# Policy Direction to Fast Track Low Impact Development (LID) Technologies Across Canada

A white paper prepared for the Canadian Water Network research project:
"An Integrated Risk Management Framework for Municipal Water Systems"

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# pt 1. introduction

Urbanization has increased significantly within the last few decades.. In 1950, 30% of the world's population was urban (United Nations, 2014). In 2014, 54% of the world's population is residing in urban areas with a projection to rise and reach 66% by 2050 (United Nations, 2014).

Urbanization offers advantages to national economics by reducing poverty and improving people's well-being (United Nations, 2011). In contrast, it also brings challenges to conventional stormwater management (Marsalek & Schreier, 2010). Urbanization increases storm water runoff volume leading to erosion, flooding and the degradation of water quality and ecosystem health (CVC & TRCA, 2010; Tsihrintzis & Hamid, 1997; Damodaram et al, 2010). Furthermore, conventional stormwater management is facing more challenges associated with aging infrastructure and climate variability (Marsalek & Schreier, 2010).

One of the most urbanized nations in the world is Canada, with 80% of its citizens living in urban areas. (Bradford, 2005). According to Insurance Board of Canada report, catastrophic events cost roughly $1.6B in 2011 and almost $1B in each of the two previous years (IBC, 2012). The majority of these insured losses was caused by Canada's aging infrastructure that is not capable of capturing volumes of water from high level of precipitation (IBC, 2012). One of the offered solutions towards this problem is by implementing innovative storm water technologies such as low impact development (LID) technology.

The Credit Valley Conservation (CVC) Authority and Toronto Regional Conservation Authority (TRCA) define LID as "stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible.

LID comprises a set of site design strategies that minimize runoff and distributed, small scale structural practices that mimic natural or pre-development hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration and detention of stormwater" (CVC & TRCA, 2010). This technology includes and is not limited to rainwater harvesting, green roofs, infiltration trenches and chambers, bioretention, permeable pavement, enhanced grass swales, dry swales, and perforated pipe systems (CVC & TRCA, 2010).

This project reviewed more than 250 publications on the effectiveness of LID and concludes that LID practices show great potential for mitigating the effects of urbanization and land development on hydrology and water quality (Ahiablame et al., 2012).

While showing great potential, implementing these technologies is not without impediments to overcome (Roy et al, 2008). Thus, the objectives of this paper are to find an answer to these questions (1) How do we adopt innovative technologies such as LID? (2) What are the barriers or impediments in adopting LID technologies? (3) How do we reduce barriers to adoption?

This paper will first touch upon the Diffusion of Innovation theory to provide an understanding in innovation decision process and attributes in adoption. Secondly, it provides a literature review to identify barriers and solutions to LID adoption providing an process to further accelerate adoption. Finally interviews were conducted to verify the theoretical findings, and the findings are discussed.

# pt 2. the diffusion of innovation theory

This research applied Roger's (1995) Diffusion of Innovation (DOI) theory to understand the general idea of innovation adoption process. Rogers (1995) describes innovation as an idea, practice or objective perceived as new by an individual, a group, or organization (Rogers, 1995). Rogers (1995) describes diffusion as a process through which an innovation is communicated over time through certain channels (interpersonal or mass media) among members of a social system (Rogers, 1995). The main elements in the diffusion of new ideas are (1) innovation (2) communication channels (3) time, and (4) the social system (Roger, 1995).

A communication channel is the means by which a message gets from a source to a receiver. Communication channels can be either interpersonal or mass media in nature. Mass media channels are modes of transferring messages that involve a mass medium such as television, newspapers, radio that enable a source of one or a few individuals to reach an audience of many. Interpersonal channels involve a face-to-face exchange between two or more individuals (Rogers, 1995).

A social system is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. A system has structure that is defined as the patterned arrangements of the units in a system, which gives stability and regularity to individual behavior in a system (Rogers, 1995).

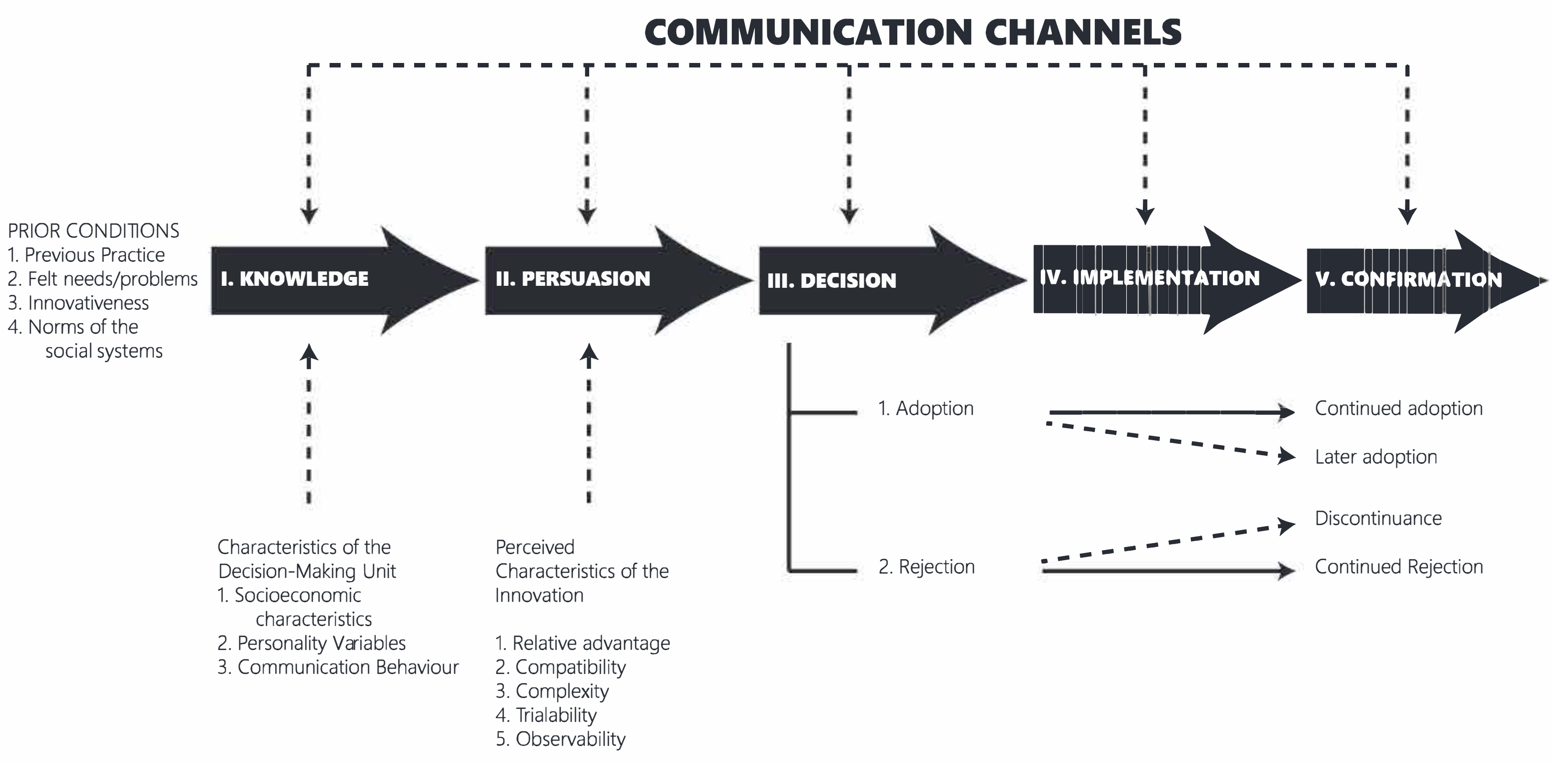
The innovation-decision process is the process through which an individual (or other decision-making unit) passes (1) from first knowledge of an innovation, (2) to forming an attitude toward the innovation, (3) to a decision to adopt or reject, (4) to implementation of the new idea, and to (5) confirmation of this decision (Rogers, 1995).

The characteristics of an innovation, as perceived by the members of a social system, determine its rate of adoption (Rogers, 1995). Attributes that contribute to its rate of adoption are (Rogers, 1995):

- Relative advantage: the degree to which an innovation is perceived as better than the idea it supersedes.
- Compatibility: the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.
- Complexity: the degree to which an innovation is perceived as relatively difficult to understand and to use.
- Trialability: the degree to which an innovation may be experimented with on a limited basis.
- Observability: the degree to which the results of an innovation are visible to others.

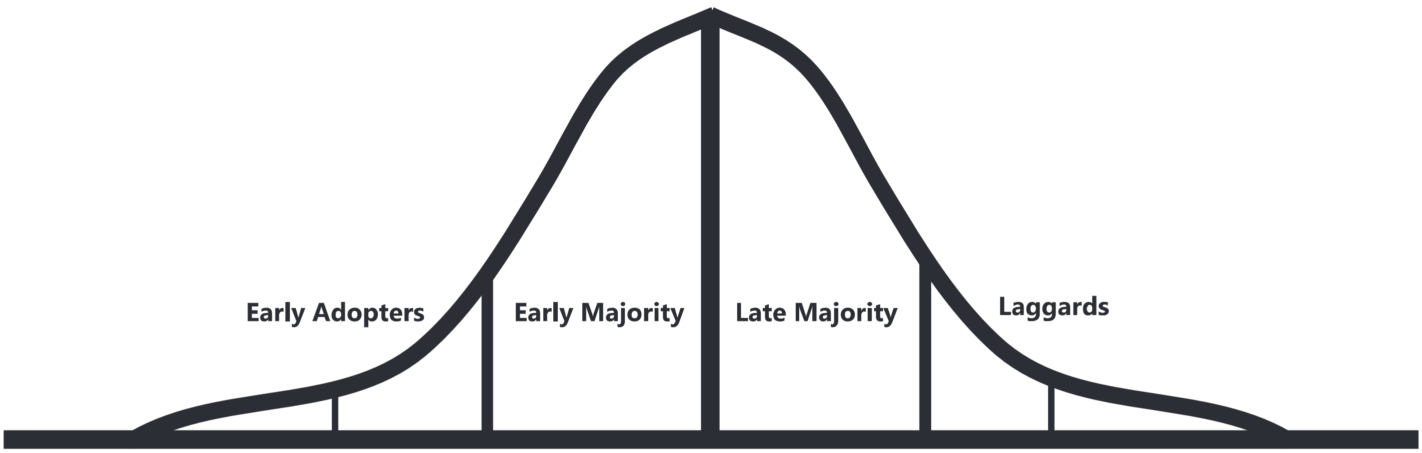
Relative advantage, compatibility, trialability and observability of an innovation as perceived by members of a social system are positively related to its rate of adoption. In contrast, complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption (Rogers, 1995).

The following figure illustrates the innovation decision process:




Source: (Rogers 1995)

Rogers (1995) then describes five adopter categories, or classifications of the members of a social system on the basis on their innovativeness, (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards:




Source: (Rogers 1995)

Research has shown that there are 3 common differences between earlier and later adopters of innovation:

1. Socioeconomic status,
2. Personality variables, and
3. Communication behavior (Rogers, 1995).

First, in a social system earlier adopter are no different from later adopters in age, but they have more years of formal education, have higher social stature, and a greater degree of upward social mobility. Thus, in this case it indicates that earlier adopter have generally higher socioeconomic status than do later adopters (Rogers, 1995).

Second, earlier adopter differs from later adopters in personality variables. For example, earlier adopters have greater empathy, greater rationality, a more favorable attitude toward change, a greater ability to cope with uncertainty and risk and a more favorable attitude toward science (Rogers, 1995).

Third, adopter categories have different communication behavior. Earlier adopters are more highly interconnected in the interpersonal networks of their system, have more social participation, greater exposure to mass media channels, engage in more active information seeking and greater exposure to interpersonal communication channels (Rogers, 1995).

# pt 3. barriers to LID adoption

After providing an understanding of the innovation decision process and the attributes of rate adoption, the next step is to understand the barriers to LID adoption. This section highlights literature drawn from journals, technical reports, case studies, government publications, thesis, dissertation, project summaries and conference proceedings. Literature review in this section was focused on the LID barriers to adoption cases from Canada and United States.

## 3.1 EDUCATIONAL BARRIERS

The first common barrier identified in the literature is that surrounding education. Examples of educational barriers are lack of basic understanding of planning and the impact of growth (Godwin et al, 2008), lack of knowledge (AUMA, 2012; STAC, 2002;), lack of information (LaBadie 2010) and technological acceptance (Cote , & Wolfe , 2014).

There is lack of knowledge on how to maintain these techniques/procedures, how it could perform in different climates (LaBadie 2010; Primeau et al 2009) and also lack of information on how to design, construct and fund (LaBadie 2010). Bracken (2011) mentioned that lack of information and awareness becomes barriers in implementation in LID technology such as green roof, bioswales and rain garden several (Bracken et al, 2011). Thus, it is important to provide knowledge of what LID is and how it works especially for LID systems in private development as they will not function in the long – term due to lack of proper maintenance (Peebles Wade 2012; Cote & Wolfe , 2014). This lack of education occur not only in the public sector but also in the local utility staff, the development and consulting industries (Clean Water American Alliance, 2011; Katherine, 2010).

## 3.2 OVERCOMING EDUCATIONAL BARRIERS

There are several solutions to overcome the educational barriers:

- Introduce LID through workshops or community hearings (Primeau et al 2009; Godwin et al 2008; Roy et al 2008). This allows two-way conversation, where the policy makers can introduce LID technology while getting direct feedback on how this technology can be made acceptable and thereby implemented within the community. It would be at best if developers, contractors, and a variety of other professionals join the education process to gain support and acceptance of these techniques and to overcome issues related to design, maintenance and funding (Katherine L, 2010). Furthermore, this community involvement provide a good educational/information process for the residents as they are both involved in the design process and understand the cost limitation associated with LID practices (Primeau et al 2009).
- Establish pilot projects. Showcasing LID has been successful at promoting water conservation techniques (Primeau et al 2009).
- Encourage volunteer involvement. Volunteer involvement promotes grass root support and engagement which improves the continuity of the project as challenges arising over it's implementation and maintenance.. Furthermore, it allows opportunity for "champion" volunteers to remain with the project for several years (Primeau et al 2009).

## 3.3 TECHNICAL BARRIERS

It has been more than a decade since the first known LID implementation in Prince George's Country in Maryland. The number projects LID continue to grow, however, there is still lack of technical support causing a barrier for widespread adoption (Tian 2011). Technical barriers include lack of design standards and maintenance guidance (Clean Water America Alliance, 2011; Roy et al., 2008; CVC, 2012; Primeau et al. 2009), lack of data demonstrating performance and cost (Roy et al., 2008). In some cases technical barriers are coming from the overly restrictive development of guidelines and standards, which makes it not conducive to the approval of green developments (Primeau et al. 2009). Furthermore, limited expertise on planning and design also becomes a technical barrier, which is the second highest barrier of LID adoption based the AUMA survey in Alberta (AUMA, 2013).

The Clean Water American Alliance conducted a survey across North America in 2011 that involved private, non-profit and academic entities asking about barriers to green infrastructure (including LID). Many respondent are concerned with the risk due to the lack of available data on cost, maintenance requirements and long term performance under different climate, soil type and flow regimes (Clean water American Alliance, 2011). Another survey conducted in Kitchener indicates that Kitchener residents are more likely to adopt permeable surface once technical barriers are resolved (Cote & Wolfe 2014). Perceptions of uncertainty and risk have a strong influence on the rate of LID adoption and implementation decisions (Olorunkiya et al. 2012).

## 3.4 OVERCOMING TECHNICAL BARRIERS

There are several potential solutions to overcoming technical barriers to LID adoption:

- Establish pilot projects. Both research and pilot projects have removed many of the technical barriers by demonstrating efficient approaches in treating and controlling stormwater runoff (Gearheart 2007).
- Support the development of open source database information on LID. Demonstrated projects and informed data would help improve design and implementation (Clean Water Alliance America, 2011). In the US, information on Best Management Practices performance are shared in an open source website that is available at: http://www.bmpdatabase.org/index.htm. The website provides information on BMP performance analysis results, studies, tools for use in BMP performance studies, monitoring guidance and other study-related publications (International Stormwater BMP Database, 2014).
- A similar site is available for LID technology called innovation stormwater management practices (http://www.iswm.ca). This site provides information on existing applications of innovative stormwater management practices including LID.
- Develop LID performance standards and guidelines. Edmonton has shown its support towards eliminating the technical barrier by providing LID guidelines (City of Edmonton, 2014). The Greater Vancouver Regional District have also developed Stormwater Source Control Design Guidelines to promote innovative design including extensive green roof, infiltration swales, pervious paving, infiltration trench and rain garden (Local Government Department B.C, 2014).
- Educate local staff and developers. Education on LID to local staff and developers can help provide relevant information's to change perceived risk and misconception. This could be carried out through workshops, in person training, training certification program or even tutorials available on the web (CH2MHill, 2008).

## 3.5 FINANCIAL BARRIERS

Financial barriers include increase maintenance cost, need for professional training or educational development cost (Roy et al. 2008) and lack of funding incentives (LaBadie, 2007; Clean Water Alliance America 2011). A recent survey conducted in Alberta by AUMA stated that financial barriers become the highest primary barrier of LID adoption (AUMA 2012). This is also the case for private land ownership, where installation cost is a major barrier prior to implementation (Cote & Wolfe 2014).

Whiles LID can result in cost saving ranging from 15%-80% compared with conventional stormwater technologies (EPA, 2007), most developers believed that low impact designs will have greater cost for both approval time and site development (Bowman & Thompson 2009).

## 3.6 OVERCOMING FINANCIAL BARRIERS

There are several potential solutions to overcoming financial barriers to LID adoption:

- Apply stormwater fees. Stormwater fees allow can be applied to capital cost for development and for human capital investment. Stormwater fees have various optional method including flat fee, runoff coefficient, intensity of development, residential flat rate, geography based and impervious area measurements (Gollan . & McGoldrick 2012). The cities of Waterloo and Kitchener are examples of municipalities that apply stormwater fees (Gollan & McGoldrick 2012). Victoria, is moving to a stormwater utility model where they create a user pay system linking impact with costs and inclusive of all properties (City of Victoria 2014).
- Establish stormwater credit programs to encourage LID adoption. As mentioned previously, one of the financial barriers is the unwillingness of developers or public owners to accept the risk in adoption of LID technologies. Therefore, providing stormwater credit programs towards private landowners and developers can be used. This type of incentive can encourage landowners to retrofit their sites with LID practices and also can be used to attract developers to use LID when designing, planning and constructing their projects (EPA, 2012). In addition, this system encourages homeowners to take responsibility for the stormwater created on their properties (Bracken, et al. 2011). Examples of municipalities that have already implemented this type of incentive include Kitchener and Waterloo.
- Conduct LID market based analysis. Municipalities can help encourage and change developer's perception of market potential by promoting alternative development techniques (Bowman, & Thompson 2009). This approach has been carried out by Alton Village with its "Low Impact Development Marketing Strategy" program. The goal of this project was build the interest of residents in alternative landscapes (low impact development front yard landscapes) by initiating market and outreach programs (CVC 2014).
- Apply for stormwater-funding programs. There are several programs from both the provincial and federal level in regards development of stormwater management projects. Some examples inlcude:

    - B.C provides funding for stormwater management related projects including integrated stormwater management plan or related feasibility studies (Local Government Department 2014).
    - Ontario's "Showcasing Water Innovation (SWI)" program is used to demonstrate leading edge, innovative and cost-effective solutions for managing drinking water, stormwater and wastewater systems in Ontario communities (Ontario 2014).
    - One Federal government program related to stormwater management is the Build Canada Fund. The goal of the fund is to address national, regional and local infrastructure priorities (Infrastructure Canada 2014).

## 3.7 INSTITUTIONAL AND REGULATORY BARRIERS

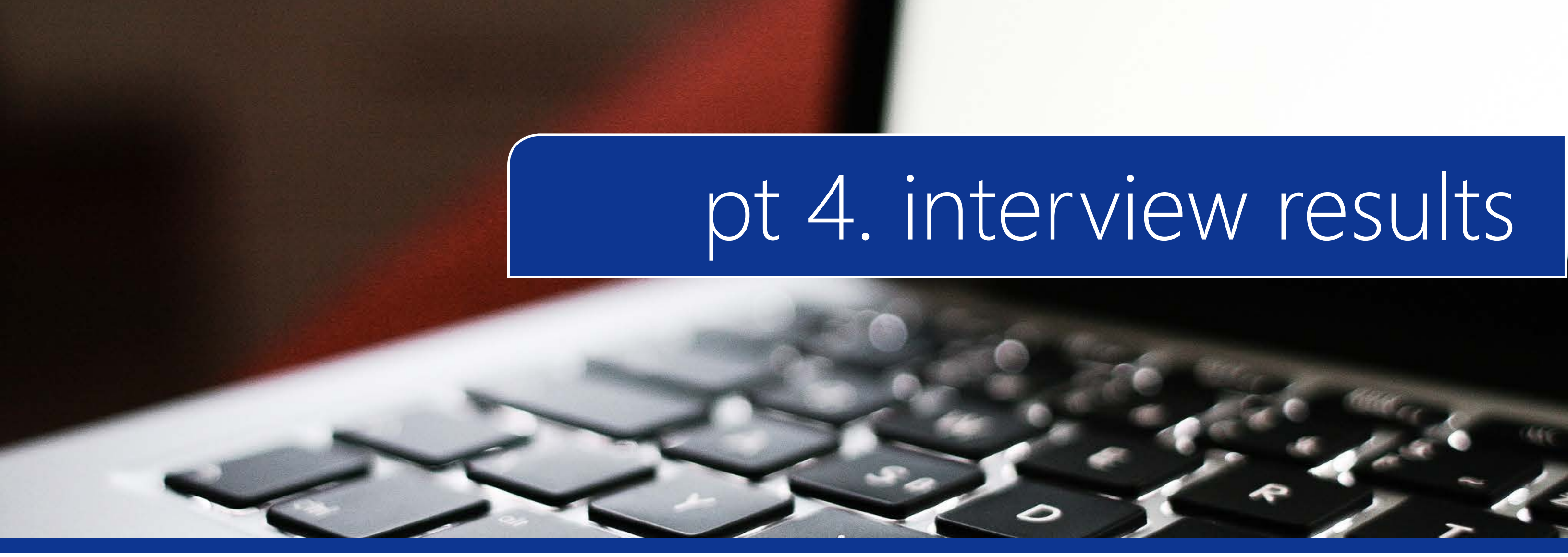
LID adoption faces both institutional and regulatory barriers that can prevent application of effective control programs (Gearheart 2007). Regulatory barriers are one of the top 5 barriers to the use of LID stormwater controls in Alberta municipalities (AUMA, 2013). Several authors point out that institutional and regulatory barriers include lack of policy or legislative mandate (Bracken et al. 2011; Roy et al. 2008; Farahbakhsh et al. 2009; LaBadie 2010) and unavailability of LID in current development standards and ordinance (LaBadie 2010: Tian 2011). Tian (2012) stated that lack of LID in current codes is caused from fragmented regulatory framework and responsibilities. In the survey by Clean Water Alliance America the common themes on institutional barriers are (Clean Water Alliance America 2012):

- Need for education for agency staff, administrators, political leaders, developers, builders, landscapers, and others, including the public.
- Need for internal agency and community cooperation
- Adjusting cultural values to appreciate green infrastructure aesthetics and characteristics.

## 3.8 OVERCOMING INSTITUTIONAL AND REGULATORY BARRIERS

Potential solutions to institutional and regulatory barriers to LID adoption include:

- Integration and collaboration between stakeholders. Implementation can be facilitated by collaboration among local organization, city agencies, and the private sector (Clean Water Alliance America 2011). York Region in Ontario carried out a program to expedite sustainable development approvals (including LID practices) and found that one of the success that they had was an integration design process which helped scope the issues, shared approaches and provide options and solutions (Clayton 2014). To support integration and collaboration Clayton recommended the designation of a municipal infrastructure innovation committee which is interdisciplinary including stakeholders from municipal CAOs, commissioners, key business leaders (early adopters) conservation authority CAOs to senior Management.
- Use grassroots efforts to garner support for ordinances and regulations (Roy et al. 2007). Public support is needed to successfully push towards any legal mandate for stormwater runoff abatement (Roy et al. 2007).
- Provide education to agency staff, administrators, political leaders, developers, builders, landscapers, and others, including the public.



# pt 4. interview results

Interviews were conducted at three municipalities that have previously adopted LID technologies. Each municipality was asked a series of questions related to the innovation decision process and attributes of rate adoption, with an intention to collect information on three main areas of interest:

- Did the municipalities go through the innovation decision process?
- What affected the rate of LID technology adoption?
- Did the municipalities come across the same types of barriers as those most commonly identified in the literature?

## 4.1 THE INNOVATION DECISION PROCESS

- Knowledge: LID was introduced through various ways to municipal staff. Most of them gain knowledge through conferences, online and workshops held by conservation authorities or interest groups. Interestingly there is one municipality that directly pursues knowledge of LID technologies through individual research and help of consultants.

- Persuasion: LID became an interest to their municipality because of the opportunity that it is given in helping manage stormwater. Not only it is perceived as an opportunity to reduce stormwater runoff but also it is seen as a tool to reduce pollution and erosion caused by stormwater runoff.

- Decision: For all 3 municipalities the decision to adopt LID came from the department staff level. Different LID applications have different areas of implementation which led to the need for collaboration among different departments within the municipality. This resulted cross departmental discussions, to council for approval. LID adoption tends to be more of a bottom-up approach. (Continued on the next page ...)

- Implementation: Two of the municipalities are in still in the early stage of the implementation phase. They are still unsure of LID performance. The barriers that they had to overcome are the same as the literature suggests: public education, cost and maintenance.

- Confirming Decision: all of the municipalities are confirming their decision of adopting LID by monitoring their LID projects. Municipalities interviewed have different views on whether LID adoption should be widely adopted. Early adopters would support more wide spread adoption while other uses are still confirming their decision.

## 4.2 RATE OF ADOPTION

Factors influencing the rate at which municipalities adopt LID technology include:

- **Relative Advantage:** "Do you believe LID is better than conventional stormwater?"
- Answer: All municipalities note that LID was not perceived as being better than conventional stormwater management, but was rather an addition to the stormwater management toolkit.

- **Compatibility:** "Do you believe LID can reduce pollution runoff? What convinced you?"
- Answer: All of the respondents would agree that logically the concept of LID "makes sense" to implement. Municipalities understood that stormwater rainfall could no longer infiltrate through the soil due to impervious pavements and that applications of LID technologies would allow natural hydrology process to occur again within their area of development. This made it easy for them to accept and implement LID within their grounds.

- **Complexity:** "What makes LID implementation possible given the complexities?"
- Municipalities had similar answers regarding with this attribute. They mentioned that internal department support, funding and knowledge on LID led to the success of implementation. It is also highlighted that internal agency cooperation was necessary to achieve their goals.

- **Trialability:** "Why did you want to test LID within your area?"
- All of the municipalities agreed that LID is seen as an opportunity to support stormwater management. Then used pilot projects to test LID performance prior to widespread adoption as LID has different performance attributes in different soils and climate.

- **Observability:** "Did you look at other jurisdictions to convince you on LID adoption?"
- All of the municipalities agreed that other LID areas convinced them to adopt and build a pilot project within their municipalities. Success stories had high influence in LID adoption.

## 4.3 INTERVIEW SUMMARY

Municipalities mentioned that compatibility and observability are the two most influential attributes in LID rate of adoption. Even though there are barriers and complexity in adopting LIDs, they highlighted the importance and benefits of having internal department support, funding and education on LID.

# pt 5. policy directions

1. Establish more knowledge sharing events. As describe in the DOI theory receiving knowledge is the very first stage in the innovation decision process. Knowledge sharing can include conferences, workshops, and webinars etc.. The types of information shared include the importance of LID in sustainable community development, as well as technical information (cost, performance, maintenance) As LID performance differs in every area, it is suggested that the knowledge sharing events include several municipalities, conservation authorities and interest groups.

2. Support the innovative stormwater management practices website. Even though there are successful cases around Canada, LID adoption is still perceived risky. Based on the interviews observability is as strong motivator for LID adoption. Success stories can stimulate adoption. The innovative stormwater management website (http://www.iswm.ca) could become a model of a central database of innovative storm water management tools in Canada.

3. Introduce economical tools in stormwater management to support capital and human capital investment. Both stormwater fees rates and incentive apply here. Municipalities can develop a sustainable funding source for future stormwater programs by applying stormwater fee rates. This fee could also be used for incentive to engage stormwater innovation practices. Not only does it help reduce pollution and volume from stormwater runoff but also it educates the public and private sector the importance of embedding robust stormwater management in future development growth.

# pt 6. conclusion

This paper focused on mechanisms that could fast-track LID adoption. Barriers to LID adoption were educational, technical, financial, institutional and regulatory. Most of the solution to overcome the barriers surround providing educational knowledge on LID.

The attributes that were found to influence the rate of adoption were identified as: relative advantage, compatibility, complexity, trialability, and observability.

Municipalities mentioned that compatibility and observability are the two most influential attributes in LID rate of adoption. They stated that internal department support, funding and education on LID helped overcome the complexity of LID adoption.

With compatibility and observability as the two most influential attributes in LID rate of adoption, the policy direction recommended is to 1) establish more knowledge sharing events 2) support an innovative stormwater management practices website 3) introduce economical tools in stormwater management to support capital and human capital investment.

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# APPENDIX

## DETAILED PROPOSED POLICY STEPS

Based on the research it is proposed that the innovation decision process can be used to identify what phase is the municipality at in adopting LID technology. The identification process will then help municipality in developing a clear objective and goal to go into the next phase of the innovation decision process and finally adopt LID technology.

Furthermore, interviews on factors influencing LID rate of adoption helped define which attributes to focus on. Based on the interview result it is proposed that to fast-track LID adoption can be carried out by overcoming rate of adoption attributes as follows:

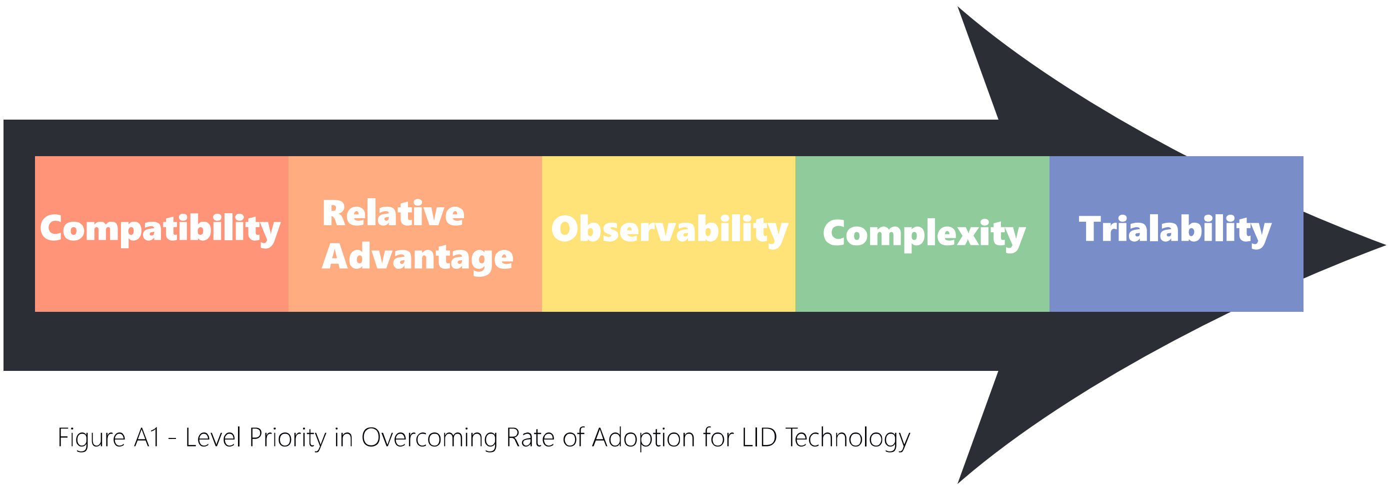



Figure A1 - Level Priority in Overcoming Rate of Adoption for LID Technology

## I COMPATIBILITY AND RELATIVE ADVANTAGE

Both compatibility and relative advantage attribute have similar factors that contribute to its rate of adoption. The similarity is that both attributes is a form of perspective in looking into LID technologies. Thus, we could use one policy recommendation to overcome these two attributes. Perspective change or paradigm shift can be achieved by providing effective and precise knowledge sharing on LID technologies. Themes that is to be focused on are:

- LID technology is additional infrastructure that can support stormwater management.
- LID technology “makes sense” to adopt as it mimics nature’s hydrological cycle.

As mentioned knowledge sharing can be carried out by several forms including but not limited to workshops, webinars, conferences, formal and non-formal discussions. It is recommended that each province have its own center of source information for knowledge sharing of LID technologies and also to carry out the knowledge sharing events. These LID knowledge center can be initiated and under municipality, educational institution, non-profit organizations, private sector or even in a form of the collaboration of all the institution.

Purposed LID Knowledge Centers"

| Province | Purposed LID Centers | Reasoning |
|---|---|---|
| Alberta | Alberta Low Impact Development Partnership | Focuses on LID |
| Ontario | Toronto and Region Conservation Authority & Credit Valley Conservation Authority | Focuses on LID |
| British Colombia | Capital Regional District | Encourage toward LID adoption |
| Saskatchewan | The Assiniboine Watershed Stewardship Association (AWSA) and the Saskatchewan Watershed Authority (SWA) | Encourage toward LID adoption |
| Nova Scotia: | Halifax Water & Halifax Regional Municipality | Encourage toward LID adoption |
| Quebec: | Ministry of Sustainable Development, Environment and the Fight against Climate Change | Encourage sustainable development |
| Manitoba | Manitoba Water Stewardship | Encourage sustainable water management |
| New Brunswick | Town of Sackville | Good example of Municipality that is moving towards LID adoption in New Brunswick Province |
| Newfoundland and Labrador | Municipalities Newfoundland & Labrador (MNL) | Strategic for becoming a knowledge center |
| Prince Edward Island | Town of Stratford | Good example of Municipality that is moving towards LID adoption in Prince Edward Island Province |

## II OBSERVABILITY

Policy recommendations to overcome the observability attribute are:

- Adopt innovative stormwater management website (http://www.iswm.ca) as a national website to showcase and map LID technologies and other innovative stormwater management practices across Canada.
- Support and fund LID knowledge centers in providing LID technology guided tours to provide up-close visibility of LID infrastructure. It would also be beneÀcial for non-adopters to see real time simulation of LID technology performance. Therefore, guided tours could be carried out during fall.
- Provide videos of various LID technology performances during various weathers. Videos of how LID works prior and after storm event can provide clear visibility thus becomes more convincing.

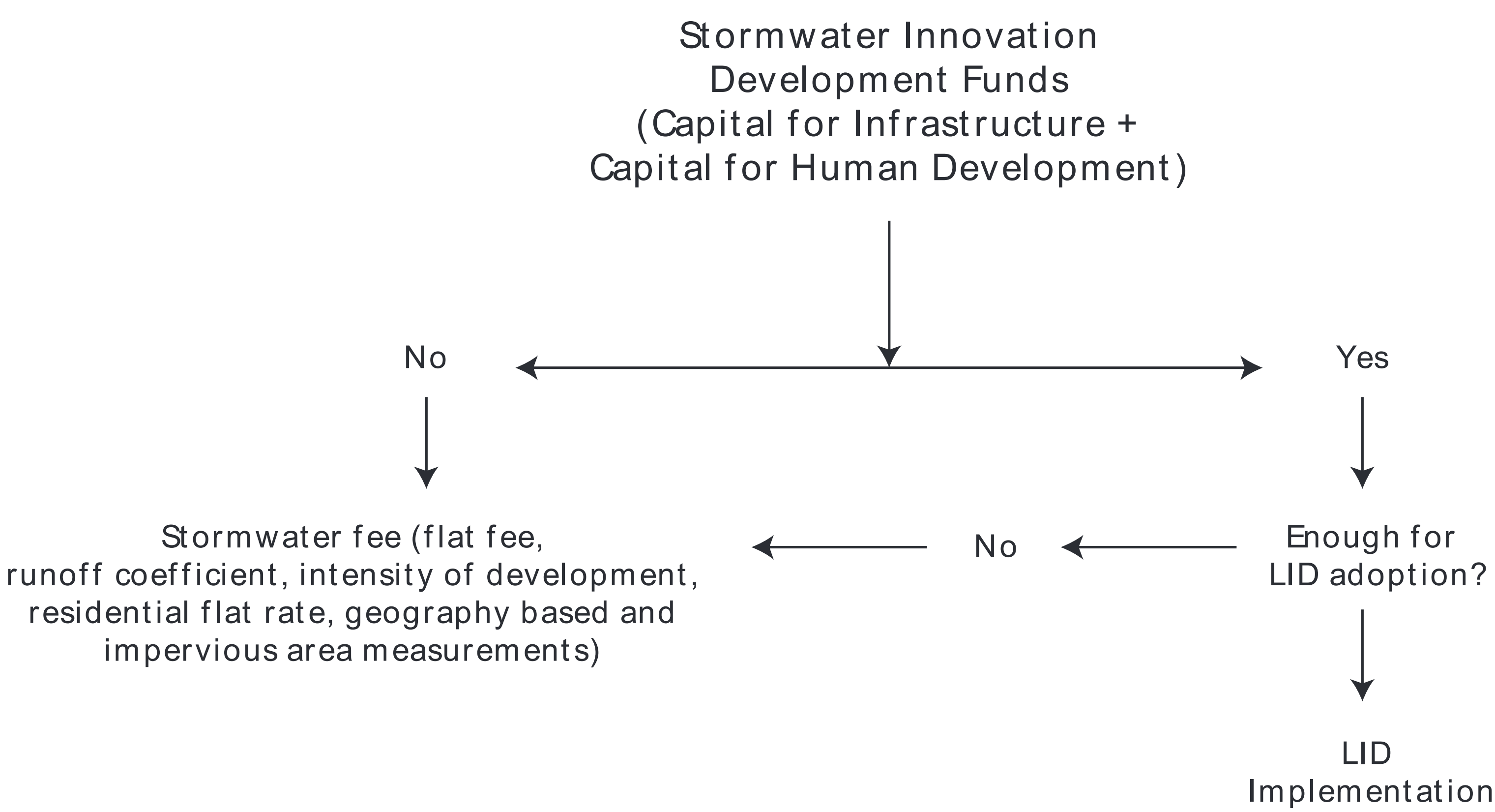
## III COMPLEXITY

For the complexity attribute: funding, internal department support and establishment of LID goals and objectives should be developed by the municipalities. The policy recommendations to overcome complexity attribute is described below.

To breakdown the complexity attribute, it is suggested that the municipalities develop a LID implementation goal therefor a clear overview of the steps in implementing LID can be foreseen. Within the LID implementation goal municipalities will have the opportunity to consider of technical and social acceptance of this technology. Furthermore, funding options would also be looked upon when developing LID implementation goal.

While stormwater fee policy is being developed, stormwater credit policy could be placed which would allow public acceptance in regards LID adoption. Stormwater fee policy should consider a reasonable timeframe for implantation, thus it would allow the community to adapt towards the shift from conventional towards innovative stormwater technologies. Both policies would educate communities on LID technology. One other advantage of applying this policy is that it helps municipalities move towards sustainable infrastructure development by highlighting the stormwater management aspect.

As mentioned, internal department support is needed to overcome the complexity attribute. It is recommended a dedicated LID team should be developed which consists of several related departments (example: Public Works, Planning, Building, Fire and Safety) within the municipality. The rationale is that it would help integrate technical expertise and provide a holistic overview in adopting LID technology, thus easier to implement LID.



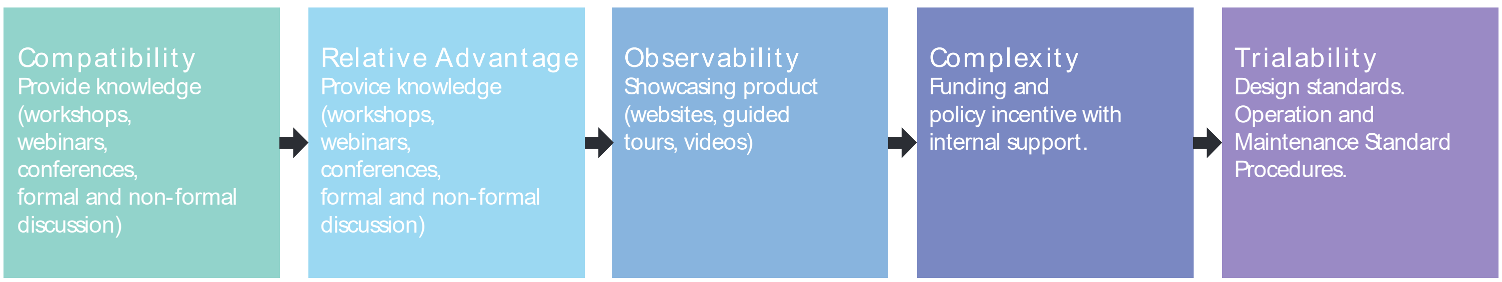
## IV TRIALABILITY

The triability attribute is the last attribute to overcome in fast-tracking LID adoption. The policy recommendations to overcome this attribute are:

- Develop design guideline standards
- Develop Standard Operation Procedures (SOP) for operation and maintenance purposes.

The dedicated LID team could carry both of the recommendation out for they are very much capable in the technical aspect.

A summary of the stages of overcoming rate of adoption (with policy recommendations) is shown below:



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