

# **RESTORATION PLAN**

## **Kobes / Ground Birch Landscape Unit**

Submitted to

Forest Renewal BC  
Omineca-Peace Region  
707 - 299 Victoria Street  
Prince George, BC V2L 5B8

December 2001

*"This document represents a typical report to be used as a guide for developing FIA Aquatic Restoration and Rehabilitation outputs as per the FIA Aquatic Restoration and Rehabilitation Standards (<http://wlapwww.gov.bc.ca/wld/fia/instream.html>). It has been reproduced with the consent of the authors. It is not intended to be used as a universal product for all projects."*

**EXECUTIVE SUMMARY**

The Kobes / Ground Birch RMP unit consists of two sub-basins including Kobes Creek (mainstem and west branch) and Ground Birch Creek. These watersheds support regionally significant fish species including: Arctic grayling, rainbow trout, bull trout and mountain whitefish. The Kobes Creek watershed within this RMP unit has been designated a Priority Key watershed area by Ministry of Water, Land and Air Protection and the Ministry of Forests and is also a target area for FRBC funding. Ground Birch Sub-basin was deemed a non-target watershed for purposes of watershed restoration.

This Restoration Plan describes in detail the work plans for the Kobes / Ground Birch RMP. Watershed rehabilitation assessments and works were initiated in this RMP unit in 1999.

Investment in the Kobes / Ground Birch RMP will provide long-term economic benefits that will be evident in improved watershed health and fish stocks. These improvements will be a result of instream habitat restoration, riparian zone restoration, and reduced sediment transport to streams from stream bank instability.

To date, a total of \$732,376 has been invested in the Kobes Creek Sub-basin and \$27,626 in Ground Birch Sub-basin. We estimate additional cost of approximately \$715,000 is required to complete implementation of the Restoration Plan for Kobes Creek Sub-basin. Restoration activities include fish rearing habitat improvements on 6-8 km of instream habitat, completion of riparian restoration treatment on 600 m of riparian habitat and 4 km of road deactivation.

Further WRP expenditures in the Kobes Creek watershed will fall in three distinct phases, Detailed Assessment and Prescription, Major Works, and Evaluation and Maintenance. Assessments and Prescriptions are required (currently in progress) for instream sections in Reaches 6, 11 and 12 of Kobes Mainstem and riparian areas of the same. Major Works (instream) are required in Reach 5 of Kobes West Branch and Reach 6 of Kobes Mainstem, and Reach 6 for riparian in Kobes West Branch. Evaluation and Maintenance will continue beyond the Major Works phase, and will encompass the implementation of Routine Effectiveness Evaluation (currently underway for instream works in Reach 8 of Kobes West Branch). Additional treatments, if needed, will be described in an Amendment to the Restoration Plan. The Evaluation and Maintenance phase will be concluded when no maintenance or additional restoration treatments are required.

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	i
LIST OF TABLES .....	iii
LIST OF FIGURES .....	iii
1.0 INTRODUCTION .....	1
2.0 RATIONALE FOR SELECTION AS PRIORITY KEY WATERSHED .....	1
3.0 DESCRIPTION OF WATERSHED .....	1
4.0 RESTORATION ACTIVITIES COMPLETED TO DATE .....	3
4.1 Assessments .....	3
4.2 Restoration Work Implemented .....	4
4.3 Monitoring and Evaluation .....	4
5.0 RESTORATION PRIORITIES FOR SUB-BASINS .....	4
5.1 Kobes Creek Sub-basin .....	4
5.1.1 Base Condition .....	4
5.1.2 Limiting Fish Habitat .....	5
5.1.3 Access Management .....	5
5.1.4 Restoration Objectives .....	6
5.1 Ground Birch Creek Sub-basin .....	7
6.0 IMPLEMENTATION/COMPLETION PLAN .....	7
6.1 Work Site Priorities .....	7
6.2 Time Frame of Works .....	7
7.0 MONITORING AND EVALUATION .....	8
7.1 Milestone and Restoration Completion Benchmarks .....	8
7.2 Effectiveness Evaluation Plan .....	8
8.0 BUDGET .....	9
9.0 LITERATURE CITED .....	10

TABLES

FIGURES

**LIST OF TABLES**

- Table 1. Channel and hillslope conditions for Kobes Creek Sub-basin.
- Table 2. Channel and hillslope conditions for Ground Birch Creek Sub-basin.
- Table 3. Evaluation of the likelihood of restoration activities benefiting fish habitat for priority sub-basins in the Kobes / Ground Birch Landscape Unit.
- Table 4. Prioritization of sub-basins and components for restoration in Kobes / Ground Birch Landscape Unit.
- Table 5. Multi-year Restoration Plan/ Cost Summary for Kobes Creek Watershed.
- Table 6. Restoration Cost Summary for Ground Birch Sub-basin.

**LIST OF FIGURES**

- Figure 1. Index map of Kobes / Ground Birch Landscape Unit.
- Figure 2. Map of Kobes Creek Sub-basin showing priority sites for restoration.

## 1.0 INTRODUCTION

The Restoration Plan (RP) for Kobes / Ground Birch Landscape Unit summarizes the assessment information that was used to select the watershed and sub-basins where restoration works will continue. The Plan then describes in detail the work plans for sub-basins. For this high priority landscape unit, the RP:

- identifies the critical limiting factors affecting fish;
- identifies the components targeted for restoration;
- describes the sub-basin, component and site level restoration objectives;
- identifies the proposed restoration activities and sites;
- provides a schedule of works and budget estimate; and
- outlines an evaluation and monitoring plan.

## 2.0 RATIONALE FOR SELECTION AS PRIORITY KEY WATERSHED

Kobes Creek supports a number of salmonids including: arctic grayling, mountain whitefish, rainbow trout and bull trout. Ground Birch Creek supports Arctic grayling, mountain whitefish and bull trout. Fish management values are considered high in Kobes Creek and low in Ground Birch Creek. The management of fish in the Halfway foothill tributaries is a high priority (Anderson, pers. Comm., 2001). The chances of restoration success are rated high by MWLAP.

The target species for restoration in Kobes Creek are Arctic grayling, rainbow and bull trout. Because these species are regionally significant, this watershed has high fisheries value rankings.

Approximately 13% of the Kobes watershed has been logged since 1970 with the bulk of the harvesting occurring between 1979 and 1987. Some roads and stream channels have been impacted through logging, however there are still significant areas of good quality fish habitat within the basin. It is believed that restoration activities can significantly improve conditions or prevent further damages that will benefit the target species. Funding support for restoration initiatives within this RMP Unit has been provided by Forest Renewal BC.

Ground Birch Creek sub-basin was dropped as a priority watershed within this landscape unit under the Watershed Restoration Program. Results from the overview assessment (LGL, 2001) showed little damage to fish habitat caused by pre-FPC logging and consequently present limited opportunity for watershed restoration activities.

## 3.0 DESCRIPTION OF WATERSHED

### Physical Features

Kobes Creek is located in the Peace River drainage near Fort St. John, B.C. The creek drains northward into the Halfway River approximately 50 km north of Hudson Hope, B.C. (Figure 1). Kobes joins the Halfway River approximately 65 km upstream from its confluence with the Peace River. From the headwaters, the mainstem flows for 21 km in a northerly direction and then turns to the east and flows for 17 km before joining the Halfway River. At approximately

15 km upstream from the mouth of Kobes Creek, the channel splits into two main branches. The east branch is the Kobes Creek mainstem and the west branch is an unnamed tributary. From the Overview Assessment (LGL and CGL 1999), the mainstem of the west branch of Kobes Creek was divided into 11 reaches and the four tributaries were assigned 12 additional reaches. From the Overview Assessment of Kobes Creek mainstem (Yazvenko et al. 2001), the mainstem was divided into 13 reaches and 9 tributaries were assigned 13 additional reaches.

Almost the entire Kobes Creek watershed lies in the Boreal White and Black Spruce biogeoclimatic zone (BWBS). Reaches 1 to 11 of the mainstem and Reaches 1 to 7 of the west branch lie in the Peace Moist Warm variant (BWBSmw1). Contained in the Murray Wet Cool variant of the Boreal White and Black Spruce biogeoclimatic zone (BWBSwk1) is Reaches 12 and the upper reaches of the tributaries within Reaches 6 to 12 of Kobes mainstem, Reaches 8 to 11 of Kobes West Branch, Reaches 1 to 3 of Tributary 3 and Reach 1 of Tributary 4 of Kobes West Branch. Further up, the upper end of Reach 13 of Kobes mainstem, and Reach 4 of Tributary 3 and Reach 2 of Tributary 4 of Kobes West Branch lie in the Moist Warm subzone of the Engelmann Spruce B Subalpine Fir biogeoclimatic zone (variant ESSFmw1). Upper areas of some small tributaries of Kobes Creek mainstem lie in the Graham Wet Cool variant of the Boreal White and Black Spruce biogeoclimatic zone (BWBXwk2).

The combined drainage area of Kobes Creek mainstem and east branch is 284 km<sup>2</sup>. The overall slope of Kobes Creek mainstem below the confluence of east and west branches is low at 0.4%. The lower 32 km of mainstem is a relatively wide, low gradient meandering channel with an average bankfull width of 30 m. The overall slope of the west branch is low at 1.1%.

The first 10 km of Kobes Mainstem up from the confluence with the west branch is a relatively low gradient meandering channel. Habitat consists of a mixture of riffle, pool and glide with cover provided by deep pool, LWD and boulder. Further upstream there is a slight increase in confinement and gradient. There the amount of fines is reduced and substrate is dominated by cobbles and boulder. Habitat is mainly riffle pool with inadequate cover provided by LWD, boulder and cutbank.

The first 10 km of the west branch is a relatively low gradient meandering channel with predominately fines followed by gravel and cobble substrate. Habitat consists of a mixture of riffle, pool and glide with cover provided by deep pool, LWD and boulder. Further upstream there is a slight increase in confinement and gradient. Here the amount of fines is reduced and substrate is dominated by cobbles and boulder. Habitat is mainly riffle pool with inadequate cover provided by LWD, boulder and cutbank.

Ground Birch Creek flows into the Halfway River approximately 60 km NW of Fort St. John, B.C. (Figure 1). The watershed lies in the Boreal White and Black Spruce biogeoclimatic zone (BWBS) in its Moist Warm subvariant (BWBSmw1). The mainstem is approximately 45km in length and flows in a E-NE direction to its confluence with the Halfway River. The drainage area is 342 km<sup>2</sup>. Slope of Ground Birch Creek is generally < 0.6% and average bankfull width is 27m.

## **Logging History**

The total area harvested in Kobes Creek watershed (mainstem and west branch) is low to moderate at 37 km<sup>2</sup> or 13% of the watershed area (Table 1). Harvesting is concentrated in the lower portions of the valley close to the mainstem and tributaries, where timber volume is relatively higher. All harvesting in the watershed occurred since 1970, and most of it occurred between 1979 and 1987.

The total area harvested in the Ground Birch Creek watershed is low to moderate at 45 km<sup>2</sup> or 13% of the watershed area (Table 2). Harvesting is scattered throughout the watershed but tends to be concentrated in the higher portions of the valley. All harvesting in the watershed occurred since 1980, and most of it occurred between 1984 and 1992.

## **Fisheries Values**

Kobes Creek supports a number of salmonid species including Arctic grayling, mountain whitefish, rainbow trout and bull trout. Non-salmonid fish species include large scale and long nose sucker, slimy sculpin, and lake chub.

Ground Birch Creek support Arctic grayling, mountain whitefish and bull trout. Non-sport fish species include longnose and large scale sucker, slimy sculpin, redbelt shiner, and lake chub.

## **4.0 RESTORATION ACTIVITIES COMPLETED TO DATE**

Early assessment, prescription and implementation work in the Kobes Creek watershed was conducted by LGL Limited, through the former Ministry of Environment, Lands and Parks (MELP), Watershed Restoration Program office in Fort St. John. Current and future works will be conducted from the same office, now the Ministry of Water, Land and Air Protection (MWLAP), Watershed Restoration Program.

### **4.1 Assessments**

The following assessments have been completed to date in the Kobes Creek Watershed. Refer to Table 5 for a cost summary of assessment works.

- Overview Assessment – Upper Kobes Cr. – streams and riparian (LGL, 1999)
- Level 1 – Detailed Assessment and Planning – Upper Kobes Cr. – streams (LGL, 2000)
- Level 2 – Detailed Assessment and Planning – Upper Kobes Cr. – streams (LGL, 2000)
- Level 1 & 2 – Detailed Assessments and Planning – Upper Kobes Cr. – riparian (LGL, 2001)
- Overview Assessment – Kobes Cr. Mainstem – streams and riparian (LGL, 2001)
- Level 1 – Detailed Assessment and Planning – Kobes Cr. Mainstem – streams (LGL, 2002)

The following assessments have been completed to date in the Ground Birch Creek Watershed. Refer to Table 6 for a cost summary of assessment works.

- Overview Assessment – streams and riparian (LGL, 2001)

## 4.2 Restoration Work Implemented

The following restoration works have been completed to date in the Kobes Creek Watershed. Refer to Table 5 for a cost summary of restoration works.

- Works – Streams, in-stream and off-channel rehabilitation (LGL, 2001)
- Works – Riparian, riparian management area rehabilitation (LGL, 2002)
- Works – Streams, in-stream and off-channel rehabilitation (LGL, 2002)

## 4.3 Monitoring and Evaluation

The following monitoring and evaluation has been completed to date in the Kobes Creek Watershed. Refer to Table 5 for a cost summary of monitoring and evaluation works.

- Monitoring and Evaluation – Fish Passage Culvert Inspection – roads (LGL, 2002)
- Monitoring and Evaluation – Routine Effectiveness Monitoring – instream (LGL, 2002)

## 5.0 RESTORATION PRIORITIES FOR SUB-BASINS

Restoration of Kobes Creek sub-basin will require the implementation of primary and secondary watershed components to protect and restore critical limiting habitats for rainbow and bull trout. The restoration objectives for watershed components in Kobes Creek are described below.

Ground Birch Creek has been classified as a low priority watershed by the WRP office in Fort St. John (see section 2).

### 5.1 Kobes Creek Sub-basin

#### 5.1.1 Base Condition

Channel and hillslope conditions for Kobes Creek Sub-basin are described in Table 1. This is a type B-2 watershed with the stream channel coupled to the hillslopes in the headwaters but uncoupled in the mid to lower reaches. Hillslope conditions are good with no forestry-related landslides evident. Natural stream escarpment erosion is occurring along Reach 1 and 2 but the rate and extent of sediment input to Kobes Creek appears to be low (Overview, Yazvenko et. al., 2001).

Overall channel condition is rated as good. Low natural rate of bed load transport and low natural rate of shifting is reported in Kobes Creek Mainstem. Human and forestry related level of disturbance is low. Some disturbance is reported in Reach 6, 11 and 12 associated with riparian logging (Overview, Yazvenko et. al., 2001). Low-moderate natural rate of bed load transport and low-moderate natural rate of shifting is reported for the west branch of Kobes Creek. Human and forestry related level of disturbance is low to moderate. Localized channel

widening in portions of Reach 4 are due to logging in the riparian. A moderate level of disturbance in Reach 8 was reported, due to road activity in the RMZ causing bank erosion (LGL and Chapman, 1999).

Instream restoration works were carried out in Reaches 8 and 4 of Kobes West Branch in 2000 and 2001 respectively to address these issues (Murray, 2001 and 2002, respectively). Instream work prescribed by Gaboury (2000) and rated high for likelihood of benefiting fish habitat has not been completed for Reach 5. Reach 6 was rated moderate for likelihood of benefiting fish habitat from instream restorations efforts, which could be considered for treatment in 2002. Reach 1 of Tributary 4 to Kobes West Branch remains unstable and migrating in alluvial fan (Yazvenko et. al., 2001).

Riparian condition is rated good overall. Harvesting to the bank occurred in parts of Reaches 6, 11 and 12 of Kobes mainstem (Kuntz, 2002). Extensive logging occurred to the bank in Reach 4 of Kobes West Branch and in Reach 8 of the same due to road construction (Kuntz, 2001). Riparian silviculture prescriptions were implemented in Reach 4 of Kobes West Branch in 2001 (Kuntz, 2002) to increase conifer stocking and bank stability. Work prescribed in Reach 6 was not completed in the 2001 field season and should be completed in 2002.

There is currently 41 km of road in the watershed but none were rated as medium or high priority. No problem gullies or landslides are present in the watershed.

### **5.1.2 Limiting Fish Habitat**

Limiting fish habitat for Kobes Creek mainstem will be described in the Level 1 Assessment Report by Murray (2002).

Riparian logging in Kobes Creek West Branch Reach 4, 5 and 8 has precipitated bank instability and erosion, and has led to extensive lateral channel migration and over widening compared with pre-logging conditions. Contemporary channel in Reach 7 appears similar to pre-logging (Gaboury 2000). Recently formed LWD jams are frequent, as are trees which have been undermined and fallen across the channel. The channel consists primarily of riffles, with a low frequency of pools (Murray and Gaboury 2000). Prior to treatment of Reaches 4 and 8, the lack of pools and loss of LWD cover in the pools reduced the quantity and quality of holding and late summer rearing habitat for rainbow trout. The sediment source from Tributary 4 of Kobes West Branch remains a problem but treatment of Tributary 4 at this time is not feasible until the channel stabilizes within the alluvial fan of Reach 1 (Kuntz 2001).

### **5.1.3 Access Management**

Canadian Forest Products has plans to deactivate Kobes Creek Road (Farrell Creek Road) from the turn off and bridge crossing at Reach 8 (bottom of reach) now that restoration measures have been completed in Reach 8.

### 5.1.4 Restoration Objectives

There are three overall Sub-basin Level Objectives for restoration in Kobes Sub-basin. These objectives are:

- \$ re-establish a more stable channel with characteristics that mimic those of a natural stream;
- \$ reduce erosion and sediment loading to downstream habitats; and
- \$ restore holding, and rearing habitats for salmonids.

The primary watershed component for restoration in Kobes Sub-basin is instream (Tables 3 and 4). Component Level Objectives for the instream habitat component are:

- \$ stabilize chronic sediment sources including; eroding stream banks in reaches or portions of reaches that were relatively stable prior to logging (ie. Reach 8, and portions of Reaches 4 and 5) [Reach 4 and 8 done, Reach 5 remaining], and the eroding logging road fill in Reach 8 where the channel is impinging on the road [done];
- \$ re-establish a more stable channel with appropriate bankfull widths in portions of reaches that were relatively stable prior to logging (ie. Reach 8, and portions of Reaches 4 and 5) [Reach 4 and 8 done, Reach 5 remaining]; and
- \$ improve holding and rearing habitat for rainbow trout by increasing pool frequency and the amount of functional LWD cover in pools at sites that have been relatively stable, both prior to and after logging, in Reaches 4, 5 and 8 [Reaches 4 and 8 done, 5 remaining].

Site Level Objectives for the instream habitats are:

- \$ reduce erosion at eroding banks by constructing LWD and boulder structures that will provide bank protection and will adjust the meander curvatures;
- \$ re-establish a narrower channel with an appropriate bankfull width by stabilizing gravel bares and protecting stream banks with boulder and LWD structures; and
- \$ provide cover and promote pool scour by constructing LWD structures at pool sites.

A secondary watershed component for restoration in Kobes Sub-basin is riparian. Recruitment of LWD to mainstem channels is expected to be limited over the next 75-100 years. Riparian treatments have been initiated in order to provide a LWD recruitment source, increase stream shading, and stabilize stream banks and channel morphology in the long term. The Component Level Objectives for riparian restoration are:

- \$ increase potential for stream bank stability;
- \$ establish optimum conifer density to provide an adequate size and number of LWD for future instream habitat and shading; and
- \$ accelerate conifer growth rate in the riparian reserve zone.

Site Level Objectives for riparian restoration are:

- \$ increase soil cohesion on stream banks; and
- \$ reduce competition to conifers from deciduous species.

There are no gullies reported, requiring restoration treatment.

### **5.1 Ground Birch Creek Sub-basin**

Ground Birch Creek Sub-basin was dropped as a priority watershed within this landscape unit under the Watershed Restoration Program. Results from the overview assessment (LGL, 2001) showed little damage to fish habitat caused by pre-FPC logging and consequently present limited opportunity for watershed restoration activities

## **6.0 IMPLEMENTATION/COMPLETION PLAN**

Rehabilitation works have been underway in Kobes Creek since 1999. We anticipate it will take another year to complete major works in the west branch. Mainstem prescription development (report) is in progress. Three to four years of instream works are anticipated in the mainstem. Some additional prescriptions may be required in the future to meet restoration objectives in Kobes Creek Sub-basin.

### **6.1 Work Site Priorities**

Figure 2 shows the proposed sites, segments or reaches where prescriptions for each priority component are recommended.

Remaining restoration work includes:

- level 2 fish habitat assessment on 2.5 km of stream (Reaches 6, 11, and 12 of Kobes Mainstem);
- instream habitat treatments on 4-6 km of stream (prescriptions under development, Reach 6 of Kobes Mainstem);
- instream habitat treatments on approximately 2 km of stream (Reach 5 of Kobes West Branch);
- completion of riparian restoration treatment on 600 m of riparian habitat (Reach 6 of Kobes West Branch);
- riparian maintenance treatments on 3 km of streambank (Reaches 4 and 6 of Kobes West Branch); and
- deactivation of 4 km of forest road (Farrell Creek Rd along Reaches 8-10 of Kobes West Branch).

### **6.2 Time Frame of Works**

Table 5 shows the proposed multi-year restoration plan cost summary for Kobes Creek Sub-basin. Instream works will continue through 2005 with effectiveness evaluations. Riparian

restoration work will continue through 2005 with effectiveness evaluations. Table 6 shows the extent of money spent to assess Ground Birch Creek for potential as a candidate for watershed restoration dollars. The watershed was not selected as a priority sub-basin for watershed restoration.

## 7.0 MONITORING AND EVALUATION

### 7.1 Milestone and Restoration Completion Benchmarks

Restoration prescriptions, works scheduling and anticipated construction budgets will continue to be prepared and managed by Lynx Consulting. Project reports will be submitted each March to District Agency WRP specialists. Reports will include:

- Prescription reports;
- As-built reports;
- Effectiveness/Monitoring reports; and
- FRBC administrative reports.

All major works are expected to be completed by the end of 2002. Evaluation and Maintenance, will continue beyond the Major Works phase, and will encompass the implementation of Effectiveness Evaluations, as well as maintenance and additional treatments, if appropriate.

### 7.2 Effectiveness Evaluation Plan

Routine Effectiveness Evaluations were conducted in 2001 in Kobes Creek West Branch. The main objectives of the Routine Evaluations have been and will continue to be:

- Assess the present configuration and condition of restoration treatments (i.e., are the works still in place);
- Through the assessment of a number of key variables, assess whether or not the treatments have been effective in addressing the restoration objectives (i.e., are the works functioning as intended); and
- Determine if remedial work is needed.

The proposed sampling frequency and methodology are:

Riparian      annual walk through inspection to assess conifer survival, vigor and free-to-grow status for 3 years following treatment. Inspections can occur at 5 year intervals once free-to-grow status is achieved.

Instream      walk through review of all installations after first, second and third year to determine habitat complexity and functional stability and condition, following Routine Monitoring Protocol (Koning et al. 1998). Measure residual pool depths, presence/absence of grayling, whitefish or trout using Gee traps or through visual observation. Sampling every five years thereafter or after a 1 in 10 year flood event.

All evaluation data, interim and final reports will be submitted annually to District Agency WRP specialists. This will provide an opportunity for adjustments to be made in the evaluation objectives, selection of variables or sampling methodologies.

## **8.0 BUDGET**

Estimated costs for assessments, the preparation of restoration prescriptions, implementation of restoration works and Routine Effectiveness Evaluations are provided in Tables 5 and 6. To date, a total of \$732,376 has been invested in Kobes Creek and \$27,626 in Ground Birch Creek. We estimate an additional cost of approximately \$715,000 is required to complete implementation of the Restoration Plan for Kobes Creek Sub-basin.

**9.0 LITERATURE CITED**

- Koning, C.W., M.N. Gaboury, M.D. Feduk and P.A. Slaney. 1998. Techniques to evaluate the effectiveness of fish habitat restoration works in streams impacted by logging activities. *Canadian Water Resources J.* 23(2)191-203.
- LGL and Chapman. 1999. Overview Assessment of Upper Kobes Creek Watershed for Fish and Riparian Habitat. Report prepared by LGL Limited, Sidney, BC and Chapman Geoscience Ltd., Nanaimo, BC for Ministry of Environment, Lands and Parks, Watershed Restoration Program, Fort. St. John, BC.
- Murray, B., and M. Gaboury. 2000. Kobes Creek Level 1 Assessment. Report prepared by LGL Limited, Sidney, BC for Lynx Consulting, Forts St. John, BC.
- Gaboury, M. 2000. Level 2 – Fish Habitat Prescriptions for Kobes Creek. Report prepared by LGL Limited, Sidney, BC for Lynx Consulting Ltd., Fort St. John, BC.
- Kuntz, P. 2001. Integrated Level 1 and 2 Riparian Assessments on Kobes Creek. Report prepared by LGL Limited, Sidney, BC for the Ministry of Environment, Lands, and Parks, Fort St. John, BC.
- Murray, B. 2001. Watershed Restoration Program Instream Rehabilitation: West Kobes Creek 2000 As-built Report. Report prepared by LGL Limited, Sidney, BC for Lynx Consulting, Fort St. John, BC.
- Anderson, B. pers. Comm., 2001. B. Anderson, Ministry of Water, Land and Air Protection - (MWLAP), Watershed Restoration Program., 400-10003 110 Ave., Fort St. John, BC v1J 6M7. (250) 787-3331.
- Murray, B. pers. Comm., 2001. B. Murray, LGL Limited, 9768 Second Street, Sidney, BC. (250) 656-0127.
- Yazvenko, S., J. Ferguson, P. Kuntz and A. Chapman. 2001. Overview Assessment of Kobes Creek for Fish and Riparian Habitat. Draft report prepared by LGL Limited, Sidney, BC, for Lynx Consulting, Fort St. John, BC.
- Yazvenko, S., J. Ferguson, P. Kuntz and A. Chapman. 2001. Overview Assessment of Ground Birch Creek for Fish and Riparian Habitat. Draft report prepared by LGL Limited, Sidney, BC, for Lynx Consulting, Fort St. John, BC.
- Murray, B. 2002. Watershed Restoration Program Instream Rehabilitation: Kobes Creek 2001 As-built Report. Report (in progress) prepared by LGL Limited, Sidney, BC for Lynx Consulting, Fort St. John, BC.
- Kuntz, P. 2002. Kobes Creek Riparian Prescription Implementation Report. Report (in progress) prepared by LGL Limited, Sidney, BC for Lynx Consulting, Fort St. John, BC.

Shuman, K. and B. Murray. 2002. Level 1 – Fish Habitat Assessments for Kobes Creek. Report (in progress) prepared by LGL Limited, Sidney, BC for Lynx Consulting, Fort St. John, BC.

Shuman, K. and B. Murray. 2002. Fish Passage Culvert Inspections Report. Report (in progress) prepared by LGL Limited, Sidney, BC for Lynx Consulting, Fort St. John, BC.

Murray, B. and B. Anderson. 2002. Routine Effectiveness Evaluation Results for Kobes Creek Instream Structures. Report (in progress) prepared by LGL Limited, Sidney, BC for Lynx Consulting, Fort St. John, BC.

**TABLES**

Table 1. Channel and hillslope conditions for Kobes Creek Sub-basin.

<b>Sub-basin</b>	Kobes Creek
<b>Drainage Area (km<sup>2</sup>)</b>	284
<b>Tenure</b>	100 % TFL (?)
<b>Area Logged (%)</b>	Approx. 13.3%
<b>Channel:</b>	
<b>Type (CAP)</b>	Riffle-pool, alluvial
<b>Width (m)</b>	Average 22m including both branches of Kobes Creek.
<b>Gradient (%)</b>	Reaches 1-8 are <0.5%, 1-3% for the remainder of east branch, 1.1% for west branch of Kobes Creek.
<b>Watershed Type</b>	Type B-2. In the downstream portion, the stream channel is uncoupled from the hillslopes. Floodplains are well developed.
<b>Channel Condition</b>	Overall good. <i>Mainstem</i> : Low natural rate of bed load transport and a low natural rate of shifting. Low gradient, alluvial and sinuously meandering. Human and forestry related level of disturbance low. Some disturbance in Reach 6, 11 and 12 associated with riparian logging. <i>West Branch</i> : Low-moderate natural rate of bed load transport and a low-moderate natural rate of shifting. High sinuous meandering pattern with low gradient, active alluvial channel and extensive lateral bar development. Human and forestry related level of disturbance low to moderate. Localized channel widening in portions of Reach 4 due to riparian logging. Moderate level of disturbance in Reach 8 due to road activity in the RMZ causing bank erosion. Reach 1 of Tributary 4 to Kobes West Branch (Reach 8) unstable and migrating in alluvial fan.
<b>Riparian Condition</b>	Overall Good. <i>Mainstem</i> : Little fire has occurred in area. Most of riparian forest is mature conifer. Harvesting occurs to stream bank in parts of Reaches 6, 11 and 12. LWD recruitment to the stream channel from the riparian zone is low in these sections. <i>West Branch</i> : Reach 4 received silvicultural treatment in 2001 to increase conifer stocking for advancement of LWD recruitment in future. Riparian lacking in sections of Reach 8 due to road right of way in RMA. Harvesting to bank of Trib. 4 on alluvial fan.
<b>Road Condition</b>	41 km of road exist in the watershed but were not assessed because they are not eligible for FRBC funding.
<b>Hillslope Condition</b>	Good. Relief is extremely low, and no forestry-related landslides are evident. Some natural stream escarpment erosion is occurring along mainstem Reaches 1 and 2, but the rate and extent of sediment input to Kobes Creek appears to be low. The extent of logging has been low, and no stream flow related changes are anticipated.

Table 2. Channel and hillslope conditions for Ground Birch Creek Sub-basin.

<b>Sub-basin</b>	Ground Birch Creek
<b>Drainage Area (km<sup>2</sup>)</b>	342
<b>Tenure</b>	
<b>Area Logged (%)</b>	Approx. 13.3%
<b>Channel:</b>	
<b>Type (CAP)</b>	Riffle-pool, alluvial
<b>Width (m)</b>	Average 27m
<b>Gradient (%)</b>	Generally < 0.6%
<b>Watershed Type</b>	Type B-2. In the downstream portion, the stream channel is uncoupled from the hillslopes. Floodplains are well developed.
<b>Channel Condition</b>	Good. Natural sediment input to the channel from eroding escarpments is occurring along Reaches 1-3. The channel along these reaches is incised into bedrock and surficial sediment, and is confined with a canyon. Some disturbance appears to be occurring at the upper end of Reach 7 as a result of erosion and sediment transport from two small tributary channels. The extent of disturbance in Ground Birch Creek appears low, but should be field examined.
<b>Riparian Condition</b>	Overall Good. Harvesting has occurred directly adjacent to a portion of the RMA on one side in Reach 10, within 60m of the RMA on one side in portions of Reaches 11 and 12.
<b>Road Condition</b>	92 km of road exist in the watershed but were not assessed because they are not eligible for FRBC funding.
<b>Hillslope Condition</b>	Good. Relief is gentle and no forestry-related landslides are evident. Natural stream escarpment erosion is occurring along Reaches 1-3 and the tributary channel erosion as noted above.

Table 3. Evaluation of the likelihood of restoration activities benefiting fish habitat for priority sub-basins in the Kobes/Ground Birch Landscape Unit.

<b>Kobes/Ground Birch Landscape Unit.</b>				<b>Watershed Components</b>					
Sub Watershed	Target Species	Limiting Fish Habitat	Watershed Condition and Restoration Benefits	Landslides	Gullies	Roads	Riparian	Channel	Instream Fish Habitat
Kobes Creek	Grayling, Whitefish, Rainbow Trout, Bull Trout	Summer and winter rearing	Level of Existing or Potential Disturbance	Low	Low	Low	Moderate	Low	Moderate
			Impact or Risk to Fish Habitat	Low	Low	Low	Moderate	Low	Moderate.
			Likelihood of Benefits to Fish Habitat from Restoration of Component	Low	Low	Moderate	Moderate	Low	High
Ground Birch Creek	Grayling, Whitefish, Bull Trout	Summer and winter rearing	Level of Existing or Potential Disturbance	Low	Low	Low	Low	Low	Low
			Impact or Risk to Fish Habitat	Low	Low	Low	Low	Low	Low
			Likelihood of Benefits to Fish Habitat from Restoration of Component	Low	Low	Low	Low	Low	Low

Table 4. Prioritization of sub-basins and components for restoration in the Kobes/Ground Birch Landscape Unit.

			<b>Likelihood of Restoration Success</b>			<b>Component for Restoration</b>		
Sub Watershed	Sub-basin	Priority	Low	Moderate	High	Primary	Secondary	Tertiary
Kobes Creek		1			*	Instream	Riparian	
Ground Birch Creek		0	--	--	--			

Table 5. Multi-year Restoration Plan / Cost Summary for Kobes Creek Watershed.

<b>Kobes Creek Watershed</b>	1996-99	2000	2001	2002	2003	2004	2005	2006	2007	2008	TOTAL
Detailed Assessments & Planning – Level 1 Interior Watershed Assessment	\$10,000										\$10,000
Detailed Assessments & Planning – Fish and Riparian Overview – Upper Kobes Creek	\$55,500										\$55,500
Level 1 - Detailed Assessments & Planning – Streams – Upper Kobes Creek		\$40,000									\$40,000
Level 2 - Detailed Assessments & Planning – Streams – Upper Kobes Creek		\$42,380									\$42,380
Level 1 & 2 - Detailed Assessments & Planning – Riparian – Upper Kobes Creek			\$21,270								\$21,270
Detailed Assessments & Planning – Fish and Riparian Overview – Kobes Creek Mainstem			\$17,626								\$17,626
Level 1 & 2 - Detailed Assessments & Planning – Streams – Kobes Creek Mainstem			\$25,000								\$25,000
Works - Streams (In-Stream and Off-Channel Rehabilitation) – Upper Kobes Creek		\$207,400	\$265,200								\$472,600
Works - Streams (In-Stream and Off-Channel Rehabilitation) – Kobes Mainstem				\$200,000	\$200,000	\$200,000					\$600,000
Works - Riparian Rehabilitation – Upper Kobes Creek			\$30,000	\$5,000							\$35,000
Works - Upslope (Road Deactivation)					\$20,000						\$20,000
Monitoring and Evaluation – Streams			\$10,000	\$10,000	\$10,000	\$12,500	\$12,500	\$12,500	\$12,500	\$2,500	\$82,500
Monitoring and Evaluation – Riparian				\$10,000	\$2,500	\$2,500	\$2,500				\$17,500
Monitoring and Evaluation – Fish Passage Culvert Inspections			\$8,000								\$8,000
<b>Total – Kobes Creek Watershed</b>	<b>\$65,500</b>	<b>\$289,780</b>	<b>\$377,096</b>	<b>\$225,000</b>	<b>\$232,500</b>	<b>\$215,000</b>	<b>\$15,000</b>	<b>\$12,500</b>	<b>\$12,500</b>	<b>\$2,500</b>	<b>\$1,447,376</b>

Note: Shaded fields represent estimated figures.

Table 6. Restoration Cost Summary for Ground Birch Sub-basin.

<b>Ground Birch Creek Watershed</b>	1996-99	2000	2001	2002	2003	2004	2005	TOTAL
Detailed Assessments & Planning – Level 1 Interior Watershed Assessment	\$10,000							\$10,000
Detailed Assessments & Planning – Fish and Riparian Overview			\$17,626					\$17,626
<b>Total – Ground Birch Creek Watershed</b>	<b>\$10,000</b>		<b>\$17,626</b>					<b>\$27,626</b>

**FIGURES**

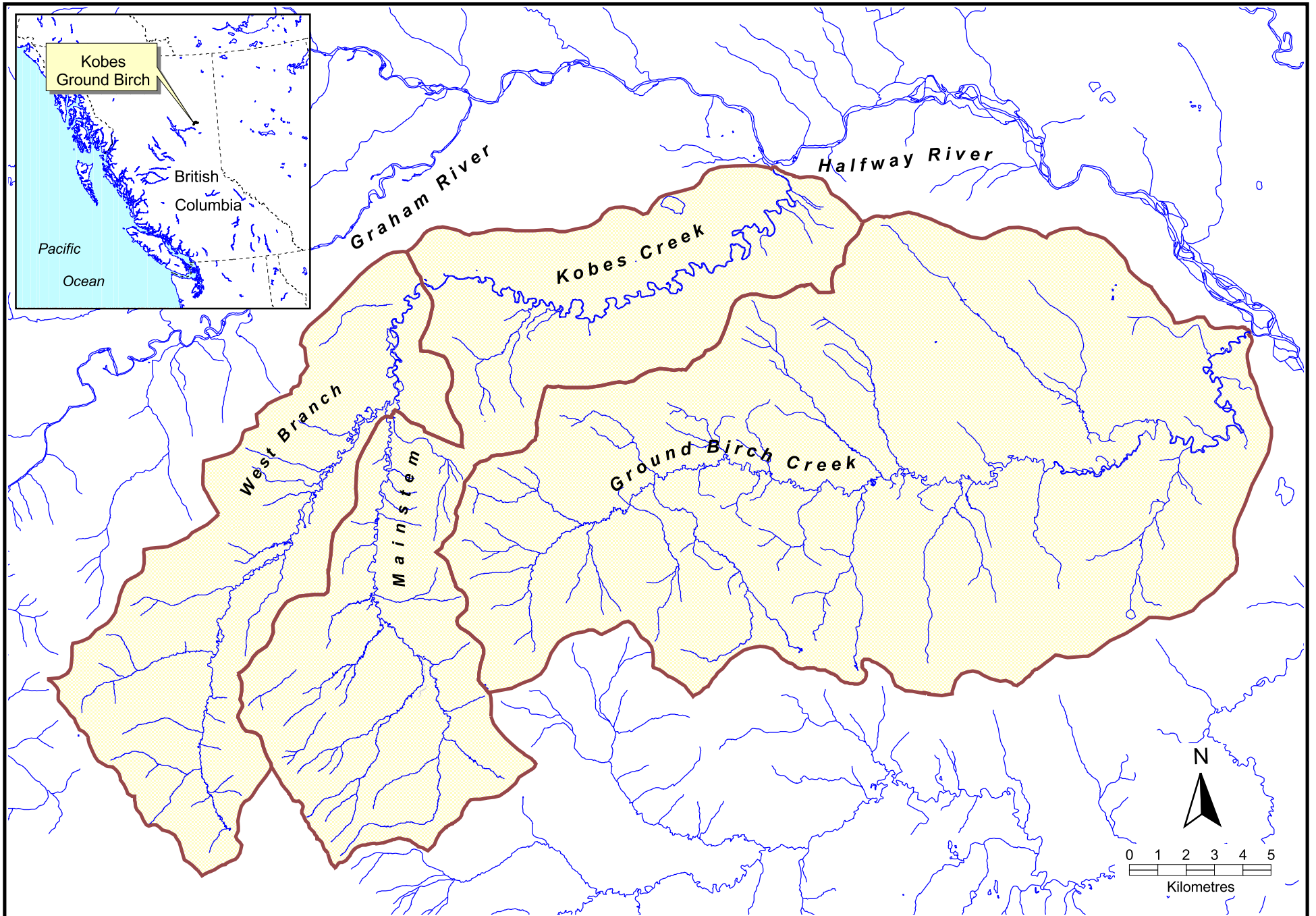


Figure 1. Index map of Kobes/Ground Birch Landscape Unit.

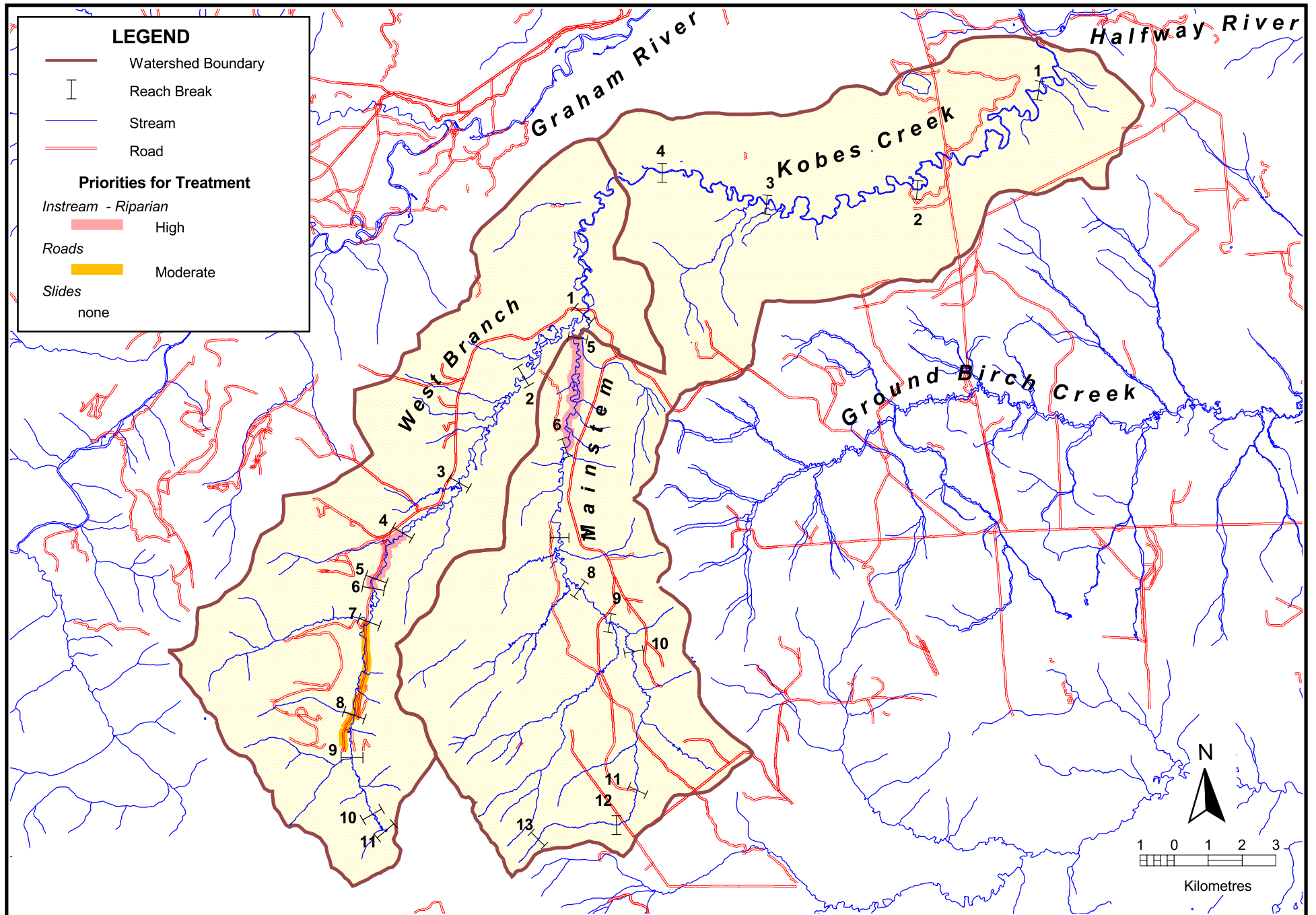


Figure 2. Map of Kobes Creek watershed showing priority sites for restoration.