Enabling the Integration of Ecosystem Service-based Approaches into Planning Organizations: Municipal Natural Asset Management

by

Zoë Emma Elizabeth Milligan

A thesis

presented to the University of Waterloo

in fulfilment of the

thesis requirement for the degree of

Master of Environmental Studies

in

Planning

Waterloo, Ontario, Canada, 2019

Author's Declaration

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.

I understand that my thesis may be made electronically available to the public.

Abstract

This research seeks to help bridge the gap between science and practice around the integration of ecosystem service-based approaches within municipal planning. This thesis identified enablers of organizational change needed to implement Municipal Natural Asset Management (MNAM) from an Ontario planning context utilizing a socio-technical system theory lens. Staff and decision-makers from municipalities and conservation authorities within the field of planning were interviewed with open-ended questions.

Enablers were formed from top challenges, opportunities, and actions identified by participants. The seven top challenges, five top opportunities, and four top actions identified resulted in the formation of six enablers. Enablers that emerged were: 1) reducing a lack of knowledge of the value of ecological systems, 2) creating a clear action plan addressing resource constraints and municipal capacities, 3) increasing cross-jurisdictional and interdepartmental coordination, 4) leveraging Ontario policy frameworks and processes to enable MNAM implementation, 5) creating clear and concise tools and processes for MNAM implementation, and 6) finding a champion to help create and continue momentum of MNAM implementation.

The enablers addressed the top challenges while utilizing opportunities and actions identified during interviews. Results provided insight into enabling the implementation of MNAM within municipalities and tangible recommendations for implementing each enabler. It is recommended that to improve MNAM implementation success, enablers are strategically approached and implemented based on careful consideration of individual needs and capacities of municipalities.

Acknowledgements

I would like to thank my advisor, Dr. Michael Drescher, and my committee member, Dr. Pierre Fillion, for their guidance and support during my research and writing. I would also like to thank Dr. Markus Moos for his/her contributions to the thesis as an external reader.

Thank you to all of the interview participants who shared their insights and experiences for this research.

I would like to extend a special thank you to Racheal Edwards for assisting with interviews, and to all the ladies from the Writing and Communication Centre who helped me improve the clarity of my writing.

Additionally, thank you to my mother, who called every week during this process, proving distance is no barrier to encouragement. And most of all, thank you to my husband, Fraser Lord, who supported me through both the highs and lows of this thesis.

Lastly, thank you to all the rest of my family and friends who have been so understanding, patient, and supportive during the last year.

Table of Contents

List of Figures

List of Tables

Chapter 1: Background

1.0 Introduction

The combined pressures of growing urban populations, continuous sprawl, climate change uncertainties, and ageing infrastructure have led to increasing service demands on municipalities. Included in these pressures is the increasing service responsibilities given to municipalities by provincial governments. Compared to other countries, Canadian municipalities are rich in resources, monetary and otherwise, but management and distribution of these resources is still a challenge, and many municipalities are starting to feel the strain. Ecosystem service-based approaches, such as Municipal Natural Asset Management (MNAM), can provide effective tools to help alleviate these growing demands that municipalities are facing, though implementing these approaches poses an additional challenge.

At its core, MNAM focuses on the services that natural systems provide to both humans and the greater environment through the identification and valuation of these services, as well as the proper management of the natural assets—natural ecosystem features and areas that provide these ecosystem services. The field of planning embodies landscape attributes, societal integration, and transdisciplinary needs, making it a natural complement to ecosystem services approaches within municipalities, and providing a strong avenue for implementation. This thesis aims to explore this integration on a tangible scale, providing practical applications and actions that can be utilized by planners and municipalities.

This thesis is split into four chapters. The first chapter is the background chapter, containing a literature review on the ecosystem service-based approaches and their integration within the field of planning. Literature is synthesized, and gaps are identified. This is followed

by a description of MNAM, the ecosystem services-based approach to be explored. The socio-technical systems theory—the theoretical lens used to examine my research—is then outlined, and an overview of Ontario's planning framework is provided for an institutional context of the research. Lastly, the evolution of two research questions from the literature review findings and background information is discussed.

The second chapter describes the research methodology, including the research paradigm, types of data collection methods, and chosen analysis. The third chapter displays and summarizes the results of the data collected. Finally, the fourth chapter delves deeper into the findings, making connections to the wider literature, the Ontario planning context, and the adopted socio-technical systems theoretical framework. From this, discussion and recommendations on how MNAM should be implemented are formed.

1.1 Literature Review: Integration of Ecosystem Service-based Approaches within Planning

Natural environments within urban areas are continuing to degrade and disappear at alarming rates. Though a greater understanding of our reliance on natural systems has grown, as well as of our impact on them, these relationships have struggled to penetrate the complex socio-economic realm that we have created and live in. An ecosystem service-based approach is a concept that natural features or ecosystems, their parts, processes, and functions, supply vital services that benefit and provide human well-being (Daily, 1997). It is an approach that aims to penetrate current socio-economic systems by aligning the concept of natural functions and processes with that of current economic and social theories and practices. It aims to clearly communicate ecological ideas and concepts, and ease the adoption of conservation practices and ecologically sustainable development (Gómez-Baggethun, de Groot, Lomas, & Montes, 2010). Ecosystem

service-based approaches have the benefit of being able to address changing societal expectations and future challenges, such as climate change, population growth, pressures on municipal provisions, higher environmental awareness, and requests for increasing transparency and higher financial accountability (Doyle et al., 2008; Krauze & Wagner, 2019; Pultrone, 2019; Schubert et al., 2018; Wamsler, Luederitz, & Brink, 2014). This informative literature review aims to provide foundational information on the concept of ecosystem services, focusing on the utilization of the concept within planning, particularly at the local government/municipal level.

The approach to this literature review was two-fold. First, in order to investigate foundational information on the ecosystem service concept, the broad term "ecosystem services" was searched in the online journal database Scopus, within Abstracts and Keywords. This produced many unrelated results, as only literature specifically addressing the ecosystem services concept as a whole was applicable. Therefore, the search was narrowed down to "ecosystem services" AND "concept," which produced more relevant literature. The University of Waterloo's library catalogue was also explored. Within Scopus, searches were organized by the number of citations, and the top 20 papers were investigated, assuming these were key pieces shaping the ecosystem services field. Primary literature sources cited within these papers were also investigated for original source material. To ensure current relevance, searches were organized by date, and sources dated between 2000 to 2019 were investigated.

The second part of the literature review focused on current research and findings on addressing the integration of the ecosystem service concept with planning. Keywords used in Scopus included "ecosystem services" with variable combinations and synonyms of "planning", "municipalities," and "urban areas." Themes and gaps in this literature were then identified in this second portion and discussed to help determine my research question.

During the literature review, it was noted that how the concept of ecosystem services is referenced can often overlap and become confusing. To ensure clarity on the differences between the terms “ecosystem services,” “ecosystem service concept,” and “ecosystem services-based approach” used in this paper, the following parameters were applied: when this paper refers to “ecosystem services” it will be referring to the actual services natural systems provide; “ecosystem services concept” will refer to the general theory of ecosystem services, while an “ecosystem services-based approach” is the application of the ecosystem services concept. These terms are further investigated and defined below in the literature review.

1.1.1 Ecosystem Services

The concept of ecosystem services within modern history first appeared in the 1970s (e.g. Schumacher, 1973; Study of Critical Environmental Problems (SCEP), 1970; Westman, 1977). It continued to grow throughout the 1980s and 1990s. In the late 1990s, Costanza et al. (1997) attempted to put a monetary value on the services the global biosphere provides to humans. In 2003, the Millennium Ecosystem Assessment advanced the concept into the realm of policy agendas through its comprehensive Ecosystem Services Assessment Framework, leading to the popularization of the topic within policy agendas (Gómez-Baggethun et al., 2010; Millennium Ecosystem Assessment, 2003). Since then, its close association with the concepts of sustainability and climate change has further boosted the topic within both mainstream literature, and policy and practice (Barbier, 2011).

Numerous definitions of ecosystem services can be found. The 2003 Millennium Ecosystem Assessment defines ecosystem services as simply, “The benefits people obtain from ecosystems” (Millennium Ecosystem Assessment, 2003). Previously, Daily (1997) defined ecosystem services as “*the conditions and processes through which natural ecosystems, and the*

species that make them up, sustain and fulfil human life" (pg. 3). Since then, many different working definitions, with increasing nuances, have come into use, such as the definition from the renowned Economics of Ecosystems and Biodiversity (TEEB) initiative, "*Ecosystem services are the direct and indirect contributions of ecosystems to human well-being."* (Kumar, 2010). Most definitions state that ecosystem services are the direct and/or indirect benefits and services that the natural environment provides to human well-being (Costanza et al., 1997; Danley & Widmark, 2016; Gómez-Baggethun et al., 2010).

The ecosystem services concept has close ties with the concept of sustainable development (Costanza & Daly, 1992). Sustainable development is often conceptualized as maintaining a balance between different "spheres" of our society: economic, social, environmental, and (more recently) cultural, in order to increase and sustain short- and long-term societal well-being (Giddings, Hopwood, & O'Brien, 2002; James, 2015; World Commission on Environment and Development, 1987). The tendency to heavily focus only on certain spheres, notably the economic realm, has contributed to the development of the sustainability concept.

The significant lack of concern for the environment and other social concerns has driven the debate on sustainability to the forefront of discussions within many industries, political realms, and academic fields in recent decades (Costanza & Daly, 1992; Giddings et al., 2002). Climate change has further accentuated the importance of environmental considerations in the last few years, driving the discussion of sustainability to new heights and bringing in new terms such as "resiliency" (Folke, 2006; James, 2015).

The concept of sustainable development has exploded among public organizations, such as municipalities. Unfortunately, traditional economic and societal systems can often be in direct opposition to environmental initiatives, and current economic pressures are difficult to

overcome. This has led to the development of new approaches intended to balance environmental and economic needs by trying to incorporate the natural environment into our economic systems. Ecosystem services-based approaches are one example that has shown great promise in providing that pathway to a more sustainable society (Balvanera et al., 2006; Barbier, 2011; Costanza et al., 1997).

1.1.2 Millennium Ecosystem Assessment

Often attributed to bringing to the forefront the concept of ecosystem services within policy, the Millennium Ecosystem Assessment, called for by the United Nations in 2000, thoroughly defines ecosystem services and its linkages to human well-being. The Millennium Ecosystem Assessment breaks down ecosystem services into four categories: supporting services, provisioning services, regulating services, and cultural services, and links them to the constituents of human well-being (Figure 1). This framework is often utilized within research, providing a universal system with comparable data references. The Millennium Ecosystem Assessment also provides: actions

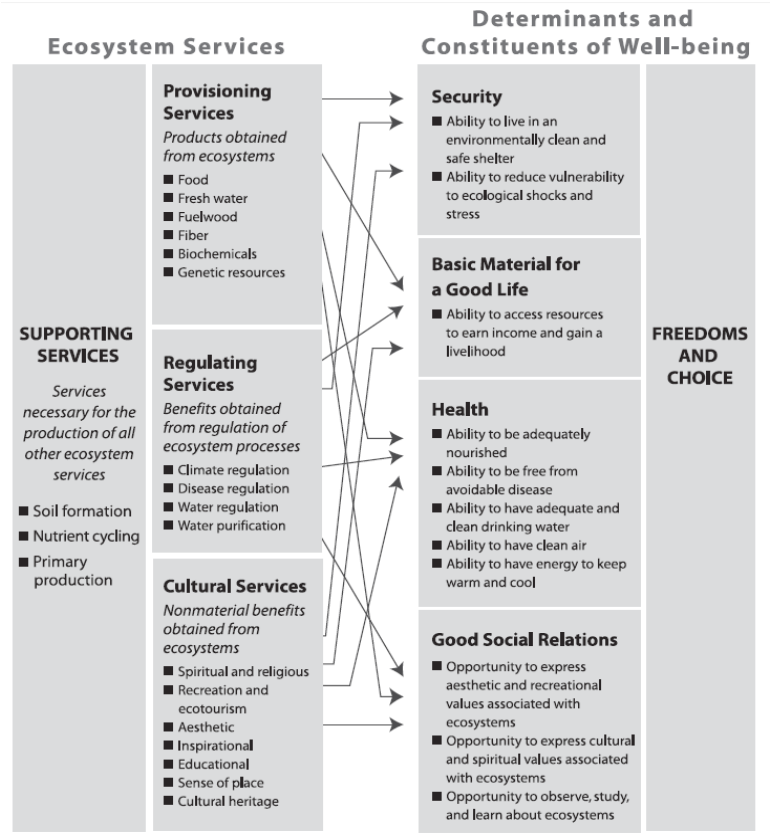


Figure 1: Ecosystem Service Categories from the Millennium Ecosystem Assessment Framework.
Source: The Millennium Ecosystem Assessment Report (2005), p.5

(responses) that can be taken, the predicted effectiveness of those actions, and the type of mechanisms needed for actions (Millennium Ecosystem Assessment, 2003, 2005). Through providing tools and options for implementation of ecosystem services approaches, the Millennium Ecosystem Assessment itself focuses on reporting the current state of the ecosystem services of regions globally.

1.1.3 The Valuation of Nature

The concept of ecosystem services is influenced by our economic perspectives, leading often, but not necessarily, to attempts to put a monetary value on nature (BenDor, Spurlock, Woodruff, & Olander, 2017; Groot, Wilson, & Boumans, 2002; Fürst, 2015). The concept of natural capital is often coupled with that of ecosystem services. Natural features and systems, such as lakes, rivers, wetlands, forests, woodlots, naturalized banks, moraines, prairies, natural reservoirs, and many more all provide a flow of beneficial services—otherwise known as ecosystem services—to human well-being. In turn, the natural feature or system is a component of natural capital—the stock from which these services are created (Barbier, 2011). Natural capital is often used interchangeably with natural assets, though the term "natural assets" seems to be used when an emphasis on the natural systems being a unit of economic resource is desired (Barbier, 2011; Brooke, O'Neill, Cairns, Machado, & Molnar, 2017). Indeed, the World Forums on Natural Capital defines natural capital as the "world's stocks of natural assets" ("What is natural capital?," n.d.).

Ecosystem health is directly linked to that of natural capital and ecosystem services. Having a healthy, fully functioning stock of natural assets increases the flow of services. A system's inner-functioning ecological state, including its biodiversity, resiliency, and richness is, therefore, important (Brand, 2009; Ekins, Simon, Deutsch, Folke, & De Groot, 2003). The

Millennium Ecosystem Assessment defines these ecological functions as 'supporting services.' These properties then combine to provide more robust processes and a stronger functioning natural system, therefore producing a greater capacity for valued services (de Groot, Alkemade, Braat, Hein, & Willemen, 2010; de Groot et al., 2002). Indeed, the important role biodiversity plays within ecosystem services has become more acknowledged, even leading to its own specific concept of "biodiversity and ecosystem services (BES)" (Cardinale et al., 2012).

1.1.4 The Debate Around the Application of the Ecosystem Services Concept

The application of ecosystem services has both strong proponents and strong critics. The benefits ecosystem services could bring to society, and the potential for the integration of the ecosystem services concept into different socio- and economic systems are large. However, it also brings along some long- and short-term concerns. The valuation of nature is a prominent topic in arguments from both sides, identifying it as a major point of contention between them. Perspectives from both critics of, and those for, ecosystem services are presented below.

1.1.4.1 Arguments for the use of the Ecosystem Services Concept

The use of the ecosystem services concept has the potential to bridge the growing gap between the environment and society by helping society reconnect to nature. One of the major obstacles for conservation efforts is society's increasing disconnect with nature (Church, 2018). The ecosystem services approach has the ability to articulate the direct and indirect linkages of nature to the individual, and bring more awareness to its benefits (Daily, 1997).

Additionally, the valuation of nature can bridge the realms of consumer society and the natural environment, providing further opportunities for the reconceptualization of both nature's economic and intrinsic value (Schröter et al., 2014). The ability to give nature and its services a monetary value also provides an opportunity for dialogue around environmental conservation to be opened at anthropogenic and economic-minded tables (Söderbaum, 2003). Many decisions

that largely impact natural areas or the environment are made by strongly economic-centric organizations, such as municipalities. In these organizations, budgeting and financial gains and losses often play a large role in final decisions (BenDor et al., 2017). The ability to bring the economic and financial sides of nature to the table is a powerful tool for both conservationists and environmentally minded decision-makers. With the expanding integration of ecosystem service and natural capital approaches in socio-economic processes, and the value of nature becoming more understood, shifts towards a society more accustomed and responsive to nature's value could lead to future decision-makers making more progressive decisions around the environment.

Another perception from proponents is that ecosystems are already part of our economy, and, therefore, should be appropriately addressed as such. Proponents argue the need for ecosystem service approaches in our economy in order to achieve a sustainable society. Some, like Barbier (2011), argue that with growing ecological scarcity occurring globally, managing our remaining natural capital is "fundamentally an economic problem," and, therefore, should be addressed as such. This indicates that market-based approaches in regard to ecosystem services may be vital for a sustainable future. However, BenDor et al. (2017) also reassures that not all ecosystem services approaches require the valuation of ecosystem services in order to be beneficial to decision-making processes. Ecosystem services can also lead to better articulation of trade-offs and actions to the public in general.

1.1.4.2 Arguments Against the use of the Ecosystem Services Concept

Critics argue that ecosystem services only value nature and all its components based on what they can provide to humans (Kosoy & Corbera, 2010; McCauley, 2006; Spash, 1997, 2002). This means that natural features and systems that are not seen to provide benefits to human well-being will not be properly conserved or protected (McCauley, 2006; Spash, 2008). Under its

application, critics argue that easier-to-integrate and more rewarding services may be more favoured, and those "less valued" may be lost, creating an imbalance of provided ecosystem services (Albert, Aronson, Fürst, & Opdam, 2014; Rozas-Vásquez, Fürst, Geneletti, & Almendra, 2018). However, natural processes act as an interconnected system. Even with features that are perceived to have less significance, cumulative impacts or destruction of these systems may have significant negative impacts that would be challenging to reverse.

Additionally, valuating nature through a commodification lens rather than a moral one can lead to ecosystem services being more susceptible to sudden "devaluation" due to commodity market fluctuations. If less costly approaches emerge, the commodification argument for conservation falls through, and these natural features and systems could be replaced (McCauley, 2006).

This intertwines strongly with the second common theme among critics: associating natural areas and their services with a monetary value. Concerns exist about utilizing market-based values for nature as it assumes an accurate reflection of the value or "worth" of nature can be achieved through monetary means (BenDor et al., 2017; Kosoy & Corbera, 2010; McCauley, 2006; Rees, 1998; Robertson, 2004; Spash, 1997, 2008). Rees (1998) points out that this accuracy of valuation is likely unachievable due to the unending complexity of nature's interconnected systems, and that often the value of a natural system is not realized until it has become scarce or completely disappeared. Monetary valuation has proven to be a challenge and—at times when incorporated into an economic framework— obscure and unscientific. For example, many payments-for-ecosystem services (PES) schemes have been criticized for their often unclear valuation processes and lack of empirical data (Brockington, 2011; Robertson, 2004). Additionally, current market-based ecosystem service approaches have focused mostly on

provisioning and regulating ecosystem services, leading to economic valuations that assume everyone uses and values ecosystem services the same way. However, groups and cultures in society value nature differently. In fact, another criticism is that the valuation of ecosystem services often disregards the cultural and spiritual value of nature (Fürst, 2015).

Critics also bring up the moral and ethical component of putting a monetary value on biotic life. Vucetich, Bruskotter & Nelson (2015) argue that nature in itself has intrinsic value. Therefore, a price tag cannot be put on it. The ethical and moral debate around how a monetary value can be assigned to a whole species is another component in this argument, as well as the debate around what responsibility humans have in protecting these species, based on their intrinsic right to exist (McCauley, 2006; Spash, 1997). Fürst (2015) agrees that current value-based approaches may be too narrow, but proposes that approaching ecosystem services from a more socio-ecological holistic system would alleviate some of the concerns by ensuring all aspects of nature's values—including intrinsic ones—are addressed. Either way, Vatn (2010) cautions that moving towards incentive-based ecosystem management has the potential to backfire over time by leading to the crowding out of environmental virtues through the encouragement of self-interest values within society.

It is crucial to consider both sides of the debate to assess the potential strengths and pitfalls of adopting the ecosystem services approach. With the disparity between the speed at which climate change pressures and environmental degradation are increasing compared to the slow adoption of strong and impactful environmental actions and policies, waiting for a large societal shift may take too long. Instead, properly operationalized ecosystem service approaches may help as a steppingstone towards stronger long-term conservation actions. Often organizations may want to help in conservation efforts and adopt better approaches but, locked

within the current system of economic restraints, cannot implement effective actions.

1.1.5 Bridging Science to Practice: Integration of Ecosystem services in Planning

The concept of ecosystem services has been around for decades (Lele, Springate-Baginski, Lakerveld, Deb, & Dash, 2013; Wilson & Matthews, 1970), and the growing understanding of the benefits that ecosystem services have for human well-being has led to an increase in literature and research around the integration of ecosystem services into planning and governance (Baker, Peterson, Brown, & McAlpine, 2012; Groot et al., 2010; Lam & Conway, 2018; Schubert et al., 2018). The pressure of climate change impacts on local municipalities has also led to municipalities searching for more cost-effective and resilient solutions to climate change challenges (Cortinovis & Geneletti, 2018). Adopting ecosystem-based approaches with a lens towards ecosystem services has the potential to address these issues, as it provides a holistic and long-term approach that utilizes natural systems that are already present and appreciate in value (Christian Albert et al., 2019; Schubert et al., 2018).

1.1.6 Implementation of Ecosystem Service-based Approaches within Planning

This literature review revealed that there has been significant debate over the best way to implement the ecosystem service approach within planning, but significantly fewer examples have been seen in its actual application (Ashnani, Danehkar, Makhdoum, & Majed, 2018; BenDor et al., 2017). Current literature frequently notes the lack of implementation of ecosystem service-based approaches within planning and policy. Many authors identify a severe lack of practical guidance for planners and decision-makers on implementing the knowledge and models gained in research and literature (Albert et al., 2014; Albert et al., 2019; BenDor et al., 2017; Cortinovis & Geneletti, 2018; Lam & Conway, 2018; Rozas-Vásquez et al., 2018), providing a large theory-to-practice gap. Both Albert et al. (2019) and Lam & Conway (2018), emphasize the

need for more context-specific examples and research on actual case studies and practical implementation.

However, there has been a recent increase in the integration of ecosystem services concepts within the field of planning (Lam & Conway, 2018; Schubert et al., 2018). Municipalities' commitment to providing services, ensuring the well-being of their residents, controlling how development happens within their borders, and owning many natural assets themselves, makes them ideal candidates to implement on-the-ground ecosystem service concepts and tools. Planners and decision-makers often are situated within municipalities to influence land use and land cover decisions, providing guidance for achieving short- and long-term community goals while ensuring the maintenance of long-term community robustness (BenDor et al., 2017). In their review of Ontario land use policies, Lam & Conway (2018) noted that certain ecosystem services were identified within municipal land use policies, but the use of the ecosystem services concept itself was rarely widespread or explicitly addressed. This lack of explicit address of the ecosystem services concept seems to be rampant among cities within North America and Europe (BenDor et al., 2017; Cortinovis & Geneletti, 2018; Schubert et al., 2018).

1.1.7 Ecosystem Services Addressed within Planning Policies, Plans, and Practices

Of the four types of ecosystem services designated by the Millennium Ecosystem Assessment (MA) framework, cultural services were found to be one of the most prominent services within planning policy and actions, while the prominence of other service types (regulating, provisioning, and supporting services) varied greatly. Cortinovis & Geneletti (2018) found that cultural and regulating services were the most prominent within Italian municipal policies and plans. Gómez-Baggethun & Barton (2013) supported this in their review of the topic, stating that

they found cultural and regulating services to be the most important to planners and decision-makers in general. On the other hand, Schubert et al. (2018) found that it was cultural and provisioning services that were most prominent within Swedish municipal policies and plans, with regulating services being poorly addressed. Lam & Conway's (2018) research on Ontario municipalities found cultural and supporting services to be most frequently addressed within planning policies and plans. Rozas-Vásquez et al. (2018) also investigated what types of ecosystem services were most dominant within municipal planning policies and plans in Chili but did so across municipal scales. They found that on a regional-municipal scale, regulating services were addressed the most; at an inter-municipal scale, cultural services were most represented; at the local-municipal scale, regulating services were most represented.

This variation in findings across different municipalities and scales emphasizes how influential the framing of a municipality's context is, and how important context-specific knowledge is to implementing ecosystem services-based approaches. Indeed, Schubert et al. (2018) included a review of types of services that were most prominently addressed within Swedish municipalities. They found that prominent ecosystem service types changed based on international policies, internal pressures, and current events. These findings revealed that context-specificity includes not only spatial considerations, but also temporal and political factors.

Across studies, the prominence of cultural services within planning plans and policies was identified as almost singularly due to the presence of recreational considerations (Cortinovis & Geneletti, 2018; Lam & Conway, 2018; Schubert et al., 2018). Even studies that investigated ecosystem services but did not specifically utilize the Millennium Ecosystem Assessment framework noted the prominence of recreational considerations within municipal plans (BenDor

et al., 2017). This demonstrates a weakness of the Millennium Ecosystem Assessment framework. The Millennium Ecosystem Assessment framework does not necessarily require a balance of ecosystem services within and among ecosystem service types (i.e. regulatory, cultural, provisioning, supporting). Having one specific ecosystem service addressed numerous times can overshadow other services within that ecosystem service type, potentially leading to a false impression of accomplishment and reassurance that that type of ecosystem service is well addressed. In regards to cultural services, the prominence of recreational services may overshadow the lack of other cultural services and provide a misleading evaluation. Recreation is only one component that augments a city's cultural system (Commonwealth Secretariat, 2007). Therefore, caution should be taken when presenting results as a comprehensive complement of all ecosystem service types.

The prominence of recreational services within the planning and municipal policies, however, is promising and provides a potential stepping-stone for planners to understand and integrate other ecosystem services. The strong planning link that has been established between nature and recreational benefits, whether implicitly or explicitly, provides a good example of planning using the ecosystem services concept. It means that planners could be potentially more receptive to the concept, especially for cultural ecosystem services, as it shows that planners already are partially trained in thinking about these connections (Cortinovis & Geneletti, 2018).

1.1.8 Notable Themes to Integrating the Ecosystem Services Approach

The literature review found notable themes regarding integrating ecosystem-based approaches into the realm of planning and identified certain implementation challenges. These included issues of scale, budget and resource constraints, participatory consultation, and institutional challenges.

1.1.8.1 Issue of Scale

A frequently cited challenge was the issue of scale, particularly around providing information and methods for the appropriate scale for implementation. The importance of implementing appropriate scale-based knowledge and processes was often emphasized (Albert et al., 2014; Gómez-Baggethun & Barton, 2013; Rozas-Vásquez et al., 2018; Schubert et al., 2018), implying that implementation in the past may not have taken this into account. The issue of scale is further complicated in that natural systems do not follow political boundaries and have the potential to cross over multiple jurisdictions. The increased complexity of needed cross-juristically cooperation can pose a challenge to the implementation of ecosystem-based approaches (BenDor et al., 2017; Rozas-Vásquez et al., 2018).

These challenges may have increased the aversion of implementing larger-scale ecosystem service approaches. Cortinovis & Geneletti (2018) noted that there is a lack of tools for addressing ecosystem services beyond the local municipal scale. This could be cause for concern as addressing ecosystem services only at the local scale through a case-by-case approach could fail to recognize cumulative impacts and larger systems issues (BenDor et al., 2017). The actual successes of integration of ecosystem service-based approaches may not be fully reliant on the scale at which they are implemented, but rather on current possibilities offered by spatial planning instruments and guidelines for implementing ecosystem service-based approaches (Rozas-Vásquez et al., 2018).

1.1.8.2 Budget and Resource Constraints

Other challenges to implementing ecosystem-based approaches identified within literature existed around the limited financial and resource capacity within municipalities (BenDor et al., 2017; Cortinovis & Geneletti, 2018; Groot et al., 2010). The need to balance multiple stakeholder interests poses a challenge to municipalities with limited resources, especially when

certain interests can directly conflict with that of ecosystem-based approaches (Ashnani et al., 2018). Often, buy-in from Council and/or upper management is needed, and uncertainty around ecosystem-based approaches within municipalities likely adds to the hesitance towards allocating resources to such approaches.

1.1.8.3 Participatory Consultation

In addition to stating the challenges, the literature often referenced the importance of participatory consultation and informing stakeholders as part of the ecosystem service-based approaches (Albert et al., 2014; Christian Albert et al., 2019; BenDor et al., 2017; Cortinovis & Geneletti, 2018; Groot et al., 2010; Rozas-Vásquez et al., 2018). Emphasis on participatory planning was often accompanied by the need to better address cultural ecosystem services. It was noted that as ecosystem services revolve around the benefits and services ecosystems and the environment provide to humans, humans will, therefore, be vital in determining the full scope of those services (Cortinovis & Geneletti, 2018; Groot et al., 2010). Additionally, ecosystem services affect a wide range of stakeholders in different ways. Therefore, ecosystem services approaches should include a wide range of informed stakeholders as part of the processes (Albert et al., 2014; Rozas-Vásquez et al., 2018).

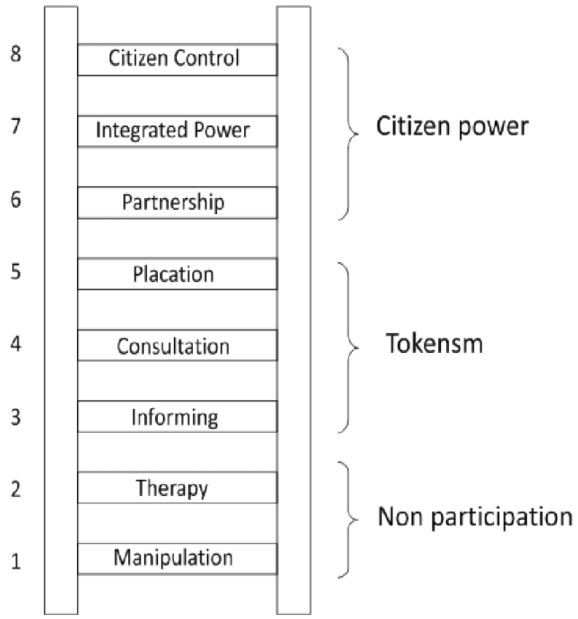


Figure 2: A ladder of citizen participation. (Arnstein, 1969)

Incorporating a stakeholder process can provide an opportunity to inform and increase awareness of the value of ecosystem services (Albert et al., 2014; Cortinovis & Geneletti, 2018). Utilizing participatory processes such as Arnstein's Ladder of Citizen

Participation (Figure 2) or IAP2 Spectrum of Public Participation (Figure 3) can provide guidance towards effective and meaningful participation and engagement, as well as constructive collection and utilization of information gained from the engagement activities (Arnstein, 1969; Depoe, Delicath, & Elsenbeer, 2004).

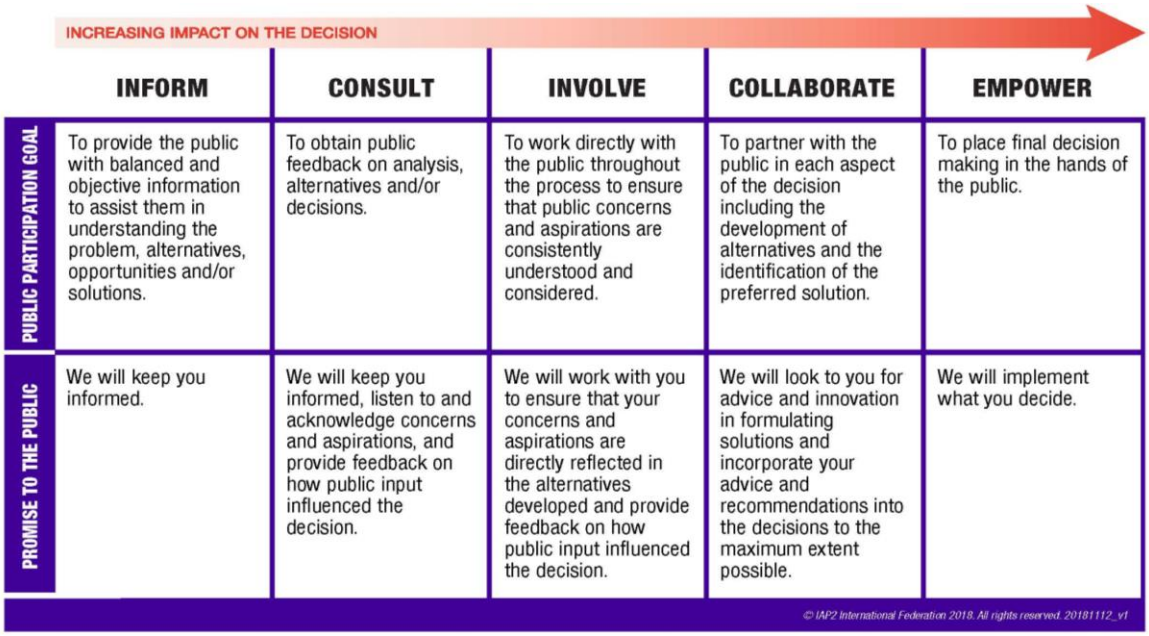


Figure 3: Spectrum of Public Participation (c) International Association for Public Participation: Retrieved from www.iap2.org

Both of these approaches scale power dynamics between participants and those that are engaging the participants—this reflects the influence participants have over decision making.

1.1.8.4 Institutional Challenges

In addition to the above themes, challenges at the institutional level were noted frequently, including concerns about risk and uncertainty (BenDor et al., 2017), resource allocation challenges (BenDor et al., 2017; Cortinovis & Geneletti, 2018; Groot et al., 2010), requirements for transdisciplinary cooperation (Albert et al., 2014; I. Kowarik, 2019), and political frameworks (BenDor et al., 2017). This implies that to improve the success of ecosystem services-based approaches and to ease transitions, the structures and internal processes of the institutions may need to be addressed. Indeed, the identified inadequacy of tools for practitioners

and the large science–practice gap identified above suggests that there are more challenges to implementing these approaches than just a lack of information and awareness.

1.2 Municipal Natural Asset Management

Primary challenges faced by Canadian municipalities today include issues associated with growing populations, ageing infrastructure, and climate change pressures within urban areas. Underlying all this is the significant degradation of the integrity of ecosystems within urban settings. Services provided by natural features are often taken for granted and lost due to urban development. However, residents still expect those services to be provided. For instance, services provided by established street trees within residential areas—such as aesthetic improvements, heat mitigation, and wind protection—are often taken for granted, but also expected to be provided. This issue is compounded when one considers the uncertain pressures of climate change, and the need for resilient systems to help alleviate such future pressures. The loss of natural features and their associated services due to development has led to increased pressure on municipalities to mitigate the losses.

Municipal Natural Assets Management (MNAM) is a novel tool created by the Municipal Natural Asset Initiative (MNAI) that has been created to address these concerns. It focuses on promoting and integrating natural areas and their functions into municipal mechanisms and asset management processes.

1.2.1 Defining MNAM

Municipal Natural Asset Management (MNAM) is an emerging approach to increase recognition of natural assets within municipalities around conservation and infrastructure decisions. It focuses on integrating considerations of natural areas, their features, and their functions, into municipal operations and accounting systems. Natural assets—such as aquifers, forests, streams,

riparian areas, and foreshores—are those natural features that provide vital services to the community. Natural assets can provide services to a community that greatly reduce infrastructure pressures in urban settings and, in some cases, even replace them. Within their "Defining and Scoping MNAM" (2017) report, MNAI indicated that natural assets fall under the umbrella of green infrastructure, but distinguished them from enhanced assets (e.g. bioswales, rain gardens, biomimicry) and engineered assets (e.g. permeable pavement, green roofs, green walls). MNAI specifically defines natural assets as "the stock of natural resources and ecosystems that yield a flow of benefits to people" (Municipal Natural Assets Initiative, 2018, p.3).

In turn, municipal natural assets are defined as "the stock of natural resources or ecosystems that are relied upon, managed, or could be managed by a municipality, regional district, or other forms of local government for the sustainable provision of one or more municipal services" (Municipal Natural Assets Initiative, 2018, p.3). Municipal natural assets are natural assets utilized by municipalities in providing services akin to those delivered by traditional engineered infrastructure or man-made structures.

MNAM refers to an overall management and asset management plan for these municipal natural assets. It views these natural areas, their features, their functions, and the services they provide through an asset management lens in order to maintain long-term sustainable and resilient services and functions to the community. In addition to providing direct regulating, provisioning, and cultural services to the municipality, natural assets can also lead to the protection of key ecological functions, biodiversity, and supporting services, such as the provision of habitat and primary production within urban areas (Millennium Ecosystem Assessment, 2003).

Following effective asset management practices, MNAM proposes a long-term,

sustainable plan to manage natural assets (Brooke et al., 2017; Municipal Natural Assets Initiative, 2018). The objective of asset management is to maximize benefits, manage risk, and provide satisfactory levels of service to the public in a sustainable manner (Federation of Canadian Municipalities, 2018; Todorova, 2017). It requires understanding what is needed versus what is provided, and involves creating a financial, operating, and maintenance plan, all created within a life cycle context for the asset (Ontario, 2016; Todorova, 2017).

1.2.2 Addressing Municipal Challenges

Emerging evidence suggests that identifying, measuring, and managing natural assets as part of an overall asset management strategy can save capital and operating costs (Brooke et al., 2017; O'Neill, 2018). Natural assets often provide unacknowledged or undervalued vital municipal services, as well as provide multiple services simultaneously (Albert et al., 2019). In addition, they have the ability to adapt to changes in the surrounding systems. These are aspects that engineered assets often lack.

In this way, local governments are finding that natural assets are more resilient and adaptable to climate change and the needs of urban growth. (Toronto and Region Conservation Authority & Green Communities Canada, 2019). For example, urban forests can reduce flooding risks, reduce erosion, provide recreational benefits, as well as assist in the conservation of natural habitats and key ecosystem functions (Endreny et al., 2017; Grau et al., 2008; Jim & Chen, 2009).

Employing asset management frameworks to natural systems has been shown to reduce infrastructure management pressures and costs (Maring & Blauw, 2018; Schäffler & Swilling, 2013). Natural assets can mitigate current and future pressures on engineered infrastructure, providing support to established systems or reducing the need to increase or improve engineered

infrastructure, and increase their overall life span (Schäffler & Swilling, 2013; Toronto and Region Conservation Authority & Green Communities Canada, 2019). In some cases, they can provide a more affordable alternative to engineered systems altogether (O'Neill, 2018; Schäffler & Swilling, 2013; Town of Gibsons, 2018).

Finally, in municipal organizations, MNAM could demonstrate the value of natural features to local residents, which can serve to engender support for conservation within the decision-making context. This would allow for greater ease in incorporating natural assets into municipal budgets, often a crucial step for the implementation of municipal projects.

1.2.3 MNAM Process

In Ontario and other provinces across Canada, municipalities are being required to create an asset management plan (Federation of Canadian Municipalities, 2018; Ontario, 2017). A key component of MNAM is trying to work in tandem with municipalities' current asset management plans. Proper and effective implementation is one of the key focuses of MNAI currently. MNAI has created an example of what the entire MNAM process entails (Figure 4). It is a six-step process, broken into three phases to implement MNAM based on initial programs.

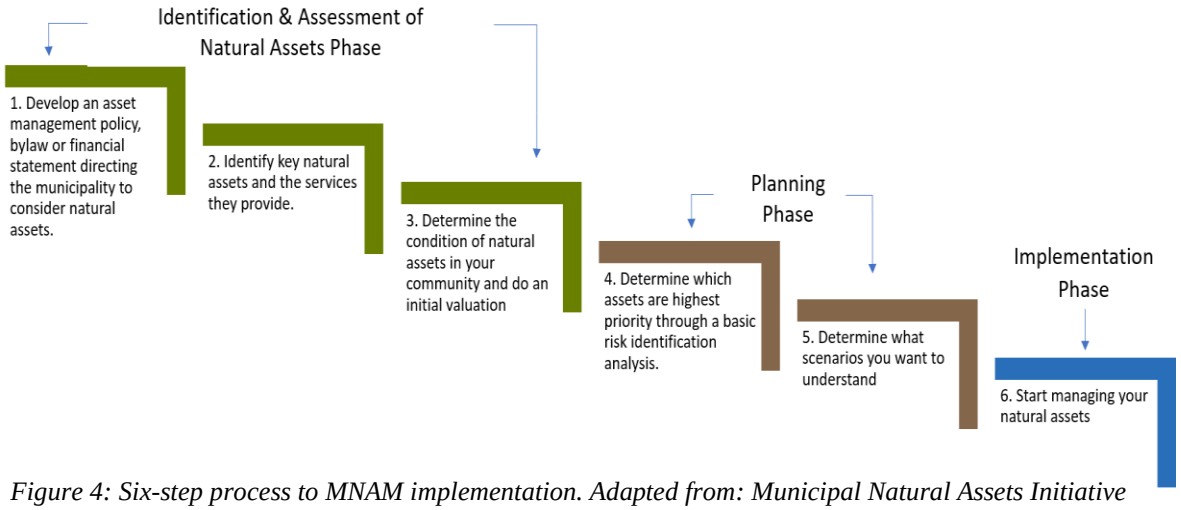


Figure 4: Six-step process to MNAM implementation. Adapted from: Municipal Natural Assets Initiative (2018).

The first phase is the identification and assessment of current natural assets within the municipality. To start the process, support from within the municipal organization for MNAM must be gained, and the processes towards enabling the integration of MNAM into the municipality operations must be started. Next, collecting initial data on existing municipal natural assets is critical to successful implementation. This is done through identifying and determining key natural features, their conditions, and their value.

The second phase is the planning phase, where the prioritization of natural assets is determined, and operational and management scenarios for natural assets are investigated. The third and final implementation phase begins the management of natural assets and continues based on the selected preferred management scenario and asset management plan.

1.2.4 MNAM Implementation

Municipalities are becoming increasingly aware of the potential for ecosystem service-based approaches to achieve greater sustainability within their municipalities. However, the implementation of these approaches has come with mixed success. Even with successful implementation in one location, implementation in another municipality may lead to less successful results (Burch, 2010a, 2010b). Though there is support for implementing resiliency and sustainability programs, traditional approaches to integrating these into current institutional systems pose a challenge (Albert et al., 2019; BenDor et al., 2017; Burch, 2010b; Cortinovis & Geneletti, 2018).

1.3 Socio-technical Systems Theory

This study views MNAM through a socio-technical systems theory lens—a theory that focuses on socio-technical transitions within institutions—by investigating currently established pathways within institutions. The importance of adopting a theoretical lens or framework is to

provide structure to the research and contextualize the findings (Adom, Hussein, & Agyem, 2018). It guides the formation of expectations and predictions of the research by connecting it to existing knowledge. A theoretical framework also provides greater transparency throughout the research, announcing the recognized approach and lens which the researcher will take, and the associated bias (Adom et al., 2018; Grant & Osanloo, 2014). Additionally, a theoretical framework helps make sense of findings and allows for a clearer interpretation of results (Grant & Osanloo, 2014). By viewing MNAM through a socio-technical systems theory lens, I hope to provide context for my research in order to supply recognized, effective, and practical guidance for planners and decision-makers.

MNAM incorporates natural features and their services into an asset management framework, addressing the need for more long-term economic management of infrastructure, resilient solutions for future climate pressures, and sustainable approaches that address economic, social, cultural, and environmental needs. MNAM has been proposed as an affordable approach to addressing these challenges. Like many other novel approaches, implementing such an approach may prove unfruitful if current institutional systems and the pre-existing pathways they form are not examined. Socio-technical systems theory attempts to analyze these pathways within an organization and determine subsequent avenues towards change in order to overcome or utilize them.

Socio-technical systems theory stems from the meeting of the rapid growth of innovation and technological advancement with stable, established institutions, also called “organizations” (Berkhout, 2002). These stable and well-established organizations are often resistant to change, causing challenges for new technologies to be integrated into them. Socio-technical systems theory looks at the rules, regimes, and subsequent pathways of the current establishment in order

to provide transitional opportunities for new technologies and approaches.

A key foundation of socio-technical systems theory is that technology does not work in isolation, rather relies on an intricate system of interdependencies between elements in which it is embedded (Borrás & Edler, 2014). These elements include complex social, cultural, and operational structures shaping the trajectories of the larger regime. This is part of the "multi-level" perspective within socio-technical systems: that of socio-technical regimes, landscapes, and niches (Geels, 2002; Rip & Kemp, 1998) (Figure 5).

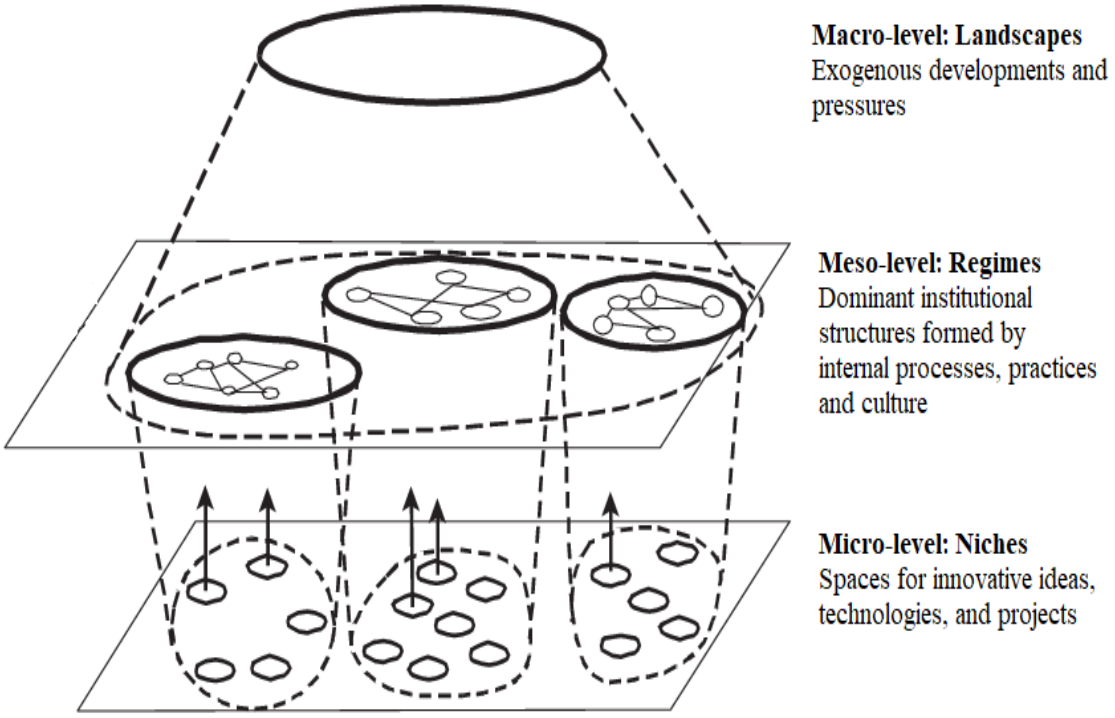


Figure 5: The socio-technical system shown as multiple levels in a nested hierarchy
Adapted from: Geels (2002), p.1261.

1.3.1 Socio-Technical Regimes, Landscapes, and Niches

Socio-technical regimes provide the "deep structure" of systems—essentially, the stable underlying structures of the established organization. The term "regime" refers to a set of "semi-coherent" rules, or a composition of rules and elements, arising from a group of interwoven

dimensions (e.g. policy framework, science network, established infrastructure, markets-user practices) (Burch, 2010b; Fuenfschilling & Truffer, 2014; Geels, 2002). These rules and dimensions create path dependencies leading to entrenched behaviours and trajectories within an organization (Berkhout, 2002; Burch, 2010b; Geels & Schot, 2007).

Regimes exist within the wider socio-technical landscape: the exogenous context and factors, that produce external pressures on existing regimes. These landscape factors, such as the wider economic, cultural, environmental, and societal trajectories, are mostly outside of the control of the system actors, but can also provide opportunities for organizational transitions to occur through shielded opportunities (e.g. political junctures) or system shocks (e.g. extreme weather events) (Geels, 2002; Rip & Kemp, 1998).

Niches exist at the micro-level of socio-technical systems. They are safe spaces for novel ideas and innovation to develop unhindered by the usual rules and pressures exerted within a regime (Geels & Schot, 2007). Due to the relative stability and established path dependencies within regimes, organizational change is usually considered slow (Berkhout, 2002). Niches provide a more unstable system, with fewer rules providing opportunities for radical innovation to form and then eventually stabilize. Once new innovations are fairly stable, ‘windows of opportunities’ provided by landscape pressures or system shocks can be taken advantage of in order to integrate these new technologies (Burch, 2010b; Fuenfschilling & Truffer, 2014; Geels, 2002).

In summary, the successful adoption of novel technologies or projects requires a shift in internal processes and dynamics within an organization (Figure 6). Regimes are the dominant underlying structure of an organization, consisting of the organization's practices, processes, and internal culture that shift to form a new organizational configuration (i.e. organizational change).

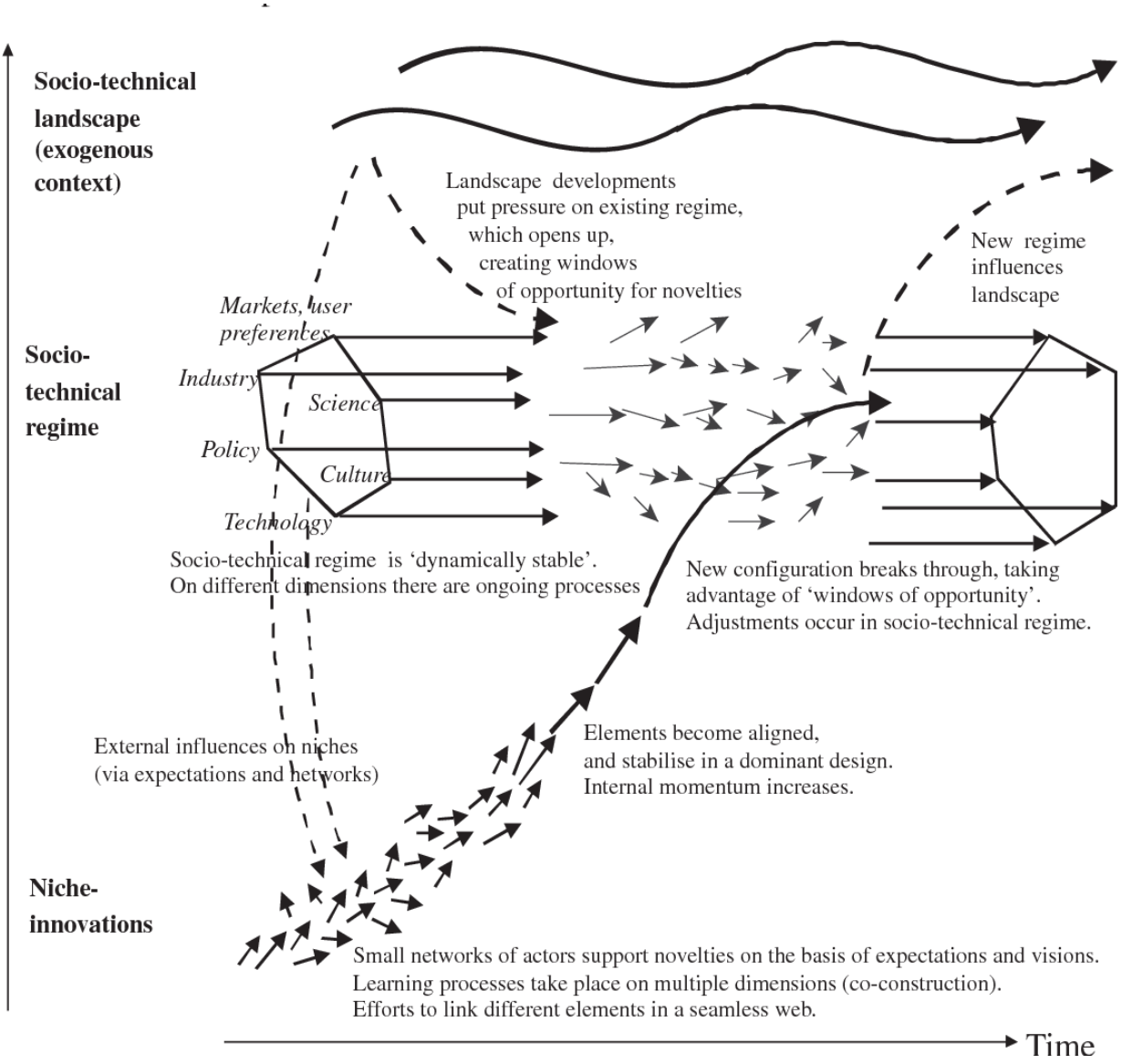


Figure 6: Multi-level perspective of socio-technical system on organizational change. This conceptual illustration of socio-technical system change depicts a stable socio-technical regime as solid, parallel arrows. However, interactions between the socio-technical regime and the socio-technical landscape (broken lines) can cause instability of the socio-technical regime (short, non-parallel arrows at centre). This instability provides a 'window of opportunity' for niche innovations (short, non-parallel arrows coming from bottom left) to embed themselves into the socio-technical regime. Once the socio-technical regime is re-configured and re-stabilized, the niche innovations are part of the re-configured socio-technical regime. Source: Geels and Schot (2007), p. 401.

New innovations are formed and stabilized in niches until a 'window of opportunity' within the organization is provided by external pressures from landscape developments. The new innovation can utilize the 'window of opportunity' to be fully integrated into the regime and its

processes, enacting organizational change or regime shifts.

1.3.2 Applying the Socio-Technical Systems Framework

Urban infrastructure is not only an artefact of technological advancements, but also of social and institutional constructs. Often given to a municipality or local government as a responsibility, infrastructure and asset management exhibit a high degree of path dependency. Entrenched in policy and regulation, engineering constraints, physical embeddedness, and safety measures, shifts within regimes are often slow and resistant to change (Guy, Marvin, & Medd, 2011).

In the context of this research, natural assets and the MNAM framework are the new technology. A foundational objective of MNAM is incorporating natural assets into the municipal infrastructure regime. The current research will be investigating this process through a planning lens, and identifying enablers of organizational change within the municipal planning system. In order to do this, an understanding of the planning framework within Ontario is needed.

1.4 Ontario Planning Framework

Insights into the Ontario planning framework provide a deeper understanding of socio-technical landscape pressures and planning rules for current Ontarian municipal infrastructure and asset management regimes. In Canada, land use planning decisions are under the power of provincial jurisdiction, creating a diverse set of planning frameworks across the country. In Ontario, planning is led by a policy-heavy system. The province creates various levels of policy and regulation to help communities balance competing interests and guide them towards the province's long-term interests, vision, and goals.

Under the *Municipality Act, 2001*, powers of local jurisdiction have been given to local governments or 'municipalities" by the Province of Ontario. Municipalities have been given

broad local governing powers and responsibility for most land use planning within their jurisdictions. Municipalities can be either two-tier or single tier. Two-tier governments have an upper-tier municipality—also known as regional municipalities—that encompasses multiple lower-tier municipalities. Two-tiered systems are often not so much hierarchal in powers, but rather jurisdictional, where municipal responsibilities are split between the two levels. For example, the Region of Waterloo in Ontario consists of three neighbouring cities—the City of Waterloo, the City of Cambridge, and the City of Kitchener, as well as four townships—North Dumfries, Wellesley, Wilmot, and Woolwich. The Region of Waterloo oversees many public services for these municipalities and townships, including but not limited to water, waste, emergency, and transit services.

The strength of relationships between the upper- and lower-tier municipalities can vary greatly between regions and influence what each municipal institution is involved in or responsible for. In contrast, single-tier municipalities assume all municipal responsibilities and are not part of an upper-tier government.

1.4.1 Ontario Planning Policy

The *Planning Act (1990) R.S.O*. in Ontario provides the foundation for land use planning in Ontario. The purpose of the Act is "to promote sustainable economic development in a healthy natural environment within the policy and by the means provided under this Act" (Section 1.1a). It provides planning mandates, guiding principles, and provincial interests for planning within Ontario. Under the *Planning Act*, the province can "issue policy statements…on matters relating to municipal planning that…are of provincial interest." (Section 3.1). This has led to the Provincial Policy Statement (Government of Ontario, 2014), providing policy directions more aligned with current provincial interests.

Decisions affecting planning matters "shall be consistent with" policy statements issued under the Act (Government of Ontario, 1990b). The *Planning Act* requires the Provincial Policy Statement to be reviewed every ten years, though there is no restriction against renewing it sooner. The current Provincial Policy Statement, updated in 2014, provides direction on community development and growth, and reinforces the Province's commitment towards "enhancing the quality of life for all Ontarians" (p.1).

Furthermore, the Provincial Policy Statement policies provide direction on "building strong, healthy communities" (Section 1), including considerations in infrastructure and public service facilities (section 1.6), as well as energy conservation, air quality, and climate change (section 1.8). Direction on the use and management of resources (Section 2.0), such as natural heritage areas (Section 2.1) and water (2.2) is also provided. Lastly, the Provincial Policy Statement promotes the protection of public health and safety (section 3.0), including natural hazards (3.1) such as erosion control (Government of Ontario, 2014).

The Ontario *Planning Act* also mandates that each municipality create an Official Plan that has to include municipal:

> "goals, objectives and policies established primarily to manage and direct physical change and the effects on the social, economic, built and natural environment of the municipality or part of it, or an area that is without municipal organization." (Section 16 (1a))

Official Plans must conform to the *Planning Act*, the Provincial Policy Statement, and to any other regional planning or environmental legislation. Official Plans are expected to be kept updated, and are required by the *Planning Act* to be fully revised every ten years in their entirety—or alternatively, reviewed every 5 years (Government of Ontario, 1990b). Official

Plans include more context-specific and explicit policies than provincial policies on growth management, services and infrastructure, community improvement initiatives, and zoning bylaws (Ministry of Municipal Affairs and Housing, 2015). Like the *Planning Act* and Provincial Policy Statement, Official Plans are strong guiding documents that direct municipal planners' goals, decisions, and actions.

1.4.2 Provincial, Regional and Environmental Policy

In addition to the *Planning Act*, the Provincial Policy Statement, and Official Plans, municipal and land use planning is heavily guided by a network of province-wide and regional policies and plans, such as the *Environmental Protection Act (1990) R.S.O.*, the *Greenbelt Act (2005) S.O.*, and the Growth Plan of the Greater Golden Horseshoe (GGH). Included in this is the *Conservation Authorities Act (1990) R.S.O.* This act has led to the creation of thirty-six Conservation Authorities—jurisdictional authorities based on watersheds mandated to "further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals" (s.20).

Conservation Authorities play a significant role in land use planning and environmental conservation in Ontario, especially around natural resources, directly and indirectly, linked to the protection and management of water. Under the *Conservation Authorities Act*, Conservation Authorities have permitting powers over land use development that neighbour or encroach on water-based features.

In addition to the Official Plan, municipalities create other policies and plans. These include secondary plans, block plans, strategic plans, master plans, and zoning bylaws. Tools such as strategic plans, master plans, and secondary plans proclaim a municipality's vision and determined needs for the future. They provide guidance on how future municipality initiatives

and actions should proceed. These plans can directly provide actions and policies that are more specific and detailed than the Official Plan. Secondary plans, block plans, and zoning bylaws are also strong tools as they can specifically dictate land use and development actions and decisions. Table 1 provides a more detailed description of each.

Table 1: Types of Municipal Plans and Policies.

Municipal Plan	Description
Official Plans	• Provide high-level direction and policy framework regarding land use and growth decisions within the municipality. • Offers a foundation for municipalities' other strategic and land use documents.
Secondary Plans	• Focuses on a specific area within the municipality. • Often prepared as an amendment of the Official Plan • Provides more detailed policies and direction specific to that area.
Block Plans	• Finer grain planning framework than secondary plans. • Outlines vision for land use road network, urban design, natural heritage network for portion of the secondary plan. • Often prepared by participating property owners, however, planners review and approve these plans and are able to provide guidance and place requirements on the development of the lands based on municipal policies and plans.
Strategic Plans & Master Plans	• Define the future direction municipalities wish to pursue and provide the roadmap of how it will get there. • Can be in regards to a specific area(s) or project within the municipality (e.g. Exhibition Place Master Plan); a general aspect of the municipal operations (e.g. Open Data Master Plan, Archaeological Master Plan), or for a general facet or service of the municipality (e.g. Transportation Master Plan, Environmental Master Plan). • Often include priorities and goals, a conceptual layout (if applicable), how decisions are to be made and resources allocated, general guidelines, and specific actions to be conducted to achieve the plan's priorities and goals.
Zoning Bylaws	• Put Official Plans and other municipal plans into effect through legally enforceable land use controls. • Can control how land is used and what can be built on it, allowable activates on the land, and building or property requirements (e.g. height, size, parking requirements).

Federal policies and legislation also play a role in municipal and land use planning, though less directly. Acts such as the *Oceans and Fisheries Act (1985) R.S.C.* and *Species at Risk Act (SARA) (2002) S.C.* indirectly affect land use decisions through legislative restrictions. Certain natural areas within Ontario, such as national parks, also fall within federal jurisdictions, causing additional considerations for municipalities abutting these areas.

1.5 Research Question Development

Albert et al. (2014) identified the need for research that looks closer at the practical implementation of ecosystem services-based approaches, focusing on the planning and decision-maker needs. This knowledge gap was further defined by Albert et al. (2019), specifically identifying the need for more 'target knowledge' that is, "how planning processes can be designed and embedded in a wider governance structure" (p.19) within nature-based systems, such as ecosystem services-based approaches.

Furthermore, Albert et al.'s (2019) identification of the need for more 'transformation knowledge' that includes "approaches for harnessing the complementary roles of state, business and civil-society in nature-based systems implementation" (p.19) emphasizes the need for more practical information on the process of implementing these approaches within municipalities. This identified lack of knowledge continues to emphasize the large gap between science and practice.

My research will aim to contribute to filling this gap, and the need for context-specific research, focusing on providing target and transformation knowledge. I will do this by taking an ecosystem service-based framework, MNAM, and looking at the pathways within urban municipal organizations that may hinder or assist in this framework's implementation. The

findings will be viewed through the lens of the socio-technical systems theory. This approach stems from the institutional constraints identified from my literature review. It will provide accessible guidance on institutional (organizational) change.

To address the context-dependent nature of the created knowledge, this research will focus on urban municipalities in southern Ontario, falling within a strong policy-led planning system, driven by the Province of Ontario.

The above literature review findings have led to the formation of two research questions:

1. *What are the organizational challenges and opportunities to implementing MNAM in Southern Ontario urban municipalities?*
2. *How can municipalities enact organizational change in order to overcome these barriers and act on these opportunities?*

Chapter 2: Methodology

2.0 Introduction

This chapter outlines the methodology for the current research. Application of this methodology, identified (i) the most important planning-based challenges that municipalities may encounter when implementing MNAM, (ii) the most important opportunities and actions municipalities can take to successfully implement MNAM, and (iii) enablers that will ease municipalities' transition towards successful MNAM implementation.

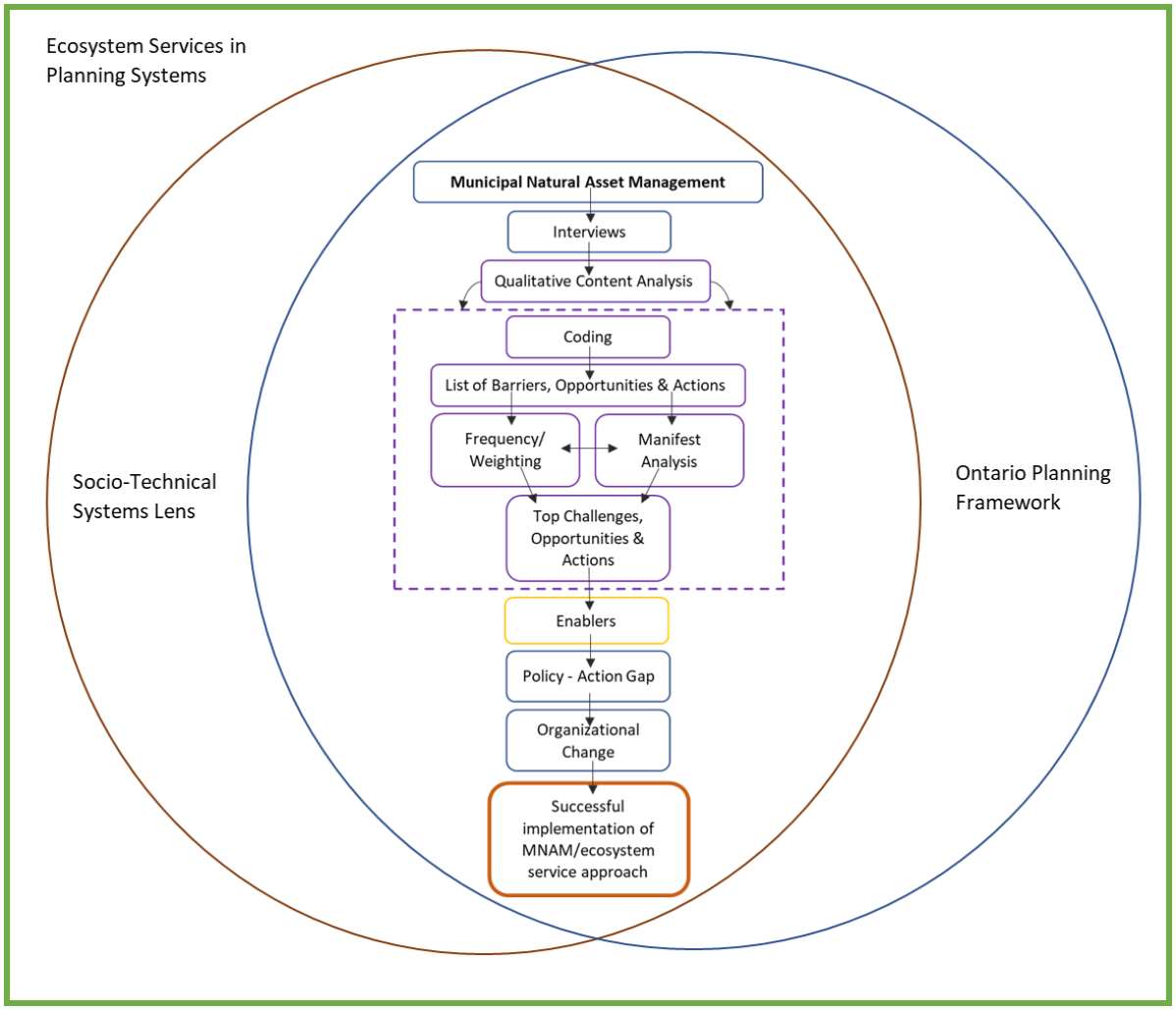


Figure 7: Visual representation of the methodological framework of this study.

The research takes a qualitative approach through the application of semi-structured interviews and inductive qualitative content analysis. Provided below is an overview of the methodology and how it fits within this study's framework (Figure 7). Outlined below are the philosophical orientation, data collection and analysis methods, as well as considerations of methodological rigour and ethics.

2.1 Research Approach: Qualitative Research

The current research applies a qualitative research approach. A qualitative research approach often focuses on the use of text, images, or aural accounts for the reflection and interpretation of findings (Carter & Little, 2007; Ritchie, Lewis, Lewis, Nicholls, & Ormston, 2013) . Qualitative research is often inductive - where a theory is formed from general noted observations collected during research (Bryman, Teevan, & Bell, 2009; Creswell, 2014). The emphasized social component of this research made the qualitative research approach suitable, as the adaptability and evaluation tools of qualitative research allow for a deep exploration of the complex and subjective nature of social realities (Bryman et al., 2009). Additionally, with its ability to be more nuanced in terms of data reflection, the qualitative research approach allows a detailed understanding of the social pathways of organizational regimes. This is a key component of socio-technical systems theory, which is the theoretical framework for the current research (see section 1.3).

Though a qualitative research approach was deemed most suitable, the drawbacks of this approach must be acknowledged. This approach is often critiqued because of its reliance on interpretation, which necessarily is subjective in nature (Bryman et al., 2009). However, it can be argued that these 'subjective perceptions' are important to understand and collect, as they are what form the social actors' reality and influences their actions. The qualitative research

approach allows for the unpacking of complex social phenomena and pathways, and the exploration of the nuances within the human condition that a more rigid approach of quantitative research cannot account for. Therefore, it is critical to acknowledge the subjectivity, perspectives, and bias of both the participants and researchers.

Another critique of qualitative research is the limited ability to replicate the research findings (Bryman et al., 2009; Willis, Jost, & Nilakanta, 2007). Though replicability is often a stated research ideal, it cannot be thought of as inherently validating when research is based on acknowledging the existence of multiple realities through the complex social transitions of actors' perspectives and context.

2.2 Research Methods

2.2.1 Recruitment

The study area was limited to Southern Ontario, Canada. Recruitment of participants focused on planners and those with planning-like roles in single and two-tier urban municipalities, as well as in Conservation Authorities. Contacts of members of the University of Waterloo's Planning department were utilized to establish initial communication with potential participants. Following this, snowball sampling was used to identify further participants (Penrod, Preston, Cain, & Starks, 2003). Following initial contact via email or phone, and an indication of interest by the contact, a follow-up email was sent containing a general information letter about the interview and research process, a consent letter, and an information package containing a description of MNAM. A total of 45 people were contacted, 15 of which ultimately participated in the study. Due to the reliance on identifying participants through interviewees, a potential weakness of this sampling approach is anchoring. Anchoring occurs when too much reliance is put on a specific target audience to gain information or, in this case, a sample of participants.

This can lead to obtaining potentially biased information because participants are not necessarily representative of the larger population (Furnham & Boo, 2011).

2.2.2 Interview Structure and Questions: Semi-Structured Interviews

Interviews were semi-structured, using 15 open-ended questions and ranged from 30 minutes to 90 minutes. The research questions of this paper revolve around individuals' interpretation of an institution and framework, and as such, the results will rely heavily on individuals' perspectives and interpretations of the current state of natural asset management, internal workings of Ontario public institutions (i.e. municipalities and Conservation Authorities), and the Ontario planning framework. Semi-structured interviews allow participants to explain how they themselves interpret and make sense of issues while maintaining focus and structure, and reducing biases between different interviews (Bryman et al., 2009; Jamshed, 2014). To the same end, semi-structured interviews provide flexibility for the interviewer to ask for further clarification if required. Semi-structured interviews also allow for a level of comparability between each interview (Bryman et al., 2009). This is important for reliable and valid conclusions to be made, as the findings of these interviews should be a representation of the larger context of Ontario municipalities and Conservation Authorities. A limitation of semi-structured interviews is that answers are more susceptible to unproclaimed biases, which in turn may produce biases in the interpretation of information by both the participant and the researcher.

By using open-ended questions, researchers do not assume that they know what answers are available. Rather, they are trying to gain the answers from those that are more knowledgeable in the sector and more familiar with its inner workings. Open-ended questions are good for exploring multi-faceted dynamic fields and allow for unusual answers that the researcher may not have contemplated (Bryman et al., 2009). One disadvantage of open-ended questions is that

this type of interviewing can be time-consuming, restricting the size of the data set collected. In answering an open-ended question, interviewees may also move away from the study's focus and not provide quality or relevant answers. Additionally, comparisons and coding of answers can be difficult, and the interviewer may be required to rely more heavily on the use of personal interpretation of the interviewee's comments, which may cause inaccuracies (Bryman et al., 2009).

Interview questions in the current research are based on the inquiries of "What are the top challenges and top opportunities to implementing MNAM from a planning perspective?" and "What role would planners play in MNAM?" The 15 interview questions used in the study were designed to investigate these inquiries. The questions were first drafted by the lead researcher and two research associates. During the creation of the questions, the MNAM process, Ontario planning framework, and need to compensate for the biases and weaknesses of the research methods were considered. Draft questions were then revised by two subject matter experts from the University of Waterloo's Planning department. The questions were then sent to the University of Waterloo Office of Research Ethics for review and approval.

Further considerations that were addressed when forming the interview questions were relevancy and clarity, different types of question structures to provide different avenues to gain a full picture of participants' knowledge, interviewee bias, the potential of leading questions, and tools and methods to prompt participants to explore a concept further. The list of interview questions can be found in Appendix B.

Interviews were conducted in-person or on the phone. All interviews were recorded with the participant's permission. Two interviewers were present during all interviews. One interviewer led the questions, and a second interviewer took notes, helped register gaps in

answers, and asked for elaboration on nuances that the lead interviewer may have missed. This increased the rigour of the interviews.

2.2.3 Transcription

Following interviews, the researchers transcribed the recordings verbatim. Transcriptions were conducted by three individuals: the lead researcher (seven interviews), one research associate (five interviews), and one research assistant (two interviews). All transcriptions were reviewed a second time by the lead researcher for quality control. Specialized software, Express Scribe Transcription (Version 8.14), was used to assist in transcribing.

2.3 Data Analysis

2.3.1Qualitative Content Analysis

Qualitative content analysis is a method of text analysis. Mayring (2000) states that qualitative analysis is "an approach of empirical, methodological controlled analysis of texts within their context of communication, following content analytic rules and step-by-step models, without rash quantification" (p.2). Qualitative content analysis contains a number of methods. The basis of this approach is to break down text into smaller units, then group them into categories and themes to derive greater meaning (Erlingsson & Brysiewicz, 2017; Mayring, 2000).

In this research, the lead researcher specifically used conventional qualitative analysis, an inductive category approach, creating categories directly from the data (Hsieh & Shannon, 2005). As part of the analysis, a combination of frequency analysis and manifest analysis is utilized. Frequency analysis assisted with the organization of categories and the initial determination of top challenges, opportunities, and actions. All frequency analysis results were further interpreted through manifest analysis and the socio-technical system theory framework. Manifest analysis was utilized as a broad surface structure review of the transcription to

determine emergent coding, categorization, and themes as well as underlying phenomena (Bengtsson, 2016). It affirmed the final determination of 'top' challenges, opportunities, and actions and it facilitated the formation of enablers. The description below outlines the specific process.

2.3.2 Coding Method

The coding software Dedoose (Version 8.2.14) was selected due to its (i) accessibility from any device, (ii) ease of coding, (iii) quick software learning curve, (iv) data analysis capabilities for the type of data collected, and (v) affordability.

Three rounds of coding were conducted, with a fourth partial round to ensure reliability and accuracy. Coding reflected the requirements for manifest analysis, holding true to the text and reflecting participant's word usage. The first round consisted of both initial or 'open' coding

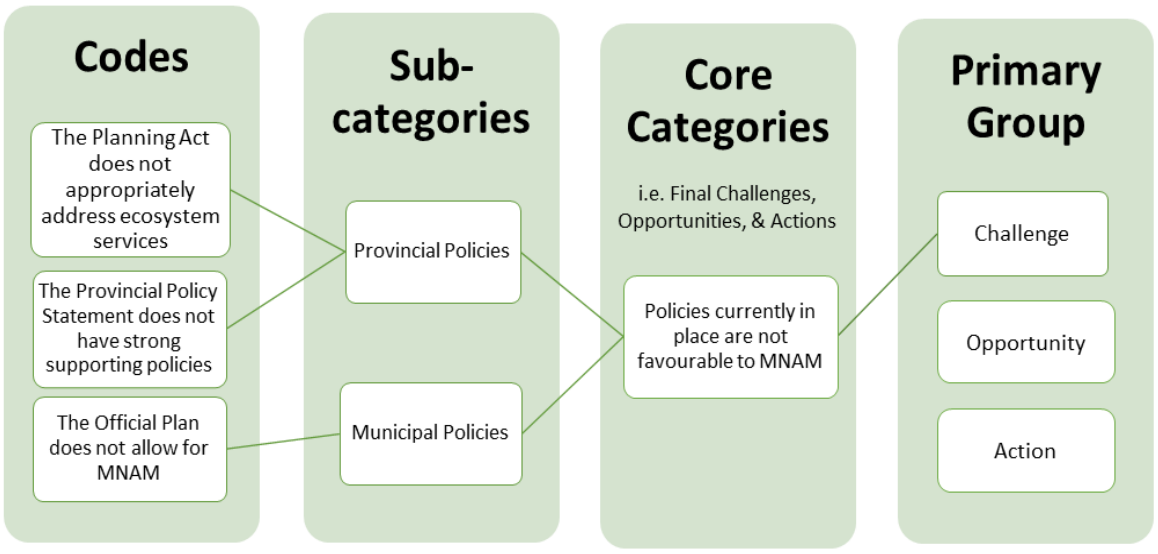


Figure 8: Example of Code, Subcategory, and Core Category formation

and 'holistic' coding. In open coding, codes emerge from the data via patterns, similarities, and differences (Figure 8). It allows the researcher to reflect on the emerging content of the text and allows for initial categorical coding alongside other code types (Saldaña, 2009). Codes are

attached to raw text representing emerging categories (Gläser & Laudel, 2013) and reflecting the inductive approach of the methods. Holistic coding was applied as well by looking at the text as a whole, identifying larger excerpts that may address one code or a larger meaning (Saldaña, 2009).

Each excerpt identified through holistic coding was weighted based on a scale from one to five for emphasis, with one having the lowest emphasis and five having the highest. A weighting guide was created and used to reduce inconsistencies between different coding sessions (Table 2). During this weighting, the lead researcher re-coded 25% of the interviews to ensure the reliability of codes and weighting.

Table 2: Weighting Guide for the Emphasis Level of Coded Interview Excerpts.

Weight	Meaning of Weight
1	Not directly said. Discussion only slightly eludes to code.
2	Not directly said. Situation/discussion eludes to code or if specifically stated, not emphasized.
3	Discussion or an example eludes to code or encompasses it indirectly or, if specifically stated, is subdued, less confident, or downplayed.
4	Stated explicitly but not emphasized. If not stated explicitly, then discussion directly implied or provided direct evidence.
5	Explicitly stated and emphasized. If not stated explicitly, then direct, strong example provided.

The second round of coding again applied open and holistic coding. In this round, a review of the first round of coding was completed to ensure its reliability of coding was completed. Additionally, codes and merging categories were more clearly defined and overlapping codes were merged. These often created the beginnings of what resulted in subcategories, refined later after top challenges, opportunities, and actions were identified. The third round of coding consisted of ‘selective’ coding, also known as ‘theoretical’ coding. Selective coding allows the researcher to systematically link all categories that are of greatest

relevance to core categories (Saldaña, 2009). From these core categories, the final challenges, opportunities, and actions emerged. The fourth and final round of coding was a random checking of codes. Approximately 40% of codes were randomly checked for consistency, accuracy, and reliability.

2.3.3 Frequency and Weighting

In qualitative content analysis, some quantification of codes is an accepted mode of analysis (Gläser & Laudel, 2013; Hsieh & Shannon, 2005; Schilling, 2006), though overuse of quantification in interpretation should be avoided (Gläser & Laudel, 2013; Mayring, 2000). To help yield additional insight into the results, frequency analyses were used and compared when determining the most important challenges, opportunities, and actions to implementing MNAM. The quantitative analysis helps the initial formation of the codes and helped the exploration of the results for nuanced outcomes (Schilling, 2006). These quantitative analyses assessed (i) the overall frequency of each code, (ii) the number of interviewees for whom the code was present, (iii) the sum of the code weighting, and (iv) the average of the code weighting. Co-occurrences of codes on excerpts were also investigated for further nuances. It should be noted that quantitative analysis did not play a role in emergent categorization, rather was only used to help organize categories and assist in determining top challenges, opportunities and actions.

2.3.4 Challenges & Opportunities

Final identification of the most important challenges and opportunities to implementing MNAM emerged from a combination of considerations. First were the above quantitative analyses, looking at weighting emphasis in relation to each other. Weighting codes based on participants' emphasis provided a deeper underlying perception of the nuances surrounding participants' answers. Weighting provided deeper insight past that of simple frequencies to a more contextual

representation of answers in the larger text. Challenges and opportunities with the greatest weighted sum and greatest weighted averages were then analyzed further through additional coding and manifest analysis. A review of excerpts to see if additional subcategories emerged within these top challenges and opportunities was done to provide a deeper comprehension of responses for discussion. Responses also were verified by reviewing source data and information collected through publicly available sources. This verification also enabled a deeper interpretation of results, helping to identify the top challenges and opportunities. These challenges and opportunities were then analyzed for underlying implications within the socio-technical systems theory.

2.3.5 Actions

A list of actions emerged from the interviews. Actions are specific deeds that can be performed, which can assist in the implementation of MNAM. Actions can help create opportunities, overcome challenges, trigger enablers, and/or maintain the long-term viability of MNAM. Actions recommended by participants provide insight into potential enablers by applying emphasis to specific organizational elements and pathways. Actions were analyzed similarly to that of opportunities and challenges, but due to their indefinite nature, less emphasis was put on weighting and in determining their importance. Rather, their relation to challenges and opportunities in order to stimulate enablers was focused on.

2.3.6 Identifying Enablers

Taking into account the context of the socio-technical system combined with the emergent challenges, opportunities, and actions, provided the foundation for the identification of enablers. Enablers stimulate or encourage transition into new organizational pathways within Southern Ontario municipalities that enable the adoption of MNAM. Opportunities, challenges, and

actions, their associations with one another, and their associations to the larger organizational regime were investigated in order to provide a rich narrative of the phenomenon. Enablers emerged initially from the data, but then were adjusted based on supporting literature. This ensured validity and relevancy of enablers to the socio-technical systems theory and research questions.

2.4 Rigor

The reliability and validity of findings are key attributes of rigorous qualitative research (Bengtsson, 2016; Krefting, 1991). During the entire research process, steps were taken to ensure rigour of the research. Overall, an effort was made to provide transparency in the research process. During the creation of the interview questions, question drafts were reviewed by multiple research professionals regarding the suitability of the interview questions. During data collection, two interviewers were present at all interviews. This provided an additional person to capture potentially unclear responses and ensure that questions were fully answered. Recordings were reviewed, and notes of interviewers' observations were compared during transcription to ensure all interview nuances were captured.

Rigour was also maintained during coding. Multiple rounds of coding were conducted to increase reliability and accuracy. Multiple accuracy and reliability checks were conducted during coding. Established coding methods were applied, providing further validity. Direct quotes from interviews are used to provide proof of findings. Whenever possible, participant answers were also checked for validity. For example, when participants made statements about policies, provided information on municipal actions or contexts, or identified specific cases, these were investigated after the interview by the lead researcher to ensure the veracity of the claims. All claims were investigated through the analysis of source documents and reports. In the case of

policies, plans, or legislation, they were fully analyzed and compared against participants' statements. Finally, during the discussion chapter, the findings of the current study are compared to other literature and research findings.

2.5 Ethics

As this research includes human participants, under the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS, 2nd edition), ethics approval was required from the University of Waterloo's Office of Research Ethics. Ethical questions around consent, vulnerability, and integrity were all applied to this research (Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, & Social Sciences and Humanities Research Council of Canada, 2014).

Since interviewees were being asked to critically analyze the workplace and institution they work within, anonymity and confidentiality were important considerations and were maintained throughout the research process. All participants were asked to sign a consent form that outlined the ethical concerns of the interview. Interview Ethics approval was gained for this research from the University of Waterloo, Office of Research Ethics, file number #22558.

Chapter 3: Findings

3.0 Introduction

Top challenges, opportunities, and actions (i.e. core categories) were identified through qualitative content analysis to identify enablers for the adoption of MNAM. The following sections outline the results from my interviews and analysis, presenting the emerging top core categories and the resulting enablers. Top core categories helped form the enablers. The purpose of this chapter is to present the main results of the interview findings and of the formation of enablers. Due to the qualitative nature of the data, some interpretation was necessary to formulate the results, particularly the enabler formation. Reflection on how enablers pertain to the socio-technical systems theory and initiate organizational change was held for the discussion chapter.

3.1 Study Sample

Recruitment of participants focused on planners and those with planning-like roles in Conservation Authorities and in single and two-tier small and mid-sized municipalities. Participants' familiarity with MNAM ranged from none, to those leading a MNAM pilot project within their respective organizations. Recruitment started in October 2018 and ended in January 2019. A total of 15 interviews were conducted. Interviews included nine participants representing six municipal governments, and four participants from three Conservation Authorities. An additional two interviews were conducted with representatives of external organizations with a relevant interest in MNAM. These two external sources were included due to their experience in MNAM and its planning processes within municipalities.

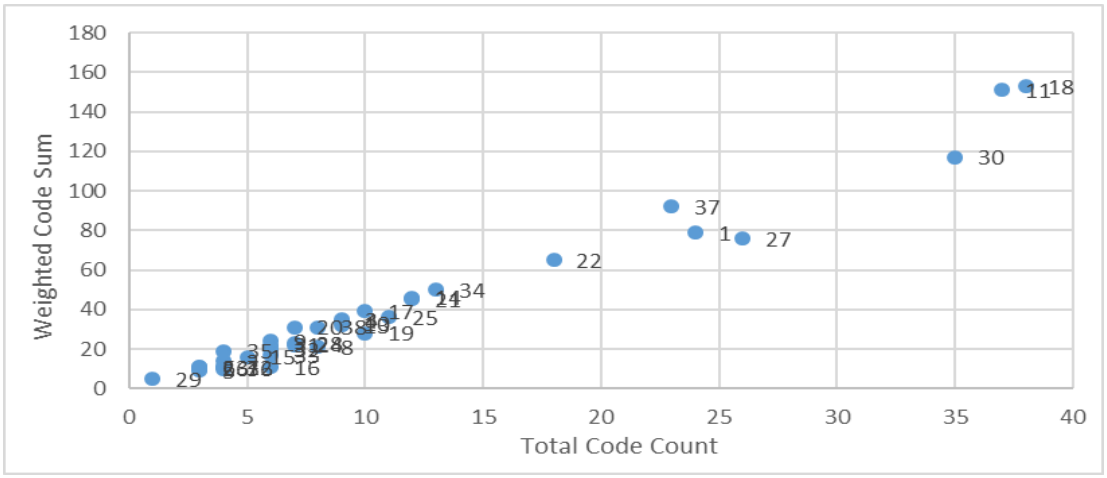
3.2 Challenges, Opportunities and Actions

A total of 38 challenges (Appendix C), 23 opportunities (Appendix D) and 28 actions (Appendix E) were identified. The frequencies of total code count (TC), weighted code sum (WS), and code presence (PA) of each challenge, opportunity, and action were plotted in order to probe for and identify potential discrepancies in the relevance of these variables. For all three variables, higher frequency equated to greater relevance. Alongside these basic quantitative analyses, core categories were further analyzed through manifest content analysis to reveal their underlying meaning and significance. The top core categories identified through frequency analysis were further explored in the context of all identified core categories to determine the validity of responses and justification of prominence. Additionally, emergent subcategories within top categories were included in the investigation to help contextualize discussion of core categories. The results of the basic frequency analysis and manifest content analysis are presented below.

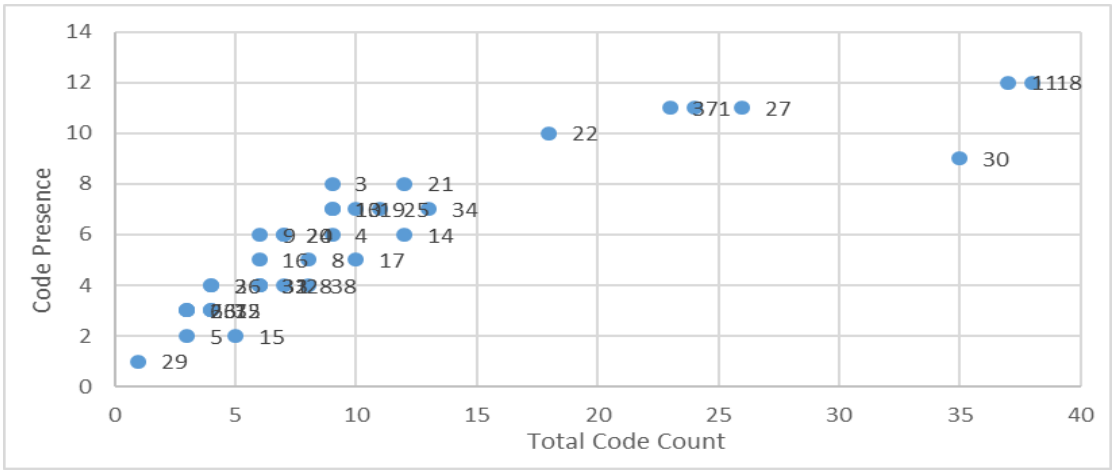
3.3 Top Challenges

Pairwise plotting of the frequencies of TC, WC, and PA for each challenge reveals strong relationships between these variables (Figure 9). Additionally, because higher plotted values indicate a stronger relevance for all variables, the pairwise plotting provides a visual indication of relevance. Each of the three plots shows a consistent cluster of seven challenges (Points #2, #14, #26, #33, #38, #45, and #22) that occur with high frequency within the plots. These seven challenges were initially identified as top challenges. There were no outliers or discrepancies between code relevance noted. The list of challenges and their associated TC, PA, WS, and mean for each are presented in Appendix C.

a)



b)



c)

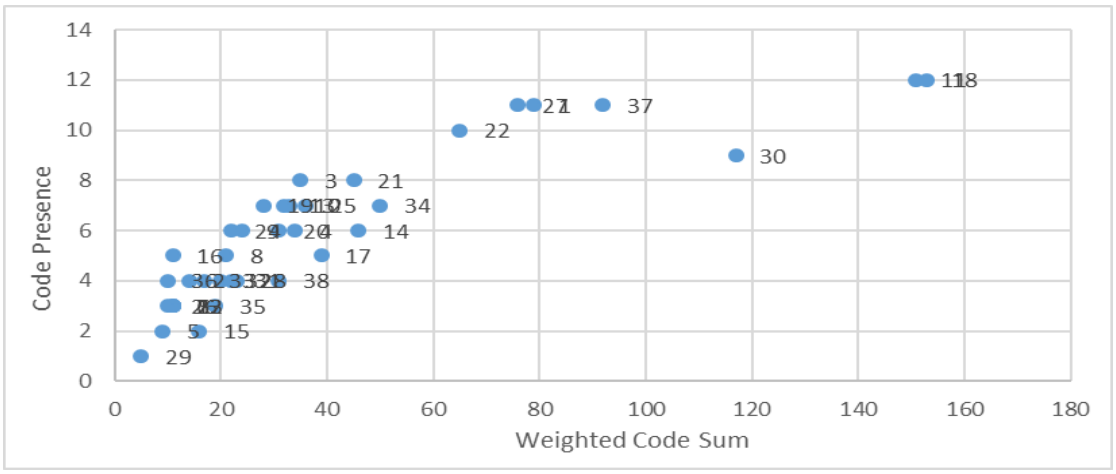


Figure 9: The relationships between the frequency of total code count, weighted code sum, and code presence for each identified challenge. Shown are the relationship between a) total code count and weighted code sum, b) code presence and total code count, and c) code presence and weighted sum. Plot numbers are identification numbers designated to each challenge formed from coding (see Appendix C).

Further manifest analysis was conducted on the cluster of seven challenges to contextualize the findings, capture nuances, and ensure they reflect the socio-technical systems lens. All seven challenges were maintained as the top identified challenges in implementing MNAM (Table 3). The manifest analyses of each challenge are described below in the enablers section.

Table 3: Top Identified Challenges to Implementing MNAM.

Challenge ID	Challenges
CH.1	Natural features are not generally conceptualized as service providing assets
CH.2	There is a lack of resources available to implement MNAM
CH.3	There is a lack of information on natural assets and the services they provide
CH.4	Policies currently in place are not favourable to MNAM
CH.5	The requirement to balance interests amongst various stakeholders can lead to pressures that do not align easily with MNAM
CH.6	There is a lack of processes/tools in place to help municipalities implement MNAM
CH.7	Cross-jurisdictional ownership of land reduces the ability to implement MNAM

3.4 Top Opportunities

Relationships between a) TC and WS, b) TC and PA, and c) WS and PA frequencies of all identified opportunities were generally high, though the WS and PA frequencies relationship was notably less strong compared to those among challenges (Figure 10). The full list of opportunities and their associated TC, PA, WS, and means are presented in Appendix D.

Upon closer investigation of the outlier (Point #21, ‘Current provincial legislation can be utilized to help implement MNAM’), its placement is due to the high values it received on all three variables but is still follows the linear relationship among the variables. Therefore, it was

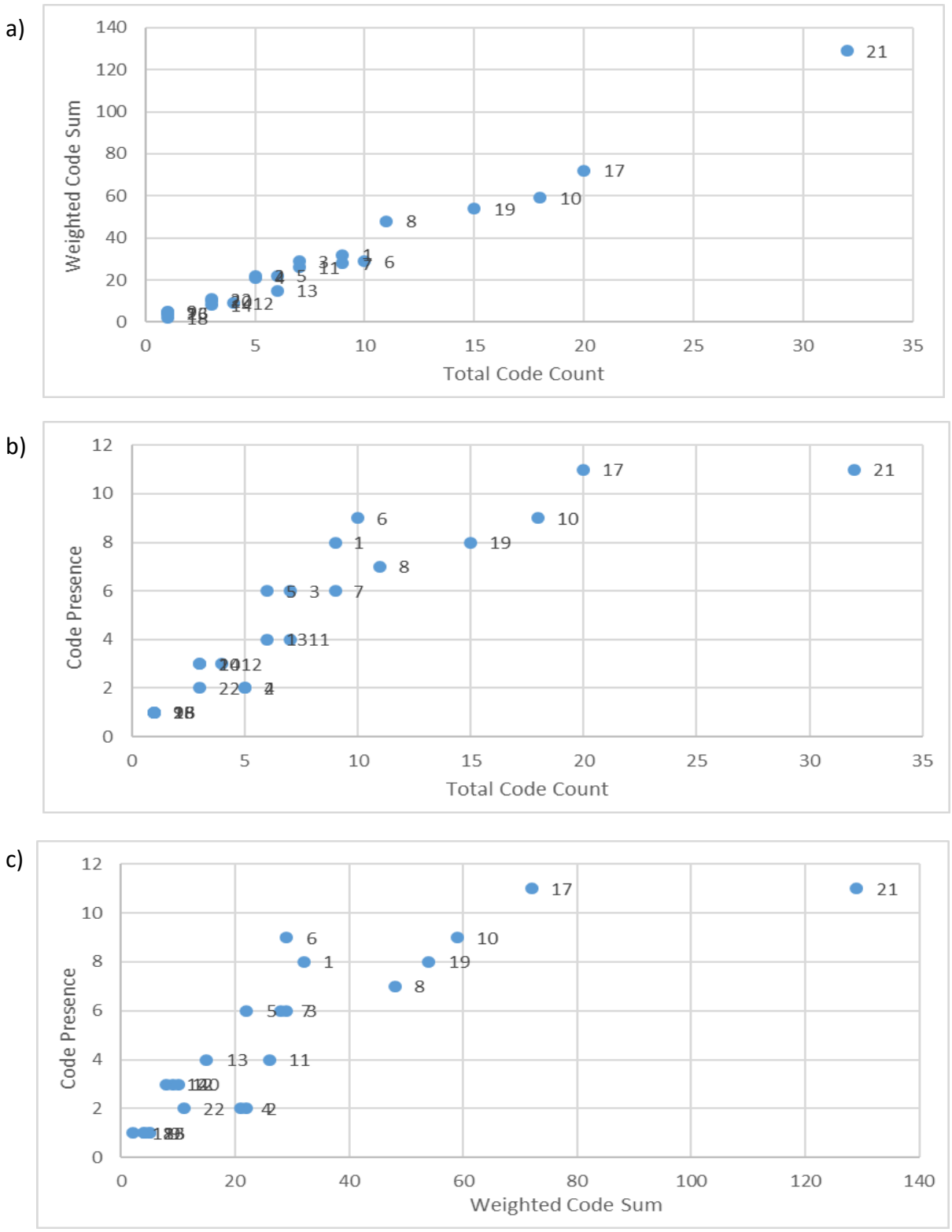


Figure 10: The relationships between the frequency of total code count, weighted code sum, and code presence/absence for each identified opportunity. Shown are the relationships between a) total code count and weighted code sum, b) code presence and total code count, and c) code presence and weighted code sum. Plot numbers are identification numbers designated to each opportunity formed from coding (see Appendix D).

considered a valid point and incorporated into the top opportunities. There was a slight cluster (Points #10, #17 and #19) in TC and WS, and TC and PA frequency plots with the addition of Point # 8 in the WC and PC plot, creating the rest of the top opportunities (Table 4).

Table 4: Top Identified Opportunities for Implementing MNAM.

Opportunity ID	Opportunities
O.1	Certain provincial legislation includes sustainable policies and mandates favourable towards MNAM implementation
O.2	Municipal policies, plans, and bylaws can be utilized to create opportunities that are more favourable for MNAM
O.3	Current projects, policies, and department mandates that are in line with MNAM can be leveraged to implement and reduce resource pressures
O.4	The Official Plan and its five-year revision cycle can provide an opportunity to update policies more supportive of MNAM
O.5	Conservation Authorities can be used as a valuable resource to assist MNAM

Two other opportunities of note were ‘Changing values within society has started to favour protection of nature’, and the ‘Rise of green infrastructure use provides an opportunity to introduce MNAM into municipalities’. Their PA (Points #1 and #6 respectively) was equal to or higher than that of Point #8 (O.4) and Point #1 (O.5), but their TC and WS were noticeably lower. Overall, Points #1 and #6 were determined to be less relevant and not included in the top opportunities because study participants’ responses put less emphasis on these points, and manifest analysis of municipal policy and planning documents emphasized the higher relevance of O.4 and O.5.

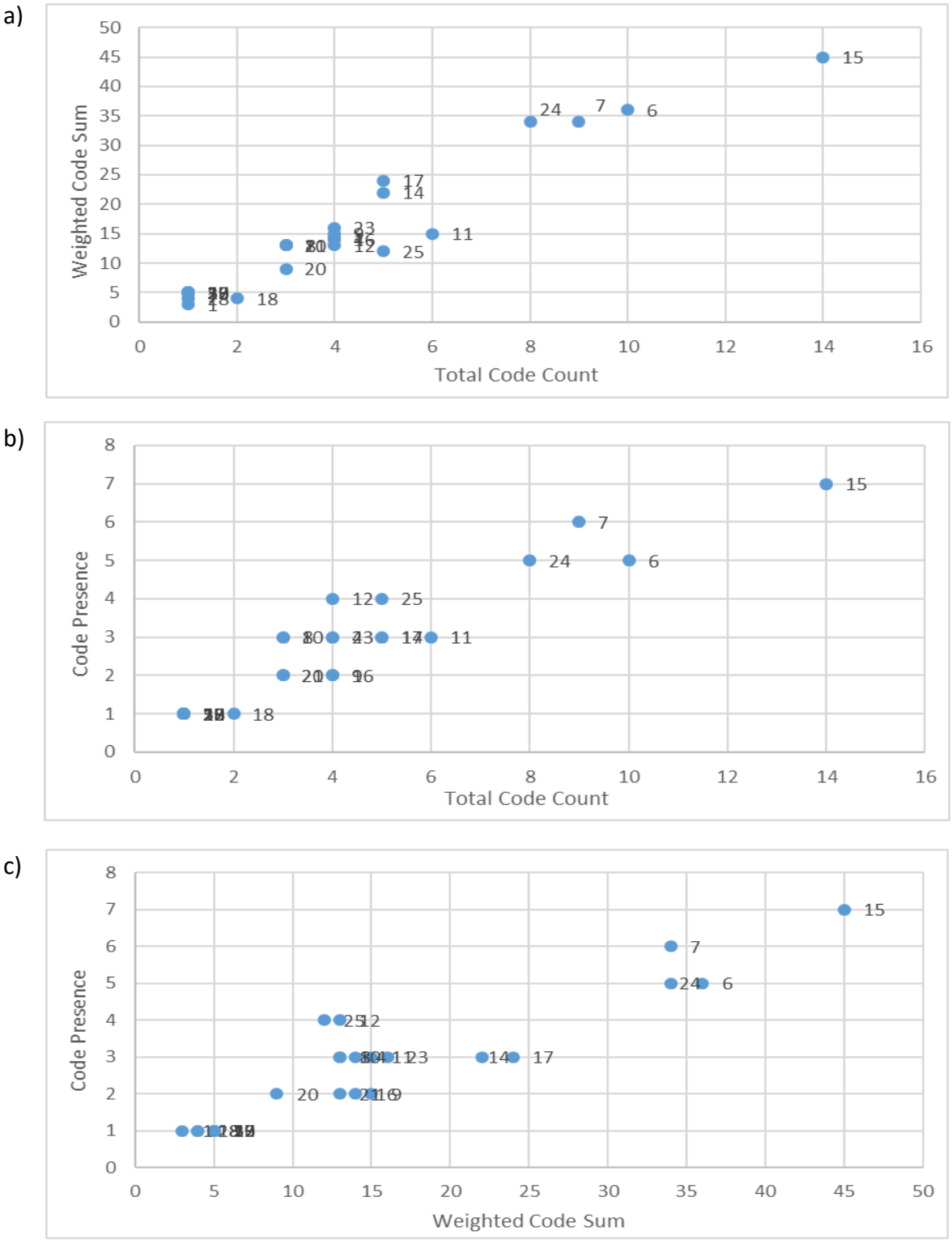


Figure 11: The relationships between the frequency of total code count, weighted code sum, and code presence/absence for each identified action. Shown are the relationships between a) total code count and weighted code sum, b) code presence and total code count, and c) code presence and weighted code sum. Plot numbers are identification numbers designated to each action formed from coding (see Appendix E).

3.5 Top Actions

Priority actions were determined based on 1) the actions that most strongly emerged from interviews determined by the frequency and weighted analysis, 2) the actions best suited to address top challenges and opportunities, and 3) the socio-technical theories on enacting organizational change. Top actions are non-hierarchical, and numerical placement should not be viewed as a level of relevance in regards to one another. The list of actions and their associated TC, PA, WS, and mean for each are presented in Appendix E.

Relationships between pairwise plots of all identified actions were fairly equal to challenges, however, generally higher than opportunities (Figure 11). Four actions are notably clustered separately from the remaining actions: points #6, #7, #15 and #24. Point #15 appears to be an outlier but continues the linear relationship of the remaining points. A cluster consisting of Points # 6, #7 and #24 is notable in all plots. These four points were selected as top actions (Table 5).

Table 5: Top Identified Actions to Implementing MNAM.

Action ID	Emerging Actions
A.1	Have a champion
A.2	Create a clear framework/process
A.3	Create partnerships with local and regional municipalities
A.4	Write clearer policies

3.6 Enabler Formation

Enablers were created from all top challenges, opportunities, and actions identified above. Enabler formation was based on the strong connections between top core categories, the accordance with socio-technical systems theory, the practicability for implementation, supporting research, and relevancy to ecosystem-based approaches within planning systems. The following six enablers were formed:

Table 6: Formation of Enablers from Top Challenges, Opportunities, and Actions.

Enabler 1	Reduce knowledge gaps to increase understanding of the value of services provided by natural features
CH.1	Natural features are not generally conceptualized as service providing assets
CH.3	There is a lack of information on natural assets and the services they provide
Enabler 2	Present MNAM in a manner that effectively utilizes direct and indirect resources available to municipalities
CH.2	There is a lack of resources available to undergo MNAM
CH.5	The requirement to balance interest amongst various stakeholders can lead to pressures that do not align easily with MNAM
O.3	Current projects, policies, and department mandates that are in line with MNAM can be leveraged to implement and reduce resource pressures
Enabler 3	Focus on creating strong cross-jurisdictional partnerships and long-lasting interdepartmental coordination
CH.7	Cross-jurisdictional ownership reduces the ability to implement MNAM
O.5	Conservation Authorities can be used as a valuable resource to assist MNAM
A.3	Create Partnerships with local and regional municipalities
Enabler 4	Utilize Ontario's planning policy framework to create a more favourable platform for implementing MNAM
CH.4	Policies currently in place are not favourable to MNAM
O.1	Certain provincial legislation includes sustainable policies and mandates favourable towards MNAM implementation
O.2	Municipal policies, plans, and bylaws can be utilized to create opportunities that are more favourable for MNAM
O.4	The Official Plan and its five-year revision cycle can provide an opportunity to update policies more supportive of MNAM
A.4	Write clearer policies into municipal and provincial legislation
Enabler 5	Create clear and concise, but flexible tools and processes for municipalities
CH.6	There is a lack of processes/tools in place to help municipalities implement MNAM
A.2	Create clear processes and frameworks
Enabler 6	Find a champion
A.1	Have a champion

Though only top challenges, opportunities, and actions were utilized within enabler formation, other challenges, opportunities, and actions identified within responses were utilized

to help address enablers based on their relevancy to each code. Due to the nature of enabler formation, interpretation and some additional information related to recent research, literature, and governmental sources (e.g. municipal documents) were necessary to include. A more in-depth discussion of enablers, as well as how they relate to other research findings and fit within Ontario's municipal planning socio-technical system will be presented in the Discussion Chapter.

3.7 Enabler 1: Reduce Knowledge Gap to Increase the Value Ascribed to Natural Features

3.7.1 Natural Features are not Generally Conceptualized as Service Providing Assets (CH.1)

Though not always explicitly stated, almost all participants referred to the lack of value attributed to natural assets and their services, for example,"… they may not realize that whatever's coming down at them from the rest of the watershed is of importance to them and how it all fits." (Participant L), and "I would submit that wetlands, forests, the natural environment is really not in people's consciousness. We enjoy them aesthetically; beyond that …?" (Participant D)

Participant responses often referred to the public as not viewing natural assets as providing services. However, a lack of understanding of the value of natural assets within municipal staff was also expressed as seen with Participant D: "So that would be the municipal staff's willingness to embrace this and understand why this is important to their municipality." (Participant D)

Total code counts showed the public was more often stated as lacking awareness of the value of natural assets. However, the difference in emphasis, based on weighted code sum, between the public as lacking awareness and municipal staff as lacking awareness was almost equal.

3.7.2 There is a Lack of Information on Natural Assets and the Services they Provide (CH.3)

Participants felt that information was lacking about the services provided by natural assets. However, the type of information discussed was somewhat varied. Some participants emphasized the lack of technical information on the value of natural assets, for example:

> We need to start understanding what are those values and what values do these natural areas and systems provide to us. Just not policy saying, this is a good idea, trust us … But the technical justification of the value it does provide to society. (Participant I)

Others referred to the challenge of providing information on quantification processes of natural asset values: "...there's a huge amount of work that could be done in better understanding how to quantify those services in a way that is meaningful to asset managers." (Participant J), and many participants overall, touched upon the need for more field information on local natural assets:

> I mean undertaking an inventory of these and then monitoring and managing that. Given the size of some of these assets. And delineating the areas of them would be very difficult to do unless you've already done that mapping. (Participant F)

Participants often expressed frustration about limited information, especially compared to the availability of information regarding engineered green infrastructure assets: "There are so many things that are different from engineered infrastructure." (Participant L)
Engineered green infrastructure assets are designed and engineered systems made to mimic natural processes. However, they lack the dynamic and continuously

evolving elements of natural assets, which causes natural assets to be so complex and difficult to understand and replicate fully.

Indeed, Participants responses' also touch on the competitiveness against engineered systems in general:

> But at the same time, green engineered infrastructure can be more easily compared to the traditional assets because it has similar life cycle costs. Whereas natural assets, it's really a grey area. (Participant L)

and *"*... and also the evaluation, right, because the engineering people…. it's fairly easy to calculate things from an engineering perspective in terms of dollar values and things like that." (Participant B). This direct competitiveness amplifies the importance of addressing this challenge.

Municipalities do not like to take risks as one participant articulated:

> And what I often see with the Councillors and the senior management is they like to see the numbers, they like to see the hard evidence that this is the way that a municipality should go, they like to see that there's minimal risk in doing something, and because this is such a new area, there's not a whole lot of examples that are concrete that they can kind of you know place there hat on and be like this shows us that this is going to be okay for us. So, I think there is a bit of risk aversion in decision-makers. So that kind of lack of data, lack of case studies, lack of pilot projects or maybe not lack of but just like they haven't reached that critical mass yet, and I think that's another kind of challenge. (Participant E)

Therefore, until municipalities can be sufficiently convinced of the criticalness of maintaining these natural assets and their services and that they are sufficiently understood, municipalities will continue to rely on well known traditional engineering methods.

3.7.3 Enabler 1 Formation

The failure to conceptualize natural features and areas as valuable assets within communities provides a foundational challenge to implement MNAM. Results showed that lack of value conceptualization is systemic in both the public and within municipalities and planning professionals, indicating that this challenge is strongly connected to cultural aspects of the organizational landscape (exogenous influences).

The emphasis and belief portrayed in the interviews that there is not enough information about natural assets and the services they provide may have been overemphasized. This overly strong emphasis highlights that participants may not realize how much information is available surrounding ecosystem services, leading to their perception that this information is greatly lacking. The available literature suggests that information present surrounding many natural assets, however, uptake of this information among practitioners has been slow (Ashnani, et al., 2018; Baker et al., 2012; BenDor et al., 2017; Schubert et al., 2018). This slow uptake may be caused by the nature and presentation of scientific information and data available that present barriers to its accessibility for practitioners.

Focusing on improving the public and professional realm's appreciation of natural assets and the services they provide is fundamental for the implementation of the long-term success of MNAM. Due to the need for more context-specific knowledge, knowledge gathering by practitioners and municipalities should not rely only on the scientific field to provide

information. Rather, information gathering will need to be a collaborative effort involving both researchers and practitioners if more tangible, robust, and context-specific knowledge is to be collected and delivered.

Both CH.1 and CH.3 refer to the availability of knowledge. To address the lack of information on natural assets and their services (CH.1), and to improve the public and municipal staff understanding of natural assets as service providing (CH.3), the knowledge gap on natural assets, their services, and how to value them will need to be reduced. Reducing this knowledge gap can enhance the dissemination of existing information and create 'windows of opportunity' for the implementation of MNAM.

3.8 Enabler 2: Stage MNAM to Effectively Utilizes Direct and Indirect Resources Available to Municipalities

3.8.1 There is a Lack of Resources Available to Implement MNAM (CH.2)

Municipal capacity in regard to resources available for implementing MNAM was at the forefront of many participants' thoughts, as articulated by the following participant:

> So it's not that stormwater managers or asset managers aren't looking in that direction, but I think that infrastructure budget is so challenging that I don't know that many are really looking to take on more, looking to identify more types of assets. (Participant J)

Within this challenge of a lack of available resources, three subcategories were identified. Lack of: (i) monetary funds, (ii) time and staffing, and (iii) expertise

Table 7). The majority of instances that participants mentioned lack of resources were connected to the lack of monetary funds, which also had the highest weighted sum and average. Comments about financial limitations were often very direct, for example, "Having to invest money into

maintaining them, urban forest, streams and so on, doing restoration projects-" (Participant C) and:

> … there would certainly be a budget or financial challenge, or there may be, if that required a financial commitment from a municipality, which it likely would of some sort. (Participant G)

The lack of staff resources available to dedicate time to MNAM was also identified as a challenge. Monetary, time, and personnel constraints are interlinked but not necessarily fully dependent on one another. MNAM's complex and data heavily requirements would need dedicated time to set up initially. In addition to this, appropriate expertise would have to be required to implement MNAM, both at the technical and facilitative level. The identification of a lack of expertise could be tied to the recent introduction of MNAM as a concept. However, it was mentioned fewer times than that of 'Monetary funds' and 'Time and staffing'.

Table 7: Frequencies of Total Code Count, Weighted Sum, and Weighted Mean for Challenge – 'There is a Lack of Resources Available to Implement MNAM' (CH.2) and its Subcategories.

Challenge ID	Challenge	Total Code Count	Weighted Sum	Weighted Mean
CH.2	There is a lack of resources available to implement MNAM	37	151	4.1
CH.2.1	Monetary resources	25	104	4.2
CH.2.2	Time and staffing resources	20	69	3.5
CH.2.3	Expertise within municipalities	7	16	2.3

3.8.2 The Requirement to Balance Interest Amongst Various Stakeholders can lead to Pressures that do not Align Easily with MNAM (CH.5)

Participants discussed the challenges around the multitude of competing interests that municipalities and planners must deal within their work. No clear subcategories emerged within

the excerpts under this category, but discussions did clearly convey the challenges resulting from maintaining interests of natural assets and that of development, as portrayed in this excerpt:

> Certainly, there's always a push and pull even if we're just trying to protect natural heritage systems in general, without factoring in the asset approach that is obviously land developers would use for development. So, there's often a lot of push and pull to define what those boundaries are. (Participant H)

The political aspect of municipal planning also provides further complexity in addressing multiple stakeholders' needs and can significantly influence the balance of interests through political jockeying and public pandering. In addition, representation for interests of the environment can be a challenge, especially in the political realm of municipal decision making, as one participant articulates:

> So the balancing of interests aspect of traditional land use planner jobs may mean that a natural asset, which doesn't necessarily have a human or voter attached to it, may get less concern, especially as it comes before our political leaders, our council - which may respond more to people standing in front of them in council and saying, look, it's only a tree, it's only a forest, we really need this development. That might be a kind of constraint: the balancing of interests that they're obligated to consider. (Participant C)

Representation of the environment significantly relies on the human actors at the table, as the environment has no legal rights in and of itself. Therefore, proper representation may be left out during these critical decision-making processes.

Additionally, the undue influence of pandering for votes by Councillors often can skew this stakeholder balance out of the environment's favour as the environment lacks voters-right.

3.8.3 Current Projects, Policies, and Department Mandates that are in line with MNAM can be Utilized to Reduce Resource Pressures and Push MNAM Through (O.3)

Participant responses were explicitly indicating that MNAM success critically depended on its alignment with other mandates at the project, departmental, and organizational level. Aligning with current mandates would help MNAM attain resources through funding pools, as well as Council and staff support.

Additionally, policy directed processes were often provided as opportunities. For example, one participant provided:

> Most municipalities will either themselves or through landowners group or developers undertake that type of inventory work, whether it's some watershed studies or environmental... basically, inventory work itself that needs to be done in mapping. There is an opportunity through that process to include this type of identification and inventory. (Participant F)

Combining MNAM processes and requirements with that of inventories or processes required by policy or other municipal programs was seen as a critical opportunity to pursue. Building on current processes and procedures is often easier to implement than creating new procedures within municipalities and also can be a more efficient use of resources.

3.8.4 Enabler 2 Formation

All core categories within Enabler 2 revolve around a strong theme of resource constraints. Therefore, this enabler focuses on acquiring resources. CH.2 and CH.5 both address the resource constraints within municipalities. Leveraging current projects, policies, and department mandates that are in line with MNAM (O.3) provides an opening towards more effectively utilizing those resources.

The need to balance the needs of multiple stakeholders can provide a challenge. Operational, policy, and decision-maker pathways within the organizational regime are currently entrenched within established engineering and development practices. However, these practices often fail to consider, or even dismiss, environmental benefits from natural assets. This reliance on engineering and development practices can create pressures that do not align with MNAM. Careful consideration of how these pressures affect MNAM and to what degree they are allowed to do so needs to be taken into account before and during the implementation of MNAM.

An initial investment of resources is required to implement MNAM. Therefore, justification of its implementation will need to be clearly laid out, which highlights a close link between Enablers 1 and 2. The value of natural features and associated cost savings need to be emphasized instead of the lack of resources. Participant N made an interesting observation on the importance of municipal budgets: *"*it's not until something makes it to the budget that it becomes implemented." (Participant N), indicating the importance of providing some type of monetary valuation and ability to report this value when implementing MNAM.

In order to achieve government support and acquire the resources needed for the successful implementation of MNAM, participants described the need to clearly identify how MNAM can align with current policies and department mandates, such as the example by one participant:

> The fact that all municipalities now are undertaking subwatershed studies and that's because of provincial legislation that's requiring watershed and subwatershed studies to be undertaken as part of the growth plan. So that's already out there, so the requirement to identify these areas and protect them is in the Provincial Policy Statement. We've already got step one, hopefully? (Participant M)

Additionally, to reduce resource pressures, further utilizing current projects that may have similar visions, goals, and requirements to MNAM can consolidate resources in pursuit of common objectives. One participant provided an excellent example:

> We are positioned because we're doing a stormwater master plan to get the field information without doing a brand new full-blown study because we had consultants in the field getting that. That work was actually underway. We just had to get more data in from an identified area which was a really nice practical add on to an existing study. So that put us in a really good, and I think fairly unique, position where we actually have staff attached to that master plan work. (Participant A)

Another participant expanded on the description of this opportunity across jurisdictions and utilizing cross-jurisdictional collaboration opportunities:

> …and then again, when other jurisdictions may be undertaking an update to their mapping or their resource inventory there would be an opportunity for the municipality to work with them. And maybe add some features to that list that the other agency might not be looking at,

> but they could do as part of the same process. Maybe jointly have someone undertake that work. (Participant F)

Cross-jurisdictional collaboration can be a powerful enabler, which is discussed in further detail in Enabler 3: ‘Focus on creating strong cross-jurisdictional partnerships’**.**

3.9 Enabler 3: Focus on Creating Strong Cross-jurisdictional Partnerships and Long-lasting Interdepartmental Coordination

3.9.1 Cross-jurisdictional Ownership Reduces the Ability to Implement MNAM (CH.7)

The identified political and administrative challenges of natural assets, often crossing cross-jurisdictional boundaries was prominent among participant responses, for example:

> ...then with the natural assets. Just sort of who has the final say over some of those features right? So we’re dealing with regional designations, local designations, and then we’ve got Conservation Authorities. Sometimes they all overlap, and then we all have different standards for buffers and things like that. (Participant B)

This challenge was identified as separate from cross-jurisdictional collaboration and coordination. This is because collaboration and coordination are considered more a cultural or behavioural issue, while cross-jurisdictional ownership is more a result of administrative restrictions and policy.

No distinct categories emerged within the excerpts of this category. However, the emphasis was put on how this challenge was significantly influenced by historical relations between municipal jurisdictions, both at the local and regional level. How well positive relations

have been fostered in the past, would determine how significantly this challenge will impact MNAM implementation or effectiveness.

3.9.2 Conservation Authorities can be used as a Valuable Resource to Assist MNAM Success (O.5)

Participants often referred to Conservation Authorities and the role they play within environmental and regional planning, for example:

> [Ours] is a massive project, and I'm finding that there's - that it is great for the Conservation Authority to do things on the bigger scale because they do things with the watershed approach. (Participant A)

No active subcategories emerged from excerpts of this category. However, participants emphasized the strong cross-jurisdictional foundation of the work of Conservation Authorities that work collaboratively with multiple municipalities. Participants also highlighted the extensive knowledge that Conservation Authorities have gained of Ontario's natural features. Though current changes in the Conservation Authorities Act could limit how much Conservations Authorities can be involved, their core mandate of protecting water resources would still qualify them as a critical player in MNAM.

3.9.3 Create Partnerships with Local and Regional Municipalities and Interest Groups (A.3)

The need to work more collaboratively with different groups was a strong theme among participants overall. This action is relevant to many of the top identified challenges, where collaboration and coordination would help alleviate some of the barriers within challenges. The importance of this action was explicitly identified by some of the participants, such as this participant:

> To do that, perhaps you would have to create somebody that would work on it together, like a committee or some sort of multi-party, community stakeholder committee or something like that that would work together on some of these items. (Participant G)

Due to the cross-jurisdictional nature of natural features, partnerships between municipalities were considered necessary. Additionally, due to the multi-dynamic services natural assets can provide, upper- and lower-tiered municipalities would need to work with each other to coordinate service needs of local residents. Partnerships with local interest groups were considered beneficial to alleviating resource pressures, educating the public, and promoting stewardship of the environment during political decision-making processes.

3.9.4 Enabler 3 Formation

Cross-jurisdictional ownership barriers (CH.7), utilizing Conservation Authorities as a resource opportunity (O.5), and fostering creation of partnerships with local and regional municipalities and interest groups (A.3) tie into the theme of collaboration and coordination within and between institutions. Though cross-jurisdictional landscapes provide a barrier (CH.7), partnerships with local and regional municipalities and interest groups (A.3) presents the avenue to overcome the challenge, while Conservation Authorities provides a resource to help navigate it. Creating strong cross-jurisdictional partnerships and long-lasting internal departmental coordination improve MNAM's implementation to take advantage of 'windows of opportunities' within the system.

Participants often directly brought up the issue of cross-jurisdictional challenges, signifying that this was a challenge that was at the forefront of practitioners' minds:

> I think collaborating on implementation might be a challenge or barrier. Because there's a lot of intricate details, a lot of this stuff comes down to implementation. Things like ownership of NAs, who gets to decide what happens to them, what if the city wants to implement something that the Region doesn't like, those types of questions of authority and implementation. (Participant G)

The fact that the borders of natural areas and features do not correspond with jurisdictional boundaries increases the complexity of managing them within current organizational structures, structures that are mostly based on jurisdictional boundaries. Jurisdictional boundaries are a human construct, and our governmental organizations are often defined by them. However, natural areas and features often cross these arbitrary boundaries, not only on the physical landscape but at an operational and political level as well. This leads to the requirement of strong collaboration between jurisdictions to coordinate projects around these natural features.

To further add to this complexity, MNAM, like many ecosystem-based approaches, is highly transdisciplinary, causing both cross-jurisdictional and inter-departmental challenges within the current silo-based organizational regimes. Although inter-departmental structures did not make it as a top challenge among participant responses, it was still a notable theme among participants' responses. However, in most cases, this challenge was implied rather than directly stated, e.g. "conventional roles and biases [as challenges]."(Participant K), and "I think it would work, if you can [ever] get cooperation from all the [departmental] parties, right?" (Participant B). The inclusion of this challenge within this enabler is supported by the literature that emphasizes the necessity of transdisciplinary coordination for ecosystem-based approaches (Albert et al., 2014; Kowarik, 2019; Rozas-Vásquez et al., 2018). Its inclusion is also supported

by the significance of an organization's internal operational structure towards the construction and creation of organizational pathways (Fuenfschilling & Truffer, 2014).

Participants identified the benefits of Conservation Authorities in regards to the implementation of MNAM:

> And then again there are a lot of, there are many Conservation Authorities, who have excellent working relationships with their municipal partners. And I think there are opportunities there to share knowledge, share information and bridge that gap of understanding. (Participant M)

Conservation Authorities employ a variety of skills and resources that can be utilized for MNAM implementation, which was highlighted by many of participants, particularly as a resource for knowledge and expertise, and as facilitators.

3.10 Enabler 4: Utilize Ontario's Planning Policy Framework to Create a More Favourable Platform for Implementing MNAM

3.10.1 Policies Currently in Place are not favourable to MNAM (CH.4)

Participants' responses often referenced policy. The discrepancy of current policy goals and MNAM implementation was a strong theme emerging from many responses. Clear subcategories appeared within this category based on different types of policies, including provincial/regional policies and municipal policies (Table 8). Provincial policies were emphasized more among participants' responses than municipal policies.

Table 8: Frequencies of Total Code Count, Weighted Sum, and Weighted Mean for Challenge– 'Policies Currently in Place are not favourable to MNAM' (CH.4) and its Subcategories.

Challenge ID	Categories	Total Code Count	Weighted Sum	Weighted Mean
Ch.4	Policies currently in place are not favourable to MNAM	35	117	3.5
Ch.4.1	Provincial Policies	14	51	3.0
Ch.4.2	Municipal Policies	13	36	2.5
Ch.4.3	Policies in general	8	30	3.5

3.10.2 Certain Provincial Legislation includes Sustainable Policies and Mandates Favourable towards MNAM Implementation (O.1)

Although participants indicated that current policies and mandates are, in general, a challenge, they also acknowledged that some policies and mandates have formed that can be an opportunity if utilized well. One participant provided a good example of a more direct response towards policy opportunities:

> I think policy instruments. They can identify these features in the landscape. And [also] the newer updates to the provincial plans like Places to Grow Act and the Green Belt Act. And the other one, Oak Ridges Moraine, but mostly the Places to Grow Act and Green Belt Act. They are acknowledging key hydrologic features and areas... That's a good step forward, so I'd say that's another opportunity. (Participants K)

Provincial legislation mentioned by participants was broken down into the types of policies and legislation participants specified were an opportunity. This formed six subcategories (Table 9). Many participants discussed provincial legislation in general, but several were able to provide specific examples. Most often, water-based provincial legislation was provided as a concrete

example. However, the Provincial Policy Statement received the greatest emphasis: *"*Well, are you familiar with the Provincial Policy Statement here in the province of Ontario? There is tons of stuff in there on natural heritage. Tons of stuff." (Participant I)

Table 9: Frequencies of Total Code Count, Weighted Sum, and Weighted Mean for Challenge– 'Certain Provincial Legislation has Sustainable Policies and Mandates favourable towards MNAM Implementation' (O.1) and its Subcategories.

Opportunity ID	Categories	Total Code Count	Weighted Sum	Weighted Mean
O.1	Certain provincial legislation has sustainable policies and mandates favourable towards MNAM implementation	32	129	4.0
O.1.1	Unidentified Provincial/Regional Legislation	11	36	3.3
O.1.2	Water-based Provincial Legislation	11	23	2.1
O.1.3	Provincial Policy Statement	8	38	4.8
O.1.4	Other Specified Provincial Legislation	6	25	4.2
O.1.5	Conservation Authorities Act	5	11	2.2
O.1.6	Ontario's Planning Act	4	18	4.5

3.10.3 Municipal Policies, Plans and Bylaws can be utilized to create Opportunities that are more favourable for MNAM (O.2)

On top of provincial-led policies (O.1), participants also indicated municipal-led policies, plans, and bylaws as a potential opportunity. Due to the more complex political and structural nature of Official Plans, they were not included in this category and instead addressed with a separate code. Similar to the types of provincial legislation identified by participants as potential opportunities to MNAM (O.1), six subcategories were identified within this opportunity based on the type of municipal policies, plans, and bylaws referenced by participants (Table 10). The highest number of participants referred to municipal policies and plans in general. Water-based municipal plans were referenced frequently as a concrete example. This mirrors the frequent

reference of water-based provincial legislation (O.1.2) as an opportunity within provincial legislation (Table 9).

Table 10: Frequencies of Total Code Count, Weighted Sum, and Weighted Mean for Challenge 'Municipal Policies, Plans and Bylaws can be utilized to create Opportunities that are more favourable for MNAM' (O.2) and its Subcategories.

Opportunity ID	Categories	Total Code Count	Weighted Sum	Weighted Mean
O.2	Municipal policies, plans, and bylaws can be utilized to create opportunities that are more favourable for MNAM	20	72	3.6
O.2.1	Municipal policies/plans (not specified)	8	23	2.9
O.2.2	Water-based plans	7	18	2.6
O.2.3	Natural Heritage/ESA Plans	5	18	3.6
O.2.4	Development Plans	3	10	3.3
O.2.5	Secondary Plans	2	9	4.5
O.2.5	Strategic Plans	1	4	4.0

Other plans, such as Natural Heritage Plans or Environmental Sensitive Area (ESA) Plans, were also referenced. Development Plans and Secondary Plans were referenced less specifically, however, the frequent references to the planning development processes in general by participants' may have been indirect references to these plans. There was only one direct reference to Strategic Plans.

3.10.4 The Official Plan and its five-year revision cycle can provide an opportunity to update policies that are more supportive of MNAM (O.4)

Official Plans were handled as their own type of opportunity because of their frequent mentioning and because of their more foundational function for municipal land use planning. One participant responded:

> Certainly, the biggest opportunity is to take a leadership role through an Official Plan. That's the one legal document that planners can really

> control. It is a general direction of policy in [the municipality].
>
> (Participant J)

Consequently, references to Official Plans as an opportunity were kept separate from references to other municipal policies, plans, and bylaws that can be utilized to create opportunities in favour of MNAM (O.2). No strong subcategories emerged from excerpts of this category; however, during analysis, the five-year revision cycle emerged as an important opportunity, e.g. "The fact that you have to do, you know Official Plan reviews every five years …" (Participant J)

3.10.5 Write Clear Policies into Municipal and Provincial Legislation (A.4)

In addition to creating clear processes, it was identified that clear and explicit policies were also needed to assist MNAM implementation (see CH.4). Participants strongly emphasized this as an action:

> That's the one risk with policy. If you don't write it properly and you don't write it in a manner that there are mechanisms in place to see the implementation of that policy. The policy falls on deaf ears. It doesn't work. So you have to think of it not only from the writing of the policy but how is it going to be implemented. (Participant I)

Due to the frequent mentioning of policies, laws, and regulations at various levels of government among participant responses overall, this action becomes very relevant in utilizing opportunities and addressing challenges.

3.10.6 Enabler 4 Formation

Enabler 4 emerged from the strong emphasis on policies among core categories (i.e. CH.4, O.1, O.2, O.4, and A.4). This indicates policy is a key element within the municipal planning regime.

The frequent mentioning of policies as opportunities guided this enabler to be more opportunistic than many of the other enablers. Consequently, this enabler is focusing on taking advantage of policy windows within the regime and the greater system landscape.

Participant's responses reflected the strong authority of policy over planning within Ontario, for example:

> As planners in Ontario, we're bound by the *Planning Act*. So those implementing measures to manage natural assets would be under that context. So, I guess you would be limited in the scope of the Provincial Policy Statement, the *Planning Act*, the Regional Official Plan. (Participant G)

However, overall, participants indicated that Ontario's planning policy framework is not generally favourable to the implementation of MNAM. When this challenge was broken down, municipal policies were often referenced, but participants put the most emphasis on provincial planning policy. This emphasis on provincial policy could be due to the structure of Ontario's planning framework, in which municipal policies and plans take strong direction from provincial legislation and policy. Therefore, municipal policies and plans can be restricted in what they implement or focus on if they do not align with provincial mandates. The provincial policy structure may limit municipalities in what they can implement, or create large challenges, that may be difficult and costly to overcome. Participants mentioned the development-heavy tone within the *Planning Act* and the 2014 Provincial Policy Statement:

> … the planners' work, at least in Ontario, is a provincially led system, that's really all about growth development and managing growth and development. And as much as the management of growth and

> development is [important], just as important to me is protecting where we're not going to grow and develop. I think [planners] are guided by the land use planning system, and that is really focused on land development and not land protection. (Participant F)

Participants also noted that the use of environmentally friendly language in policies can often camouflage tenuous wording and their strong emphasis on economic development. Clarity of language is often an issue making it more challenging to navigate and apply environmental policy.

In addition to the *Planning Act* and Provincial Policy Statement, regional planning and environmental policies such as the Growth Plan for the Greater Golden Horseshoe, *Oakridge Moraine Conservation Act (2002)*, *The Greenbelt Act*, *Water Opportunities Act*, and the *Conservation Authorities Act* are also considered to have a potential role to play in implementing MNAM. These Acts are often considered opportunities to help implement MNAM through their favourable land protection and environmental policies. For example:

> From a planning perspective, these areas are being identified and are being needed through policy. And then you've got again that Water Opportunities Act. There might be some similarities there that would begin that whole dialogue of asset and asset management. (Participant M)

Participants strongly encouraged leveraging these policies and their mandates to help MNAM implementation.

Participants also indicated that municipal policies and plans had a strong role in MNAM implementation. Planners and decision-makers have the most influence over municipal plans and

policies. Official Plans were most often cited and focused on by participants as an opportunity within municipal policies, especially around taking advantage of the five-year mandatory revision cycle of the Official Plans, where favourable MNAM policies and guidelines can be incorporated. Secondary Plans also provide an avenue to assist in MNAM implementation by implementing or leveraging broader mandates, policies, and plans through applying MNAM in a more detailed and contextual manner. One participant explained some of the opportunities of Secondary Plans:

> Secondary Plans think about intensification. A Secondary Plan is a good, big enough area to encompass some environment and some natural assets. It's still too blobby in a way. But there is a level of detail there that you don't get in the Official Plan. And the Secondary Plan gets you that piece I mentioned that's not in the Official Plan that says, 'here's what could be'. (Participant I)

The creation of favourable zoning bylaws was also mentioned as an opportunity. However, the zoning bylaws are more restricted in how they can be implemented due to their often stringent creation process and narrow application. Therefore, it is recommended as a tool after the initial adoption of MNAM.

3.11 Enabler 5: Create Clear and Concise, but Flexible Tools and Processes for Municipalities

3.11.1 There Is a Lack of Processes/Tools in Place to Help Municipalities Implement MNAM (CH.6)

Participants identified the lack of processes and tools available to help the implementation of MNAM. Often participants lamented a lack of specific tools necessary for implementation such as "Give me the tools to be able to accept something as parkland!" (Participant D), other times

participants directly stated the lack of tools in response to identifying challenges e.g. "Availability of tools and information" (Participant L), and "I'm sure availability of tools is a limitation." (Participant K). A lack of process and tools was also reflected in participants' responses in general, where hesitancy occurred when discussing the actual integration of MNAM into current processes.

No strong sub-categories emerged from the analysis of this category. However, participants' discussions frequently revolved around processes that needed to be developed that would help municipalities put a value on the services the natural feature provided: "Synthesizing the information [from the natural asset] to show the value and then allowing and engaging the municipalities to incorporate some of this work within their framework." (Participant K). Participants emphasized the need for clear processes that are transferable between municipalities.

3.11.2 Create Clear Processes and Frameworks (A.2)

The requirement for clear processes and frameworks was generally indirectly implied among participants' responses. Nevertheless, this action was considered highly relevant because a lack of processes and tools to guide municipalities in MNAM (CH.6) emerged as one of the top challenges. Participants also explained that some policies in general support of MNAM existed, but that they lacked in providing tangible and concrete guidance for implementation of MNAM:

> Well, there are policies out there that help to achieve something like this, but there's nothing out there that provides clear, consistent guidance of how this is going to happen (Participant I).

The general uncertainty among participants about how to implement MNAM increases the relevancy of this action. The uncertainty displayed by participants on how MNAM would be implemented reflects the complexity of MNAM integration into municipalities' processes.

Challenges of expertise, resources, and inherent organizational risk aversion would all need to be overcome. Creating a clear framework on how to implement MNAM would reduce these challenges and help municipalities adopt MNAM.

3.11.3 Enabler 5 Formation

Creating clear processes and frameworks (A.2) directly addresses the lack of processes and tools in place to help municipalities implement MNAM (CH.6). It reflects the need for a clear and flexible framework or process. The need for flexibility was also integrated based on its relevance to this enabler and Ontario's municipal planning (socio-technical) regime, its prevalence in literature, and its presence as one of the 28 actions identified in participants' responses (Appendix E). Creating clear and concise, but flexible tools and processes for municipalities to effectively use helps establish the long-term operational pathways of Ontario's municipal planning socio-technical regime after organizational change has occurred.

Participants emphasized the requirement for clear and concise tools to help implement MNAM, e.g. "So you have to think of it not only from the writing of the policy but how is it going to be implemented." (Participant I). However, participants demonstrated that they were uncertain about how to proceed with MNAM implementation as commented by one participant:

> [Municipalities] know [natural assets] are important, and we know we should do something about it, but we are not actually sure what we can do about it. Or how we get from here to here… (Participant O)

Processes, frameworks, information hubs, methodologies, and best practices would be valuable tools to provide direction and achievement of an organization's goal of MNAM. In order to be effective and long-lasting, these tools must be easily understood and utilized. As one participant

expressed: "…then naturally people give up because it's not working, it's too difficult. It has to be easy. There's another thing. It has to be clear and easy." (Participant I)

Additionally, participants explained that a framework for MNAM not only needs to be clear but also flexibly respond to the circumstances of various municipalities: *"*Synthesizing the information to show the value and then allowing and engaging the municipalities to incorporate some of this work within their framework" (Participant K), and "So you know the one size fits all solution of having a standard management approach would never ever work. It wouldn't just be practical." (Participant I)

Due to the multi-faceted nature of MNAM, the need for targeted tools that would ease processes within the MNAM was also apparent. For example, based on responses, the creation of a public matrix that clearly outlines different benefits and services that natural features provide to municipalities would be greatly beneficial.

3.12 Enabler 6: Find a Champion

3.12.1 Have a Champion (A.1)

This action emerged most frequently from participants' responses. With regard to this action, participants provided both direct responses, "I think sometimes all it takes is one champion at a municipality to take on something like this*."* (Participant M), and indirect responses, such as:

> So let's say that the community thought that this was something worthwhile to bring forward, or there were some leaders within the community, then you can bring it directly to Council. (Participant G)

In general, the need for a strong forward-moving force for MNAM implementation was apparent in participants' responses, for example:

> I think there's that, the intervening piece where [municipalities] need to look at what they already have, see what they can do, and actually get those approvals through the chain of the bureaucracy for municipalities. (Participant N)

Participants indicated that this driving force is necessary throughout MNAM implementation, but does not necessarily have to be provided throughout by just one person. Multiple champions at different organizational levels of the initiatives would be beneficial and even different champions at different stages of implementation may be necessary. However, participants all agreed that having someone to actively champion MNAM, especially in higher levels of management, would help push MNAM through to long-term establishment.

3.12.2 Enabler 6 Formation

Having a champion (A.1) was relevant and entrenched in the application of all other core categories, causing it to be its own enabler. A champion's fundamental importance for the implementation of MNAM is reflected by the high frequency with which it was mentioned by the study participants. The formation of this enabler was shaped by the logic that in order to have a champion (A.1), a champion must first be found or emerge.

There was an emphasis on the need and benefit of having someone champion the MNAM implementation within the municipality. An excellent example is provided by one participant's response:

> I think sometimes all it takes is one champion at a municipality to take on something like this. And you know someone who is well respected at the municipality across different departments, different divisions and

> there are people like that in every municipality. And for them to champion that and bring it, bring it to Council and make them understand the importance of it. (Participant M)

Though a champion was often cited as important, participants were not able to provide clear direction on how champions came about or how to find one. The examples of existing champions often portrayed the emergence of a champion as fortunate that someone with a strong position within their organization took up the cause as a personal one.

Chapter 4: Discussion

4.0 Ontario's Municipal Planning Socio-Technical System

The socio-technical systems perspective on municipal planning in Ontario provides a lens that allows the recognition of enablers. These enablers can be formed to supply a pathway for organizational change. Informed by the findings and literature research of this thesis, Figure 12 provides examples of landscape pressures, regime elements, and niche formations found within the municipal planning socio-technical system in Ontario.

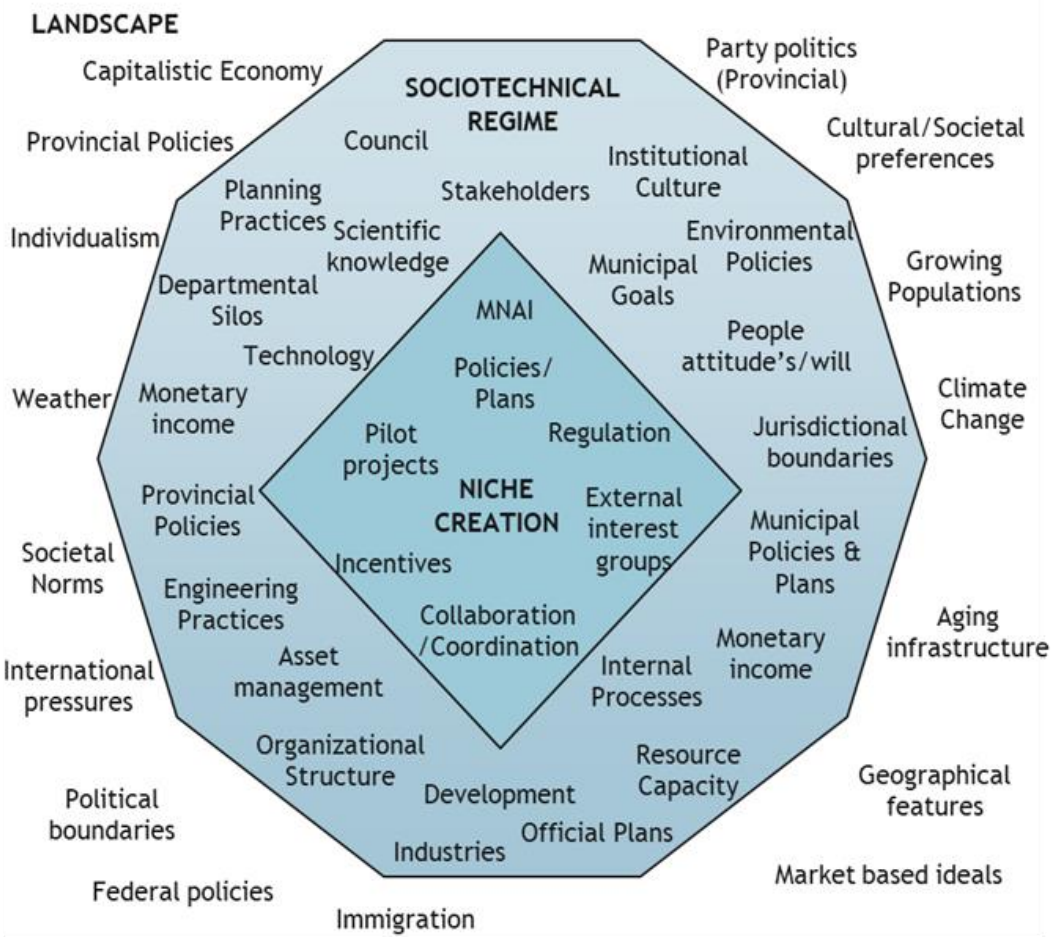


Figure 12: The multi-layered perspective of the socio-technical system of current municipal planning in Ontario demonstrating the socio-technical landscape the system is situated in and external pressures it receives, elements the regimes is made up of, and aspects that can represent niche formation within the system.

At a landscape scale, Ontario's municipal planning system is heavily influenced by political and socio-economic forces. However, growing environmental pressures, such as climate change impacts, provide unique 'windows of opportunity' within the system. MNAM has been developed, in part, as a response to these environmental pressures. Therefore, these environmental pressures will be strongly influential in MNAM implementation.

The current municipal planning regime is composed of numerous elements, such as policy, technology (including infrastructure), culture, public preferences, and market-based preferences. These elements create a complex web of connections and pathways that ultimately shape the socio-technical systems regime itself (Geels, 2002). Environmental-based elements within Ontario's municipal planning regime are scarce (Figure 13). This reflects the historical lack of strong environmental-based landscape pressures. However, at present, these environmental-based pressures are increasing and being directly felt by municipalities. These pressures are due to rapidly degrading ecosystem services and impacts of climate change, causing a notable paradigm shift within municipal planning.

Environmental considerations are becoming more prevalent throughout all aspects of municipal planning. This can be observed in the recent integration of sustainable planning practices throughout different types of planning, and the growing number of environmental policies (e.g. Toronto Green Standards and London's Tree Protection Bylaw), plans (e.g. Windsor's Environmental Master Plan and Brampton's 2040 Vision), and city-declared climate emergencies across southern Ontario (HuffPost Canada, 2019). However, this paradigm shift has been slow, likely due to the complex and entrenched pathways of the current socio-technical systems regime. MNAM integration is part of this evolving shift.

Various modes of niche formation were identified based on results from the current study, as seen within the innermost circle of Figure 12. These niches provide a safe space for MNAM to form and ensure MNAM is robust enough to take advantage of 'windows of opportunity' provided by external pressures (Figure 13).

These 'windows of opportunity' provide an opening for influencing change within an organization through the adoption of new technologies or processes, such as MNAM. Currently, MNAI is collaborating with municipalities across Canada on a series of pilot projects, including

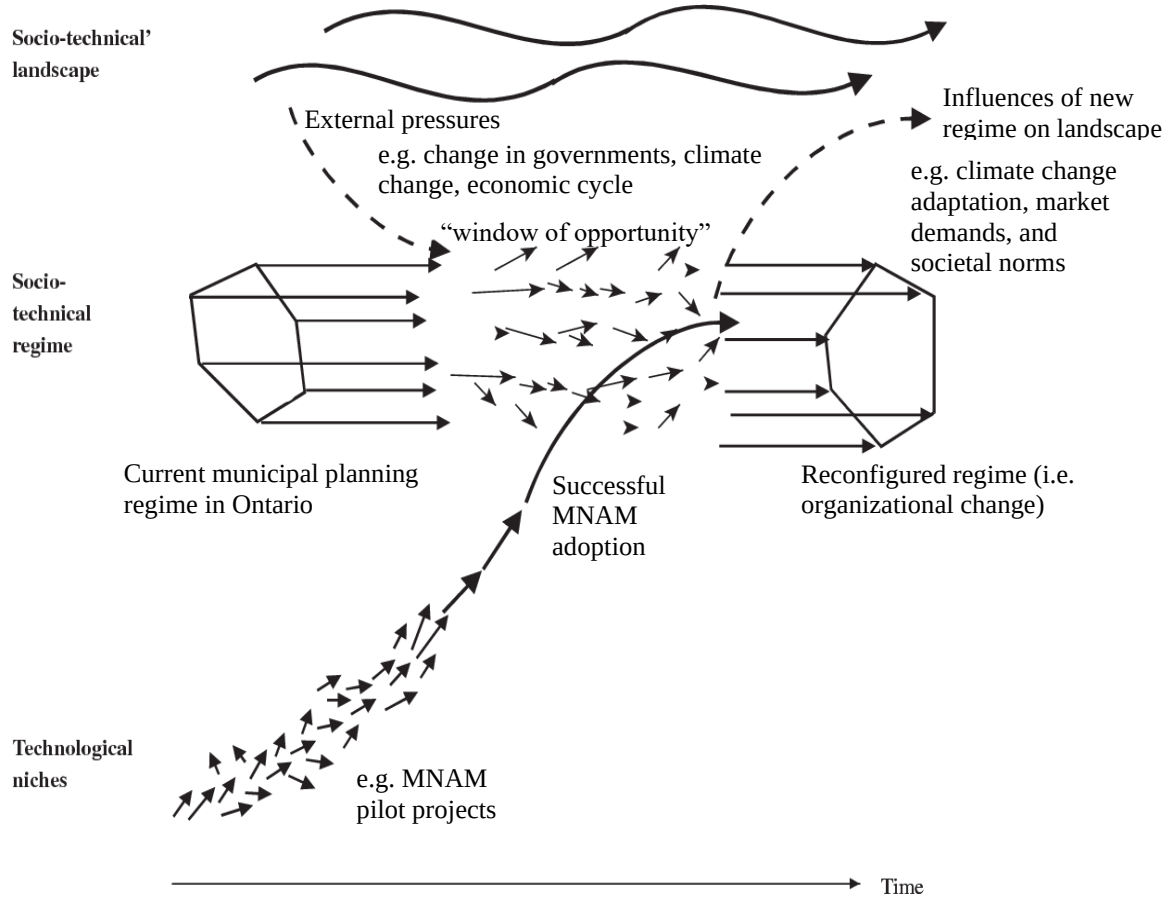


Figure 13: Multi-level perspective of Ontario Municipal Planning Regime. This conceptual illustration of change in the Ontario Municipal Planning system depicts the stable socio-technical planning regime as solid, parallel arrows. However, interactions between the planning regime and the socio-technical landscape (broken lines), such as extreme weather events, can cause instability of the planning regime (short, non-parallel arrows at centre). This instability provides a 'window of opportunity' for technological niches (short, non-parallel arrows coming from bottom left), such as MNAM pilot projects, to embed themselves into the planning regime. Once the planning regime is re-configured and re-stabilized, the technological niches (i.e., MNAM) are part of the re-configured socio-technical planning regime with enhanced sustainability aspects such as climate change adaptation. Adapted from Geels (2002).

several within southern and central Ontario, such as the Town of Oakville, City of Oshawa, and Region of Peel (Municipal Natural Assets Initiative, n.d.). These pilot projects create strong and stable niches for MNAM to establish and become more robust.

The enablers presented in this study provide tangible mechanisms and pathways to increase the success of MNAM implementation within the current municipal planning socio-technical system, supporting successful long-term organizational change. The following discussion of each enabler 1) situates the enablers in a broader context and within the existing literature, 2) locates the enablers within the context of the socio-technical system framework and 3) synthesizes actions, recommendations, and tangible tools formed from results to create recommendations specific to the enablers.

4.1 Enabler 1: Reduce Knowledge Gap to Increase the Value Ascribed to Natural Features

The under-appreciation of nature's value within municipal decision-making contexts and processes is well established (Dietz, Fitzgerald, & Shwom, 2005; Gómez-Baggethun & Barton, 2013; Hancock, 2010; Hunter et al., 2017; Rodríguez et al., 2006; Sutherland et al., 2018). The struggle to conceptualize nature as an asset likely evolved in part from our current and past economic, governance, and cultural ideologies. Societal ideologies not in favour of conceptualizing natural features as assets would be an external pressure that leads municipal organizations to regime pathways in the socio-technical system that are not accommodating to MNAM. For example, our governance systems are strongly tied to our socio-political landscape, which currently emphasizes a short-term evaluation framework for making decisions and a geopolitical boundary system (Hancock, 2010), favouring decision-making that leads to immediate and direct outcomes. In contrast, the benefits of ecosystem services are often seen

over the long-term through less direct linkages and do not adhere to political or jurisdictional boundaries (Rodríguez et al., 2006).

The capitalist nature of the western economic system has also been considered as being in opposition to ecosystem approaches (Lele et al., 2013; Magdoff & Foster, 2011; Schweickart, 2010). This may be due to societal traits capitalism encourages, such as short-term gains, self-interest, and consumerism (Schwartz, 2007), which are often contradictory to the long-term systems thinking necessary for ecosystem approaches. To try to reconcile the two, the capitalistic system often drives ecosystem approaches towards a monetization scheme (Dempsey & Robertson, 2012; Hampicke, 1999; Portman, 2013).

These economic landscape pressures in the socio-technical system are reflected in the behavioural tendencies, policies, and legislation of the regime, creating an entrenched system that is difficult to uproot. This entrenched system is causing conceptualizations of nature as an asset to not just be a cultural challenge, but also an operational one. This can be seen directly in regard to municipal planning in Ontario through the economic and development-focused processes and best practices that are unfavourable to conceptualizing natural services and features as assets. However, the recent uptake of more environmental policies and processes by municipalities shows that these perspectives may be shifting due to the impacts being directly felt by municipalities from climate change, degrading ecological systems, and increasing populations (Government of Ontario, 2014; Lam & Conway, 2018; Stuart, Collins, Alger, & Whitelaw, 2016).

The greater reference by participants of the ‘public’s’ failure to conceptualize natural assets and the benefits they provide, rather than the professionals’ lack of conceptualization within municipalities, is further supported by Schubert et al. (2018). Schubert et al. (2018) found

that planning practitioners were aware of and understood the concept of ecosystem services within the municipalities they investigated. This could be an indication of municipalities starting to recognize the benefits of natural features within communities due to them directly witnessing the cost-effective benefits of these systems from climate change pressures. Actual expertise to apply ecosystem service-based approaches, though, maybe lacking among planners (Lam & Conway, 2018).

The literature identified that there was a need to provide information on ecosystem services that is more directed and meaningful to municipalities, and supplied in a more easily accessible and tangible format for the use of practitioners (Albert et al., 2014; Albert et al., 2019; BenDor et al., 2017; Cortinovis & Geneletti, 2018; Lam & Conway, 2018; Rozas-Vásquez et al., 2018). In addition, several recent studies called for information that is more directly linked to the needs of specific municipalities (Albert et al., 2014; Lam & Conway, 2018). These findings suggest a lack of management of natural assets may not just be caused by a shortage of knowledge about natural assets, but rather by missing understanding of how to actually integrate natural assets into current planning practices and processes.

Nonetheless, there are still many natural assets and ecosystem functions that still are poorly understood (Clay, Yurco, Agrawal, & Persha, 2018; Cruz-Garcia, Sachet, Blundo-Canto, Vanegas, & Quintero, 2017; Heim et al., 2017; Schwarz et al., 2017; Woodall et al., 2019). This limited knowledge of natural assets is leading municipalities to integrate only well-studied types of natural assets and their services in ecosystem service-based projects. The type of information provided and how it is presented needs more careful consideration within research. For example, Albert et al. (2014) noted that planning does not always need the most detailed information, but rather robust data provided in a tangible, organized format to serve decision-making.

Increasing understanding of natural assets and their services will decrease the level of uncertainty around the implementation of MNAM, as well as provide better justification for adopting MNAM during important decision-making for the community. This will also allow decision-makers to argue for further investments into MNAM and its implementation. Consequently, reducing the knowledge gap on natural assets among the public and practitioners will increase the ability for practitioners to successfully take advantage of 'windows of opportunity' created by external landscape pressures as well as increasing the likelihood of change and MNAM adoption occurring successfully within the regime (Figure 13).

4.1.1 Enabler 1 Recommendations

There are numerous actions that can be taken to narrow the knowledge gaps on natural assets and their services. To reduce the knowledge gap stemming from research lacking practical relevance, close partnerships between municipalities and research institutions should be encouraged to ensure knowledge is properly contextualized and achievable. Municipalities should clearly communicate their needs and goals, while researchers should aim to focus research on clear, robust, and tangible information on services. Internal to municipalities, to reduce the knowledge gap among planning practitioners, municipalities can attend professional workshops on the topic presented by organizations such as Ontario Professional Planners Institute, local conservation authorities, or Federation of Canadian Municipalities. Additionally, an active exchange of knowledge between local municipalities and organizations on an ongoing basis can reduce redundancies in data collection. Regular information exchanges or partnerships can also provide insight into the impact local actions are having on a larger scale.

The public has an integral role in municipal decision-making. Therefore, reducing the knowledge gap related to the public's lack of understanding of natural assets and benefits they

provide is critical for MNAM implementation. Public workshops and education can help articulate to the public ecosystem services options and rational to implementing MNAM.

Lastly, pilot projects can be a strong and effective method to reduce these gaps in integrating new projects within established organizations. They purposefully establish a niche within the organization in which new approaches can be tested. They are a tool in which operational knowledge can be gained and organizational uncertainties smoothed out.

4.2 Enabler 2: Stage MNAM to Effectively Utilizes Direct and Indirect Resources Available to Municipalities

Resource constraints can often be a challenge for municipalities introducing new initiatives (BenDor et al., 2017; R. S. de Groot et al., 2010; Mitchell, Priddle, Shrubsole, Veale, & Walters, 2014). Municipalities in Ontario have limited sources of funding, relying heavily on income from property taxes within their municipal borders (Province of Ontario, 2018). Nonetheless, even with these limitations, in relation to the rest of the world, municipalities in Canada are considered resource-rich in regards to the available resource capacity they have to meet their community needs (Burch, 2010c). Therefore, it may be argued that the prioritization of resources is the main challenge, rather than a direct lack of resources. The many different interests of the community can exceed resource pools; therefore, careful consideration and prioritization of resources are required (Ashnani, Danehkar, Makhdoum, & Majed, 2018).

Planners' knowledge of natural landscapes and their systems is limited (Lam & Conway, 2018). Utilizing indirect resources, such as Conservation Authorities, interest groups or organizations, and learnings from other municipalities can alleviate monetary, expertise, and time pressures. Cross-collaboration between municipal departments, municipalities, and external groups can facilitate further access to these indirect resources. For example, the Federation of

Canadian Municipalities provides opportunities for members interested in natural asset management to network and connect through some of their information sessions and workshops (Federation of Canadian Municipalities, n.d.).

4.2.1 Enabler 2 Recommendations

A clear and concise action plan around strategies in accessing direct and indirect resources available should be created. This will help establish a protective space for MNAM implementation. This plan should include clear justifications of MNAM within the organization including, how MNAM aligns with applicable policies, mandates, and project objectives associated with resources. The plan should also include strategies for creating resource opportunities and retention, such as cross-jurisdictional or departmental coordination, collaboration with external interest groups, application for funding, and/or resource initiatives held by external organizations. Additionally, to create a stronger niche for MNAM, determining how MNAM fits within stakeholder and departmental pressures should be laid out and limits on their impacts clearly defined. This will help initial and long-term implementation.

Utilizing knowledge resources, historical inventories, and technical expertise provided by Conservation Authorities, as well as naturalist clubs and environmental organizations can help alleviate information needs and expertise. Though with some limitations, citizen science (data collection by the public or participatory interest groups) is becoming an increasingly accepted method of data collection that could also be utilized (Newman et al., 2017). Additionally, working towards aligning MNAM objectives with funding opportunities provided by external organizations, such as the Federation of Canadian Municipalities or Infrastructure Ontario can open up more funding opportunities (Federation of Canadian Municipalities, 2018; Infrastructure Ontario, n.d.)

4.3 Enabler 3: Focus on Creating Strong Cross-jurisdictional Partnerships and Long-lasting Interdepartmental Coordination

Coordination between jurisdictions and departments has long been a challenge within government sectors (Bakker & Cook, 2011; Christensen & Lægreid, 2008; Kaufman et al., 2014; Volkery, Swanson, Jacob, Bregha, & Pintér, 2006, p. 19; Wyborn & Bixler, 2013). While the current government regime in Ontario incorporates multilevel governance aspects through the creation of regional and watershed-based authorities, it is fundamentally built on the monocentric governance practice of establishing clear non-overlapping spatial and/or jurisdictional responsibilities. This often undermines the benefit of multilevel governance pathways of cross-jurisdictional collaboration and coordination (Mitchell et al., 2014; Termeer, Dewulf, & Lieshout, 2010).

Silo mentality (i.e., units within the same institution incapable of mutual information sharing or cooperation due to narrow and deviating goals (Cilliers & Greyvenstein, 2012)) has been shown to reduce general productivity and adaptability, and undermine the organizations' ability to produce effective solutions to complex challenges (Burch, 2010a; Dale, 2007; Fenwick, Seville, & Brunsdon, 2009; Measham et al., 2011). The prevalence of silo mentality internally within organizations could be seen as an influence of the current monocentric governance hybrid system (Cilliers & Greyvenstein, 2012). This monocentric system drives government departments and jurisdictions to often have narrow mandates purposefully created not to overlap each other so that financial budgets do not become entangled, and so that determining responsible parties is simplified. This reduces opportunities for collaboration and information sharing between departments and jurisdictions, which can cause tunnel vision and the creation of narrow and repetitive goals.

Based on their research on integrating asset management into the management of municipal water infrastructure, Esmaili & El-Diraby (2017) similarly suggested that breaking down internal silos and increasing coordination between different organizational networks are important towards applying asset management programs. This is reflected by the successful implementation of MNAM in the Town of Gibbons, British Columbia (B.C). At the time of implementation, the Town went through internal restructuring that reduced organizational silos. This significantly helped with the implementation of MNAM by increasing collaboration between departments (Molnar, 2019)

Ontario has an advantage over many other Canadian provinces due to Conservation Authority integration within their provincial planning and environmental framework. Under the provincial *Conservation Authorities Act*, authorities delineated by watersheds are mandated to protect Ontario's water sources and natural areas, as well as property and human life from flooding and other natural hazards (Government of Ontario, 1990a). Conservation Authorities' jurisdictional boundaries more closely mimic natural ones compared to municipal jurisdictions. Based on watersheds, the jurisdiction of a Conservation Authority typically crosses multiple municipal boundaries that are encompassed within their watershed (Mitchell et al., 2014). In regards to MNAM, this gives Conservation Authorities the distinct advantage of having established ties in place and pathways set up for collaboration and coordination between municipalities. Additionally, due to their mandate, Conservation Authorities have extensive knowledge of the local natural habitat and features as well as the technical capacity to valuate natural services.

4.3.1 Enabler 3 Recommendations

Strong cross-jurisdictional partnerships and interdepartmental coordination can improve the robustness of MNAM and establish a more stable process. Stability increases its chance of success when taking advantage of ‘windows of opportunity’ within the socio-technical system. To improve internal coordination, focus should be placed on bridging departmental mandates and eliminating silos within internal organizational structures. Internal committees or formal working groups can provide opportunities for stronger internal collaboration and coordination. In turn, a key action identified was the need for lower levels of government to create strong partnerships between local and regional municipalities. Conservation Authorities would be a good starting point to help in these partnerships, whether they are directly involved as a facilitator or as an intermediary for connecting municipalities to one another.

4.4 Enabler 4: Utilize Ontario's Planning Policy Framework to Create a More Favourable Platform for Implementing MNAM

The results suggest that challenges to MNAM implementation are more strongly caused by provincial policies than by municipal policies. In contrast, the results also suggest that municipal policies provide at least equally, if not more, of an opportunity for MNAM implementation as provincial policies. This contrast stems from the structuring of Ontario’s planning framework: municipal policies and plans take strong direction from provincial legislation and, therefore, can be restricted in what they implement or focus on by provincial mandates (Lam & Conway, 2018; Stuart et al., 2016). Unless greater provincial support for environmental protection appears within Ontario, the strong top-down policy structure of Ontario’s planning framework may limit municipalities in what they can implement in regards to ecosystem service approaches or create large challenges that are hard and costly to overcome (Burch, 2010a; Stuart et al., 2016). In

Ontario municipalities cannot exceed targets set by the provincial government unless the Province provides enabling language in policy or legislation to do so otherwise, they risk having plans or policies appealed at the provincial Tribunals. Indeed, when exploring enablers for climate action within municipalities in British Columbia, Canada, Burch (2010) found provincial climate interest is a critical component for local climate action. However, municipal planners are directly involved in the formation of municipal level policies, and have some control over the formation and language of policies based on the current powers Provinces have given to municipalities. Therefore, the lack of leadership on environmental protection by the provincial government can be somewhat compensated for by initiative taken at the municipal level.

Unfortunately, provincial planning policies, such as the *Planning Act* and Provincial Policy Statement, can be insubstantial and vague when it comes to addressing the role and benefits of natural assets and their services to the community. These planning policies distinctly lean towards favouring development. The lack of policy tools within planning policy around environmental protections as well as their distinct favouritism towards development and growth, can often undermine environmental policies and protections at the municipal and provincial level and make it difficult for municipalities to implement strong environmental initiatives. Lam & Conway (2018) noted the minimal incorporation of policies and references in regard to ecological services and functions within the *Planning Act* and the Provincial Policy Statement. This ambiguity and weak environmental stance, combined with the heavy emphasis on development and growth within both planning policy documents restricts the ability for municipalities to develop innovative approaches that incorporate long-term socio-economic solutions and land use protections, such as natural features and their services.

Presently, identifying how MNAM can align with the *Planning Act* and the Provincial Policy Statement, as well as leveraging favourable provincial, regional, and municipal policies towards natural asset management, should be a strong focus as it would greatly assist in MNAM implementation. Demonstrating a strong alignment with current policies and plans can also help create a niche for the initial implementation of MNAM. Additionally, leveraging the often development-focused policies can also be achieved during the initial development application process by providing evidence on how MNAM could save money, or protect property or infrastructure in the long-term (Baig, Rizvi, Pangilinan, & Palanca-Tan, 2016; Browder, Ozment, Bescos, Gartner, & Lange, 2019; Jato-Espino, Sañudo-Fontaneda, & Andrés-Valeri, 2019; Royal Society, 2014; Schuman & Brent, 2005).

4.4.1 Enabler 4 Recommendations

Due to the strong role policy plays in planning and municipal activities, it is vital to solidly situate MNAM within both provincial and municipal policy frameworks. Efforts should work towards aligning policy at all levels of government to increase consistency in order to achieve effective policy-making (Burch, 2010a). 'Windows of opportunity' that come in the form of policy changes, revisions, or current updates should be carefully monitored and taken advantage of. However, tenuous and vague environmental policies and references undermine the potency of the policies and restrict innovative and sustainable solutions that can address multiple challenges within a municipality. Focus should be on advocating for stronger, clearer, and robust integration of policies and definitions around ecosystem services and natural asset protection to help reduce confusion and strengthen initial and long-term implementation (Lam & Conway, 2018).

The creation of a tool such as a matrix of all favourable provincial and regional planning and environmental policies and in what capacity they could be utilized could help municipalities connect and align MNAM with current policies. This tool could provide specific information on how policies could be leveraged and be a guiding tool for municipalities across Ontario. While initiating MNAM, municipalities could add to this tool internally by reviewing their own current municipal plans and policies that may be favourable or are within their capacity to change to ease MNAM implementation.

4.5 Enabler 5: Create Clear and Concise, but Flexible Tools and Processes for Municipalities .

For a municipality, having to invest in creating its own tools and effective processes for a complex project such as MNAM can entail large financial risks and be a drain on staff time and other resources. Having access to previously developed tools and clear processes can reduce this potential resource drain and increase municipalities' ability to adopt and implement MNAM successfully. Due to the cultural and resource challenges established organizations face when adopting new practices and programs, building on existing tools and processes should be a priority (Burch, 2010c). Additionally, flexibility of processes and tools was identified as critical within the results of the current study as critical. To be most effective, tools and processes need to be flexibly adaptable to the varying needs of and scales of different municipalities (Albert et al., 2014; Rozas-Vásquez et al., 2018). This ensures the long-term success of MANM and increases its resilience against growing population pressures and climate change demands.

A key concept in the implementation of organizational change within the socio-technical systems framework is the creation of niches in which new technologies or tools can be safely implemented outside the current regime pressures (Kemp, Schot, & Hoogma, 1998). In the case

of municipalities, this can mean that tools and processes are formed by external organizations that may not experience the current resource and political pressures municipalities are exposed to. Alternatively, tools or processes can be formed internally by creating an organizational space that may initially be allowed to function outside the full pressures that a municipality is exposed to. Pilot projects are an example of organizational space that may be created for a short period during establishment of MNAM, thus decreasing financial risks and operational challenges.

MNAI has already made large strides in creating this niche in regards to the creation of the MNAM framework (Municipal Natural Assets Initiative, n.d.; O'Neill, 2018). MNAI currently is running pilot projects in municipalities across Canada. Utilizing groups such as MNAI for the creation of beneficial tools and micro-procedures continues to provide that niche.

4.5.1 Enabler 5 Recommendations

A tool that would address many of the key challenges includes a database of local municipalities and their projects and tools that have successfully utilized those services in the context of MNAM. Such a database would significantly assist with MNAM adoption by other municipalities. The creation of this database would: 1) provide knowledge that can be utilized by practitioners and increase understanding of natural assets among municipalities; 2) reduce uncertainties by providing contextual and practical examples and proof of the value of natural assets and the successful utilization of their services; 3) as a public or semi-public tool, create a venue for knowledge sharing across jurisdictions by providing municipalities with an opportunity to share their success and failures with other municipalities thereby also strengthening collaboration; 4) potentially inform neighbouring municipalities of projects they may wish to collaborate in; 5) provide useful and strong information for champions or planners to utilize and garner support; and 6) reduce resource pressures around knowledge acquisition and

tool formation through the ability to gain knowledge already obtained by other municipalities and utilize tools or processes created for similar projects. This database would need to be easily manageable and utilized by municipalities. In addition, links to other resources provided by the database would further increase knowledge access by municipalities.

4.6 Enabler 6: Find a Champion

The success of any project is based on the determination of the people who are driving it forward. Having a local champion to help drive environmental agendas has been shown to be critical for their implementation and long-term success, and is well recognised within literature as a force to drive change (Anguelovski & Carmin, 2011; Howell & Higgins, n.d.; Pasquini & Shearing, 2014; A Taylor, 2007; André Taylor, Cocklin, & Brown, 2012; André Taylor, Cocklin, Brown, & Wilson-Evered, 2011). Champions are persistent even when faced with adversity and are able to keep the main goals of the project in focus despite any arising complexities (Straith, Adamowski, & Reilly, 2014). Champions often are able to exert influence and gain support by communicating clearly the long-term benefits and relevance of the project (Howell & Higgins, 1990).

In the context of planning, Burch (2010b) and Sitas, Prozesky, Esler and Reyers (2014) emphasized the importance of champions for implementing environment-based actions in municipalities. However, Wolfe's (2008) research on advancing new agendas and policy changes for improved municipal water management suggests that having a champion alone will not guarantee success requiring consideration of other elements such as the characteristic of social networks of an organization. The dynamic and complex nature of these organizational systems requires dynamic and multi-faceted approaches.

Understanding the current functioning of an organization reveals weaknesses and strengths within the organization, which can help determine what may have been hindering the emergence of champions and the most effective avenues to obtain champions. For example, larger and established organizations such as mid to large municipalities can often become highly bureaucratic and rigid in their hierarchal structures. This rigid bureaucracy can create environments that are not supportive of innovation and can reduce the likelihood of individuals stepping out of inflexibly defined roles (Straith et al., 2014; André Taylor et al., 2012). A rigid bureaucracy can also lead to greater effort required to implement change due to the need to shift more complex and entrenched systems within the regime. However, if the right type of culture within the system is cultivated, such as a risk-based or innovative culture, or a culture of collaboration, larger organizations can also provide more flexibility, resources, and resiliency in the face of new innovations (Damanpour, 1992). More flexibility, resources, and resiliency can provide more opportunities and leeway for champions to take up their cause and successfully implement it.

Champions themselves can help create an environment for more champions to develop. In a municipal context, council members and departmental directors often can take on an executive champion role. This kind of champion has been identified by Howell, Shea and Higgins (2005) as one that holds great power and can allocate resources to innovations as well as can create environments for other champions and innovations to emerge and exert influence. Executive champions can help form niches for MNAM formation, by providing resources, and an environment protected from regular regime rules and forces. In contrast, Howell et al. (2005) described planners as ideal candidates for project champions that provide advisory and facilitation roles within and between municipalities. Project champions promote innovation on a

daily basis, relying primarily on personal forms of power (e.g. dedication, personal relationships, technical expertise, etc.) to exert influence and drive innovations forward. Project champions can lead technology or process formation and help to stabilize and structure MNAM to maximize success during full implementation.

An increase in collaborative and innovative opportunities internally can increase the production of successful champions by promoting creativity among individuals and strong leadership opportunities (Taylor, 2007; Taylor, Cocklin, Brown, & Wilson-Evered, 2011). Promoting and allowing for self-exploration and ownership within teams can lead to increasing levels of pride and confidence in their work, which can progress to someone taking on the championship of a project.

4.6.1 Enabler 6 Recommendations

Champions can take multiple roles within the socio-technical regime. They can have the foresight and will to take advantage of 'windows of opportunity' that appear (Sitas et al., 2014; André Taylor et al., 2012). Straith et al. (2014) even suggest that certain champions create their own opportunities. Champions should be fostered and found at all levels of the organization and processes of MNAM implementation to ensure long term success (Howell & Higgins, 1990; Straith et al., 2014; André Taylor et al., 2011).

Research on champions is dominated by the roles they play, the attributes necessary for a champion, and how to support champions (Howell & Higgins, 1990; Howell, Shea, & Higgins, 2005; Straith et al., 2014; A Taylor, 2007). However, literature is more sparse in terms of how to directly find or foster the formation of champions (Howell, 2005; André Taylor et al., 2012). This poses a challenge for new and establishing innovations and agendas, which may yet have to

garner strong support. Research on how to foster or create champions within municipal organizations should be conducted.

4.7 Approaching Enablers

Due to the close interrelationships between enablers, they should be approached in concert and not in isolation. However, depending on individual municipal regimes, some enablers may significantly help leverage other enablers. Therefore, determining on which enabler to focus on and when to do so should be strategically thought out based on municipal capacities and contextual landscapes. For example, if success would be achieved in reducing knowledge gaps to increase the value ascribed to natural features (Enabler 1)**,** this would help alleviate the challenges to build an action plan that takes advantage of direct and indirect resources (Enabler 2). This effect might be observed because a better understanding of the value of natural areas and features would make it easier for municipal councils to allocate resources towards MNAM. These resources would then allow more opportunities to engage Enabler 3 ‘Focus on creating strong cross-jurisdictional partnerships and long-lasting interdepartmental coordination’, Enabler 4 ‘Utilize Ontario's planning policy framework to create a more favourable stage for implementing MNAM, and Enabler 5 ’Create clear and concise, but flexible tools and processes for municipalities’. However, how exactly individual enablers can be used to leverage other enablers will depend on individual municipalities and their current internal regimes. Each municipality has different tools and capacities at their disposal, affecting their ability to engage enablers. Some enablers may not pose a great challenge while others may require stronger modifications to municipal structures.

4.8 Conclusions

This research sought to help bridge the gap between science and practice around the integration of ecosystem service-based approaches within municipal planning. Municipal Natural Asset Management (MNAM), an ecosystem service-based approach addressing municipal infrastructure, environmental conservation, and climate change pressures, was the focus of this study. Understanding the possible shift towards this new technology (i.e., MNAM) within the highly socio-political context of Ontario municipalities called for the use of a socio-technical systems perspective. This perspective focused on shifting entrenched bureaucratic pathways, the creation of protected niches, and 'windows of opportunity' within organizations.

The research determined six enablers for MNAM, conceived from the challenges, opportunities and actions identified by southern Ontario planners, municipal and regional decision-makers, and the scientific literature. Enablers addressed 1) reducing a lack of knowledge of the value of ecological systems, 2) creating a clear action plan addressing resource constraints and municipal capacities, 3) increasing cross-jurisdictional and interdepartmental coordination 4) leveraging Ontario policy framework and processes to enable MNAM implementation, 5) creating clear and concise tools and processes for MNAM implementation, and 6) finding a champion to help create and continue momentum of MNAM implementation.

The enablers addressed the top challenges while utilizing opportunities and actions identified during interviews. Addressing enablers strategically and based on individual municipality needs and capacities could significantly improve MNAM implementation. Municipalities across Canada are facing an increasing array of pressures such as climate change impacts, increasing resource needs from growing populations, degradation of natural resources, and ageing infrastructure. Ecosystem service-based approaches can provide adaptive, resilient

and cost-effective solutions, which can help alleviate many of the pressures municipalities are facing.

References

Adom, D., Hussein, E. K., & Agyem, J. A. (2018). Theoretical And Conceptual Framework: Mandatory Ingredients Of A Quality Research. *International Journal of Scientific Research*, *7*(1).

Albert, C., Aronson, J., Fürst, C., & Opdam, P. (2014). Integrating ecosystem services in landscape planning: Requirements, approaches, and impacts. *Landscape Ecology*, *29*(8), 1277–1285. https://doi.org/10.1007/s10980-014-0085-0

Albert, Christian, Schröter, B., Haase, D., Brillinger, M., Henze, J., Herrmann, S., … Matzdorf, B. (2019). Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute? *Landscape and Urban Planning*, *182*(Complete), 12–21. https://doi.org/10.1016/j.landurbplan.2018.10.003

Anguelovski, I., & Carmin, J. (2011). Something borrowed, everything new: Innovation and institutionalization in urban climate governance. *Current Opinion in Environmental Sustainability*, *3*(3), 169–175. https://doi.org/10.1016/j.cosust.2010.12.017

Arnstein, S. R. (1969). A Ladder of Citizen Participation. *Journal of the American Institute of Planners*, *35*(4), 216–224. https://doi.org/10.1080/01944366908977225

Ashnani, M. H. M., Danehkar, A., Makhdoum, M., & Majed, V. (2018). Integrating the concept of ecosystem services and values in Land use planning. *IOP Conference Series: Earth and Environmental Science*, *167*(1), 012026. https://doi.org/10.1088/1755-1315/167/1/012026

Baig, S. P., Rizvi, A. R., Pangilinan, M. J., & Palanca-Tan, R. (2016). *Cost and Benefits of Ecosystem Based Adaptation* (p. 44). Gland, Switzerland: IUCN.

Baker, I., Peterson, A., Brown, G., & McAlpine, C. (2012). Local government response to the

impacts of climate change: An evaluation of local climate adaptation plans. *Landscape and Urban Planning*, *107*(2), 127–136. https://doi.org/10.1016/j.landurbplan.2012.05.009

Bakker, K., & Cook, C. (2011). Water Governance in Canada: Innovation and Fragmentation. *International Journal of Water Resources Development*, *27*(2), 275–289. https://doi.org/10.1080/07900627.2011.564969

Balvanera, P., Pfisterer, A. B., Buchmann, N., He, J., Nakashizuka, T., Raffaelli, D., & Schmid, B. (2006). Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters*, *9*(10), 1146–1156. https://doi.org/10.1111/j.1461-0248.2006.00963.x

Barbier, E. (2011). *Capitalizing on nature: Ecosystems as natural assets*. Cambridge ; New York: Cambridge University Press.

BenDor, T. K., Spurlock, D., Woodruff, S. C., & Olander, L. (2017). A research agenda for ecosystem services in American environmental and land use planning. *Cities*, *60*(Part A), 260–271. https://doi.org/10.1016/j.cities.2016.09.006

Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open*, *2*, 8–14. https://doi.org/10.1016/j.npls.2016.01.001

Berkhout, F. (2002). Technological regimes, path dependency and the environment. *Global Environmental Change*, *12*(1), 1–4. https://doi.org/10.1016/S0959-3780(01)00025-5

Borrás, S., & Edler, J. (2014). *The Governance of Socio-Technical Systems: Explaining Change*. Edward Elgar Publishing.

Brand, F. (2009). Critical natural capital revisited: Ecological resilience and sustainable development. *Ecological Economics*, *68*(3), 605–612. https://doi.org/10.1016/j.ecolecon.2008.09.013

Brockington, D. (2011). Ecosystem services and fictitious commodities. *Environmental Conservation*, *38*(04), 367–369. https://doi.org/10.1017/S0376892911000531

Brooke, R., Cairns, S., Machado, E., Molnar, M., & O'Neill, S. J. (2017). *Municipal Natural Asset Management As a Sustainable Infrastructure Strategy: The Emerging Evidence* (pp. 1–24). Retrieved from Municipal Natural Assets Initiative website: https://mnai.ca/media/2018/01/ggkpsubmissionfinal-withcover.pdf

Brooke, R., O'Neill, S. J., Cairns, S., Machado, E., & Molnar, M. (2017). *Defining and Scoping Municipal Natural Assets*. Retrieved from Municipal Natural Assets Initiative website: https://www.assetmanagementbc.ca/wp-content/uploads/definingscopingmunicipalnaturalcapital-final-15mar2017.pdf

Browder, G., Ozment, S., Bescos, I. R., Gartner, T., & Lange, G.-M. (2019). *Integrating Green and Gray: Creating Next Generation Infrastructure*. Washington, DC: World Bank and World Resources Institute.

Bryman, A., Teevan, J. J., & Bell, E. (2009). *Social Research Methods* (2nd Canadian). Retrieved from https://www.abebooks.com/9780195429862/Social-Research-Methods-Second-Canadian-0195429869/plp

Burch, S. (2010a). In pursuit of resilient, low carbon communities: An examination of barriers to action in three Canadian cities. *Energy Policy*, *38*(12), 7575–7585. https://doi.org/10.1016/j.enpol.2009.06.070

Burch, S. (2010b). Transforming barriers into enablers of action on climate change: Insights from three municipal case studies in British Columbia, Canada. *Global Environmental Change*, *20*(2), 287–297. https://doi.org/10.1016/j.gloenvcha.2009.11.009

Burch, S. (2010c). Transforming barriers into enablers of action on climate change: Insights from

three municipal case studies in British Columbia, Canada. *Global Environmental Change, 20*(2), 287–297. https://doi.org/10.1016/j.gloenvcha.2009.11.009

Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, & Social Sciences and Humanities Research Council of Canada. (2014). *Tri-council policy statement: Ethical conduct for research involving humans*.

Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., … Naeem, S. (2012). Biodiversity loss and its impact on humanity. *Nature*, *486*(7401), 59–67. https://doi.org/10.1038/nature11148

Carter, S. M., & Little, M. (2007). Justifying Knowledge, Justifying Method, Taking Action: Epistemologies, Methodologies, and Methods in Qualitative Research. *Qualitative Health Research*, *17*(10), 1316–1328. https://doi.org/10.1177/1049732307306927

Christensen, T., & Lægreid, P. (2008). The Challenge of Coordination in Central Government Organizations: The Norwegian Case. *Public Organization Review*, *8*(2), 97–116. https://doi.org/10.1007/s11115-008-0058-3

Church, S. P. (2018). From street trees to natural areas: Retrofitting cities for human connectedness to nature. *Journal of Environmental Planning and Management*, *61*(5–6), 878–903. https://doi.org/10.1080/09640568.2018.1428182

Cilliers, F., & Greyvenstein, H. (2012). The impact of silo mentality on team identity: An organisational case study. *SA Journal of Industrial Psychology*, *38*(2). https://doi.org/10.4102/sajip.v38i2.993

City of Windsor. (2017). *Environmental Master Plan* (p. 49). Retrieved from https://www.citywindsor.ca/residents/environment/Documents/EMP%20Final%20Copy%20January%2018.pdf

Clay, N., Yurco, K., Agrawal, A., & Persha, L. (2018). Ecosystem Services in a Transitional Forest Landscape: Shifting Trajectories in Southeast Michigan, USA. *Society & Natural Resources*, *31*(4), 457–472. https://doi.org/10.1080/08941920.2017.1413692

Commonwealth Secretariat. (2007). Culture as the Fourth Pillar of Sustainable Development. In Commonwealth Secretariat, *Small States* (pp. 28–40). https://doi.org/10.14217/smalst-2007-3-en

Cortinovis, C., & Geneletti, D. (2018). Ecosystem services in urban plans: What is there, and what is still needed for better decisions. *Land Use Policy*, *70*, 298–312. https://doi.org/10.1016/j.landusepol.2017.10.017

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., … van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, *387*(6630), 253–260. https://doi.org/10.1038/387253a0

Costanza, R., & Daly, H. E. (1992). Natural Capital and Sustainable Development. *Conservation Biology*, *6*(1), 37–46. Retrieved from JSTOR.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed). Thousand Oaks: SAGE Publications.

Cruz-Garcia, G. S., Sachet, E., Blundo-Canto, G., Vanegas, M., & Quintero, M. (2017). To what extent have the links between ecosystem services and human well-being been researched in Africa, Asia, and Latin America? *Ecosystem Services*, *25*, 201–212. https://doi.org/10.1016/j.ecoser.2017.04.005

Daily, G. C. (1997). *Nature's Services: Societal Dependence On Natural Ecosystems*. Island Press.

Damanpour, F. (1992). Organizational Size and Innovation. *Organization Studies*, *13*(3), 375–

402. https://doi.org/10.1177/017084069201300304

Danley, B., & Widmark, C. (2016). Evaluating conceptual definitions of ecosystem services and their implications. *Ecological Economics*, *126*, 132–138. https://doi.org/10.1016/j.ecolecon.2016.04.003

de Groot, R. S., Alkemade, R., Braat, L., Hein, L., & Willemen, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, *7*(3), 260–272. https://doi.org/10.1016/j.ecocom.2009.10.006

de Groot, Rudolf S, Wilson, M. A., & Boumans, R. M. J. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, *41*(3), 393–408. https://doi.org/10.1016/S0921-8009(02)00089-7

Dedoose (Version 8.2.14) [Web application for managing, analyzing, and presenting qualitative and mixed method research data]. (2018). Retrieved from https://www.dedoose.com/

Dempsey, J., & Robertson, M. M. (2012). Ecosystem services: Tensions, impurities, and points of engagement within neoliberalism. *Progress in Human Geography*, *36*(6), 758–779. https://doi.org/10.1177/0309132512437076

Depoe, S. P., Delicath, J. W., & Elsenbeer, M.-F. A. (2004). *Communication and Public Participation in Environmental Decision Making*. SUNY Press.

Dietz, T., Fitzgerald, A., & Shwom, R. (2005). ENVIRONMENTAL VALUES. *Annual Review of Environment and Resources*, *30*(1), 335–372. https://doi.org/10.1146/annurev.energy.30.050504.144444

Doyle, M. W., Stanley, E. H., Havlick, D. G., Kaiser, M. J., Steinbach, G., Graf, W. L., … Riggsbee, J. A. (2008). Aging Infrastructure and Ecosystem Restoration. *Science*,

319(5861), 286–287. https://doi.org/10.1126/science.1149852

Ekins, P., Simon, S., Deutsch, L., Folke, C., & De Groot, R. (2003). A framework for the practical application of the concepts of critical natural capital and strong sustainability. *Ecological Economics*, *44*(2), 165–185. https://doi.org/10.1016/S0921-8009(02)00272-0

Endreny, T., Santagata, R., Perna, A., Stefano, C. D., Rallo, R. F., & Ulgiati, S. (2017). Implementing and managing urban forests: A much needed conservation strategy to increase ecosystem services and urban wellbeing. *Ecological Modelling*, *360*(Complete), 328–335. https://doi.org/10.1016/j.ecolmodel.2017.07.016

Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African Journal of Emergency Medicine*, *7*(3), 93–99. https://doi.org/10.1016/j.afjem.2017.08.001

Esmaili, D., & El-Diraby, T. E. (2017). Organizational competency in urban water infrastructure asset management. *Canadian Journal of Civil Engineering*, *44*(12), 1056–1070. https://doi.org/10.1139/cjce-2017-0011

Express Scribe (Version 8.14). (2018). Retrieved from https://www.nch.com.au/scribe/index.html

Federation of Canadian Municipalities. (2018). *Building Sustainable and Resilient Communities with Asset Management: An introduction for municipal leaders* (pp. 1–10). Retrieved from Federation of Canadian Municipalities website: https://www.cip-icu.ca/getattachment/Topics-in-Planning/Asset-Management/HowtoBuild_Resilient_Communities-with-AM.pdf.aspx

Federation of Canadian Municipalities. (n.d.). Events & training. Retrieved October 5, 2019, from Federation of Canadian Municipalities website: https://fcm.ca/en/events-training

Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change, 16*(3), 253–267. https://doi.org/10.1016/j.gloenvcha.2006.04.002

Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes—Conceptual foundations from institutional theory. *Research Policy, 43*(4), 772–791. https://doi.org/10.1016/j.respol.2013.10.010

Furnham, A., & Boo, H. C. (2011). A literature review of the anchoring effect. *The Journal of Socio-Economics, 40*(1), 35–42. https://doi.org/10.1016/j.socec.2010.10.008

Fürst, C. (2015). Does using the ecosystem services concept provoke the risk of assigning virtual prices instead of real values to nature? Some reflections on the benefit of ecosystem services for planning and policy consulting. *European Journal of Ecology*, *1*(2), 39–44. https://doi.org/10.1515/eje-2015-0015

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy, 31*(8), 1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy, 36*(3), 399–417. https://doi.org/10.1016/j.respol.2007.01.003

Giddings, B., Hopwood, B., & O'Brien, G. (2002). Environment, economy and society: Fitting them together into sustainable development. *Sustainable Development*, *10*(4), 187–196. https://doi.org/10.1002/sd.199

Gläser, J., & Laudel, G. (2013). Life With and Without Coding: Two Methods for Early-Stage Data Analysis in Qualitative Research Aiming at Causal Explanations. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *14*(2). Retrieved from

http://www.qualitative-research.net/index.php/fqs/article/view/1886

Gómez-Baggethun, E., & Barton, D. N. (2013). Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, *86*(Complete), 235–245. https://doi.org/10.1016/j.ecolecon.2012.08.019

Gómez-Baggethun, E., de Groot, R., Lomas, P. L., & Montes, C. (2010). The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics*, *69*(6), 1209–1218. https://doi.org/10.1016/j.ecolecon.2009.11.007

Government of Ontario. *Conservation Authorities Act, R.S.O. 1990, c. C.27.* , (1990).

Government of Ontario. *Planning Act, R.S.O. 1990, c. P.13.* , (1990).

Government of Ontario. (2014). Provincial Policy Statement, 2014. Retrieved October 18, 2017, from http://www.mah.gov.on.ca/Page10679.aspx

Grant, C., & Osanloo, A. (2014). Understanding, Selecting, And Integrating A Theoretical Framework In Dissertation Research: Creating The Blueprint For Your "House." *Administrative Issues Journal Education Practice and Research*, *2*(4), 22. https://doi.org/10.5929/2014.4.2.9

Grau, H., Hernández, M., Gutierrez, J., Gasparri, N., Casavecchia, M., Flores-Ivaldi, E., & Paolini, L. (2008). A Peri-Urban Neotropical Forest Transition and its Consequences for Environmental Services. *Ecology and Society*, *13*(1). https://doi.org/10.5751/ES-02434-130135

Guy, S., Marvin, S., & Medd, W. (2011). *Shaping Urban Infrastructures: Intermediaries and the Governance of Socio-technical Networks*. Routledge.

Hampicke, U. (1999). The limits to economic valuation of biodiversity. *International Journal of*

Social Economics, *26*(1/2/3), 158–173. https://doi.org/10.1108/03068299910229541

Hancock, J. (2010). The case for an ecosystem service approach to decision-making: An overview. *Bioscience Horizons*, *3*(2), 188–196. https://doi.org/10.1093/biohorizons/hzq013

Heim, O., Lorenz, L., Kramer-Schadt, S., Jung, K., Voigt, C. C., & Eccard, J. A. (2017). Landscape and scale-dependent spatial niches of bats foraging above intensively used arable fields. *Ecological Processes*, *6*(1). https://doi.org/10.1186/s13717-017-0091-7

Howell, J. M. (2005). The right stuff: Identifying and developing effective champions of innovation. *Academy of Management Perspectives*, *19*(2), 108–119. https://doi.org/10.5465/ame.2005.16965104

Howell, J. M., & Higgins, C. (1990). Champions of Change: Identifying, Understanding, and SupportingChampionsof TechnologicaI Innovations. *Organizational Dynamics*, *19*(1), 40–55.

Howell, J. M., & Higgins, C. (n.d.). *Championsof Change: Identifying, Understanding, and SupportingChampionsof TechnologicaInl novations*. 16.

Howell, J. M., Shea, C. M., & Higgins, C. A. (2005). Champions of product innovations: Defining, developing, and validating a measure of champion behavior. *Journal of Business Venturing*, *20*(5), 641–661. https://doi.org/10.1016/j.jbusvent.2004.06.001

Hsieh, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, *15*(9), 1277–1288. https://doi.org/10.1177/1049732305276687

HuffPost Canada. (2019, August 28). All The Places In Canada That Have Declared States Of Climate Emergency. Retrieved September 19, 2019, from HuffPost website:

https://www.huffingtonpost.ca/entry/climate-emergency-edmonton-declare_ca_5d671036e4b022fbceb5caff

Hunter, M. L., Acuña, V., Bauer, D. M., Bell, K. P., Calhoun, A. J. K., Felipe-Lucia, M. R., … Poschlod, P. (2017). Conserving small natural features with large ecological roles: A synthetic overview. *Biological Conservation*, *211*, 88–95. https://doi.org/10.1016/j.biocon.2016.12.020

Infrastructure Ontario. (n.d.). Infrastructure Ontario. Retrieved September 19, 2019, from https://www.infrastructureontario.ca/en/

James, P. (Paul W. author. (2015). *Urban sustainability in theory and practice: Circles of sustainability*. Abingdon, Oxon ; New York, NY: Routledge.

Jato-Espino, D., Sañudo-Fontaneda, L. A., & Andrés-Valeri, V. C. (2019). Green Infrastructure: Cost-Effective Nature-Based Solutions for Safeguarding the Environment and Protecting Human Health and Well-Being. In C. M. Hussain (Ed.), *Handbook of Environmental Materials Management* (pp. 1525–1550). https://doi.org/10.1007/978-3-319-73645-7_46

Jim, C. Y., & Chen, W. Y. (2009). Ecosystem services and valuation of urban forests in China. *Cities*, *26*(4), 187–194. https://doi.org/10.1016/j.cities.2009.03.003

Kaufman, N. J., Castrucci, B. C., Pearsol, J., Leider, J. P., Sellers, K., Kaufman, I. R., … Sprague, J. B. (2014). Thinking Beyond the Silos: Emerging Priorities in Workforce Development for State and Local Government Public Health Agencies. *Journal of Public Health Management and Practice*, *20*(6), 557–565. https://doi.org/10.1097/PHH.0000000000000076

Kemp, R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis &*

Strategic Management, *10*(2), 175–198. https://doi.org/10.1080/09537329808524310

Kosoy, N., & Corbera, E. (2010). Payments for ecosystem services as commodity fetishism. *Ecological Economics*, *69*(6), 1228–1236. https://doi.org/10.1016/j.ecolecon.2009.11.002

Kowarik, I. (2019). The "Green Belt Berlin": Establishing a greenway where the Berlin Wall once stood by integrating ecological, social and cultural approaches. *Landscape and Urban Planning*, *184*, 12–22. https://doi.org/10.1016/j.landurbplan.2018.12.008

Kowarik, Ingo. (2019). The "Green Belt Berlin": Establishing a greenway where the Berlin Wall once stood by integrating ecological, social and cultural approaches. *Landscape and Urban Planning*, *184*, 12–22. https://doi.org/10.1016/j.landurbplan.2018.12.008

Krauze, K., & Wagner, I. (2019). From classical water-ecosystem theories to nature-based solutions—Contextualizing nature-based solutions for sustainable city. *Science of The Total Environment*, *655*, 697–706. https://doi.org/10.1016/j.scitotenv.2018.11.187

Krefting, L. (1991). Rigor in Qualitative Research: The Assessment of Trustworthiness. *American Journal of Occupational Therapy*, *45*(3), 214–222. https://doi.org/10.5014/ajot.45.3.214

Kumar, P. (2010). *The Economics of Ecosystems and Biodiversity (TEEB): Ecological and Economic Foundations, Earthscan, London*. Retrieved from http://www.teebweb.org/our-publications/teeb-study-reports/ecological-and-economic-foundations/

Lam, S. T., & Conway, T. M. (2018). Ecosystem services in urban land use planning policies: A case study of Ontario municipalities. *Land Use Policy*, *77*(Complete), 641–651. https://doi.org/10.1016/j.landusepol.2018.06.020

Lele, S., Springate-Baginski, O., Lakerveld, R., Deb, D., & Dash, P. (2013). Ecosystem Services: Origins, Contributions, Pitfalls, and Alternatives. *Conservation and Society*, *11*(4), 343.

https://doi.org/10.4103/0972-4923.125752

Magdoff, F., & Foster, J. B. (2011). *What Every Environmentalist Needs to Know about Capitalism: A Citizen's Guide to Capitalism and the Environment*. NYU Press.

Maring, L., & Blauw, M. (2018). Asset management to support urban land and subsurface management. *Science of the Total Environment*, *615*, 390–397. https://doi.org/10.1016/j.scitotenv.2017.09.109

Mayring, P. (2000). Qualitative Content Analysis. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *1*(2). Retrieved from http://www.qualitative-research.net/index.php/fqs/article/view/1089

McCauley, D. J. (2006). Selling out on nature. *Nature*, *443*(7107), 27–28. https://doi.org/10.1038/443027a

Michelle Molnar. (2019, June). *The business case for Town of Gibsons' natural assets financial planning*. Presented at the Green Infrastructure Champions Workshop, Town of Caledon. Retrieved from https://www.glc.org/wp-content/uploads/GI-Champions-Caledon-workshop_Molnar.pdf

Millennium Ecosystem Assessment (Ed.). (2003). *Ecosystems and human well-being: A framework for assessment*. Washington, DC: Island Press.

Millennium Ecosystem Assessment (Ed.). (2005). *Ecosystems and human well-being: Synthesis*. Washington, DC: Island Press.

Ministry of Municipal Affairs and Housing. (2015). 2. Official Plans. Retrieved October 13, 2017, from Ministry of Municipal Affairs and Housing website: http://www.mah.gov.on.ca/Page1759.aspx

Mitchell, B., Priddle, C., Shrubsole, D., Veale, B., & Walters, D. (2014). Integrated water

resource management: Lessons from conservation authorities in Ontario, Canada. *International Journal of Water Resources Development*, *30*(3), 460–474. https://doi.org/10.1080/07900627.2013.876328

Municipal Natural Assets Initiative. (2018). *Primer on Natural Asset Management: FCM 2018 Sustainable Communities Conferences* (p. 3). Retrieved from https://mnai.ca/media/2018/01/FCMPrimer_Jan1_2018.pdf

Municipal Natural Assets Initiative. (n.d.). Project Communities – MNAI. Retrieved January 28, 2019, from Municipal Natural Assets Initiative website: https://mnai.ca/pilot-communities/

Newman, G., Chandler, M., Clyde, M., McGreavy, B., Haklay, M., Ballard, H., … Gallo, J. (2017). Leveraging the power of place in citizen science for effective conservation decision making. *Biological Conservation*, *208*(Complete), 55–64. https://doi.org/10.1016/j.biocon.2016.07.019

O'Neill, S. J. (2018). *Municipal Natural Assets Initiative: Results from the First National Cohort* (pp. 1–10). Retrieved from Municipal Natural Assets Initiative website: https://institute.smartprosperity.ca/sites/default/files/spmnaijuly31-summaryweb.pdf

Ontario. ONTARIO REGULATION 588/17: ASSET MANAGEMENT PLANNING FOR MUNICIPAL INFRASTRUCTURE. , Reg 588/17 § (2017).

Ontario, G. of. (2016, May 16). Building together – Guide for municipal asset management plans [Text]. Retrieved October 13, 2017, from Ontario.ca website: https://www.ontario.ca/page/building-together-guide-municipal-asset-management-plans

Pasquini, L., & Shearing, C. (2014). Municipalities, Politics, and Climate Change: An Example of the Process of Institutionalizing an Environmental Agenda Within Local Government.

The Journal of Environment & Development, *23*(2), 271–296. https://doi.org/10.1177/1070496514525406

Penrod, J., Preston, D. B., Cain, R. E., & Starks, M. T. (2003). A Discussion of Chain Referral As a Method of Sampling Hard-to-Reach Populations. *Journal of Transcultural Nursing*, *14*(2), 100–107. https://doi.org/10.1177/1043659602250614

Portman, M. E. (2013). Ecosystem services in practice: Challenges to real world implementation of ecosystem services across multiple landscapes – A critical review. *Applied Geography*, *45*, 185–192. https://doi.org/10.1016/j.apgeog.2013.09.011

Province of Ontario. (2018). *The Ontario municipal councillor's guide 2018*. Retrieved from Province of Ontario website: https://www.ontario.ca/document/ontario-municipal-councillors-guide-2018/9-fiscal-context

Pultrone, G. (2019). The ecological challenge as an opportunity and input for innovative strategies of integrated planning. *Smart Innovation, Systems and Technologies*, *101*, 691–698. https://doi.org/10.1007/978-3-319-92102-0_75

Rees, W. E. (1998). How should a parasite value its host? *Ecological Economics*, *25*(1), 49–52. https://doi.org/10.1016/S0921-8009(98)00015-9

Rip, A., & Kemp, R. (1998). Technological change. In *Human Choice and Climate Change* (Vol. 2, pp. 327–399). Retrieved from https://pdfs.semanticscholar.org/4739/5c4a2d310598d1e945873ee3787535df2844.pdf

Ritchie, J., Lewis, J., Lewis, P. of S. P. J., Nicholls, C. M., & Ormston, R. (2013). *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. SAGE.

Robertson, M. M. (2004). The neoliberalization of ecosystem services: Wetland mitigation banking and problems in environmental governance. *Geoforum*, *35*(3), 361–373.

https://doi.org/10.1016/j.geoforum.2003.06.002

Rodríguez, J., Beard, J., Bennett, E., Cumming, G., Cork, S., Agard, J., … Peterson, G. (2006). Trade-offs across Space, Time, and Ecosystem Services. *Ecology and Society*, *11*(1). https://doi.org/10.5751/ES-01667-110128

Royal Society. (2014). *Resilience to extreme weather*.

Rozas-Vásquez, D., Fürst, C., Geneletti, D., & Almendra, O. (2018). Integration of ecosystem services in strategic environmental assessment across spatial planning scales. *Land Use Policy*, *71*, 303–310. https://doi.org/10.1016/j.landusepol.2017.12.015

Saldaña, J. (2009). *The coding manual for qualitative researchers*. Los Angeles, Calif: Sage.

Schäffler, A., & Swilling, M. (2013). Valuing green infrastructure in an urban environment under pressure—The Johannesburg case. *Ecological Economics*, *86*(Complete), 246–257. https://doi.org/10.1016/j.ecolecon.2012.05.008

Schilling, J. (2006). On the Pragmatics of Qualitative Assessment. *European Journal of Psychological Assessment*, *22*(1), 28–37. https://doi.org/10.1027/1015-5759.22.1.28

Schröter, M., Zanden, E. H. van der, Oudenhoven, A. P. E. van, Remme, R. P., Serna-Chavez, H. M., Groot, R. S. de, & Opdam, P. (2014). Ecosystem Services as a Contested Concept: A Synthesis of Critique and Counter-Arguments. *Conservation Letters*, *7*(6), 514–523. https://doi.org/10.1111/conl.12091

Schubert, P., Ekelund, N. G. A., Beery, T. H., Wamsler, C., Jönsson, K. I., Roth, A., … Palo, T. (2018). Implementation of the ecosystem services approach in Swedish municipal planning. *Journal of Environmental Policy & Planning*, *20*(3), 298–312. https://doi.org/10.1080/1523908X.2017.1396206

Schumacher, E. F. (1973). *Small is Beautiful: A Study of Economics as if People Mattered*.

London: Vintage Books.

Schuman, C. A., & Brent, A. C. (2005). Asset life cycle management: Towards improving physical asset performance in the process industry. *International Journal of Operations & Production Management*, *25*(6), 566–579. https://doi.org/10.1108/01443570510599728

Schwartz, S. H. (2007). Cultural and Individual Value Correlates of Capitalism: A Comparative Analysis. *Psychological Inquiry*, *18*(1), 52–57. https://doi.org/10.1080/10478400701388963

Schwarz, N., Moretti, M., Bugalho, M. N., Davies, Z. G., Haase, D., Hack, J., … Knapp, S. (2017). Understanding biodiversity-ecosystem service relationships in urban areas: A comprehensive literature review. *Ecosystem Services*, *27*, 161–171. https://doi.org/10.1016/j.ecoser.2017.08.014

Schweickart, D. (2010). Is Sustainable Capitalism Possible? *Procedia - Social and Behavioral Sciences*, *2*(5), 6739–6752. https://doi.org/10.1016/j.sbspro.2010.05.020

Sitas, N., Prozesky, H. E., Esler, K. J., & Reyers, B. (2014). Opportunities and challenges for mainstreaming ecosystem services in development planning: Perspectives from a landscape level. *Landscape Ecology*, *29*(8), 1315–1331. https://doi.org/10.1007/s10980-013-9952-3

Spash, C. L. (1997). Ethics and Environmental Attitudes With Implications for Economic Valuation. *Journal of Environmental Management*, *50*(4), 403–416. https://doi.org/10.1006/jema.1997.0017

Spash, C. L. (2002). Informing and forming preferences in environmental valuation: Coral reef biodiversity. *Journal of Economic Psychology*, *23*(5), 665–687.

https://doi.org/10.1016/S0167-4870(02)00123-X

Spash, C. L. (2008). How Much Is That Ecosystem in the Window? *Environmental Values*, *17*, 259–284. https://doi.org/10.3197/096327108X303882

Straith, D., Adamowski, J., & Reilly, K. (2014). Exploring the behavioural attributes, strategies and contextual knowledge of champions of change in the Canadian water sector. *Canadian Water Resources Journal / Revue Canadienne Des Ressources Hydriques*, *39*(3), 255–269. https://doi.org/10.1080/07011784.2014.942576

Stuart, J., Collins, P., Alger, M., & Whitelaw, G. (2016). Embracing sustainability: The incorporation of sustainability principles in municipal planning and policy in four mid-sized municipalities in Ontario, Canada. *Local Environment*, *21*(2), 219–240. https://doi.org/10.1080/13549839.2014.936844

Study of Critical Environmental Problems (SCEP). (1970). *Man's Impact on the Global Environment*. Retrieved from MIT Press website: https://mitpress.mit.edu/contributors/study-critical-environmental-problems-scep

Sutherland, I. J., Villamagna, A. M., Dallaire, C. O., Bennett, E. M., Chin, A. T. M., Yeung, A. C. Y., … Cormier, R. (2018). Undervalued and under pressure: A plea for greater attention toward regulating ecosystem services. *Ecological Indicators*, *94*, 23–32. https://doi.org/10.1016/j.ecolind.2017.06.047

Taylor, A. (2007). *Sustainable Urban Water Management Champions: What Do We Know About Them?* 11.

Taylor, André, Cocklin, C., & Brown, R. (2012). Fostering environmental champions: A process to build their capacity to drive change. *Journal of Environmental Management*, *98*, 84–97. https://doi.org/10.1016/j.jenvman.2011.12.001

Taylor, André, Cocklin, C., Brown, R., & Wilson-Evered, E. (2011). An investigation of champion-driven leadership processes. *The Leadership Quarterly*, *22*(2), 412–433. https://doi.org/10.1016/j.leaqua.2011.02.014

Termeer, C. J. A. M., Dewulf, A., & Lieshout, M. van. (2010). Disentangling Scale Approaches in Governance Research: Comparing Monocentric, Multilevel, and Adaptive Governance. *Ecology and Society*, *15*(4). https://doi.org/10.5751/ES-03798-150429

Todorova, N. (2017). *Building Better: Setting up the Next Ontario Long-Term Infrastructure Plan for Success*. Retrieved from Ontario Chamber of Commerce website: https://apps.uqo.ca/LoginSigparb/LoginPourRessources.aspx?url=http://www.deslibris.ca/ID/10091986

Toronto and Region Conservation Authority, & Green Communities Canada. (2019, June). *Overview of Green Infrastructure and Green Infrastructure Asset Management Policy Framework in Ontario*. Presented at the Green Infrastructure Champion Workshop, Albion Bolton Community Center, Town of Caledon.

Town of Gibsons. (2018). *ADVANCING MUNICIPAL NATURAL ASSET MANAGEMENT:The Town of Gibsons experience in financial planning & reporting*. Retrieved from Town of Gibsons website: https://mnai.ca/media/2018/01/GibsonsFinancialPlanningReport-WEB.pdf

Vatn, A. (2010). An institutional analysis of payments for environmental services. *Ecological Economics*, *69*(6), 1245–1252. https://doi.org/10.1016/j.ecolecon.2009.11.018

Volkery, A., Swanson, D., Jacob, K., Bregha, F., & Pintér, L. (2006). Coordination, Challenges, and Innovations in 19 National Sustainable Development Strategies. *World Development*, *34*(12), 2047–2063. https://doi.org/10.1016/j.worlddev.2006.03.003

Vucetich, J. A., Bruskotter, J. T., & Nelson, M. P. (2015). Evaluating whether nature's intrinsic value is an axiom of or anathema to conservation: Nature's intrinsic value. *Conservation Biology*, *29*(2), 321–332. https://doi.org/10.1111/cobi.12464

Wamsler, C., Luederitz, C., & Brink, E. (2014). Local levers for change: Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. *Global Environmental Change*, *29*, 189–201. https://doi.org/10.1016/j.gloenvcha.2014.09.008

Westman, W. E. (1977). How Much Are Nature's Services Worth? *Science*, *197*(4307), 960–964. Retrieved from JSTOR.

What is natural capital? (n.d.). Retrieved January 3, 2019, from https://naturalcapitalforum.com/about/

Willis, J. W., Jost, M., & Nilakanta, R. (2007). *Foundations of Qualitative Research: Interpretive and Critical Approaches*. SAGE.

Wilson, C. M., & Matthews, W. H. (Eds.). (1970). *Man's Impact On The Global Environment*. Retrieved from https://mitpress.mit.edu/books/mans-impact-global-environment

Wolfe, S. E. (2008). Capacity, Capability, Collaboration, and Commitment: How Social Networks Influence Practitioners of Municipal Water Demand Management Policy in Ontario, Canada. *Environmental Practice*, *10*(2), 42–52. https://doi.org/10.1017/S1466046608080186

Woodall, C. W., Monleon, V. J., Fraver, S., Russell, M. B., Hatfield, M. H., Campbell, J. L., & Domke, G. M. (2019). The downed and dead wood inventory of forests in the United States. *Scientific Data*, *6*. https://doi.org/10.1038/sdata.2018.303

World Commission on Environment and Development. (1987). *Our common future*. Oxford ;

New York, Oxford ;New York, Oxford: Oxford University Press, Oxford University Press.

Wyborn, C., & Bixler, R. P. (2013). Collaboration and nested environmental governance: Scale dependency, scale framing, and cross-scale interactions in collaborative conservation. *Journal of Environmental Management*, *123*, 58–67. https://doi.org/10.1016/j.jenvman.2013.03.014

Appendix A – Participant Information Package

Municipal Natural Asset Management (MNAM): Identifying Barriers and Opportunities within Professional Planning Practice

Participant Information Package

1) Background & Study Objective

In light of concerns over ageing infrastructure and growing populations, local governments are looking for ways to improve management of critical assets that supply community services. At the same time, many communities are experiencing widespread declines in ecosystem quality. **Municipal Natural Asset Management (MNAM)** is thought to offer a sustainable solution to these twin problems.

Natural assets (NAs) can be defined as ecosystem features that provide, or could be restored to provide, community services. **Municipal Natural Assets** (**MNAs**) are those NAs that are owned/managed by a municipality, or that provide the same municipal service as an engineered asset. In other words, NAs can be referred to as MNAs when thought of through an infrastructure asset management lens.

Examples of Natural Assets, their engineered replacements, and the services they provide:

Municipal Service	Municipal Natural Asset	Engineered Replacement
Drinking water supply	Aquifer and source water area	Pipes for bringing in water supply
Drinking water treatment	Wetlands; forests; vegetation	Water treatment plant
Stormwater management	Wetlands; forests; vegetation	Stormwater pipes; culverts; storm drains; stormwater ponds
Flood mitigation	Wetlands; forests; vegetation	Dams; retaining walls, embankments
Erosion control	Wetlands; forests; vegetation	Riprap
Protection from seawater surges	Foreshore	Seawalls

When sustainably managed, these MNAs have the potential to provide municipal services to a community with no capital cost and their required maintenance or operating expenditures are often a fraction of the cost of an engineered replacement. Unfortunately, despite this value, there is a general lack of policies and methods to measure this class of assets, which have historically not been considered on equal footing with engineered assets or included in asset management plans.

The **Municipal Natural Asset Initiative (MNAI)**, a joint endeavour of the Smart Prosperity

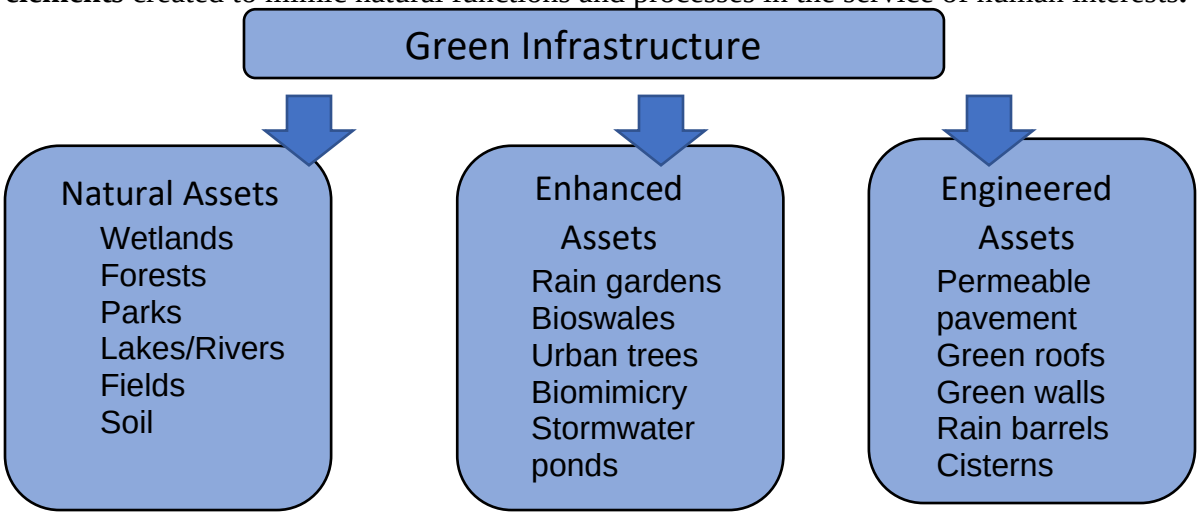
Institute and other convening organizations, aims to help local governments through offering a methodology and support for the integration of MNAs into core asset management and financial processes. This study is targeted at fulfilling this mandate through meeting the following objective:

Study Objective: Identify barriers and opportunities to refining, replicating and scaling up municipal natural assets projects within professional planning norms and standards.

Where you come in: In order to meet the above objective, we will be interviewing a range of planners involved with asset management or environmental planning, such as yourself, to obtain a variety of perspectives on MNAs, and what factors may hinder or facilitate their integration into municipal asset management.

2) Differentiating Municipal Natural Assets from Green Infrastructure

The terms NA and green infrastructure are often mistakenly used interchangeably. Whereas the term NA refers specifically to **natural resources and ecosystems** that yield a flow of benefits to people, green infrastructure is a broader term that also includes **designed** and **engineered elements** created to mimic natural functions and processes in the service of human interests**.**



3) Generalized Municipal Natural Asset Management Methodology

The MNAI has developed a prototype methodology for the management of NAs that closely resembles the steps and activities required for traditional municipal asset management. To provide you with further context for how MNAM could be applied, we have included the following overview of the steps in this methodological framework.

1) Develop an inventory of NAs and determine their condition
2) Use the cost of replacing a NAs with engineered alternatives to determine their economic value
3) Determine how the provision of services from NAs would change with alterations in land use and/or management policies
4) Assess beneficiaries
5) From the above information, develop a NA operations and maintenance plan

Appendix B – Interview Questions

Interview Questions:
Form: Semi-structured interviews - Open-ended questions with a couple closed questions. Not all questions will likely be asked. It will depend on participants answers.
All abbreviations in this document (e.g. NAM, MNAI) will be spoken in their complete form (NAM = Natural Asset Management) during the interview.
Questions:

1. Could you describe your current position?
2. Has your municipality/agency completed any general asset management planning?
    a. If yes, were you involved in any way and how so?
    b. If no, what has inhibited planners' involvement in asset management?
3. Did you have an opportunity to read the information package?
    a. Do you have any questions related to the package or Municipal Natural Asset Management (MNAM) in general?
4. Were you aware of MNAs prior to reading this document? If so, what was your understanding of them previously to reading the package?
5. From your previous understanding and the information package we provided, can you define what the term Natural Assets Management means?
6. Have you heard of NAM being done and where?
7. Have you ever been involved in any capacity in natural asset management at your municipality/agency?
    a. If yes, can you provide examples?
        1. Did it work?
        2. What were challenges & how could you see these challenges being overcome?
        3. Who/What was the lead department or champion involved in natural asset management? * not a specific person but general position (e.g. politician) or department
    b. If no, why not?
        1. Do you see an opportunity to implement NAM in your municipality?
            a. Why?
            b. Why not?
8. If your municipality were to implement MNAM, what natural assets would you see as being important to manage, and why?
    a. Which of these natural assets do you think would be easiest to integrate into natural asset management, and why?
9. Do you see an opportunity for you or your fellow planners to be involved/further involved in natural asset planning? (*probe for: Is there room for NAM in planning?*)
    a. Should they be?
    b. Why/Why not?
10. Can you specify any planning standards, guidelines or norms that may constrain you as a

planner to implementing NAM?

a. If so, how would you see this being overcome?

i. *Probe for: Process to change standards, guidelines, and norms? Timeframe for doing so? Who needs to be involved?*

11. From a planning perspective, can you provide up to five greatest barriers to implementing NAM?

i. b) And how do you think these could be overcome and/or what tools are needed?

12. From a planning perspective, can you provide up to five greatest opportunities for implementing NAM.

i. b), and how do you think these could be made use of?

13. Is there anything else you would like to add?
14. *[This is an additional question If time*] Finally, given that it is such an important issue within municipal asset management, both conventional asset management as well as for natural assets, how do you think climate change might affect this list of barriers/opportunities?

Appendix C – List of Identified Challenges

Point	Identified Challenges	Total Code Count	Total Weighted Sum	Code Presence	Weighted Mean
1	The requirement to balance interest amongst various stakeholders can lead to pressures that do not align easily with MNAM (B.5)	24	79	11	3.3
2	Contradicting mandates within and across jurisdictions can create challenges for ecosystem service approaches	4	14	4	3.5
3	Current norms around natural area management can increase the difficulty of MNAM implementation	9	35	8	3.9
4	Developer pressures are strong and are often in competition to MNAM needs	9	34	6	3.8
5	Entrenched engineering norms can be in conflict with MNAM needs	3	9	2	3
6	Environmental responsibility of an area is sometimes offloaded to the Conservation Authorities by municipalities	3	11	3	3.7
7	There is a lack of literacy around natural assets	4	11	3	2.8
8	There is a lack of communication within and across jurisdictions	8	21	5	2.6
9	There is a lack of coordination across departments	6	24	6	4
10	There is a lack of representation for the environment	9	33	7	3.7
11	There is a lack of resources available to undergo MNAM (B.2)	37	151	12	4.1
12	People often don't want to pay into common benefits	4	11	3	2.8

Appendix C – Continued

Point	Identified Challenges	Total Code Count	Total Weighted Sum	Code Presence	Weighted Mean
13	People on the projects can slow down or stall momentum	9	32	7	3.6
14	There is a lack of political undertaking & will in regards to adopting natural assets	12	46	6	3.8
15	The provision of compensation for the value of services is not clear	5	16	2	3.2
16	Public discord can stall MNAM implementation	6	11	5	1.8
17	Uncertainties and perception of risk make municipalities more adverse to MNAM adoption	10	39	5	3.9
18	Natural features are not generally conceptualized as service providing assets (B.1)	38	153	12	4
19	There is a lack of cross jurisdictional coordination/collaboration	10	28	7	2.8
20	Current accounting norms do not account for natural areas and features into asset management systems	7	31	6	4.4
21	Control over private lands by municipalities is limited and complex	12	45	8	3.8
22	Cross-jurisdictional ownership reduces the ability to implement MNAM (B.7)	18	65	10	3.6
23	Current planning processes are not favourable to considering MNAM	3	11	3	3.7
24	Current development norms can often conflict with MNAM needs	7	22	6	3.1
25	The internal structure of municipalities does not support the transdisciplinary needs of MNAM	11	36	7	3.3

Appendix C – Continued

Point	Identified Challenges	Total Code Count	Total Weighted Sum	Code Presence	Weighted Mean
26	There is a lack of monitoring programs in order to improve programs	3	10	3	3.3
27	There is a lack of processes/tools in place to guide municipalities in MNAM (B.6)	26	76	11	2.9
28	There is a lack of incentives in place for the implementation of MNAM	7	23	4	3.3
29	The current amount of legislation makes it difficult to navigate for the implementation of new processes/technologies	1	5	1	5
30	Policies currently in place are not favourable to MNAM (B.4)	35	117	9	3.7
31	The large special needs of natural features create challenges in managing and planning urban areas	6	22	4	3.7
32	Transferability of MNAM is limited	6	20	4	3.3
33	Rigid definitions can reduce the transferability of MNAM	6	17	4	2.8
34	Ambiguous vocabulary, definitions and concepts can create confusions and inefficiencies to implementation of MNAM	13	50	7	3.8
35	There is not enough information provided to the public about natural assets and the services they provide.	4	19	3	4.8
36	There is a lack of environmental knowledge in planners	4	10	4	2.5
37	There is a lack of information on natural assets and the services they provide (B.3)	23	92	11	4
38	Natural features are not static which current long-term management processes are not well adapted for	8	31	4	3.9

Appendix D –List of Identified Opportunities

Point	Identified Opportunity	Total Code Count	Total Weighted Sum	Code Presence	Weighted Mean
1	Changing values within society have started to favour the protection of nature	9	32	8	3.6
2	Current established partnerships between municipalities and external organizations can be utilized to help implement MNAM	5	22	2	4.4
3	Current champions within the organization can assist with building momentum for MNAM in the organization	7	29	6	4.1
4	Local organizations and working groups can be used as a resource to assist MNAM	5	21	2	4.2
5	Rise of climate change pressures has increased the relevance of climate actions within municipalities	6	22	6	3.7
6	Rise of green infrastructure use provides an opportunity to introduce MNAM into municipalities	10	29	9	2.9
7	Annual meetings and conferences can provide an opportunity for education and the transfer of knowledge around MNAM	9	28	6	3.1
8	Conservation Authorities can be used as a valuable resource to assist MNAM	11	48	7	4.4
9	Council endorsements can help ease the implementation of MNAM internally within municipalities	1	5	1	5

Appendix D – Continued

Point	Identified Opportunity	Total Code Count	Total Weighted Sum	Code Presence	Weighted Mean
10	Current projects, policies, and department mandates that are in line with MNAM can be utilized to reduce resource pressures and push MNAM through	18	59	9	3.3
11	Development processes can be utilized by municipalities to require certain conditions that would assist with MNAM	7	26	4	3.7
12	Certain federal legislation have sustainable policies and mandates favourable towards MNAM implementation	4	9	3	2.3
13	The ability for municipalities to create an incentive program can be a useful tool for MNAM	6	15	4	2.5
14	The ability for municipalities and Conservation Authorities to acquire land be a useful tool for MNAM	3	8	3	2.7
15	Land trusts and conservation easements can be used to protect and revitalize natural assets	1	5	1	5
16	The current MNAM framework is a flexible process, therefore, can be adapted to different municipal capacities	1	4	1	4
17	Municipal policies, plans and bylaws can be utilized to create opportunities that are more favourable for MNAM	20	72	11	3.6
18	OPPI and CIP can be used as a resource for knowledge transfer and acquisition as well as to establish external partnerships	1	2	1	2

Appendix D – Continued

Point	Identified Opportunity	Total Code Count	Total Weighted Sum	Code Presence	Weighted Mean
19	The Official Plan and its five-year revision cycle can provide an opportunity to update policies more supportive of MNAM	15	54	8	3.6
20	Present and past success stories of municipal environmental programs can provide momentum for MNAM.	3	10	3	3.3
21	Certain provincial legislation have sustainable policies and mandates favourable towards MNAM implementation	32	129	11	4
22	Modern tools and technologies can ease resource pressures and make it easier to collect data and collaborate with partners.	3	11	2	2.7
23	The multiple co-benefits natural assets provide can help prompt MNAM adoption and increase the protection of more ecosystem services	1	4	1	4

Appendix E – List of Identified Actions

Point	Identified Action	Total Code Count	Total Weighted Sum	Code Presence	Total Code Count
1	Foster public support of MNAM	1	3	1	3
2	Change current legislation and policies rather than creating new ones	1	5	1	5
3	Collect more data on local natural assets	1	5	1	5
4	Create a consistent approach to evaluating the value of natural assets	4	14	3	3.5
5	Create an inventory for municipalities of who and how people are implementing doing MNAM	1	5	1	5
6	Create partnerships with local and regional municipalities	10	36	5	3.6
7	Create a clear framework/process	9	34	6	3.8
8	Create an internal work plan for MNAM implementation and designate staff to it	3	13	3	4.3
9	Create partnerships with interest groups	4	15	2	3.8
10	Conduct education programs for professionals and the public	3	13	3	4.3
11	Create a flexible process to implement MNAM	6	15	3	2.5
12	Approach MNAM implementation through a full system lens	4	13	4	3.3

Appendix E – Continued

Point	Identified Action	Total Code Count	Total Weighted Sum	Code Presence	Total Code Count
13	Gain financial commitment from council or external agencies	1	5	1	5
14	Get decision-makers on board	5	22	3	4.4
15	Have a champion	14	45	7	3.2
16	Create a clear definition of MNAM	4	14	2	3.5
17	Incorporate MNAM into policies and regulations	5	24	3	5
18	Leverage development processes	2	4	1	2
19	Align MNAM with traditional asset management processes	1	5	1	5
20	Establish a monitoring program for natural assets	3	9	2	3
21	Physically connect people with natural assets and their services	3	13	2	4.3
22	Present MNAM findings and learnings at conferences	1	5	1	5
23	Provide local examples that demonstrate the value of natural assets	4	16	3	4
24	Put in clearer policies	8	34	5	4.3
25	Incorporate the value of natural assets and their services into municipal assets	5	12	4	2.4
26	Use performance goals	1	5	1	5
27	Utilize modern technological tools to help with data collection	1	5	1	5
28	Utilize successful public environmental initiatives to educate the public	1	4	1	4