

**Building Resilience with Forests: Documenting New Brunswickers' Values and  
Understanding of Natural Asset, Natural and Green Infrastructure**

by

Lyndsey M. Burrell

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**Supervisor:** Dr. Thomas Beckley, Forestry and Environmental Management

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## **ABSTRACT**

Many communities within New Brunswick are experiencing the negative effects of climate-related hazards. To effectively adapt and mitigate these impacts, policy and decision-makers need to increase their incorporation of nature and nature-based solutions. Forests that sequester large amounts of carbon and reduce flooding can be used to address climate change. This exploratory study has two research objectives. Objective one is to document and describe the forest values of a select group of New Brunswick citizens. This will include identifying the important ecosystem, economic, and social values of forests in qualitative terms. A second objective is to test citizens' understanding of the terms natural asset, natural infrastructure, and green infrastructure, and to determine the vocabulary they best understand and are most comfortable with. These objectives will be applied to general public participants and expert participants from three occupational categories: planners, engineers, and ENGOs. All 44 participants' top priorities focused on environmental values related to forests, with low economic values. Expert participants commonly discussed the use of forests for mitigation efforts and community resiliency. For vocabulary, the public was less familiar with the terms than the experts, with some similarities shared amongst definitions between expert groups. The term natural asset was commonly preferred for general public engagement amongst participants. This research documents citizens' values and familiarity with technical terminology that can be incorporated into future environmental strategies and ultimately improve public perception of natural and nature-based solutions.

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# TABLE OF CONTENTS

<b>ABSTRACT</b> .....	<b>1</b>
<b>ACKNOWLEDGEMENTS</b> .....	<b>2</b>
<b>TABLE OF CONTENTS</b> .....	<b>3</b>
<b>1.0 Introduction</b> .....	<b>5</b>
<b>1.1 Literature Review</b> .....	<b>6</b>
<b>1.1.1 Forest Value History</b> .....	<b>6</b>
<b>1.1.2 Forest Value Research</b> .....	<b>7</b>
<b>1.1.3 Technical Terminology</b> .....	<b>10</b>
<b>1.2 Research Questions</b> .....	<b>11</b>
<b>2.0 Methods</b> .....	<b>12</b>
<b>2.1 Participation Selection</b> .....	<b>12</b>
<b>2.2 Survey Style</b> .....	<b>14</b>
<b>2.3 Questionnaire Design and Procedure</b> .....	<b>15</b>
<b>2.4 Analysis</b> .....	<b>15</b>
<b>3.0 Results</b> .....	<b>16</b>
<b>3.1 Ecosystem, Economic, and Social Functions of Forests</b> .....	<b>16</b>
<b>3.2 Forest Values</b> .....	<b>18</b>
<b>3.3 Natural Asset, Natural Infrastructure, and Green Infrastructure</b> .....	<b>19</b>
<b>3.3.1 Defining Terminology: Public</b> .....	<b>20</b>
<b>3.3.2 Defining Terminology: Experts</b> .....	<b>22</b>
<b>4.0 Discussion</b> .....	<b>26</b>
<b>4.1 Forest Value Similarities and Differences</b> .....	<b>26</b>
<b>4.2 Terminology</b> .....	<b>28</b>
<b>4.3 Recommendations</b> .....	<b>29</b>
<b>4.4 Limitations</b> .....	<b>30</b>
<b>5.0 Conclusion</b> .....	<b>30</b>

<b>6.0 References .....</b>	<b>31</b>
<b>Appendix .....</b>	<b>34</b>
<b>Appendix I: Recruitment Email .....</b>	<b>34</b>
<b>Appendix II: Consent Form .....</b>	<b>35</b>
<b>Appendix III: Survey Questions .....</b>	<b>38</b>

## 1.0 Introduction

Many communities across Canada, and more specifically communities within New Brunswick, are already experiencing the negative impacts and climate-related hazards associated with climate change. Weather and climate patterns have become less certain, with increasing risks from flooding, storm surges, drought, ice, and windstorms (Mitchell and Reeder, 2017). These events cause significant structural damage, financial loss, and environmental disturbance, along with both physical and mental health impacts for community members. Vulnerability to these hazards vary amongst communities and more proactive strategies and planning must occur to adapt and mitigate future impacts related to climate change. Incorporating more nature and nature-based solutions are progressive ways to adapt to climate change (Griscom *et al.*, 2017). By more nature this means more climate-resilient forests that sequester more carbon and mitigate against flooding, in addition to providing the well-known benefits of timber and non-timber products, habitat, recreational experiences, spiritual values and comforts (Beckley, 1998).

In North America, about one-third of the land is forested (Weed *et al.*, 2013), and over 300 communities within Canada are forest-dependent (McFarlane *et al.*, 2011). New Brunswick consists of around 85% (6.1 million hectares) of forest land, making it amongst Canada's most forested provinces as a percent of total land area (McFarlane *et al.*, 2011). Of this forested area, 53% are on public lands (51% provincial Crown Lands, 2% federal Crown lands), 29% are small private woodlots, and 18% are private industrial lands (McFarlane *et al.*, 2011; Nadeau *et al.*, 2012). Acadian forest covers most of New Brunswick and is characterized by softwood and hardwood tree species, including balsam fir, black spruce, yellow birch, eastern white pine, eastern white-cedar, eastern hemlock, and sugar maple (Province of New Brunswick, n.d.).

New Brunswick residents show a strong connection with their forests; 94% of residents reported visiting forests at some point throughout the year (Nadeau *et al.*, 2007). Many residents spend time on personal or family-owned forest land, including spending time at camps or cottages. Other forest-related uses by New Brunswick citizens include hiking, bird watching, four-wheeling, and a large portion of residents using non-timber forest products such as fiddleheads and maple products (Nadeau *et al.*, 2007).

Forests are used in a variety of ways for New Brunswick citizens, so understanding community members' awareness of these natural ecosystems and their familiarity with nature-related terminology is important before incorporating nature-based solutions. Forests have

been highly valued for their recreational uses and forestry services, however non-market values and ecological services have only recently been documented for their value (Beckley, 1998). For a small sample of New Brunswick citizens, a series of interviews were conducted to document the values for forests. Data collected from these interviews are used to highlight key themes and trends noted amongst and between the interviewed groups. The purpose of this research is to identify additional potential benefits to the public of using nature-based solutions to combat climate change. Specifically, it is about public and expert perceptions of the additional benefits healthy forests might add to mitigating climate change and building more resilient communities.

## **1.1 Literature Review**

### **1.1.1 Forest Value History**

Values are considered important in environmental decision-making as they drive individual interests and positions and can have a significant influence in determining one's actions (Moyer *et al.*, 2008). Two value categories include held values and assigned values (Brown, 1984; Owen *et al.*, 2009). Held values are the methods of conduct and one's ethical principles, while assigned values refer to the relative worth of an object and the associated preference (Owen *et al.*, 2009). Values are numerous and can change over time as individuals become influenced by others, their surroundings, and experiences, but are found to be more deeply held than attitudes and preferences (O'Brien, 2003; Dietz *et al.*, 2005). Manning, Valliere, and Minteer (1999) state that a person's held value regarding forests is "an enduring concept of the good related to forests and forest ecosystems." Identification of values for forested areas can provide a clearer picture of how communities and individuals both understand forested ecosystems and what aspects they value most about them.

Tarrant *et al.* (2003) note a shift in forest values over the past several decades, focusing more on the inclusion of both economic and non-economic values of forests, greater understanding of human and nonhuman benefits, and the importance of including the public in management decisions. This shift is a result of greater involvement of the public with forest ecosystems and a growing concern with management practices and conservation efforts (Dobbertin and Pruller, 2002).

Beckley *et al.* (2006) describe the historic involvement of the public within forestry and documents the shift in forest values over the 19<sup>th</sup> and 20<sup>th</sup> centuries in North America.

Historically, the public's interest revolved around what could be extracted from forests and its distribution of resources. Throughout the 19<sup>th</sup> century, public values were largely utilitarian, and forests were often viewed as a barrier to land development (Beckley *et al.*, 2006). As the 20<sup>th</sup> century progressed, the combination of the establishment of Canadian university forestry faculties, the increased access and exposure to outdoor recreation, and the desire for rural landscapes produced a diverse set of public forest values (Beckley *et al.*, 2006). The environmental movement at the beginning of the 1960s and the recognition of Aboriginal rights in the late 20<sup>th</sup> century also contributed to broadening the range in forest values that are held today. These values are connected to a wide range of emotions, experiences, and judgements, and can include aesthetic, ecological, scientific, economic, and spiritual elements (Manning *et al.*, 1999; Tindall, 2003).

### **1.1.2 Forest Value Research**

Although forest values have been well-documented in Canada, it is important to identify and understand the full range of values for forests for the general public, as well as the professionals working with forests. Public participation is a key tool for identifying values. Beckley *et al.* (2006) highlight several methods, strategies, tools, and recommendations for effective public participation. Practical reasons for incorporating public participation include: legitimacy or acceptance of decisions; establishing trust in institutions and professionals; reducing conflicts; identifying values, objectives, goals, and desires; promoting learning and valued knowledge; and producing better decisions (Beckley *et al.*, 2006). The available tools that can effectively obtain public input consist of both direct (face-to-face) and indirect (non-face-to-face) approaches. Direct tools for eliciting public values include focus groups, workshops, round tables, public advisory committees, task force, and citizen juries. Indirect tools include discussion papers, comment sheets, a toll-free line, and the method chosen for this study; surveys. Surveys can be a useful tool for defining forest values for the public. There are various survey types, each containing its advantages and disadvantages. Overall, surveys are found to be most appropriate for broad goal and objective setting in forest policy planning and an effective tool for assessing the general public (Beckley *et al.*, 2006).

Multiple studies have identified the success and importance of incorporating public participation and forest value surveying. Nadeau *et al.* (2007) found over one-third of New

Brunswick respondents from their survey regarding resource management felt that they should be considered equal partners with resource professionals and called for greater inclusion in forestry policy and management decisions. This illustrates the demand and interests of the public and the need for greater engagement between planners, engineers, governmental officials, and First Nations. The government-sponsored, random sample survey also asked respondents to rank five forest values (economic, recreation, environmental protection, species variety, and non-timber products). Of these values, environmental protection was ranked as the most important forest value followed by species variety, then economic. Recreation and non-timber products were ranked considerably lower than environmental and economic values (Nadeau *et al.*, 2007). Sheppard *et al.* (2004) also documented forest values and found that respondents ranked environmental values (water and ecosystem health) of greater importance than other values (cultural/historic values and non-timber products).

Evaluation amongst varying stakeholder groups can identify common preferences and differences in values. A 2005 study identifying the values for forests and wetlands between farmers, environmentalists, and the general public. Results show that those who held more intrinsic values preferred higher levels of area protection, and those who held more use values preferred higher levels of direct use (Winter, 2005). Environmentalists opted for higher levels of conservation values, while farmers indicated higher levels of use values. The general public was in between these groups and indicated preferences across pro-use and pro-conservation values (Winter, 2005).

Many studies have also been concerned with measuring anthropocentric and biocentric value orientations (Tarrant & Cordell, 2002; Winter, 2005). An anthropocentric philosophy “emphasizes the instrumental value of forests for human society rather than their inherent worth” (Tarrant & Cordell, 2002). A more biocentric approach values the inherent worth of the forest and its components (trees, soil, water, wildlife), and thinks less about their utilization. With these viewpoints, Tarrant and Cordell (2001) report the public placing higher values on their non-use benefits (adapting a more biocentric approach). Continuing from this, Tarrant, Cordell, and Green (2003) further suggest that younger (versus older), female (versus male), urban (versus rural), and more educated individuals contain a higher likelihood of having more biocentric values. McFarlane *et al.* (2011) further analyze public values by evaluating the relationship between forest-dependent communities and their preferences regarding how forests are managed.

Generally, individuals who hold biocentric viewpoints were found to support forest protection from resource exploitation, value sustainability, and aesthetics, and perceive impacts from humans to be the largest threat to forests (McFarlane *et al.*, 2011). Alternatively, those with more anthropocentric viewpoints were found to support economic uses of forests, value forest management practices, and view natural ecosystem disturbances as the greatest threat to forests (McFarlane *et al.*, 2011). Although these authors originally hypothesized that communities who depend more on resource extraction and economic gain from forests would more strongly support anthropocentric values than those who are not as reliant on forests, this study suggests that communities are actually more diverse in their values, regardless of their dependency on forests (McFarlane *et al.*, 2011).

Specific forest types have also been studied for how they are valued. Old-growth forests provide numerous ecosystem services such as carbon sequestration, water purification, wildlife habitat, species diversity, as well as many economic benefits such as timber harvest and recreational uses. With such an important forest ecosystem, Owen, Duinker, and Beckley (2009) capture old-growth forest values for Nova Scotia residents. The most important old-growth value reported by all participants was within the forest values category “life-support” (habitat, biodiversity, water quality/quantity, carbon sequestration, and oxygen). “Moral/spiritual” was ranked second, followed by “economic”, with the “aesthetic” category rated lower (Owen *et al.*, 2009). Although the “aesthetic” forest values category was ranked lower than the others, the “natural beauty” value within the “aesthetic” category was rated the second most important value by respondents. Ordóñez *et al.* (2016) addresses public values regarding another forest type; urban forests. Respondents were asked what they most value about urban trees and reported aesthetics, air quality, naturalness, well-being, and environmental quality values. The top values noted by participants were aesthetics, air quality, and shade. The result of this study highlights the common belief that aesthetics is a value most often associated with urban forest (Ordóñez *et al.*, 2016).

Lastly, the work by Bengston (1994) emphasizes three benefits from a better understanding of forest values for forest managers, planners, policymakers, and scientists:

1. Able to establish appropriate goals for ecosystem management and shed light on the normative and ethical questions that traditional forest science is unable to answer.

2. Help managers determine how the public will react to forest practices within ecosystem management.
3. Assist in dealing with conflicts that arise over public forest management by identifying value differences and disputes.

### **1.1.3 Technical Terminology**

There is a call for greater attention to forest terminology and the implications diverse and complex terms can have on the public (Dobbertin & Pruller, 2002). As recognition of the broad-scale benefits and importance of forests increases, the public is becoming more concerned and engaged. With greater involvement comes a greater responsibility to evaluate how the language and vocabulary being used in the context of climate change is understood. A 2012 survey conducted across Canada focused on provincial residents' connection to nature and awareness of nature-based concepts (Federal, Provincial, & Territorial Governments of Canada, 2014). Awareness of nature-related concepts (species at risk, ecosystem services, biodiversity) for Canadian participants tended to increase with education and income, but decrease with age. For New Brunswick residents, about 71% were aware of the term "biodiversity", 72% of the term "ecosystem services", and 93% reported they had heard the term "species at risk". Identifying public awareness of nature-related concepts can identify the current knowledge individuals have surrounding environmental terminology. For this study, natural assets, natural infrastructure, and green infrastructure are three technical terminologies being evaluated as they are increasingly being explored and implemented for their associated benefits.

Natural assets are considered components of the natural environment. This includes the stock of natural resources and ecosystems such as wetlands, forests, fields, and soil (Brooke *et al.*, 2017). Each of these resources produces goods and services that support life on earth and provide many benefits to humans. Ecosystem goods are a product of natural systems and include food, clean air, and water. Ecosystem services are the benefits from ecosystem processes such as nutrient cycling and climate regulation, as well as non-material benefits like recreation and cultural value (Brooke *et al.*, 2017).

Natural infrastructure provides an alternative, "greener" solution to grey infrastructure (human-constructed infrastructure that includes pipes, tunnels, and factories) (ICF for Canadian Council of Ministries of the Environment, 2018). Natural infrastructure uses existing ecosystems

and natural materials to produce ecosystem services and help shape communities into more climate-resilient areas. Current natural infrastructure strategies like restoration, conservation, and sustainable management can provide natural buffers, stabilize landscapes, and create cooler temperatures for habitats (ICF for Canadian Council of Ministries of the Environment, 2018). An example of this is using tree roots to reduce erosion (St-Laurent et al., 2018). Globally, interest is growing in the use of natural infrastructure to help communities become more resilient and reduce impacts associated with climate change (ICF for Canadian Council of Ministries of the Environment, 2018).

Green infrastructure is another approach to incorporating natural solutions as it uses designs that have been created to mimic natural functions and processes (Brooke *et al.*, 2017). Green infrastructure incorporates more of the management side of natural infrastructure and implements solutions that have natural features or that mimic natural processes through man-made elements. Green infrastructure is also thought of as a strategic approach to land conservation (Benedict and McMahon, 2002). This can incorporate natural elements like vegetation and soils, as well as more built infrastructure (Brooke *et al.*, 2017). Green roofs, constructed wetlands, and swales can all be considered green infrastructure.

These terms, however defined broadly above, can have different meanings to different people. For example, some people refer to trees within urban areas as green infrastructure while others see green infrastructure as more environmentally friendly engineered structures such as green roofs and water treatment facilities (Benedict & McMahon, 2002).

## **1.2 Research Questions**

This study has two main objectives. Objective one is to document and describe the forest values of a select group of New Brunswick citizens. This includes identifying the important ecosystem, economic and social functions of forests in qualitative terms and determine how they would rank these values. A second objective is to test citizens' understanding of the terms natural assets, natural infrastructure, green infrastructure and determine the vocabulary they best understand and are most comfortable with. These objectives are also applied to "experts" from three domains or occupational categories: planners, engineers, and environmental non-governmental organization representative (ENGO). This comparison will allow us to evaluate knowledge differences between professionals and non-professional citizens with respect

to these terms. It will also identify whether there is consensus on the meaning of these terms between the different categories of professionals and the general public.

The report will summarize the major themes and address the following key questions:

1. What are the most important ecosystem, economic and social functions of forests for community residents and citizens? For planners, engineers, and ENGO representatives?
2. Do experts have different ways of understanding natural assets, natural infrastructure, and green infrastructure relative to citizens/community residents? Relative to other experts?

## **2.0 Methods**

The overall project covered two ecosystem types: wetlands and forests. This research project focuses on the forest sections of the survey. The following methods section will address the survey process as a whole.

### **2.1 Participation Selection**

The objectives explore the range of values for two particular landscapes. We wished to compare perspectives of a diversity of citizens and a select group of experts of various types. We wanted to ensure that multiple New Brunswick communities were represented that contain wetland and forested ecosystems from both Francophone and Anglophone communities around the province. New Brunswick communities represented in this study include the areas of Fredericton, Dieppe, McAdam, Maple Ridge, Edmundston, Juniper Station, Grand-Bay Westfield, Connors, Millville, Moncton, Rothesay, Saint John, Florenceville-Bristol, and the Madawaska Maliseet First Nation.

Key informants (town mayors, managers, receptionists, city hall representatives, Chiefs) from each of the above communities were contacted to facilitate the recruitment of potentially interested participants. Through the key informants, a snowball technique was used to identify additional interested participants within the area. We wanted to ensure diversity in our participants and so our sampling includes a diverse range in age, gender, and language groups. The majority of participants are persons with average knowledge and experience with wetland and forested landscapes. These participants make up the “public” group for our study, containing 23 participants (Table 1). In addition to public surveying, this project also included an “expert” group that consists of three categories of professionals: engineers, planners, and ENGO staff.

The New Brunswick Environmental Network (NBEN) and Dr. Thomas Beckley assisted in the recruitment of the 21 expert participants. Experts also varied in job type, age, and gender (Table 2). All potential participants were emailed a brief outline of the project and the respondent’s role (Appendix I). Interested participants were then provided with a consent form that outlined the project’s purpose, design, benefits and risks of participating, the confidentiality of data, and a short consent survey that permitted recording and anonymous quoting (Appendix II). A total of 44 participants were interviewed.

**Table 1.** Public participant characteristics and numbers.

	<b>Public Group</b>							
	<b>Rural</b>		<b>Urban</b>		<b>Suburban</b>		<b>Total (n=23)</b>	
	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	Male
<b>18-24</b>	1						1	
<b>25-44</b>	2	1			2		4	1
<b>45-64</b>	4	3	1	3		6	5	12
<b>65+</b>								
<b>Total</b>	7	4	1	4	2	6	10	13

**Table 2.** Expert participant characteristics and numbers.

	<b>Expert Group</b>							
	<b>ENGO</b>		<b>Planner</b>		<b>Engineer</b>		<b>Total (n=21)</b>	
	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	Male
<b>Age</b>								
<b>18-24</b>								
<b>25-44</b>	2	1		5	5	2	7	8
<b>45-64</b>	2	2	1			1	3	3
<b>65+</b>								
<b>Total</b>	4	3	1	5	5	3	10	11

## 2.2 Survey Style

We initially planned to conduct face-to-face surveys with willing participants within selected communities. Due to the restrictions from the global Coronavirus pandemic, in-person interviews could not occur, so we adjusted by employing various communication platforms (Zoom, Skype, Microsoft Teams, Google Hangouts, and phone calls) for the interviews. This allowed participants to choose a method that was most convenient to them and ensure the safety and well-being of both project members and interested participants.

## 2.3 Questionnaire Design and Procedure

The questionnaire was designed by the project leaders (Baani Dhillon and Lyndsey Burrell) with assistance from Dr. Thomas Beckley and recommendations and approval by members of NBEN and Green Analytics. Initially, the team reviewed literature on existing forest and wetland value work to aid in the development of the questionnaire. Once the final draft questionnaire was completed, we conducted five pre-test interviews. We used feedback from these to adjust the final questionnaire which was divided into five sections: (i) neighbourhood and community characteristics, (ii) forest values and functions, (iii) wetland values and functions, (iv) vocabulary and, (v) personal information (Appendix III).

A semi-structured interview format was used to guide participants through the series of open-ended questions that allowed respondents to expand and clarify their values for forests and wetlands, as well as their understanding of technical terminology explored through this project. In doing so, participants were encouraged to incorporate personal stories and experiences throughout the discussion. The questionnaire was created and conducted in English. Participants were not shown or given the survey before interviews to avoid framing or researching any potential question answers.

After interested participants were recruited and their signed consent forms were received, an interview date, time, and platform were determined. Interviews were conducted between June 19<sup>th</sup> and July 17<sup>th</sup>, 2020, and were led by Baani Dhillion and myself. Each interview consisted of one project member responsible for leading the interviews and the other responsible for documenting notes. Interview roles for the project leaders were divided evenly among the 44 participants. Before the interviews began, participants were ensured that the survey was not a knowledge test and could skip any questions they did not feel comfortable answering. Interviews were recorded using a Sony Digital recorder for transcription and analysis.

Before conducting interviews, an application for Review of Research Involving Humans was submitted and approval for the project was granted on June 10, 2020 and is on file as REB #2020-064. This research is funded by Green Analytics, in partnership with NBEN.

## **2.4 Analysis**

Interviews were transcribed to assist in the identification of trends and themes. By going over the transcripts and reviewed literature, I was seeking to determine any similarities and differences between and amongst public and expert groups. The result section addresses the important findings from selected survey questions with supporting quotes that represent the values and understandings obtained from our sampled New Brunswick citizens.

## **3.0 Results**

In our survey, several questions were selected to determine participant values surrounding forests and their understanding of natural assets, natural infrastructure, and green infrastructure. Key results highlight the major themes and trends with supporting quotations for the research questions. It is important to note that both public and expert participants were asked

the same questions for the section on forests, however questions in the terminology section of our survey differed between the public and expert groups to best capture participants' familiarity and understanding of each term.

### **3.1 Ecosystem, Economic, and Social Functions of Forests**

#### **How would you define a forest?**

The first question within the forest section of our survey asked participants how they would define a forest. All 44 participants provided their definition with common mentions of trees, vegetated understory, habitat for wildlife, green, and natural/undisturbed forests. Most participants needed a few extra moments to come up with their thoughts regarding what a forest is before providing their answer.

There's more to forests than just the trees. The forest yes, your basic would be your trees, diversity of species and age class, healthy forests. It would incorporate all values that the forest has to offer from wildlife to insects to fungus. All those sorts of things, so forest to me encompass more than just the trees. (Public participant 9)

#### **What comes to mind when you think of a forest?**

Many positive forest attributes were identified by the 44 participants. Common themes mentioned were diversity in tree species, characteristics of the forest floor (plant species, deadwood), wildlife and habitat, emotions (happiness, peaceful, comfort), forest functions (purification of air, shade, carbon capture, oxygen), quality of forest (healthy, natural, untouched), recreational activities, water features, and aesthetics. These descriptions were reflected evenly across public and expert group categories.

Nature, the great outdoors, fresh air, connecting quality to it. I need to spend time outside and in the woods to reorient myself. If I've had a busy day in the office or something has gone sideways at work, I go to the woods to collect my thoughts, to relax, to recharge, and go from there. It's a part of who I am and what I do. (ENGO participant 7)

#### **What benefits to humans do forests provide?**

For both public and expert participants, the functions of the forest were most commonly stated as a benefit that forests provide to humans and society (20/23 public and 19/21 expert). These functions included air and water purification, carbon capture, oxygen, air quality, water retention, and cooling.

Lots of benefits, most people think of their economic benefit for harvesting the trees, timber products, wood-based products, but they provide other ecosystem services that life relies on like cleaning the water, storing water, providing base flow through the year, carbon sequestration values, mitigating climate change, shade, windbreaks in urban areas, and reducing heating costs. (Planner participant 4)

Public participants (9/23) also discussed emotional connections and the feelings that forests provide to humans. This includes happiness, meditation, peaceful, and calming feelings experienced within a forest. The benefit of emotional connections was mentioned by 5/21 expert participants.

I go into the forest and I come out a better person, several times a day. Psychological effects and sociological effects that help us I think be better people and whether that's calming or focusing or relaxing you know people go walk their dogs to get away and put the stresses of their normal day behind them. (Public participant 8)

Roughly half of the expert participants (11/21) mentioned benefits of recreational activities, such as hiking, hunting, and walking dogs, whereas 26% (6/23) of public participants brought up recreation benefits in their responses. Other forest benefits to humans mentioned by both public and expert participants included wildlife habitat, economic (harvesting, timber-products, livelihood), and non-timber products. Aesthetic, educational, and cultural benefits were also mentioned, although only by 9% (4/44) of total participants.

### **What benefits do forests provide to nature?**

Public and expert participants provided similar responses on the benefits forests offer to nature. Habitat and shelter were the top attributes, with 13/23 public and 15/21 expert mentions in their responses. Functions of forests was the next most common benefit mentioned for both public and experts, followed by food source. Both protection and connectivity for habitat were also mentioned by both participant groups. Participants seemed to have an easier time discussing the benefits forests provided to nature versus the benefits provided to humans.

From a nature standpoint it's going to provide ecosystems for wildlife to exist, that's where our birds are going to be, that's where our bears and raccoons and all those types of things are going to be. So there's going to be value from that standpoint. There's going to be value from other perspectives too, so we start talking about forested wetlands, those sorts of things, well then, those things are actually providing stormwater retention, they're providing mechanisms for cooling and heating of those water features before they make their way into the rivers and streams of

New Brunswick. From a purely environmental standpoint the forest offers a lot of different value in the environmental context.” (Engineer participant 8)

### **3.2 Forest Values**

#### **Are forests important to you?**

All 44 participants stated that forests were very important to them. In both public and expert participants, top forest values mentioned when asked why forests were important were values surrounding emotional connections, recreational experiences, forest functions, wildlife, and habitat. Forest values mentioned were similar across most respondents, with few respondents mentioning medicinal, educational, privacy, cultural, and health values.

It's a refuge where we can get away from noise and other people. It's where I do most of my activities. It's very important to me, more so than a lot of people I guess, but it's also where I raised my children. (Public participant 7)

Six of the 44 participants (13.6%) mentioned positive childhood connections and experiences with forests and how it has shaped their values and appreciation for forests today.

Growing up they [forests] played a big role in my childhood and where I was brought up and the connections that I have. I think it always gives that sense of awe and wonder whenever you're in the forest, so recognizing that and recognizing the benefits that it provides on that individual level is why it's important to me. Also, extrinsically important to me: recreation value, connection value, health value, and for maintaining the natural processes that we rely on. (ENGO participant 1)

#### **Values Ranking**

Respondents who gave multiple reasons as to why forests were important to them were asked a follow-up question regarding if they could rank their values in an order of importance. Eight of twenty public (40%) and eight of seventeen expert (47%) participants who were asked this question stated that each of their listed values was of equal importance to one another. All other respondents ranged in their ranking of values. The importance of habitat for wildlife was mentioned by some respondents (total 5/37) as being the most important value. Other values ranked first by individuals were the capture of greenhouse gas emissions, harvesting, medicine, spiritual connection, and personal use. Some respondents differed in their ranking: few listed aesthetics and recreation at higher importance, while others stated that they would place them at a lower level of importance.

I guess I would say aesthetics would be near the bottom, I mean it's important to me, but I would say that I really feel that the ecological or the ecosystem services that they [forests] offer are much more important to me. (Planner participant 1)

I would say it's more important that the animals get to stay in their habitat than it is that I get to walk into the woods. I would definitely rank that as more important and also just the fact that forests in general offer way more than just stuff for animals too. (Public participant 14)

The thing that's most important for me, I guess I'm being greedy, is just how I feel when I'm around it [forests]. I like being around the forest, I think other answers would be like "we need it for oxygen, we need it for runoff, we need it for animals" so I'm being greedy and I would just say that I just like being around the forest. (Public participant 23)

### **3.3 Natural Asset, Natural Infrastructure, and Green Infrastructure**

#### **Have you heard of natural asset, natural infrastructure, and green infrastructure?**

For each of the following terms explored in this study, expert participants were more familiar with the terms natural asset, natural infrastructure, and green infrastructure compared to public participants. For natural infrastructure, about 86% of experts (18/21) had heard of the term compared to 52% (12/23) of public participants. All of the experts had heard of the term green infrastructure, while roughly half (11/23) of public respondents had heard of the term. Lastly, 86% (18/21) of experts heard of the term natural assets, and 52% (12/23) public familiarity. When presented with the terms, most public participants (9/23) felt that they sounded like different concepts. An additional four public participants felt that the terms sounded like different things, but felt they were related, "they sound different and they sound connected, but again with a different focus to me" (public participant 19). Six public respondents stated that each of the terms sounded similar, while several expert and public respondents highlighted the confusion around their understanding of natural and green infrastructure.

I would have probably naturally interchangeably used the natural infrastructure and green infrastructure but since talking about it I see those are different things. If you would have asked me prior to this I would have probably assumed those two were the same thing. (Public participant 14)

In the context of the difference between green infrastructure and natural infrastructure, I don't know the difference. If you would have asked me

green infrastructure first, I probably would have given you all the definitions for natural infrastructure. (Engineer participant 1)

Expert participants were also asked if they think the general public understands what each of the selected terminologies means. For each of the terms, results vary. Most experts (13/21) felt that the general public does not understand what the term natural infrastructure means. For green infrastructure, the opposite was the case; most experts (15/21) stated that they think the public knows or somewhat knows, what this term means. The final term, natural assets, was more evenly split with 10/20 respondents believing that the general public has some sort of understanding of the term.

If you were to give them all three terms, they might confuse them. I don't think they have a strong enough understanding yet. They [public] all have a little bit of a fuzzy understanding of it... to be honest sometimes I think mine is too. (ENGO participant 2)

### **3.3.1 Defining Terminology: Public**

Public participants who were familiar with natural assets and natural and green infrastructure were asked what each of the terms meant to them. For natural infrastructure, the 12 participants who were familiar with the term had different but related definitions. Some definitions focused on the concept of incorporating nature and the natural environment into the built environment. Others mentioned that it is the natural environment that humans can use to provide benefits, such as assistance with flooding and erosion. Participants seemed to share a common understanding that natural infrastructure incorporates naturally occurring elements that can be used as possible benefits to humans or nature.

Natural infrastructure to me means that it's naturally occurring or it's an environment that is in place that offers some sort of solution to flooding or erosion or some sort of treatment like that, it offers a benefit to the surrounding area. (Public participant 18)

Public participants who were familiar with green infrastructure generally responded with similar definitions. Respondent's definitions often highlighted the incorporation of "green" or nature into designs for specific ecosystem services or benefits and more environmentally friendly infrastructure.

It's something that is built specifically to provide certain ecosystem services based on a function. If you construct a wetland it could be to delay and mitigate the risk of flood or it could be to purify the water for

example. They are built in cities so it's basically sort of an artificial ecosystem. (Public participant 6)

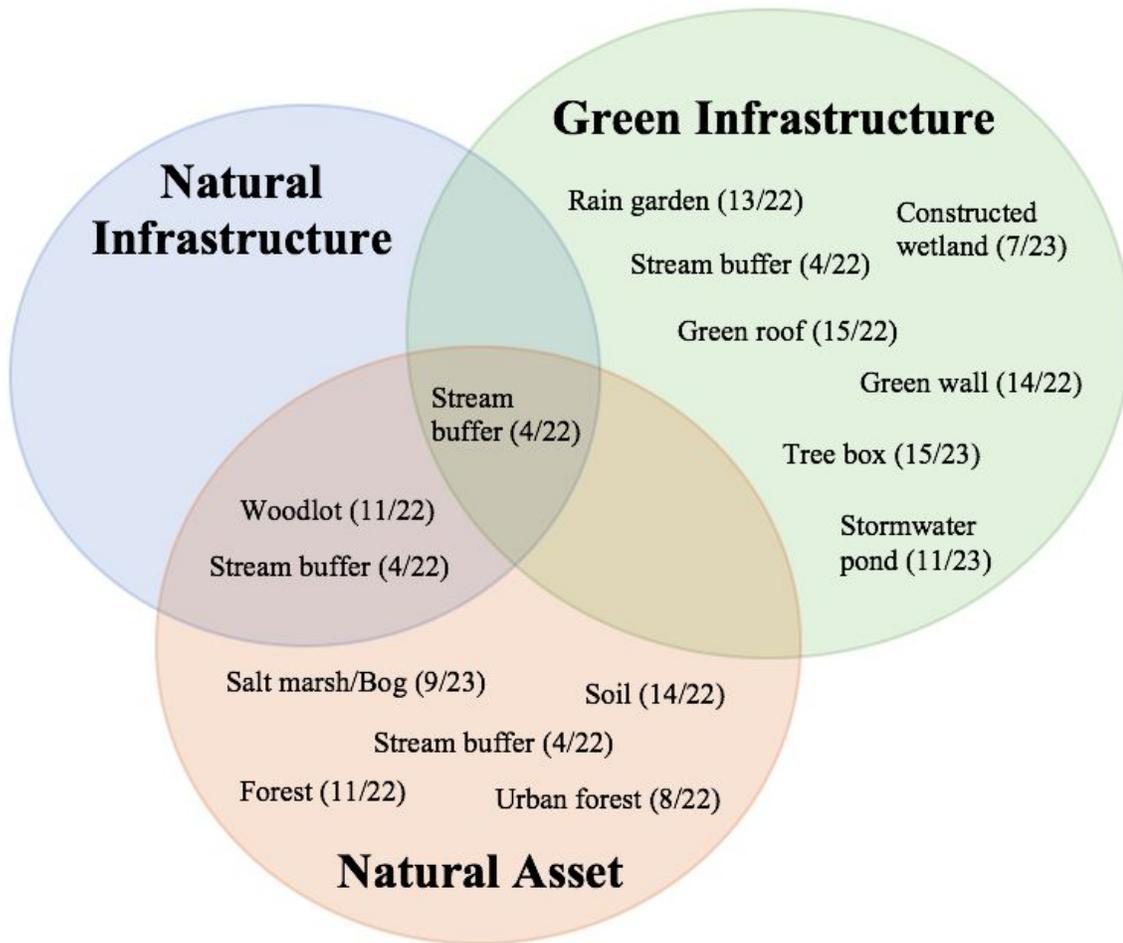
Lastly, public respondents who were familiar with natural assets shared two similar definitions and understanding of the concept. Some participants defined natural assets as the “untouched”, more natural environment, such as rivers, forests, and natural wetlands: “more of the untouched areas, for example a marsh or a forest that’s there by itself and not been built or touched by humans” (public participant 12). Other participants defined natural assets as more of the inventory and available benefits to humans:

“Natural asset is like the value of what the nature provides to the humans.” (Public participant 20)

“[It] means we have stuff available to work with; trees, forests, water, that can maybe help with whatever you're doing.” (Public participant 23)

### **Categorizing Projects**

The terminology portion of the survey was the only section that asked our public and expert groups different questions. Participants who were in our public group were shown a Venn diagram with our three terms and asked how they would categorize different projects based on their understanding of the terms (Appendix III). Participants were able to place a project in either just one of the terms, a combination of the terms (overlapping sections), the middle indicating all three terms, or outside the diagram meaning they did not feel the project fit under any of the terms. Figure 1 displays the projects and where the majority of public participants placed them on the diagram. Projects were most commonly placed in either green infrastructure or natural assets. Stream buffer occurs in several categories because the majority of participants were equally split on where it should go on the diagram. The total number of public participants varies for each of the terms as a result of those who chose to skip the project or were unsure of where to categorize it.



**Figure 1.** Categorization of projects into the terms natural asset, natural infrastructure, and green infrastructure by majority of the public participants.

### 3.3.2 Defining Terminology: Experts

Almost all experts (17/21) were familiar with natural assets and natural and green infrastructure. The following sections will focus on comparing the terminology definitions provided by each of the expert categories: ENGO, planner, and engineers.

#### Natural Infrastructure

For ENGO staff, six out of seven individuals had heard of the term natural infrastructure. The use of the term in their work environment ranged from daily, to weekly, to not very often. ENGO representatives shared similar definitions of natural infrastructure. This included identifying it as natural features (forests, wetlands, natural products) that provide some form of good or service to people, nature, and the environment. Included within this was the recognition

that natural infrastructure can be used to, “protect those municipalities against changing climate conditions” (ENGO participant 2). Common examples of natural infrastructure provided by ENGO participants were forests, wetlands, streams, and rivers.

All six of the planner participants were familiar with natural infrastructure. Definitions provided by the planners were similar to that of ENGO responses, but also commonly referenced it as an alternative method to the built environment that incorporates more natural, “engineered” methods: “trying to use engineering methods to rebuild a natural infrastructure that would maybe be able to have a runoff of water as the same quality as nature would have given” (planner participant 5). Most planners (4/6) stated that they use natural infrastructure quite regularly within their work. Examples provided were similar to ENGO, but planners generally included more built examples, such as retention ponds, passive parks, and stormwater management.

Most of the engineer participants (6/8) were familiar with natural infrastructure. Engineer participants provided definitions that contained similar elements to the other two expert categories, such as the identification of incorporating nature and natural features to enhance benefits. Similar to the planners, engineer responses to natural infrastructure also commonly included the use of nature with an engineered approach, “it’s [natural infrastructure] realizing what nature does but putting an engineered approach towards it to the benefit of what you’re trying to achieve” (engineer participant 8). Common examples included those discussed by both ENGOs and planners.

### **Green Infrastructure**

ENGO participants’ definitions of green infrastructure, although all were familiar with the term, varied slightly in their responses amongst each other. Some participants initially stated their difficulty distinguishing clear definitions for green and natural infrastructure and that they could perceive them as being interchangeable terms, “I imagine people see green infrastructure and natural infrastructure as interchangeable in a lot of ways” (ENGO participant 3). A few ENGO participants similarly defined green infrastructure as man-made systems that mimic natural processes for beneficial or mitigative efforts, while other responses focused more on energy efficiency and “greener” energy options. Common examples shared amongst ENGO participants were green roofs, retention ponds, rain gardens, and swales.

Planners provided similar responses to those of ENGO participants. Some planners noted the concept of human-made infrastructure with greener elements that mimic nature, while others

touched on the energy aspect, as seen with ENGO participants. Common examples provided were green roofs, swales, retention ponds, and culverts.

Most of the definitions for green infrastructure provided by engineer participants touched on the concept of using natural and manmade elements to reduce the impact on things such as the energy of buildings or water use. Several engineers mentioned LEED certification for buildings—buildings that are designed to use less energy and are more efficient in water use and collection. These engineers noted the similarities between LEED and green infrastructure. Common examples mentioned for green infrastructure by engineers were heat recovery for buildings, green roofs, rain gardens, and bioswales.

### **Natural Asset**

ENGO experts, all of which had heard of the term natural asset, provided similar definitions and have used the term fairly frequently within their work environments. Natural assets were generally understood to be components of the natural environment that are accounted for its benefits by municipalities. Examples commonly mentioned among ENGO participants were wetlands, forests, waterways, individual species, and the natural environment in itself.

Similar to ENGO participants, all planners interviewed had heard of the term natural assets. Responses generally followed similar definitions with ENGO, with common mentions of the natural environment and municipal involvement. A few planners mentioned more man-made components, while others stated that natural assets are the untouched, more natural elements.

Engineers were the only participants who had some unfamiliarity with the term natural assets (3/7), but they still provided their understanding. From the responses, engineers generally followed the same understanding as ENGO and planners, and also more commonly incorporated the concept of “value”: “natural asset to me would be an existing natural feature that would be seen as a benefit to the area ... has a value” (engineer participant 7). Common examples followed those of planners and ENGOs.

### **Which of these terms is more useful in engaging the general public?**

All participants were asked which term they felt was most useful to use when engaging the public. Both public and expert groups shared similar responses. Natural asset was the most preferred terminology for participants with 19/44 (43%) stating they preferred this term. Expert and public participants often described the easy ability to grasp what this concept means and how

the general public would be drawn towards the word “asset” and the associated value and benefits of the term.

For green infrastructure, this was the second most popular term for engaging with the public for 13/44 (30%) of respondents. This term had the most differences in participant responses. Some would comment on the term “green” and discuss how it is often overused, a buzzword, or getting old, while other participants pointed out how they liked the term green because it seems more environmentally friendly, positive, and healthier. A few participants also pointed out how green infrastructure is not as clear as “green” can mean a lot of things.

Lastly, Natural infrastructure was the unpopular choice amongst the terms for public engagement with only 5/44 (11%) preferring this term. Those who did choose it talked about how it seems to be all-encompassing and easily understood. Other opinions surrounded how it can be misleading and thinking too much about infrastructure and built components.

### **Other terms to capture similar concepts?**

Aside from the terms explored throughout this project, expert participants were also asked if they have used any other terms to capture similar concepts in their field of work:

- Blue economy
- Ecologically based approach
- Ecosystem based adaptation
- Ecosystem based assets
- Ecosystem goods and services
- Integrated management planning
- Integrated watershed management
- Low impact development
- Natural capital
- Natural edge
- Natural environmental area
- Natural stormwater management
- Nature based
- Nature based adaptation
- Nature based infrastructure
- Nature based solutions
- Net zero

Some participants also stated that while the work they were doing shared similarities with natural assets, green infrastructure, and natural infrastructure, it did not have a concrete term used to describe it.

### **Do you feel that Engineers, Planners, ENGOS, Government Regulators, and Developers have a common understanding of these terms?**

For the participants who were classified in the expert group, they were asked several questions on their use of each term in their workplace, as well as if they felt that individuals

within different sectors (engineers, planner, ENGOs, government regulators, developers), share a common understanding of natural asset, natural infrastructure, and green infrastructure. The expert participant responses were split. Roughly half of the experts thought these diverse sectors do not share a common understanding. Several reasons were brought up as to why they feel this is. First, expert participants noted the variety in values that each group holds and how the different value systems reflect how they use and incorporate these terms.

The different priorities and goals were also discussed and how some sectors do not seem to work with nature, with one participant stating how some sectors are “not thinking necessarily about how to develop alongside nature, often a naturally combated relationship” (ENGO participant 3). Experts also mentioned the perceptions of the different sectors of what natural features can provide and the benefits they hold versus looking at it from the economic side, “my general feeling is that some look at it from a dollars and cents perspective and want to make a dollar off whatever they can” (ENGO participant 2). This relates to how different fields can value nature.

I think where the differences lie in the different sectors you described is the value that those different groups provide to natural infrastructure and to ecosystems that are on the ground. I think that that's the big thing that's missing right now...I think a lot of it has to do with training and education in terms of those benefits and what they can provide and providing evidence that things like wetlands or houses near wetlands and subdivisions sell for more money than those that aren't. So that sort of evidence needs to be brought forward in order to kind of get on that level playing field and identify some of those shared values between those different groups. (ENGO participant 1)

The other half of the expert participants were either unsure or felt that there was some form of a common understanding between those groups. A frequent comment was made that experts who concentrate more on the environment and natural elements were perceived to have a greater understanding of these terminologies rather than those who do not concentrate, “I probably hazard to say it's fairly good within the specialties that work in this field and interface with each other routinely” (engineer participant 2). Overall, the most common impression was that more work needs to be done in defining and understanding these terms, especially across diverse sectors.

The keyword there is *common understanding*. Everybody is coming to the conversation with their own preconceived notions of what this is, and

this is the challenge with working with these multidisciplinary teams and making sure that it's clearly defined before starting into a conversation. (Engineer participant 5)

## **4.0 Discussion**

### **4.1 Forest Value Similarities and Differences**

In general, participants in this survey all used, and had experience with, forested ecosystems in a variety of ways that seemed to align with their attitudes, accessibility, and familiarity with forests. One of the primary research goals of this project was to document the values participants have regarding forests. In line with more quantitative research (Nadeau *et al.*, 2007), participants across all groups expressed their top priorities as mainly environmental values and the various goods and services forests provide to humans such as oxygen production, carbon capture, and improvement of water quality. Environmental values also included the recognition of the diverse wildlife within forests and the role forests play as a habitat and necessary food and water source for animals.

Analysis also indicated that expert participants often went into greater detail about forest functions and ecosystem services compared to the public participants regarding the benefits forests provide. This is not surprising based on the experience our expert participants have with forests; however, public participants were still very aware of the various functions and benefits forests provide. Expert participants also commonly discussed the use of forests for mitigation efforts against climate-related hazards such as flooding. This is an important observation since one of the motivations for this project was to highlight the benefits of nature-based solutions and to document the awareness surrounding the use of such solutions for climate change mitigation efforts (Griscom *et al.*, 2017). This, however, was not observed for the public participants.

A second trend within the survey responses was the lower priority participants gave to economic forest values. The benefit of an open-ended discussion survey style is that participants get to state and expound upon the values they hold, as opposed to more closed-ended studies that provide participants with predetermined values for ranking. Respondents verbally discussed all of the values they held throughout the interview process, and economic values were generally not mentioned or only mentioned in a few interviews. In recent years, studies focusing on the values people associate with forests have shown a shift away from strong economic and utilitarian values (Tarrant *et al.*, 2003; Nadeau *et al.*, 2007). The lower economic value

representation within our participant responses aligns with this finding and supports observed shifts towards a more diverse range in forest values.

An interesting observation from a handful of participants regarded concerns surrounding private woodlot owner's management decisions for economic gain:

One motif that I have observed a lot are private woodlot owners who reached a certain age, and they are looking for a pension fund. So what they do is clear cut their private hold down to the bone and they cut everything because they are down to the last dollar or for fear of old age or what have you, and they need that security so they will sacrifice everything and put the forest on the altar to get money in the bank account. (Public participant 5)

Although participants in this survey demonstrated high priority for forests and lack of heavy human interference (clear-cutting, small to large scale harvesting, intense management), these concerns demonstrate the diverse range of values associated with forests.

In terms of our first research question, environmental values were observed as the most important ecosystem, economic, and social functions of forests; this was true for both expert and public participants. Increasing nature and nature-based solutions would be perceived as a positive strategy for New Brunswick citizens based on the information obtained from this portion of the study. This would benefit New Brunswick's managers, as well as future climate action plans and strategies, by keeping up-to-date documentation of community forest value orientations (Nadeua *et al.*, 2007).

## **4.2 Terminology**

The second goal of this project focused on participant's familiarity with the terms natural asset, natural infrastructure, and green infrastructure and how public and expert participants use and understand these terms. The use of technical terminology can be a barrier to those who do not have the same understanding of the concepts used by expert individuals. When difficult terminologies or jargon are used without considering the level of familiarity and understanding of the target audience, difficulties can arise. Climate change adaptation and mitigation efforts must incorporate evaluation measures to understand public perceptions of nature-related concepts to effectively communicate the desired solutions and action plans, "communication, both mass and interpersonal, holds the key to improvement in public understanding of environmental problems" (Stamm *et al.*, 2000).

When defining the terms, public participants generally differed in their understanding of natural assets and natural infrastructure, with a more aligned definition of green infrastructure. The public seemed to be more comfortable defining the grasping the terms green infrastructure and natural asset, which was also displayed from the Venn diagram. Having the public participants categorize projects based on their understanding of each of the terms gave the impression that participants were more familiar and comfortable using green infrastructure and natural asset compared to natural infrastructure as most projects were commonly placed under those two categories. This highlights the need for clarifying the term natural infrastructure and ensuring the general public is aware of the various projects associated with each term.

With the expert participants, the familiarity and understanding of the terms generally increased. This was expected since the experts frequently encounter these terms and the practices they represent through their professional work. A common statement throughout was the recognition that some of the terms sound similar or are very related. This was also noted by public participants. Although definitions did not seem to be vastly different between experts, there was no clear observation of a “common understanding” for any of the terms. This is reflected in the last question that experts were asked. They gave their opinion on if diverse sectors such as developers, engineers, planners and so forth share a similar understanding to the terms they were describing. The variety of answers indicates that there is still a need for these concepts to be clearly defined. Since some overlap is noted, especially between green and natural infrastructure, creating a standard guideline of definitions that can be used within different sectors could help eliminate the confusion and variations between the terminologies.

Regarding our second research question if experts have different ways of understanding the terms relative to the community residents, public participants were observed to have less familiarity with the concepts, while expert participants had some similar but generally varying understandings. Additionally, expert participants often shared a similar understanding between and amongst the occupational categories, however variations did arise, and so further research should be conducted on a larger array of experts to better evaluate the understanding and use of the selected terms.

### 4.3 Recommendations

Based on the observations and analysis described above, I suggest a few recommendations for further research and possible opportunities for public engagement:

- Increasing the awareness and understanding of how forests are beneficial for mitigation efforts towards climate-related hazards for public participants. This could involve public engagement and workshops that dive deeper into the benefits and possible solutions natural systems and features such as forests can provide for a community. This can also be implemented in primary and secondary education to establish a foundation of ecological goods and services and the solutions offered by nature to adapt and mitigate future climate change impacts, “I think a lot of it has to do with training and education in terms of those benefits and what they can provide” (ENGO participant 1). Participants in this study seemed very eager and willing to learn more, and so further communication and involvement for this type of work could greatly benefit future projects, climate change mitigation efforts, and public involvement.
- Expert participant responses and discussions from this project suggest that there is a need for further research regarding the technical terms for nature-based solutions examined in this report. Developing a standard protocol for natural asset, natural and green infrastructure to use across diverse sectors and the general public can eliminate confusion and increase familiarity, confidence, and overall implementation of policies and management decisions.

I find these terms span across so many different professions and each is focused on different aspects of the ecosystem services, so it is very much tailored to their own vision of nature that they are working in. I see that as an underlying bias that prevents a common understanding of these terms. (Planner participant 4)

I think they [experts] all have an idea of it [the terminology] but nobody has a common goal so it's hard for the government to enforce some recommendations when we don't have credential goals regarding the environment or just guidelines. Once we get those out that would help cities do some better planning and it will be federal or provincial guidelines that everybody needs to follow. (Planner participant 5)

#### **4.4 Limitations**

Although findings from this project contribute to the overall understanding of New Brunswick citizens' values and technical terminology, there are limitations to the results. The work in this study was exploratory and not meant to be representative of all New Brunswick citizens or professionals in the fields we examined. Increasing the number of participants involved could allow for stronger forest value judgements and conclusions regarding familiarity with nature-related concepts. For the purpose of this study however, this was not seen as a hindering factor and the results obtained may inform larger random sample surveys that could better provide generalizations of New Brunswickers' views and subgroups of experts within that population.

#### **5.0 Conclusion**

Climate change is one of the most serious challenges facing humans today. New Brunswick's Climate Change Action Plan (2014-2020) highlights the growing concerns around climate change and its effects on New Brunswick citizens and communities. Recognition of more urgent and sustained actions to combat the impacts of climate change are discussed, stating that "New Brunswick is therefore committed to proactively managing risks and seizing opportunities in order to build its resilience and secure its prosperity in the face of the new realities of a changing climate" (Government of New Brunswick, 2014). As explored through this report, resilience and mitigation efforts can come in the form of forest and nature-based solutions. The first step to incorporating these strategies is documenting citizen's understanding and awareness of natural ecosystems, a goal achieved through this project.

Participants in this study clearly display a strong connection and appreciation for their forested ecosystems. As forestry management and policy decisions continue in New Brunswick, the findings from this report can help communities build their resilience against climate change through natural solutions and the protection of their forests. Future studies should focus more heavily on public awareness, understanding, and the value of forests and the technical terminologies—eliminating the gap between public and expert comprehension. A larger sample size survey spread across all New Brunswick communities should be the next steps moving forward from this project. Documenting the values associated with forest ecosystems and

striving for climate resiliency in communities will greatly enhance the mitigation efforts and the awareness of ecological goods for New Brunswick.

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## Appendix

### Appendix I: Recruitment Email

Dear \_\_\_\_\_,

I hope this email finds you well.

My name is \_\_\_\_\_ and on behalf of my research team, I am reaching out to ask if you would be interested in participating in our research study. My colleague and I are both graduate students, working under the supervision of Dr. Tom Beckley, in the Master of Environmental Management program at the University of New Brunswick. **(The experts involved in this study will be from a range of disciplines, including planners, consultants, engineers and non-government organization (ENGO) staff members. Through our academic and professional network, you were recommended as a valuable participant to this study).**

Our project will be looking at participants' values for forest and wetland ecosystems in the context of climate change, as well as their views on a few environmental terms. Given the current situation and restrictions in place with the Covid-19 pandemic, we will be facilitating interviews virtually. The duration of the interviews is approximately 40 minutes to 1 hour, and we are open to using any of the following platforms:

- Microsoft Teams
- Skype
- Zoom
- FaceTime
- Telephone call

We will be conducting interviews during the months of June and the beginning of July. If you are available and interested in participating, please send an email to myself or \_\_\_\_\_, who is CC'd in this email. The findings from this research could be used to inform future policy and engagement initiatives in New Brunswick, and your participation would be greatly appreciated.

In addition, we have prepared a consent form highlighting information on the participant's role and further details on the project, which we will be sharing with all interested candidates. Please let me know if you have any questions regarding our study or the participation process.

Kind regards,  
(Baani Dhillon / Lyndsey Burrell)

## **Appendix II: Consent Form**

**Project Title:** Public values for forests and wetlands in the context of climate change: New Brunswickers' views on natural assets and natural or green infrastructure

Dear Potential Research Participant,

We invite you to take part in a research study being conducted by graduate students Baani Dhillon and Lyndsey Burrell, under the supervision of Dr. Tom Beckley, from the Faculty of Forestry and Environmental Management at the University of New Brunswick. This document explains any risks or inconveniences you may experience by participating in the study, which are expected to be minimal. If you have any additional questions related to this study, please feel free to reach out to Baani Dhillon or Lyndsey Burrell, whose contact information is included below.

Your participation in this study is voluntary, and while you may withdraw from the study at any time, we are asking participants to try to be committed to the project for its duration. We are involving a relatively small number of participants, so losing anyone from the process once it begins could potentially pose some challenges to the research team. Your identity will be protected in any following academic research papers that result from this work, which would only refer to you by your cohort group (engineer, planner, ENGO staff or general public).

### **Purpose of the Study**

The proposed study to which you are invited as an active participant has the following research objectives:

- 1) Document the range of preferences and values displayed by New Brunswick residents and experts for both forest and wetland (freshwater and coastal) ecosystems.
- 2) Analyze residents' and experts' understanding of technical environmental terminology and "jargon".

### **Study Design**

We will examine the values, attitudes and beliefs of citizen and expert participants. In addition, we will be analyzing how the understanding of New Brunswick residents and experts varies on technical vocabulary such as Natural Infrastructure, Green Infrastructure and Natural Assets.

We will interview New Brunswick residents from approximately six to ten different communities throughout the province, but each must contain two or three types of the ecosystems we wish to explore (forests, freshwater or coastal wetlands). After identifying areas with these ecosystems, we will contact residents from nearby or adjacent First Nation reserves, Francophone and Anglophone communities.

The researchers will conduct semi-structured interviews with the participants, which has four parts for the different research goals. With the exception of demographic information, the questions in this study will be more open-ended in order to get a good understanding of participants' responses on ecosystem values and the terminology. Due to the limitations in place with the Covid-19 virus, we will be providing participants with alternative interview methods in place of the initial in-person plan. With consent of the participants, the interviews will be recorded, and conducted via Skype, Microsoft Teams, Google Hangouts, Facetime, or a telephone call. The mode of interview will be decided by the participant based on what is most convenient.

### **Who Can Participate in the Study?**

For this study we are recruiting two groups of participants (adults, 18+) within communities around New Brunswick:

1. General public who reside in community types that contain at least two of three types of ecosystems we wish to explore (forests, freshwater or coastal wetlands).
2. Engineers, planners, and environmental non-government organization staff (ENGOS) who will represent the “experts” for this study.

The general public will number about 20 that will represent a diverse group of citizens with mostly average knowledge of wetlands and forests and have experience with these landscape types. Participants who will represent the “experts” for this study will number about 20 to 25 engineers, planners, and environmental non-governmental organization staff.

### **Who Will Be Conducting the Research?**

This research is in fulfilment of the Master of Environmental Management (MEM) Degree requirements with the University of New Brunswick (Fredericton). The Principal Investigators of this study are Baani Dhillon and Lyndsey Burrell, two master students in the MEM program at the University of New Brunswick. Both students hold no conflict of interest related to the study. The project supervisor is Dr. Tom Beckley, a professor in the Faculty of Forestry and Environmental Management at the University of New Brunswick. This research is funded by Green Analytics, in partnership with the New Brunswick Environmental Network.

### **Possible Risks and Discomfort**

Possible risks and discomforts are expected to be little to none for this study. We are asking for 40 minutes to a maximum of 90 minute time commitment from participants during the interview process. In response to current Covid-19 protocols, this project will not be conducting any face-to-face recruitment or interviews. All forms of contact will be performed through the use of

technology to ensure the safety and well-being of both project members and interested participants.

### **Possible Benefits**

This study is not expected to provide any direct benefits to the participants. The conclusions drawn from this research could indirectly benefit the larger community in New Brunswick as government, industry and non-governmental organizations consider policy and business decisions that will impact future development decisions. The results of this research could potentially improve and contribute to research gaps identified by other researchers in this study area. The contribution to new research could also influence future policy initiatives on natural ecosystems and their importance in creating climate resiliency.

### **Confidentiality**

The data gathered from participants of the study will remain confidential in all reports or publications released and individuals will only be referred to by their cohort group. While individual responses will not be identified, participants must be willing to be voice-recorded. Recorded data will be downloaded and stored on password protected computers. Data will be securely maintained by UNB (and shared amongst the research team) for 5 years post publication. After this time, the primary data will be destroyed.

### **Questions**

If you have any questions concerning this study, please contact Baani Dhillon by email at [bdhilllo2@unb.ca](mailto:bdhilllo2@unb.ca) or Lyndsey Burrell at [lyndsey.burrell@unb.ca](mailto:lyndsey.burrell@unb.ca). This project has been reviewed by the Research Ethics Board of the University of New Brunswick and is on file as REB 2020-064.

### **Consent Survey**

**Project Title:** Public values for forests and wetlands in the context of climate change: New Brunswickers' views on natural assets and natural or green infrastructure

### **Informed Consent**

I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I hereby consent to take part in this study. However, I realize that my participation is voluntary and that I am free to withdraw from the study at any time. I consent to participate in an audio taped interview under the conditions stated above, with the specific permissions indicated below.

Participant:

Signed:

Date:

I consent to participating in an interview. YES/NO

I consent to being recorded during the interview. YES/NO

I consent for direct quotes to be used anonymously. YES/NO

## **Appendix III: Survey Questions**

### **Part 1: Neighbourhood/Community Characteristics**

- 1) What type of community do you live in?
- 2) How many years have you lived in the area?
- 3) Do you own the land on which you live? (If yes, how much)
- 4) Do you own any land somewhere else?
- 5) How would you describe the types of nature or natural features in your area/neighbourhood?
- 6) On average, how much time do you spend outdoors in nature? *Doing what?*

### **Part 2: Values/Functions (Forests)**

- 7) How would *you* define a forest?
- 8) What words and/or images come to your mind when you think of a forest?
- 9) How far away is the nearest forest? What does this consist of?
- 10) What benefits to society do forests provide?
- 11) What benefits to nature do forests provide?
- 12) Are forests important to *you*? Yes or No, why or why not? Can you rank these in terms of what is more important to you?
- 13) How would you describe/characterize the forests in your area?
- 14) In your opinion, do you consider the forests in your area to be healthy?
- 15) In your opinion, do you think the forests in your community/region are at risk?
- 16) To the best of your knowledge, how are forests in your area mostly being used? What are your thoughts on this?

### **Part 3: Values/Functions (Wetlands)**

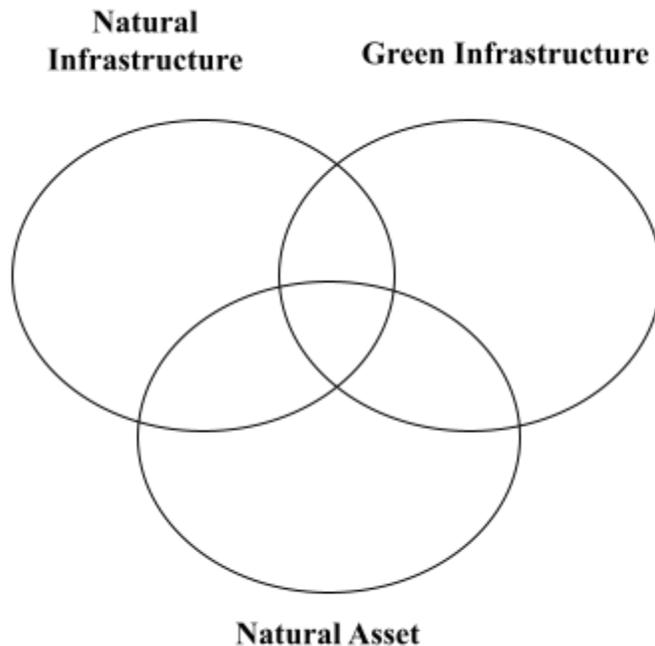
- 17) How would *you* define a wetland?
- 18) What words and/or images come to your mind when you think of a wetland?
- 19) How far away is the nearest wetland?
- 20) What benefits to humans and society do wetlands provide?
- 21) What benefits to nature do wetlands provide?
- 22) Are wetlands important to *you, personally*? If yes or no, why? *Can you rank these in terms of what is more important to you?*
- 23) How would you describe/characterize the wetlands in your area?
- 24) In your opinion, do you consider the wetlands in your area to be healthy?
- 25) In your opinion, do you think the wetlands in your community/region are at risk?

**Part 4: Vocabulary (Public)**

- 26) Have you ever heard of the term *Natural Infrastructure*?
- 27) Have you ever heard of the term *Green Infrastructure*?
- 28) Have you ever heard of the term *Natural Asset*?
- 29) Do these terms sound like different things to you?
- 30) Do you feel that one of these terms is more useful in engaging the public? (in terms of what it represents)
- 31) This is a list of different types of projects. Based on what you *think* each term means, identify which term best describes the type of project.

Please categorize the projects under one or more of the three terms.

*Green roof, saltmarsh/bog, rain garden, tree boxes, rooftop runoff, preservation of forests/wetlands stormwater planters, permeable pavement, constructed wetlands, urban forests, narrow road/sidewalk, rain barrels*



**Part 4 - Vocabulary (Expert)**

- 26) Have you ever heard of the term *Natural Infrastructure*?
  - a) What does it mean to you?
  - b) How often would you say that you come across these terms in your work?
  - c) Can you list some examples of natural infrastructure?
  - d) Do other \*insert disciplinary area\* have the same understanding of this term as you?
  - e) Do you think the general public understands what this means?
- 27) Have you ever heard of the term *Green Infrastructure*?

- a) What does it mean to you?
  - b) How often would you say that you come across these terms in your work?
  - c) Can you list some examples of green infrastructure?
  - d) Do other *\*insert disciplinary area\** have the same understanding of this term as you?
  - e) Do you think the general public understands what this means?
- 28) Have you ever heard of the term *Natural Asset*?
- a) What does it mean to you?
  - b) How often would you say that you come across these terms in your work?
  - c) Can you list any examples of natural assets?
  - d) Do other *\*insert disciplinary area\** have the same understanding of this term as you?
  - e) Do you think the general public understands what this means?
- 29) Do you feel that one of these terms is more useful in engaging the public? (in terms of what it represents)
- 30) In your field of work, have you heard of any other terms being used instead of these, to capture similar concepts?
- 31) Do you feel that Engineers, Planners, ENGOs, Government Regulators, and Developers have a common understanding of these terms? (Natural Assets, Natural Infrastructure, Green Infrastructure)

#### **Part 5: Personal Information**

- 32) Which of the following age categories do you fall under?
- Under 18 years
  - 18 - 24 years
  - 25 - 44 years
  - 45 - 64 years
  - Over 65 years
- 33) Please check the highest degree or level of formal education you have completed.
- Elementary
  - Junior/Middle school
  - Some high school
  - High school equivalency
  - High school
  - Diploma
  - College
  - Bachelor's Degree
  - Master's Degree
  - Ph.D. or higher
  - Prefer not to say
- 34) What gender do you identify as?
- 35) Which of the following best describes you?

- Unemployed
- Student
- Employed Part-time
- Employed Full-time
- Seeking opportunities
- Retired
- Prefer not to say

36) Do you have additional comments/feedback you would like to share?