Approaches to Effective Public Engagement and Education for Green Infrastructure Co-Benefits

Figure 1: A photograph of the 'Welcome to *te Statlew*' roundabout in the St. George Rainway project area taken on 7 February, 2021 (Photo by Samuel Lee).

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Table of Contents

Executive Summary 1
Report Authors 5
Introduction 6
Literature Review 6
Public Engagement and Education Plan 12
Limitations 18
Next Steps 18
Acknowledgements 19
References 20
Appendices 22

Executive Summary

Background

The development of the St. George Rainway project was initially proposed by the local community and volunteers of St. George Street in the Mount Pleasant Neighbourhood during 2008. In 2013, the project was approved by Vancouver City Council and included in the Mount Pleasant Community Plan. The Rainway project will benefit the city by reducing overloads of the city's sewage networks due to rainfall, and by reducing pollution present in urban run-off according to goals and objectives set out in the City of Vancouver's 2019 Rain City Strategy.

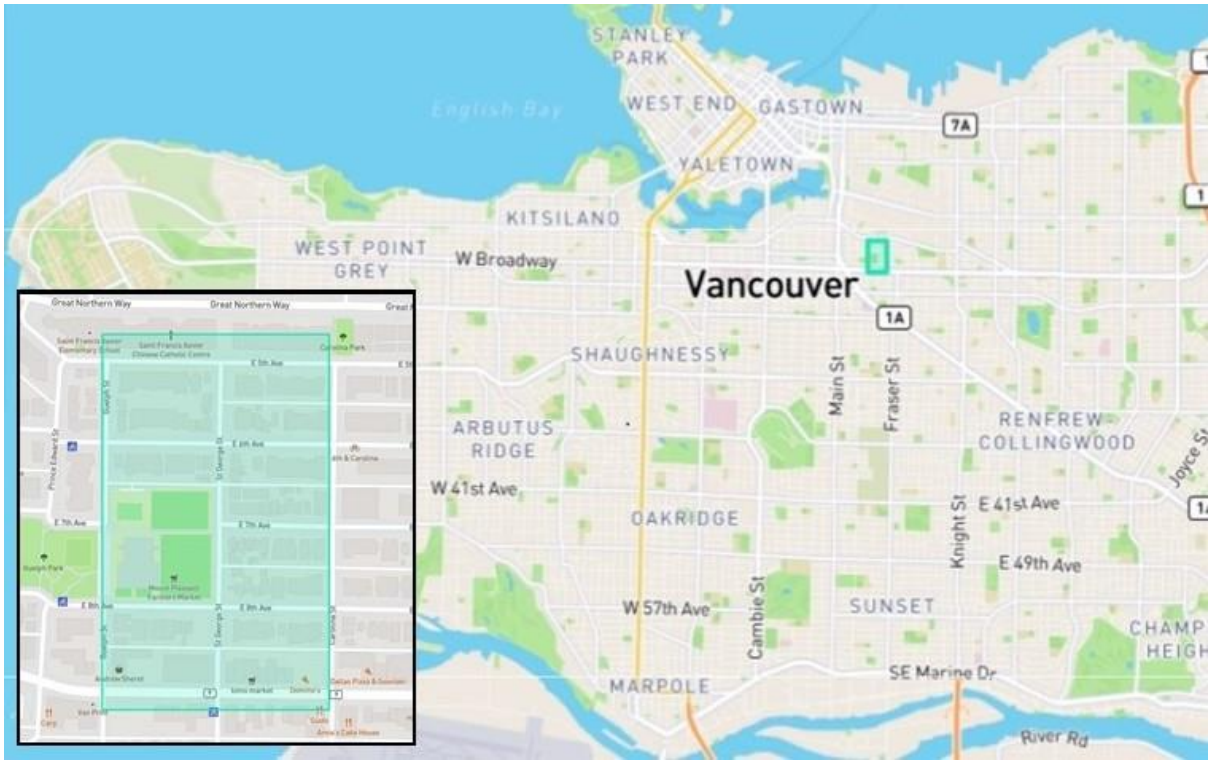

Figure 2: Location of the St. George Rainway within the City of Vancouver, indicated by the teal rectangle. Inset image shows a close up of the neighbourhood. Created using Screenshot and Publisher. Data retrieved from shapeyourcity.ca

The St. George Rainway project will be developed along St. George Street between Broadway and East 5th Avenue (Figure 2). Historically, this street was the location of the St. George Creek, known as *te Statlew* ("little creek" in the Musqueam language), before development began in the early 1990s. The creek was buried and redirected through underground pipes over the years. The main components of the current rainway project is to develop blue-green water management infrastructure elements (e.g. rain gardens) and to increase biodiversity with vegetation, such as short bushes and street trees. These measures will help reduce urban stormwater run-off and pollution, as well as mitigate and adapt to environmental challenges as our climate changes.

This Green Rainwater Infrastructure (GRI) project will also bring co-benefits to the residents of St. George Street, however the communication of those co-benefits remains a challenge. Residents may be misinformed about both the potential for, and the scope of these co-benefits that are immediately tangible in their community. For example, some residents may mistakenly believe that the stream is going to be daylighted, or deculverted, to allow the stream to flow on the surface as it had before the 1990s, or may not realize the long-term benefits and ecosystem services that this project will bring to the community. Individuals at both ends of a spectrum from not believing the Rainway is worth the effort to overestimating the potential benefits and final outcomes need to be properly educated and included in engagement plans around this project.

Objectives

Our objectives in this report are first and foremost to propose a resource tool to engage the Mount Pleasant community in learning more about the St. George Rainway project with the establishment of collaboration between residents, the City of Vancouver, and other agencies involved in the project. The aim of this resource is to clear up misunderstandings that the public may hold about the scope and details of the Rainway, as well as education on the real and tangible co-benefits the community can expect to see when the project is completed. A secondary goal in this project is to communicate in a way that is engaging, interactive, and easy to understand and interpret. This report will also accommodate COVID-19 restrictions in the creation of this resource. Finally, we aim to leave opportunities to work with the City of Vancouver in order to modify or adjust details of this resource in an iterative process as communication needs change over time.

Literature Review Summary

Implementing the St. George Rainway project will not only provide benefits to the City of Vancouver by reducing pressure on stormwater systems and minimising pollution presented in stormwater run-off, but the project will also lead to benefits to the community around the project. GRI is the term used to describe methods of rainwater management that combine traditional grey infrastructure with new green strategies inspired by natural water systems that work to purify water before the construction of cities over the landscape. GRI offers co-benefits that grey infrastructure lacks, to both the public and the environment as a whole. Some of these co-benefits to the public include energy savings, improvements in health, and the opportunity for place-making in local communities. In terms of co-benefits to the environment, GRI has the potential to address problems arising due to climate change such as biodiversity loss, urban heat island effects, and so forth.

However, one problem that arises with the implementation of GRI is a lack of public knowledge and awareness around the subject. Many may not have a solid idea of what exactly GRI is and could potentially confuse it with greenspace or parks which are not engineered as infrastructure. There is also the potential for the public to not fully understand how GRI can provide co-benefits outside of immediate rainwater management or the belief

that grey infrastructure is more effective than GRI. More specific to the St. George Rainway, residents may not fully understand the scope of the project itself.

Engagement in the planning and implementation of a project like the St. George Rainway is critical to address the needs and concerns of various stakeholders, including the community. When the public is well-informed on the details such as the costs and the benefits of a project, it allows for more effective consultation and communication between parties of interest. However, some methods that are used can be more effective than others.

Conventional methods of communication specifically for this report refers to traditional and familiar methods of public engagement, often including physical materials, such mailed-out information, or face-to-face interaction. Many of these methods are more familiar to people but have limitations in reach, effectiveness, and what can be included. On the other hand, more unconventional methods of marketing are emerging as technology advances, such as Virtual Reality (VR). VR can be used as a visual method of communication that allows for users to observe and examine a proposed scenario. Multiple municipalities around the world have already implemented VR to some degree for construction projects or as a simple virtual tour. While there are some limitations to this technology, the field is also diverse in what kinds of hardware or lack thereof are required by users, and once developed, the technology can be further applied to future projects within the City of Vancouver.

Overview of Public Engagement and Education Plan

As a result of the research conducted, this report proposes that VR be used as a primary tool to engage and educate residents about the St. George Rainway project. This resource can be developed as a web-based application so that members of the community can access it on home devices in order to explore for themselves the changes they can expect in their neighbourhood. This will also allow for misunderstandings of the scope of the project to be cleared up, and allow residents to see for themselves what kinds of benefits they can expect when the project is completed. Development of VR with the intention of the resource being hosted on a web-based platform would ensure that residents with computers or other devices with internet access would not require additional hardware such as a headset. In addition to VR, this report also suggests sending out information in a more conventional method, such as newsletters or pamphlets to reach residents who have challenges accessing web-based resources. This will ensure that these individuals are not overlooked in our education campaign. These conventional methods could also be used to further promote to residents the existence of the VR resource and how to find it online.

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Introduction

In this report, we propose the use of traditional communication methods (i.e. newsletters, websites, meetings, etc.) in conjunction with VR as our engagement and education tool. Both methods of communication will educate and encourage interactive conversation on GRI between developers, city-planners, community members and other agencies. The implementation of new innovative technology will intrigue individuals involved in the St. George Rainway project while accommodating the COVID-19 restriction. Credible sources of literature and information have been analyzed in the literature review to research and justify the use of our proposed resource. To test the effectiveness of our tool, we have formulated a metric of success for the city to gauge whether the resource has accomplished its goals. A numerical rating scale is included in the feedback survey to quantify the success of different aspects of the project.

Literature Review

Effective communication of potential co-benefits to the community surrounding the St. George Rainway project is critical to foster acceptance and understanding of Green Rainwater Infrastructure (GRI) (Rain City Strategy, 2019). According to the City of Vancouver's Rain City Strategy, GRI is defined as "a suite of rainwater management tools that use both engineered and nature-based solutions to protect, restore, and mimic the natural water cycle" (2019). The idea of the Rainway has changed from its initial proposition by the St. George Rainway volunteer group into the utilization of GRI to manage stormwater run-off while providing additional co-benefits to residents. However, both the general public and some members of the Mt. Pleasant community appear to have misconceptions and misunderstandings about GRI: what it is, how it can help, and the real tangible co-benefits it can bring. Public misunderstandings of GRI can be addressed through both conventional and unconventional engagement methods. Conventional methods tend to be more low-technical, tangible, and familiar like newsletters and discussions, while unconventional methods consist of more high-technical solutions and unfamiliar methods like Virtual Reality (VR).

Co-benefits of GRI

The implementation of GRI can provide many useful co-benefits. Co-benefits are additional benefits produced to both the public and environment that are gained from GRI implementation (Alves *et al*., 2019). Some co-benefits described in the Rain City Strategy (2019) include "improved air quality, energy savings, reduced urban heat island effect, community health and amenity benefits." Specifically for the St. George Rainway, possible co-benefits are minimization of stormwater run-off problems, better water quality in marine ecosystems, mitigation of climate change impacts in urban areas, and unity in the urban community.

Although co-benefits are difficult to measure, there have been attempts to quantify the benefits using monetary values. A study by Alves *et. al* (2019) found that when compared with grey infrastructure without co-benefits, the costs of green or blue-green infrastructure were not as viable as purely grey infrastructure. However, when co-benefits were added to the analysis, there were additional savings and benefits that made the implementation a viable option. Alves *et al*. (2019) noted that the estimation of the viability of green infrastructure may be low only because benefits are translated to monetary values in a straightforward way without considerations of co-benefits.

Lack of Public Awareness and Understanding of GRI

In general, the public may not have a concrete understanding of GRI as a whole, including what effective GRI looks like, the difference between GRI and greenspace, or even future climate change impacts such that adaptation is needed (Derkzen *et al*., 2017; Harcourt *et al*., 2019). Shape Your City's 2021 survey provides valuable insight into to what extent these factors may be at play in the Mount Pleasant community.

The first and potentially most fundamental misunderstanding that can arise is the lack of knowledge about the impacts of climate change itself. Harcourt *et al*. (2019) illustrated that there is a lack of clarity around what climate change effects are, even in a population where there is some knowledge that there are going to be adverse effects. Furthermore, there appeared to be a lack of understanding about the difference between mitigation and adaptation to climate change (Harcourt *et al*., 2019) and the capability of GRI to address these areas (Derkzen *et al*., 2017). This is important to note going forward as we cannot hope to effectively communicate the co-benefits of GRI if our target audience is not fully aware of the problems needing to be addressed in the first place. Comments made in the Shape Your City (2021) survey show that the community has these misunderstandings.

Another knowledge deficit concerns a lack of understanding of GRI as an effective form of infrastructure. There may be a preference for GRI that appears green and natural with the potential for aesthetically-pleasing recreational greenspaces to those that appear grey and unnatural even if the grey-looking option is more effective (Derkzen *et al*., 2017). This may be indicative of a misunderstanding of the differences between GRI and greenspace, something which appears in responses from residents in the Shape Your City (2021) survey claiming that there are enough greenspaces as it is without the St. George Rainway. Di Marino and Lapintie (2018) suggest that at least some of these misunderstandings stem from a lack of any concrete definition of GRI both within science and policy work. When respondents were given education on different types of GRI and its benefits, responses tended to lean away from strictly preferring green and natural looking measures to preferences for more effective but less natural-looking GRI strategies (Derkzen *et al*., 2017).

A final misunderstanding is that some residents of the affected neighbourhood have misconceptions of the scope and reality of the proposed Rainway. Responses suggest that some residents believe that the stream will be daylighted as highlighted by fears of children

falling into the stream and hopes that fish will return (Shape Your City, 2021). An effective communication strategy for this community should include this aspect as well as the co-benefits, effectiveness, and climate change driven needs for the Rainway project.

Importance of Engagement

Different stakeholders' involvement and participation in GRI project planning and implementation processes are crucial because they bring different interests and perspectives together. Stakeholders include the local community, native conservationists, developers, city-planners, government, and other agencies. In addition, participants can express cross-sectional feedback, combined approaches, various responsible authorities, social-economic support, and professional development. Therefore, a proper public engagement process can facilitate the involvement of multiple stakeholders to maximize the resource use and responsive implementation. The clear objective and feedback can allow the government and city-planners to provide responsive decisions to the GRI project. Public engagement consists of a spectrum of processes and activities designed to inform, consult, deliberate and co-create (Newfoundland, 2013) (See Table 1).

Information is the major source to the public who can understand the issue and objective of the GRI project informed from the project initiator, and it helps to minimize the misconception or misunderstanding. Furthermore, it also offers the opportunity to residents and the government to make decisions based on the finalized outcomes without any concerns. Consultation can facilitate public dialogue and find alternative resolution of the GRI project. It provides space for listening and gathering feedback from the broad public as well as assisting in policy refinement. Residents are concerned about the issues of the GRI project, and the government responds to clarify the issues with respect to related policy for seeking ultimate decision. Deliberation is an orientation of multilateral information exchange. It works directly with stakeholders in the active information development through a series of respective, alternative, and perspective processes. Co-creation is the process which includes the government and other stakeholders who create alternative solutions of the GRI project by working out together. Thus, the final decision can be taken to implement the solutions.

Table 1: Public engagement spectrum activities (Newfoundland, 2013).

Inform	Consult	Deliberate	Co-Create
• A decision has already been made • Provide facts and/or results concerning a policy or program • Immediate action is required • Simple issue • Build awareness • No opportunity for public to influence final outcome • Goal is to create awareness	• Listen and gather information • Assist in policy refinement and/or formulation • Test ideas/concepts with the public • Clarify issues or concerns with a program or policy • Advisory for government • Goal is to improve decision-making	• Goal oriented bilateral and/or multilateral information exchange • Options developed are respected • Obtain 'buy-in' • Communication of alternative perspectives, expectations and concerns • Goal is to generate ideas and/or set the stage for problem-solving	• Government and stakeholders create alternatives to complex issues/challenges • Decision-makers agree to implement the solutions to the extent possible • Goal is to undertake shared actions and decision-making

Local communities and other stakeholders may have different aspects to the GRI project in participating in public engagement because they have different aims. Stakeholders, who are government, city-planners, developers and other agencies, have various organizational interests in the project outcomes and benefits. In contrast, the local communities or residents may have interest in how the project can present any co-benefits and impacts. Local communities and residents, who are educated and engaged, are a significant group of stakeholders that can express their feedback and awareness to the government and city-planners. They can respond and focus on the policy mix of the GRI project, as well as executing the plan, regulatory, implementation, development and maintenance (John *et al.*, 2018). Therefore, a well-developed information system and open data as a toolbox in between the stakeholders are essentially significant. Thus, different levels of engagement form (e.g. inform, consult, deliberate and co-create) can be adopted with matrices of public participation spectrum such as Promise, Purpose and Tools (Table 2) (Newfoundland, 2013). The matrices can address multiple problems when implementing public engagement to different stakeholders. Furthermore, good transparent policies of government can deliver clear statements to the stakeholders as well as the local communities. They can spontaneously respond to their opinions forming a good positive feedback loop for the GRI project to move it forward (John *et al.*, 2018).

Forms of engagement can be differential from less to more engaging levels. Providing information from the initiator of the GRI project to the broad public (inform) is considered as a less engaging form. However, co-creation, which is the highest engaging form, has all various stakeholders to collaborate and finalize the practical and implemented decision of the GRI project. Furthermore, consultation and deliberation are the intermediate forms of engagement. Diverse forms of engagement adapted with a spectrum of public participation such as promise, purpose and tools are the comprehensive and higher-level public engagement processes. Promise, a purpose of engaging information exchange processes, provides an opportunity to relevant stakeholders for initiative conservation and incorporates recommendations into the final decision (Newfoundland, 2013) . Purpose is the process of

facilitating knowledge of issues, obtaining feedback from stakeholders, and sharing different aspects of stakeholders in order to assist the generation of final decisions (Newfoundland, 2013) . Tools are the processes for the broad public to be engaged with a variety of methods and workshops (Newfoundland, 2013) . They can be as simple as conventional methods such as questionnaires, pamphlets, posters, newspapers, and public meetings (COVID-19 restriction applied). The unconventional tools are websites, social media, online idea forums, and VR tools. Moreover, the higher engaging forms can include workshops and deliberating polling (online), advisory committees, formal partnerships, informal coalitions, and social networks. Workshops can be delivered locally such as educating local elementary schools as well as the broad public about the concept of green rainwater infrastructure. In general, the degree of public engagement will vary from different circumstances and its desired outcomes. It is important to select the appropriate spectrum of engagement type to optimize the final goals.

Table 2: Forms of public engagement and tools (Newfoundland, 2013).

	Form of Engagement	Promise	Purpose	Tools
Less Engaging	*Inform*	We will provide the public with the information required to understand the issue	To facilitate increased knowledge of the issue and the decisions concerning it	Fact sheets, web sites, open houses, pamphlets, social media
	Consult	We will provide the public with clear and coherent information regarding the issue, welcome the public's thoughts on the topic, and indicate how their input affected the outcome	To obtain feedback on analysis, alternatives or decisions	Public comment, focus groups, questionnaires, public meetings, Twitter town halls, online idea forums
	Deliberate	We will engage the public in two-way conversation to make certain that the public's thoughts and concerns are factored into proposed solutions/decisions	Greater level of participation by stakeholders as they assist in idea generation	Workshops, deliberative polling, advisory committees
More Engaging	*Co-Create*	We will rely on relevant stakeholders input in combination with organizational expertise to incorporate recommendations into decisions to the maximum extent possible	Shared ownership between the organization and the stakeholders as the community is involved in each aspect (and the outcomes) of the decision	Consensus-building, participatory decision-making, panels, formal partnerships, informal coalitions, alliances, networks

Conventional Methods and VR Technology to Facilitate Public Engagement and Education

Conventional methods refer to traditional and familiar methods of public engagement, involving participants to interact with physical materials and/or face-to-face. As seen in Table 2, most of the tools listed on the right column are conventional methods. Some obvious benefits include little to no need for internet or digital devices to conduct. Narrative workshops are iterative and can help encourage discussion with disengaged audiences suited

to their interests and values (Whitmarsh & Corner, 2017). Doing surveys can generate discussions and talks, such that the concerns of different groups of people can be understood (Wilker *et al*., 2016).

On the other hand, some limitations of conventional methods include in-person contact to distribute and/or facilitate a discussion. This may limit diversity of audience views and participation numbers, and, in turn, limit outreach. These methods are unable to display 3D imagery and are considered flat and static compared to VR (Laing & Apperley, 2020). Certain groups may prefer a certain kind of narrative for discussions (Whitmarsh & Corner, 2017). This can create biases and may not completely reveal all of their opinions when engagement is conducted face-to-face. It can also be time- and cost-consuming (Luyet *et al*., 2012, Wilker *et al*., 2016). In-person engagement is also difficult to facilitate during the COVID-19 pandemic due to physical distancing and provincial restrictions.

With the ever-increasing change in technology, innovative technology and methods of marketing, such as VR, is becoming increasingly popular. Opposed to conventional methods of communication, VR could be an exceptional choice in allowing clients an immersive visualization of the proposed project from morning to night regardless of their expertise on GRI (Paes & Irizarry, n.d.). If used wisely, VR can be used as an engagement tool that breaks barriers in language, age, and educational background which previously limited effective communication. It could become an integrative part of the public consultation process for new GRI projects by gathering responses to designs (Galle *et al.*, 2019). Stakeholders can participate in evaluating GRI designs and provide feedback, along with finding flaws which can boost engagement with participants (Laing & Apperley, 2020). Public misunderstandings about a project could be addressed through VR by accurately depicting the proposed design ideas and outcomes (Paes & Irizarry, n.d.). Specifically, residents, who might be concerned that the St. George Rainway project will be daylighting the stream, will be able to see that the proposed project does not intend to integrate such a feature (Shape Your City, 2021).

Some challenges do exist, however, with the current state of VR which can limit its use in early stages of project development. These include: inability to handle 3D text (Laing & Apperley, 2020; Samarskaya, 2018), lack of integration of VR software with production software such as Adobe Suite (Laing & Apperley, 2020), and limitations as a visualization tool only with no ability to make real-time or online changes to design while inside virtual simulation (Paes & Irizarry, n.d.). It should be noted as well that some users have been reported to experience discomfort or significant levels of motion-sickness after the use of VR (Paes & Irizarry, n.d.).

Furthermore, cost and equipment required will vary depending on the level of complexity of the VR project. In British Columbia, Canada, the City of Coquitlam has developed VR maps and used it to engage and consult residents about the proposed neighbourhood developments at the cost of $28,000 CAD (McKenna, 2019). Also, more complex projects will require a VR headset for each individual user which can range from $10 to $400 depending on quality and current market prices. However, VR projects could be hosted instead on a web platform accessible by computer like the mesmerizing virtual

destination tour service on the official website for the city of Santa Clara in the heart of Silicon Valley (Visit Santa Clara, 2021). In this case, users are able to control and navigate website-based VR applications such as the 3D maps, ground and aerial view, 3D graphics, and sound. In light of COVID-19, using a virtual delivery such as VR would allow individuals to navigate and interact with the proposed area without the need for headgear equipment and in the safety of their computer.

Conclusion

Members of the public may not fully understand climate change, it's effects and how GRI can be used to adapt to those changes in everyday life. Others may be unaware of other co-benefits that GRI involves, and more specifically to the St. George Rainway, residents may have additional misinformation about what the Rainway project entails. Separating methods of communication to target these misunderstandings, conventional methods including newsletters, reports, websites, meetings and workshops are potentially cost-consuming and more familiar, but lack the dynamic nature of unconventional methods like virtual reality. VR as marketing for this project, while pricier than other methods would allow residents a chance to visualize what the future could look like with the Rainway project completed in order to show co-benefits and foster realistic expectations for an end result. VR could be a useful tool in communicating the co-benefits of GRI in the case of the St. George Rainway and future initiatives, and can be paired with other lower-cost conventional methods of engagement.

Public Engagement and Education Plan

Introduction

During COVID-19 pandemic, social-distancing has become the new norm across the world. Many companies are embracing virtual and online meetings for their operational stations. To be engaged in this GRI project, virtual reality (VR) should be an ingenious tool to engage the broad public's interests toward the project. VR technology presents visual and immersive environments to garner user examination and feedback, along with helping to enable a better understanding of the GRI design aspects. Early on in a project, VR can be employed to present proposals in interactive ways and enable different stakeholders to experience a better understanding of the project in a desired environment before the implementation takes place. Therefore, VR supports information sharing throughout the engagement process. Experience through the technology can generate emotional bonds between audiences and the GRI project, and create connections that encourage stakeholders to search for additional information to what they have seen in the simulation. As a result, this new VR tool is developed to allow stakeholders and the public to be engaged and collaborate on the Green Rainwater Infrastructure (GRI) project together.

Green Rainwater Infrastructure - Virtual Reality Engagement Plan

VR is a tool to support decision-making processes in architecture and GRI design. It provides an opportunity to the public to experience and examine the envisioned design through an immersive visualization. Studies show that VR can engage public participation and provide a realistic experience to give instant feedback and positive judgement on the quality of presented content, instead of artificial 2D images (Van Leeuwen *et al.*, 2018). The VR engagement plan has four levels of participation: consultation, co-production, co-decision, and co-production (Van Leeuwen *et al.*, 2018).

Consultation:

All St George St. residents, Mount Pleasant neighbourhood and public are invited to participate in the design of GRI (Phase 1). They are instructed to use their smartphones or participate in it on their computing devices. The VR platform is designed to follow-up with questions and verbal comment sections (multi-language) which help participants to leave feedback.

Co-Production:

After Phase 1, the workgroup of all participants is engaged in a series of intensive co-design with a city-planner from the municipality. Any comments and feedback will be examined and taken into account. With the help of VR models, it leads to improved design of the GRI project (Phase 2).

Co-Decision:

After Phase 2, a few variant designs are submitted for voting by all participants using their smartphones or computing devices (Phase 3).

Co-Production:

The government, city-planners, private agencies, architects, and all participants will produce the final detailed design of the GRI project (Phase 4).

Promoting the Public Engagement Plan:

To promote the VR resource tool, we have designed the public engagement plan of the GRI project based on literature review, engagement guides, and Phase 1 Vision and Value analysis (Survey). Some of this engagement plan is designed for during COVID-19, so we conduct a larger portion of engagement processes and events on a digital engagement platform and appropriate size of conventional engagement media.

1. *Designing Community Engagement*
    - Identifying stakeholders

It is critical to first identify key stakeholders before deciding effective interaction strategies and designing engagement messages. Public and private institutions and people with a personal stake in or who are directly or indirectly affected are referred to as stakeholders. As

previously indicated, the engagement of internal stakeholders (i.e. municipal agencies) is essential but not the focus of this report. In order to identify other stakeholders, a variety of methods may be utilized and which are briefly classified as ‘unconventional’ and ‘conventional’. The tools are including but not limited to the ones stated in the below sections.

2. *Unconventional Tools to Engagement Activity*
    - Online discussion forums and blogs
    - Surveys (online or mailed)
    - Emails
    - Cell-phone Apps
    - Social networking - Facebook, Twitter, Instagram, YouTube, Snapchat

According to a summary published on Statista in 2021: there are 25.35 millions of social network users in Canada now which is around 67% of Canada's population (Tankovska, n.d.). There are Twitter, Facebook, Snapchat, Instagram, YouTube, and more others. (https://gs.statcounter.com/social-media-stats/all/canada). There are many different social media platforms, thus, for the following section, we have highlighted the use of various social media platforms and how well each can help bring in participants and engage them in participation (Tables 3, 4, 5, 6, 7) based on a guide from the National Co-ordinating Centre for Public Engagement.

Table 3: Pros and Cons of Twitter as part of analysing which social networking platform serves better.

Twitter: Users post and communicate with messages known as ‘tweets’ on certain news and other users’ posts.	
Pros	**Cons**
• Great for engagement with journalists, policy makers, MPs and other professionals and public interest groups • ‘Hashtags’ can be used to follow certain advocacy • Promote discussion and extend networks by tagging other Twitter users in tweets • Word limit for each post which ensures content is quick to read • Twitter analytics make it simple to track the reach and engagement of each interaction	• Word count limits the depth of information or content • Low visibility (i.e. ‘You’ are one account in hundreds of accounts)

Table 4: Pros and Cons of Facebook as part of analysing which social networking platform serves better.

Facebook: Users can leave comments, share photographs, post links to other websites, and watch and share short videos.	
Pros	**Cons**
• Audience is diverse • 'Groups' and 'pages' can be created for special topics • Multi-media friendly: texts, hyperlinks, videos, and images • Facebook Live, Facebook Call offer direct online face-to-face interactions.	• Networks based on user's habits (i.e. accepted friends, pages liked...) • Analytic tools are somewhat difficult to use

Table 5: Pros and Cons of Snapchat as part of analysing which social networking platform serves better.

Snapchat: Users can share images, videos, text, and sketches. Messages are deleted from the app after a few seconds or after 24 hours, depending on how it is used.	
Pros	**Cons**
• Great for online engagement of the current instance • Fast pace of spreading information	• Lack of depth of content • Not helpful for two-way interactions • Analytical metrics are not accessible.

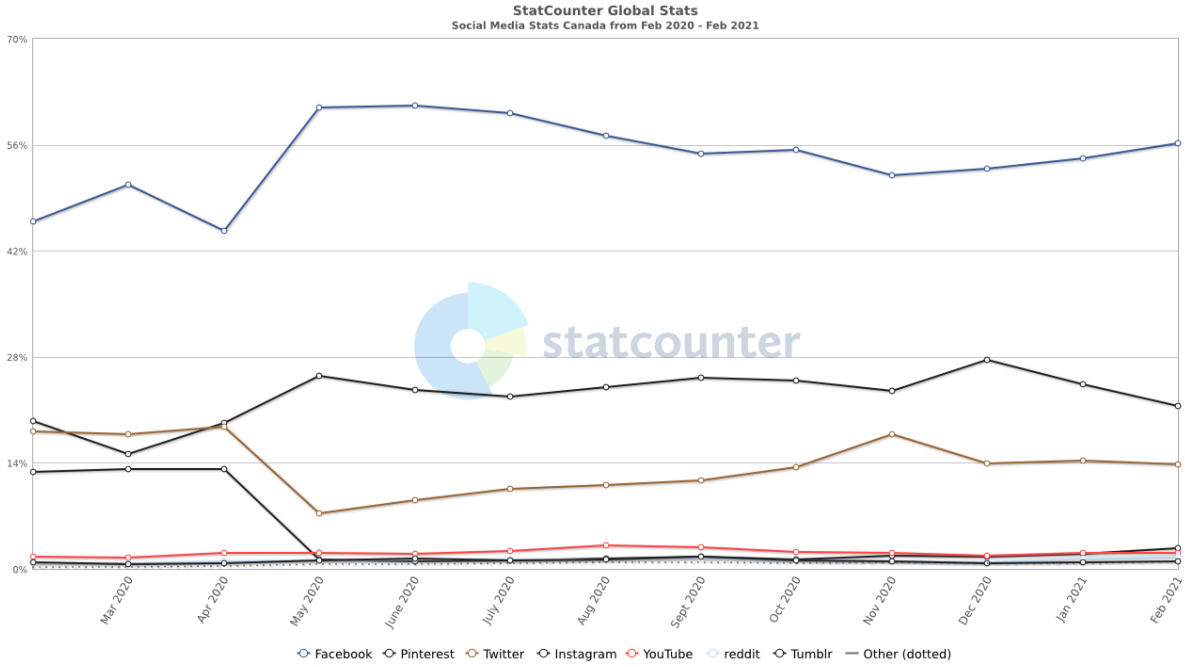
Table 6: Pros and Cons of Instagram as part of analysing which social networking platform serves better.

Instagram: Users can share photos and videos that can be edited with a variety of filters and tags. Photos and videos are shared with the general public or with followers who have been pre-approved.	
Pros	**Cons**
• Great way to share images • Can be used as a marketing tool • #hashtags can be used for creating potential discussion keywords or topic ideas	• Lack of depth of content • Can have comments but further debates are limited

Table 7: Pros and Cons of YouTube as part of analysing which social networking platform serves better.

YouTube: Users can upload, view, rate, share, favourite, comment on, and report videos, as well as subscribe to other users.	
Pros	**Cons**
• World's most popular platform for video sharing. • Can be used on other platforms (e.g. Facebook, Instagram, websites and blogs)	• Multi-media not friendly: texts, hyperlinks, and images cannot be published • Not helpful for two-way interactions

Besides the fact that Facebook offers direct online face-to-face interactions, since Facebook has the penetration rate among other social media platforms in Canada as of 2020 to 2021 (Figure 3); we would suggest the City of Vancouver could develop certain communication channels using Facebook.



- (https://gs.statcounter.com/social-media-stats/all/canada)

Figure 3: Location of the St. George Rainway within the City of Vancouver, indicated by the teal rectangle. Inset image shows a close up of the neighbourhood. Created using Screenshot and Publisher. Data retrieved from shapeyourcity.ca

3. *Conventional Media Engagement Activity*
    - Workshops and Focus Group
        - § Schools' workshops
        - § Local community workshop (Mt. Pleasant and St. George St)
    - Pamphlets
    - Radio, TV, Public transportation, and Poster advertisement
    - Questionnaires
    - Public Meetings (without COVID-19 restrictions)
    - Advisory Committees
    - Deliberative polling

Conventional activities typically require a facilitator to engage with the public. Discussions in groups are a great method for the public to provide feedback on their understanding and/or thoughts about the GRI implementation. Pamphlets and advertisements are good methods to inform the public and lessen knowledge gaps about the St. George Rainway project and the co-benefits of GRI. Questionnaires and polls can provide greater participation as opinions and ideas about the project are shared.

4. *Follow up, and Review*

In this stage, representatives from all stakeholders identified from previous stages are invited to a detailed discussion of the review issue. Stakeholders play an important role in the sharing of personal expertise and experiences which help increase their interests and enhance the

connectivity (https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-017-0104-0). between them and the GRI. Their perspectives help refine the nature and emphasis of the study by defining their preferred elements of the review issue through an open discussion. Moreover, stakeholders are able to share information among themselves. We suggest including a numerical rating scale for the participant in order to implement a metric of success for our resource. The use of a slider scale could allow the users to have control of depicting their feedback in the form of a percentage. Furthermore, another option could be adding simpler questions where the user selects a rating from a scale of 1-10 with descriptions. For example, sample questions could inquire on an individuals improvement before and after using the tool. Thus, the use of a numerical scale would aid in calculating the statistics so that stakeholders are able to quantify the results with such a metric of success.

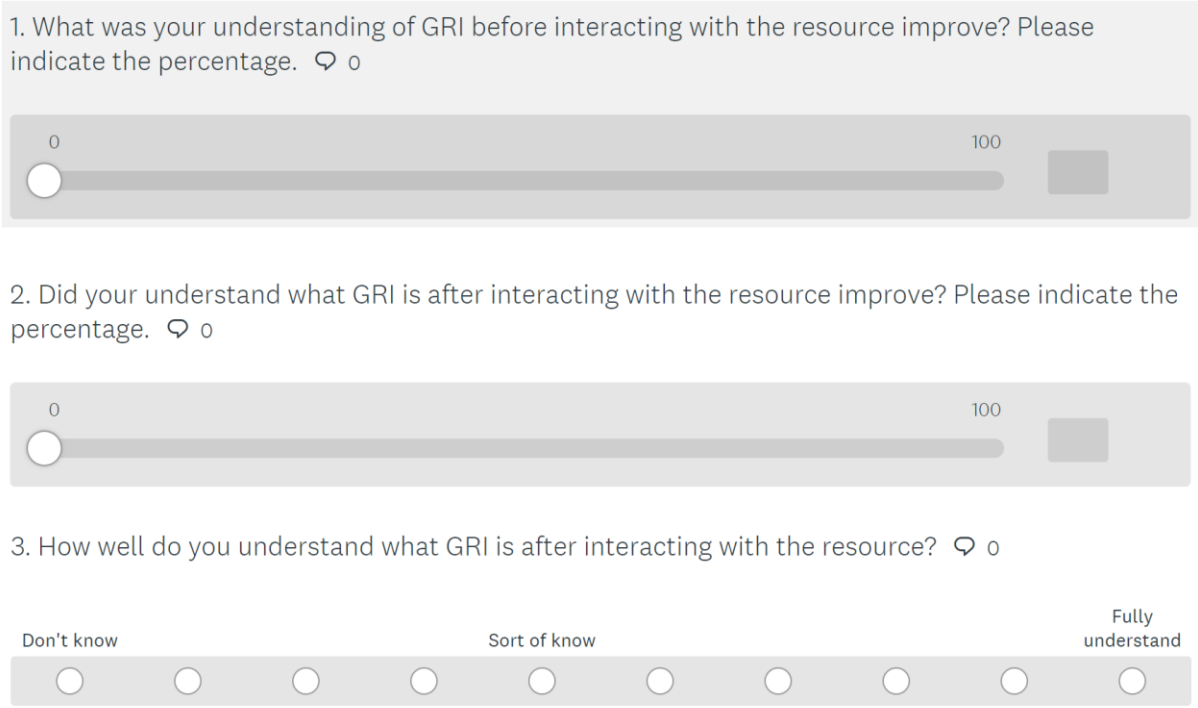


Figure 4: Sample questions made using SurveyMonkey.com to create different types of numerical rating scales. Questions 1 and 2 include a slider scale to rate a percentage from 1-100 according to the question. Question 3 uses a simpler but descriptive rating scale that can be interpreted as a rating from 1-10.

5. *Analyse and Evaluate Results*

During this stage, valuable stakeholder suggestions are analysed in accordance with the guidelines set up. These guidelines would be focused on several aspects, such as popularity among other stakeholders, the 'big picture' of social well-being, socioeconomic sustainability, and with correspondence to the co-benefits given by the rainwater management.

6. *Implementation and Feedbacks*

Implementation is the last stage of the public engagement, though it is one of the most crucial stages of all that it could serve as a beginning for another new loop for engagement. Before coming to an implementation, it is important to avoid bias from the unconditional interests of specific teams of stakeholders. It's vital to interact with a representative, various and well-balanced cluster of stakeholders.

Limitations

Limitations to VR in this context are mainly focused around cost, development platform, and accessibility. With many different and emerging visions of VR technology there is a range of potential costs, with some methods being more expensive than others. This will have to be taken into account if outsourcing development of the program is balanced between quality of the final product. Platform will also be an important consideration, as this resource will be most effective when developed for technology that is already common in resident's households. While it is a safe assumption that most residents will have access to a computer to utilize a web-based version of the modeled Rainway, it is likely untrue to generalize that all residents will be able to fully utilize this tool. Potential residents that do not have a computer or other device capable of running the VR tool, or who may dislike using technology may be missed by running an engagement campaign focused solely on Virtual Reality as a marketing tool.

Next Steps

By including a metric of success in the form of post-campaign surveys, feedback can be analyzed to quantify the degree of success for the resource. The surveys can include a rating scale that participants can complete to communicate their experiences and understanding following their use of the tool. Quantification of the surveys can help identify areas that need improvement and allow residents to express their opinions after they are able to examine the proposed site. These surveys can also be used to compare resident's opinions on the St. George Rainway with previous results of the 2021 Shape Your City survey, with particular focus on whether residents appear to have a clearer picture of the reality of what the project entails and if there is a broader recognition of potential co-benefits.

If this project is successful, similar VR technology can potentially be replicated for future GRI projects across the City of Vancouver as a tool for the public to explore and learn about changes in different neighbourhoods throughout the city. Depending on the type of VR technology chosen to be used in the GRI project, similar projects could be recreated for applications in other industries and fields. Some potential projects that are feasible for a municipality to implement include the hospitality and tourism setting, museum tours (Errichiello *et al.,* 2019), and in the field of gerontology (Serino *et al*., 2017). From the laboratory experiments of Flavián *et al*. (2021), results showed that VR had a positive impact on psychological and behavioural engagement in the hospitality setting. VR could be used as a hospitality and tourism marketing tool that reaches a global audience by helping people plan their future trips through an interactive experience while researching a destination (Huang *et al*., 2013). In addition, VR can be used as an engagement tool to combat accessibility and mobility issues common with frailty (Serino *et al*., 2017) as the elderly generation in BC is predicted to increase (Statistics Canada, 2020). Many opportunities for engagement, education, and solutions will become more evident as new technology becomes more readily available and more integrated into the daily lives of those residing in the City of Vancouver.

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References

Alves, A., Gersonius, B., Kapelan, Z., Vojinovic, Z., & Sanchez, A. (2019). Assessing the co-benefits of green-blue-grey infrastructure of sustainable urban flood risk management. *Journal of Environmental Management, 239* (2019), 244-254. https://doi.org/10.1016/j.jenvman.2019.03.036

Derkzen, M. L., van Teeffelen, A. J. A., & Verburg, P. H. (2017). Green infrastructure for urban climate adaptation: how do residents' views of climate impacts and green infrastructure shape adaptation preferences? *Landscape and Urban Planning, 157,* 106-130. https://doi.org/10.1016/j.landurbplan.2016.05.027

Di Marino, M., & Lapintie, K. (2018). Exploring the concept of green infrastructure in urban landscape. Experiences from Italy, Canada and Finland. *Landscape Research, 43*(1), 139–149. https://doi.org/10.1080/01426397.2017.1300640

Errichiello, L., Micera, R., Atzeni, M., & Del Chiappa, G. (2019). Exploring the implications of wearable virtual reality technology for museum visitors' experience: A cluster analysis. *The International Journal of Tourism Research, 21*(5), 590–605. https://doi.org/10.1002/jtr.2283

Flavián, C., Ibáñez-Sánchez, S., & Orús, C. (2021). Impacts of technological embodiment through virtual reality on potential guests' emotions and engagement. *Journal of Hospitality Marketing & Management, 30*(1), 1–20. https://doi.org/10.1080/19368623.2020.1770146

Galle, N. J., Nitoslawski, S. A., & Pilla, F. (2019). The internet of nature: How taking nature online can shape urban ecosystems. *The Anthropocene Review, 6*(3), 279–287. https://doi.org/10.1177/2053019619877103

Harcourt, R., Bruine de Bruin, W., Dessai, S., & Taylor, A. (2019). Investing in a good pair of wellies: how do non-experts interpret the expert terminology of climate change impacts and adaptation? *Climatic Change, 155*(2), 257–272. https://doi.org/10.1007/s10584-019-02455-0

Huang, Y., Backman, S. J., Backman, K. F., & Moore, D. (2013). Exploring user acceptance of 3D virtual worlds in travel and tourism marketing. *Tourism Management (1982), 36,* 490–501. https://doi.org/10.1016/j.tourman.2012.09.009

Johns, C., Shaheen, F., & Woodhouse, M. (2018). Green infrastructure and stormwater management in Toronto: Policy context and instruments, *Centre for Urban Research and Land Development. June,* 1–68.

Laing, S., & Apperley, M. (2020). The relevance of virtual reality to communication design. *Design Studies, 71*. https://doi.org/10.1016/j.destud.2020.100965

Luyet, V., Schlaepfer, R., Parlange, M. B., & Buttler, A. (2012). A framework to implement stakeholder participation in environmental projects. *Journal of Environmental Management, 111,* 213-219. https://doi.org/10.1016/j.jenvman.2012.06.026

McKenna, G. (2019, November 12). Take a (virtual) walk through Coquitlam's city center. *Tri-city news.* https://letstalkcoquitlam.ca/ccap/news_feed/take-a-virtual-walk-through-coquitlams-city-centre

Newfoundland Labrador Office of Public Engagement. (2013). *Public Engagement Guide*. *November*, 1–15. https://ope.gov.nl.ca/publications/pdf/OPE_PEGuide.pdf

Paes, D., & Irizarry, J. (n.d.). A usability study of an immersive virtual reality platform for building design review: Considerations on human factors and user interface. In *Construction Research Congress 2018* (pp. 419–428). https://doi.org/10.1061/9780784481264.041

Rain City Strategy. (2019, November 5,). *City of Vancouver*. [PDF]. 1-154. https://vancouver.ca/files/cov/rain-city-strategy.pdf

Serino, S., Barello, S., Miraglia, F., Triberti, S., & Repetto, C. (2017). Virtual reality as a potential tool to face frailty challenges. *Frontiers in Psychology*, *8*, 1541–1541. https://doi.org/10.3389/fpsyg.2017.01541

Shape Your City. (2021). St George rainway phase 1 engagement: vision and values analysis. [Unpublished Draft]. 1-47.

Tankovska, H. (n.d.). Topic: Social networking in Canada. Retrieved April 2, 2021, from https://www.statista.com/topics/2729/social-networking-in-canada/#:~:text=After%20years%20of%20constant%20growth,the%20world%27s%20most%20connected%20populations

Van Leeuwen, J. P., Hermans, K., Jylhä, A., Quanjer, A. J., & Nijman, H. (2018). Effectiveness of virtual reality in participatory urban planning. ACM International Conference Proceeding Series, February 2019, 128–136. https://doi.org/10.1145/3284389.3284491

Visit Santa Clara. (2021). *Santa clara virtual tour.* Santaclara.org. https://www.xplorit.com/santa-clara-california.

Whitmarsh, L., & Corner, A. (2017). Tools for a new climate conversation: A mixed-methods study of language for public engagement across the political spectrum. *Global Environmental Change*, *42*, 122-135. https://doi.org/10.1016/j.gloenvcha.2016.12.008

Wilker, J., Rusche, K., & Rymsa-Fitschen, C. (2016) Improving participation in green infrastructure planning. *Planning Practice & Research, 31*(3), 229-249. https://doi.org/10.1080/02697459.2016.1158065

Appendix

Appendix 1: List of abbreviations and Acronyms

CoV: City of Vancouver

GRI: Green rainwater infrastructure

RFP: Requests for Proposal

VR: Virtual Reality