
**Overcoming the risk: Interventions and activities to encourage water innovation
in Ontario's new construction industry**

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July 31st, 2013

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Acknowledgements

I would like to thank Carol Maas, for her support and direction, and the Polis Water Sustainability Project for the opportunity to conduct research in this area. I would also like to thank Dr. Kimberly Speers for her support and guidance through the development of this project.

I would like to extend special appreciation to my family, who offered their unwavering encouragement throughout this difficult exercise. Thank you to my parents Ray and Mary, my brother Chris, and my sister Andrea.

EXECUTIVE SUMMARY

INTRODUCTION

This report was prepared for Carol Maas, research alumni with the POLIS Water Sustainability Project's Water Conservation & The Water Soft Path. The POLIS Water Sustainability Project is a project within the broader POLIS Project for Ecological Governance, located at the University of Victoria, British Columbia. Maas' work in water conservation focuses on promoting the adoption and implementation of alternative water technologies in Ontario, which is part of Water Sustainability Project's larger work on Water Sensitive Urban Design (WSUD). WSUD takes a watershed approach to managing water, wastewater, and stormwater in land use planning and construction development.

This project seeks to support Maas' work by addressing important barriers to the implementation of alternative water technologies in new construction developments. Alternative water technologies are an innovative way to achieve advanced water efficiency. Yet adopting innovative water technologies, such as rainwater harvesting or greywater reuse systems, poses various risks to builders and developers. This uncertainty around risk factors in technological adoption increases the level of perceived risk involved. Due to these perceived and actual risks, builders are reluctant to adopt these technologies in their construction projects. To encourage the adoption of innovative water technologies and processes, it is necessary for proponents of WSUD to find ways to reduce the associated risks and help overcome this risk aversion.

Innovation adoption risk has been successfully managed in the past in new construction projects and can be demonstrated with the rise of green or sustainable building practices. Builders have also been motivated to overcome innovation risk in WSUD by the use of various development incentives and opportunities for low-risk collaborative partnerships. Looking to these examples assists in developing a better understanding for promoting WSUD in Ontario. The main objective of this report is to identify actions that can be used to enable and promote the adoption of innovative water technologies and WSUD in Ontario.

METHODS

This project uses qualitative methods to identify actions for overcoming perceived and actual risks to innovation. The research identifies case studies in the green building industry and forms of sustainable building where innovation risks have been managed or overcome, to determine if actions could be applied to encourage uptake of innovative water technologies. The components in the report include a thematic literature analysis, a jurisdictional scan of countries leading in the implementation of water sensitive development, and an analysis of semi-structured elite interviews.

A thematic literature analysis was conducted to determine the depth of knowledge in the research topic and establish a foundation for further research. Three bodies of literature relevant to the topic were examined in the analysis: risks of green building; barriers to low impact development; and barriers to innovation in the homebuilding industry. A jurisdictional scan of Australia, the United Kingdom, and the United States was conducted to identify drivers for water sensitive development, and uncover actions that were taken to enable or encourage the uptake of innovative water technologies. Elite semi-structured interviews were conducted with various actors in the construction development process in

Ontario and in leading jurisdictions. Interviews sought to uncover potential drivers for innovation, identify perceived adoption risks around innovative technologies specific to Ontario, and to determine actions that showed potential to overcome these risks.

Findings from the thematic literature analysis, jurisdictional scan, and elite interviews were brought together for analysis in the discussion section. Interventions and activities identified in the research were analyzed based on findings in the interviews, literature analysis, and jurisdictional scan, and formed the basis for recommendations for Ontario stakeholders.

FINDINGS

The research indicates that numerous types of interventions and activities exist to encourage builders to overcome risk aversion and adopt innovative building practices including: education and awareness raising; knowledge transfer; information transfer; collaboration; creating opportunities for builder risk-recognition; providing enhanced marketing opportunities; building and product certification labeling; the use of cash and development incentives; support from government and professional organizations, and the presence of innovation-friendly approvals processes. These and other risk reduction and management themes identified in the research were used to analyze promising programs and initiatives including: collaborative partnerships, programs that encourage knowledge and information transfer, programs that reduce uncertainty around technologies and processes, and programs that offer superior marketing opportunities. Amongst these identified programs and initiatives, the Alternative Water Ready guidelines provide the most promising way to enable the uptake of innovative water technologies while removing virtually all adoption risk for builders.

Furthermore, an examination of drivers behind WSUD and the use of innovative water technologies in Ontario revealed that innovative water technologies are rarely used in Ontario and virtually little or no market demand exists for these technologies. Although risk reduction solutions in the adoption of innovative water technologies have been identified, no solutions were found to overcome the financial risks of including no-demand building features in speculative housing developments.

Water sensitive development at home and abroad has been driven through enhanced government requirements for stormwater management. The practice of rainwater harvesting has been driven primarily through its stormwater management applications. Water efficiency applications have come as secondary concern, and have been driven through issues surrounding water scarcity and supply security in arid climates. These findings indicate that a route to elevating innovative water technologies may be through the promotion of stormwater best management practices.

RECOMMENDATIONS

An analysis of programs and initiatives based on RM themes identified in the interviews, literature, and jurisdictional scan led to the following recommendations:

- 1) Municipalities should collaborate with the local building industry to assess the feasibility and adoption of innovative sustainable building practices (SBP) and water sensitive urban design (WSUD) technologies and processes.
- 2) Municipalities with an interest in advancing water conservation should pilot an Alternative Water Ready program and other municipalities should be introduced to this program if they are not aware of it.

- 3) NRCan, EnerQuality, and local homebuilding associations should integrate innovative water technologies into the LEEP/TAP program.
- 4) Municipalities should collaborate to harmonize requirements for SBP and WSUD, to provide clarity and consistency in design and construction expectations between local jurisdictions, and to remove barriers to innovation in approvals processes.
- 5) The Government of Ontario should provide clear technical guidance on WSUD and take strong action through programs and policy to help drive uptake by municipal governments and the building industry.
- 6) The federal government should be approached to determine what their role could be in encouraging WSUD in terms of providing economic incentives and subsidies for consumers and builders.
- 7) Additional research should take place to investigate the use of economic incentives or subsidies and other policy instruments to change consumer behavior.

These recommendations call for government leadership at the federal, provincial and municipal levels, but also require the active support and participation of builders and developers. Collaboration and good faith between government and the building industry is necessary to ensure success. Although these actions do not guarantee adoption in the near term, they manage risk and raise the potential of an accelerated uptake in the long term.

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LIST OF ACRONYMS

| | |
|-------|---|
| BMPs | Best Management Practices |
| CA | Conservation authority |
| CI | Continuous Improvement |
| CVC | Credit Valley Conservation Authority |
| EPA | United States Environmental Protection Agency |
| GB | Green Building |
| GWR | Greywater recycling |
| HUD | United States Department of Housing and Urban Development |
| LEED | Leadership in Energy and Environmental Design |
| LEEP | Local Energy Efficiency Pilot |
| LID | Low Impact Development (USA/Canada) |
| MMAH | Ontario Ministry of Municipal Affairs and Housing |
| MOE | Ontario Ministry of Environment |
| NRC | National Research Council of Canada |
| NRCan | Natural Resources Canada |
| OBC | Ontario Building Code |
| RM | Risk Management |
| RWH | Rainwater harvesting |
| SBP | Sustainable Building Practices |
| SuDS | Sustainable Urban Drainage Systems (UK) |
| SWI | Showcasing Water Innovation |
| TAP | Technology Adoption Pilot |
| TRCA | Toronto and Region Conservation Authority |
| USGBC | United States Green Building Council |
| WOA | Water Opportunities Act |
| WSUD | Water Sensitive Urban Design (Australia/Canada) |

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1.0 INTRODUCTION

Conventional planning and building practices in Ontario's municipalities result in excessive and inefficient water use and discharge. The financial and environmental costs to maintain municipal water and stormwater infrastructure underscore the need to address underlying systemic issues in potable water supply (Brandes et al. 2011, p. 10-11, Farahbakhsh, FitzGibbon & Leidl, 2010, p. 1; Maas 2009, 2010; Ontario Ministry of Environment, 2007, p. 1). With the predicted impacts of a changing climate, experts foresee additional challenges to water management with potential effects on both water quality and water quantity (Expert Panel on Climate Change Adaptation [EPCCA], 2009, p. 53; Brandes et al. 2011, p. 10-11). Taken together, these issues indicate that customary forms of development founded on conventional forms of water management are no longer sustainable.

Innovative building practices that address sustainability issues break with convention, and include the use of novel products, technologies and processes (Koebel 2008, p. 46). The adoption of these products, technologies and processes can pose additional risk to builders and developers that are operating in a competitive market; introducing additional risk can serve as a disincentive to pursuing development types outside of the norm (HUD, 2005, p. iv). Risk aversion to building innovation is believed to be hindering the adoption of sustainable building practices in Ontario, including water sensitive development (Hendriks & Wolfe, p. 17).

This research examines ways for industry and government to encourage Ontario's building industry to overcome perceived and actual builder risks associated with adopting sustainable building practices in new low-rise residential housing development. The research focuses on the adoption of innovative water technologies and practices in the home to supplement the use of municipal water supply, and for use as a tool to reduce stormwater runoff. The research looks to the successful adoption of relevant initiatives and lessons learned in the building industry to identify potential interventions or activities that may be used for achieving similar, positive results in Ontario. Innovative water technologies and practices are discussed in the report as a key element within the broader integrated land-use planning approach of Water Sensitive Urban Design (WSUD).

1.2 PROJECT CLIENT, PURPOSE AND OBJECTIVES OF THE REPORT

1.2.1 THE CLIENT

The client, Carol Maas, is research alumni with the POLIS Water Sustainability Project's Water Conservation & The Water Soft Path. The Water Sustainability Project (WSP) is a project within the broader POLIS Project on Ecological Governance (also known as the POLIS Project). The POLIS Project is based at the University of Victoria.

Maas' background and expertise is in water and wastewater engineering and management. Her recent work has focused on the interrelationship between water use, energy, and carbon footprint. Maas' current work focuses on municipal and regional water conservation policy, and the application of alternative water technologies.

1.2.2 PROJECT PURPOSE

The purpose of the project is to support the POLIS Water Sustainability Project, and the client's work on water policy, water conservation, and the application of alternative water technologies. It also provides information to building industry professionals and policy makers with an interest in water conservation. Specifically, the goals of the project are:

- 1) To support the client's broader research on identifying and overcoming the various challenges to encouraging the adoption and diffusion of WSUD technologies in new residential and commercial construction projects within the Region of Waterloo
- 2) To assist building industry professionals in overcoming risk to encourage the adoption and diffusion of sustainable building practices, including WSUD
- 3) To contribute to an area of research that is not currently widely developed
- 4) To contribute to the larger dialogue of addressing municipal water sustainability planning

This report provides a valuable resource to the client by taking a multi-sectoral and trans-disciplinary approach to addressing water sustainability issues in line with the POLIS approach and because of the limited available research in this area.

1.2.3 RESEARCH OBJECTIVES

The following objectives guided the research described in this report:

- 1) To identify and analyze government and industry interventions and activities that have successfully managed perceived and actual risk associated with adopting innovative sustainable building practices.
- 2) To identify how these interventions and activities have successfully encouraged innovation adoption in relation to WSUD.
- 3) To understand the motivators and drivers for why WSUD elements were or were not included within sustainable design features of contemporary projects, and to what frequency this inclusion does or does not occur.
- 4) To identify how these interventions and activities may be implemented to encourage WSUD within Ontario's new construction industry.
- 5) To provide recommendations on how municipal and provincial governments in Ontario can benefit from lessons learned from other jurisdictions to encourage similar, positive results.

1.3 BACKGROUND

Ontario currently faces serious water infrastructural challenges. These challenges impose significant costs to society and the environment. Water services are expensive to maintain and operate, and leaks in the distribution systems limit the effectiveness of conventional water efficiency measures to address broader systemic water loss issues (Maas, 2009, p. 3; Maas, 2010, p. 5; Ministry of Environment [MOE], 2007, p. 1). Conversely, excessive stormwater flows from an increase in the frequency and intensity of precipitation events are polluting aquatic ecosystems and drinking water sources with urban runoff and potentially sewage overflows (Brandes et al., 2011, p. 10-11). Furthermore, excess stormwater flows are taking their toll on the built environment, increasing levels of damage to infrastructure and private property through flooding (Insurance Bureau of Canada, 2011, p. 4). Significant investments will be necessary over the coming years to maintain and replace Ontario's aging water infrastructure (MOE, 2007, p. 1).

The availability of, and access to clean water resources has served as a foundation for the establishment and development of Ontario's communities (CMHC, 2009, p. 69). It is unlikely that this will change. Considering current water infrastructure challenges and those expected along with climate change, conventional development practices are not a sustainable pathway forward for Ontario's municipalities (EPCCA, 2009, p. 53).

1.3.1 WATER SENSITIVE URBAN DESIGN

Water Sensitive Urban Design offers a new, adaptive approach to development that responds to the water challenges of the present, as well as to those that the future likely has in store for Ontario. WSUD is broadly defined by the CMHC as “a form of urban design that integrates urban planning with the protection and conservation of the water cycle” (2009, p. 69). WSUD takes a holistic, watershed approach to land use planning, water conservation, stormwater and wastewater management (CMHC 2009, p. 79).

WSUD includes the use of alternative water sources to reduce municipal potable water consumption (such as rainwater, stormwater, and greywater), and incorporates beneficial stormwater management practices. This form of development can be implemented on any scale of project, from large subdivisions to individual lots (Melbourne Water, n.d., p. 2).

Innovative water technologies and practices found in WSUD present an opportunity to reduce civil dependence on decaying and expensive water supply and stormwater infrastructure. These technologies and practices can significantly reduce the need to convey rainwater away from properties, treat the water to drinking water standards, and pump this water back again for mostly non-potable uses (Brandes et al. 2011, p. 11).

Pursuing WSUD in a meaningful way will require the widespread participation of municipal planning and building officials, and the building industry. Though water sustainability is largely a public issue, the adoption of WSUD technologies is a private decision. The private sector can have a significant influence on establishing and maintaining the success of commercial and residential water efficiency programs

(see City of Calgary, 2005, p. 45; City of Guelph, 2013; Hendriks & Wolfe, p. 1; Soroczan 1998). Furthermore, private development plays a key role in defining the urban landscape of new and growing communities; a combination of hardscape and softscape choices will influence the ways in which stormwater will be generated and managed within the community (TRCA, 2010, p. 7; Melbourne Water, 2010, p. 7). The developer's decisions to pursue WSUD could raise the potential to integrate beneficial stormwater management practices and water efficiency strategies on a subdivision scale, over the lifespan of the subdivision. In this way, widespread uptake by stakeholders in the development industry could have a considerable, cumulative effect on promoting water efficiency and beneficial stormwater management practices in Ontario's growing communities. This is significant, as urban sprawl in Southern Ontario has been expanding at an unprecedented rate in recent years, and this development trend is expected to increase over the coming decades (Greenbelt Ontario, n.d. para. 1).

1.3.2 RISK AND INNOVATION IN NEW CONSTRUCTION

Adopting new products and processes can bring numerous added risks to Ontario's building industry professionals, such as financial, legal, and reputational damages (United States Green Building Council, 2009, p. 4). Building professionals are often wary of the uncertainties that exist around the adoption of innovations in new construction because of the potential for various negative outcomes that ultimately lead to financial loss (Toole, 1998, p. 325). For example, the installation of a green building product that fails to perform can cause both financial and reputational damages to the builder (Slivka p. 6-8). Hendriks & Wolfe (2010), argue that risk aversion to innovation in Canada's residential building industry is widespread, and based on fear of profit loss within a competitive marketplace. Risk aversion may be hindering the adoption and diffusion of innovative sustainable building practices in Ontario's new construction industry, such as WSUD (Hendriks & Wolfe, 2010, p. 11). Examples of the successful adoption of other innovative technologies and practices may provide insight into interventions and activities for overcoming builder risk aversion in Ontario.

1.3.3 WSUD AND DEVELOPMENT IN ONTARIO

The current legislative framework affecting development in the province and the numerous public and private stakeholders involved in the development process play a role in determining potential interventions for overcoming WSUD adoption risks.

Current legislative framework

Several pieces of legislation are relevant to this study. Two key pieces of legislation that govern land-use planning, development, and construction are the *Planning Act, 1990* and the *Building Code Act, 1992*. The *Water Opportunities Act, 2010* is relevant because of its focus around promoting municipal water sustainability and the development of Ontario's water technology sector.

The Planning Act lays the foundation for development in Ontario. The Planning Act gives municipalities the authority to develop official plans, zoning by-laws, and add conditions to the development approvals process. Various land-use planning tools under the Act can be used to encourage the use of stormwater best management practices (BMPs) and climate change adaptation measures through imposing

development requirements or using different types of development incentives to influence construction practices (Binstock, 2011, pp. 9-10).

The Ontario Building Code (OBC) is a uniform code authored and overseen by the Ministry of Municipal Affairs and Housing (MMAH). The OBC dictates the building standards of residential housing throughout the province of Ontario. The Code is the sole regulation under the Building Code Act. The OBC has approached water efficiency by prescribing maximum flow rates for plumbing fixtures, which have become more restrictive over time with subsequent iterations of the Code. The recent release of the 2012 OBC has seen a significant, positive development in enabling a wider variety of domestic uses for alternative (*non-potable*) water sources (rainwater, greywater, and stormwater), and has referenced standards and guidance for the installation of alternative water systems (MMAH, 2012, S. 7.1.5.3 (3)).

The Water Opportunities Act has been a step towards municipal water infrastructure sustainability. Part three of the WOA gives the Minister authority to require Municipal Water Sustainability Plans and Performance Indicators from municipalities, in order maximize water and wastewater system capacity through increased water efficiency (MOE 2011, p. 1) The Government has also recognized economic opportunities through the development of Ontario's water technology sector. Part two of WOA establishes the Water Technology Acceleration Project (WaterTAP), a "hub" for water technology involving players in the private sector, government and academic institutions. The objective of WaterTAP is to develop Ontario's water technology sector and promote it internationally (MOE 2011, p. 1).

The Showcasing Water Innovation (SWI) program was introduced by the province to complement WOA, and fund innovative, cutting edge solutions for the management of water, wastewater, and stormwater systems in Ontario. SWI awarded total grants of up to \$17 million over three years to thirty-two successful applicants to the program.

Stakeholders in the development process

The development process can involve many public and private sector stakeholders. In the context of speculative low-rise residential housing development, builder risk exposure is largely determined by the demands of the housing market and the relationships and interactions between stakeholders. Therefore, understanding these relationships and interactions is important when seeking ways to manage the builder risks associated with introducing innovative products, technologies and practices into new housing projects. The number of stakeholders involved in a project will depend on factors such as what type of development is taking place, where the development is to be located, the design elements of the project and whether the development is speculative in nature or being constructed for a client or pre-determined end user.

Various public sector agencies and regulatory bodies play a role in the development process. These agencies and regulatory bodies oversee stormwater management requirements in the province and set the standards for water efficiency in buildings. Public sector stakeholders include the Ministry of Municipal Affairs and Housing (MMAH), the MOE, municipal governments, and conservation authorities.

- MMAH is the provincial body that oversees the Ontario Building Code (OBC). Through the OBC, MMAH dictates the uniform standard for construction of housing within the province of Ontario, including the minimum standards for the efficiency of water fixtures present in the home.
- MOE is the provincial body that is responsible for ensuring that site development plans are in compliance with section 53 of the *Water Resources Act*, which governs stormwater management

approvals.¹MOE provides technical guidance and standard of care for the building community through its 2003 Stormwater Design and Management Guidelines.

- Municipal governments are given authority to approve local development under the Planning Act. Municipal governments review site and building designs, issue building permits, install infrastructure up to development sites, and staff local building inspectors to ensure that construction is Code compliant. Under powers of the Planning Act, Municipalities may also implement their own stormwater management requirements above and beyond those of the MOE.
- Conservation Authorities (CA's) monitor and manage watersheds where development may be taking place. Conservation authorities may or may not be involved in stormwater design approvals processes depending on factors such as the size and location of the development (ex. adjacent to a conservation area versus on table lands). In cases where developments fall under CA jurisdiction, developments must gain CA approval before they may proceed.

In the private sector, key stakeholders include developers, builders, contractors, subcontractors, trades, designers and consultants, vendors, and homebuyers:

- Developers purchase the site, obtain site approvals and building permits, develop site infrastructure and run services to the lots. Depending on whether or not the developer is running a turn-key operation, they may also play the role of the builder and construct and sell the homes
- Builders purchase the permitted and serviced lots, and build and sell the homes to homebuyers
- Subcontractors and trades (such as plumbers and electricians) install products and systems within the homes, or other areas on the property
- Designers and consultants (such as architects and engineers) provide expert services or expert advice on various aspects of design and construction
- Vendors supply products and technologies installed within the home, or on the property
- Homebuyers are the end-user who purchase the builder/developer's product

1.4 CONCEPTUALIZATION OF TERMS

To provide clarity of meaning to some of the key terms and concepts found within this report, the following section provides a brief definition of terminology. Table 1 provides a list of key terms, concepts and definitions for the purposes of this study.

TABLE 1: KEY CONCEPTS IN THE RESEARCH

| Conceptualization of key terms in the research | |
|---|---|
| Industry | The term Industry is broadly used to denote organizations such building associations, trade associations, land development associations, or any other professional organization within the construction industry. This term also includes manufacturers, vendors, and other actors in the supply chain. |
| Actual risk | Actual risk refers to the type and magnitude of risk factors that would commonly be identified by those with knowledge around those risk factors. |
| Perceived risk | Risk-perception is subjective in nature, and could be defined as a "combination of the potential impact and the uncertainty of risk factors" (Shaokai & Mo, 2009, p. 4556). |

¹ Stormwater management application process happens in the early planning stages when the proposed site plans are submitted to the municipality by the developer. The municipality submits a copy to the MOE, and potentially the CA for review.

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| Innovation | Innovation is defined as "the actual use of a nontrivial change and improvement in a process, product, or system that is novel to the institution developing the change" (Slaughter, 1998, p. 226). |
| Innovative water technologies | Innovative water technologies have the potential to significantly reduce potable water usage in the home, through processes such as water reuse, and rainwater or stormwater harvesting. |
| Adoption | Adoption is defined as "the acceptance and continued use of a product, service, or idea" (Howard & Moore, 1988, p. 344). |
| Diffusion | Diffusion is defined as "the spread of an innovation throughout a social system" (Howard & Moore, 1988, p. 345). |
| Green building | Green building is defined as "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction" (USEPA, 2012b, para. 1). |
| Sustainable building | Sustainable building "refers more precisely to the goal of designing and constructing buildings that have no net impact on the environment, such that a total built environment composed of similar buildings could co-exist with the world's ecological balance indefinitely" (Building Science Corporation, 2008, p. 4). |
| Innovative sustainable building practices | Innovative sustainable building practices are construction or development methods incorporated into building projects that adhere to principals of sustainability and achieve significant operational savings in water, energy, or other resources (for example, the use of straw bale construction). |

1.5 RATIONALE AND IMPORTANCE OF PROJECT

The project is important, relevant, and timely as a great number of public and private stakeholders continue to seek opportunities to improve energy efficiency, water efficiency, and stormwater management practices in Ontario's built environment (see Canada Green Building Council, 2013; City of Toronto, 2010, p. 1; CVC & TRCA, 2010, p. 4). Within the broader movement towards improved resource efficiency, a growing interest exists among the province's policy and decision makers around water sustainability issues. Among these issues are the effects of stormwater overflow and wastewater discharges on the aquatic environment; population growth; the threats of changing climate on infrastructure; and an increase in flood risk due to an increase in extreme precipitation events (MOE, 2012, pp. 5-7). Awareness is also increasing around the limits to water supply and to the ability of municipal water infrastructure to meet rapidly expanding demand for water services (CMHC, 2009 p. 73). Running parallel to these concerns is a growing interest in advancing water efficiency and water technology opportunities within the province (MOE, 2012, pp. 58-59).

Ontario's Ministry of Finance (2012, para. 2) projects population growth in Ontario at 32.7% or 4.4 million people between 2011-2036 with the majority of growth in urban areas. The GTA alone is projected to see population growth of nearly 44.6% over the same period, amounting to an increase of 2.8 million people. Should actual growth be on track to meet projected growth, significant development will be required to meet the housing needs of the new population. Development on this scale under conventional forms may serve to exacerbate issues around water infrastructure and environmental sustainability. Transitioning to new, adaptive forms of development as a way forward for Ontario's communities could help to protect the aquatic environment, provide new economic opportunity, defer investments in new infrastructure, and promote the sustainable use of Ontario's water resources.

The research topic is important, because it seeks to identify ways to overcome a key obstacle in the transition to sustainable development, which is the meaningful participation of private sector developers. The private sector is a key player in the development of Ontario's communities, and without their participation, a transition to WSUD would not be possible. Assisting the building community in overcoming perceived and actual risk will be an important first step in transitioning to WSUD. A research gap currently exists around the role of the private sector in promoting water conservation and infrastructure sustainability, as the focus has typically been on the role of public sector on these issues (Hendriks & Wolfe, 2010, p. 2). According to Hendriks & Wolfe (2010, p. 1), "the private sector's contribution to promoting and sustaining residential and commercial water efficiency initiatives remains an untapped opportunity for collaboration".

In addition to presenting information for the client, the findings in this report may benefit the development community in that it will provide new information about risk management, building innovation, and potential opportunities in the marketplace. Information found in this report could be significant for the building community, because various aspects of innovative building practice are currently uninsurable due to a limited claim history for underwriters to draw from (Bradford, 2011, p. 15).

Other individuals who may potentially use this research include:

- Contractors, subcontractors and trades
- Builder/developers of speculative multi-unit commercial or condo developments
- Suppliers of materials and technology that specialize in green/sustainable building
- Local, regional, provincial, federal, and international governments
- Homeowners, building owners, property managers, real-estate agents, homebuyers
- Planners, designers, architects, engineers, project managers
- Insurance companies, legal firms, investors, financial institutions, mortgage specialists
- Building authorities, building associations and coalitions, building professional networks
- Researchers, program designers, educators, students, building enthusiasts, environmentalists, and advocacy groups

1.6 ORGANIZATION OF REPORT

The report is organized into 8 chapters, followed by references and appendices. The remainder of this report is organized as follows. Chapter 2 gives information about research methodology, and includes a description of theoretical and conceptual frameworks, a description of the research design, and an explanation of core concepts and definitions that are relevant to the study. Chapter 3 consists of a literature review that seeks to identify the breadth and depth of existing research on the topic. Chapter 4 provides a jurisdictional scan of several nations that are leading in the adoption of WSUD. Chapter 5 presents results from expert interviews. Chapter 6 is the discussion section and contains analysis, followed by conclusions in chapter 7 and recommendations in chapter 8.

2.0 METHODOLOGY

This chapter outlines the structure and approach to the research, containing sections on the theoretical and conceptual frameworks and research design.

Several methodological approaches were used to identify RM strategies that guided the development of recommendations. A document review was conducted to identify the depth and breath of information available on the research topic. Secondly, a comparative case study analysis took place in the form of a jurisdictional scan to identify interventions and activities implemented abroad in leading jurisdictions. A third component of this project involved primary research in the form semi-structured elite interviews. For this component, a qualitative approach to gathering of information was taken, as quantitative methods were deemed inappropriate given the research topic and research question. The primary data contributed to a thematic analysis to identify categories for interventions and activity. These three components were used in the formulation of discussion, conclusions, and recommendations for Ontario building industry stakeholders.

2.1 METHODS

2.1.1 SEMI-STRUCTURED ELITE INTERVIEWS

Semi-structured elite interviews was selected as one of the methods of data collection in this project. Interviews were conducted in person when possible, and through Skype communication software when it was not possible to meet face-to-face. Interviews were digitally recorded and transcribed for thematic analysis. Two participants provided written responses to the interview questions and contributed to this analysis. In all, twenty-four professionals participated in the study.

Target participants were separated into four main groups: A, B, C and D. The target participants in Group A were professionals within the building industry that had successfully incorporated WSUD elements into new construction projects, and had firsthand experience with or knowledge about the risks involved in adopting innovative water technologies. Key informants included: developers, contractors, subcontractors/trades, and construction project managers. Half of the ten building professionals targeted for this group were from international jurisdictions where WSUD and adaptations thereof had become more commonplace (namely Australia, the United Kingdom, and USA). In practice, seven professionals participated within this group, with only two of those seven from outside of Ontario.

The target participants in Group B were organizations that represent Ontario's building industry professionals that could speak to risk surrounding innovation adoption from the builder's perspective, and how risk might be managed. Target informants included Ontario building professional associations, and green and alternative building associations. Seven professionals participated in Group B.

The target participants in Group C were representatives of Ontario's municipal, regional and provincial governments who play a role in the development process. Key informants on the municipal and regional levels included representatives of various governments considered leaders in water conservation in the province of Ontario. On the provincial level representatives of the Ministry of Environment and of Ministry of Municipal Affairs and Housing were solicited to comment on the role these Ministries play,

and how the province might help to reduce builder risk aversion to adopting innovative water technologies. In all, nine professionals were interviewed within this group.

The target populations for recruitment of Group D were representatives of Canada’s insurance industry, who are experts in the business of risk management, and have a stake in promoting climate change resilient building practices. One participant was interviewed in this group.

Potential participants were identified through an internet-based search, and business email addresses were obtained from online directories. An invitation to participate was sent via email and included a consent form and an information package.

The information package was tailored to meet the target group being solicited. The information package (see example in Appendix A) included a general background introducing green building, WSUD and the potential for use of innovative water technologies and processes in new construction. Included also was an adaptation of Marsh's *Top ten risks of green building*, and a set of the interview questions for that specific group. The package was intended to brief the individual on the topic and to stimulate thought for discussion around construction innovation risk and risk management related to the adoption of WSUD.

Four sets of interview questions were devised, and each set of interview questions was geared towards a particular group (see Appendices B through E). Some questions were asked of all participants, whereas others were asked of a specific group or groups depending on the professional background of the group. Each of the questions was designed to meet the research objectives.

In total, twenty-four participants contributed to the research over the course of two and a half months. Of the twenty-four participants, eight were interviewed in person, and fourteen were interviewed through either Skype-to-Skype, or Skype-to-telephone calls. Two additional participants (one from group A, and one from group B) agreed to participate on the condition that their response to the interview questions would be in written form. Table 2 below displays the composition of the twenty-four participants by profession:

TABLE 2: INTERVIEW SAMPLE COMPOSITION

| Interview Sample Composition: 24 participants | | | |
|---|---|------------------------------------|---|
| Ontario builders/developers | 5 | Provincial government | 3 |
| International experts | 5 | Leading local/regional governments | 3 |
| Green building consultants | 2 | Leading conservation authorities | 2 |
| ON/Canadian building associations | 3 | Canadian insurance industry | 1 |

On occasion, lines were blurred between some of the participant groups, as some participants played multiple roles. For example, representatives of building professional associations were builders, or CA's were involved in both the R&D and the policy side of WSUD. Although this made it more difficult to position these participants within the target groups, a positive outcome of this overlap in roles is that a greater depth of perspective and insight on the issues was present.

The response rate from developers in international jurisdictions was poor, ruling out the plan for a case comparative analysis of projects abroad. Instead, the target group was modified and expanded to include other professionals abroad that were knowledgeable about SBP/WSUD technology adoption and builder risk. These international professionals were incorporated into the appropriate groups based on

their professional background. The information obtained from their interviews contributed to an analysis of intervention types that show potential for application within in Ontario.

Interview participants from leading international jurisdictions included those from Australia, the UK, and the USA. Professionals from US jurisdictions leading in Low Impact Development (LID)² implementation and green building included a recent past president of homebuilding association; a president of an organization specializing in LID; and a program manager for a green building certification program. Representing Australia was a project manager who was involved in facilitating and overseeing the transition of the state of Victoria to WSUD. The participant from the UK held an executive role within a trade organization specializing in the use of alternative water technologies.

Limitations of Method

The original intention for Group A participants was that each participant would have experience with a project that incorporated the use of alternative water sources. The experiences of these individuals would then be used to inform a comparative case study analysis on RM techniques for the use of alternative water sources in new developments. Of those that agreed to participate, the overall lack of information on specific projects at home and abroad made it difficult to compare RM techniques on a case-by-case basis. Instead, general information from participants' experiences with alternative water technologies and their recommendations for RM were used to contribute to overall findings.

Finding cases in Ontario where builders and developers were pursuing innovative technologies in low-rise development proved difficult. Due to the scarcity of private sector examples or lack of information, the research turned towards individuals who were involved in public/private projects. At first this was perceived as a limitation, but as research progressed it became apparent that pilots and public/private collaborations would play a key role in transitioning to WSUD in Ontario. Furthermore, the wide range of knowledge and expertise of those involved in these projects would become a valuable resource in seeking ways to overcome builder risk aversion.

The nature of the topic, and the multidisciplinary approach taken in the research design meant that interview participants were able to offer an expert perspective on a wide range of topic issues. However, another outcome of this approach meant that participants were knowledgeable about certain aspects of the topic, but not necessarily all aspects. For example, several participants were knowledgeable about innovative water technologies, but not as knowledgeable about the building industry. At other times, others were knowledgeable about the building industry, but less so about the technologies. Alternatively, some participants were knowledgeable about the majority of issues; though they may not have been builders or developers themselves, through their consultation with the building community and the nature of their work they were aware of the technologies and the various concerns that the building community had with the technologies. They were also aware of the concerns of local planning and building officials, as well as the other actors in the development and policy processes.

In addition to variable levels of knowledge around the issue of the topic, there were differences in the way that some participants understood the core concept of innovation. As a reflection of the variability in the understanding of the concept of innovation in construction described in Slaughter (1998), not all interview participants conceptualized innovative building practices in the same way. Despite a description of what building features would qualify as innovative within this study, a small number of interview participants chose to speak about building features that were marginal improvements in

² The term Low Impact Development is synonymous with WSUD in the USA, and is often used in Canada

conventional products and systems. Though the researcher actively attempted to align the participants' conceptualization of innovation with the study throughout the interview process, this disparity in definition may have influenced the depth of participant discussion around adoption risk, as well as the potential effectiveness of their suggested solutions for overcoming risk-aversion that could be applied to the innovative water technologies. These participants represented a small contingent within the group, so it is expected this limitation would have a minimal influence on overall interview findings.

2.1.2 DOCUMENT REVIEW

In addition to jurisdictional scan and elite interviews, a document review was conducted to identify the depth and breadth of information available on overcoming innovation adoption risk for builders and developers. Although there was a gap in literature directly related to RM and innovative water technologies in new housing, investigation led to three relatively developed subject areas which this research could draw from: the risks of green building, barriers to Low Impact Development, and barriers to innovation in the homebuilding industry.

The risks of green building literature explores the potential risks and liabilities that contractors are exposed to in implementing green building practices and adopting new building products and technologies in new construction. Although the focus of this literature is on commercial construction projects, various RM techniques are identified and discussed that could be applied to identifying and managing builder risk around the adoption of innovative water technologies into new homebuilding.

Barriers to Low Impact Development literature examines risks to builders and developers in implementing water sensitive development, how these risks may be minimized, and how builders and developers may be encouraged to adopt these practices. Though the focus of LID is primarily a stormwater management best management practice, many of the same risks and disincentives that hinder LID uptake are relevant in attempting to further an advanced water conservation agenda among the development community.

Barriers to innovation in homebuilding addresses many of the types of risks that builders and developers face when introducing new products, technologies, and processes into housing development. Although this body of work does not specifically address green building, sustainable building, or WSUD, many of the innovation adoption risks and potential solutions discussed may be applied to encouraging the uptake of innovative water technologies.

2.2 CONCEPTUAL FRAMEWORK

In 2009, Marsh insurance released a report entitled *Green Building: Assessing the Risks - Feedback from the Construction Industry*. The report presents the findings of Marsh's Green Building Team, which organized four round table discussions in several major US cities with the designers, builders, and owners of green commercial buildings. The purpose of these discussions was to identify the most significant risks associated with green building from the perspective of those best positioned to understand them (Marsh, 2009, p. iii). This report was the only research identified that evaluated the perceived risks of green building in a comprehensive manner, and through the perspective of the building professionals who had potential exposure to these risks. For these reasons, the major risk

themes identified in the Marsh report were chosen to serve as the conceptual framework for this project.

The following are ten major themes used by Marsh to categorize risk associated with green building as identified by the owners, builders, and designers of commercial projects:

- | | |
|--|---------------------------|
| 1) Brand and Competitive Edge/Reputation | 6) Regulatory |
| 2) Consultants/Subconsultants & Subcontractors | 7) Return on Investment |
| 3) Education | 8) Standard of Care/Legal |
| 4) Financial | 9) Supply Chain |
| 5) Performance | 10) Technology |

These top ten themes will be used throughout this report in several ways: To identify and categorize perceived and actual SBP/WSUD technology adoption risks to builder/developers in Ontario; to discuss RM implications of interventions and activities by public and private sector players at home and abroad; and to assist in the development of recommendations for Ontario stakeholders which may help to reduce risk and/or encourage builders to overcome these risks.

Establishing context is a key element in developing a strategy to manage an organization's risk (International Standards Organization, 2012, para. 4). In order to identify potential adoption risks to builder/developers in the new housing industry it is essential to understand the conditions under which they operate. The Marsh report was developed through consultation with actors in the US commercial building industry and their experiences with green building. The target group in this study, however, is Ontario's low-rise residential builder/developers. Although commercial builders/developers and home builders/developers may share a number of common risk exposures to innovation in new construction, there are alternate exposures that are unique to each of these groups that do not extend between commercial and new housing development. The differences in risk exposure stem from a number of contextual factors, including the following:

- Housing development is generally a speculative enterprise for builders and developers, which is not necessarily the context under which commercial construction is taking place- Home builders and developers build to meet market demand, and can begin projects with no predefined owner or client in place
- Commercial projects are often one-off projects built for a limited number of owners/clients, as opposed to housing developments where many individual units are constructed for many homebuyers
- Commercial projects have trained operations and maintenance staff managing the facility and its centralized systems, whereas housing developments typically have decentralized systems that are operated and maintained by homeowners
- Occupant behaviour within commercial facilities tends to be relatively stable and predictable compared to occupant behaviour in residential dwellings, which may see a wide range of demographics and usage characteristics
- In commercial developments, there may be high expectations from clients that a project will achieve advanced levels of green building certification, which may have greater ramifications for various parties if expectations are not met
- Homeowners commonly develop a greater emotional connection and attachment to their dwellings than owners and property managers of commercial buildings do to their facilities, which adds an additional dynamic to various forms of builder risk in the new housing context

For these reasons and others, the solutions that the Marsh report offers for overcoming risk in commercial construction may not directly apply in Ontario's low-rise residential development context. Despite incongruities in the risk context, the ten broad themes of perceived risk can offer a way for interviewees to express and categorize risk concerns with SBP/WSUD in new housing developments, and the use of innovative water technologies within the home.

The following table provides greater definition to these ten themes for the purposes of this study. Table 3 identifies the main risk concerns of interview participants regarding the inclusion of SBP, WSUD and innovative water technologies in new housing projects that fall within the ten risk categories. It is important to note that linkages and relationships often exist between risk categories, and that the risks do not exist in isolation from one another. Furthermore, these risk categories are not necessarily defined in the same manner as they are in the Marsh report; they have been adapted to apply to the low-rise residential housing sector, and are used for the purposes of classifying risk concerns. A detailed account of risk concerns specific to the inclusion of SBP, WSUD, and innovative water technologies in new housing can be found in Chapter 5: Interview Findings.

TABLE 3: MARSH'S TOP TEN RISKS ADAPTED TO REFLECT INNOVATION RISK IN ONTARIO HOMEBUILDING

| Risk Category | Risk concerns of interview participants |
|--|--|
| Brand and competitive edge/reputation | The risk or likelihood that adopting innovations may lead to events or outcomes that can adversely affect a builder/developer's reputation, and/or damage the builder/developer's brand or competitive edge in the marketplace. |
| Consultants/subconsultants & subcontractors | Builder/developer concerns around a lack of availability of finding qualified and experienced consultants and subcontractors for projects. |
| Financial | Numerous financial risks exist, and this risk category is quite broad. Financial risks can include issues ranging from construction delays to inefficiency in the production process, to market risks. |
| Education | Educational concerns revolve around the level of knowledge and experience with numerous building industry stakeholders regarding sustainable building practices. |
| Performance | Performance risks speak to the likelihood of an adverse outcome arising from the poor or failed performance of products, materials, or systems. Performance risks associated with innovative water technologies such as RWH and GWR can be linked to several other risk categories. For example, they can have an effect on both the reputation of, and pose a financial threat or liability to the builder/developer. |
| Regulatory | Regulatory risks, as interpreted by participants in this study, spoke to issues with the building code, the municipal approvals process, and building officials. |
| ROI | Risks regarding return on investment involve a failure by builders and developers to recoup the costs associated with the purchase and installation of alternative water technologies, or a failure to profit from the decision to adopt these technologies. |
| Standard of care/legal | Standard of care/legal risks arise from uncertainty in defining who is responsible when system failures occur, and where responsibility lies with any additional unintended consequences. |
| Supply Chain | Supply chain risks address the availability of products and technologies, as well as the presence of support systems to maintain and repair those products and technologies. |

| | |
|-------------------|---|
| Technology | Technology risks arise from the availability, the level of technological sophistication and robustness, and the suitability of innovative water technologies for application in Ontario. The technology risk could also be linked to several other risk categories, such as performance, reputation, supply chain, and financial. |
|-------------------|---|

Seeking interventions and activities for Ontario

Several criteria are used to guide the discussion on RM opportunities and moving forward with WSUD and alternative water technologies in Chapter 6. The criteria, presented in Table 4, are used to consider interventions and activities identified in the research that show potential to mitigate risk concerns documented within the ten categories above. Analysis in the discussion chapter leads to the formulation of recommendations to industry and government. Although part of the discussion may involve an analysis of various programs and initiatives based on the following criteria, this analysis should not be interpreted as a formal program evaluation.

TABLE 4: CRITERIA FOR ANALYSIS

| Criteria for discussion, analysis, and recommendations |
|--|
| <p>Feasibility</p> <ul style="list-style-type: none"> • The level of difficulty to implement within Ontario's current social, fiscal and political climate |
| <p>Adaptability</p> <ul style="list-style-type: none"> • The ability of potential interventions and activities to build off of existing frameworks (legal, organizational, programs, etc.) • The applicability of what has been done in other countries to furthering WSUD and alternative water technologies in Ontario |
| <p>Scope of Risk Management potential</p> <ul style="list-style-type: none"> • Looking to programs/initiatives that embody a wide range of RM characteristics that address risk concerns identified in the research findings • Seeking interventions and activities that would assist in reducing risk and uncertainty around the most prominent risk concerns identified in the interview findings, namely financial and performance concerns around the adoption of innovative water technologies |
| <p>Acceptability within the building community</p> <ul style="list-style-type: none"> • Seeking interventions and activities that could encourage the uptake of innovative water technologies which have a higher potential for acceptance and uptake among building industry stakeholders (i.e. greater market penetration) • Looking to program models that have had demonstrated benefits/successes in Ontario in the past, and embody desirable RM characteristics |

The following chapter presents findings from a review of available literature. Although there appears to be a relative scarcity of information directly related to the research topic, it is possible to look to information in related areas to further the research objectives.

3.0 THEMATIC LITERATURE ANALYSIS

3.1 INTRODUCTION

The search for literature on managing risks associated with the adoption of sustainable building practices, WSUD, and innovative water technologies led to the study of three fairly developed topic areas:

- The risks of green building
- Barriers to Low Impact Development
- Barriers to innovation in homebuilding

Within these three topic areas, a wide range of builder/developer risk exposures are discussed in the contexts of both commercial and residential development. This thematic literature analysis examines sources of builder risk and RM strategies that may be of significance in considering interventions and activities to encourage innovation in new construction. Of particular interest are strategies applicable to innovation in homebuilding and residential development.

3.2 RISK AND INNOVATION IN THE HOMEBUILDING INDUSTRY

The National Research Council of Canada (2002) identifies risk as "the single biggest hindrance to innovation," among homebuilders (2002 p. 18). According to the NRC, various risks to innovation in homebuilding, including the failure of the products or technologies to perform, rejection in the marketplace, construction delays or non-approval by regulatory authorities, rejection of technologies or products by trades and labour, and legal liabilities, all of which it associates with financial loss (p. v). These potential negative outcomes contribute to reluctance on the part of builders to innovate.

The behaviour of key stakeholders in the new housing business brings uncertainty into the adoption process, and can also increase perceived and actual builder risk. Toole (1998, p. 325) argues that three particularly noteworthy sources of uncertainty are found in homebuyers, local building officials and subcontractors. The reaction of these stakeholder groups to innovation in new construction can increase reputational and financial risks to the builder.

Due to the localized nature of the homebuilding business, homeowner word of mouth has more of an effect on a potential homebuyer's decision to purchase than conventional forms of advertising. For many homebuilders, the establishment of a reputation for high quality and durability can play a central role in the business strategy (Koebel & Cavell, 2006 p. viii). Problems that arise from a builder's decision to adopt what turns out to be flawed innovation can be damaging to the reputation of the builder, and can have deeper financial impacts on the builder than the cost to remediate the problem itself (Toole, 1998, p. 325).

Variability in the regulatory environment and in expectations by local building officials can also prove to be a source of financial risk to builders when considering product choices. Inconsistency in regulatory, permitting and inspection processes can delay projects that include innovative elements, or require extra management to see the project through the approval process (Toole, 1998, p. 325). Time is a critical element in construction projects affecting financial outcomes, and delays can have adverse financial and potentially legal consequences for the builder (Ford, 2004, p. 1). The extra resources required to usher the project through the approvals process can add to costs and reduce profit margins.

Subcontractors are a third source of uncertainty that can pose a risk to builders pursuing building practices that fall outside of convention. The coordinated effort of the numerous subcontractors required to complete a housing project is well choreographed, and established based on industry standards and building norms; changes in the process can throw this system off balance, causing disputes between trades, and lead to construction delays (Toole, 1998, p. 325). These effects on efficiency can also lead to financial loss.

Builders will be reluctant to introduce technologies, products or processes that may interrupt or increase their cycle times (the time it takes to build a housing unit), and reduce their organization's process efficiency and profitability (Koebel & Cavell, 2006, p. 6). This is particularly true of production builders where the economics of operation rely heavily on a repetitive process, and where disruptions in production could result from the need to adapt changes into their production models (Koebel, 2008, p. 47).

Green building has been leading the way in the use of innovative technologies and products to create high performance buildings. In using novel products, technologies, designs, and practices, building practitioners have exposed themselves to various forms of adoption risk. Investigating these risks may prove useful in formulating strategies to mainstream WSUD and innovative water technologies. The following section focuses on the risks of green building identified in the literature.

3.3 RISKS OF GREEN BUILDING

Within green building literature, risk dynamics discovered in the research that are particularly relevant to new housing industry could be categorized into two broad areas: risks stemming from the procurement and use of green building products and technologies, and risks resulting from a general lack of professional knowledge of, and experience with green building.

A risk topic that is particularly pertinent to this research, and is consistent with previous findings in the barriers to innovations literature, arises from the use of green building products and technologies (Slivka, 2011, p. 6). The use of novel, and relatively untested green products and technologies can lead to many issues. These products and technologies can expose builders to supply chain risks, critical path delays in the construction process, financial liability, and reputational risk.

A well-functioning supply chain³ plays a crucial role in the construction process in ensuring that materials and products get to site on time for installation. When green building products are in high demand and limited supplies exists, shortages can cause interruptions in the supply chain for green construction projects. These interruptions can range in significance, from minor delays in installation to critical path delays⁴ in the construction process (USGBC, 2009, p. 4; Anderson et al., 2010, p. 38). Green building products and technologies may take extra time to install, complete, or cure, thus contributing to the overall time requirements of the construction process (Anderson et al., 2010, p. 38).

³ Supply chain is defined by Ganeshan and Harrison (1995) as “a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers” (p. 1).

⁴ Deriving from the Critical Path Method (CPM), critical path delays in construction refer to those that affect project milestones or project completion. This is in contrast to non-critical delays, which occur in the construction process, but do not delay milestones or project completion (Trauner, Manginelli, Lowe, Nagata & Furniss, 2009, pp. 25-26).

Untested products, designs, and technologies with limited or questionable performance data can expose contractors to reputational and financial risk (Slivka, 2011, p. 6; USGBC 2009, p.4; Marsh, 2009, p. 9). Construction professionals can fall prey to the 'greenwashing'⁵ of products and technologies by manufacturers and suppliers for lack of available performance data, and face liability for damages when these products fail (Marsh 2009, pp. 8-9; Slivka, 2011, p. 8). The various costs to contractors when untested products fail to meet performance expectations could be greater than compared to the failure of conventional projects (USGBC 2009, p.4).

Lack of knowledge and experience in green building has been identified as a key factor exposing contractors to risk. According to Slivka (2011, p. 8), lack of experience is an issue among building professionals, and there is a general lack of expertise around green building. Marsh (2010, pp. 9-10) identifies a shortage of trades with specialized knowledge as a potential risk. A contractor may have a difficult time finding a suitable replacement of a subcontractor in default, which can lead to a number of negative outcomes.

Green building literature identifies innovation adoption risks that builders are exposed to in commercial, 'one off' developments; many of these risk concerns may be shared by homebuilders and developers. When considering the homebuilding industry, however, an auxiliary set of risks and challenges emerge that may influence builder adoption decisions. To better understand the risks associated with WSUD and innovative water technology adoption in housing development, one may turn to literature on the residential housing sector and experiences with Low Impact Development.

3.4 RISKS IN PURSUING WATER SENSITIVE DEVELOPMENT

Water sensitive development can be implemented on a subdivision scale to be used as an alternative form of stormwater management. In addition to promoting water conservation, rainwater harvesting is used as a means to reduce stormwater quantity within forms of water sensitive development such as Low Impact Development (HUD, 2003, pp. 44-45). The use of innovative building practices and technologies as a standard feature in housing development presents risks to the developer that translate into potential for economic loss, liability, or reputational damages.

Common risks associated with the adoption of LID in the literature stem from regulatory and approval processes, uncertainty around the function, maintenance and long term performance of LID technology by both developers and homebuyers, public perception of developers when LID measures do not perform as well as they were designed to, and market risks (see ECONorthwest, 2007; Bowman & Thompson 2009; Foss, 2005; & Strassler et al., 1999). Time delays and regulatory risks were identified as the key risk concerns.

Common regulatory risks include construction delays due to a lengthy approvals process, and the added burden of having to educate and convince building officials on the viability of LID as an effective means of stormwater management. A lengthy approvals process can lead to inflated design and regulatory costs, as well as construction delays and additional debt servicing costs (Clar 2004, p. 7; Coffman, 2002,

⁵ "The term [greenwashing] has gained broad recognition and acceptance to describe the practice of making unwarranted or overblown claims of sustainability or environmental friendliness in an attempt to gain market share" (Dahl, 2010, p. A247).

p. 7; ECONorthwest, 2007, p. 23; HUD, 2003, p. 15). Operations and maintenance risks were also discussed within the literature. Homeowners may be responsible for the operations and maintenance of LID designs, features and technologies on their properties; those that do not perform up to specifications because they were not properly maintained by the homeowner may create a negative perception of the builder amongst unaware homeowners and lead to negative outcomes for the builder (ECONorthwest, 2007, p.22).

3.5 STRATEGIES TO REDUCE ADOPTION RISK AND ENCOURAGE INNOVATION

This section draws on green building and innovation in homebuilding literature, to compile various risk management tools and strategies for encouraging innovation that can be applied to furthering the adoption of innovative water technologies in new housing. The RM strategies found below require action on the part of builders as partners in advancing sustainable building practices. RM strategies have been based on the following factors and themes: supply chain; the existence product and technology standards and protocols; clearly defined roles and responsibilities; enhanced communication; documentation of expectations; enhanced planning; the presence experience and knowledgeable personnel; training, education and raising awareness; knowledge and information transfer; collaboration; and the use of recognized building certification and product labeling. This section also introduces interventions and activities found in the literature that could be used by other parties to reduce risk or encourage builders to innovate, including: research and development programs into vetting and testing innovative technologies, the establishment of an 'innovation friendly' approvals process, the use of grants and incentives, and opportunities for professional recognition of leadership within the industry.

Managing potential risks in the supply chain has been recognized as an effective method to avoid various issues that can occur with new products and technologies found in green building. Shartzter (2007, p. 51) advocates for collaboration in, and improvement of supply chains as a way to reduce risk on construction projects. According to HUD (2005, p. iv), the size of the manufacturer of an innovative product is extremely important, and will influence the manufacturer's ability to vet the product or technology before it is released into the marketplace. A larger, more established firm will have more resources to devote to vetting technologies than a smaller, startup company. When selecting green building products, Anderson et al. (2010, p. 40) advise builders to choose with more scrutiny than conventional products. Care should be taken to ensure the availability of products and that production capacity exists within manufacturing to meet the developer's needs without causing any time delays in construction.

Uncertainty exists around the long-term performance of green technologies and products (Holbrook, 2009, p. 3). As further protection from exposures associated with product and technology failure, builders should rely on performance data instead of promotional materials and avoid greenwashing (Anderson et al., 2010, p. 40). In addition to recommending the selection and use of well-vetted products and technologies, Primavera (2009, p. 3) counsels contractors to oversee the product selection carried out by their subcontractors. HUD (2005, p. iv) argues the need for establishing "standards and protocols for durability testing" in the manufacturing process, and sees product certification and quality assurance as way to minimize risk (p. v).

Several authorities on the subject of risk management in green building stress the importance of establishing clear roles and responsibilities in a project (Anderson et al., p. 30; Primavera, 2009, p. 3;

USGBC, 2009, p. 5). Lack of clarity in roles and responsibilities of the various parties is a major source of risk that can be addressed through various means. Misunderstandings can be avoided by clearly defining the scope of work within comprehensive construction contracts (USGBC, 2009, p. 5; Anderson et al., 2010, p. 40).

Enhanced communication can also play a role in preventing misunderstandings between parties in green building projects (Institute of Management and Administration [IMA], 2009, p. 2). According to the USGBC (2009, p. 5), establishing clear understanding and communication between the architect, owner and contractor is "the greatest risk management tool". Anderson et al. (2010, p. 40) call for heightened communication between parties, particularly around product choices and the risks associated with those choices. The IMA (2009, p. 2) advises that those responsible for selecting green products, or processes to obtain a broad base of documentation that supports their use.

Establishing a key person within the project team can be a helpful way of centralizing and managing this type of information. Primavera (2009, p. 4) suggests establishing one experienced individual in the team who will be the contact person for all contractors on the project, and will organize all the information necessary to meet green building requirements. This person could serve as the primary source for up to date communications. One responsibility that this central contact position might entail is the documentation and sharing of expectations. Bradford (2011, p. 14) advises the documenting of expectations so that all parties are clear on what can be expected in the project.

To avoid many of the potential issues that can accompany green projects, sources in the literature suggest allocating additional time, resources, and forethought in the early stages of development. Developers with successful experiences in Low Impact Development have attributed their successes to investing more time and money at the early planning stages (HUD, 2003, p. ix). Contractors who are experienced in green building can provide valuable insight and expertise into the pre-planning stages of a project (Primavera, 2009, p. 3)

The use of knowledgeable and experienced personnel was identified as a key factor in reducing builder risk (Primavera, 2009; USGBC, 2009, p. 7; Bradford, 2011, p. 14). According to the USGBC, (2009, p. 7), a combination of knowledge and experience is "the most effective protection against legal risk." Contractor knowledge and experience regarding green building features is highly valued as they may be required to educate subcontractors on their sites about products/processes, and how these elements affect the overall success of the project (USGBC, 2009, p. 5).

A shortage of qualified installers and subcontractors can serve to worsen risk exposures around the adoption of innovative technologies (HUD, 2005, p. iv). Training and education therefore play an important role in reducing builder risk by ensuring that construction personnel have the right knowledge and skills to work with innovative technologies. Hendriks & Wolfe, (2010, p. 18) see a need for formal and informal opportunities for builder education around innovative technologies. Building professionals who participated in their study saw higher value in on-site training compared to a formal classroom setting, and recognized apprenticeship as way to significantly increase levels of practical knowledge (p. 9). HUD (2005, p. iv.) describes builders as "kinesthetic learners", and program developers should be sensitive to this preference for 'hands-on' experience when seeking to build knowledge around new products and technologies.

Closely related to training and educational themes are those of knowledge and information transfer. Hendriks & Wolfe (2010, p. 18) highlight the importance of professional organizations in mentorship and knowledge sharing opportunities, and see great potential for these organizations in the advancement of

knowledge transfer. The NRC (2002, p. 14) stresses the need for greater information transfer around innovative technologies and products, through a multitude of communication techniques, to raise awareness, reduce risk and encourage adoption in the housing industry. Particularly effective methods of information transfer in the homebuilding industry identified by the NRC include information obtained by word of mouth from respected peers who have tried and evaluated an innovation, and various types of demonstration projects (2002, p. 15). Demonstration projects could include collaboration between private developers and the public sector.

Hendriks & Wolfe, (2010, p. 13) found that collaboration "diffused the risk of failure" and spread risk between the parties. The RM benefits of collaboration can manifest in various forms. Shartzter (2007, p. 50) discusses collaboration with actors in the supply chain to improve quality and efficiency, and guard against supply shortages upstream that could have adverse effects on construction projects. The NRC (2002, p. 19) describes collaborative arrangements between the private sector and government that have successfully shared risk and encouraged eco-friendly developments. Participants in a study by Hendriks & Wolfe, (2010, p. 13) believed the successful collaboration between private developers, community organizations and municipal government was the primary factor enabling a large green housing development to move forward.

For those seeking to encourage innovation, collaboration offers additional forms of leverage. For example, collaboration with a municipal government may allow for improved visibility in the marketplace, and a chance to be recognized as a leader in the industry. Professional recognition and affirmation of leadership in the industry can be a particularly potent motivator for builders: Hendriks & Wolfe, (2010) express the role of peer recognition of leadership as "influential in catalyzing innovative practices" (p. 18). They describe a phenomenon they call the "risk-recognition interaction," where peer recognition and positive professional reinforcement can reduce a party's level of perceived risk of economic loss (p. 18).

Other opportunities exist for builders to differentiate themselves in the market, and be viewed as leaders among the competition. The use of recognized certification and labeling to denote superior quality or performance offers numerous marketing advantages; this can be demonstrated in the world of commercial green building through the high demand for LEED certified buildings, or in the residential homebuilding industry through Energy Star certification and labeling. According to Hendriks and Wolfe (2010, p. 16), certification programs help to legitimize green building practices. Furthermore, the presence of recognized certifications can encourage builders to adopt green technologies. According to HUD (2005, p. iv), product certification can establish a level of quality assurance for products and technologies, and minimize builder adoption risks.

In addition to the enhanced marketing opportunities offered through consumer brand recognition of building certification and labels, various types of incentives can be used to encourage innovation and among builders and developers. Incentives can take a multitude of forms, and can be offered by any party that is interested in furthering a type of behaviour or practice. According to the NRC (2002, pp. 16-17), municipalities can use incentives to pursue policy objectives, such as encouraging a specific type of development, or development in a particular location. Incentives can also be used to offset the additional costs associated with innovation, or the costs to train personnel on the implementation of an innovation.

The costs of innovation can be prohibitive to builders. Next to risk, the NRC (2002, p. 19) recognizes the high cost of innovation as the second greatest hindrance to innovation in the homebuilding industry. These high costs can be reduced by financial incentives or grants, or subsidized through government

investments in research and development and various demonstration programs. High costs for the builder can also arise from an expensive approvals process when innovation is involved. The NRC recognizes this as a systemic issue, and advocates for making the approvals process more amenable to innovation. Streamlining regulatory processes can reduce the difficulty and increased expense associated with innovation (p.19). Similar issues with regulatory and approvals processes can also affect the uptake of water sensitive development.

3.6 STRATEGIES TO ENCOURAGE WATER SENSITIVE DEVELOPMENT

Various strategies to encourage or enable water sensitive development were found within the barriers to LID literature. These approaches were oriented towards municipal planning officials, and assumed that municipalities were open to pursuing and encouraging forms of water sensitive development.

The variance process⁶ can be time consuming, and from an economic perspective serves as a disincentive to builders who may be considering LID (HUD, 2003, p. 15). Updating development standards and frameworks, such as approvals processes, zoning, and construction requirements to clearly and specifically address LID would reduce the associated regulatory obstacles that developers often face (Coffman, 2002, p. 9; ECONorthwest, 2007, p. 23; Foss, 2005, p. 6; HUD, 2003, p. 15). The risk of financial loss to developers would be reduced as they would not need to invest additional time in the approvals process, or time in educating building officials and making the case for LID (ECONorthwest, 2007, p. 23).

Development incentives, such as density bonuses, development charge rebates, and expedited approvals, could also be employed by municipalities to make LID more attractive to developers. Density bonuses could increase in the number of lots allowable on a site than would otherwise be permitted using conventional stormwater management techniques (ECONorthwest, 2007, p. 23; HUD, 2003, p.16). The increased density would allow developers to yield a higher number of units for sale and provide an opportunity to generate additional revenue over conventional development (ECONorthwest, 2007, p. 23). Development charge rebates offer another avenue to incent (ECONorthwest, 2007, p. 23; HUD, 2003, p. 16). Expedited permitting and approvals, or pre-development assurances can be used to encourage water sensitive development, saving costs and alleviating risk exposures associated with lengthy process times (HUD, 2003, p. 16).

3.7 SUMMARY AND CONCLUSION

This literature review has identified numerous risk themes associated with green building, innovation in homebuilding, and water sensitive development. Through the process, a host of potential risk management strategies have been uncovered that show potential for employment within projects in Ontario. For advocates of WSUD and innovative water technologies, a number of interventions and activities have been identified in the literature to encourage builders and developers to overcome perceived and actual risks to adoption.

⁶ A variance is an application to a municipal planning department to deviate from an established set of development codes or zoning ordinances.

Industry and government both have a role in enabling and encouraging the uptake of innovative building products, technologies, and processes. To enable adoption, regulators can revise the permitting and approvals system to make it more 'innovation friendly'. Governments can help reduce innovation costs by taking an active role in research and development. Public agencies can also educate and raise awareness among stakeholders by providing information on cost and installation, and providing clarity around codes and standards to be met when using innovative technologies. Creating opportunities for information and knowledge transfer are also ways in which the public and private sectors can reduce perceived risk, and build capacity towards innovation. Risk-sharing opportunities through various forms of collaboration can also encourage developers to experiment by reducing the threat of economic loss.

Public proponents can provide incentives to builders and developers to innovate through a multitude of ways. For example, various financial incentives can be used to offset additional costs for training staff on the new products, technologies or processes, or the additional time it may take to implement an innovation. Moreover, development incentives can save the developer time and money. Possibilities for leveraging innovative behaviour could include enhanced marketing opportunities from building labeling and certification, or professional recognition as a leader in the industry.

Industry stakeholders can also enable and incent builders to overcome risk perceptions and adopt innovative building practices. Manufacturers can provide reliable and credible information to decision-makers about product performance, installation cost, operations and maintenance, and other pertinent information such as applicable codes and standards. Professional associations can create opportunities for increasing education and awareness, and knowledge and information transfer from these opportunities can help build capacity in the industry and reduce adoption risk. Opportunities for collaboration and risk-sharing are also possible.

Various activities and interventions identified above can be found through an examination of international jurisdictions leading in water sensitive development. The following chapter will look to these experiences in furthering sustainable building practices. The jurisdictional scan will build on the findings of the literature review, and assist in identifying a way forward for reducing builder innovation risk in Ontario.

4.0 JURISDICTIONAL SCAN

4.1 INTRODUCTION

The following section examines several international jurisdictions and their approach to diffusing green building and sustainable development practices in residential development. The analysis will focus on the following forms of water sensitive development that have played a role in furthering the use of alternative water sources and innovative water technologies in new housing: WSUD in Australia, Low Impact Development (LID) in the USA, and Sustainable Urban Drainage Systems (SuDS) in the UK.

This scan seeks to accomplish two main objectives: to identify the drivers behind builder uptake of WSUD and innovative water technologies in new construction; and to uncover a broad range of interventions and enablers that may have assisted builders in overcoming perceived and actual risk. Identifying and understanding drivers and interventions abroad may prove valuable information for Ontario proponents in determining an appropriate course of action for overcoming builder risk at home. The scan begins with Australia, followed by the United Kingdom, and then addresses what is taking place in the United States. Information for this section was gathered through internet based research, an analysis of government documents available online, and various building industry related websites within these jurisdictions.

4.2 AUSTRALIA

4.2.1 DRIVERS

Australian cities have faced many of the same water issues as those in other developed countries. The effects of stormwater quality on the aquatic environment, decaying infrastructure, population growth, and the impacts of climate change were all driving forces behind exploring alternative forms of water management. WSUD was recognized as a means to address these issues, and was driven by government through Australia's National Water Initiative (Brown & Clarke, 2007, p. 3).

Water scarcity continues to be a serious issue in Australia, and those involved in developing WSUD saw the use of alternative water sources as an important part of a larger WSUD strategy. Extended nationwide drought conditions heightened the need for obtaining greater supply security, and this led to "significant investment in developing new and alternative water sources" (p. 1).

Despite the pressing need for water security and the significant investments made, the free market was failing to meet water and other sustainability objectives. It was ultimately the imposition of policy and regulation that were the key drivers towards meeting sustainability objectives in new construction. These heightened sustainability requirements have been a key driver for innovation adoption within Australia's residential construction industry (Briggs, Cole, Evesson, Gleeson, Buchanan, Larcombe & Saddler, 2007, p. 92).

4.2.3 INTERVENTIONS AND ACTIVITIES

Various activities and interventions aided in the promotion of sustainable building practices and WSUD in the states of Victoria and New South Wales, including adopting new requirements into development frameworks, and providing education, training, and support around sustainable development. Steps were taken to streamline, coordinate and reduce uncertainty in approvals processes.

The state governments of Victoria and New South Wales (NSW) incorporated sustainability requirements into "regulatory and planning frameworks" to drive sustainable building practices in new home construction. NSW used two vehicles to drive energy and water sustainability requirements: Landcom, and Basix (Briggs et al., 2007, p. 92).

Landcom is a public agency that manages the state land release. According to Briggs et al. (2007, p. 92), this agency played a key role in diffusing sustainable practice in NSW's building industry. Landcom instituted sustainability mentoring programs to educate and support a range of building industry professionals on sustainable design and building practices. Landcom's "'supervisors' of energy, waste and water" provided on-site support and guidance for builders and trades during project implementation, emphasizing a "'learning by doing'" approach to assist professionals in retaining newfound knowledge and skills (p. 93).

Basix is an online tool for assessing building design compliance with state water and energy reduction targets. Home design must meet state targets in order to receive a certificate of approval, which is required by every council within NSW as part of the application for building a new home. The system allows builders to choose from a large range of features and options to achieve the targets, including innovative technologies such as alternative water systems (New South Wales Government, 2006, p. 2).

Victoria took a different regulatory approach to helping to mainstream WSUD and the use of alternative water sources. This approach involved amending Clause 56 of the Victoria Planning Provisions and developing consistent guidance for developers between municipalities in high growth areas.

The State amended their building code⁷, to include sustainable water management requirements. Clause 56.07 in the Victoria Planning Provisions included integrated water management provisions that apply to all new residential subdivisions and mixed-use development. Local councils were now charged with the responsibility of considering clause 56.07 in all residential development applications in a low-density zone (Department of Sustainability and Environment, 2006, p. 1).

The objectives of clause 56.07 are to:

- Integrate use of all water resources including rainwater, reused water, recycled water and stormwater;
- Conserve the supply and reduce the use of potable water;
- Use alternative water supplies where potable water quality is not required, and
- Use best practice water sensitive design techniques to conserve, reuse and recycle water and manage the quality of stormwater run-off (DSE, 2006, p. 1)

Clause 56.07-1 through 56.07-4 refer to the objectives and technical standards of drinking water supply, reused and recycled water, wastewater management, and urban run-off management, and assign authority to governing bodies for maintenance of those standards (DSE, 2006, p. 2-3).

To define municipal council expectations with WSUD for developers and enhance consistency across municipalities in high growth areas around the Melbourne area, Melbourne Water partnered with participating councils and authored guidelines entitled Design, construction, and maintenance of WSUD. The guidelines outlined a standard application process for councils and developers, identified a menu of best practice WSUD features, and referenced technical standards that should be met by each feature. An addendum outlined additional requirements that were specific to the various municipal councils

⁷ The Victoria Planning Scheme is the main planning document for the state of Victoria that contains the state-wide Victoria Planning Provisions, and the regional Local Planning Provisions

within the region that were beyond the general requirements set out in the guideline (Melbourne Water, 2010, pp. 7-9).

Sustainability education, training, and support played an important role in building capacity within the industry. According to Briggs et al. (2007), Landcom proved to be "a major agent for diffusing sustainability practice, industry change and learning" (p. 92). Training and mentoring were provided by Landcom to municipalities, developers, and other professionals involved in the building industry. Professional organizations and homebuilding associations took on most of the technical training of trades and installers. Specific to the integration of alternative water sources, training was offered through the Master Plumbers and Mechanical Services Association's (MPMSA) Green Plumber courses, and the Master Plumber NSW Enviro-plumber course.

The Rainwater Harvesting Association of Australia (RHAA), formerly Australian Rainwater Industry Development group (ARID), was established in 2004 by the MPMSA to provide a national body to address installation issues, and to bring consistency to the use of RWH technologies and plumbing practices (RHAA 2011, para. 1). The RHAA engages government and industry stakeholders on behalf of its members to create a favourable and consistent environment to promote the uptake of water reuse.

The Australian government's National Water Commission, in partnership with the Australian Rainwater Industry Development Group and the Master Plumbers and Mechanical Services Association released The Rainwater Tank and Installation Design Handbook to guide regulatory authorities, trades, builders, and developers. Among other publications, the NWC and MPMSA also produced Greywater Handbook to guide industry stakeholders (National Water Commission, 2008, p. 2).

4.3 UNITED KINGDOM

4.3.1 DRIVERS

In the United Kingdom, Sustainable Urban Drainage Systems (SuDS) acts as cousin to, and incorporates many of the same principles of WSUD. Development under SuDS has been government driven. Climate change adaptation and disaster avoidance (flooding and drought) was the major impetus behind the Government's push to integrate SuDS into land development (Department for Environment, Food and Rural Affairs, 2008, p. 8).

SuDS was seen as a way to reduce flooding caused by extreme weather events, protect surface water quality from non-point source pollution, and prevent stormwater from the overloading of public sewers⁸. In addition to managing stormwater, the government recognized opportunities to meet demand for growing populations through the use of alternative water sources, and saw RWH in particular as part of the solution for areas of high growth and water scarcity. DEFRA encourages RWH among property developers and land managers (DEFRA, 2008, p. 9).

The Government's 2008 plan set new targets for average daily personal consumption of mains water (municipal water) supply. The new targets to be achieved saw a reduction from 2008's estimated 150 lcd⁹ to 130 lcd or lower by 2030 (p. 22). Changes in regulations and building codes have been the

⁸ 40% of the sewers in the UK are co-mingled stormwater and sanitary, with potential for contamination of stormwater with sanitary sewage (DEFRA, 2008, p. 56)

⁹ Litres per capita per day

primary driver to adopt innovative water technologies and process by the building community (see below).

4.3.2 INTERVENTIONS AND ACTIVITIES

Several conditions promoted the uptake of sustainable building practices in the UK. Building code and regulatory changes, the development of a code dedicated to sustainable building, and the presence of professional organizations all supported the adoption of water sensitive development and alternative water technologies.

Recent code and regulatory changes include modifications to the Planning Policy Statement, and the Building Regulations. The Planning Policy Statement is the overarching national framework that provides guidance to local government on statutory provisions, planning policy, and planning system operations (Department for Communities and Local Government 2012, para. 1). The addition of Planning Policy Statement 25: Development and Flood Risk in 2010 "formally introduced the concept of SuDS into the planning process" (Binstock 2012 p. 24; White and Howe, 2005, p. 25). Planners in the approvals process now had a formal opportunity to discuss SuDS alternatives with developers, and encourage developers to implement SuDS when planners deemed it appropriate (White and Howe, 2005, p. 25). Recent changes to the Building Regulations complement these changes to the Planning Policy Statement.

The Building Regulations function as the national building code, and dictate the minimum requirements for construction. Several changes to the Part G1 of the Building Regulations effective April 2010 provided clarity of roles and responsibilities to designers, manufacturers and installers around the use of alternative water technologies. These changes accomplished several things:

- 1) Specified the types of alternative water sources that may be used ("water abstracted from wells, springs, bore- holes or water courses; harvested rainwater; reclaimed greywater; and reclaimed industrial process water")
- 2) Enabled the use of a range of alternative water sources for 'non-wholesome' (non-potable) applications
- 3) Assigned specific responsibility to conduct separate risk assessments by designers, manufacturers, and installers of alternative water systems/units to be supplied or installed at dwellings
- 4) Referenced guidance documents and technical standards for the installation of GWR and RWH systems in dwellings (HM Government, 2010, p. 14)

In addition to these changes, new Building Regulation 17K set the maximum allowable consumption rate of new homes at 125 lcd in line with achieving the 2030 targets HM Government, 2010, p. 15). Similar daily per capita limitations can be found in the Code for Sustainable homes, and the commercial/institutional sector's Building Research Establishment Environmental Assessment Method (BREEAM) green building standards. According to the UK Rainwater Harvesting Association (2012a, p. 4), typical water conservation measures in homes will unlikely be able to meet both water use limitations and building occupant needs simultaneously, which sets the stage for the increased use of alternative water sources in new construction and major renovation. Regulation 17K raises the standard building code to the water efficiency requirements of a Code level 1 in the Code for Sustainable Homes.

The Code for Sustainable Homes is a voluntary building standard a 'step-change' above current Building Regulations that was created to provide a single national standard for sustainable building. Under the Code, buildings are assessed on a 'whole home' approach within a framework of nine sustainable design principles. A level of building certification between 1 and 6 is awarded according to performance within

the nine sustainability categories (DCLG, 2006, pp. 4-6). A Code level 1 rating uses no more than 120 lcd, whereas a Code level 6 home uses no more than 80 lcd- a feat that requires the use of alternative water technologies (DCLG, 2006, pp. 25-27).

According to the DCLG (2006, p. 4), the Code "is a means of driving continuous improvement, greater innovation and exemplary achievement in sustainable home building". The code provides homebuilders with several benefits: A 'mark of quality' above competitors building to current building regulations; regulatory certainty in the direction of future building regulations favourable to business planning and investment; and the flexibility to provide innovative building solutions made possible through performance based requirements. The development of a code such as this provides direction not only to building professionals, but to the professional organizations that train, support, and advocate for those professionals.

One professional organization that is heavily involved in these activities is the UK Rainwater Harvesting Association (UK-RHA). The UK-RHA is the national trade body for manufacturers, suppliers, and installers of RWH technologies. As the national trade body, the UK-RHA plays several roles: Provides membership based training to installers; represents the industry to government and interest groups; promotes the technology; and acts as an informational resource for professionals and the general public about RWH and its role within SuDS. The UK-RHA played a key role in developing the National technical Standards for RWH (BS-8515), and developed its own Code of Practice for members to maintain high professional standards (UK-RHA, 2012b, para. 1-4).

4.4 UNITED STATES

4.4.1 DRIVERS

The climate varies considerably in the regions of the United States, from the arid south, to the rainy Pacific Northwest, or the Great Lakes states that have a climate similar to Ontario. The difference in climate has had an influence on drivers for RWH and water sensitive development. According to the American Rainwater Catchment Systems Association (ARCSA, 2012, para. 7), both water scarcity and water quality concerns have brought renewed interest in the practice of RWH. One of the "most frequent" drivers for RWH however, is compliance with EPA and State stormwater management requirements, which are requirements that promote retention and infiltration practices to reduce stormwater run-off from site (ARCSA, 2012, para. 20). RWH is often viewed as a tool in a suite of tools for beneficial stormwater management practices found in Low Impact Development (USEPA, 2012, para. 5) In this way, RWH is driven along with federal and state government push towards the uptake of green infrastructure and LID.

Rainwater harvesting for domestic use has a long history in arid states, such as Texas, and is driven by water scarcity and supply security issues. Independence from local water restrictions during times of drought can be an incentive for homeowners to install RWH systems (Barer, 2012, p. 1). In arid states, cost savings can also be a driver in new development. In New Mexico, the use of RWH has been recognized as a means to reduce developer costs associated with acquiring water rights for new housing developments (New Mexico Environment Department, n.d., p. 2).

4.4.3 INTERVENTIONS AND ACTIVITIES

Interventions by federal, state, and local government have encouraged the adoption of water sensitive development. On the stormwater side, development regulations have established post-construction runoff requirements that encourage LID. On the supply side, a number of conditions have aided in furthering alternative water technologies: a green plumbing code has been developed that addresses alternative water systems; professional training and support is available through several trade organizations; building certification opportunities exist to enhance the marketability of homes; and professional recognition opportunities exist to celebrate leadership through industry awards. Tax incentives and rebates are available to builders and homeowners alike, to encourage uptake.

Building requirements from the EPA have furthered water sensitive development. Through the National Pollution Discharge Elimination System's Phase II MS4 permitting process, the EPA requires post-construction stormwater management for all development or re-development equal to or greater than one acre. These requirements address both stormwater quality and on-site volume retention. The EPA provides guidance on various structural and non-structural best management practices that can be combined and used to achieve these requirements (EPA, 2005, pp. 1-2). The majority of these recommended structural BMPs are LID features (see EPA, 2010). RWH is one of these LID BMPs, and new technical guidance had reduced uncertainty around installing these systems.

The International Association of Plumbing and Mechanical Officials (IAPMO) are the developers of Uniform Plumbing Code (UPC). The UPC is designated a national standard code by the American National Standards Institute. Released in 2010, IAPMO developed the Green Plumbing and Mechanical Code Supplement (GPMCS) as a supplement to the Uniform Codes. The GPMCS details requirements for green plumbing and mechanical systems that will ultimately be adopted into the Uniform Codes, including the use of alternative water sources. According to IAPMO, the GPMCS "serves as a resource for inspectors, plumbers, contractors, engineers and manufacturers in designing, installing and approving green plumbing and mechanical systems" (IAPMO, 2012, para. 5).

The use of alternative water sources is included in elite green building certification programs, such as the US Green Building Council's Leadership in Energy and Environmental Design (LEED) rating systems. The LEED for homes rating system offers points towards certification for integrating alternative water technologies into the home. Certification can offer clear marketing advantages to the builder. Achieving LEED certification can be viewed as a way to differentiate a homebuilder's product from the competition and demonstrate a mark of high performance to homebuyers (Dings, n.d., p. 1).

State and local governments have various programs and incentives to encourage the use of alternative water technologies. These programs and incentives are taking place in arid states, such as Arizona, New Mexico, and Texas. Incentives are typically in the form of tax credits cash rebates.

The State of Arizona offers individual tax credits to encourage the installation of 'water conservation systems.' Individual tax credits are offered to help cover the costs of installing a RWH or water reuse system in the home. Corporate tax credits are offered to builders to cover the cost of roughing in an auxiliary plumbing system (providing 'stub outs'). This auxiliary plumbing system will collect all sources of greywater and bring them to a central point, thereby enabling the installation water reuse at a later date (State of Arizona Department of Revenue, 2012, p. 1-3).

Tucson has taken the state's stub out program to the next level by passing an ordinance to make stub outs a building requirement. As of July 2010, all new residential construction must include stub outs for the future installation of greywater systems. At the same time, Tucson mandated that 50% of

commercial landscaping water be derived from RWH practices and technologies (Western Resource Advocates, 2010, p. 106). The City is also offering its own incentives for water conservation systems. Tucson Water is providing rebates to customers in single family residential homes for the installation of alternative water systems amounting to a maximum of \$200 for a GWR irrigation system, and up to \$2,000 for a RWH system (City of Tucson, 2012, p. 2).

The practice of rainwater harvesting is rapidly growing in the State of Texas. This rapid growth has been attributed in part to a rainwater harvesting organization that is very active in promoting the technology and lobbying government (see HarvestH2O, 2012). Professional recognition of leadership through industry Awards and financial incentives may also play a role.

The Texas Water Development Board hosts the annual Texas Rain Catcher Award "to promote the technology, educate the public, and to recognize excellence in the application of rainwater harvesting systems in Texas" (Texas Water Development Board, 2012, para. 1). The award eligibility is open to a broad range of individuals, businesses, organizations and public sector entities. According to the Board (para. 3), the benefit to recipients is public recognition, and enhanced reputation among peers in the RWH industry and in the wider development community.

As a financial incentive, Austin Water Utility is providing installation rebates to its customers to promote residential rainwater use. Rebates of up to a maximum of \$5,000 vary based on system capacity and the use of technology (\$0.50/ gallon for a non-pressurized system, and \$1.00/gallon for a pressurized system) (Austin Water, 2012, para. 1).

Several organizations in the USA have been established that support professionals in aspects around the implementation of alternative water technologies. Green Plumbers USA is a division of Green Plumbers formed in Australia in 2000 by the Master Plumbers and Mechanical Services Association of Australia (MPMSAA). Green plumbers USA offers professional accreditation to plumbing professionals, and training in a broad range of sustainable water applications, including water conservation, the use of alternative water sources, and alternative wastewater and stormwater management practices (see Green Plumbers USA, 2012).

The American Rainwater Catchment Systems Association (ARCSA) was established in 1994 "to promote sustainable rainwater harvesting practices to help solve potable, nonpotable, stormwater and energy challenges throughout the world" (ARCSA, 2012, para. 1) ARCSA offers certification and educational courses to industry professionals, as well as courses in the design, installation, and inspection of RWH systems. ARCSA is partnered with the IAMPO and offers expert advice on the Green Plumbing and Mechanical Code Supplement and the International Green Construction Code (see ARCSA, 2012).

4.5 SUMMARY

As demonstrated by the previous findings, WSUD, LID, and SuDs have been adopted by their respective governments largely in response to the need for better stormwater management practices. These practices have been integrated into development frameworks through policies, regulations, codes, and in the case of the USA, the setting of hard targets for post-construction run-off. Development requirements in Australia, and the USA have been the key driver behind the uptake of stormwater management practices by the building community. RWH has played a dual role of stormwater

management BMP, and a means to address issues of water scarcity and supply security in all three countries.

Water scarcity has driven the development of requirements to use alternative water sources within the home. Australian and UK governments have responded to periods of drought by implementing water usage restrictions. In Australia, Victoria's builders must substitute potable water with alternative water sources and adopt WSUD by code, and NSW builders must meet energy and water efficiency targets to obtain building approvals. In the UK, codified potable water restrictions mean that alternative water sources to supplement mains supply has become a *de facto* requirement in order to meet both allowable usage limits and household needs. In arid regions of the USA, where there is no blanket requirement for alternative water use, a public demand exists for ensuring personal supply and seeking immunity from the threat of municipal water restrictions. In one instance, local government has mandated the integration of alternative water systems into new construction requirements.

Various interventions and activities have been taken within the three countries that have reduced risk and uncertainty for builders around the adoption of WSUD and innovative water technologies. Interventions and activities have also encouraged and enabled uptake: enhanced codes and regulations have been introduced that have restricted municipal water usage and required developers to meet stormwater targets (leveling the playing field for the building community); clear guidance and around WSUD technologies have been developed for builders, trades, and building officials; incentives and rebates have been put in place; and professional organizations have been engaged in capacity building activities for building professionals and the alternative water industry at large.

Development and building requirements have furthered the uptake of WSUD and innovative water technologies. In the Australian state of Victoria, changes to the building code meant builders had to look at alternative sources for non-potable applications around the home and adhere to WSUD BMPs. Applications to council for development in New South Wales must be accompanied by a Basix certificate to demonstrate that home design will meet energy and water efficiency requirements. Building Regulation 17K in the UK set a hard target for per capita water usage in new home building at 125 lcd, setting the stage for the use of innovative water technologies. The US EPA and state governments set targets to meet post-construction run-off, which have become the most frequent driver for RWH.

Clear guidance on aspects of water sensitive development has been provided to the building community through development guidelines and technical standards in these three countries. A development document for high growth areas in Victoria provides guidance for developers on councils' expectations in applications for development using WSUD, standardizing requirements between councils so that general development expectations would exist from location to location. Victoria's code references technical standards, and is very clear about water conservation objectives, the integration of alternative water sources, and WSUD. Code in the UK clearly defines roles and responsibilities of building professionals, installers, and vendors with regards to RM and alternative water technologies, and references national technical standards for RWH and GWR technologies. The USA's green plumbing and mechanical code provides technical guidance and standards for alternative water technologies, reducing uncertainty among designers, installers, contractors, and inspectors of these systems.

In the USA, incentive and rebate programs for the installation of innovative water technologies have been led by state and local governments in Texas, New Mexico, and Arizona. Incentives include a 'stub out' tax credit in Arizona, a GWR irrigation incentive in Tucson, an installation rebate in Austin up to \$5,000, and a professional recognition opportunity with Texas Water Development Board's Texas Rain Catcher Award. Opportunities for enhanced marketability through brand recognition were presented

through the introduction of the USGBC's LEED rating system, and in the UK through the Code for Sustainable homes rating system.

Alternative water use is supported by the presence of various professional organizations within these three countries. In NSW, Landcom provides on the job sustainability training through a mentorship program. Organizations such as Green Plumbers in Australia and the USA offer education and training to building professionals in a number of water sustainability topics, including the installation of alternative water technologies. National RWH associations have been established in all three countries, and present education, training, and accreditation opportunities to building industry professionals. These associations promote RWH technology, and build capacity among trades and building professionals through knowledge and information transfer. These organizations provide a source of expertise for both members and code developers, and act as a communication vehicle for the RWH community.

4.6 CONCLUSION

Much can be learned from these three countries in their efforts to mainstream water sensitive development and integrate alternative water technologies into the home. Numerous interventions and activities identified in the research have the potential to reduce perceived and actual adoption risk among builders, and hold promise for application in Ontario.

Several factors identified that have the potential to reduce risk builder risk include the market leveling effect of enhanced building code requirements and advanced stormwater regulations for development sites. Furthermore, the provision of clear technical requirements by the governing authority, the patent communication of coordinated municipal design expectations, and the recognized roles and responsibilities of the parties involved can assist in smoothing out frictions occurring with SBP/WSUD uptake that contribute to adoption risk.

Other phenomenon identified in the research can encourage builders to overcome WSUD adoption risk. This encouragement can come through building certification and marketing opportunities, opportunities for professional recognition of leadership, the use of incentives to encourage builder uptake, and the presence of professional organizations that offer member support and champion the use of alternative water technologies.

Findings from this scan are combined with other research components in the report to determine how Ontario may benefit from these international examples. The following chapter, Interview Findings, also assists in uncovering next steps, opportunities, and areas for improvement in moving forward. Expert interviews identify an alternate set of program models and initiatives that may hold promise in encouraging the uptake of WSUD and innovative water technologies at home.

5.0 INTERVIEW FINDINGS

5.1 INTRODUCTION

This chapter provides an overview of results from interviews with twenty-four stakeholders within the development industry. The four groups of interview participants represent:

- Group A - Ontario builders and developers, and building professionals in leading international jurisdictions (international participation from expert in USA)
- Group B - Ontario building and green building organizations (international participation from experts in the USA and UK)
- Group C - MOE, MMAH, leading conservation authorities, and leading municipalities (international participation from experts in Australia)
- Group D - the Canadian insurance industry

Participants recognized a range of interventions and activities taken by government and industry that have encouraged innovation in relation to sustainable building and development practices. Various drivers and motivators behind SBP/WSUD uptake were identified, as well as a measure of the frequency in which WSUD elements were included in construction projects.

Within the interviews, participants identified and articulated builder risks associated with green building, sustainable building practices, and WSUD. Following this account, participants offered potential solutions to help builders and developers manage or overcome these risks. Experts considered the next steps for industry and government towards reducing builder risk and encouraging uptake. Finally, lessons learned from past experience were collected for potential application to advancing WSUD and innovative water technologies in Ontario. The information gathered in this chapter will be combined with findings in the literature review and jurisdictional scan for discussion in chapter 6. The focus of the first section is on activities and interventions that participants identified as having encouraged innovation in the building industry.

5.2 INTERVENTIONS AND ACTIVITIES THAT HAVE ENCOURAGED INNOVATION IN THE HOMEBUILDING INDUSTRY

Interview participants from groups A, B and C were asked to identify any form of interventions or activities by government or outside party that may have encouraged builders/developers to overcome innovation risk in new construction. Participant responses yielded a broad range of programs, initiatives, and incentives at home and abroad that encouraged innovative building practices. Five additional programs that are relevant to research objectives were not initially mentioned in responses to this question, but later surfaced in discussion. Programs and initiatives (see tables in Appendix F) have been categorized into the following groupings: building certification programs; technology feasibility/evaluation programs; product labeling/ certification programs; enhanced municipal stormwater requirements; provincial government initiatives; federal government initiatives; utility/service provider incentive programs; pilot development projects; contests; international initiatives; the development of guidelines; and opportunities for knowledge and information transfer. An analysis of the RM attributes of several of these interventions and activities and their potential to manage builder risk for WSUD uptake in Ontario is found in chapter 6: Discussion.

5.3 DRIVERS AND MOTIVATORS FOR SBP/WSUD IN NEW CONSTRUCTION

To better understand how to encourage WSUD adoption among builders and developers, the research seeks to identify the drivers and motivators behind adoption decisions. Determining these key drivers and motivators may assist in identifying where opportunities exist for encouraging innovation in the development community at large. Participants in the development community in Ontario and abroad, and members of Ontario and international building and green building organizations (participant groups A & B), were asked questions that explored the drivers and motivators behind the inclusion of sustainable building elements and WSUD elements in new construction projects. This section is a collection of their responses.

5.3.1 DRIVERS AND MOTIVATORS FOR GREEN BUILDING/SUSTAINABLE BUILDING PRACTICES

Several recurring themes emerged among participant responses in identifying drivers and motivators to the adoption of green/sustainable building practices. First and foremost, the primary driver for green building/SBP identified was economic. The economic driver in this case largely manifested itself in the form of a competitive marketing advantage, particularly with energy efficiency. Specifically, participants viewed more energy efficient homes as both advantageous in marketing and selling their products, but also a means to market and promote their organization. Participants made the marketing case for improving energy efficiency and other aspects of green building using the following points of reasoning:

Driver and motivators: consumer pressure

- Pressure to respond to growing consumer demand and the direction of the market
- Consumers are becoming more savvy and their expectations are changing with regards to energy efficiency and operational costs. There is increasingly higher demand for green building products and practices
- Homes are seen as a better quality product by homebuyers when recognized as high performance, energy efficient buildings

Drivers and motivators: organizational/reputational marketing advantages:

- Standing apart from the crowd, and keeping competitive
- Being recognized as a leader in the industry among peers
- Being recognized as better builders who produce a higher quality product
- Improving the marketability of their reputation and product; "a better story to tell" about the quality, performance, and environmental benefits of their homes over the competition (participant 8A)

In addition, building professionals spoke about the power of building certification (such as EnergyStar and LEED). Building certification labelling can be a powerful marketing tool, and adopting better building practices to pursue these certifications as part of standard operations can associate the company brand with brands the public associates with high performance and quality.

Despite the dominance of the economic driver and marketing motivator, other reasons for pursuing Green/SBP were also identified. One alternative builder who specializes in advanced sustainable building practices (participant 4A) even cited social and environmental considerations as his primary drivers. He notes that he was determined to promote SBP by using his projects to demonstrate to the building

community and the public that these innovative building practices are both technically feasible and economically viable at the same time as supporting social and environmental considerations.

Various motivators and reasons identified by the development community for engaging in Green/SBP spoke to an organization's internal objectives/concerns. These included:

- A sense of social and environmental corporate responsibility
- An interest in learning about new technologies and processes
- A need to keep up with the direction of the industry
- A desire to push the market forward
- A 'point of pride' in building green
- An approach to business logic: It makes sense to be a 'better builder' and produce quality homes
- An appreciation for sustainability logic: It makes sense to build something that consumes less resources
- A benefit to keeping ahead of the ratcheting up of building code requirements

One developer (participant 8A) involved in an expedited approvals pilot project to promote SBP/WSUD recognized the pilot as an opportunity to build goodwill between his organization and the municipality. He stressed the importance of goodwill in the development world, and felt that building a strong working relationship with the municipal approvals office would stand him in good stead for future development projects within this jurisdiction.

5.3.2 DRIVERS AND MOTIVATORS FOR WSUD ELEMENTS

According to participants, WSUD in Ontario has been primarily government driven and the focus has been on stormwater management. Only a limited number of municipalities, municipal officials and special interest groups have been pushing for water conservation above and beyond conventional programs such as municipal toilet replacement rebates. The role that RWH and GWR technologies play in achieving green building certification through programs such as the LEED rating system has been a minor private sector driver, and has occurred primarily in the commercial sector.

Opinions on drivers behind the inclusion of WSUD features in Ontario building projects (or lack thereof) were varied among experts. Several participants identified two factors which undercut water conservation efforts in the province, and would hinder the adoption of innovative water technologies such as RWH: the low cost of drinking water in Ontario's municipalities (5A, 1C & 7C) and the public perception that Ontario has an unlimited supply of fresh water (2D, 7C, & 21C). Participant 22B noted that certain places in the province experiencing water infrastructure challenges were most open to adopting water conservation technologies. Participant 21C saw water scarcity as a primary driver for builder adoption of alternative water sources in general, which was not perceived as an issue in Ontario: "The drivers are different depending where you are. In Ontario, where water seems plentiful, cost is an issue. In Alberta however, where water is scarce, cost ceases to be an issue when a developer faces not being able to develop their property at all." Participant 3C identified the pursuit of LEED certification as a driver for RWH in the commercial sector.

A number of participants found that the inclusion of WSUD stormwater management features on development projects were driven by municipal and provincial requirements (6C, 23A). Meeting municipal restrictions for stormwater runoff to receive site approval meant that several developers had to turn to using WSUD features over conventional methods to achieve heightened volume reduction targets (7C, 23A).

According to participant 6C, some builders, motivated by the potential for economic benefit, saw WSUD elements as an opportunity to reduce the size or eliminate the need for stormwater retention ponds on their developments. The advantage of having a smaller retention pond would free up additional land for housing, and reduce the costs of cleaning silt out of the pond before turning it over to the municipality.

5.3.3 DRIVERS FOR WSUD IN LEADING INTERNATIONAL JURISDICTIONS

Based on participant responses, WSUD uptake has been driven by numerous factors in the USA, Australia, and the UK. Water sensitive development has been driven by the economics of conservation, public awareness, water scarcity, and the negative environmental externalities of conventional stormwater management. Builder and developer uptake in these three countries has been led by both market demand and government regulation.

According to one participant from the development community in the Pacific Northwest US (16B), WSUD has been widely accepted in both water conservation and stormwater management. Energy prices are very low in this area and water constitutes a higher portion of a homeowner's utility bill. For this reason, water conservation has become a selling point to potential homebuyers. In addition, the local public is highly aware of the negative impacts that development can have on the aquatic environment caused by pollutants in stormwater runoff. The adverse effect that runoff is having on the local salmon population is a highly publicized issue, and increased public awareness has resulted in WSUD stormwater elements also becoming a selling point.

Several factors are driving the uptake of WSUD elements in the UK's development community. These drivers include conservation of the public water supply, and stormwater management requirements where post construction runoff rates must meet pre-development runoff rates. According to participant 24B, water usage restrictions in the building code and stormwater management requirements, "means that using RWH technology on new homes and commercial premises is now virtually a given."

In Australia, the development community's adoption of WSUD was driven through government legislation. One participant in the Melbourne area explained that WSUD was mandated on a state level because of the serious algae problems that were occurring in Port Phillip Bay as a result of pollutants and nutrients entering waterways through stormwater runoff. According to participant 7C, the State of Victoria changed the rules for development so that runoff would have to meet BMP targets for water quality before it could be discharged into receiving waterways. The only stormwater management technique that could make the achievement of these targets possible was WSUD.

In Victoria, water conservation efforts such as rainwater and stormwater harvesting initially came as secondary to the water quality drivers of WUSD. According to Participant 7C, the installation of WSUD features that harvested stormwater served as a method to manage runoff quality by removing rain and runoff from the system altogether. These features became an asset, however, in times of drought where municipal supply in Melbourne was down to near a quarter of normal capacity. When water scarcity became an issue, public appetite for alternative water sources rose dramatically. At this time, the demand for alternative water technologies in the home rose accordingly.

5.4 PERCEIVED RISK AND INNOVATIVE WATER TECHNOLOGIES IN ONTARIO

Understanding risk perception around the use of innovative water technologies in Ontario is a key aspect of this research. This understanding is important in considering solutions specific to the province. Therefore, it is necessary to identify risk perceptions among members of Ontario's building community and key players in the development process. To accomplish this task, interview participants were asked to identify builder/developer risks that they associated with the incorporation of alternative water technologies in new home construction, such as RWH and GWR. Participants were presented with Marsh's top 10 perceived risks of green building, and asked to identify applicable builder/developer risks within the broad categories. They were also asked to identify any other risks that came to mind outside these ten areas.

Below are the risks and concerns they identified, presented within the Marsh framework. Included in the risk categories are: brand and competitive edge/reputation; consultants/ subconsultants and subcontractors; education; financial; performance; regulatory; return on investment; standard of care/legal; supply chain; technology; and other risks.

5.4.1 BRAND AND COMPETITIVE EDGE/ REPUTATION

The main concerns of participants surrounding WSUD elements in new construction projects centred on the failure of these elements to function properly or to meet homebuyer expectations. This failure could have potentially damaging effects on the reputation of the developer/builder, even though it may be through no fault of their own. A damaged reputation could lead to loss of business, thus financial losses. While numerous participants referred to reputational damages stemming from poor technical performance of WSUD features (4A, 14C, 15C, 17C, 19B, 20B & 22B), one participant raised concerns about failure of these features to meet homeowners' return on investment expectations (9A). If the ROI was used as a selling point for including a technology, failure to meet payback and ROI expectations could also prove damaging to a builder/developer's reputation.

5.4.2 CONSULTANTS, SUBCONSULTANTS, AND SUBCONTRACTORS

Risks associated with the availability and competence of consultants, subconsultants and subcontractors were less of an overall concern amongst participants; however, several felt that the capacity of the industry in Ontario for designing, installing and supporting RWH and GWR systems was lacking (3C, 17C, 20B, 21B). Furthermore, these participants acknowledged that Ontario's designers and installers did not have adequate experience with these systems.

5.4.3 EDUCATION

Risks due to lack of awareness and education on the part of building industry stakeholders at large resonated with quite a few participants (1C, 3C, 4A, 8A, 9A, 13A, 10B, 19B). Some felt very strongly that this was one of the biggest issues surrounding WSUD. Lack of experience working with the technologies, not having a firm grasp on what WSUD really is, or how WSUD stormwater measures work. Lack of awareness and education was identified as a problem for all parties in development in that it was identified as a problem on the part of construction and development professionals, but also on the part of municipal governments, municipal planning professionals, building officials, building inspectors and with the homebuyer.

5.4.4 FINANCIAL

Most participants recognized that there were a broad set of financial risks of including innovative water technologies to consider in the home. For example, one participant explained the financial risk of time

delays to builders/developers. Time plays an important role in opportunity cost because the time taken up by a delay could have been used in another way to promote business interests. Delays also increase the builder's exposure to potentially volatile housing markets (participant 8A). Several participants discussed the relationship between time and money and its effect on profitability and stressed the importance of shortening the overall process from municipal approvals to construction and sale of homes.

Financial concerns to the builder and developer about including innovative water technologies in the home included the following:

- Financial damages resulting from failed technologies (4A, 17C)
- Callbacks for troubleshooting/ repairs taking time and adding potential costs to business (4A, 14C, 17C)
- Time risks resulting from a lengthy approvals process (6C, 8A, 11C, 16B, 17C)
- Time risks, and financial costs resulting from an alternative solutions¹⁰ approvals process (4A)
- Extra costs involved in the permitting process (11C)
- Economic losses occurring from building something consumers don't want/ didn't ask for (7C, 9A, 16B, 17C, 19B, 22B,)
- Extra time required because it's a green project (time to educate all the parties involved) translating into higher costs to the builder/developer (23A)
- Extra costs for implementing the technologies (21B)
- Increases in the cost of the home and the applicable taxes to the homebuyer, leading to decreases in saleability (10B)
- Having to take the time to educate/re-educate the homeowner on the technology, which takes up company time (16B)

Of the concerns mentioned in the financial risks categories, the three most prevalent included the potential for callbacks, the marketing risk of trying to sell features of little, no, or negative perceived value, and an onerous and lengthy approvals process. Increases in time required for regulatory processes was perceived as an increase in risk exposure to changes in the market, as well as a detriment to the profitability of the project/ organization.

5.4.5 PERFORMANCE OF RWH AND GWR TECHNOLOGIES

Major concerns about the performance of RWH and GWR technologies stem from post-occupancy operations and maintenance, and occupant behaviour. Other concerns that arose were the question of long-term performance of these technologies, and the greenwashing of various products due to lack of third party verification.

Participants felt that maintenance requirements for alternative water source technologies would be an issue for homeowners as these systems require more attention than conventional plumbing systems. GWR technology was identified as having particularly demanding maintenance requirements, and participants felt that homeowners would not be able to manage the maintenance (5A). Several participants raised the point that homeowners have a very limited capacity to perform even minor

¹⁰ Alternative solutions is a process enabled by the 2006 OBC whereby builders can present municipal planning departments with alternative approaches to design and construction from those prescribed in the code. The alternative solution may be accepted or denied at the discretion of the municipal planning department.

maintenance tasks. These participants referred to a common homeowner inability to accomplish the basic task of changing the dust filter on their furnaces.

Occupant behaviour was a concern for participant 21B with GWR technologies in particular, because of the wide range of demographics the system may be exposed to. The broad range of potential water usage requirements, and the wide variety of potential chemical/biological inputs to the system could seriously test the tolerances and design capacity of the technology. The usage of GWR technologies over a broad demographic could have variable outcomes, including adverse effects on system performance. Failure of these technologies due to overloading of design capacity, lack of or improper maintenance on the part of the homeowner, or failure of the system to meet homeowner expectations in various ways can pose a number of risks to the builder/developer (such as reputational damages, or callbacks) and ultimately lead to financial loss.

5.4.6 REGULATORY

Concerns around the approvals process and code compliance were at the forefront. These included:

- Ignorance within the building community around code and guidance for innovative water technologies in the home (1C)
- Inconsistent municipal approval requirements; different requirements to be met from one municipality to the next (3C, 7C)
- Inconsistent knowledge of WSUD stormwater measures by building officials (7C)
- Inconsistent level of education amongst building inspectors regarding new technologies and processes (19B)

Numerous participants saw the approvals process as a major drawback to WSUD and innovative water technologies in new construction, with either the perception that it was too lengthy, or there were "too many regulatory hoops to jump through to get these things implemented" (Participant 21B). The additional time and added requirements to incorporate these elements were a disincentive and posed additional financial risk.

5.4.7 RETURN ON INVESTMENT

Several participants voiced concerns about the ROI of including WSUD technologies as a standard feature in new builds. Their concern is that builders/developers would not recoup the capital and installation costs of the new technology from the sale of the home (8A, 16B, 20B, 22B). These participants questioned the added value of a RWH or GWR system from the homebuyer's perspective. Some participants even felt that including these technologies might negatively affect the home's saleability by including features that homeowners didn't particularly want, thus putting the builder/developer at a competitive disadvantage (7C, 10B).

5.4.8 STANDARD OF CARE/ LEGAL

According to several participants, there is much uncertainty about the standard of care and legal liability surrounding WSUD technologies, specifically the use of alternative water sources in the home. One concern arose from discussion around operations, maintenance, and performance; the fear that the builder/developer would be held liable for damages caused by a system that was improperly maintained by a homeowner (1C, 21B). An additional concern raised was uncertainty around the effects of these technologies on housing warranties (10B).

Health and safety concerns were also at the top of several participants' minds (5A, 7C, 14C). There is a potential health risk with RWH and GWR that occupants can become ill if they are exposed to contaminated water sources, or alternative water sources that are below an acceptable water quality. Several questions around health and safety concerns and builder liability arose during the interviews: If a subcontractor installing a RWH or GWR system accidentally makes a cross connection between the potable and non-potable plumbing lines and someone becomes ill as a result, who is responsible? If a homeowner tampers with the system, makes a cross-connection and someone becomes ill as a result, how will builders/developers be affected?

On the stormwater side, participant 6C brought up the lack of a design standard by the MOE for WSUD stormwater features as a standard of care issue. He advocated for the updating of MOE's 2003 Stormwater management planning and design manual to clearly address LID design standards, and felt this was critical in helping developers feel comfortable in turning to LID for stormwater management solutions.

5.4.9 SUPPLY CHAIN

Participants noted supply chain risks in the use of alternative water technologies, particularly in the lack of support available for the maintenance of these technologies. Participant 4A explained that there are no maintenance professionals to support the GWR systems that his company has installed, so when a problem arises with one of his clients' systems, he has to take care of it himself. Having to fulfill this role diverts his efforts away from work that is higher value to the company. Several participants commented on the lack of availability or variety of products, and the lack of external support to install and service them (5A, 17C, 20B). Participant 20B viewed the supply chain risk to be a major stumbling block for WSUD technologies in production building, where a high level of capacity is required of vendors and installers to supply and service a typical housing development, and to provide replacement parts.

5.4.10 TECHNOLOGY

Several participants voiced concerns that the technologies were not sufficiently evolved (particularly GWR), and that these systems hadn't been properly vetted. Participant 21B remarked that these technologies were new in Canada, and that use of GWR systems across Canada was "patchy". Other apprehensions about the technology included:

- Most RWH systems were designed for warm climates that didn't experience freezing temperatures, which is quite different from conditions in Ontario (7C)
- Questions about the reliability and robustness of the technology were raised (5A, 17C, 18A)
- The time and expense of having to replace failed technology (4A)
- Lack of a 'package plan' for RWH technologies (i.e. RWH technologies- cisterns, pumps etc.- are not sold together as part of a system package, or are not necessarily 'plug and play' in nature); they are all custom designed in Canada, and designers are not very experienced (21B)

These participants saw lack of third party verification, certification, or quality assurance of these technologies as a risk to the builder/developer.

5.4.11 OTHER RISKS

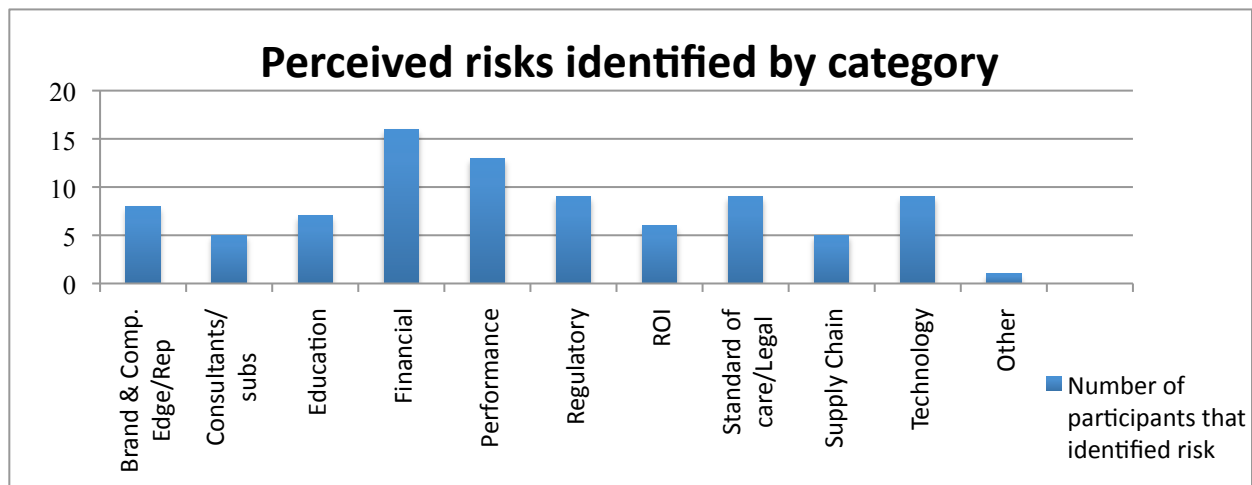
One other risk dynamic was identified in addition to the preceding risk categories that may be exclusive to forms of residential development: emotional risk. One participant touched on the emotional attachment that people have to their homes, which is unique over other forms of new construction. The personal nature of home ownership can lead to heightened homeowner expectations in new housing.

Participant 20B felt that due to a homeowner's "emotional investment" in their home, when problems arise the "blowback is much greater than in commercial construction." In this way, the emotional risk may serve to heighten builder apprehension around adoption decisions.

5.4.12 PERCEIVED RISKS IN REVIEW

Reviewing risk concerns identified in the interviews around the adoption of innovative water technologies yielded some interesting results. Financial and performance were by far the two most frequently identified categories of perceived risk among participants. Regulatory, standard of care/legal, and technology concerns were tied for third place. Figure 1 shows the number of participants who identified at least one type of risk in each of the ten broad categories. Recall that risks do not exist in isolation, and that linkages exist between risk categories. Therefore, caution should be used in any interpretation of these results.

FIGURE 1: PERCEIVED RISKS FOR ALTERNATIVE WATER TECHNOLOGIES IN NEW HOMEBUILDING



**Risk categories adapted from Marsh (2009)*

5.5 GROUP A PROJECTS: INNOVATIVE BUILDING PRACTICES AND BUILDER RISK

In this section, the research takes a closer look at RM strategies that have been successfully employed by the building community to overcome innovation risks on projects. Participants in Group A, builders and developers, were asked to identify the types of innovative building technologies and practices they have incorporated into a specific building project, and how they overcame risk to include those elements. Innovations spanned from the use alternative energy and heat sources to structural innovations such as strawbale walls and Insulated Concrete Forms for foundation walls (ICFs). WSUD design elements included RWH, GWR, permeable paving, rain gardens, bioretention swales and artificial wetlands for the treatment of greywater. It is important to note that the risk context was slightly different in each of these scenarios; there was no benchmark scenario/project type in this case. Responses regarding risk management techniques varied considerably among the participants:

- Participant 9A incorporated a GWR system as an option in new homes. He explained that because the GWR system was offered as an option, that the homeowner assumed the risk after purchasing

- Participant 23A included permeable pavement on the driveways of lots in his development. He explained that he was meeting the stormwater requirements of the municipality, and that the costs of including stormwater features such as these were passed on to the end user
- In the case of participant 4A, the risk for incorporating strawbale construction, RWH, GWR, and artificial wetlands in his project was wholly assumed by himself as the builder, and risk management relied on his expertise
- For participant 18A, the risk was assumed by the subcontractor performing the installation of the innovative structural component
- Participant 5A was involved in a pilot project, which introduced innovative water technologies into a limited number of new homes. He felt that collaboration helped everyone involved in the pilot to feel more comfortable assuming the risk for their own specific responsibility within the partnership
- Participant 13A, who managed the construction of WSUD stormwater features on a large project, responded that there wasn't much risk in a pilot "if you're clear and upfront about educating people".

5.6 GROUP B: THE FREQUENCY OF WSUD ELEMENTS IN PROJECT DESIGN FEATURES

One of the research objectives of this study was to determine the frequency of and reasons for including WSUD elements in building projects. To further this research objective, Group B, Ontario building organizations, were asked to comment on the frequency of inclusion of WSUD elements within the sustainable building features of projects, and the motives for inclusion. Responses to this question were limited.

Three participants (16B, 19B, 20B) spoke of water conservation within the context of green building certification programs, and noted that water conservation was a key element within these programs. Alternative stormwater management and the use of alternative water technologies, however, did not fall within the scope of typical residential programs (20B).

Participant 16B in the NW United States identified RWH use among 5% of total participants in a green building program, whereas total participant using WSUD stormwater elements ranged between 30-50%.

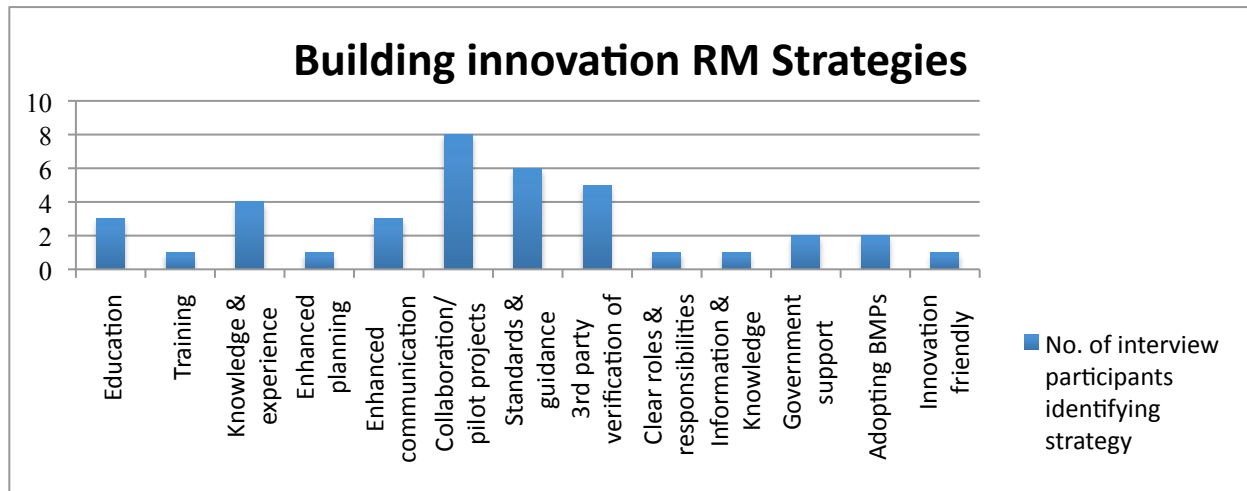
According to participant 19B in Kitchener, Ontario, of approximately 1,000 new residential permits issued per year less than 1% incorporate WSUD features. This person noticed, however, that WSUD features were "starting to gain momentum."

Participant 20B remarked that water was about 6 to 10 years behind where energy efficiency is now in Ontario, and although "the building industry is willing to adopt practices and make changes, ...[it] doesn't feel a strong need to yet." For this reason he felt that the industry will only adapt minor changes regarding water conservation.

5.7 IDENTIFYING RISK MANAGEMENT STRATEGIES

Throughout the interview process, participants were asked to draw on their experience, and share effective methods for reducing risk that might be applied to overcoming SBP and WSUD adoption risks. A wide range of RM strategies were identified to address a broad scope of potential risk exposures. Responses were broken down into general RM strategies for presentation and analysis in the report. RM strategies included: education; training; the involvement of knowledgeable and experienced personnel; enhanced planning for projects; enhanced communication within projects; collaboration among parties in projects; the presence of technical standards and guidance; 3rd party vetting and verification of technologies; the establishment of clear roles and responsibilities; opportunities for information and knowledge transfer; government support; 'being a better builder' and adopting current best practices; and the presence of an innovation-friendly approvals process. Figure 2 shows the number of participants that identified each of the strategies. A detailed account of these strategies can be found in Appendix G.

FIGURE 2: STRATEGIES TO MANAGE INNOVATION RISK



Through their responses, Group A participants (builders and developers) emphasized the importance of knowledge and experience, enhanced communication between stakeholders, and the benefits of collaboration as key areas where risks could be managed. Group B participants (building industry associations) highlighted the need for standards and guidance around innovative technologies and process, the importance of third party vetting and verification of products and technologies. Group C responses emphasized the importance of opportunities for collaboration, standards and clear guidance for the building community, third party verification of technologies, and government support for innovative projects. Group D (insurance professional) did not see any viable way to reduce the fundamental economic risk of trying to sell technologies where no market demand exists.

Various incentives were also mentioned during the interviews as a way to encourage innovative building/development practices. Three participants identified expedited approvals processes as a way to reduce builder risk and provide an incentive to adopt building practices. Participant 20B identified development charge rebates as a way to promote water efficiency in housing development. Participants 22B and 16B identified cash incentives as effective in achieving builder uptake, and 16B claimed marketing incentives through increased publicity as another form of incentive.

5.8 NEXT STEPS FOR INDUSTRY AND GOVERNMENT TO OVERCOME BUILDER RISK

Participants identified a wide range of 'next steps' for industry and government to help encourage builders to overcome WSUD adoption risk. Throughout the responses, a number of interventions and activities were geared specifically towards government. Conversely, next steps were also identified with no principal agent in mind. Recommended activities and interventions were broadly organized into a number of categories including: building code and regulatory changes; the approvals process; education, training and capacity building for building professionals; developing technical guidance and standards; public education and awareness; incentives to builders; providing opportunities for pilot projects; strong government leadership; and changes in municipal water pricing.

5.8.1 BUILDING CODE AND REGULATORY CHANGES

Several participants felt that the Government of Ontario should 'level the playing field' by creating regulation that forces builders to develop using WSUD stormwater management techniques (participants 2D & 15C). Others felt that the MMAH needed to 'raise the bar' with regards to water conservation in the OBC (participants 14C & 15C). It was felt that such regulatory responses would further the uptake of WSUD and innovative water technologies while affecting all builders/developers equally.

A contrary theme that arose with several participants around building code and increasing requirements is the model of continuous improvement - the 'stepping up' of building requirements over time (participants 10B, 16B, 20B, 22B, 11C & 12C). These participants felt that the stepping up approach was a more manageable model for improving the state of building, which allowed builders time to adapt to change. Participants 10B, 11C & 12C credited the successful evolution of the Energy Star program in Ontario to this approach. They believed that code amendments should not outpace the capacity of builders and supply chain to adapt.

In addition to building code changes, regulatory development was seen as a way forward for WSUD. Participant 1C felt that the province needed to push ahead with regulations under the Water Opportunities Act (the WOA has empowered the development of regulations, but no regulations currently exist at the moment). The province should develop and implement the municipal water sustainability planning regulation under WOA to push municipalities to make a detailed assessment of their infrastructure, and help them see the need for WSUD. This revelation could bring municipal decision-makers, planning and approvals personnel onside.

Participant 7C stressed the importance of partnership and co-operation of government and industry in the development of regulations and standards so as to ensure the feasibility of WSUD implementation. He was wary of unilateral action by regulatory bodies that would result in requirements that the industry could not meet. Participant 21B felt that in order to help builders, the province should ensure that regulations for alternative water use are not onerous, are realistic, and are sensible to all parties.

Another important next step raised in the discussion of alternative water technologies in new housing was the need to resolve issues with homeowner operations and maintenance. According to participant 21B, regulators need to determine the appropriate management model for alternative water systems in the home (i.e. will the technology be owned and maintained by organization other than the homeowner, like a water heater or water softener?). Once this management model has been well established, municipal officials would become more comfortable with approving these technologies and they would begin to streamline the approvals process.

5.8.2 THE APPROVALS PROCESS

The need to revise the approvals processes to encourage SBP was a recurring theme amongst participants. Lengthy or uncoordinated approvals processes were identified as a barrier to SBP and WSUD, and a source of various types of risk. Participants identified risk aversion among building officials as a contributing factor to slower than normal approval times for non-conventional projects. Activities and interventions that could reduce this risk aversion and increase building officials' capacity and comfort level with approving SBP/WSUD is one area where participants felt steps could be taken. Improving training and education for municipal building officials and industry stakeholders, developing clear technical guidance and standards for developers to follow, and standardizing requirements between municipal approvals processes were viewed as components of the solution.

5.8.3 EDUCATION, TRAINING AND CAPACITY BUILDING FOR BUILDING PROFESSIONALS

Participant 19B remarked on the need for education and cultural shift of building officials, and felt that they should be proactive in learning new and innovative technologies or approaches to building so that when they receive a request for something new or innovative they would have background knowledge or be more open to looking into it. He added that continuing education should be provided by the applicable professional organization.

Participant 20B believes that building organizations need to engage in capacity building through education and training, self-assessment, consultation with experts, and potentially programs such as NRCan's LEEP & TAP. This position is similar to that of Participant 19B, who feels that the industry needs training in new technologies and processes, which could come from either the province, the Federal government, or from the manufacturer of the new technology itself.

5.8.4 DEVELOPING TECHNICAL GUIDANCE AND DESIGN STANDARDS

Several participants (3C, 6C, 7C, 11C, 12C, 22B) emphasized the importance of providing the building industry with technical guidance and design standards around WSUD elements, and saw this as an important next step in removing uncertainty around the technologies and processes for builders and building officials. According to participant 3C, all levels of government and industry need to come together to create standards for the design and construction of acceptable SB/WSUD practices and technologies and "harmonize requirements" between municipalities to remove the uncertainty around the approvals process from location to location. 3C felt that the builder/developers were willing to incorporate various features, but wanted standardization and consistency in municipal approvals.

5.8.5 PUBLIC EDUCATION AND AWARENESS

Raising public awareness around water sustainability issues was also seen by participants as a next step for industry and government to take towards reducing builder risk. Participant 8A stressed the importance of education of the industry and the public, and saw building associations as well positioned to fill this role. Participant 23A felt that education of the public was an issue with SB products/technologies in general: Public knowledge must be increased so that they may recognize the benefits, and develop a willingness to pay for the premium associated with these types of features. Participant 9A felt that government needed to take steps to raise the profile of alternative water sources technologies. Participant 20B called on the government to help consumers and homebuyers see the value of a builder who is "doing things better". Participant 2D also called on the government to provide education for the public about the effects of climate change on infrastructure.

5.8.6 INCENTIVES TO BUILDERS

Several participants saw government incentives as a means to encourage builders to overcome risk. Possible incentives identified in the interviews took various forms, such as marketing incentives, rebates on development charges, tax incentives, and expedited approvals. Participant 10B felt strongly that there needs to be a benefit to builders for adopting WSUD practices to justify the added cost, whether it be an expedited approval, or greater density level on developments. Participant 20B suggested providing a rebate for development charges based on percentage water savings achieved by the new housing development over current code requirements. Participant 17C envisioned municipal incentives within various forms of collaboration, such as an expedited approval, changes in the structure of development charges, or recognizing and promoting current innovators to increase their visibility within the marketplace. Cash incentives were described by participant 16B as a great way to get builders over the "initial hurdle" and start a "chain reaction" of adoption amongst peers. Participant 22B shared similar thoughts, and described cash incentives as a "wonderful catalyst" that rapidly generate a "ton of excitement".

5.8.7 INCREASING OPPORTUNITIES FOR PILOT PROJECTS

Several people saw the development of more pilot projects and field tests as a priority. Participant 5A felt that pilot programs were a good way to get businesses and local suppliers involved. Participant 6C shared a similar viewpoint, and felt that increasing the local installation of WSUD stormwater features- "getting these things in the ground"- was critically important to increasing people's comfort level with these practices. Participant 14C stressed the importance of continuity of pilot projects such as those under the Showcasing Water Innovation fund. He called on the province to expand on the SWI program and ensure its future funding.

5.8.8 STRONG GOVERNMENT LEADERSHIP

Participants felt that the Provincial government needed to exert stronger leadership in developing SBP/WSUD in Ontario. Participant 1C believes that the province needs to take a stronger position on sustainable development, prioritize, and set a clear direction for Ontario in pursuit of SBP and WSUD. Participant 4A also felt a need for greater leadership, and that Provincial and municipal governments need to become more open to building innovation. Another building professional saw room for improvement in the way governments have engaged Ontario's construction professionals. According to participant 20B, governments need to engage with the building industry in a spirit of good faith and collaboration, and acknowledge that the concerns of industry professionals are legitimate, and that the risks are real.

5.8.9 CHANGES IN MUNICIPAL WATER PRICING

The subject of municipal water pricing was raised repeatedly throughout discussion around mainstreaming alternative water technologies. Water pricing was discussed because of the influence that it has on the demand for water conservation technologies, as well as its effects on the ROI and payback period for investing in these technologies. According to participants 1C and 7C, municipal governments should integrate full cost recovery¹¹ for water services into their municipal water pricing. 'Cheap water' is why developer 5A believes that RWH will never take hold in production subdivisions. Participant 21B believes that increasing municipal water prices would help create a market demand for alternative water technologies.

¹¹ Raising the price of municipal water services to meet or the cost of operations and maintenance of water infrastructure (Ontario Ministry of Finance, 2012, p. 322).

5.9 LESSONS LEARNED WITH SBP/WSUD

Following next steps, participants were asked to share any general 'lessons learned' with SBP/WSUD that might help government, industry associations or other building officials in assisting builders to overcome risk. Participant responses ranged from general to specific in scope. These lessons address topics such as innovation, risk management, advice specific to SBP/WSUD, or in some cases advice about building practice in general. A full account of lessons learned can be found in Appendix H. Key lessons include the following:

- Ensure that the technologies being used in a program are well vetted and that the supply chain is in place for support. Should the technologies or products fail, critics will highlight and dwell on this failure (16B)
- When pursuing a project with SBP/WSUD, start the process early- it takes more time to receive approvals and to educate all the parties involved in the project (23A)
- Innovation in the building industry is a path of continual improvement. If builders adopt a path of continual improvement over time, they become better builders and reduce their risk (20B)
- Programs have to make sense to builders: If they are too complicated or costly, they will not participate (20B)
- It is better to have wider market penetration and shallower savings in energy efficiency/ green building programs than requirements that are too steep (20B)
- Regular, high quality communication between parties in a project is very important, and saves time for all parties involved (15C)
- People don't want to pay for things they can't see (i.e. building features hidden within the structure of the house) (22B)

5.10 CONCLUSIONS

The findings in this chapter provide a largely Ontario centric portrayal of the perspectives of building professionals, and other key actors in the development process. Information gleaned from the interviews sheds light on risk perceptions around adoption in the province's building community, and potential methods to overcome risk aversion. Findings in this chapter promote the research objectives, and contribute towards resolving the main research question and subquestions.

Responses from the interviews support the findings in the literature review. Potential interventions and activities identified by participants draw parallels to those implemented in leading jurisdictions. The following chapter brings together the findings of the literature review, jurisdictional scan, and interview responses to formulate discussion around potential solutions. This discussion provides the foundation for conclusions and recommendations.

6.0 DISCUSSION

6.1 INTRODUCTION

An exploration of relevant bodies of literature, a jurisdictional scan of countries leading in WSUD, and interviews with players in the development industry have identified numerous RM themes to leverage for overcoming perceived and actual risk. An examination of various motivators for the adoption of innovative technologies and processes within construction projects has looked to the reasoning behind the inclusion of those specific to water. An exploration of the context in which innovation is occurring at home and abroad has provided insight into what directions may prove promising in managing innovation risk and furthering WSUD and alternative water technologies in Ontario. With the broad base of information found in the research, the report now sets about the task of determining how Ontario can benefit from these findings.

6.2 REVIEW OF KEY FINDINGS: LITERATURE REVIEW AND INTERVIEWS

6.2.1 DRIVERS FOR SBP AND INNOVATIVE WATER TECHNOLOGIES

In this research, it was found drivers for builder adoption of SBP and WSUD in international jurisdictions were created, for the most part, by government imposed regulations and building requirements. These interventions and activities applied to the entire building community, and constituted a 'level playing field' approach to promoting policy objectives. Regulations and requirements were structured in a manner where no builder would have a market advantage over any other as a result, and the imposition of sweeping requirements would have a mitigating effect over various types of adoption risk. Yet the circumstances are different in Ontario and current development requirements do not require the adoption of innovative technologies to meet aggressive efficiency/ BMP targets.

Drivers for the adoption of green building practices identified in the interviews of Ontario building industry stakeholders spoke to both marketing advantages and organizational objectives. Interestingly, key motivators were found to be market driven. The interview participants spoke about the need to keep up with consumer awareness and market trends and the association of increased energy efficiency with quality. Underlying the adoption of these green building technologies is consumer awareness, and market appetite. The same awareness and appetite found around energy conservation in green building, however, does not extend to water conservation because consumer awareness around water sustainability issues in Ontario is low (Royal Bank of Canada, 2008 p.1; 2012 p.1). Contributing to this lack of awareness is the cheapness of potable water, which serves to undermine investment in water conservation (5A, 7C & 21B). In discussion with participants about advanced water efficiency, findings indicate that market demand is virtually non-existent for innovative water technologies in Ontario, with the fringe exception of custom builds (4A) and fulfilling requirements for elite green building programs (3C).

One participant credited lack of market demand for these technologies with the perception of plentiful water sources in Ontario and the prohibitive cost of the system (21B). Another developer, recognized as a leader for experimenting with innovative building practices and use of alternative water technologies, stated that RWH would never take hold in mainstream housing development due to the current cheap cost of water and lengthy payback period of the system (5A).

Internal organizational objectives for adopting green building practices spoke to point of pride, environmental and social ethic, being recognized as a leader in the industry, and keeping ahead of the 'ratcheting up' of building code requirements. Discussion around 'riskier' sustainable building practices (such as RWH, or the use of straw bale construction) appealed more so to these organizational objectives. In lieu of the economic drivers for adoption of such innovations, findings suggest that this alternate set of organizational objectives should be a key area of focus in seeking interventions and activities to overcome builder risk aversion in new housing projects.

6.2.2 ADOPTION RISKS AND RISK PERCEPTIONS

Looking deeper into risk perceptions allowed interview participants to articulate risk concerns around the adoption of alternative water technologies into new housing projects. An assessment of innovation risk perceptions of Ontario building industry stakeholders found that the number one category of risk concerns among participants was financial. Performance risks came in at a close second and regulatory, standard of care/legal, and technology risks were third.

Financial concerns included market risks, increased time for approvals and other adoption aspects, the potential for callbacks, and costs of fixing or replacing failed technologies. Performance concerns looked to an inability of homeowners to maintain the systems, uncertainty around long term operation of the technologies, and the potential for reputational damages and other liabilities stemming from performance issues. Regulatory concerns focused on the inconsistency in the level of knowledge amongst building officials on innovative technologies and processes, the onerous task of getting approvals for innovative features, and inconsistencies in municipal expectations across jurisdictions. Standard of care/legal concerns included potential liability for risks to homeowner health and safety, and liability for damages caused by poor maintenance or tampering with the system. Technology concerns spoke to apprehension around system design, lack of a 'package plan', and the robustness of the technologies, and their ability to perform in a cold climate.

Reducing these concerns could be an important first step in encouraging the uptake of innovative water technologies in new residential development. The following section highlights RM interventions and activities found in the literature and interview responses that could be applied to overcoming various forms of innovation risk in Ontario.

6.2.3 MANAGING ADOPTION RISK

A number of interventions and activities were identified in the literature and interviews, which could be applied to managing various forms of builder risk. Several methods to encourage builders to overcome potential risks were also identified. These findings are highlighted in Table 5 below.

TABLE 5: INTERVENTIONS, ACTIVITIES AND TOOLS OF ENCOURAGEMENT

| Interventions and activities to reduce innovation risk found in the literature and interviews | |
|--|--|
| <ul style="list-style-type: none"> • Education and awareness • Training • Experience and knowledgeable personnel • Enhanced planning • Enhanced communication • Collaboration • Updated development standards | <ul style="list-style-type: none"> • Technical standards and guidance • 3rd party verification/ vetting of technologies • Clear roles and responsibilities • Documentation of expectations • Knowledge and information transfer • Government support (pilots/R&D) • Innovation friendly approvals processes |

| Additional interventions/ activities (Literature) | Additional interventions/ activities (Interviews) |
|---|---|
| <ul style="list-style-type: none"> • Developing standard protocols for product testing • Supply chain management | <ul style="list-style-type: none"> • Adopting BMPs into business practices; 'be a better builder' and stay ahead of Code |
| Tools to encourage innovation adoption identified in the literature and interviews | |
| <ul style="list-style-type: none"> • Cash incentives and rebates • Development incentives and rebates • Risk-recognition | <ul style="list-style-type: none"> • Enhanced marketing opportunities • Product certification labeling |

In moving forward, discussion will refer to these interventions and activities when analyzing RM characteristics of potential solutions for Ontario and their ability to address identified risk concerns.

6.3 REVIEW OF KEY FINDINGS: JURISDICTIONAL SCAN

In a review of jurisdictions leading in water sensitive development, various conditions exist in these countries that have created a favourable environment for the adoption of innovative water technologies: Water scarcity; the need for better stormwater management practices; strong government commitment to water conservation through development requirements; support, education and training for professionals; technical and design standards; the presence of professional RWH trade organizations; and market demand for technologies. Combined, these conditions serve to reduce uncertainty in adopting alternative water technologies. A review of these enabling conditions can be seen in Table 6:

TABLE 6: ENABLING CONDITIONS FOUND IN LEADING JURISDICTIONS

| Enabling conditions for RWH found in jurisdictions leading in Water Sensitive Development | |
|--|---|
| Australia | |
| <ul style="list-style-type: none"> • Strong government commitment to meeting stormwater and other sustainability objectives • Development requirements for alternative water use through building code • Education, training, guidance and technical support for innovative technologies from Landcom's 'sustainability supervisors' | <ul style="list-style-type: none"> • Professional training specific to alternative water technologies by trade organizations • Established professional organization to represent the RWH industry, to develop BMPs and provide technical support to practitioners • Harmonized municipal requirements for WSUD features and streamlined approvals processes |
| UK | |
| <ul style="list-style-type: none"> • Strong government commitment to meeting water conservation objectives • Water conservation targets in the building code which establish defacto requirements for alternative water use in new housing • Specific roles and responsibilities established around RM and the use of alternative water technologies in building code | <ul style="list-style-type: none"> • Prescriptive guidance above current basic code standards through the Code for Sustainable Homes • Established professional organization to represent the RWH industry, to develop BMPs and provide technical support to practitioners |

| USA | |
|--|---|
| <ul style="list-style-type: none"> • Strong government commitment to meeting stormwater objectives • Use of tax rebates and incentives to encourage alternative water use in arid states • Use of building certification labelling to encourage SBP uptake • Building requirements to integrate alternative water systems into new development through dual plumbing systems ('stub outs') | <ul style="list-style-type: none"> • Professional training specific to alternative water technologies by trade organizations - Green Plumbers USA • Established professional organization to represent the RWH industry, to develop BMPs and provide technical support to practitioners |

A key aspect present in these countries enabling the advance of innovative water technologies is strong government commitment on water conservation and stormwater management. This commitment has manifested itself in various forms, such as requirements for post construction stormwater flows meeting pre development conditions, or building code requirements. Imposing new requirements leveled the playing field for builders and developers by introduced standardized changes into the construction industry. Although political momentum exists towards advanced stormwater management and water conservation in Ontario, the province has not yet introduced similar, sweeping requirements. For this reason, market risk and uncertainty can still have a central influence on the decision to adopt WSUD practices and innovative water technologies in housing development. As participant 22B pointed out "necessity is the mother of invention": homebuyers, homebuilders, and regulators do not see a strong enough need for advancing innovative water conservation technologies at present.

In the case of Australia, a significant amount of public resource was invested in capacity building and the mainstreaming of WSUD. An expert on the subject attributed this investment as a key factor in the speedy and successful transition (7C). Given the financial difficulty Ontario currently finds itself in, it is unlikely that similar public investment will be made into mainstreaming WSUD in housing development. With generally low levels of public awareness around water issues and a lack of demand for the technologies, it is unlikely that the provincial government will invest in programs for education and training in these areas. For similar reasons it is also unlikely that industry or the province would invest in establishing and maintaining a professional organization for alternative water technology professionals in the province. An opportunity exists, however, for the federal government to play a supporting role. The federal government is currently in a healthy financial state, and is in a position to invest in building capacity around WSUD (see Office of the Parliamentary Budget Officer, 2012). This could come in any manner of forms, though incentives and subsidies to the establishment of various programs and activities.

One enabling aspect that Ontario could adapt and apply from these examples is in the area of standards and guidance, particularly around stormwater aspects of WSUD. Significant headway has already been made for alternative water use in the 2012 OBC, and through the development and Code reference to several CSA standards, but more could be done to advance standard of care for stormwater BMPs and reduce uncertainty in approvals processes (3C, 6C, 7C).

Based on findings in the research, it may not be possible to overcome the current market risks of adoption. It may, however, be possible for industry and government to assist Ontario builders in overcoming various types of adoption risk to accelerate the uptake of innovative water technologies over the long run. For example, it may be possible to tap into the internal organizational objectives of builders and developers to encourage their participation in activities and interventions that may create a

favourable environment for mainstream uptake. Moreover, it is possible to work within existing channels and frameworks to take advantage of these opportunities. Opportunities to minimize adoption risk exist through capacity building exercises, the advancement of recognized standards and guidance, and the development of innovation friendly regulatory processes. The following sections examines possible avenues to pursue, through industry led technology discovery programs, municipally hosted pilot projects, enhanced and coordinated guidance in the municipal approvals process, and working within a proven framework for mainstreaming types of innovation.

6.4 INDUSTRY LED PROGRAMS

Numerous programs and initiatives were identified in the interviews that participants felt had encouraged innovative building practices (see Appendix F). Several of those identified embody a wide range of RM characteristics found in the literature, and this RM potential may warrant further investigation in future. Particularly noteworthy programs are those that vet sustainable technologies and reduce uncertainty around technical performance, such as the TRCA's Sustainable Technology Evaluation Program and Guelph's Greywater reuse feasibility study. One combined program model shows unique promise for simultaneously vetting technologies, mitigating adoption risk, and building capacity around alternative water technologies within Ontario's development community: LEEP/TAP.

The Local Energy Efficiency Pilot (LEEP) is a program developed by Natural Resources Canada's CanmetENERGY. The program is described as a "builder led technology information and review process" (EnerQuality, 2011a, para. 1). The follow-up Technology Adoption Pilot (TAP) is delivered by EnerQuality on behalf of CanmetENERGY, and seeks "to connect the technology identification process to marketplace adoption" (para. 2). Through LEEP, builders are given the opportunity to explore innovative technologies and identify those that would be useful within their housing markets (para. 1). LEEP sessions are conducted in partnership with local homebuilding associations. In these sessions, numerous innovative energy efficient technologies are introduced for builder review, and a number of technologies are prioritized by participating builders for potential uptake. Specific builder concerns regarding the technologies are then discussed in technical presentations. As a follow-up to LEEP, TAP facilitates the adoption and installation of the identified priority technologies. TAP consultants support participating homebuilders with the installation of technologies into discovery homes.

LEEP/TAP touches on many themes for managing risk, reducing uncertainty, and encouraging innovation in the housing industry that have been identified in research findings. Aspects of this program involve information transfer, knowledge transfer, guidance and support, collaboration, enhanced communication, enhanced marketability, and potential for risk-recognition. In addition to all these aspects, LEEP/TAP is sensitive to the kinesthetic learning preference of builders in taking a hands-on, builder-led approach to program design (HUD, 2005, p. iv).

The program is based on information and knowledge transfer. Builders are provided with information on technologies that have been vetted by the experts, and are given the opportunity to learn about these technologies in a risk free environment. Builders select technologies of interest based on their experience, and needs within their own market. In the implementation phase, builders learn through the installation of their chosen technologies, and receive expert technical support from TAP consultants. Further information transfer opportunities exist in the numerous networking, idea-sharing, and relationship building opportunities provided through interactions with other building professionals in the program, local home building associations, and building officials (EnerQuality, 2011b, para. 2).

Developing a program such as LEEP/TAP to encourage the adoption of innovative water technologies, or expanding the current program to incorporate these technologies could be a beneficial way to raise the profile of innovative water technologies in the province. An industry led program such as this could be instrumental in vetting and identifying winning products, and building industry capacity around advanced water efficiency. Providing low risk opportunities for experience with innovative water technologies may increase the comfort level of building industry stakeholders in the short term that could serve to accelerate technological adoption in the long run. Such a program could also prove a convenient venue to educate builders on the concepts and potential economic opportunities of WSUD, and to raise awareness around 2012 OBC changes for alternative water use.

6.5 MUNICIPALITIES AND PILOT PROJECTS

Municipalities are particularly well positioned to create an enabling environment for builders to overcome risk aversion to adopting innovative technologies, or new forms of development. The influence and decision-making powers of local planning and building authorities under the Planning Act, and the ability of municipalities to engage builders in pilot projects means that local governments would be key change agents in a transition to WSUD.

The hosting of pilot projects is one domain where municipalities play an important role in reducing uncertainty and risk to builders, while raising awareness around sustainable building practices. This is exemplified by local governments in Ontario, such as the City of Guelph, who have taken a leadership role in providing low-risk opportunities for collaboration on projects that explore the viability of innovative water technologies. These collaborative partnerships provide opportunities for professional capacity building among a wide range of stakeholders, as well as opportunities for information and knowledge transfer among the parties involved. In addition to providing opportunities to vet and field test innovative technologies and processes, they also provide opportunities for public education. In this way, collaborations between developers and municipalities can provide good value for resources allocated.

Collaborative partnerships have been identified in the literature and interviews as a particularly useful method of RM that can be applied in pilot projects. Findings in the literature, however, indicate that this forum for pursuing building innovation is being underutilized in Canada: Innovative builders who participated in Hendriks and Wolf (2010) indicated "a key constraint on their progress was the lack of collaborators and the lack of municipal support, both of which would reduce the perceived or actual economic risk associated with environmental innovations and new technologies" (p. 15). Moving forward, municipalities should actively support and facilitate opportunities for collaboration with their local building communities.

In addition to providing more opportunities and support for pilots, there are other ways that local governments can show leadership to stakeholders in the development community. Planners and building officials can take a closer look at their development processes to ensure that they are not unnecessarily hindering innovation.

6.6 GUIDANCE IN THE MUNICIPAL APPROVALS PROCESS

Findings in the literature and interviews have identified the municipal approvals process as a common barrier to innovation, and a source of regulatory and financial risk. Delays, or the threat of non-approval are a disincentive to deviate from the norm. In order to overcome these risks, it is important that approvals processes for innovative projects are at minimum as timely as conventional projects (HUD 2003, p. 16).

Other complicating factors that contribute to a lack of willingness to innovate on the part of developers are the discrepancy between jurisdictions on the acceptability of various sustainable building features, and the irregularity in municipal design and construction expectations for these features (3C). Findings in the interviews show that this is particularly true with the acceptance and design of stormwater management elements found in WUSD. This dissonance between municipal expectations serves as another disincentive to innovation, as developers often operate in multiple jurisdictions; the effect of various requirements adds additional complexity into their production models and increases costs, time requirements, and risk. To remove this disincentive, greater consistency is required between municipalities on acceptable sustainable building practices, and on design and construction expectations (3C, 7C).

To address concerns around approval times and consistency in municipal requirements, Ontario can learn from the experience of Melbourne, Australia. In Melbourne, municipal councils in adjoining high growth areas partnered to develop a jointly recognized set of WSUD features for developers to choose from. In addition to establishing this menu of acceptable features, this partnership established a common set of construction guidance and recognized BMPs to instruct builders on design and construction requirements. Complimentary to these reforms, the participating councils established a standardized approvals process to promote a smooth transition for developers between municipalities.

Ontario municipalities should consider this Australian example, and realize the opportunity this would bring as far as empowering local building officials and streamlining approvals processes (7C). Agreeing upon an acceptable menu of SBP and WSUD features, and establishing common design and construction expectations would assist builders in pursuing innovation in multiple jurisdictions, and support building officials in enabling innovative practices. Harmonizing requirements in the approvals process for SBP and WSUD would 'raise the bar' for knowledge and awareness among building officials, and give comfort to developers that when they follow design and construction requirements set out in the menu of BMPs that it would reduce or remove the likelihood of regulatory delays. It could also raise the comfort level of municipal officials, knowing that they are operating based on BMPs that are jointly-recognized by experts in other local municipalities. This action could help to remove uncertainty and risk in the decision to pursue innovative building practices.

6.7 BUILDING ON SUCCESSES- MAINSTREAMING ALTERNATIVE WATER TECHNOLOGIES

Several interview participants praised Energy Star as a success story in Ontario for furthering SBP. The program did not necessarily encourage the mainstreaming of innovative technologies, however, it significantly raised the bar of energy efficiency in housing across the province. Participants attributed

Energy Star's influence on energy efficiency in new housing to the program's impressive market penetration. By the time Energy Star building requirements became effective in the 2012 OBC, many builders were already building to those standards voluntarily.

Energy Star was able to achieve excellent market penetration by balancing the marketing incentive for builders with program requirements that were not too onerous (20B). Furthermore, the introduction of Supplementary Standard SB-12 into the OBC in 2009 introduced voluntary, prescriptive guidance to builders on various options for achieving Energy Star levels of performance; this enabled early adopters to build ahead of code with relative ease (11C). By the time Energy Star requirements were absorbed by the OBC, a large percentage of Ontario's builders were already building to these standards (11C, 20B).

Another reason why participants believed that the program was successful is because program requirements were built on a model of continuous improvement (CI), which allowed builders the chance to adapt to steadily increasing requirements over time: By adhering to improvements in energy efficiency that were manageable, the program did not outpace the building community's ability to adapt to changes, or supply chain's capacity to provide quality products, materials, technologies, and support for new systems. The path of CI was identified by interview participants as a means to reduce builder risk as opposed to sudden changes in code (10B, 11C, 12C, 16B, 20B & 22B). Building ahead of code requirements was also recognized as a RM strategy by interview participants (20B, 22B), as well as a motivator/organizational objective for adopting green building innovations. This path has significant implications for potential exposures to technology, performance, supply chain, and ultimately financial risks associated with homebuilding innovation.

Builders respond to market demand and generally avoid products that the public is wary about. The poor performance of products and technologies in the marketplace can taint the public's perception for many years following (16B, 17C). It is important to ensure that products and systems being released to mass markets are capable of meeting consumer performance expectations, otherwise builders will be averse to adopting them (16B). According to interview participants 11C & 12C, 'stepping up' water efficiency requirements through programs like Energy Star that set the direction for the OBC sends a signal to suppliers and manufacturers that preparations must be made to meet future demands, and sends a signal to builders that they must become educated on new products/technologies that may ultimately be required by code.

The model of continuous improvement is supported in construction literature, through discussion on the attributes of technical innovation: This model strikes a chord with a majority preference by the building industry for what is known as incremental innovation. According to HUD (2005), "most homebuilding innovation, which can be either product- or process-related, is incremental in nature" (p. 3). Incremental innovation involves small improvements over time, versus more profound types of innovation. The Energy Star program seems to have successfully tapped into the preference for incremental innovation in Ontario's building industry.

Incremental innovations are preferred over other innovation types, because they are more market ready (HUD 2005, p. 33). Market readiness of technologies is a justified concern among builders, and the consequences for large scale implementation of inadequate products are serious, and potentially ruinous (20B). Integrative innovations such as alternative water technologies are often perceived by the building community as "prohibitively risky" (HUD 2006, p. 8); this poses a significant challenge for those who seek to encourage the use of innovative water technologies in a mainstream residential development context.

Addressing this challenge begs several questions: In the absence of market pull, how does one take a more significant innovation such as alternative water technologies and introduce it to the building community within a framework of continuous improvement? How does one promote what might be perceived by most builders as a radical innovation while appealing to industry's preference for incremental innovation? To accomplish this task, program developers must seek ways to reduce or remove adoption risk elements that make these innovations 'prohibitively risky'. Guidance for such a task may come in the form of two initiatives that are being developed to enable and diffuse sustainable building practices: Natural Resources Canada's Solar Ready Program, and the CMHC's Alternative Water Ready Guidelines.

Solar Ready is a new labeling program under development by Natural Resources Canada (NRCan) whereby builders can incorporate into their houses all the necessary technological and structural requirements to support solar power or solar domestic water heating technologies- but stopping short of actually installing these technologies (see NRCan, 2012). In doing so, builders can accommodate for renewable energy, without taking on the risks of adopting and installing renewable technologies themselves. As a benefit to builders, the certification labeling could provide an extra edge in marketing their product. The same principles of the Solar Ready program could be applied to planning for alternative water sources; the space, support, conduits, wiring and plumbing necessary to accommodate the future integration of RWH or GWR could be included during the construction stage (similar to Arizona's 'stub out' program). The CMHC are currently developing the Alternative Water Ready Guidelines along a similar premise to NRCan's Solar Ready Guidelines (CMHC 2012, p. 9).

Alternative Water Ready offers an exciting opportunity to further innovative water technologies in homebuilding, with minimal risk to the builder/developer. Many of the risks associated with technological adoption would be eliminated by virtue of preparing for, but not actually installing the technology. The installation, operation and maintenance could be carried out at a later date by a third party contractor, or service organization specializing in alternative water technologies (17C, 22B). Considering the perceived and actual risk concerns identified in the interviews regarding technological adoption, an Alternative Water Ready program could have numerous risk benefits to builders in its potential to:

- Remove concerns about the quality of technology, or its ability to meet homeowner expectations
- Eliminate the prospect of builder responsibility for issues stemming from poor performance, or inadequate homeowner maintenance
- Diffuse concerns about reputational damages, or callbacks
- Remove the responsibility to contend with operational problems that could arise with installed technologies
- Eliminate the liability concerns for system failures, or the improper installation of systems
- Avoid ROI risks of investing in alternative water technologies
- Reduce the market risks of including alternative water technologies as a standard feature that homeowners may not want
- Provide an opportunity for additional marketing benefit from a building certification label
- Dispel home warranty concerns that might otherwise arise with a full installation of alternative water technologies
- Eliminate supply chain risks, as all the materials required for programs requirements would be common plumbing supplies
- Avoid standard of care risks, as plumbing requirements are established in the OBC, and

- Avoid educational risks, as requirements for employees and subcontractors would be minimal, and guidelines would provide clear guidance to trades.

Taking Alternative Water Ready one step further, 'stub out' requirements could be introduced into development requirements over the long term at minimal risk from the builder's perspective. Working within a framework of continuous improvement, the Alternative Water Ready Guidelines could be subsumed by future versions of the Energy Star program, and incorporated into the OBC's Supplementary Standards for eventual inclusion into Code requirements. Including guidance on this program in the Supplementary Standards prior to requiring it by code would appeal to the organizational objectives of early adopters and allow them to easily adopt best practices in advance. Stub out requirements in the OBC would formally recognize the interconnectedness between energy and water conservation, and align with the province's recent mandate under the *Water Opportunities and Water Conservation Act, 2010* to advance water conservation in the Code.¹²

Several positive outcomes could arise from pursuing Alternative Water Ready. The end result of stub out requirements in the Code would be the development of housing stock that is backwards compatible to alternative water technologies at little to no marginal risk to the builder. Furthermore, the pace at which the program evolves could allow for the development of robust and well vetted technologies, supply chain, and the establishment of other support networks. This supply-oriented approach may prove the most promising way to secure and maximize the potential for alternative water use in Ontario's housing stock, in lieu of present day lack of consumer demand for innovative water technologies.

¹² The *Water Opportunities and Water Conservation Act, 2010* (WOWCA) is the overarching legislation which houses the Water Opportunities Act (WOA). Schedules within WOWCA amend the Ontario Building Code Act to raise the profile of water conservation for consideration within the periodic review process of the OBC. Schedules in WOWCA also enhance the mandate of the MMAH's Building Code Energy Advisory Council to include water conservation (Environmental Registry, 2010, para. 8).

7.0 CONCLUSIONS

This study sought to identify a range of interventions and activities for industry and government to assist the building community in overcoming perceived and actual risks to the adoption of Water Sensitive Urban Design and innovative water technologies. To accomplish this objective, research looked at numerous forms of green and sustainable building innovations to discern various forms of adoption risk, and identify actions taken to manage, or overcome risk. The research also sought to understand the drivers and motivators for innovation uptake, and how this may be used to encourage water innovation in Ontario's building industry. The ultimate goal of this exercise has been to provide recommendations to industry and government on how they may encourage the Ontario building industry to overcome perceived and actual risk, and adopt water sensitive development practices.

Recurring RM themes emerged through the various components of the research including: the presence of clear guidance and expectations through codes and standards; the use of economic and development incentives to encourage innovation; the use of collaborative partnerships as a risk-sharing mechanism; opportunities for knowledge and information transfer around innovative products and technologies; the recognition of leadership from peers and the public; innovation friendly approvals processes; enhanced marketing opportunities through product and building certification labelling; and the presence of government and professional support. Although interventions and activities based along these lines will not guarantee the adoption of innovative water technologies, they may be useful in encouraging the uptake of innovative practices among the building community.

Currently in Ontario, public awareness around water sustainability issues is low, and there is virtually no market demand for alternative water technologies in the home. As a result, there are fundamental economic risks to builders including features in their homes for a market where no appetite exists. In response to this lack of demand, there is little to compel builders to overcome perceived and actual adoption risks on their own. It is possible that in the not-so-distant future this demand will begin to shift as momentum builds behind WSUD.

Drivers that have led to government intervention on WSUD in jurisdictions abroad are gaining momentum at home. Stormwater quality and quantity issues, infrastructural sustainability, and the recognition of finite water supplies are pushing Provincial and municipal governments in this direction. RWH's role as a stormwater management BMP may allow proponents of innovative water technologies to build capacity and supply chain around RWH in this light. Looking to the examples of Australia, the UK, and USA, government must take stronger action if it intends to make meaningful progress in this area. Provincial and municipal governments must become a driving force, to oversee and support a smooth transition to water sensitive development.

Although Ontario finds itself in an era of fiscal restraints and spending cuts, there is still much that can be done to create a favourable environment for the adoption of SBP and WSUD. Steps can be taken to reduce builder risk and accelerate uptake among the development community, and much of this work can be accomplished within existing frameworks, channels, and processes. Building capacity and laying the foundations with standards, clear guidance and expectations, well-developed and vetted technologies, supply chains, and the development of expertise among building officials and building professionals are all exercises in which government and industry can engage. Such interventions and activities will promote a smooth and accelerated transition to water sensitive development while minimizing adoption risk to the building community.

8.0 RECOMMENDATIONS

8.1 INTRODUCTION

Numerous programs and initiatives were identified throughout the research that have the potential to assist builders and developers in Ontario in overcoming risk-aversion to adoption. Many of these interventions involve the creation of an enabling environment, where uncertainty around an innovation and the chance of an adverse outcome are minimized. This chapter provides a set of broad recommendations for industry and government stakeholders to help create conditions where the building community could be encouraged to adopt water technology innovations.

Several criteria have been used in review of research findings to develop recommended activities and interventions for industry and government to reduce perceived and actual builder risk around the adoption of innovative water technologies and processes in homebuilding. These criteria include:

Feasibility: The level of difficulty to implement within Ontario's current social, fiscal and political climate

Adaptability: The ability of potential interventions and activities to build off of existing frameworks; and the applicability of what has been done in other countries to furthering WSUD and alternative water technologies in Ontario

Scope of Risk Management potential: Consideration of programs/initiatives that embody a wide range of RM characteristics that address risk concerns identified in the research findings; seeking interventions and activities that would assist in reducing risk and uncertainty around the most prominent risk concerns identified in the interview findings

Acceptability Among Builders: Looking to interventions and activities that could encourage the uptake of innovative water technologies that have a higher potential for acceptance and uptake among building industry stakeholders; Considering program models that have had demonstrated benefits/successes in Ontario in the past, and embody desirable RM characteristics.

8.2 KEY RECOMMENDATIONS

1) Municipalities should collaborate with the local building community to assess the feasibility and adoption of innovative SBP and WSUD technologies and processes.

Collaboration has been identified in research findings as an effective method to overcome perceived and actual risk, and encourage involvement in a project. A lack of opportunities for collaborative partnerships with municipalities has been identified by builders as a key constraint to experimenting with innovative building practices. Municipalities who are interested in exploring SBP and WSUD technologies and processes should take advantage of the risk-sharing aspects that come through collaboration.

Collaborations can have benefits for all parties involved, and embody numerous RM characteristics identified in the research that apply to reducing various forms of builder risk. Risk-sharing aspects of collaborative partnerships can reduce builder risk perceptions around 'riskier' elements of a project (Shaokai & Mo, 2009, p.4558). Financial and technical support can reduce financial and performance

risks builders associate with innovation (7C). Pilots under a collaborative partnership can serve as a capacity building exercise for municipal officials, developers, and other stakeholders. Access to a broad range of expertise saves public and private time and money, and enables knowledge and information transfer (14C). Enhanced planning and communication opportunities presented through the use of design charrettes and the integrated design process allows problems to be identified and solved on paper before they materialize in the field (14C). Monitoring and evaluation data from these projects can provide valuable information regarding the performance and social acceptability of sustainable building technologies and practices (17C). From a resources allocation perspective, collaborations may offer good value for money spent, as each party walks away with new knowledge and experience to bring to future projects.

Pilot projects that explore SBP/WSUD features can be tailored to suit the needs of the municipality and local building community, and therefore can be highly adaptive. The level of political risk associated with SBP/WSUD pilots would generally be low, but ultimately depends on the nature of the project. These projects can work within existing development frameworks to determine the suitability of the SBP/WSUD features for adoption within local development practices. Funding for these projects could be allocated through existing channels, such as through the province's Showcasing Water Innovation fund.

Pilots that have showcased innovative water technologies have been successful in Ontario's recent past. These projects have provided valuable knowledge and experience, and technical performance data to builder/developers, building officials, and water conservation planners (14C, 17C). Builders are willing to participate in innovative building projects, provided there is a benefit to the builder (10B). Research findings have indicated that this benefit can take various forms, from cash and development incentives to enhanced marketing or risk-recognition opportunities.

2) Municipalities with an interest in water conservation should pilot an Alternative Water Ready program and other municipalities should be introduced to this program if they are not aware of it.

There are many ways in which an Alternative Water Ready Program could be introduced through a pilot. This introduction could occur as the primary feature of a pilot project, or it could be rolled in as a component along with numerous others found in the development. Proponents of this program could target municipalities in areas with known water infrastructure challenges as potential hosts. In addition to harnessing the risk-sharing benefits of collaboration and opportunities for builder risk-recognition, municipalities could make use of development, financial, or other incentives to encourage builder participation. The type of incentive could be up to the discretion of partnering municipalities provided they are adequate to entice developers or cover their extra costs in time and materials. Program requirements should not be overly onerous so as dissuade builders from participation (20B, 21B).

A pilot such as this would serve to integrate innovative water technologies into the home while removing virtually all of the risk associated with actually installing the technologies (21B). Installation of auxiliary plumbing uses conventional methods and materials, and would not require the immediate development of a supply chain to support the technologies. A municipal lead on these projects should alleviate builder concerns about time delays from lengthy approvals processes, as well as concerns about the knowledge level of building officials chosen for the project. Installing the necessary plumbing would enable future integration of these technologies, but would not expose builders to additional market risk, or any risks stemming from performance, operations, and maintenance. Information

retrieved during the process should prove valuable for subsequent efforts to enable or accelerate the uptake of alternative water technologies.

The piloting of an Alternative Water Ready Program could be achieved with relative ease. This action would be low risk politically and financially for municipal governments, particularly if provincial funding was available. Moreover, this approach to furthering advanced water conservation is based on the model of continuous improvement, which has been recognized by Ontario building industry stakeholders as an ideal, low risk way to pursue conservation objectives on a grand scale. Such a program would enable the integration of alternative water technologies into housing developments while addressing builder/ developer preferences for incremental innovation.

Similar programs have been implemented in the US, and have even been adopted into development requirements. An Alternative Water Ready Program will be looking ahead towards the integration of 'stub out' requirements in subsequent versions of Energy Star, and eventually into the OBC. This approach would formally recognize the interconnectedness between water and energy efficiency, and raise the potential for the mainstream adoption of innovative water technologies.

The province should fund an Alternative Water Ready Pilot through Showcasing Water Innovation and ensure awareness about the program throughout Ontario's municipalities. The Pilot could be used to raise awareness around 2012 OBC changes for the use of non-potable water sources and solutions to issues with water supply infrastructure. Certification labelling, professional recognition, builder incentives, or other benefits could be used as a method to encourage builders/developer participation.

3) NRCan, EnerQuality, and local homebuilding associations should Integrate innovative water technologies into the LEEP/TAP program

NRCan, EnerQuality, and local Homebuilding associations should integrate innovative water technologies into their co-operative LEEP/TAP program. This builder led program embodies numerous RM characteristics identified in research findings, and would be a positive platform to promote knowledge and information transfer around alternative water technology installation, operation and maintenance issues.

Integrating an advanced water conservation component into LEEP/TAP would provide a low-risk environment for builders to experiment with innovative water technologies. This action would be expanding off of an existing program, and should be relatively easy to implement in addition to the current program. In the short term, this program could be a way to help builders and developers to become comfortable with the technologies and knowledgeable about installation and standards.

The benefits of mentorship around sustainable technologies have shown demonstrated success in Australia, and have been identified in the literature as an effective means of knowledge transfer. Furthermore, a hands on approach has been identified as a learning preference among the building community. Although it is unlikely that this program would lead to widespread adoption of the technologies into housing developments in the near term, it could prove an excellent awareness and capacity building exercise among local builders, home building associations, and municipal building officials. In the end this could serve to accelerate the adoption of alternative water technologies should market demand begin to develop, or Provincial building requirements move in this direction.

4) Municipal should collaborate to harmonize requirements for SBP and WSUD, to provide clarity and consistency in design and construction expectations between local jurisdictions, and to remove barriers to innovation in approvals processes.

There are builders and developers in the province who are willing to pursue elements of WUSD, but are discouraged because of the inconsistency between municipal approvals processes (3C). Inconsistency in preferred SBP/WSUD practices and irregularity in design and construction expectations between municipalities have been identified in the findings as a hindrance to innovative development practices. Complications that arise due to this lack of consensus on practices and construction requirements can be costly to developers, take additional time, and bring added risk exposures. These complications can be compounded for developers who operate in adjoining jurisdictions through inconsistencies in approvals processes between local governments. All of these factors combined contribute to a structural disincentive to adopting innovative building practices. This structural disincentive penalizes those willing to innovate over those who adhere to the status quo.

As a starting point to encouraging the uptake of SBP and WSUD, it is key that approvals processes for projects that incorporate these features take no more time than conventional projects. When reviewing non-conventional designs, building officials must often spend additional time and energy to ensure that innovative building practices will meet health, safety, and environmental standards. This contributes to delays in the approvals process. To address this barrier and a range of other approvals process concerns, Ontario municipalities could draw from the experience of Melbourne Australia, and harmonize requirements for SBP and WSUD practices.

The establishment of BMPs for the design and construction of innovative construction practices introduces uniformity and repeatability into the process, an element conducive to production building. Furthermore, the establishment of jointly recognized BMPs between local municipalities draws on a larger pool of expertise, creates a wider support network, and helps to legitimize a quasi-standard of care for a particular geographical region. Development of these BMPs in consultation with the local building community would help to ensure that requirements are tenable, increase builder buy-in, and increase the likelihood of adoption by local builders and developers (20B, 7C).

Establishing a menu of SBP/WSUD BMPs, jointly recognized by local municipalities and the building community, would have numerous benefits to reducing perceived and actual adoption risk. A consensus based approach, involving major public and private stakeholders would lead to outcomes that addressed the needs of key players in the process. Established BMPs would enable clear guidance on design and construction expectations. Clear guidance and the flexibility to choose from a menu of BMP options would reduce risk to builders. Clear guidance would also increase the comfort level of building officials approving and inspecting these features, and help to reduce time in the approvals process. This approach would make it easier for partnering municipalities to design a common approvals process, which could save time and costs for developers who work across municipal lines.

Partnering to establish consensus around SBP/WSUD design expectations is a feasible activity among Ontario's local municipalities, with low political and financial risk to the parties involved. Developing mutually agreed upon standards has had demonstrated success in the Melbourne area, and has shown to benefit both builders and municipalities. The presence of WSUD standards would reduce financial risks to builders associated with lengthy approvals processes, and would allow for the further streamlining of regulatory processes. The presence of technical standards and design guidance have been identified as risk mitigating factors in research findings. Further, making approvals innovation

friendly may not require significant changes to current regulatory processes, and could build off existing development frameworks.

5) The Government of Ontario should provide clear technical guidance on WSUD and take strong action through programs and policy to help drive uptake by municipal governments and the development community.

Strong government action in furthering WSUD was found through programs and development requirements in all countries observed in the jurisdictional scan. Strong government action will also be required to further WSUD uptake in Ontario. An important intervention that needs to take place in Ontario is updating the standard of care around stormwater management.

An update of the province's 2003 stormwater management planning and design manual is long overdue. Traditional methods of stormwater management are expensive to maintain and repair, and are unsustainable financially and environmentally (3C, 7C). The province must update its provincial stormwater guidance to incorporate current best practices, and explicitly address LID BMPs. Updating development frameworks and establishing a Provincial standard of care for LID have been identified as a means to reduce regulatory risk to builders (6C).

Although the TRCA and CVC have provided guidance for developers through their LID design guide, their publication lacks the weight of the province behind it. Provincial guidance and standard of care would help reduce reluctance among building officials to LID practices, and help to reduce time delays for builders in the approvals process that serve as a disincentive for adoption. Embracing current best practices into standards, including the objective to maintain predevelopment water balance post construction¹³, would promote linkages between enhanced water efficiency and stormwater management. Findings in the jurisdictional scan indicate that the most frequent driver for the uptake of RWH in the US has been through enhanced stormwater management requirements.

Updating the 2003 manual will be a difficult endeavour, and take considerable time to accomplish (6C). Furthermore, there appears to be aversion at the political level to doing so (7C). Given the state of stormwater infrastructure in Ontario, however, it is ultimately in the best interest of the province to begin this task as soon as possible. According to interview participants, leaders in the development community, leading municipalities, and conservation authorities have been pushing the province to do this for some time, and political momentum in this direction exists.

6) The federal government should be approached to determine what their role could be in encouraging WSUD in terms of providing economic incentives and subsidies for consumers and builders.

Given the economic hardship the province of Ontario currently finds itself in, an opportunity exists for the federal government to make a significant contribution in promoting water efficiency and stormwater BMPs in Ontario. Having recently declared a healthy financial standing, the federal government is in a position to play a key role in encouraging WSUD through providing economic incentives and subsidies to

¹³ Maintaining predevelopment water balances after site development is complete is becoming a common practice in leading jurisdictions (TRCA, 2010, p. 6).

builders and homebuyers. Having been criticized in the past for inaction on important environmental issues, this could be a low risk opportunity for the current federal government to build political goodwill in this area.

Proponents of WSUD should approach the federal government to ascertain their role in encouraging uptake. This role could be through the provision of economic incentives and subsidies for builders and homebuyers, or through other programs and initiatives. A logical arm of the government to work through would be the Canadian Mortgage and Housing Corporation. The CMHC could partner with Ontario municipalities on a larger scale to deliver programs such as Alternative Water Ready, or focus on sustainability mentoring programs for building professionals such as those led by Australia's Landcom. The CMHC could use incentives to entice builder participation in pilots, and subsidies to increase appetite among the public.

7) Additional research should take place to investigate the use of economic incentives or subsidies and other policy instruments to change consumer behavior.

The preceding recommendations have addressed supply side issues of innovation adoption, focusing on enabling and encouraging uptake of WSUD technologies and processes in the building community. The research shows that although various incentives can be effective in encouraging innovation adoption among the building community, no market pull exists for these features in Ontario. Having addressed risk concerns around other aspects of adoption, additional research should focus around developing consumer demand for WSUD and innovative water technologies in the province.

The establishment of a market for WSUD in low rise residential housing would be an economic driver for the building community to adopt these technologies, and reduce the financial risks of adoption. Furthermore, an increase in demand would have a positive effect on the development of supply chain and more robust technologies. POLIS should focus its research efforts on the use of economic incentives, subsidies, and various policy instruments that exist for developing consumer interest in WSUD. Changing consumer behaviour is a crucial step in widespread implementation.

REFERENCES

- Abbotsford Mission Water and Wastewater Services (2012). Water efficiency plan- 2012 public consultation guide booklet: A starting point for discussions. Retrieved January 27, 2013. Available from: <http://www.ourwatermatters.ca/Water-Efficiency>
- American Rainwater Catchment Systems Association (2012). Frequently asked questions: Legislation, codes and ordinances. Retrieved December 14, 2012 from: <http://arcsa.org/content.asp?admin=Y&contentid=195>
- Anderson, M. K., Bigood J. K., & Heady, E. J. (2010). The hidden legal risks of green building. *The Florida Bar Journal*, 84(3) 35-41.
- Arizona Department of Revenue (2012). Water conservation systems and plumbing stub outs. Retrieved December 16th, 2012 from: <http://www.azdor.gov/TaxCredits/WaterConservationSystems.aspx>
- Austin Water (2012). Conservation: Water conservation rebates: Rainwater Harvesting Rebate. Retrieved December 14th, 2012 from: <http://austintexas.gov/department/rainwater-harvesting-rebates>
- Barer, D. (November 23, 2012). Drought drives rainwater collection across Texas. *Austin American Statesmen*. Retrieved December 14th, 2012 from: <http://www.statesman.com/news/news/state-regional-govt-politics/drought-drives-rainwater-collection-across-texas/nTDkx/>
- Binstock, M. (2011). Greening stormwater management in Ontario: An analysis of challenges and opportunities. Canadian Institute for Environmental Law and Policy. Retrieved February 15th, 2012. Available from: http://cielap.org/pub/pub_greeningstormwaterman.php
- Blayse, A. M. & Manley, K. (2004). Key influences on construction innovation. *Construction Innovation*, 2004(4), 143-154. doi: 10.1191/1471417504ci073oa
- Bowman, T. & Thompson, J. (2009). Barriers to implementation of low-impact and conservation subdivision design: Developer perceptions and resident demand. *Landscape and Urban Planning*, 92, 96–105. doi: 10.1016/j.landurbplan.2009.03.002
- Bradford, M. (2011) Construction guarantees create liability risks; Green builders urged to avoid promising LEED certs, savings. *Business Insurance*, July 25, 2011 v45 i29 p. 13
- Brandes, L., Brandes, O. M., Porter-Bopp, S. & Sandborn C. (2011). Peeling back the pavement: A blueprint for reinventing rainwater management in Canada's communities. The POLIS Project on Ecological Governance: Water Sustainability Project. University of Victoria. Retrieved April 12, 2012. Available at: <http://poliswaterproject.org/publication/426>
- Briggs, C., Cole, M., Evesson, J., Gleeson, K., Buchanan, J., Larcombe, G. & Saddler, H. (2007). Going with the grain? Skills and sustainable business development. A report for the Workplace Research Centre, University of Sydney. Retrieved December 14th, 2012. Available at: http://www.bvet.nsw.gov.au/projects_green.html

- Brown, R. & Clarke, J. (2007). Transition to Water Sensitive Urban Design: The story of Melbourne, Australia. Facility for Advancing Water Biofiltration, Monash University. Retrieved December 14th, 2012. Available at: <http://www.monash.edu.au/fawb/publications/index.html>
- Building Science Corporation (2008). Towards sustainability: Green building, sustainability objectives, and building America whole house systems research. Retrieved February 14th, 2013 from: <http://www.buildingscience.com/search?SearchableText=rr-0801-towards-sustainability>
- Canada Green Building Council (2013). Ontario green policy hub. Retrieved May 5, 2013 from: <http://ogph.ca/policy.php>
- Canada Mortgage and Housing Corporation (2009). Sustainable, healthy communities and water. *Canadian housing observer 2009*, 69-79. Retrieved March 10, 2012. Available at <http://www.cmhc.ca/en/>
- Canada Mortgage and Housing Corporation (September 13, 2012). *Rainwater harvesting*. Retrieved January 27, 2013 from: <http://www.cmhc-schl.gc.ca/en/corp/nero/retousar/2012/2012-09-13.cfm>
- Canadian Mortgage and Housing Corporation (2012). Canadian renovators committee: Canadian Home Builder's Association. Slide presentation. Retrieved February 28, 2013. Available at: <http://www.chba.ca/uploads/CRC/CMHC Presentation - October 2011.pdf>
- Canadian Mortgage and Housing Corporation (n.d). The integrated design process guide. Retrieved March 1, 2013. Available at: http://www.cmhc-schl.gc.ca/en/search/search_001.cfm
- Canadian Standards Association (2012). B218.3-12. Retrieved February 28, 2013, from: <http://shop.csa.ca/en/canada/plumbing-products-and-materials/b1283-12/invt/27034582012/>
- Casale, J (2010). New risks develop as green building projects expand. *Business Insurance*, 45, 16-17
- City of Calgary (2005). Water efficiency plan. Retrieved May 10, 2013 from: http://www.calgary.ca/UEP/Water/Documents/Water-Documents/water_efficiency_plan.pdf?noredirect=1
- City of Guelph (2012). Guelph residential greywater field test final report. Retrieved February 28, 2013. Available at: <http://guelph.ca/living.cfm?itemid=81278&smocid=2338>
- City of Guelph (2013). Request for home builder input on proposed blue built home program revisions. Retrieved May 10, 2013 from: <http://guelph.ca/living/environment/water/water-conservation/blue-built-home/home-builder/notice-of-intent/>
- City of Guelph (2013). About Blue Built Home. Retrieved February 28, 2013, from: <http://guelph.ca/living.cfm?subCatID=2248&smocid=2821>
- City of Guelph (2013b). Home builder resources. Retrieved February 28, 2013, from: <http://guelph.ca/living.cfm?itemid=79357&smocid=2821>
- City of Toronto (2010). Toronto green sector scan: Green buildings. Retrieved January 27, 2013 from: <http://www1.toronto.ca/wps/portal/toronto/content?vnextoid=e4558de60299a310VgnVC M10000071d60f89RCRD>

- City of Tucson (2012). Single family residential graywater rebate program. Brochure. Retrieved Dec 16th, 2012 from: <http://cms3.tucsonaz.gov/water/gray-water>
- City of Tucson (2012). Single family residential rainwater harvesting incentives rebate program. Brochure. Retrieved Dec 16th, 2012 from: <http://cms3.tucsonaz.gov/water/rwh-rebate>
- Clar, M. 2004. Pembroke Woods: Lessons Learned in the Design and Construction of an LID Subdivision. Presented at the Low Impact Development 2004 Conference in College Park, MD. Prince George's County, MD and the Anacostia Watershed Toxics Alliance. September 21-23. Retrieved October 26, 2012. Available at: <http://www3.villanova.edu/vusp/Outreach/pasym03/pdfs/4A4.pdf>
- Coffman, L.S. 2002. "Low Impact Development: Smart Technology for Clean Water - Definitions, Issues, Roadblocks, and Next Steps." In E.W. Strecker and W.C. Huber, Eds., Urban Drainage 2002: Global Solutions for Urban Drainage, 9th International Conference on Urban Drainage. American Society of Civil Engineers.
- Comstock, M. (2012). Demand for green buildings exceeds workforce supply. Retrieved January 27, 2013 from: <http://new.usgbc.org/articles/demand-green-buildings-exceeds-workforce-supply>
- Cooperative Research Centre for Construction Innovation (2007). Sustainable subdivisions: Review of technologies for integrated water services. Retrieved January 27, 2013, from: <http://www.construction-innovation.info/indexa916.html?id=44>
- Credit Valley Conservation & Toronto and Region Conservation Authority (2010). Low impact development stormwater management planning and design guide. Retrieved January 27, 2013 from: <http://trca.on.ca/the-living-city/water-flood-management/storm-water-management.dot>
- Dahl, R. (2010). Greenwashing: Do you know what you're buying? Environmental Health Perspectives. 118 (6) A246-A252. Retrieved June 15, 2012. Available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2898878/pdf/ehp-118-a246.pdf>
- D'Arelli, P. (2008). Selling and Governing the Green Project: Owner Risks in Marketing, Entitlement and Project Governance. Real Estate Issues, 33(3), 15-21
- Department for Communities and Local Government (2006). Code for sustainable homes: A step change is sustainable home building practice. Retrieved December 14th, 2012. Available at: <http://www.planningportal.gov.uk>
- Department for Communities and Local Government (2012). Planning: Planning Policy & Legislation: About Planning Policy: Planning Policy Statements and Guidance (PPS & PPG) (England). Retrieved November 6th, 2012 from: <http://www.planningportal.gov.uk/planning/planningpolicyandlegislation/currentenglishpolicy/ppgpps>
- Department of Sustainability and Environment (2006). Using the integrated water management provisions of Clause 56- residential subdivision. Victoria Planning Policy practice note. Retrieved December 14th, 2012 from: [http://www.dse.vic.gov.au/CA256F310024B628/0/B94519854FA94273CA257213000126AD/\\$File/VPP_Clause_56_4-Intwaterman.pdf](http://www.dse.vic.gov.au/CA256F310024B628/0/B94519854FA94273CA257213000126AD/$File/VPP_Clause_56_4-Intwaterman.pdf)

- Dikeman, I., Burgonul, M. T., & Han, S. (2007). Using fuzzy risk assessment to rate cost overrun risk in international construction projects. *International Journal of Project Management*, 25(5), 494-505.
- Dings, R. E. (n.d.). LEED for homes: Seizing an opportunity for Charlotte's homebuilders. Retrieved December 16th, 2012 from: <http://www.usgbccrc.org/?page=CaseStudies>
- East of England Water Partnership (n.d.) Water efficient buildings. Available at: <http://www.water-efficient-buildings.co.uk/>
- ECONorthwest (2007). The economics of low impact development: A literature review. Retrieved May 23, 2012 from: <http://mtwatercourse.org/resources/page.php?pageID=44>
- Elovitz, K. (2010). Green design: Risk or reward?; What risks do LEED, Green Globes, and the buzz about sustainability create for engineers, and how can engineers identify and manage those risks? *Consulting-Specifying Engineer*, January issue, 20-23
- EnerQuality (2011a). LEEP/TAP. Retrieved February 28, 2013, from: <http://www.enerquality.ca/programs/leaptap/>
- EnerQuality (2011b). LEEP participants. Retrieved February 28, 2013, from: <http://www.enerquality.ca/programs/leaptap/leep-participants/>
- Environment Canada (2009). Water: No time to waste- A consumer's guide to water conservation: Water wise. Retrieved February 28, 2013, from: <http://www.ec.gc.ca/eau-water/default.asp?lang=en&n=344B115B-1-wise>
- Farahbakhsh, K., Fitzgibbon, J. & Leidl, C. (2010). Identifying barriers to widespread implementation of rainwater harvesting for urban household use in Ontario. *Canadian Water Resources Journal*, 2010, 35(1): 93-104, doi: 10.4296/cwrj3501093
- Environmental Registry (2010). The Water Opportunities and Water Conservation Act, 2010. Retrieved May 13th, 2013 from: <http://www.ebr.gov.on.ca/ERS-WEB-External/displaynoticecontent.do?noticeId=MTA5NzY0&statusId=MTY0Nzkw>
- Ford, J. A. (2004). Time is money. Paper presented at the Construction Law Conference, October 21-22, 2004, Houston, Texas. The University of Texas School of Law.
- Foss, A. (2005). Low Impact Development: An Alternative Approach to Site Design. Retrieved May 28th, 2012. Available at: <http://www.pathnet.org/si.asp?id=1592>
- Ganeshan, R. & Harrison, T. P (1995). Introduction to supply chain management. Retrieved February 10, 2013 from: http://lcm.csa.iisc.ernet.in/scm/supply_chain_intro.html
- Ginsberg, S. (2012). NM sustainable building tax credit nearing annual \$5M cap. *New Mexico Business Weekly*. Retrieved December 14th, 2012 from: <http://www.bizjournals.com/albuquerque/news/2012/09/26/nm-sustainable-building-tax-credit.html>
- Greenbelt Ontario (n.d.). Urban sprawl. Retrieved May 5, 2013 from: <http://www.greenbeltontario.org/pages/urbansprawl.htm>

- Green Plumbers USA, 2012. Become a green plumber: Course information. Retrieved December 14th, 2012 from: <http://www.greenplumbersusa.com/training-accreditation/course-information/-waterefficient>
- HarvestH2O (2012). Regulations and statues: Texas. Retrieved December 16th, 2012. Available at: http://www.harvesth2o.com/statues_regulations.shtml
- Hendriks, E. & Wolfe, S.E. (2010). Building towards water efficiency: the influence of capacity and capability on innovation adoption in the Canadian home-building and resale industries. *Journal of Housing and the Built Environment*, 26(1) 44-72. doi: 10.1007/s10901-010-9207-4
- HM Government (2010). The building regulations 2000: Part G. Sanitation, hot water safety and water efficiency 2010 ed. Retrieved November 6, 2012 from: <http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partg/approved>
- Holbrook, E. (2009). The hidden risks of green buildings. *Risk Management*, 56 (9) 34-39
- Howard, J. A. & Moore, W. L. (1988). Changes in consumer behaviour over the product life cycle. In M.L. Tushman (Ed.), *Readings in the management of innovation* (2nd Ed.). Cambridge, MA, Ballinger.
- Institute of Management and administration (2009). Managing Risk While Pursuing and Practicing Green Design. Design firm management & administration report. *Design and Construction Firm Management*, 9 (9) 1
- Insurance Bureau of Canada (2011). The Wingham rain barrel study. Retrieved May 19th. Available from: <http://www.IBC.ca/Search/Search.aspx>
- International Association of Plumbing and Mechanical Officials (2012). Green plumbing and mechanical supplement. IAPMO home: Sustainability. Retrieved December 16th, 2012 from: http://www.iapmo.org/Pages/IAPMO_Green.aspx
- International Standards Organization (2012). ISO 31000:2009 Risk management: Principles and guidelines. Retrieved April 13, 2013 from http://www.iso.org/iso/catalogue_detail?csnumber=43170
- Koebel, T. (1999). Sustaining sustainability: Innovation in housing and the built environment. *Journal of Urban Technology*, 6(3), 75-94
- Koebel, T. (2008). Innovation in homebuilding and the future of housing. *Journal of the American Planning Association*, 74(1), 45-58. doi: 10.1080/01944360701768991
- Maas, C. (2009). Greenhouse gas and energy co-benefits of water conservation. The POLIS Project on Ecological Governance: Water Sustainability Project. University of Victoria. Retrieved March 17, 2012. Available from: <http://www.poliswaterproject.org/publication/91>
- Maas, C. (2010). Ontario's Water-Energy Nexus: Will We Find Ourselves in Hot Water... or Tap into Opportunity? The POLIS Project on Ecological Governance: Water Sustainability Project. University of Victoria. Retrieved March 17, 2012. Available from: <http://poliswaterproject.org/publication/341>

- Marsh Inc. (2009). Green Building: Assessing the risks. (Pub) Michael Feign.
- Maximum Performance (2012a). Retrieved February 28, 2013, from: <http://www.map-testing.com>
- Maximum Performance (2012b). About MaP. Retrieved February 28, 2013, from: <http://www.map-testing.com/about/maximum-performance.html>
- Maximum Performance (2012c). MaP background. Retrieved February 28, 2013, from: <http://www.map-testing.com/about/maximum-performance/background.html>
- Meder, R.C. (2007). Insurers go green. Risk Management Magazine 54(12) 31-33
- Melbourne Water (2010). Design, construction & maintenance of WSUD. Retrieved December 13, 2012 from: <http://www.clearwater.asn.au/content/design-construction-maintenance-wsud-north-west-growth-councils>
- Melbourne Water and Knox City Council (n.d). Water Sensitive Urban Design (WSUD). Retrieved April 12, 2012. Available from: http://www.melbournewater.com.au/search/results.asp?SearchPhrase=mw_wsud_brochure.pdf
- Mills, E. (2009). From risk to opportunity: An insurers response to climate change. A Ceres report. Retrieved May 18, 2012 from: http://www.ceres.org/resources/reports?b_start:int=40
- Mohamed, R. (2006). The Economics of Conservation Subdivisions: Price Premiums, Improvement Costs and Absorption Rates. *Urban Affairs Review* 41(3) 376-399.
- National Research Council of Canada (2002). Innovation in the housing industry. Retrieved May 18, 2012 from: http://www.chba.ca/uploads/policy_archive/2005/2002-01-01_02.pdf
- National Water Commission (2008). The Rainwater Tank and Installation Design Handbook. Retrieved December 14th, 2012. Available at: <http://www.rainwaterharvesting.org.au/standards>
- Natural Resources Canada (2012). Solar ready guidelines. Retrieved February 28, 2013. Available at: <http://canmetenergy.nrcan.gc.ca/buildings-communities/housing/3090>
- New Mexico Energy, Minerals and Natural Resources Department (2009). Sustainable building tax credit. Brochure. Retrieved December 14th, 2012 from: <http://www.emnrd.state.nm.us/ECMD/Multimedia/brochures.html>
- New Mexico Environment Department (n.d.). Water reuse in new developments. Retrieved December 14th, 2012. Available at: http://www.harvesth2o.com/statues_regulations.shtml - ca
- New South Wales Government (2006). Basix fact sheet. Retrieved December 14th, 2012. Available at: <https://www.basix.nsw.gov.au/information/about.jsp>
- Office of the Parliamentary Budget Officer. Fiscal sustainability report 2012. Retrieved August 10th, 2013 from: http://www.pbo-dpb.gc.ca/files/files/FSR_2012.pdf
- Ontario Ministry of Finance (2010). Ontario population projections update. Retrieved May 5, 2013 from: <http://www.fin.gov.on.ca/en/economy/demographics/projections/-s3d>

- Ontario Ministry of Finance (2012). Commission on the reform of Ontario's public services. Retrieved February 28, 2013. Available from:
<http://www.fin.gov.on.ca/en/reformcommission/chapters/report.pdf>
- Ontario Ministry of Municipal Affairs and Housing (February 16, 2011). *Home. Your Ministry. Ontario Building Code. Code consultation – 2011. Appendix A: Potential code changes for the second round of consultation. Appendix A: Water conservation.* Retrieved April 12, 2012, from:
<http://www.mah.gov.on.ca/Page9296.aspx>
- Ontario Ministry of Municipal Affairs and Housing (2012). Provincial Policy Statement review. Retrieved Dec 28, 2012. Available from: <http://www.mah.gov.on.ca/Page7243.aspx>
- Ontario Ministry of the Environment (2007). Conserving water in Ontario. Brochure. Retrieved April 12, 2012 from: http://www.ene.gov.on.ca/environment/en/resources/STD01_076227.html
- Ontario Ministry of the Environment (2011). Climate Ready: Ontario's Adaptation Strategy and Action Plan 2011-2014. Retrieved April 12, 2012. Available from:
http://www.ene.gov.on.ca/environment/en/resources/STDPROD_081665.html
- Ontario Ministry of the Environment (March 21, 2012). Newsroom. Ontario helping families save water. Retrieved April 12, 2012, from: <http://news.ontario.ca/ene/en/2012/03/ontario-helping-families-save-water.html>
- Ontario Ministry of the Environment (2012). Ontario's Great Lakes strategy. Retrieved January 27, 2013 from: http://www.ene.gov.on.ca/environment/en/resources/STDPROD_101828.html
- Ontario Ministry of the Environment, (2009). Adapting to climate change Ontario: Report of the expert panel on climate change adaptation. Retrieved April 6th, 2012. Available at:
http://www.ene.gov.on.ca/environment/en/resources/STD01_076568.html
- Ontario Ministry of the Environment, (2011). Ontario's Water Opportunities Act. Fact sheet. Retrieved November 5th, 2012 from
http://www.ene.gov.on.ca/environment/en/resources/STDPROD_086114.html
- POLIS project for ecological governance (2010). Water Sustainability Project. Retrieved January 17, 2013 from: <http://www.polisproject.org/projects/watersustainability>
- Primavera, P (2009). Green buildings: New construction concepts and new risks. A report for Lockton Companies. Retrieved April 3, 2012. Available at: http://search.lockton.com/search?q=Green Buildings: New Construction Concepts and New Risks&output=xml no dtd&client=default_frontend&proxystylesheet=lockton_website&site=default_collection
- Rainwater Harvesting Association of Australia (2011). About the Rainwater Harvesting Association of Australia. Retrieved December 14th, 2012 from:
<http://www.rainwaterharvesting.org.au/aboutarid>
- Royal Bank of Canada (2012). RBC Canadian water attitudes study- quick facts. Retrieved December 14th, 2012 from: <http://www.rbc.com/newsroom/2012/0322-water-study.html>

- Royal Bank of Canada (March 19, 2008). *Canadians over-confident in country's supply of fresh water new poll by Unilever and RBC reveals*. Retrieved May 3rd 2012 from: <http://www.rbc.com/newsroom/20080318water.html>
- Sclafane, S. (2011). Insurers 'green up' gray coverage Areas: Construction carriers tackling unique liability risks of green-building projects. *National Underwriter Property and Casualty*, January issue, 12-16
- Shaokai, L. & Mo, L. (December, 2009). The differences on risk perception ways in construction projects. *Paper presented at the first International Conference on Science and Engineering, Nanjing, China, 26-28 December 2009* (pp. 4556-4559). Chengdu, China: School of Economics and Management Southwest Jiaotong University. doi: 10.1109/ICISE.2009.1202
- Shartzler, S. (2007). Collaboration in construction. *Supply Chain Europe*, 16 (6), 50-51. Retrieved February 4, 2012 from: <http://web.ebscohost.com.ezproxy.library.uvic.ca/ehost/detail?sid=b265ff4d-1ec9-47dd-b376-d26f59a13fab%40sessionmgr111&vid=1&hid=106&bdata=JnNpdGU9ZWWhvc3QtbGl2ZSZzY29wZT1zaXRl-db=bth&AN=67116990>
- Slaughter, E.S. (1998) Models of construction innovation. *Journal of Construction Engineering and Management*, 124(3), 226–232. doi: 10.1061/(ASCE)0733-9364(1998)124:3(226)
- Slivka, J. (2011). Inexperience and unproven products: the risks of sustainable construction. *Risk Management*, 58(9) 6-8
- Soroczan, C. (1998). Regulatory Barriers to on-site water reuse. Retrieved May 5, 2013 from: <http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/98101.htm>
- Strassler, E., J. Pritts, and K. Strellec. 1999. Chapter 6: Costs and Benefits of Storm Water BMPs. Preliminary Data Summary of Urban Stormwater Best Management Practices. EPA Report No. EPA-821-R-99-012. Washington D.C.: U.S. Environmental Protection Agency, Office of Water. Retrieved May 10, 2012, from: http://www.epa.gov/waterscience/guide/stormwater/files/usw_d.pdf
- Sustainable Cities Institute (2012). Conservation subdivision design. Retrieved February 14, 2013 from: http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson_Conservation_Subdivision_Design
- Tarion (2013) About Tarion. Retrieved February 28, 2013, from: <http://www.tarion.com/About-Tarion/Pages/default.aspx>
- Texas Water Development Board (2012). Innovative water: Rainwater harvesting: Texas rain catcher award. Retrieved December 14th, 2012 from: http://www.twdb.state.tx.us/innovativewater/rainwater/raincatcher/award_details.asp
- Toole, T. M. (1998). Uncertainty and home builders' adoption of technological innovations. *Journal of Construction Engineering and Management*, 124(4), 323–332.
- Toronto and Region Conservation Authority (2013). The sustainable technologies evaluation program (STEP). Retrieved February 28, 2013, from: <http://www.trca.on.ca/the-living-city/monitoring/sustainable-technologies-evaluation-program.dot>

- Trauner, T. J., Jr.; Manginelli, William A.; Lowe, J. S.; Nagata, M. F. & Furniss, B. J. (2009). Construction delays: Understanding them clearly, analyzing them correctly (2nd Edition). Elsevier.
- UK Department for Communities and Local Government (2007). Planning Policy Statement: Planning and Climate Change Supplement to Planning Policy Statement 1. Retrieved November 6th, 2012. Available at: <http://www.communities.gov.uk/archived/publications/planningandbuilding/consultationplanningpolicy>
- UK Department for Environment, Food and Rural Affairs (2008) Future water: The government's water strategy for England. HM Government. Retrieved November 6th, 2012. Available at: <http://www.defra.gov.uk/publications/2011/06/16/pb13562-future-water/>
- UK Rainwater Harvesting Association (2012a) An introductory guide to rainwater harvesting systems. Retrieved November 6th, 2012 from: <http://www.ukrha.org/uk-rha-briefing-notes/>
- UK Rainwater Harvesting Association (2012b). UKRHA: About us. Retrieved December 14th 2012. Available at: <http://www.ukrha.org/about-us/>
- United States Department of Energy (2010). Guide to home water efficiency. Retrieved April 12, 2012. Available from: <http://energy.gov/energysaver/downloads/guide-home-water-efficiency>
- United States Department of Housing and Urban Development (2003). The practice of low impact development. Retrieved October 15, 2012 from <http://www.huduser.org/Publications/PDF/practLowImpctDevel.pdf>
- United States Department of Housing and Urban Development (2005). Overcoming barriers to innovation in the homebuilding industry. Retrieved October 15, 2012 from: <http://www.huduser.org/Publications/pdf/OvercomingBarriers.pdf>
- United States Department of Housing and Urban Development (2006). Characteristics of innovative production builders. Retrieved October 15, 2012 from: <http://www.pathnet.org/si.asp?id=2873>
- United States Environmental Protection Agency (2005). Stormwater phase II final rule: Post-construction runoff control. A fact sheet on the post-construction minimum measure. Retrieved December 16th, 2012. Available at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=5
- United States Environmental Protection Agency (2010). Post-Construction Stormwater Management in New Development and Redevelopment. Retrieved December 16th, 2012 from: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=5
- United States Environmental Protection Agency (2012). What is green infrastructure?: Rainwater harvesting. Retrieved December 16th, 2012 from: http://water.epa.gov/infrastructure/greeninfrastructure/gi_what.cfm - rainwaterharvesting

- United States Green Building Council (2009). The Legal Risk in “building green”: New wine in old bottles? A USGBC Panel Discussion. Retrieved April 12, 2012. Available at: http://www.seyfarth.com/dir_docs/publications/AttorneyPubs/White Paper_DBlake.pdf
- United States Environmental Protection Agency (February 8, 2012a). WaterSense. About us. The WaterSense label. Retrieved April 12, 2012, from: http://www.epa.gov/watersense/about_us/watersense_label.html
- United States Environmental Protection Agency, (2012b). Green building. Retrieved February 11, 2013 from: <http://www.epa.gov/greenbuilding/pubs/about.htm>
- Vancouver Economic Development Commission (2009). Green buildings in Vancouver. Retrieved January 28, 2013. Available at: <http://www.vancouvereconomic.com/userfiles/file/green-building-profile.pdf>
- Victoria Department of Sustainability and Environment (2012). Effective engagement: Design charrettes. Retrieved February 28, 2013, from: <http://www.dse.vic.gov.au/effective-engagement/toolkit/tool-design-charrettes>
- Western Resource Advocates (2010). Arizona water meter: A comparison of water conservation programs in 15 Arizona communities. Retrieved February 13, 2013. Available at: <http://www.westernresourceadvocates.org/media/pandp.php>

APPENDIX A: SAMPLE BACKGROUND INFORMATION PACKAGE - GROUP A

Water Sensitive Urban Design and Ontario's New Construction Industry

Green building and sustainable building practices integrate environmental sensitivity into designs and construction processes, and typically involve the adoption of innovations in building materials, technology, and improved water and energy efficiency (including alternative sources of water and energy). These methods of building often exceed Ontario Building Code requirements.

Water Sensitive Urban Design (WSUD; also referred to as Low Impact Development) is a sustainable building practice that takes a holistic, watershed approach to land use planning, water conservation, stormwater and wastewater management. WSUD includes the use of rainwater and greywater for buildings to reduce municipal potable water consumption, and beneficial stormwater management techniques. WSUD can be implemented on any scale of development, from large subdivisions to individual lots.

Innovative water technologies and practices found in WSUD present an opportunity for Ontario to reduce civil dependence on decaying and expensive water supply and stormwater infrastructure, protect local watersheds and aquatic ecology from non-point source pollution, protect the quality of drinking water sources, and significantly reduce the energy used and greenhouse gas emissions produced during municipal water and wastewater treatment and distribution.

The adoption of innovative building practices and technologies can bring numerous added risks to Ontario's building industry professionals. Overcoming these perceived and actual risks may assist the new construction industry in the adoption of green/sustainable building practices, such as WSUD. The adoption of WSUD by Ontario builders may prove to be a foundational step towards the province's realization of WSUD's social, economic, and environmental benefits.

Preparing for the interview

As a professional having experience with green/sustainable building or WSUD, you have likely been exposed to various types of risk associated with the adoption of these practices and technologies. The following 'top ten perceived risks of green building' may apply to projects that you have worked on in the past. Please take a moment to read over the ten broad themes. Consider specifically the risks that your organization has been exposed to in past building projects, and how those risks were managed. Are there any other risks surrounding WSUD that you may have experienced that do not fall within these categories?

When you have finished reading over the 'top ten', take a look at the interview questions. The questions will highlight the type of information that the researcher is seeking. Combined with the background information above, the interview questions may help you to consider the subject in more depth.

Please contact the Principal Investigator, Nicholas Buncic, at nbuncic@uvic.ca with any questions about the research or interview process.

Marsh Inc.'s top 10 themes of perceived risk associated with green building¹⁴

- 1) Brand and Competitive Edge/Reputation-** centers on the potential impact of green design, construction and ownership on a company's brand and reputation. This includes concern about green merely being a fad, or the opposite occurring where companies that forego building green lose competitive advantage and fail to attract tenants, buyers, as well as the best available talent (p.10).
- 2) Consultants/Subs-** these risks involve the challenges associated with identifying and using the right consultants, sub-consultants, and subcontractors on a project (p.9).
- 3) Education-** involves the need to have appropriate experience and education with respect to the green-built environment. Issues related to education include recruiting and retaining qualified staff, and having the ability to think through and resolve problems that may arise during a project requiring specialized green expertise (p.10).
- 4) Financial-** these risks relate to the impact of green design, construction and ownership on profitability, cost, and the ability to complete projects on budget (p.8).
- 5) Performance-** these risks center on the ability of products, systems and buildings to perform in a green environment (p.9).
- 6) Regulatory-** these exposures involve uncertainty about how the regulatory environment might evolve with respect to green building (p.9).
- 7) Return on Investment-** involves the ability to determine whether the benefits of green outweigh the costs. This category encompasses measuring ROI across various aspects of a project, including delays related to obtaining green building materials, investment in appropriate levels of LEED certification, uncertainty surrounding the long-term performance of green buildings, and the potential failure to attract tenants or buyers (p.10).
- 8) Standard of Care/Legal -** these risks center on determining and applying an appropriate standard of care and how the application of that standard might affect project participants (p.8).
- 9) Supply Chain-** involves issues related to the competence levels of employees, consultants and vendors with respect to green, control over contractors, including those farther down the chain, and the availability and timely delivery of specialized materials and those in short supply (p.10).
- 10) Technology-** involves concerns about the availability and use of technology suitable for green design, construction and ownership, as well as building green into Building Information Modeling and the potential lack of technological sophistication and experience of certain team members (p.10).

¹⁴ Adapted from Marsh Inc. (2009). Green Building: Assessing the Risks. Mark Feign. New York

APPENDIX B: INTERVIEW QUESTIONS GROUP A - BUILDERS AND DEVELOPERS

- 1) Could you briefly describe the innovative design features of one of your projects?
- 2) Could you tell me about design features that incorporate WSUD? (Such as alternative water sources, greywater recycling, stormwater management techniques, xeriscaping, etc.)
- 3) Were there any noteworthy programs, incentives, or actions by parties outside the project that encouraged the inclusion of innovative design features, such as sustainable design features/WSUD in the project? (For example government tax rebates or grants). If so, what were they?
- 4) Were there any noteworthy programs, incentives, or actions present relating to WSUD that you did not take advantage of? (Ex. stormwater management incentives) If so, what were they, and why did your organization not take advantage of them?
- 5) What were the primary motivations for including sustainable design features in the project? (Economic, social, environmental? ex. marketing strategy, green building certification, to save energy or operational costs, reducing greenhouse gas emissions, consumer demand, ethical reasons etc.)
- 6) What were the primary motivations/ drivers for including WSUD features in the project? (Economic, social, environmental? ex. response to drought, location relative to a municipal supply, marketing strategy, green building certification, to save energy or operational costs, reducing greenhouse gas emissions, consumer demand, ethical reasons etc.)
- 7) What risks to your organization do you associate with the inclusion of innovative water technologies and practices in construction projects, such as rainwater harvesting and greywater recycling? In commercial projects? In residential housing projects?
- 8) Out of these top 10 risks (Marsh, 2009) which ones most applied to WSUD elements in your project? How were each of these risks managed?
- 9) Are there any other risks that applied that were not mentioned in these top 10? How were they managed?
- 10) Are there any particularly effective methods or mechanisms that were used to reduce innovation risk in your project? For sustainable building elements? For WSUD elements?
- 11) Do you feel that overall risk was reduced on the project, or was it shifted to be assumed by particular parties?
- 12) Have there been any changes that you are aware of since the completion of the project, such as in the marketplace or regulatory environment etc., that would have a material effect on the risks associated with adopting WSUD?
- 13) What are the next steps or actions that industry and government in Ontario should take to help builders overcome risk aversion to adopting WSUD?
- 14) Are there any lessons learned from your experience with innovative water technologies and processes that may help government, industry associations, or other building professionals overcome associated risks?

APPENDIX C: INTERVIEW QUESTIONS GROUP B - ONTARIO BUILDING/GREEN BUILDING ORGANIZATIONS

- 1) Have there been any noteworthy programs, incentives, or actions by outside parties (such as tax rebates or grants) that encouraged the adoption of innovative products, designs, or processes by any of your members? If so, what were they?
- 2) Have there been any noteworthy programs, incentives, or actions by outside parties (such as tax rebates or grants) that encouraged the inclusion of sustainable design features/WSUD in any of your members' projects? If so, what were they?
- 3) Have there been any specific programs, incentives, or actions present relating to encouraging building innovation or WSUD that your organization's members did not take advantage of? (Ex. stormwater management incentives) If so, what were they, and why did your members not take advantage of them?
- 4) What have been the primary motivations/drivers for including sustainable design features in new construction projects? For residential developments? For commercial developments? (Economic, social, environmental? ex. marketing strategy, green building certification, to save energy, operational costs, reducing greenhouse gas emissions, consumer demand, ethical reasons etc.)
- 5) What have been the primary motivations/drivers for including WSUD in new construction projects? For residential developments? For commercial developments? (Economic, social, environmental? Ex. response to drought, location relative to a municipal supply, marketing strategy, green building certification, to save energy or operational costs, reducing greenhouse gas emissions, consumer demand, ethical reasons etc.)
- 6) How often are WSUD elements included in a project's sustainable design features?
- 7) What risks to your members do you associate with the inclusion of innovative water technologies and practices in their construction projects, such as rainwater harvesting and greywater recycling? In commercial projects? In residential housing projects?
- 8) Out of these top 10 risks (Marsh, 2009) which risks would most apply to WSUD elements in your member's projects? How would these risks be managed?
- 9) Are there any other risks that apply that were not mentioned in these top 10? How would they be managed?
- 10) Are there any particularly effective methods or mechanisms that have been used in the past to reduce innovation risk in your members' projects? For WSUD elements? For sustainable building elements?
- 11) What are the next steps or actions that industry and government should take to help builders overcome risk aversion to adopting WSUD?
- 12) Are there any lessons learned from your experience, or your members' experiences with adopting building innovations such as WSUD that may help government, industry associations, or other building professionals overcome the associated risks?

APPENDIX D: INTERVIEW QUESTIONS GROUP C- ONTARIO GOVERNMENTS AND PUBLIC SECTOR AGENCIES

- 1) Have there been any noteworthy programs, incentives, or actions taken by any level of government (such as tax rebates or grants) that encouraged the adoption of innovative products, designs, or processes by building industry professionals? If so, what were they? Were they successful?
- 2) Have there been any noteworthy programs, incentives, or actions taken by any level of government (such as tax rebates or grants) that encouraged the adoption of sustainable design /WSUD practices by Ontario's building industry? If so, what were they? Were they successful?
- 3) Were there any specific programs, incentives, or actions taken by any level of government relating to encouraging building innovation or sustainable building that building industry professionals did not take advantage of? If so, what were they, and why did building professionals not take advantage of them?
- 4) What have been the primary motivations/drivers for including sustainable design features in new construction projects? For residential developments? For commercial developments? (Economic, social, environmental? ex. marketing strategy, green building certification, to save energy, operational costs, reducing greenhouse gas emissions, consumer demand, ethical reasons etc.)
- 5) What have been the primary motivations/drivers for including WSUD in new construction projects? For residential developments? For commercial developments? (Economic, social, environmental? Ex. response to drought, location relative to a municipal supply, marketing strategy, green building certification, to save energy or operational costs, reducing greenhouse gas emissions, consumer demand, ethical reasons etc.)
- 6) From the builder's perspective, what risks do you associate with the inclusion of innovative water technologies and practices in construction projects, such as rainwater harvesting and greywater recycling? In commercial projects? In residential housing projects?
- 7) Are there any particularly effective methods or mechanisms that have been used in the past to reduce innovation risk for building industry stakeholders? For WSUD elements? For sustainable building elements?
- 8) What role can municipal or regional governments play in reducing builder risk aversion to adopting sustainable design practices? WSUD?
- 9) What role can the Provincial government play in reducing builder risk aversion to adopting sustainable design practices? WSUD?
- 10) What role can conservation authorities play in reducing builder risk aversion to adopting sustainable design practices? WSUD?
- 11) Could current governance structures be reorganized or redefined to assist the private sector in overcoming risk aversion to help mainstream sustainable building practices and WSUD in a meaningful way? If so, what might this look like? (Ex. between different public sector organizations, local, regional and provincial governments, conservation authorities, etc.)
- 12) Do you see any potential for public-private partnerships as a means to overcome these risks? (Ex. insurance companies, building organizations, actors in the supply chain etc.) If so, in which ways?
- 13) What are the next steps or actions that industry and government should take to help builders overcome risk aversion to adopting WSUD?
- 14) Are there any lessons learned from your experience with building innovations such as WSUD that may help government, industry associations, or other building professionals overcome the associated risks?

APPENDIX E: INTERVIEW QUESTIONS GROUP D - CANADIAN INSURANCE

INDUSTRY REPRESENTATIVE

- 1)** Out of Marsh's 'top ten', which risks to builders and developers do you most strongly associate with the inclusion of innovative water technologies and practices in construction projects, such as rainwater harvesting and greywater recycling? In commercial projects? In residential housing projects?
- 2)** Are you aware of any particularly effective methods or mechanisms used in the past to reduce innovation risk in new construction projects? For sustainable building elements? For WSUD elements?
- 3)** Based on available and current literature, the consensus is that the owners and managers of green buildings and properties are considered 'good risk' in the realm of Property & Casualty insurance. When it comes to the constructors of sustainable buildings or the developers of sustainable communities, are they considered 'good risk' for Commercial General Liability insurance?
- 4)** Could you describe the characteristics of the Green insurance market in Canada? What types of products are there that may be relevant? Is it a rapidly growing area?
- 5)** Are there any insurance products on the market that could address innovation adoption risks in new construction associated with sustainable building practices or WSUD? (ex. AIGRM Green, ACE, Chartis Green Reputation Endorsement)
- 6)** The IBC rain barrel project in Wingham, Ontario identified WSUD elements as a potential tool in mitigating the dramatic rise in water-related insurance claims in Ontario over the past ten years. What is the interest level surrounding WSUD, and how does Ontario's insurance industry generally regard its potential/feasibility for mainstream application?
- 7)** What are the various motivations and drivers behind the Canadian insurance industry's interests in WSUD?
- 8)** How might the insurance world encourage contractors and developers to adopt WSUD elements? (and thereby promote its own interests)
- 9)** Do you see any potential for public-private partnerships as a means to overcome these risks? (Local, regional, provincial & federal governments, building organizations, actors in the supply chain etc.) If so, in which ways?
- 10)** What are the next steps or actions that industry and government should take to help builders overcome risk aversion to adopting WSUD?
- 11)** Are there any lessons learned from your experience with building innovations such as WSUD that may help government, industry associations, or other building professionals overcome the associated risks?

APPENDIX F: INTERVENTIONS THAT HAVE ENCOURAGED INNOVATIVE BUILDING PRACTICES

The following interventions found in Table 7 were identified by interview participants as having encouraged innovative building practices. Additional interventions were also contained in the interview responses and can be found in tables below.

TABLE 7: INTERVENTIONS TO ENCOURAGE INNOVATIVE BUILDING PRACTICES

| Interventions identified as having encouraged innovative building practices | |
|--|---|
| Building certification programs <ul style="list-style-type: none"> • LEED for homes • LEED for condos • Energy Star • Blue Built Home (City of Guelph; water specific) | Technology feasibility/evaluation <ul style="list-style-type: none"> • TRCA Sustainable Technologies Evaluation Program • Guelph Greywater reuse feasibility study |
| Product labeling <ul style="list-style-type: none"> • WaterSense (USEPA, adopted by Ontario) | Enhanced Municipal stormwater requirements <ul style="list-style-type: none"> • Mandated infiltration trenches (City of Kitchener) |
| Provincial government initiatives <ul style="list-style-type: none"> • Water Opportunities Act; WaterTAP • Showcasing Water Innovation (funding initiative) • Great Lakes Protection Strategy | Federal government initiatives <ul style="list-style-type: none"> • Federal government incentives for energy conservation that relates to heat savings |
| Utility/service provider incentive programs <ul style="list-style-type: none"> • Enbridge Savings by Design • Union Gas Optimum Home • Reliance Home Comfort Builder Program • Ontario Power Authority- 'Save on Energy'- Incentives for new construction | Pilot development projects- development incentives <ul style="list-style-type: none"> • Sustainable Water Development Initiative pilot project (York, Newmarket, TRCA, Enbridge; expedited approvals) • Green Permit Program pilot (Municipality of Clarington; expedited approvals) • Sustainable Homes Incentive Program (York Region; water/wastewater allocation incentive) |
| Contests <ul style="list-style-type: none"> • The Equilibrium initiative (Canada Mortgage and Housing Corporation) | International initiatives <ul style="list-style-type: none"> • US Federal Builder tax credit • Seattle Public Utilities and King County's Waterworks program- building certification incentive |
| Additional interventions discovered in the interviews | |
| Technology feasibility/evaluation <ul style="list-style-type: none"> Maximum Performance Testing (CMWEN) | Knowledge and information transfer <ul style="list-style-type: none"> • Local Energy Efficiency Pilot (NRCan) • Technology Adoption Pilot (EnerQuality) |

| | |
|---|--|
| <p>Guidelines</p> <ul style="list-style-type: none">• Solar Ready Guidelines (NRCan)• Alternative Water Ready Guidelines (CMHC/ University of Guelph) | |
|---|--|

APPENDIX G: RISK MANAGEMENT STRATEGIES THEMES

The following tables 8 through 11 present RM strategies and action themes identified in interview responses.

TABLE 8: RISK MANAGEMENT STRATEGIES GROUP A

| Group A: Builders and developers | | |
|----------------------------------|---|--|
| | Risk Management Strategy | RM Themes |
| 4A | Describe and document potential limitations of GWR and RWH for clients; Manage expectations, and then match performance to expectations | Document expectations |
| | Document and explain risk and responsibility to the end user | Documentation/education |
| | Do not extend into SBP or WSUD products/services that other builder/developers may be doing unless there is a firm understanding of these products/services, what the risks are and how those risks may be managed | Knowledge & experience |
| | Commercial construction- If the builder/developer does not have a lot of experience with SB/WSUD features, ensure that construction contracts are based on prescriptive specifications in the design versus performance specifications to be met | Avoid performance guarantees |
| 5A | Retain in-house staff that can focus time and attention on options, solutions, alternate products; having somebody who knows what they're doing is very effective | Knowledge and experience/ Enhanced planning |
| | Include all the interested parties as partners in the project (ex. municipalities, CA's, suppliers of the innovative technology, related trades) and collaborate. As the project progresses, common purposes and objectives are established and interests are aligned. | Collaboration/ Enhanced communication |
| 8A | Engage in dialogue with those approving your project to help move the process along, and sell innovative features as enhanced parts of the project | Enhanced communication |
| | Develop expertise of the innovative features that are being included in the project so that those that you're trying to convince or sell to can be properly educated, including building approvals staff and homebuyers | Education/ Knowledge and experience |
| | Ensure that innovative features have value and make a good, positive contribution | Value added |
| | Municipalities are beginning to have expectations that higher building standards should be met. Through adapting to higher standards, coming forward and 'stepping up', it is more likely that a builder/developer's project will be prioritized over other standard projects in the approvals process, which reduces risks associated with longer approval times | Adopt best practices/ 'Be a better builder' |
| 9A | Take advantage of expert knowledge of partners in collaborations or pilot projects | Collaboration/ Knowledge & experienced personnel/ Information transfer |
| 13A | Organize interested parties in an innovative project and establish common goals and a common purpose | Collaboration/ Enhanced |

| | | |
|-----|--|---|
| 13A | Organize interested parties in an innovative project and establish common goals and a common purpose | Collaboration/ Enhanced communication |
| | Establish clear roles and responsibilities between the partners of the project, while sharing overall risk | Clear roles and |

TABLE 9: RISK MANAGEMENT STRATEGIES GROUP B

| Group B: Building organizations | | |
|---------------------------------|--|---|
| | Risk Management Strategy | RM Themes |
| 16B | Cash incentives can be used to pay for consulting fees to achieve higher levels of building certification, or to pay for innovative technologies themselves | Cash Incentives |
| | Marketing incentives, such as providing case studies, or links to magazine/newspaper articles, can be used where no funding is available to gain publicity for a building project and help reduce some of the risk in the builder's mind | Marketing Incentives/ Risk recognition |
| 19B | Builders and building officials need to become more educated on these features. Building officials need to become proactive about learning the technologies, and open to innovation | Education/ Culture shift |
| | Builders should go with recognized standards so building officials will be less averse to signing off on them | Standards |
| 20B | Firstly you have to "debug" the technology, then those involved with the installation have to be trained and learn how to install the technology properly | Training |
| | Technologies have to be fully vetted- this entails field testing the technologies a large number of homes equal to or larger than a typical residential development | 3rd party testing of technologies |
| | DC rebates | Development charge rebates |
| 21B | Once technologies are 3rd party tested and have a logo, consumer confidence improves and this improves the chances of uptake for the technology | 3rd party testing/ Branding |
| | Alternative Ready Guidelines- document being developed by CMHC provides guidance for industry to plumb houses in anticipation of retrofitting for alternative water sources at little or no risk to builders | Guidance/ Standards |
| 22B | GWR is less intimidating to builders on a communal scale where there is dedicated operations and maintenance staff- for example in condominiums | Dedicated O&M Staff |
| | Commercial and industrial projects pose less risk to builders for alternative water sources than residential, because professional operations and maintenance staff maintain facilities | Dedicated O&M Staff |
| | "Be a better builder"- adopt higher efficiency as a standard in your product- don't try and sell energy efficiency as an upgrade, because it will be competing with other, more visible upgrades like granite counter tops | Adopt best practices/ Be a better builder |

TABLE 10: RISK MANAGEMENT STRATEGIES GROUP C

| Group C: Municipal, regional, and provincial government agencies | | |
|--|---|---------------|
| | Risk Management Strategy | RM Themes |
| 1C | Create teams that include interested parties and a variety of expertise | Collaboration |

| | | |
|---------|---|---|
| 3C | An expedited approvals process can be used as a mechanism to reduce risk | Expedited approvals |
| | 3rd party verification of WSUD technologies and stormwater controls can reduce risk | 3rd party testing |
| 6C | More certainty in the regulatory review process- currently there's a lot of uncertainty around regulatory review, and builders are wary of a lengthy review | Approvals process |
| 7C | Education and training of municipal professionals- when someone brings a project to them they should know what they are looking for | Education |
| | Support and resource from the government while in the transition phase | Government support |
| | Vetting of technologies by the appropriate authorities | 3rd party testing |
| | Well developed municipal guidance documents that are easily accessible and set out clear expectations to the builder | Municipal guidance/ Approvals process |
| 11& 12C | Referencing widely recognized national standards and guidelines within the building code, and setting water quality targets for stormwater reuse- this provides direction, and minimizes risk to builders who are interested in RWH and reduces uncertainty around RWH for municipal inspectors | Building code guidance/ standards |
| | Including prescriptive tables in the Ontario Building Code far in advance to give early adopters guidance to innovate (building above current code) while working towards what would ultimately be code compliance in future, as Code requirements step up | Building code guidance/ standards |
| 14C | 3rd party verification/testing of technologies, such as Maximum Performance Testing that is conducted for toilets | 3rd party testing |
| | Developing standards for WSUD technologies, such as the CHMC is currently developing with CSA | Standards |
| | Pilot projects that are facilitated and supported- technically and financially- by municipal/regional governments; Pilot projects reduce risk to builders/developers and develop capacity for building professionals and municipalities | Pilot projects/ Collaboration/ gov. support |
| | Expedited approvals reduces time risks for builders | Expedited approvals |
| 15C | Expedited approvals save builders/developers time and money | Expedited approvals |
| | Collaborative efforts/ pilot projects reduce risk to the builder/developer by sharing risk with the other partners involved | Collaboration/ pilot projects |
| | Getting all the players around the table to talk about the development so everyone can see everyone else's perspective and concerns are | Collaboration |
| 17C | Have a third party at arms length to the builder/developer take responsibility for the installation and possible maintenance of the alternative water system | 3rd party installation and maintenance |
| | Pilot programs as a capacity building exercise- share the risk amongst the partners in the pilot program, and ensure that the necessary expertise is part of that collaboration, and that support exists where you need it | Collaboration/ pilot projects |

TABLE 11: RISK MANAGEMENT STRATEGIES GROUP D

| Group D: Canadian insurance industry representative | | |
|---|---|-----|
| 2D | No way to encourage builders to overcome the risk- "in this case I believe it is truly a matter of [lack of] demand and [lack of] need" | N/A |

APPENDIX H: LESSONS LEARNED

TABLE 12: LESSONS LEARNED WITH SBP/WSUD

| Lessons learned: Experiences with SBP/WSUD | |
|--|---|
| 5A | To mainstream a technology, it's important that it's something that homeowners don't have to think about; there should be little to no operations and maintenance requirements; "we have a hard enough time getting people to even change their furnace filters- that's the number 1 HVAC call in North America" -passive technologies require less maintenance than active ex. raingarden vs. rainwater harvesting |
| 8A | Not all sustainable technologies work well. The industry is very unorganized right now, there is a lot of greenwashing out there, and people don't generally understand these technologies very well. Make sure that you understand these technologies and products 'going forward' |
| 13A | It's better to make a lot of mistakes with WSUD over a short period of time and learn quickly rather than drag the learning process out over time |
| 18A | It is better to set low expectations and over deliver than to set high expectations and under deliver |
| 23A | When pursuing a project with SBP/WSUD, start the process early- it takes more time to receive approvals and to educate all the parties involved in the project |
| 16B | Ensure that the technologies being used in a program are well vetted and that the supply chain is in place for support. Should the technologies or products fail, critics will highlight and dwell on this failure, "and people will be averse to using the products and technologies for years to come." For example, the original no VOC paints |
| 19B | A builder that is not open to change will not have longevity |
| | Builders will not seek education on various building products or processes unless they are driven by the building code to do so, or by the demands of informed consumers. If there's no consumer demand, and it is not required by the building code, there is no motivation for further education |
| 20B | Innovation in the building industry is a path of continual improvement. If builders adopt a path of continual improvement over time, they become better builders and reduce their risk |
| | The innovation risk for production builders is far greater and products and technologies have to work; they require extra time to manage change |
| | Programs have to make sense to builders. If they are too complicated or costly, they will not participate |
| | It is better to have wider market penetration and shallower savings in energy efficiency/ green building programs than requirements that are too steep- the aggregate GHG reduction is much greater with higher participation. If the bar is set too high, then participation rate is much lower and the objective of reducing GHG is not met with the same success |
| 21B | In order for alternative water technologies to have potential of surviving in the marketplace, performance standards are critical |
| | When a technology fails, it is important to conduct a post mortem to determine the reason why it failed- was the technology itself the cause, or was it because of faulty maintenance? There is an important distinction between these two causes of failure |
| 22B | 'Necessity is the mother of invention'- when it appears that there are abundant resources, and no immediate threat, there is no motivation for behavioural change |
| | Passive alternative water technologies tend to be less risky for builders than active systems because they don't break down as frequently |
| | In times of transition, government must convince builders of the value of a new program and support them through incentives to provide a secure environment for experimentation |
| | People don't want to pay for things they can't see (i.e. building features hidden within the structure of the house) |
| | Regulatory instability factors into the issue of adoption- programs and support are only as safe as the term in which the government is still going to be in power |
| | Programs that often keep changing on builders can take an emotional toll, as it can create big problems for them. This may turn builders wary of these voluntary programs |
| | The top 25% of the market controls the direction of the market. If you can change the top 25%, you can change the whole market |

| | |
|-----|---|
| 6C | Municipalities should absorb green development standards and WUSD into their official plans. A culture that venerates principles of sustainable development needs to be fostered in municipal staff by upper management. It becomes surprisingly easy to work with a municipality after this happens. |
| 14C | Municipalities and municipal approvals offices should not assume reluctance of the building industry to engage in innovative projects; it never hurts to ask builders directly whether they would be interested in partnering or piloting an innovative project |
| 15C | Regular, high quality communication between parties in a project is very important, and saves time for all parties involved |
| 17C | Selecting the right partner is key for a successful partnership: "The appropriate partners not only bring that expertise to the table, but ensure that you can evolve to access resources you wouldn't be able to if you were working in a silo." |

Lessons Learned: Programs and Initiatives

Lessons learned also involved discussion around programs that were ineffective, had less than ideal uptake or poor outcomes. One participant from the development community described an initiative in which a town in one of the regions of the GTA became a developer with the agenda of promoting sustainable building within their community. The participant described the town's development requirements as overly restrictive, and as a result they had a difficult time selling off the lots to builders. The lesson in this was that public agencies and municipalities shouldn't try and push forward development related policy objectives by taking on the role of developer; they should work within the current economic framework and development models that exist. In this participant's view, government should stick to governing, and business will take care of business.

A participant in the development community of the Northwestern United States spoke about a program called Community Power Works. The program was one of a number of local distributors of a federal incentive through the American Reinvestment and Recovery Act (ARRA). The uptake has improved since the program's roll out, however the program was highly underutilized for the first year, something that the participant attributed to the way the program was structured. The lesson in this account was that program designers creating programs intended to deliver funding should make sure that funding is available to the target group in a timely manner, and should be wary of onerous requirements or structural barriers that prevent uptake.

Another participant representing one of Ontario's regional governments described the issues they were having with the uptake of some of their programs. The region has a sustainable building program targeting the new housing market that uses development incentives in return for meeting various sustainable design criteria. The region's housing program had seen zero uptake at the time of the interview. In discussion, the participant reflected that "the percentage or allocation [developers] would get in the grand scheme of things with regards to overall development just wasn't enough, and it was one more thing for them to have to go through." Their LEED program for multi-unit has seen only slightly better results with the development community: "A lot of them don't like the 3rd party verification. That's a barrier for them... because it's more work; it takes more time" (Participant 15C). The lesson in the poor uptake of these programs is that incentives have to be meaningful enough to make builders want to adjust their business practices, otherwise the builder sees program requirements as burdensome and perceives little value in participating.