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Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Perceptions of Stormwater Management Policy at UBC Residences

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Perceptions of Stormwater Management Policy at UBC Residences

RES 505 Qualitative Methods In Interdisciplinary Contexts

REAP 4.0: Green Buildings Policies & Biodiversity

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Abstract

Our research investigated the perceptions of key stakeholders (residents, experts and policy-makers) about nature-based solutions to stormwater management at campus residential buildings and neighborhoods. Through this research, we created five recommendations for REAP 4.0 (Resident Environment Assessment Program) informed by the perspectives of residents, experts and policy-makers perspectives, not only in terms of improved stormwater management but also more effective implementation of nature-based solutions.

1. Introduction

The Resident Environment Assessment Program (REAP) is a green building rating system that provides guidelines for the development of residential buildings for the UBC-Vancouver Campus. The REAP highlights building standards that call for lower environmental impact while having a positive impact on the community. Buildings designed under REAP must meet a set of sustainability preconditions and cross a certain threshold of additional points, which are achieved with the inclusion of additional sustainable features, or credits. Gold certification is currently reached by achieving 50 extra sustainability credits (University of British Columbia, 2020). Currently, the UBC-Vancouver campus has 35 Gold REAP certified buildings, and all new neighborhood residential buildings in the UBC neighborhood must achieve a minimum of Gold Certification. The latest version of REAP (REAP 3.2) currently awards points for eight different components, including water and biodiversity, which this project will be focusing on (University of British Columbia, 2020).[1]

[1] Along with the REAP, UBC follows an *Integrated Stormwater Management Plan* that emphasizes strengthening the campus's resilience by viewing stormwater as a resource to reduce the risk of flooding. Similarly, the *Green Building Action Plan (GBAP)* pictures a more holistic system for stormwater management enhancing the biodiversity on campus.

Following such guidelines, UBC is committed to incorporating rain gardens, water reuse, soft landscape and other similar features. Before the release of the new version of REAP (REAP 4.0), our SEEDS partners wanted to explore the opinions and perspectives of various stakeholders on the stormwater component of the REAP.

Our research aims to address the social side of implementing nature-based stormwater management at UBC residential areas. We did this by exploring the range of perspectives that exist at UBC regarding nature-based solutions for stormwater management, as well as their perceived importance in past and future projects. Based on our findings, we aim to make recommendations for REAP 4.0 on how to better incorporate a wider range of perspectives to ensure more successful implementation and sustainable management of nature-based stormwater strategies.

2. Literature Review

The impacts of climate change are increasingly being felt in urban environments. Extreme weather events such as droughts, heatwaves and flooding can have major impacts on the lives of local residents (Schiermeier, 2018). Flooding events, in particular, are largely the result of more frequent and intense storms, along with increasingly limited infiltration due to the rise in impermeable surfaces within urban areas, and the failure of existing drainage systems to accommodate the increased stormwater volumes (Zimmerman *et al.*, 2016). Conventional solutions to stormwater management have focused simply on moving water away from affected sites, without considering the ecological significance of this water. In addition to flooding, stormwater contamination by urban pollutants has been a notable element in causing the deterioration of biodiversity, as well as surface water and soil quality in urban areas (Walsh *et al.*,

2016). For this reason, a growing amount of attention has been given to the implementation of alternative methods of stormwater management - ones that facilitate climate change impact mitigation, effective stormwater management, and cultivating ecological well-being.

In recent years, nature-based solutions (NbS) have gained immense popularity as "solutions to societal challenges that involve working with nature" (Seddon *et al*., 2020). NbS provides multiple benefits for both human well-being and biodiversity. Cities have been implementing smaller-scale NbS such as green roofs, rain gardens, and bioswales for stormwater management (Shi, 2020). Creating green roofs and planting trees can moderate the impacts of heatwaves, capture stormwater, and also have positive outcomes for mental and physical health (Nature-Based Solutions Initiative, 2017). Therefore, renaturing areas through the integration of NbS not only provides an innovative, cost-effective, adaptive method for stormwater management but also has a significant positive impact on human health. Kolokotsa *et al.* (2020) claim that there are physiological and psychological benefits to human health including reduced respiratory problems, mood improvement, and lower stress. Therefore, NbS, if implemented successfully, can blur the lines between socio-economic systems and other ecosystems in reducing the vulnerability of the social-ecological system as a whole (Seddon *et al*., 2021).

Despite the many benefits of NbS, numerous studies have noted social barriers to be significant hindrances to implementation (Anderson *et a*l., 2021; Connop *et al*., 2016; Heldt *et al*., 2016; Ureta *et al*., 2021; Anderson and Renaud, 2021; Qi and Barclay, 2021). Lack of public acceptance (defined broadly as cooperation, engagement, satisfaction, and buy-in (Anderson *et al*., 2021)) and negative perceptions of infrastructure are cited as significant contributors to the unwillingness to adopt NbS (Ureta *et al*., 2021; Anderson *et al*., 2021). Various reasons have been recognized as barriers to favourable perceptions, with Turner *et al.* (2016) and Miller &

Montalto (2019) citing lack of sufficient knowledge of the infrastructure; Anderson & Renaud (2021) and Qi & Barclay (2021) mentioning unawareness of the social, ecological and risk-management benefits of green infrastructure, and Staddon *et al.* (2018) and Lee, Jordan & Horley (2015) referring to urban planning priorities and path dependency. Fostering positive perceptions of NbS is necessary, as it has been shown to determine the direction of landscape design and to improve acceptance of NbS implementation despite its higher financial costs (Hegger *et al.*, 2017). Therefore, understanding the perspectives of the relevant groups on NbS can provide valuable information of their willingness to implement, receive and/or upkeep such measures in their residential areas. Furthermore, coupling such perspectives with a consideration of how significant policy-makers and science advisors see the role of the public to be can further aid in recognizing potential barriers to effective implementation of NbS and citizen engagement.

3. Methodologies

3.1. Introduction

Our research group consisted of four young women, international students from different parts of the world, who were a part of the course RES 505: Qualitative Methods in Interdisciplinary Contexts. As part of our initial group conversations, we shared ideas with the SEEDS Sustainability research coordinator (Benjamin Scheuffler), the course instructor (Dr. Leila Harris), and our SEEDS partners (Penny Martyn and Jake Li). These conversations helped shape our research questions and the outcomes of our research.

The methods selected aligned with the initial objectives of our research, and Table 1 indicates only those methods we employed in our data collection:

Table 1: Methods, objectives and expected results.

Method	Objectives	Expected outputs
Literature review	Identify current and emerging solutions for nature-based stormwater management.	Introduction of final paper; images-based survey with world-leading examples of stormwater management; list of potential experts to interview; set of resources and theory-informed recommendations for REAP 4.0.
Semi- structured interview		Four interviews with researchers with expertise in rainwater management and green architecture solutions; references to include in the literature review; examples of successful nature-based solutions for stormwater management to inform policy recommendations.
Structured survey (visual elements)	Understand the perceptions of residents and policy-makers on REAP 3.2 strategies and nature-based stormwater management	30 responses were recorded from the survey, where the residents commented on the perceived effectiveness of the rainwater management structure and the desirability of its implementation.
Focus groups		One focus group with policy-makers involved in the REAP 3.2 formulation focused on the main concerns, frustrations and expectations about the implementation of nature-based solutions on campus residences.
Participant observation	Assess the stormwater management guidelines in REAP 3.2 and their applications and functionality in existing residential areas	Three hours of observation documented on fieldnotes and audiovisual records showing what management practices are in place in the residential areas, the distribution of green spaces and how the residents use those spaces.

All the objectives listed in the table respond to an overarching goal of recommending policy reviews to enhance climate adaptability related to natural systems for REAP 4.0 based on different stakeholders (residents, experts and policy-makers) perspectives. While collecting and analyzing our data, we kept in mind our proposal to provide concrete suggestions for REAP 4.0 policy review on stormwater management informed by the surveys, interviews, focus group, and literature review we undertook.

3.1.1. Ethics considerations

We designed our project in a way that complied with the UBC Research Ethics Board application for RES505. All group members completed ethics training prior to engaging in

research activities (TCPS 2.0 CORE). We also hosted all interviews and surveys online in consideration of COVID-19, and we followed the UBC Research Ethics Board's best practices guide for video conferencing. The focus group and interview participants (non-researchers) all signed a consent form (Appendix A), and anonymity was maintained for the survey.

To recruit researchers for the interviews we sent them an email invitation, and asked them to sign a consent form. For the focus groups, we reached out to policy-makers engaged in REAP directly by email, also asking them to sign a consent form. We also followed guidance from the research ethics office to maintain participant privacy during interviews and focus groups, and in our research outputs, namely this paper and the presentation we will make to the SEEDS partners.

3.1.2. Research Participants

Interviews: A total of four experts participated in the interviews. All the experts had experience with stormwater management and nature-based solutions for stormwater management. One of the experts had previously also been involved in reviewing the REAP.

Structured Survey: This survey was for the residents on campus. The survey was hosted online, and the survey QR code was distributed around UBC residential buildings.

Focus Groups: two policy-makers, one directly involved in the formulation of REAP 3.2, with over ten years of experience working on green buildings management at UBC, and one directly connected to the oversight of stormwater management policies.

3.2 Observations

In order to assess existing stormwater management practices at UBC certified under REAP, three hours of observations were conducted at Wesbrook Place, a residential neighborhood located in South Campus, just south of West 16th avenue. Observations took place on Monday, November 22, and Thursday, November 25, 2021. Wesbrook is UBC's largest neighborhood, and all of the residential buildings developed there are REAP-certified, with the majority being gold certified. Fifty percent of the residences are designated as "work-study" units, which means that at least one member of each household must be affiliated with UBC as an enrolled student, faculty member, or staff member. For our observations we selected several buildings used for faculty and staff housing, namely Webber House and Larkspur House, both certified as REAP gold or silver within the last 12 years (see Figure 1). Faculty and staff housing units were chosen in order to observe REAP-certified buildings that housed longer-term residents, who may be more invested in the functionality of their residences and have some desire to support improvements to building impacts on stormwater management and biodiversity. The exteriors of the residences were easily accessible for observation, and observations were conducted on days with different weather patterns in order to observe stormwater management under dry and wet conditions. In addition to stormwater management infrastructure associated with individual buildings, Wesbrook also includes a neighborhood-scale nature-based stormwater management system, which we also included in our observations. Points of interest associated with this system include Khorana Park, Mundell Park, and Nobel Park (Figure 1).

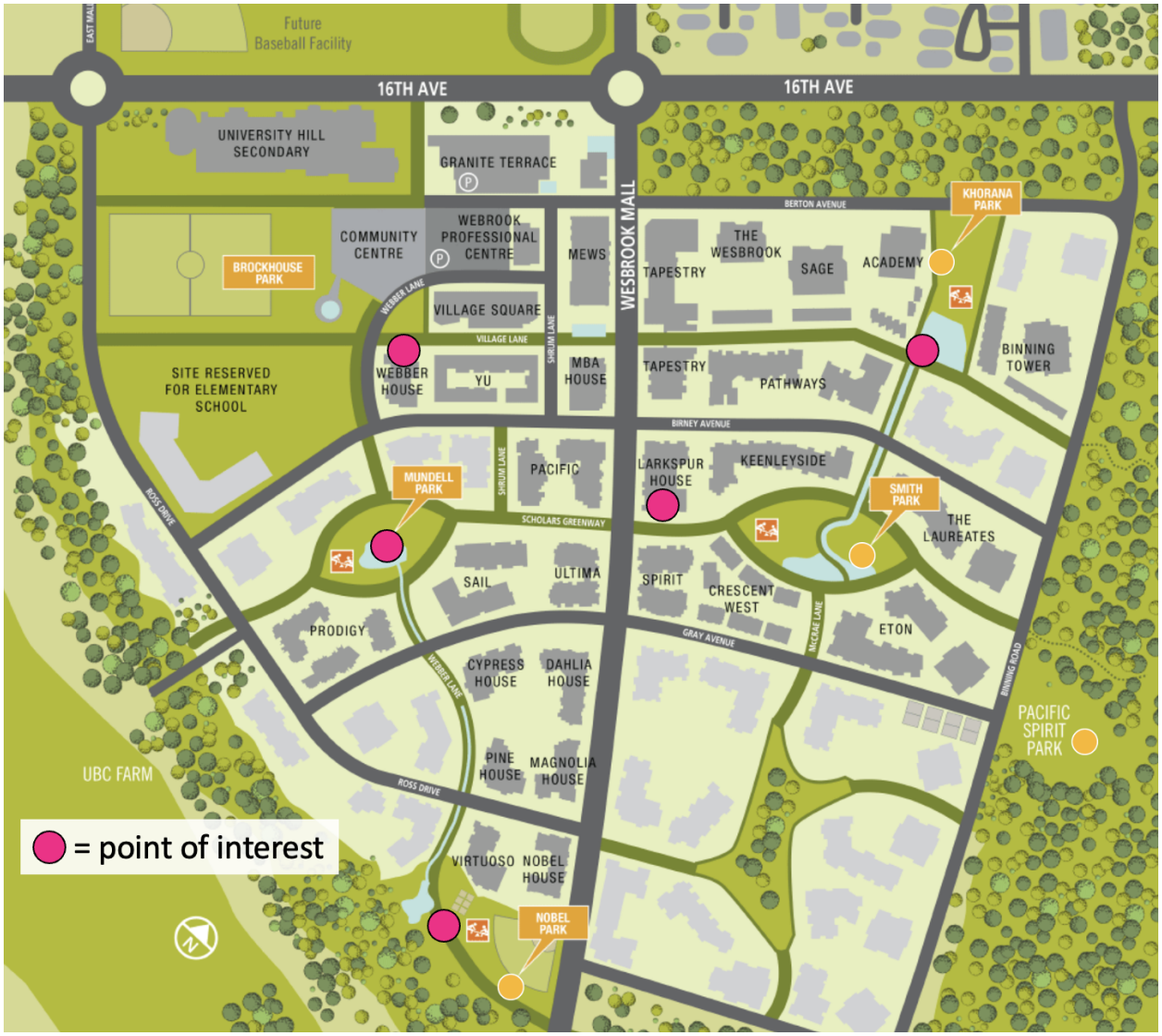


Figure 1. Map of the Wesbrook Place neighborhood with points of specific observation marked (from top to bottom: stormwater channel at Khorana Park, Webber House, Larkspur House, stormwater collection pond at Mundell Park, and stormwater retention pond at Nobel Park) (Wesbrook, 2015).

3.3 Surveys

3.3.1 Residents survey

An online survey was made using Qualtrics for the residents on campus (Appendix B). A poster was made with the survey QR code and distributed to various residential buildings with

the help of the resident life manager, Amy Stewart on November 20th. The survey took approximately 2 minutes to complete and maintained anonymity.

The survey was mostly pictorial, where the residents were provided with pictures of 6 different stormwater management methods (both green and gray) namely, rain garden, green roof, porous pavements/permeable surfaces, drain, storm pipe, and river canal. For the first part of the survey, the participants were asked to rate the perceived effectiveness of the pictured stormwater management strategies using emojis. The last part of the survey asked the participants to rank the strategies according to their desirability to be implemented on their residential buildings on campus.

3.3.2 Developers survey

An online structured survey was designed on Qualtrics and shared with buildings' developers with the support of our SEEDS partners, who reviewed the survey's questions before we submitted it to the developers. However, no responses were received to date after two rounds of follow-up emails.

We planned to survey and eventually interview some of the building developers who have been involved with REAP-certified residential green buildings on campus. The project's partners provided us with the information required to contact the developers. We submitted a ten-minute survey (Appendix C) first, in which they would indicate their willingness to be interviewed before we proceed with scheduling the interview according to their decision. We considered it essential to reach out to such developers because they have had practical, on-field experience with REAP implementation. Furthermore, they could provide in-depth information on following

the REAP guidelines and insights on nature-based solutions, their practicality, implementations, benefits, and cost.

We attribute the lack of response to the late sharing of the survey link with them because of the delay on our BREB amendment (Appendix D) assessment and the time commitment that the survey required - 10 minutes might not be considered reasonable for a busy target audience, such as real-estate developers.

3.4 Expert Interviews

Experts were identified through the recommendations from our meetings with our SEED partners, and through the online search on the UBC faculty page. We selected experts who have had prior experience working with stormwater management as well as NbS. A recruitment email was sent to the experts, and once they agreed on being interviewed, we sent out a When2meet link to arrange a time. Once we negotiated on a time, we sent them the consent form and a zoom link to conduct the interview.

The online interviews were conducted over zoom between 15th November 2021 and 29th November 2021. The interviews lasted approximately 45 minutes. The interviews followed a semi-structured format by following a set interview guide while also deviating from the guide based on the interviewees responses. We interviewed four experts on nature-based solutions for stormwater management, with Expert 1, Expert 2 and Expert 3 having experience in green landscape architecture, and Expert 4 being more closely associated with water systems. The interviews were transcribed using Otter.ai. Then using Nvivo we analyzed and coded the transcripts and defined the overarching themes.

3.5 Policy-Makers Focus Group

A 45-minutes focus group was conducted with two policy-makers on December 3rd 2021, one directly involved in the formulation of REAP 3.2 and one directly connected to the oversight of stormwater management policies. Eleven questions guided our conversation (Appendix E), formulated mainly by our research team, but our SEEDS partners also suggested some. The objective of the focus group was to assess their perceptions about the effectiveness of current REAP policies on stormwater management. To do so, our questions included themes such as the process of including stormwater management as part of REAP, with a focus on credits weight; the stakeholders and other topics connected to stormwater management considered in the policy-making process; stormwater systems currently used on campus and the possibility of nature-based adaptations; institutional, financial, operation and maintenance barriers to nature-based solutions implementation; feasibility, benefits and risks of nature-based solutions under extreme weather conditions; and the buildings developers' role in the policy-making process regarding stormwater management.

4. Results and Discussion

4.1 Observations

Upon first observation, the main stormwater management infrastructure associated with the faculty and staff residences at Wesbrook Place appear to be drain pipes (Appendix F, Figure 1) that lead from the roof and entrance overhangs to the ground surface, where they disappear. We also observed gravel trenches bordering the buildings, and gardens planted along sloping

land surfaces in order to reduce overland flow, which would move quickly over grass but is slowed by taller and more substantial bushes and perennials. This is in line with the current REAP 3.2 stormwater credits, which assign points for achieving certain percentages of permeable surface on site (one point for permeable surfaces on 30% of the site, two points for permeable surfaces on 50% of the site), as well as having the ability to retain a 10-year, 24 hour design storm volume and release it at a slower rate, or detain it on site (University of British Columbia, 2020).

On the afternoon of Thursday, November 25th, after observing the stormwater management systems at the UBC faculty and staff residences under the rain, we stopped by the 'Live at UBC' office in the Wesbrook area. This was not in our itinerary, but through the glass windows we could see a 3D model and a map (Appendix F, Figure 2) projected on a widescreen. After writing our names on the attendance list at the entrance, we greeted a person who worked there, and they asked us the purpose of our visit. We explained that we were doing a field visit to the neighborhood and studying stormwater management at on-campus residential buildings. With enthusiasm, they told us that there was a sign behind the 'Live at UBC' building that explained the whole rainwater management system in the area. They also showed us the interactive map, indicating the detention ponds in the parks and their final destination at Nobel Park near the UBC Farm. They proudly identified themself as a resident of Wesbrook, mentioning how cutting-edge the green buildings currently being developed there are.

We did not expect such a productive conversation from an interaction that lasted less than 10 minutes but provided us with significant information and insights on how stormwater management can be a source of engagement for residents. We could not consider this encounter as an interview in terms of methods, but we learned just as much by talking to this resident. After

this conversation, we followed one of the stormwater channels, and one of us visited the main detention pond in the area, which added a lot of insights into how the stormwater system works and can be integrated with the landscape solutions. More importantly, we learned to remain open to the unexpected in our observations, learning from people with more lived experience in the research site.

The signage associated with the neighborhood-scale nature-based stormwater management system (Appendix F, Figure 3) represents an attempt to inform residents and visitors about the functionality of the system, increasing their knowledge of green infrastructure and the community design. It included a brief description of the system and its benefits with a diagram showing the circularity of stormwater flow from roofs, to channels, to retention ponds, to the groundwater, and pumped back to the main channel during dry months to keep the water feature flowing year-round. While this sign may not engage every community member, our chance conversation with a resident did reveal that knowledge of the Wesbrook Place neighborhood stormwater management system could be a point of pride for residents. The sign that we observed was off the main street in a less trafficked area, and was also partially obscured by a thin layer of plant growth, making it less legible. We did not observe signs detailing the neighborhood stormwater management system at any other locations within the community. The lack of clear, well-dispersed signage may be a missed opportunity to increase residents' interest in and appreciation for nature-based stormwater management, potentially changing less favorable attitudes.

Another aspect of the neighborhood-scale stormwater management system that we observed was the attention community developers had paid to integrating the system into the community landscape in a way that was functional, beneficial, and in line with the neighborhood

aesthetics. The main channel of the system included fountains that aerated the water (improving its quality) and were visually appealing (Appendix F, Figure 4). The fact that this feature was kept flowing year-round shows that designers wanted it to be a permanent fixture of the landscape, and not something that appeared only with precipitation. In addition to the fountains, the system also includes retention ponds (Appendix F, Figure 5) where stormwater is collected and allowed to infiltrate into underlying groundwater, making them functional, but with the inclusion of benches, patio areas, and seating, also making them places to gather for socializing and enjoying outdoor spaces (Appendix F, Figure 6). The system flowed through a series of parks, which included play structures and gardens. Weaving the stormwater channels through community spaces created for outdoor life versus running stormwater into a ditch or creek outside of the community normalizes nature-based stormwater management. The visibility and integration of the system may lead to its acceptance, and combined with education, even recognition of its benefits.

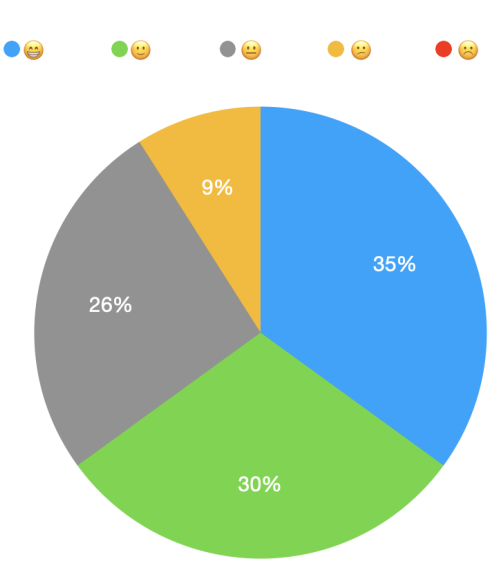
4.2 Surveys

We obtained 30 responses from the resident survey. According to the survey, 72% of our participants claimed to have had some prior knowledge regarding stormwater management. The results revealed that, among the participants, opinions on the effectiveness and desirability of nature-based stormwater management were generally positive.

The participants were first asked to indicate the perceived effectiveness of the different stormwater management strategies included in the survey. For the picture of a rain garden (Figure 9a), most residents perceived it to be on the more effective side. Similarly, residents also perceived the picture of green roofs (Figure 9b) to be significantly effective. Contrary to the results on these two nature-based solutions, for the porous pavements or permeable surface

(Figure 9c), a larger share of residents preferred not to express an opinion and remained neutral.

To conclude, respondents perceived nature-based solution strategies to be generally effective.



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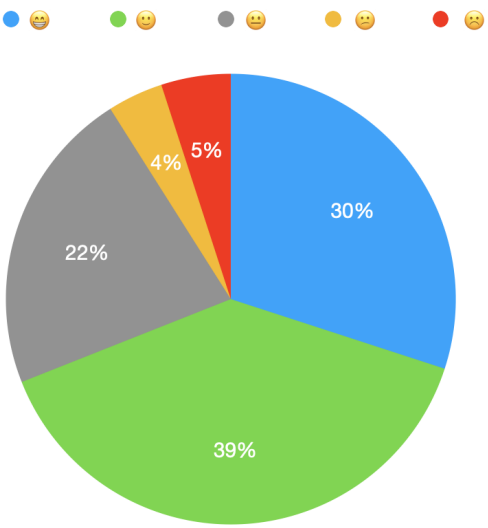

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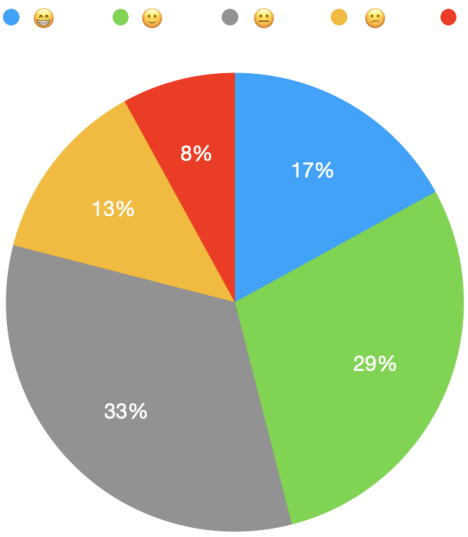
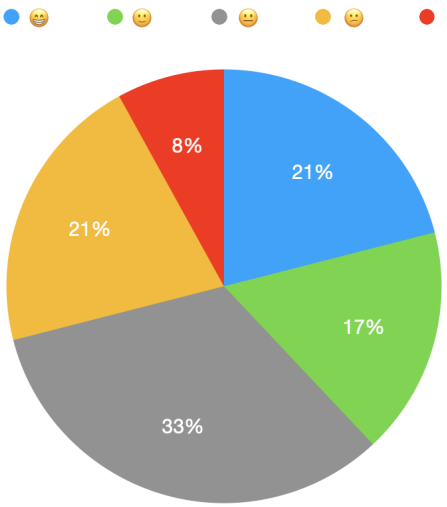


c.

Figure 9a. Survey results of the perception of effectiveness for rain gardens; **9b.** Survey results of the perception of effectiveness for green roof; **9c**. Survey results of the perception of effectiveness for permeable surface/porous pavement

For the picture of the drain (Figure 10a), a lot of the residents expressed neutrality and a few voted as ineffective, but overall it still skewed towards the more effective side. Similarly, for storm pipes (Figure 10b), a lot of residents perceived it to be effective, with a significant number of respondents still maintaining neutrality. Lastly, for the rain canals (Figure 10c), the majority of the respondents remained neutral but a higher proportion did still perceive it to be effective. To conclude, overall, for the grey infrastructures for stormwater management, opinions were mostly scattered, and a significant number of respondents maintained neutrality.



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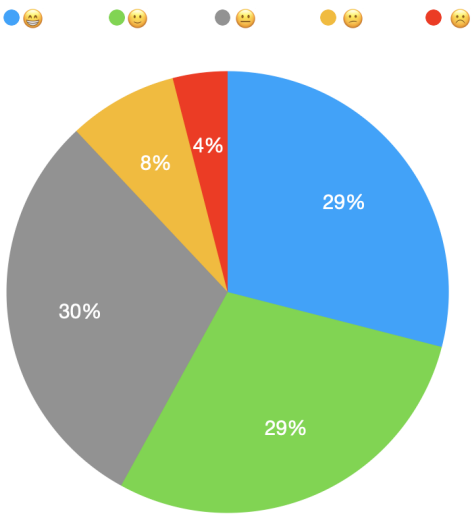

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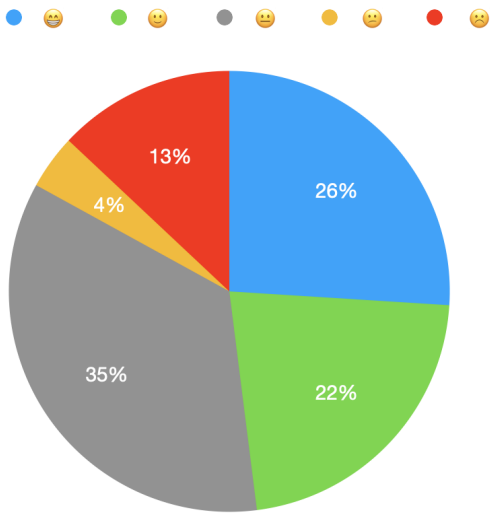

c.

Figure 10a. Survey results of the perception of effectiveness for drains; **10b.** Survey results of the perception of effectiveness for estorm pipes; **10c**. Survey results of the perception of effectiveness for rain canals.

For the second half of the survey, using the same pictures, we asked the respondents to rank the stormwater infrastructure according to what they would most like to see be implemented in their area of residence. According to the survey result (Figure 11), the participants consistently ranked the green infrastructures as more desirable than the grey infrastructures. However, the most and the least desired structures were evenly distributed between the grey and the green. Even amongst the green infrastructure, participants expressed higher desirability for the implementation of rain gardens out of the three green options. Similarly, participants expressed the least desirability towards the implementation of permeable surface/porous pavements.

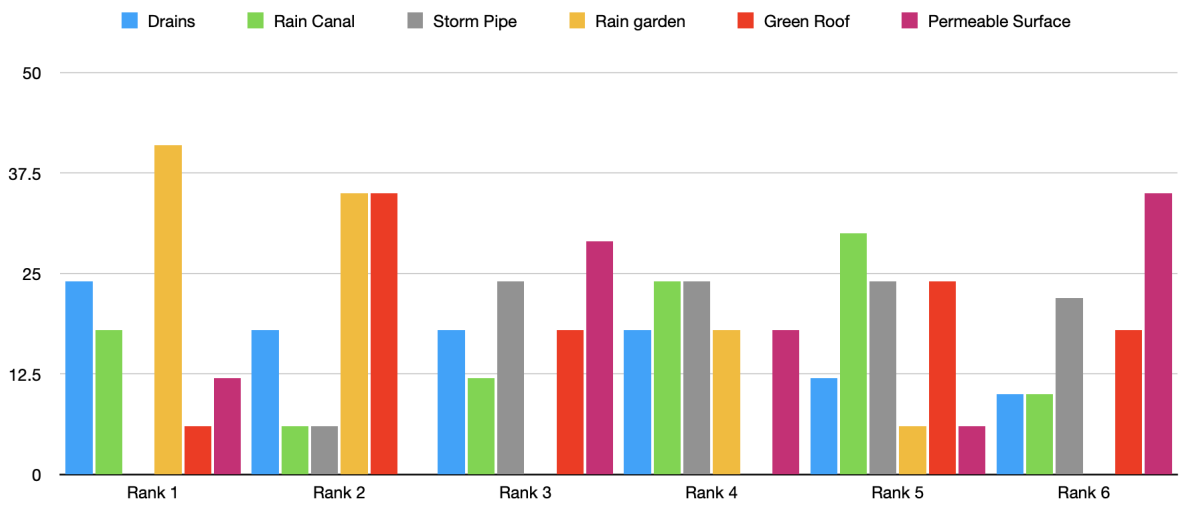

Figure 11. Bar chart from the survey results showing the residents desirability in implementing the stormwater management infrastructures.

To summarize, residents consistently perceived green solutions to be more effective, while the opinions on grey structures were more distributed . When it came to the desirability of the implementation of the two types of infrastructures, residents showed more balance. Therefore, the results show that residents are aware and understand the importance and the effectiveness of the green infrastructures.

4.3 Expert Interviews

Some of the major themes that arose from the interviews were (i) Challenges of implementation, (ii) Public participation/perception, (iii) Suggestions, (iv) the current status of NbS for stormwater management on campus, and (v) the importance of NbS.

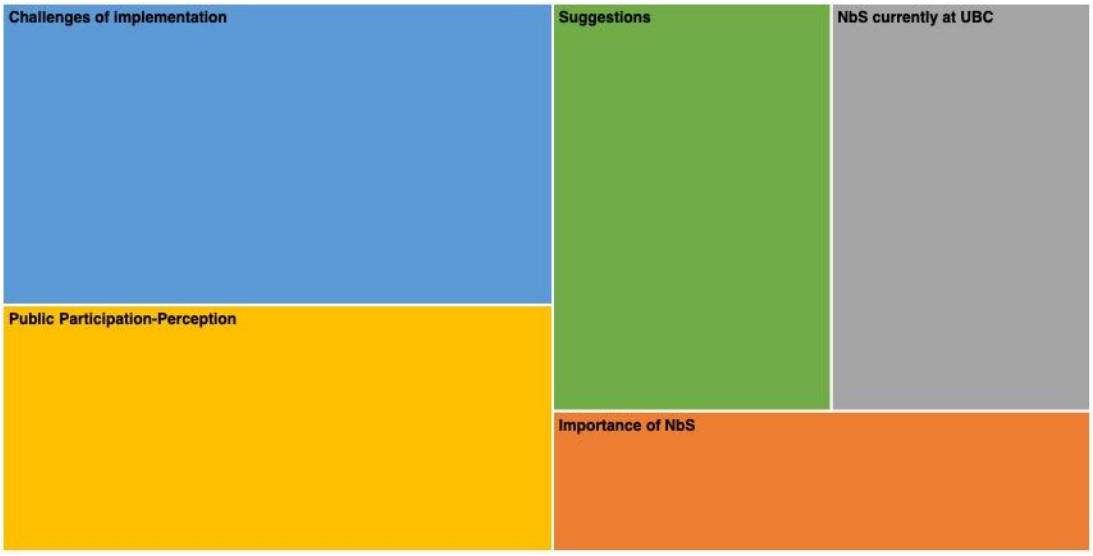

Figure 12. Major themes in the interviews, with the box size indicating their relative prevalence.

Some of the minor but important themes that were cultivated were (i) the role of REAP, (ii) future of NbS for stormwater management at UBC, (iii) Green roofs, (iv) Grey vs Green infrastructures, (v) Co-benefits of green infrastructures for stormwater management, (vi) Accomplishments at UBC regarding green infrastructures for stormwater management, and (vii) combining biodiversity with stormwater management.

Figure 13. Secondary themes from the interviews.

However, since this project was designed to investigate the perceptions of various stakeholders we will only provide further discussion of the public participation or perception theme, or themes that overlap with the perception theme.

The experts emphasized the influence of public perception and participation on the implementation of NbS for stormwater management. The experts placed heavy weight on the importance of positive public perceptions towards NbS. Notably, when asked about the role of the public, Expert 1 expressed that positive outlooks are urgently necessary: "so to be very honest, and really clear, I think they are not only necessary, they are urgently necessary" (2021). Expert 1 posited that positive perceptions towards NbS are vital towards incentivising the implementation of NbS, as the public would still be willing to purchase properties despite the higher prices resulting from NbS.

Expert 4 also emphasized the influence of NbS on property prices, and similarly to Expert 1, they maintained that fostering positive public perceptions towards such solutions will ensure willingness to purchase: "it's going to add value to my property in the end, and it's going to cost more, but we'll just charge more for the end product and people will still buy it"(Expert 4, 2021). The opinions articulated by Expert 1 and Expert 4 are consistent with literature, as Fernandes *et al*. (2019) has shown the positive relationship between housing prices and NbS, while Ruangpan *et al.* (2020) has argued that public perceptions are a significant determinant of the tolerance for such rises in price.

When asked to describe the current state of public perceptions at UBC, Expert 4 believed that awareness of the importance of NbS is not at an ideal level: "I just don't think that the public mentality is quite there yet at UBC" (2021).

Expert 2 expressed similar concern towards balancing the current public mentality at UBC with implementing effective NbS for stormwater management.

> And so they're trying to balance a public perception of what a campus should look like with this notion of introducing more nature based solutions, which don't look neat, tidy mode, you know, the way the public sort of expects the campus to look.

They outline that the expectations of the public to have neat and well-kept landscapes have determined the priorities of landscape design and limited the amount of NbS UBC has been able to implement. As such, Expert 2 demonstrates how the perceptions of the public can create pressure to implement certain solutions over others. Such findings are also prevalent in literature, with, for instance, Wamsler *et al*. (2020) showing how the public was able to guide the direction of landscape design towards less sustainable alternatives in Sweden.

The experts also reflected on the necessity of public participation. Expert 3 was particularly focused on participation, as they maintained that because public spaces are shared environments, landscape change decisions should be a shared task:

> So rather than just having something appear in a culturally shared environmental public space, it's always useful to recognize, to honor, the idea that this is, in fact, a shared space. What happens in that shared space should have an organic connection with those who typically share that space.

Expert 3 points out that by involving the public in decisions for NbS, one can facilitate closer connections to that space, while also shaping the space to fit the needs and desires of the public. The importance of creating spaces to fit the needs of the public is further emphasized by

Expert 3 when they consider the range of lived experiences that exist in residential areas: “One of my rules is everybody at the table is a designer and the lived experience of that shared space might be something that the designer or the engineer or the biologist is not gonna understand at all” (2021).

Expert 4 also highlights the need for public participation but frames it somewhat differently to Expert 3. Expert 4 recognizes the behavioral nudges that can be created through social norms (Byerly *et al*., 2018). They underline the social pressures that can rise from community members partaking in the implementation and maintenance of NbS for stormwater management: “If everybody’s doing it, it’s amazing how the social pressure of a community can influence people’s decisions. They might not be that keen on the idea, but they don’t want to be the only one not doing it” (Expert 4, 2021) .

As such, Expert 3 and Expert 4 stress the importance of public participation in fostering better connections between the community and their surroundings, while also creating more incentives for further participation. The importance of participation has similarly been recognized in literature, with Seddon *et al*. (2020) and Yuliani, Hardiman & Setyowati (2020) finding the absence of public involvement and engagement to be a significant barrier to the uptake and sustainable governance of NbS.

However as was noted by Expert 2, the public mentality at UBC is limiting the range of possibilities for implementing NbS for stormwater management. So, even if public participation in design, implementation and maintenance was high, it might not necessarily result in effective nature-based management. This highlights a significant opportunity for REAP to create awareness of NbS for stormwater management and foster more positive perceptions towards solutions that might not currently be well received by the public (such as unkept vegetation).

4.4 Stakeholder Focus Group

Our focus group with two policymaking stakeholders yielded a few recurring themes around nature-based stormwater management systems on campus. One of these themes is that they see maintenance and long-term funding for upkeep as current barriers to the more widespread implementation of NbS on campus. Policy-Maker 1, when speaking of Wesbrook Place's neighborhood stormwater management system expressed the need to factor in maintenance issues when considering the functionality of the system: "looking at those water features in Wesbrook Place is really encouraging right, but the drawbacks are, yeah, that you have to include maintenance as part of it". They continue, "the system, it does get clogged up a lot. So, you know, the maintenance is a fairly big nightmare, as I understand it". Policy-Maker 2 had a somewhat different perspective, in that they saw maintenance issues as a potential concern, but only for poorly designed systems without regular maintenance checks.

> In terms of the nature based solution (…) I think they need to be well designed and also well constructed before going to the operations and maintenance stage, right. Even during the design also the construction stage, the experts (…) will make sure, you know, it's built as designed. So there will be much less (...) operation maintenance issues.

In addition to maintenance concerns from a functionality perspective, the stakeholders also expressed concerns over the lack of funding for planning and longer-term upkeep of systems. Policy-Maker 1 stated that,

> when you're building a building, they try to get the least capital costs. And so if you have a requirement that's very firm, okay, they would have to do it…But if you were doing it

> on a neighborhood scale, you would have to plan that out over a much longer timeframe and be funded in a different way.

The University and development firms make money from neighborhood residences through real estate sales and rent from tenants. Profits are of concern, and unless green infrastructure and long-term, mitigative planning are prioritized, funding will be a barrier. Both of our focus group stakeholders recognized that there are consequences for not prioritizing long-term functionality and putting aside funding for lifecycle costs. Policy Maker 1 tied in the recent flooding and collapse of roadways in BC due to heavy rains: “there's too much focus on capital costs. Like that's what we saw in the floods in BC, right? Nobody wanted to pay for anything or do long term planning for flooding and that’s kind of what the end result is”.

Policy makers also saw potential barriers around perceptions of nature-based stormwater management held by the campus community. Policy-Maker 1 remarked that,

> In the past, there was more of a focus on a manicured kind of landscape as a selling feature. So that wasn't landscape so much for it’s kind of base in nature. It was more, you know, does it look good? I think that's a little bit of a barrier that we may be moving past.

The policy makers echoed experts saying that public perception plays a role in the likelihood of NbS being implemented on campus, but see attitudes as changing and perceptions overall becoming more positive.

While the UBC community may have become more receptive to seeing NbS implemented around campus, another important stakeholder group, the building developers, may not share this sentiment. The collaborative process of conceptualizing, drafting, and approving new versions of REAP takes approximately a year, with input needed from academic experts,

landscape architects, operations managers, residence developers, and ultimately the UBC board of governors. When discussing the limitations that accompany integrating feedback from such a diverse collection of stakeholders, Policy-Maker 1 noted that some of the more innovative suggestions for stormwater management get left on the cutting room floor: "We can't just say 'Oh we want to do, you know, every building has incredible requirements', (...) we're not able to do that, so we have to find a balance of (…) innovation and (…) cost-effective solutions". They explained that the neighborhood building developers, who are involved in the REAP updating process including the final approval, tend to push for building requirements that are easier to implement and will keep capital costs lower. The lack of credits for nature-based stormwater management solutions in REAP 3.2 is therefore not necessarily indicative of a lack of interest in or enthusiasm about innovative stormwater solutions, but more so reflective of an unwillingness or inability to secure funds for implementation of these solutions by the university higher-ups. Policy-Maker 1 wrapped up their discussion of the updating process with these sentiments: "We wish we could do more. We really do".

A third stakeholder group, academic experts, was also discussed. After highlighting the need for well designed and constructed nature-based solutions to cope not only with rainwater but stormwater management, with a larger volume of water, one of the questions that emerged spontaneously during the focus group was about potential ways to engage UBC faculty and students as 'in-house' resources to think of innovative ways to deal with stormwater management using NbS, which are currently evolving and pose a number of implementation challenges. Both policy-makers seemed enthusiastic about the possibility of collaborating with researchers, pointing to the existing SEEDS projects regarding the policy-making process. However, they were hesitant about the execution and building of these solutions. According to

Policy-Maker 1, who has worked for more than ten years on sustainable buildings development on campus:

> You still need a really good consultant who's going to design the system. And so you know, SALA can't really help with that, but you need a consultant who signs off on the design, who's hired to do the project. (...) But I think [they can] help to develop (...) innovative ideas. There's a huge, huge space there.
>
> All I'm trying to say is [that] an actual project needs an actual consultant who has a business, is an engineer, or a landscape architect and signs off on it (...). It's interdisciplinary, green infrastructure, right, (…) but there's still this underlying consultant responsibility and liability (...), if something goes wrong, you're fully liable. You can't have somebody from SALA designing a system. But on the other hand, the ideas, the innovations are wonderful, right, so we need to input those and yeah, as I say, for policy, [we are] completely open to new ideas.

We noticed that the policy makers understand academic personnel as a group disconnected from implementation processes—a group that might contribute with great innovative ideas on the policy side but that still requires external support to bring them to reality. We did not have time to go through the bureaucratic process of how a consultant is selected and if there would be room and interest for a university-led oversight of the project, but we did notice a perceived disconnect between 'think' and 'do' in the policy-makers' responses. This is something that might limit the potential of collaboration between university and external partners on matters such as stormwater management.

5. Conclusions

This research sought to understand the different perceptions of NbS for stormwater management from the relevant stakeholders of REAP 4.0 and the importance of such perceptions. Compared to other areas of REAP, stormwater management does not hold as many credits (4 out of 50). When improvements to this area are discussed, they are often connected to other topics such as biodiversity because, at times, rainwater management is taken as a technical credit that does not involve significant agency from the residents. In our interviews, experts highlighted that there is room for improvement on campus rainwater management in general. They saw opportunities to expand reflections on the importance of using nature-based solutions to address stormwater management, primarily due to the environmental risks posed by climate change extreme events, such as storms and floods.

There is an appetite for stronger collaboration between policy-makers and UBC faculty/ students to develop practical solutions for efficient and resilient NbS that suit large stormwater volumes. However, there is not much clarity on how this can be achieved on the implementation side, as external consultants must implement the projects. Furthermore, there is a consensus among experts on stormwater management that a range of perspectives and participants is necessary for the efficient design of green solutions.

On the residents' side, we identified interest and preference for greener solutions that are well integrated with the residence's landscape. Their priority is not the functionality of the NbS, but their aesthetic aspect. This finding confirmed an expert input during the interviews and could constitute an entry point for engaging them in the maintenance of solutions that are at the same time efficient and visually attractive.

6. Recommendations

Based on the results of our research, we collated five recommendations for REAP 4.0.

1. *Include more site-specific criteria in stormwater credits in order to increase the guidance for developers around NbS options available to them for each development site.*

The credits listed in the current iteration of REAP are very limited, and don't include anything concerning engagement of residents or integration of neighborhood stormwater management systems into communities. If developers have more stormwater management options to choose from when developing these neighborhoods, they may be more open to including innovative NbS in the credits system, and not see them as a barrier to development. Including a more diverse range of options explicitly in the credits could provide guidance as well as flexibility for developers.

2. *Bring the developers closer to the credit assignment process, engaging them more explicitly in the discussions prior to the decision-making rounds.*

Our second recommendation builds on the first, but brings the focus back to the process-level. More deliberately including the developers in conversations that involve academic experts could bridge the gap between "doers" and "thinkers". The experts may reach more of an understanding of the limitations developers face, and developers may become more aware of the importance and need for NbS in stormwater management. If part of the barriers to implementing more innovative stormwater management solutions is pushback from developers at the last stages of the process, including them earlier and in a more integrated, collaborative way may lead to REAP stormwater credits that are forward-thinking and feasible. This collaboration may start by creating spaces for exchanges, listening to their impressions, concerns and expectations regarding innovative approaches and solutions to stormwater management.

3. *Consider the faculty members'/residents' perspectives and promote stronger collaboration with UBC faculty/ students in terms of conception and implementation of solutions. Integration of landscape and effective solutions for stormwater management*

The significance of public perceptions was made abundantly clear by the expert interviews and focus group, as they indicated the barriers that UBC has faced with balancing effective NbS options with the public desire for well-kept landscapes. According to Anderson and Renaud (2021), favorable public perceptions and acceptance can be facilitated through increasing awareness about the benefits of NbS, not only for the environment, but also for social well-being through green spaces. Hence, our fourth recommendation is as follows:

4. *Raise awareness of residents and students about the importance of NbS stormwater management towards climate change mitigation and make the societal benefits of such solutions more explicit.*

We propose that recommendation 4 is approached through increasing resident involvement in the design and implementation of NbS. We also suggest that continuous education of the benefits of NbS is maintained, specifically in residences with high turnover (e.g student housing). This could be achieved in neighborhoods with existing NbS by simply increasing signage around those infrastructure and features. Such education and awareness systems would ensure that the significance of local NbS for stormwater management are understood even by those not involved in design and implementation (Wals 2012; Zelezny 2010). We believe that the wider communication of the benefits and significance of NbS will enable REAP 4.0 to undertake more efficient implementation and utilize more effective solutions for nature-based stormwater management. Facilitating buy-in of residents could also be motivation for developers to get on board with NbS, because if residents and potential residents view NbS

stormwater management systems as attractive and desirable features, they may be more inclined to buy or rent units, making the residences more lucrative.

5. *Create incentive programs for residents to engage in NbS for stormwater management.*

We recommend incentive programs for residents to engage in maintenance activities around NbS stormwater management, given that the high cost of maintenance is a barrier for developers to adhere to NbS. In order to define the program's details, developers and policy-makers could promote workshops with residents to assess their availability and what would be of interest to them in terms of incentives.

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a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

The University of British Columbia
Vancouver Campus
Vancouver B.C.
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Appendix A

Consent Form Template

RMES 505 Qualitative Methods In Interdisciplinary Contexts

Revisions of stormwater management guidelines in REAP 3.2 : Interview

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Climate change is predicted to exacerbate the frequency and scale of urban flooding events. A significant reason for this is the prevalence of impermeable surfaces in urban areas, causing stormwater to excessively accumulate on urban surfaces. The Resident Environment Assessment Program (REAP) works to address this occurrence in multi-unit residential areas on the UBC Vancouver campus. At the moment, REAP 3.2 is looking to update its stormwater management policies and systems to ones that are underpinned by climate adaptation and nature-based solutions. **If you wish to participate in this study, we will invite you to an interview where we will ask you more specifically about your personal experiences with implementing and complying with REAP guidelines, as well as your insights on REAPs successes and failures.**

All interviews will be conducted either online or by telephone in line with current COVID guidance. If you feel that it would be more appropriate for you to participate in this interview in person, please contact a member of the research team to advise them of your preference. However, please be advised that in order to participate in this research project in person, UBC will require all parties to provide proof that they are fully vaccinated.

Study data and results

Only the investigators (Elina Eronen, Simone Rawal, Emily Edwards, Maria Larissa Silva Santos) will have access to the interview transcripts. **The interviews will be recorded.** The interview transcripts

October 30, 2021 (v.3)
UBC Research Ethics Board ID Number: H13-02273

will be saved as electronic files and kept on the investigators' computers in password-protected files.The main findings will be summarized and submitted as a graduate course assignment for RMES 505 (Qualitative Methods in Interdisciplinary Contexts) at the University of British Columbia. General results from the research will be shared in an online archive.

Is there any way being in this study could be bad for you?

Participation in this interview involves answering questions about your personal experience with implementing REAP guidelines and your insights on its successes and failures. Therefore, there are no major risks involved with completing this study.

What are the benefits of participating?
You will benefit from this study by having an opportunity to voice your opinions on current REAP guidelines and inform the revision process.

How will your privacy be maintained?
Your interview transcripts will be marked with number codes, for which the references will be kept in a password-secured file. These number codes will also be used when summarizing and presenting the research, and hence your name and any identifying information will not be included in the final report or presentation.

Will you be paid for taking part in this research study?
You will not be paid for taking part in this study.

Who can you contact if you have questions or concerns about the study?
The graduate students undertaking this research are enrolled in RMES 505 (Qualitative Methods in Interdisciplinary Contexts) at the University of British Columbia. If you have any questions or concerns with this study, please feel free to call Dr. Leila Harris, instructor for the course for which this project is being undertaken (604) 822-4182

If you have concerns about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

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Participant consent and signature

Participating in this study is entirely up to you. You have the right to refuse to participate in this study. If you decide to take part, you may choose to pull out of the study at any time without giving a reason and without any negative consequences.

- Your signature below indicates that you have received a copy of this consent form for your own records.
- Your signature indicates that you consent to participate in this study.

_____ _____

Participant signature Date

_____

Printed name of the participant signing above

Appendix B
Survey for Residents

Online Purchase Feedback

Living in Rain-Couver can be gray 🌧️, but we are here to make it a little greener🌿

As residents, we want to hear your experiences and perspectives of how your building is dealing with rain. We also want to give you a chance to have a say on what you would like to see being implemented in the future to make this weather a little more bearable ☔.

This won't take more than 2 minutes and YOUR voice matters 🌤️

The responses from this survey will be used for a Masters level research, your anonymity will be ensured. Any questions can be directed to eeronen@student.ubc.ca

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UBC Research Ethics Board ID Number: H13-02273

Rainwater management is simply the method of draining excess water. There are many ways to do this.

Have you previously heard about Rain-water/Storm-water management ?

- ○ YES
- ○ NO

In the next section, we will include pictures of different rain-water management methods. Based on the pictures/opinions please share your thoughts on the effectiveness of each with the following emojis

😄 (very effective)
🙂
😐
😕

☹️ (very ineffective)

- ○ 😄
- ○ 🙂
- ○ 😐
- ○ 😕
- ○ ☹️

- ○ 😁
- ○ 🙂
- ○ 😐
- ○ 😕
- ○ ☹️

- ○ 😁
- ○ 🙂
- ○ 😐
- ○ 😕
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- ○ 😐
- ○ 😕
- ○ ☹️

- ○ 😄
- ○ 🙂
- ○ 😐
- ○ 😕
- ○ ☹️

Thanks for your brilliant responses💡

Now, you will see the same pictures again, but this time RANK them based on what you would want to see on your residential area 🏘️

With 1 being what you LEAST want to see and 6 being what you MOST want to see.

Feel free to add any suggestions, opinions, experiences with rain water that you wish to share with us

This is the end of the survey, by clicking submit you consent to us

using your responses in our research.

Appendix C

Survey for Building Developers

THE UNIVERSITY OF BRITISH COLUMBIA

This is a student-led collaboration with faculty and staff as part of the SEEDS Sustainability Program. It aims to get an insight on the current stormwater management strategies, your general view of the implementation of stormwater management strategies, and your perceptions of the Resident Environment Assessment Program (REAP). It won't take you more than 10 minutes to complete and it will mean a lot for evaluating the REAP 3.2 and making recommendations for improvements in REAP 4.0.

Name
Email address
Job position

What residential building were you involved in the development of?

Have you been involved in the implementation of REAP guidelines in your building?

- Yes, directly involved
- Yes, indirectly involved
- No, not at all

How important do you think it is to implement stormwater management strategies that also benefit and promote biodiversity on campus?

- Extremely important
- Very important

- Moderately important
- Slightly important
- Not at all important

Do you think stormwater management systems can be designed to help climate change adaptation and biodiversity on campus?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

How open would you be to incorporate more nature-based solutions as methods for stormwater management?

- Very open
- Open
- Slightly open
- Not open

Have you had significant positive or negative experiences with REAP 3.2 with regards to stormwater management?

- Extremely positive
- Somewhat positive
- Neither positive nor negative
- Both positive and negative

- Somewhat negative
- Extremely negative

Could you provide a short example of a positive or negative experience you had while implementing stormwater management policy?

Would you like to participate in a short interview to talk about your impressions on the review of the Resident Environment Assessment Program in terms of stormwater management initiatives? Your inputs could influence this policy review and favour the implementation of innovative nature-based solutions in your building.

- Yes, absolutely!
- No, thanks.

Appendix D

BREB Amendment

006/REAP 4.0: Green Buildings Policies & Biodiversity BRED Amendment (RMES 505)

Members:
Elina Eronen (elina.eronen@hotmail.com)
Simone Rawal (rwl.simone@gmail.com)
Maria Larissa Silva Santos (mlsantos@student.ubc.ca)
Emily Edwards (ecedward@student.ubc.ca)

Proposed Amendments to BREB

In addition to those who already fall under the current BREB, we would like to request that we extend the BREB to cover interviews with local building developers. Hearing from local developers would allow us to get the perspective of those who have to interact with REAP policy on the ground, and gain a better understanding of any current issues REAP policies are presenting to those trying to follow them.

Inclusion/Exclusion Criteria

Interviews: For the interviews, we wish to include building developers who are directly involved with REAP from residential units on UBC Vancouver Campus.

*Focus group*s: The focus groups will include residents (who are also faculty members) of buildings with REAP compliant stormwater management systems (both nature-based and conventional)

Length of the survey: Developer surveys will take no more than 15 minutes to complete

Length of interview: A minimum of 5 interviews will be held and each interview will take approximately 30-60 minutes

Length of focus groups: About 2-4 focus groups will be held with 6-8 participants in each. The length of focus groups will span from 30-60 minutes.

Recruitment

Interviews: Participants for interviews will be recruited through email, in which they will be asked to complete a short survey where they can indicate willingness to be interviewed.

Focus groups: Participants will be contacted through email (which will be obtained from department email lists) where they will be asked to indicate whether they would like to take part in a focus group.

Draft of Consent Form

a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

The University of British Columbia
Vancouver Campus
Vancouver B.C.
Canada, V6T 1Z4

Revisions of stormwater management guidelines in REAP 3.2 : Interview

Climate change is predicted to exacerbate the frequency and scale of urban flooding events. A significant reason for this is the prevalence of impermeable surfaces in urban areas, causing stormwater to excessively accumulate on urban surfaces. The Resident Environment Assessment Program (REAP) works to address this occurrence in multi-unit residential areas on the UBC Vancouver campus. At the moment, REAP 3.2 is looking to update its stormwater management policies and systems to ones that are underpinned by climate adaptation and nature-based solutions. **If you wish to participate in this study, we will invite you to an interview where we will ask you more specifically about your personal experiences with implementing and complying with REAP guidelines, as well as your insights on REAPs successes and failures**

Study data and results
Only the investigators (Elina Eronen, Simone Rawal, Emily Edwards, Larissa Silva Santos) will have access to the interview transcripts. **The interviews will be recorded.** The interview transcripts will be saved as electronic files and kept on the investigators' computers in password-protected files.The main findings will be summarized and submitted as a graduate course assignment for RMES 505 (Qualitative Methods in Interdisciplinary Contexts) at the University of British Columbia.

Is there any way being in this study could be bad for you?

Participation in this interview involves answering questions about your personal experience with implementing REAP guidelines and your insights on its successes and failures. Therefore, there are no major risks involved with completing this study.

What are the benefits of participating?
You will benefit from this study by having an opportunity to voice your opinions on current REAP guidelines and inform the revision process.

How will your privacy be maintained?
Your interview transcripts will be marked with number codes, for which the references will be kept in a password-secured file. These number codes will also be used when summarizing and presenting the research, and hence your name and any identifying information will not be included in the final report or presentation.

Will you be paid for taking part in this research study?
You will not be paid for taking part in this study.

Who can you contact if you have questions or concerns about the study?
The graduate students undertaking this research are enrolled in RMES 505 (Qualitative Methods in Interdisciplinary Contexts) at the University of British Columbia. If you have any questions or concerns with this study, please feel free to call Dr. Leila Harris, instructor for the course for which this project is being undertaken (604) 822-4182

If you have concerns about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

UBC100

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The University of British Columbia
Vancouver Campus
Vancouver B.C.
Canada, V6T 1Z4

Participant consent and signature

Participating in this study is entirely up to you. You have the right to refuse to participate in this study. If you decide to take part, you may choose to pull out of the study at any time without giving a reason and without any negative consequences.

- Your signature below indicates that you have received a copy of this consent form for your own records.
- Your signature indicates that you consent to participate in this study.

_____ _____

Participant signature Date

_____

Printed name of the participant signing above

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Vancouver Campus
Vancouver B.C.
Canada, V6T 1Z4

Revisions of stormwater management guidelines in REAP 3.2: Focus Groups

Climate change is predicted to exacerbate the frequency and scale of urban flooding events. A significant reason for this is the prevalence of impermeable surfaces in urban areas, causing stormwater to excessively accumulate on urban surfaces. The Resident Environment Assessment Program (REAP) works to address this occurrence in multi-unit residential areas on the UBC Vancouver campus. At the moment, REAP 3.2 is looking to update its stormwater management policies and systems to ones that are underpinned by climate adaptation and nature-based solutions. **If you wish to participate in this study, we will invite you to a focus group where we will ask you to share your personal experiences with rainfall and green spaces in your residence.**

Study data and results
Only the investigators (Elina Eronen, Simone Rawal, Emily Edwards, Larissa Silva Santos) will have access to the focus group recordings and notes. The session recordings will be saved as electronic files and kept on the investigators' computers in password-protected files.The main findings will be summarized and submitted as a graduate course assignment for RMES 505 (Qualitative Methods in Interdisciplinary Contexts) at the University of British Columbia.

Is there any way being in this study could be bad for you?

Participation in the focus group involves answering questions about your experiences of rainfall events, as well as your opinions of green spaces, in your residence. There will be no direct risk to you from participating in this study, but we will maintain your anonymity and confidentiality throughout the study.

What are the benefits of participating?
Your contribution will contribute to the revision of REAP guidelines.

How will your privacy be maintained?
Recordings from focus groups will be kept without names in password-protected files. Your names will not be used in the final report or presentation of the study.

Will you be paid for taking part in this research study?
You will not be paid for taking part in this study but snacks and drinks will be provided during the session.

Who can you contact if you have questions or concerns about the study?
The graduate students undertaking this research are enrolled in RMES 505 (Qualitative Methods in Interdisciplinary Contexts) at the University of British Columbia. If you have any questions or concerns with this study, please feel free to call Dr. Leila Harris, instructor for the course for which this project is being undertaken (604) 822-4182

If you have concerns about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

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Participant consent and signature

Participating in this study is entirely up to you. You have the right to refuse to participate in this study. If you decide to take part, you may choose to pull out of the study at any time without giving a reason and without any negative consequences.

- Your signature below indicates that you have received a copy of this consent form for your own records.
- Your signature indicates that you consent to participate in this study.

_____ _____

Participant signature Date

_____

Printed name of the participant signing above

UBC 100

Sample email to developers:

Subject: REAP 4.0 UBC student project survey

Dear _____,

My name is _____. I'm contacting you on behalf of a group of graduate students conducting a research project for UBC in which we assess nature-based stormwater management solutions on campus and provide recommendations for future policy. Specifically, we will be evaluating the Resident Environment Assessment Program (REAP) 3.2 and making recommendations for improvements in REAP 4.0. It is important for us to hear your perspective, as someone who may be directly affected by REAP when making development decisions and complying with building stormwater management guidelines.

We are hoping that you would be willing to take a short anonymous survey at this [link]. The survey should take no more than 15 minutes to complete. If you are willing we would also like to hear from you directly in an interview conducted over Zoom lasting up to an hour. Please let us know if this sounds of interest by answering yes to the last question in the survey. If you answer yes, we can begin to coordinate a time for the interview. If your privacy is a concern, we will take all necessary steps to remove your personal information from any interview materials.

Thank you so much for your patience and attention! I look forward to hearing from you soon.

Best wishes,

_____

Sample Email to Focus group participants

Dear _____,

My name is _____. I'm contacting you on behalf of a group of graduate students conducting a research project for UBC in which we assess nature-based stormwater management solutions on campus and provide recommendations for future policy. Specifically, we will be evaluating the Resident Environment Assessment Program (REAP) 3.2 and making recommendations for improvements in REAP 4.0. It is important for us to hear your perspective, as someone who may be directly affected by REAP when making development decisions and complying with building stormwater management guidelines.

Are you a faculty member who lives in a UBC residential building? If so, we are hoping that you would be willing to take part in a virtual focus group (30-60 min in length over Zoom) to discuss your perspectives and experiences with green spaces in your residential area . Please let us know if this sounds of interest by answering yes at this [link]. If you answer yes, we can begin to coordinate a time for the focus group. If your privacy is a concern, we will take all necessary steps to remove your personal information from any materials.

Thank you so much for your patience and attention! I look forward to hearing from you soon.

Best wishes,

_____

Survey outline

The survey will consist of brief questions to get an insight on the current stormwater management strategies, the general view of the developers on the implemented stormwater management strategies, and their perception of the REAP. The survey will also ask the developers whether they would like to be interviewed further.

Suggestions for survey questions (designed for free-response and scales)

1. What residential building were you involved in the development of?
2. What stormwater management systems are currently implemented in that building?
3. Have you been directly involved with implementing REAP guidelines in your building?
4. How important do you think it is to implement stormwater management strategies that also benefit and promote biodiversity on campus? (very to not at all)
    - OR Do you think stormwater management systems can be designed to help climate change adaptation and biodiversity on campus?
5. How open would you be to incorporate more nature-based solutions as methods for stormwater management? (very open-not at all)
6. Have you had significant positive or negative experiences with REAP 3.2 with regards to stormwater management? If yes, please provide a short description.
    - OR something else asking about their experience with REAP? But nothing too closely related to the interviews.
7. Are you willing to participate in an interview to talk about your impressions on the review of the Resident Environment Assessment Program in terms of stormwater management initiatives? Your inputs could influence this policy review and favour the implementation of innovative nature-based solutions in your building.

Interview outline

The interviews will be conducted with the developers who agree to an interview after the initial survey. Interviews are expected to last for 30 minutes to an hour. The interviews will give the developers a platform to provide more in-depth information about their experiences with following REAP guidelines, and also provide further feedback that can be taken into account for REAP 4.0 recommendations.

Suggestions for interview questions (designed to be semi-structured and open-ended)

1. What are the stormwater management systems used in the buildings you've had a hand in developing? Could you elaborate on why those systems, in particular, were chosen?
2. What requirement from the current REAP do you find most difficult to implement? Do you have any frustrations or suggestions to deal with this problem?
3. Do you see anything lacking in the current policy? What could be added to the future policy to tackle this issue?
4. Do you see nature-based solutions to stormwater management as effective? Are there any nature-based adaptations to stormwater currently implemented? If yes, what kind?
5. Would you be open to incorporating more such methods in the buildings you develop? Why or why not?
6. Do you think that developers should have a direct role in creating policy that affects building development?
7. If you could speak directly to the people creating the new REAP 4.0 policy, what would you want to tell them as someone who has to follow the guidelines?

Focus groups

Focus groups will have semi-structured discussions and will center around the themes of rainfall events, green spaces, and their preferences for stormwater management systems. This will also consist of showing pictures of nature-based solutions to bolster the discussion. The entire dynamic will be no longer than 30 minutes.

Suggestions for focus-group questions

1. Have you noted any common occurrences during rainy days? Are there any puddles or does the water drain away quickly? Are there any areas that are more prone to pondering than others? Are you satisfied with the stormwater management at your residential building?
2. Are you aware of any initiatives focusing on stormwater management in your building?
3. Are you aware of the term "green-building"? What does "green-building" mean to you?
4. Are there green spaces (e.g trees, grass, gardens) in your residence? Are these something you enjoy and would like to see more of?

Pictures of examples of global nature-based solutions for stormwater management will be shown to the participants. After viewing these pictures, the participants will be asked to share their opinions and perspectives on them.

Appendix E

Questions for Focus Group with Policy-Makers

1. What was the process of inclusion of stormwater management as part of REAP and the credits count?
2. Which stakeholders were involved in the discussions around stormwater management and what other topics were connected to it?
3. What are the stormwater management systems currently used in the residences?
4. Could you elaborate on why those systems, in particular, were chosen?
5. What requirement from the current REAP do you find most challenging to implement? Why?
6. Are there any nature-based adaptations to stormwater currently implemented in the residences? If yes, what kind?
7. Do you see any particular benefits or drawbacks to adding more nature-based stormwater solutions?
8. Do you foresee any barriers (institutional, financial, Operation & Maintenance, etc.) to implementing more nature-based solutions at the residences?
9. In your opinion, what kinds of nature-based stormwater management solutions are feasible for the residences on UBC Vancouver Campus? And why?
10. Add this question: What are the benefits and risks the nature-based stormwater management solutions can have to cope with the extreme weather (considering the extreme weather, heatwave and flooding in BC this year?
11. Do you think that developers should directly be involved in the policy-making process that affects building development? Why or why not?

Appendix F

Observation Photographs, December 3rd 2021

Figure 1. Drain Pipes at Webber House residence. [Photograph]. Larissa Santos.

Figure 2. 3D model of Wesbrook Area at 'Live at UBC' office. [Photograph]. Larissa Santos.

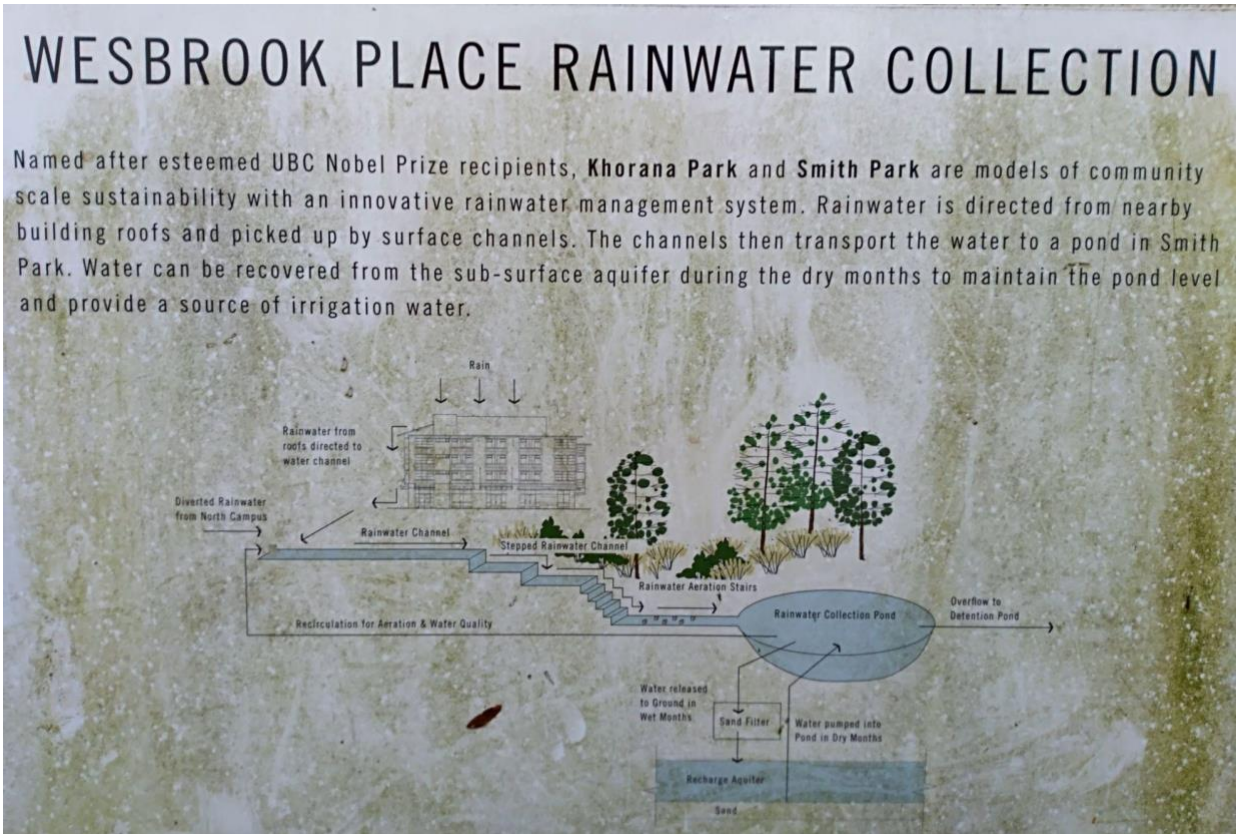

Figure 3. Explanatory signage of Wesbrook Place Rainwater Collection. [Photograph]. Larissa Santos.

Figure 4. Fountains aerating stormwater in the channel at Khorana Park. [Photograph]. Emily Edwards.

Figure 5. Nobel Park retention pond. [Photograph]. Emily Edwards.

Figure 6. Seating area along the rainwater channel. [Photograph]. Larissa Santos.