wetland
Horsefly C	94096-126	0.03	97 cutblock covers wetland
Horsefly C	94096-126	0.04	97 cutblock covers wetland
Horsefly C	94096-126	0.03	96 cutblock borders wetland
Horsefly C	94096-128	1.06	95 cutblock covers rip
Horsefly C	94096-128	1.62	95 cutblock borders rip
Horsefly C	94096-128	2.63	97 cutblock borders rip
Horsefly C	94096-134	1.13	97 cutblock borders rip
Horsefly C	95018-076	0.17	95 cutblock borders wetland
Horsefly C	95087-134	0.75	97 cutblock adjacent to rip
Horsefly C	95087-134	2.01	97 cutblock adjacent to rip
Horsefly C	95087-136	1.77	97 cutblock borders rip
Horsefly C	95087-136	2.45	97 cutblock borders rip
Mackay	95087-034		Proximity to alpine
Mackay	95087-084		Cutblock close to alpine
Mackay	95087-109		Proximity to alpine
Mackay	95087-158		Proximity of cutblock to alpine
Mackay	95087-160		Proximity of logging to alpine
Mackay	95087-162		Proximity of logging to alpine
McKinley	95095-47	0.13	97 cutblock borders wetland
McKinley	95095-47	2.87	97 cutblock covers rip
McKinley	95095-105	0.05	94 cutblock borders wetland

## Horsefly comments

McKinley	95095-107	0.33	99 cutblock covers wetland
McKinley	95095-159	0.05	99 cutblock covers wetland & borders pond
McKinley	95095-161	0.12	95 cutblock covers wetland
McKinley	95095-165		95 cutblock covers Bosk Lake
McKinley	95095-167	0.02	94 cutblock covers wetland
McKinley	95095-225	0.05	96 cutblock borders wetland
McKinley	95096-028	0.31	99 cutblock borders wetland
McKinley	95096-034	0.07	95 cutblock borders wetland
McKinley	95096-040	0.79	98 cutblock borders rip
McKinley	95096-042	0.01	95 cutblock borders wetland
McKinley	95096-042	0.06	95 cutblock borders wetland
McKinley	95096-090	0.03	99 cutblock borders wetland
McKinley	95096-090	0.07	99 cutblock borders wetland
McKinley	95096-144	0.48	95 cutblock covers rip
McKinley	95096-144	1.04	95 cutblock covers rip
McKinley	95096-146	0.41	95 cutblock covers rip
McKinley	95096-146	0.18	95 cutblock covers rip
McKinley	95096-146	0.26	95 cutblock covers wetland
McKinley	95096-148	0.02	97 cutblock covers wetland
McKusky	95087-148		Large area of wetland buffer is missing
Moffat	94095-025	1.12	95 cutblock with minimal buffer from wetland
Moffat	94095-031	0.19	98 cutblock covers wetland
Moffat	94095-109	0.13	99 cutblock close to Buster Lake & wetland
Moffat	94095-111		98 cutblock close to lake
Moffat	94095-111	0.06	98 cutblock close to wetland
Moffat	94095-111	0.31	98 cutblock close to wetland
Moffat	94095-113	0.14	97 cutblock covers wetland
Moffat	94095-113	0.14	98 cutblock close to lake
Moffat	94095-113	0.14	98 cutblock close towetland
Moffat	94095-113	0.14	98 cutblock close towetland
Moffat	94095-113	0.15	98 cutblock close towetland
Moffat	94095-115	0.07	98 cutblock covers/close towetland
Moffat	94095-115	0.06	98 cutblock covers/close towetland
Moffat	94095-115	1.06	98 cutblock covers/close towetland
Moffat	94095-117		98 cutblock close to Moffat Creek
Moffat	94095-119	2.76	98 cutblock covers wetland complex
Moffat	94095-121	2.46	98 cutblock close to wetland
Moffat	94095-121	0.09	98 cutblock close to wetland
Moffat	94095-121		99 cutblock between wetland borders
Moffat	94095-123		98 cutblock close to Moffat Creek
Moffat	94095-123	1.86	98 cutblock close to wetland
Moffat	94095-123	0.77	99 cutblock covers rip
Moffat	94095-125	1.07	99 cutblock close to rip
Moffat	94095-125	5.21	99 cutblock close to rip
Moffat	94095-125		99 cutblock close to Moffat Creek
Moffat	94095-127	3.89	95 & 96 cutblocks close to rip
Moffat	94095-133		95 cutblock appears to border converted wetland ?