APPROVAL

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LIST OF ABBREVIATIONS

AWARE	Association of Whistler Area Residents for the Environment
BC MELP	British Columbia Ministry of Environment, Lands and Parks
BC MTH	British Columbia Ministry of Transportation and Highways
BMP	Best Management Practices
CCWMP	Crabapple Creek Watershed Management Plan
EIA	Effective Impervious Area
PFC	Proper Functioning Condition
RMOW	Resort Municipality of Whistler
SPA	Streamside Protection Area
TIA	Total Impervious Area
WFSG	Whistler Fisheries Stewardship Group

CHAPTER ONE
INTRODUCTION

This chapter provides an introduction to the principal issues related to this research project. It presents a focus and rationale for the research to be presented in this report. It explains the main project objectives and research questions to be addressed. This chapter then describes the project methods and concludes with an outline of the report structure.

1.1 BACKGROUND AND PROJECT RATIONALE

The protection of our waterways for present and future generations requires appropriate planning and management at varying spatial scales. Integrated watershed management planning is currently evolving in British Columbia as a means of effectively managing water resources at local and municipal scales. As part of an overall movement towards environmental sustainability, the community of Whistler recently expressed the need for integrated watershed management planning designed to protect valuable local habitat and water resources. Crabapple Creek was selected as the first watershed to undergo an integrated watershed management planning process, thereby establishing a model framework for future watershed management initiatives in the Whistler Valley.

The primary rationale for this research project was to fulfil the demand for an integrated watershed management plan for Whistler's Crabapple Creek. While the settings and resource issues that drive local watershed management planning initiatives are diverse, communities often find that similar tools and techniques work in many watersheds. This research project identifies some of those critical features common to effective integrated watershed management plans and then applies them to the specific context of Whistler's Crabapple Creek.

Centrally located in the mountain resort community of Whistler, British Columbia, the Crabapple Creek watershed (4.8km^2) hosts a variety of land uses including commercial

management planning; recent directions of watershed management planning in British Columbia; critical features of effective watershed management plans; and tourism and mindfulness. Chapter Three provides a detailed description of the methods used to develop the Crabapple Creek Watershed Management Plan. Chapter Four presents the background and content of the Crabapple Creek Watershed Management Plan. Chapter Five offers a reflection on the unique aspects of the Crabapple Creek watershed management planning experience related to its tourism-based resort setting in Whistler, British Columbia. Finally, Chapter Six presents conclusions and recommendations for further research in this field of inquiry.

CHAPTER TWO
LITERATURE REVIEW

This chapter provides a review of the literature related to the various themes and issues addressed by this project. It begins with a definition and brief account of integrated watershed management planning and follows with a description of more recent directions associated with watershed management planning initiatives in British Columbia. Critical features of effective watershed management plans are identified and suggested as a framework for the development of the case study, the Crabapple Creek Watershed Management Plan. This chapter concludes with a synopsis of the literature pertaining to tourism and mindfulness as they relate to watershed management in a tourism destination context.

2.1 INTEGRATED WATERSHED MANAGEMENT PLANNING: AN INTRODUCTION

The health of water resources across the continent has long been deteriorating in response to growth, urban development, and natural resource extraction. Watersheds of every scale are being impacted by our actions, and the toll is revealing itself in numerous ways including the degradation of waterways and the decline of habitat and important fish populations. Partially in response to these negative effects, and more generally as the result of a greater holistic understanding of the environment, resource managers have begun to take a different approach to the management of our natural resources. This *ecosystem management* approach recognises that our environment i-7(v0e)3(niplar envi ,ses rat ,ses ratujR7 anar[r)2(cma)5(iresou)-s

use management techniques. By recognising the hydrologic cycle as the "pathway" integrating physical, chemical and biological processes, it is an ecosystem-based strategy aimed at achieving sustainability (Center for Watershed Protection 1998a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994 and 1993a; Still Creek-Brunette Basin Work Group 1996; UMA Environmental 1998).

Integrated watershed management planning is usually employed where: urban development is rapidly spreading into natural areas; areas are under pressure from resource development; communities are experiencing problems with water supply quality or quantity; streams and rivers are prone to flooding or erosion; and where fish and wildlife habitat is being degraded (UMA Environmental 1998). These situations emphasise the connection between land use and water resources, as human activities have a direct influence on the local watershed. The concept of integrated watershed management applies particularly well to the context of rapidly developing mountain tourism resort communities which typically depend heavily on local watersheds for their operating power.

The American Experience

Integrated watershed management planning in the United States has a longer and more institutionalised, legislative history than in Canada. Federally sponsored watershed planning has been occurring in the United States since the 1960s. In 1965, the Water Resources Planning Act came into legislation. It provided for a national Water Resources Council to develop water policy, organise regional and local river basin commissions and provide financial assistance to the states to support state-level planning initiatives (Riley 1998). This movement towards integrated watershed planning was complemented in 1972 by the Clean Water Act which initiated a nation wide program of regional water quality management plans. This Act required the preparation of watershed management plans for all major river basins in the United States (Riley 1998). Riley (1998) describes a "revival of federal interest in watershed-based planning" in the 1990s that is distinguished by the further

ecosystem-based watershed management through legislation at the federal level. Only in the past decade have efforts been made provincially to implement watershed management as a method of sustainable local land use planning. The Ontario provincial government has been a leader in promoting integrated watershed management initiatives locally and regionally. In the early 1990s, the Ontario Ministry of Environment and Energy and the Ministry of Natural Resources (1993a, 1993b, 1994) published a series of handbooks about watershed management planning. This series emphasises the ecosystem approach in watershed planning and management and suggests various tools and techniques to assist local governments and communities in appropriate watershed management initiatives. The implementation of planning and management initiatives by local governments with a strong focus on ecosystem integrity clearly demonstrates a shift from remediating water resource problems to proactively protecting the environment on a watershed scale.

The practice of integrated watershed management planning in Canada has evolved in recent years to become more comprehensive, integrating a broader range of stakeholders and natural resource protection issues (Curran 1999; UMA Environmental 1998). This recent approach more thoroughly recognises and addresses the important linkages between land and water and between watershed management and local planning. Cooperative, proactive, local integrated watershed management initiatives are becoming more widespread throughout the nation as managers recognise the benefits of these approaches.

2.2 RECENT DIRECTIONS OF WATERSHED MANAGEMENT PLANNING IN BRITISH COLUMBIA

Numerous examples demonstrate that traditionally in British Columbia, water resource management has been largely driven by single resource issues (e.g. forestry and hydroelectricity) and implemented from governments in a top-down approach (British Columbia Ministry of Environment 1988; British Columbia Ministry of Environment 1993; British Columbia Ministry of Environment, Lands and Parks and British Columbia Ministry of Forests 1991). In recent years, however, water resources management in British Columbia has shifted towards a more comprehensive, cooperative, and integrated approach.

Community-based roundtables, councils and alliances provide growing evidence that watershed-based, locally driven planning processes are defining sustainability objectives at a local scale (Cantwell and Day 1996; Romaine 1996).

Unlike the highly legislative approach of the United States, there is still no legal requirement in Canada, provincially or federally, for watershed management planning at any spatial scale. Rather, municipal governments, especially in British Columbia, have recently found themselves at the forefront in devising, adapting and utilising legislative mechanisms for watershed protection. In the past decade, many British Columbian municipalities have been active in adapting policies and legislation to protect and restore local streams from the impacts of urban development (Curran 1999). Recent transformations in provincial legislation are providing new tools and opportunities for local governments to promote environmental stewardship initiatives through legislation. In an attempt to address increasing concerns about the degradation of fish habitat due to urbanisation, changes to the *Municipal Act* in *Bill 26 – Local Government Statutes Amendment Act, 1997*, offer improved municipal powers to restore, protect and enhance local environmental quality (British Columbia Ministry of Municipal Affairs 1998). The new *Fish Protection Act* (*Bill 25*) of 1997 also provides additional planning tools for local governments to protect stream and riparian corridors (British Columbia Ministry of Environment, Lands and Parks 1997).

In addition to employing these recent legislative tools, British Columbian municipalities are increasingly addressing riparian protection and impervious area impacts on an ecosystem scale (Curran 1999). Efforts are moving from isolated policy measures such as Development Permit Areas and minimum riparian protection requirements towards more

1999; Stoney Creek Stormwater Steering Committee 1998). Another leading example of integrated watershed management planning can be found in Langley. There, the Salmon River Watershed Management Partnership has developed a comprehensive watershed management plan for the Salmon River, one of the last remaining near pristine salmon producing streams in the Lower Mainland (Giannico and Healey 1998; Salmon River Watershed Management Partnership 1998). Additional examples of integrated watershed management planning in British Columbia have occurred or are currently occurring in Kelowna (Kelowna Area Watershed Initiative – Mill Creek), the Comox Valley (Millard/Piercy Watershed Management Plan), Squamish (Squamish-Cheakamus Rivers Watershed Management Plan), and the Capital Regional District (Craigflower Watershed Management Plan) (Craigflower Watershed Management Forum 1998; Curran 1999; Millard/Piercy Watershed Stewards 1999; Tobe 1999; Wark, Miller and Harper 1999).

Community-Based Watershed Stewardship and Management Initiatives

Public perceptions in British Columbia have suggested that governments are not capable or willing to address the stewardship of our water resources (Litke and Day 1998; Romaine 1996). Outdated and ineffective methods of planning and land use management at all levels of government have resulted in significant impacts to water resources. The following perceived barriers to integrated watershed management in British Columbia have been identified by Romaine (1996): inadequate key information and understanding of ecological processes; inappropriate sectorial management or institutional arrangements for water management; inadequate accounting systems for valuing natural resources; limited planning frameworks and priorities; lack of provincial management responsibilities and commitments; and insufficient monitoring programs. Many of these barriers revolve around the perceived inadequacy of the current jurisdictional framework for managing water resources within the province. As a result, British Columbia has recently seen the emergence of numerous community-based, locally driven watershed planning initiatives to address the growing concern for appropriate stewardship of water resources. These initiatives have taken the form of community roundtables, councils and alliances (e.g. Salmon River Watershed Roundtable, Salmon Arm) aimed at protecting the integrity of

local watershed resources. These initiatives have largely been initiated by community citizens, often involving local governments after momentum has been gained (Litke and Day 1998; Romaine 1996). As governmental agencies shift towards a more collaborative, watershed-based approach to the management of water resources throughout the province, community-based initiatives are also evolving to incorporate such partnerships.

watersheds may be considered at various geographic scales, it is important to select a scale appropriate for the management objectives at hand (Schueler 1995b; UMA Environmental 1998). When watershed management plans address large drainage basins, the focus of the plan may be become "fuzzy", with too many sub-watersheds and varying land use conditions to be considered (Schueler 1995b; Schreier et al. 1997). Schueler describes how planning for larger watersheds often results in an increase in the number of stakeholders involved but a decrease in implementation responsibility. In such cases, the costs for watershed analysis and monitoring are elevated. Managers are faced with a baffling array of issues and problems which are much more effectively dealt with when broken down into smaller, more manageable watershed units (Schueler 1995b).

In their watershed management planning handbook series, the Ontario Ministry of Environment and Energy and the Ontario Ministry of Natural Resources (1993a, 1993b, 1994) initially separate planning efforts according to *watershed* and *sub-watershed* scales so as to avoid planning efforts towards excessively large basins. These publications, however, do not specify a range of areas (i.e. km^2) to distinguish between watershed and sub-watershed scale. The Center for Watershed Protection (1998) and Schueler (1995b) promote the *sub-watershed* as the primary planning unit for watershed management, defined as ranging from 1-15 square miles in area (1.6-105 km^2). The sub-watershed unit is preferred here for several reasons: the influence of impervious cover on hydrology, water quality and biodiversity is most evident at this scale; the influences of individual development projects are easily recognisable; sub-watersheds are likely to have fewer political jurisdictions where it is easier to incorporate all stakeholders into the management process; few confounding pollution sources are present to confuse management issues; and it is small enough to perform mapping, assessment and monitoring tasks in a relatively rapid time frame (Center for Watershed Protection 1998a, 15). Schreier et al. (1997) advocate that management planning efforts are most effective when prepared for watersheds between 10 and 200km^2 in area. They claim that as the causal relationships between land use and ecosystem health are difficult to determine in larger watersheds and smaller watersheds are inefficient as management units. Determining an appropriate geographic scale therefore plays a critical

Natural Resources 1994; UMA Environmental 1998; United States Environmental Protection Agency 1997). For example, a watershed vision may describe the desire for an "ecologically healthy watershed". The objectives would then describe the components of an ecologically healthy watershed, such as intact, protected riparian systems or a sustainable population of fish and invertebrates.

Once established, each specific objective should then be accompanied by a set of *action* items or tactics that will help achieve that objective. Actions comprise the steps towards reaching the objectives (Ontario Ministry of Environment and Ontario Ministry of Natural Resources 1994; UMA Environmental 1998). They describe who (responsible stakeholder) will do what (specific action), when (timeline) and where (Ontario Ministry of Environment and Ontario Ministry of Natural Resources 1994; UMA Environmental 1998; United States Environmental Protection Agency 1997). Examples of action items might include implementing riparian setbacks, removing culverts, or installing stormwater retention ponds. Both the objectives anmovin.001 Tcı˝0.0rrmwviron10(g)pruvin.001 Tcı˝0.0rrmw.c.0ma(e obji)-3()-13nsib s

first be established to provide a context against which to measure changes in the system. Sampling of these indicators must then be conducted consistently and at appropriate time scales as per the nature of the indicators. Monitoring results should then be used to identify needs for modifying implementation of the watershed management plan (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994). Monitoring can be costly and communities must be strategic about what, when, where and how they intend to review progress towards specific objectives.

In addition to monitoring environmental or biophysical indicators, the performance of the integrated watershed management plan and the achievement of its objectives and actions should also be monitored (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994; UMA Environmental 1998). The vision and objectives stated in a watershed management plan, although defining desired future conditions, reflect current environmental, social and economic conditions. They may need modification to address new issues or to reflect recent changes in technology or watershed conditions. Periodical progress reports should also be completed, identifying and evaluating the effectiveness of actions which have been carried out and prioritising remaining or new actions (UMA Environmental 1998). It is important to recognise that effective integrated watershed management is an iterative process. Lessons learned from monitoring the performance of the plan should be used to make appropriate revisions (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994).

Implementation

Integrated watershed management plans can only be effective if they are implemented. Integrated watershed management planning initiatives should incorporate an implementation strategy (Center for Watershed Protection 1998a; Craigflower Watershed Management Forum 1998; Millard/Piercy Watershed Stewards 1999; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a, 1994; Still Creek-Brunette Basin Work Group 1996; UMA Environmental 1998). This often involves the creation of some type of organisational or management structure responsible for guiding the

development and implementation of the watershed plan over time. The established organisation responsible for implementing and fostering the plan should be comprised of key stakeholders and decision makers (e.g. local government, First Nations, and critical land users such as tourism/recreation managers) and representatives from the watershed community as a whole (e.g. residents, non-governmental organisations, and tourism operators). The implementation responsibilities of such a committee might include: ensuring that those stakeholders responsible for specific tasks are upholding their duties in a timely manner; assessing the results of monitoring and adapting the recommendations of the plan accordingly; contacting relevant agencies for funding opportunities; suggesting further required studies or action items; communicating the progress and performance of the plan to all stakeholders; and reviewing and updating the plan according to changing watershed values, conditions or information (Centre for Watershed Protection 1998; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a; Still Creek-Brunette Basin Work Group; UMA Environmental). Having a principal coordinator to lead such a committee and facilitate the management planning and implementation process is desirable (United States Environmental Protection Agency 1997; UMA Environmental 1998).

It is crucial to establish a management structure that can be sustained over the life of the watershed planning and management process. This can be achieved in part though involving key watershed stakeholders from the beginning of the planning initiative, fostering local ownership of the plan and familiarising them with the process and components of watershed management (Center for Watershed Protection 1998a). Having the involvement and support of local governments can also prove critical in implementation, especially in cases where plan recommendations concern municipal policy, planning and development issues (Center for Watershed Protection 1998a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a, 1993b; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994).

One potential instrument to help promote coordination and effective implementation of watershed management plans is political agreements among key watershed stakeholders.

The signing of such agreements, often known as memorandums of understanding, can help to legitimise watershed management partnerships and commitments (Center for Watershed Protection 1998a). These agreements define how government agencies and other key stakeholders will work together to create and sustain the watershed planning and management effort. As statements of intent between parties, they help to formally foster watershed management responsibilities which will assist in achieving the watershed vision, objectives and recommendations developed and agreed upon by stakeholders.

Budget

Watershed management plans should include a financial budget which estimates the cost of implementing the recommended watershed actions (Center for Watershed Protection 1998a; Schueler 1995b; UMA Environmental 1998). Unfortunately, fiscal resources for watershed protection and restoration are often limited and watershed managers must make careful choices about how to allocate scarce dollars (Center for Watershed Protection 1998a). The budget might include suggestions for how the actions might be funded (e.g. stakeholders, grants). Due to the diverse nature of watershed management plans and various funding sources available, it is difficult to establish a simple standard funding formula (Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a). Watershed managers must therefore be both practical and innovative in devising a workable budget and securing funding for projects (Center for Watershed Protection 1998a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a). It should be remembered, however, that although watershed protection and restoration costs money, it is a long-term investment in the preservation of natural capital, the quality of our environment.

Public Education

A well-informed public will support and help implement a watershed management plan. A public education component should be developed early as part of the stakeholder involvement process when developing a watershed management plan. Establishing a

Size and Simplicity

Schueler (1995b) identifies length and complexity as a primary source of the ineffectiveness of many local watershed management plans. He notes examples of documents running into several hundred pages, or even several volumes. While watershed management plans have much to communicate in the way of biophysical conditions, management strategies and monitoring indicators, they should be concise enough to be manageable. Key issues and recommendations must be clear and understandable, and should not require watershed

Watershed Protection 1998a; Craigflower Watershed Management Forum 1998; Jamieson 1996; Millard/Piercy Watershed Stewards 1999; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1993a; Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources 1994; Romaine 1996; Still Creek-Brunette Basin Work Group 1996; UMA Environmental 1998; Wark, Miller and Harper 1999).

Multi-stakeholder processes can be difficult and time consuming. In some cases, it is often the first time that diverse stakeholders interact cooperatively and work towards shared objectives. As differing perspectives are put forward through these cooperative efforts, discord may arise and require facilitation or conflict resolution skills. Without communication, cooperation, and commitment among watershed stakeholders, however, effective watershed management strategies may be difficult or impossible to develop and implement. As stated by Bowers (1999), "long-term, effective watershed management requires 25% science and technology, and 75% human psychology and sociology" (11). This is especially important in a mountain resort community context, as the preservation of the natural resource base, often the foundation of the resort community's success, requires the involvement and cooperation of all watershed stakeholders.

In a resort community context, the notion of stakeholder involvement becomes critical and complex because of the "multi-agency, multi-jurisdictional nature of tourism" (Gill and Williams 1994). Managers are faced with balancing the need to control forms of tourism which potentially jeopardise the sustained use of limited resources with other desires to maximise growth and gather the benefits of increased resident/visitor use (Gill and Williams 1994). These communities in particular must seek to involve all stakeholders in planning initiatives in order to effectively manage and maintain the quality of the watershed resource base. The notion of environmental quality as a destination positioning attribute should also not be overlooked. The high quality of mountain tourism environments is an important business resource for tourism operators. This provides incentive for tourism stakeholders to become involved in integrated watershed management planning initiatives, as such efforts are, in effect, investments in the sustained future of their ventures. Mountain tourism

section provides an introduction to these biophysical issues and their relevance to effective watershed management planning.

Riparian Areas

An integrated approach to watershed management recognises that riparian conditions may have significant impacts on the quality of stream health. Good riparian habitat is a necessary condition for healthy streams. Studies have shown a strong correlation between the biotic integrity in streams and the proportion of stream with intact riparian forest (Millar et al. 1997). A critical component of watershed integrity, riparian vegetation provides many of the requirements for fish bearing streams (Kauffman et al. 1997; Malanson 1993; Millar et al. 1997; Schreier et al. 1997; Schueler 1995a; United States Department of the Interior 1998; Yates 1988; Zandbergen 1998). Some of the essential functions that natural riparian vegetation performs for streams include:

- providing stream bank stability and preventing erosion/sedimentation;
- providing large organic debris (mature growth) needed to sustain stream morphology, complexity and oxygenation;
- helping to control sediment movement within streams;
- maintaining floodplain processes;
- providing small organic debris and terrestrial insects (nutrition for fish and invertebrates);
- filtering pollutants from runoff and groundwater flows;
- providing microclimate modification (shade);
- providing cover for fish to hide from predators;
- maintaining better water depth and annual flow cycle; and
- providing more biodiversity and productivity (Millar et al. 1997; Schreier et al. 1997; Taccogna and Munro 1995; Yates 1988; Zandbergen 1998).

Recently a subject of debate within this field of inquiry is the architecture, or structure, of riparian buffers. An extensive review of the literature by Miller et al. (1997) describes the range of riparian buffer widths required to protect the various beneficial functions

Richter and Schultz 1988; Weiss 1990). Research has consistently shown declines in the integrity of streams with increasing levels of imperviousness (Harbor 1994; Leopold 1968; Schueler 1994a, 1995a; Zandbergen 1998). Results depict a fairly rapid decline occurring between 10% and 25% imperviousness as recognised stream health indicators decline from good to poor. Several studies report a threshold of around 10% imperviousness below which the detrimental measured effects are small or absent. At higher levels of imperviousness, the decline slows as impacts are already significant (Zandbergen 1998).

While the impact of impervious areas on stream health has been recognised for several decades, recent years have seen a much stronger recognition of imperviousness as an indicator of overall watershed health. A measurement of "total impervious area", the total percent area of a basin where water does not infiltrate the soil, is becoming more commonly utilised as a key indicator of watershed health and in developing appropriate management strategies (Arnold and Gibbons 1996; Claytor and Brown 1996; Schueler 1995b; Zandbergen 1998). Best management practices, state of the art innovative actions that can be taken to improve the efficiency and effectiveness of activities and planning (Bisson et al. 1992), developed and adopted by consulting firms, municipal governments and research institutions such as the Center for Watershed Protection continue to demonstrate innovative policies and practices for minimising impervious areas and their impacts on waterways.

Stream and Watershed Restoration

To date, there have been relatively few examples of lasting, effective stream and watershed restoration projects (Roper, Dose and Williams 1997). One of the primary reasons many projects have not fully succeeded has been that projects are implemented on a small scale, stream or site-specific basis. Riparian and stream ecosystems in developed areas have largely been degraded by off-channel, watershed-wide activities and might for that reason

Stream restoration will have a greater chance of being effective in the long term if planned, implemented and monitored at a watershed scale (Brouha and Chappell 1997; Reeves et al. 1991; Roper, Dose and Williams 1997). Taking a watershed approach to restoration implies recovering the fundamental natural channel hydrology to improve local habitat conditions. To do this, stream restoration projects must be expanded beyond isolated instream projects to include rehabilitation of upslope and riparian conditions that cause downstream fish bearing stream habitats to decline (Brouha and Chappell 1997; Roper, Dose and Williams 1997). This is especially important in mountain tourism destination where development (e.g. logging, construction of major ski areas, and upslope urbanisation) often detrimentally affects the condition of important headwater streams, areas frequently ignored in restoration efforts (Dorward 1990).

This watershed-based approach to restoration is linked to the concept of *ecological restoration*, "the reestablishment of processes, functions, and related biological, chemical, and physical linkages between the aquatic and associated riparian ecosystems; it is the repairing of damage caused by human activities" (Kauffman et al. 1997, 12). Kauffman et al. (1997) discuss the first critical step in ecological restoration, the cessation of those human activities causing the damage and/or preventing ecosystem recovery. This step acknowledges the capacity for ecosystems to recover naturally when negative stressors are removed. However, it is often the case that channel restoration and instream manipulations are performed without ceasing the degrading land use activities within the watershed (Kauffman et al. 1997). Ecological restoration of streams should be undertaken at the watershed scale, recognising that riparian and stream ecosystems have largely been impacted by off-channel, watershed-wide activities. These are the activities which must be addressed for restoration to be effective in the long term. In this sense, watershed restoration can be successfully addressed through integrated watershed management.

Stormwater Management

Holistic watershed management planning initiatives have recently been occurring in urban environments where natural channel and stream system characteristics have been altered by

development. In the mid-1970s, a major shift in drainage planning philosophy occurred, as engineers began to acknowledge that upstream activities have downstream impacts. Prior to this, the common approach to urban drainage management and design was to simply collect

stream corridor conditions. This recognition is critical for devising appropriate management strategies to ensure the continued health of riparian and aquatic resources.

2.4 TOURISM AND MINDFULNESS

Maintaining the quality of the natural resource base is critical to the continued sustainability of most tourism destinations. Especially in mountain regions, the "essential spirit of place" which draws tourists and residents alike to seek such environments should not be compromised (Gill and Williams 1994). Principles of sustainable tourism have become increasingly important as tourism destinations continue to expand. Sustainable tourism identifies conventional tourism as "an eternal triangle of forces, with host communities and habitats, visitors and tourism businesses in an unstable relationship. In such situations, the growth requirements of the industry can lead to the domination of host areas by visitors and tourism businesses. The aim of Sustainable Tourism is to bring the opposing forces of the triangle into equilibrium" (Lane 1991, 2). Inskeep (1991) defines sustainable tourism as providing a quality experience for visitors, while enhancing the quality of life of the host community and protecting the quality of the environment.

In mountain tourism environments, the quality of the natural resource base largely concerns the headwaters of river basins. Sustainable tourism efforts in these areas must be especially concerned with maintaining the quality of mountain watershed resources. Communities depend on the freshwater descending from mountains for drinking, domestic and industrial use, and hydropower while fish and wildlife depend on these headwater systems for critical habitat requirements (Mountain Agenda 1998). Managing increasing demands for fresh water, preserving biodiversity and habitat created by mountain headwaters, and recognising the interactions between mountains and lowlands are challenges which can be met in part by implementing integrated watershed management planning at local and regional scales (Mountain Agenda 1998).

The necessity for tourism management that is sensitive to natural and cultural heritage and host communities is exemplified by a growing number of sustainable tourism initiatives

around the world (Hawkes and Williams 1993). Sustainable tourism is becoming more connected with education and learning, as the industry strives to meet the demands of an increasingly mature and aware visitor market (Lane 1991; Leslie 1998). Urry (1990) suggests that the primary feature of all tourism is that it involves looking at and learning about other places and people. "Holidays are not so straightforwardly contrasted with education and learning as in the past. In a wide variety of ways much tourism is coming to be more closely interwoven with learning" (Urry 1990, 154). For a growing number of people, vacations and recreation are perceived as chances to stimulate and not switch off the brain (Gibson 1998). The tourism industry has recently begun to acknowledge the educational, recreational and management values of interpretation (Knudson, Cable and Beck 1995). Lane explores the connection between the increasing concern for sustainable tourism management and the role of interpretation. Lane (1991) proposes that interpretive plans be established within visitor management strategies which seek to optimise visitor enjoyment, minimise environmental damage and maximise community benefit. Lane (1991) and Moscardo (1996b, 1999) emphasise the need within the tourism industry – in relation to both visitors and managers – for education designed to promote environmental awareness and stewardship. In this way, tourism management can hope to partially address the growing need for sustainability at both local and global scales.

Mindfulness

Moscardo, working in the fields of tourism, recreation and environmental psychology, has introduced the notion of *mindfulness* to tourism management. Drawing on the work of

them of the consequences of their actions, enhancing their experience and encouraging them to engage in sustainable behaviors" (Moscardo 1996b, 378).

In tourism communities, it is important to acknowledge the potential importance of interpretation to both visitors and residents. While interpretive activities are most often associated with tourists, it can be just as effective, if not more, in fostering education and mindfulness in residents. Moscardo (1992) shows, through visitor evaluation research, that those who are familiar with a setting are more likely to learn something than those who are unfamiliar with the setting because they are better oriented. Residents and frequent or long-term visitors, therefore, are potentially more receptive to interpretive media. It is critical to encourage mindfulness on the part of residents and frequent or long-term visitors, as they are apt to be more directly connected to the daily conservation of the local environment. An increase in resident mindfulness will arguably translate into increased mindfulness on the part of visitors as a result of interactions with members of the host community.

The challenge for managers is to ensure that tourism and recreation are rewarding and sustainable for both hosts and guests and that the quality of the environment is maintained. Interpretation can play a critical role in creating mindfulness among residents and visitors, a necessary condition for sustainable tourism. Public education and interpretive strategies comprising part of an integrated watershed management planning initiative can encourage mindfulness about watershed issues among residents and visitors and contribute to sustainable tourism in a mountain resort community.

CHAPTER THREE
PROJECT METHODS

This chapter describes the methods used for this research project. The chapter is divided into two sections. The first section expresses the rationale for the initial literature review. The following section describes the methods used in developing the case study, the Crabapple Creek Watershed Management Plan. These methods included various approaches to: collecting and assessing biophysical information; engaging watershed stakeholders; identifying critical watershed issues; and refining the draft through a continuous dialogue with key stakeholders and relevant experts.

3.1 LITERATURE REVIEW

Before commencing to develop a watershed management plan for Crabapple Creek, Whistler, it was first necessary to gain an understanding of the basic principles and framework for current trends in integrated watershed management planning. For this purpose, a literature review was conducted to collect and assess relevant information. The information found during the literature review largely helped shape the process and strategies of the Crabapple Creek Watershed Management Plan.

The literature reviewed related to several areas of interest. The first area of focus addressed in the review was the concept of integrated watershed management planning. The literature review then explored recent directions of watershed management planning in British Columbia. In this phase of the literature review several critical features of effective watershed management planning were identified. These included features relating to: structure and composition of watershed management plans; stakeholder involvement and commitment; policy implications; monitoring; and various biophysical issues of importance in watershed management initiatives.

The final topics considered in the literature review were the links between tourism, education and mindfulness. The rationale of investigating this topic relates to the secondary objective of this project, which is highlighting unique aspects of the Crabapple Creek Watershed Management Plan associated with the tourism-based resort nature of Whistler. These two phases of literature review provided a framework for guiding the case study of the Crabapple Creek Watershed Management Plan that ensued.

3.2 THE CRABAPPLE CREEK WATERSHED CASE STUDY

Collection of New Information

New information about certain physical and ecological characteristics of the Crabapple Creek watershed was gathered to help determine critical watershed conditions and issues. Several reaches of Crabapple Creek were surveyed to collect relevant information about stream flow, substrate, and habitat issues. In addition, primary research was conducted to ascertain the total impervious area of the Crabapple Creek watershed.

Assessment of New and Existing Information

The assembled biophysical information was evaluated to achieve an understanding of various conditions and trends within the Crabapple Creek watershed. Key indicators of watershed health, as determined largely by information found in the literature review, were assessed to ascertain biophysical conditions within the Crabapple Creek watershed. The conditions of these key indicators for Crabapple Creek, as well as other significant biophysical findings, helped to determine issues of priority for management plan objectives and recommendations.

3.2.3 ENGAGING WATERSHED STAKEHOLDERS

Identifying and Assembling Key Stakeholders

Information gained through the literature review emphasises the critical importance of stakeholder involvement in integrated watershed management planning initiatives. This research provided the rationale for engaging Crabapple Creek watershed stakeholders in the management planning initiative. Existing key land users and decision makers within the Crabapple Creek watershed were identified and approached in May 1999. These key watershed stakeholders were asked to participate in the development of the Crabapple Creek Watershed Management Plan. Of the key stakeholders approached, all agreed to take part in the planning process and committed to long term involvement as might be required in the development and implementation stages. These key stakeholders included representatives from the following groups: the Resort Municipality of Whistler (RMOW) Parks and

Recreation Department, Planning Department and Public Works Department; the Whistler Golf Course; and Whistler/Blackcomb ski area.

As expressed in the literature reviewed, the involvement of all watershed stakeholders, key and secondary, in the planning and development stages of watershed management initiatives is beneficial. For this reason, secondary watershed stakeholders were also identified and asked to participate in the development process of the Crabapple Creek Watershed Management Plan. Various representatives from the Whistler Fisheries Stewardship Group (WFSG), the Lil'wat Nation, and the British Columbia Ministry of Environment, Lands and Parks participation in developing the management plan. The Squamish Nation, approached along with the above-mentioned secondary stakeholders, did not reply to several invitations

project Coordinator by community members resulted directly from this media coverage. However, casual dialogue between the project Coordinator and community members throughout the summer and fall of 1999 revealed that residents were made aware of the management planning initiative for Crabapple Creek due to the newspaper articles.

3.2.4 IDENTIFYING CRITICAL WATERSHED ISSUES

Key Stakeholder Questionnaire

In June 1999, a questionnaire was distributed to various key and secondary watershed stakeholders (**Appendix A**). The questionnaire was open ended and consisted of seven broad questions dealing with perceived watershed assets, watershed concerns, and respondents' willingness to commit to ongoing watershed management initiatives. The purpose of the questionnaire was to collect stakeholder views on critical watershed issues, problems, and potential solutions. The responses to this questionnaire contributed to developing the management strategies of the Crabapple Creek Watershed Management Plan.

3.2.5 DEVELOPING AND REFINING THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

A draft of the Crabapple Creek Watershed Management Plan was developed by the project Coordinator. It was based on information uncovered in the literature review, the assessed biophysical conditions and trends of the Crabapple Creek watershed, and the questionnaire responses provided by key stakeholders.

Draft Review by Watershed Stakeholders

Once a draft of the Crabapple Creek Watershed Management Plan was developed, it was circulated among watershed stakeholders for review and input. The draft review process was ongoing and iterative in nature. It occurred from July 1999 to January 2000.

Eleven representatives from three key stakeholder groups, the RMOW, the Whistler Golf Course, and Whistler/Blackcomb, reviewed each version of the draft. In total, the draft was passed through five rounds of review, with each assessment accompanied by a meeting with key representatives from the RMOW Parks and Recreation Department, Planning

Final Review

The final draft of the Crabapple Creek Watershed Management Plan was completed in January 2000. A final review of the plan is scheduled to occur during spring 2000. The draft will be reviewed by various key stakeholders including: senior RMOW staff (Parks and Recreation Department, Planning Department, and Public Works Department); the Mountain Planning and Environmental Resource Manager for Whistler/Blackcomb; the Superintendent for the Whistler Golf Course; and the British Columbia Ministry of Environment, Lands and Parks Stewardship Advisor for Whistler. Various watershed residents will also review the draft at this time, including members of several Strata Councils located within the watershed.

The final draft of the Crabapple Creek Watershed Management Plan was also made available for public scrutiny at the RMOW Municipal Hall until the document is submitted to RMOW Council for its approval as a guiding policy document for the Crabapple Creek watershed. Submission to RMOW Council is planned for May 2000.

CHAPTER FOUR
CASE STUDY – THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

This chapter provides general information about Whistler, British Columbia, then more specifically discusses the community's recent movement towards environmental sustainability. Background information about the Crabapple Creek watershed is presented, including a range of important biophysical conditions and a summary of watershed stakeholders. Most significantly, this chapter presents the content of the Crabapple Creek Watershed Management Plan, detailing specific Objectives, Recommendations, and Guidelines for restoring and maintaining ecological watershed health.

4.1 WHISTLER: MOVING TOWARDS ENVIRONMENTAL SUSTAINABILITY

The Resort Municipality of Whistler, located approximately 120km north of Vancouver in the Coast Mountain Range, is home to a year round internationally acclaimed mountain resort community. First established as an integrated planned resort in 1975, Whistler Village and surrounding municipal developments now serve as home to a permanent population of approximately 9600 that has doubled since 1991. The area receives over 2 million visitors per year (Tourism Whistler 2000). Whistler Mountain and Blackcomb Mountain provide the venue for a world class ski area, named premier North American ski resort numerous times since 1992 (Whistler Resort Association 1999).

4.1.1 GROWTH MANAGEMENT IN WHISTLER

Prior to the development of growth management policies in the 1980s, the principal aim guiding development in Whistler was to achieve a level of development which would ensure a position among the leaders in the international ski resort destination marketplace. However, as the resident and visitor populations continued to increase and as development sprawled further throughout the valley, Whistler recognised the need to impose a limit to growth. It was felt that a limit to growth, as well as guidelines to types of growth, were

needed to ensure the continued high quality of the resort environment that attracts those residents and visitors. In 1982, the RMOW restricted the amount of development to a ceiling of 45, 000 bed units as part of a growth management strategy. This development capacity was in raised 1989 and currently sits at above 52,000 bed units (Resort Municipality of Whistler 1996). In keeping with growth management strategies employed to maintain a high quality of service infrastructure and natural environment, the RMOW has been conducting an intensive annual monitoring program since 1994 to measure and help control growth patterns and impacts (Resort Municipality of Whistler 1996).

4.1.2 THE VISION: WHISTLER 2002

In 1997, the RMOW embarked on a visioning process to identify community values and priorities for the coming 5 years. The overall aim of the visioning process was to prepare a common vision and directions for guiding the resort community into the 21st Century. The Vision for Whistler primarily identified four specific priorities, including:

- Building a Stronger Resort Community;
- Enhancing the Whistler Experience;
- Moving Towards Environmental Sustainability; and
- Achieving Financial Sustainability.

This range of priorities was discussed amongst the community through means such as Town Hall Meetings and an extensive survey workbook entitled *Whistler 2002: Charting A Course For The Future*

4.1.3 THE *WHISTLER ENVIRONMENTAL STRATEGY*

In response to the overwhelming support for moving towards environmental sustainability, the *Whistler Environmental Strategy* development process was initiated to address this movement in a comprehensive manner. The development of the *Whistler Environmental Strategy* has been underway since the summer of 1998 and continues. The proposed strategy currently exists as a Discussion Paper for public review and input. The *Whistler Environmental Strategy* addresses many of the major environmental challenges facing Whistler, ranging from critical habitat and ecologically sensitive area protection to environmentally responsible energy, wastewater and transportation management. Beginning with key elements of environmental stewardship such as Values and Guiding Principles, the *Whistler Environmental Strategy* provides a road map for moving towards environmental sustainability, detailing specific Strategic Goals, Targets and Tasks.

Listed as one of the Tasks of the *Whistler Environmental Strategy* under the heading "Establishing and Maintaining a Protected Areas Network Within the RMOW" is the development of watershed management plans for 12 Whistler waterways, including Crabapple Creek. The fulfilment of this Task is aimed at implementing ecosystem-based management of various areas, thereby helping to maintain the ecological integrity of these systems (Waldron 1999). The development of the Crabapple Creek Watershed Management Plan is the first of these watershed management plans to be completed and will serve as a template for future watehe RMOW" is the

regarding some key indicators of watershed health for Crabapple Creek. A summary of Crabapple Creek watershed stakeholders is also presented.

4.2.1 GENERAL WATERSHED OVERVIEW

Whistler's Crabapple Creek watershed (**Figure 1**), also known as Archibald Creek, drains an area of approximately 483 ha (4.83 km^2), from its headwaters on Whistler Mountain, through the neighbourhoods of Sunridge Place and Brio, through the Whistler Golf Course to the confluence where it joins the River of Golden Dreams near Lorimer Road.

Crabapple Creek, like many other urban watersheds, has been experiencing the impacts of development. Various streams within this watershed have had their riparian vegetation removed, been put through culverts, and been channelised into ditches. Some of the land within the watershed has been paved for roads and housing developments, but the total impervious area is reasonably low at less than 10%.

Extensive logging in the 1950s and 1960s, along with the more recent development of a world class ski area, have disturbed the headwaters of Crabapple Creek. Disturbances to the watershed on Whistler Mountain related to Whistler/Blackcomb ski area include the removal of riparian vegetation, culvert crossings beneath roads and ski runs, the development of several buildings, a gondola and chairlifts, and the use of water from Crabapple Creek and Alder Creek (a main tributary) for drinking water and snowmaking activities.

The main stem of Crabapple Creek currently flows along the Whistler Golf Course, a flat valley area that was historically the site of a large natural wetland through which Crabapple Creek meandered freely. To accommodate the construction of the golf course, the main stem of Crabapple Creek was completely diverted to the west side of its floodplain,

The Crabapple Creek watershed is relatively close to its own build-out. 90% of development slated for the watershed is already complete. Rationales for future construction activities within the watershed include the completion of planned development, maintenance and repair of existing facilities (i.e. roads, trails, buildings, Whistler Golf Course, Whistler Mountain, etc.), and the potential rezoning of already developed lands.

The various development activities mentioned above can result in effects such as streambank erosion, water sedimentation, and increased runoff flows, all of which reduce the quality of instream habitat for fish and invertebrates (Schreier et al. 1997; Zandbergen 1998). Despite these factors, the lower reaches of Crabapple Creek currently provide some of the best spawning habitat for rainbow trout in the Whistler Valley (Thomson 1996). Although the watershed has undergone some significant changes to its natural character, the health of Crabapple Creek is relatively intact and it is the intention of this watershed management plan to help ensure the continued vitality of this important local ecosystem.

4.2.2 DETAILED WATERSHED OVERVIEW

Regional Climate Characteristics

Whistler's Crabapple Creek watershed is located in the Pacific Range of the Coast Mountains and comprises part of both the Coastal Western Hemlock and Mountain Hemlock Biogeoclimatic Zones. Areas at valley elevation experience relatively dry, warm summers (lows of 6 to 8 and highs of 19 to 23 degrees Celsius) and winters with moderate temperatures (lows of –8 to –5 and highs of –1 to 3 degrees Celsius). Coldest temperatures are typically in January, with the warmest temperatures occurring in July and August. Average valley precipitation is 1198mm per year, with peak snowpack occurring in February and March. Average annual snowfall at Whistler Mountain peak is 914cm (Resort Municipality of Whistler 1997).

Geomorphologic Background

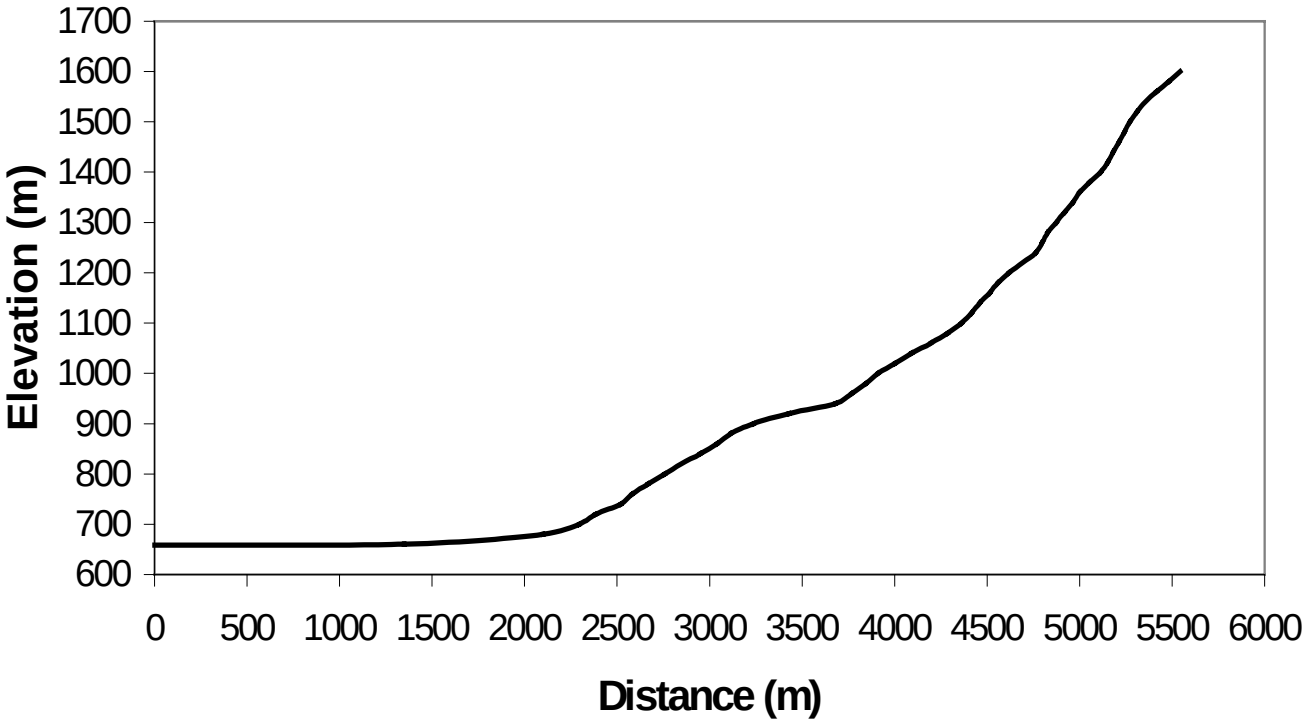
The Crabapple Creek watershed area is comprised of Gambier Group stratified rocks and Slollicum Schist metamorphic assemblage. Soils derived from the Gambier and Slollicum metamorphic assemblages are expected to be relatively fine (EBA Engineering Consultants and British Columbia Ministry of Energy, Mines and Petroleum Resources 1992).

In the upper basin, Crabapple Creek and its tributaries descend through relatively recent geologic substrate, as indicated by the predominance of large boulders and steep channel descents. In the lower basin, the Crabapple Creek watershed is primarily characterised by a fluvial history. The watershed area downstream, or north, of Highway 99 to the mouth, now mainly occupied by the Whistler Golf Course, was at one time a glacial lake, and more recently the site of a large natural wetland (Williamson 1999).

Hydrologic Characteristics

The Crabapple Creek headwaters originate on mid-Whistler Mountain, descending from approximately 1600m to 658m elevation over a 5600m distance for a total slope of 17% (**Figure 2**). With most of the elevation occurring upstream, or south, of Highway 99, this high-energy system commonly carries sediment and woody debris.

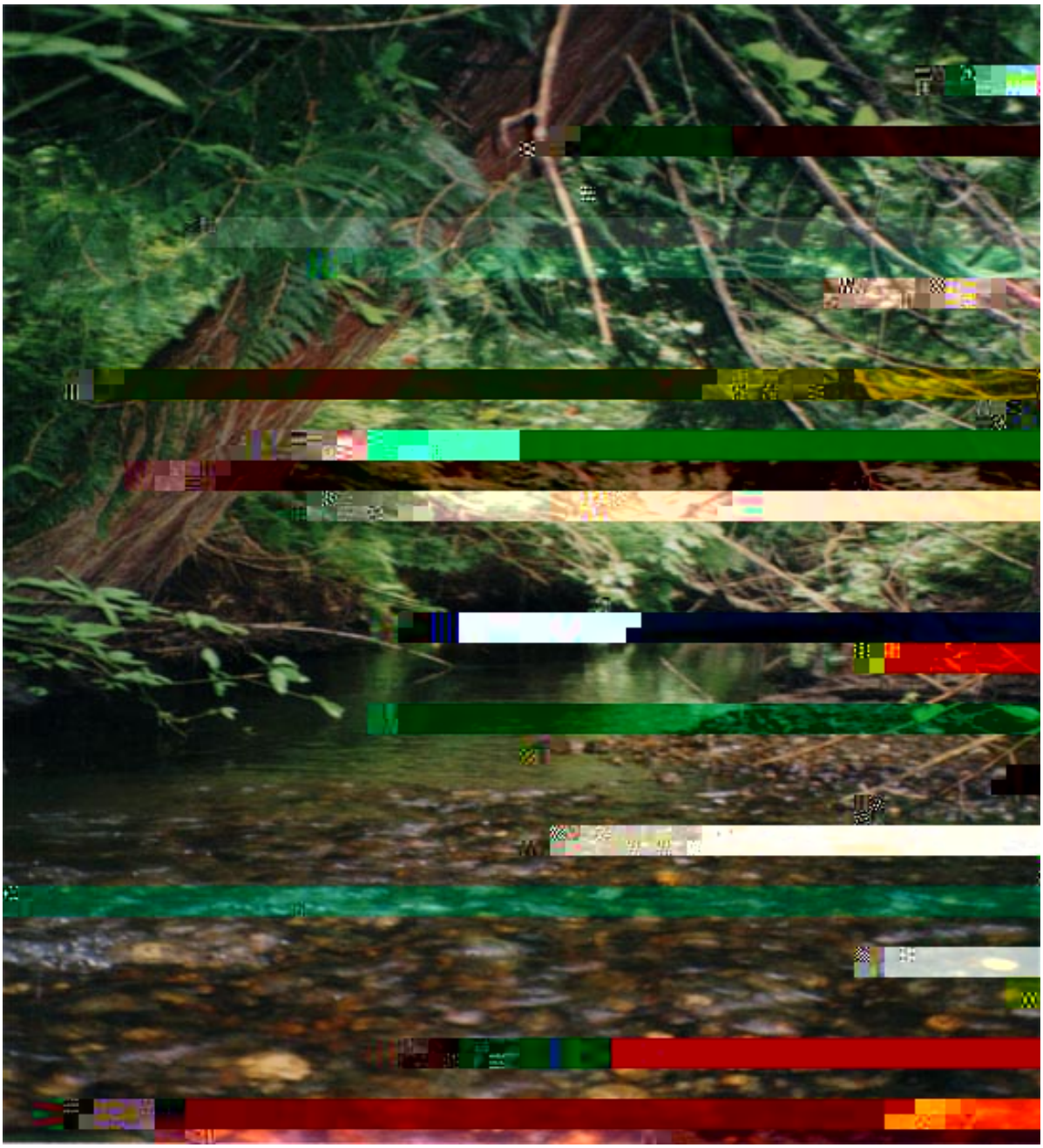
Figure 2 Crabapple Creek elevation profile



The upper basin of the watershed (**Figure 3**) is characterised primarily by the gully headwater system of Crabapple Creek and its tributaries, while the lower basin reaches (**Figure 4**) have much gentler gradients of generally less than 2%. The low-lying main stem of Crabapple Creek historically served peak flows from Whistler Mountain tributaries with the natural retention storage of a marshy wetland. This lowland marsh also served to settle out silt and debris during the freshet period. The bankfull discharge of Crabapple Creek near the confluence of the River of Golden Dreams is estimated at approximately $1.05 m^3/sec$.

Figure 3 Crabapple Creek upper basin on Whistler Mountain

Figure 4 Crabapple Creek lower basin at north end of Whistler Golf Course



Bed Paving Material

A recent survey of two upper basin reaches reveals a general substrate composition of the following:

- large boulders > 25cm in diameter (approximately 25%);

- cobble 5cm < 25cm (approximately 55%);
- gravel 2mm < 5cm (approximately 10%); and
- fines/sand < 2mm (approximately 10%).

Past and recent surveys reveal the substrate of lower basin reaches to comprise mainly fines and gravel with some cobble and few boulders (Krzesinska 1995; Neuman and Fox 1980). A 1996 survey indicates increased fines from previous assessment in several of these reaches with relatively lower gradients (Krzesinska 1996).

Water Quality

Water quality monitoring has been conducted on Crabapple Creek annually since 1995 and results have generally indicated good water quality. However, the inconsistency of sampling and limited baseline data are not sufficient for reliable conclusions.

Dissolved Oxygen

The amount of dissolved oxygen in stream water affects the kinds of life found there. Depleted oxygen levels can create adverse conditions for many aquatic organisms including fish. Temperature, flow levels, velocity, organic wastes and stream complexity are some important factors aff -1.7tr(n)-22(y)18(aqu)-12(a)2(t)f12(a)12(anTex)- 0 ondit4.00. 1ccf

pH

pH is the relative acidity of water as ranked on a logarithmic scale of 0 – 14, 0 being strongly acidic and 14 being strongly basic. Water with pH of 6.5 – 8.5 is the normal range for supporting diverse stream life (Taccogna and Munro 1995; Yates 1988).

The pH of Crabapple Creek's lower reaches has been measured at ranging between 5.0 and 8.3. Some possible reasons for low pH include heavy rainfall, snow melt, road runoff and drainage from coniferous forest areas (Taccogna and Munro 1995).

Temperature

Temperature is a key physical parameter in aquatic ecosystems and is influenced by weather, removal of riparian vegetation, turbidity from sediment transport, storm water inputs, groundwater inputs and industrial discharges. If water temperatures exceed the normal range of tolerance for some aquatic species, they may become stressed and die (Taccogna and Munro 1995; Yates 1988).

The temperature of Crabapple Creek's lower reaches, sampled normally in the sum.d6m(eache)-dr(e)]nth.00
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recorded once in recent years, these data insufficiently indicate accurate baseline conditions. With the anecdotally observed excess sedimentation levels in the lower reaches of Crabapple Creek, it is recommended that this indicator be monitored more stringently and with a consistent measurement unit such as Total Suspended Solids (TSS) or NTU.

Riparian Land Use and Conditions

Riparian, or streamside, conditions can greatly affect the health of a stream system (Malanson 1993; Schreier et al. 1997; Taccogna and Munro 1995; Yates 1988; Zandbergen 1998). As noted above in the literature review, the recognition of riparian influence on stream health is crucial in any watershed management initiative.

Currently there is no accurate measurement of percent intact riparian area for the Crabapple Creek watershed. Riparian land use along Crabapple Creek and its tributaries in the upper basin (south of Highway 99) is currently characterised primarily by Whistler Mountain ski area and by the residential developments of Sunridge Plateau and Brio. During the 1950s and 1960s, the Whistler Valley corridor was heavily logged and this undoubtedly affected the age, structure, density and diversity of riparian forest surrounding Crabapple Creek and its tributaries. The natural riparian zone has more recently been reduced along various upper reaches by the creation of ski runs and maintenance roads and trails on Whistler Mountain. The overall riparian integrity along streams in this portion appears generally intact. As Crabapple Creek flows north towards Highway 99, the natural riparian zone has been decreased significantly or eliminated in places, especially throughout Brio, by the residential road and housing network.

Riparian land use along Crabapple Creek in the lower reaches (north of Highway 99) is characterised primarily by Whistler Golf Course to the east and by the Valley Trail, Blueberry Hill and Whistler Cay Estates residential developments to the west. The existing riparian zone along this lower portion is minimal in width, since much of the historic vegetation has been removed for development of the Whistler Golf Course, housing, paved trails and residential road networks. Closer to the mouth of Crabapple Creek, past the

Whistler Golf Course, the riparian zone is somewhat more intact but is still insufficient for proper functioning conditions to be achieved. Some riparian vegetation restoration has been carried out along the lower reaches of Crabapple Creek, specifically towards the mouth by Whistler Cay Estates and Our Lady of the Mountains Catholic Church.

Common indigenous tree species found within the Crabapple Creek watershed include:

- *Tsuga heterophylla* (western hemlock);
- *Tsuga mertensiana* (mountain hemlock);
- *Psuedotsuga menziesii ssp. menziesii* (Douglas-fir);
- *Thuja plicata* (western redcedar*);*
- *Alnus rubra* (red alder);
- *Abies amabilis* (Amabilis fir);
- *Populus balsamifera ssp. Trichocarpa* (black cottonwood); and
- *Malus fusca* (Pacific crab apple).

Common indigenous shrub species found within the Crabapple Creek watershed include:

- *Gaultheria shallon* (salal);
- *Vaccinium parvifolium* (red huckleberry*);*
- *Sambucus racemosa ssp. pubens* (red elderberry);
- *Symphoricarpos albus* (common snowberry*);*
- *Sorbus sitchensis* (Sitka mountain-ash);
- *Crataegus douglasii* (black hawthorn);
- *Acer glabrum* (Douglas maple);
- *Physocarpus capitatis* (Pacific ninebark);
- *Rubus parviflorus* (thimbleberry);
- *Oplopanax horridus* (devil's club);
- *Cornus stolonifera* (red-osier dogwood;
- *Rosa nutkana* (nootka rose);
- *Rosa gymnocarpa* (dwarf rose);
- *Vaccinium alaskaense* (Alaskan blueberry); and

-

Benthic Invertebrates

Benthic macroinvertebrates serve as excellent indicators of stream and watershed health. A stream with a diverse assemblage and healthy populations of invertebrates normally indicates good stream quality, whereas a stream with low benthic diversity and large populations of species more tolerant to pollution and poor conditions may indicate problems with water quality or instream habitat (Culp, Cash and Halliwell 1997; Taccogna and Munro 1995; Yates 1988).

Sampling of invertebrates in Crabapple Creek in 1997 indicated the presence of several pollution intolerant types including caddisfly larvae, mayfly larvae and stonefly nymphs. Also found were several more tolerant species including alderfly larvae, aquatic beetles, cranefly larvae, aquatic worms, and water mites. However, recent anecdotal evidence suggests that a lack of diversity and density of invertebrate life exists in the lower reaches of Crabapple Creek. More frequent sampling would help to provide a more comprehensive basis on which to assess the invertebrate situation in Crabapple Creek.

Impervious Area

Impervious area has become increasingly recognised as a significant indicator of watershed health. The total impervious area of the Crabapple Creek watershed is approximately 9.92% (43.5 ha). A large portion of the impervious area within the watershed (55%) consists of buildings and paved roads. Unpaved roads, sidewalks, trails, driveways and parking lots make up a further 34% of the total impervious area of the watershed (**Table 1**).

Table 1 Impervious area of the Crabapple Creek watershed

Land Use Within Watershed	Area (ha)	Impervious Factor (%)	% of Total Watershed Area
Paved Roads	12.37	100	2.8
Unpaved Roadways	5.20	100	1.19
Buildings	11.78	100	2.69
Sidewalks and Trails	4.46	100	1.02

Driveways and11.6-2(in)]T2f 207.8f83

Construction	0.11	100	0.03
Bare	1.03	10	0.23
Grass/Shrub/Forest	395.35	1	90.2
Water	2.49	0	0.57
Total	438.3		100
Total Watershed Area (ha)	438.3		
TOTAL % IMPERVIOUS AREA OF WATERSHED	**9.92**		

(Adapted from Houston 1999)

Watershed Restoration

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In 1996, several instream habitat enhancement projects were completed on the lower reaches of Crabapple Creek, from the crossing beneath Crabapple Drive to the confluence at River of Golden Dreams. Projects aimed at enhancing spawning and rearing habitat included the deposition of spawning cobble, boulder placements, and placement of a root wad and several log revetments. Streamside planting was completed along this reach the following spring (Beresford 1999).

4.2.3 WATERSHED STAKEHOLDERS

The involvement of key stakeholder groups and individuals shaped and facilitated the development of the CCWMP. The primary stakeholders, meaning here those who make most of the decisions and those most affected by these decisions, within the Crabapple Creek watershed included:

- watershed residents and landowners;
- visitors and tourists;
- Whistler Golf Course (Tourism Whistler);
- Whistler/Blackcomb (Intrawest); and
- the Resort Municipality of Whistler
    - Parks and Recreation Department
    - Planning Department
    - Public Works Department (Engineering).

Secondary stakeholders within the Crabapple Creek watershed currently include:

- WFSG (a collection of partners representing various local groups including: Whistler Golf Course, Whistler/Blackcomb, RMOW, Whistler Rotary Club, Whistler Angling Club, Chateau Whistler Golf Course/Chateau Whistler Resort, Nicklaus North Golf Course, and AWARE);
- British Columbia Ministry of Environment, Lands and Parks (BC MELP);
- Mount Currie Indian Band (Lil'wat Nation); and
- Squamish Nation.

4.3.1 PURPOSE OF THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

The development of this plan was initiated by the *Whistler Environmental Strategy*. The specific purposes of the CCWMP are to:

- guide watershed decisions and activities in the best interests of ecological stream, wetland and riparian health;
- protect the health of Crabapple Creek through watershed specific Recommendations and Guidelines;
- synthesise ecological and social elements to enhance stewardship within the watershed;
- raise resident and visitor awareness of resort community watershed issues; and
- act as a model for guiding the development of future Whistler watershed management plans.

4.3.2 JURISDICTION OF THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

The Crabapple Creek watershed makes its home within the boundaries of the Resort Municipality of Whistler. Currently, the lower portions of the watershed are publicly and privately owned, while the upper portion of the watershed exists on Crown land and is currently leased to Intrawest for the development and operation of Whistler/Blackcomb ski area. Historically, the Crabapple Creek watershed lies within the traditional territory of both the Squamish and Lil'wat Nations. Once approved by the RMOW Council as a municipal document, activities and decisions within the Crabapple Creek watershed area will be guided by the CCWMP. Implementation of the CCWMP may lead to the further development of regulatory components by the RMOW (e.g. stream and riparian protection bylaws). The CCWMP will be implemented in conjunction with and within the context of other pertinent local, regional, provincial and federal policies. These regulatory elements may be implemented specifically for the Crabapple Creek watershed or they may result from the development of a comprehensive environmental bylaw initiated by the *Whistler Environmental Strategy*. Any municipal policy directives recommended by the CCWMP,

such as bylaws, site design and zoning regulations, will apply to the watershed in its entirety once approved by RMOW Council.

It is hoped that, additionally, one or several Memorandums of Understanding will be signed between key watershed stakeholders. This policy measure will further encourage strong stewardship ethics and compliance towards protecting the ecological integrity of Crabapple Creek.

The CCWMP outlines provisions for the effective **implementation** of the plan. The

Figure 5 Structure of the Crabapple Creek Watershed Management Plan

4.3.4 VISION FOR THE CRABAPPLE CREEK WATERSHED

Based on stakeholder input, an overriding vision for the management of the Crabapple Creek watershed was developed. This vision clearly states that Crabapple Creek will be a thriving resort community watershed that supports the sustained ecological health of its stream, wetland and riparian ecosystems, protected and restored from the negative pressures of land use while allowing for residential, commercial and recreational uses. Residents and visitors, encouraged by innovative watershed initiatives, will be stewards of this community resource in perpetuity.

4.3.5 CRABAPPLE CREEK WATERSHED MANAGEMENT STRATEGIES: OBJECTIVES, RECOMMENDATIONS AND GUIDELINES

This section details the CCWMP management strategies for Crabapple Creek, which include Objectives, Recommendations and Guidelines. These management strategies were developed utilising a combination of the following: information gained from the literature review; biophysical information specific to the Crabapple Creek watershed; and thoughts expressed by watershed stakeholders in their responses to the questionnaire (**Appendix A**).

Objectives

The Objectives of the CCWMP are intended to more definitively express the stakeholder Vision for the watershed, dividing that holistic aspiration into specific categories of

Recommendation is accompanied by a schedule for completion and designated responsible organisations (**Table 2**).

Guidelines

The Guidelines of the CCWMP are similar in function to the Recommendations in that they

Objective 1: Recommendation B

Implement the *Crabapple Creek Interpretive Strategy* (section 4.3.6.2).

Objective 1: Recommendation C

Develop and implement both formal and informal means of communicating watershed issues to relevant employees (e.g. managers and grounds/maintenance crews) of primary watershed stakeholder groups such as Whistler/Blackcomb, the Whistler Golf Course, and the RMOW. These employees can play critical roles both in actively protecting the integrity of Crabapple Creek and in raising awareness about watershed issues among members of the community.

Objective 1: Recommendation D

Continue to highlight Crabapple Creek for education programs such as River Life, Streamkeepers and Wetland Keepers, as well as for grade school projects and field trips.

Objective 1: Recommendation E

Provide watershed residents and landowners with a guide for household watershed stewardship and tips for riparian and stream care. This guide should include information regarding potential problems to look for and who to notify in case of problems.

Objective 1: Recommendation F

Prepare and distribute an information brochure detailing the key components of the CCWMP.

Objective 1: Recommendation G

Develop a multipurpose interpretive display about Crabapple Creek for use in presentations, workshops, conferences, watershed walks, BC Rivers Day activities, and more. The display should highlight various watershed issues such as stream ecology, development history and impacts, stewardship and restoration initiatives, and the development of the CCWMP. The

maps, written segments, photos, and potentially a three dimensional model of the watershed area.

Objective 1: Recommendation H

Highlight Crabapple Creek watershed initiatives in annual BC Rivers Day festivities.

Objective 1: Recommendation I

Provide a continual stream of articles to community newspapers and organisations regarding Crabapple Creek watershed health and stewardship initiatives.

Objective 1: Guidelines

The following Guidelines should be considered in order to encourage watershed stewardship by resort community residents and visitors.

- Partnerships relating to watershed stewardship should be encouraged and fostered among all watershed stakeholders.
- Watershed residents should be sufficiently informed of all major watershed initiatives potentially affecting stream and riparian health (e.g. newspaper announcements).
- Stakeholder input should be gathered and meaningfully considered regarding any major watershed initiatives potentially affecting stream and riparian health.
- Further opportunities for watershed interpretation and education should continually be sought and developed.

4.3.5.2 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN major waars

maintaining ecological watershed health. Riparian areas perform numerous functions that are vital to the properly functioning condition of channel hydrology and aquatic habitat. The literature maintains that the restoration and protection of riparian areas are critical biophysical issues that should be significantly represented in any integrated watershed management plan.

Objective 2

Riparian areas along Crabapple Creek and its tributaries are healthy, restored and protected.

Objective 2: Recommendation A

Identify and classify according to habitat value Crabapple Creek main stem and all non-intermittent tributaries to be included in riparian protection and restoration initiatives.

Objective 2: Recommendation B

Complete municipal mapping inventory with matching 1:2000 orthophoto maps for the upper Crabapple Creek basin on Whistler Mountain.

Objective 2: Recommendation C

Establish and implement protective riparian setback zones for Crabapple Creek and its tributaries. The riparian setback zones should be applied to undeveloped streamside areas and to already developed streamside areas proposed for rezoning or any type of additional or redevelopment. The width of riparian setbacks for Crabapple Creek and its tributaries has been determined by incorporating key stakeholder input with the technical recommendations of relevant literature. The minimum riparian setback zone for Crabapple Creek and all tributaries should be 15m from top of bank (top of bank to be determined as outlined in the *Land Development Guidelines for the Protection of Aquatic Habitat,* Chillibeck, Chislett and Norris 1993 or by evolving representative definitions). This Additional protective riparian setback zones may be based upon the Streamside Protection Area (SPA) classification determined by the Streamside Protection Policy Directives pilot project for Crabapple Creek.

Objective 2: Recommendation E

Establish priority areas for riparian restoration and replant riparian areas with indigenous vegetation according to priority. Some significant areas to be considered for riparian restoration include:

- along headwater tributaries on Whistler Mountain (various locations along ski runs and maintenance roads)
- along east side of main stem adjacent to Arbutus Drive in Brio
- along main stem through Whistler Golf Course, on both east and west sides of Crabapple Creek; and
- from the north end of Whistler Golf Course to the confluence with the River of Golden Dreams.

Objective 2: Recommendation F

Objective 2: Recommendation H

Assess and minimise potential impacts of shoulder season recreation activities around the stream and riparian area through educational signs or barriers where appropriate (e.g. mountain bike park on Whistler Mountain).

Objective 2: Recommendation I

Assess the Crabapple Creek watershed according to the *Proper Functioning Condition* (PFC) method as proposed by Patrick Lucey and Brian LeCas to the WFSG in August 1999 and at the Whistler International Proper Functioning Conditions Symposium, October 5-7, 1999. Recommendations of the CCWMP should be amended according to significant findings.

Objective 2: Guidelines

The following Guidelines should be considered in order to restore and protect the health of riparian areas along Crabapple Creek and its tributaries.

- Full riparian area protection (i.e. greater than 50m) should be encouraged and implemented whenever possible.
- Riparian restoration to a minimum of 15m in width should be implemented in existing developed areas wherever possible (e.g. along main channel throughout the Whistler Golf Course).

4.3.5.3 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN OBJECTIVE 3: RECOMMENDATIONS AND GUIDELINES

This section states the third Objective of the CCWMP and details the Recommendations and Guidelines that will contribute to achieving this Objective. The fulfilment of the Recommendations and Guidelines listed for Objectives 2 and 4 will contribute to achieving this Objective. This Objective and its accompanying Recommendations and Guidelines reflect key stakeholder input as well as relevant information gained from the literature review. This Objective recognises the potential for upland and valley development to alter

natural peak and low flows for a given stream system. While changes in peak and low flows may result from development related activities such as increased impervious area, stream channelisation and culverts, the natural drainage capacity of the channel remains unaltered,

while ensuring that the TIA remains at the lowest level possible. Effective impervious area (EIA) is another important indicator that relates to maintaining the natural hydrologic conditions of a stream system. The EIA of a watershed is generally lower than the TIA, as runoff enters the channel at a slower rate (e.g. through ditches rather than storm sewers). The EIA of the Crabapple Creek watershed should not exceed 8-9%.

Means of implementing this Recommendation through municipal policy options (e.g. zoning, bylaws, Development Permit Areas) should be investigated. This Recommendation might be accomplished partially through implementing a site coverage requirement allowing

Objective 3: Recommendation D

Minimise flood hazards by implementing flood protection measures appropriate to achieving other CCWMP Objectives.

Objective 3: Recommendation E

Where sediment removal from the main stem is required to restore channel drainage capacity, carry out these works recognising the need to reinstate natural riparian vegetation and instream complexity (i.e. large woody debris, pool/riffle sequencing, substrate

Develop a municipal master drainage study and accompanying master drainage plan to deal with issues such as natural flows and channel drainage capacities, stormwater management policies, flood control, point and nonpoint source pollution, and the maintenance of waterways and drainage corridors.

Objective 3: Guidelines

The following Guidelines should be considered in order to minimise impacts to the hydrologic characteristics of Crabapple Creek and its tributaries associated with development.

- Mitigative measures and restoration initiatives should emphasise a long term, holistic watershed approach to addressing sedimentation rather than implementing short term "quick fix solutions" that tend to deal only with reducing the symptoms or *effects* rather than dealing with the *actual causes* of the problem at hand (e.g. site specific erosion control to reduce sedimentation will not address contributing causes such as increased velocity due to channelisation and artificial stabilisation or increased runoff rates due to increased impervious area.)
- Construction and maintenance should be sensitive to the ecological needs of the watershed.
- Development on known unstable floodplains should be restricted.
- Naturalisation and restoration efforts should emphasise bioengineering solutions.
- Established riparian setbacks should be left between top of bank and training berm where building on floodplains is deemed necessary.
- Development should be clustered, aiming for maximum density per area, thereby reducing urban sprawl.
- A zero net increase in stormwater runoff should be planned from sites after development (i.e. seek to maintain the predevelopment hydrologic flow patterns).
- The use of underground storm drainage systems should be avoided.
- Steam crossings (i.e. by roads, trails, etc.) should be minimised.
- Bridges, not culverts, should be used where stream crossings are necessary.

- Culverts, where necessary, should provide for fish passage. Existing culverts should be retrofitted to provide fish passage.
- Disconnection of roof leaders should be encouraged.
- Bridges should cross the stream at right angles
- Bridge spans should equal 1.5 times the bank full width or as required for flood passage as determined by a professional engineer, whichever is wider.
- Paved areas should be reduced where opportunities exist:
    - reduce residential road lengths and widths
    - reduce parking lot sizes
    - utilise cul-de-sac donuts (vegetation island in centre)
    - reduce radius of cul-de-sacs
    - reduce size of parking stalls
    - angle parking spaces
    - install pervious surface residential driveways
    - install pervious spillover parking areas
- Grassy swales and open gutters should be used rather than curbs.
- New buildings should be equipped with cisterns, rain barrels, and other grey water recycling systems, while old ones should be retrofitted where possible.
- As a minimum standard, the RMOW draft "Construction Guidelines and Environmental Monitoring Protocol" should be complied with for circumstances or conditions not accounted for in the CCWMP or other applicable regulations.

4.3.5.4 CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN OBJECTIVE 4: RECOMMENDATIONS AND GUIDELINES

This section states the fourth Objective of the CCWMP and details the Recommendations and Guidelines that will contribute to achieving this Objective. The fulfilment of the Recommendations and Guidelines listed in all of the above Objectives should contribute to achieving this Objective.

Objective 4

Riparian and aquatic ecosystems continue to support a healthy assemblage and populations of fish and aquatic invertebrates.

Objective 4: Recommendation A

Examine and adjust where necessary fish habitat rehabilitation/stream restoration projects already planned for the watershed to ensure that they coincide with a watershed-based approach to restoration (re: recommended projects outlined in the *Whistler Region Fisheries Stewardship Plan*, Thomson 1996). Recommendations A and B reflect the emphasis placed by the literature on ensuring a watershed approach to stream restoration. A watershed approach to restoration entails re-establishing the fundamental natural channel hydrology in order to improve local habitat conditions. To do this, stream restoration projects must be expanded beyond isolated instream projects to include rehabilitation of upslope and riparian conditions that cause downstream fish-bearing stream habitats to decline. Potential projects should be identified and prioritised in part by considering broader aspects of ecosystem function and watershed condition. See **Appendix B** for useful guidelines regarding stream restoration projects.

Objective 4: Recommendation B

Design and complete further stream restoration projects to restore fish spawning and rearing habitat and natural stream and riparian functions.

Objective 4: Recommendation C

Investigate and implement ecologically sensitive alternatives to present winter snow removal debris placement activities to reduce sedimentation in stream channels. These alternative measures should be communicated to and carried out by both RMOW Roads and Drainage crew and the Ministry of Transportation and Highways. Any privately contracted snow removal operators should be informed of the instream habitat issues related to snow removal debris entering waterways and should be advised of appropriate mitigative measures. Some alternative options to present activities include placement of sediment fences and revegetation of reduced riparian areas where Crabapple Creek flows adjacent to

or crosses beneath roads. The narrowing of road widths in specific areas should be considered to accommodate effective riparian restoration (e.g. Arbutus Drive in Brio).

Objective 4: Recommendation D

Investigate and implement alternatives to the presently utilised winter road salt containing arsenic in order to eliminate the potential for deposition of harmful chemicals into stream channels. These alternative measures should be communicated to and carried out by both RMOW Roads and Drainage crew and the Ministry of Transportation and Highways. Any privately contracted snow removal operators should be informed of the instream habitat issues related to snow removal debris entering waterways and should be advised of appropriate mitigative measures.

Objective 4: Recommendation E

Require mitigative measures for stream protection during all development/construction activities within the watershed. Developers should comply, as a minimum standard, with the

Objective 4: Guidelines

The following Guidelines should be considered in order to help ensure that riparian and aquatic ecosystems continue to support a healthy assemblage and populations of fish.

- All fish habitat rehabilitation plans should be based on a watershed approach.
- Alternative, non-chemical-based pest management and turf maintenance practices should be strongly encouraged on the Whistler Golf Course.
- Alternative, non-chemical-based snowmaking activities should be strongly encouraged on Whistler Mountain.
- Alternative, non-chemical-based fertilisers and course maintenance practices should be strongly encouraged on Whistler Mountain.

4.3.5.5 SUMMARY OF RECOMMENDATIONS

This section presents a table (

E. Stewardship guide for residents	RMOW Parks & Rec. WFSG	February 2000	Ongoing
F. CCWMP Information brochure	RMOW Parks & Rec.	March 2000	March 2000
G. Multipurpose interpretive display	WFSG RMOW Parks & Rec.	May 2000	June 2000
H. BC Rivers Day activities	WFSG RMOW Parks & Rec. Whistler/Blackcomb Whistler Golf Course	September 1999	Ongoing
I. Newspaper articles	WFSG RMOW Parks & Rec.	February 2000	Ongoing
Objective 2: Riparian Areas			
A. Identify/classify tributaries	RMOW Parks & Rec. RMOW Planning	February 2000	April 2000
B. Complete mapping inventory	RMOW Parks & Rec. RMOW Planning	February 2000	June 2000
C. Implement riparian setbacks	RMOW Planning RMOW Parks & Rec.	February 2000	Ongoing
D. Require compensation	RMOW Parks & Rec. RMOW Planning	February 2000	Ongoing
E. Riparian restoration	WFSG RMOW Parks & Rec. Whistler Golf Course Whistler/Blackcomb	February 2000	Ongoing
F. Identify/protect ecologically sensitive areas			

	RMOW Planning WFSG		
D. Minimise flood hazards	RMOW Public Works	February 2000	Ongoing
E. Conduct sensitive sediment removal	RMOW Public Works RMOW Parks & Rec. Whistler Golf Course	When required	
F. Emphasise infiltration and detention in stormwater management (BMPs)	RMOW Public Works	February 2000	Ongoing
G. Mitigate disruption to groundwater flows	RMOW Public Works RMOW Parks & Rec.	May 2000	Ongoing
H. Municipal master drainage study and plan	RMOW Public Works	Indefinite	Indefinite
Objective 4: Healthy Fish and Invertebrate Populations and Assemblage			
A. Adjust existing fish habitat restoration plans	WFSG RMOW Parks & Rec.	March 2000	July 2000
B. Design and complete stream restoration projects	WFSG RMOW Parks & Rec.	Spring 2000	Ongoing
C. Implement alternatives to current snow removal debris placement	RMOW Public Works BC Ministry of Transportation & Highways (BC MTH) Relevant Contractors	February 2000	Ongoing
D. Implement arsenic-free winter road salt	RMOW Public Works BC MTH Relevant Contractors	February 2000	Ongoing
E. Require mitigative measures during construction/development activities	RMOW Public Works RMOW Planning	February 2000	Ongoing
F. Require oil/water and/or oil/grit separators for high risk developments/locations	RMOW Public Works RMOW Planning	December 1999	Ongoing

4.3.6 EDUCATION AND INTERPRETIVE OPPORTUNITIES

A critical aspect of achieving a healthy resort community watershed is public education. This project proposes the development and implementation of a creative and comprehensive interpretive strategy throughout the Crabapple Creek watershed. A network of signs,

from its headwaters to the mouth, educating recreationists along the way about the unique history and ecology of the watershed.

This section of the CCWMP emphasises the importance of education and interpretive initiatives in relation to achieving the first Objective, encouraging stewardship on the part of local government, residents and visitors. It outlines the planned initiatives of the *Crabapple Creek Interpretive Strategy* and details the chosen watershed logo, themes and messages for the Crabapple Creek watershed. The content of the *Crabapple Creek Interpretive Strategy* is intended to reflect the various principles for effective interpretation discussed in the literature review.

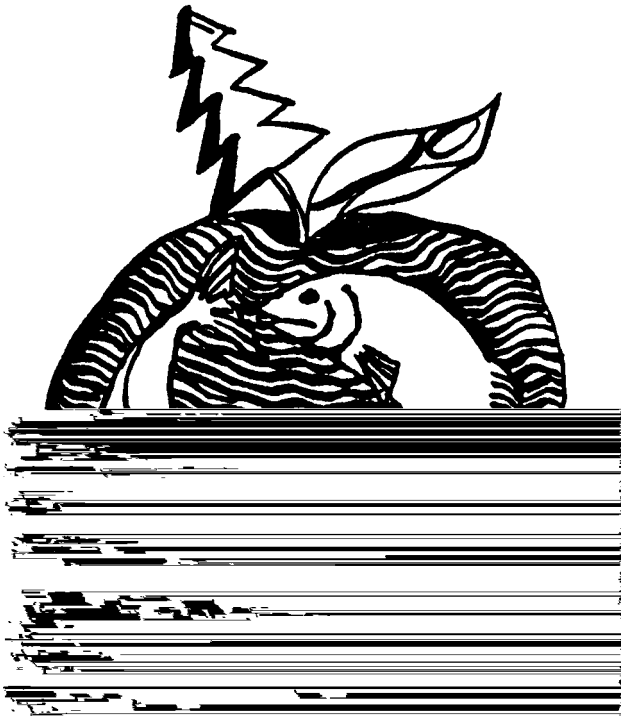
4.3.6.1 WATERSHED LOGO AND INTERPRETIVE THEMES AND MESSAGES

A logo design and a core of fundamental watershed themes will be developed for the interpretive element of the CCWMP. It will unify the signage and other interpretive medium used throughout the watershed. Key messages will be designed to raise the interest of and provide enjoyable learning opportunities for local and international audiences. All of these themes, messages and topics will be communicated in a simple, understandable yet creative and engaging manner. They will be designed to stimulate visitors and enhance their overall experience of the watershed.

Crabapple Creek Watershed Logo

Residents and visitors will become familiar with the logo for the Crabapple Creek watershed (**Figure 6**), which appears on the front cover of the "Welcome to Your Watershed: Celebrating Crabapple Creek" information brochure. This logo will be the common visual theme, identifying everything on which it appears as being connected to the Crabapple Creek watershed.

Figure 6: The Crabapple Creek watershed logo



The logo depicts the fruit of the Pacific crabapple tree, signifying the presence of this riparian species within the watershed leading to the name of this creek system. The crabapple stem depicts a coniferous tree, signifying the importance of an intact riparian zone to the ecological integrity of the creek. The leaf on the stem portrays a person, signifying the people, the community of the Crabapple Creek watershed. The people of this community are the stewards of this valued watershed, and it is they who will help achieve the Vision of a healthy Crabapple Creek into the future.

The logo also depicts two fish, representing the presence of the rainbow trout and kokanee salmon in the Crabapple Creek system. These two important species of fish produced within Crabapple Creek are a focus of the community, and are often the focal point for education and restoration activities. The two fish are shown in a pattern resembling the yin yang illustration of eastern mythology, signifying the importance of unity and wholeness within the watershed. Steep mountainous headwaters connect to gentle lower reaches, elements of land and water work together to create a healthy working system, and people learn more about their environment so that human activities have less negative impacts.

Celebrating Crabapple Creek

"Celebrating Crabapple Creek" will be the *overarching theme* for the watershed, emphasising the community embracement of this interconnected local resource. This watershed supports a variety of community social and ecological values, from hosting salmonid spawners and juveniles and other0.006irrt(c gsı˝0r-watershe)-7(r work i1 ners and jl anı˝0 kl anı˝0

- general history of development in the watershed (timber extraction, Village construction, Whistler Mountain recreational development, construction of the Whistler Golf Course); and
- potential impacts of certain types of development on watersheds (impervious area and hydrologic/biological impacts).

Walk With the Rainbow

"Walk With the Rainbow" will be another *sub-theme* for the watershed interpretive strategy. It will highlight the presence of rainbow trout in Crabapple Creek. This theme will be a primary focus of the lower basin, as the main stem is where rearing and spawning habitat are found. However, this theme will also be manifest in the upper basin, emphasising the importance of healthy headwater areas for good downstream habitat conditions. Topics to be covered in interpretive media relating to this sub-theme include:

- life cycle of a rainbow trout;
- migration patterns of Crabapple Creek rainbow trout;
- habitat needs of juvenile and adult rainbow trout emphasising instream hydraulic conditions such as pool/riffle sequencing, meander patterns, and flow dynamics; and
- importance of headwater areas contributing to lower basin habitat conditions.

Fish Grow on Trees?

"Fish Grow on Trees?" will be a *message* emphasising the importance of riparian integrity for fish habitat in the Crabapple Creek Watershed. Topics to be covered in interpretive media relating to this message include:

- types and characteristics of riparian vegetation in the watershed; and
- functions of riparian vegetation related to hydrology and habitat (bank stabilisation, pollutant filtering, large woody debris, instream cover, channel morphology, oxygenation, etc.).

Whistler Cares for Creeks!

"Whistler Cares for Creeks!" will be a *message* emphasising the stewardship and restoration activities of Whistler local government and community groups in the Crabapple Creek watershed. Topics to be covered in interpretive media relating to this message include:

- various Whistler groups and partnerships involved in watershed stewardship initiatives (e.g. WFSG, AWARE, Habitat Improvement Team, and Whistler Naturalists);
- stream monitoring initiatives of community groups;
- instream restoration initiatives of community groups (highlight at appropriate sites);
- riparian restoration initiatives of community groups (highlight at appropriate sites); and
- community stewardship groups' involvement and participation in developing and implementing the CCWMP.

Stream Restoration: The Bigger Picture

"Stream Restoration: The Bigger Picture" will be a *message* emphasising the importance of taking a watershed-based approach to instream/fish habitat restoration. Topics to be covered in interpretive media relating to this message include:

- why "quick fix" responses do not always work (band-aid solutions);
- need to address the causes of stream problems, not just mitigate the effects; and
- some examples of both types of restoration initiatives (root wad placement vs. re-establishing natural stream geometry and pool/riffle sequencing).

4.3.6.2 THE CRABAPPLE CREEK INTERPRETIVE STRATEGY

The *Crabapple Creek Interpretive Strategy*

Three *priority demonstration sites* to be developed in the watershed should be located:

1. at the north end of the Whistler Golf Course where Crabapple Creek is crossed by the Valley Trail footbridge near large cedar, spruce and fir trees.
2. in Brio at the entrance to Sunridge Plateau where the Sunridge Place road bridge arches over Crabapple Creek. Two opportunities for signage placement include: beneath the bridge, placed such that pedestrians and vehicle passengers on Panorama Ridge facing upstream may view; and just above the bridge, adjacent to Crabapple Creek where the mailbox kiosk is located.
3. on Whistler Mountain around the new Garbanzo Lift base (at Mid Station) where major headwater tributaries of Crabapple Creek converge.

Other recommended sites for placement of interpretive signage include:

- Brio entrance beside Crabapple Creek (creek is basically a ditch at this point)
- at footbridge crossing Crabapple Creek south-east of Sunridge Plateau development (just downstream of tributary confluence)
- along the Valley Trail at the following locations:
    - Highway 99 culvert crossing at south end of Whistler Golf Course
    - road bridge crossing Crabapple Creek just upstream from confluence with River of Golden Dreams
    - various sites along Blueberry Trail on west side of Whistler Golf Course
    - various sites along east side of Whistler Golf Course
- Whistler Village South at the following locations:
    - by storm drains discharging into Crabapple Creek
    - along the tributary to Crabapple Creek by the Whistler Golf Course Driving Range
- Whistler Golf Course at the following locations:
    - sediment ponds
    - along reconstructed section of Crabapple Creek (west side)
    - along tributary on east side of golf course
- Whistler Mountain at the following locations:

- at base of mountain
- mountain bike park area at Mid Station
- on lift line and gondola poles (for passengers to view as they ascend; these signs will afford a holistic, panoramic perspective)

Interpretive Strategy Initiative 2: Watershed Walks

Biweekly or monthly Watershed Walks throughout the Crabapple Creek watershed (upper and lower basins) should be conducted in the snow-free months. Walks might be led by local experts and naturalists familiar with local flora, fauna, fish, and general Crabapple

Interpretive Strategy Initiative 4: Self Guided Trail Network

The development of a watershed wide trail network will provide opportunities to connect interpretive sign locations and enhance recreation opportunities for residents and visitors. The trail need not be paved or entail high maintenance. Rather, the network may simply require the "highlighting" of existing roads and trails as being part of the Crabapple Watershed. M might also be developed to illustrate potential navigable routes.

Interpretive Strategy Initiative 5: Slide Show Presentation

The assemblage of an organised slide show with accompanying text and/or pre-recorded tape may be used to entertain and educate people about various aspects of the Crabapple Creek watershed. The slide show will tell the story of Crabapple Creek from its geologic origins and predevelopment state to its current existence as home to rainbow trout and kokanee salmon and as a model for stewardship initiatives in British Columbia. The slide show could consist of images of Crabapple Creek in all seasons, highlighting various historic and anecdotal events and uses through visuals and spoken text. The watershed themes and messages for Crabapple Creek, as outlined in section 4.3.6.1, may be used to provide organisation for presentation topics. This prepared slide show with text/tape may be presented to a wide variety of audiences for diverse occasions and purposes. Text and images may be altered and added to according to the purpose of each presentation.

Some examples of possible slides include:

- aerial photos and/or maps locating the Crabapple Creek watershed;
- aerial photos of the Crabapple Creek watershed before and after development;
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4.3.7.1 CRABAPPLE CREEK WATERSHED MANAGEMENT COMMITTEE

The fulfilment of goals in any resource management plan requires the long-term commitment of stakeholders. To facilitate the implementation and future effectiveness of the CCWMP, an ongoing *Crabapple Creek Watershed Management Committee* comprised of key stakeholders and decision makers should be formed upon approval of the document by RMOW Council.

The *Crabapple Creek Watershed Management Committee* will be comprised of representatives from the following groups (this list may be amended as circumstances oblige):

- CCWMP Coordinator;
- watershed residents;
- Whistler Fisheries Stewardship Group;
- RMOW Parks and Recreation Department;
- RMOW Public Works Department;
- RMOW Planning Department;
- BC MELP Stewardship Advisor;
- Whistler/Blackcomb (Intrawest);
- Whistler Golf Course (Tourism Whistler); and
- independent tourism operators.

The *Crabapple Creek Watershed Management Committee* should ideally meet 3 to 4 times annually (or as required) to discuss changing conditions in the watershed as revealed by monitoring initiatives, emerging management issues, and progress to date in accomplishing the Recommendations and moving towards fulfilling the Objectives of the CCWMP. The monitoring indicators suggested by the CCWMP (section 4.3.8) should help determine trends and changes in watershed condition, as well as measuring progress towards completing the Recommendations of the CCWMP. The *Crabapple Creek Watershed Management Committee* should be responsible for amending the CCWMP according to

4.3.7.3 MEMORANDUMS OF UNDERSTANDING

For effective implementation of the CCWMP, it is essential that key stakeholders and decision makers demonstrate commitment to the established Objectives, Recommendations and Guidelines for Crabapple Creek. As a type of policy tool, Memorandums of Understanding provide a formal means through which stakeholders and decision makers may state this commitment.

Potential key signatories of Memorandums of Understanding regarding commitment to upholding the Recommendations and Guidelines of the CCWMP include:

- Resort Municipality of Whistler;
- Whistler/Blackcomb;
- Whistler Golf Course;
- Tourism Whistler;
- Whistler Fisheries Stewardship Group;
- BC Ministry of Environment, Lands and Parks;
- community strata councils (bare land/condominium) within the watershed; and
- relevant property management firms (e.g. Whistler Resort Management, Crosby Property Management).

Upon the signing of one or several Memorandums of Understanding among the above stakeholders, the CCWMP will be more fully recognised as a formal document for guiding activities within the watershed.

4.3.8 MONITORING

The Vision and Objectives of the CCWMP establish the desired conditions for Crabapple Creek. The Recommendations and Guidelines lay out the first of many steps which will help reach and maintain those goals. Beyond developing goals and the measures needed to achieve them, it is essential that key indicators be monitored in order to determine progress

towards, or away from, these goals. In monitoring the effects of actions upon the watershed, approaches may be adjusted according to results and more effectively and efficiently restore and maintain the ecological health of Crabapple Creek.

To date, relatively little is known about trends in the condition of Crabapple Creek. There are recent data regarding some of the primary indicators of watershed health, but good baseline information has only just begun to be collected. Many of the following suggested indicators may prove vital in evaluating and monitoring changes in watershed conditions. Knowledge of trends, effects, and changing conditions is necessary so that appropriate and effective planning, management, and restorative decisions can be made.

This monitoring program proposed by the CCWMP reflects the emphasis placed by the literature on the fundamental importance of monitoring in integrated watershed management planning initiatives. Monitoring both biophysical indicators and progress of the plan towards achieving objectives is critical for effective watershed management.

The monitoring indicators suggested below are organised according to CCWMP Objective.

4.3.8.1 SUGGESTED INDICATORS: OBJECTIVE 1

Objective 1: *Resort community government, residents and visitors demonstrate a high level of watershed stewardship.*

Progress towards this Objective is not measurable by conventional biophysical indicators. It is possible, however, to get a sense of progress by monitoring trends in community awareness and involvement in watershed issues and initiatives.

The following suggested social indicators will help reveal progress towards fulfilling this Objective for Crabapple Creek:

a) timely implementation of all elements of the *Crabapple Creek Interpretive Strategy*;
b) participation of residents and/or visitors in watershed stewardship/restoration initiatives (e.g. volunteers for riparian planting, attendance at watershed walks);

c) familiarity with and understanding of key watershed issues by residents and visitors;
d) experience of environmental learning by residents and/or visitors as a result of interpretive signs, literature or demonstrations;
e) participation of key stakeholder group staff (e.g. RMOW, Whistler/Blackcomb, Whistler Golf Course) in environmental learning;
f) participation of schools in environmental learning and watershed stewardship;
g) development of new environmental or watershed stewardship groups;
h) development and maintenance of new and existing partnerships relating to environmental or watershed stewardship; and
i) frequency of newspaper articles relating to watershed issues and/or community initiatives in stewardship.

4.3.8.2 SUGGESTED INDICATORS: OBJECTIVE 2

Objective 2: *Riparian areas along Crabapple Creek and its tributaries are healthy, restored and protected.*

To monitor progress towards Objectives 2 and 3, the integrity of riparian ecosystems along Crabapple Creek must be assessed and evaluated according to changes within the system (e.g. restoration efforts, development, or naturally occurring conditions).

Monitoring should include a baseline evaht3(d)1F7 1 TfttJ 0Tnpcy 0Tnpc(a)310(D18(11(aTJ 0 pe) ecoue

b) number of plants effectively planted (i.e. alive one year later) in riparian zone restoration initiatives;
c) diversity in age/class structure of riparian species;
d) diversity in composition of riparian wetland vegetation;
e) species presence indicative of riparian soil moisture characteristics;
f) species presence with root masses able to withstand high flow events;
g) adequate riparian cover to protect banks;
h) adequate natural source of small organic and large woody debris; and
i) potential for riparian widening.

4.3.8.3 SUGGESTED INDICATORS: OBJECTIVE 3

Objective 3: *Development related impacts to the hydrologic characteristics of Crabapple Creek and its tributaries are minimised.*

Hydrologic Characteristics

To ensure appropriate management decisions for stormwater management and fish habitat issues, critical information is needed pertaining to channel capacity and seasonal mean, peak and low discharge rates of the Crabapple Creek system. It is recommended here that stream discharge (i.e. mean, peak, and low flows) be used as a **key indicator** of trends in stream and watershed condition.

The following additional indicators should be primary in stream monitoring initiatives:

a) relative frequency of bankfull conditions;
b) relative frequency of low flow conditions; and
c) relative frequency and magnitude of flood stage conditions (e.g. frequency of above bankfull, magnitude of theoretical 2 year, 10 year, 100 year flood).

All of the above indicators may be measured with the installation of a gauging station on the lower reaches of Crabapple Creek, as suggested in section 4.3.5.3.

The following are other significant indicators suggested for assessing and monitoring the hydrologic characteristics of Crabapple Creek:

a) percent increase or decrease in total impervious area (TIA);
b) percent increase or decrease in effective impervious area (EIA);
c) sinuosity, width/depth ratio, and gradient in balance with landscape setting;
d) excessive erosion/sedimentation levels (sediment analysis); and
e) floodplain and channel characteristics (rocks, overflow channels and large woody debris) adequate to dissipate stream energy.

4.3.8.4 SUGGESTED INDICATORS: OBJECTIVE 4

Objective 4: *Riparian and aquatic ecosystems continue to support a healthy assemblage and populations of fish and aquatic invertebrates.*

Benthic Invertebrates

Benthic macroinvertebrates, large invertebrates which live on the bottom of lakes and streams, can provide critical information about the quality of instream habitat. The structure and composition of benthic communities in streams is strongly connected to the surrounding land environment and instream chemical, hydrologic, and geomorphologic gradients. As such, stream invertebrate communities can be appropriate candidates for use as aquatic ecosystem health indicators in mountain watersheds (Culp, Cash and Halliwell 1997).

It is recommended that, in addition to stream discharge, benthic macroinvertebrates be monitored as **key indicators** of stream and watershed health.

An extremely useful guide for benthic monitoring is provided by "Volunteer-Based Monitoring Program for the Salmon River: Using Benthic Indicators to Assess Stream Ecosystem Health" (Culp, Cash and Halliwell 1997). It is recommended that this document be used as a model for benthic monitoring in Crabapple Creek.

Water Quality

A key indicator of stream and watershed health, water quality can be tested continually and used as a reference for long term monitoring. Water quality results assist in identifying and evaluating problems in the watershed, such as consistently lower water temperatures or excessive sedimentation. Monitoring of water quality can assist in selecting necessary or appropriate restoration initiatives and can also help evaluate the effectiveness of completed restoration projects.

The following include some primary indicators of water quality that should be measured at least two times per year, in relevant seasons:

a) pH;
b) turbidity/suspended solids;
c) conductivity/dissolved solids; and
d)

Fish

Monitoring of fish presence can help determine the changing quality of habitat conditions and can help assess the success of restoration initiatives. Annual juvenile and spawning sampling should be conducted to continually assess trends and abundance for rainbow trout and Kokanee salmon. Monitoring should be conducted specifically on Crabapple Creek.

Fish Habitat

Continue annual habitat assessment surveys such as those conducted by L. Krzesinska to monitor changes in habitat quality and availability. These assessments will aid in the development of potential instream habitat restoration projects.

The following are indicators for reach surveys that will help determine status and changes in fish habitat conditions:

a) reach gradients;
b) percent pool habitat;
c) percent riffle habitat;
d) percent glide habitat;
e) substrate composition (percent fines, gravel, cobble boulder, bedrock);
f) substrate embededness (percent);
g) instream cover (percent log, boulder, cutbank, instream vegetation, overstream vegetation);
h) pieces of large woody debris per mean stream width;
i) obstructions to fish passage (e.g. impassable culverts); and
j) velocity of flow.

4.3.8.5 MONITORING PROGRESS TOWARDS THE CCWMP VISION AND OBJECTIVES

To monitor progress towards CCWMP Objectives, the *Crabapple Creek Watershed*

uncompleted Recommendations and in determining potential new Recommendations required to move further towards achieving the CCWMP's Objectives.

CHAPTER FIVE
MANAGEMENT AND MINDFULNESS IN A MOUNTAIN RESORT COMMUNITY

This chapter highlights several key components of the CCWMP in relation to their emphasis on encouraging environmental mindfulness among residents and visitors to Whistler's Crabapple Creek watershed. This is followed by a discussion of some of the unique opportunities and challenges of the Crabapple Creek watershed management planning experience related to the tourism-based resort nature of Whistler.

5.1 ENCOURAGING MINDFULNESS THROUGH THE CCWMP

Whistler recognises the importance of moving towards environmental sustainability for the long-term success of the resort community. In the 1993 Comprehensive Development Plan, the RMOW declares that "the high quality of the natural environment is one of the main reasons for Whistler's success as a resort and its attractiveness as a community" (Waldron 1999). This recognition is further demonstrated by Whistler's current leadership in environmental stewardship through initiatives such as the

5.1.1 WATERSHED MANAGEMENT STRATEGIES

The CCWMP conveys a strategy for helping ensure the restoration and maintenance of Crabapple Creek's ecological integrity. Beyond this, however, the CCWMP aspires to encourage mindfulness and environmental stewardship by residents and visitors. Recall Moscardo's (1999) notion of mindfulness, characterised by a state of active mental processing involving the creation of new cognitive categories. While Moscardo's research mainly concerns the mindfulness of *visitors* to a place, the CCWMP effectively extends the notion of mindfulness to include residents and long term members of the resort community. Without mindfulness on the part of resort community residents, it is unlikely that mindfulness among visitors will be achieved. Whistler is a community based largely on regular influxes of thousands of visitors. As such, it is essential that strategies for creating mindfulness be aimed at both principal sectors of the resort community, residents and visitors.

In looking at the CCWMP Objectives and Recommendations as established by key watershed stakeholders, it becomes clear that resident and visitor mindfulness are perceived as fundamental conditions for achieving and maintaining watershed health for Crabapple Creek. Indeed, the emphasis on encouraging education and mindfulness is evident from the first Objective of the CCWMP, which states: *Resort community government, residents and visitors demonstrate a high level of watershed stewardship*. The nine Recommendations

along the creek's mainstem by the Valley Trail. Watershed walks (Initiative 2) led by local experts familiar with local flora, fauna and watershed issues will both help orient residents and visitors and acquaint them with various aspects of the watershed.

The *Crabapple Creek Interpretive Strategy* also proposes a self-guided trail network throughout the watershed (Initiative 4). This trail network is designed to help familiarise residents and visitors with the watershed and promote an understanding of local watershed issues.

A further key principle for encouraging mindfulness is to tell a good story. This is one of the most fundamental of all interpretive principles. The *Crabapple Creek Interpretive Strategy* outlines a series of themes and messages which aim to "tell the story" of the Crabapple Creek watershed. The themes and messages outline aspects of this watershed story, ranging from fish life cycles and habitat needs to the impacts of development on the watershed and stewardship initiatives by local community groups. The diversity of themes and messages, along with the various different interpretive initiatives, fulfil another leading principle for encouraging mindfulness as proposed by Moscardo, that of providing variety in interpretive content and media. These themes and messages tell a story while making connections to residents and visitors and getting them involved. This later aim, getting people involved, is an additional key principle listed by Moscardo (1999) for encouraging mindfulness. Watershed walks and the interactive internet site will also foster direct participation, as will community restoration and stewardship events such as Arbour Day and Rivers Day.

5.3 UNIQUE OPPORTUNITIES

Whistler is unique among British Columbian communities, distinguished by its position as a world-class mountain resort. This section describes some of the unique opportunities provided by this resort environment in relation to the Crabapple Creek watershed management planning experience.

5.3.1 PROJECT INITIATION: THE

active in stream stewardship and restoration and in publicising the importance of stream habitat and watershed issues throughout the Whistler Valley.

WFSG partners played a vital role as stakeholders in the development of the CCWMP. Many WFSG partners provided input, information and insight regarding key issues within the Crabapple Creek watershed. Most significantly, however, the prior existence of the WFSG facilitated the support and extensive participation of two critical watershed stakeholder groups, Whistler/Blackcomb and the Whistler Golf Course. The Whistler/Blackcomb and Whistler Golf Course representatives in the WFSG are both senior operations managers of their respective facilities, thereby having significant influence on land use decisions and activities with potential impacts on the watershed. Through their involvement with the WFSG, these stakeholders have already been active participants in stream protection and restoration. As such, gaining the support and full participation of these two individuals on behalf of Whistler/Blackcomb and the Whistler Golf Course proved an easy task. Both organisations have embraced the essence of the CCWMP and are committed to working towards achieving the Vision for the Crabapple Creek watershed. Whistler/Blackcomb and the Whistler Golf Course have already begun contributing to the implementation of various Recommendations, such as the *Crabapple Creek Interpretive Strategy* and the partial redesigning of the golf course. The involvement of key representatives from Whistler/Blackcomb and the Whistler Golf Course in the development process of the CCWMP has also likely heightened their awareness of watershed issues and of their potential to influence appropriate management decisions for protecting the integrity of Crabapple Creek.

Whistler/Blackcomb and the Whistler Golf Course, both hosting world class recreational sites, are by nature relatively well financed. Although there was no initial financial contribution to the Crabapple Creek watershed management planning initiative, both organisations have agreed to allocate the necessary resources to fulfil their commitments to the CCWMP. The fiscal contribution and responsibility being demonstrated by these two substantial stakeholders will undoubtedly prove powerful in helping to achieve effective watershed restoration and protection for Crabapple Creek.

5.3.3 OUTDOOR RECREATION: A NATURAL FORUM FOR LEARNING

Outdoor recreation has been a catalyst in the development and success of Whistler as a premier mountain resort community. From Whistler/Blackcomb providing some of the best skiing and snowboarding terrain in the world, to three championship golf courses, exceptional parks and the Valley Trail system, recreation delivery is what Whistler does best. Residents and visitors come to Whistler for the abundant outdoor recreation opportunities and this provides a strategic advantage for promoting environmental learning and mindfulness about Crabapple Creek watershed management issues and initiatives.

The *Crabapple Creek Interpretive Strategy* has added potential to bring about visitor mindfulness as a result of its implementation in Whistler, a mountain resort community. Whistler visitors and residents are typically orientated towards outdoor experiences. Hence, getting people to visit interpretive sites throughout the Crabapple Creek watershed will be significantly facilitated by numerous existing outdoor recreation opportunities. These opportunities include activities associated with the use of the Valley Trail system, the Whistler Golf Course, Whistler/Blackcomb ski area, and other shoulder season activities such as hiking and mountain biking on Whistler Mountain. The *Crabapple Creek Interpretive Strategy* is aimed at taking advantage of the fact that people in Whistler love to spend time outdoors. It seeks to develop interpretive initiatives that foster learning about the natural environment while actually experiencing that environment.

5.3.4 THE IMPORTANCE OF IMAGE IN THE TOURISM DESTINATION MARKETPLACE

There is a growing awareness among mountain resort communities of the competitive marketing benefits of “going green”. Across North America, the vigorous competition among mountain resort communities and ski areas for premier status has recently begun to include an environmental component. Mountain resort communities are increasingly addressing local environmental issues to gain the edge on this aspect of destination image

5.4 UNIQUE CHALLENGES

Just as unique opportunities have been identified regarding the Crabapple Creek watershed management planning process, unique challenges may also be distinguished. This section discusses some of these challenges as part of the evaluation of the Crabapple Creek watershed experience in relation to other recent watershed management planning initiatives.

As shown in part by the substantive number of second home owners, the Whistler community houses a somewhat transient population. Whistler residents, like those in most mountain resort communities, may be differentiated in relation to their degree of permanence as community residents. The most transient population segment includes seasonal workers, who predominantly work for Whistler/Blackcomb in the winter season, from November to April. In addition to the full time resident and second home owner population, the number of seasonal employees in Whistler each year is approximately 3000 (Laing 2000).

Given the unusual nature of Whistler's population, it is not entirely surprising that efforts to involve watershed residents in the development of the CCWMP were not especially effective. The Pique, a local Whistler newspaper, recently featured another article about the CCWMP in February 2000. The article drew attention to the CCWMP's presence at RMOW Municipal Hall, available for public review and comment. It is hoped that, due to its publication during the height of the winter season, this article has reached many watershed residents and community members who may have been absent during the summer. Additionally, it is hoped that they will subsequently be encouraged by the article to learn more about and participate in further Crabapple Creek watershed management initiatives or other stewardship activities within Whistler.

5.4.2 A DIFFERENT KIND OF DEVELOPMENT

Most communities embarking on watershed management planning initiatives have similar development issues to consider. Urban watershed concerns such as degraded riparian integrity and increased impervious area due to urbanisation are commonplace in the realm of watershed management planning. However, as revealed by the Crabapple Creek watershed management planning experience, Whistler presents some unique development issues related to the tourism-based nature of the resort community, in addition to many of the more familiar concerns. While offering unique opportunities with regards to influential stakeholder involvement and support, the presence of a world class ski area and a

championship golf course within the Crabapple Creek watershed also presents unique challenges with regards to restoring and protecting the ecological integrity of the watershed.

This challenge has already been faced by Whistler/Blackcomb, as innovative measures were employed during an expansion project within the headwaters of Crabapple Creek on Whistler Mountain. The construction of the new Garbonzo chairlift and several new ski runs was conducted during the summer and fall of 1999. During this period, a key representative from Whistler/Blackcomb was involved in the development of the CCWMP. Holding a senior position in mountain planning and operations, this individual was able to guide the planning and construction of this project towards protecting the integrity of Crabapple Creek. Minimal timber was extracted from the project site, and all identified old growth stands were left intact, recognising the importance of riparian integrity to the health of the stream system. Heli-logging was the primary method used to clear a passage for the lift line, so as not to require road building or disturbance of the forest understory. Instead of the traditional "clearcut" style of ski runs, gladed runs with partial forest cover and a minimum width of 50m were developed to incur minimal ecological and hydrologic impact. These innovative measures taken by Whistler/Blackcomb demonstrate a commitment to achieving the objectives of the CCWMP. In addition, they help to illustrate some of the unique measures required for effective watershed management in the mountain resort community of Whistler.

During the summer of 2000, the Whistler Golf Course plans to renovate the first nine holes of the course, located adjacent to the main stem of Crabapple Creek. This project will pose some unique challenges to watershed management in Whistler's Crabapple Creek. A difficult balance must be achieved between maintaining the recreational function of the golf course and protecting the ecological integrity of Crabapple Creek's lower reaches, which provide vital spawning and rearing habitat for fish. A key stakeholder in the development of the CCWMP, the Whistler Golf Course is aware that some innovative solutions may be required to effectively achieve this balance.

In addition to facing obstacles common to other communities conducting watershed

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

This chapter discusses the current status of the Crabapple Creek Watershed Management Plan. A brief evaluation of the Crabapple Creek Watershed Management Plan is presented, relating to how effectively it addresses the critical features of integrated watershed management plans as outlined in Chapter Two. A summary of the unique features of the plan related to the tourism-based nature of Whistler is also provided. This chapter concludes with recommendations for further research and some final remarks.

6.1 CURRENT STATUS OF THE CRABAPPLE CREEK WATERSHED MANAGEMENT PLAN

The CCWMP will be submitted in May 2000 to the RMOW Council for approval as a guiding policy document for the Crabapple Creek watershed. A public unveiling of the CCWMP will coincide with Arbour Day 2000 activities. It is hoped that the recommendations for implementation, as outlined in section 4.3.7, will be carried out and that suggested policy changes will occur in a timely manner. It is likely that consideration of the *Whistler Environmental Strategy* by RMOW Council will affect how quickly and in what form implementation of the CCWMP occurs.

Although the CCWMP is not yet approved as a formal RMOW guiding document, key stakeholders involved in the development process are committed to implementing as much of the plan as possible. Some interpretive signs have already been erected by Whistler/Blackcomb on Whistler Mountain and riparian planting in areas recommended by the CCWMP has been planned for late spring 2000 by the WFSG and the RMOW Parks and Recreation Department. As Tourism Whistler prepares to conduct significant design modifications to the first nine holes of the Whistler Golf Course, recent WFSG meetings suggest that there is a stcuncestss3(a -0TJ 06n)-10(-0TJ 06n)J 0 -1.73 TW.ntinby

effective, as stakeholders are beginning to fulfil their responsibilities in advance of any formal municipal regulation.

6.2 AN EVALUATION OF THE CCWMP

In Chapter Two, a review of relevant literature identified various critical features of effective integrated watershed management plans. This section presents a brief personal and subjective evaluation of the CCWMP according to how effectively it has incorporated these features. **Table 3** summarises this evaluation, rating the incorporation of critical features into the CCWMP as either good, satisfactory, or inadequate.

Watershed Scale

Experts have advocated that management plans are most effective when developed for watersheds ranging from 1-15 square miles or 10-200 square kilometres. With an area of 4.8km^2, the Crabapple Creek watershed lies at the smaller end of the preferred management size spectrum. However, due to its location in the relatively small mountain community of Whistler, the Crabapple Creek watershed was perceived by key stakeholders as an appropriate scale for effective local planning, management and decision making.

Plan Structure and Components: Vision, Objectives and Actions

The CCWMP is clear in its statement of a vision, objectives and actions for the Crabapple Creek watershed. The vision for the watershed was developed by key stakeholders and serves as the overriding aim of the CCWMP. Four central Objectives were established, each accompanied by a series of Recommendations (action items) addressing the main issues within the Crabapple Creek watershed.

Plan Structure and Components: Monitoring

Currently, relatively little is known about the ecological condition of the Crabapple Creek watershed. As such, the CCWMP clearly highlights monitoring as a key component of

effective watershed management. The CCWMP proposes a broad range of important monitoring programs and indicators aimed at measuring both biophysical changes within the watershed and progress towards fulfilling the Objectives of the plan.

Plan Structure and Components: Implementation

The CCWMP recommends the creation of two committees to oversee implementation of the plan. The Crabapple Creek Watershed Management Committee, comprised of key stakeholders, will meet periodically to discuss changing watershed conditions and progress in completing the Recommendations of the CCWMP. This committee will be responsible for amending the plan according to need. The CCWMP is intended as a living document, adaptable to the efficacy/inefficacy of selected management strategies, changes in watershed conditions, and the evolution of stakeholder values.

A secondary group entitled the Crabapple Creek Watershed Management Plan Implementation Team will be responsible for implementing the various legislative changes recommended by the CCWMP. This Implementation Team will formulate appropriate policy amendments to assist in the fulfilment of the CCWMP Objectives.

The CCWMP also proposes the signing of Memorandums of Understanding among key watershed stakeholders to more formally acknowledge their commitment to achieving the Vision and Objectives of the CCWMP.

Plan Structure and Components: Budget

The CCWMP does not include a budget to facilitate the plan's implementation. This is the most obvious shortcoming of the CCWMP, as a budget is a fundamental component to any effective watershed management planning initiative. Reasons for this omission include: the relatively short time frame of the CCWMP development process; a lack of both time and willingness on the part of key stakeholders to submit te

Biophysical Issues: Riparian Areas

Biophysical Issues: Stormwater Management

Stormwater Management	✔		

6.3 UNIQUE PLANNING FOR UNIQUE PLACES

The Crabapple Creek case study describes the development of an integrated watershed management plan in a mountain resort community. Intrinsically linked to the tourism-based nature of Whistler, the Crabapple Creek watershed management planning experience demonstrates a distinctive focus on encouraging mindfulness and stewardship through management and interpretive initiatives. The Objectives and Recommendations of the CCWMP emphasise learning and involvement on the part of watershed residents and visitors as an important means of protecting the integrity of Crabapple Creek. The CCWMP emphasises the conviction that mindful watershed stakeholders are essential to the sustained ecological health of Crabapple Creek.

The Crabapple Creek watershed management planning process reveals some unique opportunities intrinsically related to the resort character of the Whistler community. The conception of the *Whistler Environmental Strategy* has opened the door for potentially meaningful RMOW action regarding environmental issues. This movement towards environmental sustainability, led by the *Whistler Environmental Strategy*, significantly facilitated the development of the CCWMP. The prior existence of the Whistler Fisheries Stewardship Group, a partnership among key watershed stakeholders, contributed greatly to the level and quality of participation in the CCWMP development process by key stakeholders. The commitment of key stakeholders to the Objectives of the CCWMP would not be as strong without their previous interest and involvement in watershed issues gained through the WFSG. The prominence of outdoor recreational activities in Whistler also provides exceptional opportunities for fostering environmental learning. The CCWMP capitalises on the inclination of Whistler's residents and visitors towards the outdoors. The *Crabapple Creek Interpretive Strategy* encourages learning, mindfulness and stewardship among watershed residents and visitors. It is hoped that these rare opportunities will assist

in future watershed management efforts within Whistler and other mountain resort communities.

In addition to unique opportunities, the tourism-based nature of the Whistler community has also presented some unique challenges for the Crabapple Creek watershed management planning initiative. The unusual nature of the resort community's population demographics posed great difficulty to engaging watershed residents in the development process of the management plan. The exceptional degree of recreational development, including a world class ski hill and a championship golf course, also presents some unusual challenges for watershed management in the Crabapple Creek watershed. Innovative tactics are being employed as critical land users and decision makers strive to meet this challenge and work towards restoring and protecting the ecological integrity of Crabapple Creek. It is hoped that the recognition of these challenges will prove useful in developing future watershed management planning initiatives throughout the Whistler Valley.

6.4 RECOMMENDATIONS FOR FUTURE RESEARCH

The implications of the CCWMP for enhanced environmental stewardship and effective watershed management in Whistler are yet to be determined. As promising as it may seem on paper, the true test of the CCWMP's effectiveness will take time to ascertain. Indeed, the efficacy of the CCWMP will have to be measured at many levels. Changes in the ecological condition of the watershed over time will help determine the efficacy of various biophysical Recommendations. The modification of municipal policy will help determine the strength of the CCWMP in bringing about legislative watershed protection measures. Both of these areas are suggested for future research, as the efficacy of watershed management planning cannot be determined without such evaluations.

Another important question for further research includes the effectiveness of CCWMP management strategies in fostering environmental learning. An assessment of the impact of the Crabapple Creek Interpretive Strategy, once implemented, on achieving mindfulness among residents and visitors would be of great interest to many stakeholders. This

assessment could be conducted by a survey distributed at strategic locations throughout the watershed. From a tourism perspective, it would be worthy to investigate the benefits, if any, of the *Crabapple Creek Interpretive Strategy* to watershed visitors engaged in outdoor recreation activities.

Other important questions for future research include:

- what is the level of satisfaction key watershed stakeholders experienced with the CCWMP development process?;
- how might the inclusion of Whistler watershed residents in watershed management initiatives be improved?;
- how might stronger partnerships facilitating the fiscal investment needed for effective watershed management in Whistler be developed?; and
- what are some reasons why significant environmental initiatives taking place in Whistler, such as the development of the *Whistler Environmental Strategy* and the Crabapple Creek Watershed Management Plan, are not more widely advertised by Tourism Whistler, the primary marketing agency for the resort community?

6.5 FINAL REMARKS

In providing a potential framework for integrated watershed management planning, the Crabapple Creek Watershed Management Plan is designed to advance the effectiveness of watershed management initiatives not only in Whistler but throughout the province. As the practice of integrated watershed management in British Columbia is relatively new, all such initiatives play a significant role in demonstrating a variety of approaches to similar concerns. As managers learn from the experiences of others, they will undoubtedly become more proficient in bringing about effective watershed planning, management and restoration at the local and regional scales. Over time, the efficacy of these differing approaches will become more apparent, facilitating the process and escalating the overall health of British Columbian watersheds.

The Crabapple Creek watershed management planning experience may also serve as an example for North American mountain resort communities. Watershed management planning will likely become the norm in these areas, due largely to recent changes in US government requirements for ski area environmental conduct. However, it is unknown how well integrated these efforts will be with surrounding land use management initiatives. Facing similar challenges and opportunities presented by the mountain resort nature of their watershed environments, these resort communities may learn from the Crabapple Creek experience and work towards more effectively protecting their valued watersheds through integrated planning initiatives.

The Crabapple Creek Watershed Management Plan emphasises the importance of a watershed approach to the protection and restoration of our local streams. Just as the protection of headwater tributaries helps preserve the valuable fish habitat of Crabapple Creek's lower reaches, the protection of Crabapple Creek helps to preserve the ecological integrity of the stream it flows into, the River of Golden Dreams. The Crabapple Creek Watershed Management Plan, just like Crabapple Creek itself, is simply a sub-component of a larger framework. The positive effects of stewardship in the Crabapple Creek watershed, guided in part by the Crabapple Creek Watershed Management Plan, become part of the larger river continuum and will continue to flow downstream from system to system. In this way, the Crabapple Creek Watershed Management Plan is a notable step towards protecting other water resources in the Whistler Valley and beyond.

It was my deepest honour to be involved with development of such an important initiative in Whistler, an honour and an experience that I will take with me wherever my personal path should meander. I hope to see the movement towards environmental sustainability in Whistler continue with all the momentum of the Crabapple Creek initiative and more.

APPENDIX A

Crabapple Creek Watershed Management Plan Stakeholder Questionnaire

This questionnaire is meant to aid in the development of a Vision and Objectives for the Crabapple Creek Watershed Management Plan. Please be as thorough as possible in your responses and feel free to respond on separate pieces of paper if you require more writing space.

APPENDIX B

Stream Restoration Project Guidelines

Some useful guidelines for stream restoration projects as proposed by Newbury and Gaboury (1994) are as follows:

1. Define drainage basin on maps.
2. Draw longitudinal stream profile to illustrate elevation changes.
3. Examine flow records (flood frequency, minimum and peak discharges).
4. Identify sample reaches and conduct a detailed survey (channel size and shape, drainage area, bankfull discharge).
5. Complete a detailed survey (specific problems and site characteristics).
6. Examine undisturbed reference areas and identify riparian and hydrologic conditions to replicate (natural pool/riffle/meander systems). This will help ensure that restoration designs will be reinforced by the stream system and not undermined.
7. Prepare a detailed restoration design, replacing natural conditions and structures within the stream to match the energy of flood flows.
8. Test the restoration against the stream's seasonal flow variability.
9. Construct the restoration project with careful supervision to ensure minimal habitat disturbance.
10. Monitor and evaluate. Make adjustments over time if needed.

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