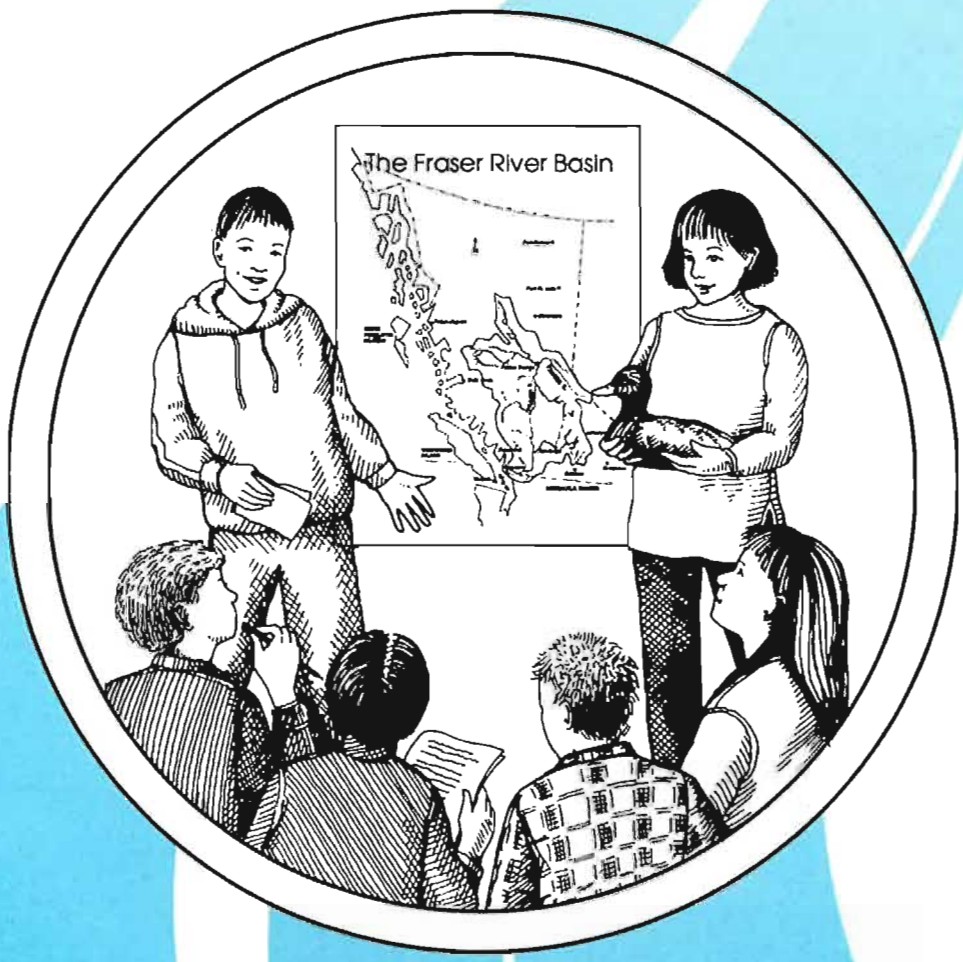
The Watershed Works

A Learning Resource for the Study of the Fraser River and its Basin



Fisheries and Oceans
Fraser River Action Plan

Pêches et Océans
Plan d'action du Fraser

Canada

The Watershed Works

Student Activities and Teaching Strategies
to promote an awareness of and an understanding about
the social, economic and environmental "workings"
of the Fraser River Basin.

Engaging Integrated Materials
(Social Studies, Science, Personal Planning, Sustainable Communities and Language Arts)
intended for use in upper intermediate classrooms.

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(Federal Department of Fisheries & Oceans)

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Barb Ballhorn	Brentwood Elementary
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Mining Association of British Columbia

B.C. Ministry of Forests

The Guided Imagery was inspired by an article by Michael Parfit in the "Water" issue of National Geographic, Vol. 184, No. 5A.

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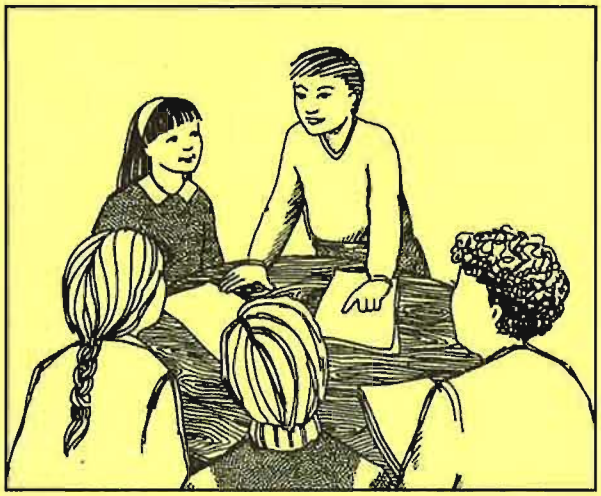


Program Overview

Each group of two or three students does an in-depth study on one aspect of the Fraser River Basin. Using a **Jigsaw** technique, students act as 'experts' on a topic and present the information to the class. At the end of the unit, students will have put together a detailed picture of the Fraser River Basin. Student Materials are provided for this study. Maps in the package may be made into overheads for the presentations. Map information from the presentations can be recorded on one large student-made wall map.

Student materials have information about the following:

Industry	How different industries operate and industry employment in the Fraser River Basin. The industries studied are: mining, forestry, tourism, agriculture and fishing.
Biology	The definition of a watershed, interesting facts about a specific watershed (Fraser River), animals and habitats within the Fraser River Basin, biodiversity, biogeoclimatic zones, what makes rivers unhealthy, and efforts by government and others to restore habitat and productivity to the Fraser River Basin.
Social	The history of the Fraser River Basin and how settlement occurred in the Fraser River Basin.

Key Concepts

- Watersheds support plants and animals and a wide variety of human activities.
- Plants, animals and human activities are all dependent on the natural features in a watershed (mountains, forests, grasslands, rivers, lakes, aquifers, soil, minerals, mountains, valleys).
- Watersheds and their valuable resources are complex and worth studying. They are affected by human activities.
- There are both rights and responsibilities associated with all human activities.
- All resource industries are managed, have unique ways of operating, produce goods and/or services, are regulated and employ people in various jobs (direct and indirect).

Jigsaw

Jigsaw is a cooperative learning model in which students become experts on part of the instructional material they are learning about. By becoming an expert, and then, in turn, teaching other members of their team or the whole class, students are responsible for learning. Students are actively involved and children of all learning abilities should be encouraged to be responsible to the same degree, even though the depth and quality of their presentations will vary.

If you are familiar with this technique, feel free to adapt our instructions. If you have not used jigsawing, we feel you will find our modified "How To" easy to follow.

Learning Outcomes

During the study of *The Watershed Works*, students will have an opportunity to:

1. work cooperatively in small learning groups
2. communicate their ideas to others in a variety of situations (small groups, teacher-student conferences, whole class)
3. read, classify, analyze, synthesize, evaluate and think critically and creatively about various topics pertinent to the study of the Fraser River Basin (wildlife, tourism, agriculture, biogeoclimatic zones, forestry, fishing, mining, etc.)

4. participate in a presentation to the class (develop criteria, prepare materials and plan delivery)
5. learn how various industries operate, are managed and regulated (agriculture, fisheries, mining, forestry)
6. learn that all resource industries (agriculture, fisheries, mining, forestry, tourism, etc.) create products and/or services and employ people in both direct and spin off jobs
7. develop an understanding of the complex and diverse nature of the Fraser River Basin, the pressures and demands on the basin's environment from human activities and the social, economic and environmental importance of the Fraser River and the Fraser River Basin in the lives of B.C.'s citizens
8. begin to understand how much is involved in making decisions about sustainable development in the Fraser River Basin

Directions for Teaching

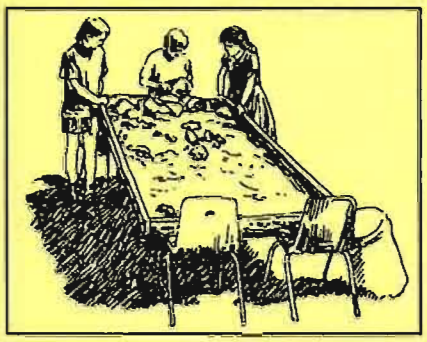
1. Watersheds

Time: 20 minutes - 12 hours

Introduce the concept of a watershed. Use any or all of the activities provided in this package. A Backgrounder for Teachers about the Fraser River Basin is on page 21.

The following Teaching Activities are provided:

- Guided Imagery page 24. (Many British Columbia cities are mentioned in the Guided Imagery. It would be helpful for the students to have a copy of the British Columbia Map and the Fraser River Basin Map. These maps are included with the Student Materials.
- Field Trip Suggestions page 27.
- Create a Model Watershed page 28.
- Make a Stream Table page 28.
- Create a "Natural" Watershed Model page 30.
- Use the background information on the watershed and watercycle from the Student Materials.



2. Fraser River Basin

Time: Minimum of 10 minutes

Introduce the Fraser River Basin. A Backgrounder for Teachers about the Fraser River Basin is on page 21.

Make sure students know:

- where the basin is located
- the location of Vancouver, Kamloops and Prince George
- the Fraser River is the main river running through this area
- the names of at least two of the other rivers in the basin (Thompson, Nechako, Pitt, Coquitlam, Chilcotin . . .)

The Watershed Topic may be used to introduce watersheds.

- Model a presentation for the students using this Topic.
- Distribute a copy of the Watershed Topic to all students and teach it as a Directed Reading-Thinking Activity.
- Give one page each from the Watershed Topic to five groups of students. Each group makes a mini-presentation based on that page. This rehearsal gives students the opportunity to experience the process of giving a presentation.

3. Introduce the Student Materials

Time: 30-60 minutes

There are 12 Topics on the Fraser River Basin. Each Topic has eight pages:

- four pages of information
- a map showing the Fraser River Basin in British Columbia (BC Map)
- a map illustrating information about the topic (Topic Map)
- an information page on the Topic Map
- a map of the Fraser River Basin (FRB Map).

To keep these materials usable over many years, make copies for classroom use or laminate the originals. **Please make sure that all overheads are made before you laminate.**

Students use the Topics and the maps to research information about the Fraser River Basin.

- Assign the Topics to partners or groups of students. (Refer to the Readability/Concept Level Chart to assign the topics.)
- Make copies of the BC Map and FRB Map and distribute to the students. (Make overheads for teacher presentation.)
    - Show the location of the Fraser River Basin in relationship to the province.
    - Show samples of some of the Topic Maps. Explain how to read the legend and interpret the map icons and symbols.
    - Explain how the Topic Maps, the FRB Map and the BC Map are related.
    - Demonstrate how to use the overheads of the Maps. Overheads of different Topic Maps may be combined and/or an overhead of one Topic Map may be combined with an overhead of the FRB Map.

Topic	Reading Level	Concept Level
Watershed	4	Easy
Fishing	4	Easy
Agriculture	4	Easy
Tourism	6	Easy
Forestry	4	Easy
Mining	5	Middle
Settlement	5	Middle
History	5 - 6	Middle
Wildlife	5 - 6	Difficult
Biodiversity	7	Difficult
Working Together	7 - 8	Difficult
River Health	6 - 7	Difficult

If you use the Wall Map Activity, then decide how the information from the Topic Maps will be recorded. (Color-coding? Shapes? Icons?) Consider how full and busy the map might become. It may be better to record the information on two separate maps. (See Sidebar)

4. Reading The Topics

Time: 5-6 hours.

To fully understand all of the information, students should read the Topic a number of times before making plans for the presentation. The following suggestions give the students the opportunity to read the Topic five times.

1. Each student reads the Topic independently. The student records the main ideas of the Topic using an organizer (i.e. web, chart, key visual, word list sorted by category). The organizer may be submitted for marking. Optional: group members meet to integrate these organizers into one that represents the ideas of all members.

2. Each student reads the Topic independently before group work begins. The student makes six questions (Who, What, When, Where, How, Why) about the Topic. On a separate paper, the student records the answers. These may be submitted for marking. Time: 15-30 minutes.

3. Group members meet to exchange questions. Students write answers to the questions made by another student in the same group. Students discuss the answers. Written answers may be submitted for marking. Time: 15-20 minutes.

4. Group members meet and read the Topic together. One student reads the first paragraph. Then a different student orally summarizes the information. Students continue through the document to make sure that all members understand the information. Time: 20-30 minutes.

5. Group members meet to discuss the Topic Map and Map Information Page. Time: 30-60 minutes.

   On the Topic Map, the students record:
   - Vancouver, Prince George and Kamloops
   - all cities mentioned in the Topic or on the Map Information page
   - all rivers or lakes mentioned in the Topic or on the Map Information page

   On a separate sheet of paper, the students:
   - provide a summary of what is shown on the Topic Map
   - tell how the Topic Map relates to the Map Information Page
   - tell how the Topic Map relates to the information on pages 1 to 4 of the Topic
   - explain three of the icons on the Topic Map

Wall Map

Students make one or two large wall map(s) to record the Map Information from the Topics during the presentations. At the end of the unit, this map will show the amount of activity within the Basin.

A system to record the information must be discussed before the presentations. For example, each group might use different icons, or a combination of colors and icons. To simplify the discussion, each Topic group meets to select a recording system. Then two Topic groups meet and come to consensus. Then four Topic groups meet. Then all Topic groups present their ideas at a class meeting. The system is fine-tuned so that all information from all Topics may be recorded.

6. Group members read through the Topic together to identify vocabulary words that may be used for their presentation. Students make a glossary of these words. Glossary may be submitted for marking. Time: 30-40 minutes.

7. Each student reads the Topic independently again. The student makes notes or uses colored pens to code the information on the Topic sheets. (What is the most important information? What order should it be presented in? What should be left out? What needs to be explained well because it is hard to understand?) Time: 30 minutes.

8. Group members meet to discuss notes. Make an initial outline of presentation. Outline may be submitted for reaction. Time: 30-40 minutes.

Presentation Criteria

Consider some or all of the following criteria for student presentations:

- Duration
- Each group member must speak
- At least one prop or visual-aid must be used
- There must be some audience participation (e.g. People Search, Anticipation Guide, Ranking Ladder, Trivial Pursuit, etc.)
- Voices must be clear and loud enough to be heard
- Eye contact with audience
- Calm demeanor (no fidgeting)
- Information is explained well
- Smooth transitions from one speaker to the next

5. Prepare for the Presentation

Time: 5-6 hours

Students need time to prepare materials, rehearse, and meet with the teacher. Although much of this work could be assigned as homework, it is suggested that the students work at school. This allows the teacher to guide and assess the students' learning.

Teacher and students agree on Presentation Criteria. Time: 20-30 minutes.

- Discuss the criteria in detail so that students understand the expectations for each one. For example, what is "words were clear, easy to understand and loud enough"? How do the students obtain the best score on this criteria? What is "audience participation"? How much of the audience must participate? How long should audience participation take? (A Presentation Evaluation based on some of these criteria is included with the Student Materials.

Teacher conferences with each student group. Time: 15-20 minutes/group.

- Go over the students' outline of the presentation. Ask each student to elaborate on one aspect of the outline.
- Ask key questions about the topic to assess the students' understanding (e.g. What is Biodiversity all about? Why is it important? Give an example of a biogeoclimatic zone).
- Assess students' plans for presentations (Do they have an organizing idea? Is the information well sequenced? Do they have too much/little information? Do they need some ideas to make the presentation interesting? See Presentation Ideas below.)
- Discuss the visual-aid. Is it integrated into the presentation? Is the size appropriate? Where will it be displayed so everyone can see it?

- Discuss the plans for audience participation. What form will it take? How will the audience react? Will audience behaviour be an issue?
- Groups meet to discuss presentation criteria and presentations. Make a final outline of presentation. Assign tasks to group members. (Who will present what information? How should information be presented?) Task assignment and outline may be handed into teacher for marking. Time: 1 hour.

Presentation Ideas

1. Bring items from the Products List (e.g. for agriculture: juice box, eggs, bread; for mining: roll of film, skateboard, pencil).
2. Use role play or skits (e.g. for agriculture: a couple start and maintain an environmentally friendly farm; for fisheries: a commercial, sport and native fisher discuss how to allocate the number of fish each group can catch).
3. Portray a "day in the life" of a mining company employee, a travel agent or a forest manager.
4. Construct models or do experiments to illustrate concepts (e.g. watershed drainage, streambank erosion, habitat restoration, amount of cover in young vs. old growth forest).
5. Ask a provocative question at the beginning of the presentation e.g. fishing: How much money is generated every year in B.C. by anglers? How many of Canada's animal species can be found in the Fraser River Basin? Is the Fraser River threatened or thriving?)
6. Use props, costumes, backdrops, audio recordings, video footage to create a setting appropriate to topic (e.g. historical events or settlement patterns, a mine or a sawmill).
7. Organize presentations in a talk show format using classmates (briefed or unrehearsed) or invite actual representatives from topic (e.g. seine boat owner, geologist, travel agent, dude ranch operator, dairy farmer, logger, wildlife biologist, inspector from environmental branch).
8. Conduct people searches prior to presentations and present the data on charts or audio or video tapes (e.g. Find Someone who spent their holiday heli skiing; Find Someone who worked on a team restoration project; Find Someone who knows a miner/logger/fisher/farmer; Find Someone who has seen a bighorn sheep/blue heron/Sitka spruce/clearcut forest/spawning salmon/a chemical spill/gillnetter catching fish).

- Group members make visual-aids, etc. Time: 1-2 hours.
- Group members practice presentations to students in another classroom, to the teacher, to each other, to one other group or at home to parents. Each student in the group evaluates his/her own performance for each practice session. Students can use the Presentation Evaluation or can complete three self-evaluation statements (In this presentation I was really good at _____because_____. I need to improve _____. My plan to improve is _____.) These evaluations may be submitted for marking. Time: 1-2 hours.

6. Presentations

Time: 4-5 hours

It is suggested that the Watershed Topic be presented first, and the River Health and Working Together Topics be presented last. The other Topics may be done in any order.

- Teacher and students discuss Presentation Evaluation (see below). Time: 20 minutes.
- Each group makes presentation. Audience members complete Presentation Evaluations and/or record information from the presentation with a Mind-Map, Diagram, Chart or Notes. (The knowledge that a test will be given can help to moderate audience behaviour.) Time: 15-20 minutes/group.

Sample Presentation Evaluation Sheet

Presentation Evaluation

Evaluator's Name_____ Date_____

Presentation Topic_____ Group Members_____

Circle Yes or No for the following criteria.

Within time limits	Yes	No	Each person spoke	Yes	No

Rate the group. Give an example to justify your decision. 1 = Disagree 4 = Agree

Words were clearly spoken	1	2	3	4	Prop or visual aid	1	2	3	4
Voices were loud enough	1	2	3	4	Audience participation	1	2	3	4
Good eye contact with audience	1	2	3	4	Calm and relaxed (no fidgeting)	1	2	3	4
Information was explained well	1	2	3	4	Moved smoothly between speakers	1	2	3	4

What was the best part of this presentation?	How could this presentation be improved?

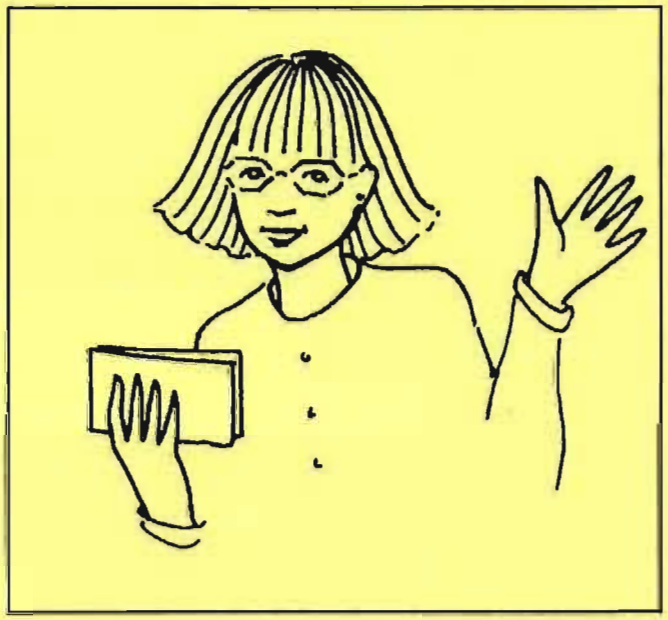
Overall rating for this group: Excellent Good OK Needs improvement

7. Evaluation

Time: 30-60 minutes.

The students' work may be evaluated in any of the following ways.

- Presentation Evaluations completed during and after the presentations (sample on page 14).
- Material submitted by individual students and student groups during the Fraser River Basin unit.
- Teacher observation of groups during reading and preparation for presentations.
- Teacher conferences with groups preparing for presentations.
- A debate based on one of the following questions:
  - Be it resolved that all development in the Fraser River Basin stop immediately.
  - Be it resolved that all the Fraser River Basin triple its population density.
- Self-Evaluation sheets completed during or after the Fraser River Basin unit (sample on page 16).

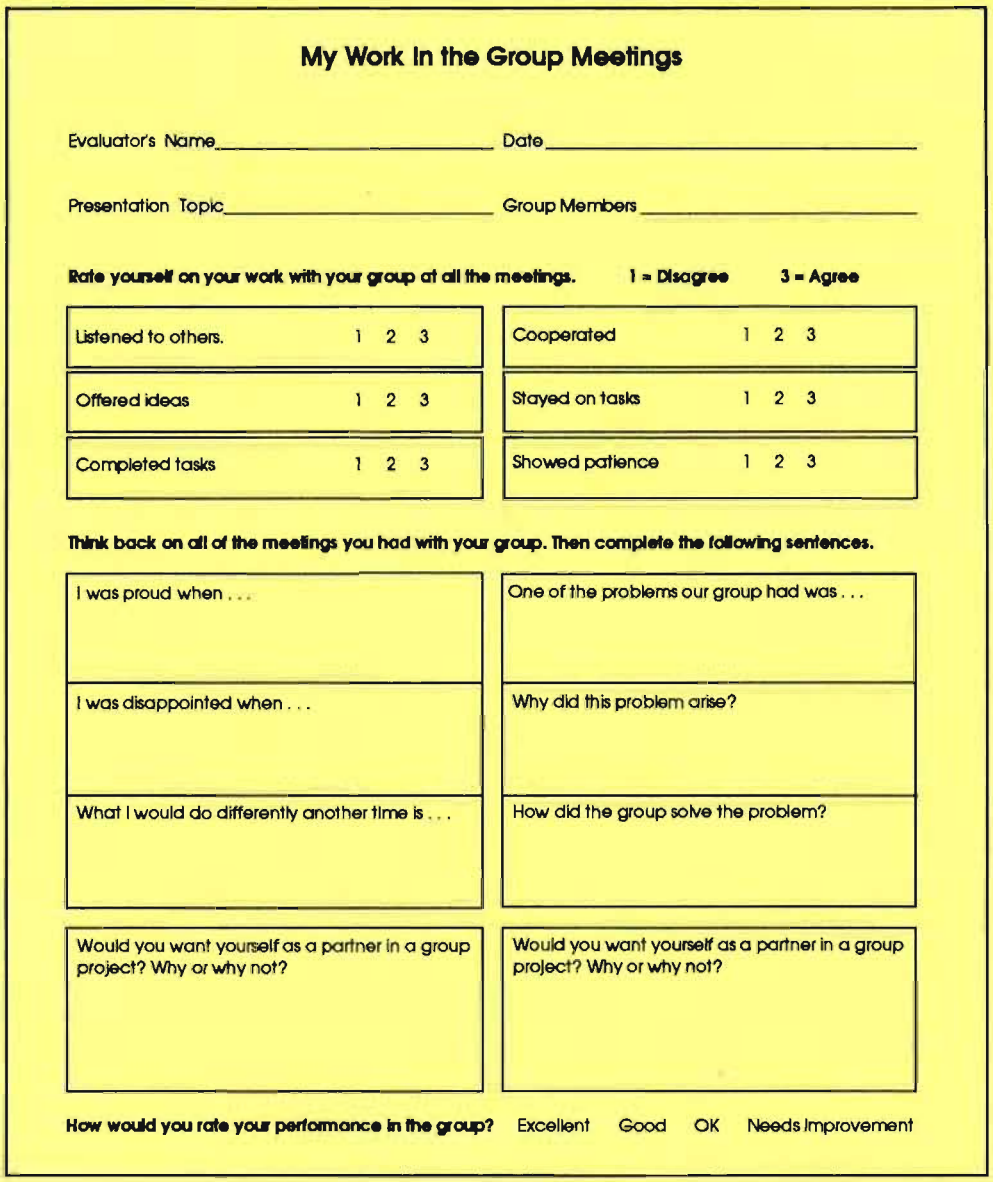


Peer or Self Evaluation

The quality of peer or self-evaluation improves if students have more direction on how to evaluate.

- Discuss the specific details for each evaluation criteria. (The best mark for calm manner is given when the presenter keeps all his/her body parts relaxed and motionless unless moving to show a chart, etc.)
- Do not accept evaluations that have general statements (I want to do better). Ensure that students give specific statements (I will do better by making the print on the chart larger.)
- Direct individual students or groups to brainstorm on specific ways to improve specific parts of presentations (e.g. stop tapping your feet, look at the audience, use cue cards with only one point on each card).
- Mark self-evaluations on the student's insight into group work and tasks.

Sample Self-Evaluation Sheet



My Work In the Group Meetings

Evaluator's Name_____ Date_____

Presentation Topic_____ Group Members_____

Rate yourself on your work with your group at all the meetings. 1 = Disagree 3 = Agree

Listened to others.	1	2	3	Cooperated	1 2 3
Offered ideas	1	2	3	Stayed on tasks	1 2 3
Completed tasks	1	2	3	Showed patience	1 2 3

Think back on all of the meetings you had with your group. Then complete the following sentences.

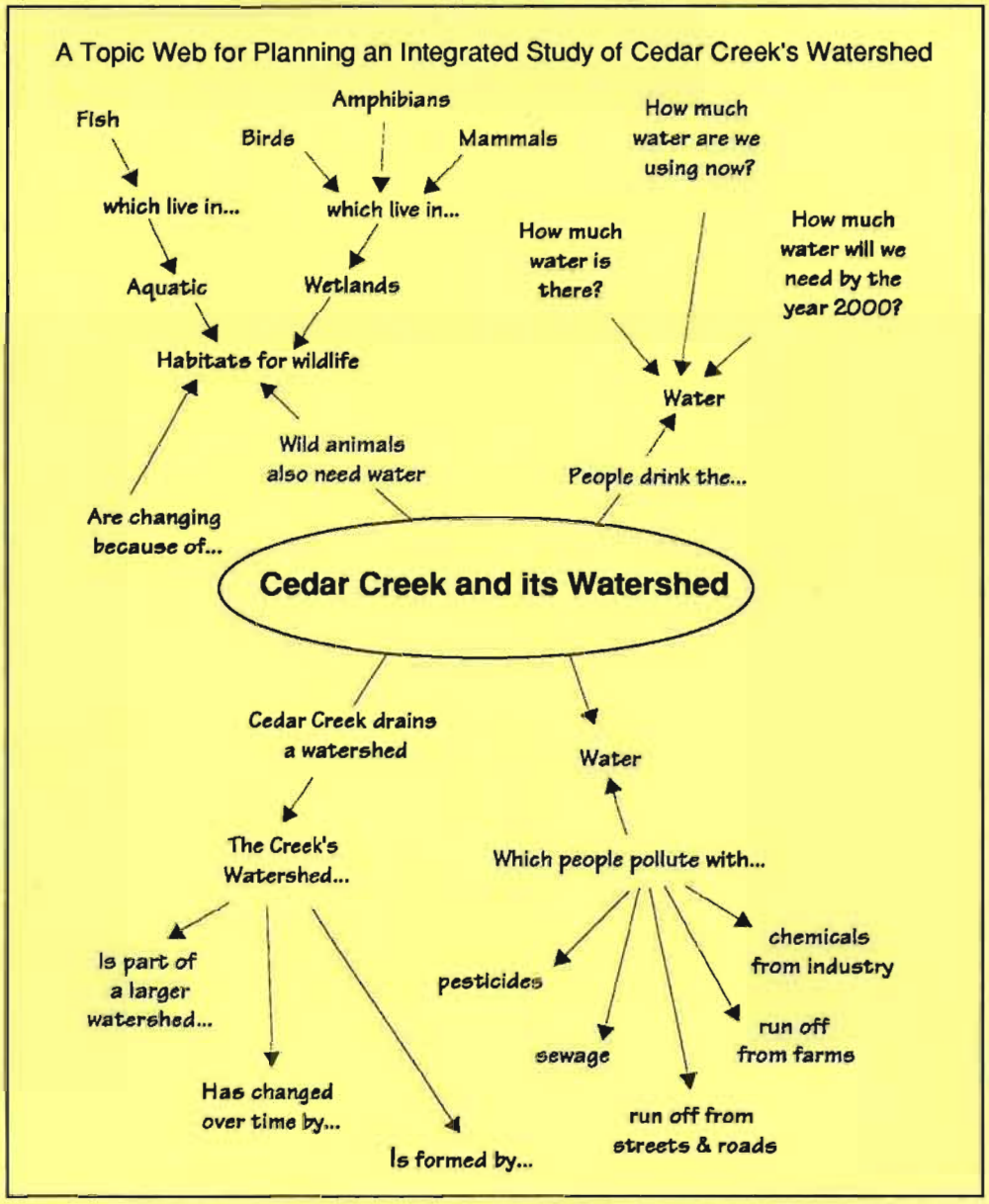
I was proud when . . .	One of the problems our group had was . . .
I was disappointed when . . .	Why did this problem arise?
What I would do differently another time is . . .	How did the group solve the problem?
Would you want yourself as a partner in a group project? Why or why not?	Would you want yourself as a partner in a group project? Why or why not?

How would you rate your performance in the group? Excellent Good OK Needs Improvement

8. Extension Ideas

1. Contact an agency associated with topic and ask for videos, charts, pictures, brochures, speakers lists.
2. Research topic from an historical perspective (what were the early days of farming, fishing, forestry, mining, like in Fraser River Basin.)
3. Collect newspaper clippings about topic.
4. Look at a controversy associated with topic (e.g. Should development be allowed within the Agricultural Land Reserve? Are forest plans always followed? Do fines really deter companies from harming the environment? Are our wetlands being adequately protected?).

5. Choose one aspect of topic and research it more extensively (e.g. select one of the species from the list of wildlife and find out about its life cycle stages/habitat requirements).
6. Research data for topic from other areas in Canada or from other countries. Contrast and compare trends/statistics (e.g. forest practices regulations, fishing methods, biogeoclimatic zones, historical development, settlement patterns).
7. Research jobs listed in each topic. Find out what the job skills are, and what training you need to get the job.
8. Mind Map your Watershed. An example from *Water Stewardship* by Kim Fulton is provided.



The Watershed Works:

Teaching Activities

The Fraser River Basin: A Backgrounder for Teachers

Excerpted with permission from the foreword by M.C. Healey, Director Westwater Research: *Water in Sustainable Development: Exploring our Common Future in the Fraser River Basin,* Dorsey, Griggs, Westwater Research Centre, UBC, 1991

The Fraser Basin is the heartland of British Columbia; the Fraser River and tributaries, its lifeblood. In a giant S, the mainstem of the River flows 1,325 kms, draining more than a quarter of the province (234,000 kms ^{2}).

From its alpine headwaters, the Fraser River flows through arid interior regions to the coastal rain forests and saline estuary in the southwest corner of the province. The Fraser Basin is the greatest salmon producing river system in the world. It is also a major part of the Pacific Flyway, an international migratory bird route between South America and Siberia. The Basin supports an amazing diversity of plants and wildlife and is related ecologically to surrounding areas, including the Georgia Strait and adjacent terrestrial zones of the coastal and interior.

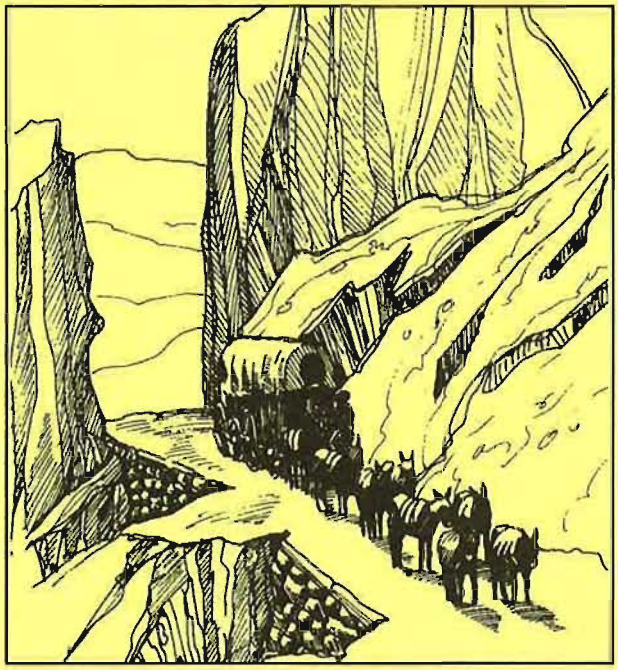
The Fraser Basin is also a resource for people. For over 10,000 years, First Nations have lived in the Basin. Now, some two million people (about 65% of B.C.'s population) make the Basin their home. The River and its tributaries supply water for communities, farms, industry and other uses. It is a major transportation link for the flow of people and goods between the interior and the coast. The Basin's importance is disproportionate to its relative size, for not only does it support almost two-thirds of B.C.'s population and labour force, it is the source of:

- 80% of the gross provincial product;
- 48% of the net operable forest area and
- 46% of the long-run sustainable yield of timber in the province;
- 60% of B.C.'s metal mine production;
- 44% of provincial farmland;
- 66% of sockeye and 60% of pink salmon catch from B.C. streams; and
- 49% of the province's sport fishery catch.

Today, the Basin is facing increasing pressures from population growth, resource extraction and economic development. In the next 25 years, its population is expected to increase 50% - in some regions by 200%. At the same time, public values are changing. While realizing that growth and development are inevitable, there is growing recognition of the need to ensure sustainability - development that meets society's social, economic and environmental needs today while ensuring that future generations will be able to meet their needs tomorrow.

The Fraser Basin is at a turning point. Substantial portions of the Basin are still relatively undeveloped. Though development has caused some serious environmental problems, these can be remedied and avoided in the future if action is taken now. Economic opportunities abound, based on the Basin's rich natural resources, but also on its growing value-added manufacturing, service and technological sectors. While social issues and inequities exist, few parts of the world enjoy the quality of life that prevails in the Basin. With care, this can be shared more equitably now and with future generations. With good stewardship and partnerships, the people of the Fraser Basin have an unparalleled opportunity for creating a sustainable future.

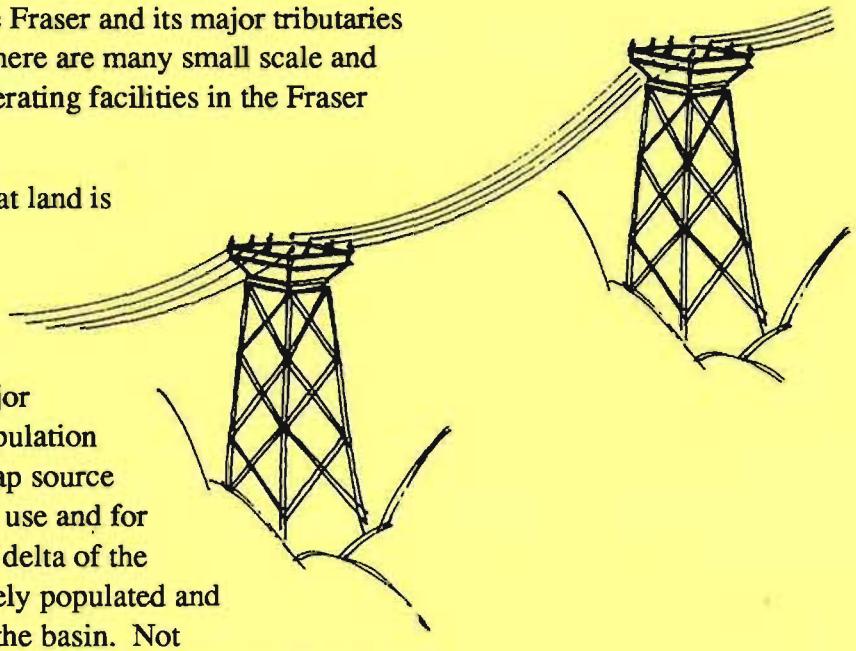
The Fraser Basin is an appropriate place to focus attention at this formative stage in the concept of sustainable development. The Fraser River is one of the great rivers of Canada and is the heart of British Columbia's resource based economy. The Fraser is, therefore, a river in which the environment and the economy are obviously and inextricably intertwined.



In British Columbia, as with the rest of the country, rivers have been at the centre of communication and economic development, particularly the Fraser River. With its steep gradients through mountain ranges, the Fraser River is less navigable than many large central and eastern Canadian rivers. Nevertheless, the valleys of the Fraser and its tributaries defined prehistoric trade routes from the coast through the mountain ranges to the interior plateau. Explorers, prospectors, and colonists all made use of these same access routes to tap the riches of the Basin.

The Fraser River and its basin was a primary source of resources for economic development following colonization of the Province by Europeans. The immense runs of Pacific salmon to the Fraser provided a predictable supply of food for aboriginal peoples and colonists alike and have sustained a valuable commercial fishery to the present day. The Fraser, the Thompson and other interior tributaries yielded up placer gold that stimulated the first great surge of immigration to the Province in the middle of the last century. Early loggers depended on the lakes and rivers for sorting and transporting their harvest to the lumber mills. The forest industry still sorts and transports logs by water. Hydro-electricity is a primary source of energy for industrial and social development in British Columbia. Because of the importance of

its salmon runs, the mainstem of the Fraser and its major tributaries remain undammed. Nevertheless, there are many small scale and some large scale hydro-electric generating facilities in the Fraser Basin.



In mountainous British Columbia flat land is rare outside of the major river floodplains and deltas. Consequently the major population centres of the Province have developed on river deltas and at major tributary confluences. For these population centres the river has provided a cheap source of water for domestic and industrial use and for waste dilution. The flood plain and delta of the lower Fraser River is the most densely populated and most intensively developed area of the basin. Not surprisingly, this is also the area where abuse and degradation of water resources is most severe.

The linking role of water through the hydrological cycle and its importance economically are well illustrated in the Fraser Basin. The great forestry, fishery, and agricultural resources of the Basin depend directly on the seasonal patterns of water movement between hydrologic storage basins. The varied climate of the Basin dictates that even in this water rich part of the world, there can be regions and seasons of acute water shortage. Where water supply is not a factor, patterns of water and other resource use in one economic sector can create problems in another. In the Fraser Basin many of the conflicts over water and land use have centred on the effects of forest harvest and other forestry related activities on salmon spawning and nursery habitats. More recently, agricultural and industrial users have come into conflict with recreational and domestic users over water quality.

Except in its lower reaches and a few other centers of population and industrial activity, the Fraser is still remarkably pristine. Yet the emerging problems of supply and quality show what its fate will be if current practices continue. The future is foretold in the degraded nature of the great rivers of Europe. If we are to redefine the future of the Fraser we have to stop regarding water, soil, and air as "free" goods and accord them their intrinsic value as the basis of all life on earth. Only on the basis of such a revaluing can we begin to appreciate what "not compromising the opportunity for future generations to meet their own needs" means to us as custodians of that generation's resources.

Teaching Activities to Introduce Watersheds

There is no 'right way' to introduce students to the world of watersheds. The following ideas provide a variety of launch pads - use one or all, modify or create new learning experiences.

1. Guided Imagery

The following Guided Imagery may help your students to visualize the *expanse* of the Fraser River Watershed or Fraser River Basin (drains 234,000 square kilometres or 1/4 of the province of B.C.) and the *complexity* of its ecosystems (supports 65% of the population, 48% of commercial forest area of the province, 60% of the metal mines, 44% of the farmland, and has the largest sockeye salmon fishery in the world).

Students will have an opportunity to bring together prior knowledge about water related experiences and new ideas generated during the reading of the images. The guided images should provide stimulation for the creation of original images. There are no "wrong" answers and all perspectives should be considered equally valid.

Successful imaging takes place when students are relaxed and are able to concentrate on the images. The tone of the voice of the reader is important to getting the overall mood. A steady, paced, and relaxed speaking style will help students create rich mental images. Some other suggestions:

- suggest students find a comfortable spot
- have students close their eyes and breathe deeply
- dim the lights
- play soft music in the background
- allow students a debriefing or reflective time (1 - 2 minutes) at the end of the experience to enable them to visually review their mental pictures
- begin discussing the imagery in terms of key Watershed concepts

Imagery

1 Imagine you are in a house. The roof is made of rainclouds ... The walls are the mountains ... The floor is the river ...

2 Now imagine this house covers 234,000 square kilometres (that is the size of Great Britain) ... In order to see all the rooms in your house you will need to travel by plane ...

3 Climb aboard your Cessna. You are about to roam ... You are about to embark upon an expedition ... You are going to explore your "home" ... This home of yours just happens to be in the Fraser River Basin. You and other people live, work and play within its walls.

4 You are 4,000 metres above the land ... It is late June. Spring has finally touched the frozen land. Spring thaw has unlocked the water ...

5 You are at the controls of your aircraft... You are high in the Rocky Mountains ... The world seems completely blank ... You are alone ... Everything is white. You are inside a cloud ...

6 The cloud blindfolds you ... You can't see water but you know it is there ... Slowly, magically, dangerously water appears on your windshield ... A thin, but growing, film of ice is covering the wings of your plane ...

7 As you descend into warmer air the ice breaks from the wings in chunks ... The cloud is starting to unload its cargo ... Slowly. Gently you are dropping ...

8 The mask of moisture swirls from your face ... The whiteness disappears ... The rain rattles on the windshield ... Suddenly, you emerge from the fog ... Beneath you are the slopes of the Rocky Mountains ... For a moment you feel like a God coming down over an unpeopled world ...

9 The world below is unpeopled but it is not lifeless ... Roaming mountain goats ... Colourful alpine meadows ... Scurrying marmots ... Trickling streams ...

10 From your airborne vantage point you realize that you are witnessing the beginning of a great river system ... The mighty Fraser River will meander, cascade, rush, plunge and finally and sluggishly make its way to the sea ... Constantly moving and constantly changing ... Endless freezing and thawing, raining and evaporating ... Oozing and flowing ... Ever moving energy ... Water and land mixing, molding the landscape ...

11 The shape and colour of the water is changing ... The water becomes muddy ... The Fraser is a muddy river ... The heavy rains add their weight ... Banks overflow ... The landscape is eroded ... The river churns on ...

12 You are moving west ... You are following the Fraser ... If you were travelling on foot, it would take you a lifetime ... If you were travelling by boat you would have to be a very experienced navigator ... The area this great river drains is immense ...

13 High up in your cockpit you spy the first major city on the Fraser's route. Prince George, in northern B.C. is bustling below you. As you follow the river your compass indicates you have turned abruptly south. Near Prince George, in northern B.C. the Fraser abruptly turns south ... Even from an altitude of 300 metres you can see that the water is muddy ... The land is covered with lush, dense evergreen forests; deep blue lakes; alpine tundras; wetlands; and broadleaf forests ...

14 Even though you are high above the mighty Fraser you can feel its urgency ... It is like a wild stallion ... Powerful ... Surging ...Cascading ... Roaring ...

15 As you manoeuvre your small airplane between Quesnel and Williams Lake, you pass over dry sagebrush and grasslands ... You are mesmerized by the widening and contracting of the river's course ... Other rivers wind and plunge and join the great Fraser to make a network of waterways ... The water moves so fast and with such energy ...

16 As you follow the river's course down the spectacular but narrow Fraser Canyon you feel hemmed in by the towering mountains ... The mighty Fraser rushes on, carving its path through the granite walls ...

17 As you continue your flight through the Fraser Valley you realize that this vast system is life giving ... You are fascinated by the power of the river ... Without the water there is no farmland ... Without the water there are no forests ... Without the water wildlife dies ... From the air you feel in control ... You know that humans and other life forms beneath you are at the mercy of the river ... While at the same time the human hand is shaping the river ... For better or worse it is a human hand that reaches for water ... Demands for water are becoming ever more persistent. The Fraser's bounty becomes more precious each day.

18 You are nearing your destination ... The Fraser is sluggish now ... The silt it has carried forms gravel and sand bars ... The mouth of the Fraser is dotted with islands, sloughs and mudflats ... Human activity is intense ... The waters teem with aquatic life ...

19 When you arrive at last to the edge of your 'home' you can see the river below emptying into the Pacific Ocean ... The muddy Fraser becomes mixed with the clear blue waters of the Strait of Georgia ... Still at the controls, you make a wide sweeping circle so that you can glance back once more at the river that connects the rooms of your house ... Just before you close the door of your magnificent mansion something catches your attention in the water below ... A huge school of sockeye salmon is entering the river from the ocean ... They will make the trip upstream which you have just completed. For the Fraser Watershed is their home too.

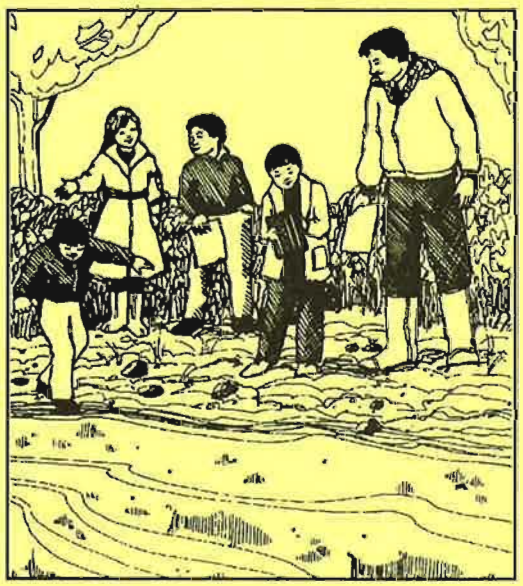
20 Everyday the Fraser River dumps billions of litres of water into the Pacific Ocean ... Everyday the sun pumps vapour right back up into the sky ... The cycle roars on ...

Adapted from "Water" by Michael Parfit. National Geographic Special Edition. Vol. 184, No. 5A, National Geographic Society, Washington, D.C., 1993.

Follow-up activities

- Trace the journey of a water drop through the Fraser River Basin.
- Use the "Image-Cluster-Draft" strategy as described in *Reaching for Higher Thought* by Brownlee, Close and Wingren.

2. Field Trips



Conduct field studies on a local creek. Contact your local Community Advisors through the Federal Department of Fisheries and discuss field trips in your area. The package *Gently Down the Stream* (Federal Fisheries) contains many field study activities.

The following "field labs" may be conducted on your own watershed:

Obtain a land use map or road map of your local area from the city or municipal planning department. Obtain a topographic map of like scale from the planning department.

- Using the topographic map, locate the boundaries or "divide" of your drainage basin and tributaries. Transpose the divide and stream pathway to your land-use map or road map. Where is the stream relative to roads? Name your watershed.
- Research or quantify the amount of rainfall in your basin.
- Locate the major natural water storage features in your watershed: lakes, streams, stream tributaries, marshes, bogs, ponds. Identify artesian wells and springs.
- Locate any major man-made water storage systems you can find - dams, irrigation ditches, lakes, ponds, neighborhood detention ponds. (Public Works Department maps may help you with locating detention ponds).
- Identify the major human contributions to decreased storage capacity in the watershed (domestic use, industrial use, agricultural use).
- Identify major natural areas which are contributing sediment to streams (unstable hillslopes, slides).
- Identify the major human contributions to increased erosion and sedimentation.
- Research historic depths of the water table in your area. *Where are the major aquifers?* Is the water table remaining at those depths, or is it being depleted? What does this mean in the long-term?

3. Create a Model Watershed

A model of a watershed can be made in many ways.

Use plasticene, boxes, cardboard tubes, wooden blocks, cans and other objects to make a model watershed in a sandbox or on a table. Drape clear plastic over the plasticene and objects. Make sure there is at least one main river with three or four tributaries. There should be hills, valleys and flat land areas.

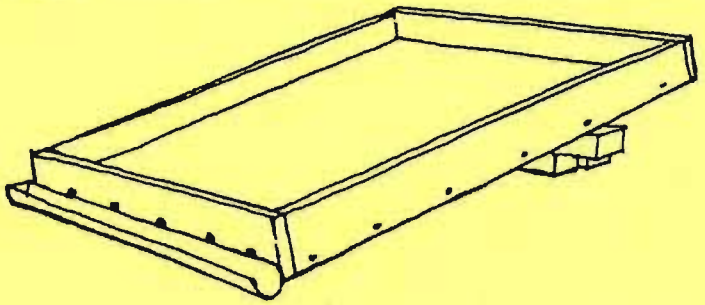
- Pour water at the top of the largest hill and watch the movement of the water: where does it run? where does it collect? how fast/slow does it move?
- Give students in one tributary some 'pollution' (food color, plastic sequins) to float down to the mainstream to illustrate how contamination moves through a watershed.

These directions used with permission from Kim Fulton, "Water Stewardship Program."

4. Make a Stream Table

Procedure:

1. Use a sheet of plywood, with pieces of 1" x 4" nailed or screwed around the edges to form a rim. Drill holes in the bottom piece of 1" x 4" so the water will run out of the box. On this same 1" x 4" fasten a piece of gutter slightly off level so the water will run to one side.
2. Raise the other end of the stream table and prop it on blocks of wood or bricks. This will help support the middle of the table and keep it from bending under the weight of sand.
3. Use a plastic drop sheet as liner, or use silicon seal to caulk the edges, and then fill the shallow box with sand. (You can get sand from most building supply centres).

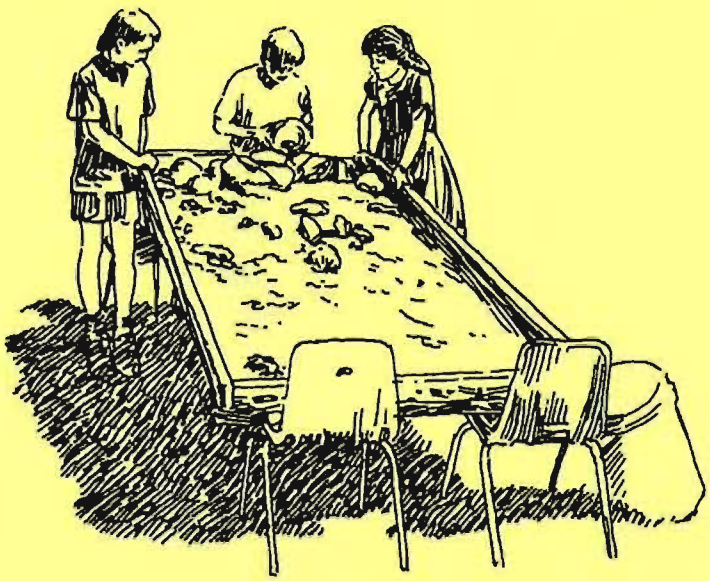


How to Use a Stream Table

Procedure:

1. Shape the sand into hills and valleys creating a tree-type pattern of branches and main streams. Create a lake area at the lower end of the table.

2. Use a small hose or plastic tubing as a source of water and run the water gently from the top of the branches so that it flows down the table. Notice any new erosion or channels created by the water and watch how the running water deposits the sand as it flows downward.



Note: it is important to use a very gentle flow of water on model stream tables — too much water flowing too hard will destroy the model.

3. Try various different landscapes by reshaping the sand on the table into different forms. Study the effect of making the slope of the table greater or less.

These directions used with permission from Kim Fulton, "Water Stewardship Program."

5. Create a "Natural" Watershed

A natural watershed can be created in your schoolyard or a nearby park. But remember to get permission from the appropriate authorities first.

Find a spot where there is open, sloping ground, covered minimally by grass or other vegetation. A loose sand and gravel bank is ideal.

Map out on the ground as natural a stream as possible with meanders, point bars and islands. A 17 m (50 foot) length of rope is most useful for this purpose with some short pieces for mapping side channels and islands.

Start digging the stream channel, carefully removing the sod and placing it to the side well away from where the activities will take place. This will ensure that once your activities are completed you can restore the site to its original condition. The stream channel should be between 15 to 20 cm (6 to 8 inches) wide and 7.5 to 12.5 cm (3 to 5 inches) deep with a reservoir at the top end about 30 cm (12 inches) deep and 40 to 50 cm (16 to 20 inches) across.

Place the PVC pipe in the channel, hooking it together to form the river and tributaries. Add the bridges, buildings, people and animals to make the watershed look 'real'!

Use a garden hose or buckets of water to simulate running water. Be careful to keep the water flow quite low and gentle—you are modelling a river on a small scale. To simulate melting glaciers make a slurry of sand and fine gravel and freeze this mix inside some 1 litre milk cartons. When the mixture is solidly frozen, peel the milk cartons away from the ice and place simulated glaciers at various spots on the model watershed. Have the students observe the changes. (e.g. temporary lakes, streams, major channels, minor channels, deltas, moraines etc.). Relate these observations to field observations in your area.

When the stream model is completed, walk the whole class along its length pointing out and flagging different problem situations. When you have done this divide the class into groups. Each group is assigned a different stretch of stream and through hands-on-activities and discussion will address the various problem sites. A spokesperson from each group explains what they have done to assure the water quality of the stream.

The model described here is just one example. Other stream models could include beaver dams, docks and marinas, housing developments with septic systems, flash dams historically used to move logs down river systems, flood plains or wet land habitats.

These directions used with permission from Neil Brookes.

Materials List

Source of water - pump, fire hydrant, school irrigation system

Length of rope - 17 metres (50') should be adequate

1/2" PVC - two or three lengths, 3 or 4 tees, 3 or 4 elbows 90 - 45

Two or more shovels

Bridges - 2 or 3 pieces of plywood 30 cm (1 foot long) 7.5-10 cm (3-4") wide

Culverts - 2 or 3 pieces PVC various sizes 5-7 cm (2"-3") diam. x 15 cm (6") long

Town and Factory scale models or wood blocks are fine

Farm scale models - livestock and fencing

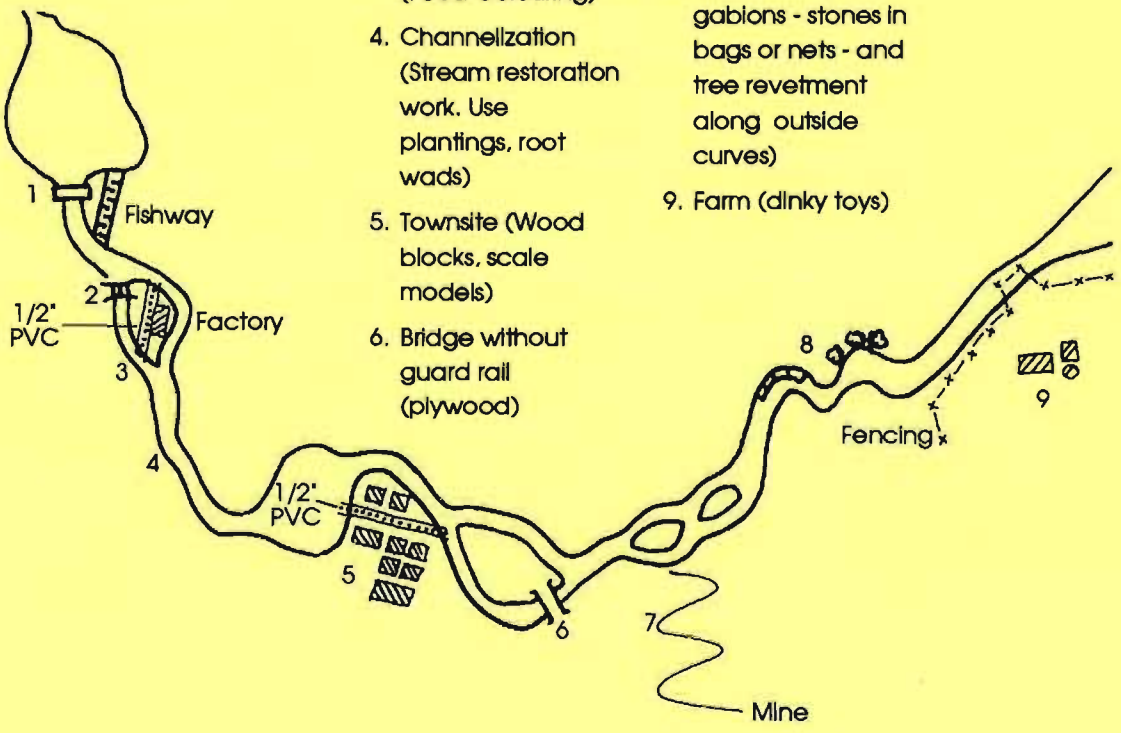
Dinky toys - trucks, excavator, caterpillar tractors (road building equipment) (not too many as children become preoccupied with them)

Scale model gabions, spillings, tree revetments and root wads, rocks and gravel

These materials are used for habitat improvements:

- Bricks for dam
- Food colouring and eye dropper used to demonstrate untreated water and storm drain run-offs from factory and town sites
- Watering can or bucket to show effects or erosion caused by road building
- Garden spade (square-nosed for lifting sod)

1. Dam (bricks)
2. Culverts (PVC)
3. Factory Discharge (Food Colouring)
4. Channelization (Stream restoration work. Use plantings, root wads)
5. Townsite (Wood blocks, scale models)
6. Bridge without guard rail (plywood)
7. Roads (use watering can to show erosion)
8. Cutbanks (place gabions - stones in bags or nets - and tree revetment along outside curves)
9. Farm (dinky toys)



Related Curriculum List

Bermbach, Melnyk, Stone, White. **Upstream Racers,** (Department of Fisheries and Oceans,1994) Board game and accompanying student/teacher support material for study of the Fraser River. Available through BCTF Lesson Aids.

Coss, L. et al. **FOREM.** Vancouver, British Columbia: Council of Forest Industries, 1989.

Department of Fisheries & Oceans. **Gently Down the Stream,** 1994. Teacher guides for field trips to 16 different sites including Horsefly Spawning Channel, Kanaka Creek Hatchery, Adams River, Shuswap River, Weaver Creek Hatchery/Spawning Channel. Available through DFO Community Advisors - see blue pages in telephone directory.

Department of Fisheries & Oceans. **Salmonids in the Classroom.** Vancouver, British Columbia: Canadian Department of Fisheries and Oceans, 1988. This is a comprehensive curriculum package about Pacific salmon in B.C., with a separate primary and intermediate resource guide. Available through BCTF Lesson Aids.

Department of Fisheries & Oceans. **Window on the Fraser**, 1994. Fifteen-minute video and accompanying pre-post materials for study of the Fraser River Basin. Available through BCTF Lesson Aids.

Dingham, C. et al. **Give Earth A Chance: A Newspaper in Education Environmental Program.** Vancouver, British Columbia: Canadian Daily Newspaper Publishers Association, 1990.

Dyckman, C. & Way, A.W., **Clean Water, Streams and Fish: A Holistic View of Watersheds.** Seattle: Washington State Office of Environmental Education, revised 1982. For further information, contact: Mr. Tony Angel, Supervisor of Environmental Education, Washington State Office of Education, 17011 Meridian Avenue North, Seattle, Washington 98133

Farthing, P. **The Stream Scene.** Portland, Oregon: Aquatic Education Program Council, 1990. Written for high-school students, but may provide some background information for teachers.

F.R.E.M.P. (Fraser River Estuary Management Program). **Conflicts of Interest.** 1992. A simulation/role play package based on actual case studies. The emphasis is on conflict resolution/decision-making. Available from FREMP office, 525-1047, New Westminster, B.C.

Fulton, Kim et al. **Water Stewardship: A Guide for Teachers**, 1994. B.C. Ministry of Environment, Lands and Parks.

Greater Vancouver Regional District. **From Source to Sea.** Intermediate drinking water and wastewater education program, 1993. Available through Communications Officer, 4330 Kingsway, Burnaby, B.C. V5H 4G8.

Kristritz, R.U. **Discover Your Estuary: Understanding and Exploring the Aquatic Environment of the Fraser River Estuary.** Vancouver, British Columbia: Environment Canada, 1992. Contact: Image Media Services, Telephone (604) 272 - 7797, Fax (604) 272 - 7798.

Miller, M. et al. **Encore.** Victoria, British Columbia: Ministry of Environment, 1975. Excellent environmental education activities for students in the intermediate grades.

Munro, Karen, and Taccogna, Gary. **The Streamkeepers Manual.** A practical guide to stream care. Available through Community Involvement Division, Department of Fisheries and Oceans, 555 West Hastings Street, Vancouver, B.C. V6B 5G3.

Seagrant Marine Education Specialists. **Gateway to the Pacific: The Columbia River.** Corvalis, Oregon: Oregon State University, 1986. This is part of a curriculum developed by the Oregon Sea Grant program for the intermediate grades.

Snively, G., et al. **Vancouver Bays & Harbours.** Vancouver: Western Education Development Group. University of British Columbia, 1986. Teacher's guide and student worksheets (separate) as well as video all contribute to "paint" a comprehensive picture of Vancouver as a major port in the Pacific Rim.

Society, Environmental & Energy Development Studies Foundation. **The Water Literacy Program.** Edmonton, Alberta: Alberta Ministry of the Environment, 1988. An extensive and sequential program to introduce students in the intermediate grades to water, the water cycle, water as a resource, how water is controlled and managed, and how water influences human use of land.

University of Alaska. **Alaska Sea Grant Curriculum Series.** Fairbanks: Sea Grant Publications, 1980.

Wallin, G. et al. **Forest Choices.** Vancouver, British Columbia: B.C. Forestry Association, 1992.

Western Regional Educational Council, **Project Wild**. Ottawa: Canadian Wildlife Federation, 1990.

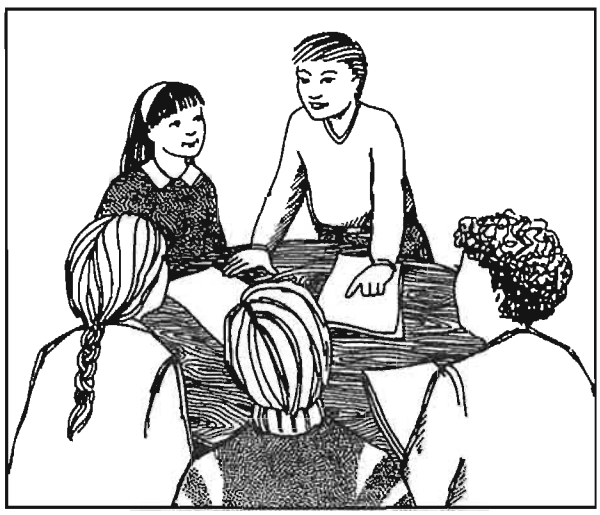
Western Regional Educational Council. **Project Wild: The Aquatic Supplement**. Ottawa: Canadian Wildlife Federation, 1985.

Yates, S. **Adopt-A-Stream.** Seattle, Washington: Adopt-A-Stream Foundation through the University of Washington Press, 1989. An in-depth look at Northwest stream life as well as an overview of streams and their watersheds. This eleven chapter soft cover book describes action-oriented educational activities and stream enhancement projects that groups can initiate.

*Consult **B.C.T.F. Lesson Aids Catalogue** for a complete listing of curriculum materials developed by the Federal Department of Fisheries and Oceans.*

The Watershed Works:

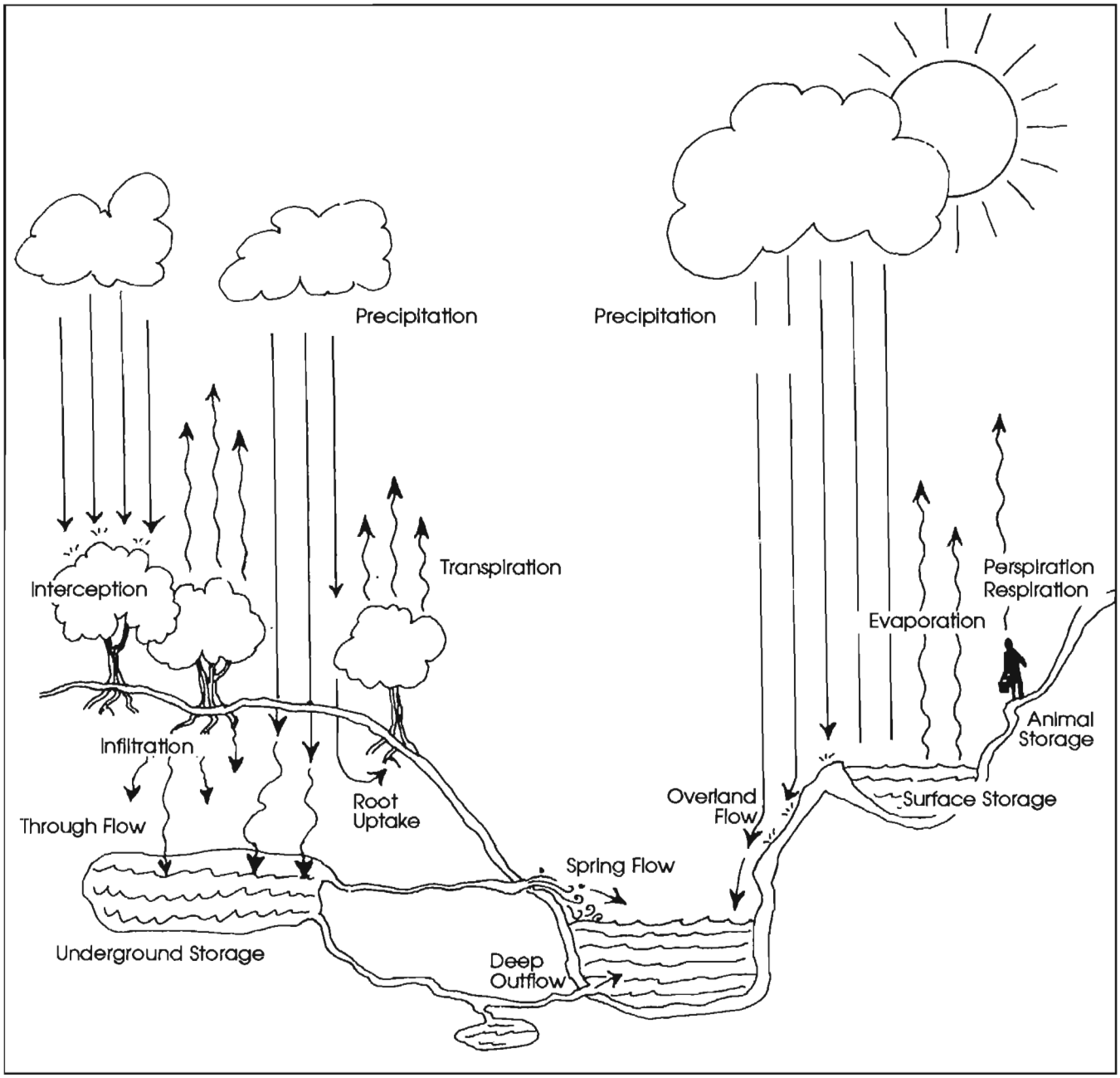
Student Materials



The Water Cycle

Water moves in a cycle from the ocean to the sky (atmosphere) to the earth to the ocean to the sky ... and so on. A water cycle is like a circle: it has no beginning and no ending. But this explanation of the water cycle must start somewhere. So it will start with precipitation.

Precipitation: Rain or snow or hail falls to the earth from the sky. Then the water may take three main routes to get back to the sky: the short route, the underground route or the overland route.



The Short Route

Interception: Some of the water falls onto leaves and is intercepted (does not fall to the ground).

Evaporation: The water on the leaves evaporates and returns to the sky.

The Underground Route

Infiltration: Some water may seep down into the ground. Then the water can take two different pathways: root uptake or through flow.

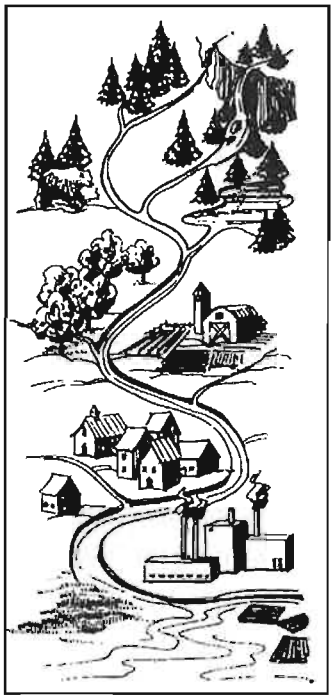
- **Root Uptake**: The water may be stored as soil moisture. Plants use this water through their roots. This is called *root uptake*. The water returns to the sky when the plants 'breathe' *(transpiration)*.
- **Through Flow**: The water may trickle further down to the underground rivers, streams and lakes. This is called *through flow*.
- **Underground Storage**: Water may be stored in underground lakes called aquifers.
  - *Spring Flow*: Water may come out onto the land surface as a spring.
  - *Deep Outflow:* Water may flow unseen into the bottoms of lakes, streams or the ocean.

The Overland Route

Overland Flow: Sometimes there is too much water for the soil to absorb. Sometimes rain lands on a surface that cannot absorb water (clay, cement, rock). The water runs downhill over the surface of the land.

Surface Storage: This water may collect above the ground in lakes, ponds, rivers and the ocean. This is called surface storage. Now the water can take two different pathways: evaporation or animal storage.

- **Evaporation**: The sun's heat evaporates some water and returns it to the sky.
- **Animal Storage**: Animals, even people, may use some of this water. It is returned to the sky through breathing *(respiration)* and sweating *(perspiration)*.



Watersheds

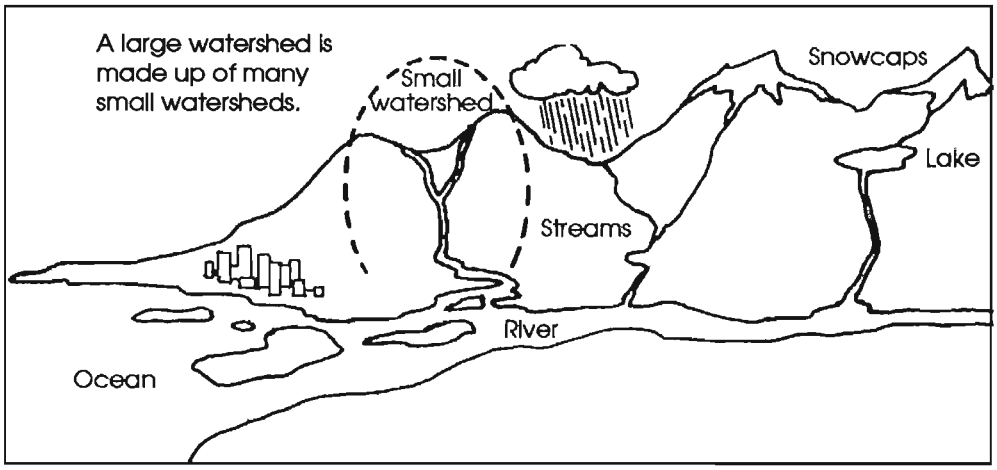
When water falls to the ground, it moves downhill. Stand at the top of a small hill and watch the raindrops fall. Some of the drops will roll down one side of the hill. Other drops roll down the other side of the hill. The top of the hill is the dividing line between two watersheds.

The land area where all the water drains into one main river is called a watershed or a basin. This draining process moves water from the land into creeks, streams, rivers, lakes and ponds and finally to the ocean. Some of the water starts the journey at the top of mountains and travels downward to the valley and then to the ocean. Some of the water falls in the valley and has a shorter journey to the ocean.

Rivers, lakes and ponds that you can see are only one of the pathways the water can take on its journey to the ocean. Some rain will seep into the soil and trickle down to form underground streams, rivers and lakes.

Some watersheds are big, like the Fraser River Basin. Other watersheds are small, like the Seymour River Basin. There are even small watersheds inside bigger watersheds. But all watersheds or basins are the same. They are made up of:

- the land which drains water into a valley bottom,
- the rivers or lakes that you see,
- the water that flows out of sight under the ground.



Presentation Evaluation

Evaluator's Name_____ Date_____

Presentation Topic_____ Group Members _____

Circle Yes or No for the following criteria.

Within time limits	Yes	No	Each person spoke	Yes	No

Rate the group. Give an example to justify your decision. **1 = Disagree** **4 = Agree**

Words were clearly spoken 1 2 3 4	Prop or visual aid 1 2 3 4
Voices were loud enough 1 2 3 4	Audience participation 1 2 3 4
Good eye contact with audience 1 2 3 4	Calm and relaxed (no fidgeting) 1 2 3 4
Information was explained well 1 2 3 4	Moved smoothly between speakers 1 2 3 4

What was the best part of this presentation?	How could this presentation be improved?

Overall rating for this group: Excellent Good OK Needs Improvement

My Work in the Group Meetings

Evaluator's Name_____ Date_____

Presentation Topic_____ Group Members _____

Rate yourself on your work with your group at all the meetings. **1 = Disagree** **3 = Agree**

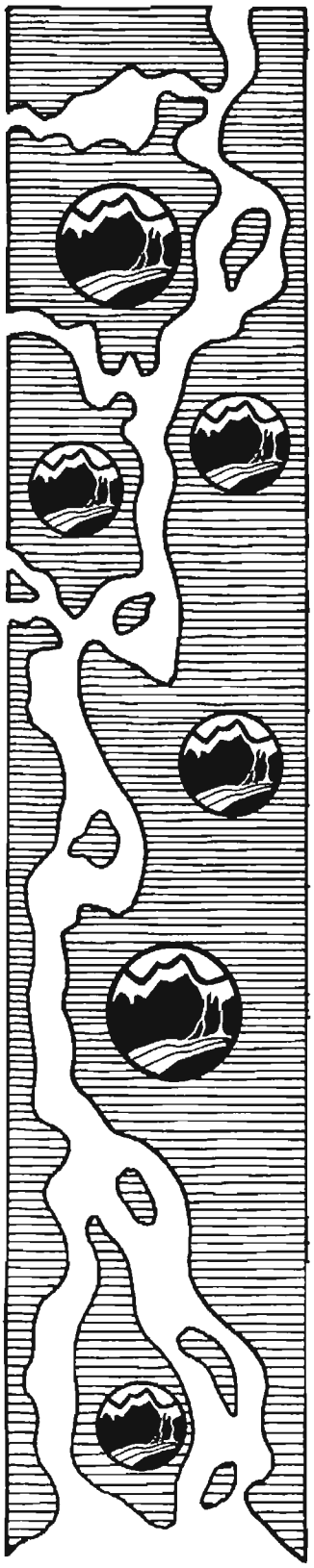
Listened to others.	1	2	3	Cooperated	1	2	3
Offered ideas	1	2	3	Stayed on tasks	1	2	3
Completed tasks	1	2	3	Showed patience	1	2	3

Think back on all of the meetings you had with your group. Then complete the following sentences.

I was proud when . . .	One of the problems our group had was . . .
I was disappointed when . . .	Why did this problem arise?
What I would do differently another time is . . .	How did the group solve the problem?
Would you want yourself as a partner in a group project? Why or why not?	Would you want yourself as a partner in a group project? Why or why not?

How would you rate your performance in the group? Excellent Good OK Needs Improvement

The Watershed



The Fraser River begins high in the Rocky Mountains near the Alberta-British Columbia border. Fed by heavy rain and snowfall, the river flows slowly northwest until it gets to Prince George.

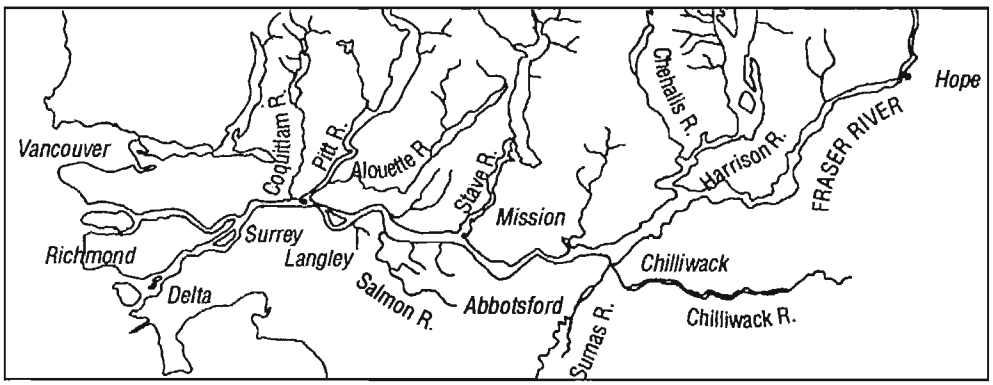
Here it turns south into the middle of British Columbia. It is joined by the Stuart, Nechako, and Chilcotin Rivers. The water from each of these major tributaries causes the Fraser River to grow and pick up speed.

As the Fraser flows south it winds through dense evergreen forests, wetlands, grasslands and dry canyons. The clear blue Thompson River joins the muddy Fraser south of Lillooet. The Fraser rushes on, boiling and powerful through the narrow Fraser Canyon.

Near Hope, the Fraser escapes the narrow mountain canyon. It turns west into a broad flat valley. The river widens and slows down. It winds through the Fraser Valley. The Chilliwack, Sumas, Stave, Pitt and Coquitlam Rivers are some of the last **tributaries** to flow in.

Tributary: *A smaller river that joins a large river. The Chilcotin River is a tributary of the Fraser River.*

Finally, near Richmond, fed by this huge river system, the mighty Fraser drains into the Strait of Georgia and the Pacific Ocean.



The Lower Fraser River

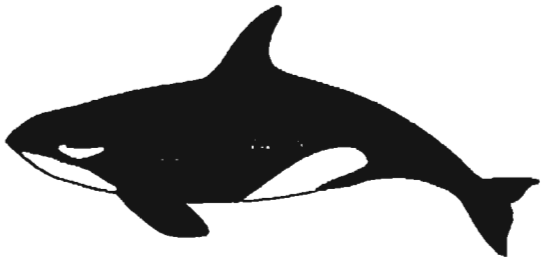
Facts & Figures

- The Fraser River is 1,375 km long.

- The Fraser River is the 5th largest river in Canada.

- The Fraser River usually flows at a rate of 3,972 m^3/second. This can fill three swimming pools in one second!

- Every year the Fraser River picks up 17 billion kilograms of sediment (clay, silt, sand, gravel). This sediment weighs about the same as 1.5 million killer whales.

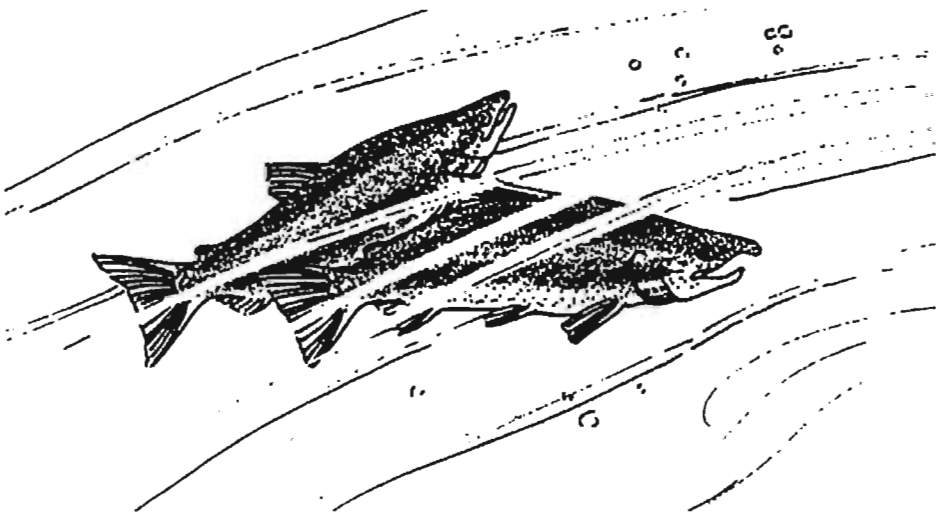


- About 600 freighters drop anchor in the Fraser River each year. These boats come from Korea, Japan, Australia, China, USA, South America and Europe.

- More than 65 kinds of fish use the Fraser River. Sturgeon, shad, smelt, herring and shellfish are only a few of these.

- The Fraser River is home to six kinds of salmon: pink, chum, sockeye, chinook, coho and steelhead.

- THE FRASER RIVER IS ONE OF THE GREATEST SALMON PRODUCING RIVER SYSTEMS IN THE WORLD.



How Watersheds Work

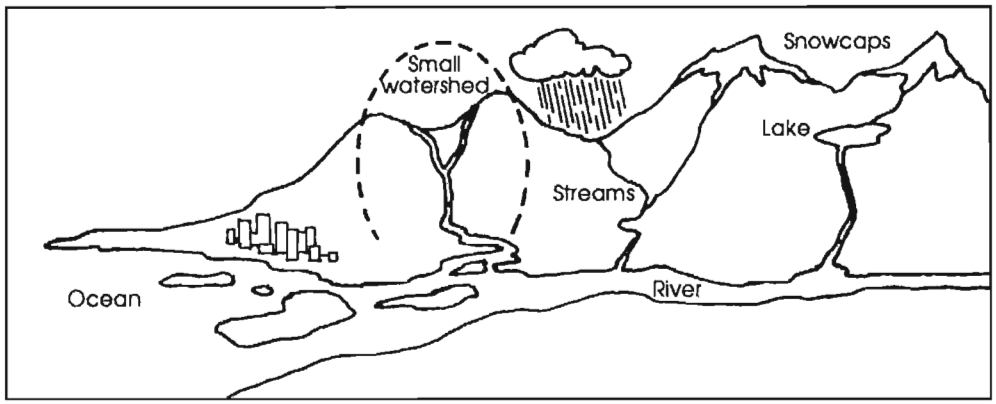
Water always moves down a slope. It moves down hills, comes across fields and into the ground. It moves down streets and drains into rivers and then to the ocean. Rivers, streams, lakes, ponds and underground rivers are the pipes that move this water down to the ocean.

When it rains or snow melts, water drains from hills down into a valley. Then the water drains to the ocean. This happens because even when land looks flat, it has some slope.

The land area where all the water drains into one main river is called a **watershed** or basin. All watersheds are made up of:

- the land which drains water into a valley bottom,
- the rivers or lakes that you see, and
- the water that flows out of sight under the ground.

***Watershed**: The land area drained by a river. Also called a river basin.*



A large watershed is made up of many small watersheds.

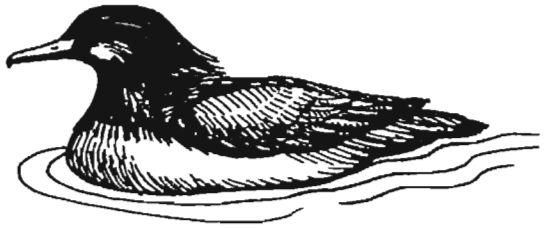
The Fraser River and its tributaries form a huge watershed. The area of land they drain is called the Fraser River Basin.

Almost all of the area of a watershed is made up of land, not water. Ninety-nine percent of what happens to a river takes place on the land area. It does not happen in the river itself. So, every activity in a watershed could affect the nearest stream and the entire downstream part of the watershed.

The Fraser River Basin

The Fraser River Basin drains one quarter of the province of British Columbia. This is about 234,000 square kilometres. All of Great Britain would fit into the Fraser Basin! The lakes, rivers, creeks and streams which flow over this vast area spread out like veins and arteries from a heart.

For many reasons the Fraser River Basin could be thought of as the heartland of the province.

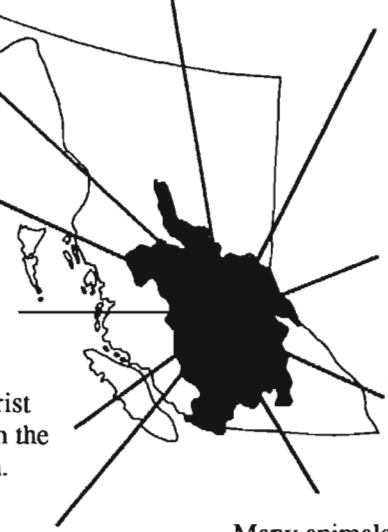


Over 2 million people live in the Fraser River Basin. This is 65% of B.C.'s population.

44% of B.C.'s farmland is found in the Fraser River Basin.

About 21 kinds of waterbirds breed within the Fraser River Basin. Western grebes, mergansers, great blue herons and mallards are some of them.

60% of B.C.'s metal mines are located in the Fraser River Basin.



Hundreds of birds live in the Fraser River Basin, including hawks, owls, eagles, wrens, sandpipers and blackbirds.

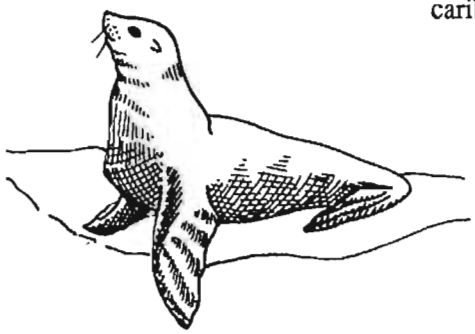
44% of the sport fish catch comes from the Fraser River Basin.

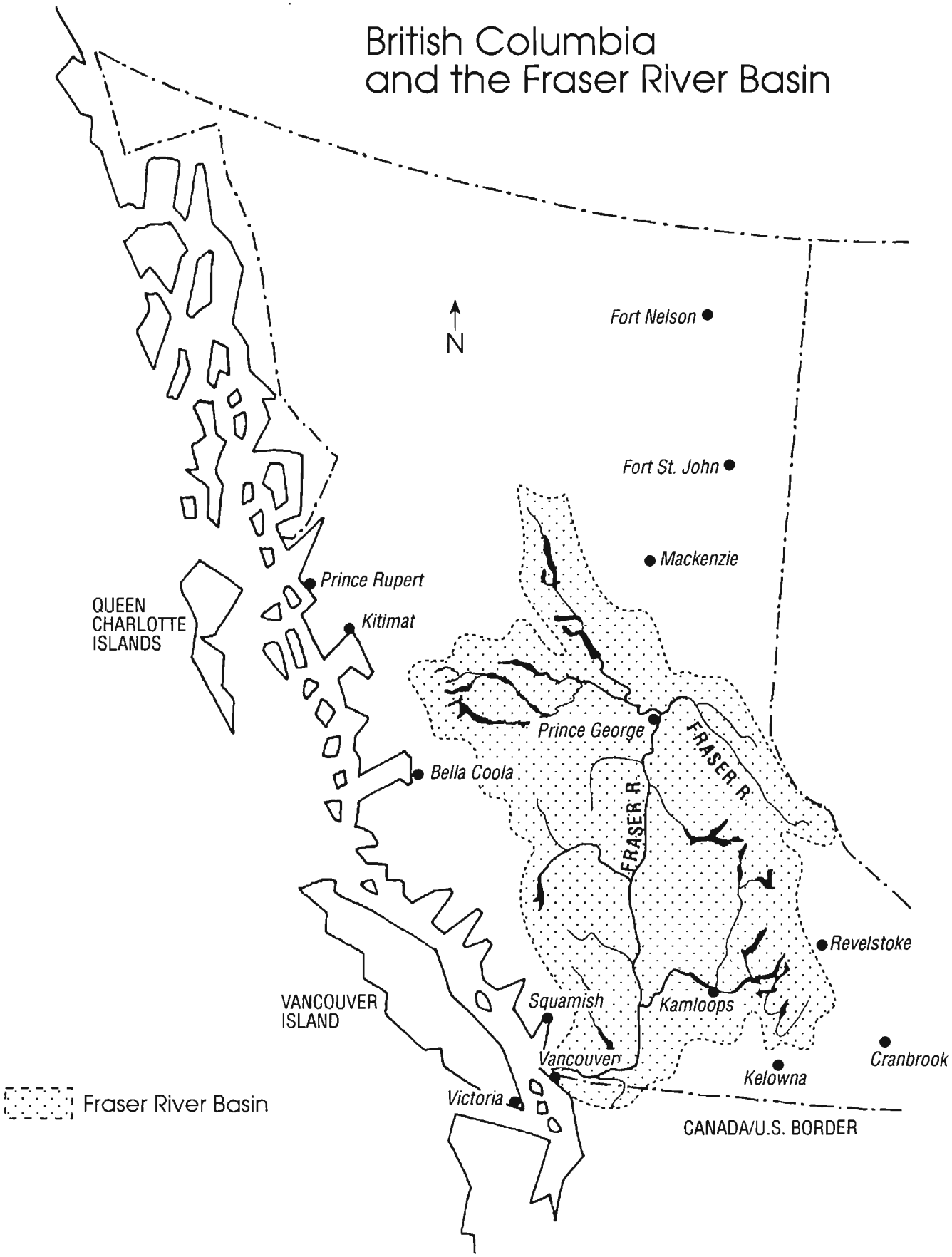
48% of B.C.'s commercial forest covers the Fraser River Basin.

67% of B.C.'s tourist money comes from the Fraser River Basin.

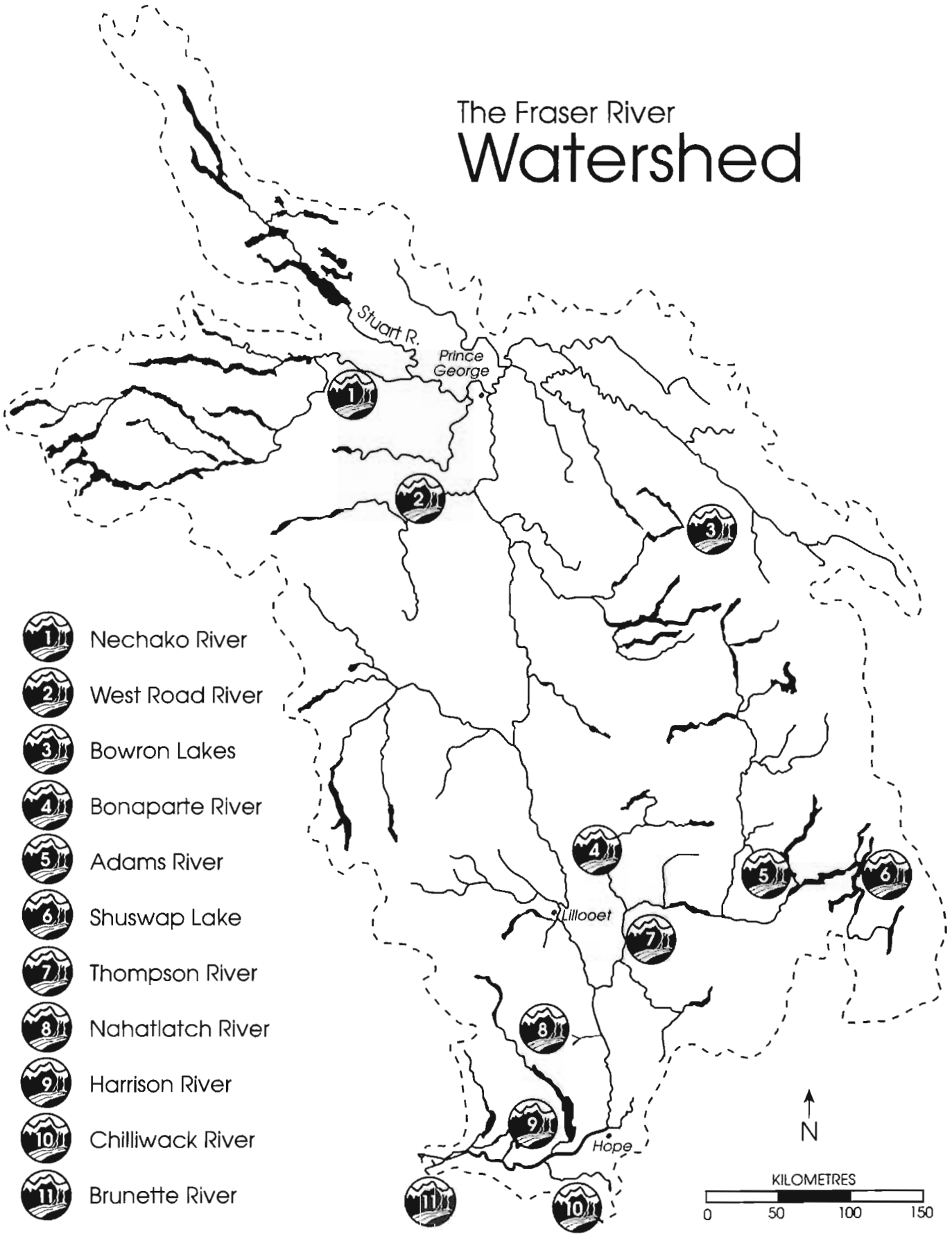
Almost 40,000 snow geese use the Fraser River Basin. They use it as a resting place, while migrating from Siberia to South America.

Many animals have homes in the Fraser River Basin: seals, beavers, coyote, mink, blacktail deer, cougars, black bears, grizzly bears, moose and caribou.




British Columbia
and the Fraser River Basin
N
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Kitimat
QUEEN
CHARLOTTE
ISLANDS
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
Squamish
Kamloops
Vancouver
Cranbrook
Kelowna
Victoria
CANADA/U.S. BORDER
Fraser River Basin

The Fraser River Watershed



See Map Information for more details.

Map Information - The Watershed

These are only some of the interesting facts about rivers and lakes in the Fraser River Basin:

1 Nechako River

In the 1950's, a Native burial ground was flooded when the Kenny Dam was built on the Nechako River.

2 West Road River

In the early days of British Columbia, the West Road River was a transportation route for Native Indians.

3 Bowron Lakes

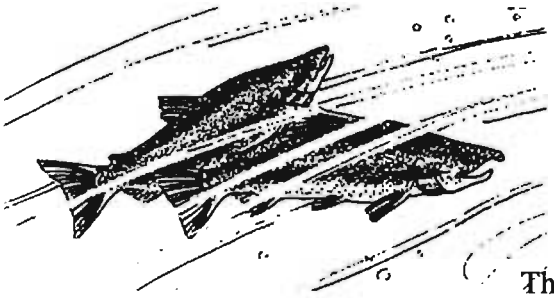
The Bowron Lakes form a great world-class route for canoeing.

4 Bonaparte River

Just north of Kamloops, the lakes of the Bonaparte River are famous for the fighting Kamloops trout.

5 Adams River

Every four years, about two million sockeye salmon return to spawn in the Adams River.



6 Shuswap Lake

Every year about 3,000 houseboats are rented on Shuswap Lake. Sicamous is the Houseboat Capital of Canada.

7 Thompson River

Songs about the fighting spirit and record-breaking size of the steelhead trout on the Thompson River have been passed down from generation to generation among Natives.

8 Nahatlatch River

There is fast, exciting white-water rafting on the Nahatlatch River.

9 Harrison River

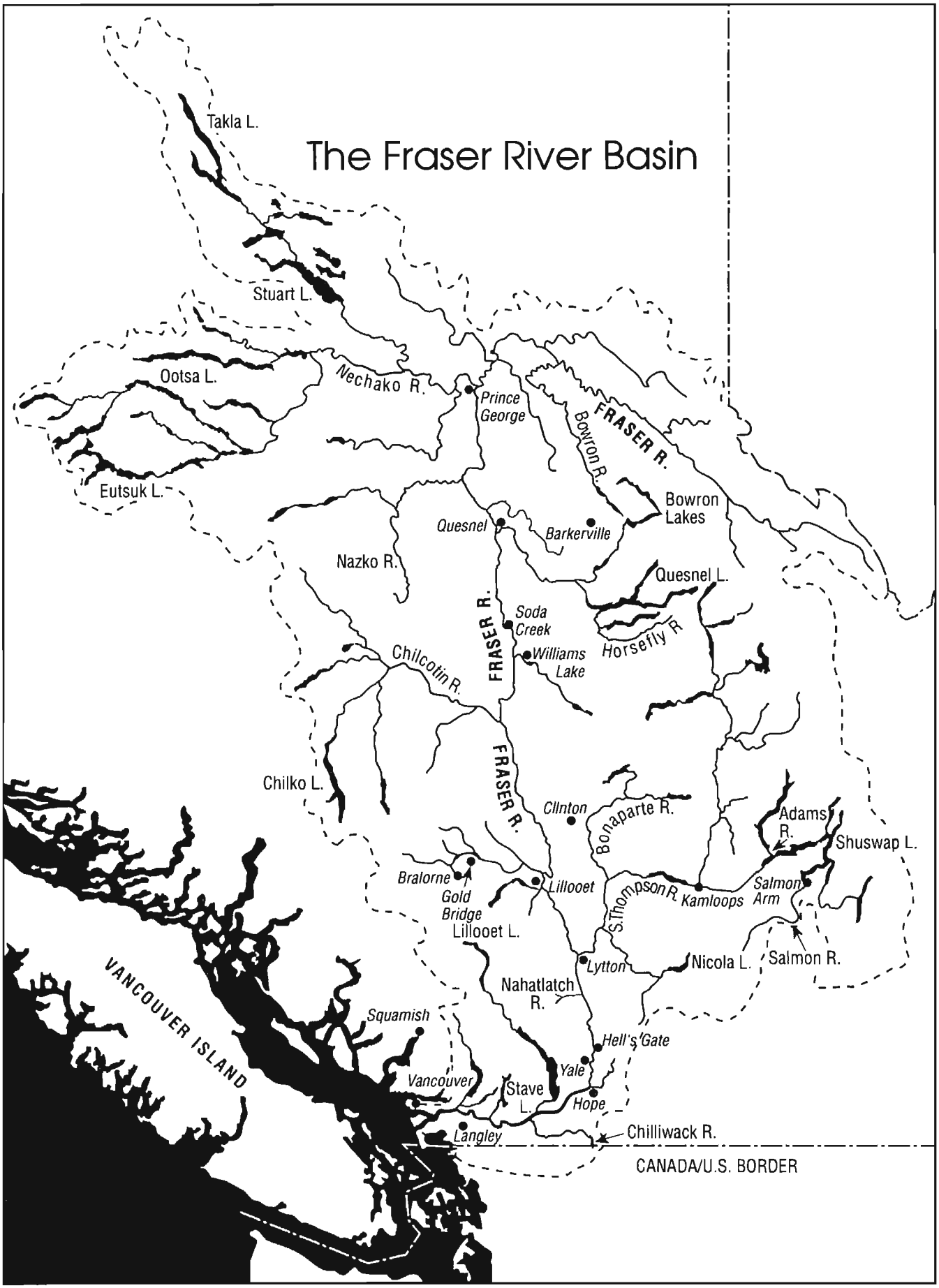
The 30-kilogram chinooks on the Harrison River are part of the Native history in the area.

10 Chilliwack River

In B.C., the endangered Pacific Giant Salamander can only be found in the Chilliwack River watershed.

11 Brunette River

The old hunting and fishing grounds for the Burrard Indian Band were in and around the Brunette River.


The Fraser River Basin
Takla L.
Stuart L.
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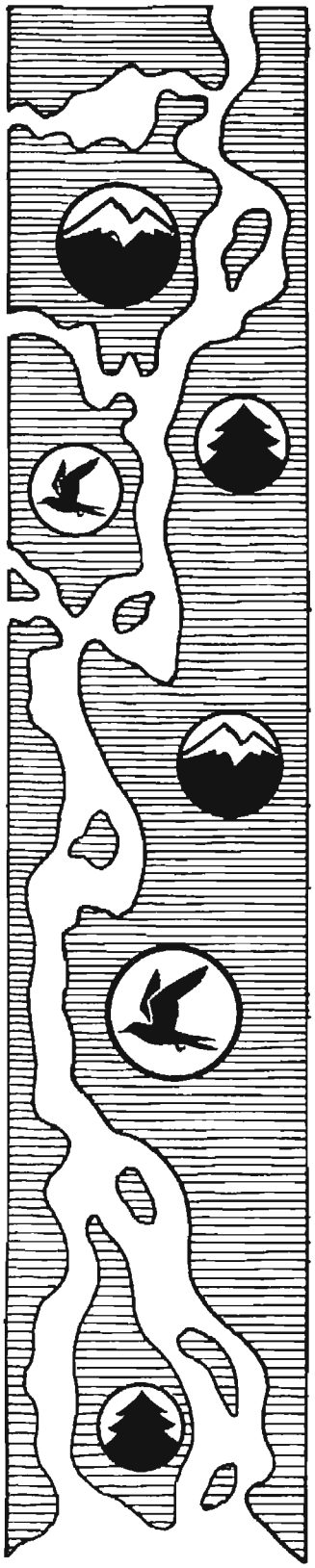
Nechako R.
Prince George
Bowron R.
FRASER R.
Bowron Lakes
Eutsuk L.
Quesnel
Barkerville
Nazko R.
Quesnel L.
FRASER R.
Soda Creek
Horsefly R.
Williams Lake
Chilcotin R.
Chilko L.
FRASER R.
Clinton
Bonaparte R.
Adams R.
Shuswap L.
Bralorne
Gold Bridge
Lillooet
Lillooet L.
S.Thompson R.
Kamloops
Salmon Arm
Salmon R.
Nicola L.
Lytton
Nahatlatch R.
VANCOUVER ISLAND
Squamish
Hell's Gate
Yale
Vancouver
Stave L.
Hope
Langley
Chilliwack R.
CANADA/U.S. BORDER

Biodiversity



Life is found in many forms and comes in all shapes and sizes. Some living things are so tiny, like a virus, they cannot be seen without a microscope. Other living things are so big, like a fir tree, they cannot be seen in one glance!

How Biodiversity Works

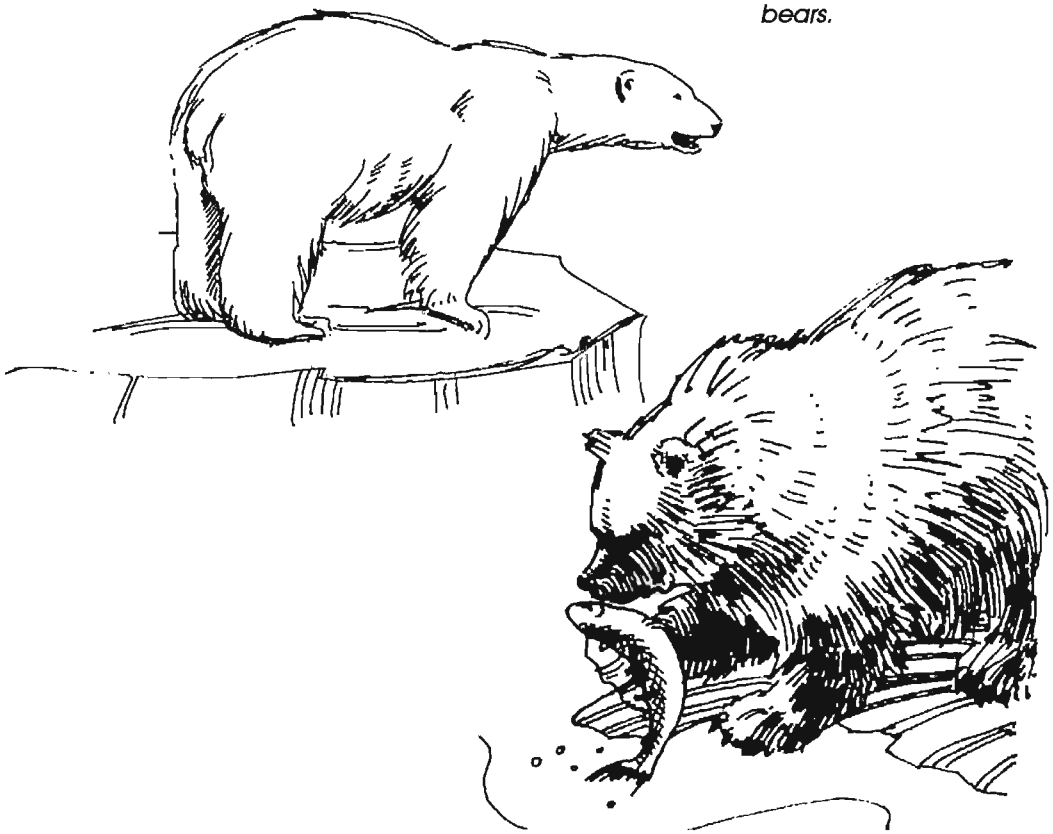
Biodiversity is about all living things:

- the variety of places they live
- the many kinds of plants and animals that exist
- the differences in one **species**.

Biodiversity is one of the keys that make it possible for life to continue when the world changes. There are three main ideas in biodiversity. Each of these is explained on the next page.

***Biodiversity**: A variety of habitats and living things. **Bio** means living things. **Diversity** means variety or lots of different kinds.*

***Species**: A group of plants or animals that are alike. They only mate with their own kind. A polar bear will not mate with a grizzly bear because they are different species of bears.*



There is a variety of habitats.

This means that there are many kinds of places for plants to grow and animals to live.

In the Fraser River Basin, there are:
- forests with thick dense bushes and forests that are open and park-like.
- desert-like areas covered with wild grasses.
- rocky mountain slopes covered with lichens.
- fast rivers and quiet ponds.

Why is this important?

Each living thing needs it own special place to live. It must have enough food, water, space and cover to survive and reproduce. The habitat must meet all the needs of the living things.
- A black bear needs 50 - 80 square km of land. When people use lots of land for mining, farming, and settlement, the bear's habitat is lost. The bear must move to a new place that may not meet all its needs. The bear may die.

If the ocean was the only habitat in the world, many plants and animals (even people) could not exist. A variety of habitat makes it possible for there to be:
- many different kinds and species of plants and animals.
- many differences within one species of plant or animal.

There are many kinds of living things.

There are bears, deer, cougars, wolves, goats, otters, raccoons, muskrats, hawks, warblers, salmon, trout, turtles, frogs, moths, spiders, trees, grasses, lichens, viruses, and bacteria.

There are many species:
- coast deer, mule deer, whitetail deer.
- Engelmann spruce trees, Sitka spruce trees, and white spruce trees.

Why is this important?

- Lots of different living things means life will likely continue as the world changes. A change in the climate or food supply may cause some living things to die. But not all living things will die because some of them can adapt to the change. This was the case when dinosaurs died: other plants and animals lived on.

- People use plants and animals for food, shelter, medicines and energy. When there are more living things, people will be able to find and use what they need. If there are fewer living things, there will not be as many options. A plant today might cure a disease in the future. But, if the plant becomes extinct, people may die in the future.

There are differences in just one species.

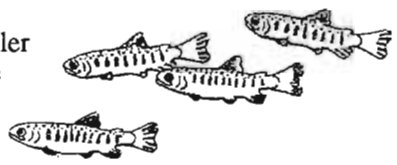
There are many stocks of chinook salmon:
- Harrison River chinook
- Nicola River chinook
- Slim Creek chinook

There are many kinds of raspberry plants:
- Meeker raspberries
- Skeena raspberries
- Nootka raspberries

Why is this important?

Differences among members of a species help that species as a whole to survive. For example, each stock of chinook salmon has adapted to its habitat. Harrison River chinook are large in body size and need deep water to swim in. Nicola River chinook have smaller bodies and are able to swim in shallower water.

- If river water levels dropped, the smaller fish would still be able to swim up the stream. They would be better able to adapt to this change. This means that some chinook salmon could still live.

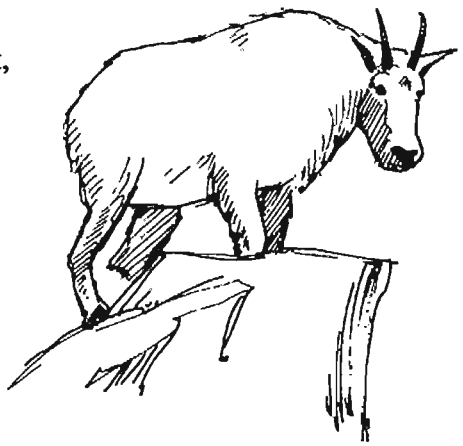


People can use these differences in each species to breed plants and animals that produce more, look better, and resist disease better.

- Most of B.C.'s raspberries are grown in the Fraser Basin. The climate is ideal. But a rainy, wet spring can make the plants get fruit rot. This could wipe out the raspberry crop. So B.C. scientists have bred a new species of raspberry plant that resists fruit rot.

Most people know as much about biodiversity in the 1990's as people in the 1930's knew about computers. There is a lot more to find out!

Biogeoclimatic Zones



B.C. has 75% of the world's stone sheep, 60% of the world's mountain goats, 50% of the world's blue grouse, 50% of the world's trumpeter swans and 25% of the world's grizzly bears and bald eagles.

British Columbia is mostly a cool, moist, mountainous region covered in forests. But there are also rolling plateaus, flood plains and areas of grasslands, wetlands, and tundra. There are many climates - hot, cold, wet and dry. This means British Columbia has many different habitats. This helps to give British Columbia the greatest variety of plants and animals in Canada.

Each area has differences in temperature, rainfall, and soil. This means each area will have its own special characteristics. For example, forests along the coast get a lot of rain and have mild temperatures. Bushes and shrubs can grow so thick they are almost impossible to walk through. But in drier areas, forests have few bushes underneath. The forest is open and park-like under the trees.

***Biogeoclimatic** is made of three words.*

***Bio** comes from biology. This is living things like plants and animals.*

***Geo** comes from geology, meaning soils and rocks and land forms.*

***Climatic** comes from climate. Climate is weather over a long time. A biogeoclimatic zone has its own biology, geology and climate.*

Scientists group these areas into types or zones to study and understand them better. These groups are called **biogeoclimatic** zones. In all of British Columbia there are 14 biogeoclimatic zones. Eleven (11) are found in the Fraser River Basin. Some zones cover large areas and can be found in many parts of the Fraser River Basin. The Interior Douglas Fir Zone covers large parts of the Fraser River Basin. Other zones are very small or there are not many of them. The Bunchgrass Zone is small. It is found in only a few places. So many zones means there is a wide range of habitats for plants and animals.

Biogeoclimatic Zones and Wildlife

The numbers and kind of wildlife vary from zone to zone. In general:

- Large zones have more species than small zones.
- Zones in southern areas have more species than zones in cool northern areas.

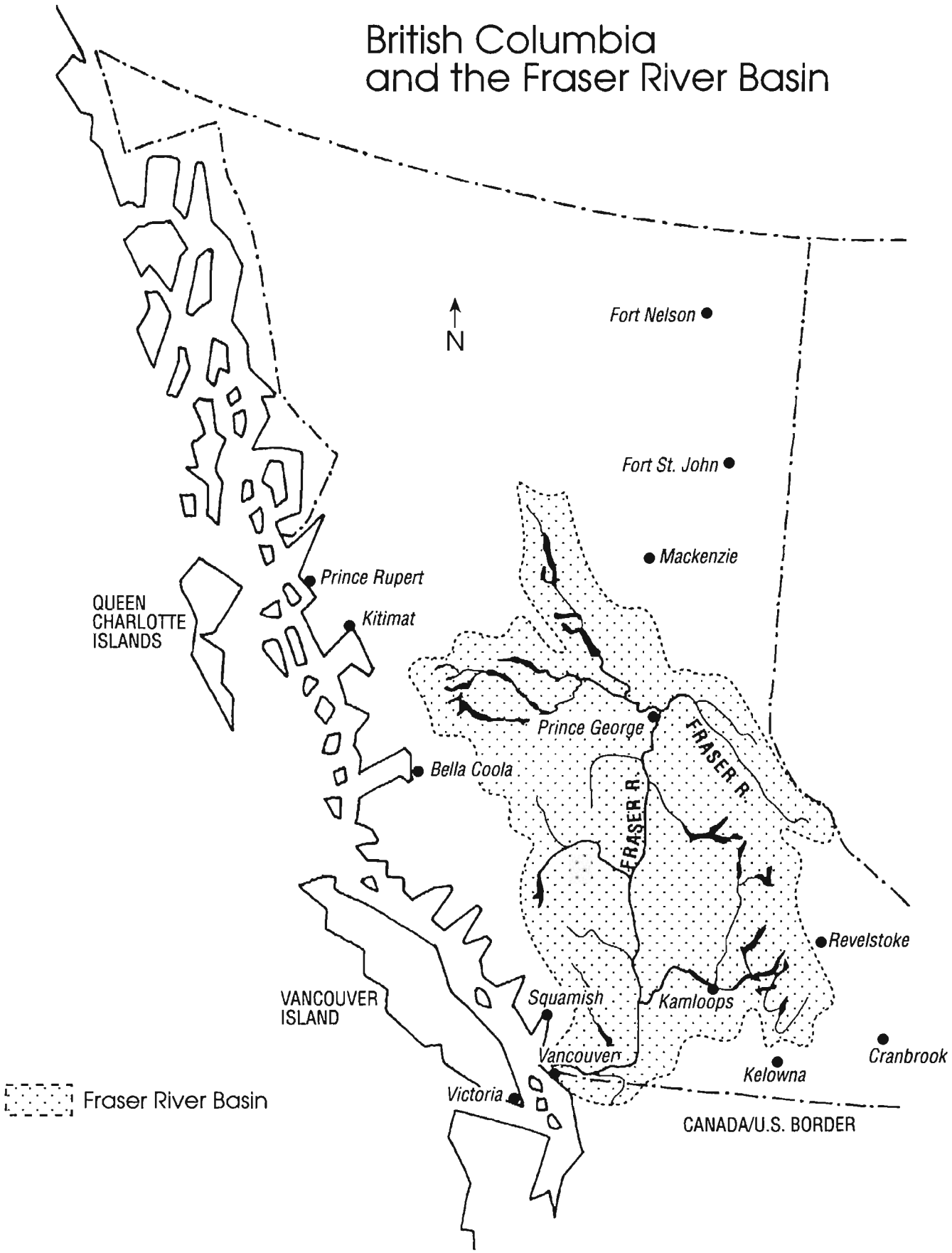
Even within one zone the number and kind of animals vary:

- More species live at lower **elevations**. The climate is milder than at higher elevations.
- There will be a wider range of wildlife if there are many different kinds of places to live, and lots of food.

***Elevation**: The height of land above sea level.*

This chart gives details about seven of the eleven biogeoclimatic zones in the Fraser River Basin.

Zone	Biology	Geology	Climate
Alpine Tundra	No trees. Dwarf shrubs, herbs, mosses, and lichens.	Rugged, rocky, steep mountain tops.	Long, cold, snowy winter. Short, cool growing season.
Sub-Boreal Spruce	White spruce and subalpine fir are main trees. Some aspen, lodgepole pine and birch.	Gently rolling plateau with lots of wetlands.	Severe, snowy winter. Warm, wet, and short summer.
Engelmann Spruce - Subalpine Fir	Engelmann spruce and subalpine fir are the main trees. Some lodgepole pine at lower elevations.	Mountain slopes just below tree line. Clumps of trees and meadows with berries, ferns, and mosses.	Long, snowy, cold winter. Short, cool growing season.
Bunchgrass	Mostly bluebunch, wheatgrass and sage. A few Ponderosa pine and Douglas fir trees.	Desert-like lower parts of dry, hot valleys.	Cool winter with little snow. Hot dry summer.
Interior Douglas Fir	Douglas fir, lodgepole pine, and ponderosa pine trees. Pinegrass and feathermoss.	Rolling hills and valleys.	Cool winter. Warm, quite dry summers with long growing season.
Interior Cedar-Hemlock	Western hemlock, western redcedar, spruce and subalpine fir. Devil's club, skunk cabbage in wetter areas.	Mountain slopes.	Cool, wet winter and warm dry summer.
Coastal Western Hemlock	Western hemlock, amabilis fir, and western redcedar.	On lower slopes of mountains and in valley bottoms.	Lots of rain. Mild temperatures all year.


British Columbia
and the Fraser River Basin
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Fort Nelson
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Mackenzie
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Bella Coola
Revelstoke
VANCOUVER
ISLAND
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Vancouver
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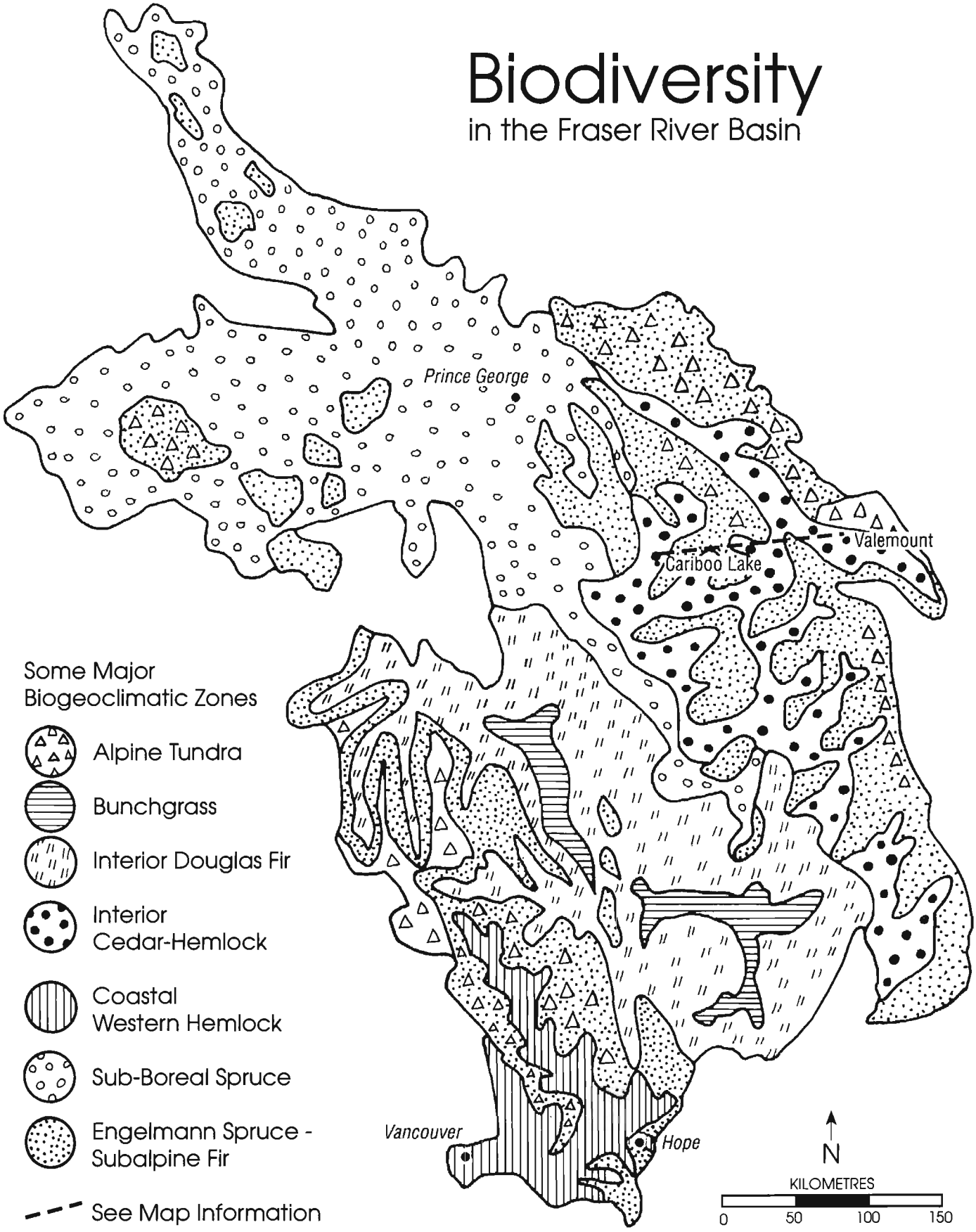
Victoria
CANADA/U.S. BORDER
Fraser River Basin

Biodiversity
in the Fraser River Basin



Some Major
Biogeoclimatic Zones

- Alpine Tundra
- Bunchgrass
- Interior Douglas Fir
- Interior Cedar-Hemlock
- Coastal Western Hemlock
- Sub-Boreal Spruce
- Engelmann Spruce - Subalpine Fir
- See Map Information

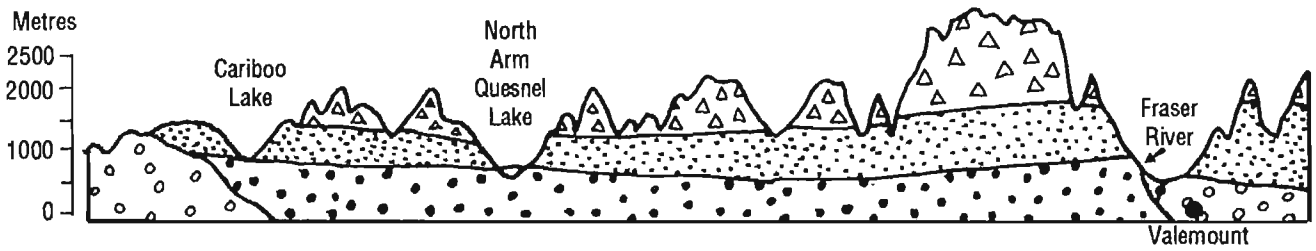
Map Information - Biodiversity

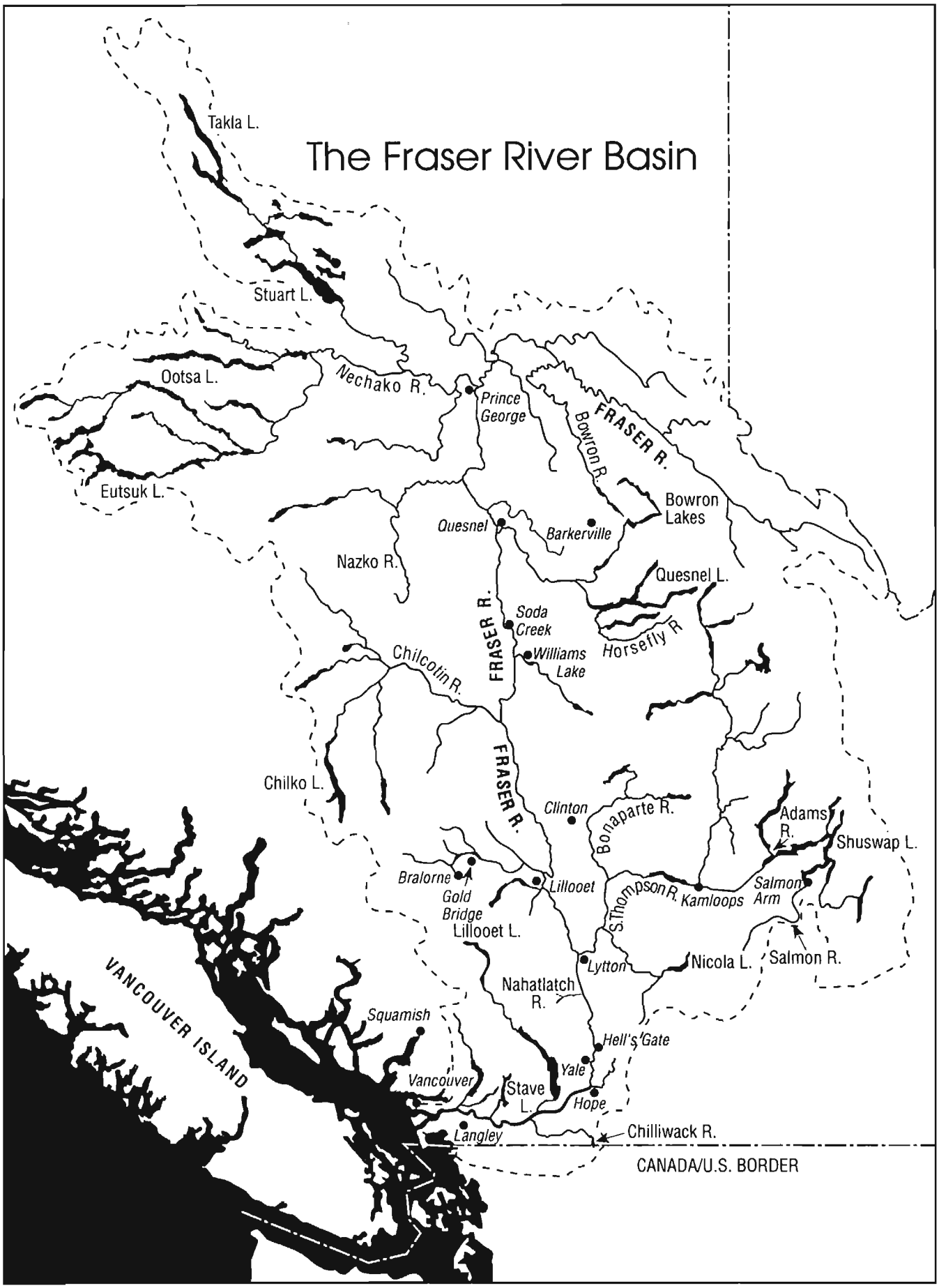
The Biodiversity Map and this chart show seven of the eleven biogeoclimatic zones in the Fraser River Basin. The zones are described in more detail on page 4.

Biogeoclimatic Zone	Location in Fraser River Basin
Alpine Tundra	In the mountains of southern B.C. above 1500 m.
Bunchgrass	Along the Fraser, Chilcotin and Thompson Rivers in the Southern Interior.
Interior Douglas Fir	In the rainshadow of the Coast, Selkirk, and Purcell Mountains.
Interior Cedar - Hemlock	West side of the Rocky Mountains and slopes of the Columbia Mountains (from 400 m to 1500 m).
Coastal Western Hemlock	At low elevations along the coast and in the valley bottoms of the Coast Mountains.
Sub-Boreal Spruce	Fraser and Nechako Plateaus.
Engelmann Spruce - Subalpine Fir	The east side of the Coast Mountains and the highest parts of the Interior Plateau.

From Cariboo Lake to Valemount

The cross-section of land below is marked by a line on the Biodiversity Map. It runs from Cariboo Lake to Valemount. A cross-section is like cutting straight down through the land. It shows how the biogeoclimatic zones change with the elevation of the land.




The Fraser River Basin
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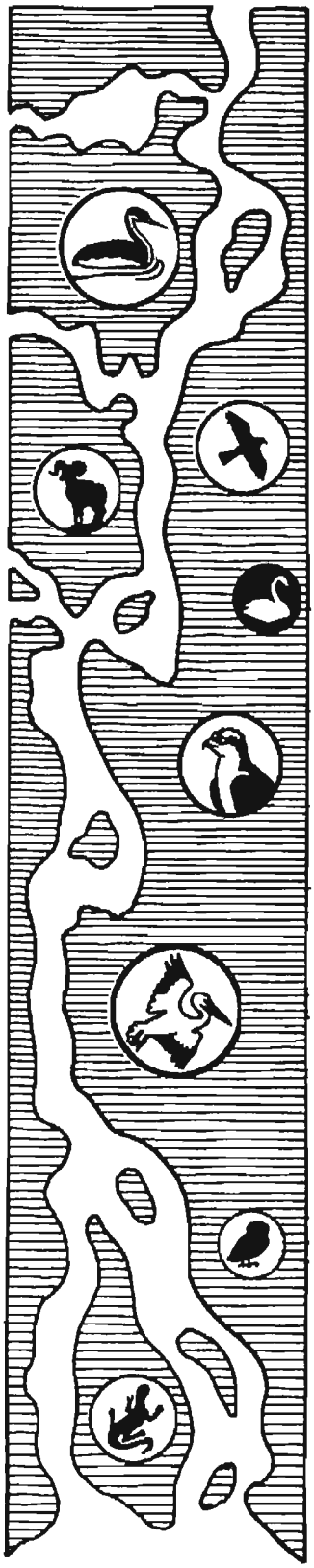
Wildlife



Wildlife means all the animals that live freely. They are not tamed or used by people for pets or farm animals. People sometimes think of wildlife as the animals that live in the wilderness. But many animals that have found ways to live near people are also wildlife. Gulls, robins, squirrels, raccoons and Canada geese are just a few examples.

How Wildlife Works

Every wild animal needs an area in which to live and move. This space is the animal's **habitat**. The habitat must have food, cover, water and space. The area must be large enough to have food for the animal to eat and have many safe hiding places.

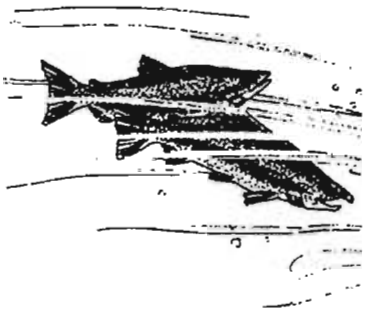
Habitat: *A place for an animal to live, grow and breed.*

Different animal **species** need different kinds of food, cover, water and space. Some animals need different habitats at different stages in their lives.

Species: *A group of plants or animals that are alike. They will only mate with their own kind. A polar bear will not mate with a grizzly bear because they are two different species.*

Some wildlife can live almost anywhere because their needs are easily met and they can adapt to their surroundings. Other animals need certain food or certain cover that can only be found in a few places. For example, the pine marten needs the other animals that live in old growth forests for its food. On the other hand, crows can find food and shelter almost anywhere!

Predator: *An animal that kills and eats another animal.*



Migrate: *To move from place to place in different seasons.*

Food

Many kinds of animals can share the same habitat. They might use it in different ways, but they are all linked together in some way. For example, in the Fraser River Basin many woodland areas are home to insects, mice, deer, hawks, moles, coyotes and owls. They share the same area, but eat different food. The insects , mice and deer eat mainly plants. The hawks, moles and owls eat the insects and the mice! And the coyote may eat everything!

Space

Every kind of animal needs different amounts of space. A termite can live its whole life in one log. A bear moves between mountain tops and valley bottoms.

Space needed by just one kind of animal can change during the year. A black bear hibernates in a small den in winter. The rest of the year, it roams an area as large as 50 - 80 sq. kilometres.

The amount and type of space an animal needs can change during its lifetime. Salmon begin life in a small nest of gravel in a stream. As adults, they **migrate** thousands of kilometres in the ocean!

Cover

Animals need places to hide. They need cover from **predators**. Weasels and mice and moles may run under a bush or down a small burrow. Salmon hide in deep water or under branches that overhang the stream.

Animals also need a safe place to have and rear their young. Birds nest in bushes and trees and old stumps. Deer graze on the edge of clearings, but use forest areas close by to hide and rest their young .

Water

Beavers, river otters and painted turtles need lots of water in streams, rivers, or ponds to drink. Mice, on the other hand, need only a bit of water. They get it from snow or dew or chewing a juicy plant.

British Columbia has the greatest variety of wildlife found anywhere in Canada. Of all the species found, 75% of the birds, 72% of the mammals, and 49% of the amphibians are found in British Columbia.

Habitats in the Fraser River Basin

The Fraser River Basin has many different types of habitats. There are forests, grasslands, wetlands and estuaries. There are rocky slopes and farm fields.

Each habitat has different amounts and kinds of food, cover, water and space. This variety of habitat makes homes for a wide range of plants and animals.

Wetlands

There is a wide variety of **wetland** habitat. Many different kinds of animals live in wetlands. For example, even a small pond contains many animals. Herons, kingfishers, ducks, dragonflies, turtles, frogs, beetles, fish, and snails may all depend on the same pond.

Wetlands: *Freshwater lakes, rivers, ponds, marshes, swamps, bogs, and small streams. They form a network throughout the Fraser River Basin.*

Some animals live in wetlands all year. Beavers often make their homes in marshes, ponds or quiet bays in lakes. They use trees along the shoreline for food and to build lodges that will shelter them in all seasons.

Other animals only use the wetlands for a short time every year. Often these areas are important for breeding.

It is important that birds have places to gather, feed and rest during their migration. Two wetland areas that have been preserved for migrating birds are the Reifel Bird Sanctuary in Delta and the Nechako Bird Sanctuary near Vanderhoof.

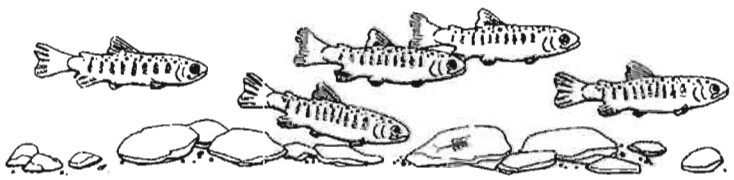
Some wetlands only exist at certain times of the year. Rain or melting snow cause the water level in a river to rise. This floods low land beside the river. Many fish live and rest in this quieter water. They move in late spring as the water level in the river drops and the land dries up.

Estuaries

The Fraser River **estuary** is a very important habitat for many plants and animals. The **brackish water** is home to millions of living things.

Estuary: *Where salt and fresh water meet and mix. Near its mouth, the Fraser River splits into several arms and drains fresh water into the salt water of the Strait of Georgia. Strong ocean tides push salt water back up the river for many kilometres where it mixes with fresh water.*

Brackish water: *A mix of salt and fresh water found in estuaries.*



Young salmon use the estuary to rear and feed. They also get used to the salty water before they migrate to the ocean. Other fish, such as smelt and flounder, spawn in the estuary. Dungeness crab bury themselves in the soft bottom areas of the estuary. They need protection from predators when their shells are soft.

Waterbirds like widgeons, teals and mallards feed and rest in the estuary on their migrations. Snow geese from Siberia spend the winter in the Fraser River estuary. They may stay as long as seven months each year. They eat the lower parts of marsh plants along the shore. They sometimes graze on farmland nearby.

Other birds such as hawks, herons and owls feed off of the many sea worms, snails and rodents that live in the land near the estuary.

Forests

***Forests**: Large areas of land covered in trees. Just like a single tree, forests grow and change.*

Forests still cover much of the Fraser River Basin. Forests change over time. Young forests have different habitats and attract different animals than older forests.

> In its early stage of life, a forest is full of plants and trees that need lots of light. As a forest grows and fills in, there is less light and more shade. The light-loving shrubs and trees die off. Trees that can grow in the shade live on. Many of these trees may live for hundred of years. As trees die (from disease, natural fires or pests) the forest is opened up. The plants and trees that need lots of light begin to grow again.

The trees and plants that grow in young forests are food for many animals. Moose, snowshoe hare and ruffed grouse eat the tender leaves, buds, twigs and bark of trees and plants. These animals often feed in areas of young forest, then move to older trees for cover. They may hide from predators. They may try and escape heavy winter snows.

There are different kinds of trees in older forests. They may not be as tender to eat, but they provide a variety of good homes for many animals. In old growth forests, there are lots of standing dead trees, live trees with broken tops, and large fallen logs. The brown creeper is a little bird that needs trees that are 300 to 500 years old. It builds its nest behind the loose and peeling bark on the trunks of very old trees.

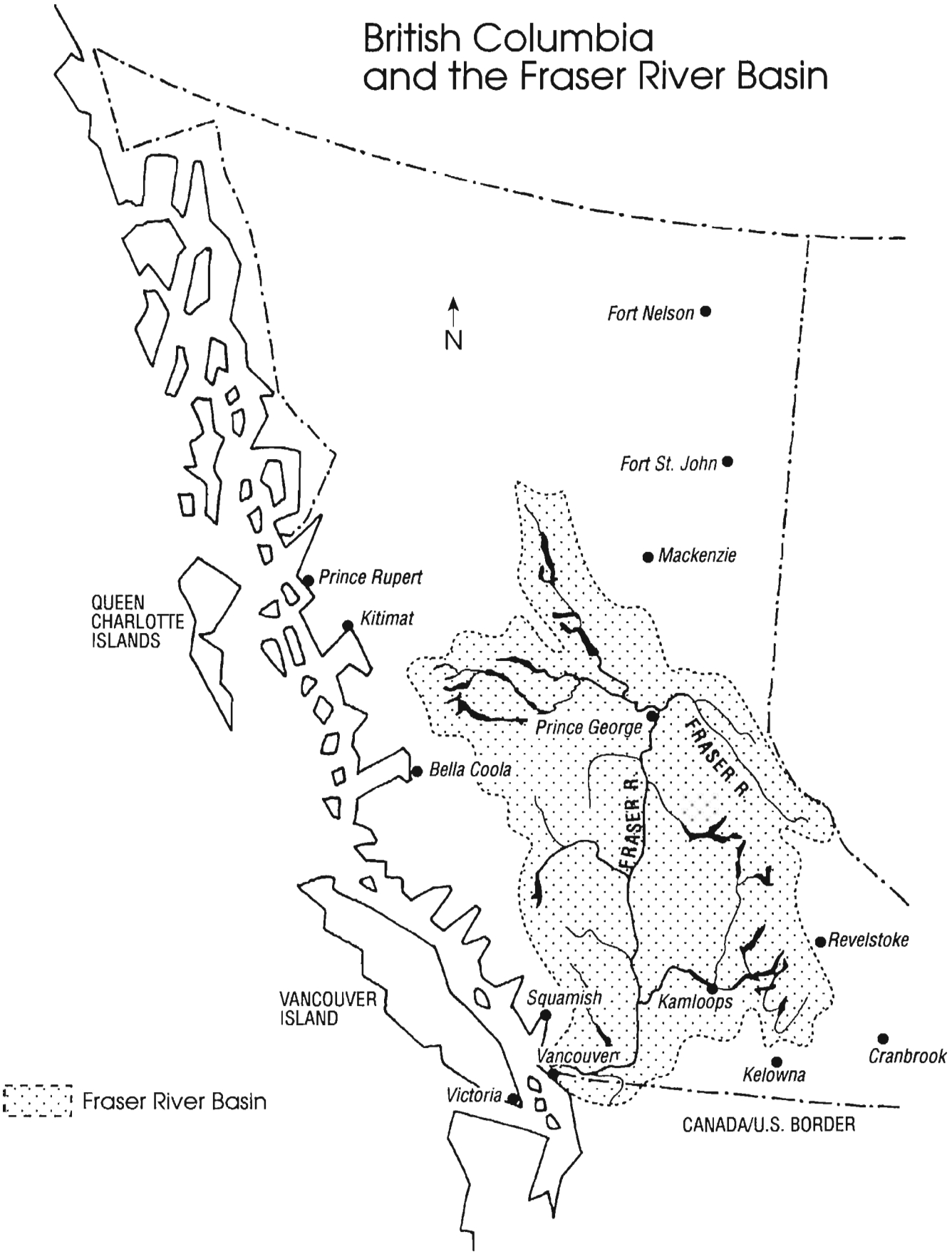
A single tree is only a small part of the forest world, but it is also a world in itself. Many insects are born, live and die on just one tree. Other animals might use it as a landing strip, a source of food, or a resting place.

Grasslands

***Grasslands**: Usually flat or gently rolling plains with few trees. They are fairly dry, at least for part of the year.*

Grasslands are habitat for small and large animals. The western rattlesnake uses open grassy spaces for hunting. Hunting is best in areas near water because more small animals live there. Rattlesnakes lie on the rocks when it is hot and hide in the cracks of rocks when it is cold.

Bighorn sheep live in high grassland areas. They feed on grasses and other small plants and tender twigs of bushes. They escape their predators by racing up the mountainous slopes above them. One of the largest herds in North America lives around the junction of the Fraser and Chilcotin rivers. Another band spends the summer in the grasslands high above Spences Bridge. But when winter snow covers their food, they move down. In winter, it is common to see bighorn sheep grazing on the cliff or in the school yard at Spences Bridge!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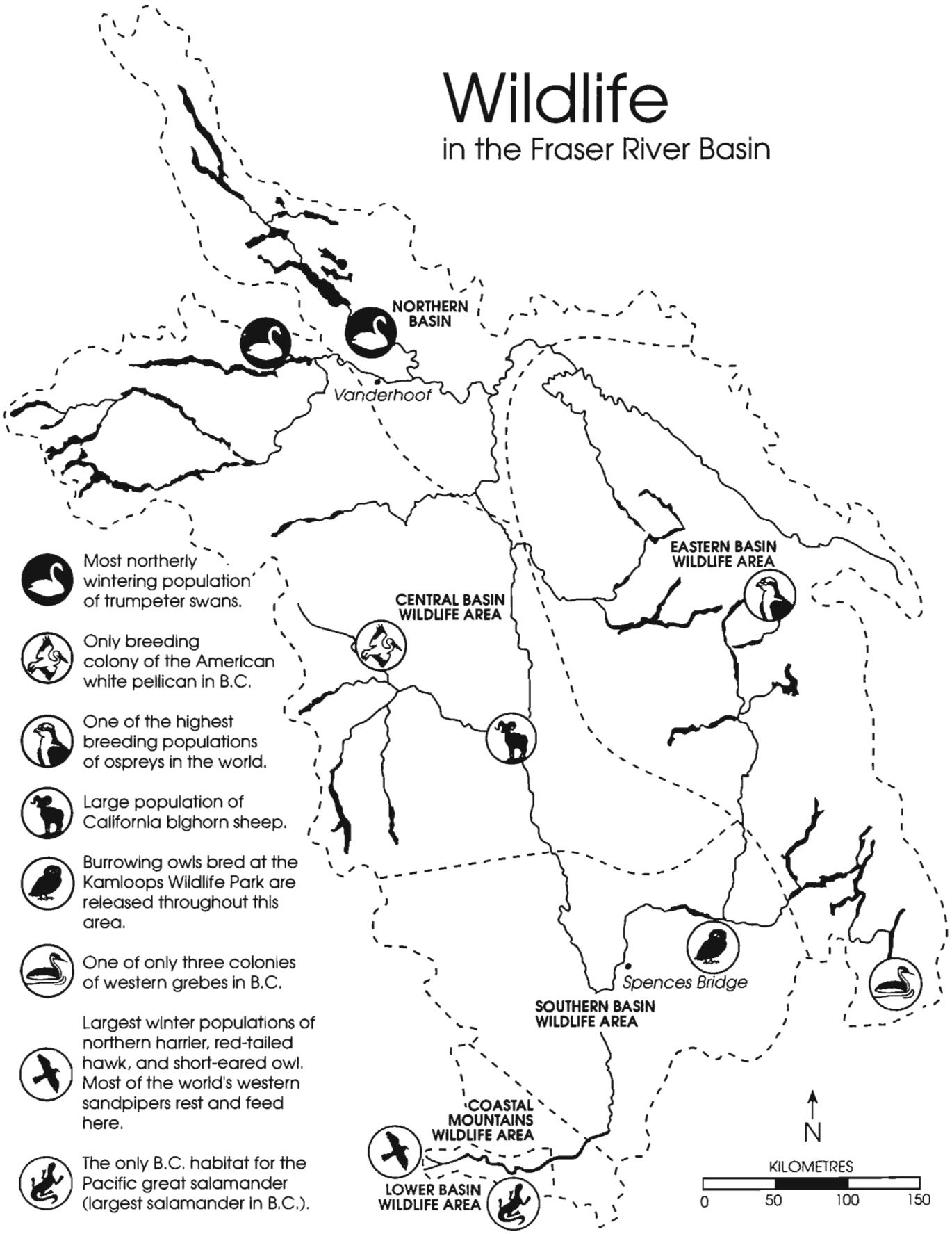
Victoria
CANADA/U.S. BORDER
Fraser River Basin

Wildlife

in the Fraser River Basin



Most northerly wintering population of trumpeter swans.

Only breeding colony of the American white pelican in B.C.

One of the highest breeding populations of ospreys in the world.

Large population of California bighorn sheep.

Burrowing owls bred at the Kamloops Wildlife Park are released throughout this area.

One of only three colonies of western grebes in B.C.

Largest winter populations of northern harrier, red-tailed hawk, and short-eared owl. Most of the world's western sandpipers rest and feed here.

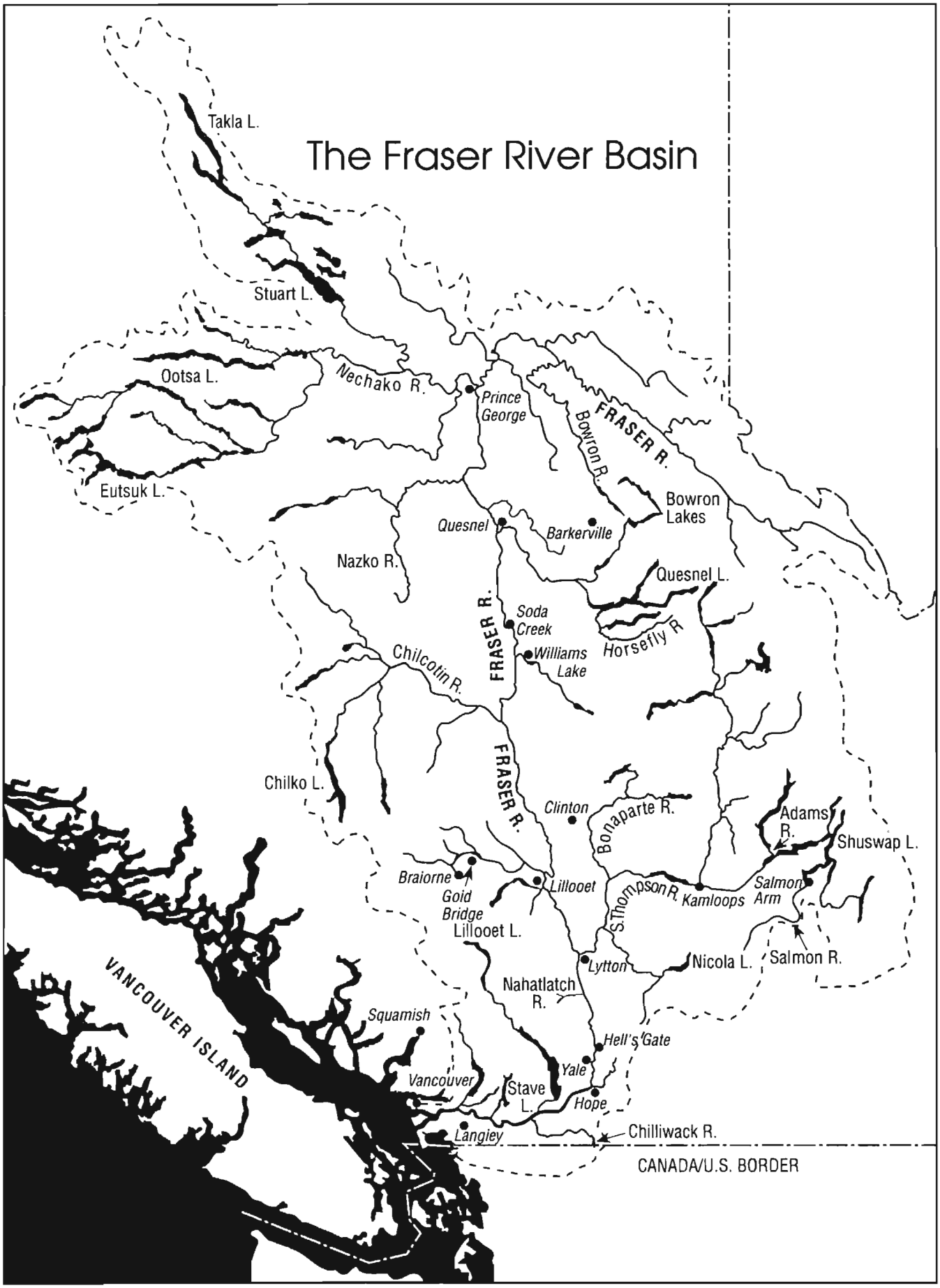
The only B.C. habitat for the Pacific great salamander (largest salamander in B.C.).

See Map Information

Map Information - Wildlife

Biologists divide the Fraser River Basin into six areas. The chart below lists some of the animals that are found in each area. It also gives one fact about the area.

Wildlife Area	Animals
Lower Basin *Largest single unit of wetland habitat in B.C.*	Coast deer, coyote, otter, mink, raccoon, Virginia possum, coast mole, Douglas' squirrel, creeping vole, barn owl, Anna's hummingbird, black oyster catcher, northwestern garter snake, Pacific salmon, steelhead, cutthroat trout, eulachon, peamouth chum, threespine stickleback.
Coastal Mountains *More birds winter in valley bottoms here than in interior.*	Mule deer, black bear, mink, bald eagle, peregrine falcon, northwestern garter snake, rough-skinned newt, red-legged frog, Pacific salmon, steelhead, cutthroat trout.
Central Basin *World centre of breeding for Barrow's goldeneye.*	Moose, mule deer, cougar, black bear, coyote, wolf, western jumping mouse, muskrat, long-tailed weasel, greater yellowlegs, yellow-headed blackbird, long-billed curlew, ring-billed gull, western terrestrial garter snake, western toad, spotted frog, chinook salmon, sockeye salmon, steelhead, white sturgeon, Pacific lamprey, rainbow trout, Dolly Varden char, lake chubb, redside shiner.
Northern Basin *Only reptile is the common garter snake (rarely seen).*	Moose, black bear, wolf, grizzly bear, lynx, fisher, muskrat, boreal owl, black tern, rusty blackbird, magnolia warbler, longtoed salamander, western toad, spotted frog, chinook salmon, sockeye salmon, rainbow trout, Dolly Varden char, slimy sculpin.
Eastern Basin *Highest concentration of caribou south of Prince George.*	Mountain goats, mule deer, white-tailed deer, grizzly bear, black bear, long-eared myotis, pika, hoary marmot, Columbian ground squirrel, water vole, Forster's tern, western grebe, white-breasted nuthatch, pileated woodpecker, brown creeper, painted turtle, western toad, longtoed salamander, chinook salmon, white sturgeon, rainbow trout, mountain whitefish, mottled sculpin, Yellowstone cutthroat trout.
Southern Basin *Greatest variety of birds in the interior of B.C.*	Mule deer, white-tailed deer, bighorn sheep, spotted bat, western harvest mouse, Lewis' woodpecker, western kingbird, lark sparrow, northern alligator lizard, longtoed salamander, great basin spadefoot toad, Pacific lamprey, steelhead, chinook salmon, sockeye salmon, white sturgeon rainbow trout, brook trout, Dolly Varden char, mountain whitefish, lake chubb, redside shiner, northern squawfish.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Adams R.
Shuswap L.
Braiorne
Gold Bridge
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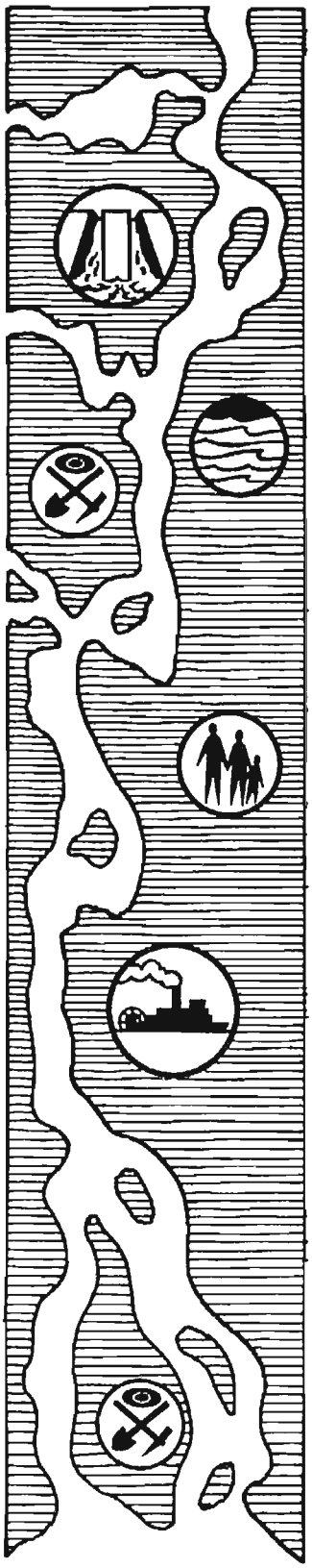
History



8000 BC **The Native people are first to live in the Fraser River Basin.**

Native people fished, hunted, and used plants and trees for food, clothing and shelter. They lived in the Basin for almost 10,000 years but they did little to change the land, rivers, lakes or streams.

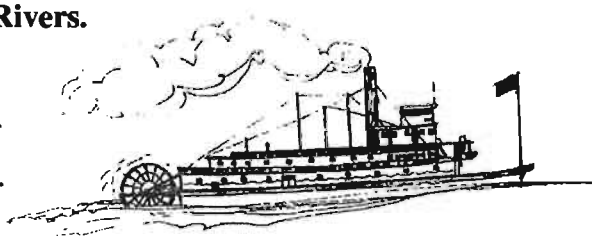
1791-94 AD **Captain Vancouver explores the coast.**

1793 **Mackenzie explores part of the Upper Fraser River.**

1806-08 **Fraser follows Mackenzie's route and beyond.**

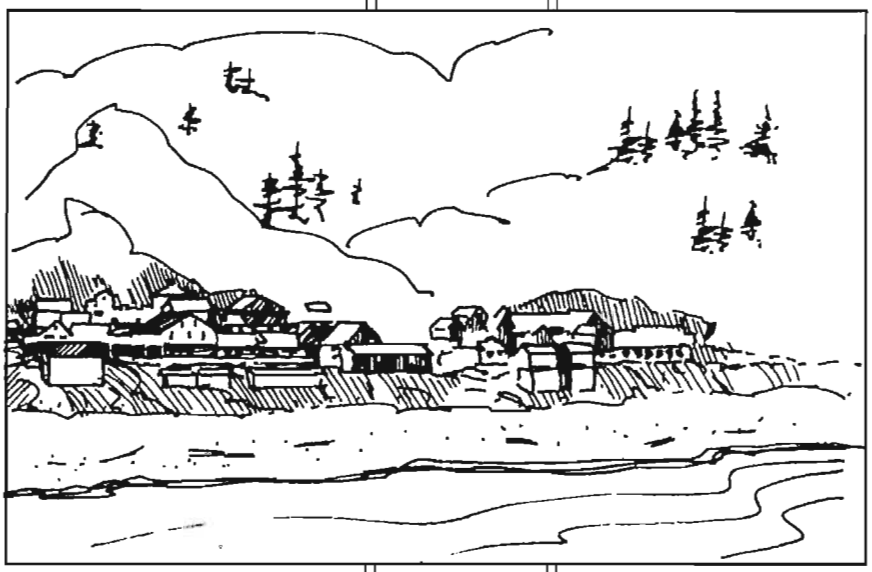
Simon Fraser thought he was exploring the Columbia River. (It also starts in B.C. but runs through the western United States.) Fraser and his men struggled by canoe down the dangerous stretch of river now called the Fraser River Canyon. When they got to the mouth of the river they saw it was not the Columbia after all. Fraser was very disappointed. David Thompson, who explored the real Columbia River, named Simon's river 'The Fraser'.

1850's **Gold is found on the Lower Fraser, Cariboo and Thompson Rivers.**



Tens of thousands of people came. Wider trails were built beside the rivers as more people arrived. Then roads were built for wagons and stage coaches. Road houses were built a day's ride from each other along the Harrison Trail and the Cariboo Road. The road houses had shelter and food for tired travellers. Prospectors, miners, and settlers could ride sternwheelers up parts of the Fraser River. Some boats moved between the Coast and Yale. Other boats travelled between Soda Creek and Quesnel.

Late 1800's **Settlers continue to come to the Basin.**



Yale, an important town on the Fraser River in the late 1880's.

Word spread about the other riches in the Fraser River Basin. The fish and forests brought more people just as the gold had. These people brought a new way of life. They used the land in different ways than the Native people had. It was the beginning of many major changes to the land.

Forests were cleared from the bottom of valleys for farming. Huge trees were cut and sent off to be sold. Salmon was salted and canned and traded to other countries. Barges and boats on the rivers moved goods from place to place. Water from the rivers was used in water wheels to help run sawmills and mines. Later, rivers would be dammed to make electricity.

All these natural resources seemed endless. People thought the forests and fish and minerals would last forever. But more people came and new machines were invented. Fishers could catch more fish. Miners could mine more minerals. Loggers could cut more trees and and they could cut them faster. And more people wanted to buy these goods. The changes to the Fraser River Basin increased.

1886 **The first railway across Canada is finished.**

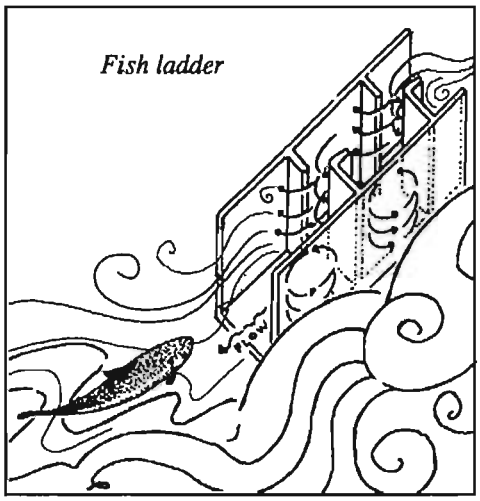
The railway ran through the Fraser River Basin beside the Fraser and Thompson Rivers. The train made it easier for people to come to the basin. It was also easier to trade goods with the rest of Canada. There were more jobs in forestry, mining and fishing. The settlers needed stores, hospitals and schools. This meant business people, doctors and teachers came to the Fraser River Basin. More people came. More land was cleared.

1894 **Largest flood on record.**

A stronger dike and drainage system was built after the flood in the lower Fraser Valley. This would help protect people in the valley from more flood damage. It also helped drain the natural wetlands to make more fields for farming.

1913 **Work on railroad causes landslide at Hell's Gate.**

The rock slide almost destroyed one of the best sockeye salmon runs in the world. The slide at Hell's Gate made the Fraser River even more narrow. Hell's Gate was like a bottle neck. The churning rushing water stopped most of the fish stocks from getting up the river to spawn. A fish ladder was built between 1944 and 1946 to help the salmon get through the narrow passage.



1916 **Grain elevators are built in Vancouver.**

The grain was brought to the coast by trains and stored in the elevators. Then it was shipped to other parts of the world by ocean freighters.

1940's **Paving begins on the road up the Fraser Canyon.**

Good roads and faster cars made it easier for people to live and travel to other parts of the Fraser River Basin.

1948 **Another flood causes more damage.**

Floods damaged many parts of the Fraser River Basin. The communities in the Lower Fraser Valley, Quesnel, Prince George and Kamloops were most seriously affected.

1950's/60's **More roads and railways are built.**

The network of roads and train routes increased. Airplanes also made it easier for people to get to and live in remote areas of the Fraser River Basin.

1950's **A large dam is built at the headwaters of the Nechako River.**

Two thirds of the water that used to flow east in the Nechako River was rerouted. The water now flows west to produce power for an aluminum plant in Kitimat.

1972 **The Agricultural Land Reserve**

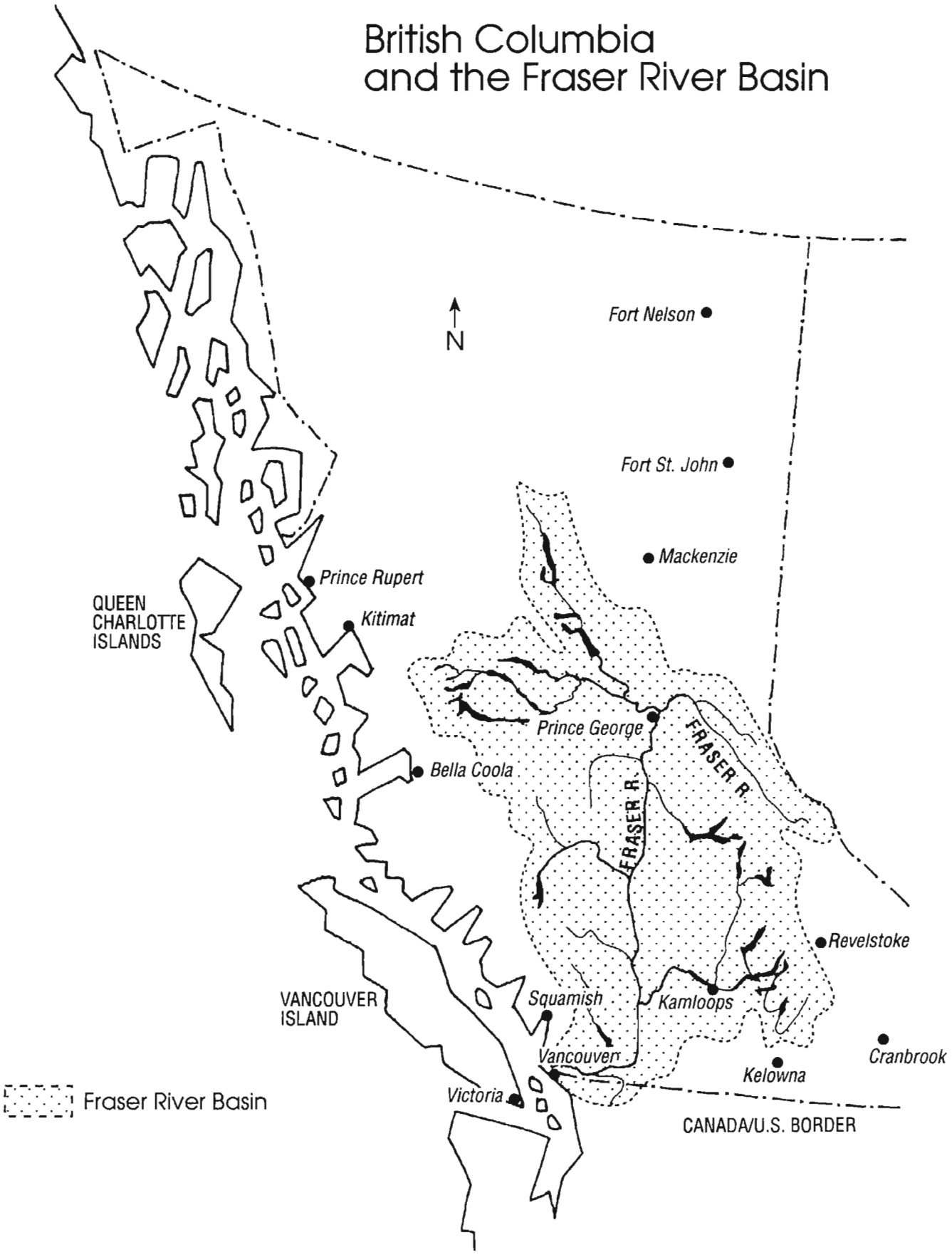
The Agricultural Land Reserve (ALR) began because so much farm land was being covered by houses, factories, stores, etc. The government passed a law to say that land in the ALR could only be used for farming or ranching. The ALR is a way to protect the small amount of farmland in B.C. to make sure there will always be land for growing food crops.

1986 **Expo 86 - The world discovers British Columbia.**

1990's **The settlement of the Fraser River Basin continues.**

People keep coming to live in the basin from other parts of Canada and other countries. Most of the people come to the Lower Fraser and the Thompson areas. In the next 25 years, the population will increase by 50%.

The number of people and the way they live has already caused major changes to the land and waterways. In the future, as settlement continues, there will be even greater impacts - good and bad - on the Fraser River Basin.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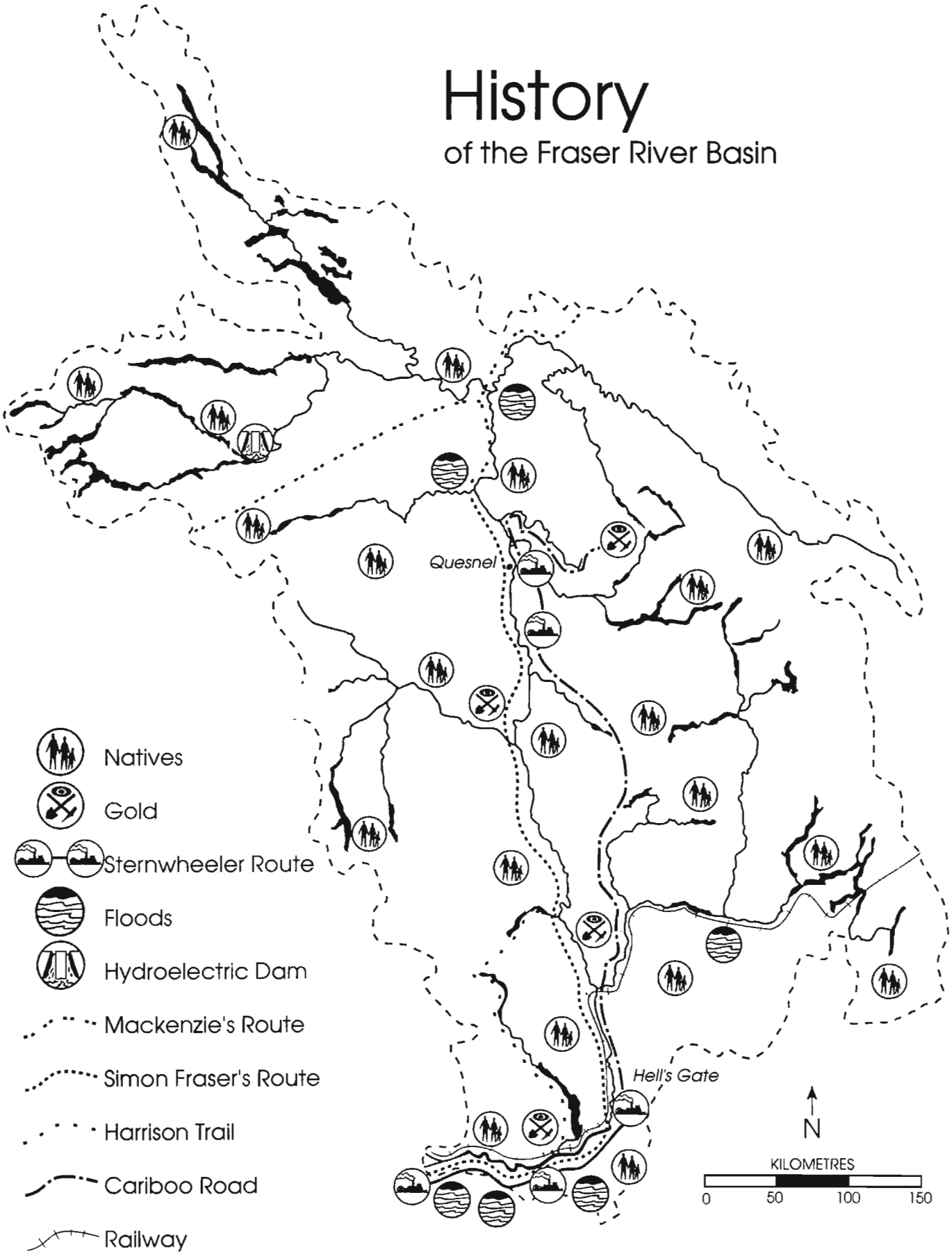
Fraser River Basin

History

of the Fraser River Basin



Map Information - History

Time Line:

8000 B.C.	Native people are the first to live in the Fraser River Basin.
1793 A.D.	Alexander Mackenzie explores a northern part of the Fraser River.
1806-08	Simon Fraser follows Mackenzie's route and beyond.
1850's	Gold is found on the Lower Fraser, Cariboo and Thompson Rivers.
1886	The first railway across Canada is finished.
1894	Largest flood on record.
1913	Work on the railroad causes landslide at Hell's Gate.
1948	Another flood causes more damage.
1950's	A large dam is built at the headwaters of the Nechako River.
1990's	Settlement continues.

We were there!

The Fraser River Basin was a wild place to be in the 1800's. Here are some of the things people said.

From Simon Fraser's Journal:

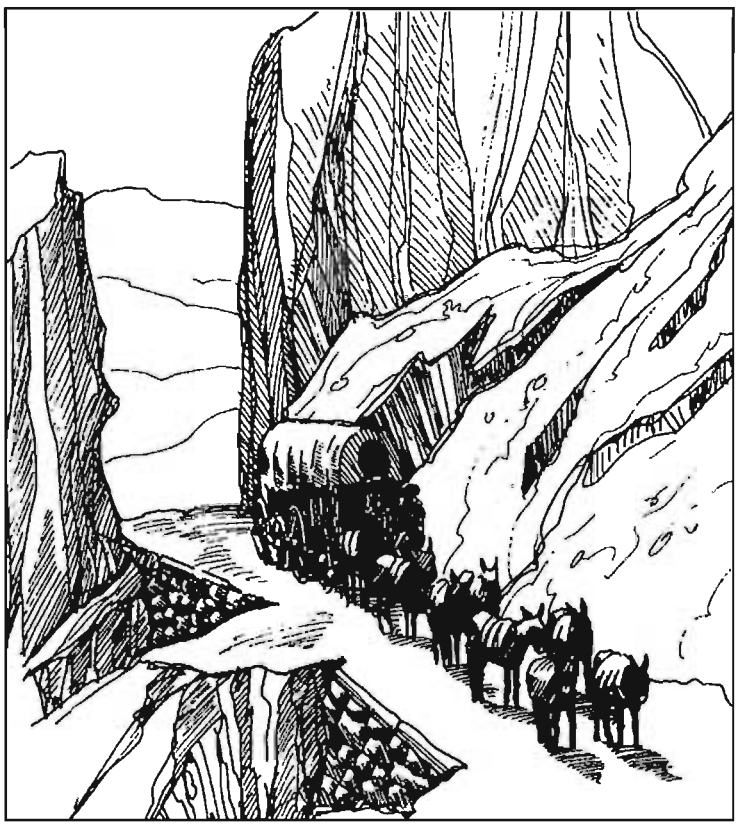
". . .the water which rolls down this extraordinary passage in tumultuous waves and with great velocity had a frightful appearance . . . the great difficulty consisted in keeping the canoes clear of the precipice on one side, and the gulf formed by the waves on the other . . ."

From the Puget Sound Herald newspaper, October 24, 1861:

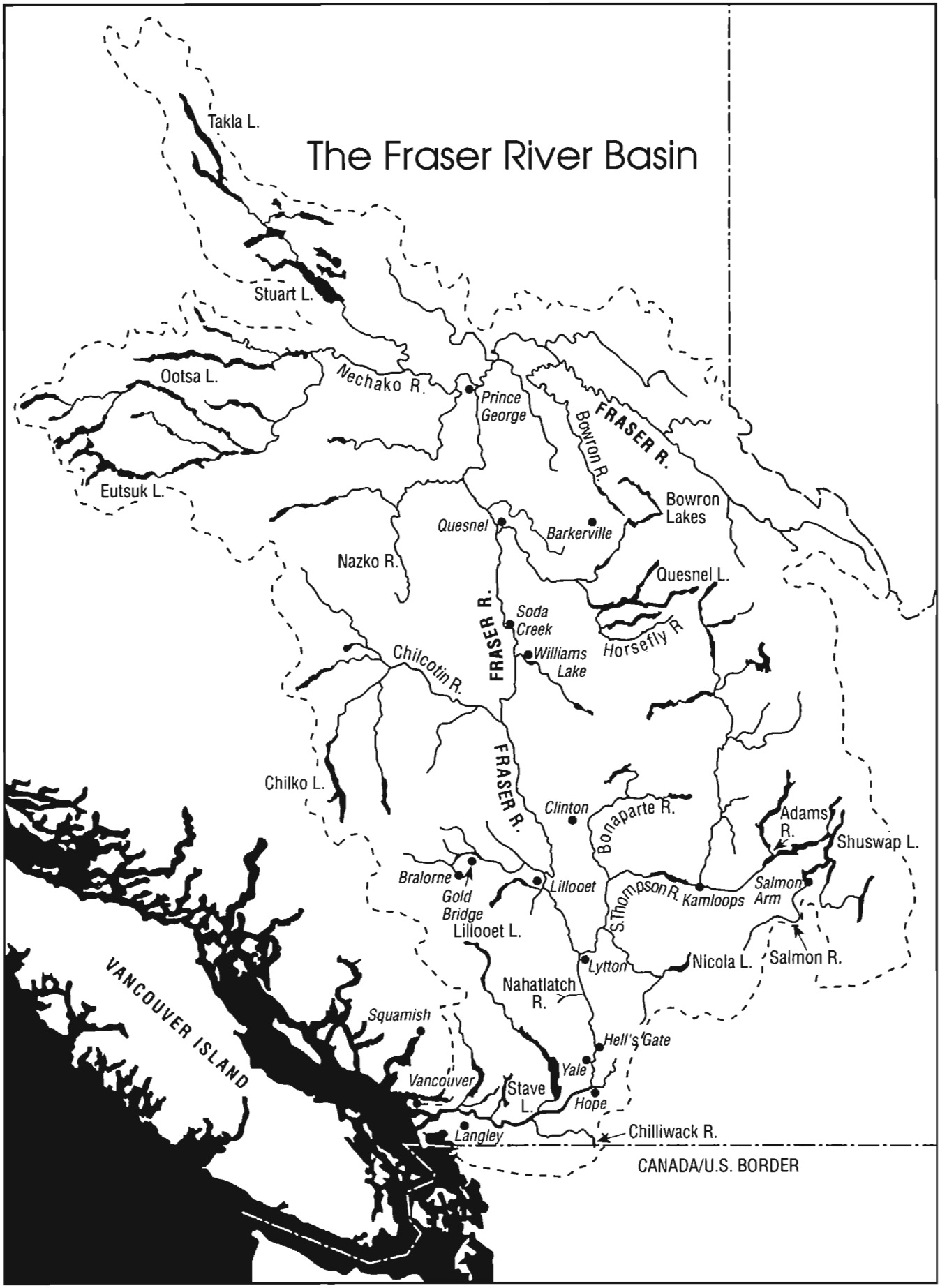
"As far as we can learn, every miner from this new gold field has brought with him from $5000 - $20,000, all of which has been obtained in the short space of two or three months." (The average wage at this time was about $2 per day.)

Said by Lieutenant Palmer, Royal Engineer, 1860, before the Cariboo Road was built:

"It is difficult to find language to express . . . the utter vileness of the trails of the Cariboo, dreaded alike by all classes of travellers: slippery, . . . fallen logs, overhanging branches, roots, rocks, swamps, turbid pools and miles of deep mud."



When the Cariboo Road was finished in 1865, travel was much faster. Pack trains could leave Yale (just south of Hell's Gate) and get to Quesnel in three or four days.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Settlement

Settlement is what people do to change the land. They make a place where they can live and work.

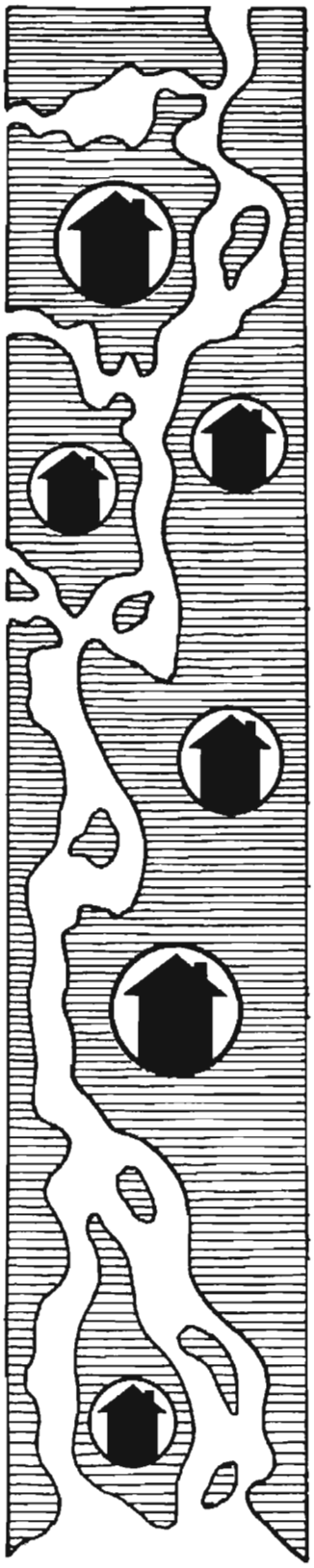
The land is changed when people settle. They:
- clear land
- put up buildings
- cover land with pavement
- take out natural plants and add new ones
- drain or fill in streams.

If only a few people settle in one place, they may not change the land very much. If a lot of people settle in one place, they may change the land a lot. Native people lived in the Fraser River Basin for thousands of years. But they changed the land very little. There were less than 50,000 Natives. In the mid-1700's, many Europeans came to British Columbia. They brought a very different way of life. They changed the land in many ways.

Products: mine, farm, factory, ferry, marina, store, road, house, school, warehouse, railroad, highway, movie theatre, library, park, office building, sewer, drain, water main, park, bike path, beach, telephone line and cable line.

Direct Jobs:
developer, planner, surveyor, engineer, building supply employee, architect, construction worker, truck driver, gardener, bricklayer, telephone lineman.

Spin Off Jobs:
banker, historian, promoter, office worker, teacher, dentist, taxi driver, lawyer, fisher.



Settlement Works Like This

In Early Days

The first big group of settlers heard about gold and came to get rich. Others came because they liked adventure.

There was lots of salmon to eat and wood for shelter. Water was easy to find. The climate was mild. There was room for everyone.

Other people heard about the rich natural resources, such as fish, huge trees, minerals, good soil, lots of water, and good climate.

If enough settlers lived in a place, someone might start a general store or run a stage coach from one place to another. As more people came, services like churches, schools, repair shops and jails followed.

People come to a place for many reasons.

People stay because their needs are met.

More people come to live and work.

More people create a demand for services.

Today

People like the climate, hope to find jobs or want to live near friends and relatives. They like the lifestyle.

B.C. has many places to live. There are shops nearby, lots of things to do and places to go. It is easy to get around.

Other people hear about B.C. by word-of-mouth, advertising, Expo 86, trade meetings, and the 1994 Commonwealth Games.

Even small towns have services like police, road repair, garbage disposal, health care, and schools. People want lots of services: parks, libraries and stores.

In Early Days

Settlers cleared small areas of land to make farms. They used the trees for shelters, fences and fuel. Waterwheels on the rivers helped work machines. Rock was blasted and pick-axed to carve out routes for roads and railways.

Barkerville boomed overnight with the goldrush in the 1860's. It was the second largest city on the west coast of North America. Later, it became a ghost town when the gold ran out and people left.

Loggers cut trees in one valley, then moved on to the next valley. Farmers cleared more land to grow more food. More people cleared and bought land to live on. Trails became dirt roads. Villages grew into big towns.

Even in early days, people bought and sold from each other. They did not use money all the time. Sometimes they traded labor for goods. Someone helping to build a barn might get tools or fresh meat instead of money.

Land is changed to suit peoples' needs.

Settlements can come and go.

Settlements spread and grow. They swallow up land.

Settlement is big business!

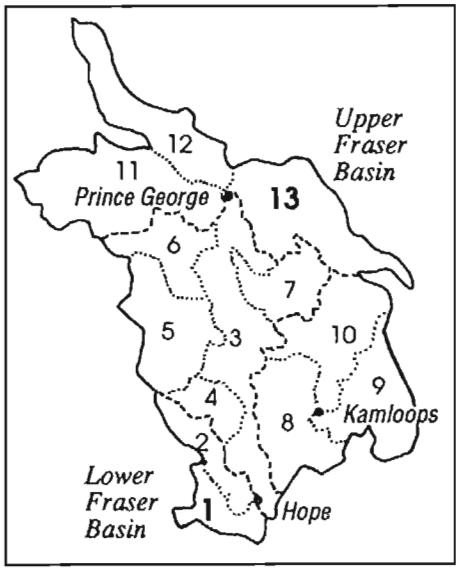
Today

Land is changed quickly and in big ways with modern machines. Rivers are dammed for electricity. Land is drained for malls, parks, golf courses and houses. Forests are divided by logging operations, power lines and roads.

Bralorne Mines built a gold mine in 1932. The small town of Bralorne thrived. When the mine closed in 1971, the town died. People left to find work. The bank, post office and stores closed.

People often move to the suburbs to get away from the noise and traffic of the city. But as more people move, wooded areas and farms are replaced by roads and buildings. The quiet outskirts become part of the big city.

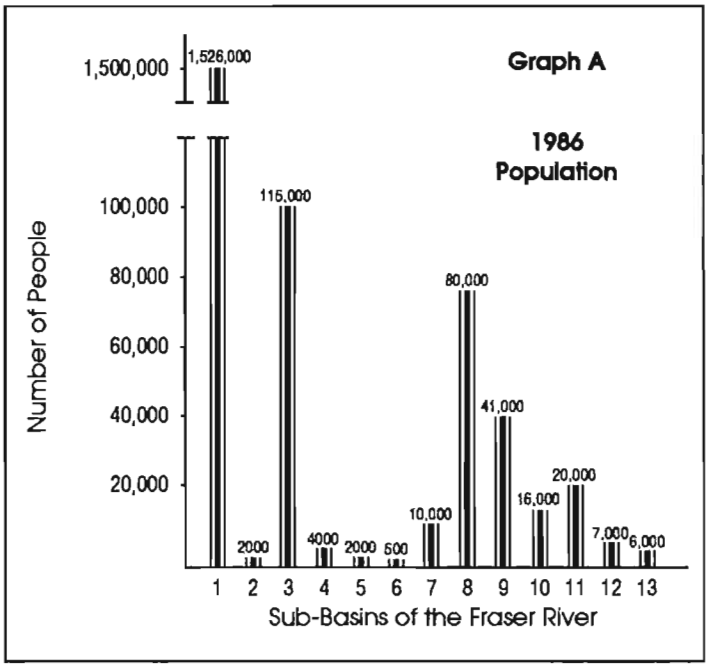
People buy and sell many goods and services. This means jobs for lots of people in building, manufacturing, and services. Jobs mean money to support their way of life.



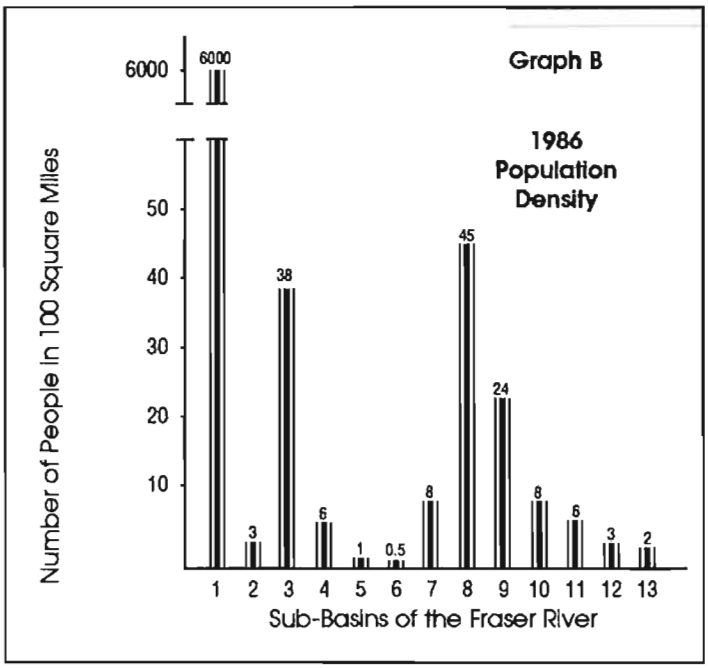
Facts and Figures

In 1994, there are almost 3.3 million people in British Columbia. About 65% of them live in the Fraser River Basin. This is just over 2 million people.

The Map shows the Fraser River Basin divided into thirteen smaller sub-basins. A **sub-basin** is a small watershed or basin within the large watershed. The two graphs on this page compare these sub-basins. The graphs were made in 1986. But the *differences* that they show are the same today.

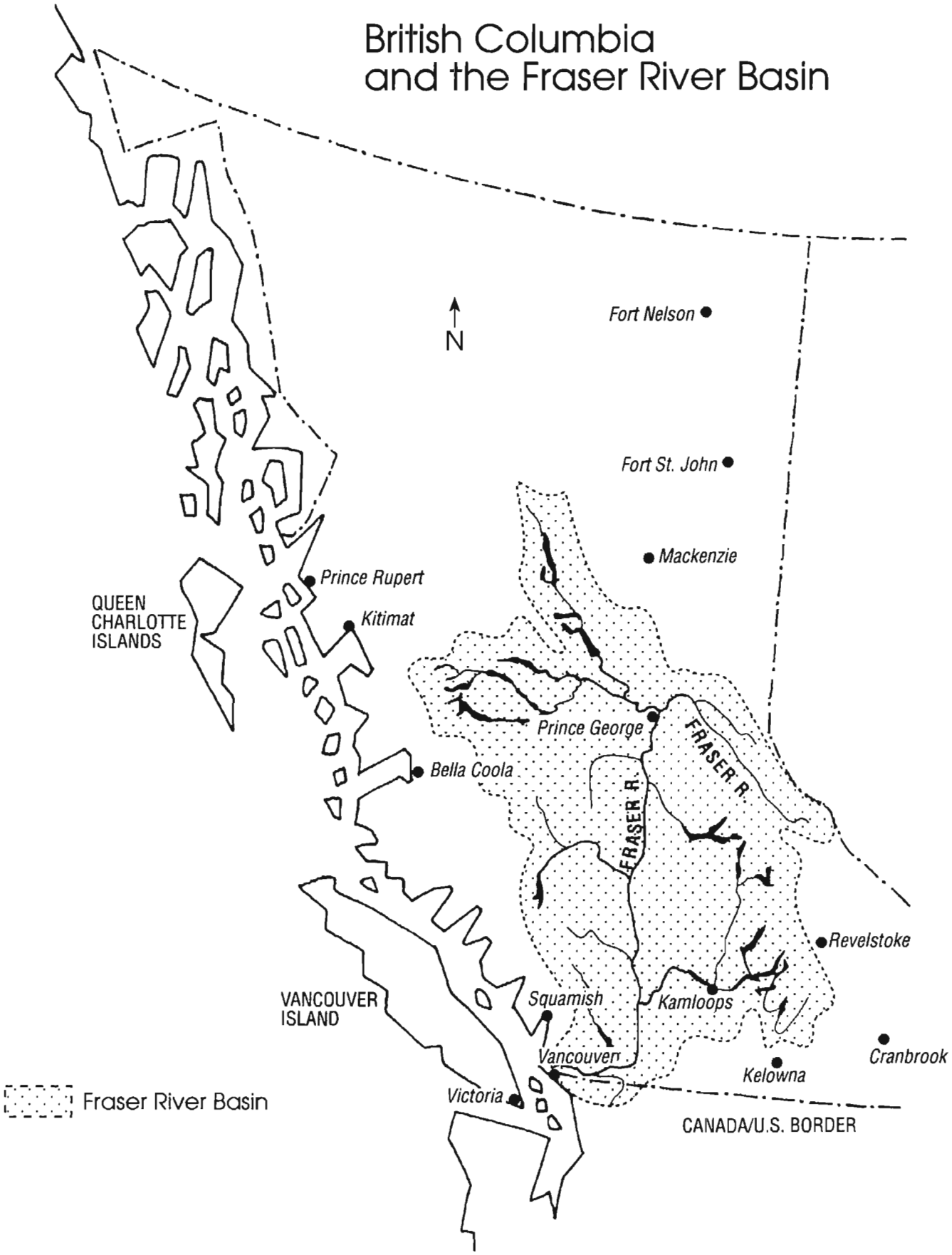


Graph A shows the **population** in all the sub-basins in the Fraser River Basin. In 1986, 1.5 million people lived in the Lower Fraser (#1). But only 5,500 people lived in the Upper Fraser (#13). This is because the big cities in British Columbia (Vancouver, Richmond, Burnaby, etc.) are in the Lower Fraser.



Graph B shows the **population density** in all the sub-basins in the Fraser River Basin. In 1986, there were about 6,000 people for every 100 sq. km of land in the Lower Fraser (#1). But the Upper Fraser (#13) had only 6 people for every 100 sq. km of land. The population density in the Lower Fraser was 1,000 times greater than in the Upper Fraser.

Population Density: *This number compares the number of people to the amount of land on which those people live. For example, if one person lived in a space the size of your classroom the population density would be 1 person for every classroom. If 30 people lived in your classroom the population density would be 30 people for every classroom.*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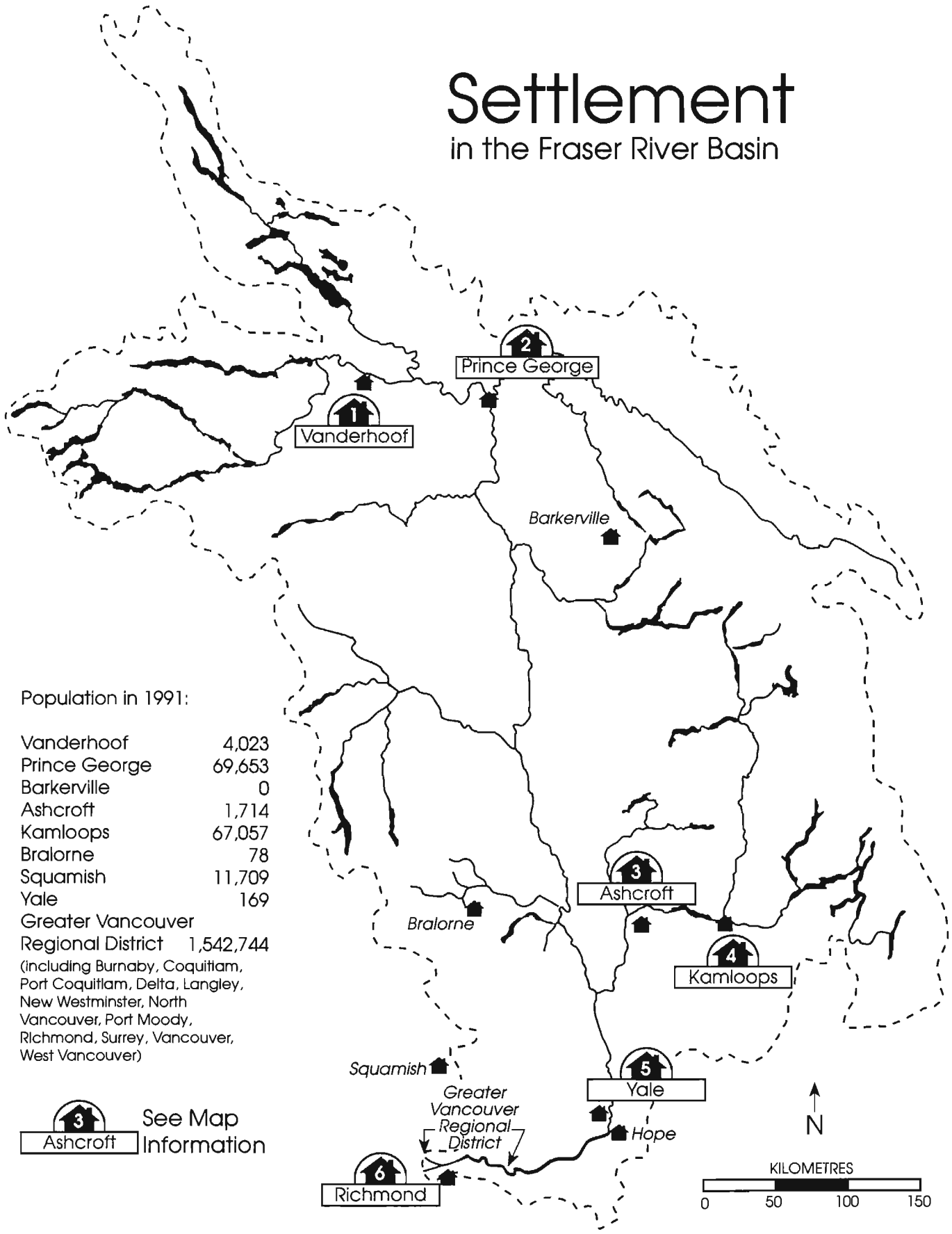
Settlement
in the Fraser River Basin



Population in 1991:

Vanderhoof	4,023
Prince George	69,653
Barkerville	0
Ashcroft	1,714
Kamloops	67,057
Bralorne	78
Squamish	11,709
Yale	169
Greater Vancouver Regional District	1,542,744

(including Burnaby, Coquitlam, Port Coquitlam, Delta, Langley, New Westminster, North Vancouver, Port Moody, Richmond, Surrey, Vancouver, West Vancouver)

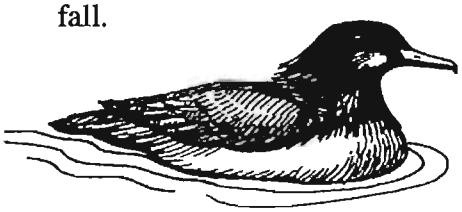
3 Ashcroft See Map Information

Map Information - Settlement

The activities that keep a town alive can change over time. Here are only a few examples.

1 Vanderhoof

Vanderhoof began with the goldrush and pioneers. It is now a small farming and logging community. It is also the service center for the Nechako Valley. The area has good fishing and camping. Vanderhoof claims to be the geographical center of British Columbia! A cairn marks the spot 5 km east of town. Nearby is the Nechako Bird Sanctuary. The sanctuary is a seasonal home for Canada geese and other waterbirds in spring and fall.



2 Prince George

Prince George is the main city in the Upper part of the Fraser Basin. Forestry, ranching and a network of roads, railways and rivers make Prince George a central hub in the north. In 1994 a new university opened in Prince George. It is small now, but will likely bring changes to the city: new students and teachers will need places to live and eat and relax.

3 Ashcroft

Railways began and ended Ashcroft's heyday. Pack trains, wagons, and stagecoaches carried people and goods north to the Cariboo. By 1884, with the railway going through town, Ashcroft was busy and booming. It was the supply center for the whole of the Cariboo! But competition brought an end to these busy times. Another railway was built into the north on a different route. Much of Ashcroft's business went through Squamish instead. Ashcroft never really boomed again. Now, people in Ashcroft have jobs in forestry, ranching, mining and vegetable farming.

4 Kamloops

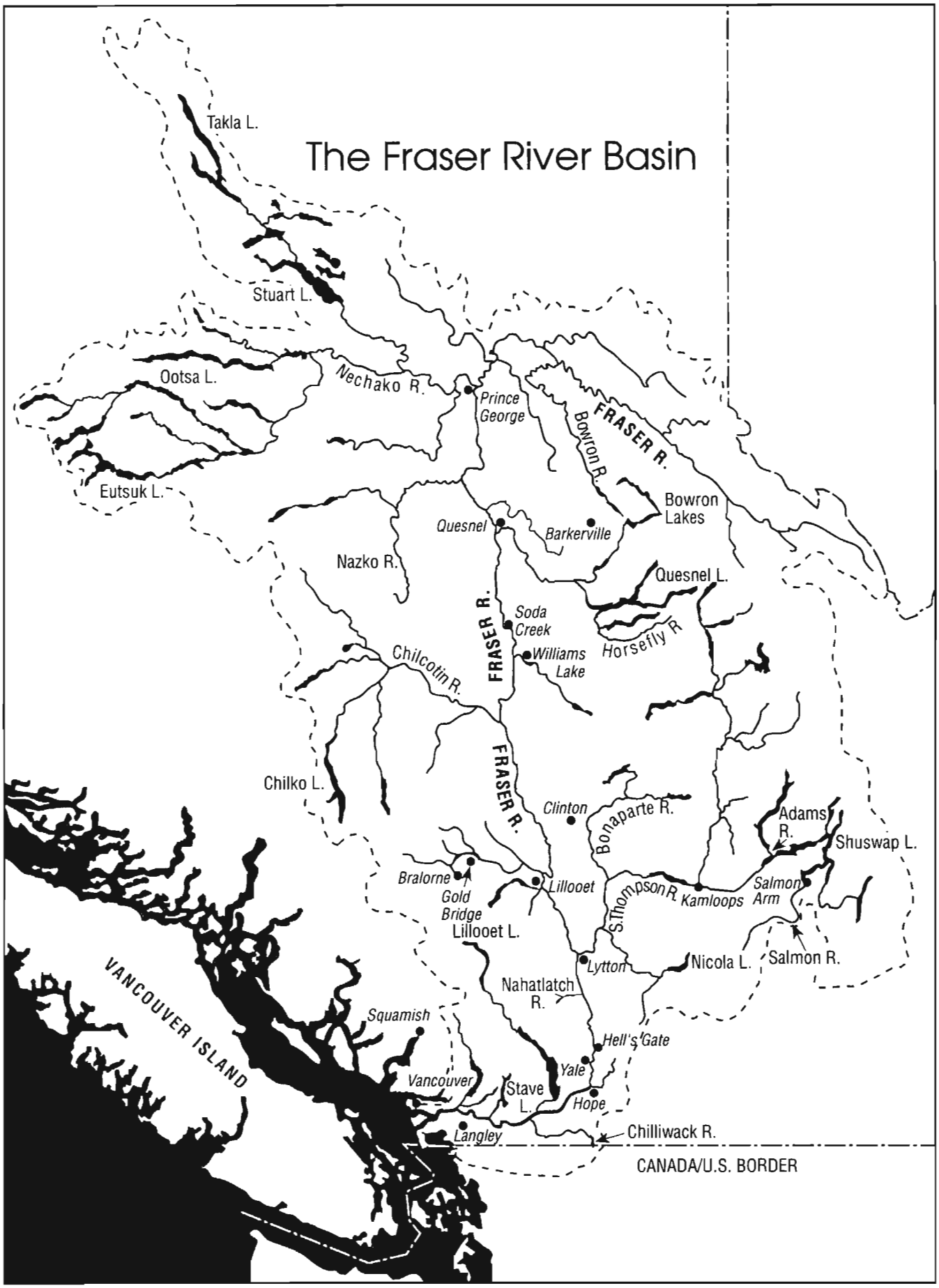
Kamloops began in the 1800's as a small stop for the railway. Over time other industries began. Up until the 1970's it was known mostly as a mill and logging town. In the 1990's, as the forests shrink and mills are closed, Kamloops is changing. The town is attracting new industries. For example, tourism is becoming big business: there are cattle drives, skiing, trout fishing and houseboat rentals.

5 Yale

At the height of gold fever over 20,000 people lived in Yale. It was first settled as a trading post for the Hudson's Bay Company. It was located at the end of the line of a huge West Coast sternwheeler business. It had also been a big work camp for men building the railway. Nowadays, less than 50 people live in Yale. It depends on tourism and its heritage.

6 Richmond

In the 1950's and 1960's most of Richmond was farmland. Fruit and vegetables were grown for people in Vancouver and for export. But Vancouver grew, and people wanted more land to build on. The farms in Richmond were bought from the farmers and made into smaller building lots. More and bigger roads, houses, malls, schools, hospitals, and bridges were built.


The Fraser River Basin
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VANCOUVER ISLAND
Squamish
Hell's Gate
Yale
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Stave L.
Hope
Langley
Chilliwack R.
CANADA/U.S. BORDER

Agriculture

Agriculture is another name for farming. Agriculture means growing crops and raising livestock (animals) for food.

British Columbia has many different kinds of **soils**, **climate** and **land surfaces**. This means lots of different farm products can be grown. British Columbia, in fact, has a greater variety of products than any other province in Canada.

Products

raspberry, strawberry, blueberry, grape, ginseng, carrot, potato, corn, lettuce, mushroom, **forage**, shrub, poinsettia, beef, poultry, venison, pig, fish, milk, egg

***Forage**: food for livestock. Grass and corn are grown and then stored to feed cows and pigs in the winter.*

Soil

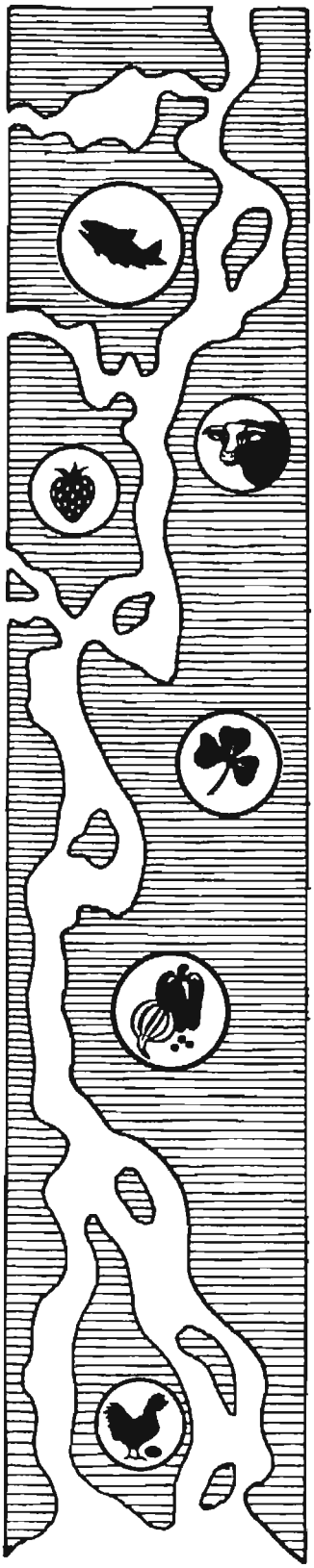
The climate all through the Lower Fraser Basin is about the same. The temperatures are mild. There is about 125 - 150 cm of rain per year. There are about 200 frost-free days each year. But the land and soil are different. In some places the land is well-drained and dry. Water does not stay up near the roots of the plants. But in other places the land is wet. Raspberries grow well when land is well-drained and dry, but not when land is wet.

Climate and Land Surface

A farm in Richmond gets more rain than a farm in Merritt. This is because Richmond and Merritt are on opposite sides of the Coast Mountains. Merritt is on the east side in the rain shadow of the mountains. The clouds dump all their rain on the west side in Richmond before moving across the mountains. The land surface between Richmond and Merritt helps to make the climate different.

British Columbia is a huge province. It has about 95 million **hectares** of land. But only 4.7 million hectares can be farmed or ranched because of the climate, soils or land surfaces. This is about 4% of the total land in British Columbia.

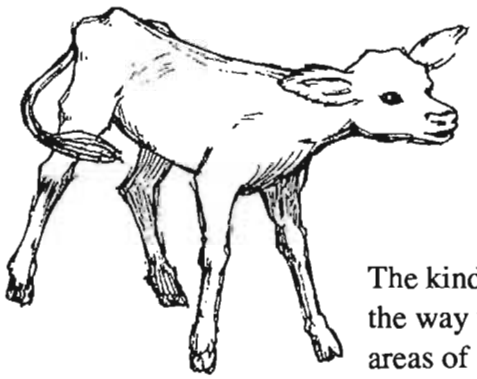
***Hectare**: 10,000 square metres. This is a little smaller than 2 football fields side by side.*



Only 50% of this land has farms on it. This is 2.4 million hectares. But in 1991 only 1.83 million hectares of land were being farmed in British Columbia. And in the Fraser Basin, only 300,000 hectares were being farmed. There are a number of reasons why some farmland is not used.

- It is too costly to make the land ready for farming.
- The owner of the land does not want to farm.
- It is expensive to grow more food or raise more animals than can be sold. If only 1000 kg of honey can be sold, the farmer should not produce 5000 kg of honey. As more people live here and buy British Columbia products, more farmland will be used.

How Farming Works



Farming is different from other jobs. A dentist or a truck driver or a plumber may be able to choose when to start or finish a task. Farmers must work when the animals and crops need them. Cows must be milked and pigs must be fed each day. Crops must be watered and cared for each day. Animals and crops that are well cared for will have more value for the farmer when they are sold.

The kind of animal that is raised or the kind of crop that is farmed changes the way farming works. For example, chickens are raised in barns on small areas of land. Cattle are raised outdoors on large areas of land. There are many kinds of farms in the Fraser River Basin. The two farms discussed here are a cattle ranch and a blueberry farm.

Rangelands: *large areas of land on which cattle roam and graze. Rangelands may be wet meadows, grasslands and forested areas. They may be many km away from the ranch.*

*A **backgrounder** is just like a ranch, except there are no adult animals. The young cattle are fed for 8 - 12 months. They are sold in the spring or fall and weigh about 500 kg.*

*A **feedlot** is an open space outdoors that is fenced. It holds 400 - 800 head of cattle. The young cattle are fed barley, oats and wheat. They gain about 1.5 kg of weight a day on this diet. In December or January, the cattle weigh about 500 kg and are sold.*

Cattle Ranch

Beef cattle are raised on ranches and sold as meat. Most ranches are in the Fraser River Basin between Lillooet and Prince George. Beef is the third most valuable farm product in British Columbia.

There are two or three kinds of cattle ranches. One kind of ranch has both cows and calves. The calves are raised to be sold as meat. The adult animals are kept for breeding.

Female cows are bred in the spring so the calves are born the next winter. For the first two months, the calves and their mothers are kept outside near the farm buildings. The calves drink their mother's milk.

Then the calves and cows go out to the **rangeland**. The young calves keep drinking milk but begin to graze on grass as well.

In late summer the calves are six to eight months old. They are taken away from their mothers. At this time, some ranchers move the calves to **feedlots** and some ranchers move the calves to **backgrounders**.

The adult animals are not sold. They are kept close to the ranch and fed over the winter. The cows will have calves again in January or February. The cycle starts again.

Cattle need lots of land so they can get enough grass to eat. The amount of land they need depends on the soil. In wetter places, with rich soil, the cow and calf may need only one hectare of land. In dry grasslands, the cow and calf may need as much as 20 hectares of land. (This is the amount of land needed for 130 houses.)

A family-run ranch may have as many as 150 - 200 cattle. In the dry grasslands of the Fraser River Basin, this ranch would need 3000 - 4000 hectares of land. It is too costly for most ranchers to own all of this land, so the government rents forest land to them.

Blueberry Farm

Most of the blueberries in British Columbia are grown in the Fraser Basin. They grow well in Richmond, Pitt Meadows, Matsqui and Surrey. British Columbia grows 95% of all the blueberries in Canada. This is about 9 million kg each year.

A blueberry plant can grow as high as 2 - 2.5 metres and live up to 50 years.

Blueberry plants are started from plant cuttings. They are grown in a greenhouse for the first year. Then the bushes are planted in rows in a field. A **mulch** is placed around the plants to protect the shallow roots from high or low soil temperatures. Mulch also keeps the soil moist and the weeds down.

***Mulch**: Wood chips and sawdust.*

Plants are pruned, or cut back, each year because too much growth will make the berries small. In the spring, the farmer fertilizes the plants. The farmer also rents bee hives to make sure the flowers are pollinated. Insecticides to control insects are only used if insects begin to attack the plants.

As the blueberries ripen, they must be protected from birds. Farmers try to scare the birds with noise, balloons or kites shaped like hawks.

Weather can harm the blueberry crop. When the spring is cool and wet, the plants

- do not get pollinated as well because the bees are not out
- may get more diseases
- grow poorly
- do not produce as many blueberries.

Blueberries are harvested every 10 - 14 days between July and September. Berries for the fresh market in British Columbia are hand-picked. Berries for export to other countries or processing (e.g.. freezing) are harvested by machine. This makes them less costly.

Blueberries are a good crop to take to market because they can sit on the shelf longer than raspberries. Also, blueberries do not crush as easily as raspberries.

Direct Jobs

agriculturist
agrologist
rancher
ranch worker
soil scientist
picker
farmer
sprayer
truck driver
veterinarian

Spin Off Jobs

researcher
chemist
inspector
truck driver
grocer
waiter
food processor
chef
artist
longshore worker
machinist

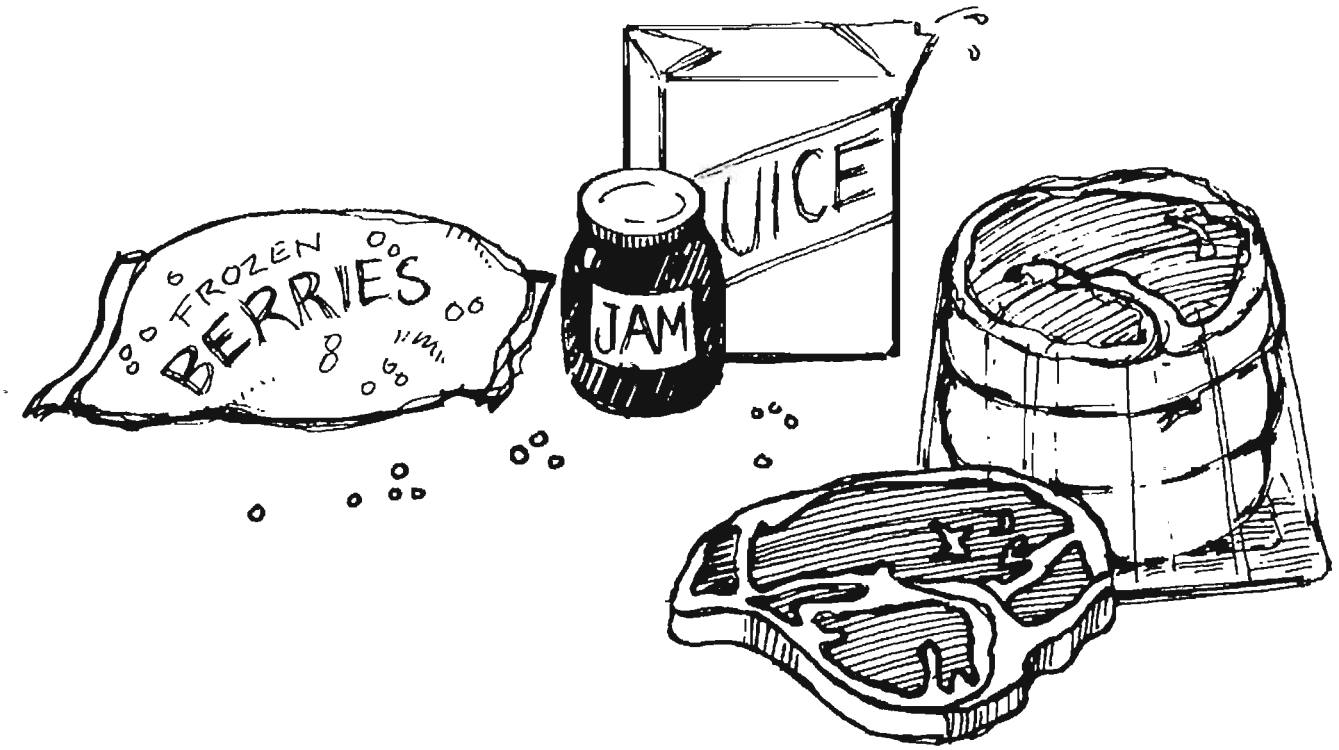
Agriculture Facts and Figures

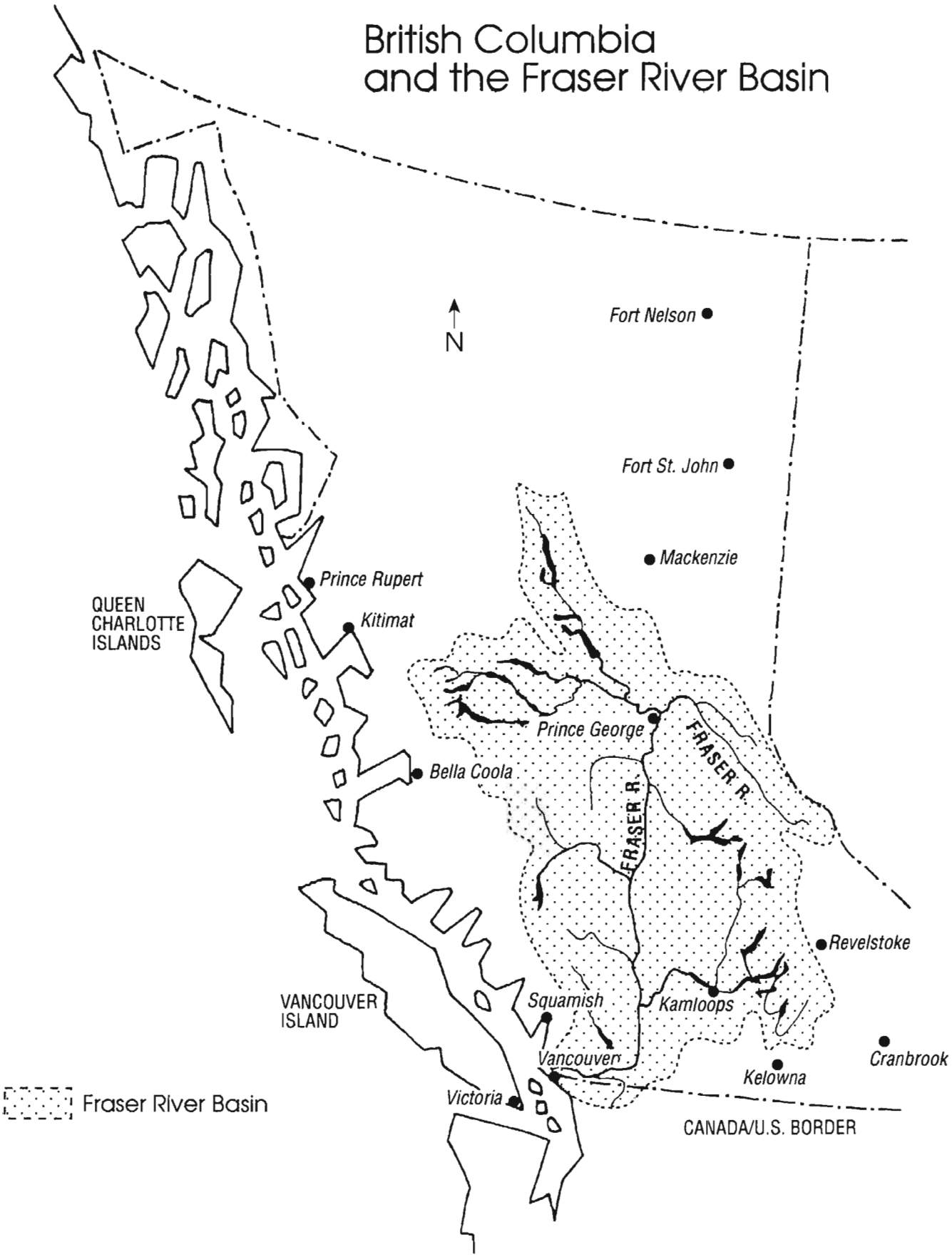
On a small farm, all of the jobs may be done by one or two people. On a large farm, 10 - 15 people may be needed to do all the work. These workers may only be needed for a short time. Sometimes they work on two or more farms during the picking times.

There are about 37,000 people with jobs in farming in British Columbia. About 25,000 of these jobs are in the Fraser Basin. And most of these jobs (18,000) are in the lower Fraser Basin, west of Hope.

Food Processing Plant

A food processing plant is a place where crops or livestock are turned into food products. At a fruit plant, berries are inspected and washed or vacuumed. The fruit may be frozen, canned, or made into jam, juice or fruit leather. At a meat plant, the animal carcass is cut in half and inspected. Then it is sold to grocery stores and butcher shops. These stores cut the sides of beef into smaller portions. More than half of the food processing plants in British Columbia are in the Fraser River Basin.




British Columbia
and the Fraser River Basin
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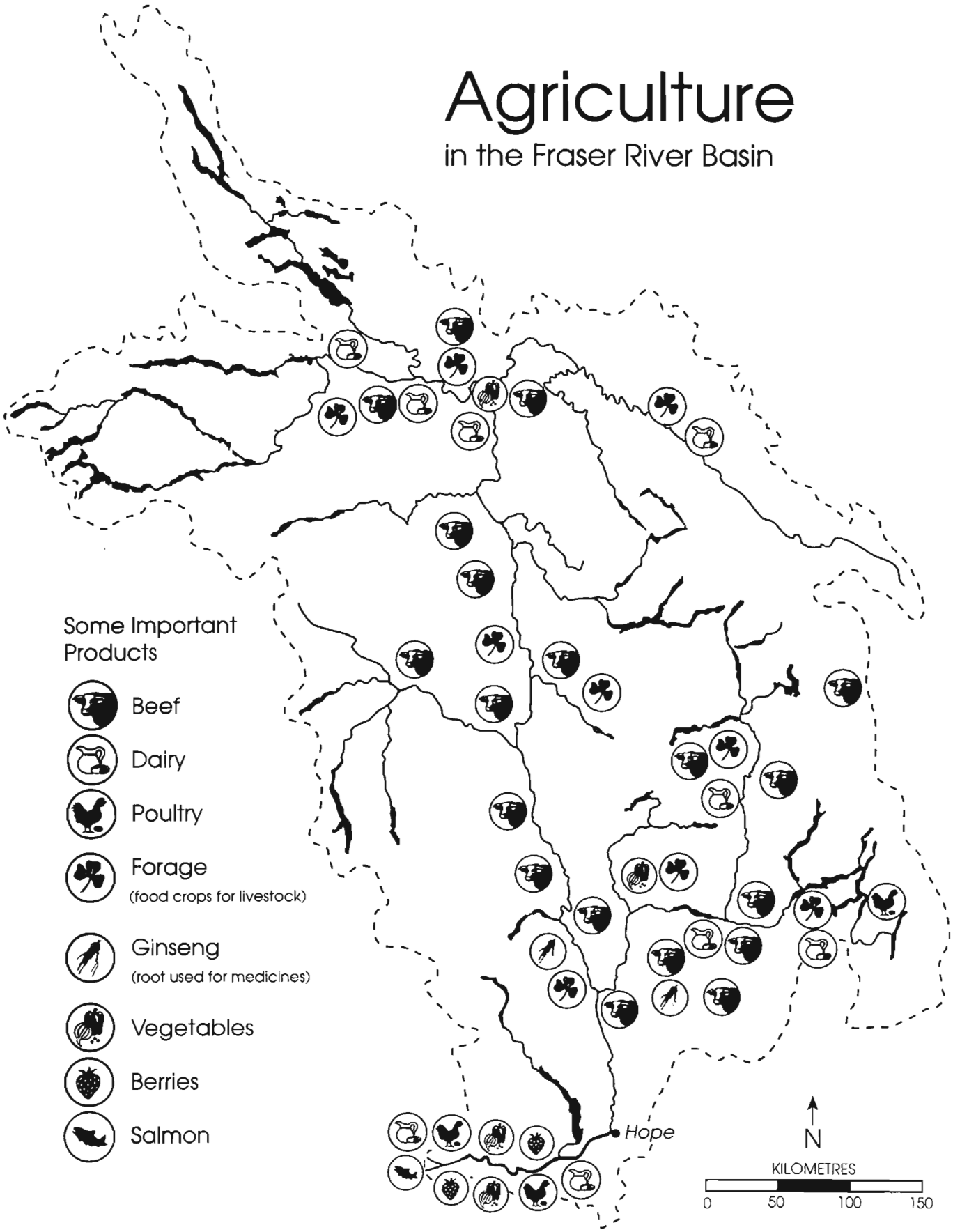
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Kitimat
QUEEN
CHARLOTTE
ISLANDS
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
Squamish
Kamloops
Vancouver
Cranbrook
Kelowna
Victoria
CANADA/U.S. BORDER
Fraser River Basin

Agriculture

in the Fraser River Basin

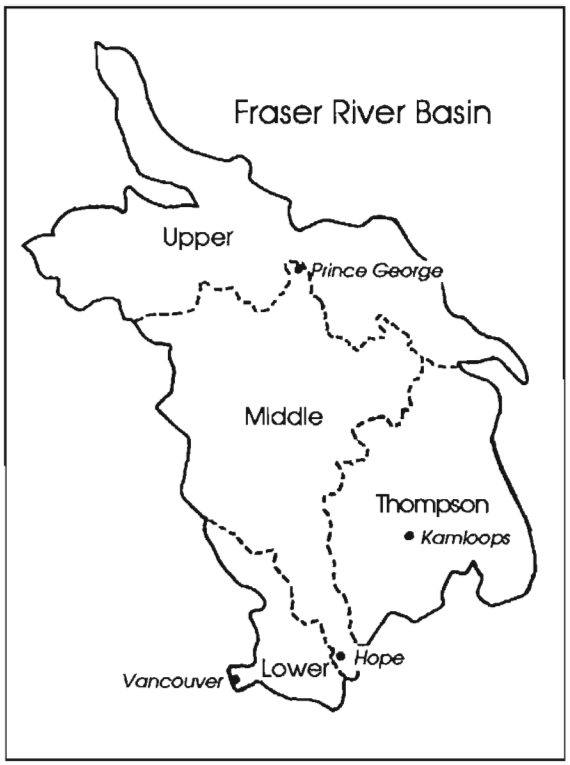


Map Information - Agriculture

The Agriculture Map shows the farm products in the Fraser River Basin. The land west of Hope is used for a greater variety of products because the temperatures are mild in the winter and there is more rain. The land north of Hope is mostly used to raise cattle because the winter temperatures can be very cold and there is not much rain.

This chart shows the number of farms and the value of the products in the Fraser River Basin in 1986.

Area	Number of Farms	Product Value
Lower Fraser	3143	$440 million
Thompson	1464	$ 91 million
Middle	817	$ 37 million
Upper Fraser	626	$ 24 million

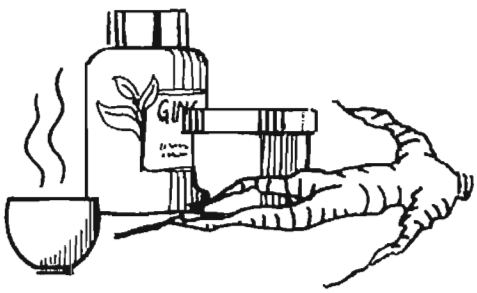


The sale of farm products brings in about $600 million. Most of this money ($440 million) is made from the sale of farm products from the Lower Fraser Basin. There are at least three reasons for this fact.

1. Salmon are caught in the Strait of Georgia and at the mouth of the Fraser River. They are counted as one of the farm products of the Lower Fraser. Salmon have the most value of all farm products in British Columbia, so more money is made in the Lower Fraser.
2. There are more farms in the Lower Fraser than in any other part of the Fraser River Basin.
3. The climate and soil is better for farming in the Lower Fraser than in any other part of the Fraser River Basin.

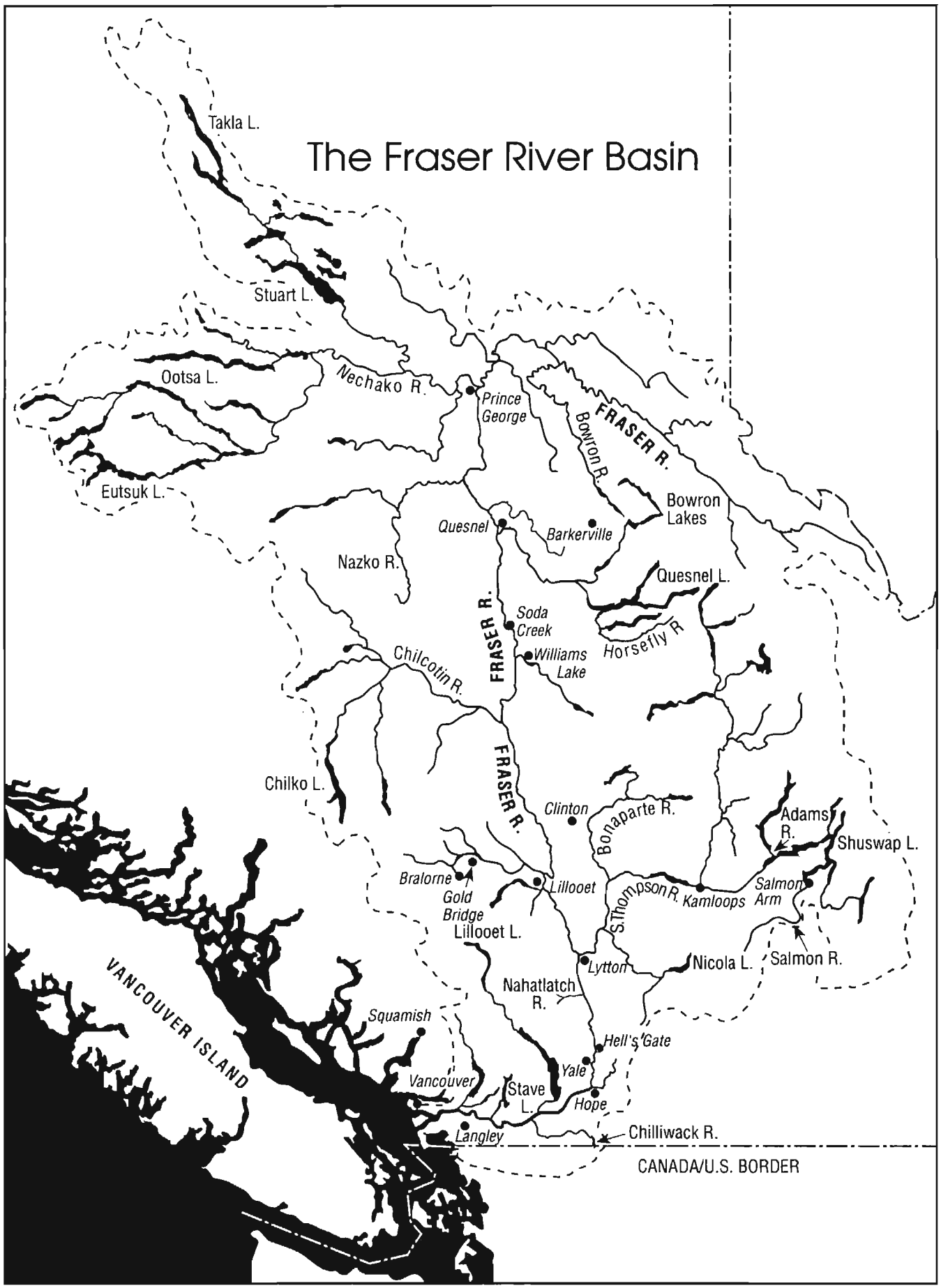
Ginseng

Ginseng has been grown in Asia for 3000 years. But it is a new crop in British Columbia. The first ginseng farm started in 1982. Ginseng is a good crop to grow because it can be sold at high prices. In 1995, the ginseng root sold for $88.00/kilogram, but carrots sold for only $1.50/kilogram.



Ginseng is a root like carrots, turnips or parsnips. The root is long and thick and has long root hairs hanging down. Ginseng grows best in dry climates in the shade.

Ginseng has been used as a medicine in Asia for thousands of years. Some people think ginseng will help you to be healthier. Ginseng can be used to make tea, soup, candies, drinks and pills.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Fishing

In British Columbia fish are harvested (caught) in freshwater (rivers, lakes and streams) and in saltwater (ocean).

The Fraser River is one of the greatest producers of salmon in the world.

Caught in Freshwater: salmon, sturgeon, trout, eulachon, smelt, kokanee, char, rainbow trout, perch, and steelhead trout.

Caught in Saltwater: salmon, halibut, herring, cod, sablefish, shellfish (clams, oysters) shrimp, rockfish, flounder, steelhead, and perch.

How Fishing Works

In British Columbia there are three different kinds of fishers: commercial, sport and Native Indian.

The government of Canada manages the fishing industry. It has a law called the Fisheries Act. This Act has rules about fish and their habitat (rivers, lakes, ocean). It tells people what they can and cannot do with fish in or near the water.

Each year the government and the fishers make a plan. The plan first lets some fish escape from the fishers. These fish can lay eggs so there will be fish the next year. This plan divides the fish between the commercial, sport and Native fishers. The government makes sure the plan is followed by selling fishing licences. The fishing plan tells fishers:

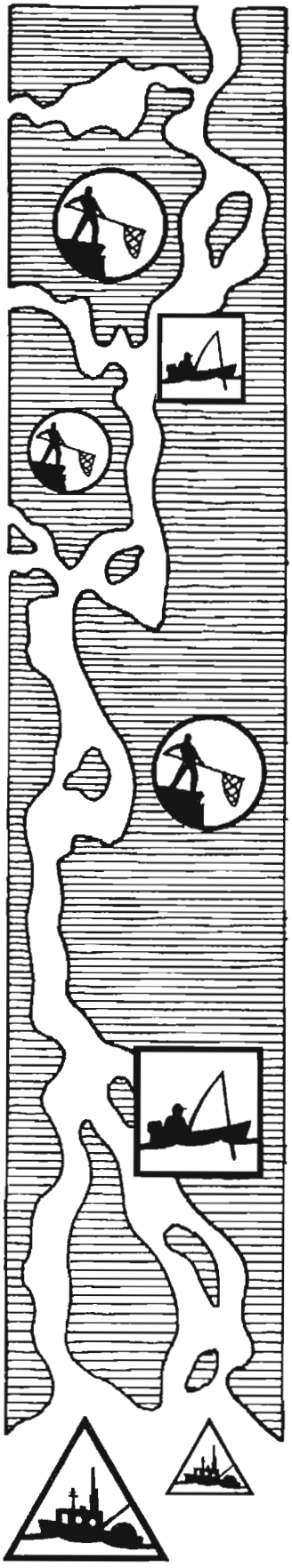
- when each group can fish (certain days, certain months),
- where each group can fish,
- what type of fish each group can catch,
- how many fish each group can catch.

Salmon Fishing

In 1991 in B.C. there were 12,000 commercial salmon fishers. They fished from June - October in many places in the ocean along the coast. They could catch as many salmon as they were able to in the areas and times open for fishing. They ended up catching about 82,500,000 kgs or about 41 million salmon.

In 1991 there were 700,000 sport fishers licences. About 300,000 of these were licences to fish in freshwater and 400,000 of these were licences to fish in saltwater. Anglers fished all year round but mostly from May until September. Sport fishers who fished in the ocean caught 1.2 million salmon and 200,000 ground fish. Sport fishers who fished in freshwater mainly caught fish such as trout, char, and perch.

In 1991 in B.C. all native fishers could catch fish. They fished all year but mainly from April - November. They could fish in the ocean and in rivers near their homes. They could catch as many fish as they needed for food.



Direct Jobs

fisher
fish processor
inspector
Fishery Officer
biologist
fishery manager

Spin Off Jobs

boat builder
net maker
marina operator
equipment salespeople
exporter

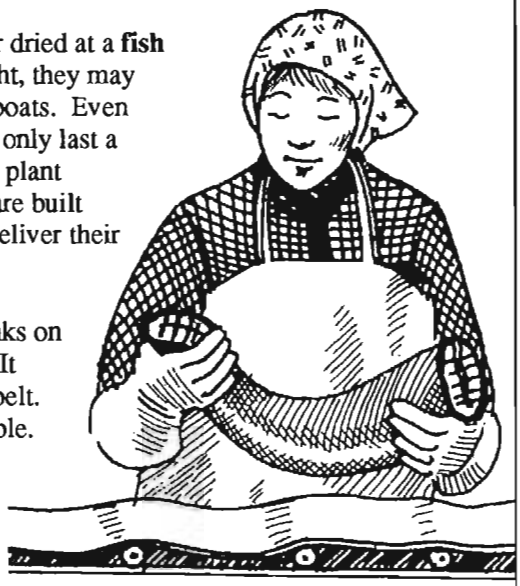
Commercial Fishery

Commercial fishers sell the fish they catch. But first they must follow these steps:

1. Buy or lease a boat and a licence to fish commercially (e.g. as a gillnetter, seiner, troller, long liner). Make sure it is safe. Fishers that gather clams and oysters do not need a boat. Check all the fishing gear to make sure it works.
2. Apply for and buy a personal fishing licence from the Department of Fisheries and Oceans.
3. Catch fish or shellfish following government rules for commercial fishers.
4. Keep the fish clean and cold to prevent spoiling. (Crabs and some groundfish are kept alive in tanks.)
5. Take the fish to a fish buyer. The buyer may be one person, a small company, or a large **fish processing plant**.

At the Fish Plant

Fresh fish is canned, smoked, frozen or dried at a **fish processing plant**. When fish are caught, they may be stored in large tanks on the fishing boats. Even though the fish are kept cold, they will only last a few days. The fish must get to the fish plant quickly. This is why most fish plants are built along the waterfront where boats can deliver their catch directly.



The fish are often sucked out of the tanks on the boat with a vacuum-like machine. It pumps the fish out onto a flat moving belt. This belt moves the fish to a sorting table. Here the fish are weighed, so the fishers can be paid. When the fish are sorted, the better quality fish are sold fresh or frozen and the other fish are canned.

Fish to be canned go to a butchering machine which cuts off the head, fins, and tail. It also takes out the organs of the fish. The fish body is washed in cold running water by workers wearing rubber boots and waterproof aprons. Then machines cut the salmon into pieces and put it into cans. The cans are weighed to make sure they are full. Lids are put on the cans and the cans are sealed by a closing machine. The canned salmon is cooked in a steam oven for more than two hours. Lastly, the cans are labelled and boxed to be shipped to stores.

Commercial Fishing Facts & Figures

Fish and seafood products are British Columbia's number one food **export**. They make up about four percent of the value of British Columbia's total exports.

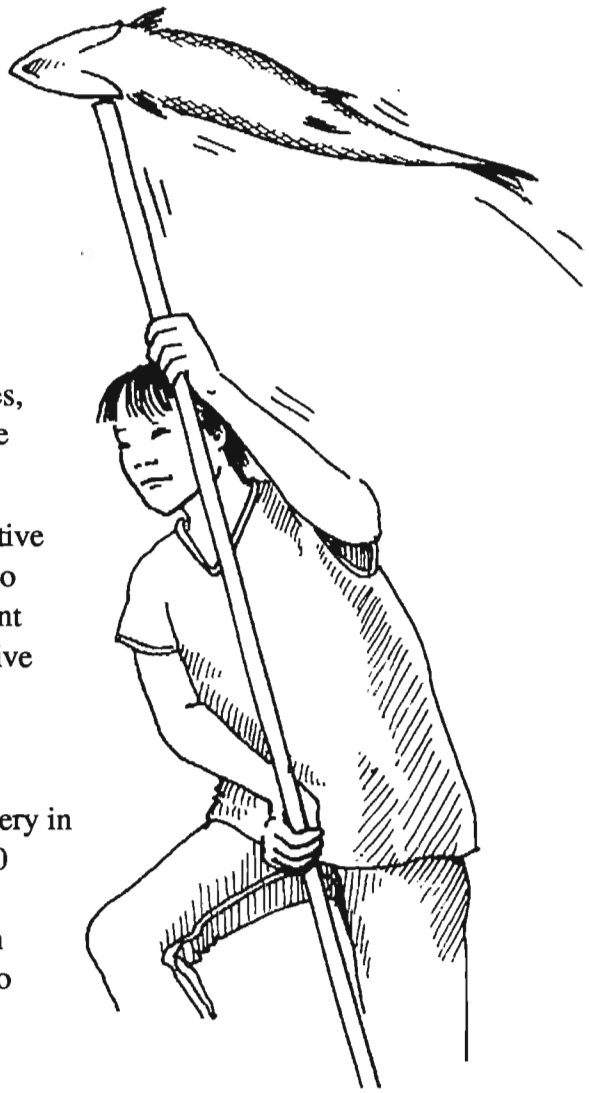
Export: *Product that is sold in another country. B.C. salmon and other fish are sold in many countries.*

Commercial fishers can only fish in the ocean and in the Fraser River as far up as Mission. They cannot catch fish anywhere else in the Fraser River Basin. But many of the fish caught in the ocean were hatched as eggs in the rivers of the Fraser Basin.

In 1991 the fishers caught 312,000 tonnes of fish and shellfish. The total value to the fishers was a little over $380 million.

In 1991 there were 18,000 licenced commercial fishers in British Columbia. Most of these fishers (12,000) caught salmon. There were 5,900 licenced commercial fishing boats.

Native Food Fishery



First Nations people are allowed to catch fish for their own use. In most cases, they cannot sell the fish they catch. Native people may use traditional fishing methods (traps, weirs and nets) or modern fishing methods (boats, rods and reels).

First Nations people believe that some things (e.g. fish, trees, wildlife) cannot be owned or managed. They feel that since they have always hunted and fished it is their right.

Because fish are such an important part of their culture, Native people have a special right to fish for food. Natives can also catch fish to use for their ceremonies. When the government makes the rules for the groups of fishers each year, the Native right to fish is very important.

Native Facts & Figures

About 1.2 million salmon are caught in the native food fishery in British Columbia. More than half of these salmon (752,000 salmon) were caught in the Fraser Basin in 1991. Sockeye salmon made up 80% of the catch. Native people also catch other species of salmon. Herring, trout and shellfish are also caught by Native people.

Sport Fishery

Direct Jobs

marina operator
fishing guide
boat builder
fishing lodge operator
sporting good store owner

Spin Off Jobs

pilot
hotel/motel owner
restaurant owner
tackle manufacturer

Sport fishing is when people catch fish for fun. Sport fishing is also called angling. Sport fishers cannot sell the fish they catch. Anglers must check the rules carefully to find out how many fish they can catch (catch limit) of each kind of fish. Some of the things anglers do are:

1. Get fishing gear (rod, reel, lures).
2. Buy a fishing licence.
3. Follow the government rules for sport fishing. Use a boat or fish from the shore.
4. Enjoy the fishing experience. (Be outdoors, take pictures, have a holiday, swap fishing stories with others, and enjoy the peace and quiet).
5. Prepare fish for eating. (Fish can be barbecued, baked, poached, canned or smoked).
6. Sometimes release the fish they catch. More and more anglers are releasing the fish they catch.

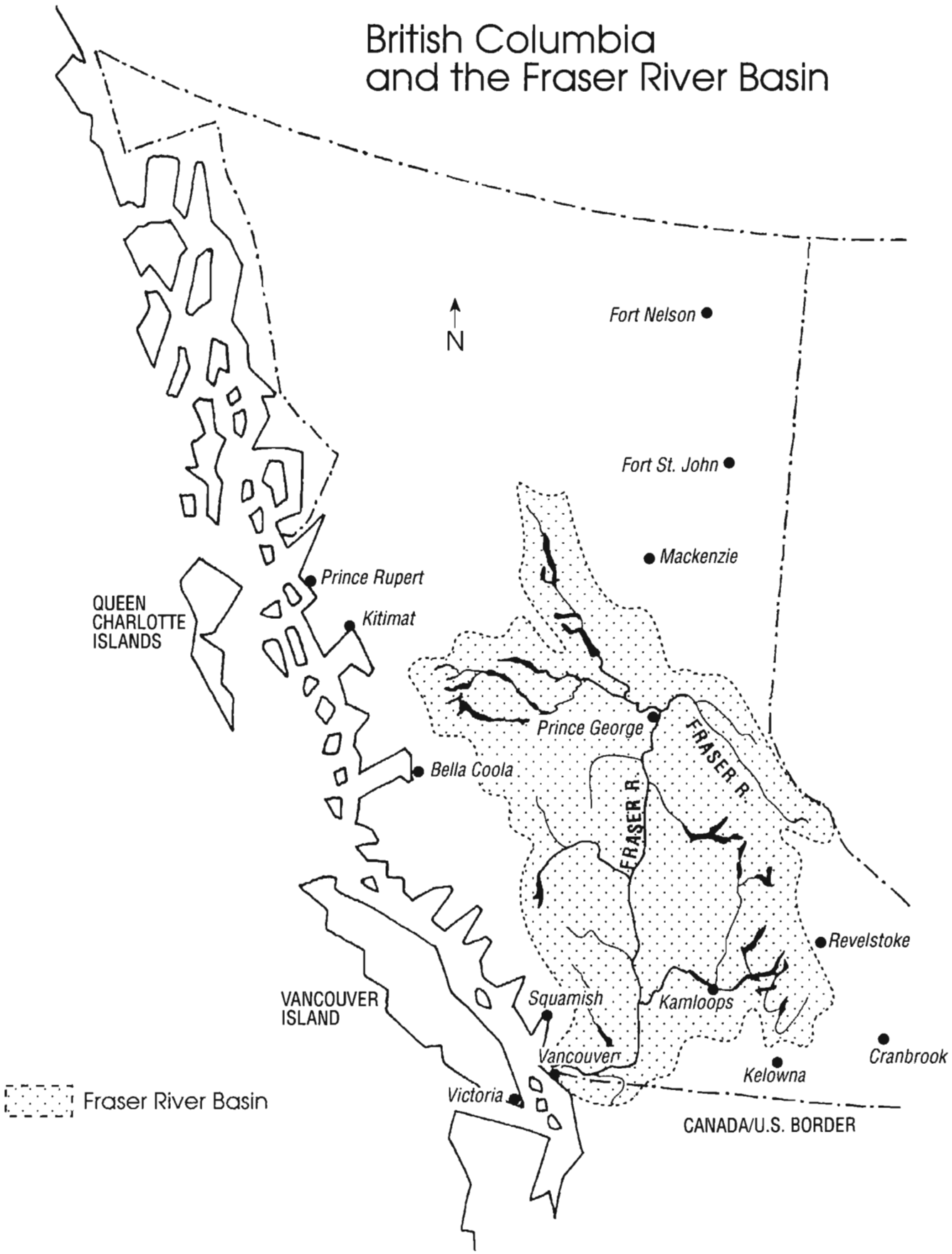
Sport Fishing Facts & Figures

In British Columbia many people fish for sport every year. This means many fishing licences are sold. Tourists also spend a lot of money on angling in British Columbia. One third of every tourism dollar is spent on sport fishing.

In 1991 there were 700,000 licenced sport fishers in B.C. Some sport fishers have licences to fish in saltwater (400,000); other sport fishing licences are only for freshwater. Some anglers have both licences.

Anglers spend about $700 million each year in British Columbia. About half of this money ($370 million) is spent in the Fraser River Basin.

Of the fish caught by anglers in British Columbia almost half are caught in the Fraser Basin. Many of these fish (about 20%) were caught in the Thompson-Nicola area.


British Columbia
and the Fraser River Basin
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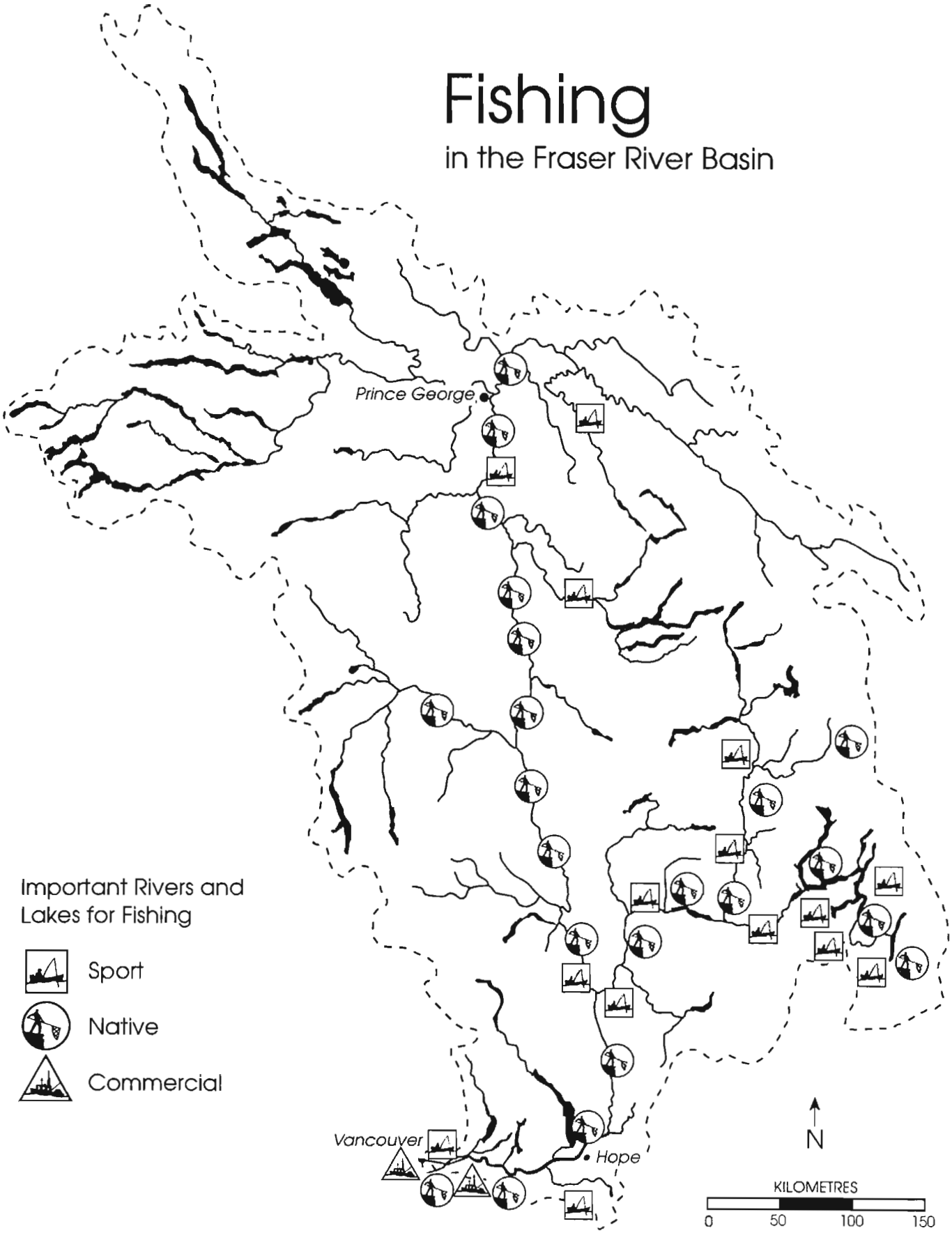
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Kitimat
QUEEN
CHARLOTTE
ISLANDS
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
Squamish
Kamloops
Vancouver
Cranbrook
Kelowna
Victoria
CANADA/U.S. BORDER
Fraser River Basin

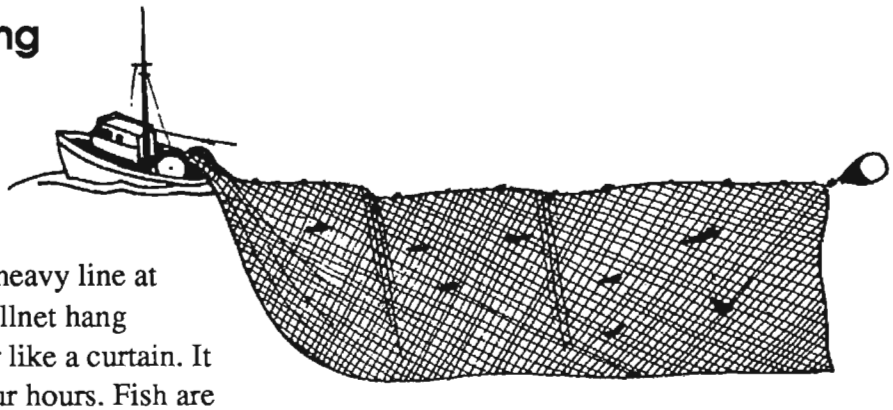
Fishing

in the Fraser River Basin



Map Information - Fishing

Commercial

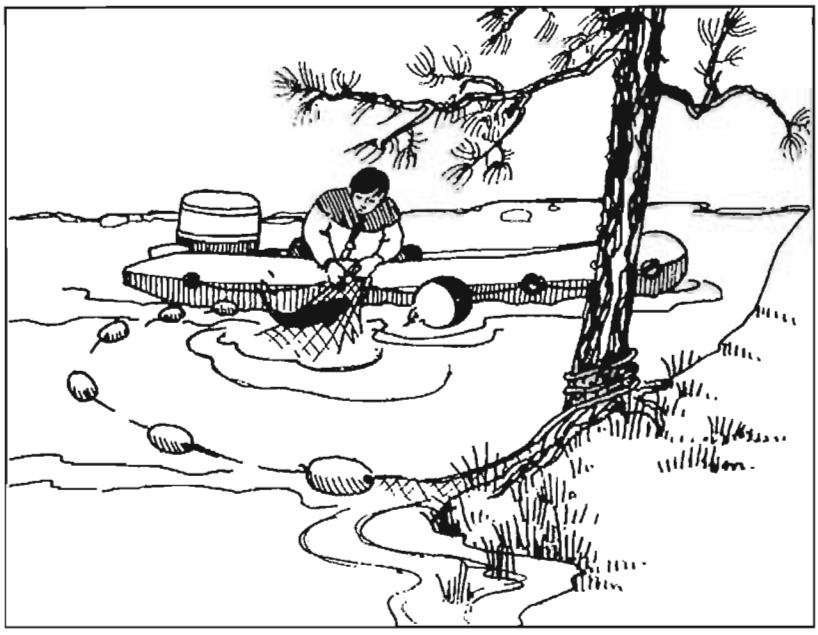


One boat used by commercial fishers is a salmon gillnetter. A gillnet is a long, rectangular net. It has floats on the upper edge and a heavy line at the bottom edge. This makes the gillnet hang down from the surface of the water like a curtain. It drifts behind the boat for one to four hours. Fish are caught when they swim into the gillnet and get tangled in the webbing. There is often only one fisher in this boat. The fisher winds the net in and pulls the salmon out. On a good day, a fisher may catch over 500 salmon.

Sport

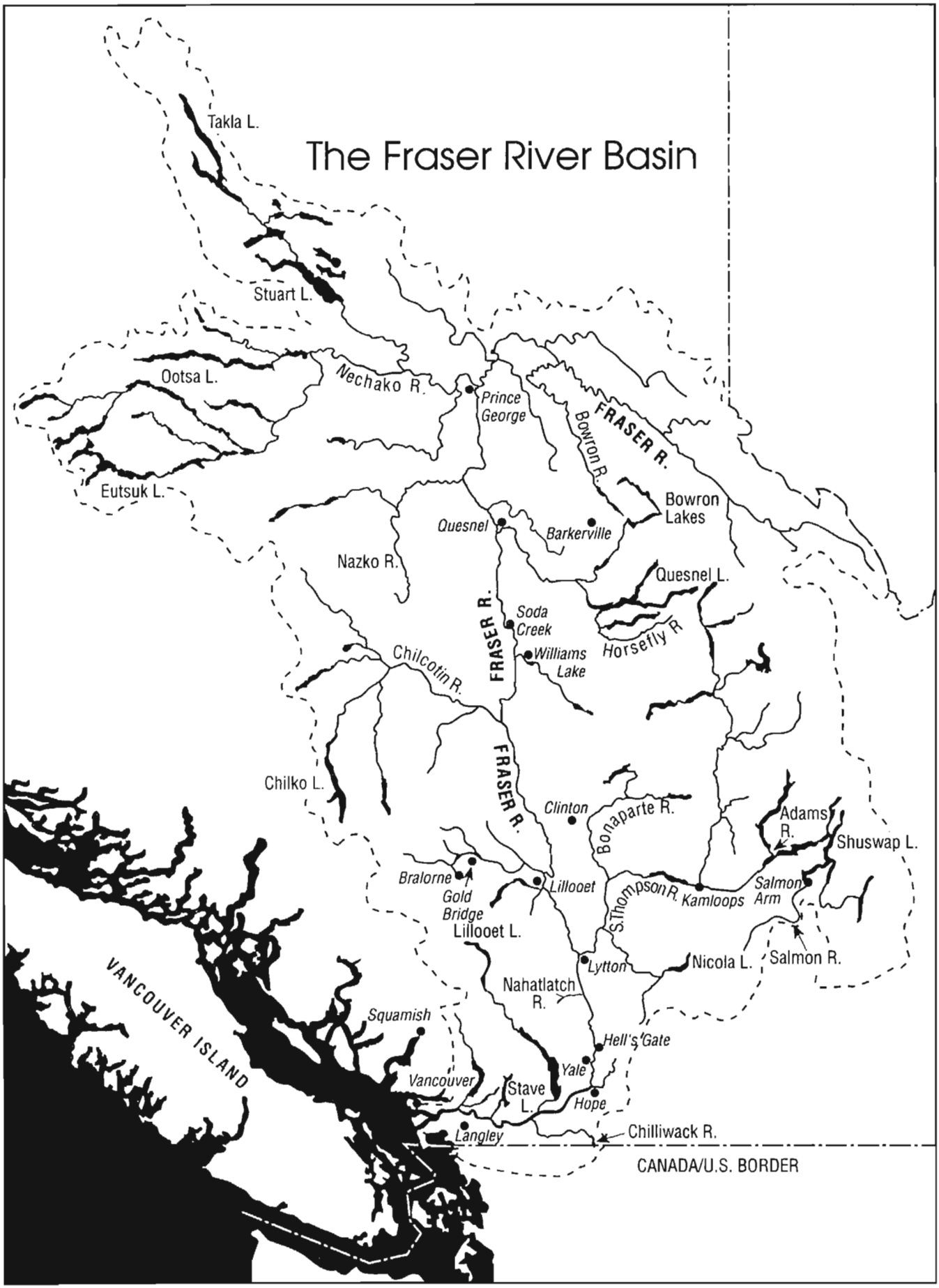
Anglers fish in saltwater, in freshwater, or in both. They fish off sandbars, from the sides of streams or lakes, and from boats. Anglers use fishing rods (long poles), reels (spools that hold the fishing line) and lures (shapes that attract the fish). For many anglers, fishing is a magical time. Anglers may have special or "lucky" lures they always use. They may follow a set of customs or routines. They may always wear the same clothes, eat the same food, or awake at the same time. Anglers believe these customs will make them catch more fish. More and more anglers are releasing the fish they catch.

Native



Years ago, Native Indians caught salmon with spears, harpoons, gaff hooks, nets, and traps. Nowadays, almost all Native fishers use gillnets or dip nets. For example, gillnets are used in three ways:

- The net drifts behind a boat. This is the same as commercial gillnetting, except the net is shorter. This method is used in the middle of slow-moving rivers.
- One end of the net is tied on shore. The other end of the net is weighted with an anchor in the water. The fishers use a boat (canoe, motor boat, rowboat) to get the fish out of the net. This method is used in the slower parts of fast-moving rivers.
- The net is strung along a pole, like a shower curtain. A pulley line makes the net move in or out along the pole. When the net is in the water, it hangs down and the fish get tangled in the mesh. The fisher pulls the net in along the pole, and takes the fish out. This method is used when the water is moving fast and the fish swim near the edge of the shore.


The Fraser River Basin
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VANCOUVER ISLAND
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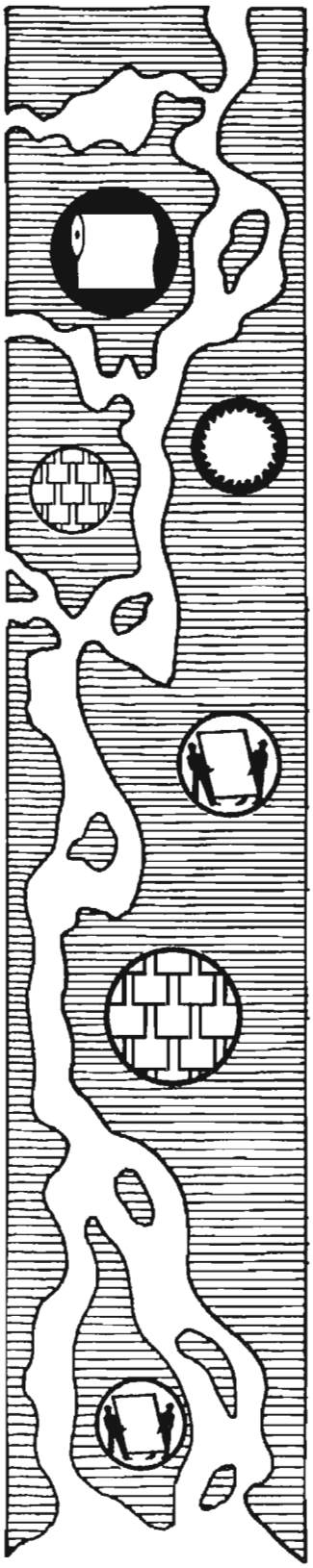
Forestry



Many people think the forest industry just **harvests** trees. It is also responsible for:

- managing (making decisions about forests)
- milling (making products from trees);
- silviculture (replanting and caring for forests).

Some of these activities are described below.

***Harvest**: To gather in a ripe crop. Trees are harvested, or cut down, in B.C. when they are mature.*

How Forestry Works

The Province of British Columbia owns 94% of the forest land. The government lets the forest industry harvest some of this land. In turn, it gets money from the industry for: the sale of the trees, taxes, licences and leases (like rent).

Managing

The government of British Columbia manages the forests. It makes a plan to show: how much forest may be logged, where the forest may be logged and who can do the logging. It must make sure that logging does not harm water, wildlife, ranches, tourism and recreation. It also fights forest fires and controls bugs that harm trees.

Harvesting

Logging companies cut down trees. Before they cut they must make a logging plan. The plan is shown to the Ministries of Forests and Environment. It is shown to the Department of Fisheries as well. All people who live in British Columbia can see the Forest Plan.

How Trees Are Logged in B.C.

Clearcut Logging

All of the trees from an area of forest are cut. It is used when most trees are about the same age. About 80% of B.C.'s logging is clearcut.

Selection Logging

Only some of the trees from an area of forest are cut. It is used when trees in a forest are uneven in age. The older trees are cut. The young trees are left to grow. About 15% of B.C.'s logging is selection.

Seed-tree Logging

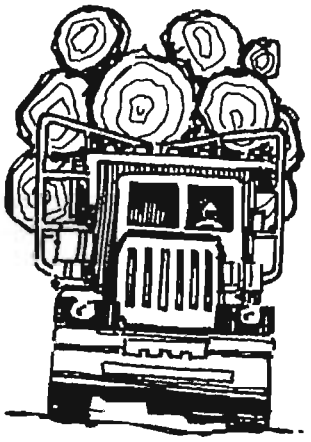
All of the trees are cut except for a few older trees. These trees are healthy and strong enough to withstand the wind. These trees provide seed to reforest the area. About 5% of B.C.'s logging is seed-tree.

Shelterwood Logging

This new method is being used in a few places in B.C.

The plan is checked to see how the logging might affect fish, other wildlife, the water and the soil. This plan makes sure the logging company follows rules. The company must:

- tell how the trees will be logged;
- show what roads will be built to get to the trees;
- have a plan to replant the forest when logging is finished;
- show how fish, wildlife, water and recreation will be protected.



Once the logging plan is approved, the roads and bridges are built. Then the trees are harvested, as shown on the chart.

Felling	The trees are cut down.
Bucking	The branches are cut from the fallen trees and the trees are cut into logs.
Yarding	The logs are moved from the cutting area to the loading area. They are pulled along an overhead cable system, dragged along the ground by a skidder or lifted by helicopters or balloons.
Loading	Large machines load the logs onto trucks.
Hauling	Trucks, booms or barges move the logs to a sorting yard.
Scaling	The logs are weighed.
Sorting	The logs are sorted by quality (how good the wood is).
Hauling	Trucks or log booms move the logs to the mills.

Milling

Mills take raw logs and turn them into something that people use. Sawmills change logs into lumber to build houses, schools and other buildings. Most mills have some wood waste (sawdust, wood chips, shavings, bark). It is not thrown away. It is used to make pulp for paper, absorb oil spills and add to sausages. It is used in stalls for horses, for topsoil, for dykes around cranberry fields, and on pathways for trails in parks. It is also burned to make electricity and steam in pulp and paper mills and to dry wood in sawmills. There are four main kinds of mills: sawmills, panel mills, shake and shingle mills, and pulp and paper mills.

Sawmills

In some sawmills, bark is stripped off the raw logs. (This is like a huge carrot peeler.) The logs are then cut lengthwise into 10 - 15 cm thick slabs. Each slab is cut by another saw into different sizes of lumber. The lumber is dried in a huge oven or kiln. Another machine makes the lumber smooth.

Panel Mills

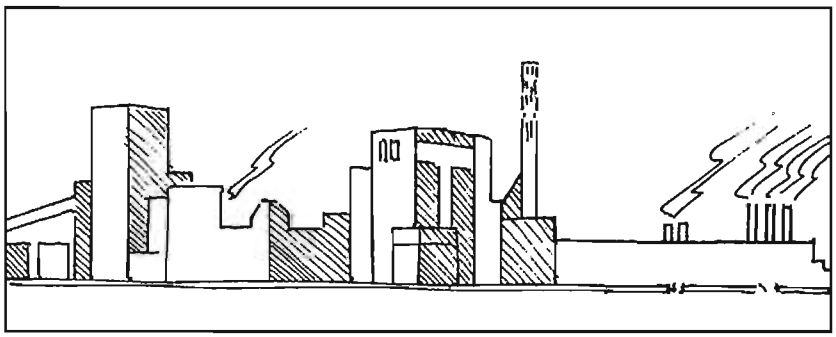
Panels are layered sheets of wood. Each sheet is about 2.4 m long by 1.2 m wide. Plywood, particle board and strand board are all panels:

- Plywood can be made by removing a thin layer of wood from a turning log. This thin piece of wood (2 mm thick) is called veneer. The veneer is cut into rectangles. Layers of veneer are glued together, heated and pressed to make plywood.
- Particle board is made when sawdust is glued and pressed tightly.
- Strand board is almost the same as particle board. But it uses sawdust and wood chips and it is stronger.

Shake and Shingle Mills

These mills use only western redcedar trees to make shakes and shingles for house roofs. The oils in cedar keep it from moulding and decaying for a long time. It is a good product to use outside. At the mill, cedar logs are cut into 45 - 60 cm lengths. A large mechanical axe splits each piece into 5 or 6 blocks. This is like chopping firewood, but the pieces are much bigger (32 - 45 kg). To make shingles, the block is tilted each time it is cut by the saw. This makes a thin, wedge-shaped piece of wood. (Like a thin slice of cake, lying on its side. The thick edge slopes down to the thin edge.)

Pulp and Paper Mills



Pulp and paper mills use wood chips from sawmills to make pulp. They also use logs that are not good enough for lumber by chipping them into wood bits. Pulp is a soupy mixture, like oatmeal, that is used to make paper. Pulp is made by adding water and chemicals to the wood chips. This mixture may be put into a grinder and heated, or just heated. Paper is made when the pulp is fed through rollers and pressed tightly to squeeze out the water.

Facts and Figures

Hectare: *10,000 square metres. A bit bigger than two football fields side by side.*

About 26% of the land (21 million **hectares**) in the Fraser River Basin is forested. But only half of this area (10 million hectares) is good for cutting.

Most of the logging in the Fraser River Basin takes place north of Hope. Only a few people live in the north so there is still a lot of forest land. The Lower Fraser River Basin, between Vancouver and Hope, was logged many years ago. The forests were also damaged by floods. This land was not reforested because it was used for cities and farmland. There are still some patches of forest, but there is less logging than in the northern part of the Fraser Basin.

In 1992, about 80,000 people worked in the forest industry in British Columbia. The best guess about the number of people employed in the forest industry in the Fraser River Basin is between 48,000 - 53,000.

Products:

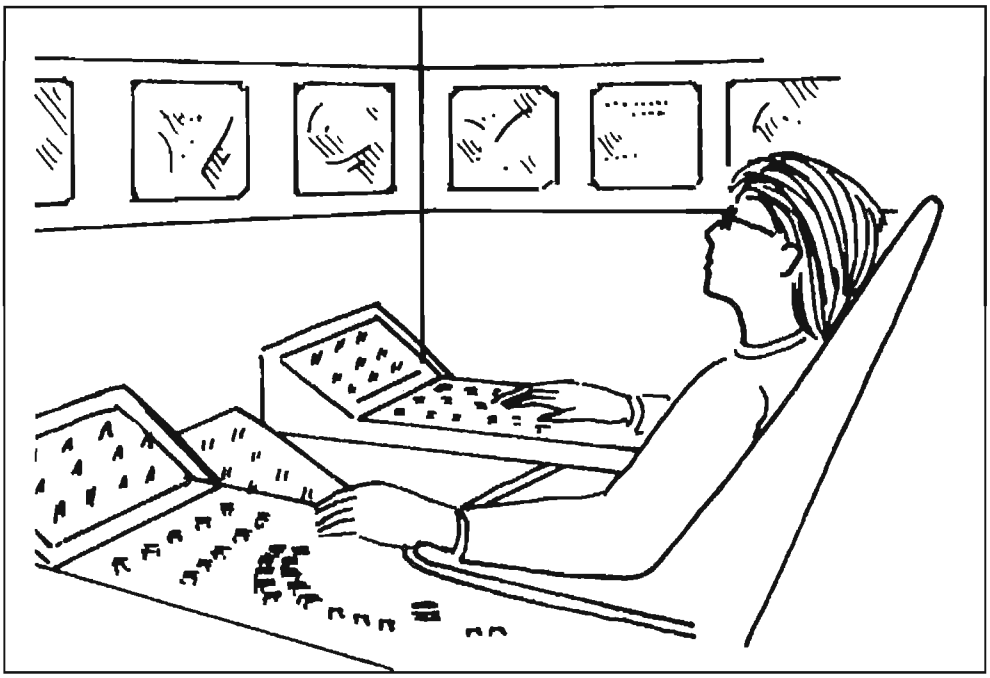
lumber
newsprint
shingle
paper
ceiling tile
paint
antifreeze
heating fuel
cellophane
cosmetic
glue
film
aspirin
candle
paper towel
newspaper
cardboard

Direct Jobs:

faller/bucker
forester
sawyer
timber cruiser
tree planter
equipment operator
lumber trader
millwright
chokersetter

Spin Off Jobs:

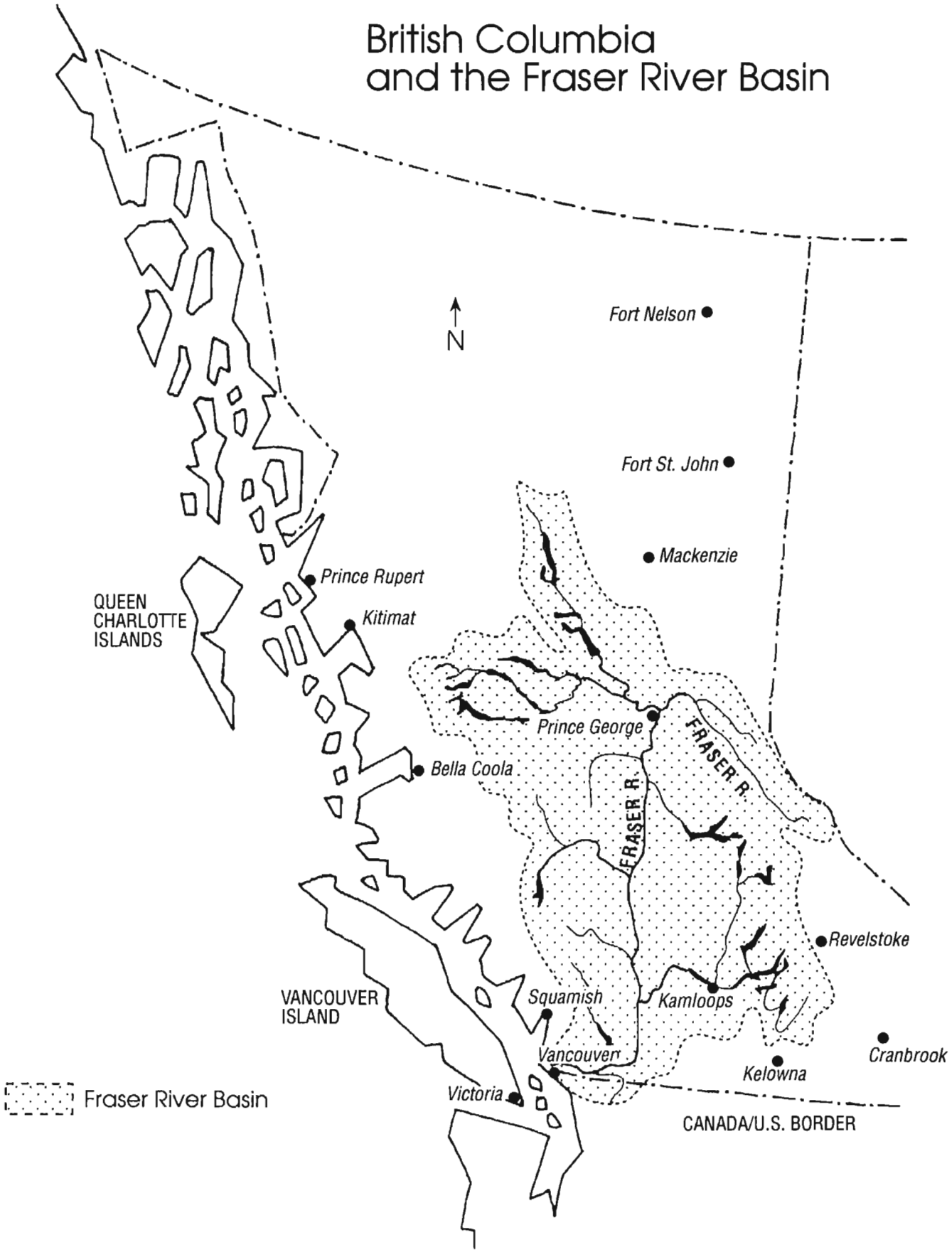
forest ecologist
conservation officer
fire fighter
guide
mechanic
park interpreter
furniture maker
furniture salesperson
carpenter
pilot



Computerized sawmill control room

It is hard to give the exact number of people working in the forest industry in the Fraser River Basin because:

- workers may live in the Fraser Basin, but have jobs on Vancouver Island
- mills in the Fraser Basin may get wood from Vancouver Island, the Sunshine Coast or the Queen Charlotte Islands;
- the Chief Forester may change the amount of wood that may be cut in an area depending on the health of the forest, and jobs are gained or lost in a short time.


British Columbia
and the Fraser River Basin
N
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Kitimat
QUEEN
CHARLOTTE
ISLANDS
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
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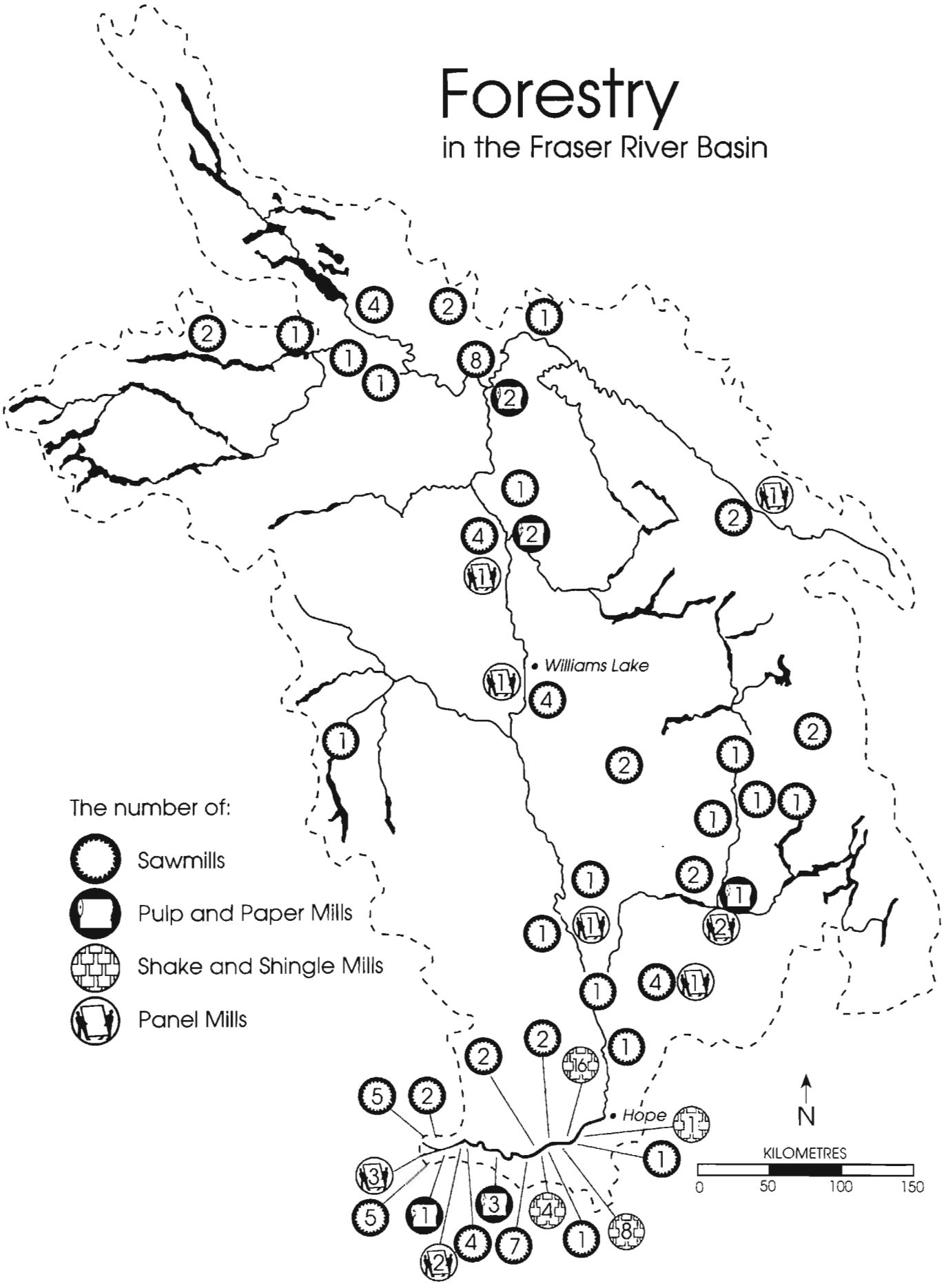
Forestry

in the Fraser River Basin



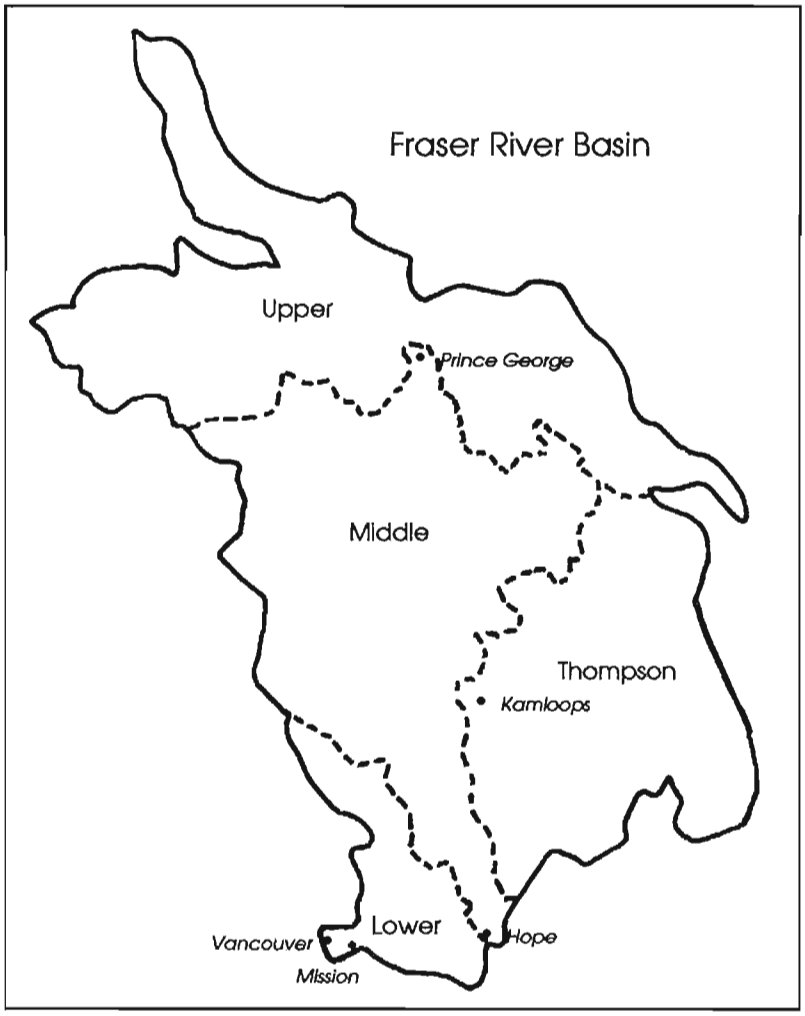
Map Information - Forestry

The Forestry Map shows the location of some of the sawmills, pulp and paper mills, shake and shingle mills and panel mills in the Fraser River Basin.

As well as these mills, there are at least five other kinds of mills in British Columbia. There are mills that make wood chips, log homes, posts, rail ties and poles. There are even two mills making chopsticks!

Area	Sawmills	Pulp & Paper Mills	Shake & Shingle Mills	Panel Mills
Lower	29	4	30	6
Thompson	8	1	1	4
Middle	29	4	0	4
Upper	16	0	1	1
Total	82	9	32	15

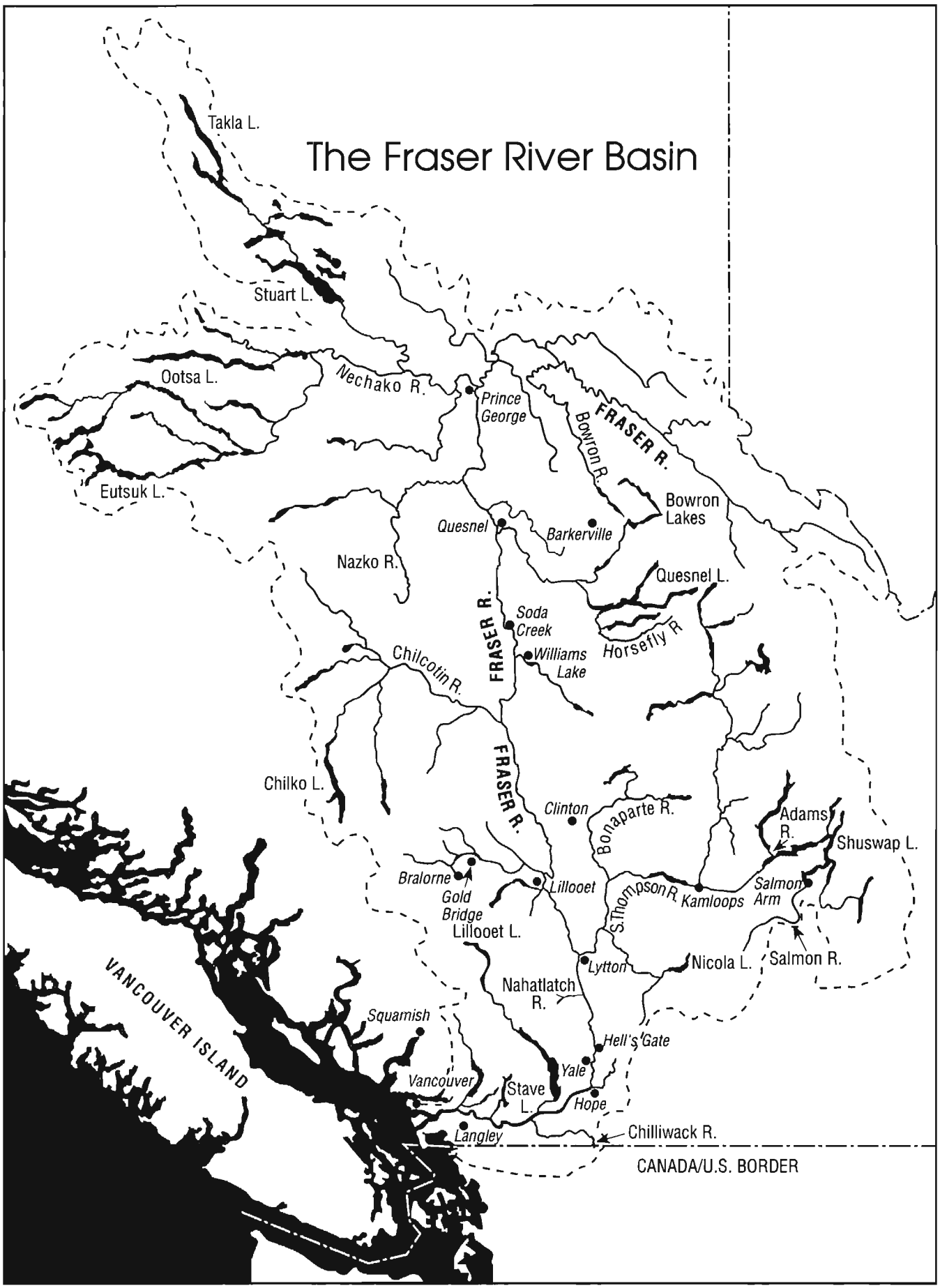
This chart shows the number of mills in each of the four parts of the Fraser Basin in 1994.



Almost all of the shake and shingle mills are in the Lower Fraser. In fact, about 16 of these mills are near Mission. There is good reason for this. The Western Redcedar used to make shakes and shingles grows mainly in the Lower Fraser. It is easier and less costly to use this wood in mills that are nearby. When the trees are cut, they are placed in log booms in Stave Lake and Pitt Lake. The booms move down the Stave or Pitt Rivers to the Fraser River, where they are pulled to the mills on the Fraser.

There are far more sawmills than pulp and paper mills. This is because of the size of the mills.

- Sawmills may be small (1 - 2 people) or big (300 - 400 people).
- About 25% of the sawmills in British Columbia employ less than 25 people.
- Pulp mills are usually large (200 - 400 people).
- It may take many small sawmills to supply the wood waste to one large pulp mill.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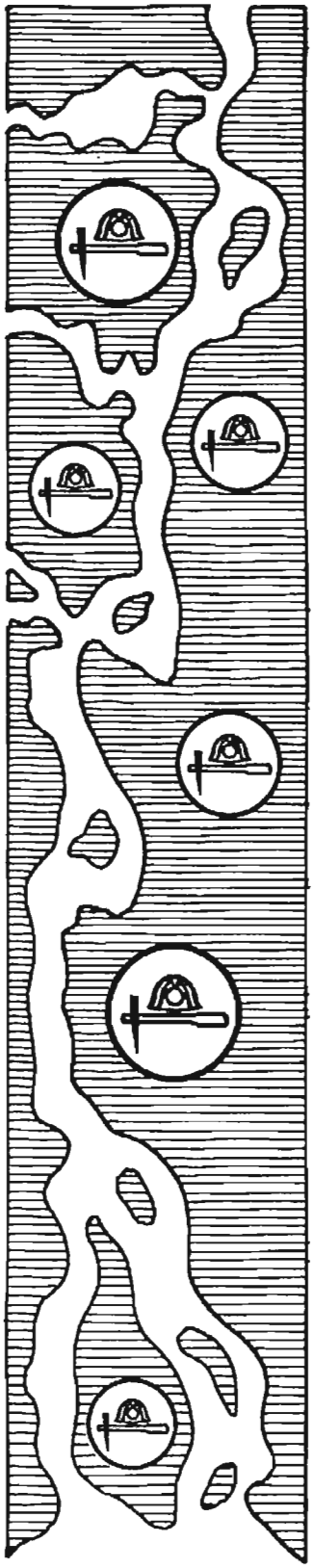
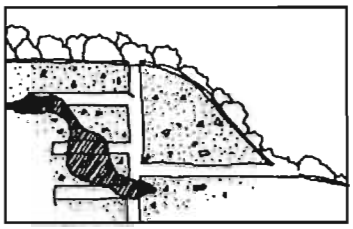
Mining



The mining industry takes minerals and coal from the earth for use by people. Minerals are substances in nature that are not animals or plants. Salt, graphite, gold, copper and sulfur are some minerals.

Mineral deposits are all over the earth. They are being formed all the time, but it can take millions of years. The limestone that is mined now was formed by the remains of ancient ocean animals. Coal was formed in swamplands millions of years old. Gold, silver, lead and zinc are formed in rock by heat within the earth.



Mineral Deposit: *An area in the ground that has a lot of minerals.*

How Mining Works

Before mining can start, the company must get a work permit from the government. Then they can start exploring for minerals. **Exploration** may take years and cost millions of dollars. Often the geologists (people who study minerals) find that there are not enough minerals found in one place. This means it will cost a lot of money to get the minerals out of the ground. Sometimes geologists find lots of minerals in one place. This helps make the mine profitable. The mineral value is so high, it can pay for all the costs of mining and leave a profit for the company. But out of 500 places there may be only one that is good to mine.

Exploration: *To search. Geologists try to decide if the land has valuable minerals. They use maps and satellite images. They may drill test holes in the earth.*

What do companies think about before they decide to mine?

Value - Some minerals are worth more than others because people need or want them.

Size - Minerals in large deposits give more minerals for less work.

Difficulty - Minerals near the surface cost less to mine.

A valuable mineral will be mined, even if it is in a small deposit or hard to mine.

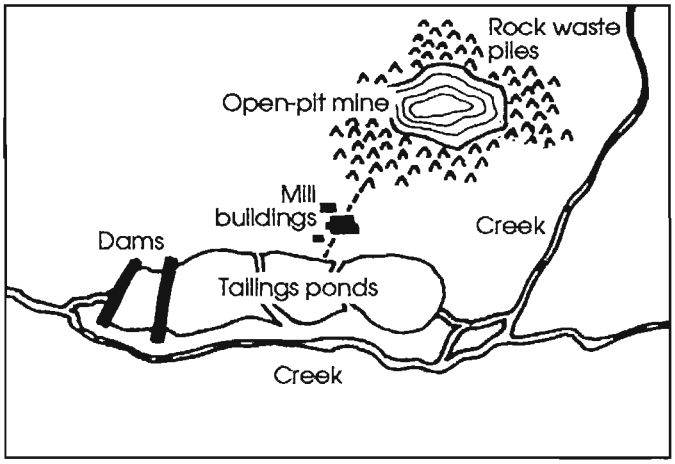
There are laws that the mining company must follow. Some of the laws help to protect the environment. Other laws keep the workers safe in the mine.

Reclaimed: *Restored. The land is put back to a natural state.*

Once the company decides to mine, it gives the government a detailed plan of how the land will be mined and **reclaimed**. The plan must be approved before mining starts.

Then all parts of the mine are built.

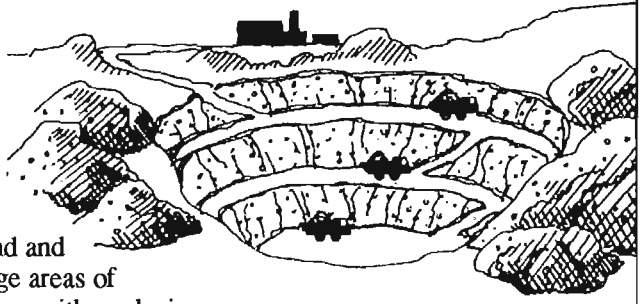
- All the buildings are constructed. These include: offices, storage space, labs and mills.
- Power lines, roadways and water and sewer pipes are put in place.
- Areas for rock waste are chosen.



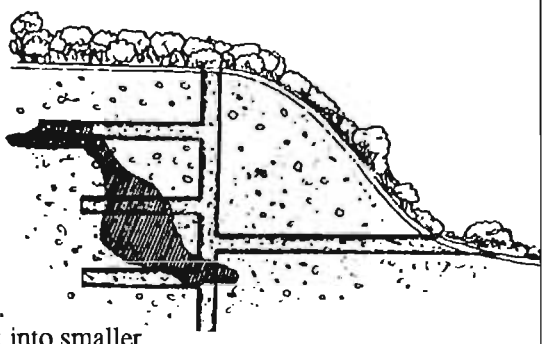
Plan of a Zinc Mine

Then the mine is opened. It may be a surface or an underground mine.

Open-pit mining is a **surface mining** method. It is used when small amounts of minerals are widespread in a large volume of rock near the surface of the earth. The soil is removed from the land and stored to be used later. Large areas of rock are broken up by blasting with explosives.



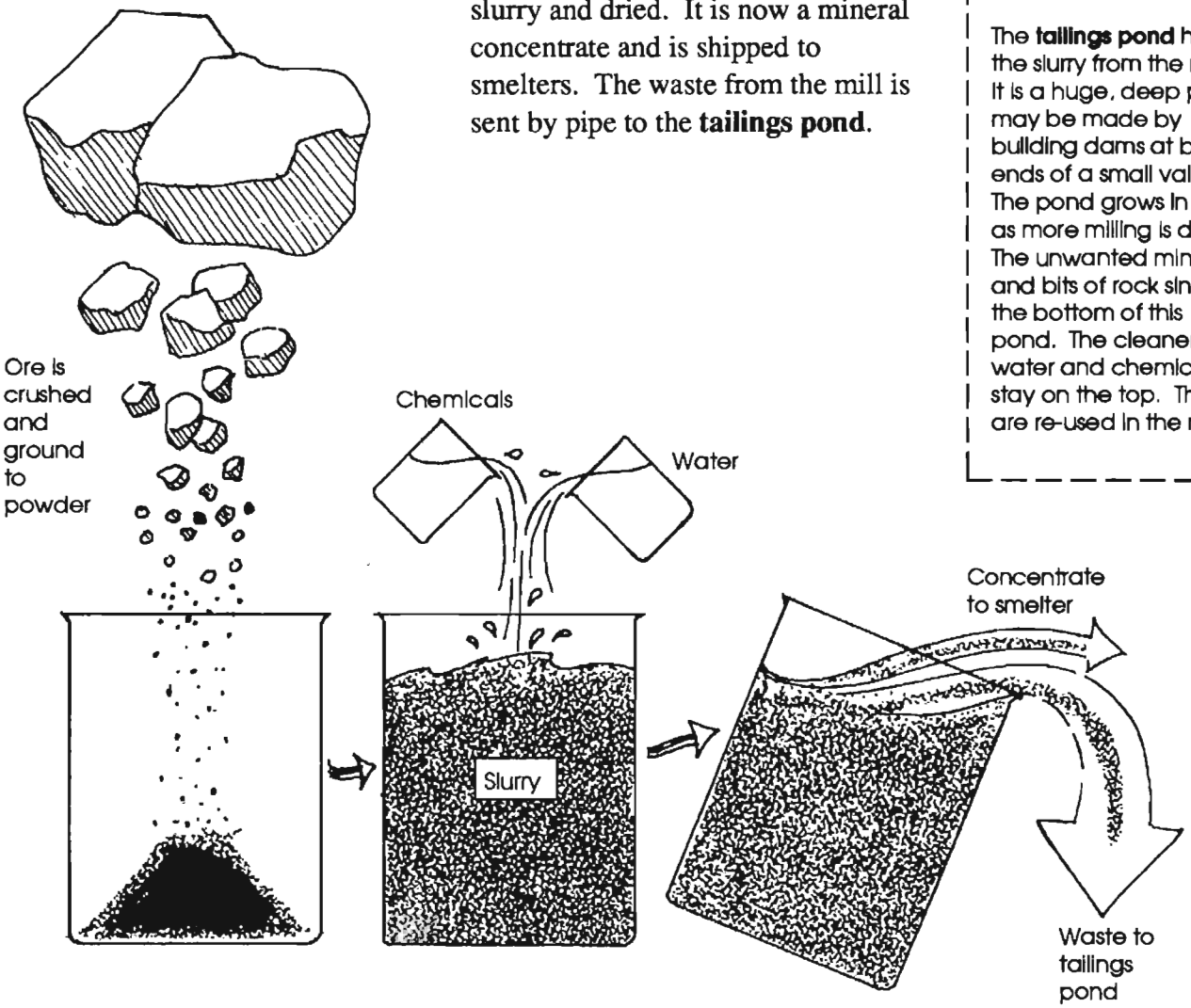
Level and shaft mining is an **underground mining** method. It is used when minerals are deep in the ground and concentrated in zones. It may be used when surface mining cannot be done. A shaft like an elevator is dug down into the earth. Then tunnels, called drifts, are dug from the shaft along the line of the mineral deposit. Explosives are used to blast the rock into smaller chunks. The rock is moved by small trucks or trains to the shaft. It is lifted by machine to the opening of the mine.



Some of the rock brought out of a mine has no minerals. This **waste rock** is put in large piles away from the mine. The rock that has the minerals is taken to a crusher. Here the large boulders are made smaller for the mill.

At the mill, the minerals are separated from the rock. First, the rock is fed into large grinding mills and crushed until it looks like flour. Next, water and chemicals are added. This is called a slurry. The chemicals make the minerals separate from the rock.

The bits of mineral are taken from the slurry and dried. It is now a mineral concentrate and is shipped to smelters. The waste from the mill is sent by pipe to the **tailings pond**.



Waste rock does have some minerals. But often they are not taken out of the rock, because it is costly. However, some mines now have ways to get these minerals. This makes it more profitable for the mine because more minerals can now be taken from the same amount of rock.

The **tailings pond** holds the slurry from the mill. It is a huge, deep pit. It may be made by building dams at both ends of a small valley. The pond grows in size as more milling is done. The unwanted minerals and bits of rock sink to the bottom of this pond. The cleaner water and chemicals stay on the top. They are re-used in the mill.

When mining is finished, the land is reclaimed. Underground mines are sealed. Then the land around the mine may be covered with the stored soil and replanted. Surface mines may be replanted as well, or the open pit may be flooded to make a new lake.

Direct Jobs

driller
blaster
loader
hauler
computer operator
accountant
first aid personnel
mechanic
geologist
biologist
supervisor
engineer
carpenter.

Spin-Off Jobs

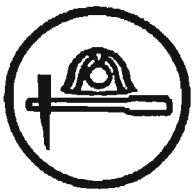
jewellery store owner
dentist
concrete plant
manager
manufacturer
accountant
steel worker
train engineer
truck driver
freighter crew
long-shoreman

Products

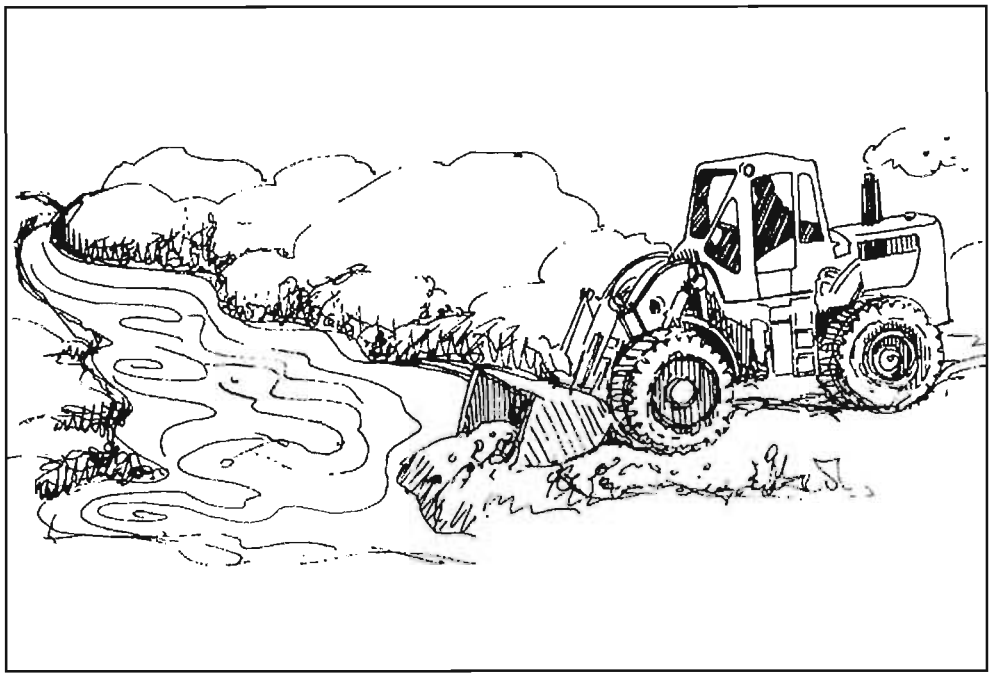
skateboard
desk
glass
linoleum
cement
carpet
sidewalk
brick
car
book
chalk
pencil
paint
pen
cosmetic
plastic

Facts and Figures

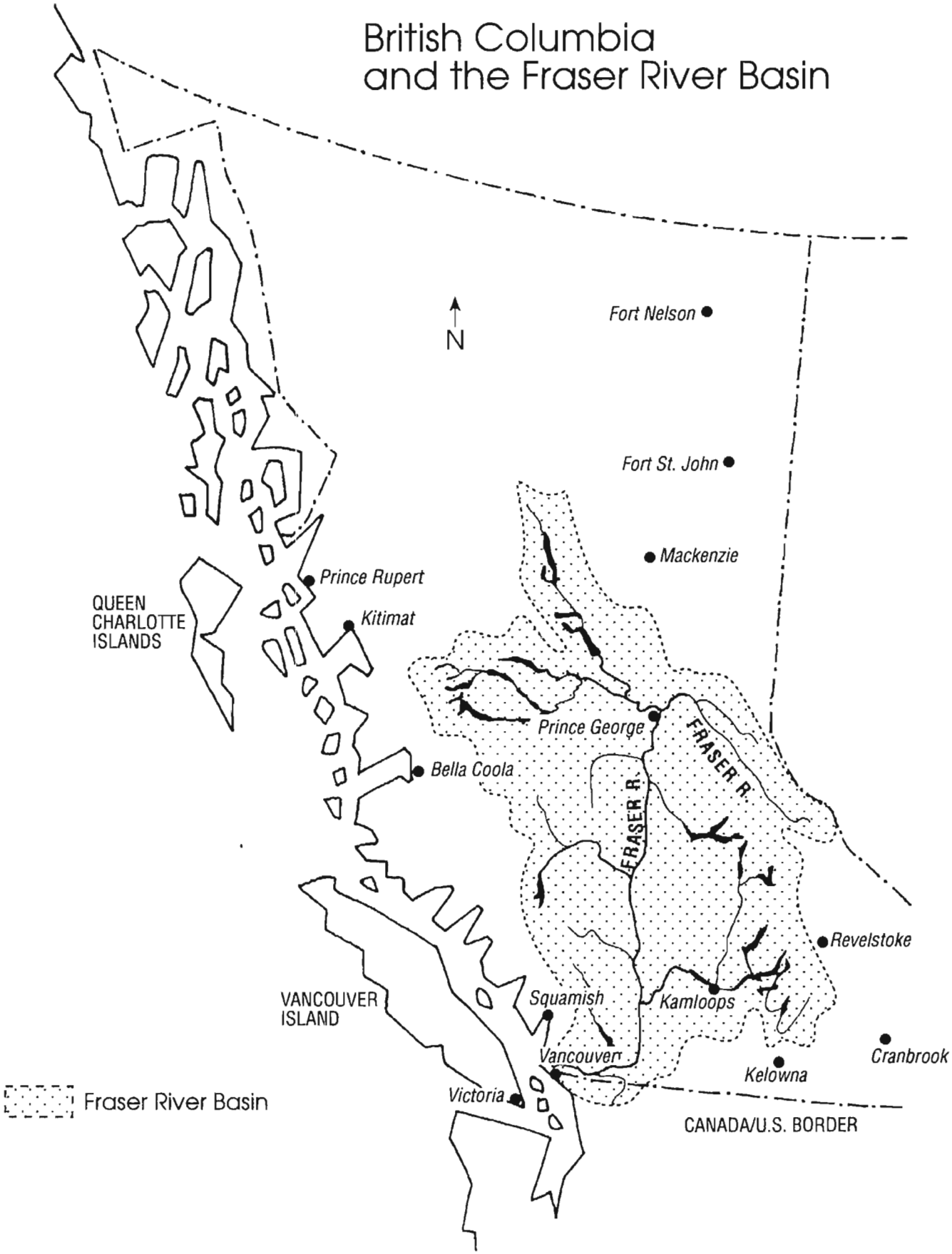
In 1993, about 9,000 people were employed by the mining industry in British Columbia. The best guess is that 42% of these people (3,700) were employed in the Fraser River Basin.



In 1994, there were fifteen mines working in the Fraser River Basin. The minerals being mined were: gold, copper, silver, limestone, clay, granite, magnetite, fire clay and shale and molybdenum. There were also many small placer mines (one-person gold panning).



Today's placer miners may use a front-end loader .


British Columbia
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Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Kitimat
QUEEN
CHARLOTTE
ISLANDS
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
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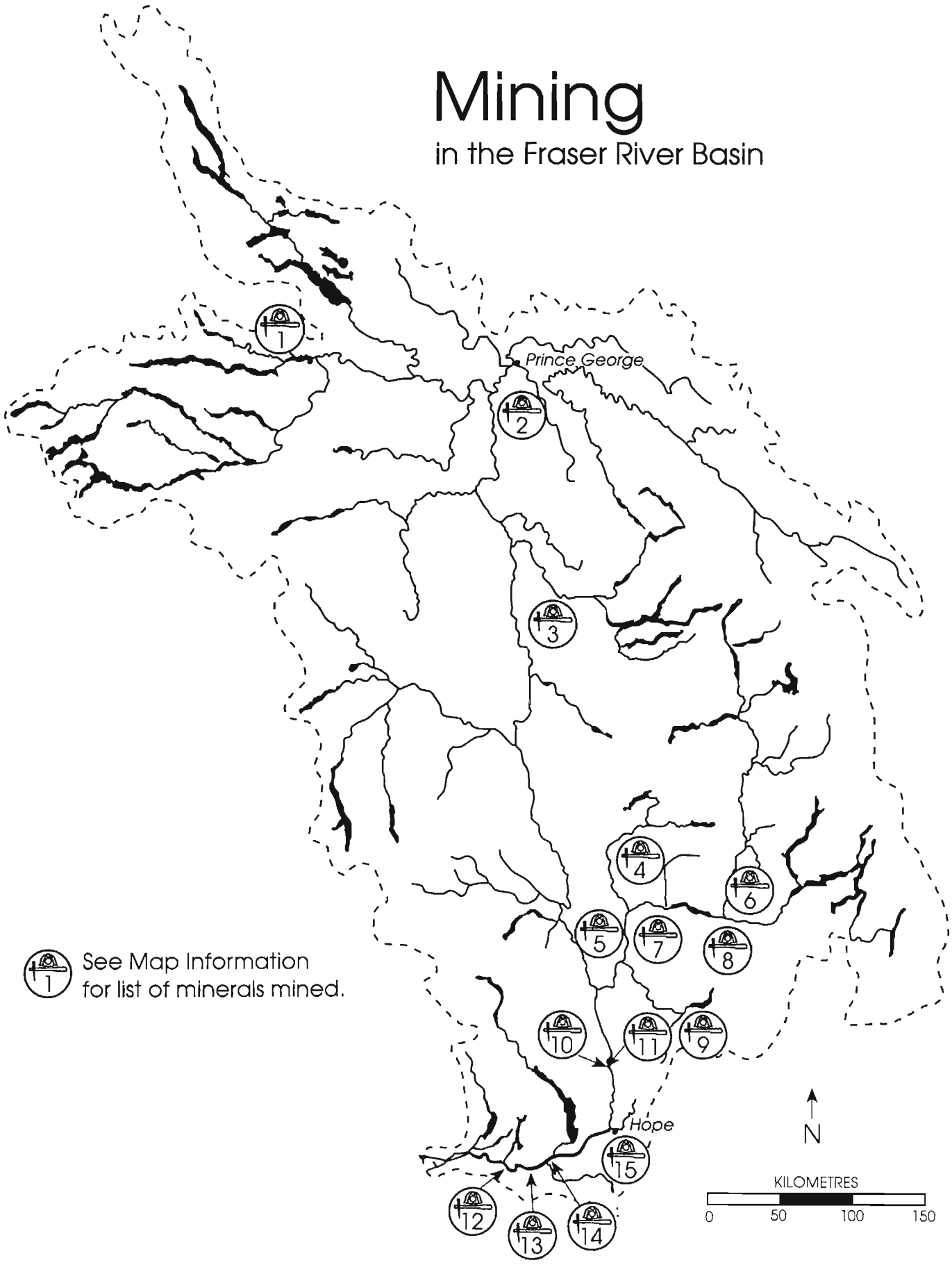
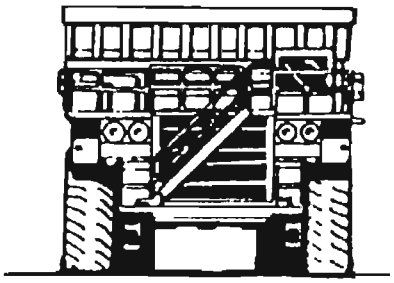
Mining

in the Fraser River Basin



See Map Information for list of minerals mined.

Map Information - Mining

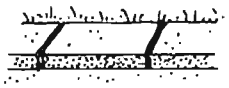


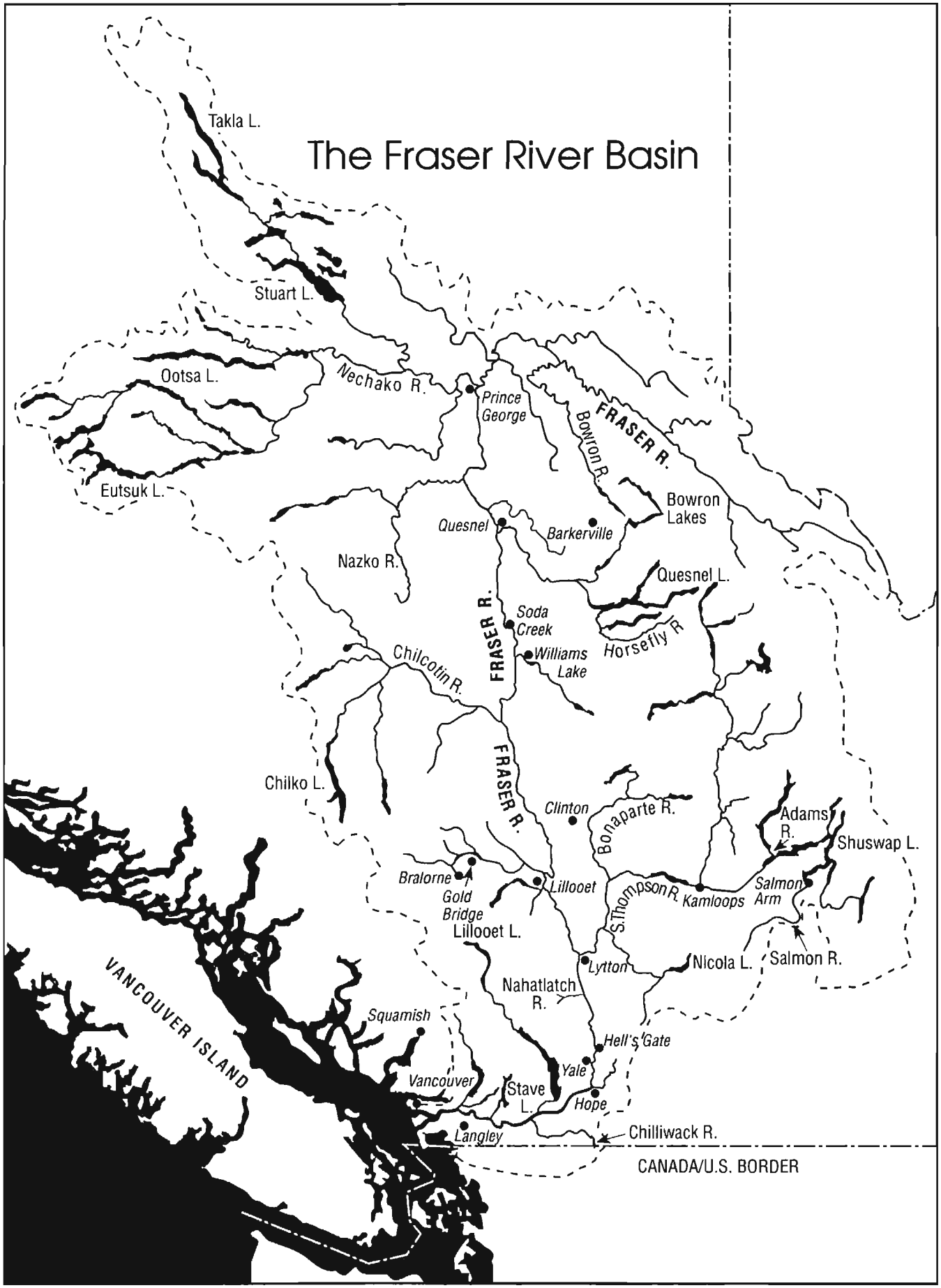
The Mining Map shows working mines in the Fraser River Basin in 1994.
Mines may close because the value of the minerals is low or the cost of mining is too high. Mines may also close because there are no valuable minerals left.
When the mineral value goes up or the costs go down, the mine reopens.

#	Minerals	Tonnes Milled Each Year	Days Open Each Year	People Employed
1	Molybdenum	9,500,000	350	228
2	Limestone	20,000	60 - 90	10
3	Copper, gold, silver, molybdenum	23,700,000	304	244
4	Clay	No Data	365	35
5	Limestone	260,000	365	35
6	Limestone	150,000	365	10 - 15
7	Copper, gold, silver, molybdenum	44,500,000	365	1,140
8	Copper, gold, silver	No Data	No Data	No Data
9	Magnetite	75,000	270	30
10	Granite	2,000 - 3,000	60 - 90	4.- 8
11	Granite	1,000 - 2,000	150 - 180	4 - 6
12	Fire clay	30,000	365	10 - 15
13	Shale	150,000	365	2 - 5
14	Granite	1,000 - 2,000	90 - 120	4 - 6
15	Granite	2,000 - 3,000	60 - 90	4 - 8

Products

Some products made from minerals and other materials are listed in this chart:

Product	What's In It? (Minerals are in *italics*)
Skateboard 	*Iron, aluminum, wollastonite, calcium carbonate, clay, sulfur, silica, talc, mica,* coal
Pen 	*Limestone, wollastonite, mica, talc, clay, silica, sulfur,* petroleum products
Sidewalk 	Sand, gravel, *gypsum, iron, dolomite, diatomite, limestone*
Cosmetic 	*Iron, silica, limestone, talc*
Book 	*Clay, limestone,* sodium sulfate, *feldspar*


The Fraser River Basin
Takla L.
Stuart L.
Ootsa L.
Nechako R.
Prince George
FRASER R.
Bowron R.
Bowron Lakes
Eutsuk L.
Quesnel
Barkerville
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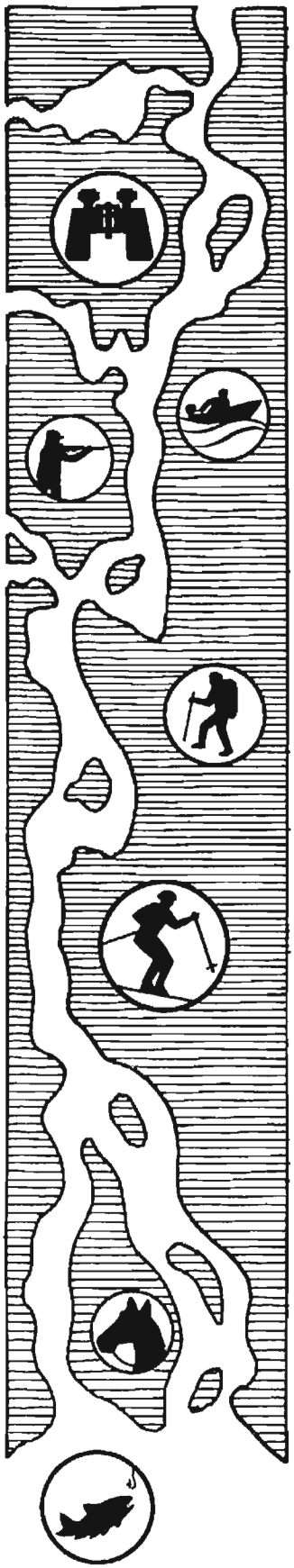
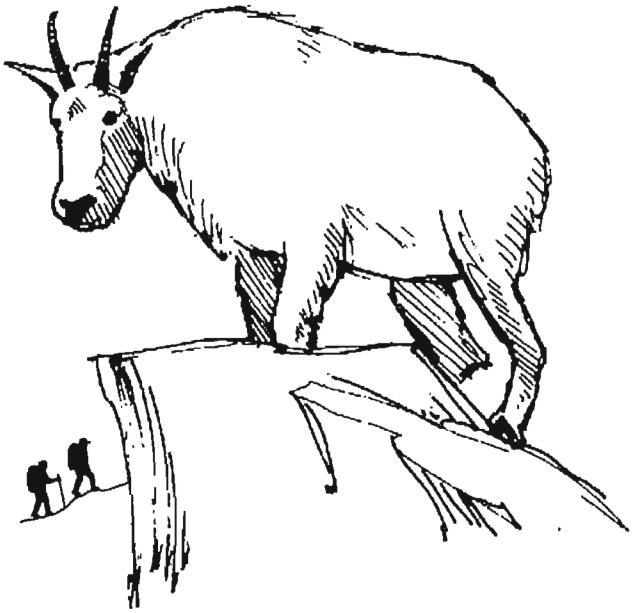
Lytton
Nicola L.
Salmon R.
Nahatlatch R.
VANCOUVER ISLAND
Squamish
Hell's Gate
Yale
Vancouver
Stave L.
Hope
Langley
Chilliwack R.
CANADA/U.S. BORDER

Tourism



Tourism is travel for enjoyment and relaxation. The tourism industry sells anything that makes people want to visit an area. Tourism promotes outdoor recreation, scenery, historical buildings, special events, and wildlife.



How Tourism Works

Many tourists plan a vacation by asking questions. The answers help tourists decide what to do. The plans of two tourists are shown on the chart below. Look at the way the answers affect each vacation plan.

LET'S GO!	**Tourist A**	**Tourist B**
What do I want to spend?	$4400.	$80.
Where do I want to go?	The Fraser River Basin.	The Fraser River Basin.
How long to get there?	It does not matter.	Only 3 or 4 hours by car.
How long can I stay?	One week.	Four days
What do I want to do?	Ski and see the wilderness.	Hike , enjoy the outdoors.
Vacation Plan	Stay at a resort near Gold Bridge and go helicopter skiing.	Camp in Emory Creek Provincial Campsite near Hope.

Tourists can get help planning vacations from the tourism industry by talking to a Travel Agent or a Tourism Centre:

Travel Agent	Tourism Centre
A travel agent will do all the work for the tourist: • get the information, • arrange the transportation, • make hotel reservations, • arrange tours or other activities.	British Columbia is divided into tourism areas. Each one has a Tourist Centre. Tourists use information from the Tourist Centre to plan vacations in that area. But the tourist must make all the arrangements.

A guest ranch is one of the many tourist attractions in the Fraser Basin. Most tourists go to a guest ranch because they want to go horseback riding. Read the chart to find out how a horseback riding adventure happens.

What the Tourist Does	Who Helps
Television advertising attracts tourists to guest ranches in the Cariboo.	film maker, local tourism association
Make reservations at the Rocking XYZ Ranch.	reservation clerk
Catch a plane to a town near the ranch.	pilot, flight attendant
Rent a car and drive to the ranch.	car rental clerk
Check in at the front desk.	reservation clerk
Have a riding lesson on a horse.	riding instructor
Enjoy the home-cooked meals in the cookhouse.	ranch cook, waiter
Sleep in the bunkhouse.	cleaning staff
Go on a seven hour horseback ride.	head wrangler
Buy cowboy hats and books about horses.	gift shop clerk
Pay the bill at the end of the vacation.	guest ranch manager

Tourism is Growing

Tourism has grown to be one of British Columbia's two main industries. Much of this growth is due to more advertising. Both the tourism industry and the government want tourists to see British Columbia as an outdoor province with natural beauty. There are many advertisements that show British Columbia as wild, rugged, beautiful, untouched, and remote.

Rivers and lakes in the Fraser Basin play a main role in this picture of British Columbia. The rivers and lakes attract many tourists. There are over 60 river rafting companies that use the Fraser River and its **tributaries**. Five of the top 10 wilderness canoe routes in British Columbia are in the Fraser River Basin.

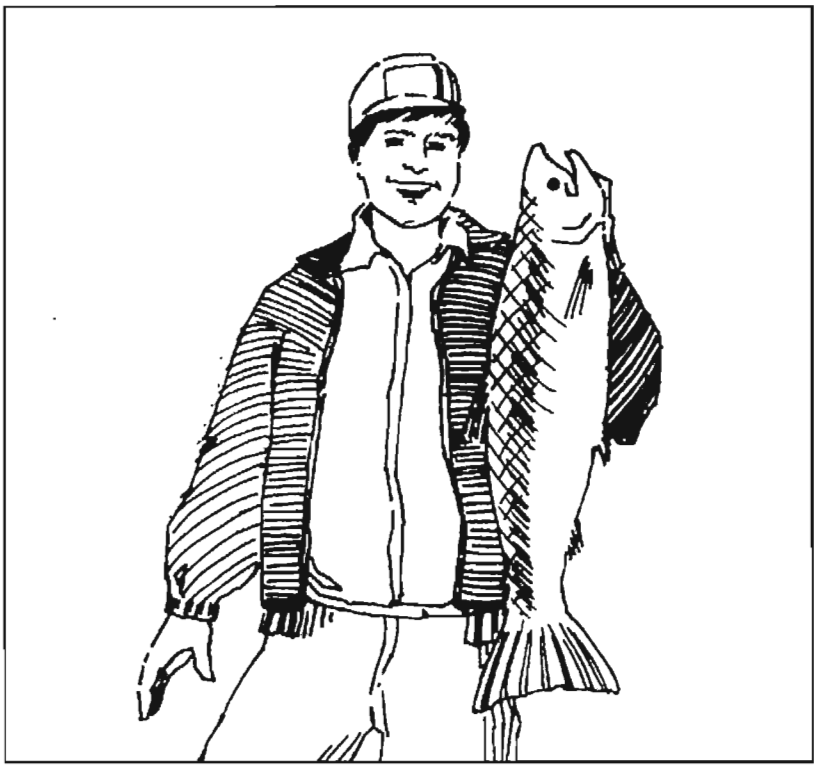
Tributaries: *Smaller rivers that join the main river. The Chilcotin River is a tributary of the Fraser River.*

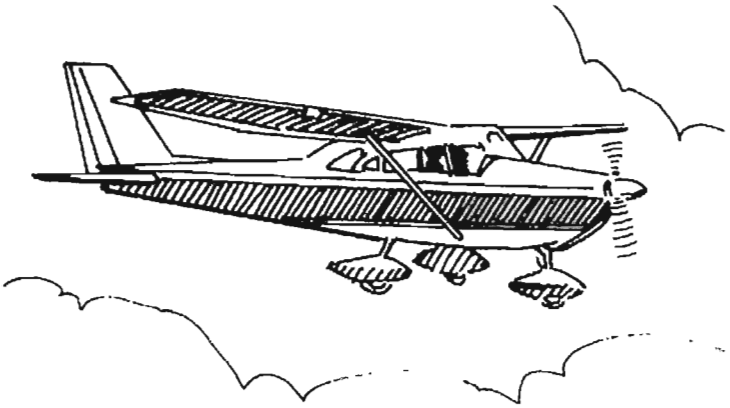
Advertising is just one reason that tourism is growing. Some of the other reasons are listed below.

- There is a wide range of tourism activities.
- People want to do many different things.
- More and more people live in the Fraser Basin.
- People will now spend more money on tourism.
- British Columbia is famous for its scenery, wildlife, wilderness, and outdoor recreation.
- It is easy for people in other countries to find out about British Columbia.
- There are lots of easy ways to travel in the Fraser Basin (car, plane, bus, ferry, train).

Tourism Activities

canoeing
horseback riding
hiking
whitewater rafting
skiing
mountain climbing
snowmobiling
fishing
hunting
camping
kayaking
nature trails
wildlife viewing
photography
shopping
museum
theatre
heritage site
garden
art gallery
science center





There are many tourism businesses. Each one helps to meet the needs of tourists (see chart). For example, the Science Centre in Vancouver is a place tourists like to go. There is a gift shop inside. Across the street is the SkyTrain, which makes it easy to get to the Center. Tourists can eat lunch at one of the restaurants nearby. The Science Center is the main tourist attraction. But the other businesses make some money from tourism because they fill the other needs of the tourists.

Tourists need:	**Businesses that meet those needs are:**
to visit attractions	theme park, museum, natural wonder, garden, park, theater, campground, recreation, outdoor wilderness
to stay somewhere	hotel, motel, resort, bed & breakfast, campground
to travel	car rental agency, airline, bus line, railway, cruise ship
to eat	fast food, take-out, restaurant, delicatessen, supermarket
to buy items	photography, sports equipment, clothing, souvenir
to get help	travel agency, travel research, advertisement, government and community travel information service.

Tourism and the Economy

Direct Jobs
- market researcher
- travel agent
- pilot
- guide/outfitter
- hotel manager
- chef
- park ranger
- information officer

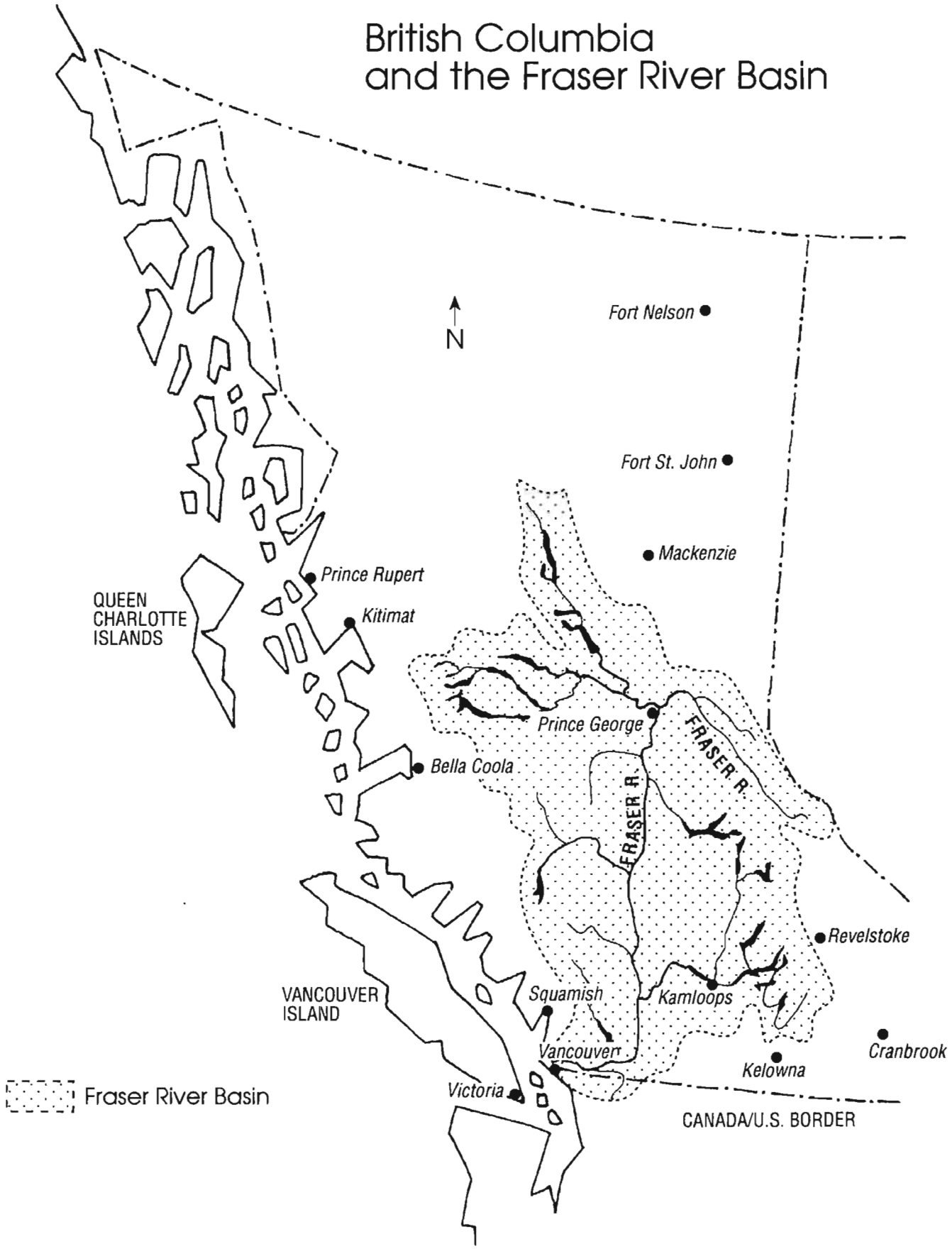
Spin-Off Jobs
- police officer
- doctor
- grocery store clerk
- airport maintenance
- ship repair

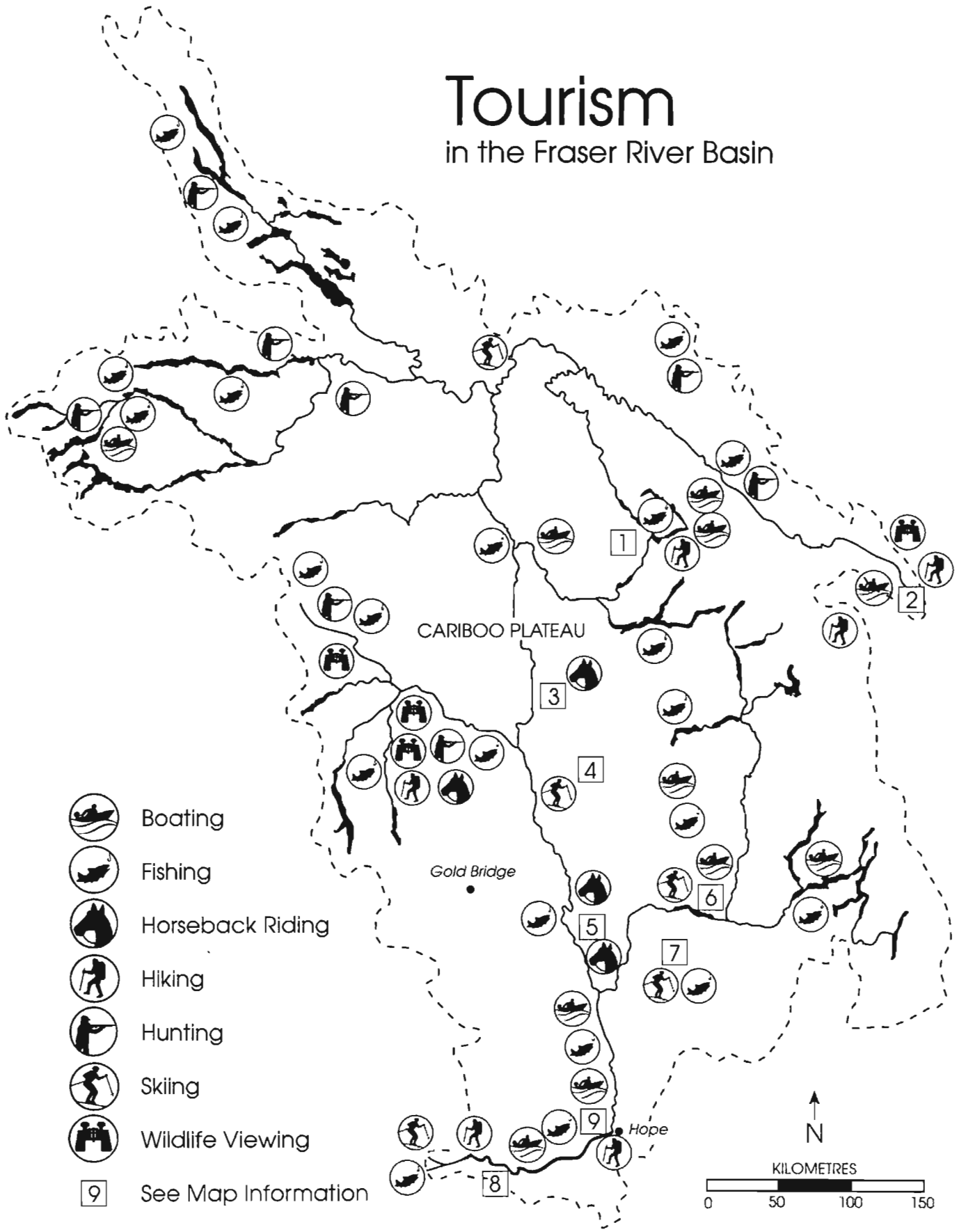
The tourism industry keeps track of the number of tourists that come to British Columbia. It also keeps track of the money that these tourists spend.

In 1992, about 23.9 million visitors stayed overnight in British Columbia. It is not known for sure how many of these tourists stayed in the Fraser Basin. But a good guess is that at least 60%, or 14 million of the overnight visitors stayed somewhere in the Fraser Basin.

In 1992, tourists in British Columbia spent about $5.5 billion dollars. About 67% or $3.7 billion came from tourism in the Fraser Basin.

In 1988, about 85,000 people in British Columbia had jobs in tourism. It is not known how many of these jobs were in the Fraser Basin. But it is likely that at least 60% (50,000) of all the tourism jobs were in the Fraser Basin.


British Columbia
and the Fraser River Basin
N
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Kitimat
QUEEN
CHARLOTTE
ISLANDS
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
Squamish
Kamloops
Vancouver
Cranbrook
Kelowna
Victoria
CANADA/U.S. BORDER
Fraser River Basin


Tourism
in the Fraser River Basin
CARIBOO PLATEAU
Gold Bridge
Hope
1
2
3
4
5
6
7
8
9
Boating
Fishing
Horseback Riding
Hiking
Hunting
Skiing
Wildlife Viewing
See Map Information
N
KILOMETRES
0
50
100
150

Map Information - Tourism

Here are just a few of the places to visit in the Fraser River Basin:

1

Barkerville

It's August 22, 1862 and Billy Barker strikes gold in the Cariboo. Gold fever! Hundreds of people follow the gold rush trail along the Fraser River. And a town is born. Today, when you visit Barkerville, you can tour the original city, pan for gold, ride the stage coach and talk to historic characters.

4

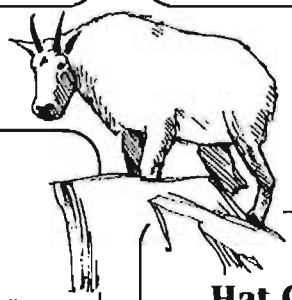
Great Cariboo Ride

Calling all greenhorns! Join city slickers from all over the world! Saddle up for a nine-day trailride near 100 Mile House. Help the ranch hands drive the cattle in the Great Cariboo Ride. Gallop over rolling hills and beside sparkling rivers. Eat a chuckwagon meal. Sleep under the stars and ponderosa pines.

7

Highland Valley Copper Mine

Tour the Highland Valley Copper Mine near Logan Lake. See how copper is mined and milled. Highland Valley is one of the largest open pit copper mines in the world!



2

Mount Robson

Climb Mount Robson, the highest peak in the Canadian Rockies, and see where the Fraser River begins. In a remote part of Mount Robson Provincial Park, near a trail for grizzlies, caribou, and mountain goats, the river bubbles up from under a rock. It flows down into a pond and the rest is geography!

5

Hat Creek Ranch

Treasure seekers! More than $3 million in gold is buried near Hat Creek Ranch. The Ranch was a roadhouse along the Cariboo Wagon Road, where miners rested overnight. Go on wagon rides and trail rides, or watch the blacksmith or the saddlemaker.

8

Fort Langley

Trappers carried their furs up the hill to Fort Langley to trade at this Hudson's Bay Company post. They would get food, money or tools.

3

Williams Lake Stampede

Watch cowpokes compete in the Williams Lake Stampede. You will see bull riding, calf roping, bronc riding, barrel racing and wild horse racing. At night, join in the square dancing.

6

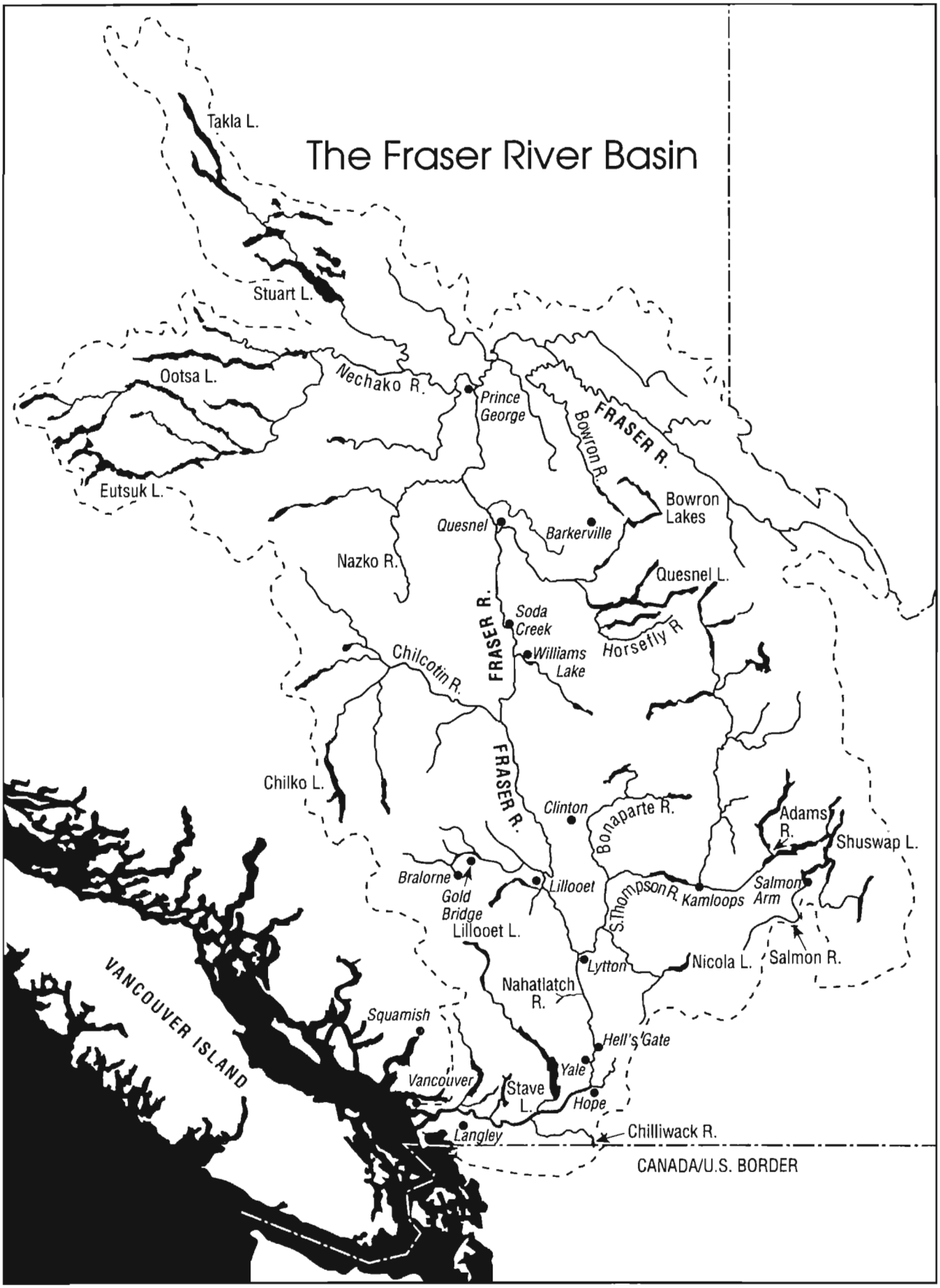
Native Heritage Park

Come to the yearly Pow Wow to see native dancers and enjoy bannock and salmon. The Secwepemc Native Heritage park is near Kamloops. It is built on the site where the Secwepemc people lived 2400 years ago. The Park shows the traditional culture and lifestyle of the Secwepemc people.

9

Othello Tunnels

Afraid of the dark? Explore the Othello tunnels near Hope. Use a flashlight to see the black soot on the walls from the old steam locomotives. These old railway tunnels were built from 1911 to 1918, to link the cities of Hope and Midway. The tunnels cut through the granite walls of the Coquihalla River canyon.


The Fraser River Basin
Takla L.
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Salmon R.
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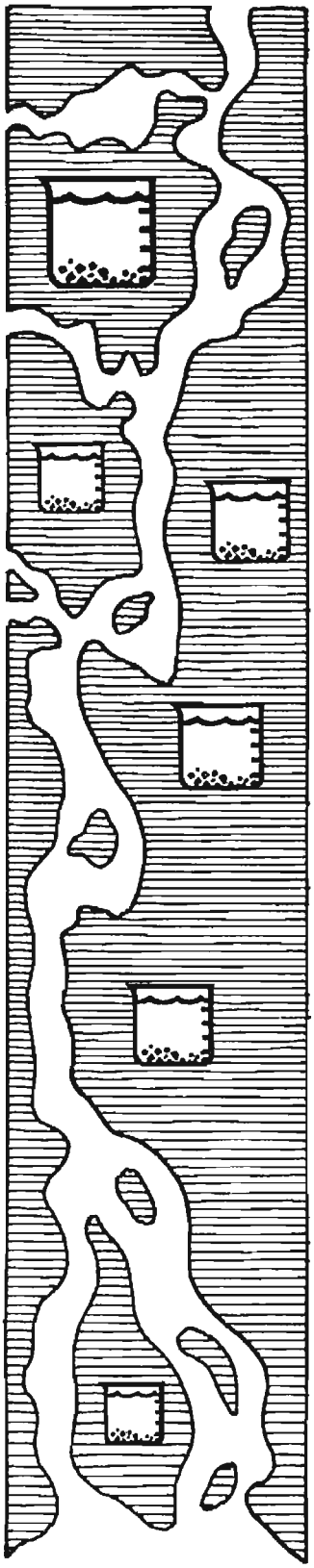
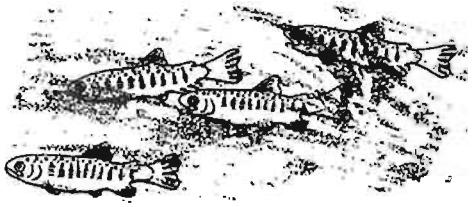
Nicola L.
Nahatlatch R.
VANCOUVER ISLAND
Squamish
Hell's Gate
Yale
Vancouver
Stave L.
Hope
Langley
Chilliwack R.
CANADA/U.S. BORDER

River Health



A healthy river keeps the plants and animals living in it for a long time. An unhealthy river can harm the plants and animals living in it. In 1995, most of the rivers north of Prince George were healthy but some of the rivers in the Fraser Basin were unhealthy.



What Makes Rivers Unhealthy?

Almost all of the area of a watershed is made up of land, not water. Ninety-nine percent of what happens to a river takes place on the land area. It does not happen in the river itself. So, every activity in a watershed could affect the nearest stream and the entire downstream part of the watershed.

In any one area, there may be healthy or unhealthy rivers and streams. (Just like in any one classroom, there may be a healthy student and an unhealthy student.) How is this possible? Rivers become unhealthy for one or more of the following reasons:

Flow Rates

In some rivers, it takes three months for water at the top of the river to be flushed down to the ocean. In other rivers, it takes three years. The fast river may be healthier than the slow river because it moves **pollution** into the ocean more quickly. But remember, that only moves the pollution problem from the river to the ocean.

***Pollution**: Substance that is unhealthy or unclean. Many things can cause water to become polluted.*

Amount of Water

In some places, farmers take lots of water out of the river for the crops. The river has less water. Then the farmland is sprayed with **fertilizers** and other chemicals. When it rains, the fertilizers and other chemicals dissolve in the water and are washed through the soil into the river. The pollution is stronger because there is less water in the river to weaken the fertilizers and chemicals.

***Fertilizer**: Something put on the soil to make it grow more crops.*

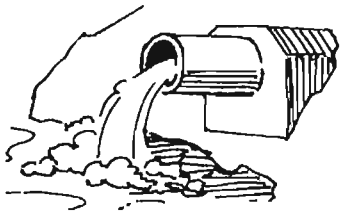
When 3 drops of red dye are put in a glass of water, the water will have a strong red color. When 3 drops of red dye are put in a full bathtub, the water will have a weak red color. This is true for pollution too!

Build-Up of Pollution

Think about two streets: Mall Street has many stores; Spruce Street has only two stores. Walk down Mall Street and buy something from each store: you must carry many packages. Walk down Spruce Street and buy something from each store: you will only carry two packages.

Rivers may be compared to streets. The "stores" are places along the river where pollution enters the water. One river may have many "stores" (factory, city, pulp mill, farm) and carry lots of pollution. Another river may have few "stores" and only have some pollution. Rivers with many sources of pollution may be less healthy than rivers with only a few sources of pollution.

People



People have habits that harm rivers and streams. For example, many people drive to work every day. Often there is only one person in the car. Each car leaves behind oil drops and exhaust particles on the roads. When it rains, the oil and exhaust dissolve in the water and flow into streams. This pollutes the water.

The pollution of the streams would be less if there were fewer cars on the road. But this means that people must change their habits and car pool or use public transit.

The following chart lists some of the things people do to harm the water in the Fraser River Basin. More details are given about the two things in **bold print.**

Paving	Large land areas are covered with roads, parking lots, and sidewalks
Water Use	Large amounts of water are taken out of the river for irrigation, drinking, washing, and power.
Construction	Large amounts of dirt are dug up and moved around.
Chemical Spills	Chemicals may spill or leak when they are moved or stored.
Leaching	Harmful materials dissolve in water and then flow into the river or trickle down into the soil to the underground lakes.
Logging	Large areas of land are cleared of trees. Logging roads are built.
Effluent Discharge	Liquid wastes are dumped into rivers (see next page).
Intensive Farming	Large amounts of fertilizers are used on small areas of land to produce more crops (see next page).

Effluent: *Liquid waste*

Effluent Discharge

Effluent can contain many things that may pollute water: metals (copper, zinc, cadmium, mercury), dioxins, furans, oil, wood preservatives, or ammonia. Effluent is left over from:

- people's daily activities (washing, flushing, cleaning),
- cities (water is polluted when it runs over roads), and
- industries (water is polluted when a product is made).

The pollution can dissolve in the water or get attached to dirt particles and fall to the river bottom. This can harm the wildlife in or near the water in many ways. The animals may get sick or die right away. The animals might get caught more easily by predators. The animals may pass the pollution to the predators that eat them. Then the predators of water animals may get cancer or be unable to breed successfully.

About 2 million cubic metres of effluent are discharged every day in the Fraser River Basin. This could fill 1500 swimming pools. 50% comes from storm drains and sewers; 30% comes from pulp mills; 20% comes from other industries.

Intensive Farming

Natural soil can only grow a certain amount of food. A garden with natural soil may only grow 10 tomato plants. But, fertilized soil can grow more food. The same garden with fertilized soil may grow 25 tomato plants.

Some farms use fertilizers to grow larger amounts of food. This type of farming is intensive. The land is sprayed with huge amounts of fertilizer, insecticide, and herbicide. When the rain falls, these chemicals dissolve in the water. The water is then polluted. It can happen in two ways:

Most farms in Canada use 400 kg of fertilizer for each hectare of land. In the lower Fraser Basin, farms use about 625 kg of fertilizer for each hectare of land.

1. The polluted rainwater soaks into the ground. It seeps through underground streams into underground lakes (aquifers). The Brookswood Aquifer (part of the Salmon River in Langley) has been polluted in this way.

2. The polluted rainwater runs over the land and into the river. The Sumas River and Matsqui Slough have been polluted in this way.

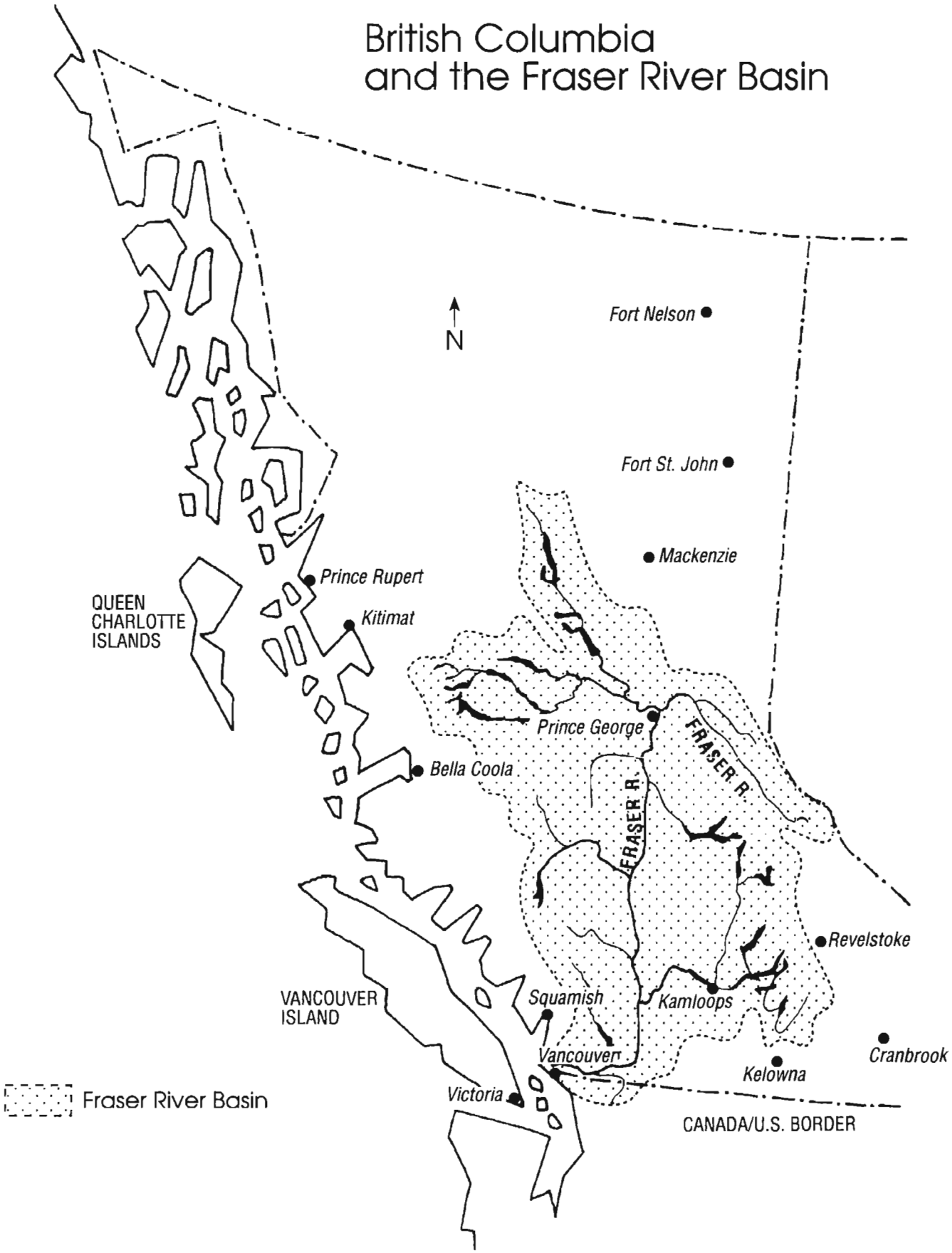
Future Health

Rivers are harmed for three reasons.

People, industries and government **may not have learned the proper way to do things.** They may not understand new ideas, or have the right equipment, tools or methods.	People, industries and government **choose not to follow the laws that protect the environment.** It takes more money, time, people or effort to do things the proper way.	People, industries, and government **do not know enough about the natural world.** What the best scientists think is safe today, may be found to be harmful in 20 or 30 years.
When film is developed, the liquid waste that is left over is harmful to rivers. But in 1994, a scientist found a way to make this waste less harmful.	*People choose to put used car oil into storm drains. The oil runs straight into the river and pollutes it. The oil should be taken to a recycling plant, but this takes more time.*	*Years ago, people did not know that smoke was harmful. People got rid of leaves by burning them in the fall. Now it is against the law to burn leaves in many big cities.*

The health of the Fraser River, now and in the future, depends on how each and every person in British Columbia acts towards the environment. A town is made up of people. So is a company. And so are governments. If the Fraser River is to be healthy, each person must:

- care about the river;
- learn about the river;
- act in responsible ways towards the river.


British Columbia
and the Fraser River Basin
N
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
QUEEN
CHARLOTTE
ISLANDS
Kitimat
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
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Vancouver
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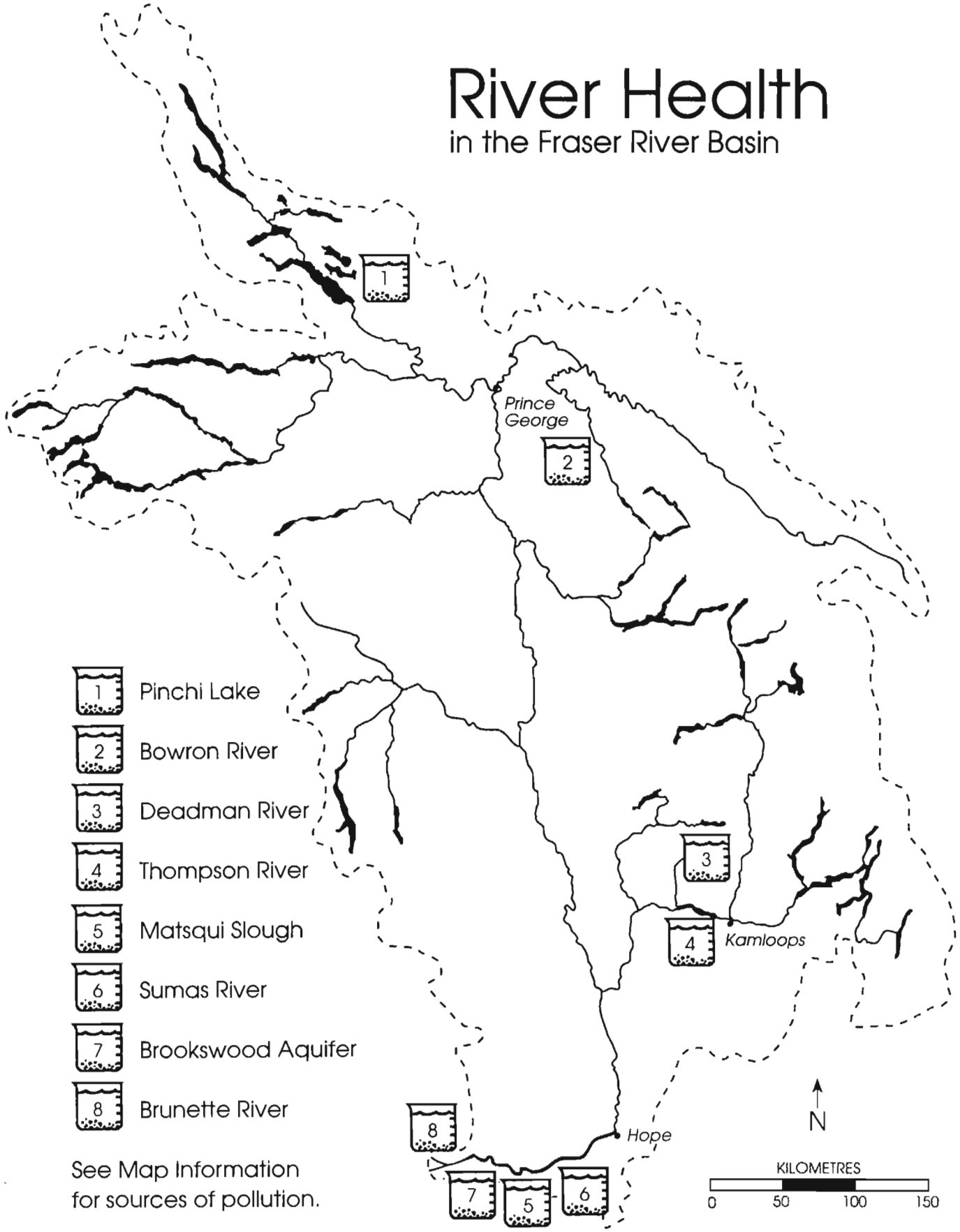
CANADA/U.S. BORDER
Fraser River Basin

River Health
in the Fraser River Basin



1 Pinchi Lake
2 Bowron River
3 Deadman River
4 Thompson River
5 Matsqui Slough
6 Sumas River
7 Brookswood Aquifer
8 Brunette River

See Map Information for sources of pollution.

Map Information - River Health

Some of the pollution problems in the Fraser River Basin are described below.

Pinchi Lake

Pinchi Lake is part of the Stuart River system. It has high levels of mercury due to an old cinnabar mine nearby. (Cinnabar is a bright red mineral that contains mercury and sulfur.)

Bowron River

Parts of the upper Bowron River have increased sediment levels. This is due to the logging roads and large clearcutting that happened in the early to middle 1980's.

Deadman River

The Deadman River is in an area that is ranched intensively. Most trees have been removed from the river banks, which makes them unstable. The river has problems with flooding and erosion. There are high levels of sediment and coliforms (from manure). The Deadman has been mostly affected by poor cattle ranching practices.

Lower Thompson River

The Lower Thompson River is contaminated with bacteria from farming, sewage treatment plants, and septic tanks.

Matsqui Slough

Matsqui Slough has high levels of phosphorous, aluminum, copper, iron, zinc, chromium, and coliforms. It has low levels of dissolved oxygen at different times of the year. This is from urban development and agriculture.

Sumas River

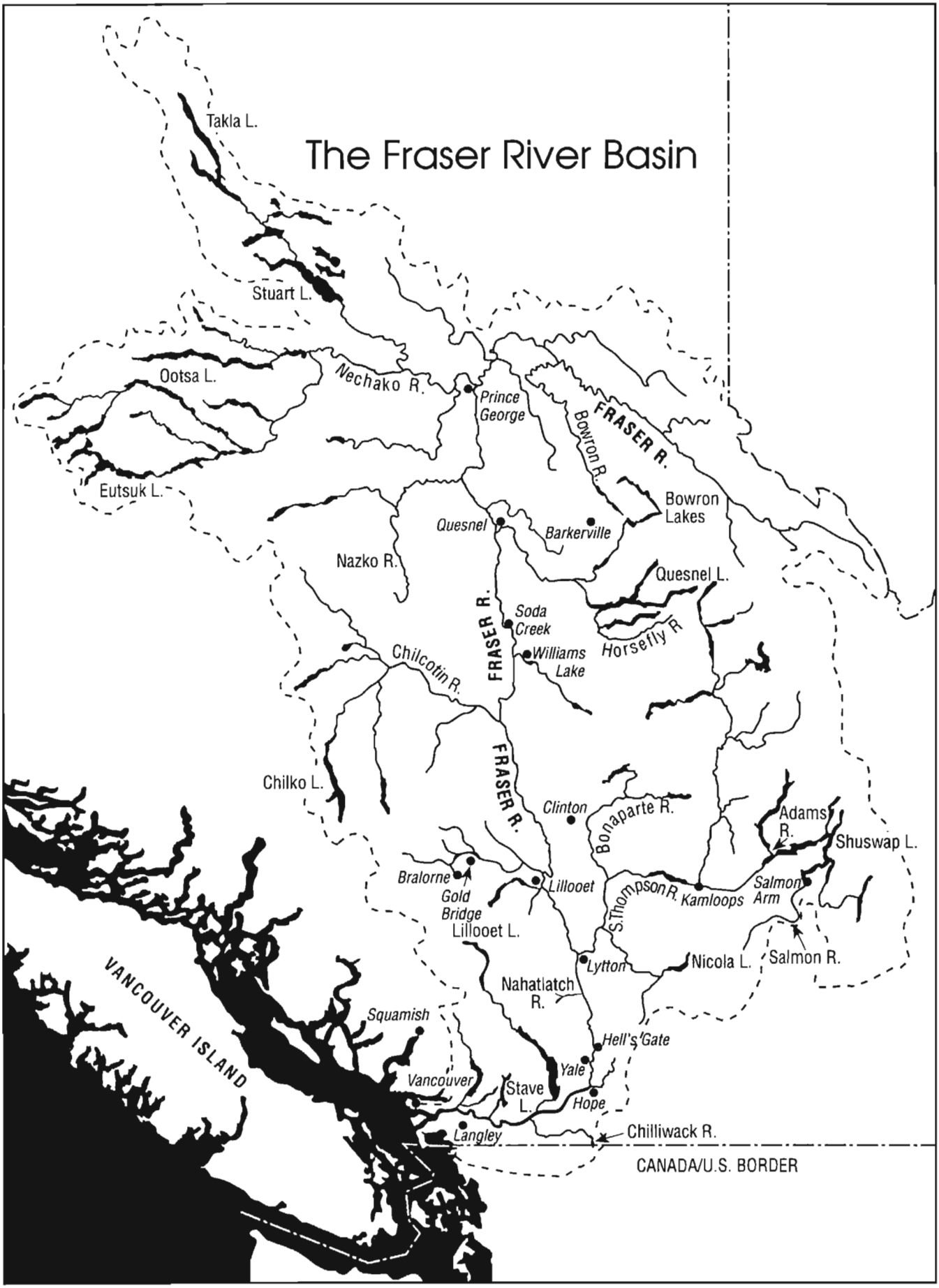
The Sumas River is in an area that is farmed intensively. There is also a large population. The Sumas River has high levels of phosphorous, nitrate, ammonia, pesticides, aluminum, and coliforms. It has low levels of dissolved oxygen at different times of the year. This is mainly from urban and agriculture runoff: car exhaust particles, fertilizers, pesticides, herbicides and manure.

Brookswood Aquifer

The Brookswood Aquifer is part of the Salmon River. It has high levels of nitrate. This is mainly from septic tanks and animal wastes.

Brunette River

The Brunette River is in Burnaby. Burnaby has one of the highest population densities in the Fraser Basin. The Brunette River has high levels of copper, lead, and zinc. This is mainly from runoff from roads covered by car exhaust particles, oil and grease.


The Fraser River Basin
Takla L.
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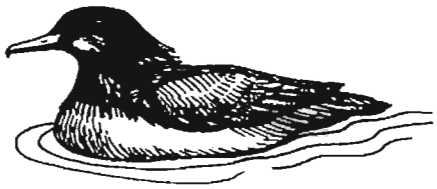
Ootsa L.
Nechako R.
Prince George
FRASER R.
Bowron R.
Bowron Lakes
Eutsuk L.
Quesnel
Barkerville
Nazko R.
Quesnel L.
FRASER R.
Soda Creek
Williams Lake
Horsefly R.
Chilcotin R.
Chilko L.
FRASER R.
Clinton
Bonaparte R.
Adams R.
Shuswap L.
Bralorne
Gold Bridge
Lillooet
S.Thompson R.
Kamloops
Salmon Arm
Lillooet L.
Lytton
Nicola L.
Salmon R.
Nahatlatch R.
VANCOUVER ISLAND
Squamish
Hell's Gate
Yale
Vancouver
Stave L.
Hope
Langley
Chilliwack R.
CANADA/U.S. BORDER

Working Together

People who work for the federal government are trying to protect and improve the environment of the Fraser River Basin. The Basin is getting special attention because many people are worried about some rivers in the basin being **polluted**. They are also concerned about the low numbers of some kinds of fish and the loss of habitat for birds and fish.

***Polluted**: Made unhealthy or unclean.*

There are biologists, secretaries, cartographers (map makers), engineers, chemists, writers, and ecologists who work for the government. These people are working on three main goals:



1. To study and clean up pollution;
2. To restore habitat and increase the number of fish and birds;
3. To get people working as partners to protect the future of the Fraser River and its basin.

Studying Pollution

Scientists want to answer these questions: What are the things that pollute? Where do they come from? How much is there? What is pollution doing to the plants and animals living in or near the river?

*An **indicator** is a warning. Long ago, miners would take a canary into the mine. They wanted to make sure the mine had enough air for the miners. If the oxygen in the mine was low, the canary died before the miner was harmed. This let the miners know they should get out of the mine. The dead canary was an indicator that the area was harmful, because the bird died. It was a warning to the miners.*

To measure the effects of pollution in the Fraser River Basin, scientists study animal **indicators**. Many things that pollute are very hard to measure in water. Scientists have to look for other ways to measure them. One way is to measure the muscle of fish. The pollution in the muscle is an indicator of the pollution in the river.

Rocky Mountain whitefish are being studied near Prince George because they had high levels of dioxins a few years ago. Scientists think this shows that the fish could be a good indicator of the pollution in the water from the pulp mills. The scientists designed a study to see if these fish would be good indicators.

Research Scientists: *Men and women trained to find answers to puzzling questions. They design experiments using the scientific method. They must gather a lot of data (information). Sometimes research scientists have to capture, and even kill animals in order to learn more about them. Before this happens, a lot of thought is given to the experiments. The animals are treated humanely and with respect.*

To do this **research scientists** must find out where the fish spend most of their time. Scientists tag the fish with small radio transmitters and then track them. This shows the scientists where the fish go and how often they are exposed (near) to the pollution. They must also find out how far the fish wander because the best indicators of pollution are fish which do not wander very far. For example, if the fish downstream of the pulp mills at Prince George stay in the area for most of their life, they would be good indicators of the changes in chemicals from the pulp mills.

Cleaning Up Pollution

The government is helping industries find new ways of working. Many industries do things that could harm the river, or the animal and plant habitat. When industries change how they work, the amount of pollution that enters the river can be reduced and habitat can be protected. The chart shows some old and new ways of working for some industries. Not all industries have begun using these newer ways of working because people need time to learn new information.

Industry	Old Way	New Way
Agriculture	Cattle walk into streams. The streambanks erode and the water gets silty. The cattle use the stream as a toilet and pollute the water.	Ranchers put up fences to stop the cattle. This protects the streams.
Settlement	Small streams and marsh areas are filled with dirt to make more land to build on.	The small streams and marshy areas are left alone. These areas are used by fish and other animals for habitat.
Settlement	Trees and bushes are cut down right up to the edge of the stream. There is no shade for the stream. The streambanks erode and the water gets silty.	When land is cleared, trees and bushes are left along stream edges. This keeps water temperatures low and prevents erosion.

Governments make sure that **pollution laws** are obeyed. Inspectors visit sewage treatment plants, pulp and paper mills, metal mines, landfills, farms and even storm drains near homes. During the inspection, the inspector checks to see if environmental laws are being obeyed. If the laws are not being obeyed, the inspector points out what is wrong. But in some cases, the company has caused so much damage that governments must lay legal charges against the people. In a court case, the government tells the judge what the company did wrong. The judge then decides if the company is guilty or not. If it is guilty, the judge makes the company pay a fine (money) for breaking pollution laws. The people may even be put in jail.

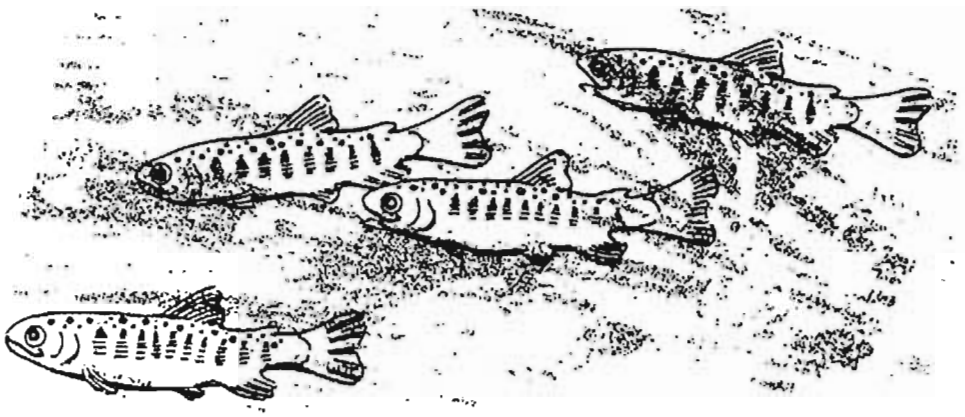
***Pollution Laws**: Rules made by the government to protect the environment from pollution.*

Restoring Habitat

For many reasons, the habitat or homes of fish, animals, birds and plants in the Fraser River Basin has been lost or harmed. It needs to be restored or fixed up. Below are three of the many projects to restore habitat in the basin.

- Marshes and bogs in the Fraser Estuary are important fish habitat. Each year about one billion salmon fry swim through the **estuary** on their way to the sea. They rest, feed and adapt to salt water in this area. Along the shores of Burnaby, the government has rebuilt marshes and fixed up a backwater marsh. Now there is more habitat for fish.

***Estuary**: Area where salt and freshwater meet and mix.*



- In the Chilliwack River, important salmon habitat was damaged by heavy floods. Flooding made the clay banks erode and silt got into the river. Silt can smother eggs and cause problems for young fish. This project lowered the level of silt by moving part of the river away from the clay banks.
- Waterbirds use the wetland marshes of lakes and streams for breeding. Many wetlands are in the middle of the Fraser River Basin, where there are many cattle ranches. Cattle can damage or destroy wetlands. The government is helping ranchers find new ways to manage the cattle to protect the wetlands. Ranchers can put up fences to keep cattle from walking in and polluting the streams and from eating in wildlife areas.

Partners

The government has programs to teach young people about the importance of the Fraser Basin and the need for sustainability. Young people are also involved in some Fraser River Basin projects.

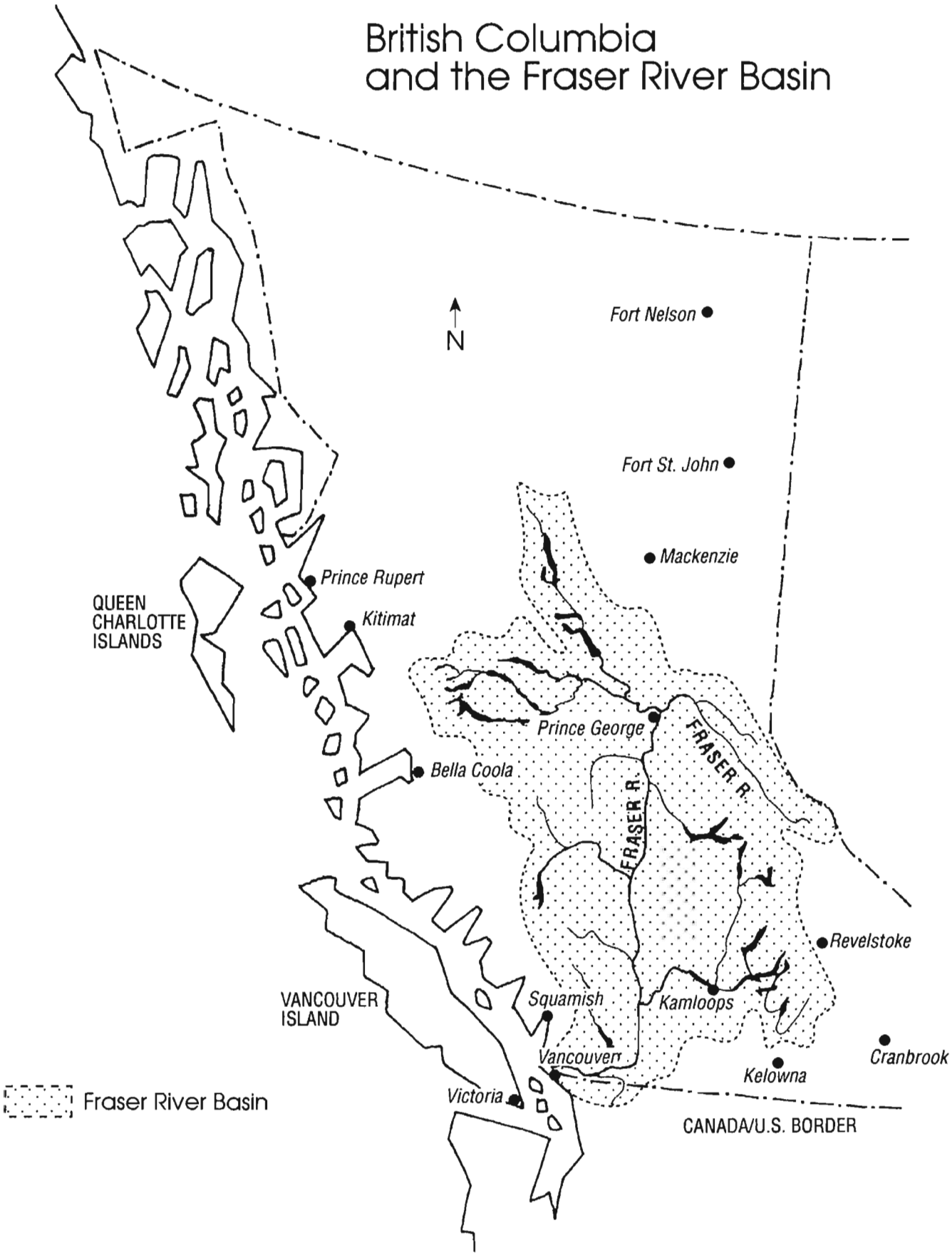
The government wants people to work together in the Fraser River Basin. Many people live in the Fraser Basin. Most people use water from the river, and many jobs depend on the river. The government believes people are the solution to the problems in the Fraser River Basin. People who believe in something will put all their energy, excitement and creativity into it.

The government tries to get as many people as possible involved in caring for the Fraser Basin. Many projects are carried out with partners. Partners include the provincial and municipal governments, First Nations people, universities, groups such as Ducks Unlimited, industries, ranchers and other landowners, and community groups. Even school children can get involved.

For many years, most people in British Columbia thought that there would always be clean water, lots of fish, forests forever and enough farmland to grow all our food. Now almost everyone is beginning to be concerned about our natural resources. People realize that British Columbia will not be a beautiful and prosperous place to live in the future if we do not use our forests, minerals, farmland and water wisely.

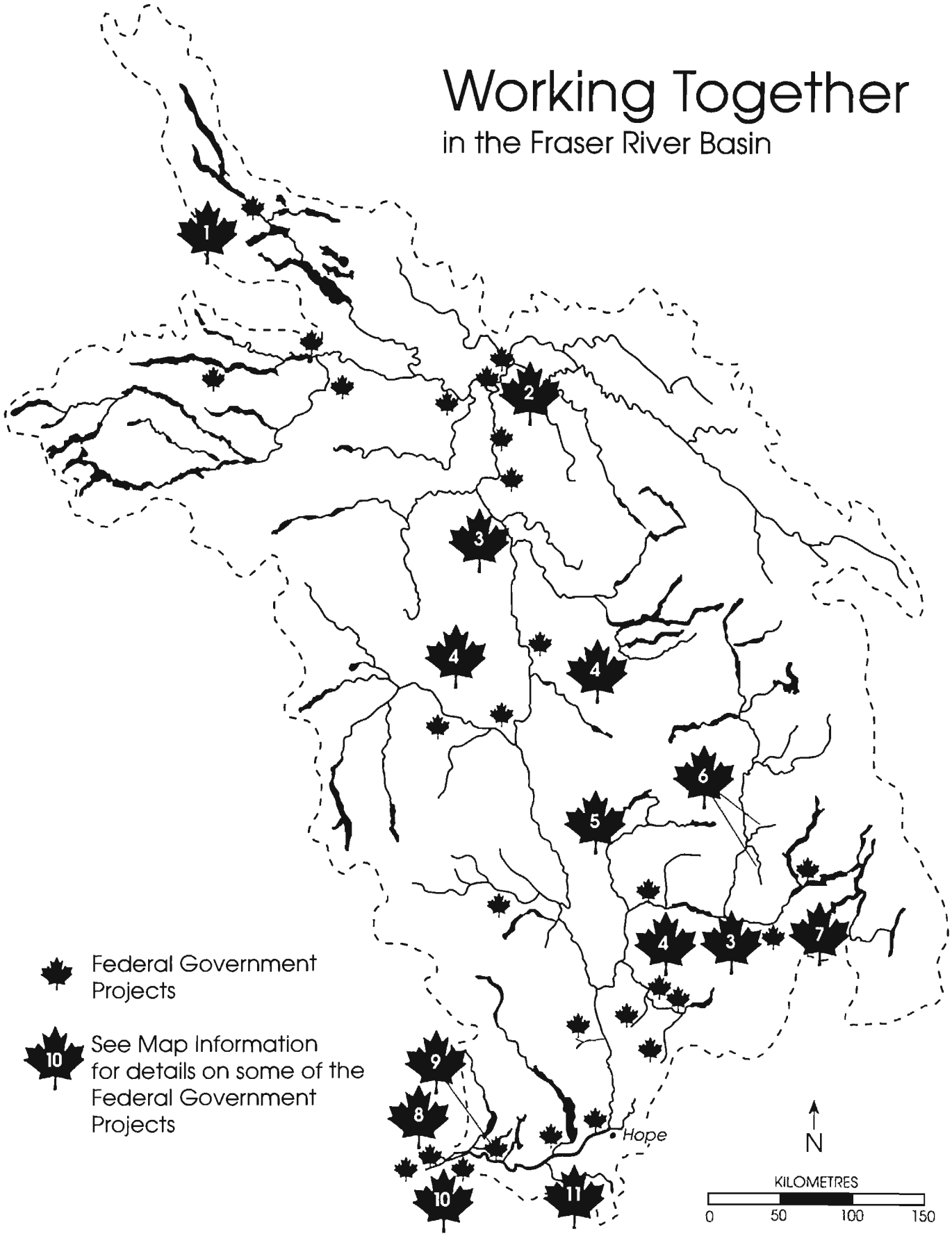
All the partners working together in the Fraser River Basin adds to the spirit of building a **sustainable** community for everyone in British Columbia.

***Sustainable**: Development that meets our needs and makes sure that future needs are met.*


British Columbia
and the Fraser River Basin
N
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Kitimat
QUEEN
CHARLOTTE
ISLANDS
Prince George
FRASER R.
FRASER R.
Bella Coola
Revelstoke
VANCOUVER
ISLAND
Squamish
Kamloops
Vancouver
Cranbrook
Kelowna
Victoria
CANADA/U.S. BORDER
Fraser River Basin

Working Together

in the Fraser River Basin



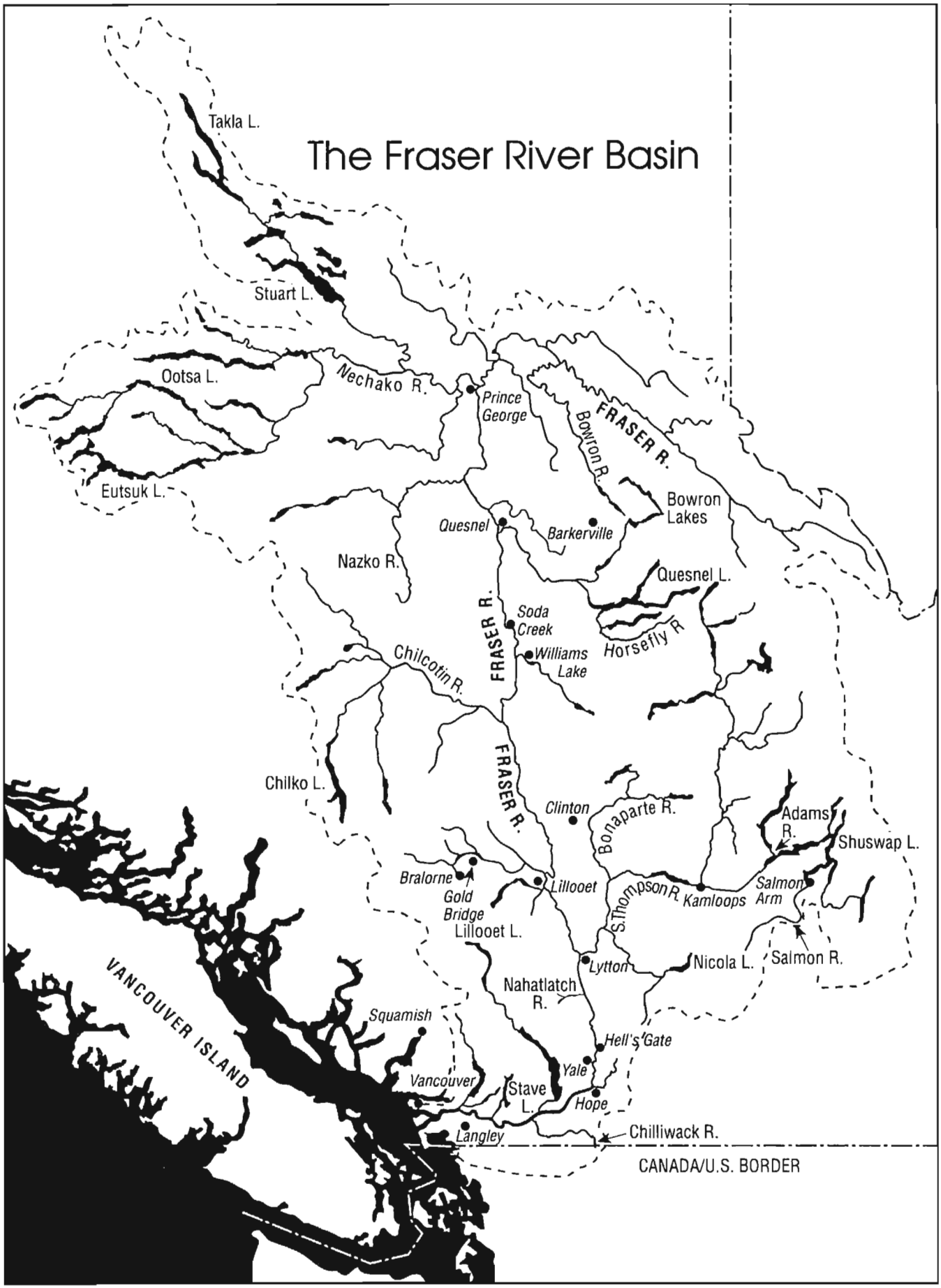
Map Information - Working Together

The Working Together Map shows many of the places where the federal government has projects in the Fraser River Basin.

More details about some of these projects are listed on this chart, which shows:

- the location of the project,
- the purpose of the project, and
- the partners for the project.

Location	Purpose	Partners
1 **Stuart-Takla**	To study how logging in the northern interior of the province affects sockeye salmon and habitat.	Tl'Azt'En Tribal Nation, universities, Canadian Forest Products, B.C. Government
2 **Prince George**	To study how pulp mill effluent affects Rocky Mountain Whitefish.	Scientists, universities
3 **Quesnel and Kamloops**	To study how pollution affects ospreys (birds).	Scientists, universities
4 **Interior Wetlands**	To restore damaged wetlands that are needed for waterfowl habitat.	Ducks Unlimited, B.C. Government, First Nations, biologists, farmers, ranchers
5 **Bonaparte River**	To improve the water flow in the river. This will help fish survive.	Biologists, engineers
6 **Lemieux and Louis Creeks**	To get a better understanding of the life cycle of coho. Young coho are wire-tagged and tracked.	Biologists
7 **Salmon River (near Salmon Arm)**	To rebuild salmon stocks and plan how best to use land and water for everyone's benefit.	District of Salmon Arm, B.C. Government, First Nations, farmers, ranchers, forest companies, citizens
8 **Annacis Island**	To clean up the wood waste in marshes to improve fish habitat.	Volunteers (industry, Boy Scouts, children)
9 **Stave River (below Ruskin Dam)**	To increase habitat for salmon eggs. Spawning channels were made deeper and filled with extra water from the dam. This should result in 30,000 chum adults.	B.C. Hydro, biologists, engineers
10 **Salmon River (in Langley)**	To make sure this productive watershed is not harmed by urban development.	Township of Langley, University of B.C., Langley Environmental Partners Society, volunteers
11 **Chilliwack River**	To stop the silt from eroding river banks from getting into the river. This will help fish survive.	Biologists, engineers


The Fraser River Basin
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