Restoring a "Paradise of a Place": Exploring the potential for urban Ecosystem-based Management in the Still Creek Watershed, Vancouver, BC

by

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Abstract

This study examines the potential value of applying Ecosystem-based Management (EBM) in the urban setting. It explores how community-driven watershed restoration can be augmented by reframing community perceptions of healthy ecosystems through a holistic, ecosystem-based approach to watershed management. The case study of watershed restoration in Still Creek, Vancouver, British Columbia is informed by an analysis of planning documentation and interviews with local community members, local government representatives, and experts in EBM and urban ecological restoration. The research explores a variety of themes: understanding community motivation for implementing an Ecosystem-based Stewardship Plan, the nature of collaborations between stakeholders, and the potential value that EBM may bring to watershed restoration. Results indicate that EBM is helping the community to perceive Still Creek as an asset that provides significant benefits to the area. To fully implement EBM, the community needs to address challenges that include navigating jurisdictional context, identifying the spatial scale of focus for watershed restoration, and establishing priority areas for restoration. This research recommends solutions to these challenges to implementing EBM in the urban setting.

Keywords: Ecosystem-based Management; urban stream restoration; community engagement; environmental stewardship; social-ecological systems

For my family.

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List of Acronyms

BBCC	Brunette Basin Coordinating Committee
BCIT	British Columbia Institute of Technology
CIT	Coast Information Team
DFO	Department of Fisheries and Oceans Canada
EBM	Ecosystem-based Management
GBIA	Grandview-Boundary Industrial Area
GVRD	Greater Vancouver Regional District
ISMP	Integrated Stormwater Management Plan
NGO	Non-Government Organization
REM	School of Resource and Environmental Management
SBS	Shifting Baselines Syndrome
SFU	Simon Fraser University
UHI	Urban Heat Island
V&DJSC	Vancouver and District Joint Sewerage Committee

Glossary

Adaptive Management	A systematic and iterative approach for improving resource management by emphasizing learning from management outcomes.
Daylighting	The act of removing streams from underground pipes and culverts, restoring some of the form and function of historic streams. Daylighting is the most profound form of stream restoration, recreating a surface waterway.
Ecosystem-based Management	An adaptive approach to managing human activities that seeks to ensure the coexistence of healthy, fully functioning ecosystems and human communities. The intent is to maintain those spatial and temporal characteristics of ecosystems such that component species and ecological processes can be sustained, and human well-being supported and improved.
Ecological Integrity	The abundance and diversity of organisms at all levels, and the ecological patterns, processes, and structural attributes responsible for that biological diversity and for ecosystem resilience.

Chapter 1.

Introduction

> *"Urban ecological systems present multiple challenges to ecologists—pervasive human impact and extreme heterogeneity of cities, and the need to integrate social and ecological approaches, concepts, and theory."*
>
> -Grimm, Grove, Pickett, and Redman, 2000

1.1. Urban Ecosystem Degradation

Urban ecosystems face a variety of socio-ecological challenges. An increasing trend over the past century has been the worldwide growth of urban populations, caused by natural increase and the migration of people from rural to urban centres (UN, 2011). To accommodate urban population growth and development, green spaces have been replaced with roads, buildings, and other urban structures. While urbanization has arguably improved lifestyle and well-being for many people, it has also reduced the integrity of life-supporting ecosystems in urban areas. Patterns of urban development have tended to favour the economic benefits of the built environment at the cost of losing intact natural ecosystems (Eraydin and Taşan-Kok, 2013). The result is that urbanization has significantly altered the form and function of natural ecosystems (Alberti, 2005) by disrupting biodiversity, hydrological patterns, and energy flows.

Urbanization significantly impacts biodiversity in a number of ways. Urban development fragments natural ecosystems, reducing the ability of native species to find suitable habitats (McKinney, 2010). Fragmentation reduces native species population

size and alters their natural distribution (Aminzadeh & Khansefid, 2009; Bastin & Thomas, 1999; McKinney, 2010). In addition, human introductions of non-native, invasive species decrease habitat and resources available to native species, which negatively impacts ecosystem health by simplifying it and altering its natural function (McDonnell et al., 1997; Pickett et al., 1997). These impacts threaten the resilience of ecosystems, rendering them less capable of responding and adapting to disturbances (Alberti & Marzluff, 2004; Pickett, 2004).

Further impacts include the extent to which built urban structures such as roads and buildings affect the hydrological dynamics of urban ecosystems. Urban streams often exhibit characteristics of “urban stream syndrome” (Walsh et al, 2005). Streams are partially or fully diverted, paved over, and/or filled to create more space for the built environment. Less water becomes available for evapotranspiration (Shuster, Bonta, Thurston, Warnemuende, & Smith, 2005). Urban structures also increase impervious surface area, which decreases water infiltration into soils and surfaces that were once pervious. Streams in urban areas consistently demonstrate “flashy” hydrographs (see Figure 1.1), where peak flows are more frequent and higher in magnitude because less water infiltrates into the ground and instead is delivered to streams through highly efficient culverts (Walsh, Fletcher, & Burns, 2012; Walsh, Roy, Feminella, Cottingham, Groffman, & Morgan, 2005). Streams and riverbeds erode and riparian habitat quality degrades due to increased magnitudes and durations of high flows (Kennen et al., 2008). Urban streams and rivers often contain high concentrations of pollutants because water is forced to flow over contaminated urban structures (Hatt, Fletcher, Walsh, & Taylor, 2004; Wenger, Roy, & Jackson, 2009).

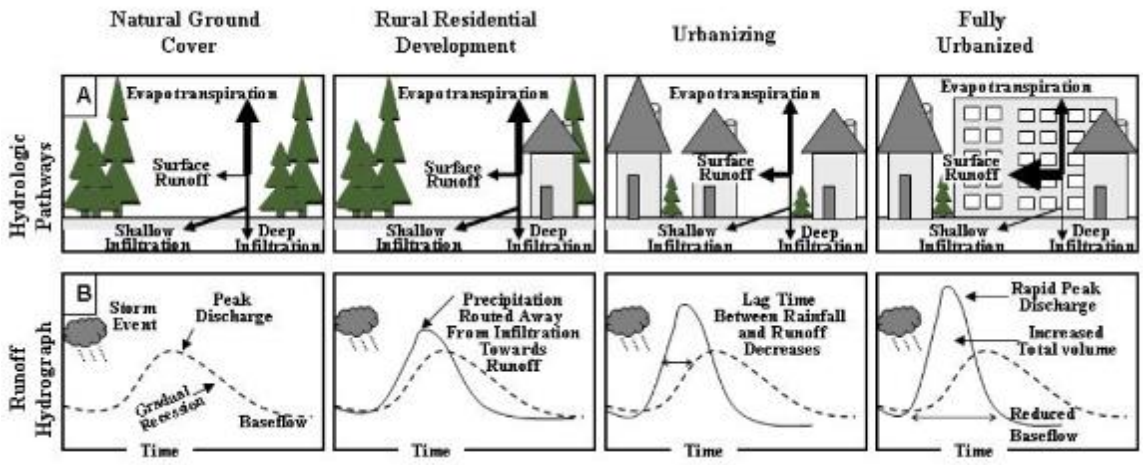

Figure 1.1: Changes that occur to hydrologic pathways and runoff with increasing impervious surface area in urbanizing watersheds.
A. As an ecosystem becomes more urbanized, the path of water is altered. The proportion of water moving through each route changes, as indicated by the thickness of the arrow. B. With urbanization, timing and magnitude of runoff after a single storm event also change. Base flows in the dry season are also reduced with increasing development. The dashed line represents predevelopment hydrograph and solid lines show hydrographs through progressive stages of development. Figure: Harte et al., 2010, pg. 51.

Cities also impact natural energy flow through ecosystems in several ways. Urban populations require a large amount of the earth's energy and materials. They also produce a large amount of waste, placing significant demand on the waste-assimilation capacity of ecosystems (Alberti et al., 2005). In terms of energy input, the ratio of biomass production to consumption in urban areas is less than that of natural ecosystems and agricultural ecosystems, because biomass in cities is relatively unproductive and much of the energy used by cities is imported (McGregor, Simon, & Thompson, 2006). Since cities import energy and resources, they impact distant regions and also increase total ecological footprint through the transportation costs to import energy and resources. The combination of high amounts of non-natural surfaces and excess heat and pollution produced from human activities in cities contributes to a problem called urban heat island (UHI), where urban temperatures are higher than that of their more natural surroundings (Unger, 2004). UHI can have meteorological, health, and ecological impacts on a city and its inhabitants.

The negative environmental impacts of urbanization are important to society because they reduce our ability to obtain resources and benefits from the environment.

Humans rely on ecosystem functions to obtain ecosystem services required for subsistence. Urban ecosystems, even in their compromised state, can offer a large amount of natural resources and environmental services (Bolund and Hunhammar, 1997; Savard, Clergeau, & Mennechez, 2000). Altering ecosystem functions will ultimately affect the availability of ecosystem services to humans (McGranahan et al., 2005). Proximity to and interaction with nature also impacts human quality of life. For example, humans obtain recreational, cultural, economic, and aesthetic benefits from nature that contribute to quality of life. Since urbanization decreases the presence of nature in urban areas, it decreases quality of life for urban dwellers (Bolund & Hunhammar, 1999). Lastly, urbanization impacts are important because they amplify the growing separation of humans from nature. Humans struggle to understand and respect ecosystem dynamics in environments void of nature (Savard et al. 2000; Shandas & Messer, 2008). The more disconnected humans become from nature, the less likely we are able to recognize and respond to ecological problems. These environmental issues can be better addressed through a lens that recognizes the social factors at play in urban settings.

1.2. Institutional Factors in the Urban Setting

Urban ecosystems are impacted by a variety of human activities and a complex mixture of people and interests. The diversity of stakeholders present in the urban setting combined with the transient nature of urban populations and social norms creates an interesting challenge for urban environmental management. An additional challenge is that there is no conclusive evidence that any one form of governance regime or tenure is more successful than any other (Moran & Ostrom, 2005). Rather, urban environmental problems arise from cumulative impacts of all individuals that interact with urban ecosystems and therefore need to be solved with collective action (Mincey et al., 2013). Top-down “command-and-control” approaches to environmental management tend to ignore the broad diversity of interests of all stakeholders and can lead to management regimes that are insensitive and unreactive to changing conditions and community desires (Holling & Meffe, 1996). The process of bureaucratization, where the rule structure of governments becomes increasingly formal, can drive departments within

government organizations to operate in silos as they each try to accomplish their own mandates (Kofinas, 2009). While it is not exclusively the responsibility of governments to solve urban environmental issues, there can often be insufficient incentive for private property owners to contribute to the production of public goods (such as restoring a stream flowing through their yard or volunteering their time to clean up a local ecosystem) because there is a lack of ecosystem services accounting in a formal marketplace (Mincey et al., 2013). It can also be a challenge for a community to motivate all stakeholders behind a common vision. Therefore, decision-making processes need to incorporate a blend of interests and institutional arrangements that are suited to the context of a place (Kofinas, 2009).

1.3. Focus of this Research

The focus of this research is to determine the potential usefulness of Ecosystem-based Management (EBM) in the urban setting in seeking to reduce or mitigate the socio-ecological impacts identified above. Citizens and governments in many places are investing significant efforts to resolve some of the environmental problems that have emerged from the complex interplay of social and ecological dynamics in cities. Many scholars are encouraging an ecosystem-based approach to managing social-ecological systems in urban settings (Shandas, Graybill, & Ryan, 2008). While studied and used widely in resource communities in rural and coastal areas, an ecosystem-based approach is relatively novel, relatively unstudied, and represents a departure from conventional environmental management in the urban setting. Few studies to date discuss the application of EBM in urban planning (Shandas et al., 2008). Adoption of EBM terminology in Canadian legislation and policy has generally occurred at the federal level more so than provincial and municipal levels of government (Quinn and Theberge, 2004). This research evaluates EBM as a potential tool to assist urban communities in restoring their local ecosystem.

1.3.1. Ecosystem-based Management in the Urban Setting

There are several reasons why EBM may be a valuable approach for urban communities to adopt. First, EBM emphasizes a whole-system approach to managing

ecosystems. As such, it can help to reduce the environmental impacts of urbanization by incorporating broad sources of knowledge pertaining to social and ecological dimensions of human activities into urban planning policies (Shandas, Graybill, and Ryan, 2008). Critical to the knowledge component of EBM is incorporating both social and natural science into policy (Shandas et al., 2008). Second, environmental issues in urban areas are complex in terms of both the degree to which humans are driving change, and in terms of the wide range of stakeholder interests. EBM can offer an adaptive approach that provides urban communities with the ability to cope with change (Borgström, Elmqvist, Angelstam, and Alfsen-Norodom, 2006). It can do so by helping communities to recognize and account for ecosystem characteristics such as ecosystem thresholds and interactions across spatial scales (Borgström et al). Third, and perhaps most importantly, EBM challenges traditional institutional structure and establishes a need for greater cross-jurisdictional collaboration (Grumbine, 1994) and motivation behind a common vision (Leslie and McLeod, 2007). While this aspect of EBM can sometimes be a challenge for communities, it is highly relevant to the urban setting given the degree of jurisdictional complexity.

1.3.2. Research Purpose and Objectives

The purpose of this research is to determine the usefulness of EBM to urban communities who are attempting to restore their local ecosystem. The study evaluates the process of implementing urban EBM at its early stages, with the goal of providing insight to communities who wish to implement EBM or who are already attempting to do so. The specific objectives of this research are:

1. To identify factors that motivate urban communities to develop and implement Ecosystem-based Management plans.

2. To determine the types of successes and challenges an urban community might face when planning and implementing Ecosystem-based principles, and to evaluate alternatives and solutions to reduce challenges for communities.

3. To determine if Ecosystem-based Management is a practical approach to urban ecosystem restoration, and if so, to provide recommendations for how to successfully introduce it.

The insight gained from this research will be useful to urban planners and policy-makers, urban citizens and stakeholders, and will make a significant contribution to the academic fields of EBM, urban ecology, and urban planning and policy-making. Most importantly, this research will help urban communities to better understand the utility of EBM as an approach to urban environmental management.

1.4. Report Organization

This report is organized into seven chapters. Following this introduction, Chapter 2 explains my research approach and methodology. In Chapter 3, I provide a review of literature pertaining to EBM. In Chapter 4, I describe the Still Creek case and provide an overview of historical development, recent restoration, and institutional factors in the Still Creek watershed. Chapter 5 outlines the results of document analysis and interviews conducted with government representatives, community representatives, and experts on EBM and urban ecological restoration. In Chapter 6, I characterize environmental management in the Still Creek Watershed and provide recommendations for how to better integrate EBM into the planning process. Chapter 7 provides insight into the usefulness of EBM as a management approach for Still Creek and other urban communities, summarizes key messages, and provides recommendations for future research.

Chapter 2.

Methods

This is an exploratory and descriptive case study that addresses the potential usefulness of Ecosystem-based Management in the urban setting. This research employs multiple methods of data collection and analysis, including review of literature, document analysis, and semi-structured interview analysis. In this Chapter, I outline the research methodology of this study. Section 2.1 describes the literature review. Section 2.2 characterizes the case study approach used in this research, explains my case selection, and outlines my research questions. Section 2.3 describes how data was collected and analyzed. Section 2.4 identifies study limitations.

2.1. Literature Review

The literature review provides an overview of the concept of Ecosystem-based Management. There is a relatively large body of literature that addresses the theoretical and practical components of EBM with academic, government and industry contributors. My review is a synthesis of important concepts and principles that I have distilled from the literature. I narrow the focus of my discussion to the ten principles of EBM outlined by Grumbine (1994), which address ways of managing social and ecological challenges and uncertainty in environmental management.

Throughout my literature review, I incorporated information from literature pertaining to 'Ecosystem Management' and Ecosystem-based Management.' While there are differences between the two terms, both terms provide important insights into ecosystem approaches to environmental management, which is an evolving field of research and practice. I choose to use the term 'Ecosystem-based Management' because it is more reflective of a biocentric approach to environmental management

(Slocombe, 1998b) that can challenge communities to more fully appreciate the role that humans play in ecosystem health.

The review of literature also provides an opportunity to characterize EBM as an environmental management paradigm. Understanding what distinguishes EBM from other environmental management approaches may help communities to better achieve implementation of and coherence to a plan. Sherman and Duda (1999) identify the features of EBM that set it apart from a traditional environmental management paradigm. In contrast, Yaffee (1999) and subsequently Leech, Wiensczyk, and Turner (2009) describe the different ways that EBM can be expressed depending on the values of those implementing EBM. I use the literature to establish a framework for evaluating the status of EBM in the case study that I examine.

2.2. Case Study Approach

In this research, I use a case study approach to study the usefulness of EBM to urban communities. A case study is defined as "an exploration of a 'bounded system' or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context" (Creswell, 1998, pg. 61). Information can be collected from a variety of sources (Creswell). Sources for this study include documents, archival records, and interviews (Yin, 2003). Case study analysis involves the production of a detailed description of the case, theme analysis, and interpretive assertions about the case (Creswell).

There are several strengths of the case study approach. Case studies are appropriate modes of inquiry in unique situations that require study and provide relevant practice-based observations (Creswell, 1998; Yin, 2003). Case studies provide information that can be used for both within-case analysis, and in the larger social, political, and economic context to offer a complete view of the processes, relationships, and themes that emerge (LeCompte and Schensuel, 2010). They allow for a critical analysis of contradictory information coming from multiple sources of information (Eisenhardt, 1989). The conflicting realities that can emerge from case study research encourage the researcher to stay open-minded to new constructs, themes, or biases

(Eisenhardt). An additional strength of case study research is that theories are derived from measurable constructs, as opposed to theory that is derived apart from direct evidence (Eisenhardt).

This research uses a single-case approach instead of a multi-case approach. In part, the single case approach is the result of the uniqueness of the research. There are very few urban communities attempting to implement EBM. In addition, multiple case studies can sometimes add complexity to the research because more cases increase the challenge of reaching an appropriate depth of analysis and theoretical saturation in any single case in the study (Creswell, 1998). In addition, when presented with a high volume of rich data in multi-case approaches, a researcher may produce overly complex theories and perspectives (Eisenhardt, 1989). Single cases are manageable and allow the researcher to derive relevant, practice-based themes.

2.2.1. Case Selection

Selecting the appropriate case study that can provide answers to the research questions is important because it increases the generalizability of the research findings (Eisenhardt, 1989). I chose to study the Still Creek watershed in Vancouver and Burnaby, British Columbia because the community has shown a keen interest in implementing EBM. The creek and watershed also hold ecological and social importance to the local community. Still Creek has also been the subject of many studies and restoration efforts. Despite its intense development history, there is opportunity to obtain significant social and ecological benefits from implementing EBM.

Ecologically, Still Creek is important because it is one of two remaining streams in Vancouver that is still partially daylighted. Approximately fifty other Vancouver streams were culverted or buried as settlement progressed throughout the 1900's, but Still Creek was partially spared (Proctor, 1989). Still Creek was once very ecologically productive. Its watershed drains stormwater runoff and carries it to the Brunette River and then to the Fraser River, making it a significant part of an important biological and hydrological system in the Lower Mainland of Vancouver.

From a social perspective, the creek has been an important feature of the local community. The creek was used for fishing and travelling until it started to degrade from development. As the creek became polluted, community members and groups took an active role in improving the health of the stream (Chan, 2012). Today, many members of the community want to improve stormwater drainage, ecological health, and recreational access to the creek. Local governments are also interested in improving the stream's ecological health. In recent years, the interest from the community has culminated in a vision to create an Ecosystem-based Stewardship Plan to continue restoring Still Creek.

This case study research is part of a larger partnership that includes community members, researchers, and environmental non-government organizations in a network that is working towards helping urban communities improve their local ecosystems. Partners worked together to identify common goals and research responsibilities. Table 2.1 provides a list of partners and their role in the larger research partnership.

Table 2.1: Research Partners and their Roles

Partner	Role
David Suzuki Foundation	To help share results of this research with other urban communities, municipalities, and environmental organizations across Canada.
Silva Forest Foundation	To provide a knowledge base and develop Renfrew Ravine and Still Creek Watershed assets survey. To train students and community members through their involvement in EBM implementation in Still Creek watershed.
Still Moon Arts Society	To co-ordinate activities, provide leadership, and ensure liaison between all collaborators. To connect people to resources in the community through EBM implementation.
Vancouver school Board through Windermere Secondary Schools Leadership Program	To integrate EBM into Leadership Program at Windermere Secondary School.
Collingwood Neighbourhood House	To network with community and build support for ravine stewardship.
Renfrew Collingwood Aboriginal Youth Canoe Club	To share knowledge of First Nations traditions and educate people on the traditional uses of the waterways and land in the watershed.
Renfrew Park Community Centre and Association	To provide recreational, cultural, and social support and resources for the EBM initiative.
City of Vancouver Planning	Coordinated Still Creek restoration initiatives. To supply resources and assist in moving initiatives through the city and other jurisdictional processes.
Renfrew Collingwood Seniors Centre	To connect seniors with initiative.
Centre for Sustainable Community Development, Simon Fraser University	To provide research support and insure coordination of partners.

2.2.2. Research Questions

The goal of this research is to determine the usefulness of EBM to urban communities such as the Still Creek watershed. My research objectives were to understand what motivates urban communities to implement EBM, identify what successes and challenges an urban community might face when planning and implementing EBM principles, to find solutions to mitigate challenges, and to understand the overall usefulness of EBM in urban ecosystem restoration. In order to fulfill these research objectives, the questions that I asked throughout my literature review and case study analysis included:

- What was the original character of Still Creek and how has it been modified through human activity?
- What is the ecological condition of Still Creek and what type of restoration work has been to improve its condition? How have people been involved in restoration?
- How does the community understand EBM and perceive its utility?
- What makes EBM difficult to implement in Still Creek? What influences the process and outcomes of EBM implementation?
- How is knowledge of the watershed shared in the community and what type of knowledge is shared?
- How is EBM impacting the community's relationship with nature?
- How is this watershed impacting the broader community (city and region)? What lessons can be shared with other communities in the world?
- What type of collaboration exists in the watershed?
- How is community engagement impacted by EBM?
- Is a paradigm shift taking place in the watershed?

These questions will help to identify the role that EBM can play in urban ecosystem management. The jurisdictional complexity and highly impacted nature of urban ecosystems offers a valuable opportunity to expand the field of EBM to the urban setting and to establish a better understanding of how to effectively manage social and ecological dynamics in cities.

2.3. Qualitative Data Collection and Analysis

2.3.1. Document Review

The types of documents and archives I reviewed were community planning documents, bylaws, meeting minutes and other administrative documents, newspaper clippings, and any other relevant documents. The purpose of document and archival review is to obtain social and ecological information about Still Creek. The benefits of collecting data from documents and archives are that it can be reviewed repeatedly

(stable), it is not created as a result of my conducting research on the case itself (unobtrusive), it contains specific information like names, references, and details about events (exact), and it allows for long spans of time, large amounts of events, and many settings to be studied (broad coverage) (Yin, 2003).

2.3.2. Semi-Structured Interviews

This research also involved primary data collection through interviews. I conducted twenty semi-structured interviews with twenty-one interviewees. I developed two different questionnaires to guide my interviews. The first questionnaire was developed for community members, local government representatives, non-government organizations, and any other parties who were involved with restoration in the Still Creek Watershed in some way (see Appendix A for Community Questionnaire 1). To develop this questionnaire, I identified core themes in the literature and derived questions that would help me to identify how EBM is being used, why the community thinks EBM is useful, how they understand EBM, and the degree to which collaboration is occurring in the watershed restoration process. The second questionnaire was developed for EBM and urban ecological restoration experts and key informants (see Appendix A for Key Informant Questionnaire). Interviewees for this questionnaire were not necessarily involved in the Still Creek watershed, but were involved with EBM, green urban planning, or collaborative governance in a capacity that would make them experts in the field. The questions promoted a discussion of what Ecosystem-based Management is and how it might be implemented in the urban setting. The questions also promoted discussion of collaboration, engagement, and knowledge sharing.

I interviewed civil servants, community groups, local residents, non-government organizations, scholars, and scholar-practitioners (see Table 2.2). Interviewees were selected through various methods. Some interviewees were selected through connections that were already established through the research partnership. Interviewees were also recommended to me by existing study participants. Other participants were selected because of their involvement in the Still Creek watershed or particular knowledge of some aspect of this research. Recruitment was ongoing until theoretical saturation was reached.

Interviews were between 30 minutes to 1.5 hours and took place in person at a public or semi-private location such as a coffee shop, library, or office. The interviews were semi-structured which places some parameters on the direction of the discussion (Cook and Crang, 1995), but allowed flexibility in the conversation and exploration of relevant information brought forth by interviewees. Interviews were recorded and transcribed.

2.3.3. Analysis and Coding

To analyze the results of the interviews, I engaged in a reflexive process of reviewing transcripts and identifying emergent concepts. Creswell (1998) describes open, axial, and selective coding as developing categories of information, interconnecting categories, and further connecting categories to build a 'story.' Open coding helps to identify properties of each category. Axial coding involves choosing a single category and exploring its interconnectivity with other categories. Selective coding involves determining key themes that emerge from categories and checking data to ensure it is properly categorized and themed. I followed this approach in my coding procedure.

Table 2.2: Interviewees and their Affiliation

Group	Interviewee	Affiliation
1 (local residents and involved with Still Moon Arts Society)	Interviewee 1	Still Moon, Local resident
	Interviewee 2	Still Moon, Local resident
	Interviewee 3	Still Moon, Local resident
	Interviewee 4	Still Moon, Local resident, former student of Windermere Leadership Program
	Interviewee 5	Still Moon, Local resident, former student of Windermere Leadership Program
	Interviewee 6	Still Moon, Local resident, former student of Windermere Leadership Program
2 (local/regional government representative, NGO representative, other individuals with particular knowledge and/or interest in Still Creek restoration)	Interviewee 7	City of Burnaby Planning Department
	Interviewee 8	(Former) City of Burnaby Planning Department
	Interviewee 9	City of Vancouver Councillor
	Interviewee 10	City of Vancouver Councillor
	Interviewee 11	City of Vancouver Planning Department
	Interviewee 12	Vancouver Parks Board
	Interviewee 13	Metro Vancouver
	Interviewee 14	Metro Vancouver
	Interviewee 15	Evergreen
	Interviewee 16	Vancouver Historian
3 (EBM/ Restoration Expert)	Interviewee 17	Silva Forest Foundation
	Interviewee 18	School of Resource and Environmental Management
	Interviewee 19	BCIT Rivers Institute
	Interviewee 20	BCIT Rivers Institute
	Interviewee 21	Partnership for Water Sustainability

2.4. Limitations

One of the limitations of this study is that because only one case was studied, the results and conclusions may not be applicable beyond this specific case. A researcher may be better able to generalize the results of their research beyond their case study if they use a multi-case approach because it decreases the chances of obtaining results that describe only an extremely unique case (Creswell, 1998).

Another study limitation is the inherent bias that I carry with me and its impact on the objectivity of this research. Objectivity in research is dependent on the researcher establishing control over their bias and any other outside influences by remaining neutral toward the results of the study and by creating conceptual separation between the researcher and things under study (LeCompte and Schensul, 2010). While I attempted to remain as unbiased as possible, my interests and motivations may have impacted the direction of research, questioning, and conclusions drawn in this research. My identity and societal upbringing provide an additional source of researcher bias.

It is possible I did not collect an accurate representation of the opinions of people in the Still Creek community through my interviews. Studies that lack community representation have weaker validity and theoretical saturation may not be accurately researched (Schensul and LeCompte, 2012). I did not interview anyone from the business/industry community in the Still Creek watershed. However, I do feel that other interviewees were able to provide at least a partial insight into the opinions of the business/industry community. I also interviewed people who were previously involved with restoration in the Still Creek watershed, but no longer involved. It is best to interview informants who are currently involved in the project of study because they will have the best memory recollection of events and insights will be new (Spradley, 1979). To increase internal validity in this case study, I employed the triangulation method. Triangulation is the use of multiple sources of evidence to determine facts and truths (Yin, 2003).

By relying on literature as a basis for verification of facts and themes, one can increase the internal validity of a case study (Schensul and LeCompte, 2012). Unfortunately, there is very little research on EBM and its application to the urban setting. Thus, it is challenging to use the literature as a place of verification, because most of the examples are from significantly different research contexts. My research would have stronger internal validity if I was better able to refer to literature that was directly relevant to the urban setting (Eisenhardt, 1989).

One major challenge that I experienced early on in data collection was that I had written my questionnaires with the idea that the Still Creek Ecosystem-based

Stewardship Plan was further along than it was. In reality, the EBM plan itself was in its infancy. I modified my research questions and interview questions slightly to permit a broader discussion of the value of EBM to the community. It is possible and often beneficial to revisit and shift research questions during research (Eisenhardt, 1989). I shifted the expected outcomes from product-base conclusions (i.e. Was EBM successful at helping the community to achieve their goals?) to process-based conclusions (i.e. How is EBM currently helping the community? What is challenging about EBM?). While this experience initially appeared to weaken the value of this research, I would now argue that it is still highly relevant research for two reasons. First, I can provide immediate feedback to the community on how to improve their EBM implementation process and mitigate their challenges. Second, I can provide a process-based analysis of EBM in the urban setting as opposed to a results-based analysis, which provides tremendous insight into the complexities of shifting the environmental management paradigm that various urban communities will need to overcome.

Chapter 3.

Literature Review

> *"The basic tenet of an ecosystem based approach is that conserving ecosystem functions and integrity is vital because viable ecosystems are the basic life support system for human communities."*
>
> -Leech, Wiensczyk, and Turner, 2009, pg. 2.

This research aims to provide insight into the usefulness of Ecosystem-based Management in a relatively novel setting—the urban environment. In order to understand its usefulness, it is important to establish the theoretical and practical characteristics of EBM as it has been described in the literature. This chapter provides a summary of literature pertaining to EBM. In Section 3.1, I define EBM and describe its principles. In Section 3.2, I describe the characteristics of EBM that set it apart from other management approaches. In Section 3.3, I describe a few other environmental management approaches that have been used in the urban setting and provide a comparison to the EBM approach.

3.1. What is Ecosystem-based Management?

In recent decades, Ecosystem-based management has emerged as an approach to environmental management that draws upon social and ecological principles to holistically manage human activities in ecosystems. It does so by finding solutions that apply to whole ecosystems instead of individual components and parcels of land

(Slocombe, 1998b). However, a certain degree of contention exists in explicitly defining ecosystem management (Grumbine, 1997; Rigg, 2001; Stanley, 1995; Yaffee, 1999).

The field of ecosystem-based management lacks definitional precision and agreement because there are two similar terms often used interchangeably: ecosystem-based management and ecosystem management. Ecosystem-based management emphasizes an approach where people manage *human activities* in an ecosystem such that ecosystem health is maintained (Slocombe, 1998b). Of the two concepts, it is more biocentric, emphasizing the priority of ecosystem integrity over human uses (Slocombe). Ecosystem management is a concept that emphasizes the management of *the ecosystem itself* (Slocombe). This concept, in relation to ecosystem-based management, is more anthropocentric in that it implies that humans can control nature (Slocombe). The challenge in using these terms interchangeably arises because management practices in ecosystem management emphasize smaller spatial scale approaches in comparison to ecosystem-based management (Slocombe). In addition, these terms have been used to describe environmental management that has taken place in different political contexts. Ecosystem management has been associated with U.S. Forest Service policies that have been implemented in recent decades. Ecosystem-based management is a term that describes the nature of some environmental management practices that have taken place in Canada (Hutton, 2004). As mentioned, however, these terms are often used interchangeably, and there is no doubt that their meanings continue to evolve as more communities and organizations begin to adopt ecosystem approaches.

Another challenge in defining ecosystem-based management is the wide degree of interpretation of the concept that exists in literature and in practice. Some definitions are so different that they omit the ecological integrity priority, which is recognized by some scholars as the feature of EBM that distinguishes it from other environmental management approaches (Coast Information Team (CIT), 2004; Stanley, 1995). EBM is difficult to define because it challenges our conventional norms of resource management. Grumbine (1997) argues that inconsistency in definitions is a result of an inability to think broadly about problems in different contexts (e.g. political, economic), not just in scientific terms. Divergent definitions can also arise because people have

different values and perceive the meaning of EBM in their own way (Yaffee, 1999). In fact, scholars have acknowledged that ecosystem approaches to environmental management can take on both anthropocentric and biocentric attributes (Leech, Wiensczyk, Turner, 2009; Stanley, 1995; Yaffee, 1999). What is more important than achieving "ecosystem management" is moving progressively along the environmental management continuum and learning and adapting in the process. Given the political nature of introducing new terms to governance arenas (Grumbine), it is not surprising that there is inconsistency in defining ecosystem-based management.

The goal of this research is to establish those aspects of EBM that might assist urban communities with restoring their local ecosystem and adopting a new environmental ethic toward their community. I will integrate information from the literature on ecosystem management and ecosystem-based management, without discriminating between the terms. This approach will help to illuminate the aspects of EBM that can both challenge norms and cultivate change in urban communities. I will proceed by establishing a few guiding definitions and core principles often associated with ecosystem-based management.

Grumbine's definition of ecosystem management is often cited in the literature (e.g. CIT, 2004; Lackey, 1998; Osborn, 2002; Stanley, 1995):

> Ecosystem Management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term (Grumbine, 1994, pg. 31).

While this definition acknowledges the importance of sociopolitical factors, it does not speak to the nature of environmental resource use by humans. An alternative definition given to EBM by the Coast Information Team[1] (CIT, 2004) is perhaps more descriptive and offers greater opportunity to incorporate the human dimensions of ecosystems. CIT's definition provides a solid foundation from which to build:

[1] CIT is an independent science team that provides Ecosystem-based Management advice and information practitioners in British Columbia's Central and North Coast and Haida Gwaii.

> Ecosystem-based Management is an adaptive approach to managing human activities that seeks to ensure the coexistence of healthy, fully functioning ecosystems and human communities. The intent is to maintain those spatial and temporal characteristics of ecosystems such that component species and ecological processes can be sustained, and human well-being supported and improved (CIT, 2004, pg. 9).

There are common themes throughout the literature that help to characterize EBM principles (Osborn, 2002; Rigg, 2001) and bring clarity to the concept. An ecosystem-based perspective requires consideration of the whole ecosystem and all of its components and interactions, at various spatial scales and through time. As such, the principles span beyond ecological knowledge and extend into the realm of social knowledge.

In an effort to enhance the soundness and relevance of EBM, several scholars or scholar-practitioners have systematically reviewed literature and summarized their observations of key characteristics and overarching principles. For example, Rigg (2001) summarized the principles of EBM into four main themes: ecological and integrated systems management, adaptive scientific management, cooperation and collaboration, and integrating social values. Alternatively, Grumbine's (1994) review of EBM literature yielded ten principles, summarized in Table 2.1. The work by Rigg and Grumbine provide insight into the defining features of EBM.

Table 3.1: Principles of Ecosystem-based Management

Theme/Aim	Principle and Description
Ecological	*Maintain Ecological Integrity* Ecological Integrity is "the abundance and diversity of organisms at all levels, and the ecological patterns, processes, and structural attributes responsible for that biological diversity and for ecosystem resilience" (CIT, 2004, pg.13).
	Ecological Boundaries Management that recognizes and follows ecological boundaries such as watershed boundaries is more effective at maintaining ecological integrity of an ecosystem than management that follows political (jurisdictional boundaries)
	Hierarchical Context It is essential that managers make connections between patterns and processes at all scales within an ecosystem, including site, neighbourhood, ecosystem, and regional scales and species, population, ecosystem, and watershed levels of analysis.
Managing Uncertainty	*Data Collection* Data collection involves collection of both social and ecological data to establish the condition of an ecosystem and to implement monitoring (Slocombe, 1998a).
	Monitoring Monitoring involves identifying and using data and indicators of change to characterize ecosystem status and maintenance/improvement of health.
	Adaptive Management Adaptive Management is "a systematic and iterative approach for improving resource management by emphasizing learning from management outcomes" (Bormann, Haynes, & Martin, 2007). Adaptive management involves testing assumptions and exploring alternatives. Data collection and monitoring can be seen as components of the adaptive management cycle.
Social	*Interagency Cooperation* In conjunction with the principle of managing through ecological boundaries, governments, non-governmental organizations, and citizens will need to work together to implement components of EBM.
	Organizational Change The structures of land management agencies and their operations may need to change, for example by forming interagency committees, or changing professional norms and shifting power dynamics.
	Humans Embedded in Nature Humans need to acknowledge their impact and dependence on ecological patterns and processes.
	Values Acknowledge the role that humans play in ecosystem management goals, even in the presence of adequate scientific information.

Note: Principles are derived from Grumbine's (1994) general observations in the literature and other sources where noted. The categories in the left column are author-generated.

Ecological integrity is often recognized as the central principle of EBM (Christensen et al., 1996; CIT, 2004; Clayoquot Sound Scientific Panel, 1995; Holt, 2001; Grumbine, 1997; Yaffee, 1999). The emphasis on ecological integrity is indicative of a broader recognition that the economic and social benefits of resource use can only be realized if the ecological patterns, structures, and processes of an ecosystem are optimized. Protecting native species, ecosystem diversity, and natural disturbance regimes are mechanisms to protect ecological integrity. A related concept is ecosystem resilience, which emphasizes the importance of ranges of natural variability in ecosystems such that ecosystems can absorb a greater degree of disturbance without losing their inherent characteristics (Holling & Meffe, 1996). Advancement in scientific knowledge is a critical component of managing for ecological integrity, but can also be a significant challenge for communities (Price, Roburn, & MacKinnen, 2009; Leech et al, 2009). It can also be an opportunity for communities to learn by doing in the field (Brunner & Clark, 1997).

Management that considers *ecological boundaries* as opposed to political boundaries ensures that ecological processes are considered in their entirety; management does not stop at jurisdictional borders. This concept has also been coined 'bioregionalism' (Slocombe, 1998b). Managing through ecologically-defined borders often implies that people in different jurisdictions will need to work together to implement EBM. This principle can be achieved through mapping projects that incorporate ecological data and demarcate the natural spatial character of ecosystems (Rigg, 2001). *Interagency cooperation* is closely connected to the principle of ecological boundaries. Management by ecological boundaries requires collaboration. Collaboration might require that agencies undergo *organizational change*, where an agency's operating structure changes to create capacity within organizations to better manage ecosystems holistically (Grumbine, 1994). A potential challenge associated with interagency cooperation and organizational change that can arise may be inflexibility in bureaucratic decision making to allow such structure and process changes to occur within and between organizations (Rigg).

Environmental managers need to be aware of the *hierarchical context* in which they are operating, and how the processes and interactions at one scale are interacting

with processes and interactions at other scales (Savard, Chergeau, & Mennechez, 2000). In addition, biological responses and cumulative impacts have may be most obvious at course scales of focus (Szaro, Sexton, and Malone, 1998). For example, biodiversity trends may appear very different and even conflicting, depending on the scale of observation (e.g. population-level vs. landscape level) (Savard et al.; Goddard, Dougill, & Benton, 2009). The distribution of a fish species at the scale of a reef patch may be very unpredictable, whereas at a broader scale of reef system, the population distribution is predictable (Hobbs, Higgins, & Harris, 2009). Thus, it is critical that environmental managers be aware of how processes operate on different scales (Szaro et al.). EBM places an emphasis on 'systems thinking' through inter-agency collaboration, collection of both scientific and social information, and several other principles (Grumbine, 1994; Yaffee, 1996). Systems thinking can help to ensure that observations, experiments, and decisions are always grounded in context.

EBM also encourages management approaches that are flexible and responsive to complexity and uncertainty. Ecosystem dynamics are complex and interactive (Alberti, 2005). Biodiversity is dependent on many factors and can change as ecosystems are disturbed by a variety of biotic and abotic factors (Landres et al., 2009; Mori, 2011). EBM principles pertaining to complexity and uncertainty include *data collection, adaptive management, and monitoring*.

Adaptive management—a concept first introduced by Holling (1978)—is a 'learning by doing' approach that equips managers with a process built for managing uncertainty (Grumbine, 1994). It involves the process of *collecting data*, *monitoring* indicators of change as management actions are implemented, and adjusting management actions to achieve desired outcomes (see Figure 3.1). Recognizing that knowledge is not always perfect and that ecosystems are complex, non-linear, and unpredictable is essential to the adoption of adaptive management. The operationalization of adaptive management can take a few different shapes. Management actions can be implemented as an experiment to test the outcome—typically referred to as *active* adaptive management (Williams, 2011). Alternatively, in *passive* adaptive management, management actions are be implemented with the

expectation that the outcome will be effective, but with the understanding that some learning may happen along the way (Williams).

Figure 3.1: The adaptive management cycle.
Source: Australian Government Department of the Environment and Heritage, 2007.

Essential to the adaptive management approach is having the ability to *monitor* indicators of change, evaluate progress, and react to outcomes of management practices (Lessard, 1998). Monitoring allows managers to determine if management practices are effective based on objectives set out prior to implementation. A challenge that adaptive management can bring to communities, governments, and institutions is that these entities can sometimes be inflexible in their ability to both integrate new information that is rapidly accruing into policies (Leech et al., 2009) and adapt with appropriate funding resources (Schueller, 2004). These challenges emphasize the need for flexible policies (Rigg, 2001) and long-term planning and funding (Schueller, 2004).

The remaining two principles emphasize the importance of the human component in EBM. Regardless of what our scientific knowledge tells us, human *values* ultimately determine the types of human activities in an ecosystem. In this respect, EBM

is no different than any other approach to environmental management—it suggests a values approach. The value that is emphasized and encouraged in EBM is maximizing ecological integrity before any other priority, including economic benefits of resource extraction from an ecosystem (Lackey, 1998). Opting to take an ecosystem approach to environmental management requires more than simply calling it "ecosystem-based management." The social values of stakeholders in a community need to accurately reflect the values that EBM embodies. Even within the paradigm of ecosystem management, there is a continuum of approaches that can range from slightly anthropocentric to highly biocentric (Lackey, 1999; Yaffee, 1999). The role of collaboration and consensus-based decision making in aligning values and objectives and creating buy-in to decisions is therefore critical to the success of any ecosystem-based process.

Lastly, recognizing that *humans are embedded in nature* is a fundamental tenant of EBM. Lertzman (2010) draws parallels between First Nation's intimate relationship with nature and the EBM paradigm that encourages human recognition of their part in ecosystems. The role that scientists, managers, and citizens play in making this transition to a more biocentric approach to ecosystems is paramount.

EBM encourages management of whole ecosystems, of which humans are a part. Lack of clarity surrounding the definition and philosophical underpinnings of EBM at times create disillusionment in the field (Yaffee, 1999). However, common themes and principles have emerged from both theory- and practice-based research, providing a strong foundation for understanding and utilizing EBM. The pairing of social and ecological principles is critical to shifting people's relationship with nature. It is apparent that the Ecosystem-based Management field is still evolving, adapting (Berkes, 2012), and setting itself apart from other management approaches as researchers and practitioners continue to gain a better understanding of its benefits and challenges.

3.2. What sets EBM apart?

The previous section highlighted the defining characteristics of Ecosystem-based Management and how there is some uncertainty in defining the term and the approach.

The risk in introducing new terminology to the field is that it remains that—just a buzzword that holds no true meaning or practical relevance. However, there is value in exploring the opportunity for EBM to shift the way humans interact with their environment. In this section, I will highlight a few aspects of EBM that might set it apart from traditional resource management paradigms.

One way that EBM stands apart from other management paradigms is that it incorporates broad principles that integrate social, ecological, and uncertainty-based solutions. The integration of social and ecological dynamics is not as explicitly addressed in traditional environmental management paradigms (Holling & Meffe, 1996). The emphasis on a systems approach also challenges traditional management regimes because it requires collaboration and collective management of the environment. Table 2.2 characterizes the ways in which EBM represents a paradigm shift through a systems approach and the integration of social, ecological, and uncertainty-based principles.

Table 3.2: Conceptualizing Ecosystem-based Management as a Paradigm Shift

From	To
Individual Species	Ecosystems
Small spatial scale	Multiple scales
Short-term perspective	Long-term perspective
Humans independent of ecosystems	Humans as integral parts of ecosystems
Management divorced from research	Adaptive management
Managing commodities	Sustained production potential for ecosystem goods and services

Source: Sherman and Duda, 1999; UNEP, 2006.

As mentioned previously, EBM can be expressed in different ways (Yaffee, 1999). Stanley (1995) argued that EBM is simply a continuation of the anthropogenic tendency of humans to want to control nature. Stanley states that EBM falls under the "doctrine of final causes," where humans perceive themselves as the ultimate deciders of nature's fate. However, the implementation of EBM may appear more anthropocentric in some places and more biocentric in others—there is a continuum of paradigms and movement between paradigms is possible (see Figure 3.2). EBM is driven by the values of people in a place (Lackey, 1998), and values can change over time. This aspect of EBM is not novel to environmental management. What does set EBM apart is that it

challenges business-as-usual and encourages movement along the continuum towards biocentrism and ecocentrism (Imperial, 1999). As such, it can help humans to re-establish their relationship with the land upon which they depend (Brussard, Reed, & Tracey, 1998). When compared to business as usual, the ecosystem-based approach presents an alternative that can succeed where other approaches have left ecosystems degraded (Yaffee, 1999). If humans can begin to perceive their livelihood as fundamentally integrated with ecosystems, our paradigms of environmental management will reflect this change.

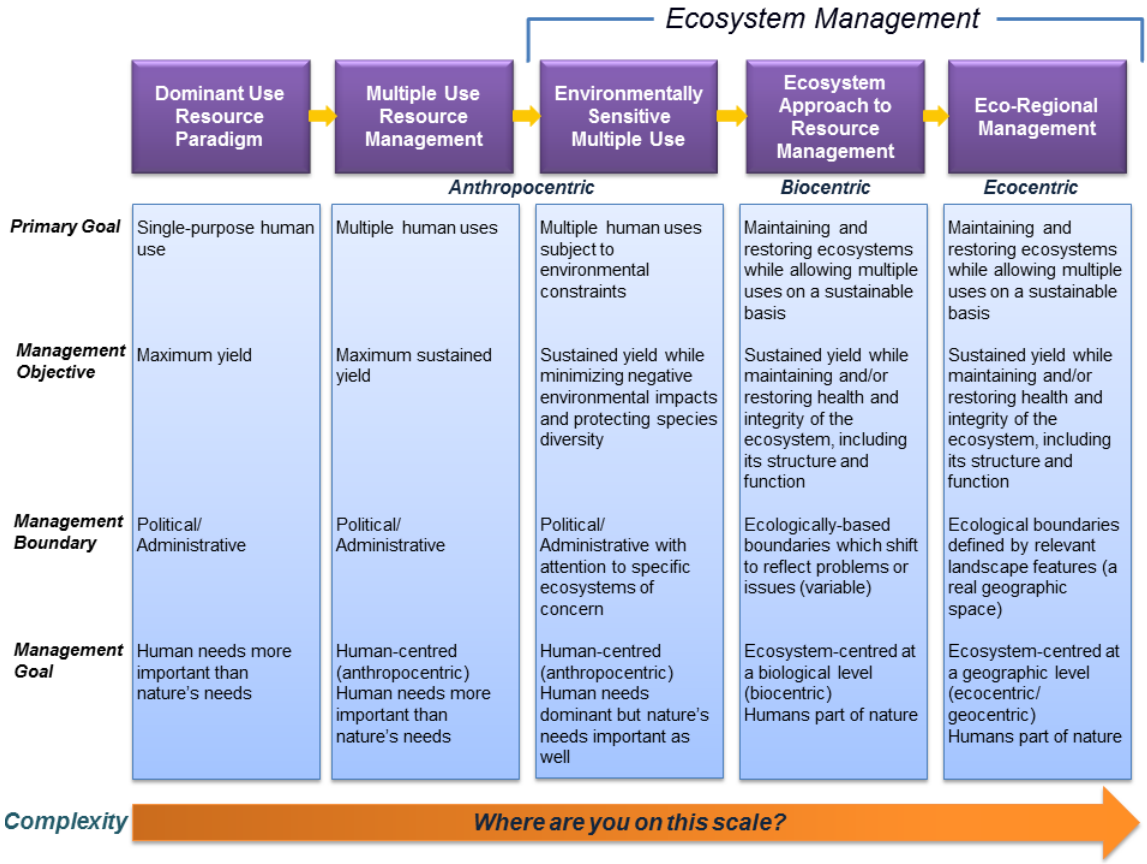

Figure 3.2: Continuum of resource management approaches.
Note: Adapted from Leech, Wiensczyk, and Turner, 2009 and Yaffee, 1999 (original).

The ecological principles of EBM also set it apart from other management paradigms. At one time, a dominant thought paradigm in ecology was that ecosystems should exist in an equilibrium state and disturbances should be limited (e.g. 'the balance of nature'). Today, ecologists acknowledge that variability in ecosystems (e.g. 'nature in flux') is crucial to ecosystem persistence. The 'nature in flux' theory suggests that it is

natural for an ecosystem to shift between two or more states (Folke et al., 2004). While a ecological regime shift may be natural, having the scientific knowledge of ecosystem variability will help environmental managers to know when a regime shift is unnatural, i.e. human-induced. If management interventions such as fire suppression continue to eliminate natural variability in ecosystems, the result is a system that is less resilient to external perturbations (Holling & Meffe, 1996). Several scholars have asserted that the EBM approach provides environmental managers with the opportunity to gain a better understanding of natural ranges of variability in ecosystems (e.g. Holling & Meffe, 1996; Christensen et al., 1997; Cissel, Swanson & Weisberg, 1999; Landres, Morgan, & Swanson, 1999; Aber et al., 2000; Folke et al., 2004), which can help to reduce the suppression of natural disturbance regimes that often occurs in a traditional environmental management approach.

Finally, the flexibility that EBM encourages is a new approach to environmental management that is uncharacteristic of other environmental management paradigms. Adaptive management permits the development of ecosystem approaches without requiring environmental managers to have all of the answers. In most cases in ecology and social science, we do not have a full understanding of ecological and social processes (Christensen et al., 1997; Cissel, Swanson & Weisberg, 1999; Landres, Morgan, & Swanson, 1999; Aber et al., 2000), and best management practices are always evolving. There is some hesitation in implementing EBM in communities because people feel that do not have sufficient science to support an EBM approach (Osborn, 2003). However, scholars have asserted that communities such as this are in an opportune position to implement EBM, because it allows for the integration of new knowledge (Christensen et al, 1997; Brunner & Clark, 1997; Holling & Meffe, 1996; Yaffee, 1999). EBM approaches also welcome non-traditional sources of knowledge—including Traditional Ecological Knowledge and citizen science—to diversify knowledge sources, manage uncertainties, engage people in knowledge production and decision-making, and strengthen the adaptive capacity of social-ecological systems (Cooper, Dickinson, Phillips & Bonney, 2007; Lertzman, 2010)

Among other scholars, Berkes (2012) argued that governance needs to adapt and incorporate multi-level management that is inclusive of stakeholders and founded on

the premise of collaboration in order to achieve environmental management goals. He calls for revolutionary governance and redesign of our resource management institutions that enable social and ecological learning in the face of uncertainty. Aldo Leopold once said “no matter how intently one studies the hundred little dramas of the woods and meadows, one can never learn all the salient facts about any one of them.” Ecosystem-based Management is an opportunity to enable social-ecological systems to be ready to deal with and adapt to the dramas of nature. However, Yaffee (1999) reminds us that it is as important to understand the uniqueness of EBM as it is to understand its place on the continuum of environmental management approaches. Suggesting a far-fetched, unrealistic, shift in the way we manage human activities in ecosystems can be paralyzing to practitioners (Yaffee, 1999).

3.3. Related Concepts

This research attempts to contribute to the theoretical and practical knowledge pertaining to urban ecosystem restoration by evaluating the potential applicability of a concept that is new to the urban setting. Many communities and local governments are attempting urban ecological restoration through the use of similar, related approaches. It is important to acknowledge all these approaches as viable alternatives to urban ecosystem restoration. The goal of this research is ultimately to assist urban communities with ecosystem restoration and create meaningful environmental change in communities. If there are multiple approaches that can help communities to achieve this goal, it is important to identify their merit.

An increasingly common term being used by communities to promote settlement and development that is balanced with ecology is, “Design with Nature.” Design with Nature is a term coined by Ian McHarg in 1969 that encourages the use of ecology in landscape and urban planning. Smart Growth is a concept similar to Design with Nature that has also been adopted by urban communities across North America. Smart Growth is often considered synonymous with policies that promote high density development—a development approach that is not universally accepted as a precursor to achieving healthy, livable cities. Design with Nature is sometimes considered a less politically charged version of Smart Growth because it does not necessitate high density

development. Both Design with Nature and Smart Growth encourage more efficient land use and protection of urban social-ecological systems. Table 2.3 compares the contrasts the principles of Design with Nature and Smart Growth.

Table 3.3: Principles of Design with Nature and Smart Growth.

Design with Nature	Smart Growth
• Developing compact and complete communities • Increasing in transportation options • Reducing the loads on water, waste, and energy systems • Protecting and restoring urban greenspace • Striving for a lighter 'hydrologic footprint • Achieving higher levels of stream protection	• Mix land uses • Take advantage of compact building design • Create a range of housing opportunities and choices • Create walkable neighborhoods • Foster distinctive, attractive communities with a strong sense of place • Preserve open space, farmland, natural beauty, and critical environmental areas • Strengthen and direct development towards existing communities • Provide a variety of transportation choices • Make development decisions predictable, fair, and cost effective • Encourage community and stakeholder collaboration in development decisions

Sources: Water Bucket, 2010; Smart Growth Network, 2006.

In recent years, the concept of ecosystem services has gained significant international recognition. The Millennium Ecosystem Assessment identified types of ecosystem services, how they impact human well-being, and frameworks for assessment. Ecosystem services are "the benefits people obtain from ecosystems" (MEA, 2003). There are provisioning, regulating, cultural, and supporting services, all of which are essential to human well-being. The goal of an ecosystem services approach is to help identify the integral part humans plan in ecosystems. It does so by encouraging the valuation of all ecosystem services so that they can be accounted for and monitored through time, as humans continue to interact with ecosystems. It has been argued that the ecosystem services approach is valuable for land use planning in urban areas because the approach helps to link human activities with ecosystem processes, and because cities tend to place a large demand on ecosystem services (Niemelä et al., 2010).

3.4. Conclusion

In this chapter, I have discussed the concept of Ecosystem-based Management and its conceptual underpinnings. Despite variability in the use of the concept, common themes exist in the literature. The literature provides insight into the implementation of EBM in the urban setting. It is also important to recognize that while EBM can be considered a distinct environmental management paradigm with best practices that distinguish it from other resource management paradigms, the goal is to progress on the continuum of environmental management approaches towards ecosystem-based approaches. It is also more important that implementation occurs, and less important what terminology is used—as other approaches such as Design with Nature, Smart Growth, and Ecosystem Services may also help communities to improve social-ecological resilience.

Chapter 4.

Case Description

"Still Creek was a little paradise of a place at that time."

-Henry S. Rowling—one of the first loggers in Still Creek—in reference to Still Creek's condition in the 1800's (MacDonald, 2013).

Figure 4.1: The mouth of Still Creek at Burnaby Lake.
Photo: Author, Nov 2014.

This Chapter describes the case study that I have evaluated and provides context for the Findings and Discussion. In Section 4.1, I outline the geographical location of the Still Creek watershed today, the watershed's natural character prior to urban development, and a brief history of 150 years of development. I also characterize

the evolving nature of the environmental management approach to Still Creek throughout recent history and how it exists today. In Section 4.2, I provide an overview of the current jurisdictional context in the Still Creek watershed.

4.1. Still Creek Watershed

The Still Creek Watershed is a 28 square kilometer watershed located in the Lower Mainland of British Columbia (City of Burnaby, Greater Vancouver Regional District, and City of Vancouver, 2007). It is the largest tributary to the Brunette River basin, which flows into the Fraser River basin. Two thirds of the watershed catchment resides in the City of Burnaby and the remaining one third is in the City of Vancouver (see Figure 4.2) (City of Burnaby et al.).

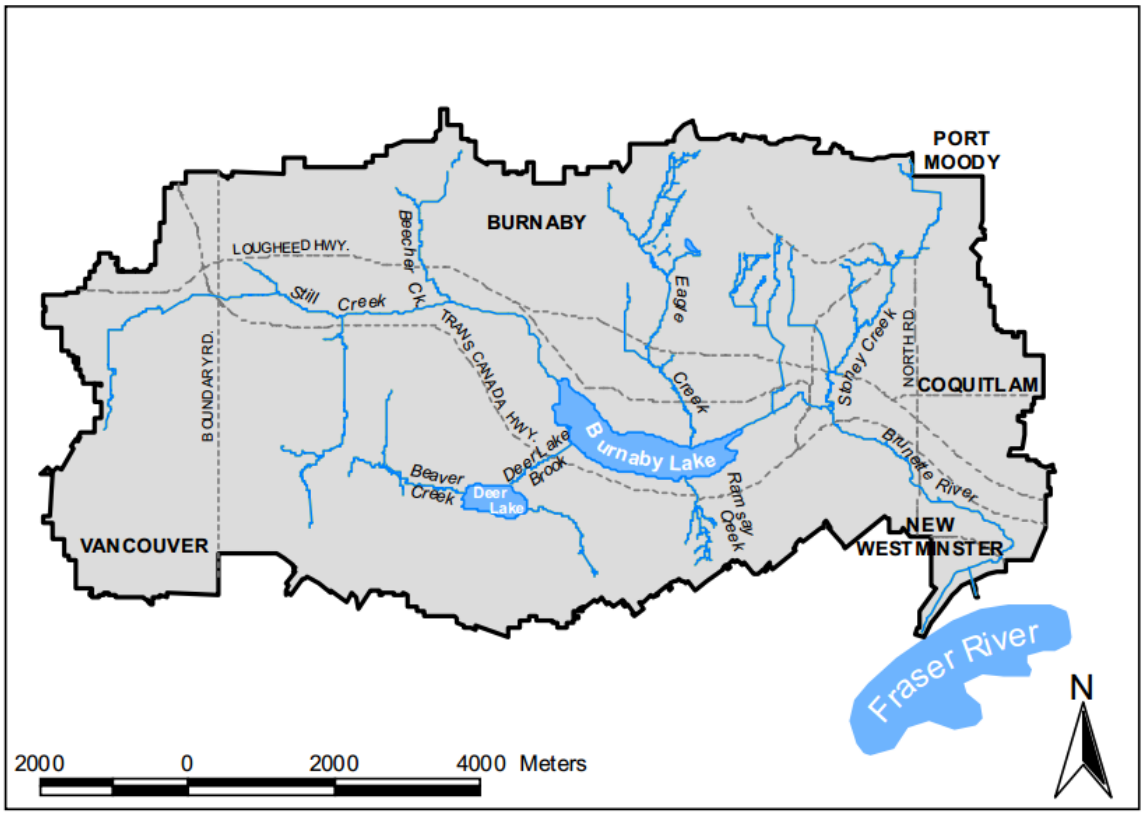

Figure 4.2: Map of Still Creek situated within the Brunette River Watershed.
Source: Greater Vancouver Regional District (GVRD), 2001b.

4.1.1. Present-day Description

Today, the creek begins at Metrotown and flows underground until it emerges aboveground at Renfrew Ravine. It flows aboveground through Renfrew Ravine and Renfrew Community Park but is culverted in some parts (see Figures 4.3 to 4.6 and 4.9) (City of Burnaby et al.). The creek is then piped underground from Renfrew Community Park until it re-emerges at Grandview-Boundary Industrial area (see Figure 4.9) (City of Burnaby et al.). From here the creek flows through a few large culverts but remains mostly aboveground until it reaches its mouth at Burnaby Lake (see Figure 4.1 and 4.10) (City of Burnaby et al.). It is a relatively narrow, fast-moving creek in its higher reaches until it widens and slows near its mouth. Still Creek has various tributaries including Chub Creek, Beecher Creek, and Guichon Creek (City of Burnaby et al.).

Figure 4.3: Still Creek at entry point into Renfrew Ravine. The creek remains underground from its headwaters to this point.
Photo: Author, Nov 2014.

4.1.2. Natural Character Predevelopment

In the 1800's, Still Creek was Vancouver's biggest salmon stream (Proctor, 1989). The stream also supported trout and steelhead (City of Vancouver, n.d.), and provided habitat for many other wildlife. The land around the creek was largely covered

in forests of Douglas fir, cedar, and hemlock trees (MacDonald, 1992). The creek was a wide, flat, slow-moving water body (City of Vancouver). Its headwaters began around 50th Avenue and Royal Oak Avenue in Vancouver (Lees and Associates, Karen Hurley and Associates, Dayton and Knight Engineers, and Hudema Consulting Group, 2002). Towards its mouth, Still Creek was a swampy peat bog (City of Burnaby et al, 2007).

Figure 4.4: Still Creek at north end of Renfrew Ravine.
Photo: Author, Nov 2014.

4.1.3. Development and Management History in Since the 1800's

Still Creek has a complex history consisting of a multitude of management approaches. In the 1800's prior to urbanization, First Nations lived on the land in Vancouver and used the stream to travel by canoe (MacDonald, 2013). The land remained largely forested and did not begin to become urbanized until European settlers started logging the Vancouver area in the late 1800's (City of Vancouver, 2015; City of Burnaby et al., 2007). Logging dams were installed in Still Creek to facilitate movement of logs to the Fraser River for shipment (City of Vancouver, n.d.). Agriculture was also prominent in the early stages of settlement in the watershed. The creek was used as an agricultural runoff drain by early settlers (City of Burnaby et al.). In the early 1900's, a railway line was constructed in the North part of the Still Creek watershed (City of Burnaby et al., City of Vancouver). To make way for the railway, numerous waterways

entering the creek were culverted (City of Vancouver). These early patterns of development paved the way for how the creek would continue to be modified in the next 100 years.

Figure 4.5: Still Creek at Renfrew Ravine near 27th Ave land bridge.
Photo: Author, Nov 2014.

As urban development continued to take place in Vancouver, city engineers adopted a new perspective towards urban waterways (City of Burnaby et al., 2007). Still Creek began to be treated primarily as a stormwater drainage channel. It lost its cultural and ecological significance as a wildlife refuge and functioning ecosystem. Driving this paradigm shift were strong beliefs held by engineers and local government about the utility of the creek. One belief was that the creek occupied valuable space that was needed for built urban structures that would accommodate a thriving region (City of Burnaby; Chan, 2012). Another belief was that the water disposal capacity of Still Creek should be maximized (City of Burnaby et al.). The outcome of engineers and local governments assuming this anthropocentric approach to the creek was that ecological values were forgotten and the watershed slowly transitioned into a human-controlled ecosystem.

Figure 4.6: Culvert that carries water from Renfrew Ravine to Renfrew Community Park (under Boyd Diversion at 22nd Ave.).
Photo: Author, Nov 2014.

In 1914, R.S. Lea, an engineer with the Vancouver and District Joint Sewerage Committee (V&DJSC)[2], proposed a plan and began to modify Still Creek and Burnaby Lake (City of Burnaby et al., 2007; City of Vancouver, n.d.). Lea's idea was to modify the system by increasing its stormwater capacity while accommodating urban growth (City of Burnaby et al.). This work included damming, deepening and lowering the water level of Burnaby Lake (City of Vancouver).

Despite these efforts to fully utilize Still Creek for its natural water disposal function, water management was a major problem in the area. Several major floods occurred in the Still Creek watershed throughout the 1920's and 1930's, prompting further modification to the creek (City of Burnaby et al., 2007). The creek was channelized and deepened to accommodate the high runoff levels caused by increasing impervious surface area in the watershed (City of Burnaby et al.). This work continued through to the 1950's and was simultaneously used as an opportunity to provide employment for men returning from war (City of Burnaby et al.).

[2] The V&DJSC was the predecessor to the Greater Vancouver Sewer and Drainage District (GVS&DD).

Figure 4.7: Culverting Still Creek near Rupert Street, Vancouver
Source: GVRD, 1953

Figure 4.8: Culverting Still Creek near 29th Avenue, Vancouver
Source: GVRD, 1960.

To address flooding and public demand for better flood management, a new plan was adopted by the GVS&DD in the 1950's. A.M Rawn, the engineer behind the plan, stated that "it is proposed that Still Creek be eventually enclosed in suitable conduit from the vicinity of Renfrew Street in Vancouver to the vicinity of the upper end of Burnaby Lake" (as cited in City of Burnaby et al., 2007). The 'Rawn Report' marks a departure in engineering approach from seeing any value in the natural function of nature, to a

system where humans completely control nature (Chan, 2012). From that point forward, much more of the creek was buried (see Figures 4.7 and 4.8). Regulations on development near the creek were very relaxed, and much of the creek and riparian area was encroached upon (see Figure 4.9). Salmon populations disappeared from the watershed in the 1960s and 1970s (McCallum, 1995).

Figure 4.9: Still Creek in the Grandview Boundary Industrial Area (Cornett Rd).
Photo: Author, Nov 2014.

Protection, Restoration, and Enhancement

Attitudes towards urban waterways shifted again in the 1960's and 1970's as environmental issues gained attention. Still Creek earned a significant amount of public attention because of its dire condition (Chan, 2012). In addition to various other ecological and hydrological issues, the creek was severely contaminated with fecal coliform caused by oil spilling and sewer-stormwater cross-connections, warranting health advisories warning against human contact with stream water and sparking investigations to understand and fix the problem (GVRD, 2001a).

Gradually, local government policies began to reflect the changing nature of attitudes toward Still Creek. In 1973, the City of Burnaby—who had retained more of their natural waterways and ecosystems than Vancouver—passed a Watercourse Bylaw which required that Still Creek (and other urban watercourses) remain an open waterway.

Figure 4.10: Still Creek at lower reach (Sperling-Burnaby Lake Skytrain Area).
Photo: Author, Nov 2014.

It was also recommended that public accessibility to the creek be increased. In 1985, Vancouver implemented a similar policy by banning further enclosures in certain parts of the creek. Despite its highly disturbed and ecologically degraded state, Still Creek's value became increasingly recognized in Vancouver as it remains one of the few (partially) open watercourses in Vancouver today (see Figure 4.11).

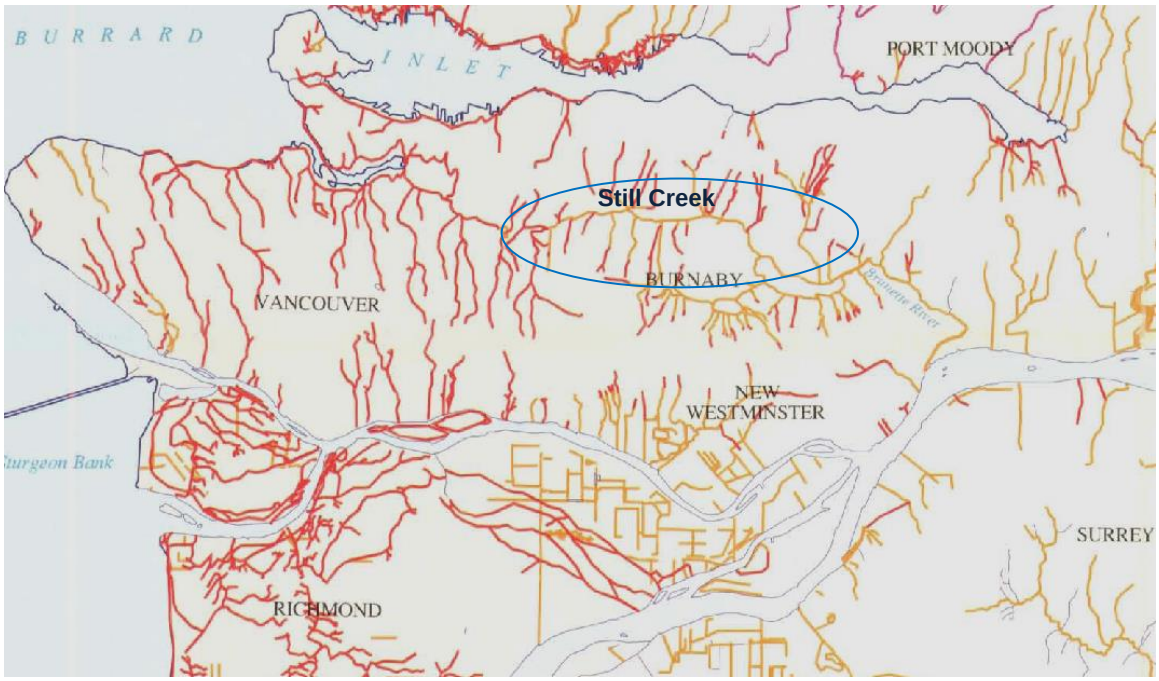

Figure 4.11: Historical and endangered streams of Vancouver. Red indicates the historical location of streams that are now lost (buried) and yellow indicates location of endangered streams as of 1997.
Source: DFO, 1997.

The last twenty years have been marked with significant efforts by the community and local governments to restore stream health and improve stormwater management in Still Creek. There have been several studies conducted on Still Creek watershed that are aimed at improving the condition of Still Creek (see Table 4.1). Restoration efforts have been directed at improving flood management, water quality, biodiversity, and providing recreational access to the creek.

Figure 4.12: Educational signage in Renfrew Ravine Park. Signs were a collaborative effort between Still Moon and City of Vancouver.
Photo: Author, Nov 2014.

A few key studies that I will discuss in more depth include the *Still Creek Rehabilitation and Enhancement Study*, the *Still Creek Integrated Stormwater Management Plan*, and the *Renfrew Ravine and Renfrew Community Park Master Plan*. Many of the studies operate in some way to achieve restoration and enhancement of the creek. In addition to these studies, community and stewardship groups have been active in raising awareness of the importance of watershed health, as well as improving ecological conditions in the watershed. It is arguable that the combination of community and government initiatives in the past 20 or so years indicates a shift to a new paradigm of environmental management in the Still Creek watershed. The new paradigm is moving closer to that of a holistic, ecosystem approach.

Table 4.1: Studies completed on the Still Creek Watershed since the 1990's

Name of Study/Plan	Author(s)	Description
Water Quality and Stormwater Contaminants in the Brunette River Watershed (1997)	Macdonald,Hall, and Schreier. Westwater Research Unit Institute for Resources and Environment University of British Columbia	Measures urban runoff contaminant concentrations and loading
Still Creek Action Plan (1997)	Unknown-unable to retrieve.	Unknown-unable to retrieve.
Brunette Basin Watershed Plan (2001)	Greater Vancouver Regional District	Plan for managing flooding, erosion, and quality of streams in Brunette Basin. Mechanism for Liquid Waste Management in Metro Vancouver
Still Creek Rehabilitation and Enhancement Study (2002)	Lees & Associates, Karen Hurely & Associates, Hudema Consulting Group Limited, Dayton & Knight Ltd for City of Vancouver	Prescribes opportunities and challenges for rehabilitation of Still Creek through Grandview Boundary Industrial Area and Renfrew Ravine
Biological Inventory of Still Creek (2004)	Laura Sampson, Marnie Watson of British Columbia Institute of Technology (BCIT)	Assessed biodiversity along Still Creek corridor based on land use and buffer size. Established baseline data to monitor trends after restoration
Still Creek Watershed Biodiversity Conservation Case Study (2005)	AXYS Environmental Consulting Ltd., Judith Cullington & Associates Prepared for GVRD	Developed a spatial framework for conserving biodiversity in the Greater Vancouver Region
Invasive Plants in the Still Creek Watershed (2006)	Nick Page for City of Burnaby and City of Vancouver	Inventory of invasive plants in the Still Creek watershed. Recommends how to restore riparian plant communities
Relative Abundance and Diversity of Small Mammals along Still Creek, Burnaby & Vancouver, BC (2006)	Cameron Bennett & Laura Wenn, Fish, Wildlife & Recreation BCIT, Burnaby, British Columbia for Fish, Wildlife & Recreation BCIT and City of Burnaby	Surveyed abundance and diversity of small mammals in the Still Creek corridor to monitor biodiversity
From Pipe Dreams to Healthy Streams: A Vision for the Still Creek Watershed (2007)	City of Burnaby, Greater Vancouver Regional District, & City of Vancouver	Organizes actions and provides an overall plan for mitigating flooding, improving water quality, and increasing recreation in Still Creek
Renfrew Ravine Hydrology and Geotechnical Study (2008)	Kerr Wood Leidel Consulting Engineers for Still Creek Stewardship Society	Provides hydrology and geotechnical analysis for Renfrew Ravine Park and Renfrew Community Park Master Plan
Renfrew Ravine and Renfrew Community Park Master Plan (2013)	Vancouver Parks Board	Recommends stewardship strategies for Renfrew Ravine

Note: This list is as comprehensive as possible given the availability of documents and information that is publicly available online and in archives. Some studies may be unintentionally omitted.

Still Creek Rehabilitation and Enhancement Plan (2002)

The *Still Creek Rehabilitation and Enhancement Plan* was developed to generate practical approaches to restoring parts of Still Creek in Vancouver. The spatial focus of the plan was the Renfrew Ravine area and Grandview Boundary Industrial Area (GBIA). The plan identified five sections of the creek within the GBIA and established 10-year and 10-to-50-year Action Plans. Planned actions include:

- widening sections of the creek to accommodate pools or wetland areas; establishing meanders and proper banks
- installing woody debris to create better instream habitat
- creating a grassed or dry swale where creek is entirely paved to mimic its historic drainage path
- establishing native plantings and removing invasive species in the riparian area
- planting shade trees to enhance in-stream cover and streetscape
- installing art to raise awareness and promote watershed stewardship
- building venues for public art to enhance community participation
- daylighting sections of the creek
- creation of wetlands at various points along the creek
- creation of a multi-use pathway
- installing education signs and viewing platforms
- improving riparian habitat and stream complexity through instream installments
- installing porous pavement and green roofs to increase infiltration

To date, the City of Vancouver and Metro Vancouver have completed enhancement work at 2900 Nootka, 3400 Cornett Road, 3003 Grandview Highway, including widening the channel, reconstructing the creek bed and banks, replacing invasive species with native species, installing fish habitat features, and adding seating, pedestrian bridges, paths, and interpretive signage (see Figure 4.13). The city also worked with a developer (Canadian Tire) at 3300 Cornett Road to daylight a small section of Still Creek in that location.

Figure 4.13: City of Vancouver's interpretive signage explaining success of rehabilitation efforts in the Grandview Boundary Industrial Area.
Photo: Author, Nov 2014.

The funding mechanism that made much of this rehabilitation possible was the establishment of the Still Creek/Greenway Enhancement Fund. This fund was established in July 2000 as part of an agreement for the rental of Cornett Rd from the City of Vancouver by Vancouver Film Studios. The rent money is placed directly into the Still Creek/Greenway Enhancement Fund and is to be used for the enhancement of Still Creek.

From Pipe Dreams to Healthy Streams: A Vision for the Still Creek Watershed; Integrated Stormwater Management Plan (2007)

In 2007, the GVRD, City of Burnaby, City of Vancouver, and other collaborators including Department of Fisheries and Oceans (DFO), British Columbia Institute of Technology (BCIT), local residents and landowners produced an Integrated Stormwater Management Plan (ISMP) for Still Creek. An ISMP is a plan that establishes rainwater management, land use, stormwater engineering, flood and erosion protection, and environmental protection goals for a watershed. The mandate for developing an ISMP is given to local governments through both provincial and regional government directives.

The British Columbia *Environmental Management Act, 2003* authorizes local governments to develop Liquid Waste Management Plans (LWMPs). LWMPs are approved by the Minster of Environment. During the development of Metro Vancouver's LRMP, all member municipalities agreed to develop ISMPs for all urban and suburban watersheds.

The Still Creek ISMP establishes strategies and action items that achieve better rainwater management, recreation, and environmental protection for the creek (see Figure 4.14). The ISMP established a formalized plan for the growing interest in improving the ecological health of the watershed. The vision established by the plan was:

> "To protect or enhance the aquatic and terrestrial ecosystems and the human populations they support in an integrated manner that accommodates growth and development (City of Burnaby et al., 2007, Pg. iii)."

The plan identifies several hundred potential actions including agencies responsible for the action. To date, several strategies and actions have been implemented, including daylighting, instream habitat improvements, greenway installment, support for streamkeepers, and watershed education. The plan serves as a guide for local governments and residents working to restore the watershed.

No formal evaluation of implementation success has been completed. As part of the commitment to the original 2002 Liquid Waste Management Plan for Metro Vancouver, municipalities are required to review and update their ISMP's every twelve years, which will be due for the Still Creek ISMP in 2019. However, when the 2002 LWMP was superseded by the new LWMP in 2011, the requirement for a 12-year formal review process was removed. Instead, local governments can take the place of the 12-year review process by including a long-term adaptive management protocol in the ISMP. The Still Creek ISMP did not have an adaptive management protocol built in.

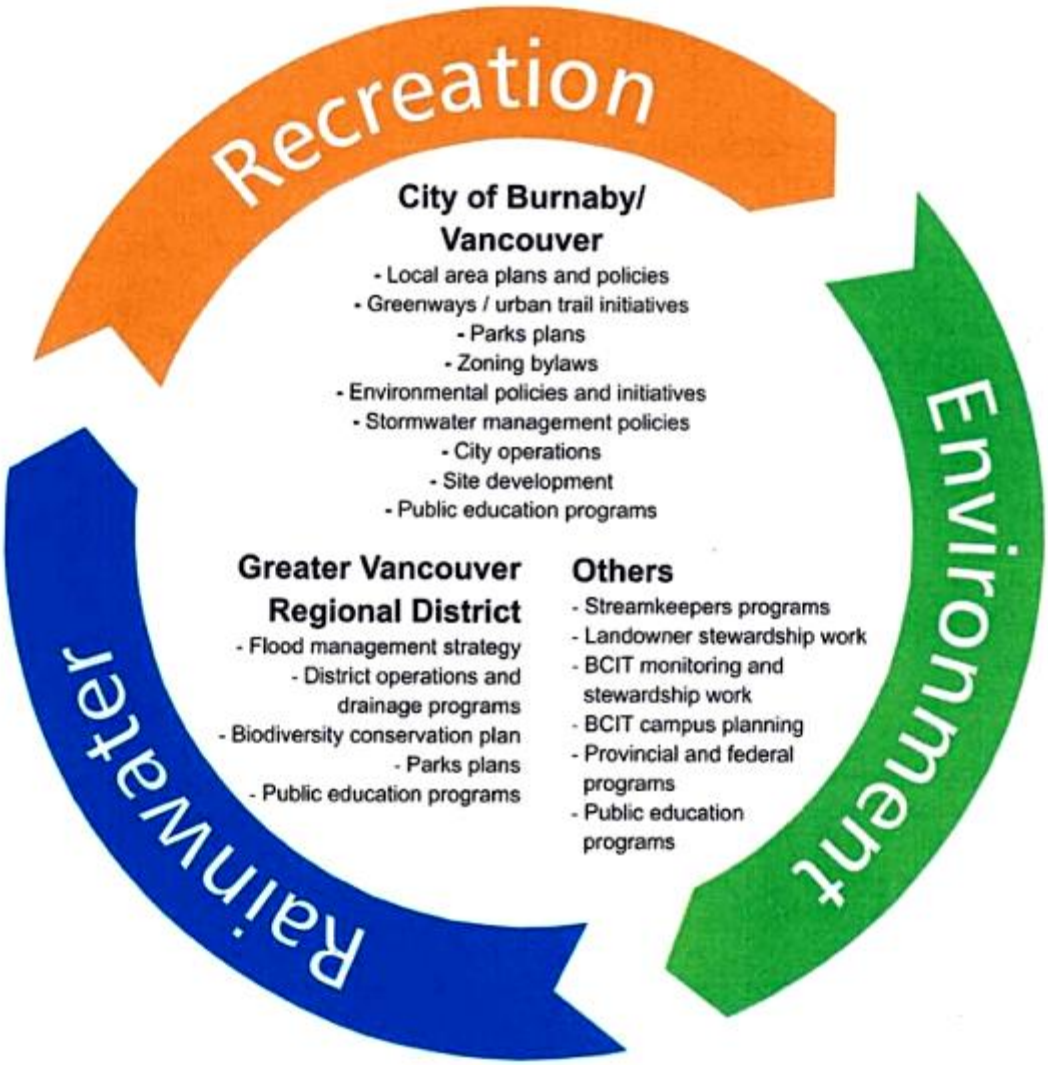

Figure 4.14: Tools for Implementing Still Creek Integrated Stormwater Management Plan.
Source: City of Burnaby et al., 2007.

Renfrew Ravine and Renfrew Community Park Master Plan

The Vancouver Park Board developed a Master Plan to provide recreation and education opportunities and increase access to nature, while also enhancing and preserving the ecology of Still Creek at Renfrew Ravine and Renfrew Community Park. The plan involved public engagement workshops and stakeholder meetings as well as Steering Committee Meetings. Renfrew Ravine is a relatively natural space that supports wildlife and vegetation. Renfrew Community Park is highly developed and features

many amenities including a library, community centre, and sports fields. The plan outlines visions and strategies for improving Renfrew Ravine and Renfrew Community Centre. The plan was approved by the Vancouver Parks Board in September 2013.

Figure 4.15: Still Creek at Renfrew Community Park.
Photo: Author, Nov 2014.

Stewardship Activities

Residents in the watershed have played a large role in shifting the management approach in the watershed. Several of the Still Creek watershed studies conducted by or on behalf of local governments have engaged local residents. The plans for restoration put forward in the studies conducted on Still Creek are reflective of community interests and goals to restore the health of the creek. In addition, stewardship groups such as Still Creek Stewardship Society (now inactive), Still Moon Arts Society, and Evergreen have worked throughout the past few decades to develop watershed awareness and restore the ecological health in the Still Creek Watershed. Activities have included invasive species removal, native species plantings, garbage removal, water quality monitoring, partnerships with local organizations, and community oriented arts events (see Figures 4.12 and 4.16).

Figure 4.16: Community mural painted on bridge at 29th Avenue to raise awareness of Still Creek watershed below.
Photo: Author, Nov 2014.

4.2. Governance and Stakeholders

The complex environmental management history that has taken place in the Still Creek watershed, as described in Section 4.1, is in part a result of the complex jurisdictional context in the watershed. There are several jurisdictional bodies involved in the governance of Still Creek, including federal, provincial, regional, and municipal governments (see Table 4.2). In some cases, jurisdictions overlap. There is also private land ownership along the Still Creek corridor and within the watershed. The large amount of private land ownership has resulted in the formation of engaged environmental community groups who also have an impact on policy outcomes in the watershed. I will briefly describe the nature of the jurisdictional landscape in the Still Creek watershed.

All orders of government are involved in the management of Still Creek. Still Creek is part of the larger Brunette River salmon bearing system and has supported very small salmon returns in 2012, 2013, and 2014. As a salmon-bearing system, it falls under the jurisdictional mandate of both the provincial and federal governments, who are responsible for protection of fish habitat in streams and riparian areas. The federal

government becomes involved through the federal *Fisheries Act, 1985.* The *Fisheries Act* was amended in November 2013. The former Act protected fish habitat including riparian areas from harm through development. The amended Act protects the habitat of commercial, recreational, and Aboriginal fisheries. This directive can and is broadly interpreted. While it is not fully clear how these amendments will affect places where there are limited fisheries (such as Still Creek and other urban streams), it seems to have little effect on the permitting that DFO requires for development near fish-bearing streams (Kerr Wood Leidel Consultant, personal communication).

The provincial government assumes responsibility of riparian and in-stream protection through pollution, water use, and development regulations and laws. Applicable provincial legislation includes the *Water Act, 2000,* the *Fish Protection Act, 1997*, and the *Environmental Management Act, 2003*.

Local governments also hold jurisdiction in the Still Creek Watershed. The regional government, Metro Vancouver, has a legal mandate to ensure stormwater conveyance in Still Creek through the *Greater Vancouver Sewerage and Drainage District Act, 1956.* Metro Vancouver also holds jurisdiction of Burnaby Lake Regional Park. The City of Burnaby and the City of Vancouver, through *the Local Government Act, 1996*, manage land use adjacent to the creek. Local governments might sometimes own property that falls within the riparian area, where DFO and the Ministry of Environment also hold jurisdiction. The Vancouver Parks Board holds jurisdiction of the land in Renfrew Ravine Park and Renfrew Community Park through the *Vancouver Charter, 1953*.

Other stakeholders in the Still Creek watershed include residential, business, and industrial land owners. Many land owners have private property that is intersected by Still Creek, immediately adjacent to Still Creek, or elsewhere within the watershed. Their land ownership in the watershed warrants their participation in watershed governance because they have an impact on total impervious area and water quality in the watershed through actions they take on their own private property. Therefore, private land owners have a significant role to play in the outcome of the stream's restoration. Some local community members have asserted their interests in restoring the health of

their local ecosystem, and through this process, several community non-profit stewardship organizations have emerged.

The complex jurisdictional context and development history in the Still Creek watershed presents an interesting and valuable opportunity to explore the social and ecological aspects of urban watershed restoration. An EBM plan for the watershed will provide an opportunity to address some of the ecological issues in a holistic way. The next chapter presents the findings of this research and helps to describe social and ecological dynamics in more detail.

Table 4.2: Jurisdictional Context in Still Creek Watershed

Order of Government	Jurisdiction	Relevant Legislation	Responsibilities in Still Creek Watershed
Federal	Department of Fisheries and Oceans Canada	*Fisheries Act, 1985* (Section 35)	• Prevent serious harm to fish that are part of commercial, recreational, or Aboriginal fisheries through permitting process
Provincial	BC Ministry of Environment	*Fish Protection Act, 1997* (Section 12)	• Protect and enhance fish habitat • May establish policy directives to ensure protection of riparian areas • Can designate "sensitive stream" status and require recovery plans
		Water Act, 2000 (Section 9)	• Regulate and approve changes to beds and banks of streams
		Environmental Management Act, 2003 (Sections 78, 24)	• Can mandate Environmental Assessment for any development that may cause negative harm to environment • Require and approve Liquid Waste Management Plans
Local/ Regional	Metro Vancouver Regional District	*Greater Vancouver Sewerage and Drainage District Act, 1956*	• Manage liquid waste for region, including stormwater • Manage stormwater conveyance in Still Creek (drainage area)
Local/ Municipal	City of Burnaby, City of Vancouver	*Local Government Act, 1996*	• Own and steward public land adjacent to Still Creek (riparian area included) • Own land and infrastructure in watershed such as roads and sidewalks • Determine overall development patterns in watershed through land use and Zoning • Can leverage Zoning powers to negotiate with developers for restoration/protection of Still Creek in new development or redevelopment applications • May require permitting for environmental protection of streams
	Vancouver Parks Board	*Vancouver Charter, 1953*	• Own and steward public land in Renfrew Ravine Park and Renfrew Community Centre
--	Private Land Owner	*Land Title Act, 1990*	• Comply with land use and Zoning regulations

Chapter 5.

Findings

In this Chapter, I present the findings from semi-structured interviews and document analysis. This Chapter is organized into five sections. In Section 5.1 I begin by reporting on the current ecological condition in Still Creek. Section 5.2 outlines the nature of management and collaboration in most recent years and the role that community groups and local governments have played in collaboration and restoration. In Section 5.3, I provide an overview of the perceived need and usefulness of EBM in the watershed. I also report how historical information is used in watershed management. Finally, Section 5.4 describes challenges and Section 5.5 describes successes that the Still Creek community has experienced to date in attempting to restore the watershed and move to a new paradigm of ecosystem management.

5.1. Ecological Condition in the Still Creek Watershed

Ecologically speaking, Still Creek has characteristics typical of many degraded urban streams, including urban stream syndrome. Its major ecological and hydrologic issues are the result of its interface between the urban built environment and the actions of people living in the watershed. The majority of interviewees reported that the ecological condition in Still Creek is poor, but better than it has been in the recent past. Ecological and hydrological issues in Still Creek include:

- Pollution from urban surface runoff
- Contamination from sewage-stormwater system cross-connections (accidental) and combined sewage-stormwater overflow units
- Household and industrial waste dumping

- Poor vegetative structure and soil structure
- Soil erosion
- Poor biodiversity including high levels of invasive species
- Impervious surface coverage leading to flooding (mainly downstream of Boundary Rd.) and other hydrological issues
- Stream channel straightening and narrowing causing encroachment into riparian area
- Sediment transportation

The amount of waste and household garbage in the ravine is much lower compared to when ravine clean-ups first began in the 1990's. Coliform levels in the water were at one point very high, but have dropped to within the "normal" range for urban creeks. There may be spikes in coliform and nutrient levels from time to time, but generally speaking, levels are normal for an urban stream. Flooding and invasive species are still areas of significant concern. Interviewees noted that the creek appears to be visually functioning at best, but physically it is not.

Figure 5.1: Health advisory sign warning community members that Still Creek water quality does not meet health standards for swimming.
Photo: Author. Nov 2014

Salmon Return

Several decades passed where no salmon returned to the Vancouver section of Still Creek to spawn. In the 2012, 2013, and 2014 spawning seasons, small numbers of chum salmon returned to Still Creek in Vancouver (see Figures 5.2 and 5.3). For example, there were reports of about ten fish returning to Vancouver in November, 2014. The small run of salmon indicates that some positive changes are occurring in the creek, but habitat suitability is still low. There is no conclusive evidence to explain why the return has occurred. The return appears to be more indicative of the removal of physical barriers and fish access issues, and less so a result of a significant improvement in stream ecological health (e.g. habitat quality, water quality), although all improvements have likely contributed to some extent. Coho salmon are an indicator species of good ecological health, but few, if any Coho salmon have returned to the Vancouver stretch of Still Creek. The run consisted primarily of Chum salmon.

Figure 5.2: Chum Salmon return to Vancouver section of Still Creek.
Photo: Author, Nov 2014.

Figure 5.3: Chum Salmon return to Vancouver section of Still Creek.
Photo: Author, Nov 2014.

When interviewees were asked to address the reasons for the salmon return, one prominent reason that was cited was that a 250 ft. long culvert at Highway 1 and Boundary Road was modified to be more fish-friendly. The gradient of the culvert was reduced and baffles were installed to provide resting areas and an easier swim for returning salmon. The Caribou Dam at the outlet of Burnaby Lake on the Brunette River was also a major physical barrier for fish access into the Still Creek-Burnaby Lake system. A fish ladder was replaced with a fishway in 2011 (see Figures 5.4 and 5.5), increasing the potential for salmon to repopulate Still Creek. Some interviewees also mentioned greater ocean survival of salmon as a possible explanation. Ocean survival would increase the competition of salmon for suitable habitat, thus promoting the movement of salmon further up the system to find new stream reaches for spawning.

Figure 5.4: Caribou Dam on the Brunette River with fishway on far right side.
Fishway was installed in 2011. Photo: Author, Nov 2014.

Figure 5.5: Fishway at Caribou Dam.
Photo: Author, Nov 2014.

Flooding in Still Creek

There are several reasons that flooding has become a major issue in the Still Creek Watershed. First, the creek's flow regime significantly changes at Boundary Rd., where several tributaries flow into the creek and the creek widens and slows. The creek

is prone to flooding downstream of this point because of the increase in water and the relatively flat gradient of the creek. Second, 70% of the watershed is impervious (GVRD, 2001a). Watershed imperviousness increases stormwater delivery efficiency, which increases the magnitude and duration of peak flows, leading to greater possibility of flooding (Walsh et al, 2005). Flooding occurred historically in Still Creek prior to urban development because of the boggy nature of the lower reach of the stream. Today, this tendency is intensified by land use patterns (Interviewee 13). Third, the chance of a flood is dependent on the degree of rainfall that the stream has taken on in the days preceding a storm—if several days of rainfall are followed by a large storm event, the likelihood of a flood is high (Interviewee 13).

Figure 5.6: Flood in Still Creek at Willingdon Ave., Burnaby, January 23, 2015.
Photo: Rebecca Seifert.

The ecological condition of Still Creek has improved in recent years; however, there is still a significant amount of ecological and hydrological issues that need to be addressed by all members of the community, including residents and local governments. To understand what actions the collective community needs to take, it is first important to understand the nature of collaboration taking place today.

5.2. Management and Collaboration in the Still Creek Watershed

5.2.1. Role of Non-government Organizations

Still Moon Arts Society

In the 1990's, some residents in Renfrew-Collingwood neighbourhood community were interested in addressing some of the social and ecological issues in their local neighbourhood. Leaders in the neighbourhood recognized that residents lacked a common vision. Not all residents were committed to resolving neighbourhood issues in the same way. Renfrew Ravine was a significant landmark in the neighbourhood, but the ravine and creek were in poor condition and relatively underappreciated. Although some community members recognized the ecological and social value of Still Creek and Renfrew Ravine, a considerable amount of dumping and polluting in the creek by residents took place. Community leaders rallied and began to focus their energy on improving the condition of Renfrew Ravine. Their goal was to reframe the minds of local residents by demonstrating the importance and value of the ravine. After several years of informal environmental stewardship work in the neighbourhood, Still Moon Arts Society (hereafter Still Moon) was established in 2004 by local community members to provide a more formal way of promoting and engaging the community in arts and environmental stewardship.

Since 2004, Still Moon has played a significant role in generating community interest in Still Creek. Through initiatives such as the Renfrew Ravine Moon Festival, ravine labyrinths and mosaics, native gardens, and other community festivals (see Appendix B for explanation of activities), Still Moon helped to build community spirit by emphasizing the beauty and rareness of Renfrew Ravine as a "jewel" in the city. The return of salmon to just beyond Vancouver's section of Still Creek was a major event that sparked even greater interest in the community to work towards improving watershed health. One of the major goals and initiatives that Still Moon is involved in is creating an Ecosystem-based Stewardship Plan for the Renfrew Ravine neighbourhood community. Several Group 1 and 2 interviewees spoke of an increase in involvement of community

members in ecological activities and an increase in ecological awareness of residents in the watershed:

> It's a very positive example of how a community helped to raise awareness about a park and its value to them and their concerns about its condition. (Interviewee 12)

> It's a good example of how community activism or engagement has pushed that agenda forward, protecting what space we do have, and educating people around it. (Interviewee 12)

> I notice a difference in the volunteers. There are more and more people coming back to events. I don't personally live in the Renfrew-Collingwood neighbourhood. But I have noticed less garbage. For example, we restored the southern slope, cleared invasive species out. There aren't piles of garbage there anymore. People walk through and ask what we're doing, so at the least it sparks curiosity and makes people think it might be a special place because people are paying attention to it. It's a whole different level of education for those in the [volunteer] program. (Interviewee 15)

> The nice part about Still Moon is that it's indicative of the fact that a lot of residents are embracing the creek a bit more. I think the time will come where if water quality continues to improve, Still Creek will not only be this great river, this lifeline, but a recreational corridor too. (Interviewee 19)

Still Moon has also played an important role in establishing collaborations between people and organizations in the watershed. A collaboration that has taken place in the neighbourhood is between the Windermere Secondary School Leadership Program and Still Moon. Still Moon has helped to coordinate ecological restoration activities with the high school to educate students and foster environmental stewardship in youth. Students involved in the Leadership Program are given a small restoration project that they tend to for the entire duration of their high school experience, helping them to become stewards of the watershed. A City of Vancouver councillor noted the impact that this collaboration has had on youth in the local neighbourhood:

> Although as a city we look at water all the time—we live on the ocean—if you live in East Vancouver you actually have very little access to it. The sound of moving water actually has a huge impact. People take the time to walk past it, near it, sit by it in ways that I think are surprising in that community. I think the children that have been brought up in the last 10 years or so since it's been daylighted have a total different orientation to

> nature than many other children living in nearby communities that don't have the same opportunity. (Interviewee 9)

Evergreen

Still Moon has also partnered with Evergreen, an environmental non-profit organization that works with citizens to restore urban ecosystems across the Lower Mainland. The relationship between the two organizations has been effective in delivering funding and support to ecological restoration efforts in Still Creek. Group 2 Interviewees acknowledged the important role for community organizations such as Still Moon and Evergreen. An interviewee from Evergreen explained why governments might appreciate the contributions of non-governmental, community-based organizations:

> I think they [local governments] see the value of us, as outreach and engagement. We have resources and staff and they understand our role. Sometimes we make more work for them, but on the flipside, there's an added value of the community caring about a space. With respect to barriers, we don't have the funding or capacity to change the course of the stream. But, we can talk to people about the [Renfrew Ravine] Master Plan. We can explain what it is and why it's necessary and encourage involvement. We have very few barriers because the City [of Vancouver] and Metro Vancouver see the value of our work. (Interviewee 15)

Still Moon and Evergreen serve similar but slightly different roles in the community. Still Moon has motivated the community and brought people together by raising awareness and promoting art and stewardship activities. Evergreen has provided ecological education to the community and supplies equipment for ecological restoration efforts. The overall focus of both organizations in Still Creek has been to deliver watershed education, engage people in watershed stewardship, and improve the understanding of Still Creek's importance among local community members.

There is a strong desire for EBM stemming from the local residents in the Still Creek Watershed. Still Moon has served an important unifying role within the community by emphasizing the need for collaborations. They have also asserted their interest in holistically managing the watershed to local governments, who have been receptive to the idea. Next, I will discuss the role that local governments play in collaborative management of the watershed.

5.2.2. Role of Local Governments

Local governments hold a large degree of responsibility in the management of the Still Creek watershed because they have a jurisdiction or legal mandate to do so. Metro Vancouver's responsibility is to manage stormwater conveyance. The City of Burnaby, City of Vancouver, and Vancouver Parks Board are owners of public land immediately adjacent to Still Creek.

The main opportunity for collaboration so far for these governments has been through the Brunette Basin Coordinating Committee (BBCC), a committee made up of representatives from Metro Vancouver, member municipalities (Burnaby, Vancouver, Port Moody, Coquitlam, and New Westminster), streamkeepers groups, DFO, and the British Columbia Institute of Technology (BCIT). There is no legal role for the BBCC in restoring Still Creek, however, they are given non-legislative authority by committee members and their organizations to advice, make decisions, coordinate watershed activities, and implement the Brunette Basin Watershed Plan. These stakeholders and agencies are also signatories on the Still Creek ISMP. Metro Vancouver provides a strong coordinating role for Still Creek through this collaboration. While the primary responsibility for Metro Vancouver is to ensure stormwater conveyance through Still Creek, they have recently endeavored to improve instream and riparian habitat to return some of the ecological functions back to the creek. One interviewee noted the importance of Metro Vancouver's watershed approach in collaboration:

> In some ways cities tend to operate in isolation, but as far as Still Creek and Brunette River go, there has been a fair bit of interaction. It could always improve, but the reality is you have two City Halls. The nice thing about Still Creek is you've got cities that have both participated in Metro Vancouver initiatives on stormwater. There was interaction on the Gateway Project and how we could use money to enhance environmental values in Still Creek. Both [cities] worked on that. Dialogue is pretty good, and a lot better than 40 years ago. It used to be hard to get people to recognize the problem, but things are a lot better now. Metro Vancouver is really pushing this idea of a watershed plan. (Interviewee 19)

Beyond the BBCC, informal collaborations also exist between local residents (through community organizations such as Still Moon) and local governments. Engagement works in multiple directions. For example, Still Moon holds Advisory

Committee meetings to organize plans and goals for the community's restoration efforts in the Renfrew Ravine section of Still Creek. Local government representatives are invited to participate in Advisory Committee meetings and to offer their insights and support for community driven initiatives. On the other hand, local governments engage with community members to ensure their interests are represented in plans that are being developed by local governments. In general, there is a positive attitude towards collaboration in the atmosphere. However, there are also some significant challenges to collaboration. The next section will discuss the perceived need for EBM, the context within which EBM may be operating, and the challenges that the community has faced in establishing goals, gaining buy-in, and achieving effective collaboration in their ecological restoration efforts in the Still Creek watershed.

5.3. Ecosystem-based Management in the Still Creek Watershed

5.3.1. Why Ecosystem-based Management?

One of the questions that this research attempts to answer is: why there is a strong interest in implementing an Ecosystem-based Management plan in the Still Creek watershed? The hope is that findings will enhance understanding about how community-driven EBM in the novel setting of an urban watershed may improve the experience for other communities and practitioners attempting to implement EBM in other urban contexts. The high degree of enthusiasm for an Ecosystem-based Stewardship Plan demonstrated by the local community is driven in part by the fact that management in the watershed to date is lacking some elements an ecosystem approach and could be improved by a stewardship plan that motivates the local community behind a holistic ecosystem vision. When asked whether EBM is already being practiced in Still Creek, perspectives of interviewees indicate that there may be some efforts that reflect an ecosystem approach, but there is an overall lack of systematic and coordinated planning and implementation of EBM.

> There are environmental warriors doing native plantings that are endorsed by the City, but the challenge is to get everyone pulling in the same direction. The [Renfrew Ravine] Master Plan? I'm fairly positive

> about what they've done. But I think the devil is in the details. (Interviewee 1)

> Yeah. I think of it [EBM] as planting trees along the ravine for soil erosion, and not adding a concrete wall. So yes, small actions have been made towards it. (Interviewee 6)

> I think so. To me it was a new terminology that I hadn't heard before, but it didn't seem that different from some of the previous enhancements, where we tried to take out invasive species, put in boulders, create structure that would allow habitat for fish, bring native species. It seems to be the same stuff. It just didn't have that name yet. (Interviewee 11)

> No. I mean it has not been practiced anywhere so I don't begrudge it, but it's not. It's not practiced anywhere in the city. (Interviewee 9)

> Within the City of Vancouver, I am not sure that there are lots of examples. Well—that's not totally true. On the Burnaby side of Still Creek, a lot more of the stream has been left open. There's the lake for flood attenuation and that. I see lots of potential for it [EBM] to be used, and the Master Plan is a great place to start. What they have planned for the stream itself is great, and vegetation restoration. So I think there's lots of potential not just in Still Creek but in other watersheds as well. You put money into it now and it pays for itself later. (Interviewee 15)

The impetus for introducing EBM in Still Creek originates from the local community's interest in seeing the stream returned, as much as possible, to its natural state. Much of the recent restoration activities have attempted to return the creek to a more natural state, however they have largely been implemented ad hoc. Group 1 Interviewees mentioned the importance of creating a holistic plan that sets the direction for managing Still Creek with ecological integrity as a top priority. An EBM plan would provide the direction for future restoration work in Still Creek that acknowledges the explicit human component in the watershed.

> I just think we've been doing this stewardship stuff for so long. It's a bit frustrating because some things are successful and some things are not. Obviously something worked because the salmon came back this year so we're doing something right among many, many, many other players. We have also contributed to some of that success. But we just need a more concrete action plan that people can see how there plan is important and going to make change and how it affects their lives. (Interviewee 1)

> EBM? I don't know, I would say yes but there could be more [happening], that's what this plan is about. In the past the work has been piecemeal in my opinion. There have been many good things—picking up trash,

> studies, surveys, plantings, education. These things are all great, and lots, of stuff and groups, but up until now there hasn't been a cohesive effort that is really bringing all of these initiates together and saying 'Is this actually what we should be doing? Is this were we should be doing the plantings? What is actually going to make the biggest difference?' Because maybe working in the ravine itself isn't the biggest difference, maybe it's working around it. (Interviewee 4)

> I think what's good with this [Ecosystem] management system that you're talking about, and one of the things that is missing is that we're focusing too much on individual actions and we could be more coordinated. We do well with cities but I think bringing other groups into it could be really good. (Interviewee 14)

Community Priorities

In addition to achieving a comprehensive plan for an Ecosystem-based approach in Still Creek, Group 1 and 2 interviewees identified priority areas for restoration. Re-establishing ecological integrity and supporting the re-establishment of the ecosystem's keystone species were mentioned by several interviewees. Given that the recent return of salmon has drawn attention to the creek and inspired the community, it serves as an important indicator to the community of how successful restoration efforts have been and suggests a great potential for future efforts. Interviewees also noted that continuing to educate and raise awareness in the local community and beyond is an important priority that impacts the long-term success of introducing an ecosystem approach to the community. Daylighting and stormwater management were also priorities.

The Merit of Urban Ecosystem-based Management

The suggestion of applying EBM in an urban watershed can be controversial. One of the central principles that distinguishes EBM from other management approaches is that the management priority is to optimize for ecological integrity. In an urban setting, ecological integrity is mostly already lost through development. Often, and in the case of Vancouver throughout development history, managers of urban areas optimize for development space, which sacrifices natural green space and reduces ecological integrity. It may be challenging to conceive of how EBM principles like ecological integrity could be optimized for in an urban setting where it is already so compromised.

Group 3 interviewees and some Group 2 interviewees who had significant familiarity with the concept of EBM were asked their opinions on whether it is valuable to use an Ecosystem-based approach in the urban setting. Their responses indicate that EBM will likely need to be adapted to suit the urban setting. However, interviewees felt that it is a valuable approach for practitioners who are visualizing, planning, and implementing urban ecosystem restoration. A particular aspect of EBM that makes it a valuable approach for urban settings is the explicit human component, where humans are regarded as an integral part of the ecosystem.

> There is absolutely no doubt in my mind that it makes sense to think of urban systems as ecosystems. If we think of ecosystems as having structure, energy and material, throughput, flows, all of that—it all maps onto urban settings just as good. We talk about all different ecosystems, urban is just another. (Interviewee 18)

> The question is, if EBM is about managing the structure of an ecosystem, what is the goal? It's clearer in other situations… What would be those goals for an urban ecosystem for EBM? OK so we might define it around avoiding extreme states, so for example, New Orleans ecosystem, we would want to avoid aftermath of hurricane. So maybe if they had EBM they would adopt a different strategy around risk assessment with the diking system in terms of extreme events. Most ecosystems are driven by extreme events, so if we were going to take an EBM approach in terms of floods and rivers, fires and insects and forests, we might think about what are the extreme events in urban ecosystems. In Greater Vancouver, we might think about climate change adaptation and Richmond, sea level rise. Or hydrologic systems in Vancouver and drinking water flow from watersheds in the north shore and down into city and outflows. We take a systems approach to that sort of thing. Groundwater or surface flow of streams, but not just as a water management problem, but biodiversity too. There's a bunch of really interesting stuff about urban streams in Vancouver and efforts around culverted streams. Think about bird communities. In some parts of Greater Vancouver, we have some semi-natural areas with great biodiversity. From a landscape ecologic perspective, there are lots of flows between the interface of wild and urban. All of those would be great things to include in an urban EBM approach. So bears and cougars in North Vancouver backyards are not a human safety problem, it's an indication of something about the health of the system that urban systems are butting up against, and the permeability of that interface. (Interviewee 18)

> Yeah. I think that's the only way to look at it. You have to understand what you're managing for. In the urban setting, you're not managing for large megafauna like bears; maybe there are some core areas like Burnaby Lake, but other areas, maybe its bird species. There are other

> indicator species that you're managing for. To really narrow down what you're trying to achieve, set those principles for when to dig your heels in and when to let it go because it's not so important. So I think an ecosystem based approach is really important because you're never managing for one tree, you need to be thinking about the context of what you can/cannot protect, and what's the potential. Is this tree really that important? Maybe we need that area for a utility corridor or something. Can we get compensation on a 2 to 1 basis somewhere else? You need to pick your battles and understand the context. Principles are slightly different in urban setting. You're not looking for blocks of habitat and the corridors, although rural (forestry) those are important, but you've still got stuff in between where species could exist. In the urban setting, it's desert and then something else, unless you're a bird. (Interviewee 8)

If EBM is to be realized in Still Creek, there are several issues that the community and local governments need to address. It will be imperative to collaborate and identify the priority issues and the most valuable components in the Still Creek watershed.

5.3.2. View of Ecosystem-based Management

The majority of Group 1 and Group 2 interviewees acknowledged that their understanding of EBM was relatively limited. Several Group 1 interviewees noted that they had first heard of EBM through their involvement with Still Moon Arts Society and the Still Creek Ecosystem-based Stewardship Project. When asked to provide a definition of EBM, nearly all Group 1 and 2 interviewees provided a definition that incorporated some concepts reflected in the definition given by Grumbine's (1994) seminal paper.

> Basically what I know about it is to try and take an urban forest or natural place back as far as you can to its original state, something like that, that's what I know about it. Because it's hard to take something back 100 years ago but take it back as far as you can. (Interviewee 2)

> There are many different ways a place gets used. With Ecosystem-based Management, you still have those activities taking place, but the first question you have to ask is what about the health of the environment? (Interviewee 1)

> The primary lens through which we look at things, the first lens, not the last lens, is how we can do it from an ecosystem perspective. (Interviewee 1)

> I see [EBM] as meaning planning based on maintaining as much as possible of the natural system without prioritizing our urban needs. (Interviewee 6)

> My definition [of EBM] would be taking care of a particular area by thinking a bit more holistically than we might in other situations. Just taking a broader picture of all the different pieces and how they fit together and how one affects another. So when you're doing things one way you are doing that because it will have some other kind of positive impacts later or some back loop. It will have bigger impacts later, or the other way, removing a negative impact because you realize it fits into a bigger picture in the ravine and also the surrounding communities. (Interviewee 4)

> I haven't heard of the term before but it could mean two things. It could mean sort of managing and profiting from the ecosystem. On the other hand, Ecosystem-based Management could be coming from an ecology centric perspective, so what's good for ecology is good for humans, rather than what's good for humans is taking from ecology. (Interviewee 3)

It is apparent that understanding of EBM is relatively introductory for Group 1 and 2 interviewees. Needless to say, there is a strong community interest in pursuing an Ecosystem-based approach to management in the Still Creek watershed. This finding indicates a desire to improve the current management approach in the watershed.

5.3.3. Collection and Use of Historical Information

Historical information can help environmental managers to identify historical baselines of ecosystem form and function and the degree to which an ecosystem has departed from its original function. If historical information is not used by environmental managers, there is a risk that managers will perceive the function of an ecosystem to be as they have witnessed it in their lifetime instead of how it existed prior to major human disturbances—a phenomenon often referred to as "shifting baselines syndrome (SBS)" (Papworth, Rist, Coad, and Milner-Gulland, 2009). Another way that SBS may manifest is through memory loss, where within a person's lifetime, they may forget environmental conditions that they witnessed in the past (Papworth et al.). SBS is an issue because it results in a lowering of environmental standards over time (Pauly, 1995). In an urban setting, this could be detrimental because each new generation of residents and

environmental managers may operate under socio-ecological conditions that are less diverse and resilient than the previous generation (Folke et al., 2004).

In the Still Creek watershed, historical information is obtained from archived photos, stories, and reports that the local governments and community centres have archived. Elderly community members who have lived in the Still Creek watershed for many years are also sources of historical knowledge, although many have passed on. One of the projects that Still Moon has begun is *Still Creek Stories*, a book compilation of community memories of Still Creek. Still Moon is also planning to create a website that will house studies, stories, and scientific information about Still Creek's past and present. Thus, historical information about Still Creek is a mix of anecdotal and scientific information.

> So mainly historical information comes from small anecdotes and publications. Less and less is available as people pass on. (Interviewee 11)

Historical information is mainly used to educate the local community about the historical character of the Still Creek Watershed and the degree to which it has been altered by human development. This information is shared through historical walking tours, volunteer restoration events, interpretative signage, newsletters, and other community events.

> I don't know how much the city uses it. We use it a lot in our education. We usually talk specifically about the ravine, it's logging, how the vegetation used to be, how the stream wouldn't have had rock walls, no houses. Also talk about how the stream would have been if so much of it wasn't in culverts, and what it means to have so much of it paved, for fluctuations, what it means for habitat, morphology. I think Still Moon relies on that information; it's at the core of what they are doing. They really try to bring to light where the stream was, what it was for people. (Interviewee 15)

Interviewees from local governments indicated that historical information is used to provide some context to their work, and in some cases, is used as a reference baseline. However in other cases, historical information can have relatively little bearing on the outcome of restoration plans because some managers feel that it is too unrealistic

to attempt to restore the watershed to its original character, given how much the condition of Still Creek has changed.

> We were going to do some interpretive signage that would help people to understand the pre-existing condition and the desire to as much as possible recreate that. (Interviewee 12)

> I use it for context. There is a presentation I threw together for development sites. It's where I start. I have one presentation on the development site. I usually use it on a big site when there are good opportunities for restoration. Colleagues use it, and development team use it. It provides context for the Official Community Plan, this plan [Burnaby Environmental Sustainability Strategy], and some of the things that came out of the Still Creek strategic plans. I also like to situate it in the larger context as well—larger ecosystem issues and how we're connected to those areas. I walk them [developers] through the historical context and try to get other people thinking about what used to be here. I think the message is that we aren't trying to recreate the past. We can't go back in time but it still provides a useful reference and that's something I try to bring to my work. We can't go back to that to that but we can still use it for guidance and what components we could recreate. We won't get all wetlands back but maybe on a particular site we can get some wetland back and use knowledge of what plants used to grow there as a guide for planting and have ideas of native species. For hydrology and function, the watershed context is really important. Some sites we look at are high up in the watershed, historically that would have been a location important for groundwater recharge or ephemeral streams, so we don't want to recreate lake or wetland in that situation but it can guide the function of landscape design and show how its developed and how we can manage can water flow. Burnaby is at the bottom of Still Creek. We're more interested in cleaning the water as opposed to stormwater or groundwater recharge function because we're already down at the bottom of the watershed. It gets people thinking beyond development and to more of a landscape context, rather than oh it's just a development site, it's just a ditch. Well it's not just a parking lot with a ditch. How can we make progression back to something healthy? (Interviewee 7)

> No we don't seek out what it [Still Creek] used to be like to move forward. We look at what we have now and do what we can to make it function. We can't go back to what it was like 100-150 years ago just because the creek is not even where it used to be, the whole creek is a manmade channel at least from Boundary Road down to Burnaby Lake. (Interviewee 13)

The overall trend in responses indicates that interviewees feel it is unrealistic to plan to restore the creek to its original function. Restoring some of the natural functions of the creek is a more achievable goal (Interviewee 18).

5.4. Challenges in the Still Creek Watershed

Previous sections highlighted the context within which the Still Creek community is considering an EBM approach to restoration of the Still Creek watershed. Within this community context, there are also several challenges that will require careful consideration and collaborative problem solving from local governments, the local community, and other interested parties. These include navigating the physical barriers to restoring an urban watershed, balancing conservation goals of stakeholders, gaining greater buy-in from stakeholders, establishing more effective collaborations, planning across multiple spatial scales, and finding a way to help local governments see EBM as an opportunity as opposed to another responsibility that they do not have the capacity to fulfill.

5.4.1. Physical Feasibility in Urban Setting

A significant challenge for urban EBM will be to decide a reasonable vision for urban ecosystem restoration given the physical constraints of a highly developed watershed such as Still Creek. Is it possible to restore the functions of this urban ecosystem? What should the targets be for reducing watershed impermeability? Is it possible to daylight the entire stream? Is there any way to provide the appropriate space for the riparian area along daylighted sections of the creek? As I have discussed in previous sections, there is a perception that EBM will need to be modified in the urban setting due to the extent to which ecological integrity has already been lost. However, interviewees' perceptions of what is physically feasible were not unanimous. While some interviewees noted that daylighting the entire span of Still Creek is geographically and politically very challenging and unlikely, others felt that it was a high priority. Similarly, one interviewee raised the question of whether it is reasonable to attempt to remove invasive species entirely from the riparian area of the creek and the forested area of Renfrew Ravine. Given the rate at which invasive species repopulate an area, the tolerance they have relative to native species, the current extent of their habitat in Still Creek, and the amount of person power and financial resources required to solve the issue, it may not be a realistic goal. Community groups, on the other hand, have already spent a significant amount of time attempting to remove invasive species from

the watershed. It will be important for the community to consider what actions will yield the greatest results given the limited resources—and in particular, financial resources—that they do have.

> The problem with Still Creek is there's nothing really left to preserve in certain areas. It's far-gone other than Renfrew Ravine, less so Renfrew Park, and there's not much area left other than when you get down to Burnaby Lake. So now it's more like 'What can we re-establish? What are the limits of what we can re-establish?' With the tiny little right-of-ways, it's really tough. (Interviewee 13)

> I suspect it's almost nothing like it originally was. Right now it's only alders. I think it was logged 150 years ago. You can still see cedar stumps. So in terms of returning to some old, what-it-was-before state, in a way that might be very naïve or impossible and not even desirable. Is that what we really want? I think it's important to think about what it was before but it is nothing how it used to be. This place was covered in old-growth forest and now we're sitting in a library. But even that, do we think we can make this tiny piece what it was before? I don't think so. So I think what is important to me is maybe a little different in urban versus rural EBM, there's a different way to think about it. The best we can do is incorporate these natural things into our cities. It is a stormwater conveyance channel. It always did that but not in such an intensive way. (Interviewee 4)

> It has to come along at the right time. You can't go in there and knock down a building. It has to be the right time to do replacement. For example, infrastructure is failing, there's erosion, a change from industrial to residential neighbourhood. You have to take advantage of a natural rotation. There's some bigger issue that triggers it that asks where you spend this limited amount of money. It tends to be spent smartly on what's causing the grief, what's going to get you the most for what you put in it. At the individual level people know what's going on. (Interviewee 20)

5.4.2. Balancing Conservation Goals

The Still Creek watershed is both a recreation corridor and a natural space that supports wildlife. During the Master Planning process for Renfrew Ravine and Renfrew Community Park, there was significant deliberation around whether there should be improved trail access to the creek in Renfrew Ravine. The concern with introducing a formal trail system in Renfrew Ravine was that it would cause overuse and ecological degradation. The Central Valley Greenway provided some increased access to Still

Creek, but arguably encroaches too far into the riparian space the stream requires (Interviewee 19). A challenge that the Still Creek community will continue to face is finding a balance between human use and protection of the stream's ecological integrity.

5.4.3. Buy-in

Complete buy-in has been and will continue to be a challenge for community members and local governments interested in restoring Still Creek and implementing an EBM Plan. Politically speaking, local governments are limited in resources and capacity and hold many responsibilities to their entire population base. Still Creek is not necessarily the City of Vancouver's top priority for funding and planning.

> I have been here for a long time, so there have been different council and city mayors. That really plays into it. If there's pressure from the community to the politicians that sometimes will make things happen. It's also been a bit of a changing time for the city. We have been a growing city, we had the economic downturn in 2008, and also the management style at the City has changed. Still Creek hasn't really been a priority. The [Still Creek Rehabilitation and Enhancement] Plan is done and we are chipping away at it as we can, but it's not really high profile. (Interviewee 11)

> Their [Still Moon's] vision would be to daylight the whole creek. The challenge is there are houses on top of it and pretty important transit and infrastructure. Given our housing issues in the City, we probably aren't going to take out a house to daylight a stream. (Interviewee 9)

> It's such a good idea [EBM in the urban setting], I think I met with [Still Moon] last year maybe, and I was like I just don't know how you do this …At the same time, these are fantastic ideas, and we should explore them more. Either exhaust them as a possibility or figure out what we can do with this. And maybe a hundred years from now, it is a perfectly balanced ecosystem. But it's not happening tomorrow or next year. So we talk a lot about gap management like 'this is where we want to go, this is where we are, what is the next step to get us to EBM. (Interviewee 9)

Interviewee 9 pointed out that private property ownership will be a significant barrier that could hinder stream restoration efforts. Some interviewees noted that there was some resistance to restoration and daylighting in Still Creek by local businesses in the Grandview-Boundary Industrial Area whose properties are immediately adjacent to the creek. The concern for local business owners is that restoration and enhancement

will encourage more foot traffic and recreation in the stream corridor and increase security issues for the business properties.

Many interviewees from Groups 1, 2, and 3 feel that local residents in the Renfrew-Collingwood neighbourhood have an increased awareness of the Still Creek watershed and some of the issues it faces. However, there are still significant gaps in awareness. There are instances of dumping and pollution. There also tends to be cultural barriers (such as language), misconceptions about the potential dangers of a large forested ravine, and a lack of appreciation for nature by some local residents. Thus, more education is required to unite the community behind the EBM vision.

5.4.4. Challenges with Collaboration

Collaborators in the Still Creek Watershed have successfully coordinated a range of restoration activities. Several interviewees mention that there seems to be greater cohesion between those involved in restoration activities, that there is greater trust and credibility established through some of the recreation successes, and that activities feel harmonious in this watershed. However, interviewees also mentioned several issues pertaining to collaborative management in the Still Creek watershed.

One of the major challenges mentioned by interviewees in Groups 1, 2, and 3 is the dealing with political and bureaucratic limitations. These limitations include navigating priorities of politicians and bureaucratic and jurisdictional complexities in the watershed. Given that interviewees in all Groups mentioned this challenge, it is worthwhile to consider why this challenge exists, and how it can be mediated. The following quote illustrates how an interviewee perceived challenges with collaboration in the watershed.

> Still Creek has all the tributaries, which is potentially an issue, because Metro Van has a mandate over Chub creek (Still creek north branch) and the main stem of Still Creek. Whereas City of Vancouver has responsibility of all the tributaries that come into Still Creek that Metro Vancouver has no mandate to do anything on, those are the City's responsibility. So we don't even have a coordination role on those creeks. In fact we don't even know what's happening with those creeks. (Interviewee 13)

This point highlights the challenge that local governments are facing in managing the Still Creek watershed. Metro Vancouver is interested in managing urban streams with a holistic watershed approach but do not have the jurisdiction or coordination roles in small tributaries entering the Still Creek and Brunette River systems. This raises complex challenges when attempting to manage human disturbances to the main stem of Still Creek when its tributaries may not be monitored at all. Other interviewees noted similar scenarios where management starts and ends at political boundaries:

> This particular project with Renfrew Ravine and Renfrew Community Park [referring to the Master Plan] is parkland. That's park boundary, so yeah. But certainly we are part of the Still Creek Enhancement project undertaken by the City of Vancouver. So we've worked with city departments related to it. But we are not looking beyond it [Renfrew Ravine and Park], we are saying we want to make the creek healthy in that section so that it will make the creek healthy in other sections downstream too but that's the limit of this project is the boundaries of this park. (Interviewee 12)

> For example, when Metro Vancouver was thinking about a sediment retention pond, they were also looking at doing something in Burnaby. They met with us to say these are the things we are looking at doing. One is upstream, one downstream. That will have an overall impact on the system. In terms of Burnaby or Metro Vancouver being involved in a specific site activity that we do—Metro Vancouver for sure, but Burnaby not so much. (Interviewee 11)

> Unfortunately, there's not a lot of interaction and I don't even have a contact in Vancouver about the stream…I wish we had a bit more cross-boundary stuff going on. Part of it is just capacity, I just don't have a lot. Sometimes it is a bit of a wall. (Interviewee 7)

Interviewees from Group 1 noted how challenging it can be to navigate the bureaucratic structures in place in order to achieve their goals of restoring Still Creek and making their community a better place. When asked about working with local governments, a representative from Still Moon commented on some of the challenges:

> Cities have silos in that they don't talk to each other. There are many things going on that makes it complicated. There are all sorts of players, all sorts of agendas. Greenest City Vancouver has to still be friends with the stormwater management sewer guys. So all those players have to be on the same page in order to make things happen in Still Creek that are positive. The stormwater management guys and engineering are really annoyed by some of the Greenest City Initiatives of the city because it

> wrecked the way the world is doing things. You have to find ways to make it win-win-win. Everyone has their own power systems. How much hassle is it going to be to change their systems? (Interviewee 1)

Interviewees in Group 2, and in particular, local government representatives, noted that stewardship has been a very important aspect of restoration efforts in the watershed. However, their role in the collaborative efforts has not been consistent throughout the years as some community groups experience burn-out. The Still Creek Stewardship Society dropped out of their role in the collaboration. While it does not seem likely Still Moon Arts Society will do the same, it is a challenge for local governments to manage the dynamic nature of community interests.

5.4.5. Spatial Scale of Analysis

An interesting finding in this study is that there tends to be different scales of spatial focus depending on who is discussing the Still Creek watershed and what their relationship is to the watershed. The regional government considers Still Creek to be part of the Brunette River Basin watershed system. On the other hand, interviewees from Group 1 and some interviewees from Group 2 referred to Still Creek with hardly any reference to the larger Brunette River system. This difference in spatial scale of focus will challenge the collaborative aspects of an Ecosystem-based approach in the Still Creek watershed.

5.4.6. Is "Ecosystem-based Management" a new name for the same old concept?

One of the issues addressed in the literature is whether the concepts behind EBM have already been employed in environmental management, but had been called something different, such as Design with Nature or Smart Growth. This point was also mentioned by a few interviewees. For example, one interviewee noted:

> Pick your name. It usually means someone has come up with a new name for the same thing and is trying to take credit for it but when you follow it back to the source, it's all about managing runoff. (Interviewee 20)

Another interviewee noted why this issue could potentially be a significant challenge for the Still Creek community to reconcile. Local governments are constantly being presented with new ideas or new ways of achieving the same goal. It can be overwhelming for local governments to begin to try to implement another new approach when they are limited in resources and capacity.

> People don't connect the dots if they aren't even talking to each other. There's not too many places where they encourage integrated themes. Everybody in local government is overworked. Seventy percent of what they do is coming in from the public and they have to process it. So they don't have time. They are always responding to the person at the front desk. There's not much time for 'yes, let's have an EBM Approach.' (Interviewee 21)

This participant later explained how it might be feasible for urban governments to adopt practices of EBM:

> If they have to do it, if there's a regulatory requirement, you can remind them of that, and say here's how you get there [EBM]. Make it simple. It has to be simple. How do you take a complex idea and make it simple. (Interviewee 21)

The result of presenting a new concept to governments that are already experiencing issues with capacity might be that they reject the idea because it is not simple enough to implement. However, tying a new governance tool to a regulatory requirement may be an excellent way to help governments see how the tool can help them fulfill their responsibilities.

The formative stage of EBM in the Still Creek watershed has helped the community to begin to reframe their approach to nature. The shift has also been met with challenges that indicate the community has a significant way to go in implementing EBM. Capitalizing on the momentum of successes might help the community to move closer to implementing EBM in the Still Creek watershed.

5.5. Successes in the Watershed

Still Creek has a checkered history with several distinct phases of environmental management. A significant shift in management approach occurred in the 1960s-70s, and momentum continues to grow as local residents continue to become more aware of the importance of the watershed. The Still Creek community, including local governments and non-profit organizations has achieved many successes in restoring the watershed. Table 5.1 highlights restoration successes in the Still Creek watershed.

The evolution of environmental management approaches in the Still Creek watershed in the past 150 years has been driven by complex social dynamics in combination with degrading ecological conditions that have driven social change. In this chapter I have characterized ecological condition in Still Creek, collaboration among stakeholders, community interest and understanding of EBM, and successes and challenges of restoration and management of the Still Creek watershed. These findings provide valuable insights into how the Still Creek community can better integrate an ecosystem approach into their watershed management plans in the near future. Chapter 6 will discuss how the community can address challenges and leverage successes to achieve better integration of social and ecological dynamics into their future restoration and management plans, and how this case study can serve as an example for other urban communities attempting to implement EBM.

Table 5.1: Restoration Successes in the Still Creek Watershed

Success	How Achieved
Improved Ecological Condition of Still Creek	• Reduction in pollution and dumping • Improved car technology • Development mechanisms (required ecological compensation on new development and redevelopment) • Funding mechanisms established (Still Creek/Greenway Enhancement Fund) • Increased awareness of watershed existence and watershed health • Shift in management approach including policies (e.g. Open Watercourse policies) and actions (e.g. habitat enhancement, daylighting) • Invasive species removal and native species planting
Return of Keystone Species (salmon) to Ecosystem	Several reasons postulated: • physical barriers to fish migration reduced • water quality improvements, greater ocean survival • habitat enhancements • shift in management approach
Greater watershed awareness	• Community collaboration • Grassroots leadership in recognizing, appreciating, and caring for local watershed • Recognition of creek's importance and interest in creek's health from local government
Long-term vision for Ecosystem-based Management established	• Increased community awareness • Collaboration within local neighbourhood • Collaboration between local community and other organizations and community groups • Collaboration between local community and local governments
Collaborative management of watershed	• Stewardship activities supported • Complex jurisdictional context forcing recognition of need for collaboration

Chapter 6.

Discussion and Recommendations

Chapters 4 and 5 introduced the Still Creek case and outlined experiences that the community has had so far in reconnecting with their local watershed and stream after decades of ecological degradation. Beyond efforts to restore the creek with varying degrees of coordination, the community's keen interest in introducing EBM and early attempts at doing so provide an opportunity for studying the potential usefulness that it can offer to urban ecological restoration. This chapter will discuss the current status of EBM in the Still Creek watershed, recommendations for addressing implementation challenges, and opportunities for leveraging community successes.

6.1. Presence of EBM in the Still Creek Watershed

A good starting point for understanding the usefulness of EBM in the Still Creek case is to determine the degree to which ecosystem-based practices and perspectives have been utilized to date. Gaining this perspective will help to identify which aspects of EBM have not been realized and how a formalized plan of action can help the community to better implement EBM.

Section 2.2 and Table 2.2 highlighted how the EBM perspective differs from other resource management paradigms because it encourages a systems approach, multiple scales of analysis, long-term planning, integration of humans into our understanding of ecosystems, adaptive management, and sustainability of ecosystem services. Table 6.1 provides an evaluative summary of the extent the EBM approach and perspectives in the Still Creek watershed.

Table 6.1: Presence of the EBM approach in the Still Creek Watershed

EBM Perspective	Extent of Perspective in Still Creek Watershed
Ecosystem perspective as opposed to species perspective	• More emphasis placed on value of intact, healthy watershed now than past management of watershed through early- and mid-1900s • Large focus on keystone species due to their recent re-inhabitation of creek in Vancouver; salmon return an inspiration to community
Multiple scales of analysis and planning as opposed to small spatial scales	• Jurisdictional complexity has created silos and lead to smaller scales of focus for municipal governments • Collaboration that occurs on a wider watershed scale with Brunette Basin Coordinating Committee is positive but limited in scope o Could be improved through a greater commitment to restoration of Still Creek watershed by action on multiple scales • Capacity of local residents and property owners to act and make change is restricted to small spatial scales, either through action their own properties and ad hoc stewardship activities
Long-term perspective and planning as opposed to short-term	• Some attempts at long-term visioning through ISMP and Still Creek Enhancement Plan • General lack of consistency and clarity in visions for long term watershed restoration
Humans as integral parts of ecosystems as opposed to humans independent from ecosystems	• Perceived improvement in residents behaviours' towards watershed (e.g. stewardship events, partnerships and activities to improve ecological conditions of watershed, decreased dumping and pollution, more opportunities for recreation and appreciation of nature) • Efforts to control nature still present through dammed and culverted parts of creek although there have been some attempts to reduce these aspects of the management regime through daylighting and naturalization • Large focus on what humans can gain and lose from the creek (e.g. how flooding impacts humans, how creek can provide recreation, etc.)
Adaptive management as opposed to management divorced from research	• Infrequent, informal monitoring of water quality and other forms of data collection • Lack of formal evaluation of plan implementation and restoration success • Some use of historical information but mainly for public education, not necessarily used enough to guide restoration
Sustained production potential for ecosystem goods and services as opposed to managing commodities	• Difficult to evaluate/quantify sustainability of ecosystem goods and services because no valuation or quantification of ecosystem goods and services has been done in this watershed • Commodities in this case are recreational access to creek as well as liquid waste disposal services

Note: EBM perspectives are taken from Sherman and Duda, 1999; UNEP, 2006.

The Still Creek community is moving towards an ecosystem-based perspective. Local governments, stewardship groups, and local citizens have all been part of establishing an ecosystem perspective, recognizing the role that humans play in watershed health, collaborating, and planning at multiple scales and for long term change. However, there is still significant progress to be made. One aspect of the ecosystem management approach that has not been extensively adopted in the Still Creek watershed is adaptive management. Water quality testing and other forms of data collection have not been institutionalized. Implementation of restoration and watershed management plans such as the Still Creek ISMP has not been formally evaluated, making it difficult to evaluate improvements and adapt to new challenges in the watershed. In addition, human activities dominate the ecosystem form and function and cause significant impacts. Restoration planning may occur on multiple scales but can often be uncoordinated.

With respect to the continuum of environmental management regimes, the Still Creek case exhibits characteristics of a management approach that borders on *Multiple Use Resource Management*, *Environmentally Sensitive Multiple Use,* and an *Ecosystem Approach to Resource* Management (see Figure 6.1). This course scale evaluation of place on the environmental management paradigm continuum is not representative of individual actions. Rather, it summarizes the overall direction of environmental management in Still Creek. Environmental management regimes can at times be better represented on continuum because it is more reflective of the dynamic nature of social and ecological dynamics in ecosystems (Yaffee, 1999). In the Still Creek watershed, there are many stakeholders and a multitude of human activities. The characterization of the environmental management regime in the watershed needs to reflect this dynamic setting. Generally, however, there is still a largely anthropocentric approach in the watershed because it is dominated by human activities.

The Still Creek community has indicated a strong desire to implement EBM. Understanding where the Still Creek watershed is positioned on the environmental management continuum is the first step in understanding how community goals are being met and what attributes of the environmental management approach need to change in order for EBM to be realized. The principles of EBM have only been partially

implemented because there are several barriers that are impeding progress. I will now turn to a discussion of the barriers that need to be addressed in order for the Still Creek watershed community to continue in the direction of EBM.

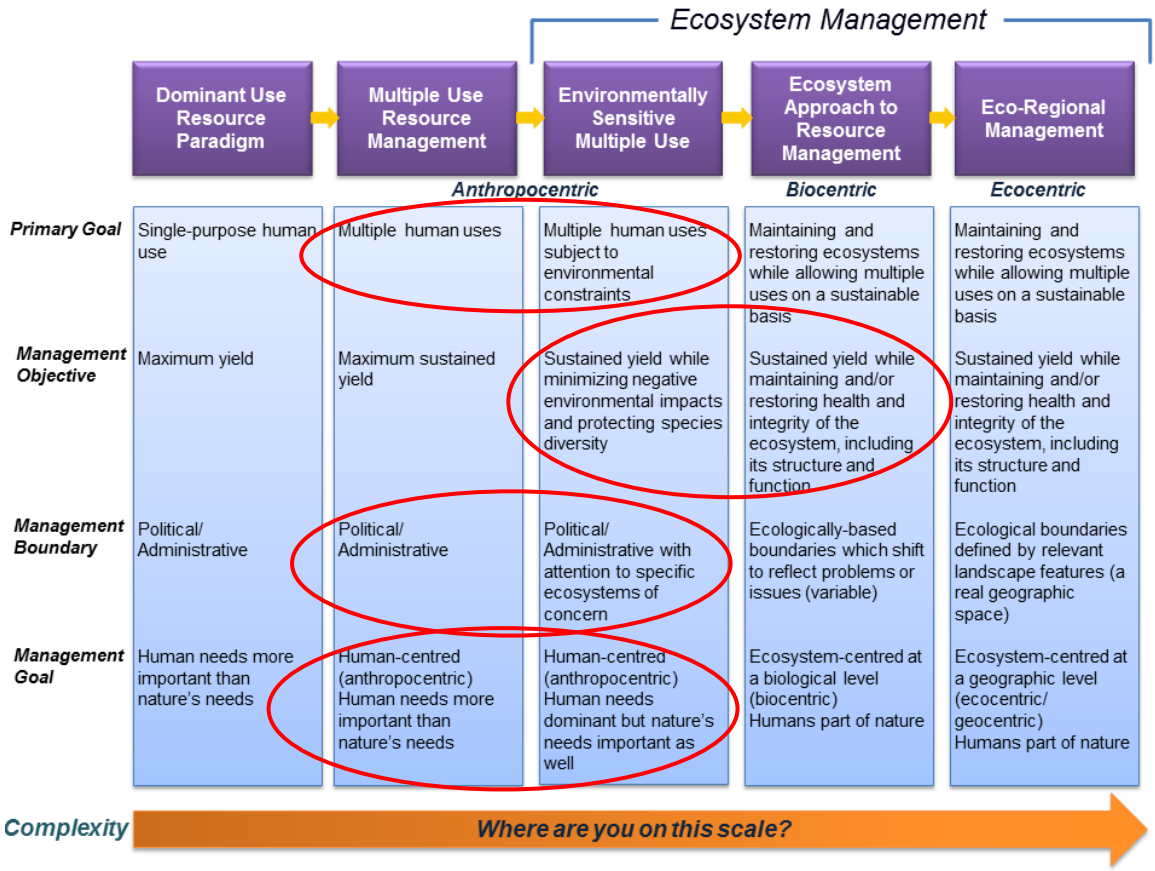

Figure 6.1: Evaluation of Still Creek on the resource management Continuum
Note: Figure is adapted from Leech, Wiensczyk, and Turner (2009) and Yaffee (1999).

6.2. Addressing Challenges in the Still Creek Watershed

Important to the discussion of improving environmental management is addressing the challenges that prevent communities from achieving their watershed management goals. Often, the challenge with implementing EBM is that there are institutional, policy, science-based, and management barriers that impede its implementation (Leech, Wiensczyk, and Turner, 2009). The challenges outlined in Section 5.3.4 include both social and ecological barriers to implementing EBM in the Still Creek Watershed. Table 6.1 provides a summary of these challenges.

Table 6.2: Challenges to implementing EBM in Still Creek

Challenges and Key Questions
Balancing Conservation Goals • Determining socially acceptable balance between recreational access to creek and creek protection • Determining ecosystem restoration needs that meet community's priorities
Physical Feasibility • How does EBM take shape in a highly developed urban watershed? • Determining what can realistically be expected of ecosystem restoration
Buy-in • Gaining political support for EBM • Gaining local residents' support for EBM
Collaboration • Improving communication between local governments • Navigating jurisdictional silos • How to incorporate all stakeholders in watershed into EBM?
Spatial Scale • What spatial scales are relevant and which restoration activities should take place on each scale?
Terminology and Understanding EBM • Educating stakeholders on EBM and EBM principles • Ensuring that EBM is actually implemented. How to ensure EBM means something different than business-as-usual?

One of the challenges I identified through the interviews was that there may be a lack of understanding of the EBM approach and associated principles. While many participants in Group 1 and 2 had heard of EBM and understood the general concept, it was apparent that the principles of EBM were less understood. Quinn and Theberge's (2010) survey of EBM practices among governments and non-governmental organizations across Canada identified similar trends about the use of the term "Ecosystem-based Management" in government. Most notably, most jurisdictions in Canada lack a definition for EBM, adoption of EBM terminology into policy and legislation occurs mainly at the federal level, and the details and meanings differ slightly across agencies. EBM is new terminology to the urban context, and therefore is not surprising that there is a need to improve knowledge. Some interviewees also expressed concern that "Ecosystem-based Management" is another name for many other similar concepts. Thus, there is a need to provide education on to distinguish EBM

from other environmental management regimes in order to achieve greater buy-in and coherence to EBM.

Another challenge has been envisioning the degree to which EBM can be realistically implemented in the watershed. Interviewees were not certain how realistic it was to plan a full scale implementation of EBM because of the physical barriers that currently exist. It seemed to some interviewees that the goals of local residents and environmental stewardship groups may be unrealistic since about 70% of the watershed is impervious and predominantly private property. It is possible that a lack of understanding of EBM may be contributing to some groups having greater expectations for change and other groups seeing those expectations as unrealistic. There have also been issues with gaining buy-in to the EBM approach from all stakeholders. There has been some resistance to watershed restoration from local businesses and political support has not been fully realized.

The Still Creek community has also experienced challenges finding a balance between conservation and recreational use in the watershed. As an urban waterway, Still Creek is a desirable place for urban dwellers to recreate and experience nature close to their home. The Central Valley Greenway, Burnaby Lake Regional Park, and Renfrew Ravine and Renfrew Community Park have provided access at various points along the creek corridor and in the watershed. The challenge has been determining what is ecologically appropriate and socially acceptable for the creek in terms of increasing accessibility. The challenges so far indicate that the community needs to determine what their shared priorities are for ecosystem restoration.

Collaboration in the watershed has been also challenge. Although there is a positive and supportive atmosphere, local governments operate relatively independently from each other. The BBCC is the main opportunity for watershed collaboration and has been an important opportunity for dialogue regarding the health of the Still Creek Watershed. However, the combination of jurisdictional complexity and resource capacity issues has led local governments to at times work in silos and has detracted from the prioritization of restoration of the Still Creek watershed.

Another foreseeable challenge that can potentially decrease the effectiveness of collaboration is the differing spatial scale of focus of stakeholders. Private property ownership in the watershed indicates that buy-in and education might best occur at small spatial scales. However, ecological processes often exhibit characteristics over multiple spatial and temporal scales (Borgström et al., 2006). At present, community groups are focused on initiatives in Renfrew Ravine. In contrast, Metro Vancouver perceives Still Creek to be a part of the larger Brunette River Watershed. There are very different spatial scales of focus depending on the stakeholder. Thus, management approaches must be sensitive to ecological and social needs at all scales, presenting an interesting challenge to Still Creek. Harte et al. (2010, pg. 36-37) provide insight into the dilemma of scale mismatches in environmental management of streams:

> Streams within developed areas are commonly perceived at local scales otherwise known as stream reaches. At this scale, streams might traverse a neighborhood or section of town and integrate a series of habitats (e.g., glides, riffles, and pools) that support differing fish assemblages. Local residents have the majority of their direct interaction with rivers, aquatic organism, and riparian and aquatic habitat rehabilitation projects in such locations. Consequently, the stream reach provides numerous opportunities for education and community involvement. However, the hydrological, water quality, and fish passage factors that often limit fish assemblages in developed areas are most likely operating at watershed (Fitzpatrick et al., 2005) and river basin scales. Effectively addressing aquatic ecosystem impairments caused by rural-residential and urban developments may require actions taken at several spatial scales and maintained for variable lengths of time. Because management actions take place in larger political, economic, and cultural contexts, the boundaries of management jurisdictions may not match those of important ecological processes (Hanna, 2008). When the scale of management is not aligned with the scale (spatial and/or temporal) at which ecological processes or disturbance regimes operate, actions intended to protect natural resources may be ineffective (Borgström et al. 2006; Cumming et al. 2006).

The Still Creek community can take several actions to address these challenges. Leech et al. (2009) proposed seven steps that will help communities to implement EBM (see Figure 6.2). These steps identify the sequence of major events that need to occur in order to implement the principles of EBM. The Still Creek community has completed some components of process. In addition to continuing to implement these steps, I also provide three specific recommendations that may help the community to achieve greater success with EBM implementation in Still Creek.

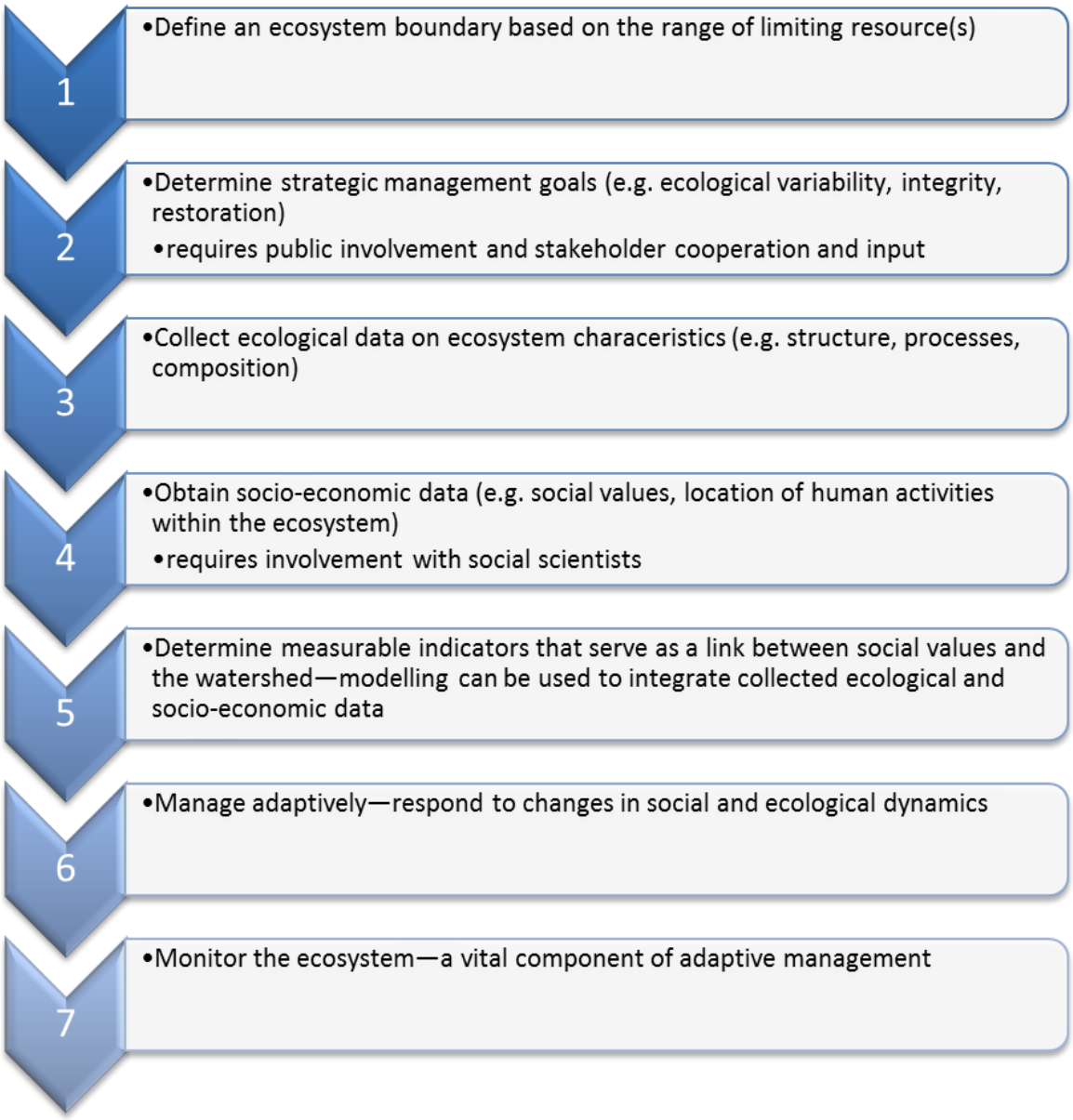

Figure 6.2: Steps for EBM Implemention.
Note: Adapted from Brussard et al. (1998) and Leech, Wiensczyk, and Turner (2009).

Recommendation 1: Establish Watershed Committee or Forum

In order to improve collaboration, conduct realistic long-term planning, and ensure plan implementation, I recommend that a Still Creek Watershed Committee or Forum be established to guide the EBM implementation process. The benefits of establishing a Committee are that a multitude of interests are represented, representatives can work collaboratively and share expertise, decision-making is shared,

and that responsibility of plan implementation and monitoring becomes the responsibility of a broad group of stakeholders (Keough and Blahna, 2006).

The first step in establishing a Watershed Committee is to involve representatives from all stakeholder groups—including the public—who have a role to play in the outcome of the watershed's health. The Watershed Committee will act as the core planning and collaborating body, but meetings and restoration work should also be open to the public (Conservation Authorities of Ontario, 2003; Ecosystem Approach Task Force, 2003).

The Watershed Committee can engage in long-term planning to determine desired future scenarios for the watershed. A desired future scenario approach is a form of backcasting where future alternatives for a watershed are developed (Carlsson-Kanyama et al., 2007). Once alternatives of future scenarios are established, the Committee can establish a plan of action with short-term, medium-term, and long-term objectives and goals for improving the health of the watershed.

There are some examples of other communities employing a watershed committee approach, including in the Bowker Creek and Coquitlam River watersheds of BC. The committees differ in some respects, but the overall objectives and make-up of the committees are similar. Table 6.3 provides a comparative example of watershed committees of the Bowker Creek Watershed and the Coquitlam River Watershed Roundtable. Both of these examples demonstrate a commitment to involving multiple stakeholders through a non-legislative authority such as a committee.

Table 6.3: Examples of Watershed Forum Structure

	Bowker Creek Initiative Steering Committee	Coquitlam River Watershed Roundtable
Vision/Mission	"The varied human uses and natural areas in the Bowker watershed are managed to minimize runoff and pollution, making Bowker Creek a healthy creek that supports habitat for native vegetation and wildlife, and provides a community greenway to connect neighbourhoods."	"The Coquitlam River Watershed Roundtable will: • Facilitate collaborative resolution of urban growth and natural resource use pressures consistent with agreed community objectives and values, • Inform and educate people about these matters and the watershed, and • Promote and support conservation of a sustainable, healthy watershed environment."
Make-up	Committee coordinators, residents, stewardship groups, community associations, educational institutions, and local and regional governments	Roundtable Coordinator, local governments, First Nations, provincial and federal governments, aggregate industry, Real Estate development, outdoor recreation, stewardship, Arts and Culture, Education
Authority	No authority to make decisions on jurisdictional or legislative matters. Steering Committee established 100-yr Blueprint for Bowker Creek, which provides strong recommendations for local governments that will be incorporated into local government policy.	No authority to make decisions on jurisdictional or legislative matters. Roundtable makes recommendations to local governments.

Sources: Bowker Creek Initiative, Westland Resource Group Inc., Kerr Wood Leidal Associates Ltd., and Murdoch de Greeff Inc., 2015; Coquitlam River Watershed Roundtable, 2015.

The boundaries of the Still Creek watershed have already been defined through the Still Creek ISMP. However, citizens, environmental stewardship groups, and local governments are still operating at spatial scales defined by their jurisdictional authority. Stewardship groups conduct activities at the neighbourhood or stream reach scale. For

the regional government, the Brunette Basin Watershed Plan identifies Still Creek as a subwatershed contained within the larger Brunette Basin Watershed. The relevance of these differences in scales of focus is that management interventions at one spatial scale may completely ignore ecosystem functions and processes at other scales (Borgström et al., 2006). Cross-scale interactions are one of the greatest challenges to urban environmental management (Borgström et al., 2006). This could reduce the success of restoration initiatives and even have a negative effect on the ecosystem. The scales of relevance for urban ecological restoration are depicted in Figure 6.3. A watershed coordinating committee can help to achieve collaboration across scales.

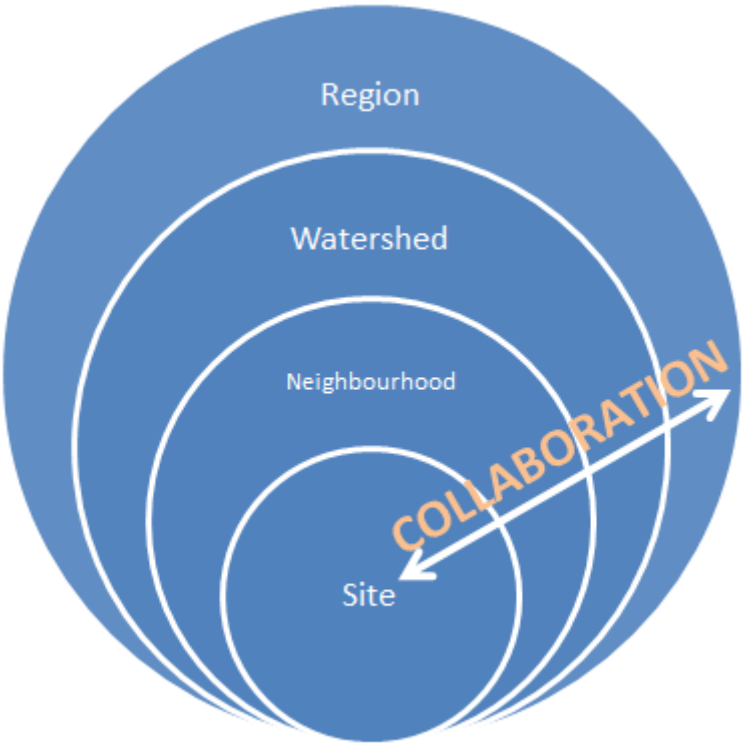

Figure 6.3: Scales of Ecosystem Function. Scales of social organization for management of ecosystems should match scales of ecosystem function.
Note: Adapted from Stephens, Graham, and Reid, 2002.

Recommendation 2: Conduct an Ecosystem Assessment to collect social and ecological data.

EBM requires a systems approach to environmental management. As mentioned, it can be very challenging to achieve ecological restoration goals without an understanding of the processes and functions that occur on different scales. A critical step in EBM is to collect data and information to gain a better understanding of these interconnections. It can also be very challenging to identify how urban development patterns are linked to ecosystem functions (Alberti, 2005). Ignoring these linkages leads to poorly devised strategies that do not achieve intended outcomes of environmental management (Alberti). What is required is the collection and integration of social, ecological, hydrologic, and other sources of data to characterize processes occurring at site, neighbourhood, watershed, and regional scales (Ecosystem Approach Task Force, 2003; Stephens, Graham, & Reid, 2002).

There have been several studies conducted that can form the foundational basis of data collection in Still Creek. Currently, there is ecological research being conducted such as water quality and Habitat Assessments for salmonids. This data collection needs to occur more often and incorporate social and ecological aspects of the watershed health. A greater integration of historical knowledge of the watershed character is also required. Thus, an ecosystem assessment should focus on these aspects of the Still Creek watershed:

1. Describing the original character of the watershed by collecting historical information.
2. Continuing to describe the current condition of the watershed.
3. Characterizing the social/urban development patterns and how they have impacted ecosystem processes in the watershed.
4. Characterizing the social values in the watershed and understanding how these values will impact restoration efforts.
5. Determining the priority areas for restoration based on historical character, current condition, and social values.

Social and ecological data collection will help the community to establish historical baselines, today's reference baselines, and priority areas for restoration. It will also contribute to the development of a plan that is responsive to social and ecological dynamics.

Recommendation 3: Develop an adaptive management strategy.

Adaptive management is critical to the success of restoration efforts in the Still Creek watershed and should be included in the EBM plan. In conjunction with initial data collection, ongoing monitoring and evaluation of ecosystem components is necessary to ensure that management objectives are met. The adaptive management strategy should incorporate indicators of ecological health that are linked to social values. Ecosystem modelling is an excellent evaluate tool when establishing indicators, determining desired future states, and incorporating social values into the planning process (Ecosystem Approach Task Force, 2003). In addition, an adaptive management strategy should identify stakeholders' roles and responsibilities in achieving certain aspects of the plan. An adaptive management strategy should include (Nyberg, 1999):

1. Description of the problem to be solved.
2. Design strategy for how to achieve the solution.
3. Monitoring strategy.
4. Evaluation strategy, including indicators.

Designing an adaptive management strategy will establish legitimacy for the EBM plan. It also ensure that the long-term planning process is flexible, should there be significant changes in social or ecological dynamics (Lessard, 1998).

6.3. Leveraging Successes in the Still Creek Watershed

The Still Creek case is an example of positive community change that has occurred due to both bottom-up and top-down actions working to improve the ecological health of the watershed. While full implementation of a biocentric, ecosystem-based approach to environmental management has not yet occurred, the Still Creek community has experience several successes that offer opportunities from which to build.

The Still Creek ISMP was an excellent starting point to start to work collaboratively and plan for watershed health. The community may benefit from a comprehensive evaluation of the successes and challenges that emerged after the plan was implemented. It may also be valuable to assess how social values have shifted in

the watershed, and if there is a need to revisit the watershed vision and objectives. Information from the evaluation of the ISMP can then inform the design of the EBM plan.

Another opportunity in the watershed is to build on the positive relationships that have already been built. Local government representatives were supportive of community groups and grassroots initiatives to integrate EBM into the watershed. Community groups also identified the opportunity despite bureaucratic barriers, they feel supported in their efforts and they have a positive outlook on the local governments' restoration initiatives in the watershed. Beyond establishing a watershed committee, another way to enhance the engagement of local community residents and landowners is to establish a citizen science program that involves them in the monitoring of outcomes of the EBM plan (Cooper et al., 2007). Increasing the level of monitoring responsibility and shared decision-making will improve the efficiency of collaboration, reconnect people to nature, instill a new ecological ethic, and decrease the burden of improving watershed health that is placed on local governments (Cooper et al.).

A third opportunity for the Still Creek community is to invest in green infrastructure on public and private property. Green infrastructure provides a mechanism to introduce nature back into the water infrastructure system in the Still Creek watershed. Reducing impervious surface coverage in the watershed through green infrastructure techniques can increase biodiversity in the watershed, reduce streambed erosion, filter pollution, help manage climate, and contribute to residents' well-being and educational experiences (Rudd, Vala, & Schaefer, 2002). In addition, green infrastructure is a cost-effective long term solution to stormwater management because it mimics natural hydrologic functions like infiltration and evaporation in a watershed (American Rivers, Water Environment Federation, American Society of Landscape Architects and ECONorthwest, 2012). Green infrastructure therefore addresses the challenges of urban ecological degradation within the framework of an ecosystem-based approach. There are several opportunities available to introduce green infrastructure into the watershed. One opportunity is to incorporate policies into Official Community Plans and By-laws, such as low impact stormwater policies that set maximum impervious surface coverage. Another opportunity is to incentivize land owners to reduce stormwater runoff from their property by providing tax credits or

subsidies for rainwater retention and infiltration measures, such as rain gardens, permeable pavement, natural vegetation, and rain barrels.

There are several social and environmental challenges that the Still Creek community will need to address in order to implement EBM. Major challenges can be addressed through the establishment of a watershed committee, the ongoing collection of social and ecological data, and the development of an adaptive management strategy. Other opportunities include utilizing green infrastructure techniques, collaborating and engaging citizens in science, and using the Still Creek ISMP as a starting point for moving forward with future Ecosystem-based Management plans.

Chapter 7.

Conclusion

The Still Creek case has provided an interesting opportunity to explore the value and usefulness of EBM in the urban setting. It has also been a source of insight into the challenges that can arise through EBM implementation and how communities can mitigate these challenges. This chapter will address the need for urban EBM, identify opportunities for the research community, and provide key messages to local governments, practitioners, community groups, and urban residents.

7.1. EBM in the Urban Setting

The traditional approach to environmental management in cities has been a top-down, command-and-control paradigm with the intention of increasing predictability and reliability of nature (Holling & Meffe, 1996). The evolution of this approach has effectively removed humans from our understanding of how ecosystems function. Command-and-control approaches reduce the range of natural variability of ecosystems, leading to degraded urban environments, reduced quality of human relationships with nature, overall lack of social-ecological resilience—or ability to cope with change (Grimm et al., 2000).

Urban communities have shown a greater interest in urban environmental protection and restoration in recent decades. As communities attempt to reduce impacts on urban ecosystems, enhancing our understanding of new paradigms of environmental management such as EBM can help to reduce human control of nature and integrate humans back into ecosystems. Urban communities can benefit from EBM for several reasons:

- EBM can facilitate the paradigm shift in our relationship with nature. EBM encourages a systems perspective and emphasizes that humans are part of ecosystems.
- EBM can help urban communities to re-establish important ecological functions that have been lost through development. The emphasis on data-collection, monitoring, and adaptive management provide the impetus for ecologically-based solutions.
- EBM can improve the effectiveness of restoration efforts by encouraging the consideration of hierarchical context. EBM will help to guide small community initiatives at the site and neighbourhood scale within the context of watersheds.
- EBM can provide a framework to address institutional barriers that reduce the adaptive capacity of urban social-ecological systems. The mandate for collaboration across jurisdictional boundaries and organizational change challenge our traditional approach to environmental management.
- EBM can help communities to develop ecosystem-based priorities and plans and put them into action in ways that ensure the long-term sustainability of an ecosystem and the activities that take place within.

7.2. Future Research

Significant opportunity exists to further explore the application of EBM in the urban setting as urban communities become increasingly more focused on ecosystem services and sustainability. This research is constrained to one experience with urban EBM in one community. Extending our knowledge of EBM in the urban setting and how it is useful to cities will create opportunity to improve humans' relationship with nature and will ensure wiser management of urban ecosystem services. Research questions that could serve to expand our understanding of EBM as a tool to urban communities are listed below.

- What challenges and opportunities do urban communities encounter once EBM is fully implemented?

- How does the EBM approach compare to other ecocentric/biocentric environmental management approaches such as Design with Nature? How does the EBM approach differ in terms of its ability to shift peoples' relationship with nature?
- How might the principles of EBM need to be adapted to the urban setting?
- What are the economic benefits of EBM in the urban setting from a full-cost accounting perspective?
- How can EBM be better incorporated into municipal and regional policy?
- How does the ecological integrity priority of EBM impact urban environmental management?

7.3. Key Messages

This research has explored the potential usefulness of Ecosystem-based Management in urban environmental management through a case study analysis of the Still Creek watershed. For urban communities, the transition away from traditional environmental management regimes will require dedication to resolving institutional, policy, science-based, and management barriers that currently limit our ability to reduce uncertainty and adapt to change. Advantages that urban communities can gain in using EBM as a tool include using it as a framework for shifting focus from control of nature to ecological integrity and ecosystem dynamics, a challenge to the status quo of watershed health, an improvement in collaborative governance, knowledge sharing, shared-decision making, and citizen engagement. The adaptive management imperative of EBM may also equip urban communities with the ability to better understand social and ecological dynamics, reduce uncertainty, and respond to change.

One of the questions raised in EBM literature is whether EBM is a complete paradigm shift or an approach that is more biocentrically oriented on the environmental management continuum. Ultimately, for the urban setting, it is less important that a paradigm shift takes place and EBM is perfectly implemented, and more important that communities begin to move toward an ecosystem-based approach that is suited to their local context. The highly complex social dynamics of urban settings will require tailored

strategies that address social and ecological issues in a realistic manner while still improving the social-ecological resilience of urban systems.

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Local Government Act, 1996 (RSBC 1996, c.323)

Water Act, 2000 (RSA 2000, c. W-3)

Vancouver Charter, 1953 (SBC 1953, c. 55)

Appendix A.

Interview Questionnaires

Community Questionnaire

Part 1-Questions about the participant

1. Tell me a bit about how you are involved in ecological restoration taking place in the Still Creek-Renfrew Ravine area.

Part 2- Context-ecological condition, types of restoration activities

1. How would you describe the current ecological condition of Still Creek and Renfrew Ravine?
2. What types of restoration activities are taking place in Still Creek-Renfrew Ravine?

Part 3- Ecosystem-based Management

1. Have you heard of the term Ecosystem-based Management (or Ecosystem Management)? What does it mean to you?
2. How did you first learn about EBM? (Who, where, why).
3. What principles do you consider most important to EBM? For ex., Ecological Integrity.
4. How might these principles best be put into practice in an urban setting?
5. So far, how has Ecosystem-based Management been practiced in Still Creek?
6. Why is EBM important to the Still Creek ER Project?
7. When you think about the Still Creek/Renfrew Ravine, what values come to mind that are either important to you or to the community?
8. To your knowledge, how has the ecology and form of Still Creek and Renfrew Ravine changed in the past 150 years?
9. How is historical information incorporated into current restoration planning?

Part 4-Knowledge and Learning

1. Where do you learn about ecological aspects of Still Creek?
2. How do you share information about Still Creek/Renfrew Ravine with the community?
3. How would you characterize the integration of various sources of knowledge into the Still Creek EBM ER project?

Part 5-Effect on Community

1. Could you talk about the local residents' relationship with nature, and how that may be changing as EBM is implemented?
2. Has the EBM project had an impact beyond the local community? How?
3. How has the community dealt with differing viewpoints regarding how Still Creek/RR should be utilized?
4. How has this project impacted environmental awareness in the area?
5. Do you think that this EBM approach represents an approach that is truly different than anything the community has done before?
6. How has the integration of arts and nature had an impact on this community?

Part 6-Collaboration

1. How does the Still Creek EBM ER project fit within the broader Vancouver context? Metro Van context?
2. How are City of Vancouver and Metro Vancouver involved in the Still Creek EBM Project?
3. Have you experienced or do you foresee specific challenges or opportunities to effectively achieving your ER goals given that you are a community based project working independent from the municipal government?
4. Which organizations are involved as collaborators in the project? What is their role?
5. How involved are these collaborators?
6. Why did these collaborators come together on this project?

Part 7-Personal Experience

1. What contributions do you feel that you bring to the Still Creek EBM ER project?
2. What are the most important things you have gained from being a part of the project?

Part 8- Impact beyond local community

1. How might this project serve as an example for other communities?

Key Informant Questionnaire

Part 1-Ecosystem-based Management

1. Could you tell me a little bit about your experience with Ecosystem-based Management (EBM)?
2. How would you describe EBM?
3. How is EBM distinct from other resource management approaches?

Part 2- Urban Setting

1. How might the principles of Ecosystem-based Management best be put into practice in an urban setting?
2. How are EBM principles currently being applied to the urban setting?
3. What is the relevance of historical information in planning ecosystem-based restoration?

Part 3- Opportunities and Challenges

1. Are there any opportunities that you have observed, experienced, or can foresee that communities/governments might experience as they try to implement EBM in the urban environment?
2. Are there any challenges that you have observed, experienced, or can foresee that communities/governments might experience as they try to implement EBM in the urban environment?

Part 4-Other

1. Are there any other examples of urban communities such as the Still Creek community that are trying to implement EBM?
2. Are there any aspects of the Still Creek community that make it a unique case to study?
3. How might this (these) communities serve as an example(s) for other communities?

Appendix B.

Still Moon Arts Society Community Stewardship Activities and Descriptions

Initiative/Activity	Description
Renfrew Ravine Moon Festival	The Renfrew Ravine Moon Festival is celebrates the full moon, cultural diversity, harvest abundance, arts, music, environmental stewardship, and community engagement. The event involves a summer garden competition and a parade along Renfrew Ravine at dusk guided by lanterns and dancers. The Moon Festival brings the community together around the ravine, a landmark to the Renfrew-Collingwood neighbourhood.
Ravine labyrinth	The Renfrew Ravine labyrinth is a network of pathways created by a mosaic of stones in the ground in a grassy patch near the ravine. Individuals can use it on their own to connect with the ravine, or it is also used to guide community labyrinth walks.
Still Creek Stories	Still Creek Stories is an initiative to collect and organize stories about the history of the creek.
Sanctuary and native gardens	The Sanctuary Garden was installed in partnership with the City of Vancouver to create a space for local residents to enjoy the ravine. Other native gardens were also installed
Various other festivals and concerts	Concerts and festivals raise awareness of environmental issues and unite community through arts.
Performance Summer Day Camp	Professional artists teach stilt walking, theatre, costume design, visual arts and music to contribute to cultural development in Renfrew-Collingwood Community.