Stormwater Technology Transfer in the Great Lakes Region

A Needs Assessment

July 26, 2017

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1   Introduction

Innovation in stormwater management is slow to proliferate. Green infrastructure design techniques, data driven water management systems, and proprietary structural systems are all vital to protect our environment and neighborhoods from polluted stormwater and flooding. Innovation in stormwater management has historically been limited to pilot projects in large cities and wealthy communities. As technology advances, a gap is developing between the supply of these technologies and demand for them. This gap in technology transfer limits the advancement of stormwater management. Bringing innovative stormwater technologies to a wider audience and closing the gap between supply and demand is essential to responding to ever-increasing demands of stormwater management and ultimately to protecting the Great Lakes communities, rivers, and the lakes themselves from the negative impacts of mismanaged stormwater.

With funding from the Fred A. and Barbara M. Erb Family Foundation, Lawrence Technological University and the Great Lakes Commission are bringing together leaders from across the stormwater management field to foster the exchange of stormwater technology throughout the Great Lakes region. This Stormwater Technology Transfer project engaged experts from the public and private sectors to share their knowledge and identify specific barriers to stormwater management and related green infrastructure technologies. While there is no single definition of green infrastructure, the U.S. Environmental Protection Agency (EPA) uses this generally agreed upon definition: "green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits."[1] Stormwater technologies are novel ways of dealing with difficult stormwater management problems, and are often, but not always, proprietary in nature.

A tiered approach was taken to better understand the current state of stormwater technology transfer. Stormwater professionals from across the region were interviewed during the first phase of a needs assessment. In the second phase, the stormwater technology transfer needs identified in the interviews were refined and validated by a series of focus groups in select communities. **A stormwater technology transfer collaborative is proposed to help overcome the challenges identified through this needs assessment.**

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[1] https://www.epa.gov/green-infrastructure

2   Methods

This document outlines the results of a five-month information gathering process. To begin, the project advisory group was solicited to help scope interview questions and identify potential interviewees from the Great Lakes region's stormwater management profession. Interviewees included community leaders, non-governmental organizations (NGOs), manufacturers of stormwater technologies, and design/consultant firms. The goal was to conduct 50 interviews with people that represented a mix between those on the supply side who provide stormwater technology (~10), those on the demand side who need or desire stormwater technology (~25), and those in-between who might both need and provide the technology (~15).[2] In total, 43 interviews were actually conducted (9 on supply side, 23 on demand side and 11 consultants that fall on both categories). The sample was slightly smaller than the target of 50 due to challenges in finding willing participants and the time needed to schedule interviews. Interviewee names have not been attributed to specific quotes or sections of this needs analysis, but a list of all interviewees is given in Appendix A.

2.1   Interviews

Most interviews were completed using a two-step process. First, potential interviewees were sent an online survey asking for their professional background and familiarity with stormwater management. Based on these results, candidates were then contacted to set up phone interviews. To streamline the process, select interviewees were directly asked for an interview, skipping the online survey step.

Interviews were conducted over the phone and typically lasted between 30 and 60 minutes. Most interviews were recorded, unless the interviewee declined permission. Interviews began with a brief introduction of the interviewer, project, and logistics of the interview. After the introduction, all interviewees were asked to describe their stormwater management career and whether they see themselves on the supply and/or demand side of stormwater technology. Based on these initial responses, specific interview questions were selected from the prepared list of interview questions. At the conclusion of the interview, interviewees were given a chance to clarify any of their statements, provide any closing thoughts, and ask questions of the interviewer (mostly about the future of this project and requests for this document). An interview question template can be found in Appendix B. Eleven common themes emerged from the interviews; these are highlighted in boxes throughout this assessment.

2.1.1   Demand-Side Interviewees

To gain a strong depiction of the demand in the Great Lakes region, the advisory team was asked to select several communities that would have an interesting perspective on stormwater management. The advisory group specifically sought communities that are on a spectrum of stormwater management sophistication to ensure we captured a complete picture of the current state. Scheduling challenges arose in trying to interview the selected communities, so the interview team added additional communities where gaps in coverage developed. Contacts for each community were solicited from the advisory group, found on community websites, and shared from fellow interviewees. A total of 23 interviews were

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[2] Interviewees were given a figure depicting the breakdown of the supply and demand of stormwater technologies. This figure can be found in Appendix C.

conducted from 11 communities (including NGOs that work closely with specific communities). These communities included:

- Buffalo, New York
- Detroit, Michigan
- Duluth, Minnesota
- Erie, Pennsylvania
- Guelph, Ontario
- London, Ontario
- Milwaukee, Wisconsin
- Oshkosh, Wisconsin
- South Bend, Indiana
- Thunder, Ontario
- Toledo, Ohio
- Traverse City, Michigan

2.1.2   Supply-Side Interviews

The advisory group was helpful in finding contacts within the stormwater technology and design supply community to share their comments with the project. The interview team found additional participants through direct solicitation of stormwater technology companies. A wide range of stormwater technology companies were interviewed, all of which have done some work in the region. NGOs that work closely with stormwater technology companies were also included in this portion of the analysis. A total of 9 interviews were conducted from seven unique stormwater technology organizations.

2.1.3   Consultant Interviews

Consultants often work closely with both communities and suppliers. As such, they are exposed to both sides of the supply and demand of stormwater technology and green infrastructure design. Because of this, they offer an interesting perspective for this analysis and their interview responses are captured in this separate section. With this dual perspective, many of their comments expand on or validate points made from both the demand and supply side of stormwater management. The advisory team was asked to provide contacts for consulting companies. A total of 11 interviews were conducted from 10 consulting companies. The results from consultant interviews are presented separately, but often reflect on the results discussed for the demand and supply interviews.

2.2   Focus Groups

Three focus group sessions were conducted across the Great Lakes region in spring 2017 to validate the interview results:

- Mississauga, Ontario, on April 25
- Cleveland, Ohio, on May 3
- Appleton, Wisconsin, on May 19

For expediency during the focus group process, the 11 interview themes were consolidated into the following five themes for discussion:[3]

- Matching Technology to Needs
- Confidence in Performance
- Cost/Benefit Ratio
- Reducing Risk – Shifting Cultures to Test New Technologies/Approaches
- Drivers: Leadership, Coordination, and Regulations

Local hosts helped find participants for each focus group. During the focus group sessions, participants were separated between stormwater technology supply and demand, with consultants selecting with which side they most identified. Unique questions for supply and demand were developed for each theme[4] and used to facilitate discussion within each group for 15 minutes per theme. The groups then briefly shared their group's discussion with the other group. After all themes were discussed, each group was given a few minutes to share their final thoughts. Focus group results are discussed after the demand and supply sections below.

3 Findings

The following sections summarize the findings of the interviews and briefly discuss results from the focus groups. Results are broken down into three sections based generally on the sector that the interviewee represents: demand, supply, and consultants. Section 3.1 is a summary of interviewees that are most associated with demand; these include comments from city personnel, but also non-profits closely related to a community's work. Section 3.2 is a summary of interviewees that are most associated with supply; these include comments from manufacturers, designers, and installers of stormwater technology. Section 3.3 is a summary of consultant interviews, which falls somewhere between supply and demand; these include design/build engineering firms, advisors, and testing laboratories. Because the focus groups were split between supply and demand, findings from the focus groups are only included in the supply and demand sections.

3.1 Demand-Side Themes

3.1.1 Stormwater Management Decisions – Local and Regional Controls

Many communities are managing stormwater at the local level. As one community put it, because local challenges (topography, soils, climate) drive stormwater management decisions, "there will always be some component of local control." Additionally, citizen awareness of stormwater management differs between communities, which changes the priorities of stormwater management within each community. These issues have caused some communities to grow concerned that efforts to tighten stormwater controls might drive development outside their jurisdiction to a community less interested in managing

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[3] During the first focus group, six themes were used: "Coordination and Regional Approaches" and "Drivers: Leadership and Regulations" were combined into one theme for the last two focus groups based on participant responses.

[4] See Appendix D for an example of the focus group questions.

stormwater. **Any effort to encourage technology transfer should take local regulations and sentiment towards stormwater management into mind, including how communities handle local conditions and concerns about driving development out of the community.**

State and county authorities help guide local stormwater management activities through a balance of guidance and rules. Additionally, communities look toward similarly situated communities for tips and guidance on what stormwater management tools to use. **These outside influences are important to take into consideration when thinking about why some technologies and design techniques are adopted over others.** If a state authority gives three examples of technologies that meet the requirements in their regulations, or if a leading community has had success with a certain type of green infrastructure design, those technologies and design techniques will likely be more common for other communities to use.

Theme:

Influences by other orders of government

Some regions are starting to work together to manage stormwater. This includes efforts in Canada to work with conservation authorities.[5] Often the regional approach relies on guidance, not mandated regulations, to help communities manage stormwater. This approach allows for local flexibility. Regional efforts also help guide communities that may not have the resources to implement stormwater management on their own. This strengthens stormwater management across the region - not just in communities that can afford it. **In regions where communities have come together to manage stormwater, the regional authority is an important component in the decision-making process regarding which stormwater technologies and designs to use.** This is especially true in Canada where conservation authorities are leaders and looked to for which technologies and design techniques to use.

Theme:

Regional Coordination and Approaches

Many communities expressed interest in working more on a regional scale to tackle difficult stormwater problems. They saw that stormwater problems don't end at a community's border, so a watershed level approach is needed. These communities expressed concerns that different needs and resources between communities will weaken any efforts to work as a region. **Non-profit organizations were often brought up as possible facilitators where there is a lack of regional cooperation.**

3.1.2   Current Cole of Technology in Stormwater Management

Traditional stormwater management tools, often called "pipes and ponds", are commonly used when stormwater regulations are loose and cities have space to grow. As state and local regulators tighten rules and land for large stormwater facilities becomes expensive, new tools are needed to handle stormwater

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[5] Conservation authorities are local watershed management agencies in Ontario, Canada that deliver services and programs that protect and manage water and other natural resources in partnership with government, landowners and other organizations. The 1946 Conservation Authorities Act authorizes municipalities within a common watershed to form a conservation authority within the province. There are currently 36 conservation authorities in Ontario.

management. These constraints have many communities looking toward new stormwater technology and green infrastructure design techniques.

Many communities felt that current technologies are meeting current stormwater requirements. As cities move beyond pipes and ponds, the toolbox is full of proprietary technologies, engineered systems, and green infrastructure design techniques. Most communities were interested in figuring out how the current suite of tools can be used to meet their specific stormwater challenges. **An often-heard complaint was that the newest technologies were either too complicated, expensive, or not tailored to the conditions in the community or region.**

> *Theme:*
> **Matching Technology to Needs**

Many communities have already started incorporating new stormwater technologies and green infrastructure techniques into their stormwater management systems. A wide range of technologies are in use, including: porous pavement, bioswales, tree-boxes, rain barrels, rain gardens, downscaling traditional infrastructure, and in-pipe (i.e. hydrodynamic separation) and end-of-pipe (i.e. filter units) proprietary technology. Often a specific technology is the go-to for a community, with others being neglected. Some communities still felt like many of these newer technologies were too novel and only used them sparingly or as pilot projects. **Getting communities more aware of all that is out there and showing that they can work beyond just pilot projects would encourage the use of newer technologies.**

All the communities were at least warm to the idea of new technologies being developed and used, but many expressed concerns that the current suite of technologies is not being maximized. A common refrain was, "why do we need a new technology when the current suite of technologies is not being used?" The general sentiment behind this was that new technologies are nice, but will not do any good if they are not utilized. **To encourage the adoption of new technologies, an effort needs to be made to show how the newest technologies will benefit the particular stormwater conditions and needs of a community and not how they outperform other technologies.** Communities highlighted certain stormwater needs that have gone unmet, **including in-pipe basic treatment, maintainable porous pavement, underground storage options, and natural tree systems.**

Most communities were open to using proprietary technology. Communities often said they are more likely to use them when constraints make traditional or green infrastructure infeasible. Smaller communities will often rely on outside consultants to drive the use of proprietary technology, as they don't have the time to keep up with the latest trends. Larger communities often take the concepts seen in proprietary technologies and design them into their stormwater system themselves as a cost saving measure. **Suppliers and consultants need to do a better job showing the benefits of using their systems over what the community already does, not how they outdo their competitors.**

> *Theme:*
> **Operation and Maintenance Concerns**

Other common concerns about proprietary technologies are that they are **difficult/expensive to incorporate into a city's stormwater design; the lack of**

contractors in the region driving up costs; uncertain maintenance costs; and, suppliers' unwillingness to support their products through design, installation, and maintenance.

Developing trust in these new technologies is often a challenge for many communities. The biggest concern was that communities do not want to be on the 'bleeding edge' when it comes to stormwater management. Communities, and the engineers who work for them, are cautious about being the first community to try a new technology. They need to **see that the technology has been successfully used in other communities (the closer the better) before they are willing to try it in their community.** Pressed on what would get them to try new technologies, communities said that third party-funded projects (including maintenance) help alleviate these concerns.

Another concern for communities developing trust in new technologies is the lack of reliable performance assessment of the product/technology. While communities often didn't mind being sold something, they were often skeptical of how the product would actually perform in their community. **The industry needs to do a better job of showing their products' cost, performance effectiveness, and maintenance support – especially compared to traditional technologies and over the long-term**. This includes suppliers being more open about how their product works and **transparent about what data they are using to demonstrate their product.**

Theme:
Confidence in Performance

An interesting idea brought up by many communities was that suppliers should team up with communities and/or third party organizations such as universities to help monitor their installed products. This would benefit the city because the supplier could help with any challenges, but would also benefit the supplier because they could have a steady stream of data to prove their products work.

Many communities felt like they don't have the time to learn about and compare all the new technologies available. This forces them to use what they have seen/done in the past. **Unbiased education efforts are needed to build confidence in new technologies before they will be considered in many communities.** This includes educating the engineers and the contractors who install the technology. A community's interest in stormwater management often reflects their citizens' interest in stormwater management. It is unlikely a community will invest in new stormwater technologies when traditional technologies have met current regulatory requirements and citizen expectations. Two ways to drive the use of new stormwater technologies in these situations are **more stringent regulations and/or educating the public about the need for more stormwater management**.

Theme:
Regulations as Drivers

3.1.3 Data Needs

Many of the communities highlighted the need for more data before they would be willing to implement new technologies. **The two biggest data gaps that need the most attention are life-cycle costs (initial installation and long-term) and operation/maintenance**. For communities that are comfortable with the

status quo, there needs to be data to show that a new technology will actually benefit them; be it through inexpensive upfront/long-term costs or through simpler operation/maintenance programs. Additionally, because of the climate of the region, **more cold weather data is needed, including how technologies handle deep freezes, freeze-thaw cycling, winter rain events, snow removal, and sand/salt applications.**

A challenge highlighted by some communities is that they sometimes do not trust the data provided by suppliers. While most communities are open to learning from suppliers, they often see through invalid, unreliable, or misleading data. This calls for **reliable, realistic data**; including data from representative pilot projects, community run installations, and how products meet regulations. Ideally this **data would be produced or vetted by third parties - universities, regulators, peer engineers, or other cities**.

Most communities are **comfortable using data from other cities in the region**, especially when the other community is viewed as a leader in new stormwater technology. Because the region is not homogeneous, with climate and regulations in Thunder Bay, Ontario being very different than what is seen in Buffalo, New York, sharing regional data can only go so far. Ultimately, the best data a community can see is from within the community itself, so suppliers should be **cautious when trying to translate data across the region**.

Additional data gaps seen by communities include **the need for more data beyond volume and phosphorus**. This includes how new technologies handle heavy metals, salinity, and other pollutants. Finally, some communities saw a gap in data of **how new technologies interact with traditional stormwater systems.** This also highlights a gap in knowledge of how current stormwater management systems function. Some communities were asked about real-time management of stormwater and while the idea was interesting to them, many felt such a system would be impossible to implement in their community without first knowing how their current system is functioning. **Helping communities better understand their current system – what the system currently can and cannot do, where the needs are, and how new technology can supplement what is in place – could go a long way toward promoting new technologies.**

3.1.4   Current Efforts to Strengthen Technology Transfer

Communities pointed to a few efforts already trying to strengthen stormwater technology transfer, but still felt there were gaps in this effort. The general consensus among communities was that there are currently a lot of disparate efforts that are effective on their own, but collectively aren't promoting new stormwater technologies successfully. For example, New Jersey has a respected standard for testing stormwater technologies, but it has not been universally adopted. So, while a community may rely on New Jersey data to vet technologies, there is no guarantee that their state's regulatory agency will accept that the new technology meets their regulations. Interviewed communities did not explicitly champion for the New Jersey standard, but instead looked for any standard that everyone could rely on. Similarly, communities look to a wide range of best management practice manuals, with little consensus on which to follow.

Some helpful organizations mentioned by communities include those that represent cities and trade groups. Among these organizations, none stood out above the rest. Trade organizations are effective in determining what new technologies exist, and city organizations are good for disseminating what other

cities are doing; but **none have the ability to thoroughly vet technologies, help communities know what is possible, and learn what is working in other communities.**

3.1.5 Largest Barriers to Stormwater Technology Transfer and Use

The interviewed communities were asked to identify key issues in stormwater technology transfer and use. A few points came across from many of the communities.

Among the most common concerns expressed by communities was that municipal engineers are generally risk averse in nature and implementing new technologies come with some amount of risk. This already puts new technologies behind traditional ones. If municipal engineers don't have any other reason to try a new technology, it is easy for them to dismiss it. Many interviewees saw **the need for efforts to show that these newer technologies are effective, efficient, and can save the community money. A culture shift needs to happen to include stormwater management early in a project. This can only happen if design engineers are willing to think beyond what is strictly required by regulations.**

Theme:

Shifting Culture to Test New Technologies/Approaches

Another key issue identified was that many **communities don't have the capacity to try every new technology**. They don't have time, training, and/or resources to "give new technologies a chance." **New technologies need to be as easy to use as possible: to use a computer software analogy, new technologies should be plug-and-play**. Communities do not want to tear up their standard design practices or incorporate "fifty" new operation/maintenance procedures just to try something new.

Another key concern is that stormwater regulations are not consistent across the region. This inconsistency creates a barrier for communities that are interested in trying a technology that has been successful in other communities. **Simplifying and unifying stormwater regulations in the region would go a long way to encourage technology transfer**. Regulations need to encourage, allow, or even require new technologies before some communities are willing to try something new.

Basic stormwater education is also critical, but it shouldn't be through the lens of specific stormwater products. Suppliers may not be the best organizations to teach communities. **Consultants, trade organizations, universities, regulators, and other third parties are in good positions to act as unbiased groups that can help communities understand new technologies**. These organizations need to do a better job of getting the word out regarding what new technologies are out there, where they are working, and how they will meet specific regulations.

3.1.6 Demand-Side Interview Conclusions

The communities interviewed were interested in trying new stormwater technologies, but pointed to a handful of obstacles to incorporating them. The most frequent concern was that the newest technologies were either too complicated, expensive, or not tailored to the conditions of their community or area. Suppliers and consultants need to do a better job of showing the benefits of using their systems compared to what a community is already doing, not how they out perform their competitors.

Communities rarely like to be the first to adopt a new stormwater technology, so efforts should be made to show off other communities' successes. Education and outreach efforts are needed to build trust in new technologies before they will be considered in many communities. This includes educating municipal engineers, community leaders, and the contractors who will install the technology. Lack of requirements (e.g. regulations) for more effective stormwater management is an inadvertent barrier to adopting new technologies: without a requirement or incentive to do more, many communities will do the bare minimum required to stay in compliance.

There is a major need for more reliable data before new stormwater technologies will be implemented. This includes better data on the full costs of new technologies and the operation/maintenance that is needed throughout its lifetime. More cold weather data is especially important in this region, as many communities are hesitant to install something without proof it will work during and after winter. Some communities are comfortable using data from other parts of the region, especially if the other community is seen as a stormwater leader. Others need more local data, including pilot projects within their community, before they will try a new technology. Consultants, trade organizations, universities, regulators, and other third parties can provide this data and help communities understand and adopt new technologies.

3.1.7 Demand-Side Focus Group Findings

The demand focus groups generally validated the interview findings. Overall, there was agreement across the three focus groups about the challenges of adopting new stormwater technologies in communities. The responses from the Mississauga focus group were the only ones that deviated from the other focus groups – especially about cost not being a major issue. These can partially be explained by the different regulatory structure between Canada and the United States.

The most common discussion point from the focus groups about stormwater technology meeting the needs of communities was about operation and maintenance concerns. This includes life-cycle cost and monitoring. These concerns were like those shared during the interviews. Another similar thread between the focus groups and interviews was the need for outside organizations to help identify stormwater needs and available technologies that meet those needs. Focus group participants identified consultants as a major influencer in stormwater management decisions. Multiple regional, national, and international organizations and initiatives were also identified as potential leaders in helping communities with stormwater management decisions.

Like the interviews, the focus groups highlighted the need for more data. While pipes and ponds are a known commodity, there are perceived uncertainties associated with new stormwater technologies or green infrastructure design techniques. Focus group participants wanted field testing data over lab data, though they did understand the limitations of collecting field data for every new technology. If field data were used to promote a new technology, it was repeatedly mentioned that the data should come from locations near where the product would be installed. The focus groups also highlighted the need for more knowledge transfer beyond data. Most communities don't have the time or resources to understand every new technology, so it was very important to the focus group participants that information is shared about advancements in stormwater management. This includes more "lunch and learns", trade shows, and other

organizational outreach. Lessons learned need to be shared between communities since communities cannot try every new technique individually.

Every focus group identified the perception that new stormwater technologies are more expensive than traditional stormwater management techniques. The Mississauga focus group didn't see this as an important barrier as their provincial rules require them to select the lowest bid, regardless of perception. The U.S.-based focus groups were both in agreement that the perception of higher cost was a major factor in the limited use of new technologies. All of the focus groups mentioned the need for more education to breakdown the perception that traditional technologies were always the cheapest option. Education that highlights potential co-benefits could significantly mitigate the fear of higher costs. Education is especially important for communities that are stuck providing traditional stormwater management and ignore new alternatives.

Focus groups identified that a culture shift is needed to make new technologies more appealing. Communities need to shift away from asking "where do we put the pond?" to "what technology should we use?" Focus groups recognized that more education for the public and community leaders is needed to bring about this shift. When a community understands that traditional stormwater management techniques have limitations, the community may be more willing to accept the risks associated with new stormwater technologies. It's especially important for leaders to be willing to try new things and for engineers and contractors to be familiar with (installing and maintaining) new technologies. An alternative way to reduce risk identified by communities is for suppliers to willingly collaborate with communities. Focus group participants suggested providing special warranties, helping with field tests, or reducing costs for pilot projects. This would lower the barrier to entry for new technologies in a community.

The focus groups also identified major drivers that could lead to the use of new stormwater technologies. Leadership was brought up as a driver to break down organizational silos and allow communities to try new things. Focus group participants observed that if stormwater goals and policies comes from higher-level officials and leaders in a community, it is easier for the technical staff to try something new. Coordination was also seen as a potential driver because it can create a platform to collaborate. Regional collaboration allows leaders to step in and champion causes without worrying that their community will stand out negatively. Official policies and regulations were also discussed as a driver. When there are easily understood rules and policies that allow or even encourage new stormwater technologies, communities may be more willing to go beyond how they traditionally manage stormwater.

3.2 Supply-Side Themes

3.2.1 Opportunities and Challenges Selling Stormwater Technology

Many of the stormwater technology suppliers expressed optimism about the future of stormwater management. They saw the marketplace as growing, with many opportunities for economic growth and environmental protection. Even with this optimism, some obstacles are inhibiting new stormwater technologies coming to market. Some of these views were similar to those expressed by the interviewed communities, while others could only be seen from the perspective of the suppliers of new stormwater technologies and are discussed in the following sections.

3.2.1.1 Developing Trust

One of the biggest challenges in bringing any new technology to market is building trust with potential consumers. This is especially true given that municipal engineers are generally risk averse. Suppliers expressed some ideas on how to develop trust in new technologies. One of the best ways to build trust is through establishing accountability. This includes **standing by your product through design, manufacture, installation, operation, and maintenance.** There also needs to be reliable testing to show what your product can really do. Some testing methods are more reliable than others. Interviewees **preferred field testing over laboratory testing; wanted more transparent and vetted testing procedures; and looked for clear and concise results**.

> *Theme:*
>
> **Product Assurance/Warranty**

Another way to build trust is to modify the sales pitch. Different approaches to selling new technologies were discussed. There will never be an absolute standard for sales, but there are a few techniques that help build trust in communities. What can really set a sales pitch apart from another is knowing the individual needs of communities. **This means listening to a community's concerns, understanding community regulations, and knowing site characteristics (soil, climate, hydrology, etc.). To do this, suppliers should go beyond just selling a product to understand the technical capabilities of their products.** One manufacturer mentioned that working with private developers and contractors are good ways to develop this mindset as it allows for more time to understand the product. Others mentioned working with regulators to drive home the point that these new technologies meet community standards.

3.2.1.2 Receptive Communities

A common challenge for suppliers was finding receptive communities and working with those that were not. **Two key factors made a community more receptive to trying new stormwater technology: leadership and enforcement**.

Communities that have broad-minded leadership, helping guide the city toward introducing more progressive stormwater management, were much more open to trying new technologies. Often this leadership comes from within the community, possibly from the mayor's office, or municipal planning, engineering, and environmental departments. The leadership can also come from outside the government through a highly motivated and educated NGOs. **For communities with active leadership, innovation is available to help them differentiate and achieve their goals.**

> *Theme:*
>
> **Leadership as a Driver**

A community may also be more receptive to trying new things if they are under some sort of regulatory pressure. This includes consent decrees, MS4 permits, or other compliance orders. **When traditional stormwater management is not meeting regulatory requirements, a community is usually open to trying new ideas.** This even includes trying technologies that may be more expensive or are on the cutting edge. A method for making a community more receptive to trying new things is to strengthen stormwater regulations. A complaint often heard from suppliers was that regulations are not tight enough to truly

meet our stormwater challenges. Any efforts to make stormwater policy consistent and more aggressive across the region could go a long way toward making communities more receptive to newer technologies.

3.2.1.3   Unique Challenges of Green Infrastructure Design vs. Proprietary Technology

When it comes to stormwater technologies, there are two general categories: 'green infrastructure' and 'proprietary technology'. The challenges for getting these technologies to market can, at times, be different. For green infrastructure, there are often high standards that may not be consistent with other stormwater technologies. For proprietary technologies, there are challenges in comparing one technology to others.

Green infrastructure is often seen as a way to meet the triple bottom line – social, environmental, and economic goals. Specific green infrastructure design techniques often perform well showing the benefits of these technologies, but without dependable data (like long-term environmental or economic metrics) to back it up. Further, green infrastructure often sacrifices one goal to reach others. For example, a bioswale may incorporate a walking path at the cost of better environmental protection. These challenges are often used as reasons to avoid their use. An example given by one supplier was that green roofs attempt to meet the triple bottom line, but other options meet each individual goal better. **Green infrastructure designers need to do a better job of selling the benefits of their products and optimizing their products to meet the specific needs of a community.**

For proprietary technology, a unique challenge arises due to the nature of being proprietary. Because the technologies are often designed to meet specific performance criteria, they can be challenging to implement across a broad spectrum of situations. As one interviewed manufacturer put it, "it's almost like comparing apples to oranges to bananas, yet the products all look the same." Communities have a hard time believing suppliers' claims that their products are superior when they all do the same thing. Suppliers of proprietary technology need to do a **better job highlighting what makes their product different and how it can benefit a community**. Tighter testing standards and stronger regulations would help proprietary technology because a single technology may be the only option available to meet the new requirements.

3.2.1.4   Regulating Stormwater Management

One of the common themes expressed by stormwater technology suppliers is a general frustration with the current state of regulations. Because many suppliers have a regional footprint, challenges arise when trying to comply with all the local and state regulations their products might be subject to. A lack of national standards and strong guidance further compounds this problem. **One of the frustrating aspects of this multijurisdictional approach is that some areas have well thought-out and implemented regulations, while others have regulations that are confusing and/or hard to comply with.** Suppliers saw this as a challenge since understanding local issues will ultimately dictate which technologies are used, however there is real potential for establishing a region-wide, agreed upon set of basic standards.

3.2.2   Data and Stormwater Management

The consensus from suppliers of new stormwater technology was that good data favors their products. This makes sense: why would they be in the market if they didn't think their product was superior? It is

all about how the data is produced and presented. Communities know that data can be manipulated to show exactly what the seller wants, so it becomes important to present it in a fair and impartial way.

Some suppliers have relied solely on laboratory testing to predict how their products will work in the field. While lab testing has its place, many in the industry understand that it is seen unfavorably. To remedy this, some suppliers see the need for **independent third party testing** to lessen the worries of manipulated data. Others suggest **standardized testing procedures that are independently vetted**. These efforts somewhat mirror what was suggested by communities and would help to **easily compare technologies – especially proprietary technology and green infrastructure.** Unfortunately, without uniform rules and regulations, it may be difficult to set up an effective third party testing organization or standardized testing procedures.

Site specific, local field data is probably still the best way to show a technology works as promised. Unfortunately, it is unlikely that reliable local data will be developed in every situation because it is difficult and expensive to produce. Fortunately, advancements in equipment and data processing have driven down the cost of field monitoring and have made data much more transferable. To further these advancements, **dedicated funding streams for testing and regionally accepted, consistent monitoring and testing protocols and would help the industry**.

3.2.3 Efforts to Strengthen Technology Transfer

Suppliers identified organizations that have been doing work to improve stormwater technology transfer but they also identified a few areas of need. Areas of focus by third party organizations include establishing common standards and championing responsible stormwater management. State programs in New Jersey and Washington were discussed as good sources of common standards to use. While these programs are outside of the basin, they offer standards that can be relied on to prove the quality of new stormwater technologies. **The Stormwater Equipment Manufacturers Association (SWEMA) and Water Environment Federation (WEF) both have programs that champion the advancement of stormwater management. Some suppliers saw shortcomings in these organizations.** They felt that these organizations do a decent job within their subfields, but do not do enough to tackle all of the issues involved with stormwater management more comprehensively. To get at the heart of the problem, an **organization needs to support both supply and demand**.

A few suppliers expressed concern about the power of large suppliers and consultants on third party organizations. As with any industry, large companies may squeeze out competition, which can stifle innovation. Any efforts done to help bridge the gap between supply and demand of stormwater technology needs to **ensure there is room for small suppliers to have a voice. Further, there needs to be facilitators that help bring the innovations to market, with third party review to accelerate adoption.**

> *Theme:*
>
> **Market Barriers for Small Suppliers**

3.2.4 Largest Barriers to Stormwater Technology Transfer and Use

The most common barriers to stormwater technology transfer and use were not technical, but rather business problems. **New technologies will always face the challange of upsetting the status quo**.

Suppliers highlighted the need to do a better job of selling their product. This includes understanding what the product can really do through proper testing and verification. Suppliers need to get past handshake business deals that worked in their backyard; this technique won't work when the product is being sold across the region.

There are many challenges in testing new technologies and getting them approved by local and state regulators. Many suppliers identified a need for a **streamlined testing process and more unified regulations**. For many technologies, the process of approval, certification, and verification is cumbersome and takes too long. Efforts to speed up this process would expedite the adoption of new stormwater technologies. Additional efforts by regulators to endorse or require the use of new technologies would also begin a shift away from traditional stormwater management.

3.2.5   Supply Interview Conclusions

Suppliers understand that standing by their product through design, manufacture, installation, operation, and maintenance is important. But there is growing concern that without fair testing, bad products are marring the industry. The need for independent, streamlined testing or a standardized set of testing procedures is apparent. To help this, more funding is needed to help produce reliable monitoring and testing results. Ultimately, suppliers need to do a better job at selling what their products do well and optimize their products to meet the specific needs of the community.

Suppliers also identified concerns like those expressed by communities. A major issue is trying to get products into many jurisdictions. This multijurisdictional approach highlights that some areas have well thought-out and implemented regulations, while others are confusing and/or hard to comply with. Even those that are easy to understand and comply with are often not stringent enough to require anything beyond traditional stormwater technologies.

3.2.6   Supply Focus Group Findings

Like the demand focus group, the supply focus groups generally validated the interview findings. There was agreement across the three focus groups about the challenges of providing new stormwater technologies to communities, as discussed below.

Suppliers mentioned three primary ways to help match their technology to address a community's stormwater management needs. First, and most importantly, is understanding a community's needs. It is easier to sell a product to a community when the product is in line with a community's actual needs. Second, knowing how a community makes stormwater decisions is critical. If it is impossible for the city engineer to try new stormwater management techniques without a council's approval, it is pointless for a supplier to try to sell a city engineer on their product. Sometimes the connection should be to the non-technical staff first, which can give authority to the engineers to try something new. Third, education is significant in encouraging a community to try new technologies. City engineers or managers often don't have the time to search for the best product, so the path of least resistance is frequently taken. As such, suppliers should be ready to provide the education needed for decision-makers.

Suppliers found lots of possibilities to build confidence in performance. Concentrating on operation and maintenance plans can be beneficial since communities need installed systems to function for years or

even decades. Additionally, any assurances or warranties provided by the supplier will build confidence in their products. When it comes to proving data with a product, suppliers understood that field testing is critical. There was some disagreement between the focus groups about the value of performance standards and approval organizations. Some felt that cost always outweighed performance, so it didn't matter if a product over-performs on standards or had certain approvals. Others saw value in performance standards and approval organizations when there are no competitors to compare with cost.

Another common discussion point was that because traditional stormwater management is commonly perceived as the cheapest option, both in terms of capital and life-cycle costs, suppliers saw that selling the other advantages of new stormwater technology was important too. The major additional advantages that newer technology might have are reduced operation and maintenance costs, co-benefits, and easing land constraints. When properly compared, some new stormwater technologies have significantly fewer operation and maintenance costs compared to traditional techniques. The focus group participants all pointed out, though, that proper comparisons between the two are rarely done. Co-benefits are also seen as an advantage for new stormwater technologies. Co-benefits that can be expressed financially were identified as particularly important, especially when trying to sell to communities that only care about the financial bottom line. Finally, newer technologies can reduce the space required to manage stormwater. This could allow suppliers to sell their products to developers and city planners by demonstrating how to maximize land values. Focus group participants noted one major challenge of selling the advantages discussed above is that getting "apples to apples" comparisons are difficult.

When the supplier focus groups discussed risks associated with new technologies, they concentrated on education. Municipal engineers and decision-makers were seen as "set" in their ways, needing education to show that beneficial alternatives exist for traditional methods. One focus group participant's comment that "perception is reality" hit on the issue that education is needed to bypass the misconceptions surrounding new stormwater technologies. Peer-to-peer education, branding, and storytelling were highlighted as good ways to promote new technologies and techniques. Another central theme to reducing risk was to improve funding mechanisms. One of the biggest risks associated with new technologies is that they might be too expensive upfront and/or over the life-cycle of the product. More consistent funding mechanisms could give communities a chance to better plan for the use of new technologies.

Education again played an important role for suppliers in leadership, regulations, and regional cooperation. As drivers of technology adoption, educated leaders were especially important for suppliers because it limited the number people who needed to be sold on a product. A complication of educating and dealing with leaders in a community is that they might not be there in the future. Ensuring institutional knowledge is retained was important to some focus group participants. Regulators that understand new technologies and how they can fit within old regulations is a challenge, especially in stormwater management. Keeping these regulators up-to-date with the newest technologies was critical for focus group participants. When working within a region, finding the right partners was important. Certain organizations or communities may have significant influence in a region. If these key partners can be educated on new stormwater management techniques, it could go a long way in the region.

3.3   Consultant Themes

3.3.1   Effectiveness of Stormwater Management

The consultants agreed that communities are doing well managing stormwater, but there is a long way to go if we want to really eliminate all issues surrounding stormwater management. Many consultants mentioned that a few areas are practicing effective and interesting stormwater management, while most others are lagging. One of the problems is that there is a "patchwork" of regulations governing how each area manages stormwater; something consultants often experience with their work. **It is easier to impact new development, because once infrastructure has been built it is hard to go back and retrofit.** Some **consultants pointed to outdated design, zoning, and landscaping standards that prevent communities from trying new things and subsequently forcing everyone to scale back their stormwater management ambitions.**

Within most communities, citizens see stormwater management as being free - once it is off their property, it is someone else's problem. This often means the benefits of stormwater management don't go to those who pay for it. **Often it takes a significant change to a beloved waterbody before communities realize they need to do something**.

3.3.2   Current Role of Technology in Stormwater Management

Most consultants agreed that there is technology out there to help meet the challenges of stormwater management. For new stormwater technologies, **problems arise with cost, effectiveness, installation, and maintenance**. Performance criteria for new stormwater technologies are also lacking, making it difficult for consultants to sell a new technology to developers or a community when they can't show how much more effective one technology is over another.

3.3.2.1   Developing Trust in New Technologies

Many communities, especially smaller ones, are risk averse; they don't want to be the first one to try a new stormwater technology. Consultants saw two ways they could help develop trust in new technologies: education and cost. Because most communities don't have the time to learn about every new stormwater technology, consultants can help **identify community's needs and which stormwater technologies meet those needs**. This is dependent on consultants knowing what each community is looking for in terms of stormwater management. It is key to understand the whole community's motivations and needs, not just one department – for example, engineering, planning, parks/rec, or public works.

Cost is a harder issue for consultants. If there is a real need for advanced stormwater management, it's easier for a consultant to convince a community to look past the perception that new stormwater technologies are more expensive. For communities lagging behind, it is important to show them the **complete cost of a product (install, operation, maintenance),** something consultants can do better than direct suppliers of stormwater technology. One way to do this is to highlight pilot projects. Additionally, local projects in the community might be the only way to show off these technologies to skeptical communities. Working with local contractors to drive down costs and getting third party funding are also effective ways to alleviate a community's cost concerns.

Many consultants noted that without strong local leadership, most communities will do the bare minimum with regard to regulations. That's why it is important to **work with regulators to incorporate new stormwater standards into their rules**. Model ordinances and allowing/encouraging drainage fees would help with this effort.

Because consultants often find themselves between communities and suppliers, their perception of new technologies is important. Every consultant had interest in seeing new technologies develop, but some worried that supply is outpacing demand. They still see communities that are unwilling to try even the simplest steps towards more advanced technologies. **Consultants work for their clients, so they can only go so far in pushing new technologies.** As one consultant put it, "you can lead a horse to water, but you can't make it drink."

3.3.2.2   Interest in New Technologies
Consultants often use vendor promotions, conferences, and trade magazines to keep up-to-date with what new technologies are out there. Almost all of the consultants mentioned that a supplier's relationship with them is very important in deciding whether they will use their technology or not. This relationship is critical, because the consultant then must sell the product or design to the community. **Suppliers who stand by their products, provide reliable data to back it up, and work with consultants and communities - before, during, and after installation - will have less trouble getting their technologies installed**. One consultant suggested suppliers should start building trust by providing monitoring of their installed products. This will give the suppliers more data to help sell their product and it shows that they are standing behind their product.

While some consultants had a bias toward using more green infrastructure, all agreed that proprietary technology has its place in stormwater management. **Areas where consultants looked to proprietary technology the most were small project sites and where full treatment train approaches are constrained**. Ultimately, the product has to work and meet the requirements of the particular project. **The consultants identified more small-site technologies, retrofits of traditional stormwater management tools, better nutrient reduction technologies, and improved modeling as areas where new stormwater technologies need improvement.**

3.3.3   Data and Stormwater Management
The consultants agreed that there is a need for more data to help them make stormwater management decisions. There is **skepticism regarding the numbers provided by suppliers** and many consultants wish there were more third party data available, but funding for monitoring is difficult to obtain. One consultant suggested that more state and federal money should be provided to start monitoring installed projects. It is becoming cheaper and easier to collect data, so any additional funding stream might go a long way. Additionally, when considering new technologies, communities like to look toward similar communities that have installed them as examples. Each region has its own 'champions', so understanding from which communities to collect data is important.

The consultants highlighted a similar set of data that is needed to convince communities to try a technology. The largest area of need was **better life-cycle assessment**. This includes understanding **upfront installation costs, but also operation and maintenance needs over time**. Data concerning the

unique climate challenges of the region is also needed. Effectiveness is also a huge concern for consultants because they must convince a community that a new technology will be an improvement over what is already being done. These data concerns were compounded by the fact that **real-world numbers are needed** as consultants sometimes have a hard time selling lab data to hesitant communities. If lab data is to be used, more diverse particle size distribution and flow rates need to be included to better show the overall effectiveness of the technology across a range of storm events.

3.3.4   Current Efforts to Strengthen Technology Transfer

There is a consensus among consultants that there are a lot of groups trying to encourage the use of new stormwater technologies. They have been doing a **good job of getting practitioners talking, but actual results are lacking**. For example, one consultant pointed out that WEF is doing a good job finding new stormwater technologies, but is falling short of targeting communities to get those technologies installed. Another consultant pointed out that technical conferences are generally focused at consultants and suppliers, but there is not much involvement from municipal managers and engineers.

There are opportunities in taking steps beyond just talking about new stormwater technologies. **Regional planning agencies and professional organizations need to help bring along reluctant communities by providing education, accessible tools, and funding sources.** Organizations that already have a strong following, like the US Green Building Council, could help champion the use of new stormwater technologies. Some consultants were surprised that academia wasn't more involved, especially in providing third-party testing and data.

3.3.5   Largest Barriers to Stormwater Technology Transfer and Use

Consultants understand that new stormwater technologies are being encouraged and demanded more and that now is the time to begin adopting them on a wide scale. One of the biggest challenges pointed out by the consultants is that stormwater management is often an **unfunded mandate for communities**. This makes cost a critical concern. So, while nobody is promoting pipes and ponds, often that is what is built because there is a **perception that the alternative is more expensive**. Just the perception that new technologies are more expensive can thwart any chances of them being used. For consultants who need to work with communities, they cannot spend their whole design budget learning and advocating for new technologies.

> *Theme:*
>
> **Cost**

Current regulations make it difficult for new technologies to enter the marketplace. Approval processes are often long and expensive, especially if a product is meant to be used across the region. **There needs to be more "hard and fast rules" for suppliers and consultants to work with and better testing procedures for products to show they meet standards**. Consultants repeatedly found that communities are willing to try new technologies if it can be shown that the technology easily meets regulatory standards and can save the community money.

The **lack of regional stormwater management hinders the adoption of new technology**. If a community begins to have success with new technologies, it is difficult for other communities to follow if they are under a completely different regulatory scheme. Any movement towards more regional management

would open the marketplace to newer technologies. Even efforts to bring communities with similar challenges together would help them better understand how best to approach them.

3.3.6 Consultant Conclusions

Consultants see that some communities are implementing effective and innovative methods to manage stormwater, but many are lagging. Most communities are willing to try new technologies, but problems arise with cost, effectiveness, installation, and maintenance. Consultants need to do better identifying community needs and which technologies meet those needs. Positioned between the supply and demand of stormwater technology, consultants are in a unique position to work with regulators to help streamline rules to encourage more advancements in stormwater management.

Suppliers who stand by their products, provide reliable data to back it up, and work with consultants and communities - before, during, and after installation – are something consultants are looking for when trying to decide if they should include a new technology in their design. There is still a level of skepticism of data provided by suppliers. The largest need for more reliable data is better understanding of life cycle assessment; this includes understanding upfront installation costs, but also operation and maintenance needs over time.

There are some organizations out there that are getting practitioners talking, but actual results are lacking. Too often these organizations are only concerned about their field of focus to make a significant impact on the broad adoption of new stormwater technology. The lack of regional stormwater organizations and management also hinders the adoption of new technology.

4 Overall Conclusion

There appears to be consensus across the spectrum of stormwater professionals on a few key points needed to encourage stormwater technology transfer. To begin, there is consensus that, while there are some communities managing stormwater well, most communities lack effective stormwater management. This is not solely a technical issue, as there is a host of technologies available to communities to help them manage stormwater. The biggest concern is likely that most communities do not want to take the risk of trying a new or unproven technology. This initial hurdle is a significant challenge for most new stormwater technologies. A community may be willing to try something new if they are forced to do so, have solid leadership, or can be convinced that it is the economical thing to do.

For most communities, stormwater regulations are easy to meet using traditional techniques, but consent decrees, MS4 permits, or other compliance orders have begun to force some communities to try alternative or more sophisticated stormwater management practices. However, the majority of communities are not subject to these requirements, so the overall adoption of advanced stormwater technology has been slow. Strengthening regulations and having rules/guidance that encourage the use of new technologies would help hesitant communities try new technologies.

Communities that are willing to think about stormwater management differently usually have some sort of leadership guiding the way. This can be internally through an active mayor's office or department that manages stormwater, or externally through an active NGO or interested public. Additionally, consultants

that are willing to take the time to educate and explain the benefits of new stormwater technologies can act as a catalyst to their adoption.

Often the biggest constraint for new stormwater technologies is the perception that they are more expensive than traditional stormwater management tools. Advocates for new stormwater technologies need to do a better job showing that these technologies can be more effective and/or less expensive. This can be demonstrated by showing that upfront costs may be less or that operation and maintenance are economical. Suppliers that stand by their product through design, manufacture, installation, operation, and maintenance effectively ease the cost concerns of many communities.

When it comes to presenting new stormwater technologies, data is important. Most interviewees understood the need for more high quality data. This includes a better understanding of the life-cycle of these technologies (installation, operation, maintenance) and how they handle the unique conditions of the region (cold weather). How the data is collected and presented also needs improvement. While laboratory data is fine, most communities are looking for on-the-ground results. Suppliers and consultants then must do a better job of presenting the data in a way that highlights the benefits compared to what a community is already doing, not compared to their competitors.

Many communities believe they are managing stormwater adequately and are unwilling to do more than the minimum required. Additionally, these communities do not have the time to learn about what new technologies can provide. There is a real lack of simple, unbiased assessments of what can be done with the technologies currently available. There is also a lack of a reliable process that vets and validates new stormwater technology performance. This information could be used by communities and consultants to better understand what effective stormwater technologies are available to them.

The comments received during the focus groups validated the key themes from the interviews. While the focus groups concentrated on the five themes presented to them, a few major concerns repeatedly came up during the discussions. One of these major concerns was the need for more education. Both supply and demand groups repeatedly mentioned that new stormwater technology will not proliferate unless decision makers, regulators, and engineers are educated on what is available. The need to demonstrate new technology with local field tests and a true understanding the needs of a community were also very important for all focus group participants.

While there are groups trying to advance stormwater technology, they have been limited in their effectiveness. Trade and city organizations (like WEF and the Great Lakes and St. Lawrence Cities Initiative) are effective on their own, but with little communication between. Trade organizations do not know what cities really want and city organizations do not know what stormwater technologies are available. Additionally, there is a lack of regional organizations (both multi-community and multi-state) that understand the unique challenges of the region; promote cities that are trying alternative concepts; and advocate for uniform regulations. It is clear there is a need for a group working to advance the development of stormwater technology - one that can educate decision-makers, drive the adoption of uniform regulations, and advocate for both the supply and demand side of the market.

Appendix A - Interviewees

Communities

Buffalo, New York

Julie Barrett O'Neill
General Counsel
City of Buffalo Sewer Authority

Kerrie Gallo
Deputy Executive Director
Buffalo Niagara Riverkeeper

Detroit, Michigan

Erin Kelly
Lead Landscape Architect
City of Detroit Office of Strategic Planning

Duluth, Minnesota

Tom Johnson
Project Engineer
City of Duluth Public Works and Utilities

Erie, Pennsylvania

Sarah Galloway
Sustainability Coordinator
City of Erie

Rick Morris
Township Engineer
Millcreek Township

Guelph, Ontario

Rachel Ellerman
Engineering Technologist
City of Guelph

Waterloo, Ontario

Pat Gilbride
RAIN Program Manager
REEP Green Solutions

London, Ontario

Shawna Chambers
Division Manager
City of London Stormwater Engineering

Imtiaz Shah
Environmental Engineer
Upper Thames River Conservation Authority

Milwaukee, Wisconsin

Karen Sands
Director of Planning, Research & Sustainability
Milwaukee Metropolitan Sewerage District

Erick Shambarger
Environmental Sustainability Director
City of Milwaukee Environmental Collaboration Office

Oshkosh, Wisconsin

John Ferris
Civil Engineer Supervisor
City of Oshkosh Stormwater Utility

Steve Gohde
Assistant Director of Public Works
City of Oshkosh Department of Engineering

South Bend, Indiana

Kieran Fahey
Director of Long-Term Control Plan
City of South Bend

Thunder Bay, Ontario

Aaron Ward
Project Engineer
City of Thunder Bay

Appendix A - Interviewees

Toledo, Ohio

Regina Collins
Stormwater Coordinator
City of Toledo Division of Environmental Services

Lorie Haslinger
Senior Engineer
City of Toledo

Patekka Pope Bannister
Chief of Water Resources
City of Toledo Division of Environmental Services

Traverse City, Michigan

Dave Green
Department of Public Works Director
City of Traverse City

Tim Lodge
City Engineer
City of Traverse City

Russ Soyring
Planning Director
City of Traverse City

Sarah U'Ren
Program Director
Grand Traverse Bay Watershed Center

Manufacturers

Derek Berg
Director – Stormwater Regulatory Management
Contech Engineered Solutions

Scott Gorneau
National Sales Manager – Stormwater Systems
ACF Environmental

Jon Grant
Manager of Research
WaterTAP

Trish Johnson
Better Best Practices Lead
WaterTAP

Ray Kennedy
President
Kennedy Solutions Inc.

Jim Lenhart
Chief Technology Officer – Stormwater
Contech Engineered Solutions

Kevin Mercer
Chief Executive Officer
RainGrid

Marcus Quigley
Chief Executive Officer
Opti

Consultants

Bob Bailey
Senior Civil Engineer
DGL Consultants

Brian Cenci
Vice President
Eng., Inc.

Dennis Dreher
Senior Consultant
Geosyntec Consultants

Bob Givens
Senior Project Manager
OMNNI Associates

Appendix A - Interviewees

Troy Naperala
Michigan Water Business Leader
AECOM

Charles Poat
Project Manager
Mannik & Smith Group

Jim Ridgway
Vice President
Environmental Consulting & Technology

Dan Schechter
Program Manager – Water Resources Services
Environmental Consulting & Technology

Ron Scheckenberger
Principal Engineer
Amec Foster Wheeler

Brian Verspagen
Senior Project Manger
WatlerFedy

Greg Williams
Managing Director
Good Harbour Labs

Appendix B – Interview Questions

"This project is being funded by the Erb Family Foundation and seeks to investigate the role of technology transfer in stormwater management. The goal of this interview is to understand either stakeholder motivations for or barriers against implementing new stormwater management technologies and green infrastructure design techniques. This interview is being recorded to ensure I am able to document your complete thoughts on this topic. Your answers will be compiled, but not personally attributed to you in any of our published materials. Have you reviewed the interview introduction document?"

General Questions

- Can you describe your position and your interest in the project?
- Would you consider yourself part of the supply or demand side of stormwater technology?
    - What role do you primarily identify with (reference Figure 1)? Are there other roles on the figure you have or are current serving?
- How is current technology meeting current challenges?
- How would you define green infrastructure?
- How well is stormwater managed in the community or region in which you reside? Explain your opinion.
- How are stormwater management decisions made in the community or region you reside? Would you like to see the process of making SW management changed?

Supply Questions

- What is your role in developing trust in new stormwater technologies and/or green infrastructure designs?
- When are communities that you service (i.e. work in) receptive to learning about or implementing stormwater technologies (this includes design methodologies)?
- What are the largest barriers to stormwater technology transfer in the basin?
- What are the largest barriers to green infrastructure implementation?
- What is your perception/reaction to proprietary technology in managing stormwater?
- How does data and/or information technology play in stormwater management technologies?
- Are there current efforts to strengthen technology transfer that you are aware of and should those be continued?
- What physical or intellectual space represents the largest opportunity for technology transfer in the communities you work?
- Do you have any closing thoughts that you would like to share or advice for the project team on how to proceed?

Demand Questions

- What is the current role of technology in managing stormwater?
- Are you interested in seeing new stormwater management technologies developed? Deployed in your community? Why or why not?
- How prevalent is GI in your community? What types of GI (i.e. rain barrels, porous pavement) are present and why?
- What would you need to develop trust in your community (could be physical community or personal communities) in new stormwater technologies? How about trust in GI designs?

- Are you exposed to proprietary technologies designed to assist in managing stormwater?   What is your perception/reaction to proprietary technology in managing stormwater?
- What do you know about real-time stormwater management?
- What role does data or information technology play in your stormwater management?
- What are the largest barriers to stormwater tech transfer in the basin? How about green infrastructure implementation?
- What physical or intellectual space represents the largest opportunity for technology transfer in the communities you reside?
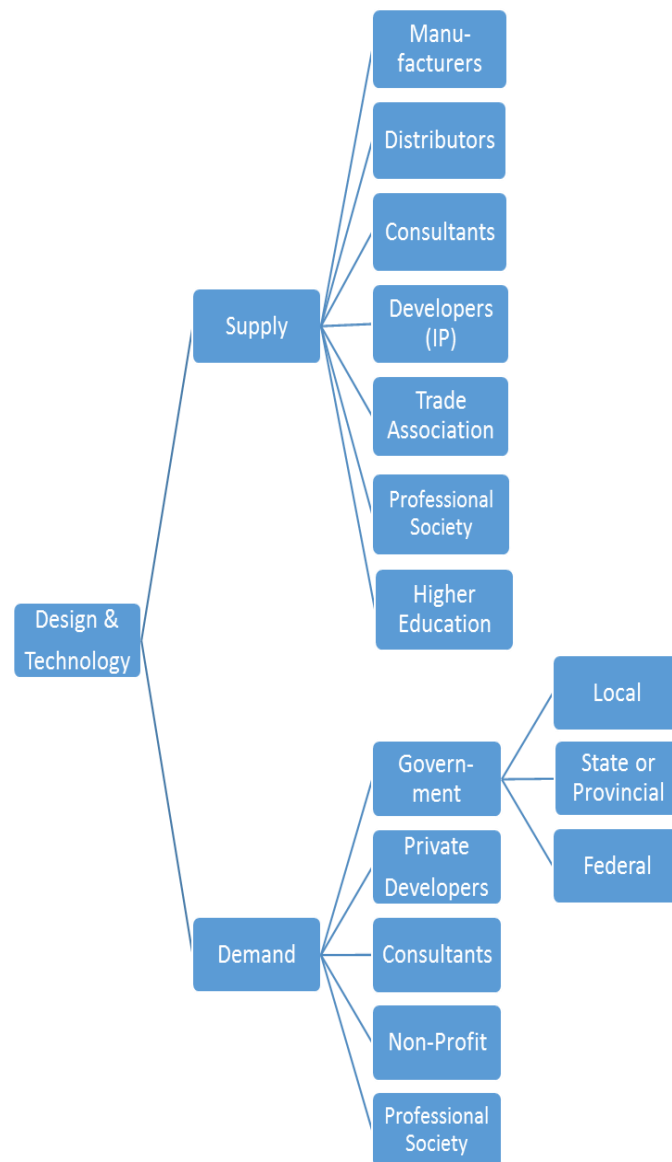- Do you have any closing thoughts that you would like to share or advice for the project team on how to proceed?

Technology Transfer

This process chart represents the two sides of the tech transfer equation (supply and demand). There are differences in the application when considering the two main categories (GI Design and Stormwater Technology) but the general structure is the same for both.

```
Design & Technology
    ├── Supply
    │     ├── Manu-facturers
    │     ├── Distributors
    │     ├── Consultants
    │     ├── Developers (IP)
    │     ├── Trade Association
    │     ├── Professional Society
    │     └── Higher Education
    └── Demand
          ├── Government
          │     ├── Local
          │     ├── State or Provincial
          │     └── Federal
          ├── Private Developers
          ├── Consultants
          ├── Non-Profit
          └── Professional Society
```

Supply Side Definitions

- <u>Manufacturers</u> – companies who manufacture physical stormwater management devices. This category does not exist if only considering GI Design Knowledge Transfer.

- <u>Distributors</u> – companies who market and distribute stormwater management devices. This category does not exist if only considering GI Design Knowledge Transfer.

- <u>Consultants</u> – these are companies (Landscape Architects, Architects, Engineers, and Planners) who represent the supply side in a variety of functions.

- <u>Developers</u> – companies or individuals who develop Intellectual Property (IP) in this space.

- <u>Trade Associations</u> – professional organizations or associations that represent members of the supply side.

- <u>Professional Societies</u> – professional societies (American Society of Civil Engineering, American Society of Landscape Architects, etc.) that could have a role on the supply side of tech transfer but whose mission or activities would be broader.

- <u>Higher Education</u> – institutions of higher learning that might undertake in research, IP development, or have offices of tech transfer that play a role in supporting the supply side

Demand Side Definitions

- <u>Government</u> – broad category of governmental units that spans many departments and would include elected officials and full-time employees. This group could set policy/regulations but also be a direct user on the Demand side.

    - <u>Local</u> – municipal, township, or county units of government

    - <u>State or Provincial</u> – state or provincial level of government that could include agencies such as Department of the Environment, Department of Transportation, etc.

    - <u>Federal</u> – federal level of government that would include US Environmental Protection Agency, US Army Corps of Engineers, US Department of Transportation, etc.

- <u>Private Developers</u> – companies or individuals that are developing land for a variety or purposes including residential, commercial, and industrial.

- <u>Consultants</u> – these are companies (Landscape Architects, Architects, Engineers, and Planners) who represent the demand side in a variety of functions.

- <u>Non-profit</u> – non governmental organizations such as watershed councils, environmental groups, etc. that might be implementing green infrastructure or managing stormwater.   In the context of Demand side this would include institutions of higher education.

- <u>Professional Societies</u> – professional societies (American Society of Civil Engineering, American Society of Landscape Architects, etc.) that could have a role on the Demand side of tech transfer but whose mission or activities would be broader.

Appendix D – Focus Group Questions

1. Matching Technology to Needs

2. Confidence in Performance

3. Cost/Benefit Ratio

4. Reducing Risk—Shifting Culture to Test New Technologies/Approaches

5. Drivers: Leadership and Regulations

1. Matching Technology to Needs

Demand

- What stormwater management needs in your community are not being met by new stormwater technologies or green infrastructure?

  - What is the biggest data/information challenge to meeting your communities stormwater needs? (e.g. data doesn't come from a similar community, information isn't relevant to my community's needs, or difficulty in keeping up with the newest technologies)

  - How do you perceive data that doesn't come from within a similar community?

  - What outside organizations do you feel give reliable information to help you better understand your needs and possible solutions?

  - Do you find value in trade shows, annual conferences, and gathering meetings for municipal planners, city engineers?

Supply

- How do you approach meeting a community's stormwater needs?

  - What challenges do you encounter when trying to sell your product to a new community?

  - What are the differences working with community leaders, city engineers, or consultants?

  - Do you find value in trade shows, annual conferences, and gathering meetings for municipal planners, city engineers?

Appendix D – Focus Group Questions

2. Confidence in Performance

<u>Demand</u>

- How important is testing and evaluation methods to the adoption of a new technology?

    o What sort of data/testing do you look for the most? Cost, performance, operation & maintenance?

    o Do you prefer lab or field testing?

    o What are the challenges of comparing different stormwater technologies and green infrastructure, especially to what is traditionally used?

    o Would you be interested in warrantees by suppliers or consultants?

<u>Supply</u>

- How do you provide assurances about the cost and performance of your products and services?

    o Do you prefer lab or field testing? What about your customers?

    o How do you approach comparing or contrasting your product with others in the market? How does the performance, or lack thereof, of a similar product affect your product line?

    o How do you assure the performance of your product will continue beyond installation?

3. Cost/Benefit Ratio

Demand

- Is the perception that new stormwater technologies and green infrastructure are always more expensive than traditional stormwater management systems a barrier to technology transfer?

    o Are alternative funding sources required before new stormwater technologies or green infrastructure are considered in your community?

    o What are the most important cost factors in stormwater management (capital/upfront, operation and maintenance, or whole lifecycle?)

    o Besides reducing the cost of the product, how can suppliers and/or consultants make their product more palatable for your community? (warranty options, performance guarantees, operation & maintenance plans)

Supply

- What can be done to help overcome the perception that new stormwater technologies and green infrastructure are always more expensive than traditional stormwater management systems?

    o What challenges are there to promoting your product's lifetime cost effectiveness?

    o Operation and maintenance costs are often seen as too high for new stormwater technologies and green infrastructure; how do you get around these perceptions?

    o Besides reducing the cost of the product, how can you make your product more palatable for your community? (warranty options, performance guarantees, operation & maintenance plans)

4. Reducing Risk—Shifting Culture to Test New Technologies/Approaches

<u>Demand</u>

- What will it take for community leaders, design engineers, stormwater program managers to become more willing to think beyond what is strictly required by regulations and try new approaches/technologies?

    o What sort of risks need to be considered when using new stormwater technologies or green infrastructure?

    o What are the biggest obstacles to trying something new in your community?

    o How can suppliers and consultants help you overcome these risks?

<u>Supply</u>

- What will it take for community leaders, design engineers, stormwater program managers to become more willing to think beyond what is strictly required by regulations and try new approaches/technologies?

    o What are the biggest obstacles you've encountered to getting your product or design implemented?

Appendix D – Focus Group Questions

5.   Drivers: Leadership, Coordination, and Regulations

<u>Demand</u>

- How does leadership, regional coordination, and enforceable regulations contribute to the adoption of new stormwater management in your community?

    - Do community leaders know about the challenges and new opportunities for stormwater management?

    - What are the challenges/opportunities of managing stormwater across community boarders?

    - Which do you prefer: regulations that spell out exactly what a community should do for stormwater management, allowing for specific technologies to be measured against specific standards; or regulations that are more general, allowing for multiple methods to meet standards?

<u>Supply</u>

- How do you work with leaders and regulators to foster the adoption of stormwater technology and green infrastructure?

    - How do you educate community leaders to think about stormwater management progressively?

    - What are the challenges/opportunities of managing stormwater across community boarders?

    - How do you coordinate across multiple jurisdictions within a specific municipality?

    - Which do you prefer: regulations that spell out exactly what a community should do for stormwater management, allowing for specific technologies to be measured against specific standards; or regulations that are more general, allowing for multiple methods to meet standards?