HORSEFLY RIVER WATERSHED

Watershed Restoration Program - Cariboo Region

RIPARIAN, WETLAND AND TERRESTRIAL ASSESSMENT

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EXECUTIVE SUMMARY

The watershed of the Horsefly River, a very important rainbow trout and salmon stream, covers an area of 213,800 hectares on the eastern edge of the Interior Plateau, south of Quesnel Lake and east of Williams Lake (Figure 1). The lowlands in the western part of the watershed are mostly private land that has been developed for agricultural purposes with large areas of the Moffat Creek and Horsefly River riparian zones converted from riparian wetlands to agricultural use. The upper elevations and most of the eastern portion of the drainage are Crown land and part of the provincial Forest.

The Riparian, Wetland and Terrestrial assessment focused on the identification of disturbance and access to sensitive wildlife habitats. Mapping of sensitive areas was conducted from recent aerial photos. Areas where logging activity appeared to be having an impact on wildlife resources were identified, total area affected estimated, and areas where restoration activities could be undertaken were identified (Figure 5).

A biodiversity analysis of the Horsefly River watershed was conducted using seral stage information provided by the Ministry of Forests, and mule deer winter range information provided by the Ministry of Environment, Lands and Parks. Actual seral stage distributions were compared to target seral stage distributions under Forest Practices Code guidelines. Within the Horsefly River study area, the amount of old growth forest remaining in each of the biogeoclimatic zones failed to meet FPC recommended guidelines for the intermediate biodiversity emphasis option in at least half of the sub-basins. Old growth forests in the NDT1 (ESSF) and NDT3 (SBS) biogeoclimatic zones exhibit the greatest departures from FPC targets, with over 80% of the sub-basins with these forest types being below FPC seral stage targets. Nearly two-thirds of the sub-basins with NDT1 (ICH) forest cover have excessive early seral stage growth according to FPC guidelines. From a biodiversity perspective, those sub-units closest to the outer boundaries of the watershed, that is to say the more remote areas, meet the FPC guidelines for seral stage distributions. In contrast, four sub-units near the central portion of the watershed are the most out of compliance with FPC targets. These sub-units generally are deficient in both old and mature plus old seral stages and also have too much early seral cover. Old growth forest types exhibit the greatest departure from target levels with more than three-quarters of the NDT/biogeoclimatic variants having less than the recommended percentage of old growth.

Of the 2,183 km^2 study area, 1,769 km^2 has been identified as forested. Nineteen percent of the total study area, or 24 percent of the forested area, had been logged according to the aerial photos taken in 1994 and 1995. Five percent of the study area consisted of wetland although this figure varied considerably between sub-basins. 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^2 of converted wetland was identified for the Moffat sub-basin and 7.71 km^2 in Horsefly C.

The Horsefly watershed had an overall average of 0.08 km/km^2 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^2 of missing buffers for riparian and wetland areas. In contrast, the McKinley and Horsefly B had high densities of missing buffers, 0.24 km/km^2 and 0.22 km/km^2 respectively. A total of 828 unrehabilitated landings resulted in an average density of 0.37 landings per km^2 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).

A total of twenty-three areas were assigned a high or very high rating for habitat concerns (based on air photos, may include more than one site per photo). Of these areas, 10 were related to alpine habitats and 13 related to riparian and wetland visibility. Extensive impacts were noted on riparian habitats along the Horsefly River, between McKinley and MacKay Creeks. High priority restoration concerns were also identified along McKinley and MacKay Creeks south of the Horsefly River and along Molybdenite Creek.

Recommendations arising from this report included incorporating the site specific data from the report and the sediment survey report into a GIS format to facilitate integrated assessment of these two components. Field inspections were recommended to evaluate needs and feasibility of rehabilitation at the Very-High and High Priority riparian sites. Field visits were also recommended to address agricultural impacts and road driveability. A review of road access and options for implementing restrictions or deactivation was recommended for the sites providing access to alpine habitats.

Summaries of individual sub-basins and their sub-units follow.

5.1.1 Horsefly A (Sub-unit 1)

The Horsefly A Sub-basin is characterized by very mountainous terrain. Forest harvesting development is not extensive and has thus far been confined to the lower portions of the watershed. There are no mule deer winter ranges in this sub-unit. Aerial photo analysis revealed that approximately 3% of the sub-basin has been logged. However, future valley bottom logging has been identified on Forest Development Plans. The total road density was 0.16 km/km^2. A total of 21 unrehabilitated landings were enumerated. No wetland or riparian areas appeared to have been disrupted by logging activity. The sediment source survey (Carr 1996), found 84% of the sediment sources to be natural slope and gully problems, with most of the slope failures concentrated in the alpine and sub-alpine areas.

Most of this sub-unit consists of mature and old seral stages (91%) with only a small proportion (7%) in early seral stages. Of the two natural disturbance types (NDT1 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents only 5% of the total forested area. Within NDT1 (ESSF) only the climax or old seral stage falls short of the recommended minimum.

5.1.2 Horsefly B (Sub-units #2 and 14)

The Horsefly B Sub-basin covers an area of 169 km^2 of which 47% has been logged. The road density was established at 1.03 km/km^2 and a total of 127 unrehabilitated landings were noted. A total of 139 wetlands occur in this sub-basin with an area of approximately 15 km^2. Eighteen instances of missing wetland buffers totaled 19.5 km in length. Logged riparian zones lacking buffers equaling 21.4 km, have been identified as high priority for restoration. In many cases the Horsefly River valley had been harvested on both sides leaving only a minimal or no buffer strip adjacent to the riparian zone. Of the 138 sediment sources noted in these sub-basins (Carr 1996), 77% of which were man-made, all but one associated with forest development. The relatively high number of natural slope and gully problems (22) indicates sensitivity of the soils and terrain to resource development.

Sub-basin 2 has a total forested area of 15,856 hectares, with 1.7% (271 ha) within known mule deer winter ranges. Most of this sub-unit, not including the mule deer winter range area, consists of early seral stages with relatively little old seral stage growth remaining. Within NDT1 (ESSF) both the early and the old seral stages do not meet the recommended targets. Neither NDT1 (ICH) or NDT2 (ICH) meet the seral stage target percentages. Within both natural disturbance types, the mature plus old and old seral stages fall short of the recommended minimum requirements.

Sub-basin 14 has a total forested area of 2011 hectares, roughly equally distributed between the early, mid-seral, and mature plus old categories (i.e. 38%, 28% & 34%, respectively).

5.1.3 Horsefly C (Sub-unit #15)

The Horsefly C Sub-basin covers an area of 238 km^2 of which 8% has been logged. The road density was established at 0.52 km/km^2 and a total of 47 unrehabilitated landings were noted. A total of 139 wetlands occur in this sub-basin with a total area of approximately 14 km^2. Two wetland areas, totaling 0.5 km^2 have been isolated by logging activity. Agricultural modification of wetlands was identified in 13 locations for a total of 4.86 km^2. Riparian buffers were missing along 9.41 km (5.5%) of stream. No high priority sites for restoration activity were identified in this sub-basin. However, concerns were noted with respect to the amount of riparian habitat which had been converted to agricultural use along the Horsefly River.

Sub-basin 15 has a total forested area of 21,207 hectares, with 11.5% (2448 ha.) in known mule deer winter ranges. Most of this sub-unit, including the mule deer winter range area, consists of mature and mid-seral stages with only a lesser proportion in early and old seral stages. Mid-seral stages represent nearly two-thirds of the forested area in this unit at present, due largely to the previous forest harvesting history.

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

The McKusky Sub-basin consists of 4 sub-units and covers an area of 307 km^2 of which 21% has been logged. The road density was established at 0.75 km/km^2 and a total of 72 unrehabilitated landings were noted. A total of 139 wetlands occur in this sub-basin with a total area of approximately 14 km^2. Two wetland areas, totaling 0.5 km^2 have been isolated by logging activity. A total of 70 wetlands occur in this sub-basin with a total area of approximately 6.93 km^2. Four instances of missing wetland buffers were observed for a total of 1.49 km in length. Riparian buffers were found to be missing in 16 instances along 14.7 km (approximately 10%) of the riparian zones). The sediment source survey revealed that the majority of sediment sources (61 cases) were associated with sub-unit 3 and that over half of these were man-made (57%).

Sub-unit 3 includes all of the lower watershed of McKusky Creek between its confluence with the Horsefly River and the point where McKusky Creek flows into Crooked Lake. Most of the forest development activity in this sub-basin has occurred along the lower portions of McKusky Creek with more recent activity along the western side of Crooked Lake. Of the two natural disturbance types (NDT1 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents only 3.6% of the total forested area. Within NDT1, early seral stages are overrepresented in this unit at present, due to the previous forest harvesting history. Within NDT1 (ESSF) both the early and the old seral stages fail to meet the recommended targets.

Sub-unit 5 is a small (29 km^2) sub-basin of upper McKusky Creek, above Crooked Lake. There are no roads into this area and no forest development has occurred to date. Present seral stage distributions meet all of the recommended guidelines for FPC, except for the early seral stage of NDT1 (ESSF) which is only slightly higher than the target figure.

Sub-unit 6 represents the mainstem of McKusky Creek, above Crooked Lake. It has an area of 73.8 km^2. There are no roads into this area and no forest development has occurred to date. Except for old growth in NDT1 (ESSF) present seral stage distributions in this sub-unit meet all of the recommended guidelines for FPC.

Sub-unit 7 is a small (20 km^2) drainage of an unnamed creek which enters McKusky Creek from the south, a short distance above Crooked Lake. No forest development has occurred in this sub-basin to date, and there are no roads entering this area. Present seral stage distributions in this sub-basin meet all of the recommended guidelines for FPC.

5.1.5 MacKay (Sub-unit #4)

The MacKay Sub-basin encompasses 144 km^2 approximately 19% of which has been logged. The road density was established at 0.34 km/km^2 and a total of 42 unrehabilitated landings were noted. A total of 16 wetlands occur in this sub-basin with a total area of approximately 1 km^2. No instances of missing wetland buffers were observed. However, 12.1 km of missing riparian buffers (17 instances) were noted. The sediment source survey (Carr, 1996) noted 89 sources, of which approximately 39% were man-made. This sub-basin has generally very steep terrain. A high number of natural slope and gully problems (52) are an indication of the sensitivity of the soils and terrain within the sub-basin. Several instances of cutblocks occurring in close proximity to alpine habitats were noted. However, most of the forest development activity in this sub-basin has occurred along the lower elevations of MacKay Creek and several locations of missing riparian buffers were identified as high priority sites for restoration action. Most of forest harvesting activity is relatively recent so that climax and mature forest types still predominate this sub-basin.

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

The McKinley Sub-basin encompasses 443 km^2 approximately 35% of which has been logged. The road density was established at 0.51 km/km^2 and a total of 292 unrehabilitated landings were noted. A total of 122 wetlands occupy a total area of approximately 23 km^2. Missing wetland buffers were observed in 38 locations, totaling over 31 km. Missing riparian buffers were noted along 8.5 km of stream. A major wetland complex along Molybdenite Creek was identified as a high priority for restoration action as was a site situated to the east of Bosk Lake. Fifteen instances of missing lake buffers were detected for a total of 10.1 km.

Sub-unit 8 on the northeast side of Gotchen Lake covers approximately 25.5 km^2. Some forest development activity has occurred in this sub-basin in recent years. Present seral stage distributions meet all of the recommended guidelines for FPC, except for the old seral stage of NDT1 (ESSF) which is considerably lower than the target.

Sub-unit 9 includes the upper reaches of the McKinley Creek watershed, upstream of Gotchen Lake. Approximately two-thirds of the total forested area in this sub-unit is in NDT1, with the balance in NDT2. Present seral stage distributions meet all of the recommended guidelines for the Forest Practices Code, except for the old seral stage of NDT1 (ESSF) which is considerably lower than the target.

Of the total forested area in this **sub-unit 10**, one-half is in NDT1 and one-half in NDT2. Present seral stage distributions meet all of the recommended guidelines for the Forest Practices Code, except for the old seral stage of NDT1 (ESSF) which is considerably lower than the target.

Sub-basin 11 has a total forested area of 16,242 hectares. Most of this sub-unit consists of early and mature seral stages with only a lesser proportion in mid-seral and old seral stages.

Sub-basin 12 has a total forested area of 7,173 hectares. Within NDT1 (ESSF) all of the seral stages are presently within Forest Practices Code guidelines. Within NDT2 (ICH) the seral stage percentages meet the target percentages with the exception of old forests.

Sub-unit 13 includes 722 ha (11%) within known mule deer winter ranges. Most of this sub-unit, not including the mule deer winter range area, consists of early (18.1%) and mid-seral (58.7%) stages with lesser amounts in mature and old seral stages.

5.1.7 Tisdall (Sub-unit #16)

The Tisdall Sub-basin encompasses 71 km^2 approximately 12% of which has been logged. The road density was established at 0.29 km/km^2 and a total of 32 unrehabilitated landings were noted. A total of 39 wetlands occupy a total area of approximately 3.5 km^2. No instances of missing wetland or riparian buffer strips were noted. One instance of a missing lake buffer accounted for 0.33 km.

Sub-basin 16 encompassing a total forested area of 6378 hectares, with slightly more than one-half in the mid-seral category (54% or 3441 ha) has no known mule deer winter ranges within its boundaries

5.1.8 Moffat (Sub-units #17 and 21)

The Moffat Sub-basin encompasses 557 km^2 approximately 19% of which has been logged. The road density was established at 0.35 km/km^2 and a total of 202 unrehabilitated landings were noted. Wetlands are prominent in this sub-basin with a total of 361 wetlands occupying an area of approximately 89 km^2. Fourty-six instances of missing wetland buffers, totaling 30.4 km were observed. Eight instances of wetlands surrounded by cutblocks accounted for 2.47 km^2. Agricultural modification of wetlands was identified in 22 locations for a total of 8.33 km^2. Riparian buffer strips were noted as absent along 10.9 km of riparian habitats (15 instances) accounting for less than 10% of the riparian lengths observed.

Sub-basin 17 has a total forested area of 8,319 hectares, with nearly one-half (49.5%) in the mature seral category with no known mule deer winter range areas within its boundaries. With the exception of the old seral stage in the NDT1 (ESSF) all of the seral stage components are within Forest Practices Code biodiversity guidelines.

Sub-basin 21 has a total forested area of 40,454 hectares, with less than 1% (378 ha) in known mule deer winter ranges. Most of this sub-unit, including the mule deer winter range area, consists of mature and mid-seral stages (75.7%) with only a lesser percentage (24.3%) in early and old seral stages.

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

The Woodjam Sub-basin encompasses 90 km^2 approximately 11% of which has been logged. The road density was established at 0.31 km/km^2 and a total of 38 unrehabilitated landings were noted. A total of 361 wetlands occupy a total area of approximately 89 km^2.

A total of 58 wetlands occupy a total area of approximately 5.1 km^2. Missing wetland buffers were observed in 7 locations for a total of approximately 5 km. Three instance of wetlands surrounded by cutblocks totaled 0.39 km^2. Less than 1.8 km of riparian zones had missing buffers (5 instances).

Sub-basin 18 has a total forested area of 6036 hectares, with more than one-half (57.8% or 3494 ha) in the mid-seral category.

Sub-basin 19 has a total forested area of 1253 hectares, with nearly 85% (1056 ha) in the mid-seral category. Within all three natural disturbance types in this sub-unit, the mature plus old and old seral stages fall short of the recommended Forest Practices Code minimum requirements.

Sub-basin 20 has a total forested area of 1249 hectares, with nearly half (45% or 560 ha) in the mid-seral category. Within NDT1 (ESSF) none of the three seral stages (early, mature plus old, and old) meet the recommended Forest Practices Code requirements. Within NDT3 (SBPS) the existing seral stage distribution is within the levels recommended under FPC guidelines. Within NDT3 (SBS) the early seral stage component is within FPC guidelines, however, the mature plus old and old seral stages fall short of the recommended Forest Practices Code minimums.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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 Interior Watershed Assessment Procedure (IWAP)
- 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 discussion of the results from the Level 1 IWAP and Sediment Source Inventory where applicable. Section 5.1 of this report 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. The results of the Biodiversity Assessment, based on seral stage analysis (GIS) of Ministry of Forests data, are presented in Section 5.2. Roads, wildlife visibility and sensitivity concerns as well as potential restoration activities are addressed in the remainder of the report.

2.0 Objectives

2.1 Riparian, Wetland, and Terrestrial Assessment

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.

2.1 Biodiversity Assessment

The objective of the biodiversity analysis is to assess whether old growth and forest seral stage targets are being met in the various sub-units of the watershed. Information regarding the seral stage composition of known mule deer winter ranges within the sub-units was analysed separately to allow determination of potential impacts on wildlife habitat based on seral stage data.

3.0 Watershed Characteristics

The Horsefly River watershed, above the Little Horsefly River, covers an area of 213,800 hectares. 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 western portions of the Horsefly River watershed are characterized by lowlands with extensive wetland areas. The Horsefly River is a very important rainbow trout stream, and supports an important salmon fishery.

The lowlands in the western part of the watershed are mostly private land that has been developed for agricultural purposes. Large areas of the Moffat 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.

Based on the Interior Watershed Assessment Procedure (IWAP), conducted by Dobson Engineering Ltd. as part of the overall Horsefly River Assessment Project, the watershed has been divided into 21 sub-basins (Figure 1, Table 3.1). These sub-basins formed the basis for the biodiversity assessment.

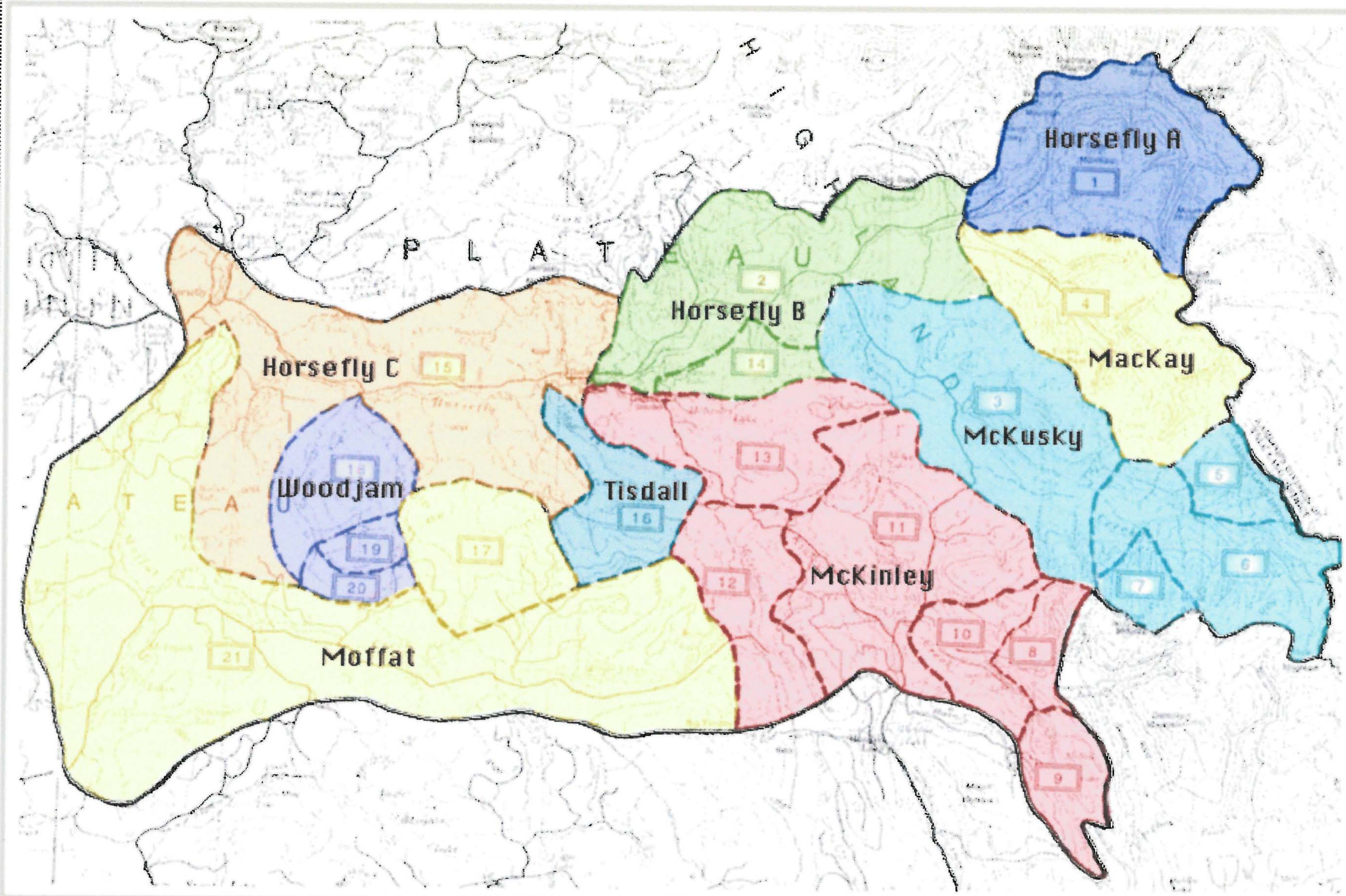


Figure 1: Horsefly River Watershed Subbasins

Table 3.1. Horsefly River Watershed Sub-unit Areas

Sub-Basin	Area (sq. km)	Sub-Basin	Area (km^2)
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	**Total**	**2183**

For the purposes of the Riparian, Wetland, and Terrestrial assessment and the watershed road summary, all 21 sub-units that were used for the biodiversity -seral stage analysis but were pooled into 9 larger sub-basins (Table 3.2) for the photo interpretation and analysis of impacts.

Table 3.2. Horsefly River Watershed Sub-basin Areas

Sub-basin	Sub-units	Area (km^2)
Horsefly A	1	145
Horsefly B	2, 14	189
Horsefly C	15	238
MCKINLEY	8, 9, 10, 11, 12, 13	445
MCKUSKY	3,5,6,7	307
MACKAY	4	144
MOFFAT	17, 21	557
TISDALL	16	71
WOODJAM	18, 19, 20	90
TOTAL		2186

4.0 Approach and Methodology

4.1 Riparian, Wetland and Terrestrial Assessment

The Riparian, Wetland and Terrestrial assessment focused on identification of disturbance and access to sensitive wildlife habitats. Mapping of sensitive areas included all of those areas which could be discerned from recent air photos. 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.

Black and white air photos at a scale of 1:15,000 were provided to AIM by the Ministry of Environment for the purposes of this assessment (except for southern portions of sub units 9, 10 and 21). The lower two-thirds of the Horsefly basin were photographed in September 1994, while the remaining upper third was flown in 1995 (Appendix 1).

In addition to conventional stereoscopic air photo analysis, this project used computer enhancement of the air photos 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. All roads which bordered or entered areas where wildlife visibility was of 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 MOELP 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. Images which include moderate-High to Very-High impacts are included(Appendix 4).

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 of 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.

The errors identified above could be compensated for by using orthophotography or by georeferencing images to a planimetrically correct database such as TRIM.

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"[1]. 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.

4.2 Biodiversity Assessment

The Horsefly River Watershed Biodiversity Assessment is based on the 21 sub-units developed for the purposes of the IWAP (Interior Watershed Assessment Procedure) completed by Dobson Engineering Ltd. in March 1996. Figure 1 shows the boundaries of the 21 sub-units or sub-basins which make up the Horsefly River watershed upstream of the Little Horsefly River. Appendix 3 summarizes the biodiversity information used for this report. The seral stage computations for this biodiversity assessment were completed by Inland Timber using Ministry of Forests data. This information appears in the attached Appendix 3.

The Forest Practices Code of British Columbia publication "Biodiversity Guidebook" (September 1995) identifies biodiversity objectives for the province based on five natural disturbance types (NDT's). Within each natural disturbance type, seral stage objectives (forest ages) have been established for the various biogeoclimatic subzones and variants. Recommended or target seral stage distributions (in percent cover) for each biogeoclimatic unit occurring in the NDT is presented in tabular form with objectives identified for each of three biodiversity emphasis options (low, intermediate, and high). The intermediate biodiversity emphasis option was used for the analysis.

[1] IWAP Level 1 Procedures Manual

5.0 Results and Discussion

5.1 Riparian, Wetland, and Terrestrial Assessment

Aerial photo interpretation focused 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 for each sub-basin 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. Of the 2183 km^2 study area, 1769 km^2 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 (Table 5.1). The greatest proportion of logging has occurred in the Horsefly B sub-basin, over 45% of this sub-basin has been harvested. Of all the other sub-basins only McKinley and McKusky exceeded 20% harvesting (Figure 2).

The Horsefly watershed had 188 km of missing buffers for an overall average of 0.08 km/km^2. 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^2 of missing buffers for riparian and wetland areas. In contrast, the McKinley and Horsefly B had high densities of missing buffers, 0.24 km/km^2 and 0.22 km/km^2 respectively (Table 5.2). The Moffat sub-basin had the greatest length of missing wetland buffer, followed closely by McKinley and Horsefly B (Figure 3). Riparian buffer impacts were greatest in Horsefly B followed by McKusky, MacKay and Moffat sub-basins.

A total of 828 unrehabilitated landings resulted in an average density of 0.37 landings per km^2 for the watershed. The greatest density occurred in the McKinley sub-basin (1.15) followed by Horsefly B (0.67). Actual numbers of landings were greatest in the McKinley sub-basin, followed by the Moffat sub-basin (Figure 4). 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).

Figure 2: Horsefly River Watershed - Proportions of Logged and Wetland Area According to Sub-basin

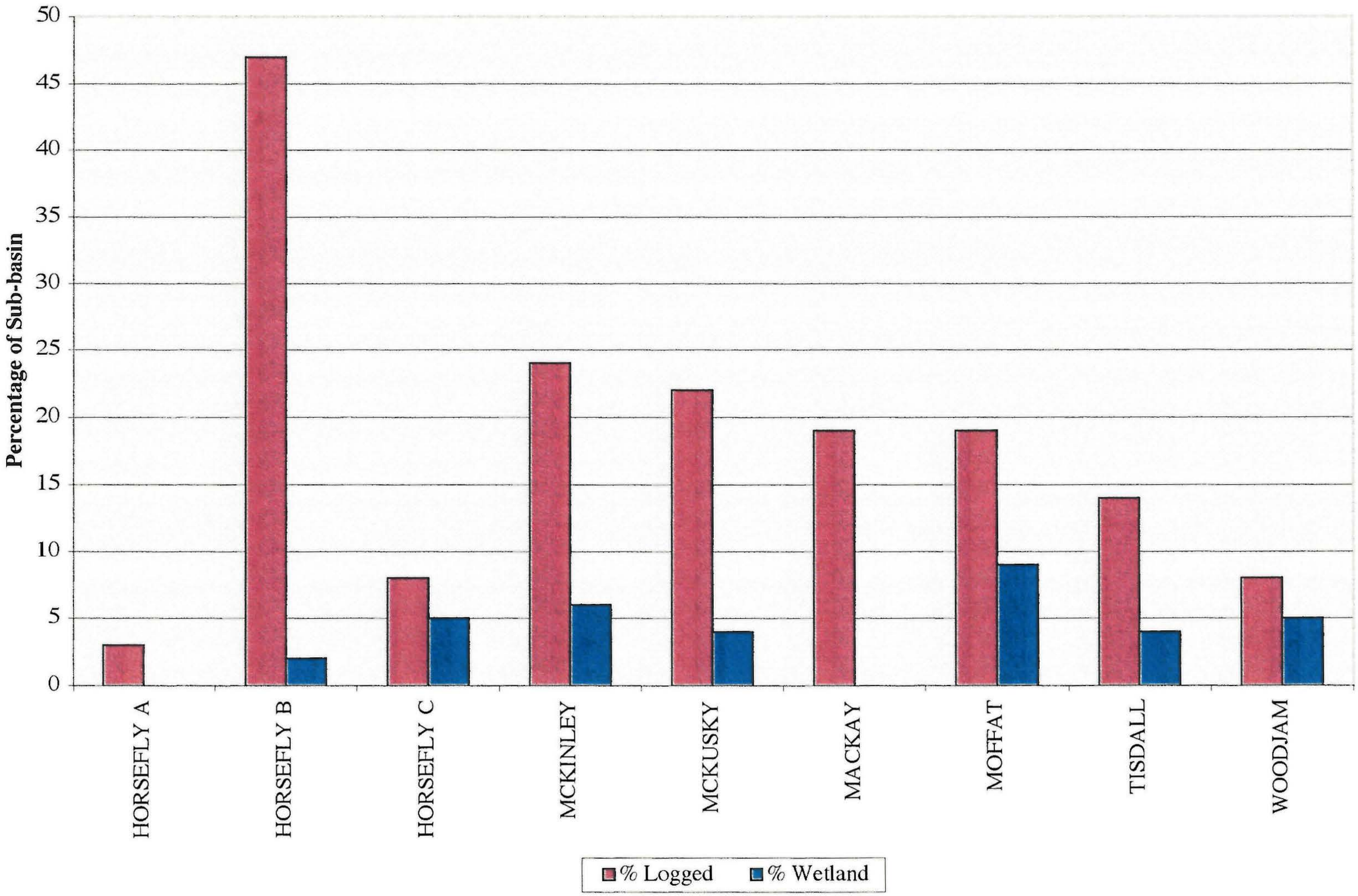


Figure 3: Horsefly River Watershed - Length of Missing Buffers According to Sub-basin

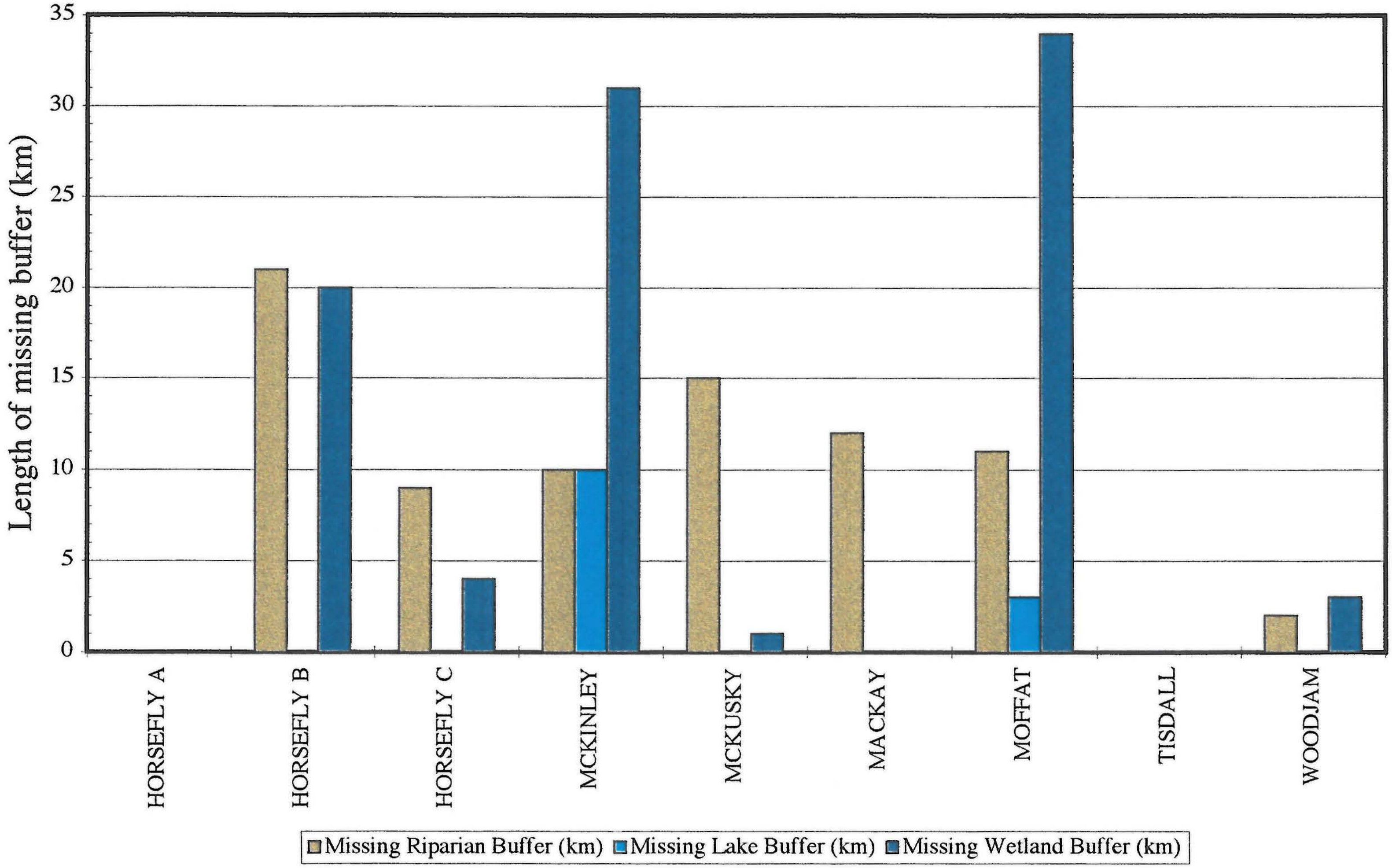
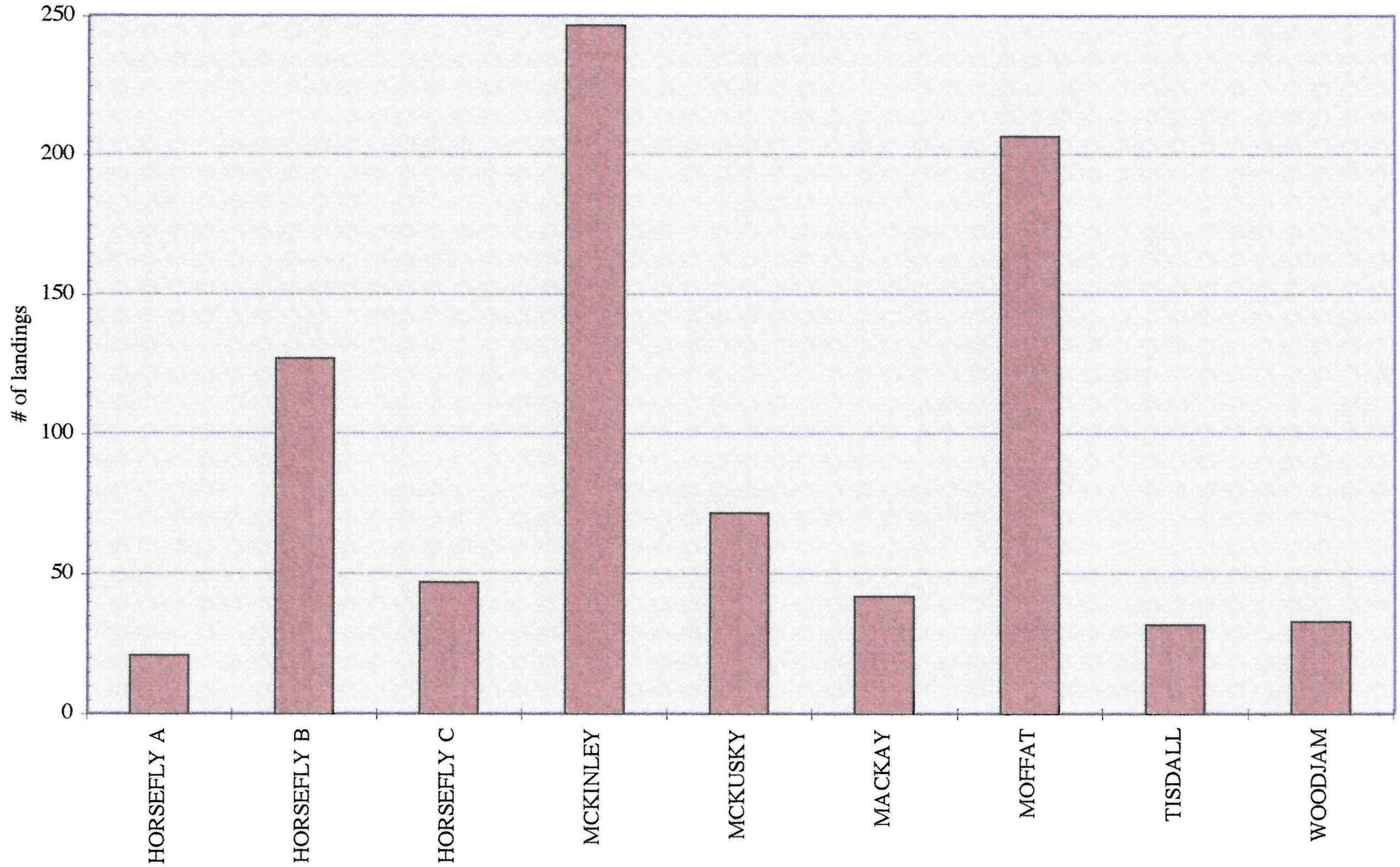


Figure 4: Horsefly River Watershed - Number of Landings According to Sub-basin



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^2 of converted wetland was identified for the Moffat sub-basin and 7.71 km^2 in Horsefly C.

Table 5.1 below summarizes the previous information by sub-basin for the percent area logged, percent wetland area, length of missing riparian buffer and missing lake buffer, the total number of landings, and the road lengths.

Table 5.1: Horsefly Watershed Sub-basin Summary

	% Logged	% Wetland	Missing Riparian Buffer (km)	Missing Lake Buffer (km)	Missing Wetland Buffer (km)	# of Landings
HORSEFLY A	3	<1	0	0	0	21
HORSEFLY B	47	2	21	0	20	127
HORSEFLY C	8	5	9	<1	4	47
MCKINLEY	24	6	10	10	31	247
MCKUSKY	22	4	15	0	1	72
MACKAY	19	<1	12	0	0	42
MOFFAT	19	9	11	3	34	207
TISDALL	14	4	0	<1	0	32
WOODJAM	8	5	2	0	3	33
TOTAL	19	5	80	15	93	828

Table 5.2 below summarizes the above information by sub-basin for the density of forest related activity including the density of landings, roads, and missing buffers.

Table 5.2: Density of Forestry Related Activity

	landings # per km^2	road density km/km^2	missing buffers km/ km^2
HORSEFLY A	0.11	0.16	0
HORSEFLY B	0.67	1.03	0.22
HORSEFLY C	0.16	0.52	0.04
MCKINLEY	1.15	1.00	0.24
MCKUSKY	0.17	0.30	0.04
MACKAY	0.26	0.45	0.07
MOFFAT	0.37	0.35	0.08
TISDALL	0.42	0.36	0.00
WOODJAM	0.29	0.27	0.04
Total	0.37	0.47	0.08

5.1.1 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 MacKay Creek (Figure 1). The area of Sub-unit #1 was determined by GIS analysis to be 142 km^2.

Aerial photo analysis revealed that approximately 3% of the sub-basin 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 30 km with a density of 0.16 km/km^2. A total of 21 unrehabilitated landings were enumerated for these logged areas resulting in an estimated area of 0.11 km^2.

A total of 11 wetlands with a total area of approximately 0.61 km^2 were identified in this sub-basin. The wetlands were concentrated in two biogeoclimatic zones; 69% in AT and 31% in ESSFwk1. No wetland or riparian areas appeared to have been disrupted by logging activity. The sediment source survey found 84% of the sediment sources to be natural slope and gully problems, with most of the slope failures concentrated in the alpine and sub-alpine areas.

5.1.2 Horsefly B (Sub-units #2 and 14)

The Horsefly B Sub-basin is comprised of two Sub-units; #2 covers an area of 169 km^2 and is located in the north central portion of the watershed centered along the Horsefly River from MacKay Creek to McKinley Creek. Sub-unit #14 covers an area of 20 km^2 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 sub-basin 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/km^2.

A total of 127 unrehabilitated landings resulting in an area of 0.64 km^2 were enumerated for this sub-basin.

A total of 139 wetlands occur in this sub-basin with a total area of approximately 15 km^2. The wetlands were concentrated in two biogeoclimatic zones; 68% in ICH wk2 and 32% in ESSFwk1. Two wetland areas, totaling 0.32 km^2 have been isolated by logging activity. Eighteen instances of missing wetland buffers were observed for a total of 19.5 km in length. Of the riparian zones examined on the aerial photos, 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%). Most of these have been identified as high priority for restoration. In many cases the Horsefly River valley had been harvested on both sides leaving only a minimal or no buffer strip adjacent to the riparian zone (see photos 95087: 36-40; 72; 106; and 126-130).

5.1.3 Horsefly C (Sub-unit #15)

The Horsefly C Sub-basin (Sub-unit #15) covers an area of 238 km^2 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 sub-basin 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/km^2. A total of 47 unrehabilitated landings resulted in an estimated area of 0.31 km^2 in this sub-basin.

A total of 139 wetlands occur in this sub-basin with a total area of approximately 14 km^2. The wetlands were concentrated in two biogeoclimatic zones; 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, totaling 0.5 km^2 have been isolated by logging activity. Agricultural modification of wetlands was identified in 13 locations for a total of 4.86 km^2.

Riparian lengths as determined from aerial photo interpretation totaled 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 km) was identified. No high priority sites for restoration activity were identified in this sub-basin. However, concerns were noted with respect to the amount of riparian habitat which had been converted to agricultural use along the Horsefly River.

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

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

Aerial photo analysis revealed that approximately 21% of the sub-basin 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 $ICHwk^2$ (54%) with lower proportions in the remaining four biogeoclimatic zones. The total road length was determined to be 130 km with a density of 0.75 km/km^2.

A total of 72 unrehabilitated landings were enumerated resulting in an estimated area of 0.36 km^2 in this sub-basin.

A total of 70 wetlands occur in this sub-basin with a total area of approximately 6.93 km^2. The wetlands were concentrated in two biogeoclimatic zones; 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 km^2 had been isolated by logging activity.

Riparian buffers were found to be missing in 16 instances along 14.7 km (approximately 10% of the riparian zones). Over half of these occurrences (54%) were in ESSFwc3 with the bulk of the remainder (42%) in ICH wk2. Several sites along the lower McKusky Creek (see aerial photos 95087: 122 and 148) were identified as high priority sites for restoration action as did two sites northwest of Crooked Lake (see 94096:200-202 and 267). The sediment source survey revealed that the majority of sediment sources (61 cases) were associated with sub-unit 3 and that over half of these were man-made (57%).

5.1.5 MacKay (Sub-unit #4)

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

Aerial photo analysis revealed that approximately 19% of the sub-basin 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/km^2.

A total of 42 unrehabilitated landings were enumerated resulting in an estimated area of 0.21 km^2 in this sub-basin.

A total of 16 wetlands occur in this sub-basin with a total area of approximately 1 km^2. The wetlands were concentrated in two biogeoclimatic zones; 55% in ESSFwc3 and 38% in AT. No instances of missing wetland buffers were observed.

Riparian lengths as determined from aerial photo interpretation totaled 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. The sediment source survey (Carr, 1996) noted 89 sources, which were approximately 39% man-made. A high number of natural slope and gully problems (52) are an indication of the sensitivity of the soils and terrain within the sub-basin.

Several instances of cutblocks occurring in close proximity to alpine habitats were noted in this sub-basin. These occurred on both sides of the valley and affect the Eureka Peak region to the southwest, and the McCallum Peak/Mount Perseus areas to the northeast. Several sites along the lower MacKay Creek (see aerial photos 95087: 78 to 82) were identified as high priority sites for restoration action.

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

The McKinley Sub-basin consists of 6 sub-units totaling 443 km^2 (Figure 1). Sub-unit #8 covers an area of 26 km^2 and is located east of Gotchen Lake. Sub-basin #9 covers an area of 40 km^2 encompasses McNeil Lake). Sub-unit #10 covers an area of 42 km^2 and is located south of McKinley Lake and west of Gotchen Lake. Sub-basin #11 covers an area of 180 km^2 encompassing Elbow and Bosk Lakes and Bassett and McKinley Creeks. Sub-unit #12 covers an area of 80 km^2 and is along Molybdenite Creek with the Moffat sub-basin to the west. Sub-unit #13 encompasses McKinley Creek covering an area of 77 km^2 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 sub-basin has been logged. Cutblocks occurred in five biogeoclimatic zones; the majority in ICHmk3 (43%) and ESSFwc3 (33%). The majority of roads were in ICHmk3 (63%). The total road length was determined to be 216 km with a density of 0.51 km/km^2.

A total of 292 unrehabilitated landings were enumerated resulting in an estimated area of 1.46 km^2 in this sub-basin.

A total of 122 wetlands occur in this sub-basin with a total area of approximately 23 km^2. 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 31 km. Three instance of wetlands surrounded by cutblocks totaled 0.36 km^2.

Riparian lengths as determined from aerial photo interpretation totaled 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. A major wetland complex along Molybdenite Creek (see aerial photos 95087: 028-030 and 086-088) was identified as a high priority for restoration action as was a site situated to the east of Bosk Lake (94096: 080 - sub-unit 10). Fifteen instances of missing lake buffers were assessed, totaling 10.1 km.

5.1.7 Tisdall (Sub-unit #16)

The Tisdall Sub-basin (Sub-unit #16) covers an area of 71 km^2 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 the sub-basin 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/km^2.

A total of 32 unrehabilitated landings were enumerated resulting in an estimated area of 0.16 km^2 in this sub-basin.

A total of 39 wetlands occur in this sub-basin with a total area of approximately 3.5 km^2. Over 95% of the wetlands occurred in SBSdw1. Missing wetland buffers were not observed. One instance of wetlands surrounded by a cutblock accounted for 0.02 km^2.
No instances of missing buffer strips were detected. One instance of a missing lake buffer accounted for 0.33 km.

5.1.8 Moffat (Sub-units #17 and 21)

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

Aerial photo analysis revealed that approximately 19% of the sub-basin 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/km^2.

A total of 202 unrehabilitated landings were enumerated resulting in an estimated area of 1.01 km^2 in this sub-basin.

A total of 361 wetlands occur in this sub-basin with a total area of approximately 89 km^2. The wetlands were concentrated in two biogeoclimatic zones; 45% in ESSFwc3 and 27% in SBPSmk. Fourty-six instances of missing wetland buffers, totaling 30.4 km were observed. Eight instances of wetlands surrounded by cutblocks accounted for 2.47 km^2. Agricultural modification of wetlands was identified in 22 locations for a total of 8.33 km^2.

Riparian buffer strips were noted as absent along 10.9 km of riparian habitats (15 instances) accounting for less than 10% of the riparian lengths observed. The majority of these occurrences (41%) were in SBPSmk with the remainder divided between SBSmc (26%) and ESSFwk1(25%). The sediment source survey noted 12 sediment sources in Sub-units 17, all of which are harvesting and access road related, and 127 sediment sources in Sub-unit 21. Approximately 91% of these sediment sources were man-made, with 73% associated with forest development. There are 22 sediment source sites associated with agricultural areas, primarily associated with Moffat Creek.

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.

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

The Woodjam Sub-basin includes three small sub-units and covers a total area of 90 km^2 as determined by GIS analysis. Sub-unit #18, covering 64 km^2, 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^2 immediately upstream of sub-unit #18. Sub-basin #20 covers an area of 13 km^2 and is located in the headwaters of Woodjam Creek.

Aerial photo analysis revealed that approximately 11% of the sub-basin 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/km^2.

A total of 38 unrehabilitated landings were enumerated resulting in an estimated area of 0.19 km^2 in this sub-basin.

A total of 58 wetlands occur in this sub-basin (5%) with a total area of approximately 5.1 km^2. 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 totaled 0.39 km^2.

Of the riparian zones examined on aerial photos, less than 2% or 1.8 km had been logged (5 instances). Most of these occurrences were in SBPS mk (52%) and SBSdw1 (27%). The sediment source survey found a total of 15 sediment sources for this sub-basin, only one of which was considered to be a natural source, with the remainder associated with forest harvesting and access roads.

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.

5.2 Biodiversity Assessment

Excluding NDT5 (Alpine Tundra), which does not have defined seral stages, there are three natural disturbance types (NDT's 1,2,&3), representing five different NDT/biogeoclimatic zone combinations in the watershed study area. The following table shows both the total number of sub-units in which each NDT variant occurs, and the percentage of the total number of sub-units (21) in the watershed.

NDT	BGCZ	Number of sub-units occurs in	Percentage of total sub-units (21)
1	ESSF	21	100 %
1	ICH	9	43 %
2	ICH	10	48 %
3	SBPS	4	19 %
3	SBS	9	43 %

NDT1 (ESSF) is the most widely occurring biogeoclimatic type, appearing in all 21 sub-units in the watershed study area. Three other variants (NDT1-ICH, NDT2-ICH, and NDT3-SBS) are found in slightly less than half of the sub-units. NDT3 (SBPS) has the narrowest distribution, occurring in only 19% of all the sub-units.

The following table shows the percentage of watershed sub-units in which the actual seral stage components do not meet the recommended levels for the intermediate biodiversity option under the Forest Practices Code. Within the mature plus old and old growth seral stages, the figures represent the percentage of the total number of sub-units, excluding sub-units which consist entirely of mule deer winter range areas, which have less than the FPC recommended minimum levels for these age classes. For example, within NDT1 (ESSF) in the old growth seral stage we see that 84.2% of the sub-units with this forest cover type have less than the FPC recommended guidelines. For the early seral stage component, the percentage figure indicates the proportion of the non-mule deer winter range sub-units having more than the FPC recommended maximum level.

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	36.8%	21.0%	84.2%
1	ICH	62.5%	50.0%	62.5%
2	ICH	11.0%	44.4%	66.6%
3	SBPS	0%	25.0%	50.0%
3	SBS	0%	62.5%	87.5%

Within the 213,800 hectare Horsefly River study area, that is to say that portion of the watershed upstream of the Little Horsefly River, the amount of old growth forest remaining in each of the biogeoclimatic zones fails to meet FPC recommended guidelines for the intermediate biodiversity emphasis option in at least half of the sub-basins. Old growth forests in the NDT1 (ESSF) and NDT3 (SBS) biogeoclimatic zones exhibit the greatest departures from FPC targets, with over 80% of the sub-basins with these forest types being below FPC seral stage targets. With respect to early seral stage distributions nearly two-thirds of the sub-basins with NDT1 (ICH) forest cover have excessive early seral stage growth according to FPC guidelines.

5.2.1. Sub-unit #1 - Upper Horsefly River above MacKay River

Sub-unit 1 is the Horsefly River watershed upstream of the MacKay River. It has an area of 141 km^2. Much of this sub-basin is characterized by very mountainous terrain. Forest harvesting development is not extensive and has thus far been confined to the lower portions of the watershed. Of the 93 sediment sources identified in a related study only 16% (i.e. 15 sites) were identified as forestry-related, while the rest (84% or 78 sites) were from natural sources. There are no mule deer winter ranges in this sub-unit.

With respect to biodiversity, the following table of actual and FPC target seral stage distributions indicates that most of this sub-unit consists of mature and old seral stages (91%) with only a small proportion (7%) in early seral stages.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	7 (<22)	91 (>36)	7 (>19)
5	AT	0	0	0

Of the two natural disturbance types (NDT1 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents only 5% of the total forested area. Within NDT1 (ESSF) only the climax or old seral stage falls short of the recommended minimum requirement of >19%. This old seral stage objective can be reached over time, by allowing portions of the mature component to age further.

5.2.2. Sub-unit #2- Middle Horsefly River above the Falls

This sub-unit is a face unit of the mainstem Horsefly River and is comprised of a number of small drainages which flow directly into the Horsefly River between the MacKay River and McKinley Creek. The surface area is 168.5 km^2. This sub-unit falls within two separate Landscape Units, the draft boundaries of which were changed after this study was initiated.

Forest development is widespread throughout this sub-basin. A recently completed sediment source inventory for the Horsefly River watershed identified 138 sediment sources in this sub-basin, 77% (106 of 138) of which are man-made, with all but one (i.e. 105 of 106 sediment sources) associated with forest development.

Sub-basin 2 has a total forested area of 15,856 hectares, with 1.7% (271 ha.) within known mule deer winter ranges. In terms of biodiversity, the following table of actual and FPC target seral stage distributions indicates that most of this sub-unit, not including the mule deer winter range area, consists of early seral stages with relatively little old seral stage growth remaining.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	55 (<22)	48 (>36)	5 (>19)
1	ICH	77 (<30)	20 (>34)	1 (>13)
2	ICH	87 (<66)	3 (>31)	1 (>9)
3	AT	0	0	0

Of the three natural disturbance types (NDT1, 2 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents less than 1% of the total forested area. Early seral stages are overrepresented in this unit at present.

Within NDT1 (ESSF) both the early and the old seral stages do not meet the recommended targets. Only the mature plus old category is presently within FPC guidelines. The old seral stage minimum requirement of >19% can be reached over time by allowing portions of the mature component to age further.

Within NDT1 (ICH) none of the seral stage percentages are within the targets and it will be some time before the early seral stage areas mature into the older categories. Old growth targets can be met in the future by allowing most of the existing mature cover to reach climax conditions.

Within NDT2 (ICH) the seral stage percentages are well outside the target percentages. It will be a considerable length of time before the early seral stage areas mature into the older categories as the mid-seral stage (between early and mature) is only a small portion (10%) of the total forested area in NDT2 at present. Old growth targets can only be met in the future through careful planning and retention of existing mature and old forests.

The 271 ha of mule deer winter range in this sub-basin are found within two natural disturbance types (NDT1&2), and the seral stage distributions of these are as follows:

MULE DEER WINTER RANGE

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	3 (<22)	**17** (>36)	**10** (>19)
2	ICH	7 (<36)	**6** (>31)	**0** (>9)

Most of the mule deer winter range in this sub-unit (211 ha or 78%) occurs within NDT2 (ICH), and NDT 1 (ESSF) represents only 22% of the total mule deer winter range area. Within both natural disturbance types, the mature plus old and old seral stages fall short of the recommended minimum requirements. Because the mid-seral stage covers 86% (233 ha) of the mule deer winter range area, these mature and old seral stage objectives may be reached over time by allowing portions of the mid-seral stage component to age. It is interesting to note that the seral stage distributions of the mule deer winter range are very different from the seral stage distributions of the rest of the sub-unit, with the mid-seral stages covering only 6% of the non-winter range area and 86% of the mule deer winter range.

5.2.3. Sub-unit #3 - Lower McKusky Creek

Sub-unit 3 includes all of the lower watershed of McKusky Creek between its confluence with the Horsefly River and the point where McKusky Creek flows into Crooked Lake. It thus includes several small creek drainages which flow directly into Crooked Lake.
The surface area of sub-unit 3 is 184 km^2.

Most of the forest development activity in this sub-basin has occurred along the lower portions of McKusky Creek with more recent activity along the western side of Crooked Lake. A recent sediment source inventory for the Horsefly River watershed identified 61 sediment sources in this sub-basin, of which 57% (35 of 61) are man-made, with only two of the man-made sediment sources not associated with forest development (one being related to agriculture, the other related to recreation).

Sub-basin 3 has a total forested area of 13,111 hectares. In terms of biodiversity, the following table of actual (and target) seral stage distributions indicates that most of this sub-unit consists of early seral stages with lesser amounts in mature and old seral stages.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**55** (<22)	42 (>36)	**6** (>19)
1	ICH	**63** (<30)	**33** (>34)	**11** (>13)
5	AT	0	0	0

Of the two natural disturbance types (NDT1 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents only 3.6% of the total forested area. Within NDT1, early seral stages are overrepresented in this unit at present, due to the previous forest harvesting history. In addition, the mid-seral stages represent only a very small portion (3.4%) of the total forested area within this disturbance type.

Within NDT1 (ESSF) both the early and the old seral stages fail to meet the recommended targets. Only the mature plus old category is presently within FPC guidelines. The old seral stage minimum requirement of >19% can be reached, over time, by allowing required portions of the mature component to age further.

Within NDT1 (ICH) none of the seral stage percentages are within the targets, although both the mature and old categories are only 1% and 2% under target, respectively. It will be some time before the early seral stage areas mature into the older categories, due to the paucity of mid-seral stage forest cover. Old growth targets may be met in the future by retaining the existing mature and old forest cover classes.

5.2.4. Sub-unit #4 - MacKay River

Sub-unit 4 represents the drainage of the MacKay River, which has an area of 144 km^2. This sub-basin has generally very steep terrain.

Most of the forest development activity in this sub-basin has occurred along the lower elevations of MacKay Creek. Most of this activity is relatively recent so that climax and mature forest types still predominate this sub-basin. The recent sediment source inventory for the Horsefly River watershed identified 89 sediment sources in this sub-basin, of which 39% (35 of 89) are man-made, with all but one of the man-made sediment sources associated with forest development (the other being related to a minesite).

Sub-basin 4 has a total forested area of 7,562 hectares, with only a small portion in mid-seral stages. In terms of biodiversity, the following table of actual and target seral stage distributions indicates that most of this sub-unit consists of early and mature seral stages with a smaller amount of old seral stage forest.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**31** (<22)	67 (>36)	**9** (>19)
1	ICH	**100** (<30)	**0** (>34)	**0** (>13)
5	AT	0	0	0

Of the two natural disturbance types (NDT1 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents less than 9% of the total forested area. Within NDT1, early seral stages, at first glance, appear to be highly overrepresented in this unit. Furthermore, the mid-seral stages represent only a very small portion (2.6%) of the total forested area within this disturbance type, an indication of the relatively recent introduction of forest harvesting to the sub-basin.

Within NDT1 (ESSF) both the early and the old seral stages fall short of the recommended targets. Only the mature plus old category is presently within FPC guidelines. The old seral stage minimum requirement of >19% can be reached, over time, by allowing appropriate portions of the mature component to age.

Within NDT1 (ICH) none of the seral stage percentages are within the targets, although it is important to recognize that this biogeoclimatic zone covers only one hectare of the sub-basin. The overall contribution this biogeoclimatic zone to the sub-basin is thus relatively insignificant.

5.2.5. Sub-unit #5 - Upper McKusky Creek

This sub-unit is a small (29 km^2) sub-basin of upper McKusky Creek, above Crooked Lake. There are no roads into this area and no forest development has occurred to date. Only two natural sediment sources were found during the sediment source inventory.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**27** (<22)	65 (>36)	29 (>19)
1	ICH	1 (<30)	99 (>34)	87 (>13)
5	AT	0	0	0

As an unlogged watershed this sub-unit contains little in the way of mid-seral stage forest cover. Present seral stage distributions meet all of the recommended guidelines for FPC, except for the early seral stage of NDT1 (ESSF) which is only slightly higher than the target figure.

5.2.6. Sub-unit #6- Upper McKusky Creek

Sub-unit 6 represents the mainstem of McKusky Creek, above Crooked Lake. It has an area of 73.8 km^2. There are no roads into this area and no forest development has occurred to date. Only three natural sediment sources (gully/slope failures) were found during the recent sediment source inventory.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	6 (<22)	89 (>36)	**15** (>19)
1	ICH	6 (<30)	89 (>34)	64 (>13)
5	AT	0	0	0

Except for old growth in NDT1 (ESSF) present seral stage distributions in this sub-basin meet all of the recommended guidelines for FPC. The early and mid-seral stages represent only 10% of the total forested area in NDT1. Similarly, NDT2 (Alpine Tundra) accounts for only 5% of the total forested area in this sub-basin. There is sufficient mature plus old in this biogeoclimatic zone to enable this target to be met in the future.

5.2.7. Sub-unit #7 - Upper McKusky Creek

This sub-unit is a small (20 km^2) drainage of an unnamed creek which enters McKusky Creek from the south, a short distance above Crooked Lake. No forest development has occurred in this sub-basin to date, and there are no roads entering this area. Only one natural sediment source, a gully/slope failure, was found during the sediment source inventory.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	0 (<22)	100 (>36)	31 (>19)
1	ICH	0 (<30)	100 (>34)	67 (>13)
5	AT	0	0	0

Present seral stage distributions in this sub-basin meet all of the recommended guidelines for FPC. Within NDT1, the early and mid-seral stages are completely absent from this sub-unit, and all of the forested area is covered by the two oldest age classes, mature and old. NDT2 (Alpine Tundra) accounts for 15% of the total forested area in this sub-basin.

5.2.8. Sub-unit #8 - Upper McKinley Creek

A small drainage on the northeast side of Gotchen Lake covering some 25.5 km^2. Some forest development activity has occurred in this sub-basin in recent years.

A recent sediment source inventory for the Horsefly River watershed identified 6 sediment sources in this sub-basin, of which 33% (2 of 6) are man-made, with one associated with forest development and the other related to recreation.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	0 (<22)	79 (>36)	3 (>19)
2	ICH	14 (<36)	70 (>31)	24 (>9)
5	AT	0	0	0

Present seral stage distributions meet all of the recommended guidelines for FPC, except for the old seral stage of NDT1 (ESSF) which is considerably lower than the target. There is sufficient mature plus old in this biogeoclimatic zone to enable this target to be met in the future.

5.2.9. Sub-unit #9 - Upper McKinley Creek

Sub-unit 9 includes the upper reaches of the McKinley Creek watershed, upstream of Gotchen Lake. The surface area is 39.7 km^2. A recent sediment source inventory for the Horsefly River watershed identified 5 sediment sources in this sub-basin, all of which are natural sediment sources.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	20 (<22)	45 (>36)	3 (>19)
2	ICH	0 (<36)	53 (>31)	24 (>9)

Approximately two-thirds of the total forested area (2251 of 3429 ha) in this sub-unit is in NDT1, with the balance in NDT2. Present seral stage distributions meet all of the recommended guidelines for the Forest Practices Code, except for the old seral stage of NDT1 (ESSF) which is considerably lower than the target. There is sufficient mature plus old in this biogeoclimatic zone to enable this target to be met in the future through natural recruitment from mature stands.

5.2.10 Sub-unit #10- Upper McKinley Creek

This sub-unit covers that portion of the McKinley Creek watershed, between Gotchen Lake and Bosk Lake. The surface area is 41.6 km^2.

A recent sediment source inventory for the Horsefly River watershed identified 15 sediment sources in this sub-basin, of which 73% (11 of 15) are associated with forest development. The rest are natural sediment sources.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	1 (<22)	82 (>36)	4 (>19)
2	ICH	22 (<36)	68 (>31)	12 (>9)
5	AT	0	0	0

Of the total forested area in this sub-unit, one-half is in NDT1 and one-half in NDT2. NDT5 (Alpine Tundra) represents less than 1% of the total forested area in this sub-unit. Present seral stage distributions meet all of the recommended guidelines for the Forest Practices Code, except for the old seral stage of NDT1 (ESSF) which is considerably lower than the target. There is sufficient mature plus old in this biogeoclimatic zone to enable this target to be met in the future through natural aging of existing mature stands.

5.2.11 Sub-unit #11 - Middle McKinley Creek

Sub-unit 11 includes the middle portion of the McKinley Creek watershed, between Elbow Lake and Bosk Lake. This sub-unit covers an area of 180 km^2.

Forest development is widespread throughout this sub-basin. A recently completed sediment source inventory for the Horsefly River watershed identified 83 sediment sources in this sub-basin, 94% (78 of 83) of which are man-made, with all but five (i.e. 73 of 78 man-made sediment sources) associated with forest development. The five non-forestry related sediment sources are associated with recreation (4) and mining (1).

Sub-basin 11 has a total forested area of 16,242 hectares. In terms of biodiversity, the following table of actual (and target) seral stage distributions indicates that most of this sub-unit consists of early and mature seral stages with only a lesser proportion in mid-seral and old seral stages.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**35** (<22)	57 (>36)	**11** (>19)
1	ICH	**36** (<30)	35 (>34)	**9** (>13)
2	ICH	31 (<36)	48 (>31)	**4** (>9)
5	AT	0	0	0

Of the three natural disturbance types (NDT1,2 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents less than 1% of the total forested area. Early seral stages of NDT1 are overrepresented in this unit at present.

Within NDT1 (ESSF) both the early and the old seral stages fall short of the recommended targets. Only the mature plus old category is presently within FPC guidelines. The old seral stage minimum requirement of >19% can be reached over time, by allowing portions of the mature component to age further.

Within NDT1 (ICH) only the mature plus old category is presently within FPC guidelines, with 35% actual compared to 34% recommended. Both the early and the old seral stages do not meet the recommended targets. Mid-seral stages in this category occupy 1109 ha, or one-third, of the total forested area. However, it will be some time before the early and mid-seral stage areas mature into the older categories.

Within NDT2 (ICH) the seral stage percentages meet the target percentages with the exception of old growth forests. Old growth targets can only be met in the future by retaining sufficient mature forests.

5.2.12 Sub-unit #12 - Molybdenite (McKinley) Creek

This sub-unit covers that portion of the McKinley Creek watershed drained by Molybdenite Creek. The surface area is 80 km^2.

A recently completed sediment source inventory for the Horsefly River watershed identified 43 sediment sources in this sub-basin, 98% (42 of 43) of which are man-made, with all but two of these (i.e. 40 of 42 sediment sources) associated with forest development. The three non-forestry related sediment sources are associated with mining (1) and natural slope/gully failures (2).

Sub-basin 12 has a total forested area of 7,173 hectares. The following table shows actual and target seral stage distributions within this sub-unit.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	9 (<22)	78 (>36)	46 (>19)
2	ICH	34 (<36)	52 (>31)	**1** (>9)
3	SBS	30 (<54)	**20** (>23)	**0** (>11)
5	AT	0	0	0

Of the four natural disturbance types (NDT1, 2, 3 and 5) in this sub-unit, NDT5 (Alpine Tundra) represents less than .03% of the total forested area. Within NDT1 (ESSF) all of the seral stages are presently within Forest Practices Code guidelines.

Within NDT2 (ICH) the seral stage percentages meet the target percentages with the exception of old forests. Old growth targets for NDT2 can be met in the future by retaining a sufficient amount of the mature forest component.

Natural disturbance type 3 represents only slightly more than 1% of the total forested area in this sub-unit. Within NDT3 (SBS) only the early seral stage category is presently within FPC guidelines. Both the mature plus old and the old seral stages fall short of the recommended targets. There is no old growth SBS left in this sub-basin. Mid-seral stages occupy 40 ha, or one-half, of the total forested area in this category. As the mid-seral and mature stages age they have the potential to meet the recommended percentages for the two oldest categories.

5.2.13. Sub-unit #13_- Lower McKinley Creek

Sub-unit 13 covers the lower portion of the McKinley Creek watershed between the Horsefly River and Elbow Lake. It has a surface area of 77 km^2.

Forest development is widespread throughout this sub-basin. A recently completed sediment source inventory for the Horsefly River watershed identified 37 sediment sources in this sub-basin, 84% (31 of 37) of which are man-made, with all but three (i.e. 28 of 31 manmade sediment sources) associated with forest development. Of the three man-made, but non-forestry related, sediment sources two are associated with recreation and one with agriculture.

Sub-basin 13 has a total forested area of 6,724 hectares, with 11% (722 ha.) within known mule deer winter ranges. In terms of biodiversity, the following table of actual and target seral stage distributions indicates that most of this sub-unit, not including the mule deer winter range area, consists of early (18.1%) and mid-seral (58.7%) stages with only lesser amounts in mature and old seral stages (16.1% and 7%, respectively).

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**25** (<22)	**24** (>36)	**13** (>19)
1	ICH	**32** (<30)	**30** (>34)	**5** (>13)
2	ICH	18 (<36)	**31** (>31)	**8** (>9)
3	SBS	2 (<54)	3 (>23)	2 (>11)

Within NDT1 (ESSF) all three seral stages do not meet the recommended targets. The mid-seral stage represents the largest category of forest cover type in NDT1 (ESSF) at present.

Within NDT1 (ICH) none of the seral stage percentages are within the targets and it will be some time before the two early seral stages (early and mid-seral) can mature into the older categories. Old growth targets can be met in the future by allowing an appropriate amount of mature cover to reach climax conditions.

Within NDT2 the seral stage percentages are close to the target percentages for the mature plus old and old categories. Careful planning of forest harvesting activities should allow these figures to be maintained in the future.

Actual seral stage distributions in natural disturbance type 3 (SBS) diverge considerably from recommended targets. Nearly 96% of the total forested area in NDT3 consists of the mid-seral stage. It will be some time before the mid-seral stage areas mature into the older categories. Old and mature plus old targets can only be met in the future through careful planning and retention of existing mature and old forests.

The 722 ha of mule deer winter range in this sub-basin are found within three natural disturbance types (NDT1, 2 & 3), and the seral stage distributions of these are as follows:

MULE DEER WINTER RANGE

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	0 (<22)	**0** (>36)	**2** (>19)
2	ICH	5 (<36)	**6** (>31)	**5** (>9)
3	SBS	0 (<54)	**4** (>23)	**0** (>11)

Most of the mule deer winter range in this sub-unit (619 ha or 86%) occurs within NDT2 (ICH). NDT1 (ESSF) and NDT3 (SBS) represent only 6.6% and 7.6%, respectively, of the total mule deer winter range area. Within all three natural disturbance types, the mature plus old and old seral stages fall short of the recommended minimum requirements. Because the mid-seral stage covers 90% (649 ha) of the mule deer winter range area, these mature and old seral stage objectives may be reached over time by allowing portions of the mid-seral stage component to age.

5.2.14. Sub-unit #14 - Horsefly River (Doreen Creek)

This small sub-unit (20 km^2) consists of the watershed of Doreen Creek which enters the Horsefly River from the south, approximately half way between McKusky and McKinley Creeks. Of the 13 sediment sources recently identified in the sub-basin, 11 are associated with forest harvesting activities, while two are natural sediment sources. This entire sub-unit lies within known mule deer winter ranges.

Sub-basin 14 has a total forested area of 2,011 hectares, roughly equally distributed between the early, mid-seral, and mature plus old categories (i.e. 38%, 28% & 34%, respectively).

MULE DEER WINTER RANGE

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**45** (<22)	**24** (>36)	3 (>19)
1	ICH	18 (<30)	47 (>34)	**11** (>13)
2	ICH	**50** (<36)	43 (>31)	16 (>9)

Most of this sub-unit (1160 ha or 57.7%) occurs within NDT1 (ESSF); NDT1 (ICH) and NDT2 (ICH) represent only 27% and 15%, respectively, of the total area.

Within NDT1 (ESSF) all three seral stage categories fall short of the recommended levels. The mature and old seral stage objectives may be reached over time by allowing portions of the early and mid-seral stage components to age.

Within NDT1 (ICH) the old seral stage category falls short of the recommended target. The old seral stage objective may be reached over time by allowing portions of the mature seral stage component to reach climax conditions.

The early seral stage composition in natural disturbance type 2 (ICH) is considerably greater than the recommended target, likely due to recent forest harvesting activities. Both the old and mature plus old seral stages currently fall within Forest Practices Code guidelines and careful planning will allow retention of appropriate amounts of these mature and old forest types.

5.2.15. Sub-unit #15 - Middle Horsefly River above Little Horsefly River.

This sub-unit is a face unit of the lower mainstem of the Horsefly River and consists of a number of small drainages which flow directly into the Horsefly River between McKinley Creek and the Little Horsefly River. It is one of the larger sub-units with a surface area of 237.5 km^2.

Forest development is widespread throughout much of this sub-basin. A recently completed sediment source inventory for the Horsefly River watershed identified 79 sediment sources in this sub-basin, 77% of which are man-made, with 53% associated with forest development. Of the nineteen man-made, but non-forestry related, sediment sources, sixteen are associated with agriculture, two are associated with mining and one with recreation.

Sub-basin 15 has a total forested area of 21,207 hectares, with 11.5% (2448 ha.) in known mule deer winter ranges. Most of this sub-unit, including the mule deer winter range area, consists of mature and mid-seral stages with only a lesser proportion in early and old seral stages.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	11 (<22)	**32** (>36)	**3** (>19)
2	ICH	0 (<36)	3 (>31)	**0** (>9)
3	SBPS	17 (<66)	36 (>17)	13 (>7)
3	SBS	9 (<54)	**21** (>23)	**2** (>11)

Of the three natural disturbance types (NDT1,2 and 3) in this sub-unit, NDT3 (SBS & SBPS) represents more than 82% of the total forested area. Mid-seral stages represent nearly two-thirds of the forested area in this unit at present, due largely to the previous forest harvesting history.

Within NDT1 (ESSF) both the mature plus old and the old seral stages fall short of the recommended targets. Only the early category is presently within FPC guidelines. The old seral stage minimum requirement of >19% can be reached over time, by allowing portions of the mature and mid-seral stage components to age further.

Within NDT2 (ICH) only the early category is presently within its seral stage target. This natural disturbance type represents only 0.3% (69 ha) of the total forested area outside the mule deer winter range.

Within NDT3 (SBS & SBPS) the seral stage percentages are generally well within the target percentages. The two exceptions are the mature plus old and old seral stages in the SBS biogeoclimatic zone. The mid-seral stage (between early and mature) represents a large portion (nearly 70%) of the total forested area in NDT3 (SBS) at present. Old and mature plus old targets may be met in the future as this mid-seral component ages.

The 2,448 ha of mule deer winter range found in this sub-basin are found within three natural disturbance types (NDT1, 2 & 3), and the seral stage distributions of these are as follows:

MULE DEER WINTER RANGE

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	0 (<22)	**0** (>36)	**0** (>19)
2	ICH	0 (<36)	**5** (>31)	**0** (>9)
3	SBS	2 (<54)	**19** (>23)	**4** (>11)

Most of the mule deer winter range in this sub-unit (2249 ha or 92%) occurs within NDT3, while NDT2 (ICH) and NDT1 (ESSF) represent only 7.5% and 0.5% respectively, of the total mule deer winter range area. Within all three natural disturbance types, the mature plus old and old seral stages fall short of the recommended minimum requirements. Because the mid-seral stage covers 80.5% (1,971 ha) of the mule deer winter range area, these mature and old seral stage objectives may be reached over time by allowing portions of the mid-seral stage component to age.

5.2.16. Sub-unit #16 - Tisdall Creek

Tisdall Creek drains Tisdall Lake into the Horsefly River just below Black Creek. Sub-unit 16 encompasses some 71 km^2 of land near the geographic centre of the Horsefly River drainage. Of the 29 sediment sources recently identified in the sub-basin, approximately 86% are associated with forest harvesting activities. Of the four other non-forestry sediment sources, one is related to recreational interests and the remaining three are natural sediment sources. This sub-unit has no known mule deer winter ranges within its boundaries.

Sub-basin 16 has a total forested area of 6,378 hectares, with slightly more than one-half in the mid-seral category (54% or 3441 ha).

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**34** (<22)	50 (>36)	**0** (>19)
2	ICH	35 (<36)	**15** (>31)	**0** (>9)
3	SBS	7 (<54)	**21** (>23)	**8** (>11)

Of the three natural disturbance types (NDT's 1, 2 and 3) in this sub-unit, NDT3 (SBS) represents more than 57% of the total forested area.

Within NDT1 (ESSF) both the early and the old seral stages do not meet the recommended targets. Only the mature plus old category is presently within FPC guidelines. The old seral stage minimum requirement of >19% can be reached over time, by allowing portions of the mature and mid-seral stage components to age further.

Within NDT2 (ICH) only the early category is presently within its seral stage target. Over 50% of the total forested area in this natural disturbance type is in the mid-seral stage category. Old and mature plus old targets may be met in the future as this mid-seral component matures.

Within NDT3 (SBS) the seral stage percentages are generally close to or within the target percentages. The mid-seral stage (between early and mature) represents a large portion (nearly 72%) of the total forested area in NDT3 (SBS) at present. In the future, old and mature targets may be met as this mid-seral component ages.

5.2.17. Sub-unit #17 - Moffat Creek

A small sub-unit covering the north-central portion of the Moffat Creek watershed and covering 74 km^2. All of the 12 sediment sources recently identified in the sub-basin are associated with forest harvesting activities. This sub-unit has no known mule deer winter range areas within its boundaries.

Sub-basin 17 has a total forested area of 8319 hectares, with nearly one-half (49.5%) in the mature seral category.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	13 (<22)	47 (>36)	4 (>19)
3	SBS	13 (<54)	85 (>23)	24 (>11)

There are two natural disturbance types within this sub-unit. With the exception of the old seral stage in the NDT1 (ESSF) all of the seral stage components are within Forest Practices Code biodiversity guidelines. The old seral stage requirement for NDT1 (ESSF) can eventually be met through recruitment from the mature seral stage forest type in the sub-unit.

5.2.18. Sub-unit #18 - Woodjam Creek

Sub-unit 18 includes the lower portion of Woodjam Creek which flows directly into the Horsefly River from the south. The surface area is 64 km^2. Of the 12 sediment sources recently identified in the sub-basin, two-thirds (8) are associated with forest harvesting activities. Of the four other sediment sources, one is a natural sediment source and the remaining three are related to agriculture. This sub-unit has no known mule deer winter range area within its boundaries.

Sub-basin 18 has a total forested area of 6036 hectares, with more than one-half (57.8% or 3494 ha) in the mid-seral category.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	0 (<22)	35 (>36)	15 (>19)
3	SBPS	0 (<66)	59 (>17)	10 (>7)
3	SBS	7 (<54)	24 (>23)	7 (>11)

Within NDT1 (ESSF) both the mature plus old and old seral stages are slightly lower than, but within 1% to 4% of, the recommended targets. The mature and old seral stage requirements for NDT1 (ESSF) can eventually be met through recruitment from the mid-seral stage forest type in the sub-unit.

There are two biogeoclimatic subzones within natural disturbance type 3 in this sub-unit. In NDT3 (SBPS) all of the seral stage components are within Forest Practices Code biodiversity guidelines. In NDT3 (SBS) the old seral stage component is less than that recommended in the Forest Practices Code biodiversity guidelines. There is a large component (68%) of mid-seral stage forest type in the NDT3 (SBS) which will allow the old growth target to be met in the future.

5.2.19. Sub-unit #19 - Woodjam Creek

A small sub-basin of Woodjam Creek, sub-unit 19 covers 12.7 km^2. There were no sediment sources identified in this sub-unit. Sub-basin 19 has a total forested area of 1253 hectares, with nearly 85% (1056 ha) in the mid-seral category.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	9 (<22)	**19** (>36)	**0** (>19)
3	SBPS	0 (<66)	**2** (>17)	**1** (>7)
3	SBS	3 (<54)	**8** (>23)	**0** (>11)

Within all three natural disturbance types in this sub-unit, the mature plus old and old seral stages fall short of the recommended Forest Practices Code minimum requirements. Because the mid-seral stage covers nearly 85% of the forested area in sub-unit 19, the mature and old seral stage objectives may be reached over time by allowing adequate portions of the mid-seral stage component to age.

5.2.20. Sub-unit #20 - Woodjam Creek

Sub-unit 20 incorporates the upper portion of Woodjam Creek immediately north of the Moffat Creek watershed. The surface area is 13 km^2. Three man-made sediment sources were identified in this unit, all associated with forest harvesting and access roads.

Sub-basin 20 has a total forested area of 1,249 hectares, with nearly half (45% or 560 ha) in the mid-seral category. This entire sub-unit is located in mule deer winter range.

MULE DEER WINTER RANGE

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	**100** (<22)	**0** (>36)	**0** (>19)
3	SBPS	0 (<66)	56 (>17)	24 (>7)
3	SBS	37 (<54)	**6** (>23)	**2** (>11)

Within NDT1 (ESSF) none of the three seral stages (early, mature plus old, and old) meet the recommended Forest Practices Code requirements. NDT1 covers only 11% (138 ha) of the total forested area in the sub-unit and all of this natural disturbance type is in an early stage of seral development. It will be a long time before the mature and old seral stages can become reestablished in the NDT1 (ESSF) zone.

Within NDT3 (SBPS) the existing seral stage distribution is within the levels recommended under FPC guidelines.

Within NDT3 (SBS) the early seral stage component is within FPC guidelines, however, the mature plus old and old seral stages fall short of the recommended Forest Practices Code minimums. Because the mid-seral stage covers nearly 57% of the forested area in NDT3 (SBS), the mature and old seral stage objectives may be reached over time by allowing sufficient amounts of the mid-seral stage component to develop into these age classes.

5.2.21. SUB-UNIT #21 - Moffat Creek

The largest of all the sub-units at 483 km^2, sub-unit 21 encompasses most of the Moffat Creek drainage. Moffat Creek enters the Horsefly River just upstream of the community of Horsefly.

Forest development is widespread throughout much of this sub-basin. A recently completed sediment source inventory for the Horsefly River watershed identified 127 sediment sources in this sub-basin. Approximately 91% of the sediment sources are man-made, with 73% associated with forest development. Of the 22 non-forestry related, man-made sediment sources, all are associated with agriculture. There are only 12 natural sediment sources in this sub-unit.

Sub-basin 15 has a total forested area of 40,454 hectares, with less than 1% (378 ha) in known mule deer winter ranges. In terms of biodiversity, most of this sub-unit, including the mule deer winter range area, consists of mature and mid-seral stages (75.7%) with only a lesser percentage (24.3%) in early and old seral stages.

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
1	ESSF	21 (<22)	44 (>36)	**13** (>19)
3	SBPS	14 (<66)	51 (>17)	**7** (>7)
3	SBS	16 (<54)	60 (>23)	**2** (>11)
5	AT	0	0	0

Of the three natural disturbance types (NDT1, 3 and 5) in this sub-unit, NDT3 represents more than 73% of the total forested area. Mid-seral stages represent one-third of the forested area in this unit at present, due largely to the previous forest harvesting history. NDT5 (Alpine Tundra) represents only a small fraction of 1% of the total forested area in this sub-unit.

Within NDT1 (ESSF) the old seral stage component falls short of the recommended target. The old seral stage minimum requirement of >19% can be reached, over time, by allowing portions of the mature and mid-seral stage components to age further.

Within NDT3 the seral stage percentages fall well within the target percentages except for the old seral stage components in the SBS and SBPS biogeoclimatic subzones. The mature seral stage represents a significant portion (47.2%) of the total forested area in NDT3 at present. Old growth targets may be met in the future as this large mature component ages. The 378 ha of mule deer winter range found in this sub-basin are located within natural disturbance type 3, and the seral stage distribution of the mule deer winter range area as follows:

<u>MULE DEER WINTER RANGE</u>

SERAL STAGE DISTRIBUTION PERCENTAGES -Actual (Target)

NDT	BGCZ	EARLY	MATURE & OLD	OLD
3	SBPS	22 (<66)	47 (>17)	27 (>7)

Within this natural disturbance type, all three seral stage groupings (early, mature plus old and old) fall within of the recommended levels of the Forest Practices Code.

6.0 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 logging roads throughout the watershed. A summary of road lengths found in each sub-basin are found in table 6.1.

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 6.1: Horsefly Watershed Sub-basin Road Lengths

Watershed Sub-Basin (Sub-Unit)	Length (km.)	Watershed Sub-Basin (Sub-Unit)	Length (km.)
Horsefly B (2)-Horsefly A (1)	5.0	Moffat (21)	79.0
Horsefly C (13)	1.5	Moffat (21)-Horsefly C (15)	10.0
Horsefly C (15)	65.5	McKinley (9)	0.5
Horsefly C (15)-Horsefly B (2)	35.0	McKinley (10)	14.5
Horsefly C (15)-Horsefly C(13)	19.5	McKinley (11)	21.5
MacKay (4)	20.5	Tisdall (16)	9.5
McKusky (3)	17.0	**TOTAL**	**299.00**

The UTM coordinates for each road are shown in Table 6.2. 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 6.2: 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

7.0 Wildlife Sensitivity and Visibility Concerns

7.1 Distribution of Red and Blue Listed Species and Species of Regional Importance

Species distributions and habitat preferences dictate the degree of impact which can be assigned to landscape level changes. The objectives of this study were in part to determine "*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*".

The study area straddles the Quesnel Highland, of the Southern Interior Mountains Ecoprovince to the east and the Cariboo Plateau ecosection of the Central Interior Ecoprovince to the west. The known distributions or likely occurrences of the Red and Blue listed species within these regions were reviewed to determine implications of habitat loss. Many of the red and blue listed species for the Cariboo (Table 7-1) are not likely to be found in the study area as they tend to be associated with drier, low elevation habitats (e.g. several of the bat species, rubber boa, and painted turtle among others) or the marine environment (sea otter). The Red listed avian species are all migratory and are likely rare visitors or even more uncommon breeders in the area. The American Peregrine Falcon's breeding habitat consists of cliffs associated with lakes and in river canyons. It has been noted as an uncommon local breeder in the Cariboo/Chilcotin. The Upland Sandpiper is one of the most elusive birds in B.C. It has been observed in various parts of the province without any strong association with any particular region. Based on the rare occurrence of these species it is difficult to infer any direct forestry related impacts upon their distribution in the study area.

Several blue listed avian species are likely to occur in the study area. Those most sensitive to riparian and wetland habitat alteration are the: Great Blue Heron, Sandhill Crane, American Bittern, and Trumpeter Swan. The American Bittern is known to breed in central British Columbia and prefers to forage and breed in wetland habitats with cattails, bulrushes or willows. Great Blue Heron occurs in a variety of freshwater environments and is regularly observed in the Cariboo. However, little information is available about seasonal movements or breeding sites in the Cariboo. The Sandhill Crane is a summer resident and breeder in the Cariboo region. Its habitat requirements are marshes, bogs and shallow lake margins. The Trumpeter Swan is a common winter visitant in the central interior but is not known to breed in the region. It prefers shallow sheltered aquatic habitats.

The shorebirds which occur on the blue list (Lesser Golden-Plover, American Avocet, Hudsonian Godwit, Red-necked Phalarope, Short-billed Dowitcher, Long-billed Curlew) are all uncommon or rare transient species. Their habitat needs are muddy shores of lakes and in the case of the Long-billed curlew, include meadows and grasslands.

Of the raptors identified in the Blue-list, only the Bald Eagle is widely distributed throughout the region. Its habitat preference is aquatic; lakes, rivers, and marshes with nest sites found in adjoining large trees. The Swainson's Hawk and Short-eared Owl may breed locally in the Cariboo region; both prefer open country and forest clearings. The Gyrfalcon, Barn Owl, and Flammulated Owl are considered uncommon visitants. Lewis' Woodpecker is a species which utilizes riparian forests, but its normal range is far to the south of the study area.

The White-throated Swift, and Sharp-tailed Grouse are both uncommon in the Cariboo region and are found primarily associated with dry grassland habitats. The Yellow-bellied Flycatcher, Lark Sparrow, Bobolink and Black-chinned Hummingbird may occur as accidental visitants to the region.

The remainder of the blue-listed species (Peal's Peregrine Falcon, California Gull; Caspian Tern; Marbled Murrelet; Ancient Murrelet; Tufted Puffin; Cassin's Auklet; Oldsquaw; Surf Scoter; and Double-crested Commorant) are coastal in distribution and may only be observed in the interior regions as extremely rare visitants.

Visibility is primarily of concern to large mammals and specifically those species which may be subject to hunting pressures. The major species of concern in the Horsefly Watershed are the Blue-listed species, Grizzly Bear, Caribou, Fisher, Wolverine as well as the regionally important species: Mountain Goat, Mule Deer, and Moose. Grizzly Bear use a variety of habitats but riparian and wet forests are important for foraging and travel. They are distributed throughout the eastern portion of the study area. This species is particularly sensitive to human disturbance. Wolverines are likely to occur throughout the study area and use all seral stages of forests. However, little is known about their distribution and abundance in the region. Fisher use of forest habitats varies by season; during the summer they use mixed forests with young to mature seral stages; in winter they are primarily found in mature old-growth with coarse woody debris.

Caribou use alpine areas and high elevation mature and old growth forests in the ESSF and ICH biogeoclimatic zones[2]. Rocky habitats are used for calving. Recent sightings have been in the Boss/Deception/Mica region. Caribou have also historically been sighted at Big Timothy Mountain and south of the Moffat Lakes[3].

Mountain Goats make use of rugged high elevation terrain during summer and are believed to use forested areas in winter. Mountain Goat ranges include Deception peak and the south side of Boss Mountain, with probable ranges in the vicinity of Mica Mountain, and peaks to the northwest of Boss Mountain.

Mule deer are ubiquitous in their distribution and make use of a wide variety of habitat types including recently logged areas. They are, however, most conspicuous when concentrated in their winter range areas, therefore visibility concerns for mule deer specifically target areas where roads adjoin or pass through winter range. The Horsefly River Mule Deer winter range extends across the lower end of the McKinley sub-basin and along the north side of the Horsefly River in the Horsefly C and a small portion of Horsefly B sub-basins. Roads and extensive agricultural development along the Horsefly River riparian lands are a common feature in this area. The McIntosh Lakes Mule Deer Winter Ranges are located to the northwest and south of McIntosh Lakes near areas of agricultural use.

Moose are also ubiquitous in the watershed but have a strong affinity for wetlands and riparian habitats. Black Bear and Grizzly also make use of wetland areas, particularly in early spring when sedges green up in advance of other forage. Complex wetland/riparian systems in particular have great value in providing food sources and movement corridors. Because wetlands are relatively open areas, with sedge meadows or low shrubs, they provide easy viewing of any animals located in them.

[2] Stevenson et al. 1994
[3] MOE map dated July 27, 1973 "Actual Caribou Sightings"

Table 7-1: Red and Blue Listed Species

1993 RED LIST FOR CARIBOO REGION

Birds
American White Pelican
Brandt's Commorant
Anatum Peregrine Falcon
Prairie Falcon
Westem Grebe
Upland Sandpiper
Sprague's Pipit
Brewer's Sparrow
Yellow-breasted Chat

Mammals
Northern Long-eared Myotis
Keen Long-eared Myotis
Sea Otter

Fish
Giant Pygmy Whitefish
Lake Whitefish

1993 BLUE LIST FOR THE CARIBOO REGION

Amphibians and Reptiles
Rubber Boa
Painted Turtle

Fish
Brassy Minnow
Chiselmouth Chub
White Sturgeon

Mammals
Westem Small-footed Myotis
Fringed Myotis
Spotted Bat
Townsend's Big-eared Bat
Grizzly Bear
Caribou
California Bighorn Sheep
Fisher
Wolverine
Badger

Birds
Bald Eagle
Gyrfalcon
Peale's Peregrine Falcon
Swainson's Hawk
Great Blue Heron
American Bittern
Double-crested Commorant
Sharp-tailed Grouse
Sandhill Crane
Barn Owl
Flammulated Owl
Short-eared Owl
White-throated Swift
Black-chinned Hummingbird
Lewis' Woodpecker
Lark Sparrow
Bobolink

Birds cont'd.

Hudsonian Godwit
Lesser Golden-Plover
American Avocet
Red-necked Phalarope
Short-billed Dowitcher
Long-billed Curlew
California Gull
Caspian Tern
Marbled Murrelet
Ancient Murrelet
Tufted Puffin
Cassin's Auklet
Trumpeter Swan
Oldsquaw
Surf Scoter
Yellow-bellied Flycatcher

Sources:
Updated list using: Bill Harper's new 1993 Red and Blue species list and
Updated Cariboo species list - G. Roberts; B. Kolotylo
B.C. Conservation Data Centre, Animals of Concern List, Cariboo-Chilcotin Region (red & blue)
B.C. Environment(Fish & Wildlife) knowledge of species within the Cariboo Sub-Region
Julie Steciw, Dec. 30,1993

7.2 *Wildlife Sensitivity and Visibility Assessed From Air Photos*

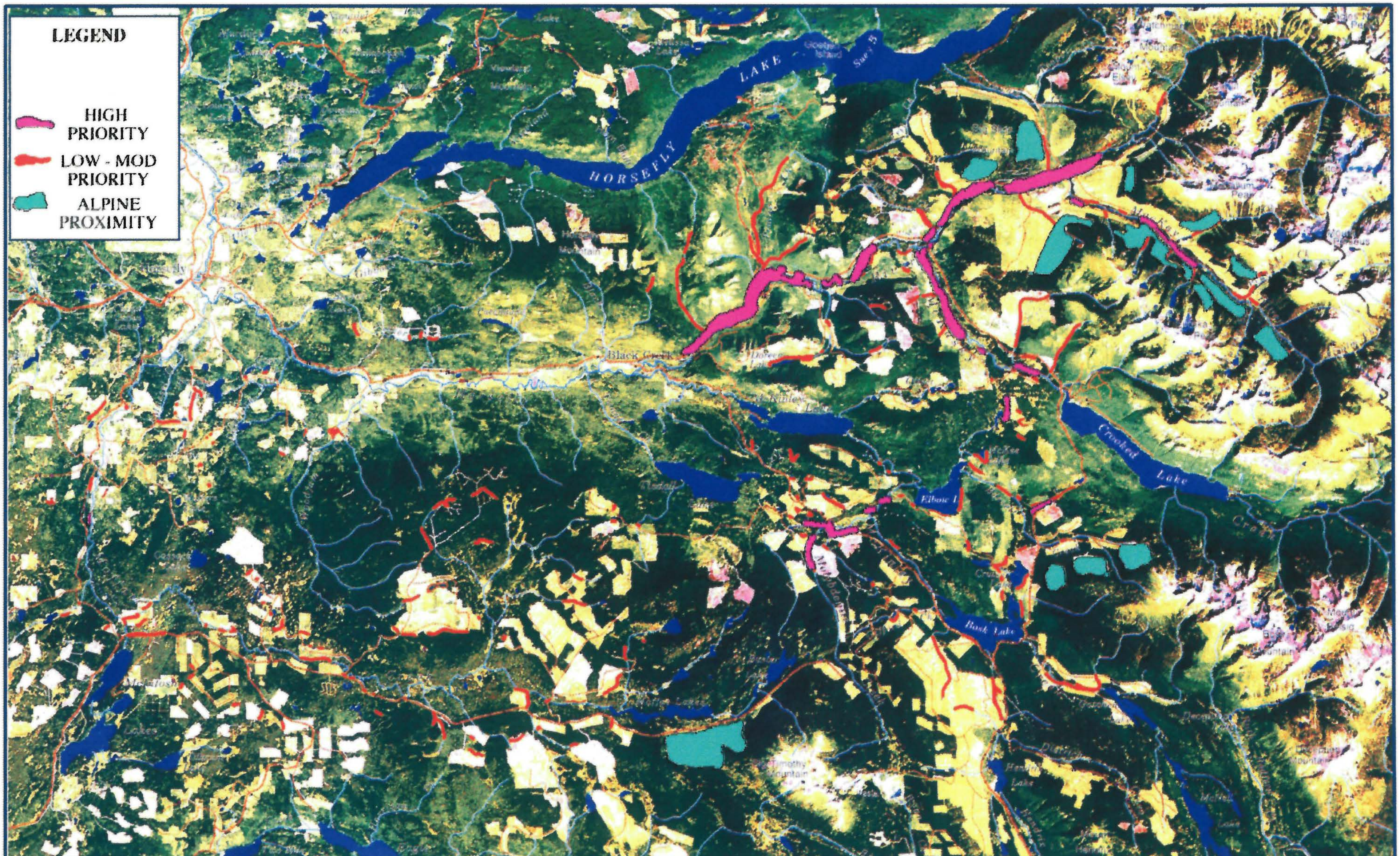
Based on the landscape level approach, the effects of forestry related impacts are more easily inferred for certain species than others. Evaluation of forestry related change utilizing air photo interpretation is most feasible for the assessment of harvested area and for determining boundary effects on wetlands, riparian habitats and alpine environments. Impacts on those species dependent on specific seral stages of forests can be more easily inferred from biodiversity/seral stage analyses.

The visibility and sensitivity concerns identified by aerial photo assessment, primarily addressed locations where buffers were lacking between wetlands and roads or cutblocks. A subjective rating of very high, high, moderate-high, moderate, moderate-low or low concern was applied to each location. This was based on whether impacts were associated with a short segment of a small isolated wetland (low concern) or longer or multiple segments associated with a large wetland complex (high concern). High concern ratings were applied to those wetlands or riparian zones which were part of an extensive wetland complex, and which could serve as corridors for wildlife movements. The length of missing buffer, number of missing buffer locations, degree of visibility and amount of access all entered into the subjective rating applied to each site.

Sensitive habitats (in addition to the wetlands and riparian zones) were primarily alpine habitats. Alpine habitats which were within 1 km of cutblocks or roads were identified as being of concern even if visibility was not an issue. It was felt that the openness of sub-alpine habitats would provide easy access to the alpine. As well noise and activity in these locations would be of concern to animals utilizing high elevation habitats.

Points of concern for wildlife visibility are addressed individually in Table 7.2 and have been mapped at a landscape scale (Figure 5). A total of twenty-three locations were assigned a High or Very-High rating for habitat concerns; 9 Very-High and 6 High were related to alpine habitats; the remaining 4 Very-High and 5 High were related to riparian and wetland visibility. Of these sites, 8 were in the Horsefly B sub-basin, 5 in the McKinley, 4 in MacKay, and 3 each and in McKusky and Horsefly A. A further 8 sites were identified as Moderate-High, all of which were associated with wetland and riparian. These sites were distributed among the MacKay (3), McKusky (2), Moffat (2), and Horsefly B (1) sub-basins. Copies of the interpreted photos for all of the Moderate-High, High and Very -High sites are included in Appendix 2.

FIGURE 5:
WILDLIFE SENSITIVITY AND VISIBILITY CONCERNS ASSOCIATED WITH FORESTRY PRACTICES IN THE HORSEFLY RIVER WATERSHED



based on Quesnel Lake Sattelite Image Map dated August 17, 1992.

Table 7.2: Visiblility and Sensitive Habitat Concerns.

PHOTO #	WILDLIFE CONCERNS	RATING	BIOGEOCLIMATIC ZONE	WATERSHED SUB-BASIN
95014.258	No buffer between wetland, stream, & cutblock.	M-H	SBS wk1	Ahbau
95068.117	Many missing buffers: lake, wetland, riparian.	M-H	ESSFwk1	Ahbau
95013.170	No buffer between riparian, wetland, & cutblock. road x stream	L-M	SBSmw	Ahbau
95014.029	No buffer between stream & cutblock.	M	SBS mw	Ahbau
95014.031	No buffer between wetland, stream, & cutblock.	M	SBS mw	Ahbau
95014.033	No buffer between wetland, lake, & cutblock.	M	SBS mk1	Ahbau
95014.043	No buffers- stream, lake, wetland & cutblock. road x stream	M	SBS wk1	Ahbau
95014.168	No buffer between cutblock & stream.	M	SBSwk1	Ahbau
95014.211	No buffer between stream, wetland, & cutblock. Road x stream	M	SBSmw	Ahbau
95068.115	No riparian buffer. Thin riparian buffer. Road x stream	M	ESSFwk1	Ahbau
95014.212	No buffer between stream & cutblock.	L-M	SBSmw	Ahbau
95014.272	No buffer between stream, wetland, & cutblock.	L-M	SBS wk1	Ahbau
95014.004	Road x stream	L	SBSmw	Ahbau
95014.021	No buffer between stream & cutblock.	L	SBS wk1	Ahbau
95014.023	Road x stream.	L	SBS wk1	Ahbau
95014.027	No buffer between stream, wetland, & cutblock.	L	SBS mw	Ahbau
95014.037	No buffer between wetland & cutblock.	L	SBS mk1	Ahbau
95014.039	No buffer between stream & cutblock.	L	SBS wk1	Ahbau
95014.045	Road x stream.	L	SBS wk1	Ahbau
95014.122	No buffer between riparian, wetland & cutblock.	L	SBSmw	Ahbau
95014.207	Road crosses wetland.	L	SBSmw	Ahbau
95014.275	No buffer between stream & cutblock.	L	ESSF wk1	Ahbau
95014.277	No buffer between stream & cutblock.	L	SBS wk1	Ahbau
95018.182	No buffer between wetland & road.	L	SBSmw	Ahbau
95018.188	No buffer between stream & cutblock.	L; P	SBSmw	Ahbau
95068.078	Road x stream.	L	SBSmw	Ahbau
95068.107	No buffer between cutblock & stream. (0.67)	L; P	SBS wk1	Ahbau
95068.130	Road x stream.	L	SBSwk1	Ahbau
95068.132	No buffer between stream & cutblock.	L; P	SBSwk1	Ahbau
95068.134	Road x stream.	L	SBSwk1	Ahbau
95068.092		P	SBSwk1	Ahbau
95068.150		P	SBSmw	Ahbau
94094.236	No buffer between wetland/riparian/cutblocks.	H; P	SBS mw	Cottonwood Residual
94094.258	road x stream. No buffer road/reclaimed wetland/mod. floodplain.	H	SBS mw	Cottonwood Residual
95018.146	No buffer stream/cutblock. Road x stream.	H	SBS mw	Cottonwood Residual
95018.148	No buffer stream/wetland/cutblock. road x stream	H	SBS mw	Cottonwood Residual
95018.150	No buffer between stream & cutblock.	H; P	SBS mw	Cottonwood Residual
94094.175	Loop road. No buffer between cutblock & wetland.	M-H	SBS mw	Cottonwood Residual
94094.238	No buffer between wetland/riparian/cutblock.	M-H	SBS mw	Cottonwood Residual
95018.152	Visibility of riparian from road and old cutblock	M-H	SBS mw	Cottonwood Residual

Table 7.2: Visibiltiy and Sensitive Habitat Concerns (continued).

PHOTO #	WILDLIFE CONCERNS	RATING	BIOGEOCLIMATIC ZONE	WATERSHED SUB-BASIN
94094.242	No buffer between wetland/riparian/cutblock.	M	SBS mw	Cottonwood Residual
94094.260	No buffer between cutblock & streams.	M; P	SBS mw	Cottonwood Residual
95014.178	road borders river/agricultural conversion of riparian	M	SBSmw	Cottonwood residual
95014.180	road borders river/agricultural conversion of riparian	M	SBSmw	Cottonwood residual
95018.174	No buffer between wetland/cutblock.	M	SBSmw	Cottonwood Residual
94094.170	No buffer lake/wetland/cutblock. Thin buffer between riparian & cutblock.	L-M	SBS mw	Cottonwood Residual
95014.170	No buffer between riparian, wetland, & cutblock.	L-M	SBSmw	Cottonwood residual
95014.172	No buffer between road & wetland.	L-M	SBSmw	Cottonwood residual
94094.171	No buffer between stream/wetland/cutblock.	L	SBS mw	Cottonwood Residual
94094.173	No buffer wetland/riparian/cutblock.	L	SBS mw	Cottonwood Residual
94094.234	Thin buffer between road & wetland.	L	SBS mw	Cottonwood Residual
94094.240	No buffer between cutblock & wetland.	L	SBS mw	Cottonwood Residual
94094.252	No buffer between streams & cutblock.	L	SBS mw	Cottonwood Residual
94094.253	No buffer between wetland/riparian/cutblock.	L	SBS mw	Cottonwood Residual
94094.255	No buffer between stream & cutblock.	L	SBS mw	Cottonwood Residual
94094.257	No buffer between riparian & cutblock.	L	SBS mw	Cottonwood Residual
95014.118	No buffer between wetland & cutblock.	L	SBSmw	Cottonwood Residual
95014.122	No buffer between riparian, wetland, & cutblock.	L	SBSmw	Cottonwood Residual
95014.176	No buffer between stream & cutblock.	L	SBSmw	Cottonwood residual
95014.202	riparian access	L	SBSmw	Cottonwood residual
95018.154	No buffer waterbody/road. Stream crosses road.	L	SBS mw	Cottonwood Residual
95014.080	No buffer between cutblock /wetland/stream.	M-H	SBSmw	John Boyd
95018.146	No buffer streams/cutblock. road x stream.	M-H	SBS mw	John Boyd
94094.261	No buffer between cutblock & wetland.	M; P	SBS mw	John Boyd
94094.263	No buffer between streams & cutblock.	M	SBS wk1	John Boyd
95014.072	No buffer stream/cutblock. road x stream (3).	M	SBS wk1	John Boyd
95014.078	No buffer stream/cutblock. road x stream (3).	M; P	SBSmw	John Boyd
95014.128	No buffer between riparian/wetland/cutblock.	M	SBSwk1	John Boyd
95018.136	No buffer stream/cutblock. road x stream. landings: 9.	M; P	SBS wk1	John Boyd
95018.138	No buffer between streams & cutblock. landings: 23.	M	SBS wk1	John Boyd
95018.140	No buffer riparian/wetland/cutblock. # of landings: 24.	M; P	SBS mw	John Boyd
95018.142	No buffer between wetland & cutblock. # of landings: 12.	M	SBS mw	John Boyd
95018.144	No buffer between streams/wetland/cutblock.	M	SBS mw	John Boyd
95014.074	No buffer lake/stream/cutblock. # of landings: 15.	L-M	SBS mw	John Boyd
94094.232	No buffer stream/cutblock. road forms loop.	L	SBS wk1	John Boyd
95014.070	No buffer between road & cutblock. # of landings: 1	L; P	ESSF wk1	John Boyd
95014.076	No buffer between cutblock & stream. # of landings: 8	L	SBS mw	John Boyd
95014.132	borders wetland & riparian?	P	SBSwk1	John Boyd
95014.134		P	SBSwk1	John Boyd
94094.270	No buffer between road & wetland	H	SBS wk1	Lightning
94094.272	Road runs through wetland. Road x stream.	H	ESSF wk1	Lightning
94094.273	Thin buffer between wetland and road.	H	ESSF wk1	Lightning
94094.275	No buffer between road & wetland.	H; P	ESSF wk1	Lightning

Table 7.2: Visibility and Sensitive Habitat Concerns (continued).

PHOTO #	WILDLIFE CONCERNS	RATING	BIOGEOCLIMATIC ZONE	WATERSHED SUB-BASIN
94094.277	No buffer between road. & wetland. Road x stream	H; P	ESSF wk1	Lightning
95018.130	No buffer between wetland & road.	H	ESSF wk1	Lightning
94094.177	No buffer between cutblock & stream. Road x stream	M	SBS mw	Lightning
94094.216	Road x stream. Cutblock borders riparian.	M; P	ESSF wk1	Lightning
94094.218	Road borders stream.	M; P	ESSF wk1	Lightning
94094.221	No buffer between stream & cutblock	M	ESSF wk1	Lightning
94094.223	No buffer between stream & cutblock	M	ESSF wk1	Lightning
94094.230	No buffer between riparian & cutblock. Road x stream	M	SBS wk1	Lightning
94094.267	No buffer between stream & cutblock.	M	SBS wk1	Lightning
95014.064	No buffer between stream & cutblock. No buffer between wetland & road.	M; P	ESSF wk1	Lightning
95014.066	No buffer between stream & cutblock. No buffer between wetland & cutblock.	M	ESSF wk1	Lightning
95018.136	No buffer stream/cutblock. road x stream. 9 landings.	M; P	SBS wk1	Lightning
94094.179	Road x stream	L; P	SBS mw	Lightning
94094.180	No buffer between stream & cutblock. 1 tree buffer road-wetland	L	SBS wk1	Lightning
94094.190	Thin buffer riparian/cutblock. Road cross stream.	L	ESSF wk1	Lightning
94094.191	No or thin buffer riparian-cutblock.	L; P	ESSF wk1	Lightning
94094.215	Cutblock borders riparian.	L; P	ESSF wk1	Lightning
94094.220	Road x stream.	L	ESSF wk1	Lightning
94094.226	No buffer between stream & cutblock.	L	ESSF wk1	Lightning
94094.228	No buffer between stream & cutblock.	L	ESSF wk1	Lightning
94094.269	Stream crosses road	L	SBS wk1	Lightning
94094.279	No buffer between stream & cutblock. Road x stream.	L	ESSF wk1	Lightning
95014.062	No buffer between cutblock & stream.	L	ESSF wk1	Lightning
95018.126	Thin buffer between stream & cutblock	L	ESSF wk1	Lightning
95018.134	Recreational ski area	L	SBS wk1	Lightning
94094.136		P	ESSF wk1	Lightning
94094.185		P	ESSF wk1	Lightning
94094.187		P	ESSF wk1	Lightning
94094.193		P	ESSF wk1	Lightning
94094.195		P	ESSF wk1	Lightning
94094.197		P	ESSF wc3	Lightning
94094.225		P	ESSF wk1	Lightning
94094.232	No buffer between stream & cutblock. 2 roads cross stream. road loop	P	SBS wk1	Lightning
94094.278		P	ESSF wk1	Lightning
94094.021	No buffer between riparian. & wetland.. Road bisects wetland.	H	SBS wk1	Little Swift
94094.023	No buffer between cutblock & riparian.	H	ESSF wk1	Little Swift
94094.113	One tree buffer. between wetland & cutblock	H; P	ESSF wk1	Little Swift
94094.129	No buffer between riparian. & cutblocks; PROXIMITY TO ALPINE	H	ESSF wc3	Little Swift
94094.131	PROXIMITY TO ALPINE	H	ESSF wc3	Little Swift

Table 7.2: Visibility and Sensitive Habitat Concerns (continued)

PHOTO #	WILDLIFE CONCERNS	RATING	BIOGEOCLIMATIC ZONE	WATERSHED SUB-BASIN
94093.217	Cutblocks impeding on wetland & riparian areas.	L; P	SBSwk1	Little Swift
94093.219	Cutblocks abutting riparian & wetland areas.	L	SBSwk1	Little Swift
94094.058		L	ESSF wk1	Little Swift
94094.060	No buffer between wetland & cutblock	L	ESSF wk1	Little Swift
94094.114	Thin buffer between riparian. & cutblock. Road x stream.	L	ESSF wk1	Little Swift
94094.133	No buffer between road & wetland	L	ESSF wk1	Little Swift
94094.134	One tree buffer between cutblock and wetland	L	ESSF wk1	Little Swift
94093.258		P	SBSmw	Little Swift
94094.056		P	ESSF wk1	Little Swift
94094.116		P	ESSF wk1	Little Swift
94094.117		P	ESSF wk1	Little Swift
94094.119		P	ESSF wc3	Little Swift
94094.121	alpine	P	ESSF wc3	Little Swift
94094.127	alpine	P	ESSF wc3	Little Swift
94093.254	No buffer between riparian. & cutblock. Small buffer between cutblocks.	M	SBSwk1	McMartin
94093.217	Cutblock impeding on wetland & riparian areas.	L; P	SBSwk1	McMartin
94093.225	Cutblock/road abuts wetland area.	L; P	ESSFwk1	McMartin
94093.166		P	ESSFwk1	McMartin
94093.215		P	ESSF wk1	McMartin
94093.227		P	ESSFwk1	McMartin
94093.229		P	ESSFwk1	McMartin
94093.242		P	ESSFwc3	McMartin
94093.246		P	ESSFwk1	McMartin
94093.248		P	ESSFwk1	McMartin
94093.252		P	SBSmw	McMartin
94094.033		P	ESSFwk1	McMartin
94094.051		P	ESSF wc3	McMartin
95018.174	No buffer between wetland & cutblock	M-H	SBSmw	Nelson Kenny
95068.070	No buffer between stream, wetland, cutblock. road crosses wetland & stream	M	SBSmw	Nelson Kenny
95068.072	No buffer between stream & cutblock. Road x stream.	M	SBSmw	Nelson Kenny
95014.001	Road x stream.	L	SBSmw	Nelson Kenny
95014.002	No buffer between wetland, stream, & cutblock.	L	SBSmw	Nelson Kenny
95068.074	No buffer between wetland & cutblock. Road x stream.	L	SBSmw	Nelson Kenny
94094.018	Road bisects wetland. No buffer between cutblock & wetland.	H	SBS wk1	Reddish
94094.019	Little/no buffer between wetland & cutblock s.	H	SBS wk1	Reddish
94094.062	Thin buffer (1-0 tree width) between riparian & cutblock.	H	ESSF wk1	Reddish
94094.066	No buffer between wetland, riparian, & cutblock.	H; P	SBS wk1	Reddish
94094.107	No buffer between wetland, riparian, & cutblock.	H	SBS wk1	Reddish
94094.109	No buffer between wetland & cutblock.	M-H	ESSF wk1	Reddish

Table 7.2 Visibility and Sensitive Habitat Concerns (continued)

PHOTO #	WILDLIFE CONCERNS	RATING	BIOGEOCLIMATIC ZONE	WATERSHED SUB-BASIN
94094.138	No buffer on 1 stream edge.1 tree width buffer on stream	M	ESSF wk1	Reddish
94093.261	Little/no buffer between cutblock & wetland. Impeded drainage.	L	SBSmw	Reddish
94094.064	cutblock borders riparian	L; P	SBS wk1	Reddish
94094.140		P	ESSF wk1	Reddish
94094.095	No buffer between stream & cutblock	VH	SBSmw	Soverign
94094.097	No buffer between stream & cutblock.	VH	SBS wk1	Soverign
94094.153	No buffer between cutblock , stream, & riparian.	VH	SBS mw	Soverign
94094.154	No buffer between cutblock , stream, & riparian.	VH	SBS mw	Soverign
94094.068	Thin buffer between wetland & cutblocks.	M	SBS wk1	Soverign
94094.099	No buffer between riparian & cutblock.	M; P	SBS wk1	Soverign
94094.101	No buffer between stream & cutblock	M; P	SBS wk1	Soverign
94094.143	1tree buffer along riparian zone.	M	ESSF wk1	Soverign
94094.149	No buffer between wetland & cutblock	M; P	SBS wk1	Soverign
94094.182	No /1 tree buffer between wetland & cutblock.	M; P	SBS wk1	Soverign
94094.184	zero-1 tree buffer along stream. Stream crosses road	M	ESSF wk1	Soverign
94094.104	No/one tree buffer between cutblock & riparian.	L-M	SBS wk1	Soverign
94094.070	Thin buffer between wetland & cutblock	L	SBS wk1	Soverign
94094.145	Poss. shrub-carr wetland. No buffer between road & wetland	L; P	ESSF wk1	Soverign
94094.147	Road x stream	L; P	SBS wk1	Soverign
94094.151	Road crosses wetland	L; P	SBS wk1	Soverign
94093.209	No buffer for riparian in cutblock & along Swift river.	VH	SBSwk1	Swift
94094.156	No buffer between streams & cutblock. Many unmeasured spur roads.	VH	SBS mw	Swift
94093.203	Cutblock infringes on wetland.	H; P	SBSmw	Swift
94094.005	Thin buffer around riparian. areas.	H	SBS mw	Swift
94094.007	No buffer between cutblock , riparian, & wetland. Large # of spur roads	H	SBS mw	Swift
94094.075	No/thin buffer between wetland, riparian, & cutblock	H; P	SBS wk1	Swift
94094.094	No buffer between stream, wetland, & cutblock.	H	SBS mw	Swift
94094.011	cutblock borders riparian	M-H	ESSFwk1	Swift
94094.077	No buffer between wetland, riparian, & cutblock	M-H	SBS wk1	Swift
94094.091	No buffer between wetland, riparian, & cutblock	M-H	SBS mw	Swift
94094.092	No buffer between wetland, riparian, & cutblock	M-H	SBS mw	Swift
94093.263	No buffer between cutblock & wetland & riparian.	M	SBSwk1	Swift
94093.265	No buffer between cutblock & wetland	M	SBSwk1	Swift
94094.015	No buffer between cutblock & wetland.	M; P	SBS wk1	Swift
94094.079	No buffer between riparian., wetland, & cutblock	M	SBS mw	Swift
94094.089	No buffer between wetland & cutblock	M	SBS mw	Swift
94093.267		L-M; P	ESSF wk1	Swift
94093.269	No buffer between cutblock, riparian, & wetland	L-M; P	SBSmw	Swift
94093.271	No buffer between cutblock , riparian, & wetland.	L-M	SBSmw	Swift

Table 7.2: Visibility and Sensitive Habitat Concerns (continued)

PHOTO #	WILDLIFE CONCERNS	RATING	BIOGEOCLIMATIC ZONE	WATERSHED SUB-BASIN
94093.273	Cutblock invades riparian. & wetland	L-M	SBSmw	Swift
94093.104	Thin buffer between stream & cutblock	L; P	ESSF wk1	Swift
94093.141	Road bordering wetlands	L; P	SBSwk1	Swift
94093.145	cutblock goes through riparian. (no buffer). Also abuts wetland	L; P	ESSF wk1	Swift
94093.176	several riparian riparian segments in cutblock.	L	ESSFwk1	Swift
94093.178	cutblocks infringe on wetland & riparian areas.	L; P	SBSwk1	Swift
94093.184		L; P	SBSwk1	Swift
94093.211	Cutblock near wetland.	L; P	SBSwk1	Swift
94094.013	No buffer between cutblock & riparian.	L; P	SBSwk1	Swift
94094.157	No buffer between cutblock & wetland	L	SBS mw	Swift
94093.049		P	ESSFwk1	Swift
94093.086		P	ESSFwk1	Swift
94093.090		P	ESSFwk1	Swift
94093.092		P	ESSFwk1	Swift
94093.106		P	SBS wk1	Swift
94093.108		P	SBS mw	Swift
94093.110		P	SBS wk1	Swift
94093.139		P	SBSmw	Swift
94093.143		P	SBSwk1	Swift
94093.180		P	SBSwk1	Swift
94093.182		P	SBSwk1	Swift
94093.186		P	SBSmw	Swift
94093.188		P	SBSmw	Swift
94093.190		P	SBSmw	Swift
94093.207		P	SBSmw	Swift
95014.080	No buffer between wetland/stream/cutblock.	M-H	SBSmw	Umiti
95014.082	No buffer between wetland/riparian/cutblock.	M-H	SBSmw	Umiti
95014.128	No buffer between riparian/wetland/cutblock	M-H; P	SBSwk1	Umiti
95014.164	No buffer between stream & cutblock.	M-H; P	SBSwk1	Umiti
95014.084	No buffer between stream & cutblock. road crossings of stream: 4	M	SBSmw	Umiti
95014.160	No buffer between stream & cutblock.	M; P	SBSwk1	Umiti
95014.162	No buffer between stream/cutblock. road crossings of stream: 3	M	SBSwk1	Umiti
95014.219	No buffer between stream & cutblock. Road x stream.	M	SBSwk1	Umiti
95014.221	No buffer between stream & cutblock.	M	SBSwk1	Umiti
95014.223	No buffer between stream & cutblock.	M; P	SBSwk1	Umiti
95014.224	No buffer between stream & cutblock.	M	SBSwk1	Umiti
95068.144	No buffer between stream & cutblock.	M;P	SBSwk1	Umiti
95068.146	No buffer between stream & cutblock. road crossings of stream: 2	L-M; P	SBSwk1	Umiti
95014.156	riparian buffer	L	SBSwk1	Umiti
95014.124		P	SBSmw	Umiti

Table 7.2: Visibiltity and Sensitive Habitat Concerns (continued)

PHOTO #	WILDLIFE CONCERNS	RATING	BIOGEOCLIMATIC ZONE	WATERSHED SUB-BASIN
95014.132		P	SBSwk1	Umiti
95014.218		P	SBSwk1	Umiti
94093.034	No buffer between cutblock & wetland. May encroach on wetland & riparian.	H; P	SBSwk1	Victoria
94093.051	Lack of riparian. through cutblock.	H; P	SBSwk1	Victoria
94093.055	No buffer between large wetland & cutblock. Road through wetland. SANDHILL CRANE HABITAT	H; P	SBSmw	Victoria
94094.009	No buffer between cutblock & complex riparian wetland.	H; P	SBS mw	Victoria
94093.022	No buffers between wetland and 2 segments of road	M; P	SBSmw	Victoria
94093.080	No buffer for wetland & poss. riparian. Shadows obscure view.	M; P	SBSmw	Victoria
94094.007	No buffer between cutblock , riparian, & wetland. Large # of spur roads.	M	SBS mw	Victoria
94093.026	No buffer between .21 sq. km wetland & cutblocks	L-M; P	SBSmw	Victoria
94093.269	No buffer between cutblock & riparian. & wetland.	L-M; P	SBSmw	Victoria
94093.271	No buffer between cutblock & riparian. & wetland	L-M	SBSmw	Victoria
94093.030	small wetland bordered by cutblock	L; P	SBSmw	Victoria
94093.032	Road borders wetland. Road passes through wetland	L; P	SBSwk1	Victoria
94093.036	No buffer zone. 2 strips of cutblock bordering on wetland.	L; P	SBSwk1	Victoria
94093.038	riparian crossing at present end of road.	L; P	ESSFwk1	Victoria
94093.057	No buffer for wetland & riparian areas. Limited buffer in other areas.	L; P	SBSmw	Victoria
94093.059	Minimal buffer between wetland & cutblock	L; P	SBSmw	Victoria
94093.063	No riparian buffer through cutblock. Min. buffer between road & wetland.	L; P	SBSmw	Victoria
94093.137	Unbuffered riparian. at edge of cutblock.	L; P	SBSmw	Victoria
94093.192	No buffer for riparian & wetland in large cutblock.	L; P	SBSmw	Victoria
94093.203	Cutblock infringing on wetland.	L; P	SBSmw	Victoria
94093.047		P	ESSFwk1	Victoria
94093.076		P	SBSmw	Victoria
94093.082	Proximity of road to creek bank.	P	SBSmw	Victoria
94093.084		P	SBSwk1	Victoria
94093.088		P	ESSFwk1	Victoria
94093.112		P	SBSmw	Victoria
94093.114		P	SBSmw	Victoria
94093.118		P	SBSmw	Victoria
94093.120		P	SBSmw	Victoria
94093.122		P	SBSmw	Victoria
94093.129		P	SBSmw	Victoria
94093.131		P	SBSmw	Victoria
94093.133		P	SBSmw	Victoria

Alpine habitats in proximity to roads and cutblocks were identified in the following locations:

- MacKay sub-basin (6 sites north and northeast of Eureka Peak; 3 sites vicinity of McCallum Peak),
- Horsefly B (Sub-basin #2) (2 sites south and east of Big Slide Mountain)
- McKinley sub-basin (3 sites northwest of Boss Mountain)
- Moffat sub-basin (northwest of Timothy Mountain),

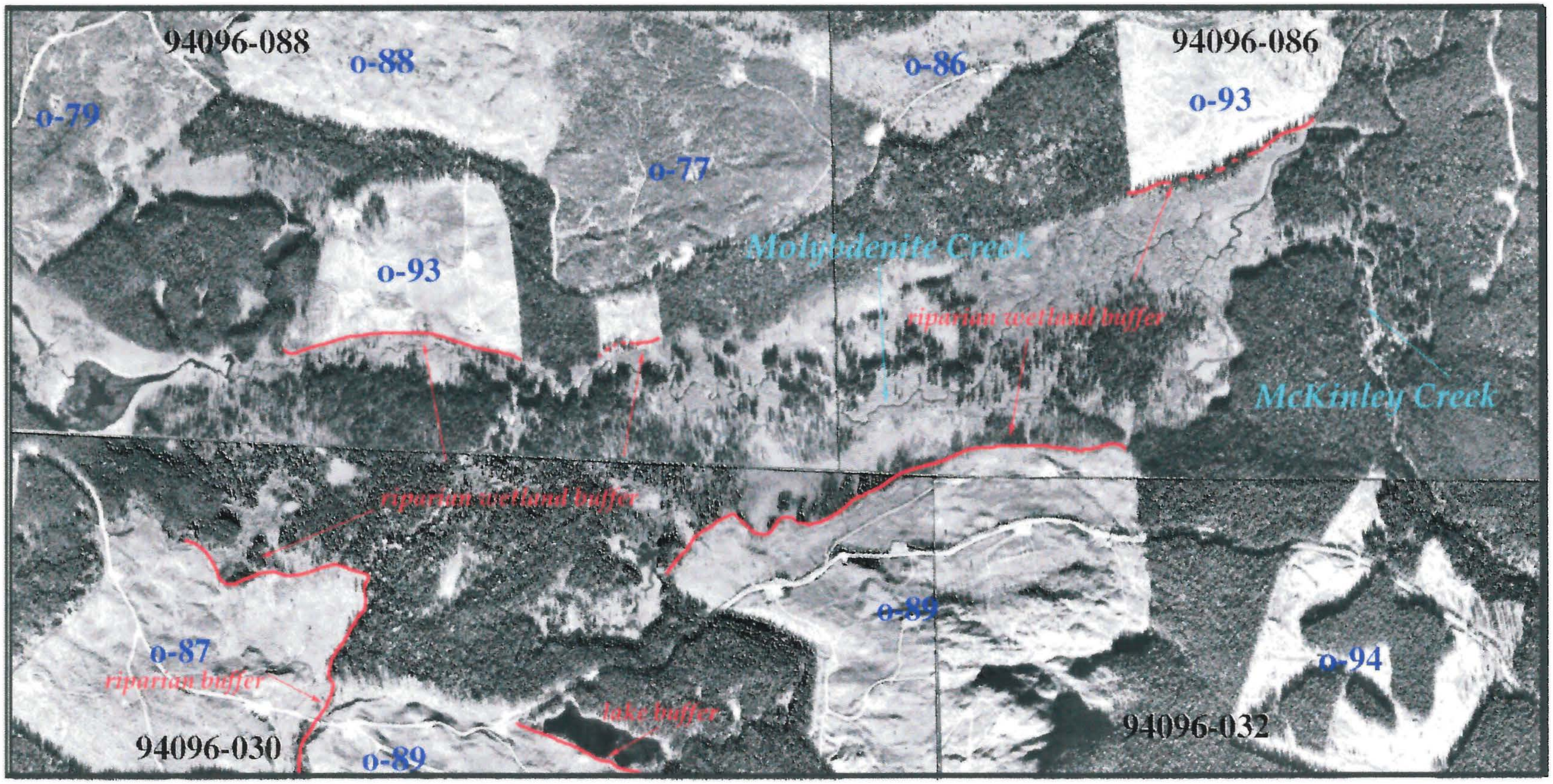
Extensive areas of riparian habitats have been affected along Horsefly River, between McKinley and MacKay Creeks (see photos 94087:036-040; 072; 126-130; 95018 105-106). Forest cover maps indicate that most of the harvesting adjacent to the river occurred in the 1962 to 1970 period. However, the lack of apparent timber cover in the aerial photographs establishes the need for field inspection to determine riparian functional recovery.

The McKinley (see Photos 95087:122 and 148) and MacKay (see photos 95087:078-084) Creeks south of the Horsefly River also show extensive riparian impacts. Harvesting in the MacKay riparian zones occurred between 1978 and 1986; and in the McKinley in 1969. Well established roads through these valleys provide visibility and access to the riparian zones in select locations. Field inspections are recommended at these sites to evaluate the need for any restoration activities.

Prairie and Club Creeks north of Horsefly River have extensive areas of harvesting adjacent to riparian zones, but most of the logging in these areas occurred over three decades ago. Although these areas have been impacted, the ratings are low.

One major wetland complex on Molybdenite creek above its confluence with McKinley Creek was identified as having Very-High visibility concerns (see photos 94096:30-32, and 86-88). The Black Creek- Bosk Lake FSR (1253.01) skirts the northern edge of the wetland in question. Several cutblocks, with harvesting dates ranging between 1979 and 1993 surround this wetland with buffer strips missing along several sections of the riparian wetlands (Figure 6). Due to the recent harvesting and the frequency and extent of impacts on this large wetland, the location was ranked as a high priority site for restoration action.

Figure 6: Forest Harvesting Impacts on Molybdenite Creek Wetlands



mosaic of 4 photos - numbers shown on each

8.0 Restoration and Mitigation Potential

8.1 Alpine Environments

Mitigation of some issues identified in this report is possible by closing access to roads or cutblocks adjacent to sensitive alpine habitats. This has already occurred in some areas. The Eureka Peak Motor Vehicle Restricted area (MU 5-15) closed year-round to the operation of all vehicles from 1500 m elevation to the height of land. The Crooked Lake Forest Service road and any side roads from its point of commencement to its termination are closed to hunting. However, cutblocks have also been identified in close proximity to Timothy Mountain and northwest of Boss Mountain (Figure 5) which provide reasonably easy access into these alpine habitats. Further examination of ease of access in these environments is recommended.

8.2 Riparian and Wetland Buffers

Major areas of concern occur along the Horsefly, McKusky and MacKay Rivers, and Molybdenite Creek where missing buffers adjacent to riparian wetlands place wildlife using these habitats under increased hunting pressure (Figure 5). In addition, the lack of riparian buffers increases the risk of sediment input into streams.

Road deactivation and closures need to be examined in concert with other watershed issues such as fisheries concerns and sediment sources delivery from riparian zones. Digitizing the sediment source data and incorporating the riparian and wetlands data into a GIS database would facilitate comparisons of multiple parameters within the watershed. Locations with additive problems need to be examined on site to evaluate needs for further action. Specific sites identified as wildlife visibility concerns in this report should be examined in the field to determine the needs, feasibility and likelihood of success for a riparian restoration program.

Identification of problem areas is a first step toward identifying solutions. Since wetlands and riparian habitats serve a number of functions, each high priority site should be visited and rehabilitation objectives defined. Issues to be considered include: current state of recovery, specific problem areas (wildlife visibility, stream shading, eroding habitat or sediment source), potential for long-term recovery, feasibility of restoration and the need for intervention.

Restoration of riparian zones by the planting of rapidly growing shrubs and deciduous trees (such as willows and cottonwoods) to provide a visual barrier is an accepted, proven methodology. However, such a program requires additional investigation of site suitability, and advance planning. Planting of deciduous stock is economically feasible by using cuttings provided that they are planted prior to bud-break in the spring. This process is a manual, labour-intensive operation, both in terms of obtaining and installation of suitable stock. It can be a relatively inexpensive operation if suitable plant material can be obtained on-site or in nearby areas. If the sites in question are heavily eroded, stream-bank stabilization measures may be required prior to vegetation establishment. Examples of techniques range in degree of intervention and equipment requirements, such as movement of boulders, placement of root wads and site scarification by heavy equipment, to manual placement of brush bundles or fabric matting to achieve bank stability until protective vegetation can become established. All of these techniques require on-site assessment of conditions and design of specific solutions to address the individual needs of the site.

9.0 CONCLUSIONS

The approach employed in dealing with the wide range of concerns identified in the objectives of the study was to utilize the most up-to-date information available (aerial photography for the impact assessment and forest cover maps for the seral stage analysis) to conduct a landscape scale overview of impacts within the Horsefly River watershed. The detailed results have been presented in the body of this report. General conclusions regarding the suitability of this approach in addressing the questions at hand are dealt with below.

Forest harvesting impacts in the terrestrial and riparian areas have been determined by measuring the amount of habitat which has been disrupted, i.e. numbers of sites of disruption, areas of impact and lengths of riparian habitats which have been affected. The use of recent aerial photos has been highly suitable for an overview assessment, to determine locations and magnitude of forestry related impacts. On the other hand, impacts of more subtle activities such as range use and recreational activity cannot be ascertained using a landscape level approach except in extreme cases.

Impacts of 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^2 of converted wetland was identified for the Moffat sub-basin and 7.71 km^2 in Horsefly C. Of concern are the large tracts of lowland riparian habitats which have been removed from wildlife use. Impacts from domestic livestock trampling riparian habitats were also noted. In many cases it was not possible to determine from the air photos if riparian agricultural areas were fenced adjacent to the stream. Field inspection is necessary to address this component.

Of the 2,183 km^2 study area, 1,769 km^2 has been identified as forested. Nineteen percent of the total study area, or 24 percent of the forested area, had been logged according to the aerial photos taken in 1994 and 1995. Five percent of the study area consisted of wetland although this figure varied considerably between sub-basins. The greatest amount of wetland was found in the Moffat sub-basin (89 km^2) while the least amount, less than 1 km^2, was found in the Upper Horsefly (sub-basin 1). The greatest area of wetlands was found in the ESSF biogeoclimatic zone.

The Horsefly watershed had an overall average of 0.08 km/km^2 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^2 of missing buffers for riparian and wetland areas. In contrast, the McKinley and Horsefly B sub-basins had high densities of missing buffers, 0.24 km/km^2 and 0.22 km/km^2 respectively. The length and number of missing buffers is in itself not an adequate assessment of habitat impact. The IWAP procedure undertaken using the forest cover database provided comparable assessments of missing stream buffers. However, what the numbers do not address are wetlands not associated with streams, magnitude of wetland areas and connectivity to other wetlands or important habitat features. The site by site examination of wetland and riparian impacts has allowed such a subjective assessment to be made, which is addressed both in tabular and graphic form (Table 7.2, Figure 5).

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). Road densities give an indication of the amount of road in a sub-basin, but need to be coupled with the types of habitats they traverse or provide access to in order to determine impacts on wildlife habitats. The overview assessment conducted using aerial photography has been very suitable for determining locations of identifying access concerns, and areas of high wildlife visibility. However, given the date of the aerial photography (September), long shadows obscured roads in forested areas making road driveability assessments unreliable. Field inspection is necessary to address this component.

A total of twenty-three locations were assigned a high or very high rating for road visibility and sensitive habitat concerns, 13 of these were primarily related to riparian and wetland visibility and 10 related to alpine habitats. Of the Very High and High sites, 8 were in the Horsefly B sub-basin, 5 in McKinley, 4 in MacKay, 3 in McKusky and 3 in Horsefly A. Detailed site inspections to determine current stage of recovery and potential restoration practices are recommended for the riparian sites. Road access restrictions are recommended for the sites providing access to alpine habitats.

The biodiversity analysis of the Horsefly River watershed was conducted using seral stage information provided by the Ministry of Forests and mule deer winter range information provided by the Ministry of Environment, Lands and Parks. Actual seral stage distributions were compared to target seral stage distributions under Forest Practices Code guidelines.

Within each sub-unit, three separate seral groupings were assessed for compliance with FPC recommended levels. The three seral stage groups are early seral, mature plus old seral, and old seral. Each of these was analysed according to natural disturbance type (NDT) and biogeoclimatic zone. The following table summarizes the detailed information (presented in Section 5.2). It shows the percentage of the total number of seral stages in each sub-unit which do not meet the recommended FPC targets. Alpine Tundra (NDT5) information was not included in the table.

Table 7.3: Percent of Seral Stages Outside of FPC Targets.

Sub-Basin	Seral stages outside FPC (%)	Sub-Basin	Seral stages outside FPC (%)
1	33	13	83
2	89	13 MDWR	66
2 MDWR	66	14 MDWR	55
3	83	15	50
4	83	15 MDWR	66
5	17	16	66
6	17	17	17
7	0	18	33
8	17	19	66
9	33	20 MDWR	55
10	17	21	33
11	55	21 MDWR	0
12	33		

The 21 sub-basins, and 6 sub-basins containing mule deer winter range, fall into three groupings with respect to the percentage of seral stages outside of FPC guidelines. The following table shows the distribution of sub-units and is an indication of the relative priorities for forest harvesting planning and potential rehabilitation activities.

Table 7.4: Mule Deer Outside of FPC Targets.

GROUP	Seral stage outside FPC (%)	Sub-unit Numbers
1	0-34	1,5,6,7,8,9,10,12, 17,18,& 21 MDWR21
2	34-67	11, 15,16,&19 MDWR 2,13,14, 15&20
3	67-100	2,3,4,&13

In general, those sub-units closest to the outer boundaries of the watershed, that is to say the more remote areas, meet the FPC guidelines for seral stage distributions. In contrast, four sub-units near the central portion of the watershed are the most out of compliance with FPC targets. These sub-units generally are deficient in both old and mature plus old seral stages and also have too much early seral cover.

As part of the biodiversity assessment, the total number of NDT/biogeoclimatic variants which do not meet FPC guidelines was determined for each of the seral stage groupings. Numbers and percentages are presented in the following table.

Table 7.5: Number of NDT/Biogeoclimatic Variants Outside of FPC Targets.

SERAL STAGE	NDT/BGC # vs. total #	Percentage of total
EARLY	16/63	25
MATURE & OLD	28/63	44
OLD	48/63	76

Within the two oldest categories, mature plus old and old growth, a significant proportion of the NDT/biogeoclimatic variants are well under FPC recommended seral stage targets. Old growth forest types exhibit the greatest departure from target levels with more than three-quarters of the NDT/biogeoclimatic variants having less than the recommended percentage of old growth. Forest planning in the Horsefly River watershed must take these target deficits into account with respect to future harvesting activities.

10.0 RECOMMENDATIONS

Many of the concerns identified in this report relate to missing buffer areas adjacent to wetlands and riparian zones. Recommendations are made in this report to investigate specific sites identified in the visibility concerns as well as those areas located near sediment delivery sites to assess the potential for restorative actions.

The air photo analysis which focused on the absence of riparian, wetland and lake buffers detected historical logging practices and their ensuing impacts. Adherence to Forest Practices Code requirements should prevent such occurrences in the future.

Detailed recommendations:

1) The wildlife visibility concerns identified in this report and the Sediment Source data should be digitized into a GIS database to facilitate an integrated assessment of risk at specific sites.

2) Future airphoto analysis should be undertaken using orthophotos or georeferenced photos.

3) Field inspections should be carried out to determine:

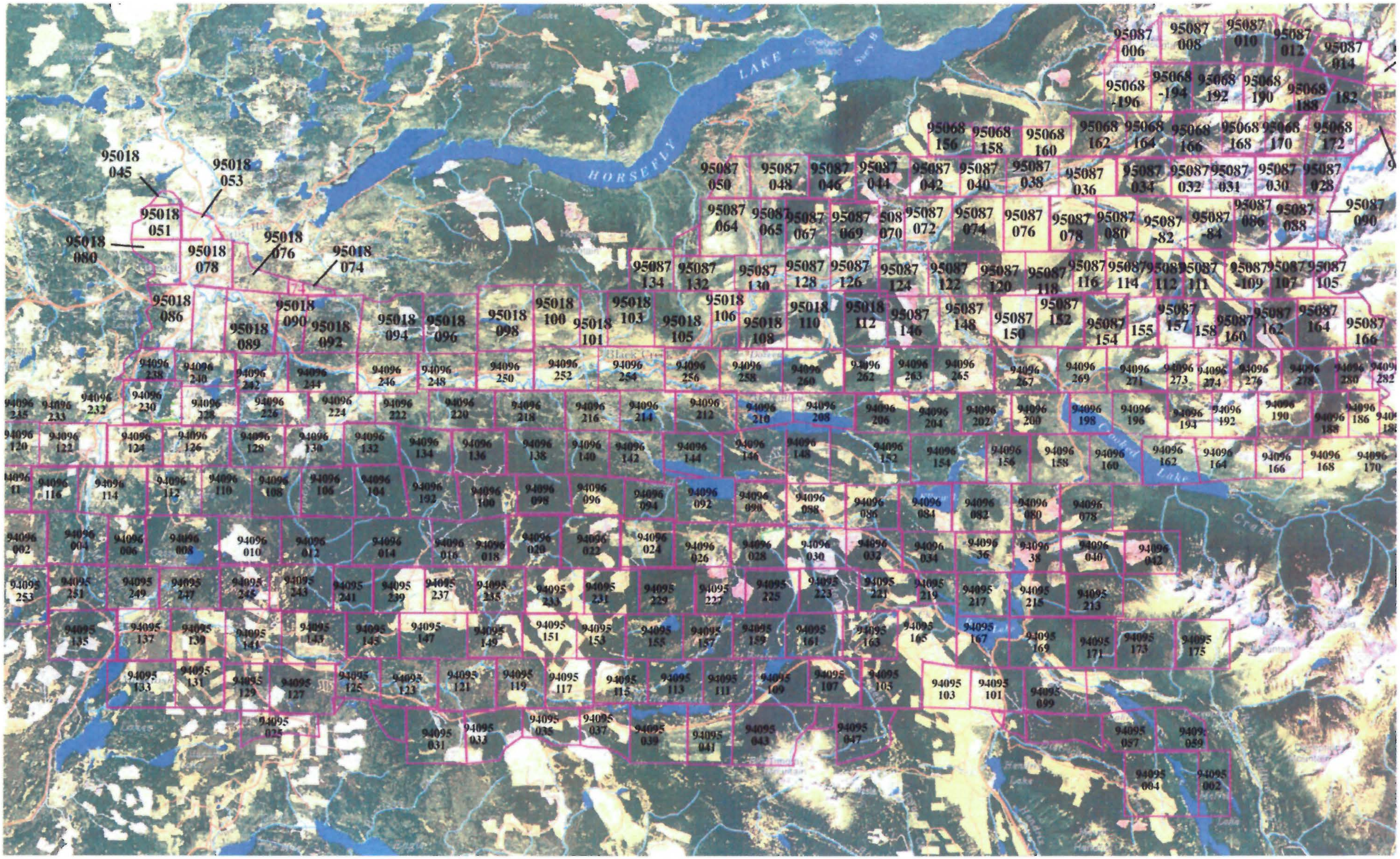
   - site specific riparian condition and rehabilitation objectives based on the Very-High and High priority sites identified in this report

   - agricultural impacts (especially those associated with identified sediment sources and to identify feasibility of remedial action)

   - road driveability

4) Road access and options for implementing restrictions or deactivation be reviewed for the sites providing access to alpine habitats.

APPENDIX 1



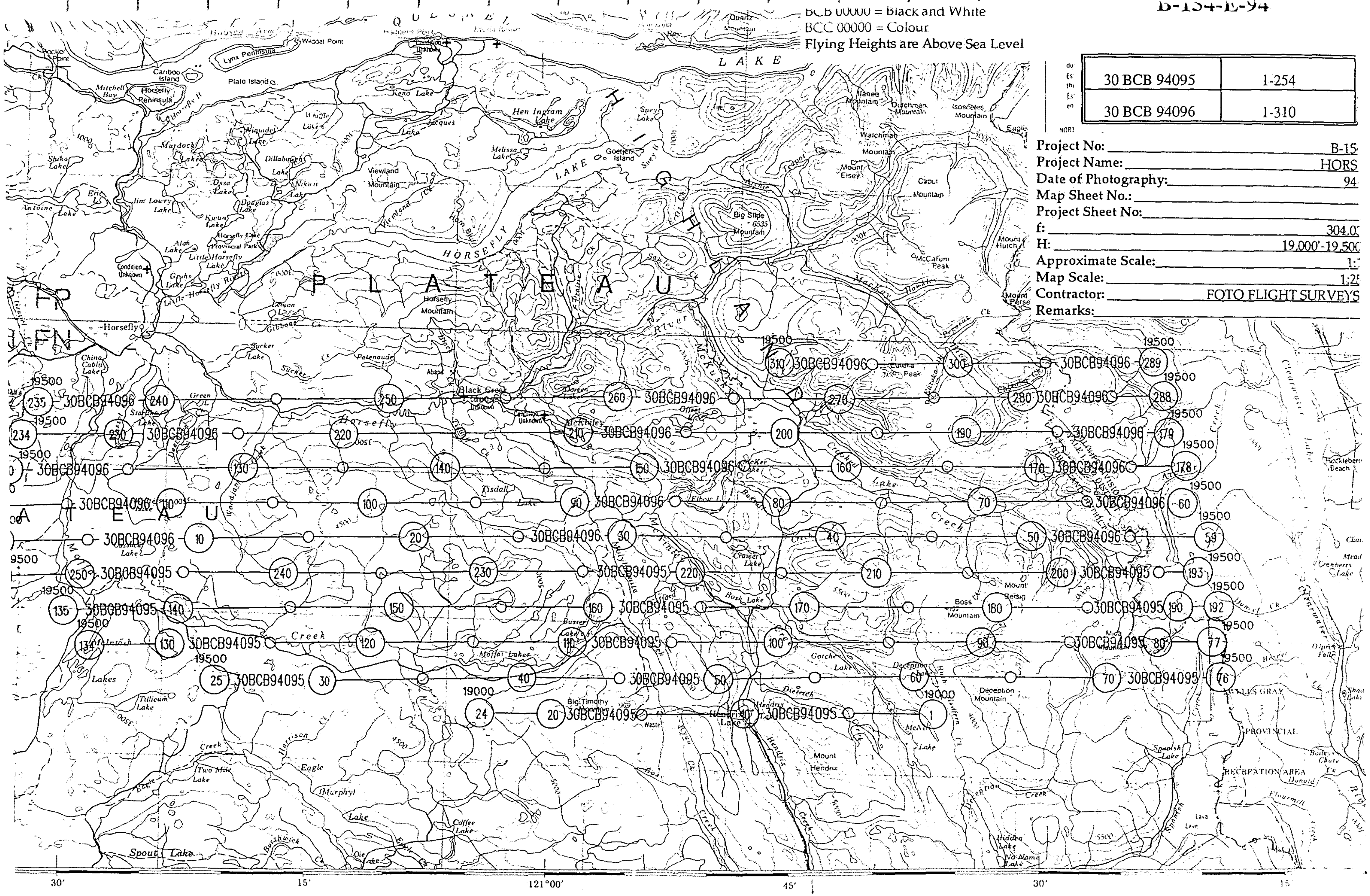
Guide to Aerial Photo Images Interpreted for the Horsefly Watershed

B-154-E-94

BCB 00000 = Black and White
BCC 00000 = Colour
Flying Heights are Above Sea Level

30 BCB 94095	1-254
30 BCB 94096	1-310

Project No: B-15
Project Name: HORS
Date of Photography: 94
Map Sheet No.:
Project Sheet No:
f: 304.0
H: 19,000'-19,500
Approximate Scale: 1:
Map Scale: 1:25
Contractor: FOTO FLIGHT SURVEYS
Remarks:



QUESNEL LAKE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE

E FOR MAPPING, AND RESOURCES. MATION CURRENT 989

ANADA MAP OFFICE, SOURCES, OTTAWA.

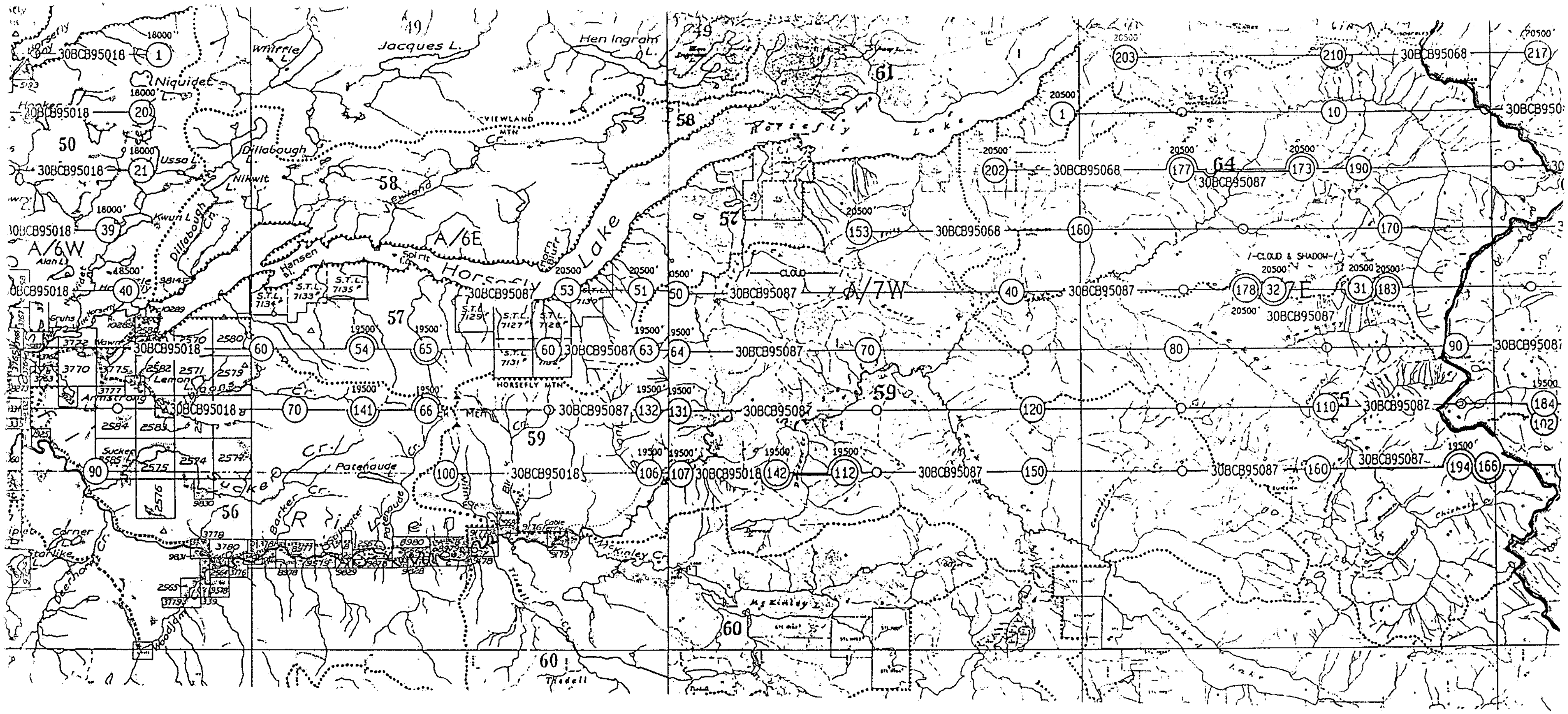
RIGHT OF CANADA, L RESOURCES.

Information concerning bench marks and horizontal survey monuments can be obtained from Geodetic Survey, Canada Centre for Surveying, Ottawa

Pour tout renseignement concernant les repères et les bornes altimétriques s'adresser aux Levés géodésiques Centre canadien des levés Ottawa

ÉTABLIE PAR LE CENTRE CANADIEN DE CARTOGRAPHIE MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES TIRÉE DE CARTE AU 1/50 000 RENSEIGNEMENTS A JOUR ... OU INDIQUÉS DANS LE DIAGRAMME PUBLIÉE EN 1989

CES CARTES SONT EN VENTE AU BUREAU DES CARTES DU CANADA, MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES, OTTAWA, OU CHEZ LE VENDEUR LE PLUS PRÈS



30BCB95018
30BCB95087
30BCB95068
Jacques L.
Hen Ingram L.
Niquidet L.
Ussa L.
Dillabough L.
Nikwit L.
Kwun L.
A/6W
A/6E
A/7W
VIEWLAND MTN
HORSEFLY MTN
Horsefly Lake
/-CLOUD & SHADOW-/
CLOUD
Patenaude
Barker Cr.
Lemon
Armstrong
McKinley Cr.
Corner L.

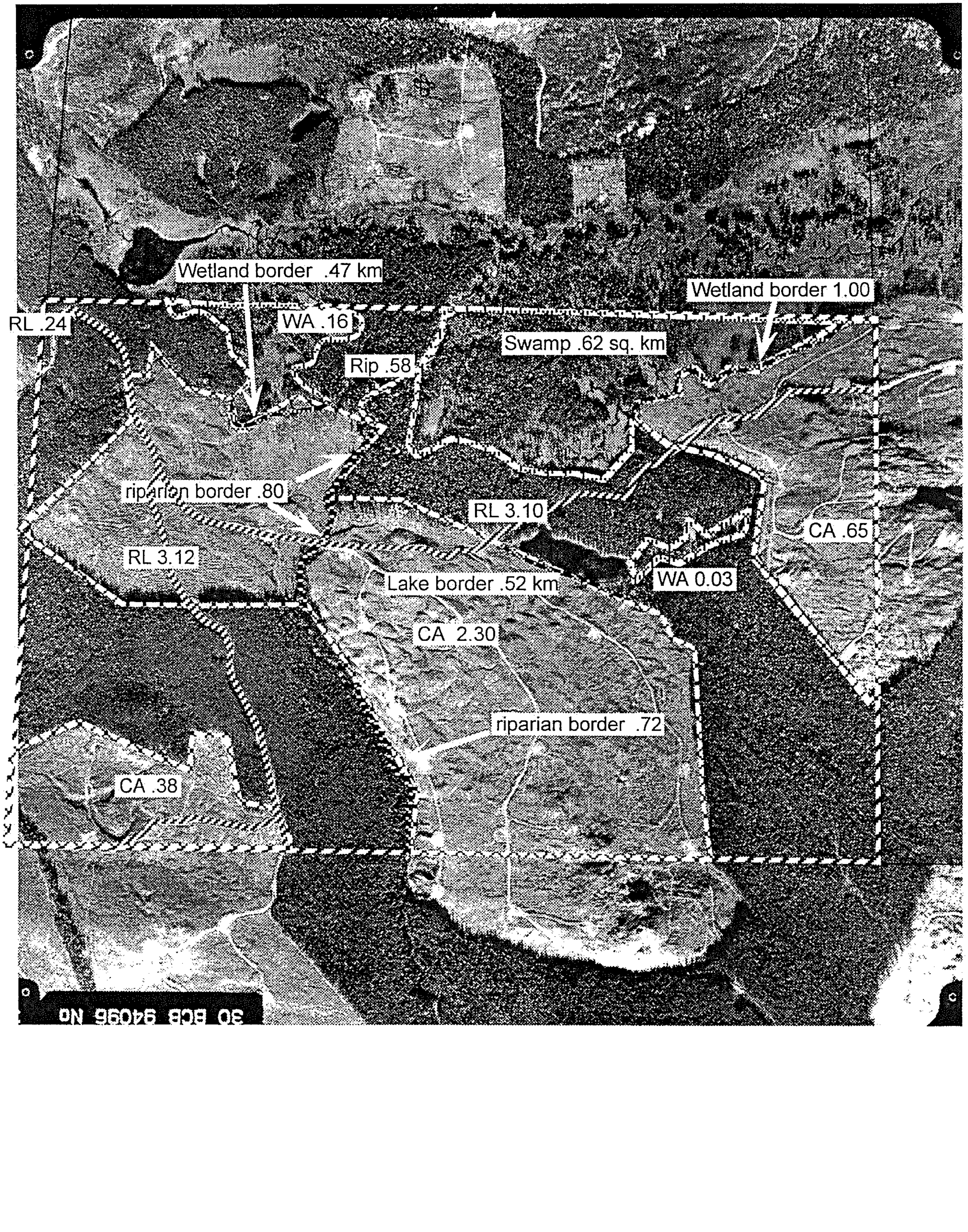
APPENDIX 2

APPENDIX 2: AERIAL PHOTOS SHOWING HIGH PRIORITY SITES

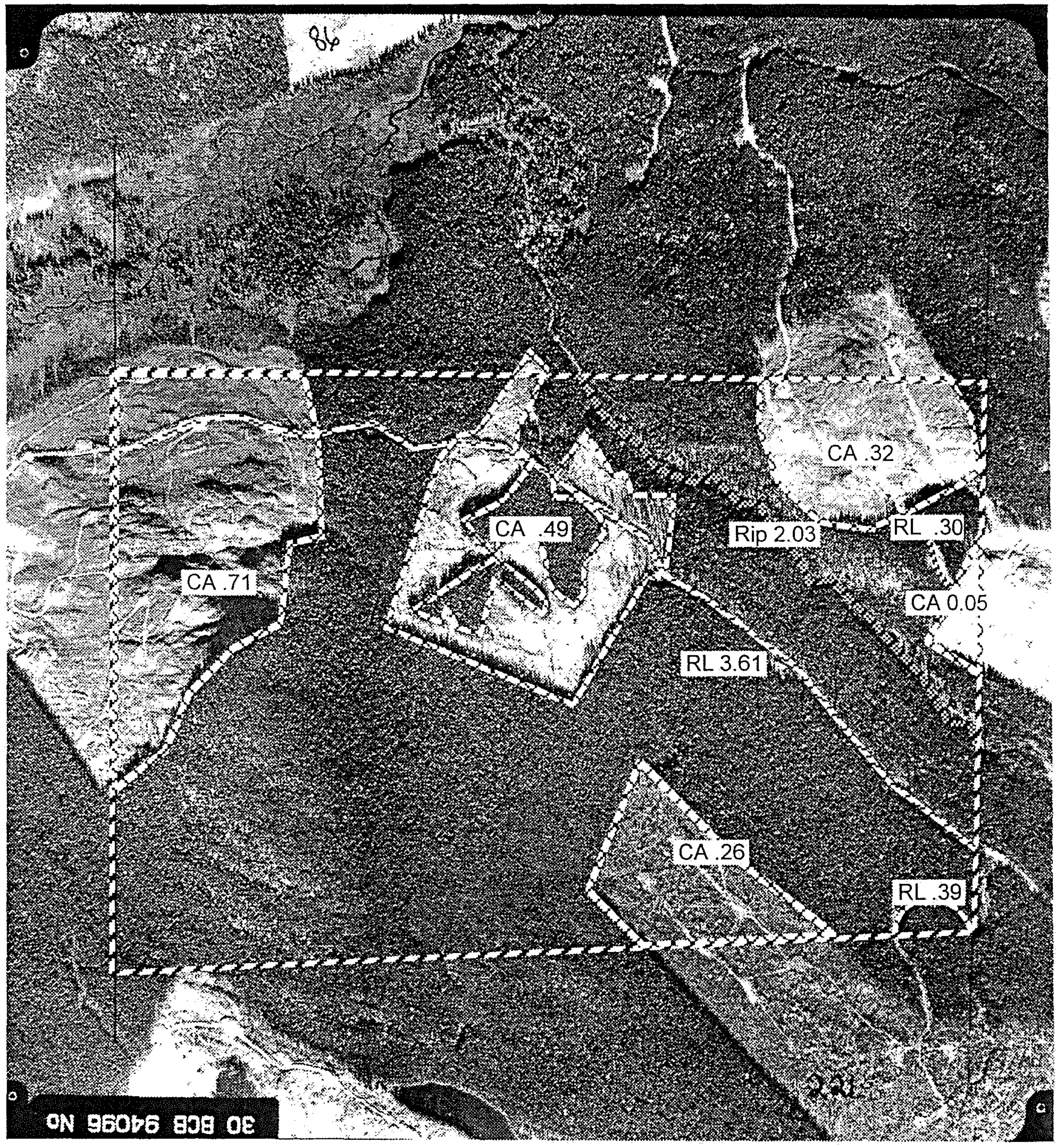
PHOTO #	VISIBILITY AND SENSITIVE HABITAT CONCERNS	RATING	POTENTIAL CONCERNS (based on 5 year development plans)	BGC	Sub-basins
94096.030	cutblocks border wetland complex (see 94096.088)	H		ICHmk3	McKinley
94096.032	cutblock borders wetland complex (see 94096.086)	H		ICHmk3	McKinley
94096.080	view into complex wetland along 2.5 km of road	H		ICH wk2	McKinley
94096.086	view into major wetland complex from cutblocks (see 94096.032)	H		ICH mk3	McKinley
94096.088	view into major wetland complex from cutblocks (see 94096.030)	H		ICH mk3	McKinley
94096.267	view of large wetland complex from road	H		ICH mk3	McKusky
95018.106	road borders large wetland along stream	H		ESSF wk	Horsefly B
95018.108	road borders large wetland along stream	H		ICH wk2	Horsefly B
95068.156	proximity to alpine; cutblock close to ridge	VH		ESSF wk	Horsefly B
95068.158	alpine surrounded by logging	VH		ESSF wk	Horsefly B
95068.160	proximity to alpine	H		ESSF wk	Horsefly B
95068.164	proximity to alpine	H		ESSF wk	Horsefly A
95068.166	proximity to alpine	H		AT	Horsefly A
95068.192	proximity to alpine	H, P	98 cutblock borders riparian	AT	Horsefly A
95068.194	proximity to alpine	H, P	98 cutblock borders riparian	ESSF wk	Horsefly A
95068.196	proximity to alpine	H		AT	Horsefly A
95087.034	cutblock & road proximity to alpine	M		ESSF wk	Horsefly A
95087.040	cutblock touches on alpine; road borders riparian approx 2.7km	H		ICH wk2	Horsefly B
95087.042	lack of riparian corridor in proximity to alpine	H		ICH wk2	Horsefly B
95087.082	proximity to alpine; road view into riparian	H		ESSF wk	MacKay
95087.084	cutblock close to avalanche slopes & alpine, no riparian buffer	MH		ESSF wk	MacKay
95087.109	lack of riparian buffer; proximity to alpine	H		ESSF wc3	MacKay
95087.116	alpine ridge - cutblocks visible on adjacent photo	H		ESSF wk	Horsefly B
95087.118	cutblocks within 1 km of alpine ridge	H		ESSF wk	McKusky
95087.122	visibility of large wetland from road and cutblock	MH		ICH wk2	McKusky
95087.126	long stretch of riparian borders road (3.3 km); logged riparian 1 km	VH		ICH wk2	Horsefly B
95087.128	long stretch of riparian borders road (2 km)	VH		ICH wk2	Horsefly B
95087.130	long stretch of riparian borders road	VH		ICH wk2	Horsefly B
95087.154	no buffer both sides large wetland	VH		ICH wk2	McKusky
95087.148	no buffer both sides large wetland	VH		ICH wk2	McKusky
95087.158	proximity of cutblock to alpine (trail from cutblock to alpine)	VH		ESSF wc3	MacKay
95087.160	proximity of cutblock to alpine	VH		ESSF wc3	MacKay
95087.162	proximity of cutblock to alpine	VH		ESSF wc4	MacKay

VH- very high; H-high; MH-moderately high; P-potential for impact based on development plans

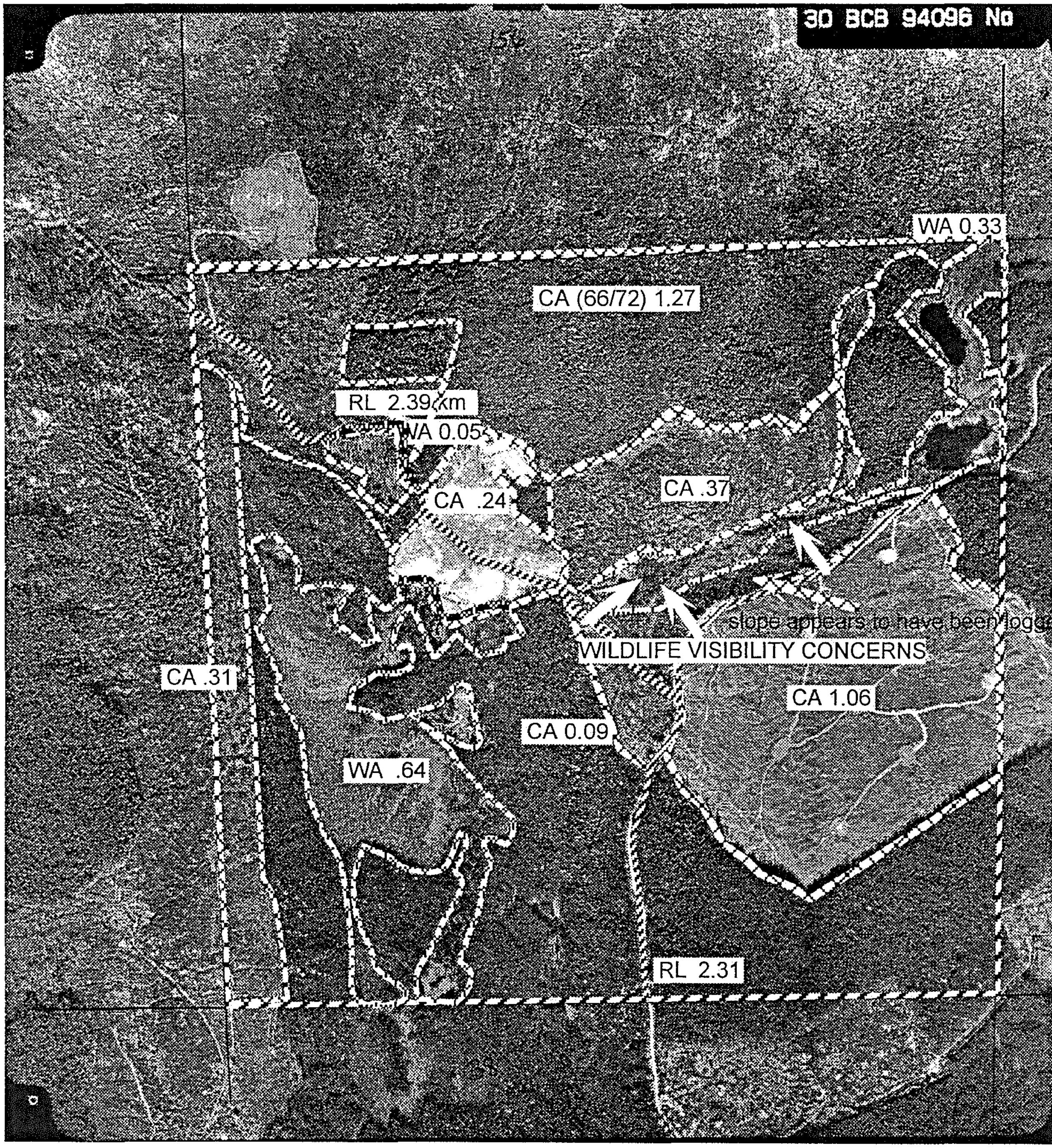
94096-30


Wetland border .47 km
Wetland border 1.00
RL .24
WA .16
Swamp .62 sq. km
Rip .58
riparian border .80
RL 3.10
CA .65
RL 3.12
Lake border .52 km
WA 0.03
CA 2.30
riparian border .72
CA .38
30 BCB 94096 No

94096-32

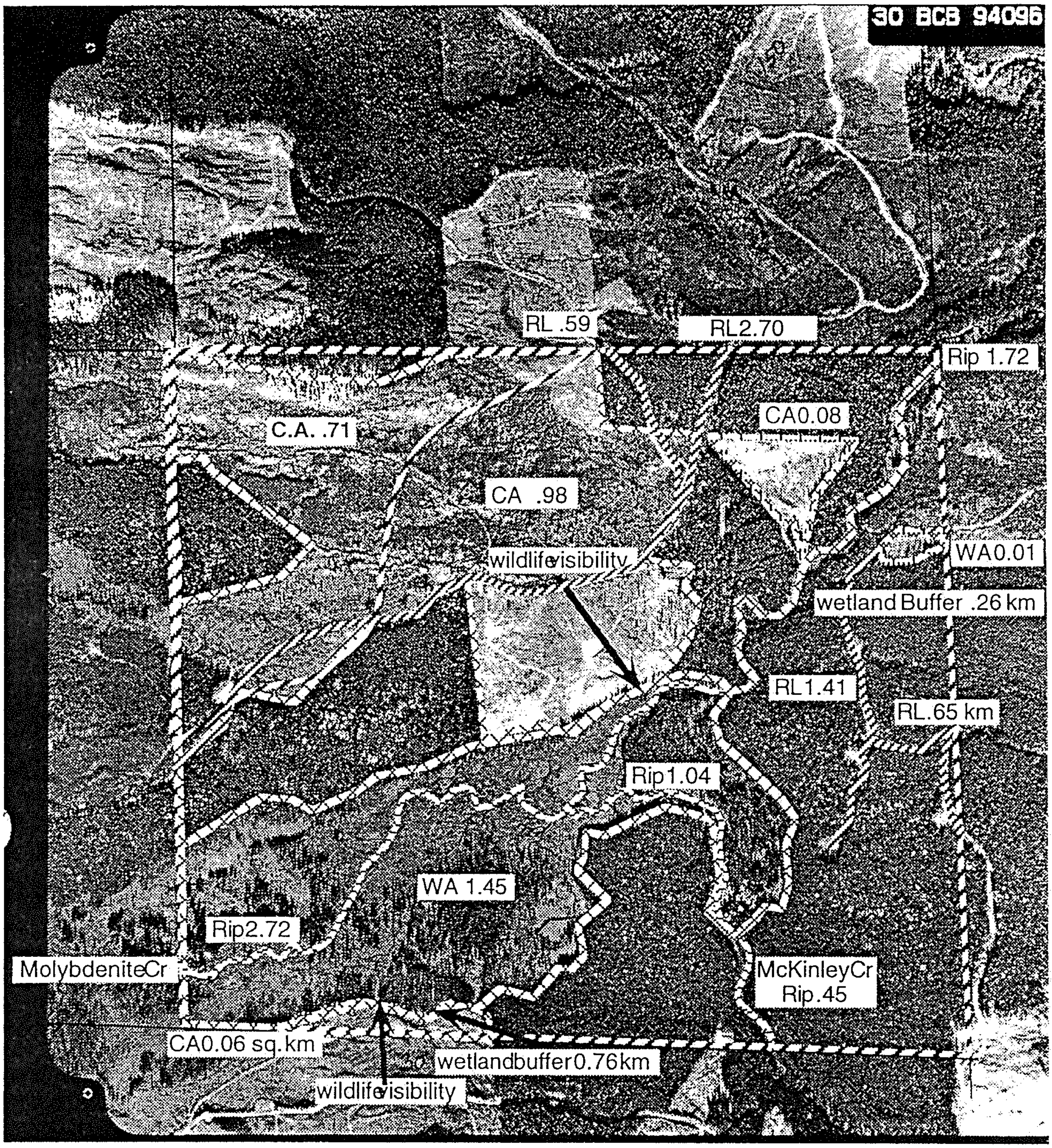


86
CA .32
CA .49
Rip 2.03
RL .30
CA .71
CA 0.05
RL 3.61
CA .26
RL .39
30 BCB 94096 No



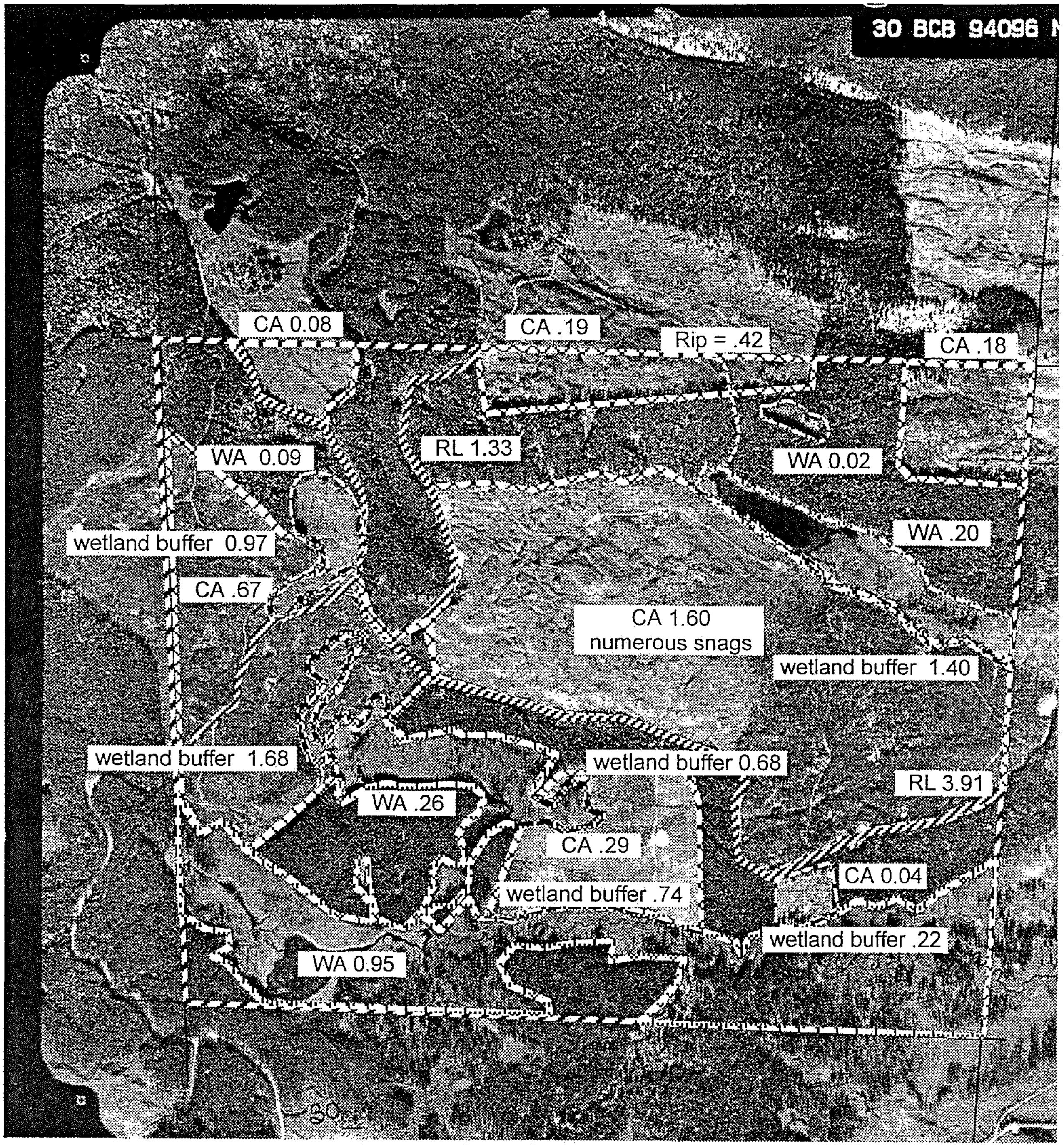
3D BCB 94096 No
WA 0.33
CA (66/72) 1.27
RL 2.39 km
WA 0.05
CA .24
CA .37
slope appears to have been logged
WILDLIFE VISIBILITY CONCERNS
CA .31
CA 1.06
CA 0.09
WA .64
RL 2.31

80

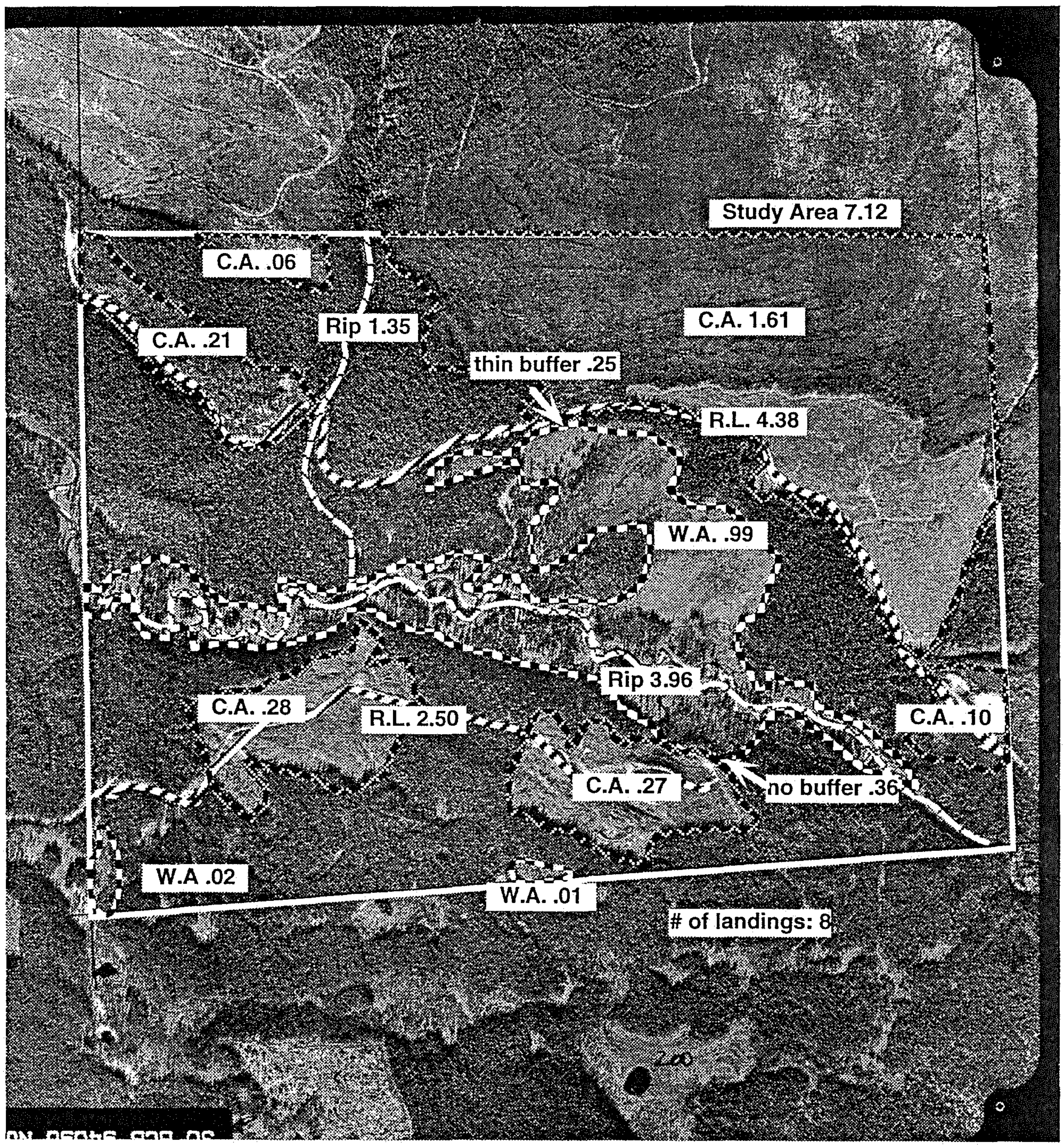


30 BCB 94096
RL .59
RL2.70
Rip 1.72
CA0.08
C.A. .71
CA .98
wildlife visibility
WA0.01
wetland Buffer .26 km
RL1.41
RL.65 km
Rip1.04
WA 1.45
Rip2.72
MolybdeniteCr
McKinleyCr
Rip.45
CA0.06 sq.km
wetlandbuffer0.76km
wildlife visibility

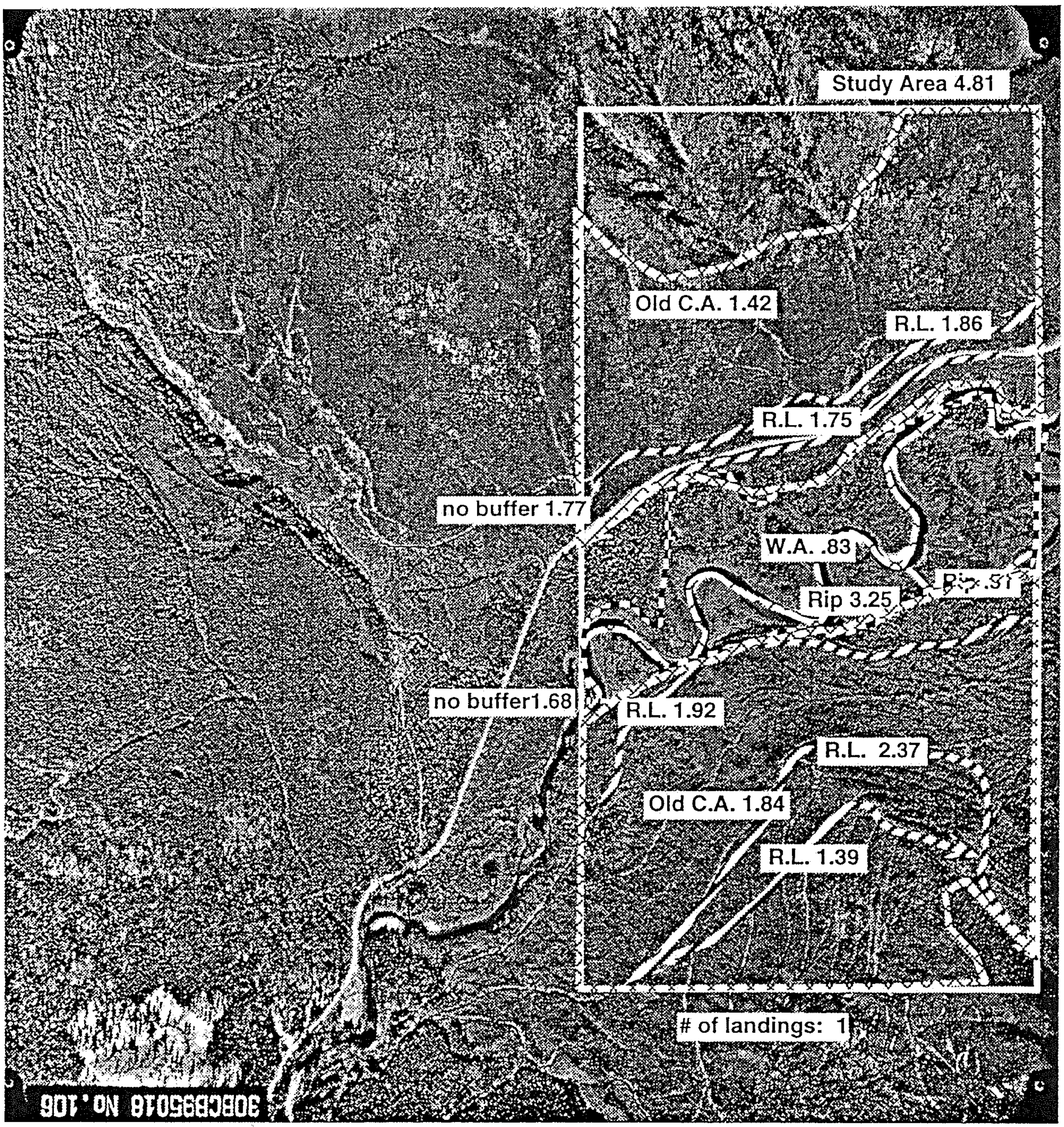
86

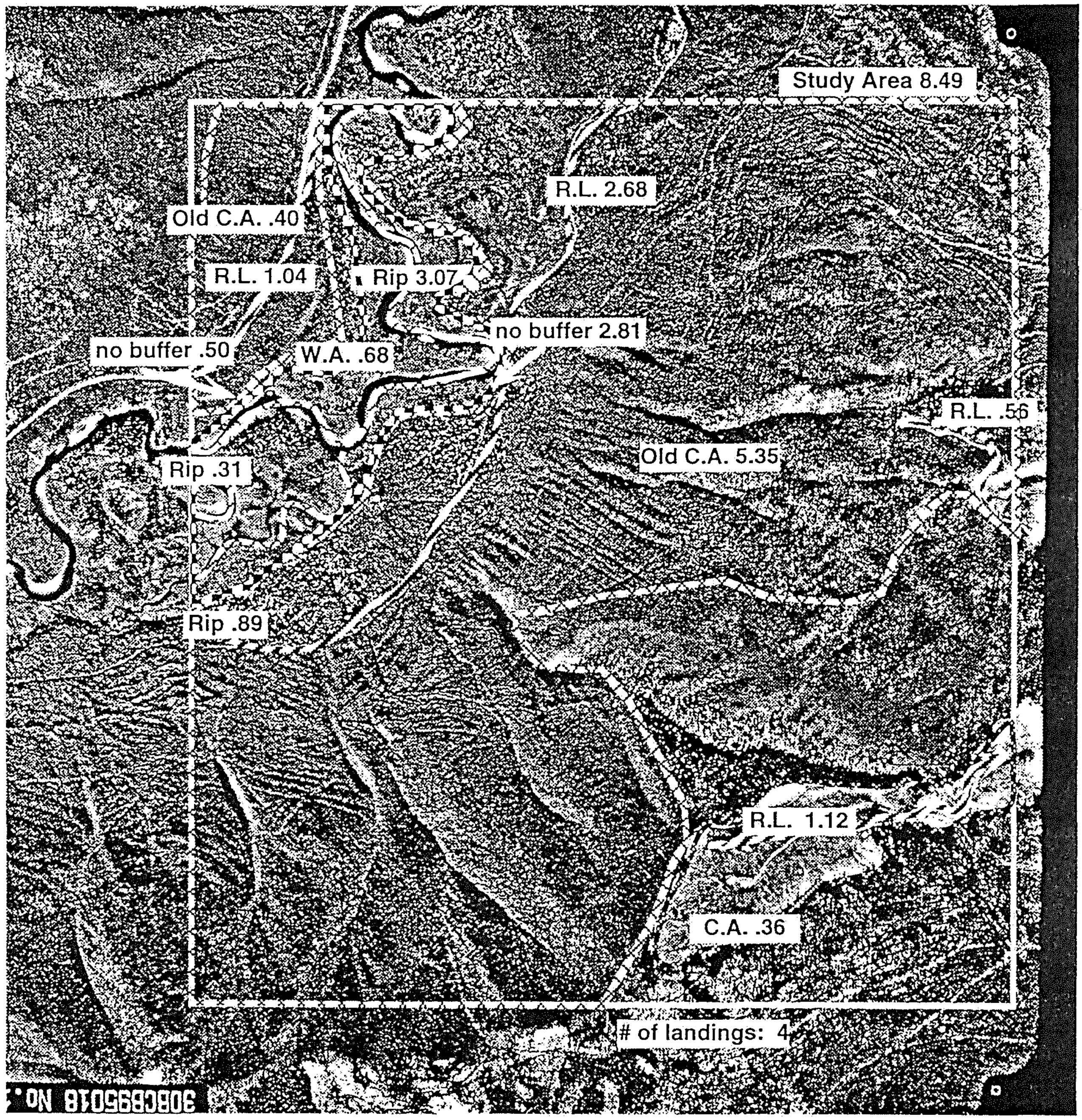

30 BCB 94096 N
88
CA 0.08
CA .19
Rip = .42
CA .18
WA 0.09
RL 1.33
WA 0.02
WA .20
wetland buffer 0.97
CA .67
CA 1.60
numerous snags
wetland buffer 1.40
wetland buffer 1.68
wetland buffer 0.68
RL 3.91
WA .26
CA .29
CA 0.04
wetland buffer .74
wetland buffer .22
WA 0.95

267-94096


Study Area 7.12
C.A. .06
C.A. .21
Rip 1.35
C.A. 1.61
thin buffer .25
R.L. 4.38
W.A. .99
Rip 3.96
C.A. .28
R.L. 2.50
C.A. .10
C.A. .27
no buffer .36
W.A .02
W.A. .01
# of landings: 8

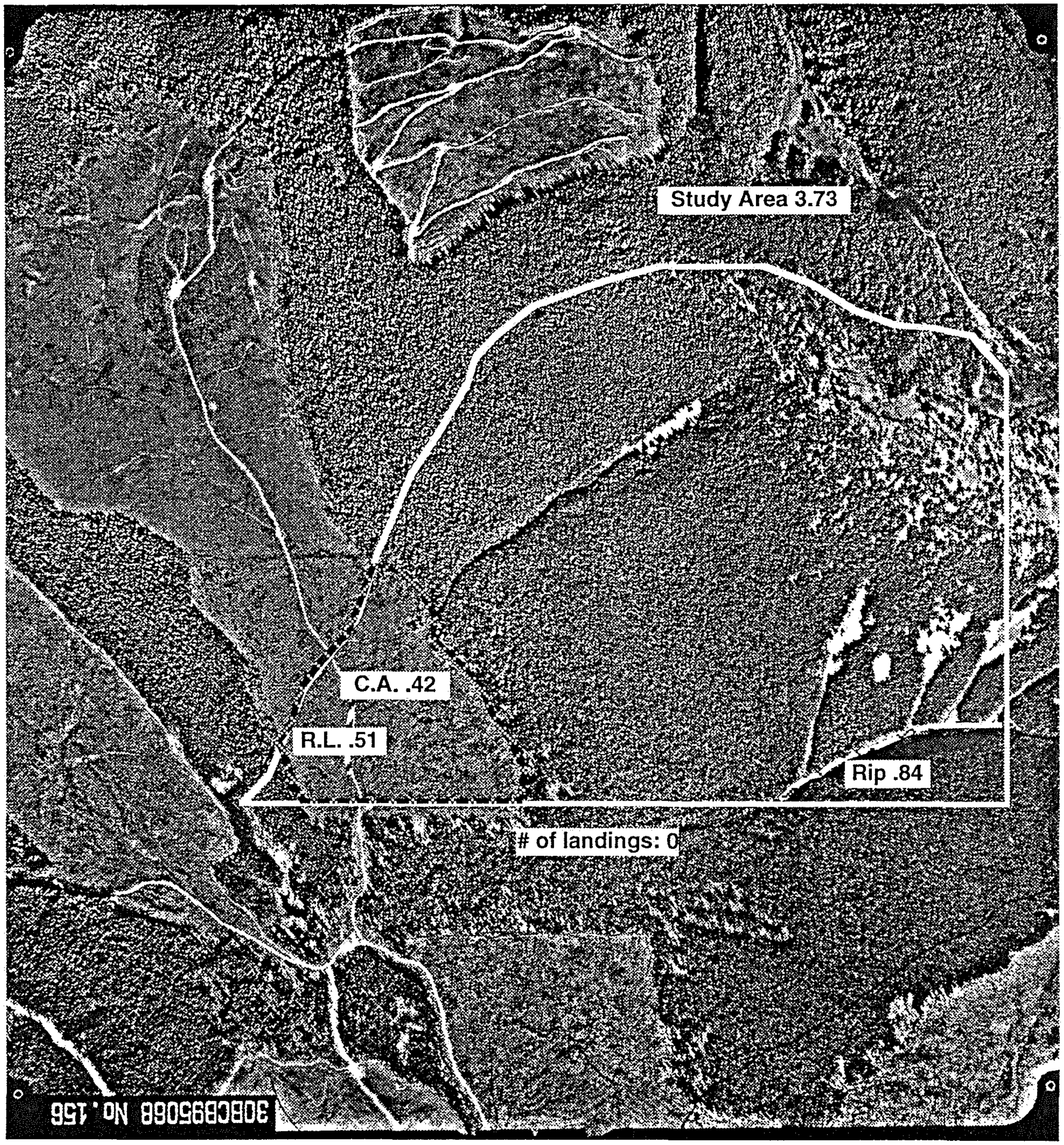
95018/106


Study Area 4.81
Old C.A. 1.42
R.L. 1.86
R.L. 1.75
no buffer 1.77
W.A. .83
Rip 3.25
no buffer1.68
R.L. 1.92
R.L. 2.37
Old C.A. 1.84
R.L. 1.39
# of landings: 1

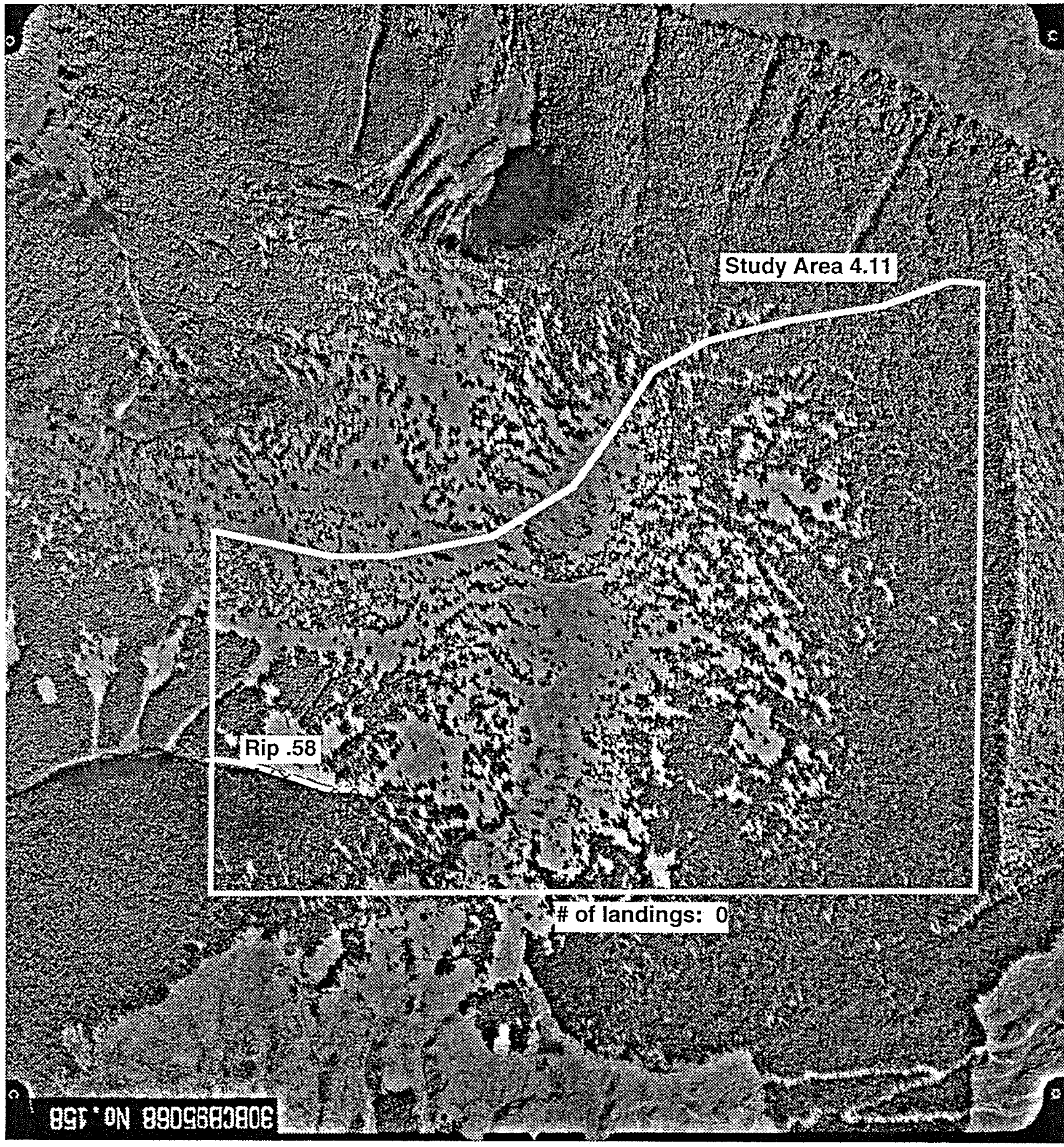


Study Area 8.49
R.L. 2.68
Old C.A. .40
R.L. 1.04
Rip 3.07
no buffer 2.81
no buffer .50
W.A. .68
R.L. .56
Old C.A. 5.35
Rip .31
Rip .89
R.L. 1.12
C.A. .36
# of landings: 4

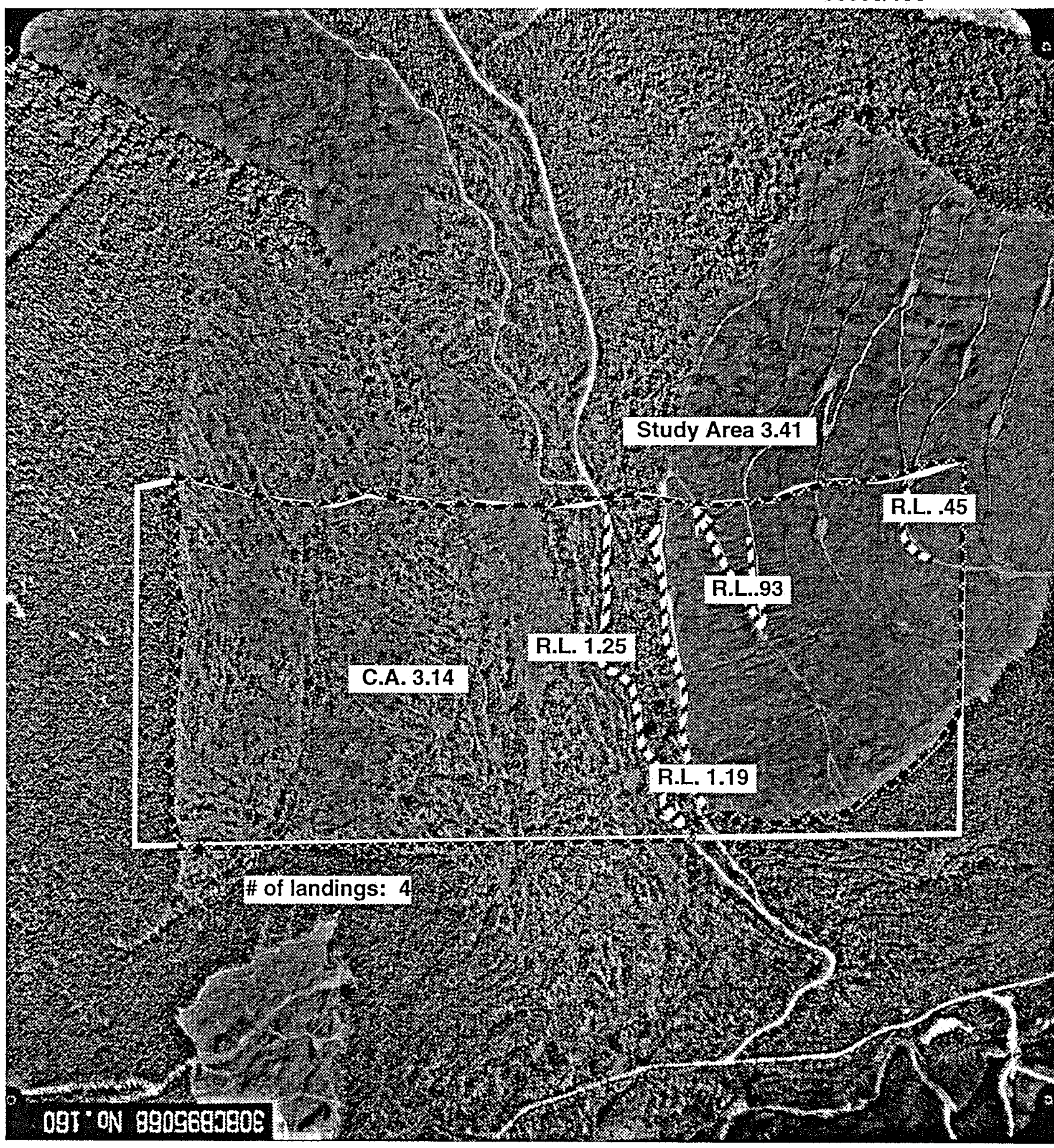
95068/156



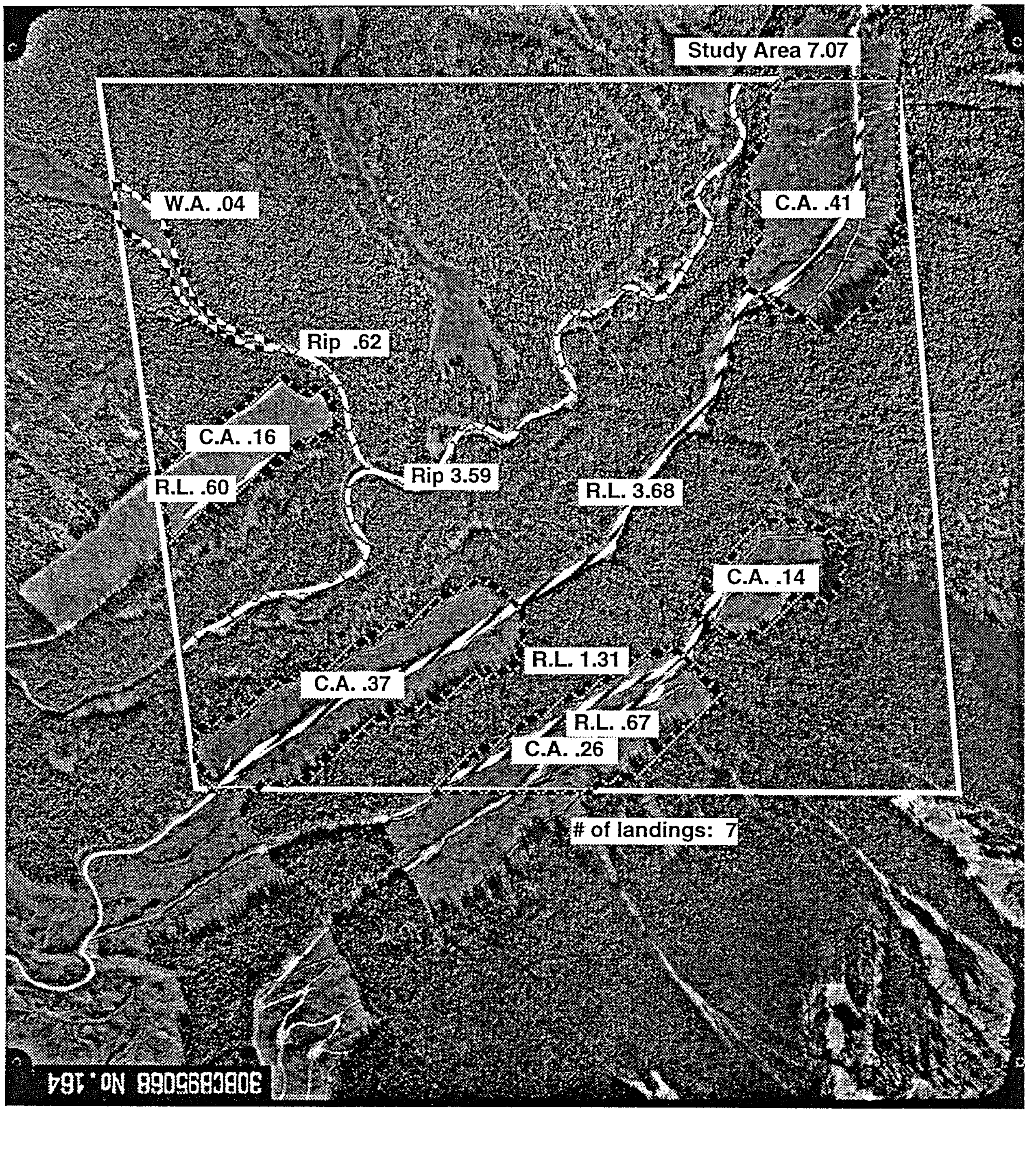
95068/158



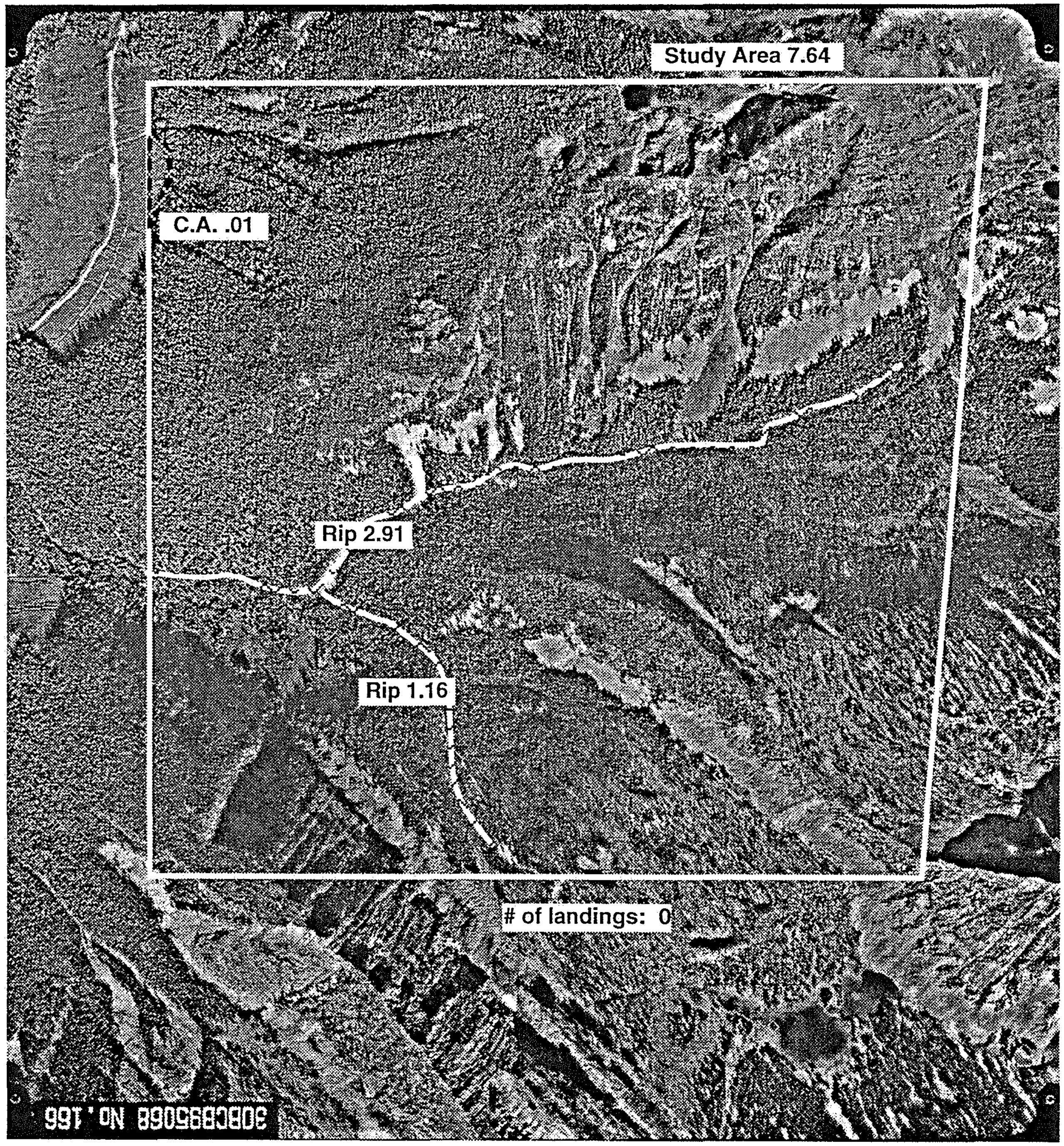
95068/160



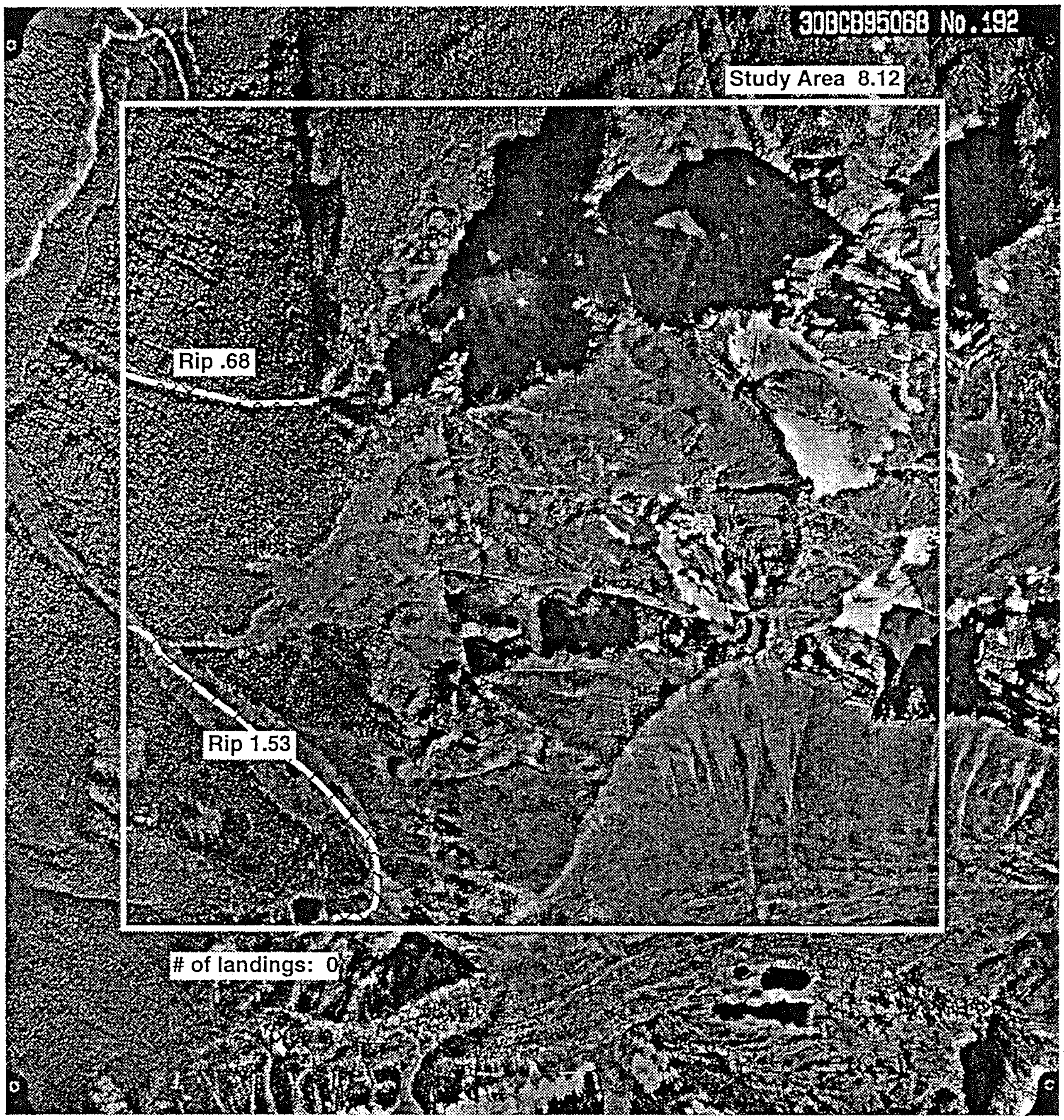
95068/164


Study Area 7.07
W.A. .04
C.A. .41
Rip .62
C.A. .16
R.L. .60
Rip 3.59
R.L. 3.68
C.A. .14
R.L. 1.31
C.A. .37
R.L. .67
C.A. .26
# of landings: 7

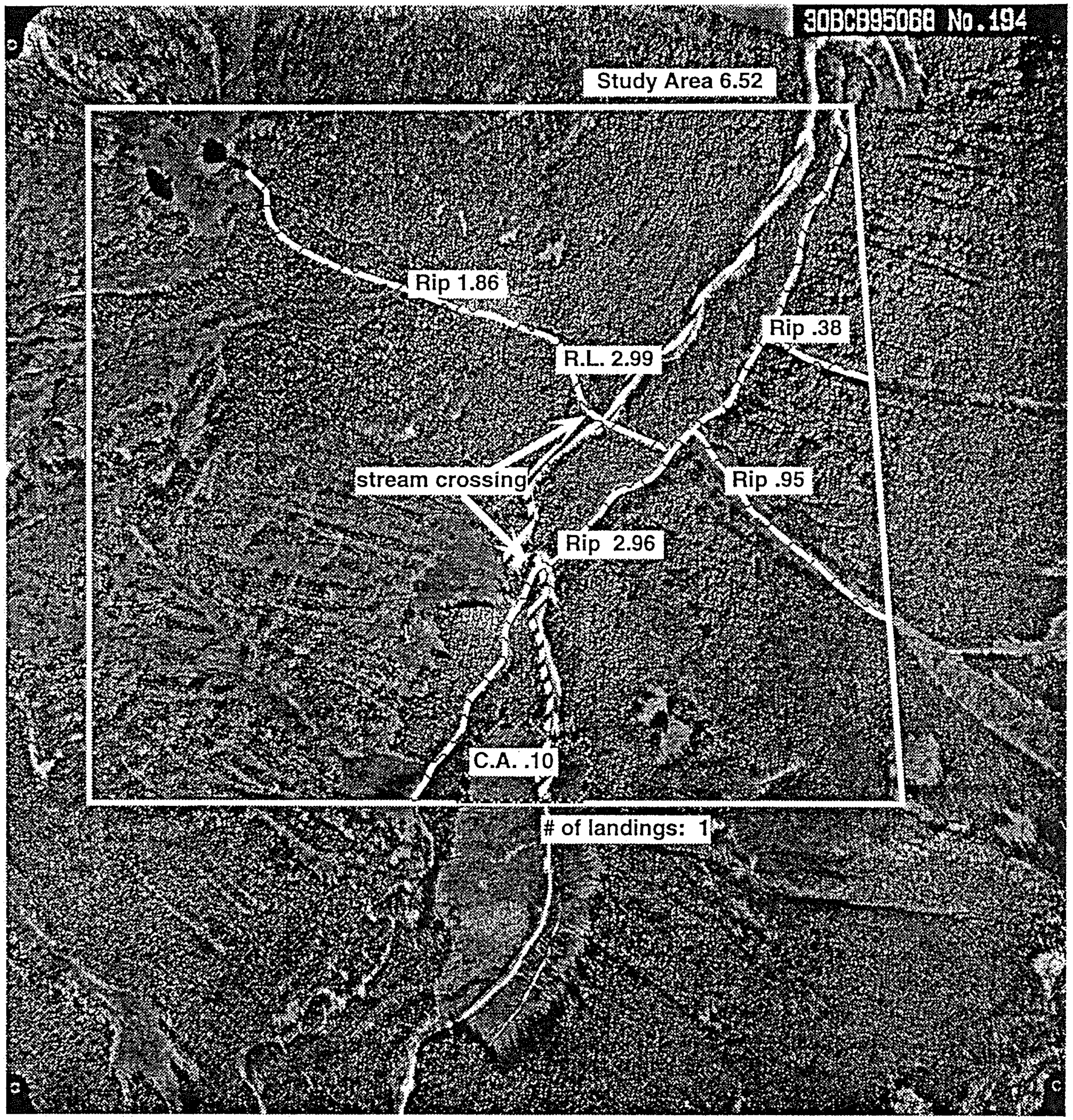
95068/166

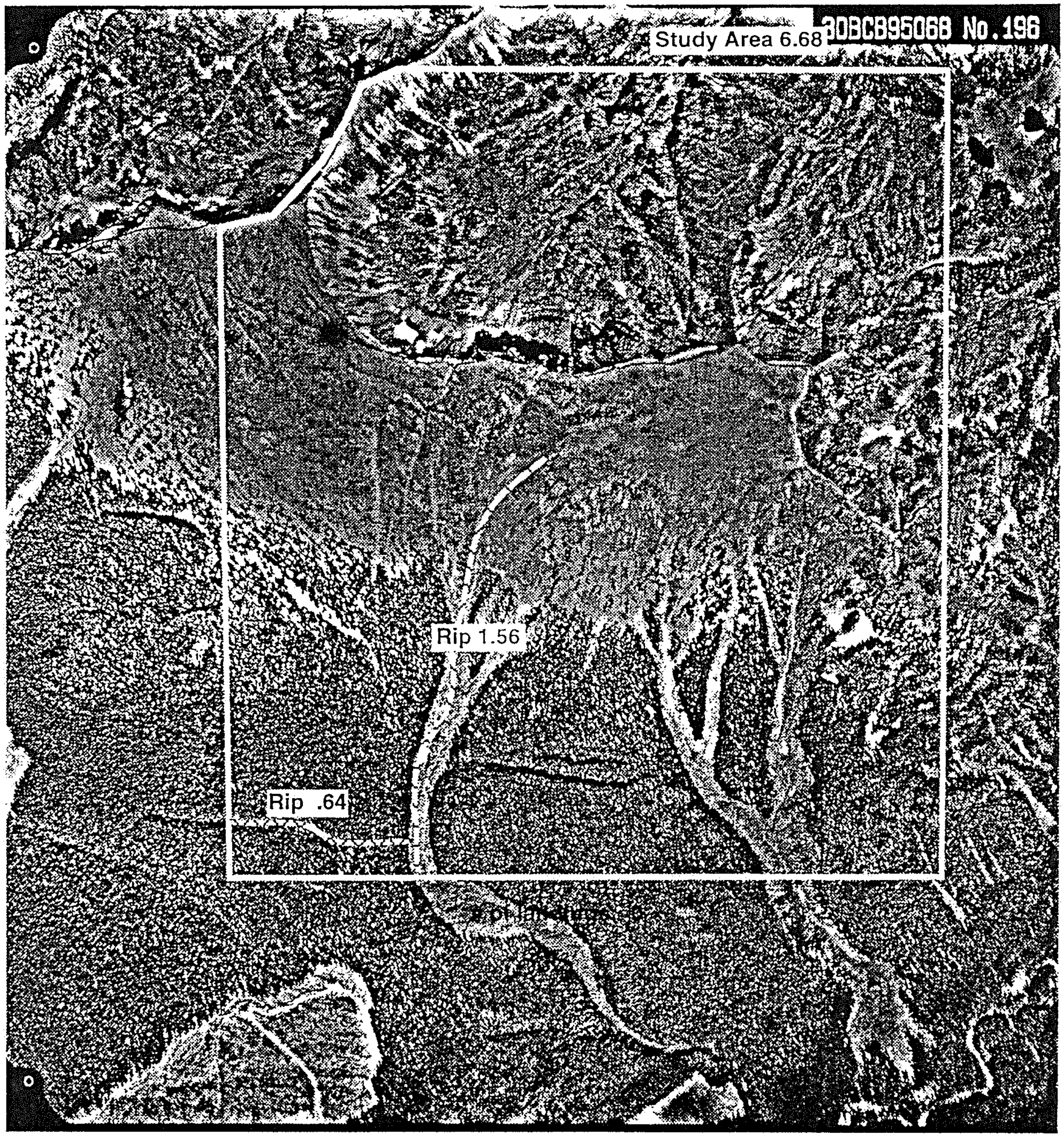


95068/192

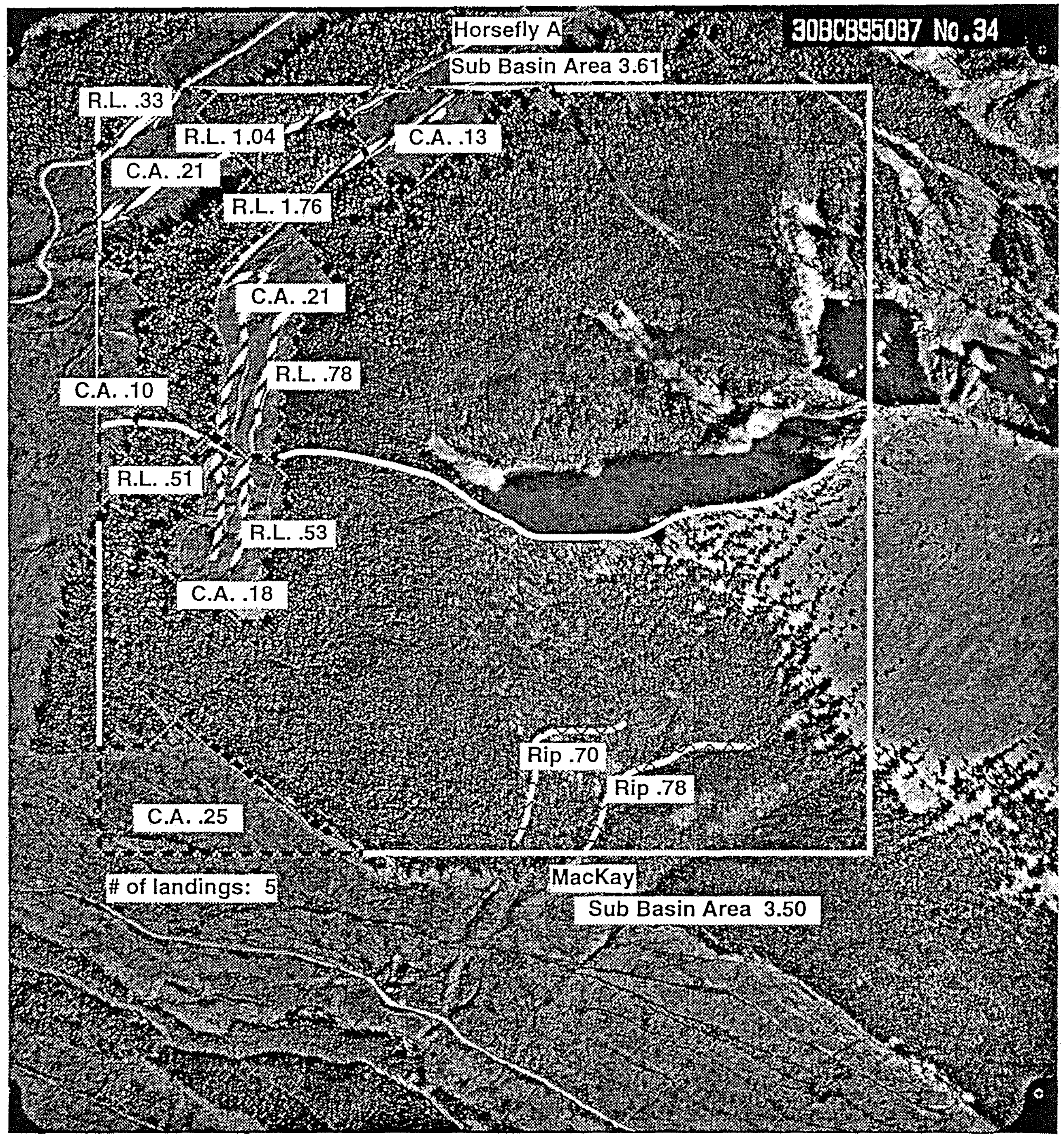


95068/194

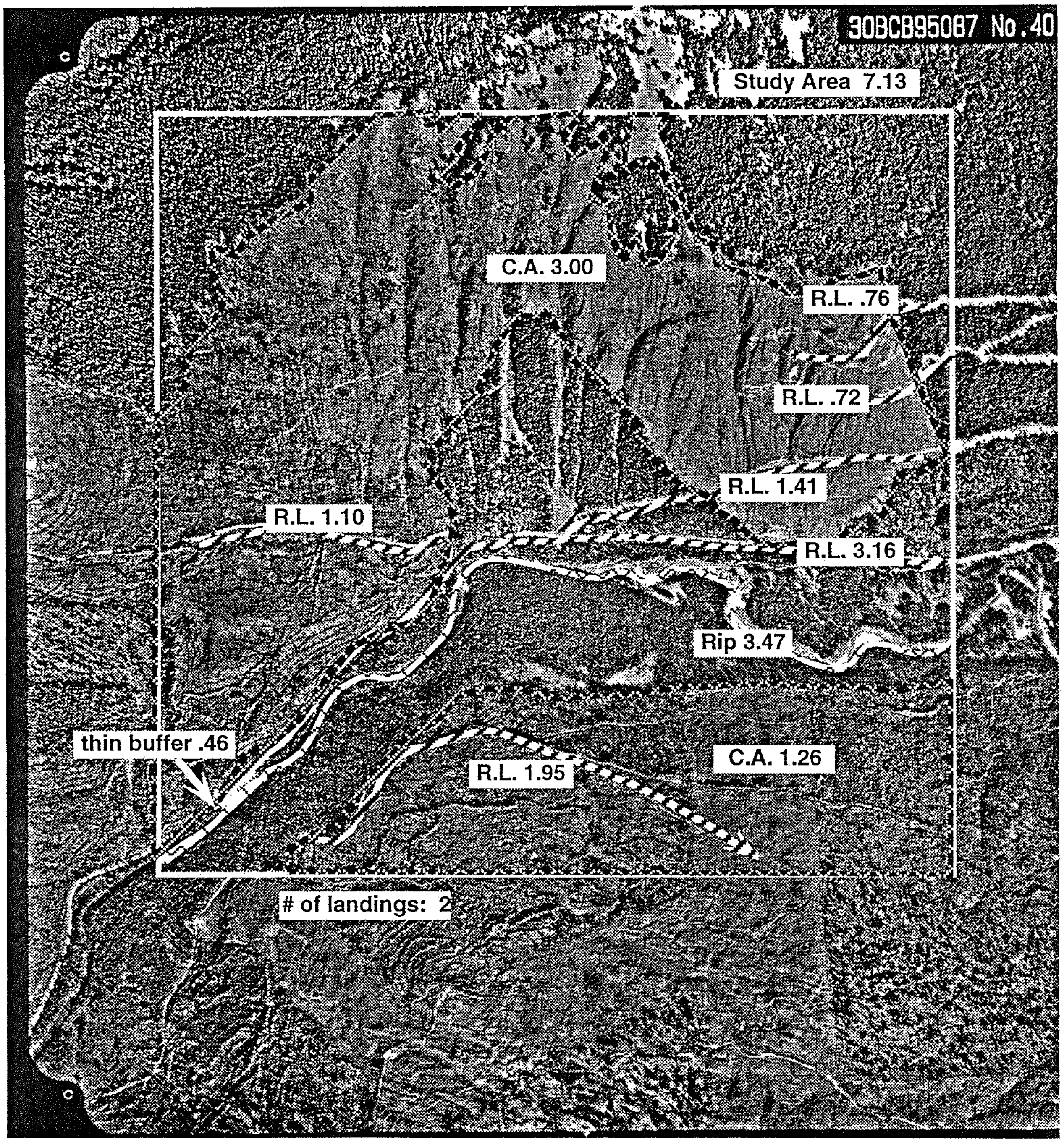

30BCB95068 No.194
Study Area 6.52
Rip 1.86
R.L. 2.99
Rip .38
stream crossing
Rip .95
Rip 2.96
C.A. .10
# of landings: 1


30BCB95068 No.196
Study Area 6.68
Rip 1.56
Rip .64

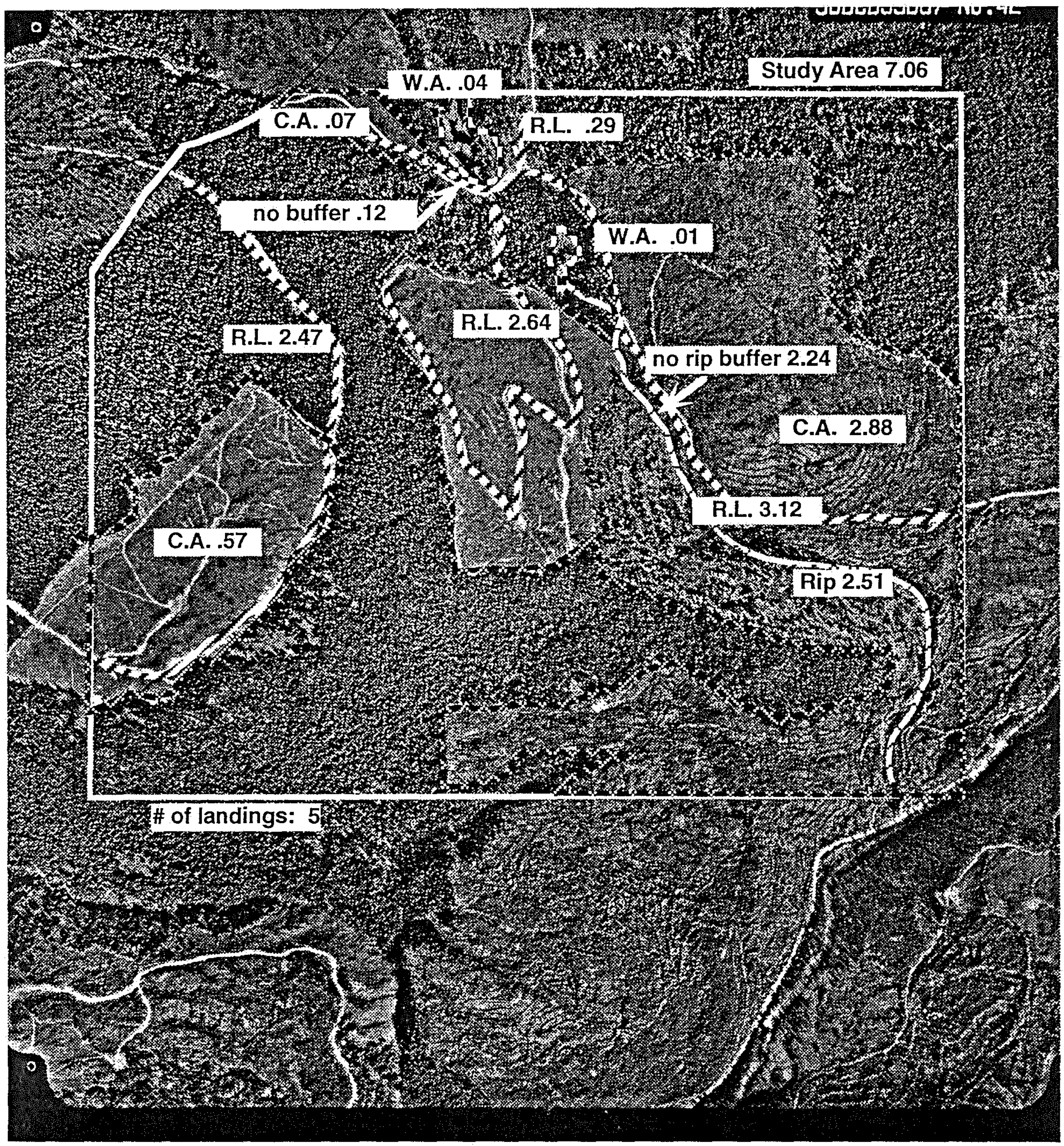
95087/34


Horsefly A
30BCB95087 No.34
Sub Basin Area 3.61
R.L. .33
R.L. 1.04
C.A. .13
C.A. .21
R.L. 1.76
C.A. .21
R.L. .78
C.A. .10
R.L. .51
R.L. .53
C.A. .18
Rip .70
Rip .78
C.A. .25
# of landings: 5
MacKay
Sub Basin Area 3.50

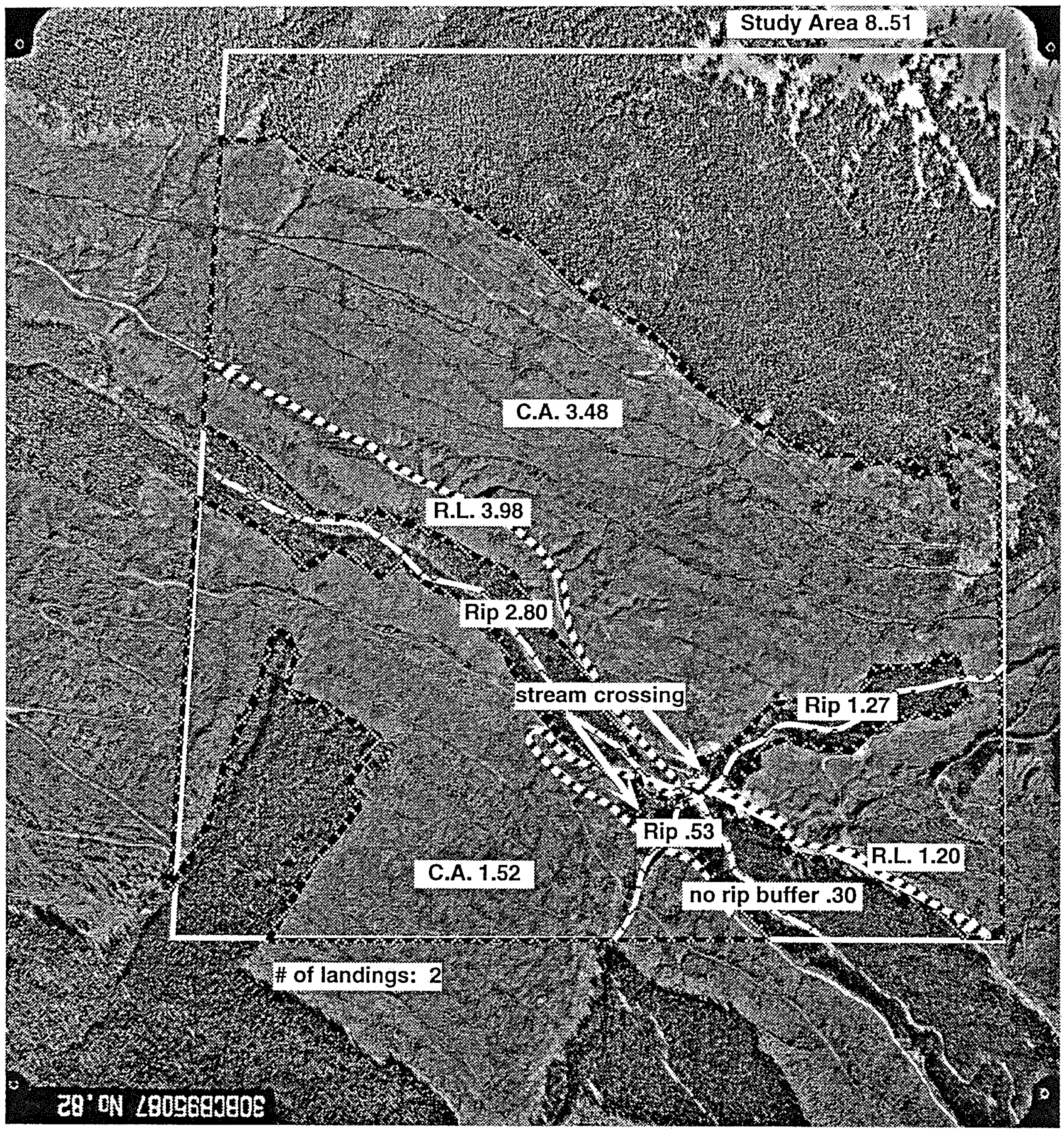
95087/40


30BCB95087 No.40
Study Area 7.13
C.A. 3.00
R.L. .76
R.L. .72
R.L. 1.41
R.L. 1.10
R.L. 3.16
Rip 3.47
thin buffer .46
C.A. 1.26
R.L. 1.95
# of landings: 2

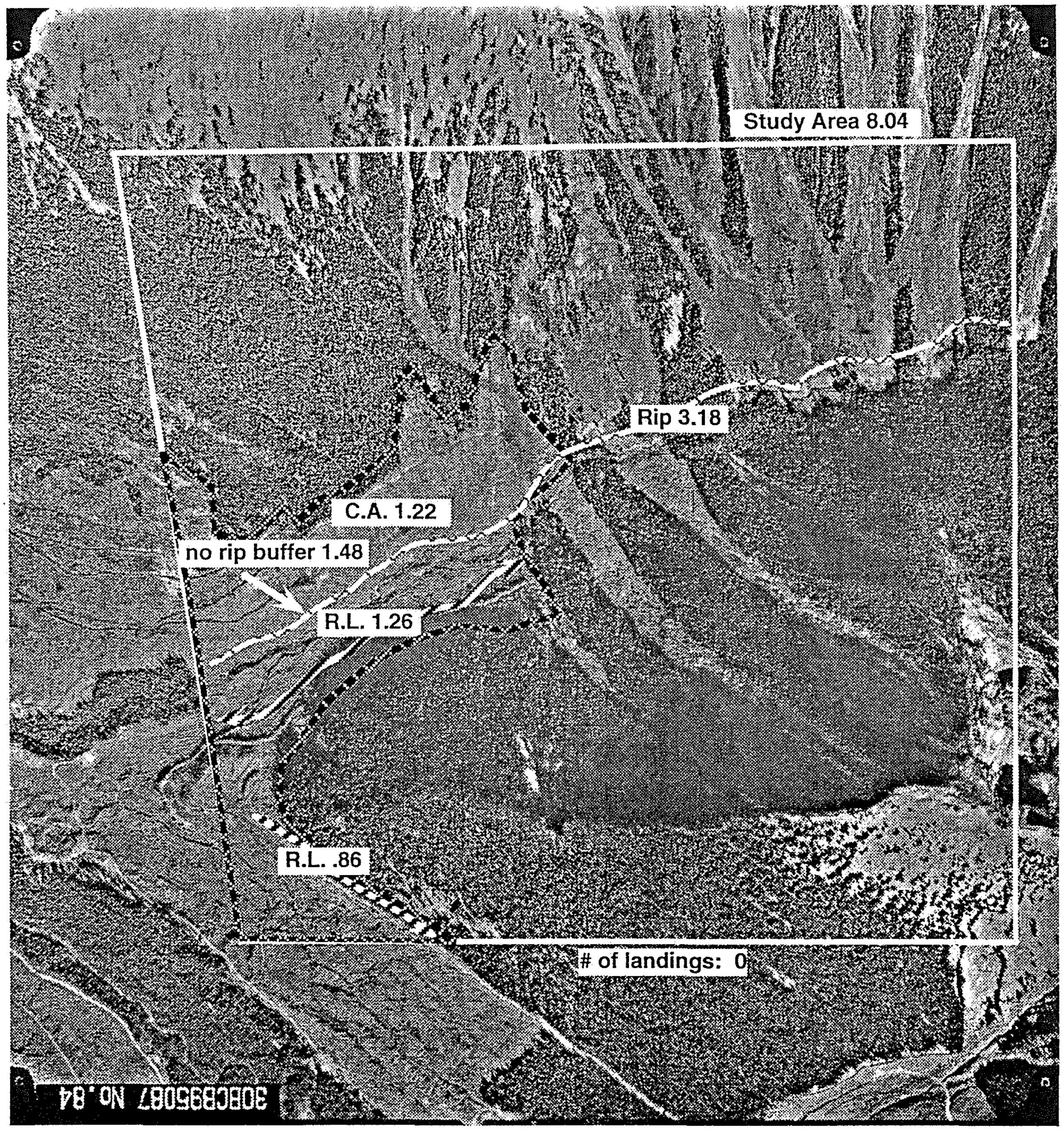
95087/42


Study Area 7.06
W.A. .04
C.A. .07
R.L. .29
no buffer .12
W.A. .01
R.L. 2.64
R.L. 2.47
no rip buffer 2.24
C.A. 2.88
R.L. 3.12
C.A. .57
Rip 2.51
# of landings: 5

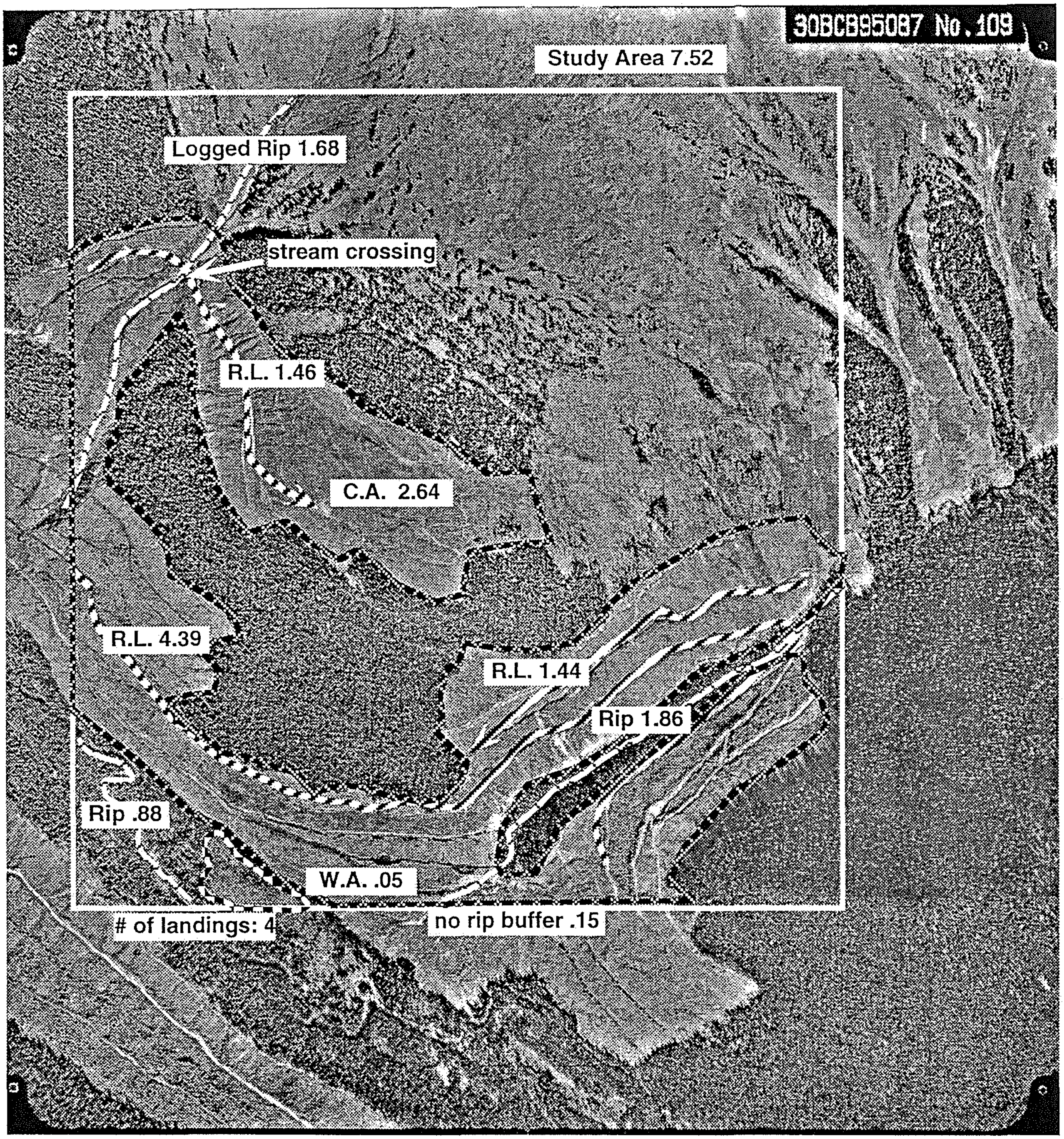
95087/82



Study Area 8..51
C.A. 3.48
R.L. 3.98
Rip 2.80
stream crossing
Rip 1.27
Rip .53
R.L. 1.20
C.A. 1.52
no rip buffer .30
# of landings: 2
308CB95087 No.82


Study Area 8.04
Rip 3.18
C.A. 1.22
no rip buffer 1.48
R.L. 1.26
R.L. .86
# of landings: 0

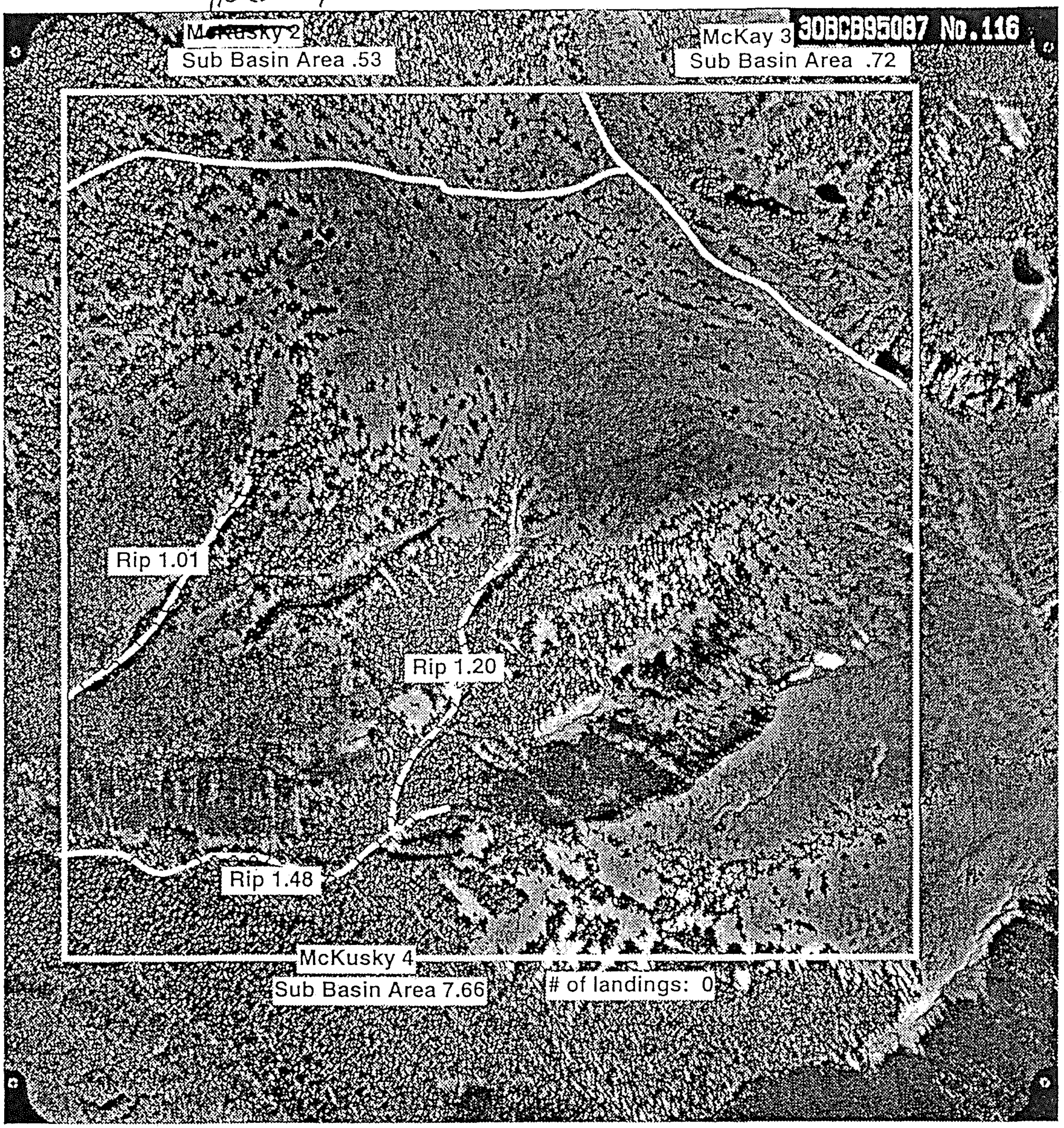
95087/109



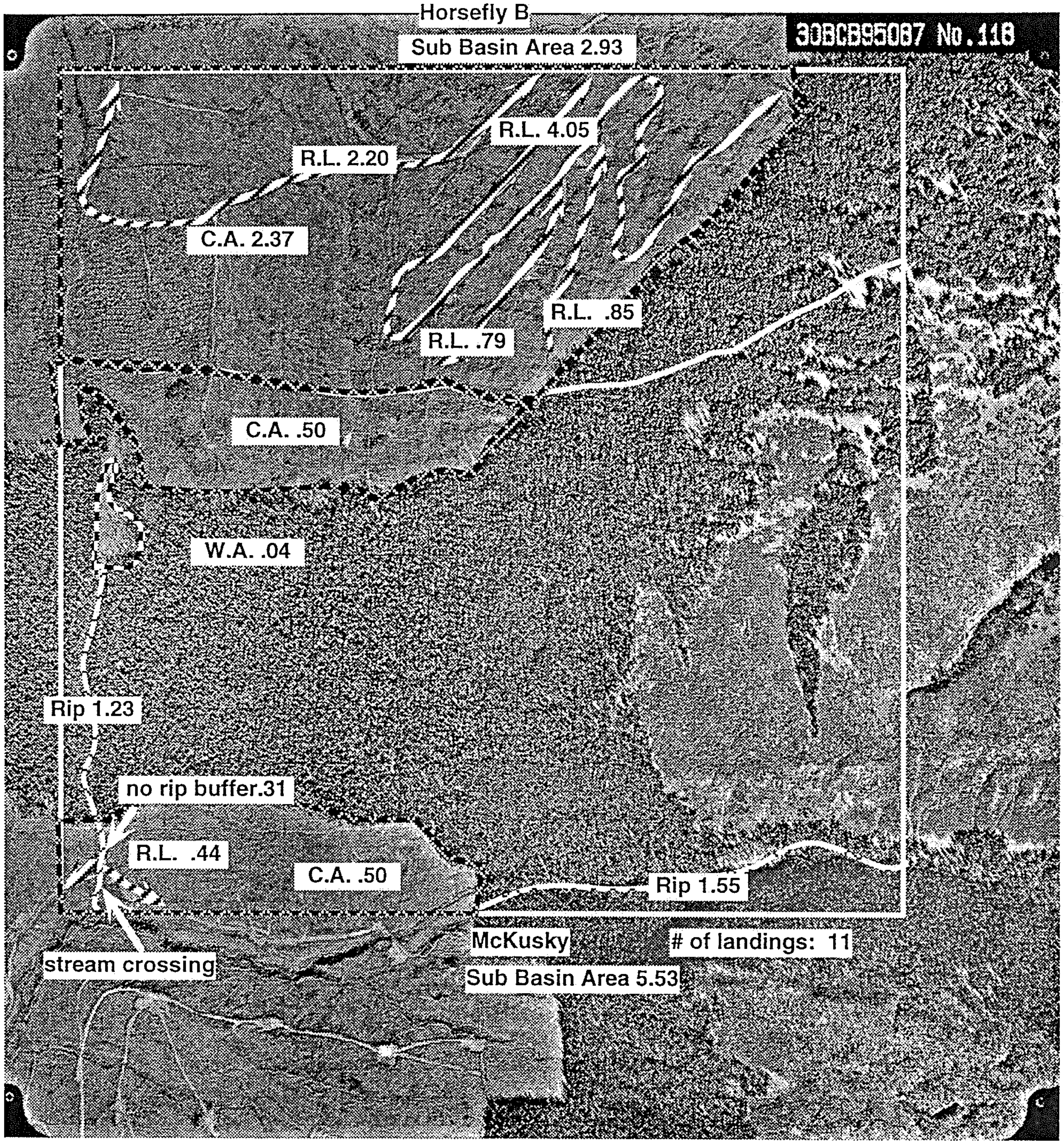
30BCB95087 No.109
Study Area 7.52
Logged Rip 1.68
stream crossing
R.L. 1.46
C.A. 2.64
R.L. 4.39
R.L. 1.44
Rip 1.86
Rip .88
W.A. .05
# of landings: 4
no rip buffer .15

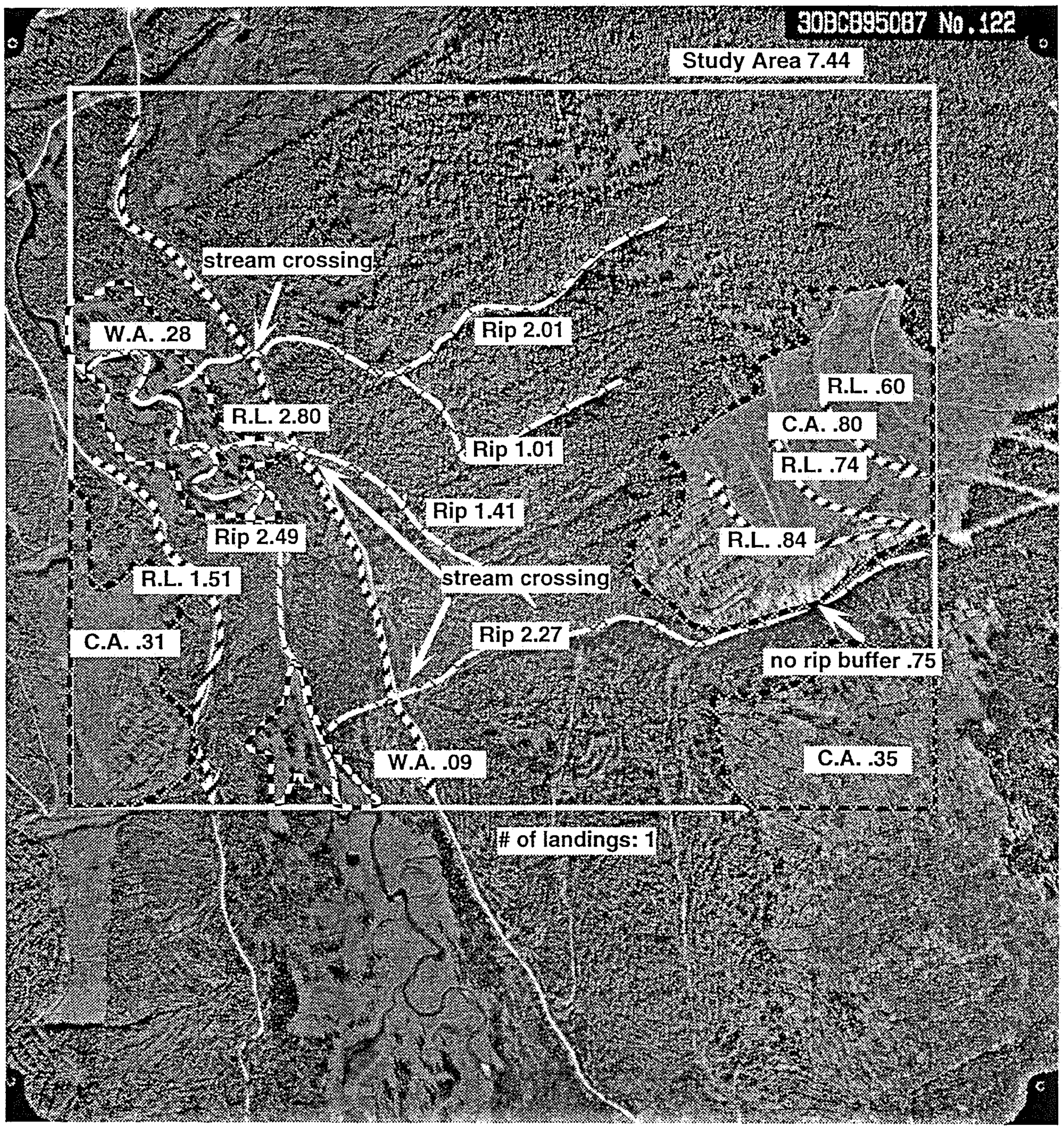
HORSEFLY

95087/116



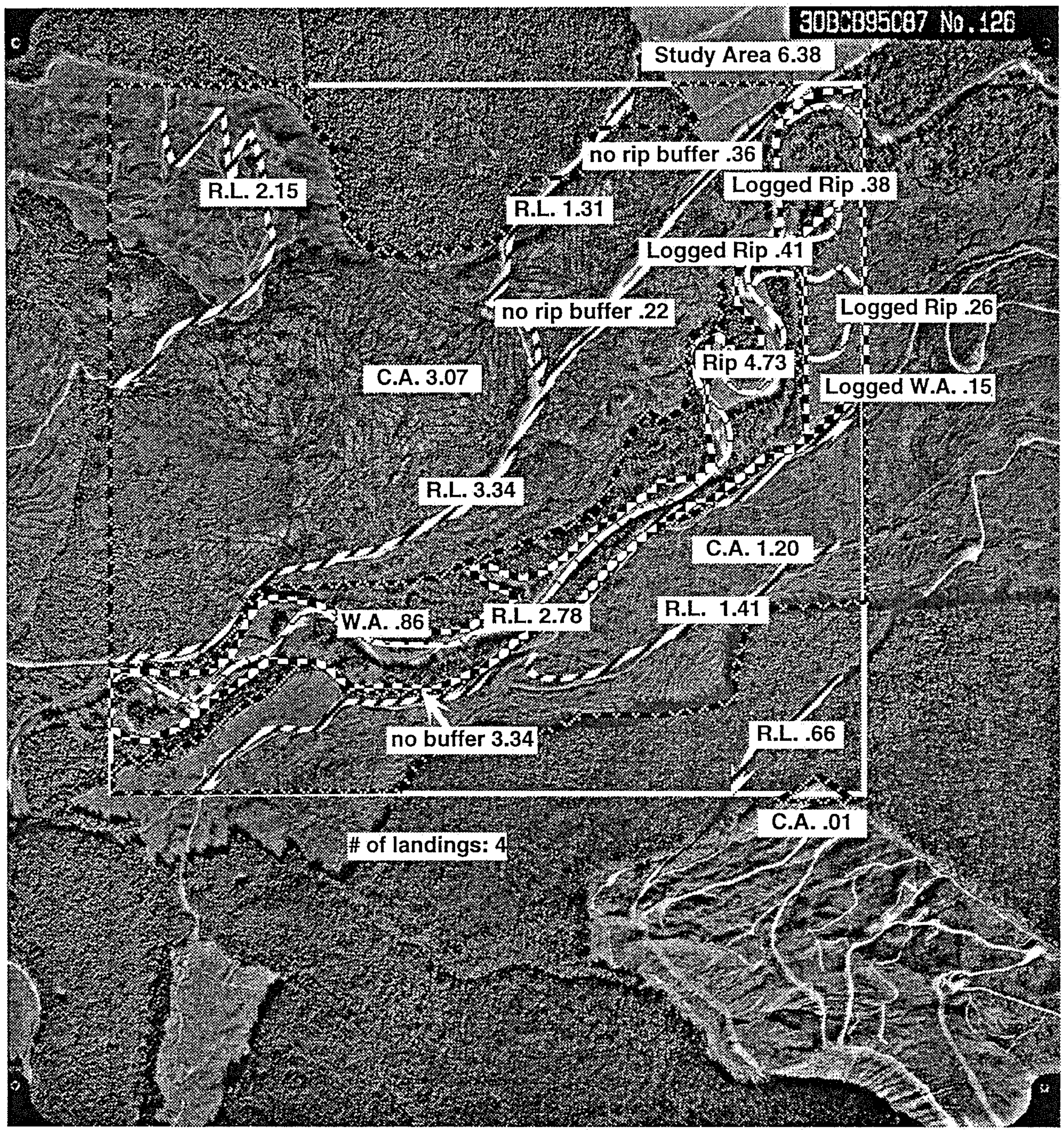
95087/118


Horsefly B
Sub Basin Area 2.93
30BCB95087 No.118
R.L. 4.05
R.L. 2.20
C.A. 2.37
R.L. .85
R.L. .79
C.A. .50
W.A. .04
Rip 1.23
no rip buffer.31
R.L. .44
C.A. .50
Rip 1.55
stream crossing
McKusky
Sub Basin Area 5.53
# of landings: 11

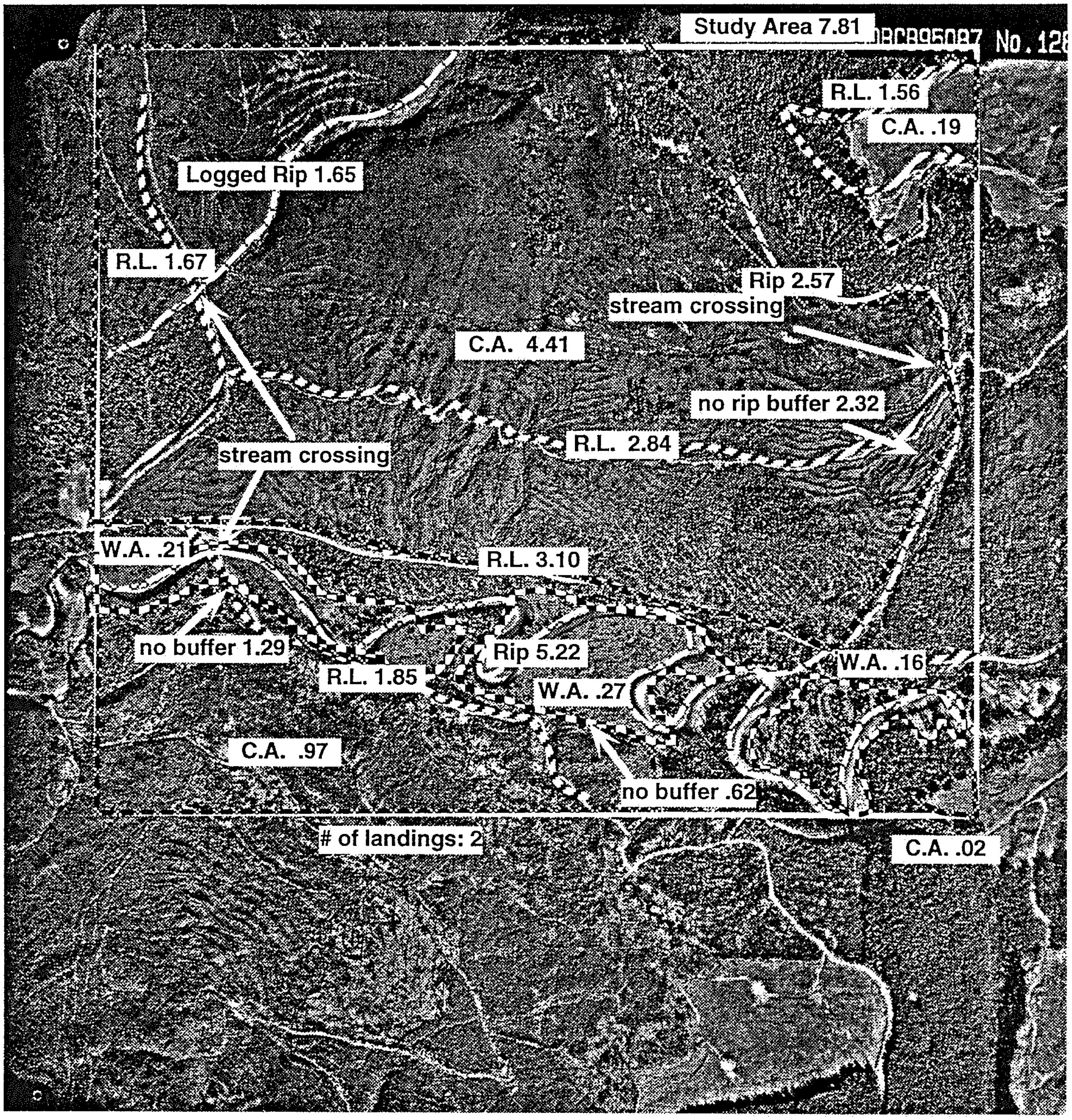


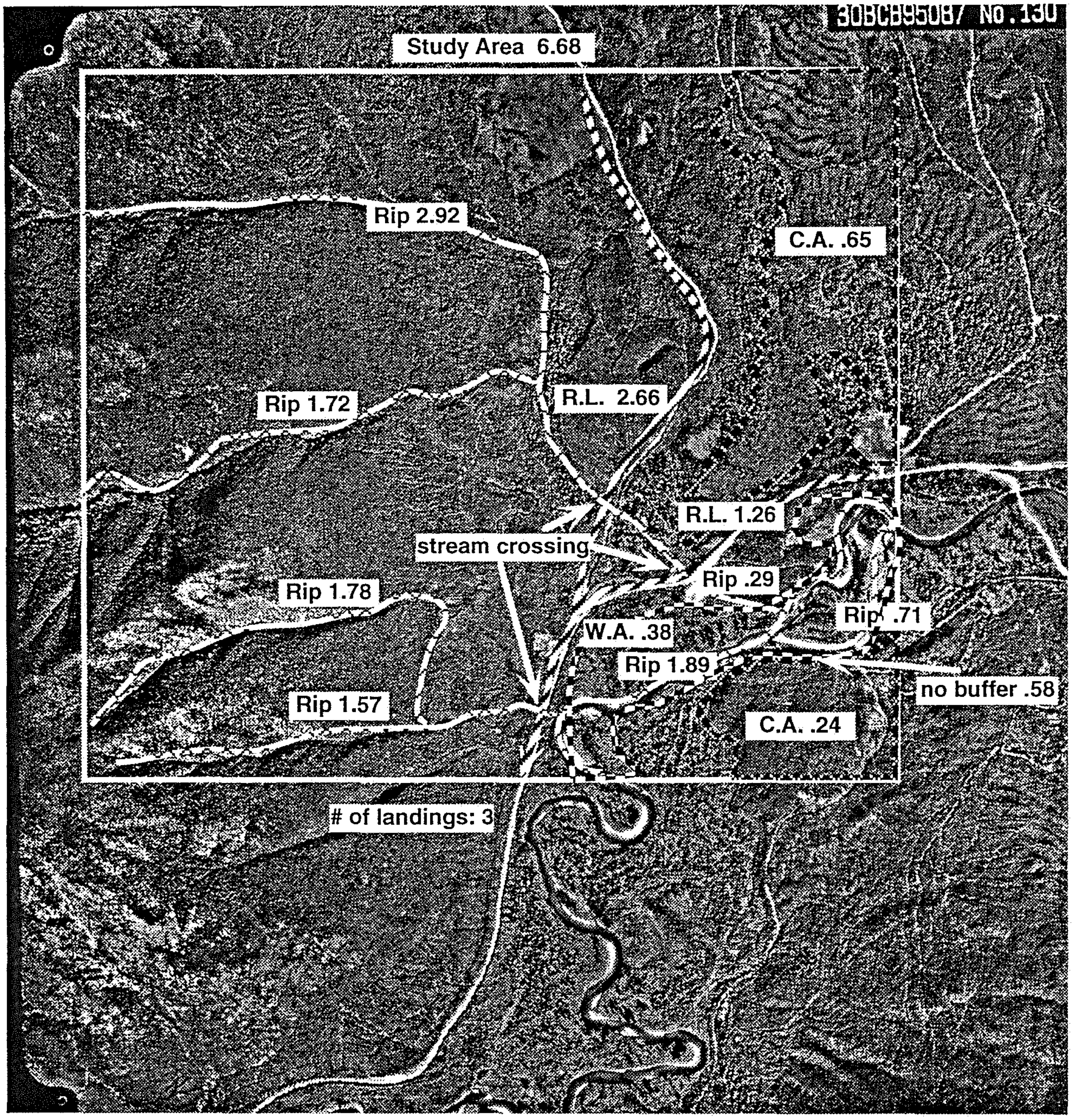
30BCB95087 No.122
Study Area 7.44
stream crossing
W.A. .28
Rip 2.01
R.L. .60
R.L. 2.80
C.A. .80
Rip 1.01
R.L. .74
Rip 1.41
Rip 2.49
R.L. .84
R.L. 1.51
stream crossing
C.A. .31
Rip 2.27
no rip buffer .75
W.A. .09
C.A. .35
# of landings: 1

95087/126

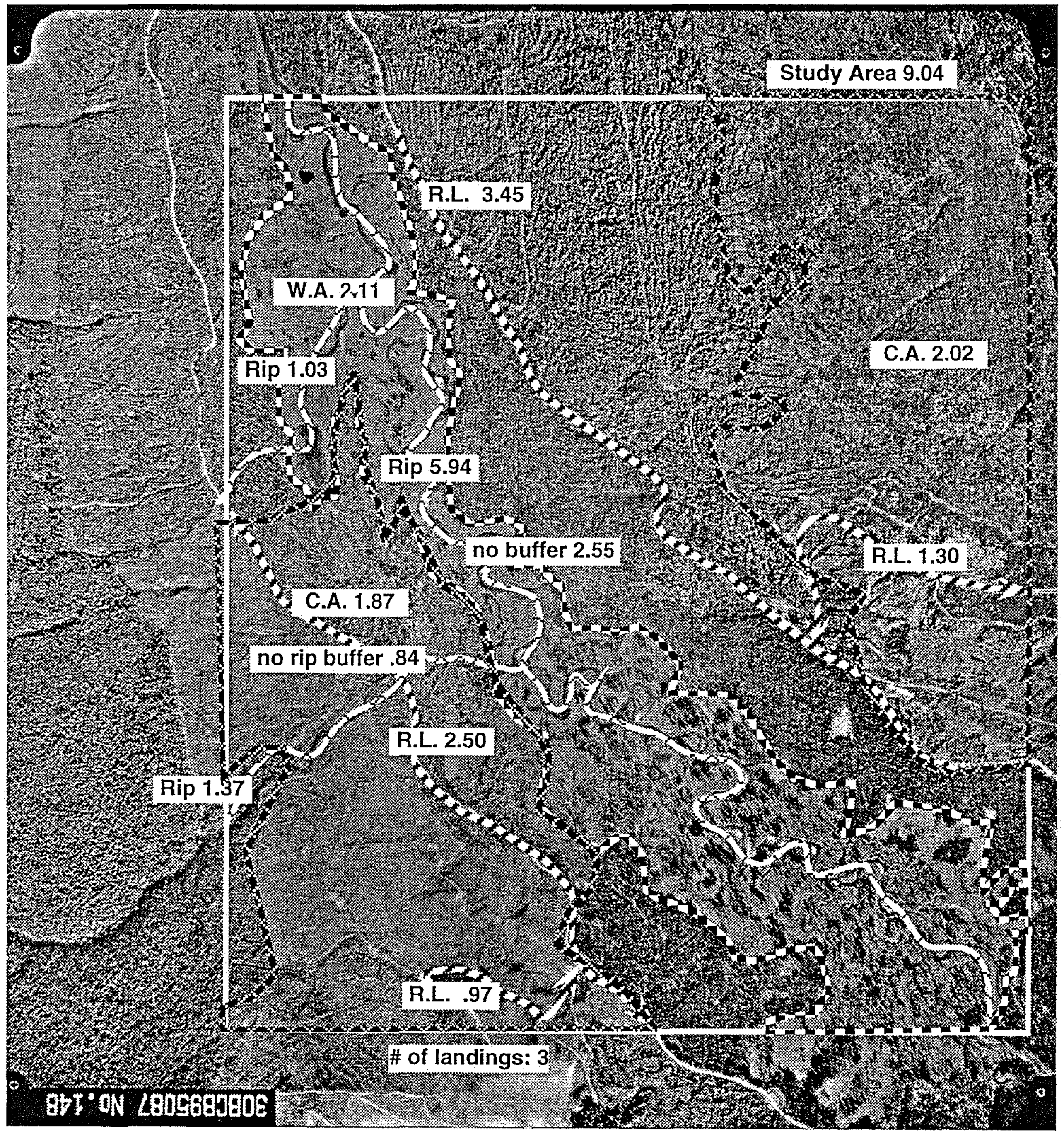

30BCB95087 No.126
Study Area 6.38
no rip buffer .36
Logged Rip .38
R.L. 2.15
R.L. 1.31
Logged Rip .41
no rip buffer .22
Logged Rip .26
Rip 4.73
C.A. 3.07
Logged W.A. .15
R.L. 3.34
C.A. 1.20
R.L. 1.41
W.A. .86
R.L. 2.78
no buffer 3.34
R.L. .66
C.A. .01
# of landings: 4

95087/128


Study Area 7.81
DBCB95087 No. 128
R.L. 1.56
C.A. .19
Logged Rip 1.65
R.L. 1.67
Rip 2.57
stream crossing
C.A. 4.41
no rip buffer 2.32
R.L. 2.84
stream crossing
W.A. .21
R.L. 3.10
no buffer 1.29
Rip 5.22
R.L. 1.85
W.A. .16
W.A. .27
C.A. .97
no buffer .62
# of landings: 2
C.A. .02

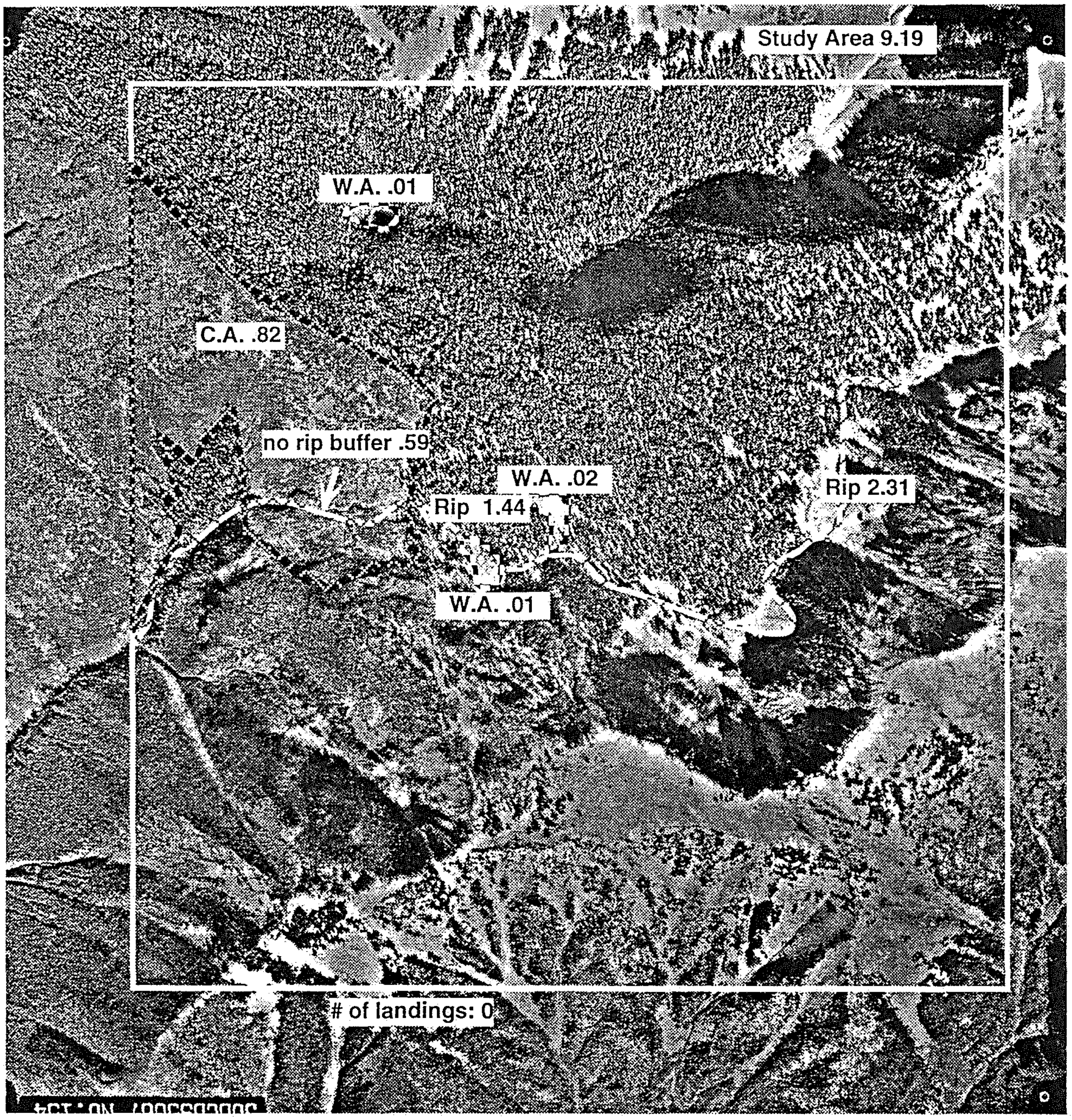

30BCB95087 No. 130
Study Area 6.68
Rip 2.92
C.A. .65
Rip 1.72
R.L. 2.66
R.L. 1.26
stream crossing
Rip .29
Rip 1.78
Rip .71
W.A. .38
Rip 1.89
no buffer .58
Rip 1.57
C.A. .24
# of landings: 3

95087/148

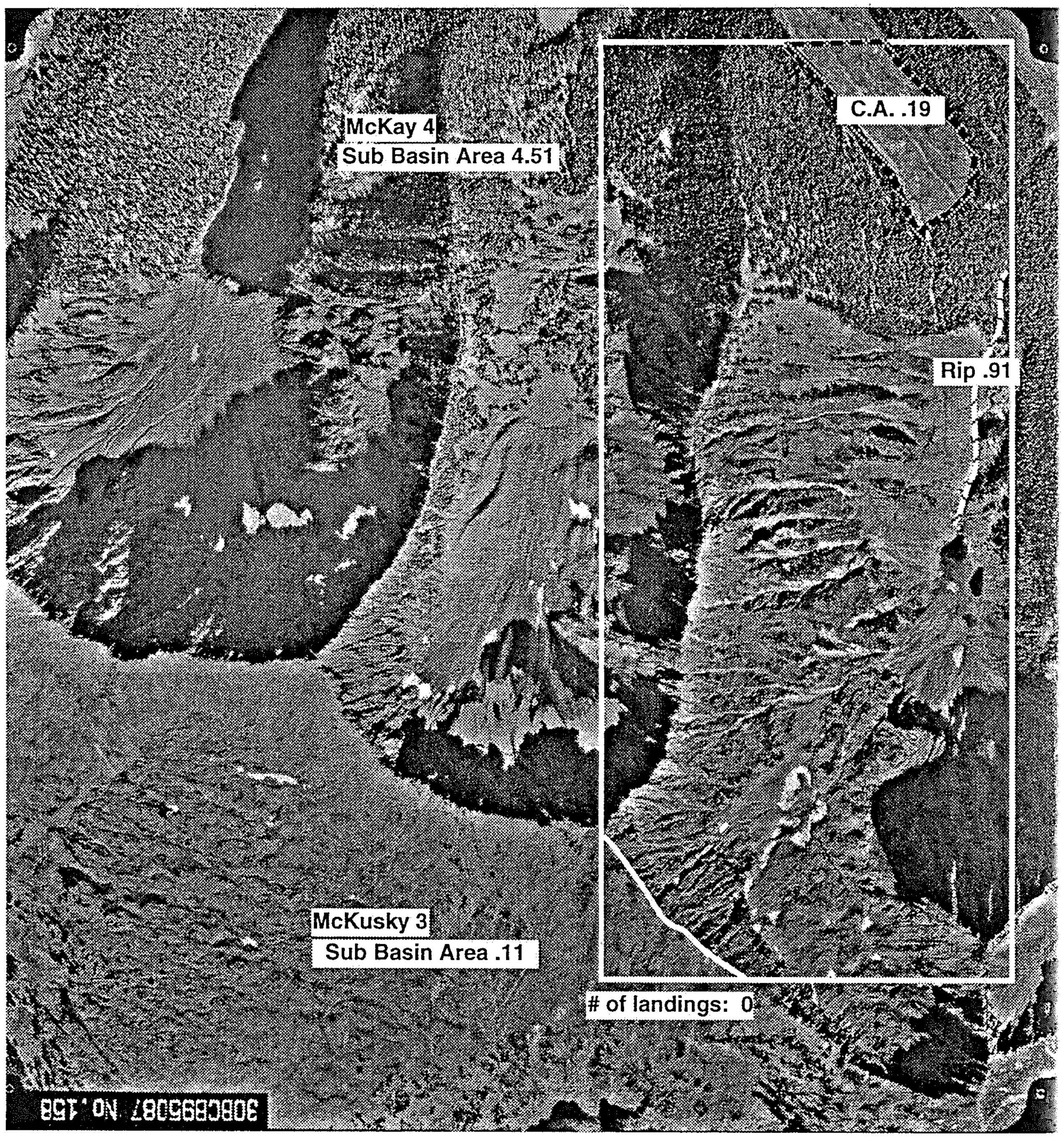


Study Area 9.04
R.L. 3.45
W.A. 2.11
Rip 1.03
C.A. 2.02
Rip 5.94
R.L. 1.30
no buffer 2.55
C.A. 1.87
no rip buffer .84
R.L. 2.50
Rip 1.37
R.L. .97
# of landings: 3

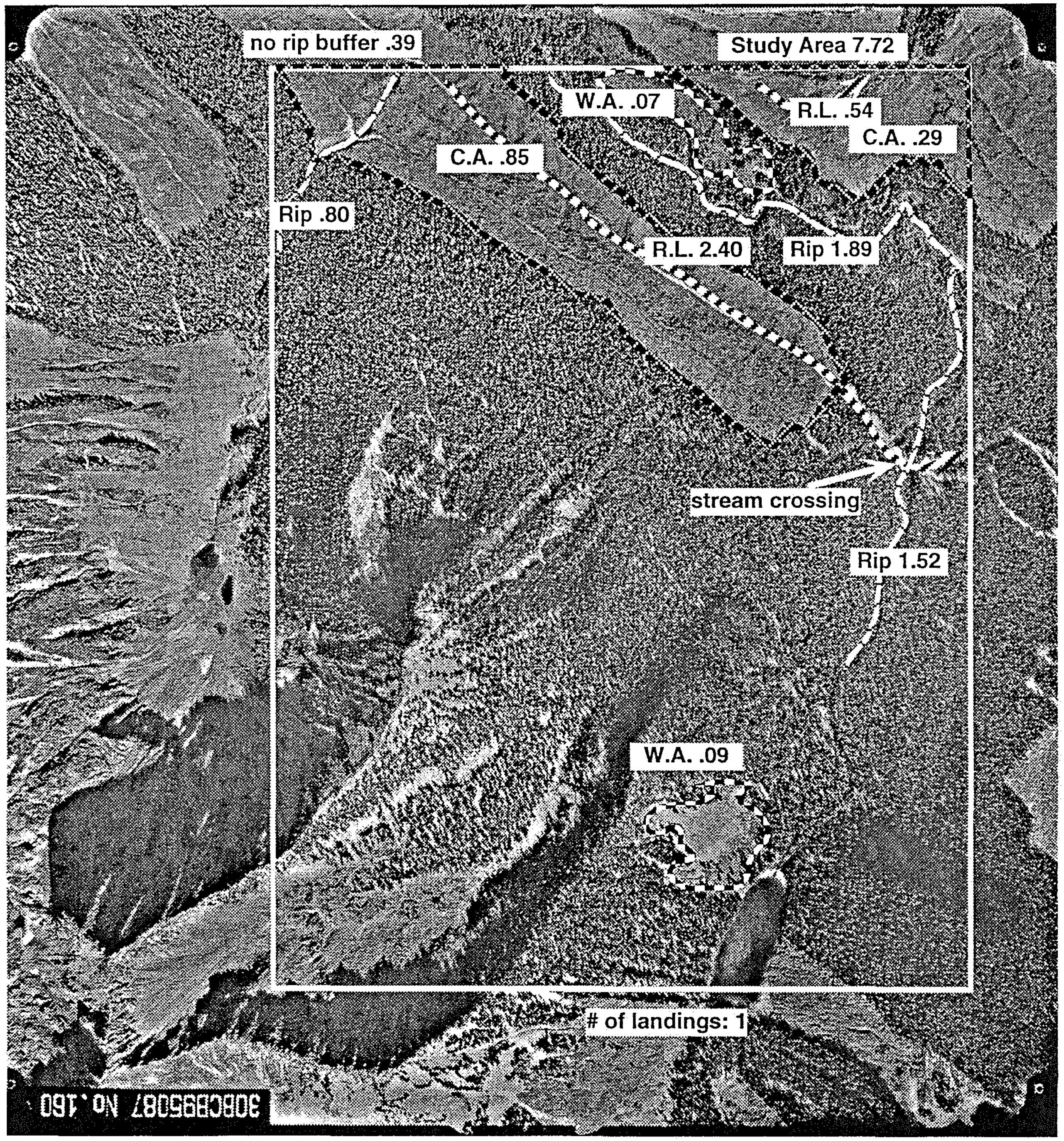
95087/154


Study Area 9.19
W.A. .01
C.A. .82
no rip buffer .59
W.A. .02
Rip 1.44
Rip 2.31
W.A. .01
# of landings: 0

95087/158

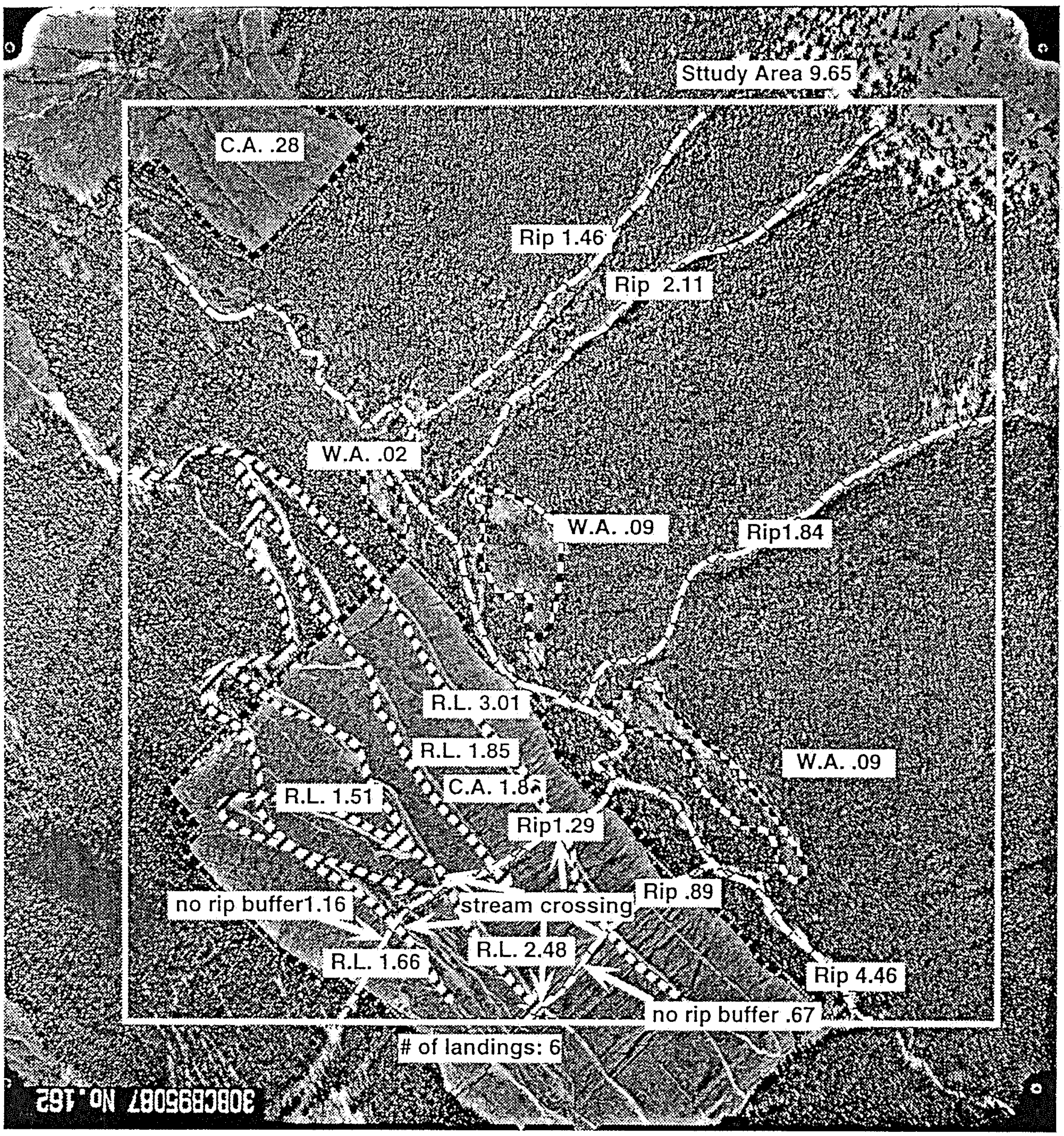

McKay 4
Sub Basin Area 4.51
C.A. .19
Rip .91
McKusky 3
Sub Basin Area .11
# of landings: 0

95087/160



no rip buffer .39
Study Area 7.72
W.A. .07
R.L. .54
C.A. .29
C.A. .85
Rip .80
R.L. 2.40
Rip 1.89
stream crossing
Rip 1.52
W.A. .09
# of landings: 1
308CB95087 No.160

95087/162



Sttudy Area 9.65
C.A. .28
Rip 1.46
Rip 2.11
W.A. .02
W.A. .09
Rip1.84
R.L. 3.01
R.L. 1.85
W.A. .09
C.A. 1.8
R.L. 1.51
Rip1.29
Rip .89
no rip buffer1.16
stream crossing
R.L. 1.66
R.L. 2.48
Rip 4.46
no rip buffer .67
# of landings: 6

APPENDIX 3

HORSEFLY WATERSHED
BIODIVERSITY ASSESSMENT
(according to Biodiversity Field Guide, Nov. 16/94)

Biogeoclimatic Zone	Total Forested Area (ha)	Area (ha) per seral stage				Seral Stage Distribution % (required)			
		Early	"Grey"	Mature	Old	Early	"Grey"	Mature	Old
WATERSHED: 1 - Horsefly just upstream from MacKay River									
NDT1									
ESSFwc3	2042	0	14	2019	9	0 (< 22)	1	99 (> 36)	0 (> 19)
ESSFwk1	3685	414	64	2815	392	11 (< 22)	2	76 (> 36)	11 (> 19)
	========	======	======	======	======				
	5727	414	77	4834	401				
NDT5									
AT	318	0	318	0	0	0 ( )	100	0 ( )	0 ( )
	========	======	======	======	======				
	318	0	318	0	0				
	========	======	======	======	======				
Watershed Totals	6045	414	395	4834	401				
WATERSHED: 2 -									
NDT1									
ESSFwc3	3004	1112	120	1620	152	37 (< 22)	4	54 (> 36)	5 (> 19)
ESSFwk1	7206	3995	533	2367	311	55 (< 22)	7	33 (> 36)	4 (> 19)
ICHwk2	4663	3586	135	885	58	77 (< 30)	3	19 (> 34)	1 (> 13)
	========	======	======	======	======				
	14874	8693	788	4872	521				

NOTE: The "Grey" zone includes everything that falls in between the early and mature stages; it has been included to give a better perspective of the distribution.

HORSEFLY WATERSHED
BIODIVERSITY ASSESSMENT
(according to Biodiversity Field Guide, Nov. 16/94)

Biogeoclimatic Zone	Total Forested Area (ha)	Area (ha) per seral stage: Early	"Grey"	Mature	Old	Seral Stage Distribution % (required): Early	"Grey"	Mature	Old
NDT2									
ICHmk3	657	571	68	13	5	87 (< 36)	10	2 (> 31)	1 (> 9)
	========	======	======	======	======				
	657	571	68	13	5				
NDT5									
AT	54	0	54	0	0	0 ( )	100	0 ( )	0 ( )
	========	======	======	======	======				
	54	0	54	0	0				
	========	======	======	======	======				
Sub-Total	15584	9264	909	4886	526				

Mule Deer Winter Range: HORSEFLY_RIVER

Biogeoclimatic Zone	Total Forested Area (ha)	Early	"Grey"	Mature	Old	Early	"Grey"	Mature	Old
NDT1									
ESSFwk1	60	2	49	4	6	3 (< 22)	81	7 (> 36)	10 (> 19)
	========	======	======	======	======				
	60	2	49	4	6				
NDT2									
ICHmk3	211	15	184	12	0	7 (< 36)	87	6 (> 31)	0 (> 9)
	========	======	======	======	======				
	211	15	184	12	0				
	========	======	======	======	======				
Winter Rge Total	271	17	233	16	6				
	========	======	======	======	======				
Watershed Totals	15856	9281	1142	4902	532				

NOTE: The "Grey" zone includes everything that falls in between the early and mature stages; it has been included to give a better perspective of the distribution.

HORSEFLY WATERSHED
BIODIVERSITY ASSESSMENT
(according to Biodiversity Field Guide, Nov. 16/94)

Biogeoclimatic Zone	Total Forested Area (ha)	Area (ha) per seral stage				Seral Stage Distribution % (required)			
		Early	"Grey"	Mature	Old	Early	"Grey"	Mature	Old
WATERSHED: 3 -									
NDT1									
ESSFwc3	2274	1266	0	980	28	56 (< 22)	0	43 (> 36)	1 (> 19)
ESSFwk1	3542	1919	168	1164	292	54 (< 22)	5	33 (> 36)	8 (> 19)
ICHwk2	6820	4322	262	1515	721	63 (< 30)	4	22 (> 34)	11 (> 13)
	12636	7506	430	3659	1041				
NDT5									
AT	475	0	475	0	0	0 ( )	100	0 ( )	0 ( )
	475	0	475	0	0				
Watershed Totals	13111	7506	905	3659	1041				
WATERSHED: 4 - MacKay River at its mouth									
NDT1									
ESSFwc3	2728	241	82	2355	50	9 (< 22)	3	86 (> 36)	2 (> 19)
ESSFwk1	4164	1864	99	1610	591	45 (< 22)	2	39 (> 36)	14 (> 19)
ICHwk2	1	1	0	0	0	100 (< 30)	0	0 (> 36)	0 (> 13)
	6893	2106	181	3965	641				

NOTE: The "Grey" zone includes everything that falls in between the early and mature stages; it has been included to give a better perspective of the distribution.

HORSEFLY WATERSHED
BIODIVERSITY ASSESSMENT
(according to Biodiversity Field Guide, Nov. 16/94)

Biogeoclimatic Zone	Total Forested Area (ha)	Area (ha) per seral stage: Early	"Grey"	Mature	Old	Seral Stage Distribution % (required): Early	"Grey"	Mature	Old
NDT5									
AT	669	0	669	0	0	0 ( )	100	0 ( )	0 ( )
	669	0	669	0	0				
Watershed Totals	7562	2106	850	3965	641				

WATERSHED: 5 - Right bank tributary upstream from Crooked Lake

Biogeoclimatic Zone	Total Forested Area (ha)	Early	"Grey"	Mature	Old	Early %	"Grey" %	Mature %	Old %
NDT1									
ESSFwc3	1038	340	65	383	250	33 (< 22)	6	37 (> 36)	24 (> 19)
ESSFwk1	490	80	47	171	193	16 (< 22)	10	35 (> 36)	39 (> 19)
ICHwk2	316	2	2	32	280	1 (< 30)	1	10 (> 34)	89 (> 13)
	1843	422	113	586	723				
NDT5									
AT	122	0	122	0	0	0 ( )	100	0 ( )	0 ( )
	122	0	122	0	0				
Watershed Totals	1966	422	236	586	723				

NOTE: The "Grey" zone includes everything that falls in between the early and mature stages; it has been included to give a better perspective of the distribution.

HORSEFLY WATERSHED
BIODIVERSITY ASSESSMENT
(according to Biodiversity Field Guide, Nov. 16/94)

Biogeoclimatic Zone	Total Forested Area (ha)	Area (ha) per seral stage: Early	"Grey"	Mature	Old	Seral Stage Distribution % (required): Early	"Grey"	Mature	Old
/ATERSHED: 6 -									
'DT1									
ESSFwc3	2335	101	144	2064	27	4 (< 22)	6	88 (> 36)	1 (> 19)
ESSFwk1	1458	111	56	738	553	8 (< 22)	4	51 (> 36)	38 (> 19)
ICHwk2	1091	72	46	269	703	7 (< 30)	4	25 (> 34)	64 (> 13)
	========	======	======	======	======				
	4883	283	246	3071	1284				
IDT5									
AT	344	0	344	0	0	0 ( )	100	0 ( )	0 ( )
	========	======	======	======	======				
	344	0	344	0	0				
	========	======	======	======	======				
Vatershed Totals	5227	283	590	3071	1284				
VATERSHED: 7 - Left bank tributary upstream from Crooked Lake									
IDT1									
ESSFwc3	309	0	0	248	61	0 (< 22)	0	80 (> 36)	20 (> 19)
ESSFwk1	280	0	0	159	121	0 (< 22)	0	57 (> 36)	43 (> 19)

NOTE: The "Grey" zone includes everything that falls in between the early and mature stages; it has been included to give a better perspective of the distribution.

HORSEFLY WATERSHED
BIODIVERSITY ASSESSMENT
(according to Biodiversity Field Guide, Nov. 16/94)

Biogeoclimatic Zone	Total Forested Area (ha)	Area (ha) per seral stage				Seral Stage Distribution % (required)			
		Early	"Grey"	Mature	Old	Early	"Grey"	Mature	Old
10T1 ICHwk2	224	0	0	73	151	0 (< 30)	0	33 (> 34)	67 (`3)
	========	======	======	======	======				
	813	0	0	480	333				(> 13)
DT5									
AT	143	0	143	0	0	0 ( )	100	0 ( )	0 ( )
	========	======	======	======	======				
	143	0	143	0	0				
	========	======	======	======	======				
atershed Totals	957	0	143	480	333				

ATERSHED: 8 - Stream entering north end of Gotchen Lake

Biogeoclimatic Zone	Total Forested Area (ha)	Early	"Grey"	Mature	Old	Early	"Grey"	Mature	Old
DT1									
ESSFwc3	665	0	42	623	0	0 (< 22)	6	94 (> 36)	0 (> 19)
ESSFwk1	676	0	242	400	34	0 (< 22)	36	59 (> 36)	5 (> 19)
	========	======	======	======	======				
	1341	0	284	1022	34				
DT2									
ICHmk3	565	77	92	260	136	14 (< 36)	16	46 (> 31)	24 (> 9)
	========	======	======	======	======				
	565	77	92	260	136				

OTE: The "Grey" zone includes everything that falls in between the early and mature stages; it has been included to give a better perspective of the distribution.