

**PROPOSAL FOR THE MARK CREEK WATERSHED RESEARCH
AND REHABILITATION PROJECT**

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Dedication

This project is dedicated to my son Aaron who regularly reminds me that we need trees
and other vegetation in order to breathe.



Aaron on the Mark Creek Trail

Abstract

The Mark Creek Watershed Research and Rehabilitation Project proposes a community-based educational and community development program that includes students and educators from Kindergarten through university in a small watershed surrounding Kimberley, B. C. in Canada. By focussing on the ecology and the environmental and resource use issues in a watershed the students will acquire the attitudes and skills that will enable them to be responsible stewards of their 'home places'. Using a community-based approach will ensure that the research and rehabilitation will be valuable and appropriate for all of the inhabitants of the watershed. Research for the project included a search of current literature and numerous Internet sites and the review of recommended resources for watershed studies. A survey of participants in similar projects was conducted on-line and in place at four schools and institutions. An outline for the proposed Mark Creek Watershed Research and Rehabilitation Project was developed based on the research and surveys.

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Introduction

Valleys

By Aaron Swanson

The path is slithering as a snake
The flowers are fresh smelling
The hot sun is a big star in the sky
The roads so tough to travel
Cars are moving fast like speeding bullets
Animals are making mournful cries
Trees standing straight as soldiers in the army
The water flowing dangerously
The wind is moving with a warning
Life slithers through this world
Some taking notice of its beauty
Others not.

The poem captures the essence of the Mark Creek Watershed and the principal aim of this project. The lower portion of the watershed is a busy and noisy place. Much of the movement in the watershed is hurried whether for pleasure or work. It is the aim of this project to slow these movements down enough that more people will "notice its beauty".

The basic premise of this project is that the aesthetic appreciation of the environment, coupled with a more scientific understanding of natural systems will encourage individuals to take greater responsibility for the thoughtful stewardship of the area in which they live. Integration of people, curriculum, and resources will enhance this process and help everyone involved better understand the complexity of natural and human systems and the myriad of values that humans derive from their environment.

The idea for the project began with the poem, a recent creek side development, and a community workshop entitled "Mark Creek: Kimberley's Past, Present, and Future"

held in the spring of 1998. Public education was the top priority of the participants in the workshop followed by protection of current green spaces and the creation of greater green space adjacent to the creek. The project outline at the end of the report describes possible research projects and other activities that can be undertaken by students, community members, and educators to help achieve these and other objectives.

Research and the Surveys of participants in similar projects have indicated that an integrated, community-based approach has been the most successful. The main difference between this project and most of the other similar projects is the emphasis on qualitative rather than quantitative research, especially in the lower portion of the watershed. By focusing on the quality of the watershed system, the twin objectives of aesthetic appreciation and scientific understanding are inextricably linked.

Most of the research that has been carried out in the watershed, to date, has been quantitative. The students and community partners who require this type of information can use the data from this research. Some people need numbers in order to understand, or be convinced that the research is scientific or valid. By integrating this data into a Geographic Information System (GIS), more useful and accessible information can be developed.

The Mark Creek resource most valued currently is the potable water derived from the upper portion of the watershed. This portion of the watershed is not readily accessible for students and, therefore, a remote sensing approach combined with a more traditional hydrological study is proposed for this portion of the watershed.

Many groups have come together in many communities throughout the developing and developed world to study and improve their local and regional

watersheds. The literature is full of success stories and analysis of the benefits to the students involved in the projects and to their communities. Local or regional government or educational institutions have instigated some of these projects, but many have grown out of community concern for the deterioration of their water supply and the negative impact of human development on other residents of the watershed. Disappearance of aquatic life, particularly fish and birds, have inspired some projects, while contaminated or diminished water supplies have spurred others to act.

The threat of damage due to logging in the upper portion of the Mark Creek watershed has led to a great deal of public interest in this section. However, most of the changes and damage to the lower portion of the watershed were incremental from industrial and residential development that took place over the last century or occurred before or after a major flood in 1948. The annual changes from acid mine drainage and other waste being dumped into the stream were slow. The changes after 1948 were seen as necessary to protect the city from another disaster. The abundance of other and better fishing streams in the area meant that the loss of fish and other aquatic life from the lower reaches of Mark Creek was not very significant to most local residents.

Most of the people who attended the 1998 workshop used the many trails that follow Mark Creek and have already 'noticed the beauty.' Unfortunately, this group did not include many teachers from the K-12 public schools. Representatives from the City, local industry, and government did participate and appeared committed to improving practice in and around Mark Creek.

The first challenge of any new community-based project is to determine what has already been done, by whom, which activities succeeded and which failed, and why. The

Survey, see Appendix of this report, attempted to determine this on a local as well as regional scale. The number of responses from each group was not high enough to derive statistically reliable results, but several responses were consistent within each group. The survey responses mirrored the results from the literature. Several projects have been described and discussed in the various journals and on the Internet. The purpose of this project is to reflect the results of my survey and my research in an outline of educational research and watershed rehabilitation for the Mark Creek watershed.

Aims and Objectives

The principal aim of environmental and outdoor or field-based education is for students to better understand the relationships between humans and their environment. Through this understanding will come the realization that exploitation of natural resources has consequences and limits. Through careful study of a portion of their environment, in this case a small watershed, individuals may take greater responsibility for their actions and activities, make better choices, and take actions that will lead to a healthier environment.

Community-based Research, which is initiated and controlled by people in the community who are trying to resolve an issue or problem, has been found to enhance the relationship between educational institutions and the community and have encouraged the young to take greater ownership of their education and their community.

Field-based education projects accommodate individuals who learn best from constructive activities and while working with others. All students benefit from the exposure to professionals and other mentors who are usually part of these projects. The students also often use tools and techniques that cannot be accommodated in a classroom setting. The tools and techniques are often "state of the art" which prepares students for future jobs or education.

Research

The research for this project tried to address the following questions:

1. What is the value of community-based research to students?
2. What is the value of community-based research to the community?
3. What are the main impediments and drawbacks for community-based research?
4. What are the principal aids to successful research?
5. What are some worthwhile and relatively inexpensive activities and projects that could be undertaken by students over the short and long term?

I have attempted to answer the first three questions directly based on my research and the Survey of participants in similar projects (Appendix). The fourth and fifth questions have been answered by describing the benefits of studying a watershed and various successful watershed research and restoration projects.

Value of Community-based Research to the Student

Although many of the educators and researchers (Chawla, 1998; Chen, 1997; Schaefer, 1998; Volk, 1990) had ready responses to this question, few of the students surveyed had very definite answers. Researchers and educators saw improvements in interest and attitude, increased understanding of curriculum topics, and acquisition of new skills and knowledge as the main benefits to the students. The student responses often focussed on one particular thing they had learned or the social aspects of the project. The students generally felt that the projects were worthwhile and more interesting than the other 'stuff' they did in the school setting. This increased interest is carried back to the school and may encourage a better attitude towards education in general.

During the act of research, students may acquire the attitudes of mind that some call scientific literacy. To complete the research projects students will need to be able to recognize the various problems and issues in the watershed and collect evidence and data that relates to the problem or issue. . The choice of problems and issues to be addressed must be based on the priority of the community not on the students' or educator's personal agendas. They will need to determine what evidence and data is relevant to the solution of the problem or issue, and propose a solution based on the evidence and data collected rather than on personal beliefs or biases (Volk, 1990). The research process and method must reflect best scientific practice with equal attention paid to all sides of an issue or problem. As Volk points out "we can best prepare learners to deal with those (environmental) issues by helping them to develop the intellectual tools they will need to access information about those issues, to evaluate that information, and to use it in forming sound decisions"(Volk,1990, p. 2). These 'scientific' habits of mind will probably be the most important skill that the students acquire during the research.

Contact with educated and skilled professionals is exciting for most students. These individuals may become mentors or role models for the students with whom they come into contact. For the projects where older students were mentors for younger students, most responded that this was the most interesting and enjoyable part of the project. Research has shown that intergenerational influence has a marked impact on attitudes to the environment. Chawla (1998) found that 42% of environmental educators cited mentors as a major influence on their choice of occupation. A similar international study found that older friends and teachers had a major influence on environmental

educators, particularly in Australia, Canada, and the United Kingdom (Palmer et al, 1998).

While working in and for their community, students will encounter a variety of individuals. These community partners will have different ideas, knowledge, and skills, some of which they may even share with the students. They will definitely share their varying points of view and their ideas of how things are and how they should be.

Community-based research also affords the opportunity to involve other family members in the education process. Palmer et al (1998) found that the influence of close family members on attitudes toward the environment was universal. Over 60% of South African Environmental Educators cited close family as a major influence.

There is also growing evidence that children and adolescents have an important impact on attitudes of their parents (Ballantyne, Connell, & Fien, 1998). Other research has found that "parents who have participated in an experimental environmental education program at school were significantly more likely to report increased awareness and concern for a local environmental problem than a control group whose parents had not participated in the program" (Uzzell, 1994 from Ballyntyne et al, 1998, p.289).

As Ballyntyne and company point out, although today's students will be making tomorrow's policies, parents and other adults in the community have the power to influence current policies and practices. Fresh ideas and youthful enthusiasm will hopefully spur some of the adults they encounter to change their attitudes and bury some of their biases. Standing face to face with the future generation may help some adults to act now rather than later. Current environmental problems must be addressed now.

Although sensitivity to environmental issues is very important, the development of an attitude of environmentally appropriate action is critical (Hammond, 1995). Ideas and concerns must be turned into best practices if the deterioration of the Earth's environment is to be slowed or stopped. Community-based research or Participatory Action Research is defined by action and the resultant actions determine whether the research was valuable or not. Research provides students and their communities with the skills and knowledge to implement appropriate action. Community-based research ensures that these actions take into account the social and economic impacts, as well as the environmental benefits, of the proposed actions.

Many similar projects have led to political action as well. In Midwestern U.S.A. junior high school students developed a land use plan for state-owned property adjacent to a local river and submitted and defended the plan at a public hearing (Volk, 1990). In Kentucky a group of elementary and secondary students from intercity schools in Louisville successfully lobbied the state legislature to pass a bill establishing a Kentucky Land Heritage Trust Fund to be used to purchase environmentally significant lands across the state (Hammond, 1995). As Malone (1999) puts it: "research should enable the research participants ... and the readers of the research to reflect on their own lives in a way that is supportive of change through empowerment, ideology-critique, the production of popular knowledge and political action" (p. 165).

Community-based research will lead to more appropriate actions by the students and other community members. Researching requires honesty and habits of mind that will conquer personal biases and prejudices. Analysis and reflection on the results of research will govern future actions within the community.

Many of the students who responded to the survey stated that they were more likely to be active stewards of the environment after the research project. Aesthetic appreciation of the environment leads to a change of attitude, which leads to appropriate action. The Mark Creek Watershed Research and Rehabilitation Project will hopefully lead to an increase in environmental sensitivity and effective action to protect and enhance the watershed and its communities.

Most of the students who responded to the Survey stated that they had acquired skills and knowledge that they would not have acquired if they had not participated in the project. They often listed practical skills such as glassing for wildlife or operating chainsaws as their favorite activities during the project. Others listed organization and planning activities such as helping to plan a controlled burn to develop habitat for wildlife.

Although all of the projects were carried out under the supervision of teachers, instructors, or other adults, many students reported that they enjoyed working on their own or with their peers. "Learners are placed into a situation where they must act based on their own conclusions and face the many barriers and complications this entails" (Schaefer, 1998, p. 1). The personal and social skills required to successfully complete a project which involves working outside your normal environment, often with people you don't know, are quite different from those used in a classroom situation, even if the work is done in a cooperative learning environment.

Most students reported that their time on the project was well spent. The responses from a group of Grade 11 Biology students who had first investigated the health of a local stream, accompanied by professional stream ecologists, and then

mentored a group of grade 4 and 5 students, often included comments such as "I actually learned a lot about ecology" from the process. It would be interesting to see if they would have the same response about the rest of the Biology 11 curriculum, which is all about the ecology of various organisms but which focuses on nomenclature and classification.

Some of these students may have the opportunity to revisit the creek next year and again share what they have learned with others. As some wise person once said: "There is no better way to learn something well than by teaching it to someone else." Hopefully, the students involved in this project will not only be lifelong learners but lifelong mentors as well. Many of the environmental educators surveyed in Canada and around the world by Hart, Palmer and others, listed influence of people as one of the primary factors in determining their level of environmental awareness (Palmer et al, 1998).

The accounts of various projects in Canada and the United States record the many complex tasks undertaken by students at all levels in the K-12 system. Some programs such as the Globe Program (LaHart, 1998) set the level of instrumentation and rigor for the data that is to be collected and submitted under these programs. Students learn the sampling, recording, and data entry and manipulation techniques involved in these types of monitoring programs.

The Mark Creek project will not involve this level of sophisticated monitoring, unless the participants and/or community in general requires it and is willing to finance the equipment and training required. The Canadian schools that participated in the Globe Program financed the equipment through fund raising and School District funding of

special projects. Fundraising and proposal writing are two skills that some students will acquire from participating in the project.

Almost 90% of the respondents in the Chawla (1998) study reported that outdoor experience affected their attitude towards the environment. In the Palmer et al (1998) study, childhood experiences of nature was the single most important influence on the environmental educators who participated. Locally, "working in the woods" was the most interesting and enjoyable activity for students involved in a habitat enhancement project. The linking of work, woods, and enjoyment is significant. Nearly all of the respondents (both educators and students) reported that they had fun taking part in their projects. Although many of the participants obviously enjoyed the outdoors before taking part in their project, many had not experienced the joy of organized work and learning in the woods.

Although outdoor and wild land experiences are common for most students in the Rocky Mountain School District, the amount of time doing education activities in an outdoor setting has continually decreased, particularly at the secondary school level. Hopefully, the Mark Creek project will help to reverse this trend. The students and educators in Kimberley have the benefit of woods and wetlands immediately adjacent to their schools. All that is required is deciding what joyful work and learning has the highest priority for the community and the greatest potential benefit for the students.

Value of Community-based Research to the Community

By participating in participatory research, the participants will move "beyond a group of like minded people changing their immediate physical environment, to a community of politically literate individuals willing to engage in critical reflection and

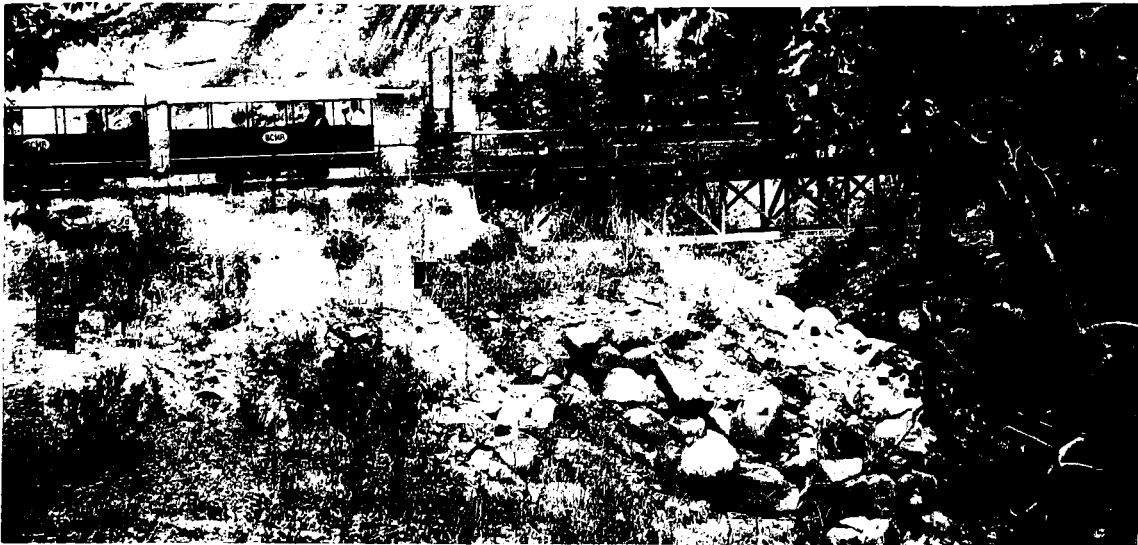
action, through praxis" (Malone, 1999, p. 171). They will be able to move beyond the current project to not only other environmental problems, but to other social and economic challenges that are facing the community. The social ties and skills developed in this project could be used to solve future issues and maintain a community of active learners for generations. Although this appears to be idealistic, and overly hopeful, the successes of similar projects in Europe, United Kingdom, the USA and Australia, (GLOBE,2000; & GREEN, 2000) show that it is possible to mobilize and empower communities by focussing first on a single issue or problem.

Although the main object of this project is to increase the health of Mark Creek, the various changes will have lasting social and economic impacts on the community. The new and improved green spaces will provide locations for social encounters year round. The improved aesthetics of the creek area will enhance the property values in Kimberley, particularly for those properties in close proximity to the creek. The Urban Ravine (1992) project in Burnaby was partly financed by the BC Real Estate Board because they understood the potential benefit to their business. Land along restored waterways and wetlands in Greater Victoria have also dramatically increased in value.

The Boulder Creek Project resulted in an increased sense of community for those who took part in the project or participated in the community events. Kimberley is already blessed by a strong sense of community and community pride, particularly for long term residents of the city. Hopefully the Mark Creek project will increase this pride and be a vehicle for newer residents to join the community.

Community-based projects are an effective means of building lasting links between different groups and individuals within the community (Schaefer, 1998). What

goes on in local schools and other educational institutions becomes more relevant to parents, business operators, public officials, and even pensioners. Public support for education is increased substantially and this often results in greater community involvement in the schools. This could be the greatest long term benefit to Kimberley and the surrounding area.



The Bavarian City Mining Railway - A community- based project

Main Impediments to Community-based Research

The literature and the Internet are full of success stories and ideas but the records of failures and problems are more difficult to come by. Four factors that appear to have the greatest negative impact on community-based research projects appear to be lack of time, lack of funding, divergent points of view, and lack of public support (or public apathy)(Stevenson,1997 ; Robertson & Krugly-Smolka ,1997).

Time appears to be the critical resource for researchers at all levels. Elementary school teachers are reluctant to carry out many outdoor activities due to the time required. Acquiring permission from administration and parents, accumulating the equipment and supplies, and finally organizing volunteer support, transportation, and addressing the numerous safety issues related to taking 25-30 children out into the real world are time consuming. Creeks and wetlands are considered especially dangerous places for children and therefore extra care and extra adults are required. Middle School and Junior Secondary School teachers face all of the same time consuming activities and must deal with a less cooperative group of students. They, therefore, must spend more time organizing and planning the field trip to ensure maximum participation and benefit. By grade eight and nine, the curriculum begins to take precedence as teachers worry about ensuring they have "covered all of the material."

Senior secondary teachers face increasing amounts of curriculum and decreasing amounts of time with their students. Blocks of time are generally not available as the school timetable is chopped into shorter and shorter periods. Students and teachers who wish to carry out community and field-based activities find themselves in conflict with other teaches and administrators. Grade 12 teachers have the added burden of Provincial

Final Exams in most subjects. Poor exam results reflect badly on the school and the teachers. Grade point averages have become very important to academic students as tuition and other costs go up and scholarships, bursaries and grants become even more important.

At the post secondary level, instructors and students face short semesters with heavy course loads. Each student usually has a different personal and academic timetable and therefore blocks of time are almost impossible to coordinate. Field-based activities are therefore usually restricted to one or two times per semester or short trips during lab periods if the study area is readily available.

All of the teachers and instructors who responded to the survey listed lack of funding as one of the factors limiting the scope of their projects. Field and community-based activities cost more than school activities and are considered 'extras' by most administrators. At the post secondary level, funding for field-based activity has been reduced to a level where one field trip uses up the entire budget for one year.

Lack of funding also often leads to lack of proper equipment and safe transportation which are two other common complaints of instructors and teachers. Lack of proper equipment generally means unreliable data and poor samples, which leads to student dissatisfaction. Lack of safe transportation puts schools, institutions, and individuals at financial risk if an accident does occur before, during, or after the field-based activity.

Many teachers have become reluctant to get involved in community-based projects because they may involve public controversy (Robertson & Krugly-Smolka, 1997). This is particularly true of projects that include environmental and resource use

issues. In British Columbia, land and resource use issues have become very polarized between supporters of resource industries and 'environmentalists'. In turn the 'environmentalists' are divided as to how much resource development is sustainable or desirable, particularly in sensitive areas such as watersheds which supply potable water to individuals or communities.

Public apathy and the lack of personal commitment to community-based enterprises has become a major impediment to projects that require long term planning, funding, and volunteer activity. Personal commitment tends to last only as long as self-interest is being satisfied. Political support usually only lasts until the next crisis or the next election comes along. Individuals who do make a commitment to lead a project often find that they are doing most of the work themselves. This makes them even more reluctant to commit to future projects. Teachers and instructors usually are involved with several community and school-based activities and therefore must be selective when choosing which projects to become involved with. They are usually very reluctant to participate in projects with a heavy time commitment.

Time, money, opposing attitudes, and public apathy are the main obstacles. By starting small and focussing on areas of the watershed that are close at hand, the issue of time can be diminished. By using the current resources of the community, combined with those of the partner educational institutions, the need for additional funding should be minimal. The small successes will increase public support and hopefully open up the private and public purses.

The common ground of the watershed will force people with opposing attitudes to listen to the results of the research (Brody, 1997). Whether they will hear and act

appropriately will partly depend on the quality of the research and the public education program.

Public apathy will hold back the start of the project and be a drag on its progress. The numerous projects sited in this report demonstrate how a few dedicated individuals, working together can turn apathy into enthusiasm. Participants must "be like water": generally fluid and following the path of least resistance forward, while slowly wearing away the obstacles that stand in the way. Occasionally, they must be solid and resistant and may even need to boil now and then.

Watershed Studies

Why Study a Watershed?

As we have seen, research and community-based learning activities have many benefits to both students and their communities. As Brody (1997) points out: " the watershed provides a definable unit of ecology and community which can be used by educators to frame educational experiences for diverse groups of people" (p. 114). A watershed provides an ideal location for studying concepts such as "place", connectivity, and interdependence. The various environmental issues and problems in a watershed occupied by humans support discussions on the different perspectives on the environment and the use of natural resources, human impacts on natural systems, and impacts of nature on human systems.

Very few people take the time to develop a clear understanding of the place in which they live. Although some may have a good idea of the physical geography of the area , few know the history, or the social and economic aspects of their 'home place'. Fewer still know anything about the natural systems of which they are a part. By

participating in research and other activities within a watershed, students gain a much greater sense of "place" and how they fit in the complex web of the watershed.

By focussing attention on the geographic area in which they live, students will begin to understand the complex biological, social, and political systems that impact their daily lives. The relationships between natural and human systems will be self-evident. Using an interdisciplinary and qualitative approach to most of the research will afford many opportunities for students to link ecology with economics; human health with the health of the environment; and the past and present with the future of their 'home place' (Jonker, 1997). Understanding how the actions of one person or group upstream affect other organisms and people downstream in both positive and negative ways. Collecting histories of settlement and land use leads to an understanding of how past practices influence the present and future of a community. "The water that flows through the watershed and ties our lives together exemplifies the timelessness of our relationships in the watershed" (Brody, 1997, p.129) and in the global community. Through the study of watersheds, we can link each community to other communities and eventually to the global community. The Mark Creek Watershed is part of the St. Mary's River Watershed, which is part of the Kootenay River Watershed, which is part of the Columbia River System, which empties into the Pacific Ocean.

By learning to think spatially (Alibrandi, 1995), students will be able to understand the physical relationships between communities, by studying what happens to the water we can understand the biological and economic relationships between communities (Brody, 1997). If one community decides to build a dam upstream, it reduces the flow past all downstream communities. If a downstream community decides

to build a dam, it may flood upstream communities or affect the natural resources that form its economic base. These relationships are obvious when studying a watershed.

The Mark Creek project will also link students and educators to several Global Education projects whose paramount aim is to: "recognize connections between phenomena, to view the planet as an organic whole, an interactive, dynamic system in which choices, events and trends occurring in one location have present and future implications for the well-being of people and their environment in many other parts of the system." (Pike, 1997, p. 8)

A watershed also provides the focus that Stevenson (1997) and others believe is required for students "to develop enduring habits of environmental thoughtfulness" (p.183). In-depth studies of watershed adds context and cohesiveness to the subject matter being studied and forces participants to think critically about the issues and problems under investigation. I agree with Stevenson when he argues that the development of the "habits of thoughtful inquiry and moral deliberation" on issues is a "more important and more enduring outcome than merely acquiring discrete content knowledge of the environment"(Stevenson, 1997, p.191)

By focussing attention on the geographic area in which they live, students will begin to understand the complex biological, social, and political systems that impact their daily lives. The relationships between natural and human systems will be self-evident. Using an interdisciplinary and qualitative approach to most of the research will afford many opportunities for students to link ecology with economics; human health with the health of the environment; and the past and present with the future of their 'home place'

The human use of natural resources in Supernatural British Columbia is very controversial. By studying the Mark Creek Watershed and developing plans to maintain the quality of water from the upper watershed and rehabilitate the lower watershed, students must deal with most of the important resource use issues. Impacts of logging, recreation, residential and industrial development, particularly mining, have and will continue to have impacts on Mark Creek and downstream lakes and streams. Kimberley and downstream communities have dealt with and must live with the environmental impacts of these developments while enjoying the economic benefits. Perhaps this study will help the members of these communities to make the shift from viewing resources as something to exploit for immediate personal gain to something to steward and conserve for future generations.

Watersheds provide a confined space to study cause and effect. Water in all its forms is not only very important to humans but also very interesting (Morin, Stinner, & Coffman, 1997). By studying what happens to water as it passes through a watershed, students will begin to understand the importance of other natural resources such as soil and air. By "playing in the water," as one student put it, they will acquire a greater affinity for the streams and the organisms that are dependent on them for survival.

Models for Mark Creek

North American and international projects.

Watershed monitoring and related studies (see Resources) have become almost commonplace, especially in North America. In the United States agencies such as the EPA have actively encouraged such studies and have helped to develop curriculum that can be used both in the classroom and in the field to study watersheds and the impacts of

human activity on water quality. Most of the funding for watershed projects actually comes from state natural resources agencies and several states have volunteer monitoring programs. Some programs such as the Adopt-a-Stream program (which started in Washington State) have spread across several states (Oregon, Idaho, and Montana) and even across the border into Canada (British Columbia). Other states and provinces have similar programs that are organized and run by state or local agencies.

Many of the watershed monitoring and restoration programs are part of national and international environmental monitoring networks. The GLOBE Project, which originated in the United States, is now an international network of schools and other educational institutions monitoring several environmental attributes. The curriculum and the data collected by participating schools are shared by the rest of the network. The Global Rivers Environmental Education Network (GREEN) is an international organization with active members in 130 countries. Through their central office at the University of Michigan's School of Natural Resources and Environment, participating schools are supplied with curriculum materials for the monitoring of streams and the improvement of watersheds. They have also developed software for modeling data and digital technology for field investigations, including Internet-accessible environmental technology. Project Wet is a similar program that is currently coordinated through Montana State University.

These programs and networks use various methods to ensure the quality of monitoring and data acquired. GLOBE insists that schools and school districts acquire or commit to acquire certain monitoring equipment before schools can be registered as part of the network and teachers can take part in training activities. GREEN takes a softer

approach by offering three monitoring kits, of increasing sophistication (and cost), and field manuals to try to ensure quality of sampling. Project Wet insists that instructors attend workshops before using their materials. The River Watch Network, based in Vermont, provides various direct services and supports for high quality watershed monitoring and building effective community partnerships.

Other research and restoration projects have been instigated by groups with a special interest in particular inhabitants of the watershed. Trout Unlimited is a cold water fisheries conservation organization with over 70,000 members which provides technical assistance on water monitoring and stream restoration. Local chapters provide the money and the manpower, often in cooperation with other community groups. 1000 Friends of Frogs, which began out of concern for the rapid disappearance of some species of frogs in Minnesota, now compiles frog and toad surveys from several states and provides materials and support for monitoring the health of wetlands.

The sharing of ideas and curriculum combined with active monitoring and rehabilitation projects have resulted in the numerous success stories worldwide. It is the story of very local watershed projects that are the most interesting and provide the best models of what to do and not to do in Mark Creek.

Neighbourhoods United, with 13 members, is protecting a small urban stream in Cedar Rapids, Iowa, by organizing clean-up days and the monitoring of the stream by school children and other community members. In Boulder, Colorado, the Boulder Creek Watershed Work Group has instituted a variety of educational and social activities to encourage community ownership of the Boulder Creek Watershed. Instead of having several specialists all talk about different aspects of the watershed at one workshop, they

have monthly forums which includes a presentation followed by active public discussion. Each year, in tents along the banks of Boulder Creek, a three-day Boulder Creek Festival is held. The festival, which includes creek tours, cleanups, and displays and presentations by local artists, brings together all of the groups and government agencies that have interests in or information about the watershed. An annual Children's Water Festival brings together most of the grade five students within the watershed for an educational fair. Stream Teams, and River Watch programs are also underway monitoring parts of the watershed.

To restore and maintain the creek, an Adopt-a-Stream program is coordinated through the City of Boulder parks and Recreation Department. Local volunteer or employee groups adopt parts of Boulder Creek to clean and maintain during a year. As well as removing solid waste from the area, projects include bank stabilization and planting.

The Thorton Creek Project in Seattle, Washington, again is an urban-based watershed network of "students, teacher, residents, and other decision-makers, all working together to understand and actively care for the watershed. Of special interest in this project is the Watershed Community Library, which is available to all community members, as well as an on-line map server that provides GIS-based maps of different parts and aspects of the watershed. This project is coordinated by North Seattle Community College, which supplies both a project manager and a technical coordinator.

Canadian projects.

In Canada, Environment Canada has instituted several programs and facilitates some international programs to encourage public participation in the monitoring and

rehabilitation of watersheds. Ecowatch, which is the volunteer monitoring component of Ecological Monitoring and Assessment Network provides protocols to ensure that programs produce scientifically reliable data. Environment Canada also provides monitoring kits and some funding for participants in the Rescue Mission's Indicator Project, a large international network which assesses the sustainability of communities based on 16 indicators. This organization also promotes Agenda 21, which was the action plan for sustainability from the 1992 Earth Summit at the United Nations. Industry Canada and Environment Canada coordinate the GLOBE project in Canada.

In Ontario, the Citizens Environment Watch, which is coordinated through the University of Toronto, monitors water quality in several streams and lakes, four times a year. Both Ontario and Nova Scotia have Frogwatch programs that are very similar to the 1000 Friends of Frogs and are coordinated and promoted by the Toronto Zoo and the Nova Scotia Museum of Natural History.

In British Columbia four projects have special relevance to the Mark Creek Project. The Colquitz Watershed Stewardship Project on Vancouver Island includes 20 schools, over 2000 students, 75 teachers and 20 community partners. The River Works project, which was initiated and is coordinated by the Vancouver Aquarium, has numerous 'teams' monitoring and maintaining various sites in the Fraser River Estuary of Greater Vancouver. The Urban Ravines project which began as a service learning project for students at Douglas College in New Westminster has resulted in the conservation and rehabilitation of ravines in Burnaby B.C. It has also formed the basis of the Green Links project, which is attempting to establish a network of greenways throughout Greater Vancouver.

The Colquitz Watershed Stewardship Project illustrates several important lessons for the Mark Creek project. The project was initiated by an elementary school teacher and an education coordinator for Project Wild, a Ministry of the Environment environmental education program. The project used curriculum from Project Wild and the Fisheries and Oceans Streamkeepers Program. It started small with one class and now involves teachers and students at 20 elementary, middle, junior secondary, and secondary schools in two school districts. A committee supported by a coordinator from Project Wild oversees the project.

The participating schools participate in a variety of activities and use a variety of curriculum that is interdisciplinary and suits the interests and needs of the students and teachers participating in the activity. Although the primary funding for the program has come from ministries and departments of the Provincial and Federal Government, ten thousand dollars was contributed by a trust company and several smaller donations have been received from other community partners. Many of the workshops and community events have been organized and funded by local groups such as Ducks Unlimited, BC Hydro and the Saanich Parks and Recreation Department.

The River Works project started with a team of volunteers from the Vancouver Aquarium. Teams from community centers, home school associations, and elementary schools now monitor and maintain 5 different sites throughout Vancouver and Richmond. Activities are usually coordinated through the Aquarium and include social as well as "work" activities. Environment Canada provides the majority of funding for this project.

The Urban Ravines Project in Burnaby had several components that are important for the success of the Mark Creek project. The students not only did an inventory of the

biophysical environment but also conducted a public use and perception survey of the residents in the surrounding area. The funding for the survey was provided by the BC Real Estate Foundation. These activities along with the rehabilitation of one of the ravines increased the public profile of these urban treasures.

The Green Links project, also coordinated through Douglas College, aims to maintain and enhance the biodiversity of the Lower Mainland by providing greenways between the larger fragments of green spaces such as Burns Bog and Stanley Park. Projects include enhancement of utility right of ways and riparian areas and planting trees and other vegetation along streets. Public education projects to encourage private landowners to plant diverse gardens instead of sterile lawns are also a key component of the program. This community-based program has begun with three model sites in three different municipalities and with a variety of different community partners. Funding and other supports for the project are provided by the municipal governments , BC Hydro, BC Gas and the BC Real Estate Foundation. Some of the benefits to the communities and the community partners have been decreased maintenance costs and increased property values adjacent to the green links.

Local activities.

Locally Environment Youth Teams have conducted surveys and established photo monitoring sites along several creeks including Mark Creek. This work has supplemented the work of University of Victoria students and instructors. This work was carried out under the supervision of Aquatex Consultants who are carrying out research in the watersheds for Cranbrook and Kimberley and the Provincial Government. Some support was also provided by faculty and staff from the College of the Rockies (COTR). Aquatex

has also conducted field workshops on stream assessments for Cranbrook elementary and secondary school students.

The Ecology class at COTR has been involved in a public education program focussing on non point sources of pollution for the past two years. The program has focused on Joseph's Creek, the main source of water for the City of Cranbrook and the site of biologic as well as chemical contamination. The first resulted in a serious health problem for Cranbrook residents and the second in a massive fish kill. The public education program has had a wide audience and provincial as well as local interest.

The Mark Creek Watershed Research and Rehabilitation Project Outline

General

This project outline is meant as a resource to be used by participants when planning their watershed research and rehabilitation activities. It is by no means comprehensive but includes many of the activities carried out at other projects along with some original ideas for local activities. Exemplars are provided for some and the information on these resources is found at the end of this report. All activities should be as inclusive as possible and include groups from inside and outside the school community.

Project Aims and Objectives

Educational Aims

Increase the opportunity for students to apply their learning while benefiting their community

- Provide the opportunity for students to learn practical skills related to field research and watershed rehabilitation
- Enhance students' sense of ownership of their education

Community Development Objectives

- Build or enhance relationships between students, educators, and their community
- Increase cooperation and collaboration between educational institutions and other public and private groups within the Mark Creek Watershed
- Develop a community of active learners throughout the region
- Develop an attitude of stewardship of the environment in the students and, through them, the community as a whole

- Establish a public process for problem-solving and decision making within the watershed

Project Organization and Structure

As Freeman (1995) points out in *Conservation of Great Plains Ecosystems: Current science, future options*, "we get what we organize for" (p. 400). All the successful projects cited in the literature and alive on the Internet shared good organization and well defined but flexible structures. Some organizations had the luxury of policy boards supported by paid staff and various volunteer committees that planned and carried out the monitoring, education, and maintenance and rehabilitation of the watershed. Most organizations had advisory boards of self-selected individuals or representatives of various groups who shared an interest in the health of the watershed.

Two committees already exist with the expressed aim of sustaining the health of the Mark Creek Watershed. The Mark Creek Integrated Watershed Management Planning Committee, which was established by the Ministry of Forests and includes members from various Provincial ministries and agencies, municipal representatives, resource industry representatives, local environmental and business groups, and interested individuals. This group has focussed on the upper portion of the Mark Creek watershed.

A recent group has been established to propose a Community Forest for the Kimberley area. The Mark Creek Watershed is entirely within the boundaries of the proposed Community Forest. Development and land use on Crown (government owned) land within the Community Forest would be controlled by a Community Forest Board. The future of this proposal should be determined within the next few months.

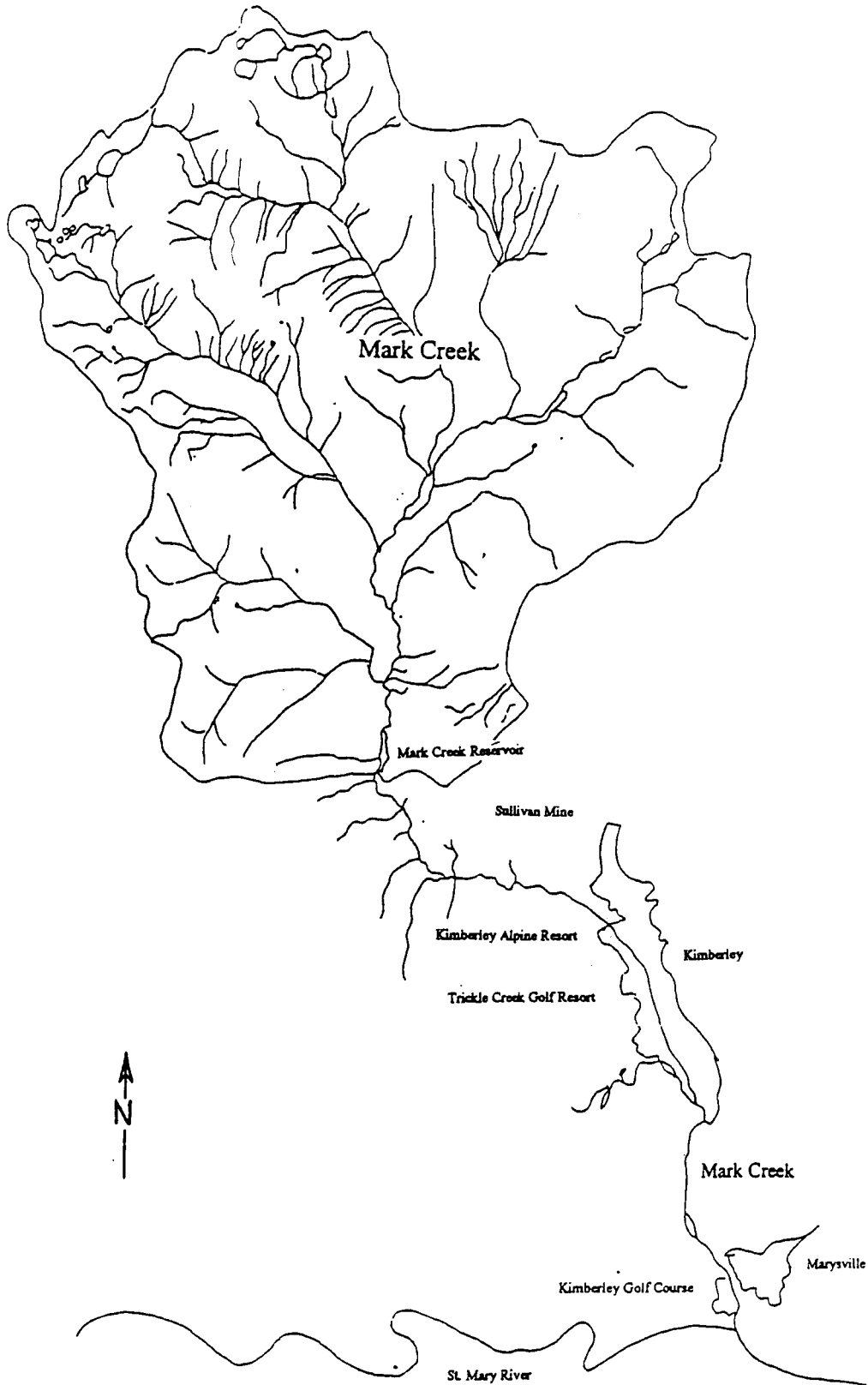
Based on public response to the plans proposed by the Mark Creek Integrated Watershed Management Planning Committee and the limited scope of membership in the Kimberley Community Forest Group, it appears advisable that a third non-aligned advisory board should be formed to oversee the Mark Creek Research and Rehabilitation Project. This group should include several members of both of the other committees along with the educational and community partners involved in the project. To steal another clever turn of phrase from Freeman (1995): "we must make a mesh of things" (p. 408).

If both groups continue to exist after the start of this Project, then the Mark Creek Watershed Advisory Board (MCWAB) should actively seek input from the other two groups and share results of any research as it is completed. Hopefully, one board will eventually be responsible for all the planning within the Mark Creek Watershed and set priorities for research and rehabilitation activities. The coordination and funding of various activities will be the responsibility of the various groups and educational institutions that are taking part in the activities. Figures 3,4, and 5 include possible partners and sources of funding for the proposed activities.

Although the watershed should be dealt with as a whole, I have divided it into the Upper Mark Creek and Lower Mark Creek Watersheds (See Figure 1). The Upper section includes all the area above the dam and reservoir for the municipal and industrial water supply. The Lower section encompasses the City of Kimberley and most of the industrial, commercial and residential development in the watershed. The Upper Watershed has limited access and the City of Kimberley, along with the various Provincial ministries, is attempting to limit public access to the area. The development or conservation of this

portion of the watershed is creating a great deal of controversy in the community. The Lower Watershed is readily accessible to several of the schools in the Rocky Mountain School District. The Meadowbrook and Wasa schools have other streams, lakes, and wetlands close by that they can focus their research on while perhaps partnering with other schools within the Mark Creek Watershed.

Figure 1 - Map of Mark Creek Watershed



I have divided the Lower Mark Creek Watershed into several reaches and suggested which schools might adopt which section as their area of study. I have divided up the watershed to simplify the outline process and to demonstrate the variety of possibilities for research and rehabilitation activities in the watershed. Figure 2 shows the various portions of the watershed and the locations of the schools named in the outline. The division of the watershed and the assignment of research responsibilities must be undertaken by the students and teachers who take part in the project.

Each reach affords different learning opportunities. A lesson learned in Blarhmont Elementary will help that student in Science 8 at McKim Middle School or Biology 11 at Selkirk Secondary. A study of the geomorphology of the Upper Mark Creek watershed will aid a student in Geography 102 at the College of the Rockies.

Figure 2 - Lower Mark Creek Watershed

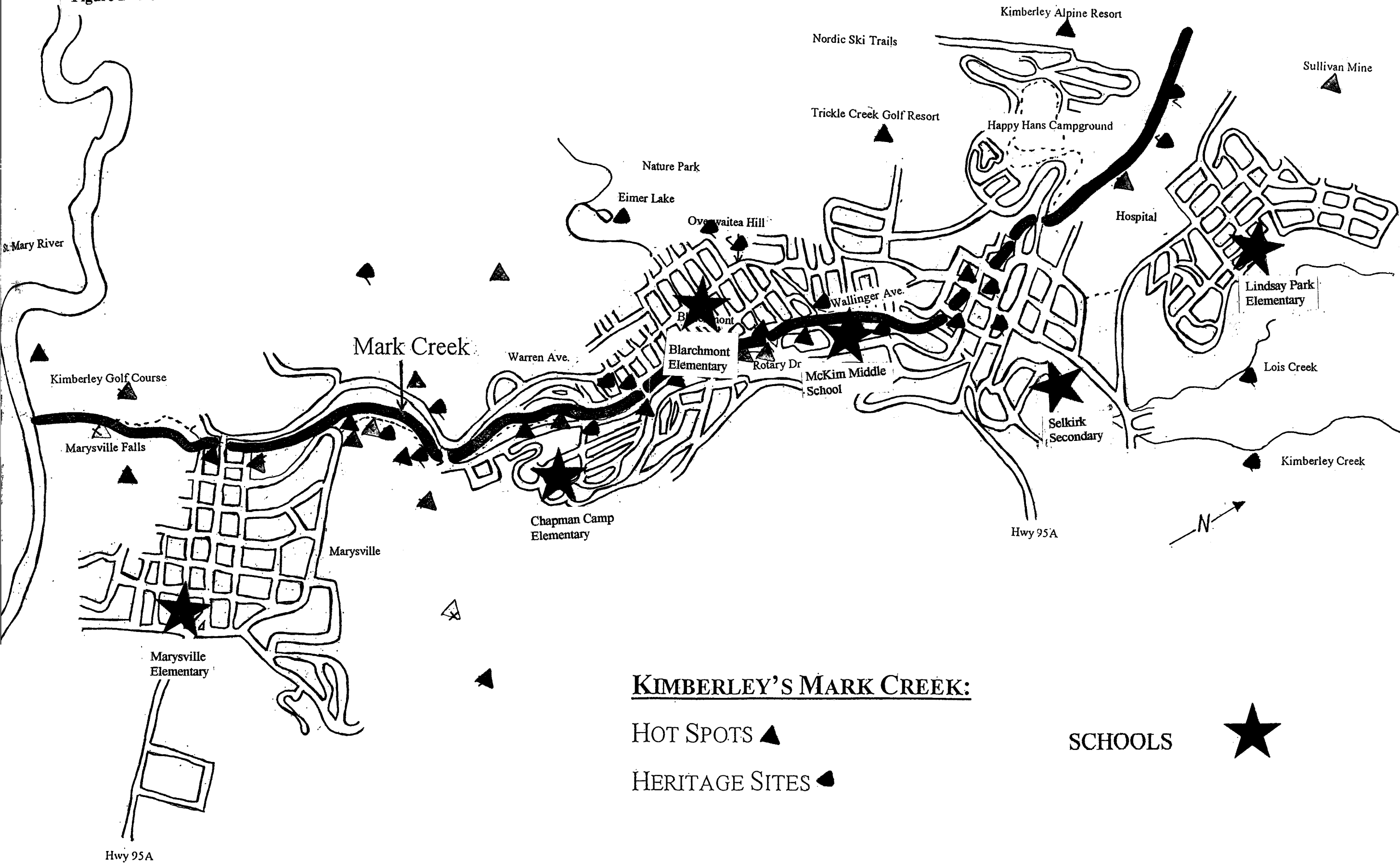
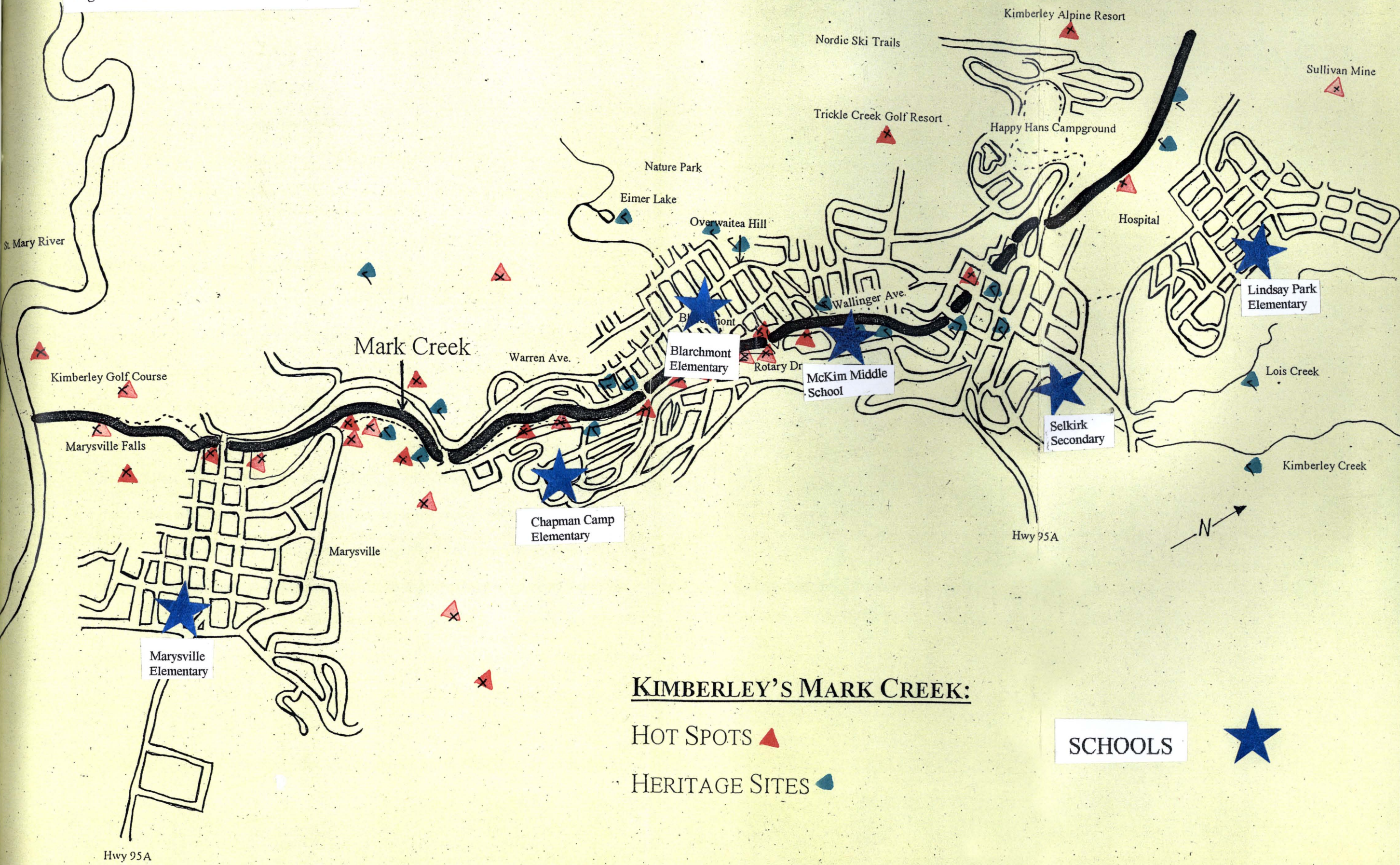


Figure 2 - Lower Mark Creek Watershed



KIMBERLEY'S MARK CREEK:

HOT SPOTS ▲

HERITAGE SITES ●

SCHOOLS ★

Project Components

The Mark Creek Project includes:

1. Planning and conducting primary research including accumulating, managing, and analyzing existing data
2. Public education and consultation
3. Planning, carrying out, and monitoring stream rehabilitation projects
4. Public actions to promote the best practices supported by the research and the community

Planning and Conducting Primary Research

For a true community-based research project, the community would determine their research needs and the students, paid personnel, and volunteers would carry out the research. Research of the literature, however, has shown that for educational research projects to be successful and have enduring value for the students, the project must involve "aspects of the environment which they judge important and significant for their lives" (Elliot, 1995), cited in Stevenson, 1997, p. 194). Surveys of adult students reflected this attitude with most expressing dissatisfaction if the subject and nature of the research was not relevant to their personal and/or career goals. Interviews and surveys of instructors and teachers also indicated that the research must be of personal interest or relevant to the curriculum of their classes for them to participate. It is apparent that the optimum first step in the planning of the primary research is for students, their teachers or instructors, together with individuals from the community to develop a list of research projects that are interesting and important to all three groups. Figure 3 has a list of some of the primary research projects that may be carried out in Phase One of the project.

Research and planning for the Mark Creek watershed carried out by the Ministry of Forests has used the integrated resource management approach which attempts to develop plans for the region that take into account all the resource values and interests of groups and individuals in the region. In B.C. this generally means that the plan is developed based on maximizing the timber resource use while minimizing or mitigating the impacts on other resources such as freshwater and wildlife.

Research and planning for the upper portion of the watershed should use an Ecosystem Management Approach. This approach to natural resource management is based on the belief that the health of the entire ecology of a region will determine the sustainability of a natural resource and its use by humans. Plans for the extraction of the natural resources of the watershed must be designed to have minimum impact, not only on the resource base, e.g. trees, but also on the ecosystem as a whole.

Due to the lack of access to the upper portion of the watershed a remote sensing approach is the most appropriate for student research. Students will analyze the physical and biological aspects and relationships using data from airborne or satellite-based sensors and cameras. Students may also use of a Geographic Information System (GIS), a computer-based data management approach for information that includes a geographic component. The GIS will allow them to store and analyze large data sets or output the data as maps, charts, or data reports. Data collected in the lower portion of the watershed should also be input into a GIS.

Figure 3 - Primary Research Activities

Upper Watershed

Research Topics	Partner Institutions	Possible Community Partners	Exemplars & sources of Curriculum Materials
<p>Remote Sensing Projects:</p> <p>Digital Elevation Model of Watershed</p> <p>Digital Map of Slope & Aspect</p> <p>Ground cover Map of Watershed</p> <p>Map of Geomorphology of Watershed</p> <p>Slope Stability Analysis of Upper Watershed</p> <p>Natural Hazard Assessments</p> <ul style="list-style-type: none"> - Forest Fires - Floods - Insect infestation 	<p>Selkirk Secondary School (SSS)</p> <p>College of the Rockies (COTR)</p> <p>University of Victoria (UVIC)</p> <p>Nicola Valley Institute of Technology (NVIT)</p>	<p>Ministry of Environment</p> <p>Ministry of Forests</p> <p>City of Kimberley</p> <p>Cominco</p> <p>Eagle Vision Remote Sensing</p>	<p>GLOBE (LaHart,1998)</p> <p>Lake Tahoe Basin Study (Smith and Blackwell, 1980)</p> <p>Protected Area Design and Management (Scott et al, 1993)</p> <p>Kootenay River Basin Study (Gan & Kite, 1987)</p> <p>Fornet</p>
<p>GIS Projects:</p> <p>Map of trails and other access to upper watershed</p> <p>Integrated Map of Land Status (mining claims & ownership)</p> <p>Watershed Hydrology Study:</p> <ul style="list-style-type: none"> - potential flows - flood potential - stream classification 	<p>SSS</p> <p>COTR</p> <p>NVIT</p> <p>UVic</p>	<p>Ministry of Forests</p> <p>Ministry of Environment</p> <p>Ministry of Mines</p> <p>City of Kimberley</p> <p>Aqua-Tex Scientific Consulting Ltd.</p> <p>Cominco</p>	<p>GREEN (several projects, data, & software)</p> <p>Puerto Rico Study (Civco, et al, 1995)</p> <p>Thornton Creek Project</p>

<p>Figure 3 - (Cont'd)</p> <p>GIS Projects (Cont'd): Forest Inventory</p> <p>Note: much of this work has been started as part of the Integrated Watershed Management planning process but has not been compiled or integrated into a GIS.</p>		<p>Eagle Vision</p> <p>Interior Reforestation</p> <p>EKES</p>	<p>Fornet</p> <p>ESRI</p>
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Lower Watershed

Reach #1 - Mark Creek Reservoir to Gerry Sorenson Way

Research Topics	Partner Institutions	Possible Community Partners	Exemplars and Sources of Curriculum Materials
<p>Water Quality Monitoring:</p> <ul style="list-style-type: none"> - transparency - water temperature - dissolved oxygen - pH - electrical conductivity - heavy metals <p>Historical Land Use Study</p> <p>Habitat Assessment: -Rapid Bio-assessment Protocol</p> <p>Proper Functioning Condition Assessment</p> <p>Interpretive Trail Feasibility Study</p>	<p>SSS</p> <p>COTR</p> <p>UVIC</p>	<p>City of Kimberley</p> <p>Ministry of Environment</p> <p>Aqua-tex</p> <p>Cominco</p> <p>Kimberley Heritage Society (KHS) Sullivan Mine Interpretive Centre Society (SMIC)</p> <p>MOE</p> <p>Aqua-tex</p> <p>MOE SMIC City of Kimberley</p>	<p>GLOBE</p> <p>GREEN</p> <p>EPA</p> <p>Environment Canada</p> <p>Mapping Home Places (Harrington,1994)</p> <p>EPA GLOBE</p> <p>Joseph Creek Study</p> <p>Mapping Home Places (Harrington,1994)</p>

Reach #2 - Gerry Sorenson Way to Archibald Street Bridge

Research Activities	Partner Institutions	Possible Community Partners	Exemplars & Sources of Curriculum Materials
Hydrology of Stream Channels: - comparisons of flows in flume with flows in diked channel. Location of all Storm Drains Inventory and Map of Historical Buildings within two locks of Mark Creek Location of buried Creeks and Springs ALL OF THE ACTIVITIES LISTED FOR REACH # 1	SSS COTR Lindsay Park Elementary (LPE) McKim Middle School (MMS) MMS SSS MMS SSS	City of Kimberley EKES City of Kimberley KHS SMIC City of Kimberley EKES	EPA Blue Thumb Project Wet BC Heritage Community Mapping (McRae, 1998)

Reach #3 - Civic Centre to Black Bear Bridge

Research Activities	Partner Institution	Possible Community Partners	Exemplars and Sources of Curriculum Materials
Current Land Status within two blocks of Mark Creek	MMS SSS	Local Real Estate Companies	Community Mapping (McRae, 1998)
Establish Photopoints to monitor changes in creek	MMS Blarhmont Elementary School(BES) Chapman Camp Elementary (CCES)	Aqua-Tex EKES	Joseph Creek Project Colquitz Project
Wetland Study	CCES	Ducks Unlimited	Frogwatch EPA Call of the Wetlands (Stewart, 1998) River Works
Construct a Wetland	MMS BES	City of Kimberley EKES	A Constructed Wetland (Kowal, 1998)
Water Use within the Reach	SSS	City of Kimberley EKES	River Watch Project Wet
Non point sources of pollution within the reach	BES CCES MMS	MOE City of Kimberley EKES	Project Wet Natural Science Teacher's Assoc. <i>Earth - the Water Planet</i> Joseph Creek Study
Waste Dump Sites along Mark Creek and it tributaries: - storm drains - yard waste - snow - waste (earth and rocks, etc.) from construction.	BES CCES MMS COTR BES MMS CCES	MOE City of Kimberley EKES	Boulder Creek Study River Works Urban Ravines Project
ALL OF THE ACTIVITIES LISTED FOR REACH # 1 AND 2.			

Reach #4 - Black Bear Bridge to Mouth of Mark Creek

Research Activity	Partner Institutions	Possible Community Partner	Exemplar & Sources of Curriculum Materials
Waste Water Treatment: - industrial - municipal	Marysville Elementary School (MES) SSS	City of Kimberley Cominco	EPA (excellent classroom activity)
Solid Waste Disposal and Impacts on Water: - mine waste - municipal waste	BES CCES MMS SSS	EKES MOM City of Kimberley	Ministry of Mines Acid Mine Drainage Treatment using constructed Wetlands (Skousen et al, 1994)
Erosion by Water and Natural Sources of water contamination within the reach.	BES CCES MMS SSS COTR	Ministry of Transportation & Highways (MOTH)	Canadian Council of Ministers of the Environment BC Ministry of the Environment (MOE) MOE Environment Canada Project Wet
Survey of Users of Lion's Walk	BES CCES MMS	Lion's Club	Urban Ravines study
ALL OF THE ACTIVITIES LISTED FOR REACH # 1,2, and 3.			

Community Education Activities

As the research proceeds, it is important that the findings of the students are passed on to the community at large in a timely and understandable manner. In the process, students will get to learn or master personal communication skills while using several types of media to get their message across. Figure 4 shows a list of possible Community Education Activities that can be undertaken by students at all levels in cooperation with various community members.

Figure 4 - Community Education Activities

Community Education Activity	Partner Institutions	Possible Community Partners	Exemplars
<p>Photographic & Print Media</p> <p>Mark Creek News - a quarterly in newspaper format that could be distributed with the local daily or weekly advertiser -Articles from each school could also be included in the school newsletters that are sent home with each student.</p> <p>Posters: Single sheet posters with artwork, photos and text information displayed in community kiosks and on bulletin boards throughout the community.</p> <p>Mark Creek Chronicle - a historical record of Mark Creek based on research and community contributions - compiled in a large display-size format</p>	<p>SSS With contributions from MMS BES CCES LPES MES</p> <p>All Schools Kimberley Community Skills Centre (SCSC) COTR</p>	<p>Daily Bulletin Kootenay Advertiser</p> <p>Rocky Mountain Travel Bavarian Society</p> <p>Kimberley Heritage Society SMIC Kimberley Library Cominco Daily Townsman</p>	<p>The Middle Sea (Mayer, 1992)</p> <p>SPECTRUM (SPEC)</p> <p>Fresh H2Outlook (MOE)</p> <p>Joseph Creek Project</p>

<p>Figure 4 (cont'd)</p> <p>Mark Creek- Now and Then - a pictorial comparison of various locations on Mark Creek.</p> <p>Mark Creek Musings - collection of poems and songs inspired by Mark Creek and/or its history.</p> <p>Mark Creek Murals - large scale wall murals of sections of Mark Creek showing the good, the bad, and the ugly.</p> <p>Mark Creek Mosaics - same as Mark Creek Murals, only with photographs.</p> <p>Mark Creek Maybes - student drawings and paintings of what parts of Mark Creek might look like. - Could have community members draw their own.</p> <p>Mark Creek Moments - student art work based on site visits or photographs of Mark Creek.</p> <p>All About Mark - video describing results of research and community participants.</p> <p>Snapshots of Mark - snapshots and slides of Mark Creek and various student and community activities.</p> <p>Digital Format</p> <p>All of the above public education materials can be reproduced in digital format and published on CDs or on a Mark Creek Watershed Web Page.</p>	<p>All schools</p> <p>All schools</p> <p>All schools</p> <p>All Schools</p> <p>All Schools</p> <p>All Schools</p> <p>All Schools</p> <p>MMS COTR SSS</p> <p>COTR MMS</p> <p>COTR MMS SSS</p>	<p>All of the above</p> <p>EKES</p> <p>Daily Bulletin (paper ends)</p> <p>Photo Shops Kimberley Drug Mart</p> <p>Kimberley Arts Council and Centre 64</p> <p>Kimberley Office Supplies</p> <p>Kootenay Cable</p> <p>Kootenay Cable</p> <p>Local Multi Media Consultants</p>	<p>Rivers Project (Morin, Stinner, & Coffman, 1997)</p> <p>Rivers Project (Morin, Stinner, & Coffman, 1997)</p> <p>Community mapping: Creating a sense of place (McRae, 1998)</p> <p>Up the Creek (COTR)</p> <p>Urban Ravine Project (Douglas Community College)</p> <p>Most projects have their own web page See Resources - Online</p>
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Performing Arts			
<p>Drama</p> <p>Mark Creek Mysteries:</p> <p>1) What Killed Mark?</p> <ul style="list-style-type: none"> - mystery with characters such as Apathy, Ignorance, Greed, and Carelessness. <p>2) Who Killed Mark?</p> <ul style="list-style-type: none"> - drama showing nonpoint water pollution sources in the watershed. <p>Music</p> <p>Ballad of Mark Creek</p> <ul style="list-style-type: none"> - song based on historical research (each school could add a verse or two). <p>Mark Creek Rap</p> <ul style="list-style-type: none"> - about life and death on Mark Creek. <p>Community Events</p> <p>Mark Creek Madness</p> <ul style="list-style-type: none"> - community education fair combined with visual and performing arts festival. <p>Clean up the Creek</p> <ul style="list-style-type: none"> - one day massive clean up of Mark Creek, during last week of school. <p>Mark Creek Duck Race</p> <ul style="list-style-type: none"> - annual fundraising event for research and rehabilitation activities. <p>Mark Creek Watershed Forums</p> <ul style="list-style-type: none"> - public meetings to inform and educate the community about work in the watershed and the global watershed. 	<p>MMS SSS</p> <p>MMS SSS</p> <p>All Schools</p> <p>All Schools</p> <p>COTR KCSC All Schools</p> <p>All Schools</p> <p>All Schools COTR</p> <p>All Schools COTR KCSC UVIC</p>	<p>Kimberley Community Theatre</p> <p>Kimberley Community Theatre</p> <p>Lost Dawg Singers Kimberley Community Band</p> <p>Local Rock Bands</p> <p>City of Kimberley (Parks & Rec.) Bavarian Society</p> <p>City of Kimberley (Public Works) Local Recyclers and Waste Removal Companies.</p> <p>Local Service Clubs</p> <p>MOE MOF Ministry of Tourism City of Kimberley</p>	<p>Up the Creek (COTR)</p> <p>Boulder Creek Days</p> <p>Part of most watershed projects - Adopt a Creek is one example</p> <p>Boulder Creek Forums</p>

Watershed Rehabilitation Activities

Although the flume which carries Mark Creek through the downtown area of Kimberley has been identified as the portion of the creek most in need of rehabilitation, this will be the most expensive and controversial section to modify. Research and interviews with individuals who have been involved with similar projects all teach the same lessons:

1. Start with small and inexpensive projects.
2. Start with projects that have a good chance of success (in portions of the creek that are already in fairly good shape.)
3. Start with projects that will have enduring benefit to the health of the creek.
4. Begin with activities that have obvious benefits to the community and are readily accessible.

To the above list I would add that the first activities that are undertaken should be those that are the most interesting and beneficial to the students involved in the activity. Activities that can be undertaken with minimum help and supervision from adults in the community and where older students can work with younger students should also be at the top of the list. Figure 5 is a list of some activities that could be considered in the different reaches of the Lower Mark Creek Watershed. As with many of the research activities, many of these activities could be undertaken in all the reaches of Mark Creek and in the tributary creeks and wetlands.

Figure 5 - Possible Watershed Rehabilitation Activities

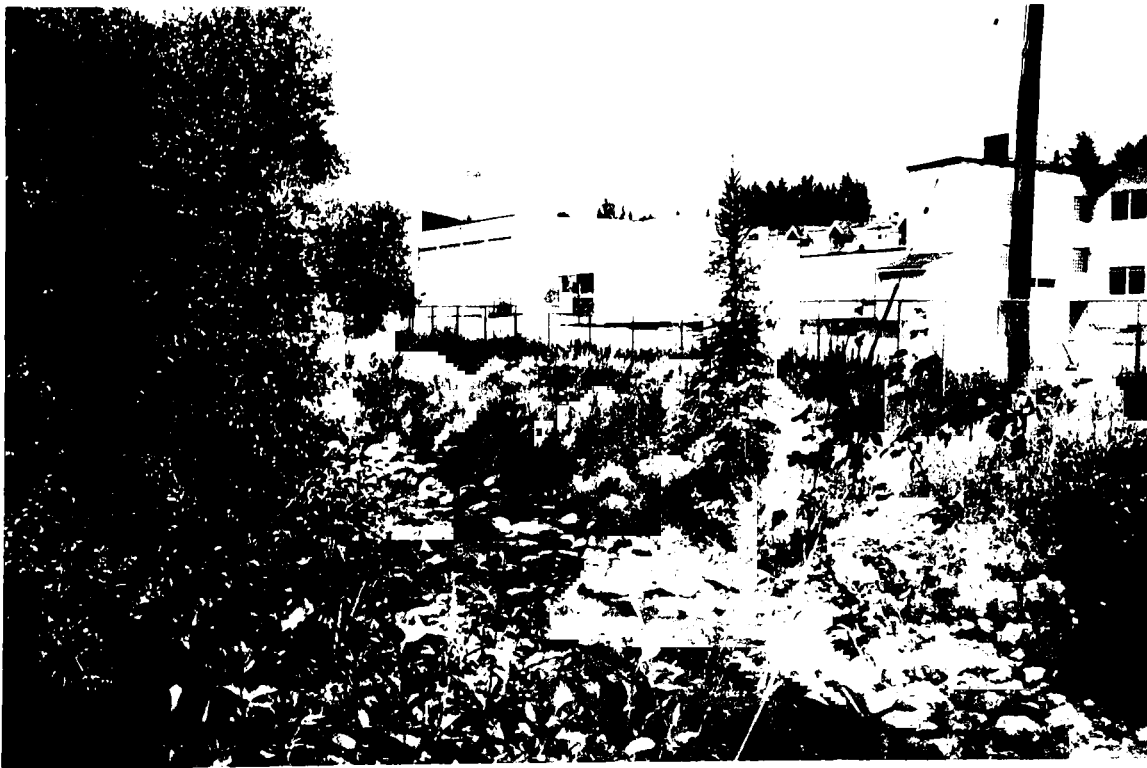
Rehabilitation Activity	Partner Institutions	Possible Community Partner	Exemplars
<p>Reach #1 Interpretive trail from old reservoir to Bavarian Railway Station.</p>	<p>COTR SSS UVIC</p>	<p>SMIC Cominco Nature Trail Society</p>	<p>Urban Ravines Project</p>
<p>Picnic area and stream overflow upstream of Cominco flume.</p>	<p>COTR SSS UVIC</p>	<p>SMIC Cominco MOE MOM</p>	<p>Boulder Creek Project</p>
<p>Bank Stabilization and planting between Railway Station and beginning of Flume.</p>	<p>COTR SSS UVIC</p>	<p>SMIC City of Kimberley Royal Canadian Legion Owners of Adjacent Property</p>	<p>Green Links</p>



Current Channel Downstream of Bavarian Railway Station

Figure 5 - Possible Watershed Rehabilitation Activities (cont'd)

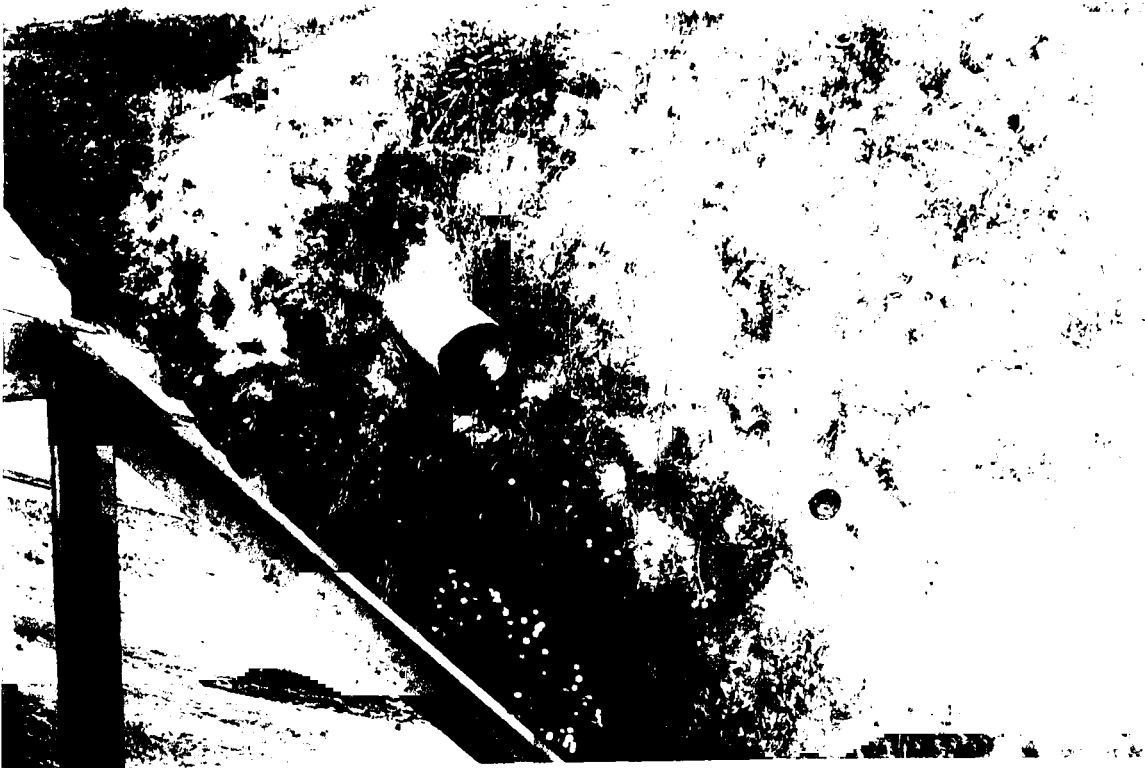
Reach #2			
Bear and brute proof waste receptacles - construction, installation, and maintenance.	SSS MMS LPES	City of Kimberley Local Welding Shops	
Marking Storm Drains	LPES MMS	City of Kimberley Local Hardware & lumber stores	Blue Thumb website gives a list of materials needed
Bank Stabilization and planting along New McKim Middle School	MMS	Ministry of Education contractor for construction of new school.	Green Links



Channel of Mark Creek Adjacent to Current McKim School

Figure 5 - Possible Watershed Rehabilitation Activities (cont'd)

Reach #3			
Construction of wetland on Blarchmont School playground.	BES MMS SSS	City of Kimberley Local Excavation Contractor	Constructed Wetland Denver, Colorado. (Kowal, 1998)
Dog Waste disposal sites and poop scoop dispensers.	BES CCES	City of Kimberley	
Rehabilitation of wetlands adjacent to Chapman Camp School and CP Rail spur line to Concentrator.	CCES	CP Rail City of Kimberley	Boulder Slough Project
Construction of splash pads or basins at all storm drainage outfalls	BES CCES MMS SSS	City of Kimberley	



Typical Storm Drain Outfall on Mark Creek

Figure 5 - Possible Watershed Rehabilitation Activities (cont'd)

Reach #4			
Reconstruction of wetlands upstream or downstream of Black Bear Bridge.	CCES MMS MES	EKES	Amphibian Oasis (Gosselin & Johnson, 1994)
Bank stabilization downstream from Black Bear Bridge.	MMS SSS	City of Kimberley MOTH	Various projects throughout region
Construction of offtake ditches and ponding along trail.	BES CCES	Local Service Clubs Kimberley Naturalists	Constructed Wetland Denver, Colorado. (Kowal, 1998)
Planting and park development upstream from highway bridge in Marysville including a local swimming hole.	All Schools	City of Kimberley Bavarian Society Marysville merchants MOTH	Joseph Creek Park

**Current Swimming Hole on Mark Creek**

Public Actions to Support Mark Creek.

Students at all levels can take leading rolls in the planning and policy development for Mark Creek Watershed. Some of the activities that students might undertake are:

1. Petition the City of Kimberley and Cominco not to sell any more land within two blocks of Mark Creek for development.
2. Lobby the City of Kimberley to designate any city-owned land within this corridor or along tributary streams and drainages as green space.
3. Develop a code of best practices in cooperation with the City of Kimberley and the Ministry of Transportation and Highways.
4. Make presentations at zoning, bylaw, subdivision, or community planning meetings outlining concerns and proposing improvements to the Mark Creek Watershed during any development or reconstruction.
5. Attend election forums to question candidates on their positions with regard to issues related to Mark Creek.

The students' contributions to the public debate on the future of the Mark Creek Watershed will encourage them to be active participants in other discussions about the sustainability of their local and global community. They will learn to seek consensus not confrontation, and that the contribution of each individual is relevant and important.

Conclusions and Recommendations

The Boulder Creek and Colquitz River Watershed Projects are the best models for the comprehensive program outlined in this project. Both projects started small and included community partners from the beginning. They link professional researchers with students and other community members and research with community action. They have garnered the support of governments at all levels and use staff from these government agencies and corporations to organize and facilitate many of the research, rehabilitation, and public education activities. Initial funding has come from some level of government including school boards, but has been quickly supplemented by the private sector and community groups and individuals.

Community clean-up days have led to stream restoration and rehabilitation projects, one small area at a time. Public celebration of successes and professional and personal linkages have maintained the momentum of the projects despite some decreases in public funding. The Mark Creek project will not be a success without similar long term commitment from a variety of community partners.

The Mark Creek Watershed does not have the population of Boulder, Colorado, or Lower Vancouver Island. We do not have the proximity to numerous research stations and post secondary institutions or to political power in Denver and Victoria. We must look to the other smaller projects, such as the Thornton Creek Project, which is supported by a small community college, or River Works where a small group of dedicated volunteers has grown into an organization that includes a number of different community groups.

We must copy Neighborhoods United where a very small group of individuals

made a big and lasting difference to the health of their urban stream. In the process they have moved beyond a group of concerned people to a community of environmentally, socially, and politically literate individuals ready to take action to solve other problems in their community. This initial group must put aside their personal agendas and biases and form a work group that will include people with a wide variety of backgrounds, skills, and ideas of how best to maintain and rehabilitate the Mark Creek watershed.

The outline for the Mark Creek Watershed Research and Rehabilitation Project tries to build on what others have accomplished, inside and outside the region. It is designed to provide educators and community groups with a wide variety of choices. Most of the educators that I surveyed and/ or interviewed stated that flexibility with timing and choice of projects was critical to their participation in the project.

The proposed research should be the primary focus of students and educators. Its multidisciplinary and qualitative nature will teach students to look at the whole picture not just each part and to understand the intricate web that binds natural and human communities. Initial activities should be designed to be completed within one school year or semester but should form the foundation of longer term projects.

Linkages with other educational institutions and community groups involved in watershed research and rehabilitation projects must be one of the first steps in the process. Partnerships with other local institutions and community groups will help to overcome the restraints of time and funding which are the main impediments to the success of this type of project.

The research will be of little use to the community if it is not effectively communicated to those who need to hear about it. Public forums, displays and

celebrations will spread the word and increase the excitement and enjoyment of all that get involved. Visual and performing art works will lock the lessons learned in the minds of the students and their audiences forever. Kimberley has an abundance of talented artists and communicators who could mentor and support the students. Participants will understand the power of the pen as they write their poems, proposals, and petitions.

The planning of the rehabilitation of Mark Creek will build relationships within the participating schools and in the community. Initial projects must be small and require limited time and financial resources but the initial work must fit into a larger plan for the rehabilitation of the watershed. The first projects should also be fairly accessible and will be a source of pride and a sense of ownership for all those who participate in the projects. A plan for maintenance of the parks, plants, and ponds must be followed in order for the work to have a lasting benefit to the watershed and the community.

The Mark Creek watershed provides the ideal location for students to develop the skills, knowledge, and attitudes that will make them successful stewards of their local and global environment. By participating in the proposed community-based project they will learn to experience the joy of learning, and sharing that learning with others in their community. The participants will build bridges of trust and understanding between groups and individuals through communication and cooperation. They will leave a legacy of a healthier 'home place', wherever that may be on this Water Planet.

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Resources

On-line Resources

Adopt - a - Creek. - Knoxville

Available at: <http://www.kornet.org/wqf/adopt.html>

Bluethumb - American Water Works Association

Available at: <http://www.awwa.org/bluethumb/>

Boulder Creek Watershed - Education and Outreach

Available at: <http://csf.colorado.edu/bcw/JimmyD.htm>

Chem Window - water contaminants

Available at: http://www.chem.duke.edu/~jds/cruise_chem/water/

Colquitz Watershed Stewardship Project

Available at: <http://www.strawberryvale.com/watershed/>

ESRI - GIS data and educational resources

Available at: <http://www.esri.com/resources/k-12/k12.html>

ForNet - Natural Resource Database

Available at: <http://www.gis.umn.edu/fornet>

GLOBE - Teacher's Guide

Available at: <http://www.globe.gov/sda-bin/wt/ghp/tg>

River Watch 2000

Available at: <http://www.riverworks.org/>

U.S. Environmental Protection Agency (EPA) - Office of Ground Water and

Drinking Water - Educational activities

Available at: <http://www.epa.gov/OGWDW/kids>

U.S. Environmental Protection Agency (EPA) - Office of Water- Watershed
Protection - Rapid Bioassessment Protocols

Available at: <http://www.epa.gov/owow/monitoring/rhp/>

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APPENDIX A

STUDENT SURVEY

The following survey will be used to help design and gain support for a proposed community based research and restoration project at Kimberley, B.C. Please circle all answers that best represent your opinions or give brief written answers if necessary.

Note: All your answers are confidential. No names will be attached to your responses.

- 1) a) What grade/level were you at when you participated in the research project _____
- b) What was the topic of the class in which you took part in a field research or public information project? _____
- 2) a) Do you have any special needs or challenges? Yes no
- b) Please describe your special needs or challenges.
- _____
- _____
- 5) Who chose the topic/area for your research?
(Please circle more than one if this was the case).
- a) yourself.
- b) student group.
- c) teacher/instructor.
- d) other e.g. member of your community.
- 6) How long did you spend on the research project?
- 4 months or less 8 months 1 year over 1 year
- 7) How many hours did you spend on the project? _____
- 8) Do you believe that your time was well spent? Yes no
Why and/or why not?
- _____

- 9) Did you successfully complete the project (or your part of the project)? Yes
 no No
 If no, why?
-

10) Do you agree with the following statements?

- | | | |
|--|-----|----|
| a) I developed friendships and contacts with other students, teachers, and other community members during the project. | Yes | No |
| b) I applied the theory of the course to this project. | Yes | No |
| c) I learned practical skills that I would not have learned if I had not participated in the project. | Yes | No |
| d) I took greater ownership of my learning as a result of the project. | Yes | No |
| e) I am more aware of my impacts on the environment as a result of the project. | Yes | No |
| f) I have taken increased responsibility for the care of the environment as a result of my participation in the project. | Yes | No |

11) Which of the following caused you problems when trying to do the research?
 (Please circle more than one if this was the case).

- a) lack of time.
- b) lack of funding.
- c) lack of proper equipment.
- d) problem of access to project sites.
- e) weather.
- f) poor participation from other student
- g) conflicts with other courses.
- h) lack of support from your instructor
- i) lack of public support.
- j) other Please describe - _____

- 12) Which of the following helped you to perform your research?
(Please circle more than one if this was the case).
- a) Help and encouragement from other students.
 - b) location for research.
 - c) student and/or teacher's knowledge of the area of research.
 - d) Student and/or teacher's knowledge of the study area.
 - e) support from teacher.
 - f) support from public especially parents.
 - g) support from private sector.
 - h) adequate funding.
 - i) good transportation.
 - j) Other Please describe _____
- 13) Which of the following did you create during the research project?
(Please circle more than one if this was the case).
- a) a printed report.
 - b) a public information package.
 - c) a video.
 - d) other multimedia presentation.
 - e) maps or other images.
 - f) a digital database.
 - g) written logs.
 - h) a paper record of results.
 - i) narrative of the project (journal)
 - j) other Please describe _____
- 14) Would you voluntarily participate in another field/community-based project? Yes
no
Why or why not? _____
- 15) Which activities did you find the most interesting and/or enjoyable during the project?

APPENDIX B

TEACHER/INSTRUCTOR'S SURVEY

The following survey will be used to help design and gain support for a proposed community based watershed research and restoration project at Kimberley, B.C. Please CHECK BOXES that best represent your opinions or give brief written answers if necessary.

- 1) Have you used field or community based research as a learning activity for your students during the last 10 years? yes no
- 2 a) What was the area of study of the program, class or workshop? _____
- b) What level were the students in your class/workshop?
- ELEMENTARY JR. SECONDARY SECONDARY COLLEGE
TECHNICAL INSTITUTE OR UNIVERSITY
- 3) The research topic was chosen by (Please check more than one if this was the case).
- The students
- The instructor
- Others - e.g. member of the community.
- 4a) Did students with special needs or challenges participate in the research?
 yes no
- ii) special needs or challenges of the student who participated. _____
- b) If no which of the following applied?
(Please check more than one if this was the case).
- No one with special needs or challenges enrolled in the class.
 Research was too demanding for students with mental challenges.
 Study area was not accessible for people with physical challenges.
 Other - please describe. _____

c) If answer to 4a) is yes.

i) Was any special accommodation made to allow students with special needs or challenges? yes no

ii) If yes, what was the nature of the accommodation ? _____

5) The duration of the study was? 4 months 8 months 1 year more than 1 year

6) Was the research part of a longer-term study? yes no Years to date _____

7) Did you successfully complete the study? yes no

8) Which of the following did the students create as an outcome of the study?

- a printed report.
- a public information package.
- a video
- other multimedia presentation.
- maps or other images.
- a digital database.
- written logs.
- a paper record of results.
- narrative of the project (journal).
- other Please describe _____

9) Which of the following objectives were achieved by the field based research carried out by your students?

- Students took ownership of their learning.
- Students were able to apply theory to the research project.
- Students gained practical skills during the project that they would not have learned without taking part in the research.
- Increased awareness of human impacts on the environment within the student group.
- Increased awareness of human impacts on the environment within the community.
- A network of active and knowledgeable stewards developed within the community.
- The project increased support for your institution within your region.

10) Which of the following factors created difficulties while carrying out the research?

- lack of time.
- lack of funding.
- lack of proper equipment.
- problem of access to project sites.
- poor student participation.
- conflicts with other courses.
- lack of public support
- other Please describe _____

11) Which were the greatest assets that supported your research?

- enthusiasm of students.
- location for research.
- student and/or personal knowledge of the area of research.
- Student and/or personal knowledge of the study area.
- support from administration.
- support from public especially parents.
- support from private sector.
- adequate funding.
- good transportation.
- other Please describe _____

12) Are you planning to participate in field or community based research
with your students in the future? yes no

13) What impact did the research have on your own personal or professional
development?

14) Please comment on any aspect of the research or the outcomes of the research that was not adequately covered by this questionnaire.

15) I would like to receive a summary of the survey results yes no

Thank you for your cooperation and I will be pleased to send you a summary of the results of the survey.