Organizational Knowledge Creation to Enhance Adaptive Capacity:
Exploratory Case Studies in Water Resource Management

by

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AUTHOR'S DECLARATION FOR ELECTRONIC SUBMISSION OF A THESIS

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

This research focuses on how conservation authorities create organizational knowledge to enhance adaptive capacity to improve environmental policy. Organizational knowledge creation refers to the ability to create, disseminate and embody knowledge to improve products, services and systems (Nonaka and Takeuchi 1995). Organizational knowledge is required for building adaptive capacity, which is defined as the ability to anticipate, respond to and learn from disturbance and change. Highly adaptive organizations can anticipate, respond to and learn from disturbances to adjust management practices and overcome weaknesses in policy created by changing circumstances (Ascher 2001). As quasi-government agencies responsible for water management in Ontario, conservation authorities need to respond to change if they are to learn from past experiences and develop innovative water resource policy that adequately addresses increasingly complex social-ecological problems.

A broad multidisciplinary literature review was conducted to develop a theoretical framework of conditions that potentially facilitate organizational knowledge creation and adaptive capacity. A case study analysis was conducted using five conservation authorities to acquire insight into the circumstances under which these conditions facilitate knowledge creation and adaptive capacity based on practical water resource management experience in three programs areas: flood damage reduction, low water response and source water protection. The case studies include Credit Valley Conservation, Grand River Conservation Authority, Maitland Valley Conservation Authority, Nottawasaga Valley Conservation Authority and Toronto Region Conservation Authorities and were chosen because they reflect a cross section of institutional attributes in terms of budget, staff, rate of growth and population. A qualitative, exploratory research methodology was employed to undertake analysis of empirical evidence from 64 semi-structured interviews with water resource practitioners. Analysis of interview transcripts was conducted with QSR NVivo, a computer-assisted

qualitative data analysis software, to provide insight into the role facilitating conditions played in water resource management.

Findings from the analysis suggest there are twelve facilitating conditions for creating organizational knowledge to enhance adaptive capacity in conservation authorities. A conceptual model illustrates the relative importance of the facilitating conditions to conservation authorities and highlights three core conditions: values of trust and respect, social capital and accountability. The other nine conditions include leadership, surveillance of the environment, social memory, autonomy, motivation, conditions for social interaction, dialogue, shared vision and adaptive mental models.

The conceptual model identifies and operationalizes theoretical facilitating conditions in water resource management. The model has a strong theoretical underpinning developed through a consolidation of insights from various fields of study including social-ecological systems, knowledge management, organizational learning and collaborative planning. The model's structure is derived from the observations and experiences of practitioners in managing water resources and can in turn, provide practitioners with an opportunity to recognize how their daily activities and decisions can influence organizational knowledge creation processes and adaptive capacity. From a planning perspective, this research highlights the importance of creating organizational knowledge and building adaptive capacity in planning institutions to improve their ability to develop informed and adaptive public policy.

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Chapter 1

Introduction

1.1 Research Context and Objectives

"Apart from the air we breathe, water is the most basic, most urgent need, that we all have…Water has no substitute."

"...meeting water needs (and managing our water demand to fit water availability) is both a major challenge for the 21st century and will define more widely our ability to coexist with nature and make good use of the planet's fast diminishing 'natural capital'."

"…if we can get water right, we will be able to get most things right."

(Pearce 2006).

The preceding quotations are from Paul Comstock's interview with Fred Pearce March 14, 2006, author of *When the Rivers Run Dry: Water – The Defining Crisis of the Twenty-First Century,* 2006. He argues that the world will not run out of water because it will be cleaned and recycled through the hydrological cycle. He cautions, however, that water resource management must account for the cross-scalar interactions between the social demand, the uses of water and the natural water cycle for it to be sustainable in the long term.

The level and depth of knowledge required to understand cross-scalar challenges suggest that institutions managing water resources must recognize and address social and ecological systems complexity without over simplification (Berkes *et al.* 2003, Ascher 2001). Berkes and Folke (1998) started using the term "social-ecological systems" to denote the integrated elements of human and natural systems to emphasize that the distinction between the two domains is artificial and arbitrary (Folke 2005). Water resource management requires consideration of social systems, encompassing issues such as governance, access to resources and property rights, as well as ecological systems, which involve issues of ecosystem function, structure and processes (Berkes *et al.* 2003). To manage within social-ecological systems, water resource organizations must have the capacity to create organizational knowledge and enhance adaptive capacity to improve policy development (Goucher and Michaels 2004).

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This research explores the circumstances under which water resource organizations facilitate organizational knowledge creation and adaptive capacity. Organizational knowledge creation refers to the ability to create, disseminate and embody knowledge to improve products, services and systems (Nonaka and Takeuchi 1995). Knowledge creation is a complex process that differs from data or information acquisition. Data is discrete, objective facts with no inherent meaning while information is meaningful or useful data that has been contextualized, categorized or calculated. Knowledge is both process and product and can evolve from information which has been compared, connected or conversed. It is a personal combination of experience, values, contextual information and insight providing a framework to evaluate and incorporate new experience and information. Organizational knowledge is embedded within documents, routines, processes, practices and norms (Davenport and Prusak 1998, Michaels *et al.* 2006a). As such, organizational knowledge creation is a context-dependant process that varies across circumstances, depending on factors such as local resource systems, local community demographics and external social, physical and institutional environments (Agrawal 2002). Recognizing learning as a context-dependant process is therefore an important aspect of this study which focuses on the circumstances under which water resource organizations facilitate knowledge creation as opposed to defining universal, discrete or predictive theories. Recognizing the conditions that facilitate adaptive capacity also requires consideration of contextual circumstances and past experiences.

Organizational adaptive capacity refers to the ability of an institution to anticipate, respond to and learn from change. It enables "… an organization to return to sound resource management after an inappropriate policy has been adopted or previously appropriate policies are rendered unsound by changing circumstances" (Ascher 2001, 753). Organizations must be able to identify weaknesses in policy and create knowledge to overcome such weaknesses (Ascher 2001). In this way, the study of adaptive capacity can not be separated from organizational knowledge creation because adaptive capacity reflects the presence of mechanisms that enable institutions to learn, create, maintain and store knowledge. Creating organizational knowledge to enhance adaptive capacity introduces flexibility into problem solving and improves decision making (Carpenter *et al.* 2001, Folke *et al.* 2003, Nayak 2004, Quinlan *et al.* 2004).

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This research explores facilitating conditions of organizational knowledge creation and adaptive capacity within the five case study conservation authorities, organizations that manage, plan and coordinate water resources on a watershed basis (Conservation Ontario 2000). Conservation authorities are appropriate case studies because they have planning and policy development responsibilities, and are collaborative, watershed-based organizations that have overcome challenges in the past. As local water resource managers, conservation authorities must work within a complex governance structure to coordinate and facilitate watershed planning (Goucher and Michaels 2004).

Planning involves "… future-oriented, public decision making directed toward attaining specific goals" (Fainstein and Fainstein 1996, 265). As such, planning structures guide the policy process through integrated, long term strategic management to move towards desired objectives (Friedman 1987, Healey 1995). In this way, planning explicitly links knowledge and action (Friedman 1987, Davenport and Prusak 1998). Planning has significant influence over quality of life, economic vitality and ecological integrity through decision-making, influencing development processes, transportation, safety and security, recreation, environment, health and so on. This wide range of perspective and influence provides planners with a unique position to foster sustainability through public policy. Conservation authorities collaborate with various partners across the governance network to undertake watershed-based planning.

Governance in this discussion refers to the structures, processes and conditions created for ordered rule, collective action and social coordination that help people make decisions and share power (Folke *et al.* 2005, Stoker 1998). Governance is an important concept to consider while investigating conservation authorities because these organizations function within a complex network of agencies each with different roles and responsibilities for water management. In this way, water in Ontario is managed across multiple scales (Shrubsole 1996). Berkes (2003) has characterized governance structures where natural resources are managed within social-ecological systems as "polycentric," meaning there are multiple overlapping centers of authority to deal with intersecting domains of public policy. This accurately characterizes water management in Ontario where the federal, provincial and local governments have shared jurisdiction over water management. Consequently, there is no one agency designated to manage

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all aspects of water. Instead, those agencies involved, including conservation authorities, must cooperate with others to address problems (Conservation Ontario 2000).

To explore facilitating conditions for learning and adaptation processes in conservation authorities, three objectives were established:

1. Develop a research methodology to assess the applicability of theoretical facilitating conditions of organizational knowledge creation and adaptive capacity in five conservation authority case studies. The term 'facilitating condition' refers to a factor or general principle that enhances organizational success and contributes to better performance over time (Agrawal 2002).

2. Create a theoretical framework, based on a multidisciplinary literature review, that consolidates the potential facilitating conditions of organizational knowledge creation and adaptive capacity in water resource management organizations.

3. Develop a conceptual model that illustrates how the conditions in the theoretical framework facilitate organizational knowledge creation and adaptive capacity in five case study conservation authorities, based on practical water resource management experience in three programs areas: flood damage reduction, low water response and source water protection.

1.2 Theoretical Paradigm

This research is meant to explore the potential applicability of a theoretical framework of facilitating conditions of organizational knowledge creation and adaptive capacity in conservation authorities. To investigate this phenomenon, a constructionist theoretical paradigm guides the direction of this qualitative, exploratory inquiry. Instead of defining causal relationships such as in explanatory research, or systematically describing the phenomena, as in descriptive research, this study will explore the circumstances under which the five case study conservation authorities have been able to create organizational knowledge and adaptive capacity.

It is argued that case studies are the most appropriate strategy for exploratory research (Robson 2002). Five case study conservation authorities (Credit Valley, Grand River, Maitland Valley, Nottawasaga Valley and Toronto Region) are investigated to investigate the potential

applicability of this theoretical framework for exploring conditions that facilitate organizational knowledge creation and adaptive capacity in resource management organizations. The five case studies represent a cross-section of various organizational attributes that provide a broad context with in which to study circumstances that may influence organizational learning and adaptation.

1.3 Justification for Research

Various studies outline factors that contribute to organizational knowledge creation and/or adaptive capacity (for example, Folke *et al.* 2003, Innes and Booher 2003, Nonaka and Takeuchi 1995, Senge 1990, Walker *et al.* 2006, Westley 2002). The literature contains significant gaps in the understanding of how and why multiple factors in a complex system influence organizational capacity. This research attempts to address this gap by first organizing criteria identified from the literature into a conceptual framework. Second, this framework is applied to water resource management in Ontario through empirical evidence gathered from five conservation authority case studies. This research offers a framework to improve understanding of how and why the case study authorities create organizational knowledge to enhance adaptive capacity.

1.4 Outline of Chapters

The study begins by describing the qualitative, exploratory, case study approach used to gather and analyze empirical evidence to test the applicability of the theoretical framework in conservation authorities. The third chapter reviews background material on authorities to provide contextual background necessary to understand examples of water management in later chapters. Chapters four and five review and synthesize the salient literature. Chapter four reviews four areas of scholarship that inform the development of the theoretical framework: social-ecological systems, knowledge management, organizational learning and collaborative planning. Chapter five presents a theoretical framework to explain how the twelve facilitating conditions enhance organizational knowledge creation and adaptive capacity in resource management organizations. Chapter six presents results of the analysis through a conceptual model depicting the relative importance of the facilitating conditions to conservation authorities. Chapter 7 highlights the potential contributions of this work as well as recommendations for future research.

Chapter 2
Methodology and Methods

This research examines factors that enable conservation authorities to create organizational knowledge to enhance their adaptive capacity. The chapter begins by describing the epistemological perspective of this research. Constructionism emphasizes the role of human perception in determining social behaviour (Palys 2003). As a result of this epistemological stance, this research attempts to understand the social processes of organizational knowledge creation and adaptive capacity through the perspective of those closest to the phenomenon, the water management practitioners. Consequently, a qualitative, exploratory methodology is used to examine the applicability of facilitating conditions in five case study conservation authorities. Facilitating conditions refer to factors or principles that contribute to organizational success and performance over time (Agrawal 2002). Conservation authorities are collaborative, watershed-based organizations that plan and manage water resources (Conservation Ontario 2000).

This chapter describes the methodology and methods used to gather and analyze the empirical evidence from the case studies to a) determine how conservation authorities manage water resources through organizational knowledge creation and adaptive capacity; and b) to gain a pragmatic view of how and why the theoretically-based conditions facilitate organizational knowledge and adaptive capacity in conservation authorities. The chapter is divided into three main sections: theoretical paradigm, research procedure and research standards. The theoretical paradigm outlines the epistemological perspective of the research and rationalizes the choice of qualitative, exploratory and case study research approaches. The next section describes the five-step research procedure employed to undertake this investigation: (1) selection of appropriate case studies and data collection techniques; (2) review of conservation authorities (3) development of a theoretical framework; (4) analysis; and (5) interpretation of results. The last section explains how the research limitations inherent in a qualitative, exploratory research approach are dealt with through consideration of research standards including objectivity and dependability.

2.1 Theoretical Paradigm

This section describes the theoretical paradigm used to undertake research into factors that enable conservation authorities to create organizational knowledge and adaptive capacity. The paradigm is important because it influences the epistemological perspective of the research and the choice of the framework employed to understand the nature of the research to be conducted.

2.1.1 Epistemological Basis: Constructionism Tradition

The research process is based on a constructivist theoretical tradition, which recognizes that reality is only a perception or a construction of what people understand as truth (Patton 2002). Constructionism is a version of idealism that suggests,

> *"... there exist multiple, socially constructed realities ungoverned by laws, natural or otherwise [and that] those constructions are devised by individuals as they attempt to make sense of their experiences. [These] constructions can be and usually are shared...this does not make them more real, but simply more commonly assented to"* (Guba and Lincoln 1989, 86).

Constructionism helps to explain the approach taken to investigate facilitating conditions of organizational knowledge creation and adaptive capacity in conservation authorities. "To be a constructionist is not to deny that certain phenomena exist, but just to insist that their existence cannot be completely understood unless one understands why, how, and to whom they are applied" (Palys 2003, 12-13). Consequently, this research attempts to understand how and why the conditions facilitate learning and adaptation from the perspective of those who are close to the phenomena. This differs from a realist philosophy, the belief that there is a reality (Palys 2003). A realist would be inclined to evaluate or measure the "effects" of facilitating conditions on learning and adaptation. From a constructionist perspective, there is no "real" effect of the facilitating conditions that is true across time and space. Instead, we can only begin to develop social theories about situations that hold true in certain circumstances (Palys 2003, Yin 2003).

Constructivism also asserts that investigating social realities require different research methods than natural or scientific realities. While natural sciences attempt to deduce data to develop "laws," the social sciences are focused on those observations that are unique, individual

and qualitative (Gray 2004). Qualitative, exploratory case study inquiries allow researchers to explore concepts and ideas in detail and in a real-life context (Yin 2003).

2.1.2 Qualitative Exploratory Research

A qualitative research methodology emphasizes the importance of context, depth of understanding and the perspective of those close to the phenomena. Qualitative inquiry involves discovering the meanings and patterns of relationships that can be explored but not predicted (Babbie 2001). It is useful when trying to understand human and social problems that require complex, interpretive and holistic details (Creswell 1994). Qualitative research is conducted through non-numerical exploration of concepts and ideas and interpretation of observations as opposed to quantitative research which involves testing theories and variables through numeric measurement and statistical analysis with an overall goal of trying to predict and generalize (Babbie 2001, Creswell 1994). Unlike quantitative research, consideration of rich details, context-bound information as well as the social context and surroundings are important in qualitative research (Denzin and Lincoln 2000).

This qualitative research is exploratory in nature. Consequently, it involves the investigation of ideas and concepts to begin to understand perspectives, suggest future research questions and identify potential variables of interest to allow a theory to emerge. Exploratory research contrasts with explanatory research, which attempts to establish causal relationships between variables, as well as descriptive research, which involves a more systematic and accurate description of phenomena (Palys 2003). Exploratory research is an appropriate choice for this inquiry since no previous studies have investigated facilitating conditions of organizational knowledge creation or adaptive capacity in the context of conservation authorities and little is known about potential variables to test. As a result, the focus of this study is to begin to understand the complex and in-depth relationships, contexts and organizational experiences that have influenced the learning and adaptation processes in the case study conservation authorities. True to a constructionist perspective, the goal of this exploratory research is to begin to identify patterns and processes.

Exploratory studies can provide in-depth, rich and detailed data for understanding a particular phenomenon (Babbie and Benaquisto 2002). Exploratory studies are limited in their inability to provide definitive proof and causal explanations. While the results of exploratory

studies can hint at answers and provide insights into new issues, they often fail to provide results that can be generalized to larger populations because of lack of representativeness (Babbie and Benaquisto 2002). Flyvberg (2006) explains that while these limitations are valid, exploratory studies that investigate the role of context in determining social behaviour, still have an important role in academic research. Such studies have the potential to go beyond understanding symptoms and frequencies of problems, to exposing meanings and patterns. Furthermore, generalizing results is not always the goal of research: "formal generalization is overvalued as a source of scientific development, whereas the 'force of example' is underestimated" (Flyvberg 2006, 228). It is not this study's intention to generalize the results to all conservation authorities, rather it is to explore the circumstances in which the case study conservation authorities have been able to create organizational knowledge and adaptive capacity.

2.1.3 Case Study Research Strategy

It is argued that case studies are the most appropriate strategy for exploratory research (Robson 2002). Yin (2003, 13) defines a case study empirical study as one that "investigates a contemporary phenomenon within its real-life context," This research strategy is appropriate to investigate organizational knowledge creation and adaptive capacity from a constructionist paradigm in that the various perspectives of those involved can be preserved by retaining holistic and meaningful attributes of real-life events such as organizational processes and personal relationships (Yin 2003). Case studies enable investigation of "how" and "why" questions to achieve an in-depth understanding of the contextual circumstances pertinent to the study (Yin 2003). As a result, a case study research strategy has been used to investigate how facilitating conditions enable conservation authorities to create organizational knowledge to enhance adaptive capacity. The focus on uncovering in-depth relationships, complex variables and new perspectives makes case study research well suited to learn about theoretical facilitating conditions for knowledge creation and adaptive capacity.

2.2 Research Procedure

This study employed a five-step research procedure to select, acquire, analyze and interpret data to investigate the conditions that facilitate organizational knowledge creation and adaptive

capacity in natural resource management organizations. This section describes each of the following five steps:

1. Selection of appropriate case studies and data collection techniques
2. Review conservation authority literature and document relevant contextual material
3. Develop theoretical framework of facilitating conditions by reviewing literature on organizational knowledge creation and adaptive capacity
4. Analysis of interview transcripts
5. Interpret findings and document insights into how conservation authorities apply facilitating conditions to undertake water management

2.2.1 Selection of Case Studies and Data Collection Techniques

The first step in conducting this case study research was to select the case studies and the data collection procedures. As Yin (2003) notes, it can be very difficult for students and independent researchers to undertake an effective multiple-case study on their own considering financial and time constraints. As a result, the author of this thesis worked in collaboration with a research team on a project funded by the Social Science and Humanities Research Council (SSHRC), to generate data suitable for investigating organizational knowledge creation and adaptive capacity in conservation authorities. The project, entitled *Organizational Knowledge Creation for Watershed Management*, was led by principal investigator, Dr. Sarah Michaels, ORE file #10968. As part of this project, 685 pages of transcripts were generated from 64 interviews in five case study conservation authorities.

The SSRHC project provided the researcher with interview transcripts well suited for analyzing organizational knowledge creation and adaptive capacity in conservation authorities for six reasons:

1. The SSHRC project focused investigation on three issues (flood damage reduction, low water response and source water protection). These issues represent various aspects of water resource management, providing a wider range of insights into knowledge creation processes than would have otherwise been possible through a smaller scale study which a Masters student could generate solely.

2. The interviews covered the three issues across timelines by asking how problems were handled in the past, how they are currently managed and what might be expected in the

future. This provides insight into how current practices may be influenced by experiences from the past and how future issues are anticipated.

3. The interview questions were semi-structured, and this enabled thematic analysis of the transcripts to undertake exploratory research into how conservation authorities learn to adapt to change.

4. A range of perspectives was obtained with professionals of various backgrounds, education and experience.

5. Staff, both internal and external to the organization, who dealt with watershed resource management were interviewed. This provided valuable insight into knowledge creation and the building of adaptive capacity across governance structures.

6. Robustness was achieved through stringent procedures for generating and managing transcripts, thereby enhancing the dependability of the transcripts (Miles and Huberman 1994).

Given the use of SSHRC project-generated transcripts, this study is able to explore a broad range of management practices to achieve a sense of the possible range of factors influencing the knowledge creation and adaptation strategies across organizations. The details of this project, in terms of the pilot study, case study selection and data collection procedures, are described below.

Pilot Study

The three year project, *Organizational Knowledge Creation for Watershed Management,* began with a pilot study funded by a University of Waterloo SSHRC grant in 2002, ORE #10238. The intent of the pilot study was to test the applicability of Nonaka and Takeuchi's (1995) five enabling conditions and seven requirements for creating organizational knowledge in the Grand River Conservation Authority (Goucher and Michaels 2003, 2004). The author of this thesis was part of the research team that conducted ten interviews with employees. The study participants were asked to describe how each of the following enabling conditions may apply to the Grand River Conservation Authority:

- Commitment and intention
- Autonomy
- Fluctuation and creative chaos

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- Requisite Variety
- Redundancy

They were also asked if the Grand River Conservation Authority has the capability to:

- Identify information they need
- Do something with the information once it has been gathered
- Re-categorize information
- Leverage tacit knowledge
- Socialize tacit knowledge
- Amplify knowledge across multiple levels
- Enhance the enabling conditions

Two important lessons from the pilot study are salient to the methods employed to generate information analyzed in this thesis. First, it is not effective to present participants with pre-determined constructs and ask them to comment on theoretical concepts with which they are understandably not familiar. Second, interviewees need to be able to tell their own stories of how knowledge is created using their own language. As a result, interview questions for the comparative case study SSHRC project were open-ended and designed to encourage participants to tell stories about how issues were managed.

Identification of Case Studies

As part of the SSRHC project, five conservation authorities were selected: Credit Valley Conservation (CVC), Grand River Conservation Authority (GRCA), Maitland Valley Conservation Authority (MVCA), Nottawasaga Valley Conservation Authority (NVCA) and Toronto and Region Conservation Authority (TRCA). All five conservation authorities were investigated as part of the research for this thesis to enhance robustness of the results by demonstrating applicability of the theoretical framework across case studies. The case studies represent various contextual backgrounds.

Issue Selection

The SSHRC study focused on three issues within watershed management to investigate organizational knowledge creation within individual conservation authorities. Three issues emerged as salient from the pilot study: flood damage reduction, low water response and source water protection. They represent diversity in terms of longevity of concern, existence of scientific and technical knowledge, public attention, institutional arrangements and available organizational resources.

Interview Process

Interviews were conducted with 64 experts associated with five conservation authorities between October 2003 and December 2004 (see Appendix B). Interviews were chosen as an appropriate method for targeting specific topics and obtaining in-depth insights from those closest to the phenomenon (Yin 2003). Depending on the size of the conservation authority, between 9 and 19 interviews were conducted with conservation authority staff and staff in other organizations that work closely with at least one of the five case study authorities. Of the 64 interviews, 41 were conducted with conservation authority staff and 23 were held with partner organizations. Researchers interviewed a wide range of personnel including managers, chief administrative officers, water resource coordinators, engineers, planners, hydrogeologists and ecologists. Personnel were questioned about problems they must address, how the authority addresses them and what enables and hinders their ability to affectively undertake water resource management (see Appendix A for interview questionnaire). As mentioned earlier the interviews focused on three specific areas of water management and gathered information relevant to past, present and future management practices (Michaels *et al.* 2006b). The flexibility of semi-structured interviews over structured interviews allowed the interviewer to probe deeper into certain areas or follow interesting leads while ensuring the questions stay on track (Gray 2004). Altogether, staff dedicated over 96 hours of time to this research project, equivalent to 2.5 work weeks. Interviews ranged from 35 to 140 minutes and averaged 90 minutes overall (Michaels *et al.* 2006b). Appendix B lists interviewee identifier codes which are used in this thesis to refer to participant comments anonymously.

Managing and Recording the Interview Transcripts

During the interview process, at least two members of the SSHRC research team were present at each interview. The author of this thesis participated in 45 interviews. Using a laptop computer, one team member took electronic notes while the other member(s) recorded the discussion with paper and pen. Note taking was chosen over tape recording to encourage respondents to remain attentive to the conversation, to encourage candid conversations and to save time and costs associated with transcription (Hughes 2002). The importance of these considerations, under the circumstances, led to the decision not to use tape or digital recorded transcription. Note taking also allowed researchers to record commentary and contextual aspects

of the interview outside of the responses to questions (Arthur and Nazroo 2003). Without verbatim transcripts, results are discussed using paraphrased comments and no quotations. Another limitation of not having verbatim notes is not having access to the exact language and terminology used by the study participants. The consequences of this have been mitigated by not attributing analytical value to terminology, but instead focusing analysis on the meaning, patterns and context attached to the stories told by the interviewees.

Preparing the Transcripts

Following each interview, transcript notes were immediately reviewed to ensure all ideas were accurately captured. Notes were amended for intelligibility by clarifying statements and expanding personal abbreviations or annotations to ensure all comments were true to the interview and clear to those research members not present. Once amended individually, the notes of all team members in attendance were compared to create the most complete set of notes possible. Transcripts were renamed with standard file names and then converted to rich text format and entered into a qualitative analysis software program, QSR NVivo.

2.2.2 Review of Conservation Authorities

It is critical in a case study approach to provide context and background information on the case studies (Yin 2003). To outline the context and conditions which may influence the applicability of the facilitating conditions to the case study conservation authorities, the third chapter provides an in-depth description of the contextual background information that may have influenced the learning and adaptation processes of conservation authorities. Such information includes key historical, geographic and political factors that, according to the literature, have influenced the management of water resources. Specific details for each of the five case study conservation authorities are also provided.

2.2.3 Develop a Theoretical Framework

The third step in the research procedure was to develop a theoretical framework of facilitating conditions of organizational knowledge creation and adaptive capacity. According to Yin (2003), theoretical frameworks clearly outline the context and conditions in which the

phenomenon is likely to be found and become the vehicle in which the results of the study can be generalized to new cases.

In this research, the literature used to develop the theoretical framework is described in chapter four and the framework used to guide data analysis is presented in chapter five. The framework lists conditions that facilitate organizational knowledge creation and adaptive capacity. It was developed based on a multidisciplinary literature review. This theoretical framework influenced the data analysis process, as described below and served as a heuristic tool for constructing concepts that were elaborated and modified on the basis of analysis of the empirical data (Richardson 2006).

2.2.4 Analysis

The fourth step in the research procedure was for the author of this thesis to conduct an analysis of the case studies. Analysis involved becoming familiar with 685 pages of transcripts to identify stories told by the study participants. In this way, a deductive approach was used to identify discussions that provided specific insight into how and why facilitating conditions influence knowledge creation and adaptive capacity in the conservation authorities. Deductive reasoning, as opposed to inductive reasoning, refers to beginning the analysis process with a general, logical argument and working backwards to find supportive evidence (Gray 2004). At the same time that evidence was sought to support the theoretical framework, the detail and context of the interviewee stories was maintained to enhance the theoretical framework and contribute insight into how the specific concepts facilitate knowledge creation and adaptive capacity. The researcher used a qualitative analysis software program to support this analysis process.

QSR NVivo

The transcripts were analyzed using a computer-assisted qualitative data analysis software (CAQDAS) called QSR NVivo. The software reduced analysis time and systematized procedures while remaining flexible enough to allow the data to be organized and reorganized in a variety ways (Miles and Huberman 1994). While qualitative analysis software can usually do simple counts, the heart of the analysis is done by the researcher in the form of understanding the meaning of the text. NVivo is essentially a database that stores and handles the data, allowing the

researcher to keep records of hunches, ideas, searches and analysis (Gibbs 2002). As a result, the analysis process was iterative, recursive, dynamic and time consuming.

Critics argue qualitative analysis software creates distance between the researcher and data (Gibbs 2002). NVivo addresses some of these concerns by allowing the researcher to easily jump to and from the original complete transcripts and the coded text. This ability to maneuver through the text facilitates improved understanding of how interview comments relate to nodes while retaining original meaning and context (Gibbs 2002). NVivo eased the process of locating and highlighting stories illustrating the use of facilitating conditions in conservation authorities.

Coding with NVivo

Qualitative data coding organizes and manages the original data into groups where the data is tagged with a representative title. "Coding is the process of identifying and recording one or more discrete passages of text or other data items…that, in some sense, exemplify the same theoretical or descriptive idea" (Gibbs 2002, 57). NVivo allows you to connect passages to a node, which can have an associated name or shorthand for the representative idea. Consequently, the software makes it convenient to make connections between codes to develop higher order classifications and categories to formulate theory, assertions and conceptual frameworks that fit the data (Miles and Huberman 1994).

Nodes in NVivo can be organized according to hierarchies. The nomenclature in NVivo is derived from a family tree. The set of hierarchically organized nodes is called a "tree." The first category is the "root" idea and from the root, subcategories are called "children." Categories at the same level are called "siblings." Tree nodes are helpful in organizing ideas, keeping things tidy and in representing conceptual ideas and interconnected relationships (Gibbs 2002).

Plan of Analysis

The purpose of the analysis was to determine if the interview transcripts could provide practical insight into the theoretical framework. Systematic analysis of the interview transcripts took place in two phases, initial coding and focused coding, a method proposed by Lofland and Lofland (1995). With initial coding, the researcher becomes orientated with the data, using his or her skills, knowledge, commitment and expertise to understand the content of the data. The

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initial coding strategy involved basic coding and open coding techniques. These steps were essential in preparing the data and the researcher for the next phase of analysis.

Focused coding is described by Lofland and Lofland (1995) as a process of narrowing analysis to highlight relevant concepts to the topic being investigated. It involves the winnowing out of less productive or useful codes to allow the researcher to elaborate and reflect on the most useful concepts and bring together overarching ideas and propositions that contribute to the prominent topic of the study. The focused coding for this study was conducted in a series of four different "cuts" through the data to capture the stories, statements or ideas applicable to the theoretical conceptual framework.

2.2.5 Interpretation of Findings

The final step in the research procedure was to interpret the findings. Initial and focused coding techniques produced a total of 252 pages of output. Results were collectively reviewed and stories illustrating the application of facilitating conditions in water management were organized as they related to the theoretical facilitating conditions. Together, these stories provide insight into how conservation authorities create organizational knowledge and adaptive capacity through the facilitating conditions, from the perspective of those closest to the organization. While the results are not able to measure the relative importance of each of the conditions to the conservation authorities, the detailed descriptions and context maintained by using a case study approach provide insight into the theoretical framework.

This step also included a review of the results from each case study to determine the extent of replication logic, or the applicability of the theoretical framework across the case studies. Such replication is considered to enhance the robustness and worthiness of the investigation (Yin 2003). Within this study, the extent to which facilitating conditions were recognized as valuable by participants were compared across conservation authorities. The results are described in chapter six.

2.3 Research Standards

The above section describes the research procedure employed to undertake this study. This section describes how research standards were maintained throughout the qualitative, exploratory

study through two types of validity: objectivity and dependability (Lincoln and Guba 1985, Miles and Huberman 1994). First, consistency was maintained through use of qualitative data analysis software, QSR NVivo. The software helps to systematize analysis procedures by providing a platform for organizing and storing data, allowing the researcher to keep intricate records of hunches, ideas, searches and analysis (Gibbs 2002). It is recognized that researcher biases towards constructionism has developed results that emphasize what those close to the organization believe is influential on the basis of context and experience.

Second, dependability or reliability of the results and findings were achieved through triangulation (Denzin and Lincoln 2000, Miles and Huberman 1994). In this research, reliability is strengthened through triangulation, which refers to the use of "multiple methodological practices, empirical materials, perspectives, and observers in a single study…[to] add rigor, breadth, complexity, richness and depth to any inquiry" (Denzin and Lincoln 2000, 5). As described in the research protocol above, this research used multiple interviews in each of the case studies to achieve a broad understanding of the how conservation authorities learn and adapt, from various perspectives of those closest to the situation. Another mode of triangulation applied in this research is to use various methods of analysis (Lincoln and Guba 1985). By using various coding techniques to take different "cuts" through the data, the analysis process ensured that the same sources of evidence were identified despite the use of different coding techniques.

2.4 Chapter Summary

This chapter describes the methodology and methods used to identify and describe facilitating conditions for organizational knowledge creation and adaptive capacity in conservation authorities. A constructionist perspective establishes the orientation of the research, to focus on improving understanding of facilitating conditions of organizational knowledge creation and adaptive capacity based on insights from water resource practitioners. A qualitative, exploratory, case study approach was used to investigate the context in which select conservation authorities facilitate knowledge creation and adaptive capacity.

The research procedure involved five steps. The first step was to identify appropriate case studies and a data collection procedure. For this, the author of this thesis collaborated with a research team to generate transcripts well suited for analysis of organizational knowledge creation and

adaptive capacity in conservation authorities. The second step involved investigating the context in which these organizations create organizational knowledge and adaptive capacity. The third chapter summarizes the conservation authority mandate as well as historical, geographic and political factors. The third step of the research strategy was to develop a theoretical framework of facilitating conditions of organizational knowledge creation and adaptive capacity in natural resource management organizations. The literature used to develop the framework is described in chapter four, while the facilitating conditions are presented in chapter five. The fourth step involved analyzing the interview transcripts to identify insights water resource practitioners can offer regarding the application of the facilitating conditions to water management in the five case study conservation authorities. The final step was to interpret the findings and summarize the insights developed through the use of the theoretical framework. The results are presented in chapter six. The next chapter presents the results of the second step of the research strategy by providing a detailed description of the mandate, governance structure and history of conservation authorities to outline the context and conditions which may influence the applicability of the facilitating conditions to the case study conservation authorities.

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Chapter 3

Setting the Context:

A Review of Conservation Authorities

Conservation authorities are quasi-government organizations that plan, coordinate and manage water resources on a watershed basis. There are 36 conservation authorities in Ontario managing watersheds where 90% of the province's population resides. While all conservation authorities are governed by the *Conservation Authorities Act* (Conservation Ontario 2000), there is great variation in how these organizations conduct water management based on available resources and the context in which they function (Ivey *et al.* 2002, de Loe and Kreutzwiser 2005). Ontario's water management context is important to understand to begin to investigate the circumstances under which conservation authorities create organizational knowledge and enhance adaptive capacity. This chapter provides background information on the conservation authority mandate, water management program, water governance in Ontario and watershed-specific issues for each of the five case study conservation authorities.

This research focuses on five of the 36 conservation authorities in Ontario: Credit Valley Conservation (CVC), Grand River Conservation Authority (GRCA), Maitland Valley Conservation Authority (MVCA), Nottawasaga Valley Conservation Authority (NVCA) and Toronto Region Conservation Authority (TRCA). As described in the previous chapter, these five authorities were reviewed because they represent diversity in terms of socio-political and economic context, issues of concern and approaches to watershed management.

This chapter also explains why conservation authorities are well suited for an investigation of organizational knowledge and adaptive capacity. The first section describes the mandate of conservation authorities through an overview of the development of watershed-based, integrative resource management in Ontario and the role these organizations play in Ontario's water management framework. The overview serves to highlight two key reasons why conservation authorities were chosen as appropriate case studies. First, conservation authorities are collaborative organizations that work within a complex governance structure through networks of agencies including local and provincial governments, non-government organizations, private

sector and other public organizations. It is both a strength and a weakness that conservation authorities depend on a network of organizations (Connick and Innes 2003, Folke *et al.* 2005, Innes and Booher 1999a). Understanding knowledge creation and adaptive capacity in conservation authorities, therefore, requires exploration of internal organizational processes within each conservation authority as well as processes that occur across the network of agencies involved in water resource management.

Second, in managing on a watershed basis, conservation authorities plan and develop environmental policy within complex social-ecological systems where environmental, social and economic issues must be considered in decision-making. Watershed-based planning, therefore, has the advantage of using a holistic, integrated approach to planning and management that works towards recognizing interconnections between ecosystem components (Brandes and Ferguson 2004, Malone 2000, Mitchell 2002, Shriberg 2002, Slocombe 1998). Because conservation authorities manage on a watershed scale, they are well suited to conduct integrated resource management (Carter 2006) and to facilitate the building of partnerships at other scales of management.

3.1 Mandate of Conservation Authorities

Through their prescribed mandate, conservation authorities have an enabling institutional framework that supports adaptive capacity via their need for learning, collaborative approaches and watershed-based planning and management. The origin, mandate, and institutional arrangements of the business of conservation authorities and their role in water resource management are described in the following sections.

3.1.1 Origin of Conservation Authorities

Conservation authorities were established as a result of a movement towards watershed-based conservation in the early 1940s in Ontario. Problems such as flooding, soil erosion and poor water quality were increasing in severity and frequency across the populated areas of the province. As a result of a degrading environment, the provincial government worked with conservation groups to create the *Conservation Authorities Act* to establish local, watershed-based agencies to undertake conservation management on behalf of municipalities (McLean 2004, Mitchell and Shrubsole 1992). This section presents an overview of the development of the

Conservation Authorities Act, and the business of conservation authorities, focusing on three program areas: flood damage reduction, low water response and source water protection.

Ontario's approach to conservation was shaped by two conferences: the 1941 Guelph Conference and the 1944 London Conference (Etobicoke and Mimico Watershed Task Force 2002, McLean 2004, Mitchell and Shrubsole 1992, Richardson 1974, TRCA 2004c). Fear that the degree of environmental degradation would impair economic development anticipated for the post-war resurgence led to the Guelph Conference. One outcome of the conference was a pilot survey that would assess the condition of the Ganaraska watershed to suggest improvements and determine how much work could be generated for returning soldiers (Etobicoke and Mimico Creek Watersheds Task Force 2002). The resulting 1943 report, the Ganaraska Survey, "… became a landmark plan for watershed-based conservation" (McLean 2004, 5). It provided an outline for the comprehensive institutional framework necessary for watershed planning that considers the implications of environmental, social and economic factors at a watershed scale (Mitchell and Shrubsole 1992, Richardson 1974).

In 1944, Dana Porter, the Minister of the newly created Department of Planning and Development, held the London conference to consolidate responses to the Ganaraska Survey and confirm public support for a watershed approach to conservation in Ontario. This meeting served as the *"... most definitive action taken by government, leading directly to the passing of the Conservation Authorities Act*" (McLean 2004, 6). Suggestions from the conference, including that locally based conservation authorities be created, that conservation lands be purchased and that the province assist local conservancy projects, were closely followed in the drafting of the *Conservation Authorities Act*. The Conservation Authorities Branch was created in November 1944 within the Department of Planning and Development. The new branch drafted the *Conservation Authorities Act* and it was passed in 1946.

The *Conservation Authorities Act* is an important piece of legislation contributing to the ability of conservation authorities to adapt and apply a collaborative, integrative approach to managing the social-ecological system on a watershed scale. Collaboration is a central theme in the legislation, and influences most aspects of the business of conservation authorities including how they are established, financed and make decisions (Mitchell and Shrubsole 1992, Shrubsole 1996). The legislation allows municipalities within a watershed to decide if they want to set up

an authority. As a result, the establishment of an authority is dependant on the willingness of the local residents to financially support them. Once an authority is created, the legislation ensures continued collaboration through various sections that promote partnerships including section 21(1)(n), which provides authorities with the ability to *"... collaborate and enter into agreements with ministries and agencies of government, municipal councils and local boards and other organizations"* (*Conservation Authorities Act, 1990).* With regard to financing, the *Conservation Authorities Act* requires projects to be financed with cost sharing programs through provincial-municipal partnerships, meaning that initiatives put forth by the authority need to be supported locally (*Conservation Authorities Act* 1990, Mitchell and Shrubsole 1992). While financing arrangements have changed since the provincial government cutbacks in the mid 1990s, the idea of sharing the cost of resource management remains intact, as demonstrated by new funding announcements from the provincial government in 2004 (MOE 2004b). More details about the provincial government cutbacks will be provided below. With respect to decision-making, the legislation requires municipal representatives to serve on the authority's executive Board of Directors. The Board is responsible for decisions regarding the administration and operation of the organization. The representatives in turn liaison between municipalities and the Authority to keep their municipal councils informed as to the actions of the conservation authorities (*Conservation Authorities Act* 1990, GRCA 2006a). The relationship between conservation authorities and municipalities is described in more detail below.

The legislation is also powerful because it promots watershed management of natural resources. Conservation authority boundaries are generally delineated using watershed boundaries (Shrubsole 1996). The use of the watershed as the administrative unit has enabled authorities to implement an ecosystem based approach to managing land and water resources. This has facilitated the identification of the significance and sensitivity of the natural environment, appropriate areas to develop and required environmental management as well as the cumulative impacts of existing and future land use changes (MNR and MOEE 1993, Shrubsole 1996).

Watershed management also facilitates collaboration and management across municipal boundaries and promotes cross-boundary issues to be addressed in a more systemic and holistic manner than would otherwise be possible at a municipal scale (GRCA 2006a). For example,

municipalities must recognize not only the quality of water at the intake pipe for their water supply system, but also the quality of water they discharge back into the river. This is because the discharged water, in turn may become a source of drinking water for downstream communities. Watershed-based management, therefore, allows authorities to influence the decisions of one jurisdiction for mutual benefit of all within the watershed (GRCA 2006a).

The *Conservation Authorities Act* enables those living in the watershed to be the ones to identify and mange issues as opposed to higher levels of government that may not be as in touch with unique local situations as those who have daily encounters with the environment. Local management enhances anticipation of change by enabling recognition of early signs of problems and through the development of past experience and knowledge of the local context (Folke 2003).

3.2 Water Management in Conservation Authorities

This section describes the general mandate of conservation authorities, followed by a review of the unique issues encountered by the individual case study authorities to familiarize the reader with water issues and management approaches of these organizations. It will illustrate how a collaborative approach to managing water on a watershed basis enhances the ability of conservation authorities to adapt management strategies and policies to overcome challenges in the past. This information will provide essential background necessary for understanding examples of organizational knowledge creation and adaptive capacity discussed in later chapters.

Under the *Conservation Authorities Act,* an authority's mandate is to:

> *"... establish and undertake, in the area over which it has jurisdiction, a program designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals." (Revised Statutes of Ontario, 1990, c. C. 27 s. 20)*

The *Conservation Authorities Act* empowers authorities to undertake research, acquire and sell land, control surface water flows, create regulations and prescribe fees and permits. They can regulate land they own and collaborate with stakeholders to carry out projects on lands they do not own. These powers are broad enough to provide authorities the flexibility to manage many

aspects of water management, including flood damage reduction, low water response and source water protection (Ivey *et al.* 2002).

Planning Responsibilities

Conservation authorities are also granted specific planning responsibilities. Watershed planning is an important part of their mandate as it guides long term management decisions and the interactions between land and water. Watershed plans, subwatershed plans and other technical documents are carried out by conservation authorities to address specific land use issues and impacts to protect, maintain and restore the health of watersheds (GRCA 2006a, MNR and MOEE 1993). While authorities lead the watershed planning process, they do not have legislative authority to implement recommendations through land use controls outside of floodplains and lands they own. As a result, they must work with local and provincial partners that have the ability to develop, implement and enforce land use policy (MNR and MOEE 1993). Issue-related planning functions associated with flood damage reduction, low water response and source water protection are described below.

3.2.1 Flood Damage Reduction

Flood damage reduction has been a core responsibility for conservation authorities since their inception and has served as an important connection between the authorities and the province through a continuously funded relationship (Conservation Ontario 2005, Shrubsole 1996). Flooding is one of the reasons for the establishment of each authority in this study. Conservation authorities are one of the key players in a broad provincial and national framework developed to protect communities from natural hazards and disasters such as flooding. The primary objective of a flood damage reduction program is to minimize social disruption and property damage in the watershed that may be caused by disturbances such as flooding, erosion, and unstable slopes (NVCA 2003b). This section provides an overview of the expertise these organizations have developed in creating partnerships, managing the river and land use on a watershed basis and adapting to evolving federal and provincial program priorities.

In Canada, responsibility for water management and flood programs falls under multiple jurisdictions. Under the Canadian constitution, provinces have primary responsibility for water resources and land use including flood plain management. The federal government retains

responsibility for reducing major disruptions to the economy and providing disaster assistance payments. The Canadian government, therefore, has an interest in reducing damage resulting from natural hazards. Over the years, federal water policy has had an impact on local approaches to flood management. The *Canada Water Conservation Assistance Act,* 1953 was the first federal policy to directly address water resource management. It enabled the federal government to assist provinces and municipalities in flood management, but only for the construction of water control and conservation works. Following a period of frequent flooding in the 1970s and significant disaster payments, water managers realized that structural projects to control flooding were expensive, offered a false sense of security and therefore did not discourage development in the floodplains (Environment Canada 2000).

The Flood Damage Reduction Program, 1975 under the *Canada Water Act* represented a change in attitude towards more comprehensive water management including non-structural alternatives to flood control. These policies enabled the federal government to assist a variety of water resource management programs and focused on prevention and non-structural approaches to flood damage reduction to reduce vulnerability to flooding (Environment Canada 2000).

The federal Flood Damage Reduction Program is implemented at the provincial level through Flood Damage Reduction Program Agreements. Details of the agreements are unique to each province and outline issues such as cost-sharing, mapping of flood risk areas, flood forecasting, structural controls and flood related studies. The Canada-Ontario agreement was signed in 1978 (Environment Canada 2000).

The signing of the Canada-Ontario agreement did not represent the beginning of the Ontario government's interest in flood damage reduction. The province had been developing a framework for dealing with future floods and natural hazards since areas around the City of Toronto experienced severe flooding when the remnants of Hurricane Hazel swept through the area, killing eighty-one people and causing over $180 million worth of damage in 1954 (Environment Canada 2004, MNR 2001). Hurricane Hazel is an example of an environmental disturbance that initiated policy change at the provincial and watershed levels (Michaels *et al.* 2006b). Protecting human life and natural resources through flood warning and forecasting is also one of the main objectives of the Ministry of Natural Resources (MNR 2003). As a result

the Ministry of Natural Resources worked closely with conservation authorities, following Hurricane Hazel, to implement this program based on three main elements:

1. Prevention – by providing information to planners and public to guide land use planning, regulating development within floodplains, predicting flows and water levels, operating flood control structures and communicating flood warnings;

2. Protection – through the use of flood control infrastructure and flood forecasting; and

3. Emergency preparedness and response – by working with the Ministry of Natural Resources to advise municipalities in preparing contingency plans

(TRCA 2004c)

Conservation authorities were designated lead agencies to implement this three-step approach primarily because they were able to take a holistic, watershed approach to mitigating floods (Mitchell and Shrubsole 1992, Richardson 1974, TRCA 2004c). The province has guided the direction of authorities through the *Conservation Authorities Act* and its regulations. Section 21 of the *Conservation Authorities Act* outlines responsibilities and powers of authorities regarding flood damage reduction including to build, maintain and operate reservoirs, dams, and other flood control structures; control the flow of surface waters to prevent floods; and prohibit, regulate or require permission of the authority to build within the flood lines if the development may impact flooding, erosion or dynamic beaches (*Conservation Authorities Act*, 1990).

There are also Fill, Construction and Alteration to Waterways Regulations pursuant to Section 28 of the *Conservation Authorities Act*. These regulations require property owner(s) to obtain a permit for alterations to watercourses, development within areas susceptible to flooding and the deposition of fill in an area that may affect the control of flooding or pollution. The establishment of these regulations aims to reduce impacts of flooding and erosion (NBCA 2005).

As lead implementing agencies for flood damage reduction in Ontario, conservation authorities work with numerous players to manage land and water on a watershed basis and have adapted to changing program priorities set by provincial and federal governments. Conservation authorities collaborate with the provincial government, municipalities and landowners to protect human lives and property from flood damage. This includes working with the Ministry of

Natural Resources to manage flood forecasting and warning through stream gauges, weather stations and rain gauges. Authorities also work with municipalities and landowners to establish emergency and communication plans and to regulate land use activity within vulnerable areas. (Conservation Ontario 2000, Conservation Ontario n.d. c. 2004, MNR 2003)

Changing federal and provincial approaches to flood damage reduction have resulted in explicit recognition of the value of managing land and water on a watershed basis to reduce vulnerability to hazards (Environment Canada 2000). This change has meant that some authorities who originally focused on operating structural flood control works have had to adapt organizational strategies to also manage non-structural components of the flood program. This involved expanding their expertise to include land use planning, watershed stewardship and community education to understand land and water dynamics of the watershed system including the relationship between social and ecological components (de Loe and Wojtanowski 2001). Overall, the flood damage reduction program represents the ability of conservation authorities to work with various partners to manage a wide variety of socio-ecological issues on a watershed basis (TRCA 2004c).

3.2.2 Low Water Response

The Low Water Response program is a new program in Ontario relative to flood damage reduction. The Ontario Low Water Response Plan was first released by the provincial government in 2000. Subsequent versions were released in 2001 and 2002. The plan describes a strategy for managing low water situations that incorporates local water users and concerned stakeholders into the decision making process. The plan includes indicators to measure the level of drought, general priorities for water use and a general response framework (MNR 2001, MNR 2002).

Conservation authorities are involved in low water response both as technical experts on low water conditions and as facilitators and coordinators of local response. However, other than through the operation of dams and reservoirs controlling water supply, authorities have little direct control over water supply because they do not manage water allocation, make final decisions regarding water permits or regulate sensitive recharge areas they do not own (GRCA 2006a, Ivey *et al.* 2002). Instead, authorities must work with the Ministries of Natural Resources

and Environment to monitor low water conditions, identify the severity of low water, identify local water supply needs, implement local action and monitor effectiveness of management strategies. Conservation authorities are also responsible for establishing Water Response Teams consisting of local stakeholders to implement actions and direct management and use of water. Local teams are composed of representatives from municipal, provincial, First Nations, and local agriculture, industry, recreation, and resource management interests (MNR 2002). Conservation authorities facilitate the activity of these teams to promote locally driven solutions that are appropriate responses for the unique hydrological, social and economic features of the watershed. In becoming involved in the low water response program and developing low water response teams, conservation authorities have demonstrated their adaptive capacity to undertake new responsibilities, and to become facilitators and coordinators of local action. Furthermore, because of lack of jurisdiction in low water response, authorities have to be resourceful to address such issues (Ivey *et al.* 2002).

3.2.3 Source Water Protection

Most recently, conservation authorities are expanding their expertise into source water protection (*Clean Water Act*, 2006). Source waters include water that serves as existing or potential drinking water supplies and may include surface waters, aquifers and groundwater recharge areas. Source water protection therefore consists of practices to prevent, minimize or control activities and potential contaminants that may impair the quality of drinking water sources. Such practices may consist of land use planning, risk assessments, best management practices, municipal by-laws, incentive programs and education programs among other actions (Groundwater Foundation 2006, CCME 2006).

Source water protection became a priority for the Ontario government following the Walkerton event. In May 2000, the drinking water supply in the small southern Ontario town of Walkerton became contaminated primarily with Escherichia coli O157:H7. Over 2,300 people became ill and seven people died (O'Connor 2002). As a result of the contamination and the loss of public trust in the quality of municipal drinking water, the province initiated a judicial inquiry into the tragedy, led by Justice Dennis O'Connor. There are two parts to the inquiry, the first addresses circumstances that caused the outbreak; the second investigates how to prevent future outbreaks. To write Part II, Judge O'Connor sought the advice of a wide variety of groups with

expertise in water management. Conservation Ontario and the Grand River and Saugeen Valley Conservation Authorities had official standing in the inquiry. Judge O'Connor incorporated the views of the authorities and others into his report and recommended that source water protection be watershed-based. As a result, source water protection in Ontario will include the development of source protection plans to address management of water resources and human activity (Conservation Ontario 2005, O'Connor 2002).

Completed in May 2002, the inquiry concluded that the province should implement a multi-barrier approach to ensuring safe drinking water, the first step being source water protection. To implement this recommendation, the province was in the process of developing a *Clean Water Act* at the time of the interviews. This statute was passed October 19, 2006. Initial drafts of the regulations suggest that conservation authorities will play a key role in source water protection specifically in coordinating the development of new scientific knowledge on source waters and in facilitating source protection through watershed-based planning and more specifically through source water protection plans (GRCA 2006b). Provincial interest in source water protection represents a return of the provincial government to watershed management issues which has been absent since the mid 1990 provincial cutbacks. More information about how the cutbacks have affected the relationship between conservation authorities and the province is provided below.

The *Clean Water Act* (2006) and associated regulations require that authorities be grouped into source protection regions where two or more authorities will work together to develop watershed-based source protection strategies. Authorities will not directly implement recommendations, but will work closely with municipalities to address threats to drinking water sources (MOE 2006).

Managing at a watershed scale has given conservation authorities an advantage that has proven valuable. They are recognized as logical entities to develop source water protection plans over other agencies such as municipal and regional governments in the Walkerton inquiry. Judge O'Connor (2002) recommended that source water protection be conducted on an *"... ecologically meaningful scale, that is a watershed basis… [because] impacts on water resources are integrated within watersheds, not municipalities"* (O'Connor 2002, 90). O'Connor (2002) also recommended transparency and municipal, provincial and public input into the planning process.

This requires conservation authorities to apply their experience at collaboration and working closely with the public to source protection planning.

The source water protection program represents change for conservation authorities in a number of ways. First, they have had to adjust to a change in the level of provincial interest in watershed issues. More about this is discussed later but essentially the province has once again increased funding for conservation authorities (Conservation Ontario 2004). Second, they have not only adjusted to policy enacted by the province but have taken steps to influence the framework that guides their work by participating in the Walkerton inquiry. Third, authorities are also adapting to a changing financial and organizational structure as funding will go to groups of authorities instead of individual organizations.

Altogether, through their mandate and more specifically through flood damage reduction, low water response and source water protection, conservation authorities have collaborated with partners to manage social and ecological issues on a watershed basis and demonstrated an ability to adapt to various program needs. Authorities have a broad role in watershed management and are involved in monitoring watershed conditions, developing watershed plans, and guiding land use development. The ability to be flexible and undertake new issues such as source water protection is partially achieved through the broad mandate provided under the *Conservation Authorities Act* and partially through their ability to collaborate with other agencies and the public to undertake watershed management.

3.2.4 Summary: Water Management in Conservation Authorities

This discussion of the conservation authority program suggests that these organizations must continuously learn to adapt to changes from all levels to undertake innovative water management. Being required to manage on a watershed scale has assisted them in applying an integrated and holistic approach to water management. While authorities often lack the power to implement and enforce their recommendations and strategies (Ivey *et al.* 2002), the governance structure encourages authorities to work with other agencies to accomplish tasks such as planning and designing storm water management, improving management of water in a drought situation and protecting drinking water from non-point source pollution. This is beneficial in diversifying sources of funding, sharing information and knowledge, and involving numerous

stakeholders in moving towards their mandate. However, dependency on others to adequately manage water resources can also have drawbacks, such as slowing decision-making and increasing bureaucracy. This information provides a foundation for the following discussion regarding the context within which the case study conservation authorities must manage water resources.

3.3 The Water Resources Playing Field in Ontario

Conservation authorities manage water resources within a dynamic playing field of constantly evolving players (organizations with a role to play in water management) and context. The water governance framework is important to understand to understand who conservation authorities must work with to manage water resources and how this influences their capacity to create knowledge and adapt. The state of the playing field has changed from 1946 to present day through key events that have defined the formal relationship between conservation authorities and the provincial and municipal governments: the development of the *Conservation Authorities Act* and the associated delegation of responsibility to local agencies; the provincial government cutbacks in the mid 1990s corresponding with the increasing municipal role in conservation authority activity; and the return of provincial interest in local watershed planning by conservation authorities and municipalities as a response to the Walkerton crisis. The evolving nature of the relationships between the agencies significantly influences the institutional dynamics of conservation authorities including lessons learned, cultures and routines. The capacity of authorities to adapt, collaborate and manage the social and ecological components of the watershed depends, in part on the nature of the relationships across the provinces, municipalities, watershed residents and conservation authorities.

One formal key event in the history of conservation authorities was the passing of the *Conservation Authorities Act*. Through this Act, the Provincial Legislature created conservation authorities to conserve, restore and ensure responsible management of Ontario's water, land and natural habitat on a watershed basis (Conservation Ontario 2000). As discussed above, this broad mandate has enabled conservation authorities to adapt to changing priorities in water management, form collaborative networks and develop programs to balance human, environmental and economic priorities on a watershed basis. To achieve this mandate,

conservation authorities work closely with other agencies in Ontario that have responsibility for water management. For a list of general areas of responsibility, see Table 3.1.

Table 3.1 List of Provincial Agencies in Ontario with Water Management Responsibilities

Ontario Agency	Water-related Mandate(s)
Ministry of the Environment (MOE)	Water quality, water allocation and source water protection
Ministry of Natural Resources (MNR)	Fisheries, forestry, public lands and the conservation authority program
Ministry of Agriculture, Food and Rural Affairs (OMAFRA)	Diffuse pollution sources
Ministry of Municipal Affairs and Housing (MMAH)	Land use planning policy
Ontario Clean Water Agency (OCWA)	Water supply

Adapted from Shrubsole 1996

At times, the numerous agencies responsible for various aspects of water management in Ontario along with the broad conservation authority mandate has created confusion about the specific roles and responsibilities for the organizations involved in water programs. For instance, in 1993, it was estimated that the inefficiencies associated with overlapping institutional arrangements in water management were over $100 million (ACAO 1993). A lack of definition in the roles and responsibilities for organizations involved in water resource management can create tension within working relationships requiring time and effort to be placed on determining responsibilities instead of addressing problems.

In Canada, the provincial governments have primary jurisdiction over most areas of water management and protection including flow regulation, authorization of water use development, water supply, pollution control and thermal and hydroelectric power development. In Ontario, water management is primarily managed through the Ministries of Environment, Natural Resources, and Agriculture, Food and Rural Affairs which regulate, set standards, monitor and manage data, train and educate, coordinate and fund projects (Environment Canada 2006, Ivey and Rush 2003). These ministries have the power to delegate some of their responsibilities to municipalities and conservation authorities. For example, flood damage reduction programs have been delegated to conservation authorities by the Ministry of Natural Resources (MNR 2001).

Provincial ministries have delegated some responsibility for water management to municipal and regional governments primarily related to the ownership and operation of public water and wastewater systems as well as land use planning. These responsibilities mean that municipalities have the most direct authority over issues such as source water protection and consumption or use of water from municipal supplies. To regulate water, municipalities can pass by-laws, implement official plan policies and incentive-based programs to protect water, educate residents, encourage water conservation or limit water use (Ivey and Rush 2003).

While municipalities do not delegate responsibilities to conservation authorities as the province does, they have direct influence over decision-making, setting of policy priorities and financial provisions of authorities. Member municipalities are involved in decision-making and policy direction through their elected representatives who sit on the Board of Directors of each conservation authority (Ivey *et al.* 2002). The board makes the decisions regarding administration and operation of the organization and approves programs and policies which staff members implement. Through this process, board members are responsible for representing the interests of their municipalities, considering goals and requirements of the conservation authority and serving as a medium of communication between local jurisdictions and the conservation authority. Most board members are elected with each local election. This means that conservation authorities, along with local governments, must adjust to a potentially new set of decision-makers every three years. It can be challenging for authorities because the level of leadership can vary greatly and they know little about the priorities, interests and level of knowledge about watershed issues of the new members (Ivey *et al.* 2002). Municipalities also play a key role in determining the financial capacity of authorities by contributing annual municipal levies as well as special levels for projects which directly benefit a jurisdiction (GRCA 2006a, NVCA 2004).

Conservation authorities, local and provincial governments as well as the federal government, to some degree, are all players in water resource management in Ontario. The regulatory framework is set by the province but local governments also influence watershed management through land use planning, the conservation authority board and financial provisions. As a result, authorities are not independent entities and must work with their key partners to manage their water programs such as flood damage reduction, low water response

and source water protection. As a result, they are vulnerable to change at the provincial and municipal levels. The degree of dependency was made clear when the provincial government decided to cut funding to conservation authorities in the mid 1990s (Shrubsole *et al.* 1997).

In the mid 1990s, the Conservative party of Ontario gained power by running on a platform of what it proclaimed would be a 'smaller government' and balanced budgets, sometimes referred to as the "Common Sense Revolution". The new government redefined municipal and provincial responsibilities, resulting in the downloading of many planning and water management programs to the municipal level. For conservation authorities and other environmental agencies, the attempts to achieve balanced budgets had severe consequences. The budget for the Ministry of Environment was cut 44% between 1995-1996 and 1997-1998. Furthermore, operating grants to conservation authorities from the Ministry of Natural Resources were reduced by 42% in the same period (Kreutzwiser 1998, de Loe and Kreutzwiser 2005). The degree of cutbacks during this period was unprecedented, and caught some authorities off guard forcing quick reaction (Michaels *et al.* 2006).

Conservation authorities reacted in a number of ways. By 2000, they had between 50% and 75% fewer employees than they had prior to the 1995 provincial election (Clark and Yacoumidis 2000). They also diversified sources of funding to include more self-generating activities in addition to municipal levies and senior government grants (Ivey *et al.* 2002). During the time between the provincial cutbacks and the funding announcement for source water protection, the only source of funding from the province was for the flood control program and taxes on provincially designated environmentally significant lands (Shrubsole *et al.* 1997). As a result of the provincial cutbacks, authorities increased reliance on municipal funding and the local government became one of the most important partners in watershed management with authorities (Ivey *et al.* 2002).

In May 2000, the Walkerton crisis was an impetus for change in the relationship between conservation authorities and the provincial and local governments. The tragedy led to several changes in water management in Ontario, including the decision to ensure sources of drinking water are protected using a watershed management approach (de Loe and Kreutzwiser 2005, Michaels *et al.* 2006b). However, even if source protection plans are completed on a watershed basis and facilitated by conservation authorities, the Ministry of Environment indicates that local

government will play a key role in implementing the plans and addressing the risks to drinking water through land use planning regulations (MOE 2004a).

Another significant change has been that the provincial government is once again taking interest in local water management issues other than flood damage reduction. Following the mid 1990 cutbacks, the provincial government was only providing conservation authorities with funding for some flood damage control and taxes on provincially designated environmentally sensitive areas (Shrubsole *et al.* 1996). On November 17, 2004, the provincial government announced $13 million in new funding to assist conservation authorities and their partners in source water protection (MOE 2004b). Along with this funding, however, the provincial government retains more control over conservation authority activity and spending than before. This may be a limitation for authorities in that it could reduce their flexibility and level of independence.

These events illustrate the evolution of relationships between conservation authorities and their key partners. It is evident that the nature and degree of relationships are defined by external influences such as the regulatory framework, established through legislation such as the *Conservation Authorities Act*, events such as Walkerton and institutional procedural events such as provincial and municipal elections. These external influences affect organizational culture, routine and learning practices by affecting financial provisions, policy direction and decision-making processes. The nature of the relationships between all three players has been dynamic and as a result, conservation authorities have had to adapt in a number of ways to adjust to a complex institutional environment, fluctuating government support and reduced funding.

A review of these events also demonstrates that while collaboration between various agencies is required to move towards sustainable resource management (Connick and Innes 2003, Folke *et al.* 2005, Innes and Booher 1999a, Margerum and Whitall 2004, Olsson *et al.* 2004), it can also be a challenge to work within a tightly connected network of organizations. For conservation authorities, collaborative water management within a complex playing field has been both a strength and a weakness. Surprise at one level in the network can affect other closely-associated organizations, as was the case with the 1995 provincial cutbacks. An election at the provincial level not only changed the way business was done in the ministries but also in local agencies including conservation authorities (Ivey *et al.* 2002, Michaels *et al.* 2006). On the other hand,

collaboration has been useful for conservation authorities in obtaining funding from a variety of sources, as prescribed in the *Conservation Authorities Act*. With the financial arrangement outlined in the Act, local projects must be financially and environmentally sound to obtain the support of all parties, ensuring agencies with various points of interest work together to facilitate the development of strong working relationships (Mitchell and Shrubsole 1992, Shrubsole 1996). However, it can be challenging to be dependant on other organizations and at times may create a conflicts of interest. This is true of the relationship with municipalities who both financially support authorities and at times require their approval for development.

3.4 The Five Case Study Conservation Authorities

This study investigates conditions for knowledge creation and adaptive capacity within five conservation authority case studies in southern Ontario (Figure 3.1). Conservation authority management practices are influenced by different contextual and institutional circumstances, as outlined in tables 3.2 and 3.3. As demonstrated below, the five case studies investigated are different in terms of dominating land use activities, total population figures, residential densities and access to financial resources (Table 3.2). While all authorities address flooding, low water and source water, there are inconsistencies in the route of the problem, solutions available and level of concern that exist across the case studies. These variations demonstrate different pressures and incentives for learning. Therefore including a range of case studies in this research is valuable for investigating circumstances in which conservation authorities enhance organizational knowledge creation and adaptive capacity processes. Key contextual local issues for each case study are discussed next, followed by an overview of how each organization manages the three program areas that are the focus of this study: flood damage reduction, low water response and source water protection. The background information is provided to outline key aspects of the context with which learning takes place in each organization. See tables 3.2 and 3.3 for key institutional and geographic watershed characteristics for each of the cases study conservation authorities.

Figure 3.1 Map of Case Study Conservation Authorities

Case Study Conservation Authorities
in Southern Ontario
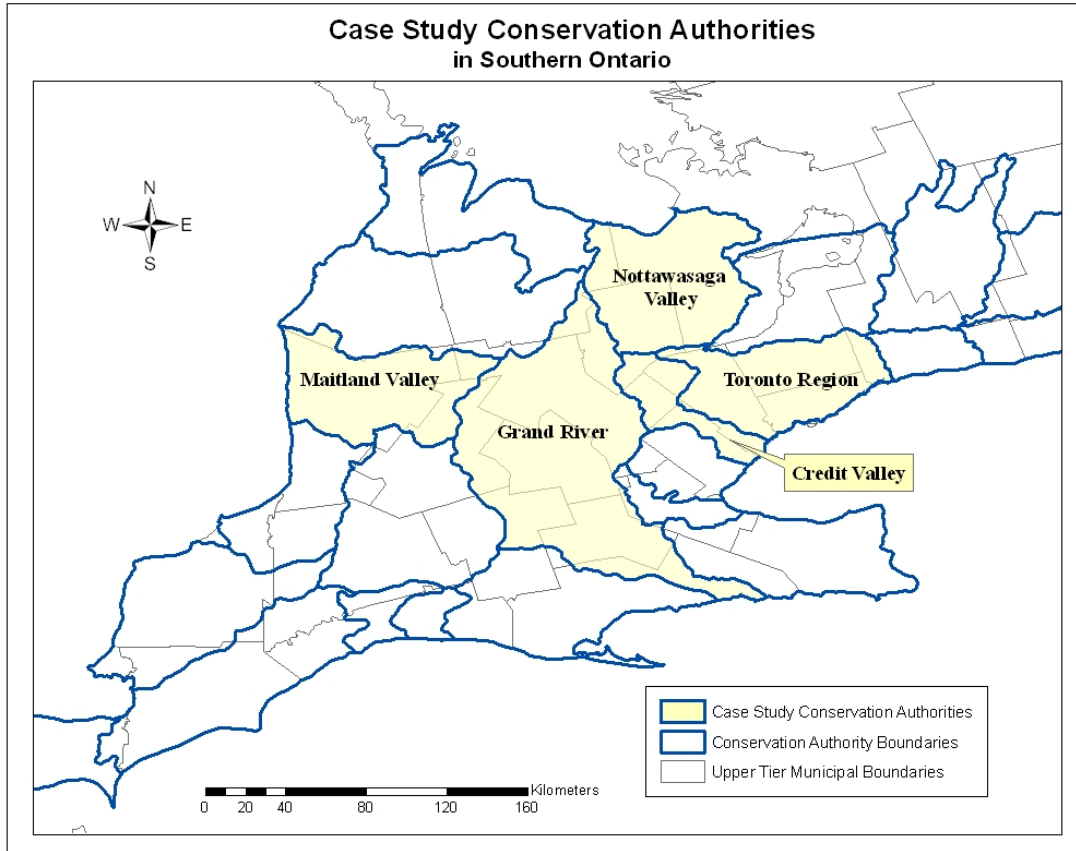
Table 3.2 Basic Organizational Characteristics of Case Study Conservation Authorities

	CVC	GRCA	MVCA	NVCA	TRCA
Size of Jurisdiction (Sq. KM)	1000[1]	7000[3]	3260[6]	3361[8]	2492[11]
Percent Urbanized	21%[1] (2004)	10%[3] (2002)	Unknown	3.74%[9] (1998-2002)	48%[11] (2002)
Population	565,855[1] (2004)	875,000[4] (2004)	60,000[6] (2004)	171,479[9] (2005[1])	1.7 million[12] (2001)
Budget (2004)	$9.5 million[2]	$20.7 million[5]	$1.7 million[7]	$2.4 million[10]	$56.4 million[11]

References: 1. CVC 2004b 2.CVC 2004a 3. Ivey 2002 4. GRCA 2004b 5. GRCA 2004a 6. Rush 2003 7. MVCA 2004 8. Department of Energy and Resources Management 1964 9. Personal Communication, T. Salkeld, August 21, 2006 10. NVCA 2004a 11. Personal Communication, D. Clayton, December 4, 2006 12. Personal Communication, L. Turnbull, December 4, 2006 13. TRCA 2004a

[A]All effort was made to find a population figure for 2004, however it is not available.
[B]This is a very rough estimate based on approximate census tract information and not by watershed boundaries. Population data is not calculated for TRCA's jurisdiction.

Table 3.3 Geographic Watershed Characteristics of Case Study Conservation Authorities

	CVC	GRCA	MVCA	NVCA	TRCA[A]					
Main River(s)	Credit River	Grand River	Maitland River	Nottawasaga River	Humber River	Etobicoke (E) and Mimico (M) Creeks	Don River	Duffins (D) and Carruthers (C) Creek	Highland Creek	Rouge River
River Length (KM)	90[1]	310[2]	150[3]	121.5[4]	120[6]	E - 60[8] M - 33[8]	38[9]	D - 49KM[10] C - 20KM[9]	74[13]	55KM[11]
Watershed Size (Sq.KM)	1000[1]	7000[2]	2500[3]	3361[4]	903[7]	E - 211[8] M - 77[8]	360[9]	D - 232[11] C - 38[11]	102[13]	336[14]
Approximate Location of Headwaters	North of Niagara Escarpment[1]	Near town of Dundalk[2]	Near Arthur Township[3]	Moraines of Amaranth Township[5]	Oak Ridges Moraine and Niagara Escarpment[6]	Southern portion of Oak Ridges Moraine[8]	York Region in Oak Ridges Moraine[9]	D - Oak Ridges Moraine[12] C - Halton Till[12]	Toronto and Southern Markham[13]	Oak Ridges Moraine[14]
Approximate Location of River Outlet	Into Lake Ontario at Port Credit[1]	Into Lake Erie at Port Maitland[2]	Lake Huron at Goderich[3]	Georgian Bay[5]	Lake Ontario at Humber Bay[6]	Lake Ontario[8]	Lake Ontario[9]	C - Lake Ontario through Carruthers Marsh[12]	Lake Ontario[13]	Lake Ontario at Rouge Beach[14]
Major Urban Areas	Mississauga, Brampton, Caledon and Orangeville[1]	Kitchener, Waterloo, Cambridge, Guelph and Brantford[2]	Goderich, Wingham, Harriston, Listowel and Clinton[3]	Barrie, Collingwood and Wasaga Beach, New Techumseth and Alliston[5]	Town of Caledon, King City, Toronto and Vaughan[6]	Caledon, Brampton, Mississauga, Toronto[8]	Toronto[9]	Toronto and Durham Region[12]	Toronto[13]	Toronto, Pickering, Markham, Stouffville, Richmond, Hill[14]

References: 1. CVC 2004b 2. Ivey 2002 3. Rush 2003 4. MNR 1973 5. NVCA 2003 6. Humber River Alliance 2003 7. Personal Communication, J. Ivey, November 28, 2006 8. TRCA 1998 9. City of Toronto 2006 10. Personal Communication, D. Clayton, December 4, 2006 11. Bowen, *et al.* 2004 12. TRCA 2006c 13. TRCA 2006d

A. TRCA presides over nine watersheds and areas in between that drain directly into Lake Ontario. This review provides information for the eight largest watersheds which are currently under study by the TRCA.

3.4.1 Credit Valley Conservation

The Credit Valley watershed is located in southern Ontario (Figure 2.1) and includes the cities of Mississauga, Brampton and the towns of Orangeville and Caledon within the Regions of Peel and Halton. The watershed covers an area of approximately 1000 km^2, and is home to 565,855 residents. About 87% of the population lives in the southern portion of the watershed (CVC 2004b).

One key issue within the watershed is the impact of rapid urban development. Some of the highest development rates in Canada occur in the watershed's largest municipalities of Brampton and Mississauga. While 21% of the watershed was considered urban in 1999, that number is expected to grow to 40% by 2020 (CVC 2004b).

Flooding of the Credit River is a concern especially with respect to ice jams and spring flooding. Some communities such as Glen Williams experience regular flooding primarily because the majority of homes in the hamlet lie within the regulatory flood elevation (Shrubsole *et al.* 1997). The Credit Valley Conservation's flood damage reduction program consists of flood warning and monitoring, floodplain mapping and data collection. The authority is continuously updating its floodplain mapping and all watercourses are expected to have up-to-date floodplain maps by 2006 (CVC 2006b). To address low water, the authority monitors surface and groundwater levels and collects data regarding the watershed's hydrology, water levels, river flow conditions, water quality and quantity, stream morphology, climate change and land use change monitoring. Credit Valley Conservation is also developing a water budget in an attempt to improve hydrological understanding of the watershed and to help decision makers implement effective water taking policies (CVC 2006b). Regarding source water protection, the authority has worked with its municipal partners to protect drinking water at its source over the past ten years. One project involves detailed monitoring program of groundwater and surface water including monitoring of wells, baseflows and piexometers. Monitoring is done predevelopment, as well as during and post-development (CVC 2006b). It is expected that Credit Valley Conservation will be working with the Toronto Region Conservation Authority and the Central Lake Ontario Conservation Authority to develop source protection plans (*Clean Water Act*, 2005). Credit Valley Conservation is valuable to this study because it has been required to manage rapid urban development while protecting water and ecosystem integrity.

3.4.2 Grand River Conservation Authority

The Grand River watershed is located in southern Ontario (Figure 2.1), and includes the cities of Kitchener, Waterloo, Cambridge, Guelph and Brantford in addition to multiple towns and villages. The Regions of Halton and Waterloo, the Counties of Brant, Oxford, Haldimand and Norfolk all have jurisdiction within the Grand River watershed. The Grand River drains almost 7000 km^2 of land, making it the largest tributary to Lake Erie on either side of the Canadian-United States border and contributing 10% of the drainage into Lake Erie (Ivey *et al.* 2002). About 80% of the 875,000 residents live on 10% of the land leaving most of the watershed to be used for rural and agricultural purposes (Ivey *et al.* 2002, GRCA 2004b).

Rapid population growth is a primary concern for this watershed. The area has some of the highest growth rates in Canada and these rates may increase with new provincial legislation that protects a greenbelt around the Greater Toronto Area. The *Greenbelt Act,* passed February 24, 2005, along with the *Oak Ridges Moraine Conservation Act*, *2001* and the *Niagara Escarpment Planning and Development Act, 1973* are intended to protect greenfield areas around the Greater Toronto Area but may result in more development in the Grand River watershed, which is just outside the areas protected from development (GRCA 2004b, MMAH 2006).

The Grand River Conservation Authority has a full suite of programming to manage flooding, low water and source water. Flooding on the Grand River has been an issue since large portions of the watershed were cleared in the early 1900s. Today, the river is characterized by a highly structured system of dams and artificial lakes to control low flow and flooding (Ivey *et al.* 2002). Despite the reservoirs, low flow remains an issue within the watershed. Droughts have occurred in 1997-1999 and 2001-2001. For example, during the summer in 2003, it is estimated that without the reservoirs, the flows in the Grand River in Kitchener would have dropped by 82% (GRCA 2004b). The Grand River Conservation Authority also has programs for protecting source water. This is a necessity in the watershed because residents rely primarily on groundwater for drinking water supplies.

The cities of Kitchener, Waterloo, Cambridge and Guelph are the only major urban centers in Ontario that depend on groundwater recharge for water supply (Ivey 2002). Other than groundwater, sources include the Grand River (less than 20%) and the Great Lakes (1%) (Ivey 2002, GRCA 1998). The increase in projected growth rates is of significant concern to these

inland cities because they are unsure if there is enough groundwater to supply the growing population. These inland municipalities are looking to other sources of water such as the Great Lakes (GRCA 2004b). The Grand River Conservation Authority has protected groundwater supplies by managing and protecting groundwater recharge areas and by developing watershed-wide supply strategies. The organization is working to identify sources of drinking water including wells, river intakes and aquifers, as well as outlining potential threats to water quality and quantity (GRCA 2006b). The Grand River Conservation Authority is expected to work with a couple of smaller authorities including the Kettle Creek, Catfish Creek and Long Point conservation authorities (*Clean Water Act*, 2005).

The Grand River Conservation Authority is a valuable case study due to its unique issues compared to other authorities in this study. Because of the dependency on groundwater in the Grand River watershed, the authority has been required to identify and gather scientific information about local wellheads and aquifers, even prior to the release of the *Clean Water Act*. This expertise became valuable when the Grand River Conservation Authority participated in the Walkerton Inquiry (O'Connor 2002). The authority's experience in working closely with landowners and regional municipalities to address water related issues provides insights into the collaborative nature of organizational knowledge creation and adaptive capacity processes.

3.4.3 Maitland Valley Conservation Authority

The Maitland Valley Conservation Authority's jurisdiction covers 3260km^2 of land adjacent to the eastern shoreline of Lake Huron in southern Ontario (Figure 2.1). The Maitland River watershed alone is roughly 2500 km^2 but the conservation authority's jurisdiction extends over a few other small watersheds including the Nine Mile and Eighteen Mile watersheds (Department of Energy and Resources Management 1967). The area is primarily rural with only 60,000 residents mostly within the Towns of Goderich, Wingham, Harriston, Listowel and Clinton and Goderich (Rush 2003). Agriculture accounts for about 80% of the land use in the watershed (MVCA 1994). Major concerns include agricultural intensification, shoreline development, flood events, droughts and the management of water quality and quantity (Rush 2003).

Major sources of flooding in the Maitland valley are due to snow melt, ice jams and heavy rainfall. The Maitland valley does not have any major flood related structures except for conduits

in Listowel and Harriston. The Town of Listowel was vulnerable to flooding before the building of the conduit in 1986. Before then it was known as the most frequently flooded community in Ontario (Department of Energy and Resources Management 1967, Rush 2003). Drought is also a problem in the Maitland watershed. There were droughts in 1997-1999 and 2000-2001. The latter resulted in the drying up of private wells, the reduction of baseflows and the lowering of water tables. It also served to raise public awareness of the issue and bring attention to the need for water in the river to assimilate waste (Rush 2003).

Like other conservation authorities, the Maitland Valley Conservation Authority works closely with local stakeholders to address watershed management issues. It has a program called the Maitland Watershed Partnerships that involves government, economic development, agriculture, local businesses, environmentalists, engineers, and other non government organizations (Guelph Water Management Group 2005). The Maitland Valley Conservation Authority has used its experience and contacts made through the partnerships program to create a Low Water Response team, under the Ontario Low Water Response Plan. One program it created to address water quality includes the Rural Water Quality Program, initiated in 2000. It encourages land owners to implement best management practices such as watercourse fencing and manure management through financial incentives. The authority also actively collects surface water quality data and operates ten groundwater monitoring sites (Rush 2003). With regard to source water protection, the authority has programs to manage non-point source pollution and include agricultural Best Management Practices (BMPs) and stewardship projects such as the Reforestation Assistance and Conservation Education programs. It is expected that the Maitland Valley Conservation Authority will work with the Ausable Bayfield Conservation Authority to undertake source water protection (ABCA and MVCA 2006).

The Maitland Valley Conservation Authority, as a case study, is important to this research because it represents a primarily rural watershed with concerns such as dispersed populations, low tax levies and other agricultural-specific practices including manure spreading. In experiencing different issues and contextual circumstances, this authority has focused on different aspects of water management than other authorities in the case study as demonstrated through programs such as the Maitland Valley Partnerships.

3.4.4 Nottawasaga Valley Conservation Authority

The Nottawasaga Valley Conservation Authority presides over 3561 km^2 of land where 171,479 people lived in 2005 (Department of Energy and Resources Management 1967, T. Salkeld, personal communication, August 21, 2006). The Nottawasaga watershed is located north of the Greater Toronto Area and includes portions of the City of Barrie, and the towns of Collingwood and Wasaga Beach, New Techumseth and Alliston (NVCA 1996) (Figure 2.1). Agricultural land uses are dominant in the watershed, although increasingly population growth is becoming a concern. The population is expected to increase 25% by 2028. Specific areas under pressure include those that are relatively accessible from nearby Toronto, along the Highway 400 corridor, including the City of Barrie, as well as south Simcoe County, in towns such as New Techumseth (NVCA 2003a).

The Nottawasaga Valley watershed experiences issues related to flooding, low water and drinking water quality. There are 15 flood prone areas within the watershed and irrigation issues are of particular concern for some of the agricultural areas. In addition, more information is required regarding source water (NVCA 1996). The Nottawasaga Valley Conservation Authority flood program includes updating operating and maintenance flood and erosion control manuals, stream and weather monitoring systems and flood forecasting programs (NVCA 2003b). To manage low water situations, the authority is coordinating a Low Water Response Team, developing a low water monitoring and reporting strategy and organizing Permit to Take Water workshops. These actions were developed to learn more about water taking in the Innisfil Creek subwatershed and ensure water can be supplied for irrigation while simultaneously ensuring water availability for aquatic systems (NVCA 2003b). The Authority is also beginning to address source water protection by working closely with local municipal councils and the Lake Simcoe Conservation Authority to complete a South Simcoe Groundwater Study, the purpose of which is to learn more about local groundwater aquifers, potential risks to groundwater quality and quantity, municipal wellhead protection areas and develop strategies for protecting and managing groundwater supplies (LSCA 2006).

The Nottawasaga Valley Conservation Authority is in a unique position compared to other authorities in this study. Population growth estimates for the coming years predict significant increases in urban development; however, unlike the Grand River and Credit Valley

conservation authorities, Nottawasaga has a much lower level of financial and personnel capacity to manage change (see table 3.3). As a result, the Nottawasaga faces challenges in creating capacity to prepare for and manage anticipated landscape changes.

3.4.5 Toronto Region Conservation Authority

The Toronto Region Conservation Authority is distinctive compared to other conservation authorities in this study in that it is an amalgamation of four conservation authorities. Originally, there was a conservation authority established to manage each the main river systems in the Toronto area: (1) Etobicoke Creek, (2) Humber River, (3) Don River, and the (4) Rouge, Duffins, Highland and Petticoat Creeks. In 1957, these four authorities were combined to create the Metropolitan Toronto and Region Conservation Authority (MTRCA). The name later changed to the Toronto and Region Conservation Authority to reflect the amalgamation of former municipalities into Metropolitan Toronto in 1997 (McLean 2004). In addition to the main river systems, the Toronto Region Conservation Authority now manages an area in downtown Toronto that is not included in the river watersheds and is most commonly referred to as Lake Ontario Waterfront (McLean 2004, TRCA 2006e). The Toronto Region Conservation Authority has jurisdiction within the City of Toronto, the Regions of Peel, York, Durham, and a small section of Mono Township in the north (Figure 2.1). The Toronto Region Conservation Authority does not keep track of its population figures for its entire jurisdiction (C. Bach, personal communication, November 27, 2006); however, a very rough estimate based on 2001 census data suggests that the approximate population of the Toronto Region Conservation Authority jurisdiction is 1.7 million (D. Clayton, personal communication, November 27, 2006).

Each watershed in the Toronto Region possesses different attributes. Table 3.2 provides a comparison of the physical characteristics for each of the watersheds. From the table, it is evident that the size of the watersheds varies greatly from 38 km^2 in the Carruther's River watershed to 903 km^2 in the Humber River watershed. Furthermore, those rivers entirely located within an urban area have higher urbanization rates (i.e., Mimico, Don and Highland) than those originating in more rural areas (i.e., Duffins and Carruthers, Humber and Rouge) (TRCA 2003, 2006b). Watersheds such as the Mimico, Don and Highland that are at least 77% developed have significant challenges with respect to degradation of water quality, high peak flows, flooding and erosion, stormwater control and impaired flora, fauna and aquatic species (Etobicoke and

Mimico Creek Watersheds Task Force 2002, Don Watershed Regeneration Council 2003, City of Toronto and TRCA 1999).

To address flooding, the Toronto Region Conservation Authority manages a highly structured system of watercourses. By 1995, the Authority was managing five dams, twelve flood control channels, two flood dykes and over 280 erosion flood control works. The conservation authority has also acquired over 32,000 acres of land to reduce flood damage, developed a flood forecasting and warning program as well as a stormwater management program to monitor weather conditions, issued warning messages to the public in cases of emergencies and monitor the impact of development on flooding, erosion and water quality (McLean 2004, TRCA, n.d. c. 2002).

Related to source water protection, the conservation authority is working with its source water protection partners, Central Lake Ontario and Credit Valley conservation authorities to undertake a groundwater management strategy which involves collecting data on the amount of groundwater available in the area to develop a groundwater flow model to predict the effects of different development schemes, groundwater extraction and proposed mitigation strategies on groundwater supplies (Humber Watershed Alliance 2003).

The Toronto Region Conservation Authority is an important contribution to the case study because it differs from the other authorities in that it manages the most heavily populated area in Ontario and as a result, its watersheds are significantly degraded and face persisting problems with water quality, poor aquatic habitat and high peak flows (City of Toronto and TRCA 1999). Unlike other authorities, the Toronto Region must develop means of maintaining, protecting and rehabilitating watershed health in a primarily built-out area.

3.4.6 Summary: Review of Conservation Authorities

Conservation authorities deal with a wide variety of local contexts and issues ranging from highly controlled river systems to rivers with few structural controls; from depleting sources of groundwater to dropping river levels; from protecting water quality within an intense agricultural area to protecting water quality within a densely urbanized environment. Therefore authorities have developed different approaches towards water management to deal with the unique issues within their watershed. As a result, there is variability in the issues that are given priority across

the conservation authority network (Ivey *et al.* 2002). For example Credit Valley Conservation has developed expertise in water quality monitoring while the major challenge in the Maitland Valley Conservation Authority is learning how to collaborate with land owners in a rural setting to enhance voluntary water protection measures. In addition to managing water based on different contexts, conservation authorities have inconsistent levels of organizational capacity to manage local watersheds due to varying sizes in jurisdiction, staff numbers and budgets. Specifically, a significant portion of conservation authority revenues are derived from municipal levies that are raised from property taxes. Therefore population tends to influence conservation authority budgets (Ivey *et al.* 2002). For the five authorities in this study, the population ranges from 60,000 in the Maitland Valley to around 1.7 million in the Toronto Region. The 2004 budget of the Maitland Valley Conservation Authority was $1.7 million; while Toronto Region's budget was $56.4 million (MVCA 2004, TRCA 2004a, D. Clayton, personal communication, November 27, 2006) (see Table 3.1). These variations create a different management context for each conservation authority, leading to various approaches for managing water related issues and possibly different strategies for creating organizational knowledge and enhancing adaptive capacity (Ivey *et al.* 2002).

3.5 Chapter Summary

This chapter outlined necessary background information on conservation authorities and in doing so provides a rationale for selecting them as case studies. This background is essential in understanding the context of the examples from the empirical evidence that illustrate how conservation authorities facilitate knowledge creation and adaptive capacity. A review of the program and mandate of conservation authorities suggests the institutional and regulatory frameworks for water resource management in Ontario require conservation authorities to collaboratively work with other agencies such as local and provincial governments, to plan, coordinate and manage water resources. The combination of a watershed-based management approach and the collaborative nature of water resource management in Ontario prompted this study to include a review of internal authority dynamics and the interrelationships between authorities and local and provincial government departments involved in water governance.

Conservation authorities have been able to learn and build from their past experiences in adjusting to changing provincial priorities, drastic financial cutbacks and the return of provincial

interest in local watershed issues. In overcoming such disturbances, conservation authorities are useful case studies to begin to understand how aspects of the organizational environment and governance network facilitate knowledge creation and adaptive capacity in the five case study conservation authorities. The next chapter takes a step away from conservation authorities to focus on the areas of scholarship that influenced the development of the facilitating conditions for organizational knowledge creation and adaptive capacity.

Chapter 4
Theoretical Foundations

As discussed in the previous chapter, conservation authorities are appropriate organizations from which to learn about organizational knowledge creation and adaptive capacity. Chapter four intends to first, situate this research within the literature and second, to introduce four areas of literature that contributes to scholarship on how organizations develop capacity to learn and/or adapt to change: social-ecological systems and adaptive capacity; knowledge management; organizational learning; and planning. These four fields of study were chosen because they represent various theoretical perspectives and epistemological foundations for understanding how knowledge is created and how sound resource management is maintained or improved following disturbance. Considering different ways of understanding how learning and adaptation occurs strengthens the theoretical underpinning of this thesis. It does so by incorporating ideas and concepts from disparate areas of research into a framework that presents potential facilitating conditions for organizational knowledge and adaptive capacity in conservation authorities.

4.1 Social-Ecological Systems and Adaptive Capacity

Concepts from general systems theories have influenced the study of social-ecological systems (Folke *et al.* 2003). Berkes and Folke (1998) started using the term "social-ecological systems" to denote the integrated elements of human and natural systems to emphasize that the distinction between the two domains is artificial and arbitrary (Folke 2005). Sustainable resource management requires consideration of social systems, encompassing issues such as governance, access to resources and property rights, as well as ecological systems, which involve issues of ecosystem function, structure and processes (Berkes *et al.* 2003).

Effective watershed management including problem identification, policy development and program implementation requires consideration of social-ecological factors. Watershed systems can be viewed as social-ecological systems because effective management requires the balancing of human, environmental and economic needs (Conservation Ontario 2000). Folke *et al.* (2005) argue that natural resource management organizations that focus solely on social dimensions of

management will have an incomplete understanding of how to guide the system towards sustainable ecological outcomes. On the other hand, without an appreciation of the social dimensions of ecological systems, management may lead to narrow decision-making.

4.1.1 Resilience and Adaptive Capacity in Social-Ecological Systems

Gunderson and Holling (2002) suggest resilience and adaptive capacity are essential in sustaining social-ecological systems and overcoming uncertainty and surprise. The meaning of resilience is often confused with adaptive capacity. However, resilience is a slightly broader term than adaptive capacity. Resilience measures the amount of change a system can endure before it starts to lose control, function and structure. Resilience within social-ecological systems is determined by the capacity of the organization to self-organize, learn and adapt (Berkes *et al.* 2003, Gunderson and Holling 2002, Holling 1973).

Folke *et al.* (2003) list requirements for building resilience in social-ecological systems, based on lessons learned from case studies in ecosystem management.

1. Evoking disturbance – "Small-scale pulse disturbance" can help local renewal cycles and avoid large scale crisis (i.e., small forest fires can prevent large fires that get too hot and reduce chance for rejuvenation).

2. Learning from crisis – Crises are often caused by surprises resulting from incomplete understanding of the system. They can therefore be used to learn more about the system and initiate re-evaluation of paradigms and conceptual models.

3. Expecting the unexpected – This requires a recognition of uncertainty and the inevitability of change. Management actions can prepare for and anticipate change. Risks can be spread through diversification of resource patterns and alternative activities.

4. Enhancing social-ecological memory – Social-ecological memory includes knowledge about the social management of ecological dynamics. It can be used to frame human action in terms of diverse and evolving ecosystem dynamics.

5. Combining experiential and experimental knowledge – Recognition of the complementarity of experimental (i.e., scientifically based) and experiential (i.e., learned

through practice) knowledge. "Practice informs theory as much as theory informs practice" (Folke *et al.* 2003, 371).

6. Expanding from knowledge of structure to knowledge of function – Understanding both ecosystem dynamics, functions and processes and management dynamics, functions and processes are important.

7. Building processes of knowledge into institutions – Natural resource organizations need to have knowledge of the ecological processes they are managing. Organizational worldviews, mental models and cultural values should reflect recognition of the dependency humans have on the ecosystem.

8. Fostering complementarity of different knowledge systems – Scientific knowledge can be enriched with insights from local managers and experiential knowledge especially during times of crisis and reorganization and when a longer time series of observations is required.

9. Recognizing the interplay between diversity and disturbance – Diversity of memories provides alternative options to managing change and instance to cope with change and reorganize following change. Disturbance opens space for change. The interplay involves reducing impacts of change while taking advantage of opportunities created. This requires redundancy and learning to live with change and uncertainty.

10. Dealing with cross-scale dynamics – This involves recognition of a variety of institutional and ecosystem linkages and dimensions across various scales. This could include temporal, spatial or geographical scales.

11. Matching scales of ecosystem and governance – Such correspondence would ensure institutional learning includes operational monitoring and mechanisms for evaluation to create and refine ecological knowledge. This is related to adaptive co-management so that management takes advantage of diverse knowledge, management experience, information technology, etc.

12. Accounting for external drivers – Account for such drivers to recognize interdependency between local resource systems and larger systems like globalization. Such drivers can

include socio-economic factors, urbanization, international trade, new technology, climate change and human health impacts.

While these requirements are necessary to build resilience in both social and ecological systems, this study focuses specifically on enhancing adaptive capacity of the social organizations which manage social-ecological systems. The next chapter builds on this list by selecting those requirements that may specifically facilitate adaptive capacity in conservation authorities.

Organizations with the capacity to adapt have the ability to anticipate and respond to change and return to sound resource management following a disturbance (Ascher 2001, Folke *et al.* 2003). Identifying and building adaptive capacity enables organizations to adjust to, learn from and shape change as well as recover and reorganize following change. Organizations with low levels of adaptive capacity have fewer options, many of which may be constrained during reorganization and renewal. As a result, the organization may find itself on an undesirable trajectory following a disturbance (Folke *et al.* 2003). In an organization, adaptive capacity reflects the presence of mechanisms that enable institutions to learn, create, maintain and store knowledge to introduce flexibility into problem solving, and to improve decision making (Carpenter *et al.* 2001, Folke *et al.* 2003, Nayak 2004, Quinlan *et al.* 2004). The ability of an organization to learn is expressed through improvements in meeting its targets and management objectives over time as well as an ability to deal with new issues and objectives when the context changes (Adger *et al.* 2005, Folke *et al.* 2005). It can cope with forms of surprise and uncertainty, which requires openness to learning, acceptance of the inevitability of change and the ability to apply an adaptive management approach to testing novel ideas and adjusting methods based on lessons learned (Gunderson 1999, Adger 2000).

Walker *et al.* (2006) outline three ways that building adaptive capacity can have unintentional consequences. First, increased adaptive capacity in one location can result in a reduced capacity in another place. Implementing a change in policies may benefit individuals at one level, but could reduce regional or industrial resilience as a whole. For example, Walker *et al.* (2006) illustrate this point by describing the attempts of the New South Wales government to establish stable prices for wool made by pastoralists. This helped individual farmers build adaptive capacity in times of market fluctuation but led to a stockpile of wool that reduced the

economic resilience of the region and industry as a whole. Second, managers need to be aware of systemic and cascading effects of implemented policies and programs. Walker *et al.* (2006, 9) describe this in terms of conscious effort to address specific shocks to the system: "Increasing adaptability to specific or regular shocks may "optimize" the system to this class of shock or regime of shocks, decreasing its general resilience to unknown shocks." For example, fire application in an ecosystem at the same time each year may increase resilience of the species present during that season but may reduce capacity to adapt to disturbances at alternative times. Third, adaptation may lead to efficiency in the use of resources at one scale but may also result in a loss of response diversity because there is no longer have the same range of options available. This is the case with mono-cropping with single genotypes (Walker *et al.* 2006).

4.1.2 Adaptive Management

> *"Learning is a key component of adaptability and is enhanced by careful experimentation in the form of active adaptive management"* (Walker *et al.* 2006, 8)

Adaptive management is based on the theoretically proposition that the complexity and uncertainty of ecosystems prevents full understanding, prediction and control of such systems (Holling 1973). Management of these systems therefore require adaptability and openness to learning. An adaptive management approach produces policy outcomes, decision-making and plans that are flexible and adaptive to accommodate surprise and unexpected outcomes. In this way, this approach values experimentation and innovation and emphasizes "learning-by-doing." It is based on ideas of feedback learning to reach its goal of increased adaptive capacity (Berkes *et al.* 2003, Gunderson 1999, Nayak 2004).

Holling (1995) and Senge (1990) discuss the concept of adaptive management and its application at the institutional level to create "learning organizations." As such, the organization recognizes the impermeability of programs and policies. The development of strategies and solutions can rarely account for all factors because of the unpredictability of the cascading consequences of changes to the system. Instead, policies and approaches should evolve with the system assisted by organizational learning (Mitchell 2002).

4.2 Knowledge Management

The concepts of knowledge, knowledge creation and knowledge management are critical to this research. If organizations are to build adaptive capacity, they must recognize inherent uncertainty and surprise within the social-ecological systems they manage. This requires capacity to create organizational knowledge so that innovative ideas and strategies based on lessons learned can be implemented to move in the direction of sustainability (Folke 2003, Walker *et al.* 2006). This section reviews concepts primarily from the knowledge management literature: data, information and knowledge as well as distinguish between tacit and explicit knowledge. These concepts are important establish the level complexity involved in knowledge management, as opposed to data or information management.

4.2.1 Data, Information, Knowledge

The terms data, information and knowledge are commonly interchanged and are at times similarly defined. This research, however, distinguishes between the three terms because there are different processes associated with data, information and knowledge (Davenport and Prusak 1998, Michaels, Goucher and McCarthy 2006a). The differences between these processes are important to this research because they help illustrate that the study of knowledge creation is more complex and systemic than would be a study of data or information acquisition.

Data is discrete, objective facts with no inherent meaning and may be stored in the form of structured records, databases and tables. Information is meaningful or useful data that has been contextualized, categorized, calculated, corrected or condensed. It is presented through messages such as documents, or through audible or visible presentations. Knowledge can evolve from information which has been compared, connected, conversed or which has consequences. Knowledge is both process and product. It is a personal combination of experience, values, contextual information and insight providing a framework to evaluate and incorporate new experience and information. Organizational knowledge is embedded within documents, routines, processes, practices and norms (Davenport and Prusak 1998, Michaels *et al.* 2006a).

Data and information management therefore differ from knowledge management in terms of decision-making, evaluation, dissemination and storage. In this way, knowledge management

goes beyond considering data and information acquisition to evaluate more complex social phenomena, including the various processes involved in creating tacit and explicit knowledge.

4.2.2 Categorizing Knowledge: Tacit and Explicit Knowledge

Distinguishing between tacit and explicit knowledge is important when studying knowledge creation processes because organizational capacity to observe, disseminate, store and manage explicit knowledge differs from its capacity to manage tacit knowledge. Understanding the difference between the two types of knowledge can help to explain the multifaceted nature of the function and character of knowledge such as how it is created and who is involved. This section will define the difference between tacit and explicit knowledge.

A popular framework for thinking about knowledge was originally developed and presented by Polanyi (1966). He categorized knowledge as either "tacit" to "explicit." Tacit knowledge is connected to the senses and is difficult to communicate because it is held within bodily movements, personal beliefs and values, individual perceptions and physical experiences. It is generally intangible and learned through experiences, observations and intuitions. Explicit knowledge can be articulated and shared through formal language. Compared to tacit, explicit knowledge is more recordable through common mediums such as writing, speaking and mathematics (Nonaka and Takeuchi 1995, Von Krogh *et al.* 2000). Nonaka and Takeuchi (1995) are generally credited with connecting this knowledge framework to organizational knowledge creation theory. Nonaka and Takeuchi (1995) view knowledge creation as a process involving the continuous interaction between tacit and explicit knowledge (Patrottia 2003). In recognizing the differences in knowledge through management practices, organizations can improve the utilization, dissemination and embodiment of knowledge within the institution (Nonaka and Takeuchi 1995).

4.2.3 Knowledge Creation

Knowledge creation is complex, multifaceted and dynamic. How knowledge is created and the processes of learning are discussed within various fields including philosophy, sociology, economics, organizational science, epistemology, phenomenology, among others. This section

reviews the concept of knowledge creation only as far as it will be helpful in understanding how organizations learn for the purpose of enhancing adaptive capacity.

The definition of organizational knowledge creation involves the ability of an institution "… as a whole to create knowledge, disseminate it through the organization and embody it in its products, services and systems" (Nonaka and Takeuchi, 1995, viii). Organizational knowledge creation is an on-going process of personal and organizational self-renewal which constantly re-creates the institution.

Knowledge management literature distinguishes between individual knowledge creation and organizational knowledge creation. The difference is important because characteristics of knowledge and knowledge creation processes vary according to whether the knowledge is individual or social. It may seem intuitive to assume that social knowledge is the sum of what individuals know. While organizations cannot create knowledge without individual learning (Senge 1990), Chaiklin and Lave (1993) argue that the organization as a whole possesses knowledge which is not retained at the individual level or stored through technical systems but exists within the organizational structures, routines, roles and processes.

> *"Knowledge and learning will be distributed throughout the complex structure of persons-acting-in-setting. They cannot be pinned down to the head of the individual or to assigned tasks or to external tools or to the environment, but instead lie in the relations among them."* (Chaiklin and Lave 1993, 7)

Thus, organizational knowledge is not just the aggregation of individual knowledge. The difference between individual and social knowledge is relevant to this research because for organizations to adapt and effectively manage water resources, they need to be able to benefit from the knowledge of their employees. Essentially Spender (1996) argues that both individuals and organizations hold explicit and tacit knowledge each of which is utilized in different ways. Organizational strategies including adaptive management and knowledge management describe the necessity of utilizing and disseminating all forms of knowledge throughout the institution.

4.2.4 Knowledge Management

Knowledge management (KM) is a discipline focusing on continuously enhancing knowledge production and its integration into the organization. Implementing a knowledge management strategy may enhance innovation and an organization's ability to improve decisions because it has capacity to create new knowledge and learn how to manage disturbance (McElroy 2003). Writing from a knowledge management perspective, Nonaka and Takeuchi (1995) identify five conditions for creating organizational knowledge creation:

1. Intention – Establish aspirations and goals. The intention focuses staff efforts so everyone knows what is required to move towards the vision.

2. Autonomy – All staff members have the capacity to act autonomously of other individuals and management as long as actions are working towards the organization's intention. Autonomy increases unexpected opportunities and the possibility of new ideas.

3. Fluctuation and creative chaos – External or internal disorder, creative chaos, and rapid change can create a sense of urgency within the organization and encourage innovation. Such change can evoke reconsideration of fundamental thinking and assumptions through self-reflexivity and increase tension within the organization to focus attention on problems and resolutions.

4. Redundancy –"Information that goes beyond immediate operational requirements of organization" (Nonaka and Takeuchi 1995, 80). It involves the identification of common ground and encourages transfer of knowledge by enabling staff to obtain a sense of what others are struggling to communicate. Redundancy enhances the flow of knowledge to accelerate knowledge creation processes.

5. Requisite variety – Ensures that the diversity inside the organization compares to that which is outside. Requisite variety assists in combining and re-combining information differently, flexibly and quickly.

In the next chapter these five conditions contribute to the development of the twelve facilitating conditions for the conceptual framework.

Knowledge management, as a field of study, originally focused on aspects of information technology to assist the business sector in enhancing innovation by identifying, codifying and acquiring knowledge (McElroy 2003). In this context, the purpose of knowledge management is to supply knowledge to workers with the information they need to do their job most efficiently. Some authors such as McElroy (2003) and Fuller (2002) have incorporated ideas of complexity and systems into knowledge management and McElroy entitles this second generation knowledge management. The second generation of knowledge management explicitly recognizes that while knowledge itself cannot be managed, the social processes in organizations that encourage the production, integration and dissemination of knowledge can be. It aims to create optimum organizational conditions that will enhance learning and organizational knowledge creation. To do this, knowledge management has drawn on many of the insights and lessons learned through organizational learning, which unlike knowledge management, focuses solely on how to create an organizational environment that encourages learning (McElroy 2003).

4.3 Organizational Learning

The concept of learning has a long history in psychological disciplines, but has only been reviewed as part of organizational discourse since the late 1970's (Argyris and Schön 1978, Argyris *et al.* 1985, Argyris and Schön 1996, Fiol and Lyles 1985 and Senge 1990). Organizational learning has roots in four main schools of thought: organizational behaviour, cognitive studies, pragmatism and situated learning. It is for this reason, that much of the organizational learning literature is focused on three areas: learning as a competitive advantage; the relationship between knowledge and learning; and the applicability of theoretical concepts to organizational management (Sauquet 2004).

The term 'learning' refers to both process and product. An organization has learned when it has acquired new data, information, knowledge, understanding, know-how, techniques or practices. The learning process consists of acquiring, processing and storing information (Argyris and Schön 1996). Learning can also be seen as a process resulting in an "enduring alteration in behaviour" due to a "perceived stimulus" (Helco 1974, 306). The process of learning involves being able to do something or see something that was not previously possible. It is essential for evolution of organizational thought (Senge 1990).

There are two specific contributions within the organizational learning literature that provide insights into how organizational knowledge is created: the concept of single and double loop learning (Argyris and Schön 1978) and the consolidation of five disciplines required in a learning organization (Senge 1990). First, the knowledge creation process can be viewed as either single-loop or double-loop learning. Actors participate in single-loop learning by building on what they know to solve problems. They respond to feedback when expected outcomes do not correspond with the predetermined set of norms and assumptions. Responses involve detecting errors and reacting to internal and/or external environmental changes. Detection of change may result from a variety of sources including hunches, intuition, scientific monitoring or database analysis. Single-loop learning is generally most effective in day-to-day modifications of routines and problems. Double-loop learning is a process better suited for complex issues that cannot be tackled with simple adjustments or tweaking of existing norms and premises (Argyris and Schön 1978, Argyris and Schön 1996). It involves establishing new premises through the development of new models, paradigms, schemata and perspectives (Nonaka and Takeuchi 1995). For double loop learning to occur, the actor must consider and possibly change his or her worldviews, norms and assumptions.

Second, Senge (1990) specifically focuses on various processes and relationships within an organization that contribute to learning at different levels: mainly individual, team and organizational. Learning is a human trait that we use to re-create ourselves. A "learning organization" therefore is *"... an organization that is continually expanding its capacity to create its future"* (Senge 1990, 14). In his book, Senge outlines five requirements of a learning organization:

1. Systems Thinking – This mode of reasoning involves recognizing "… interrelationships rather than linear cause-effect chains, and seeing processes of change rather than snapshots" (Senge 1990, 73) to gain a more "accurate" picture of reality.

2. Personal Mastery – The improvement of skills of individual staff by *"... continually clarifying and deepening our personal vision, of focusing our energies, of developing patience, and of seeing reality objectivel*y*"* (Senge 1990, 7).

3. Mental Models – Unconscious assumptions or models determine how reality is understood. In recognizing and working with mental models, we start to understand our *"... internal pictures of the world, to bring them to surface and hold them rigorously to scrutiny"* (Senge 1990, 9).

4. Shared Vision – A shared vision can enhance learning when an organization *"... hold[s] a shared picture of the future"* (Senge 1990, 9) with consistent goals, values and missions to bind people around a common identity and sense of purpose.

5. Team Learning – The ability of teams to work together to create new ideas is beneficial. This is important because teams are a key learning unit within organizations.

Along with other sources of literature, Senge's insights have influenced the development of the twelve facilitating conditions of organizational knowledge creation, outlined in Chapter five. The final area of scholarship reviewed is planning and more specifically, collaborative planning.

4.4 Collaborative Planning

Planning involves linking knowledge to action (Friedman 1987). Related to organizational knowledge in enhancing institutional adaptive capacity, collaboration can be used as a tool to link knowledge to action, whether in the form of decision-making, policy development or agenda setting. Collaborative planning has theoretical roots in the social learning tradition and advocates that undistorted communication, interaction and relationship-building between government, interest groups, other major sectors of the community and the public can improve policy development through social learning and consensus-building (Healey 2003, Margerum 2002). Economic exploitation of people and places alike is reduced when the insights, thoughts and values of various groups are considered in policy development through collaborative processes (Healey 2003). As a result, collaborative planning requires skills for mutual learning and understanding, conflict resolution and relationship building (Innes and Booher 2000).

Innes and Booher (2000) integrate ideas from systems thinking into collaborative planning to argue that modern institutions need capacity to recognize uncertainty to manage crises and deal with new complex problems caused by *"... globalization, rapid growth, technology, instantaneous worldwide communication and fragmentation of institutions and communities"* (6).

They express the need for organizations involved in public policy (i.e., planning) to enhance their learning and adaptive capacity if they are to deal with complex issues. Innes and Booher (2003, 7) identify four aspects of capacity, listed below, that contribute to an organization being able to *"... learn, experiment, and adapt creatively to threats and opportunities."*

1. Individual capacity – The capacity of individuals to be self-reflective, self-aware and to be willing to learn and experiment. Individuals with high levels of capacity may have leadership skills and a strong sense of vision and assist others in achieving this vision. Individual capacity enables an organization to make sense of different kinds of information, maintain networks and empower others to accomplish tasks and goals.

2. Organizational capacity – Refers to organizations that encourage creativity and accept failures and experimentation. They are often non-hierarchical where rules are flexible. Adaptive organizations are those that contribute to sharing of skills and information through well networked communications, they have developed mutual trust and understanding and have the ability to deal with unanticipated events quickly.

3. Relational capacity – Involves the ability to share information, undertake constructive dialogue in group formats and engage teams with diverse interests and utilizes individual strengths. Relational capacity produces interactions inside and outside of the system to share understanding of problems and interests. It can mobilize movement, encourage accountability and initiative, and develop strong leaders and innovative solutions.

4. Governance capacity – Involves the inclusion of diverse interests and knowledge in a network of relationships among jurisdictions, agencies of different interests, private sectors and other public sector departments. Trust among players is required to take advantage of everyone's individual knowledge and expertise. In such situations the individual as well as the whole benefits when everyone is active, engaged and concerned for the collective welfare of all.

This research is focused on improving capacity of water resource public policy organizations to build knowledge creation skills (Innes and Booher 2000). Chapter five builds on these ideas areas of capacity to develop conditions for conservation authorities.

4.5 Chapter Summary

The two goals of the fourth chapter were to situate this research within existing literature and to outline epistemological basis for the literature that informs the conceptual framework. True to a systems approach, a variety of perspectives on knowledge creation and adaptive capacity were sought through a multidisciplinary literature review. Consequently, conditions were identified based on a synthesis of primarily four bodies of scholarship each with different strengths, weaknesses and goals. Social-ecological systems studies review connections between social and ecological systems (Berkes and Folke 1998) and provide insights into the concepts of adaptive capacity, resilience, adaptive management as well as polycentric governance structures (Berkes *et al.* 2002, Gunderson and Holling 2002, Holling 1973). These insights suggest adaptive capacity is required for effective resource management (Berkes *et al.* 2003).

Knowledge management distinguishes the difference between tacit and explicit knowledge and introduces organizational knowledge creation (Nonaka and Takeuchi 1995, Von Krogh *et al.* 2000). It describes the complexity of knowledge creation, as opposed to the more simple processes of data or information management (Chaiklin and Lave 1993, Davenport and Prusak 1998, Michaels *et al.* 2006a, McElroy 2003, Nonaka and Takeuchi 1995). Unlike organizational learning, knowledge management considers organizational processes required to create, disseminate and utilize knowledge, not only knowledge creation (McElroy 2003).

Organizational learning outlines internal organizational dynamics required to enable learning. It establishes that organizational knowledge creation takes place at individual, team and organizational levels and therefore facilitating conditions must be considered at each scale (Senge 1990). It also suggests there is a difference between single and double loop learning (Argyris and Schön 1978, Argyris and Schön 1996). This distinction is important as major changes in perspectives, assumptions and mental models are required to move towards sustainability (Biermann 2002) and therefore natural resource management organizations must have capacity to undertake both types of learning. Similarities between knowledge management and organizational learning result in part from a similar focus on building organizational advantage through innovation (Nonaka and Takeuchi 1995, Senge 1990). This research explores the applicability of concepts focused on enhancing innovation for public organizations with the mandate to make effective public policy decisions.

Collaborative planning focuses on improving public policy through involvement of various stakeholders in decision making (Innes and Booher 1999a, 1999b, 2003). It emphasizes consensus building through organizational, relational, individual and governance capacity and argues that multiple perspectives and ideas help address complex public policy issues (Innes and Booher 2003). Insights from each of the four aspects of capacity are used to inform the twelve facilitating conditions.

Overall, these four bodies of scholarship contribute to the theoretical underpinning of the conceptual framework. The next chapter builds on the literature presented here to identify and consolidate facilitating conditions for creating organizational knowledge and/or adaptive capacity. Interview transcripts with water resource practitioners are then examined to identify insights they may have about the context and circumstances in which conservation authorities facilitate knowledge creation and adaptive capacity.

Chapter 5

A Conceptual Model of Facilitating Conditions for Organizational Knowledge Creation and Adaptive Capacity

This chapter presents a conceptual framework of conditions that may facilitate knowledge creation and adaptive capacity in resource management organizations. It delineates some of the most significant and commonly cited conditions that may apply to conservation authorities as organizations that manage water resources. The 4-step process used to identify the facilitating conditions that compose the theoretical framework is described below. The term 'facilitating condition' refers to a factor or general principle that enhances organizational success and contributes to better performance over time (Agrawal 2002).

Scholarship on organizational knowledge creation and adaptive capacity spans many fields of research. Consequently, the conceptual framework used in this research is the result of a synthesized multidisciplinary literature review. To achieve a broad, systemic perspective of knowledge creation and adaptive capacity, this work is primarily influenced by research from social-ecological systems (Berkes 2002, Folke *et al.* 2003), knowledge management (Leonard and Sensiper 2002, Nonaka and Takeuchi 1995, McElroy 2003, Von Krogh *et al.* 2000), organizational learning (Senge 1990), and collaborative planning (Innes and Booher 2003). Other important sources of literature include environmental management (Mitchell 2002), public administration (Dubnick 2005), biology (Conrad 1983) and common property management (Agrawal 2002, Ostrom et. al. 1999). The facilitating conditions in the theoretical framework include:

1. Values of mutual trust and respect
2. Social capital
3. Accountability
4. Leadership
5. Surveillance of the environment
6. Social memory
7. Autonomy
8. Motivation
9. Conditions for social interaction

10. Communication and dialogue
11. Shared vision
12. Adaptive mental models

These conditions were derived from a consolidation of the theoretical concepts that potentially contribute to organizational knowledge creation and/or adaptive capacity. The first step in developing the theoretical framework involved identifying areas of scholarship that discuss facilitating conditions of organizational knowledge creation and adaptive capacity. The four most relevant areas of literature are described in chapter four. The second step was to list the facilitating conditions from each area of literature. A summary of these lists are also presented in chapter four. The third step involved consolidating the lists and eliminating overlap. The fourth step included screening the conditions for applicability to natural resource management organizations and to emphasize only those conditions that facilitated knowledge creation and adaptive capacity in organizational systems, as opposed to ecological systems.

At the end of this four-step process, there were a total of eighteen conditions identified. The concepts highlighted by scholars as facilitating conditions, but not included in the framework include: communities of practice, evoking disturbance, creative chaos, diversity of knowledge, not fearing change and bridging organizations These first three concepts were examined for applicability in conservation authorities, along with the twelve conditions in the conceptual framework, but were not recognized as facilitating conditions by water resource practitioners in the case studies. The last three concepts were amalgamated with other conditions in the framework, following the analysis. The adjustments to the theoretical framework, based on the analysis, are described in further detail in chapter six.

While this chapter presents the conditions as discrete categories, it is more appropriate to understand them as cross-scalar, interconnected and mutually reinforcing. For this reason, ordering of the conditions was difficult and somewhat arbitrary because it is possible to present them in numerous ways. For example, Walker *et al.* (2006) argues that leadership, social networks and trust are part of social capital, while Innes and Booher (2003) view redundancy, requisite variety, social capital and trust all as elements of governance. Lebel *et al.* (2006) categorize accountability, trust and social capital as aspects of governance. This framework applies the latter approach of Lebel *et al.* (2006) and presents the values of trust and respect, accountability and social capital as aspects of governance. The interactions and relationships

between the conditions will be defined as they are applied to the context of water management by conservation authorities as described in Chapter six.

This chapter provides an overview of a variety of social dynamics that either directly enhance the ability of organizations to create knowledge and build adaptive capacity or help to create an enabling atmosphere. What is often not discussed is the flip side of the conditions. For example, social capital can facilitate the sharing of knowledge across agencies but it can reduce independency and the capacity to address issues if relationships are compromised.

This chapter is organized into twelve sections organized the facilitating conditions. Each condition is defined and then described with respect to its contribution to knowledge creation and adaptive capacity. The chapter begins by describing how values of trust and respect contribute to the ability of organizations to create organizational knowledge and adaptive capacity.

5.1 Values: Mutual Trust and Respect

> *"Complex social dynamics, such as trust building and power relations, have often been underestimated"* (Folke *et al.* 2005, 462).

The values of trust and mutual respect are critical in organizational knowledge creation and building adaptive capacity. Trust and respect are essential in the development of social capital and accountability, thereby contributing to an enabling organizational environment that can anticipate surprise and tackle complex problems. These values are also closely associated with other facilitating conditions including autonomy and motivation of individual staff members.

Trust and mutual respect are frequently cited as a critical element in a caring and knowledge creating environment (Von Krogh *et al.* 2000, Leonard-Barton 1995). Such values contribute to active empathy, willingness to help others, lenience in judgement, courage, tolerance of failure and openness to ideas (Leonard-Barton 1995, Von Krogh *et al.* 2000). Folke *et al.* (2005, 451) echo the importance of trust, especially as it relates to social capital and social memory for the purpose of enhancing adaptive capacity, "Trust makes social life predictable, it creates a sense of community, and it makes it easier for people to work together." Respect is a key value that underpins effective and productive relationships by encouraging acceptance of alternative perspectives and discouraging harsh judgement and retribution for calculated risks. Trust and

respect are established through continuous interaction, critical for developing innovative and effective responses to new issues, threats and other disturbances (Lebel *et al.* 2006).

5.1.1 Values, Knowledge Creation and Adaptive Capacity

Where values of trust and respect exist, organizations create a learning environment by enhancing relationships between staff and encouraging the dissemination of ideas through social interaction. Courage and constructive criticism contribute to a knowledge creating environment by allowing staff to experiment and take calculated risks to come forward with new ideas and innovations. Instead of trying to "get ahead," individuals attempt to leverage knowledge for the benefit of all which leads to social knowledge creation (Ascher 2001, Leonard-Barton 1995, Von Krogh *et al.* 2000). A caring atmosphere, where members trust one another, invites more open-ended conversations leading to the development of new concepts (Von Krogh *et al.* 2000, Leonard and Sensiper 2002). When individuals work in groups without trust, actors aim to *appear* to be cohesive by either avoiding disagreements or by expressing divergence of opinions in a manner that lays blame (Ascher 2001). Consequently, this *"... fails to reveal the underlying differences in assumptions and experience in a way that the team as a whole could learn"* (Senge 1990, 24). Trust and respect are important attributes within an organization but also in developing effective and collaborative relationships across a network (Baland and Platteau 1996, Brown 2002, de Loe and Kreutzwiser 2005, Folke *et al.* 2005, Pretty and Ward 2001).

Section Summary

Values of trust and respect are important in creating an enabling organizational environment where staff can freely exchange information, develop productive relationships, help one another, accept risk and interact without fear of reprisal. These attributes enhance learning and motivation, thereby contributing to the ability of the organization to learn about the system in which it functions. These values are particularly relevant to this research to examine the degree to which conservation authorities create an enabling internal context through trust and respect and whether they are trusted and respected by the public and other partner organizations.

5.2 Social Capital

> *"A social-ecological system with low levels of social memory and social capital is*
> *vulnerable to such changes and may as a consequence deteriorate into undesired states."*
> (Folke *et al.* 2005, 455)

Social capital refers to the associated benefits and assets available to an organization because of their networks and relationships (Nahapiet and Ghoshal 2002, Pretty and Ward 2001). Nahapiet and Ghoshal (2002) outline three dimensions of social capital: structural, relational and cognitive. The structural dimension refers to properties of the bonds and relationships such as the density of the network, the location of connectors and linkages between individuals and organizations. The relational dimension refers to the type of relationships that exist within a network and how it influences behavior. It characterizes "actor bonds" through measures such as trust, norms, obligations and expectations. Both structural and relational dimensions are dependant on trust and respect. The third dimension of social capital is cognitive, or the presence of common narratives, representations and language that lead to mutual understanding and therefore contribute to functional relationships. While difference of opinion is inevitable, a good working relationship between individuals and across agencies is assisted by the establishment of partnerships based on a mutual understanding of how others understand the world.

5.2.1 Social Capital, Knowledge Creation and Adaptive Capacity

Social capital is important to organizational knowledge creation and adaptive capacity by providing access to new information, ideas, solutions, assumptions and perspectives on a variety of scales. It does so primarily through opening lines of communication and building capacity for shared understanding. Social capital enhances knowledge creation through communication by reducing transaction costs, including time, resources or other effort it takes to develop relationships. Dense, well established, social networks have redundant lines of communication to lower transaction costs including the time and resources it takes to communicate with others (Agrawal 2002, Pretty 2003). Communication can lead to the use of shared language and codes that also assist knowledge creation because language is the means by which people exchange ideas and ask questions. Common language therefore facilitates shared understanding and provides access to others' ideas and knowledge (Kersten 2000).

Social capital is frequently mentioned as an essential factor in developing adaptive capacity (Adger 2003, Baland and Platteau 1996, Brown 2002, Folke *et al.* 2005, Olsson *et al.* 2004, Pretty and Ward 2001). Social capital is important in multiple ways - from developing partnerships with those with unique vantage points to anticipate disturbances to accessing resources to deal with a current crisis to acquiring information and knowledge necessary to reorganize following a crisis (Folke *et al.* 2005).

Social capital is also important specifically within resource management where there is increasing agreement that sustainability requires a move away from a command and control resource paradigm (Berkes *et al.* 2003, Brunner *et al.* 2005, Holling and Meefe 1996, Ludwig 2001, Walker *et al.* 2001). This move requires strong governance networks to manage issues at multiple scales as opposed to conventional bureaucratic paradigms with top-down control mechanisms (Ostrom 1996). Social capital through governance networks builds adaptive capacity through access to lessons learned and other experience of partner agencies. Such knowledge can be used to solve complex multi-scalar problems, characteristic of those in resource management. Where agencies collaborate through social networks to create and disseminate knowledge, decisions may be more applicable across temporal and spatial scales. There is some evidence that this leads to more successful management of ecological and hydrological systems within watersheds because of the parallelism between social rules and ecosystem dynamics (Folke *et al.* 2003, Lebel *et al.* 2006).

Section Summary

Social capital has structural, relational and cognitive dimensions. Properties of social capital including density of the network, the types of relationships and the level of mutual understanding are important in developing trust, pathways of communication and lowering the transaction costs between actors and agencies. Within resource management social capital across governance networks has been regarded as a significant stepping stone in effective water management. It will therefore be important to examine if knowledge creation and adaptive capacity are facilitated by collaborative partnerships for conservation authorities.

5.3 Accountability

In this research, it is assumed that Ontario's provincial and local governments are reasonably honest and therefore aspects of accountability in this discussion are focused more on the processes of building effective policy rather than correcting corruption. Accountability is a long debated concept in the field of public administration (Dubnick 2005) and can be seen as one aspect of governance (Walker *et al.* 2006). It refers to the obligation to honour one's commitments and to face sanctions if those promises and responsibilities are otherwise not met. The term 'accountability' is often synonymous with answerability, responsibility, blameworthiness and liability (Dubnick 2005). From a public administration perspective, accountability can enhance transparency and openness in public policy making. It enables the challenging of authorities and promotes the questioning of decision-making (Dubnick 2005).

Accountability is hierarchal, both upward and downward (Brown *et al.* 2000, Ribot 2002). Upward accountability takes place when local authorities must answer to a central authority. For instance, some conservation authorities who have signed agreements with the federal Department of Fisheries and Oceans (DFO) are responsible for undertaking fish habitat impact assessments on certain project proposals (LRCA 1998). Authorities must demonstrate to DFO that they meet the requirements of the relationship otherwise there may be changes to their agreement.

Downward accountability refers to agencies held responsible by the public and/or community groups (Ribot 2002). Conservation authorities are accountable to the public through their Board, many members of which are elected representatives on local government council (GRCA 2006a, *Conservation Authorities Act* 1990). Authorities are also accountable to the public for their safety through the operation of dams and other flood damage reduction infrastructure (Boyd *et al.* 2000).

5.3.1 Accountability, Knowledge Creation and Adaptive Capacity

Accountability can contribute to knowledge creation and adaptive capacity in public sector natural resource management organizations in three ways: by providing opportunity for public participation to increase public access to knowledge and decision-making rationale; by reinforcing trust within relationships; and by ensuring that issues at each scale of management are addressed.

First, accountability encourages increased public involvement in environmental policy making and provides opportunity for a wider degree of input in decision-making, agenda setting and implementation of policies. This encourages information dissemination and increased scrutiny of issues addressed by public agencies, thereby encouraging debate and deliberation without forcing consensus. As the public becomes involved in resource decision-making, they are able to broaden the issues and topics that are examined because different stakeholders have different interests (Walker *et al.* 2006, Trosper 2003). This can enhance learning about and surveillance of previously unexplored issues (Folke *et al.* 2003). Second, accountability reinforces trust and respect between actors and across agencies because there is additional confidence in the commitment to fulfill promises when organizations are held responsible. This enables agencies to work across scales and benefit from these interactions (Lebel *et al.* 2005). Third, accountability works within polycentric governance structures, such as those exhibited by conservation authorities, to ensure activities and performances at all scales are monitored. Accountability ensures there are sanctions or methods of removing the corrupt and incompetent players if an agency at one scale of the system is not fulfilling its obligations. Such players weaken the adaptive capacity of the entire system (Adger 2003, Lebel *et al.* 2006, Pretty 2003). Accountability provides agencies with increased confidence that their partners will invest in collective activities because there are sanctions otherwise (Pretty 2003).

Section Summary

Accountability can enhance innovation and adaptability of public sector organizations by facilitating the broadening of issues examined by public agencies, building capacity of the community to become involved in decision-making, reinforcing trust between agencies by increasing confidence in partner relationships and in ensuring that agencies work together to address issues at multiple scales. The study will examine how accountability has played a role in conservation authorities through relationship building with partner agencies and the public.

So far, the discussion has focused on attributes of governance: values of trust and respect, social capital and accountability. The conditions discussed below focus more on internal organizational dynamics but also apply to relationships and connections across agencies.

5.4 Leadership

> *"Leadership is essential in shaping change and reorganization by providing innovation in order to achieve the flexibility needed to deal with ecosystem dynamics"* (Folke *et al.*, 2005, 451)

Leadership is a process of social influence (Parry 1999). Senge (1990, 359) distinguishes outstanding leaders as those with "… clarity and persuasiveness of their ideas, the depth of their commitment and their openness to continually learning more." Leaders are good teachers who motivate others to express their ideas and question assumptions (Senge 1990). They expect more from people than would otherwise be expected, pushing them to perform their best (Parry 1999). They have a comprehensive understanding of their personal contribution to the bigger picture and can make sense of different kinds of information. Leaders also help maintain networks and empower others to accomplish tasks and goals (Innes and Booher 2003).

Leaders can be formally or informally appointed and can be in charge of a small working group, an organization or a set of organizations (Crossan and Hulland 2002, Mintzberg 2001). While some researchers treat upper management and leadership as synonymous, Crossan and Hulland (2002) have determined that acts of leadership, affecting processes and flows of organizational learning, occur at various levels in organizations not just management. However, leaders at an organizational level have additional responsibilities. These leaders have formal influence over strategic and policy direction. They must align strategy with structures, procedures and systems to help create an enabling organizational culture (Crossan and Hulland 2002, Mintzberg 2001, Senge 1990). Important roles for organization leaders include providing a vision for others to work towards and recognizing risks and challenges to meeting this vision (de Loe and Kreutzwiser 2005, Senge 1990). Within the public service sector, leaders must also set agendas, attract attention to issues, create policy solutions, broker deals and devise support for options (Folke *et al.* 2005). It is particularly important for political leaders to recognize potential threats and risks and be willing to implement solutions to prepare for disturbances as opposed to waiting for a crisis to react to (de Loe and Kreutzwiser 2005).

5.4.1 Leadership, Knowledge Creation and Adaptive Capacity

Effective leadership can facilitate learning at all scales both internal and external to the organization (Senge 1990). Great leaders are able to facilitate knowledge creation and adaptive capacity through organizational processes and culture. They can assist people in sharing information and developing new ideas by leveraging and disseminating knowledge throughout the organization (Crossan and Hulland 2002). They can also direct high level strategies through systems such as structures, routines and procedures, to guide and encourage learning. For example, leaders can create an organizational culture that threatens those taking risks and experimenting with new ideas or it can impose a reward system to encourage actors to openly share ideas and knowledge (Crossan and Hulland 2002).

Specifically related to adaptive capacity, leaders can influence processes of social influence to initiate small degrees of change in preparation for crises (Danter *et al.* 2000). Leaders can guide innovative processes (Folke *et al.* 2005), and help others through the difficult aspects of change by managing effective communication between staff (Parry 1999). Leaders can also play an important role in developing an organizational culture that accepts change as opposed to fears change. They can ensure that organizational aspirations, goals and visions address and account for the instability of social-ecological systems. This can facilitate the development of a response to a crisis that enhances their ability to anticipate and prepare for change.

Furthermore, leaders across the governance network can facilitate learning and adaptive capacity through building social capital by strengthening institutional arrangements, providing financial and technical resources and offering legislative support where feasible (de Loe and Kreutzwiser 2005).

5.4.2 Balance between Leadership and Sharing of Power

Leaders can also hinder knowledge creation processes (Leonard-Barton 1995). Adaptive capacity and organizational learning may be reduced when leaders have too much power or are negatively manipulating social processes. There is a fine line between leadership and control. Flexible organizational structures where lines of authority are blurred can also be beneficial to organizational learning and adaptation processes. For example, in instances where policy actors are able to work closely together and build trust, collaboration there is more willingness to share

information and develop common perspectives on issues (Folke *et al.* 2005). Optimal conditions for knowledge creation and adaptive capacity balance the power of authority with flexible adaptive management (Folke *et al.* 2005).

Section Summary

Altogether, leaders are significant to learning and adaptive processes especially with respect to teaching, motivating and helping others in dealing with change. Leaders can be influential within small groups, the entire organization or within a network of organizations and are often important in various learning-oriented processes such as strategy setting, visioning, and developing social capital. For leadership in conservation authorities, it is important to not only investigate management within each organization, but leadership organizations across the water management network.

5.5 Surveillance of the Environment

"Building social-ecological resilience in the face of uncertainty and surprise is about promoting the capacity to expect the unexpected and absorb it" (Folke 2003, 362)

Surveillance of the environment refers to the ability to identify hard to reverse changes in a timely manner. This is important because early detection could prevent an undesirable level of change and/or allow for some time to prepare for the change (Carpenter *et al.* 2001, Holling 1978, Scheffer and Carpenter 2003). From a biological perspective, Conrad (1983) discusses the importance of an organism's ability to anticipate change as one of three main components of adaptability. Organizations need to undertake surveillance of the environment to anticipate change. Surveillance requires understanding that change within complex systems cannot be controlled or eliminated. Instead organizations need to learn to accept uncertainty and anticipate disturbances (Folke 2003). Interventions therefore should not be viewed as final decisions but as experiments in line with an adaptive management approach (Adger 2000, Gunderson 1999, Lebel *et al.* 2006).

Surveillance of the environment also requires an understanding of the structures, frameworks and patterns internal and external to the organization, thereby enabling recognition of sources and forces of change. It is important for organizations to have people to undertake surveillance of the environment throughout the organization, not only at the management level. Staff closest to

the issues play an important role in anticipating change because they presumably have the most connection to local context. They are often the first to see indicators of change (Folke 2003). Social capital and partnerships are important "receptors" that enable the anticipation of change across geographic, temporal and institutional scales. In addition, there needs to be communication between those on the ground and those at decision-making levels as well as across all scales to be able to exchange ideas about what is to come and to connect details with the larger picture (Conrad 1983, Senge 1990).

Of particular concern to this research is to what degree conservation authorities take part in surveillance of their environment. Surveillance does not only involve monitoring data from the environment but also requires awareness of changes, patterns and relationships in the socio-ecological system outside of the organization. This is essential to optimize the position of the organization to best react to possible future change.

5.6 Social Memory – Redundancy and Requisite Variety

> *"… human actions and innovations framed by a dynamic, diverse, and evolving social*
> *memory in tune with ecosystem dynamics have the potential to foster adaptive capacity"*
> (Folke *et al.* 2003, 369)

Social memory is a collection of management experiences developed through social learning (Folke 2003, Folke *et al.* 2005, McIntosh 2000). It provides the basis for social response to change and enhances flexibility and adaptive response. It is particularly important during crises because it links past experiences with the present (Folke *et al.* 2002). Organizational memory is subset of social memory and is an accumulation of institutional rules and experiences, such as mental models and conceptual understandings of reality that guide actions (Folke *et al.* 2002). While organizations may rely on social memory, novelty, innovation and organizational learning remain critical to building adaptive capacity (Folke *et al.* 2005).

Redundancy is a subset of social memory that facilitates knowledge transfer and communication through the overlap of memory and knowledge. Redundancy refers "… the existence of information that goes beyond the immediate operational requirements of

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organizational members… [and the] intentional overlapping of information about business activities, management responsibilities, and the company as a whole" (Nonaka and Takeuchi 1995, 80). It encourages frequent dialogue and communication by creating a "common cognitive ground" among employees and facilitating knowledge transfer. When staff hold overlapping information, they are able to have a stronger sense of what others are struggling to articulate, thus specifically contributing to the transfer of tacit knowledge.

Requisite variety is one of the two types of diversity important for management of social-ecological systems. It can be thought of as social diversity, a match between the internal diversity of an organization and the complexity of environmental issues to be managed (Nonaka and Takeuchi 1995). Requisite variety requires an array of available expertise accessible to the organization to understand and manage the range of current and potential issues within complex social-ecological systems (Lebel *et al.* 2006, Ostrom 2005). Natural resource management organizations, such as conservation authorities need to be aware of both social and ecological diversity.

5.6.1 Social Memory, Knowledge Creation and Adaptive Capacity

Responding to feedback and turbulence requires continuous social and organizational adjustments. The role of social memory is to store past experiences and adjustments. This helps to explain why local responses to change may be more effective than centralized actions because local actors may remember what has worked and failed in the past (Folke *et al.* 2003). Cross-scale partnerships are one way of expanding social memory to more knowledge, experience and memory through networks. Networks can be a used as a source of knowledge that can be drawn on to learn about past changes and responses. This knowledge can be disseminated through social capital to contribute to decision making, management practices and conflict resolution (Folke *et al.* 2005, Westley 2002). Organizations with access to diverse and dynamic social memory have enhanced adaptive capacity developed when knowledge from various sources are combined, recombined, added to, filtered, influenced and transferred. Closed systems of memory that do not expand and diversify ways of storing and developing memory are vulnerable to surprise and systemic flips (Folke *et al.* 2003).

Section summary

Social memory is an institutional collection of experiences and lessons learned that provides a basis of possible responses to new stimuli and can be expanded through social capital. The research will examine if social memory assists conservation authorities in accessing expertise and knowledge through local and provincial networks. How do conservation authorities "store" local knowledge about their watershed?

5.7 Autonomy

When individuals *"... are capable of acting autonomously in response to events and information...the system can respond more quickly and intelligently"* (Innes and Booher 2003, 8)

Adaptive capacity and organizational learning partially depend on the capacity of individual actors. Skilled individuals with an understanding of the problem and who have opportunity and creative ideas can be invaluable assets to organizational learning. Organizations can assist in the development of individual capacity by providing individuals with a certain level of autonomy (Innes and Booher 2003), or the ability to set their own task boundaries to pursue the organizational vision (Nonaka and Takeuchi 1995). Individuals need to be able to make their own decisions as circumstances permit. This increases the ability of the organization and individuals to react quickly to new change as well as unexpected opportunities, thus enhancing the adaptability of the organization and the system being managed. Furthermore, individuals with capacity and autonomy may become motivated to take initiative and create new knowledge (Nonaka and Takeuchi 1995, Walker *et al.* 2006).

Autonomy is of particular concern in this study which will investigate how trust and respect are linked to providing conservation authority staff with the ability to react on their own. It will also examine the relationship autonomy and motivation.

5.8 Motivation

Motivation involves committing oneself to continuously grow, to take initiative and to have a deep sense of responsibility for one's work and to continuously learn (Senge 1990). Dedication and hard work are required to evaluate mental models, learn effective dialogue, and leadership

skills. Knowledge creation and enhanced adaptive capacity requires individuals who are committed and motivated to learn about the patterns and relationships in the system they are governing.

Related to motivation, Senge (1990) discusses the importance of providing an organizational environment that values the individual goals of its employees as well as the organization. To develop a skill requires recognition of a vision and then action to move towards the goals. Senge (1990) describes the difference between personal vision and the present situation as "creative tension". The difference creates an energy that can either motivate or intimidate. The tension can be released by working towards the vision or by adjusting the vision itself to make it easier to achieve. Those who are intimidated or are too anxious may cope by either eroding their vision, creating an artificial crisis or by using will power. Senge (1990) explains that the key to motivation is to not think of reality as an enemy to be fought against, but to remain focused on one's desired destination. Individuals can draw on energy created by running away from their current situation. But if this is the case, they will only be able to change when there is a strong enough threat. This results in reacting to stimuli instead proactively anticipating and preparing for change (Senge 1990).

Organizations can assist staff in meeting the collective organizational vision by believing in and encouraging their staff to learn. Consistency between personal and organizational visions encourages commitment and passion for the organizational goals (Senge 1990). As well, organizations can motivate their employees by encouraging them to improvise, try new ways of doing things and undertake initiates of their own while retaining a sense of the organizational vision (Tsoukas and Vladimirou 2001).

Reviewing the impact of motivation in the conservation authority context will be particularly important in understanding motivation for working at conservation authorities. The research will examine how conservation authority managers motivate staff to move meet the conditions of the organizational vision.

5.9 Conditions Enhancing Social Interaction

> *"The capacity to effectively combine or integrate understanding gained from different sources and forms of knowledge, including tacit and formal knowledge, increases the*

> *likelihood that the key thresholds and components of diversity will be acknowledged"* (Lebel *et al.* 2006, 4)

Social interaction refers to the social processes necessary in combining perspectives and ideas from various sources to create new insights and knowledge. These social processes include mental sorting, grouping, matching and melding and may occur at the conscious, semiconscious or unconscious levels (Leonard and Sensiper 2002). Interaction between individual actors is essential to knowledge creating processes (Grundstein *et al.* 2003, Leonard and Sensiper 2002, Nonaka and Takeuchi 1995). Nonaka and Takeuchi (1995) refer to social interaction as "knowledge conversion" and argue that knowledge is created through the dynamic interaction of tacit and explicit knowledge that takes place during social processes, between individuals and not solely within individuals. They present four types of knowledge conversion: (1) socialization, the process of sharing tacit knowledge through experiences; (2) externalization, the conversion of tacit knowledge into explicit concepts; (3) combination, the exchange of explicit concepts; and (4) internalization, the process of embodying explicit ideas into tacit knowledge. Social interaction and knowledge conversion can be enhanced by organizations through the five conditions listed below.

Nahapiet and Ghoshal (2002) build on the work of Moran and Ghoshal (1996) to identify four conditions required for social interaction: (1) opportunity; (2) intention; (3) motivation; and (4) organizational capacity to assimilate. First, there must be opportunity for exchange of social knowledge through means such as databases, intranets and other technical and non-technical solutions that allow employees to access collective data, information and knowledge (Von Krogh *et al.* 2000). Second, actors must also have intention to interact, exchange and combine ideas. There must be willingness to positively affect learning and innovation. In this way, it is important for staff to trust and respect their organization, their vision, their leadership and colleagues. Third, actors will not learn unless they are motivated to learn. People must feel that it is worthwhile to interact with others. This includes a willingness to be open and share information for the purpose of enhancing shared understanding and combining ideas to produce new knowledge schematics. Fourth, the organization must have capacity to assimilate and apply new knowledge. This includes being able to recognize valuable insights and information, which depends on existing capacity (Nahapiet and Ghoshal 2002).

5.9.1 Social Interaction, Knowledge Creation and Adaptive Capacity

Leonard and Sensiper (2002) argue that knowledge creation through social interaction is enhanced when organizational culture encourages the combination of ideas or the interlocking of previously unrelated skills. People with different backgrounds in education, organizational experience, preferred cognitive styles, culture, etc. bring together different experiences, knowledge, perspectives and ways of thinking. The knowledge base contributed by each individual makes them an immediate asset to a group (Leonard and Sensiper 2002). The process of combining different ideas is called "integration," which involves developing shared understanding among actors to coordinate action through mutual adjustment (Crossan and Hulland 2002). Elements of integration include dialogue and shared experience, both critical in developing shared understanding.

Alternatively, differences between people can hinder knowledge creation when those with contrasting opinions argue about who is right. In such cases, organizations need to encourage staff to view the clashing of ideas as an opportunity rather than a barrier to knowledge creation. Individuals frame problems and solutions by applying a mental schemata or patterns they understand. Ideally, unique perspectives offered by each individual member foster "creative abrasion" and "intellectual conflict". This produces energy channeled into the development of new ways of thinking (Leonard and Sensiper 2002). Multiple, unique perspectives and diverse experience is important for knowledge creation because the more options presented, the more likely a new idea will be developed. As well, minority opinions can be extremely valuable in stimulating brainstorming by challenging majority viewpoints and common assumptions that may be taken for granted (Leonard and Sensiper 2002).

Organizations encouraging social interaction are generally more flexible and able to cope with external and internal drivers of change. Social interaction helps mobilize, make use of and combine different knowledge systems to assist organizations in managing complexity and uncertainty (Folke *et al.* 2005).

Section Summary

Conditions that enhance social interaction are important to the knowledge creation process and therefore in creating ideas, approaches and strategies to manage change. This study will examine the level of social interaction within conservation authorities as well as across the social

network. Investigating social interaction may provide insights into the importance of this concept in the building and maintaining relationships.

5.10 Communication and Dialogue

> *"Good conversation management is not only a key knowledge enabler in its own right*
>
> *but also a driving force behind the other enablers"* (Von Krogh *et al.* 2000, 140).

Communication and effective dialogue are essential in developing other facilitating conditions, particularly social interaction, social memory and social capital (Von Krogh *et al.* 2000). From the above quote, dialogue can assist in the challenging of mental models and assumptions. Communication involves transmitting a message through a common system of symbols, signs or behavior (Merriam-Webster 2006). Dialogue is a subcategory of communication. The word "dialogue" is from the Greek word dia-logos, meaning "free flowing meaning." It involves open, unrestrained conservation between people to develop a common understanding or shared meaning (Senge 1990). Nonaka (2002) defines dialogue as face-to-face communication where the goal is to build a collective conceptualization or understanding. Characteristics such as "… openness, patience, ability to listen, experimentation with new words and concepts, politeness, the formation of a persuasive argument, courage" are the Socratic ingredients of effective conversations (Von Krogh *et al.* 2000, 127).

5.10.1 Dialogue, Knowledge Creation and Adaptive Capacity

Effective communication, especially dialogue, is critical in the processes of knowledge exchange and conversion (Nonaka 2002). In the early stages of knowledge creation, creative dialogue is particularly helpful in sharing images and metaphors by merging perspectives (Nonaka 2002). Dialogue is also important for testing assumptions and hypotheses. It is the means by which multiple perspectives can be accessed and utilized to verify ideas and new knowledge (Nonaka 2002). In organizations, dialogue can be an important tool for determining if new knowledge is justified according to organizational values or if it is worthwhile to pursue further by revealing hidden assumptions and perceptions.

According to Senge (1990), individuals should all work towards personally mastering the art of dialogue. Employees should promote the purpose of conversation as gaining insights that

could not be achieved on one's own instead of being declared "right" or the "winner". Dialogue enables the exploration of complex situations by providing access to multiple perspectives and mental models important in moving towards a systems approach to management by providing insight into the more difficult aspects of socio-ecological systems such as patterns and interrelationships between variables.

Communication and dialogue are essential for adaptive capacity and can facilitate the anticipation of change, surveillance of the environment, creating innovative responses by combining multiple perspectives. Effective collaboration and dialogue is essential in having capacity to react and respond to possible surprises as well as funding opportunity in change to move towards goals (Folke *et al.* 2005).

Section Summary

Dialogue directly assists knowledge creation as well as the development of other facilitating conditions. "Good conversation management is not only a key knowledge enabler in its own right but also a driving force behind the other enablers" (Von Krogh *et al.* 2000, 140). Through attributes such as openness, patience, listening skills, politeness and courage, dialogue can assist in the exchange of knowledge, thereby testing hypotheses, assumptions and mental models. Of particular concern to this research is the level of two-way communication between conservation authorities and their partners.

5.11 Shared Vision

> *"The most critical element of corporate strategy is to conceptualize a vision about what kind of knowledge should be developed and to operationalize it into a management system for implementation"* (Nonaka and Takeuchi 1995, 74)

A shared vision consists of a shared picture of the future with agreed on goals, values and missions. It acts to bind people around a common identity and sense of purpose (Holling 1995, Mitchell 2002, Slocombe 2004). An effective and genuinely shared vision generates enthusiasm, commitment and sincere belief in its goals. It also motivates people to learn and work towards what they believe in as opposed to doing work because they are told to (Senge 1990, 9).

A shared vision guides the knowledge creation process. It should provide a conceptualization of what kind of knowledge should be developed and operationalzed. The vision plays a critical role in judging the truthfulness and usefulness of new knowledge (Nonaka and Takeuchi 1995, 74-75). A vision should also set overall goals and direction for the system being managed. Shared visions can be harmful if they promote stability and control as opposed to sustainability and resilience. But they can also be used to keep managers "on track" and moving towards goals as opposed to fighting change. Visions should promote acceptance of uncertainty and expect the unexpected (Folke *et al.* 2005). A shared vision that recognizes that change can help avoid policies focused purely on removing surprise and variation. Furthermore, following a crisis, such a vision can be useful in reorganizing the system by focusing management efforts on "getting back on track" and moving towards the goals of the vision.

This study will investigate how visions influence relationship building with conservation authorities, the public and other partners. How important is it for those within a network to share a common vision?

5.12 Adaptive Mental Models

> *"An accurate, insightful view of current reality is as important as a clear vision"* (Senge 1990, 157)

Adaptive mental models are unconscious "… deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action" (Senge 1990, 8). In combination with ethical standards, mental models are important because they provide a framework for perception and judgement. They influence understanding of the system structure, processes and interrelationships (Walker *et al.* 2006). Mental models, as "internal pictures of the world" affect perceptions and assumptions (Senge 1990, 9). They are created through experiences and background including education, training, social expectation, emotional state, social expectation, turning point, job-related tasks, tastes and preference (Senge 1990, Von Krogh *et al.* 2000). Individuals and organizations hold mental models, socially oriented assumptions and worldviews (Senge 1990).

5.12.1 Mental Models, Knowledge Creation and Adaptive Capacity

Mental models affect sensemaking process, how problems are approached and which strategies are selected (Weick 1995). They influence how and when knowledge is created (Von Krogh *et al.* 2000). Sometimes they assist the learning process and other times, they can inhibit actors and agencies from understanding a situation, especially complex ones (Andreissen and Fahlbruch 2004). Argyris and Schön (1978) distinguish between single-loop learning, which consists of adjustments and "tweaks" to existing ways of understanding, and double-loop learning which often requires a change to mental models. The latter process can often be emotional and stressful because it requires adjustment of unconscious assumptions and ideals such as beliefs, routines and habits (Von Krogh *et al.* 2000). Organizational mental models that are flexible and open to new ideas are more likely to support a learning culture.

If a resource management organization assumes a predictable, stable state, the organization has reduced ability to adequately understand and manage the system and therefore a reduced capacity to anticipate, buffer and shape change (Holling and Meefe 1996). Awareness of mental models and how they affect decision making, perspectives and approaches to daily life can reveal what is not considered and what conclusions and beliefs are unjustified. Ignorance can therefore lead to surprises and unexpected change (Senge 1990). Adaptation or new insights and ways of looking at problems can arise when recognizing assumptions that sometimes lead to inaccurate understanding of reality.

Effective communication and dialogue can provide staff with the freedom to openly discuss their mental models and identify gaps in logic to anticipate possible sources of change and create effective strategies for managing change. Evidence of ideas should not be hidden and inquiries into reasoning behind ideas, suggestions, knowledge and data should be encouraged. The goal should not be to win but to honestly find the best ideas and innovations (Leonard and Sensiper 2002, Senge 1990). Those able to adapt their models based on lessons learned and new insights into complex social and ecological systems will have a greater ability to build adaptive capacity (Folke *et al.* 2003).

Section Summary

Mental models can be enabling or hindering to creating knowledge for the purpose of adapting. The first step is to developing an enabling mental model is to recognize assumptions

and biases in stated facts and truths (Senge 1990). The next steps involve creating an organizational culture of an inquisitive nature that questions mental models and is willing to examine alternative viewpoints. Within this study, the use of mental models in developing social capital will be investigated in conservation authorities.

5.13 Chapter Summary

This chapter presents a theoretical framework that highlights the twelve facilitating conditions for organizational knowledge creation and adaptive capacity in natural resource management organizations. The development of the conditions is the result of a multidisciplinary literature review of four bodies of scholarship outlined in the fourth chapter. This chapter reviewed each of the twelve conditions, defined the concepts and discussed how each theoretically facilitates knowledge creation and adaptation. The next chapter presents results of the case study analysis and highlights examples of the circumstances under which conservation authorities have applied the facilitating conditions to create organizational knowledge and enhance adaptive capacity.

Chapter 6

Results of Case Study Analysis

Organizational Knowledge Creation and Adaptive Capacity in

Conservation Authorities

This chapter presents results of the empirical case study analysis. The analysis provides documented examples that illustrate the applicability of the twelve facilitating conditions to water management in conservation authorities.

examines how the theoretical facilitating conditions presented in the previous chapter apply to water management in the context of five conservation authorities. The results provide insight into (1) how conservation authorities create organizational knowledge to develop adaptive capacity; (2) how theoretical facilitating conditions are applied by conservation authorities to manage water resources; (3) how the conditions within a conceptual model relate to one another to facilitate knowledge creation and adaptive capacity (Figure 6.1).

The third chapter provided background on the water management context in Ontario. Because organizational learning is context-dependant (Agrawal 2002), the contextual, historical and geographic information on conservation authorities is essential for understanding the stories that describe the enabling factors of organizational knowledge creation and adaptive capacity in conservation authorities. Chapters four and five synthesize literature on organizational knowledge creation and adaptive capacity into a conceptual model of twelve facilitating conditions. The conditions are organized into a conceptual model (see Figure 6.1) to illustrate interrelationships and relative importance to conservation authorities in managing their water programs. The facilitating conditions serve to provide structure to the conversation below and provide insight into the organizational processes that influence knowledge creation and adaptive capacity in conservation authorities.

The conceptual model emerged out of the analysis. Components of the model were derived from the literature review, but the organization of the conditions in the model is based on the results of the case study analysis. The model depicts the relationships between the explicit conditions that facilitate organizational knowledge creation and adaptive capacity in conservation authorities.

The findings in this chapter reflect the bias of those interviewed as they tend to focus on successes and strengths of their organization rather than failures and weaknesses (Robson 2002, Palys 2003). The tendency of participants to tell stories to communicate thoughts about problems, solutions, enabling and hindering factors is reflected in the material presented in this chapter. This allowed them to frame issues within their own context and experience. Efforts were made to preserve the intent of the story and retain the context in which comments were based.

The results are presented as they relate to each of the facilitating conditions of the conceptual model (Figure 6.1). Each of the twelve sections include stories from the empirical research to illustrate how the conditions are applied to water management in conservation authorities. The examples serve to demonstrate the interrelationships and connections between conditions.

The first three conditions comprise the core of the model: values of trust and respect, social capital and accountability. They are defined as core facilitating conditions because they are discussed consistently throughout the transcripts and are central themes in the stories describing how conservation authorities create organizational knowledge to enhance adaptive capacity.

The second section of the chapter discusses the next three conditions: leadership, social memory and surveillance of the environment. These conditions were also found to be important to organizational knowledge creation and adaptive capacity in each of the five case study conservation authorities. The third section introduces the last six conditions, paired into three groups: (1) autonomy and motivation; (2) conditions that enhance social interaction and

communication and dialogue; and (3) adaptive mental models and shared vision. These facilitating conditions are relevant to knowledge creation and adaptive capacity but not to the same degree as the other conditions identified because they were not described as key to the development of the other facilitating conditions.
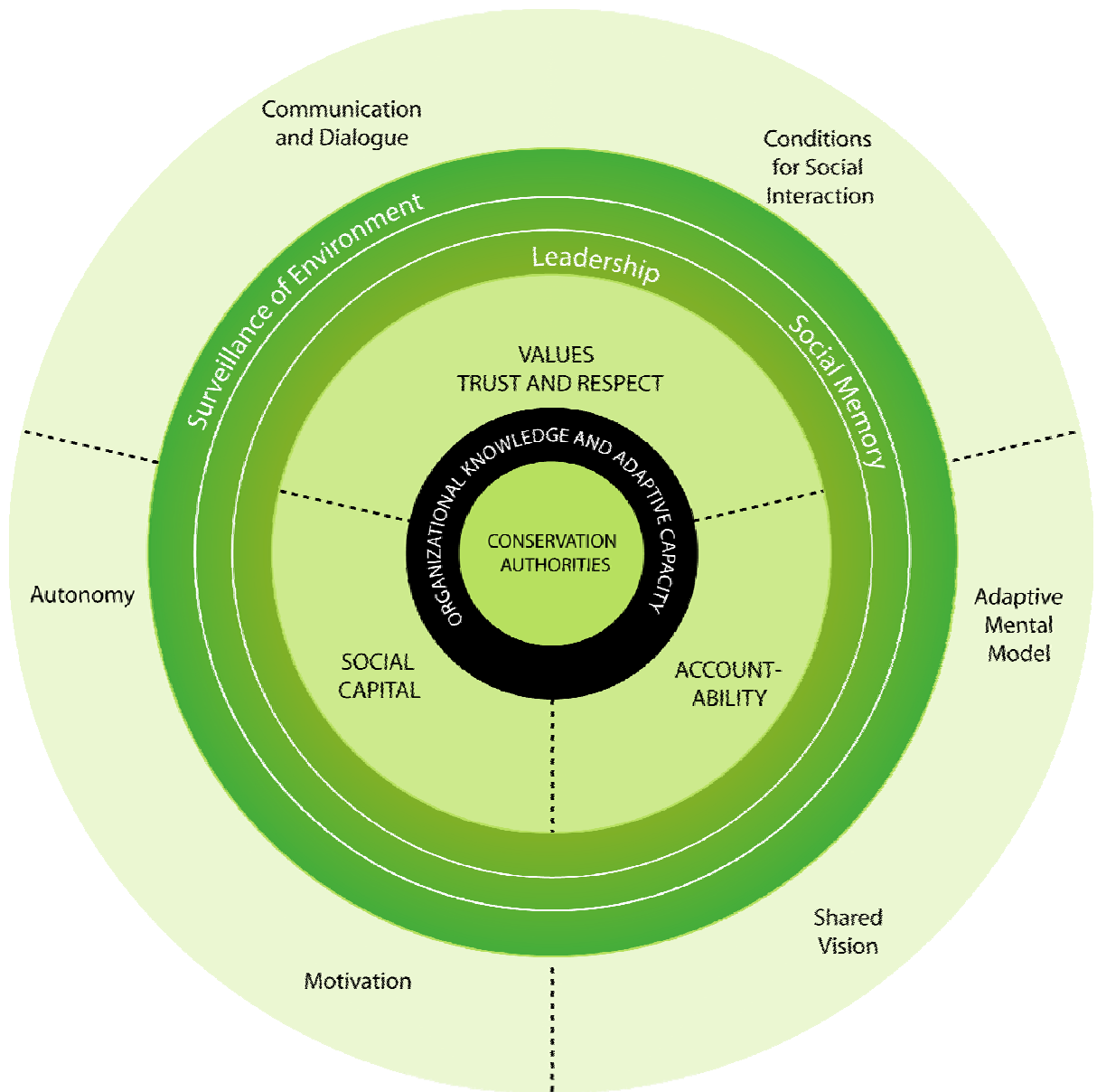
Figure 6.1 Conceptual Model of Facilitating Conditions of Organizational Knowledge Creation and Adaptive Capacity

6.1 Part One: Values, Social Capital and Accountability

Results suggest that trust and respect, social capital and accountability were core conditions for creating organizational knowledge and adaptive capacity in the five case study conservation authorities. They are frequently mentioned in the transcripts and are described as key enabling factors in the development of the other facilitating conditions. Values, social capital and accountability are all aspects of governance integral to authorities who function within a complex, dynamic network of agencies.

6.1.1 Values of Mutual Trust and Respect

According to practitioners, trust and respect are dominant core themes for creating knowledge in conservation authorities. Values, specifically trust and respect, are important conditions for establishing the credibility. Values within an organization or across a network create an enabling atmosphere for those within. A trusting and respectful environment encourages people to freely exchange ideas, develop relationships, and accept a minimal level of risk without fear of reprisal. These attributes can also facilitate motivation and learning (Folke *et al.* 2005, Senge 1990, Von Krogh *et al.* 2000).

Values are significant at multiple scales of management in conservation authorities. First, values must exist between individuals in small groups, teams and departments. All team members must trust and respect their leader and the leader, in turn is responsible for creating an enabling atmosphere for learning. Second, conservation authorities must trust and respect their key partner agencies. Third, being publicly funded, authorities must earn public trust and respect. Fourth, trust and respect must exist between conservation authorities because the collective capacity of all authorities reflects on the reputation of each authority. Trust and respect at each scale is illustrated through examples from the transcripts.

The Maitland Valley Partnerships (MVP) exemplifies the importance of trust and respect within working groups. As described in the third chapter, these partnerships were established by the Maitland Valley Conservation Authority and act as a multi-stakeholder forum consisting of members from 24 organizations. The members represent a variety of

associations and agencies including those private businesses, farmers, stewardship networks, woodlot owners, local and regional government, engineering consultants, cottagers and other non-government organizations (Guelph Water Management Group 2005, Ferreyra and Beard 2007). Interviewees working at the Maitland Valley Conservation Authority and partner agencies explained that over time, as trust and respect were developed, the MVP has been a significant learning experience for all involved (M1, M3, M4, M6, M9).

The Maitland Valley Conservation Authority realized that the MVP would not work without its members being able to trust one another and the conservation authority, as the facilitator. As a result, the authority invested time and resources to develop trust and respect in the group. It hired a facilitator, respected by all and with no personal stakes in the issues, to develop "group skills." The authority also provided technical training and involved all members in process evaluation to build capacity. As a result, the Maitland Valley Conservation Authority will use lessons learned from the MVP to guide decision-making (M3, Guelph Water Management Group 2005, Ferreyra and Beard 2007).

Values are also important in developing and maintaining relationships between conservation authorities and their partners. Trust and respect make it easier to work with existing partners and form new working relationships with other agencies. For instance, according to one participant (M1) from the Maitland Valley Conservation Authority, it was able to develop and demonstrate its expertise in agro-ecological issues while working with the Environment Canada. Consequently, when the World Wildlife Fund (WWF) was searching for a partner to develop a manual on implementing ecological farming practices, it turned to Maitland Valley Conservation Authority because it had demonstrated expertise and the WWF trusted the authority's credibility.

External awards and other forms of recognition can also demonstrate credibility and facilitate the development of trust and respect. Awards can improve an organization's reputation as well as the confidence of its own staff. Three staff members at the Grand River Conservation Authority (G1, G8, G7, G16) recognized that winning the Theiss International River Prize garnered recognition and respect from key partner agencies and the public. They

believe the award raised the profile not only of the Grand River Conservation Authority, but also of all of Ontario's conservation authorities, thereby earning international attention and new partners (G1).

Knowledge creation and adaptive capacity for conservation authorities is also dependant on collectively earning trust and respect of the public and partner agencies. One interviewee at the Toronto Region Conservation Authority expressed frustration with the provincial government because he thought his authority had demonstrated capacity to manage water taking permits (T3). As described in the third chapter, conservation authorities currently have little direct control over water supply (GRCA 2006a). The province is reluctant to relinquish control to over the program to conservation authorities. Provincial representatives (G9, G16, N13, M6, G18), argue that despite Toronto Region's high level of capacity, conservation authorities as a whole, have varying levels of capacity to undertake low water management and therefore the decision to download responsibility is based on the collective capacity of the authorities as opposed to what an individual authority can handle. This may also be the case with source water protection where the provincial government needs to be confident that all authorities have capacity to undertake new responsibilities under the *Clean Water Act* (G14, G18).

Altogether, values are strongly associated with knowledge creation in conservation authorities. Without trust and respect both internal and external to the organization, it would be more difficult for authorities to develop functional relationships and to be seen as credible agencies. Consequently, conservation authorities are inclined and required to demonstrate their credibility in ways recognized by the public, partners and various levels of the government including through effective working relationships with stakeholders, obtaining recognition from external agencies and by establishing collective capacity.

6.1.2 Social Capital

Social capital facilitates learning in conservation authorities. This is highlighted by two examples from the empirical evidence. First, learning can be inhibited where there is a lack

of social capital between conservation authorities and the provincial government. Second, social capital can facilitate the development of common goals and strategies to establish effective working relationships and address complex social issues.

The story for the first example was told by an employee from the Toronto Region Conservation Authority and illustrates the consequences to adaptive capacity where linkages between organizations are weak and social capital is reduced (T9). The province used to collect hydrologic data used by various organizations including the Toronto Region Conservation Authority. Due to the loss of a staff member, the Ministry of the Environment stopped data collection without notification to users of the data. The authority is now missing unrecoverable data points. In this case, relatively weak structural and relational social capital reduced the adaptive capacity of the authority because the loss of data points may affect its ability to observe trends over time, anticipate possible instances of feedback and note other ecological changes in the river. The Toronto Region Conservation Authority staff member (T9) stated that if he had known the Ministry of the Environment was cutting the program, the authority may have been able to conduct the monitoring themselves. Weak relationships, irregular communication and reduced social capital limit the ability of staff to stay informed of the actions of other agencies.

The second example illustrates how the cognitive dimension of social capital can play a role in knowledge creation in conservation authorities. One interviewee who works for a member municipality of the Grand River Conservation Authority (G8) stated that one of the reasons why his organization works well with the conservation authority is because both parties agree that low water is an issue and that it deserves attention. They have established a common goal and have agreed on strategies for addressing the issue. Both agree that education and public involvement are critical for achieving water conservation. Pre-existing trust and respect between the agencies facilitates the development of a "common" language and understanding. The importance of mutual understanding and common goals between partners is echoed in research conducted by the Guelph Water Management Group regarding

how conservation authorities build capacity by working in partnerships (Guelph Water Management Group 2005).

Together with the other facilitating conditions, social capital is crucial in the development of organizational knowledge and adaptive capacity. The examples illustrate two significant lessons learned about how conservation authorities can improve development of social capital. First, conservation authorities should actively work to expand their social capital by building partnerships and improving relationships with existing partners. They should develop a pattern of regular communication across their network of agencies to increase opportunity to learn of upcoming changes, such as changes to monitoring programs. Second, developing a common cognitive understanding between agencies can enhance the quality and effectiveness of relationships. Conservation authorities should attempt to understand the goals and strategies of their partner organizations and work to develop relationships with organizations that have similar visions and goals. If conservation authorities are working with partners with contradicted objectives, it is important to recognize this can be a source of tension.

6.1.3 Accountability

Accountability refers to taking responsibility for actions and honouring promises and obligations. Analysis found two insights into how accountability affects the way conservation authorities function and relate with the public and their partners. First, conservation authorities are held accountable through planning process such as the Ontario Municipal Board (OMB). Such institutional processes require authorities to demonstrate accountability by justifying their decisions, often accomplished by ensuring that reports and policies are scientifically defensible. Second, the nature of relationships between authorities and their partners is partially dependent on the establishment of clearly defined boundaries and agreement on who is accountable for what. Lack of clarity in roles and responsibilities creates tension in relationships, slows progress in implementing policies and reduces effective management of complex cross-jurisdictional issues.

As described in the third chapter, conservation authorities play a role in land use development through watershed planning. They develop watershed and subwatershed plans used by local and regional governments to develop Official Plans. These high level plans guide development of zoning by-laws, subdivision plans and stormwater management (Ministry of Environment and Energy and Ministry of Natural Resources 1993). As such, conservation authorities are held accountable for the policies, recommendations and plans they release and they must base decisions on scientifically defensible knowledge of ecological processes in their watershed. This sentiment is echoed by interviewees who describe the context in which they function as one where the power of science-based, technical knowledge influences the structures and priorities of the organization.

The analysis of empirical evidence found that over 40% of the interviewees, or 26 people, recognized the pressure for conservation authorities to develop reports and recommendations that are evidence-based and based on scientific principles. This pressure comes from a variety of sources including the Board of Directors, municipal and provincial partners and the public.

The Ontario Municipal Board (OMB) is a quasi-judicial system set up to handle planning-related conflicts. Twenty-three participants mentioned the role of the OMB in influencing agenda setting and policy development processes in conservation authorities. OMB influence is prevalent in watersheds facing high levels of development pressure such as Credit Valley Conservation. All staff interviewed from this authority said that the OMB pressures them to develop evidence-based procedures, processes and recommendations to ensure it can defend its position at Board hearings. This, in turn affects the methods it chooses to collect and analyze data and the nature of relationships it has with their partners (C1, C2, C3, C4, C5).

One interviewee from Credit Valley Conservation explained that another source of pressure for developing scientific defensible policies is from residential and commercial developers. The relationship between the authority and developers in the watershed has been affected by instances of disagreement and failure to achieve consensus (C2). As a result, the

authority has been forced to defend its position at the OMB. It has learned from past experiences at the OMB, which have taught them the value of complete, current and science-based subwatershed studies. One staff member explained that CVC has never lost an OMB case where the authority has completed the subwatershed study for the area under question (C2).

Credit Valley Conservation has justified allocating resources to collect evidence-based data and develop necessary science to write subwatershed studies and avoid costly OMB hearings (C1, C2). This example highlights how relationships that authorities have with private sector developers influence internal knowledge creation processes through priority setting.

Analysis suggests that accountability to local and regional governments for recommendations regarding local land use planning also provides incentive for authorities to develop scientific knowledge. For example, as described in the third chapter, dependency on groundwater in the Grand River watershed along with significant projected population growth has created a condition where local governments are worried that groundwater supplies may soon need to be supplemented by a pipeline to the Great Lakes. The Grand River Conservation Authority fears a pipeline would contradict the authority's efforts at water conservation and sustainable water management. As a result, the authority must find a way to argue its position in a way that would resonate with the public and local and provincial governments. The Grand River Conservation Authority is conducting related studies and developing plans that are evidence-based and supported with scientific data (G2, G5).

As suggested by the examples above, accountability also influences knowledge creation processes through establishment of roles and responsibilities. Interviewees explained that defining roles and responsibilities can impact how conservation authorities develop and maintain partnerships, and therefore how they develop adaptive capacity. Eight interviewees described that the source of tension, anxiety and strain in their relationships with partner agencies was created by a lack of understanding in who is accountable for what. This

problem is most common during establishment of new programs. Interviewees thought this was because it takes time to demonstrate credibility and capacity (N7, G19).

Two of the respondents (M1, N4) suspected that the lack of established accountability regarding source water protection is creating tension between authorities and local and provincial governments. One of these respondents (M1) compared the development of the source water protection program to the establishment of the flood damage reduction program in the mid 1980s where the conservation authorities had to prove their credibility over time by demonstrating expertise. He is confident that conservation authorities will earn the trust and respect necessary to undertake effective source water protection in time. This example illustrates that the establishment of roles and responsibilities takes time but may be enhanced by the demonstration of expertise to acquire trust and respect of watershed residents. Furthermore, drawing on lessons learned from past experiences is the example of the use of social memory in developing responses to current problems. In this case, the interviewee also recognized that implementation of source water protection needs to be supported by landowners. To do so, the authority needs to work closely with watershed residents and build acceptance. The use of science alone was not enough to earn the trust of watershed residents in the flood program and will most likely not be enough in the source water protection program as well. From past experience, he believes the approach to protecting drinking water must be collaborative and focused on building relationships.

To review, these examples provide insight into how values, social capital and accountability promote organizational knowledge creation and adaptive capacity. Each core condition can stand alone to enhance capacity but is also essential in the development of the other core conditions. Accountability encourages increased value in science-based knowledge through mechanisms that require justification of decisions such as structures like the OMB and local government planning processes. In turn, trust and respect and social capital are closely associated with the ability of conservation authorities to justify their decisions, develop recommendations and enforce their policies.

6.2 Part Two: Leadership, Surveillance of the Environment, Social Memory

Part two of this chapter describes how leadership, surveillance of the environment and social memory have assisted in the creation of organizational knowledge for enhancing adaptive capacity in the context of conservation authorities. For each of the three conditions, the empirical evidence suggests each condition is most effective when applied to multiple scales of management.

6.2.1 Leadership

Thirty-two respondents discussed the role of leadership in addressing watershed management. In the conservation authority context, leadership refers to more than just the head of the organization. There were three primary observations regarding leadership that help to demonstrate how important this condition is at various levels of management in conservation authorities. The first describes how formal leaders, consisting of those such as Chief Administrative Officers (CAO), Board members or managers, are critical for the organization in learning how to address problems. The second illustrates the importance of leadership across the Ontario water management network. The third observation describes how conservation authorities need leadership from other agencies in water management, especially the provincial government, in the form of legislative support.

First, one formally recognized leader suggested that he goes beyond setting a vision and asking staff to follow it. He decided his organization needed to change the way it did business based on an evaluation of organizational and decision making structures and the lack of positive change being created by the organization over time. As a result, this leader has reorganized the institutional and decision-making structure of the authority to work towards decision-making that is more consistent with the vision. He is also adjusting the programming and areas of priority for the authority to address sustainability issues that he feels need to be considered (T7, T9, T3, T1).

Second, individual conservation authorities aspire to be leaders by developing ideas, solutions, programs, models and other knowledge that can be applied by other organizations

(C2, G1). Interviewees describe one of the objectives of their organization is to be known as a leader in water management provincially and internationally (G3, G10, G15, M1, M4, T7, G1, G2). According to one participant from Toronto Region Conservation Authority (T7), her organization does not wait for the province to provide direction, guidelines or science before it moves forward on an issue.

Because conservation authorities work together through a network, one organization that takes a leadership role on the provincial scale can influence agenda setting for all authorities. For example, four interviewees thought that the leadership demonstrated by select conservation authorities through the Walkerton Inquiry influenced the definitions of the roles and responsibilities of authorities in source water protection (C2, M6, N16, T1). Senge (1990) argues that one characteristic of leadership is being able to take advantage of opportunities that arise. The drinking water contamination in Walkerton and the fallout from this disaster created an opportunity to change provincial water policies through increased public awareness in drinking water issues (Michaels *et al.* 2006b). The public became deeply concerned about public health issues and drinking water quality and the province reacted by initiating a public inquiry led by Justice O'Connor. Conservation Ontario, Saugeen Valley and the Grand River Conservation Authorities acquired standing for Part II of the Walkerton Inquiry. They used this opportunity to promote the work of conservation authorities and argued that the watershed scale is the most appropriate for managing and implementing source water protection (O'Connor 2002, Conservation Ontario 2001). As a result, conservation authorities are key players in the development of source water protection plans (*Clean Water Act* 2006). In this case, the leadership demonstrated by a few conservation authorities has had consequences for the business of all conservation authorities in Ontario and therefore the needs for organizational knowledge.

Third, just as conservation authorities need to be leaders, they also need to rely on other organizations for leadership as well. Since authorities have limited regulatory authority, they require leadership from the provincial government to provide guidelines, regulations and policy that allow conservation authorities to manage the watershed ecologically by, for

example, defending their position at the OMB with the support of provincial policies (G4, T1).

In summary, results demonstrate that leadership is important on a number of levels. Formally recognized leaders play an important role in knowledge creation and anticipating change in the organization. Leaders can be motivators, mentors, connectors between various issues, disciplines and organizations as well as boundary spanners. Conservation authorities should encourage the development of leadership skills such as the ability to see the patterns, interrelationships and connections in social and ecological systems. This was also recommended by Senge (1990). As well, leadership across conservation authorities and within other agencies such as provincial ministries can influence water management. Conservation authorities need to be aware of opportunities for change and should prepare for these opportunities by developing capacity to influence the direction of the change instead of just responding to the fallout.

6.2.2 Surveillance of the Environment

As discussed in the previous chapter, surveillance of the environment does not refer simply to monitoring of the ecological environment. For an organization to anticipate change, it must continuously survey all possible sources of change, including political, ecological, social or technical disturbances. It is also important to monitor at the level closest to the change to increase the possibility of anticipation through feedback, making it important to have contact with those who have different vantage points (Conrad 1983, Senge 1990).

Conservation authorities have sophisticated ecological monitoring programs. For example, Credit Valley Conservation has been collecting baseline data from one subwatershed for the last eight years covering the entire development process, prior to, during and after building. As a result, the authority determined there is room for improved sediment control (C2). But surveillance of the environment refers to more than just monitoring the environment for physical changes. It also refers to paying attention to other types of change such as political, organizational and relational as well as simultaneously

monitoring all fronts and scales. For instance, when Maitland Valley Conservation Authority was able to hire another staff member, it looked outside its organization to determine the kind of expertise that may be required in the near future. The authority evaluated the political climate and asked Conservation Ontario, an organization with a different perspective, for its advice. The conservation authority decided to hire a hydrogeologist, which was seen as an insightful strategy considering the importance of this expertise for the increasingly important source water protection planning (M1).

Surveillance of the environment also relates to leadership. One of the interviewees (C2) mentioned that it is a significant challenge for leaders in conservation authorities to manage at various scales. Leaders need to be concerned with what is going on internally, such as through organizational structures, staff motivation, and mission statements as well as what is occurring outside of the organization such as the nature of their relationship with municipalities, or what is new in provincial policy development (C2). This observation is reiterated by Westley (2002), who argues leaders need to address natural resource issues at multiple scales of management. They need to: "*Manage In*" by being conscious of intra-organizational dynamics including management of personnel and power relations; "*Manage Out*" through overseeing external stakeholders and partnerships to generate communication and strong linkages between groups of people; "*Manage Through*" to the management of the problem solving processes, whether it is the scientific approach or adaptive management; and "*Manage Up*" by being aware of one's context including the political and economic environments. Westley (2002) argues that adequate management requires consideration of all four scales and ignoring any one of these four areas leaves the organization more susceptible to surprise. Conservation authorities should be aware of all levels of management to anticipate change that could occur at any one of those four scales.

6.2.3 Social Memory

There are two main sources of social memory important in conservation authorities: (1) knowledge that is stored and utilized within the organization; and (2) expertise and knowledge stored by other organizations but accessed through social capital. Examples

provided below illustrate the importance of social memory within authorities and within the authority network.

One example of the use of social memory is explained by a long time employee of Maitland Valley Conservation Authority who has applied the lessons he learned from flood damage reduction to source water protection. This example also demonstrates the importance of earning trust and respect of the public because as described in chapter three, the *Conservation Authorities Act,* 1946 assigns responsibility to conservation authorities. However, authorities must still demonstrate capacity and earn public trust to manage the issue. Seven out of sixty-four interviewees thought that authorities must be viewed as credible and trustworthy with the necessary expertise to solve watershed problems and enforce standards and recommendations (M1, N1, G9, G11, G15, T9). For instance, two interviewees from separate organizations (M1, T14) explained that one reason why authorities are able to manage the flood program is because landowners accept that standards in place are necessary to protect lives and property from flood hazards. But that the standards were not always accepted and conservation authorities had to earn the trust and respect of landowners and municipalities by demonstrating that the policies were developed through evidence-based research and experience. One member of Maitland (M1) believes that water management policies cannot be imposed on landowners, especially within rural areas. Instead part of the authority's job is to work with stakeholders to education, implement best management practices and finance projects to change behaviour. These lessons were learned from experiences in imposing flood damage reduction policies on people in the 1980's. He advocates that these lessons need to be applied to the implementation of source water protection policies, an example of social memory.

In addition to building on organizational experiences, conservation authorities can also access social memory through social capital, providing another incentive for conservation authorities to work with partners. For example, when one relatively new conservation authority staff member did not know the history of a program he was discussing, he referred to someone who would have that information (G10). This suggests that new staff may not

have a wide range of redundant knowledge, but if they know who to ask for help, they can still access a range of social memories. Knowing who to ask for specific information can improve information flows.

Employee turnover is an issue that relates to social memory and of concern to conservation authorities and partners alike. Thirteen respondents from all five authorities and local and provincial government agencies mentioned that employee turnover was of high priority to their organization. One interviewee from the Ministry of Natural Resources explained that if it had the resources to hire new staff prior to the departure of the experienced staff, the organization would not have lost as much knowledge (G14). One possible solution for managing employee turnover is to encourage redundancy to increase staff awareness of diverse social and ecological issues even when it does not directly relate to their defined responsibilities (Folke *et al.* 2003, Nonaka and Takeuchi 1995). Redundancy can be encouraged by increasing communication within working groups and allowing team members to learn more about tasks of other staff.

For example, one interview participant from the Toronto Region Conservation Authority (T6) explained that when his authority reviews development proposals, it does so through Strength, Weakness, Opportunities and Threat (SWOT) work sessions, where technical teams consisting of planners, hydrogeologists, geotechnical engineers and fluvial geomorphologists meet biweekly to provide input for all plan reviews. This has two main benefits. First, the applications are reviewed and commented on in a much shorter timeframe than prior to the SWOT team process. Second, each staff member is exposed to the knowledge and expertise of others on their team (Woodland 2005). As a consequence, for example the planner would learn more about hydrogeology by participating in the meetings. If a staff member left this team, the rest of its members could help orient newcomers. However, despite the level of redundancy in an organization, it is not possible to capture all individual knowledge and experience of staff for the benefit of the organization (Nonaka and Takeuchi 1995).

Empirical evidence suggests that social memory and redundancy are important sources of knowledge for conservation authorities and their partner organizations. Social capital is

specifically useful as a vehicle for transferring social memory between organizations. Redundancy should be encouraged to improve exchange of knowledge and reduce effects of employee turnover.

6.3 Part Three: Autonomy, Motivation, Social Interaction, Dialogue, Shared Vision and Adaptive Mental Models

Part three summarizes the final six conditions that help create an enabling organizational environment for knowledge creation and adaptive capacity in conservation authorities. As shown in Figure 6.1, these conditions are located in the outer layers of the conceptual model. They support the development of the other conditions and are influential in their own right.

6.3.1 Autonomy and Motivation

Autonomy and motivation are closely interrelated. The relationship between the two conditions is well articulated by one staff member at the Maitland Valley Conservation Authority, who said that he is motivated to work hard, think creatively and find the best solutions even if it is not always the easiest because he is entrusted by the organization to make independent decisions (M4). Autonomy involves staff having the latitude to choose how to accomplish tasks and being provided with the opportunity to take their own calculated risks and make measured mistakes (Nonaka and Takeuchi 1995). Seven conservation authority employees agree that making independent decisions has motivated them to do a good job (G4, G7, M4, N1, N6, T7, G1). One respondent from the Grand River Conservation Authority said that the ability to see direct impact of his actions has been rewarding and motivates him to work hard (G1). It is also beneficial for the organization to advertise autonomy to attract and maintain highly qualified staff. One employee explained that the ability to consider topics that he feels are worthwhile was enticing when he was contemplating whether or not to accept take the job (M4).

Interviewees also mentioned other sources of motivation including working with others who have the same goals and desires as they do. Eight interviewees discussed the motivating

nature of mutual understanding and an immediate connection between authority staff by sharing common interests and values (G5, G13, G11, N1, N4, T6, G4, G1). Authorities are also able to attract highly qualified individuals who could earn higher salaries elsewhere but chose to work on environmental issues because they can improve the quality of the environment and the lives of watershed residents through their jobs (N1). It is also motivating when the goals of partner organizations are shared by the authority. It is easier to make decisions, approve policies and implement solutions with consensus (G3, G4, T7).

This review demonstrates that autonomy and motivation can facilitate knowledge creation and adaptive capacity. Conservation authorities can motivate staff by creating situations where employees are able to see the benefits of their work, where there is congruence between staff and organizational goals and where staff have a level of flexibility and autonomy.

6.3.2 Conditions for Social Interaction and Dialogue

Knowledge creation is facilitated by the presence of social interaction and communication within conservation authorities and across the network (Leonard and Sensiper 2002, Nonaka 2002). The following section provides three examples from the transcripts. First, communication of reports and recommendations to partnering agencies assists in building social capital. Second, communicating findings in a format amenable to your audience enhances uptake of recommendations. Third, effective communication and social interaction assists in being able to recognize various perspectives and new ways of understanding problems.

Forty-eight participants, or three-quarters of those interviewed discussed how important it was to improve communication with the public, using various mediums or marketing techniques. Furthermore, communication and dialogue also play an important role in relationships with key partner agencies as well as directly in knowledge creation by developing new ideas through diversity. Conservation authorities must also report to their partner agencies but they must also develop mechanisms to listen to their partners as well.

For example, one member of the Nottawasaga Valley Conservation Authority (N1) acknowledged that it was not only important for authorities to distribute their science and knowledge through reports and recommendations but they must also be reflect on municipal issues and pressures to address problems of concern to those who provide funding.

Five staff explicitly recognized the importance of communicating and interacting across areas of expertise (C2, M1, T5, T7, T13). One staff member explained the importance of incorporating diverse expertise into reports and recommendations (T7). For example, the Toronto Region Conservation Authority recognized that the subwatershed plans they produced were under utilized at the municipal level and their recommendations were not being implemented. After some investigation, the authority found there was a lack of understanding in how to apply the scientific findings from in the watershed report into municipal policies. To ensure the science and the implications of findings were being understood and utilized by their partners, the authority brought together scientists, planners and hydrogeologists with municipal representatives and members of the public to create a document that converted the technical advice into user-friendly policy recommendations. As a result, the authority learned the benefit of monitoring the results of their recommendations and reports. Through feedback from their partner organizations, the authority learned the importance of communicating findings in a simple format. Incorporating ideas from various areas of expertise assisted this process.

In this way, the transcripts highlight that communication between organizations within a network is critical in developing effective working relationships and undertaking successful water management initiatives. It is important that conservation authority staff communicate with others inside and outside of the organization.

6.3.3 Adaptive Mental Models and Shared Vision

Empirical evidence suggests that the visions of conservation authorities direct the type of issues addressed and the knowledge creation processes. Interviewees explained their organization's commitment to collaboration is central to their ability to facilitate and

coordinate water management. As explained in the third chapter, the *Conservation Authorities Act* helps to establish this vision. Empirical evidence suggests that past situations also play an important role including the provincial cutbacks which encouraged authorities to turn towards their member municipalities to obtain funding to maintain basic programming (G15, G19, N7, C1).

Analysis also revealed that recognizing organizational visions and mental models in conservation authorities facilitates effective working relationships through mutual respect of goals and objectives. For instance, the Grand River Conservation Authority collaborated with the Region of Waterloo to reduce rural water demand. In meetings with staff from both organizations, two strategies or reducing rural water demand were contemplated. The first strategy involved providing landowners with detailed guidance documents on how to reduce water use. The second idea was to develop relationships with landowners to educate them on the value of reducing water use and to personally show them ways to implement water saving technologies. It would take longer and be more expensive to choose the second strategy, but staff from both organizations agreed that relationship-building was ultimately more efficient because they believed that true buy-in was essential for reducing water demand. Agreement was made easier because both organizations shared a similar philosophy regarding community buy-in and education (G15, G16). This example suggests that organizational visions may influence the relationships between conservation authorities and their partner agencies. Although, as suggested by the literature on social interaction and surveillance of the environment, different perspectives are also healthy and can contribute to innovative problem solving.

6.4 Comparative Analysis across Five Case Study Conservation Authorities

The sections above describe the circumstances in which facilitating conditions promote organizational knowledge creation and adaptive capacity. The purpose of this section is to present the results of the study in a comparative format to emphasize the potential for applicability of the theoretical framework across the five case studies. Table 6.2 highlights the number of stories told about the applicability of each facilitating condition in the five

case studies. While theoretical replication, explained in the second chapter, is considered to enhance the robustness and worthiness of the investigation (Yin 2003), table 6.2 must be interpreted carefully. The number of stories told does not correlate with the applicability of the facilitating condition to the organization or its relative importance. First, the number of interviews differ across case studies. Second, the interview questions were broad and did not focus on each facilitating condition as articulated in the model. Therefore, not recognizing the applicability of a condition does not necessarily represent its absence. Third, some respondents are more inclined to reflect out loud than others.

The results presented in the table suggest the water resource practitioners associated with each authority recognize that all twelve conditions play a facilitative role in water resource management by enhancing organizational knowledge creation and adaptive capacity. The only exception is autonomy in Credit Valley Conservation.

Table 6.1 Conservation Authority Comparison: Number of Stories Related to Each Facilitating Condition

Facilitating Condition	Credit Valley	Grand River	Maitland Valley	Nottawasaga Valley	Toronto Region
Values – trust and respect	6	17	7	10	12
Social Capital	12	14	5	15	10
Accountability	11	14	6	14	6
Leadership	9	13	14	6	16
Surveillance of the environment	17	20	17	20	9
Social memory	7	10	11	7	8
Autonomy	0	4	5	1	5
Motivation	13	15	15	17	16
Social interaction	8	12	5	4	11
Communication and dialogue	15	13	12	4	9
Organizational vision	3	11	4	5	10
Adaptive mental models	4	4	8	9	13

6.5 Summary of Insights

This chapter highlighted examples of how the twelve facilitating conditions promote organizational knowledge creation and adaptive capacity within the five case study conservation authorities. The stories told by study participants provide detailed, contextual-based accounts of situations that have enabled the authorities to improve water management. This section describes two examples from above that provide insight into the theoretical understanding of how and why the facilitating conditions enhance knowledge creation and adaptive capacity.

First, the empirical evidence suggests that motivation of employees in the case studies involves more than a clear organizational vision and creative tension, as discussed in the literature (Senge 1990). In conservation authorities, one key motivator for staff is being able to work with others who have common personal as well as professional goals. Study participants explained that they are motivated to work hard because they are dedicated to improving the quality of the environment, protecting the watershed ecosystem and promoting sustainable lifestyles (G5, G13, G11, N1, N4, T6, G4, G1).

Second, examples of leadership from the empirical evidence highlight the complexity of building capacity to learn and adapt. Study participants explained that the actions of conservation authorities can be stalled or inhibited by a lack of decision, policy or direction from their key partners, especially the provincial government (G4, T1). As a result, the ability to create knowledge and adapt to change is sometimes out of the direct control of these organizations. They must develop social capital with their partners to overcome these obstacles or find other indirect and creative solutions, which may involve assisting in the development of capacity in partner organizations. Empirical evidence suggests that capacity building in the five case study conservation authorities is not straight-forward or simple process.

Altogether, the detailed contextual-based stories have provided some insight into theoretical understanding of what enables the case study conservation authorities to create knowledge and adapt to changes in their policy and programming. Table 6.2 summarizes

other insights into how the twelve conditions facilitate organizational learning and adaptation in the case study conservation authorities.

Table 6.2 Summary of Insights: Facilitating Conditions in Case Study Conservation Authorities

Facilitating Condition	Summary of Insights
Values – trust and respect	▪ Trust and respect needs to exist at three levels of management to facilitate knowledge creation and build adaptive capacity– within teams and departments, between authorities, partners and the public and across the authority network ▪ The building of trust and respect between organizations takes time ▪ Authorities can build trust and respect with stakeholders through facilitators
Social capital	▪ Social capital can be enhanced by working with organizations with similar objectives and goals ▪ Regular interaction and casual relationships facilitate the effectiveness of social capital ▪ Partner relationships can be enhanced through mutual understanding of mental models
Accountability	▪ Scientific, evidence-based justification of decisions and policies can demonstrate accountability and facilitate development trust and respect in authorities ▪ Clarification of roles and responsibilities in water management can enhance effective working relationships
Leadership	▪ Staff can be encouraged to build leadership skills including the ability to inspire others and to recognize patterns, interrelationships and interconnections ▪ Staff can be encouraged to be helpful towards others internally and externally ▪ Leadership involves taking advantage of instances of disturbance to benefit from opportunity ▪ Effective leadership builds trust and respect both internally and externally
Surveillance of the environment	▪ Surveillance of the environment can be expanded through enhanced social capital. ▪ Strong relationships with regular interaction can enhance social interaction and adaptive capacity ▪ Effective surveillance includes monitoring at multiple scales of management by *Managing In, Managing Out, Managing Through and Managing Up* (Westley 2002)
Social memory	▪ Redundancy, in terms of acquiring knowledge beyond one's minimal job requirements, facilitates social interaction and knowledge transfer between employees. It can reduce the negative effects of employee turnover ▪ Partnerships can be of value in providing access to knowledge and experience that can expand an organization's repertoire of possible responses to stimuli
Autonomy and	▪ Motivation of staff is important for knowledge creation and can be accomplished

motivation	by ensuring staff recognize the benefits of their work ▪ Staff are motivated with the congruence of personal and professional goals ▪ Staff are motivated when provided with a level of autonomy and flexibility to think and act creatively to contribute to the organizational mandate
Communication and social interaction	▪ There are differences between communication and dialogue. Dialogue is more effective in creating organizational knowledge and building adaptive capacity ▪ Knowledge creation and adaptive capacity can be enhanced by encouraging diversity in many ways (i.e., knowledge, experience, discipline) ▪ Effective communication of science includes explaining its relevance to policy makers
Shared vision and adaptive mental models	▪ Differences in perspectives and mental models can create learning opportunities ▪ Adaptive mental models based on new insights, observations and perspectives through social capital can improve working relationships and create learning opportunities

6.6 Chapter Summary

This chapter highlights examples of the circumstances in which conditions are applied to facilitate organizational knowledge creation and adaptive capacity in the case study conservation authorities. The results of the study suggest that the conceptual model (figure 6.1) is a helpful tool for exploring knowledge creation and adaptive capacity in the case study conservation authorities. This is demonstrated by table 6.1, which illustrates that for the most part, study participants recognized the application of each of the twelve conditions in all five the case studies. The stories by the study participants offer insight into how the facilitating conditions apply to pragmatic, every day activities in water management. As well, some of the stories have contributed to the theoretical understanding of how and why select conditions facilitate knowledge creation and adaptive capacity in conservation authorities. The final chapter discusses contributions this study makes to conservation authorities and planning. It will also highlight areas of future research that build on the results of this chapter.

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Chapter 7

Conclusions, Implications and Future Research

Chapter seven summarizes and consolidates concepts and results presented in this thesis. It does so by elaborating on the conclusions established in each of the chapters and by highlighting the potential implications of this research. These insights provide a basis for recommendations for water managers and planners in natural resource management and to make suggestions for future research.

7.1 Thesis Summary

Conservation authorities, as watershed-based organizations that plan, coordinate and manage water resources, are examples of agencies that require advances in knowledge and adaptive capacity to manage the complex social-ecological systems (Conservation Ontario 2000, Yorque *et al.* 2003, Goucher and Michaels 2004).

To investigate how conservation authorities make advances in knowledge creation to enhance adaptive capacity, this thesis applies a qualitative case study research approach to explore the circumstances in which facilitating conditions enable the organization to learn and adapt. A five step research procedure was developed to undertake this research. The first step, described in chapter two, involved selecting appropriate case studies and data collection techniques. The author of this thesis worked with a research team to acquire 64 interview transcripts from five case study organizations. This data provided the researcher with a broad overview of water resource management practices that could be used to explore enabling conditions for creating organizational knowledge and enhancing adaptive capacity.

The second step in the research procedure was to review conservation authorities and document contextual material that influence the circumstances in which these organizations manage water resources, create knowledge and adapt to change. The results of this review are summarized in chapter three. The identification of values, social capital and accountability as core facilitating conditions suggest that the governance network in which these organizations

manage water resources, described in chapter three, is an influential aspect of context that influences how conservation authorities learn and adapt. The institutional and regulatory frameworks for water resource management in Ontario require conservation authorities to collaboratively work with other agencies such as local and provincial governments, to plan, coordinate and manage water resources.

The third step in undertaking this research involved developing a theoretical framework of facilitating conditions for creating organizational knowledge to enhance adaptive capacity in natural resource management organizations. Four primary areas of literature that informed the framework are described in chapter four: social-ecological systems, knowledge management, organizational learning and collaborative planning. Each of these areas of scholarship discuss theoretical requirements of organizational knowledge creation and/or adaptive capacity. The theoretical conditions from all four literatures were amalgamated and screened for validity in natural resource management organizations. A total of twelve facilitating conditions were identified. Chapter five defines each and describes how they theoretically facilitate knowledge creation and adaptive capacity.

The final step in the research was analysis, the results of which are presented in chapter six. Analysis of the 685 pages of transcripts involved identifying discussions that provided specific insight into how and why facilitating conditions influence knowledge creation and adaptive capacity in the conservation authorities. The results suggest that the conceptual model developed is an appropriate tool for exploring theoretical concepts within a pragmatic context and that water resource practitioners can provide insight into how and why the facilitating conditions identified contribute to organizational knowledge creation and adaptive capacity processes.

7.2 Implications of Research

The results of this study have implications for conservation authorities and planning. First, as articulated by Senge (1990), organizations do not learn unless individuals learn. The facilitating conditions listed in the conceptual framework present a tool for understanding how individual actions contribute to a learning experience or an improved adaptive capacity for the organization. For instance, establishing a single friendship with someone in a partner organization or even a different department can create opportunity for timely, efficient and uninhibited knowledge exchange.

Second, planning involves linking knowledge to action (Friedman 1987). Therefore planning organizations should consider knowledge requirements necessary for taking action to meet goals. This study builds on the collaborative planning work of Innes (Innes and Booher 1999a, 1999b, 2000, 2003). She argues that planning must adapt to address increasingly complex planning problems. Management of such issues requires high levels of collaboration and social interaction with various stakeholders to develop public policy that addresses multifaceted problems. This research suggests that there may be other conditions, as presented in the theoretical framework, that could facilitate knowledge creation and adaptive capacity.

7.3 Further Directions for Research

This research focused on explicit facilitating conditions. Studies focusing on tacit conditions that support knowledge creation and adaptive capacity may contribute to a more holistic perspective of the learning and adaptation processes in natural resource management. The knowledge management literature suggests that tacit knowledge plays an important role in developing new ideas and innovations (Nonaka and Takeuchi 1995, Nonaka 2002). Social-ecological systems literature discusses the importance of experiential in addition to experimental knowledge (Folke *et al.* 2003). Together, these literatures suggests that knowledge, which is based on intuition, experience and observation and embodied in action instead of verbally communicated, may have important implications for how disturbance is

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perceived, how responses are developed and how environmental policy decisions are made (Folke *et al.* 2003, Nonaka and Takeuchi 2002, Von Krogh *et al.* 2003). Consequently, future research might investigate how tacit knowledge is created, utilized and disseminated to enhance adaptive capacity. This may be useful in exploring how organizations develop innovative ideas, anticipate turbulence and create a holistic understanding of social-ecological systems. Such research may also provide insight into how various forms of knowledge work together to inform understanding of social-ecological systems including traditional ecological knowledge and insights from other members of the public.

This research provides a 'snapshot' of conditions facilitating organizational knowledge creation and adaptive capacity in five case study conservation authorities at a significant point in time, prior to the implementation of the *Clean Water Act.* This research is timely because it corresponds with the return of active provincial interest in local water resources management. This inquiry could provide a useful baseline for future comparative studies in organizational knowledge creation and adaptive capacity in conservation authorities. Future studies might also investigate whether significant changes as a result of the new source water protection program affect the relative importance of various facilitating conditions.

7.4 Conclusions

According to Ojibway teachings, *"... water, like the blood of humans is the blood of Mother Earth and is the basis and the lifeline to all life"* (Ministry of Environment 2005, 15).

Water is the blood of the planet which supports all life. Humanity is responsible for its management and so far, water has been poorly managed (Pearce 2006). Water resource organizations must be able to adapt their management approaches through evolving organizational strategies and policies. This research provides insights into how facilitating conditions have been applied within five case study conservation authorities to enhance water management through organizational knowledge creation and adaptive capacity. Improving our understanding of such social issues is one of the first steps required to improving cross-scalar management of natural resources (Biermann 2002).

Appendix A

Interview Guide

Section A

A1) From your perspective, what are the most critical problems that the conservation authority has confronted / is confronting / will need to confront to address the information management dimensions of flood damage reduction, low water response, and source water protection?

A2) How has the conservation authority dealt with / are dealing with / might deal with each of these problems?

A3) What has enabled / is enabling / will enable the conservation authority to deal with each of these problems?

A4) What factors have hindered / are hindering / may hinder adequately addressing each of these problems?

Section B

B1) With what organizations has the conservation authority worked / is the conservation authority working / will the conservation authority work with on each of these problems?

B2) How has the conservation authority worked / is working / will work with these organizations to address each of these problems?

Section C

C1) Whom else do you suggest we talk to about each of these problems?

C2) What do you regard as the key documents to read to understand each of these problems?

Section D

D1) Do you wish to add to or amend any of the remarks you have made?

D2) Do you wish to make any concluding remarks?

This interview guide received approval from the Office of Ethics, University of Waterloo, ORE file #10968 as part of the project entitled, *Organizational Knowledge Creation for Watershed Management*.

Appendix B

Interviewer Identifier Codes

This appendix describes the details of the qualitative analysis coding procedure. The following five tables (Tables B1-B6) list the interview identifier codes used to maintain anonymity for the interviewees. These codes are used in this thesis to attribute remarks to individual interviewees.

Table B.1 Interview Identifier Codes for Credit Valley Conservation (CVC)			
ID Code	**Organization**	**General Area of Expertise in Organization**	**Interview Date**
C1	CVC	Management	31/03/2004
C2	CVC	Water Resources	05/04/2004
C3	CVC	Planning	31/03/2004
C4	CVC	Lands and Stewardship	05/04/2004
C5	CVC	Stewardship and Natural Heritage	06/04/2004
C6	Town of Orangeville	Environmental Development Services	19/10/2004
C7	Region of Peel	Planning	03/11/2004
C8	Ministry of Environment	Water Resources	04/11/2004
C9	Ministry of Natural Resources	Water Resources	10/11/2004
C10	City of Mississauga	Environmental Services	03/11/2004

Table B.2 Interview Identifier Codes for Grand River Conservation Authority (GRCA)			
ID Code	**Organization**	**General Area of Expertise in Organization**	**Interview Date**
G1	GRCA	Management	02/11/2004
G2	GRCA	Management	23/11/2004
G3	GRCA	Information Systems	23/10/2003
G4	GRCA	Planning	23/10/2003
G5	GRCA	Water Resources	24/10/2003
G6	GRCA	Water Quality	24/10/2003
G7	GRCA	Water Resources	03/11/2003
G8	GRCA	Information Management	03/11/2003
G9	GRCA	Water Resources	04/11/2003
G10	GRCA	Water Resources	04/11/2003

G11	GRCA	Water Resources	05/11/2003
G12	GRCA	Engineering	04/11/2003
G13	GRCA	Conservation Services	03/12/2003
G14	City of Brantford	Engineering	27/10/2003
G15	City of Guelph	Management	19/11/2003
G16	First Nations	Management	03/12/2003
G17	Ministry of Natural Resources	Water Resources	01/12/2003
G18	Ministry of Environment	Water Resources	28/10/2003
G19	Region of Waterloo	Water Resources	05/11/2003

Table B.3 Interview Identifier Codes for Maitland Valley Conservation Authority (MVCA)

ID Code	Organization	General Area of Expertise in Organization	Interview Date
M1	MVCA	Management	03/03/2004
M2	MVCA	Communications	10/03/2004
M3	MVCA	Water Resources	04/03/2004
M4	MVCA	Water Resources	04/03/2004
M5	R.J. Burnside and Associates	Engineering	27/10/2004
M6	Ministry of Natural Resources	Water Resources	27/10/2004
M7	B.M. Ross	Engineering	01/12/2004
M8	Ministry of Environment	Water Resources	14/10/2004
M9	Huron County	Planning	26/10/2004

Table B.4 Interview Identifier Codes for Nottawasaga Valley Conservation Authority (NVCA)

ID Code	Organization	General Area of Expertise in Organization	Interview Date
N1	NVCA	Management	22/03/2004
N2	NVCA	Communications	23/03/2004
N3	NVCA	Planning	24/03/2004
N4	NVCA	Engineering	25/03/2004
N5	NVCA	Planning	23/03/2004
N6	NVCA	Planning	25/03/2004
N7	NVCA	Water Resources	23/03/2004
N8	NVCA	Stewardship Services	22/03/2004

N9	NVCA	Water Resources	24/03/2004
N10	NVCA	Information Management	24/03/2004
N11	City of Barrie	Policy and Development	25/08/2004
N12	Town of New Techumseth	Planning	25/08/2004
N13	Ministry of Natural Resources	Water Resources	24/08/2004
N14	Ministry of Environment	Water Resources	14/10/2004
N15	County of Simcoe	Planning	24/08/2004
N16	Lake Simcoe Conservation Authority	Water Resources	10/11/2004

Table B.5 Interview Identifier Codes for Toronto Region Conservation Authority (TRCA)			
ID Code	**Organization**	**General Area of Expertise in Organization**	**Interview Date**
T1	TRCA	Management	30/11/2004
T2	TRCA	Management	30/11/2004
T3	TRCA	Resource Sciences	21/09/2004
T4	TRCA	Information Systems	14/09/2004
T5	TRCA	Water Resources	14/09/2004
T6	TRCA	Water Resources	20/09/2004
T7	TRCA	Planning	16/09/2004
T8	TRCA	Water Resources	21/09/2004
T9	TRCA	Management	20/09/2004
T10	City of Toronto	Subwatershed Studies	04/11/2004
T11	Regional Municipality of York	Water Resources	08/12/2004
T12	Ministry of Environment	Water Resources	04/11/2004
T13	Ministry of Natural Resources	Water Resources	10/11/2004
T14	City of Mississauga	Environmental Services	03/11/2004

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