Weaving Perspectives in Environmental Justice and Socio-spatial Mapping Tools: Using key-informant interviews and an arts-integrated approach

by

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Declaration of Originality

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Environmental justice (EJ) is an ever-evolving term with multiple definitions, applications, and practices across geographies and disciplines. With a strong history in the United States, it is a growing field in Canada in legislation, research, and policy. A central, historical, and current dimension to environmental justice are socio-spatial tools and data applications, which is a term that refers to digital tools, including maps, that integrate spatial data to assess, visualize, and understand negative and inequitable cumulative impacts experienced by communities and ultimately guide action and decision-making. However, given an overemphasis on distributive justice in research, policies, and socio-spatial tools, scholars assert that more fulsome and simultaneous engagements of three dimensions of justice – distributive, representational, and recognitional – are necessary.

As the EJ landscape grows in Canada, this thesis project explores how researchers and practitioners who develop and use integrative socio-spatial mapping tools implement and engage with environmental justice in their work. The author of this thesis conducted key-informant, semi-structured interviews with eight researchers and practitioners from across Canada who play a crucial role in developing or supporting integrative socio-spatial mapping tools and use a range of data sources through their work across various sectors within Canada. These interviews were coded and distilled into themes using a thematic analysis approach concurrently with an arts-integrated methodology. The emergent arts-integrated methodology used weaving as a modality to support data analysis and knowledge translation to explore, visualize, and make visible tacit dimensions of participants' experiences while making the researchers' role in shaping the research more tangible.

Core findings and discussion of this thesis articulate critical conceptions, practices, and processes that are vital to consider at the individual, institutional, and collective levels while seeking more wholistic applications of dimensions of EJ in operationalizing socio-spatial tools in research, community engagements, and policy spaces. This research and application of an arts-integrated methodology offers novel contributions to interdisciplinary fields of the academic literature of environmental justice, health sciences, and arts-related research.

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Chapter 1: Introduction

Background & Context

Although Canada cultivates an image of a healthy environment with abundant clean air and fresh water, innumerable environmental injustices impact the health of many living on its lands (Giang et al., 2022; Agyeman et al., 2010). One in six Canadians lives within one kilometre of a significant pollution-producing facility (Boyd, 2015); meanwhile, every year, Canadian industries release billions of kilograms of toxic substances into the air, water, and soil (Environment and Climate Change Canada, 2016). Many of these substances are environmental hazards linked to adverse health outcomes, including cancers (e.g., acute lymphoblastic leukemia, lung cancer, bladder cancer, skin cancer) and birth and fertility impacts (e.g., premature births, lower birth weights and fertility impacts) (Morello-Frosch et al., 2011). Moreover, exposure to environmental hazards such as persistent organic pollutants and chemical exposures risk impairing childhood development, including neurodevelopment and cognitive delays (Hubal et al., 2020). Additionally, air pollution is one of the most significant risk factors for premature death and disability around the world (Fuller et al., 2022). Negative health outcomes of air pollution include asthma, chronic obstructive pulmonary disease (COPD), Parkinson's disease, heart attacks, strokes, reduced fertility, and acute gastrointestinal illness, to name a few (Boyd, 2015). Air pollution is estimated by Health Canada to cause 15,300 premature deaths per year in the country (based on 2016 population metrics) (Health Canada, 2021), while the socio-economic cost of air pollution is estimated to be 120 billion per year (based on 2016 currency) (Health Canada, 2022) with 2.7 million people experiencing adverse asthma impacts (Health Canada, 2021).

Moreover, these impacts are not felt equally by all residents of Canada. Giang et al. (2022) describe Canada as an "archetypal site of environmental injustice" (p.437), given that disproportionate exposures and impacts primarily affect marginalized communities and populations. Salient examples of environmental injustices in Canada include disputes about logging (e.g., Fairy Creek), mining (e.g., Ring of Fire), oil and gas extraction (e.g., Alberta oil sands), pipelines (e.g., Coastal GasLink), and hydroelectric projects (Giang et al., 2022); drinking water advisories and water infrastructure challenges in northern Indigenous communities (McFarlane & Harris, 2018); industrial chemical exposures (e.g., Mercury poisoning in Grassy Narrows First Nation) (Ilyniak, 2014); environmental racialization of

industrial and toxic waste sites (Waldron, 2016) as well as the disproportionate impacts of climate change (Schlosberg, 2012).

Through the lens of *environmental justice* (EJ), such disproportionate impacts on human health do not occur in isolation. They result from complex, overlapping and cumulative interactions between various health determinants that arise within and between layers of environmental, socio-economic, political, and physical determinants and health disparities (Huang & London, 2016; Schulz et al., 2016). For instance, disproportionate impacts from environmental exposures are exacerbated by social and political systems such as housing, healthcare, and education (Bullard & Johnson, 2000), as well as socio-economic status, ethnicity, gender, and age (Morello-Frosch et al., 2011).

There are many definitions of environmental justice. Following the inception of EJ grassroots movements in the United States in the 1980s, environmental justice research was primarily concerned with the toxic and hazardous waste impacts on low-income and communities of colour to advocate for policy changes (Sze & London, 2008). This early and seminal focus identified trends of an essential dimension of EJ, distributive justice, charting the unjust distribution of harms and benefits across time and space (Blue et al., 2021).

Since then, definitions of EJ have continued to evolve. For instance, an early definition in the 1990s by the United States EPA (Environmental Protection Agency) used the term "environmental equity" to refer to the environmental justice phenomenon, which is defined as the equitable distribution of environmental risks across population groups (EPA, 1992). Other seminal definitions include the meaningful involvement and fair treatment of all people and communities — regardless of socio-economic status, ethnicity, gender, or age — in developing, implementing, and enforcing environmental laws, regulations, and policies (Bullard, 2000). Advocates for environmental justice argue that everyone has the right to live, work, study, and play in safe, clean, healthy, and sustainable environments, a right recently recognized by the United Nations (United Nations Human Rights Council, 2021). Today, scholars explain EJ as both a transdiscipline in academia, social policy strategy, as well as social movement(s) (Agyeman et al., 2010; Sze & London, 2008), including climate change, transportation, health, housing, land use, water, energy development, brownfields, and militarization (Sze and London, 2008; Agyeman et al., 2010). Amidst the broad umbrella of EJ that spans movements, disciplines, and research, it is important to note that the limited scope of this thesis is largely

focused on the sub-field of EJ in connection to using and developing socio-spatial tools engaged at the intersection of environmental and human health.

In the research presented herein, reference to mapping and spatial identification methods are called *integrative socio-spatial mapping tools.* The term *"socio-spatial mapping tools"* is informed by Huang & London's scholarship (2016), who defines them as digital tools, including maps, that integrate spatial data to assess, visualize, and understand negative and inequitable cumulative impacts and ultimately guide action and decision-making. The term "*integrative*" is added to this term to refer to socio-spatial tools developed and used to respond to overlapping health, social and ecological concerns through a cumulative lens (Parkes et al., 2019). Overall, socio-spatial maps help make cumulative impacts visible and can help increase collaboration between regional advocates, communities, policy, and decision-makers to address environmental injustices (Huang & London, 2016).

While socio-spatial tools can use similar spatial methodologies to assess cumulative impacts, the available data to researchers and practitioners developing these tools and the social and environmental contexts in which these cumulative impacts manifest make each tool unique (Huang & London, 2016). While describing the methodologies of socio-spatial analysis is outside of the scope of this thesis, a salient example to better situate the reader of this thesis of what constitutes a socio-spatial tool is the CalEnviroscreen. The CalEnviroscreen is an interactive online tool regularly maintained and updated by the California Office of Environmental Health Hazard Assessment (OEHHA). Users can filter by geography across the state of California in the United States (county, city, or legislative district) and by any combination of the results from 21 indicators to assess increased vulnerability caused by multiple sources of pollution (August et al., 2021). This socio-spatial tool utilizes 21 indicators to assess cumulative impacts, which are separated into categories of 1) pollution burden (e.g., exposures such as drinking water contaminants and ozone concentrations, and environmental effects such as hazardous waste sites) and 2) population characteristics (e.g., sensitive populations such as cardiovascular disease and low-birth-weight infants, and socioeconomic factors such as education and employment). In simplified terms, the spatial methodology of the CalEnviroscreen consists of a calculated percentile for each census tract, which is calculated based on the multiplied averages of the indicators associated with pollution burden and population

characteristics. This way, each census tract has a percentile that visually depicts a higher or lower vulnerability index across the whole State of California (August et al., 2021).

While not an exhaustive list, other examples of typical environmental, community and health indicators used in socio-spatial tools include environmental indicators (e.g., air quality, hazardous waste and solid waste facilities, air pollution, drinking water contamination, agricultural pesticide application, waste disposal sites and traffic impacts), socioeconomic characteristics (e.g., demographic info such as race, income, education, language fluency, gender, housing quality, and age), health indicators (e.g., cancer rates, asthma, cardiovascular disease and low-birth-weight infant rates) (Buse et al., 2022; Sadd et al., 2014; Schulz et al., 2016).

As socio-spatial tools help illuminate the distribution of cumulative impacts, building the capacity to interact with and implement these tools effectively is of great importance to lead to meaningful changes for healthier communities, particularly as cumulative impacts manifest across distinct populations and geographic areas and are shaped by individual, behavioural, institutional, and systemic factors (Huang & London, 2016).

Using mapping and socio-spatial tools to clarify the distribution of inequities and support changes to policy and community health continues to play a central role in the field of environmental justice and is a vital subfield of EJ research, particularly in the United States (Bullard & Johnson, 2000; Haluza-Delay, 2007), and increasingly in Canada (Blue et al., 2020; Johnson et al., 2016). In Canada, the environmental justice literature has grown in quantity and scope (Giang et al., 2022; Masuda et al., 2008), where methods and tools for assessing environmental injustices, including socio-spatial tools, have expanded notably over the last 30 years (Buse et al., 2019; Giang et al., 2022).

Contemporary EJ scholars contend that there continues to be an overemphasis on patterns of toxic exposures and an overfocus on distributive justice in Canadian EJ research and assessment processes, including socio-spatial tool applications (Masuda et al., 2008; Blue et al., 2021; Giang et al., 2022). Additionally, scholars contend that Canadian methods and assessment processes fail to engage a wholistic perspective that accounts for critical interrelationships between our environments, socio-economic structures, and health (Johnson et al., 2016; Blue et al., 2021). Scholars call for advances in the application of socio-spatial mapping tools to support EJ research, policy, and action, particularly in ways that include representational and

recognitional dimensions of justice as well as distributive justice (Blue et al., 2021). As such, explorations, and critical dialogue around how to best apply dimensions of EJ while using and developing socio-spatial tools are crucial to exploring more wholistic applications of EJ in ways that lead to meaningful action or change at the levels of research, community well-being and policy (Schlosberg, 2004). After all, the tools we use are only as good as the people and the methods using them.

Research Aim and Objectives

In the context of this background, the overarching goal of this research is to explore how researchers and practitioners developing and using integrative socio-spatial mapping tools implement and engage with environmental justice in their work. To this end, the specific objectives are:

- To investigate how researchers and practitioners developing socio-spatial mapping tools are understanding and engaging with environmental justice in their work;
- To describe the major challenges and limitations faced by those researchers and practitioners in applying the dimensions of environmental justice to their work;
- To identify opportunities to deepen engagement with environmental justice in the context of integrative socio-spatial tools;
- To engage in and experiment with a novel arts-integrated practice that enriches data analysis and knowledge dissemination, using weaving as a modality.

Data was collected through eight in-depth, semi-structured key informant interviews. Key informants included researchers and/or practitioners who have played a crucial role in developing or supporting integrative socio-spatial mapping tools and who use a range of data sources through their work across various sectors within Canada (e.g., federal, provincial, and municipal levels of government; policy spaces; universities; and not-for-profits). Grounded in the interpretive framework of pragmatism and drawing on the scholarly literature on environmental justice, this research articulates environmental justice through three core dimensions: recognitional, representational and distributive. Braun & Clarke's 6-step thematic analysis approach (2022) was used to code the data and identify emergent themes, and an experimental arts-integrated practice to support the data analysis as a form of inquiry and as a mode of knowledge translation (Sameshima et al., 2019).

Rationale

In Canada, environmental justice is a growing focus in federal legislation. Canada's political landscape is increasingly adopting environmental justice into its legislative actions, exemplified by Bill C-226 and Bill S-5. Bill C-226 calls for a national strategy to advance environmental justice and address environmental racism in Canada. Some strategies include improved data and information collection to reduce adverse health outcomes related to environmental justice issues and inequities, amendments to federal laws, policies, and programs, and improved community involvement in policy-making (National Strategy Respecting Environmental Racism and Environmental Justice Act, 2023). Bill S-5, an amendment to the Canadian Environmental Protection Act (1999), calls for the protection of the environment and human health because all Canadians have the right to a healthy environment; enhanced research and processes to protect this right of all Canadians while using cumulative factors (social, economic and health) during assessments; and, the inclusion of principles of environmental justice, including the avoidance of adverse effects that disproportionately affect vulnerable populations (An Act to amend the Canadian Environmental Protection Act, 2022).

Additionally, researchers and practitioners across Canada are increasingly interested in developing and using socio-spatial tools guided by environmental justice principles (Buse et al., 2018; Blue et al., 2021). While socio-spatial tools are adept at showing distributional justice — described as the fair distribution of benefits and burdens (Engen et al., 2021) — a recent scoping review in the Canadian context by Blue et al. (2021) has called for a more multidimensional view of environmental justice in assessment methods including socio-spatial tools where all three dimensions are equally valued and incorporated: distribution, recognition, and representation. This call for a simultaneous application of these three dimensions of EJ is also corroborated by other scholars in the broader EJ literature (Schlosberg, 2012; Engen et al., 2021; Fraser, 1997). Currently, distributional justice remains the dominant framing for environmental justice research in Canada related to environmental hazards (Giang et al., 2022; Blue et al., 2021), including in policy spaces (Schlosberg, 2012; Bullard et al., 2008) and assessment projects utilizing socio-spatial tools (Blue et al., 2021). One of the two lesser applied dimensions of EJ is representational justice (also known as procedural justice), which relates to decision-making processes, including who is involved and has influence and where and when decisions happen. The other is recognitional justice, which "acknowledges the plurality of people's values,

identities, cultures, rights, institutions, knowledges, and capabilities" (Schlosberg, 2007, p.130) and is described as a prerequisite for representational and distributional justice (Fraser, 1997; Schlosberg, 2012).

However, there are limited critical explorations on how operationalizing socio-spatial tools might support wholistic applications of EJ principles at research, decision-making, and policy levels. Developing socio-spatial tools is highly complex and technical while often utilizing a range of data at various geographic, socio-political and population scales (Parkes et al., 2019), but as socio-spatial tools have great potential to support dimensions of EJ, how people operationalize socio-spatial tools requires critical and thoughtful action (Giang et al., 2022; Blue et al., 2021). As such, there is significant value in exploring the rife space between theoretical calls for more wholistic dimensions of EJ (distributive, representational, recognitional) and how researchers and practitioners might better, or currently do, apply more wholistic dimensions in practice while using and developing socio-spatial tools. At the time of writing this thesis, no research exists that seeks to learn from researchers and practitioners currently involved in developing socio-spatial mapping tools centred around environmental justice in Canada. As Canadian applications of EJ continue to grow in research and legislation, this thesis offers a valuable contribution to the scholarly discourse by exploring critical conceptions, practices, and processes relevant to engaging with dimensions of EJ (distributive, representational and recognitional) through the use and development of socio-spatial tools by researchers and practitioners who are currently doing that work in Canada (Agyeman et al., 2010; Blue et al., 2021; Giang et al., 2022).

After all, how individuals and institutions engage with and build knowledge, including the concepts and processes that shape them, are often not easily perceptible or definable, yet essential to clarify as interdisciplinary researchers and practitioners are "increasingly confronted with complex, interconnected social and environmental problems that span disciplines, knowledge bases and value systems" (Harris et al., 2011, p.13). As this research explored and made visible the processes, practices and conceptions that shaped participants' work of using and developing socio-spatial tools in connection to EJ, this thesis also offers an innovative and thoughtful exploration of how an individual graduate researcher can attempt a different way of experimenting with knowledge creation and question and make visible their processes and practices of shaping knowledge.

As an artist-researcher, I explored different ways of collecting, analyzing, and connecting to knowledge while bridging ideas from EJ and arts-related research in this thesis. Specifically, this thesis used an arts-integrated, practice-led approach that experimented with rendering and analyzing qualitative data inspired by two core scholarly ideas.

Firstly, I was inspired by the vocalized need by scholars for greater recognitional capacities in EJ, where scholars assert the importance of our individual and collective capacity to engage in more wholistic dimensions of EJ, including acknowledging the plurality of people's values, identities, cultures, rights, institutions, knowledges, and capabilities that might be outside of our current lens of knowing (Engen et al., 2021; Schlosberg, 2012). Meanwhile, western academic institutions have specific and often limiting structures of valuing and constructing knowledge, favouring certain ways of knowing and being more legitimate than others (Chapman & Sawchuk, 2012) that play a role in perpetuating epistemological inequities (Quinless, 2022). It struck me that such exclusions of other ways of knowing run counter to principles of EJ, particularly recognitional justice, that insist on more vast epistemological inclusion in knowledge valuing and practice (Agyeman et al., 2010). Meanwhile, interdisciplinary scholars deeply encourage student researchers to transgress disciplinary boundaries in their research as an opportunity to be adaptable and curious while engaging in alternative ways of thinking, connecting to, and generating knowledge to be better equipped to engage with worsening societal inequities that lack finite solutions (Vereijken et al., 2023; Porter, 2021). All in all, I wondered about possible individual practices that might help unsettle a person's current knowing and to help move towards what they do not yet know, an essential element of recognitional justice. While this is a question with many answers, I wondered: while I interviewed participants about the complexities around how they engage with EJ in their work, is there a way I could experiment in my analysis process that might unsettle my relationship to knowledge and allow me to connect to and analyze the data, participants experiences and stories through not only cognitive reasoning, but types of knowing that are more embodied, sensorial, tacit, and affective?

Scholars in the fields of arts-related research assert the value in the social sciences of practices and methodologies that expand individual and collective capacities for creative and expansive thinking, encouraging processes that allow time and space for recognizing the unexpected and the arrival of the unknown, including what we cannot yet see and comprehend (LeBlanc, 2018; Abma et al., 2019; Sameshima et al., 2019). Sameshima et al. (2019) contend

that an arts-integrated approach facilitates experimentation with potentialities to collect, view and investigate data through different lenses, modalities, and sensibilities —allowing "different ways of enhancing knowledge and understanding through the enhancement of generative possibilities" (Sameshima et al., 2019, p.18).

As such, incorporating an arts-integrated approach as an objective of this research is an important thread informed by the academic literature and the researcher's positionality (see methodology). As an artist and student of curiosity-driven, practice-led, creative, and non-linear approaches to constructing and connecting to knowledge, I believe that how we connect to and create knowledge merits our attention and space to expand and shift, guiding the fourth objective of this thesis. After all, given that we all have relationships to knowledge (Wilson, 2008) and that there are many ways to connect to and create it (Sameshima et al., 2019), exploring alternative ways of constructing knowledge (Irwin, 2013) while making our relationships to knowledge more visible and known is a meaningful practice and "presents a unique possibility to engage with recognition" (Sze, 2015, p.108).

As participants were confronted with complex questions and struggles in their work utilizing socio-spatial tools and their processes and practices to make inequities more visible, this arts-integrated approach was an analogous complement to this line of inquiry as I engaged in synthesizing their narratives and experiences. As Agyeman et al. (2010) state, there are as "many stories as there are storytellers" (p.5) in EJ, requiring questioning who is telling those stories, what narratives are distilled from those stories, and whose voices are heard or silenced. To Agyeman's point, this arts-integrated method made the role of the researcher in synthesizing these narratives more tangible, as well as participants' experiences in engaging in environmental justice while using and developing socio-spatial tools, through the representation of a final woven tapestry and a written thesis, while experimenting with a practice-led and embodied approach to data analysis. Threading back and forth between interviews, weaving, and artifact making as a form of knowledge translation allowed the researcher to distill themes from the data, weave and make visible the tacit expressions of participants of their work through embodied, contextual, and materially mediated processes of inquiry (Paquin & Noury, 2020).

Chapter 2: Literature Review

The following literature review will address three key areas - Environmental Justice (EJ), socio-spatial tools guided by EJ and arts-related research. I will present a brief overview of critical milestones and principles in relation to the EJ movement, discuss definitions of EJ and outline the distributional, procedural and recognitional dimensions of EJ. Subsequently, I will describe examples of socio-spatial mapping tools focused on EJ from recent literature, along with a summary of the trends in selecting indicators, geographic units, and data. I will then present the knowledge gaps in the literature relevant to my research. Finally, to better contextualize the arts-integrated dimension of my research, I will characterize the broad academic umbrella that composes arts-related research and define arts-integrated research in the academic literature and its fundamental characteristics.

Environmental Justice

Given the rich history of EJ as a social movement, a field of study (Bullard & Johnson, 2000), and a theoretical lens (Scott, 2014), the following section presents common definitions of environmental justice, provides an overview of the history of the EJ movement, presents EJ in the Canadian context and shows the core dimensions of EJ as commonly theorized in the academic literature in terms of distributive justice, procedural justice and recognitional justice.

Following the core definition and work from the U.S. Environmental Protection Agency (EPA), *environmental justice* is commonly defined as "the fair treatment and meaningful involvement of all people regardless of race, colour, national origin, or income concerning the development, implementation and enforcement of environmental laws, regulations and policies" (Mohai et al., 2009, p.4). Much of the early thinking around environmental justice is shaped by the EPA's early definitions in the 1990s, defining EJ as environmental equity, specifically the distribution of environmental risks across population groups, particularly people that might bear higher risk, such as racial minorities and low-income populations, and the policy response to these distributions (EPA, 1992, p.2). However, other definitions of EJ are also used in the literature, including, for example, EJ as "… a field of study and a social movement that seeks to address the unequal distribution of environmental benefits and harms and asks whether procedures and impacts of environmental decision making are fair to the people they affect" (Bryant & Callewaert, 2003, p.597) or, more simply, "… the disproportionate effects of environmental pollution" (Sze & London, 2008, p. 1331). Definitions of EJ generally centralize

the reality that the risks and impacts attributed to environmental hazards are felt to a greater degree by low-income and people of colour and include social and political systems such as housing, healthcare, and education (Bullard & Johnson, 2000). Overall, revealing patterns of inequity, discerning the processes driving and perpetuating patterns of inequity, and examining possible responses to these inequities are critical characteristics of EJ scholarship (Taylor, 2000).

As a social movement and primarily within the United States, environmental justice started in the 1980s in Warren County, where civil rights activists and neighbours organized to stop the dumping of soil contaminated with polychlorinated biphenyls (PCBs) (persistent, bioaccumulative, carcinogenic and toxic pollutants) (Mohai et al., 2009). This was the first environmental injustice to garner widespread national media attention that raised public awareness of environmental injustices towards African Americans and other people of colour, which "triggered subsequent events that would increase the visibility and momentum of the environmental justice movement" (Mohai et al., 2009, p.408). These protests prompted a scholarly investigation into the spatial distribution of hazardous waste sites in the Southern States, which were found to be built majorly in disproportionately African American communities (Mohai et al., 2009).

Propelled by these findings, a national-level study in the United States was conducted in 1987 by the United Church of Christ Commission for Racial Justice to investigate links between social characteristics and impacts from the waste sites on nearby communities (Bullard et al., 2008). Using novel multivariate statistical and mapping techniques, scholars found that waste site locations correlated most significantly with race as a determinant (Mohai et al., 2009). The findings were compiled in a 'landmark report' for EJ called *Toxic Wastes and Race in the United States* (Bullard et al., 2008, p.371), which was the first use of strong methodologically collected evidence of toxic exposures to substantiate environmental injustices and environmental racism (Bullard et al., 2008). As such, mapping the geographic distribution of inequities, particularly the unjust distribution of harms and/or benefits related to toxic exposure, has been central to environmental justice work with a strong focus on redressing harms to communities (Bullard & Johnson, 2000).

More recently, environmental justice has expanded from the early anti-toxic focus to issues of public health, worker safety, land use, transportation, housing, resource allocation, and community empowerment, to name a few (Bullard et al., 2008) and is not limited to one

paradigm of thought or action (Agyeman et al., 2016). This lineage of mapping and tools that support spatially identifying inequities is a foundational lineage important to the growing fields of research and community efforts that are expanding outside of the singular focus of toxic risks and pollutants. The original aim of spatial methodologies to assess and mitigate environmental injustices and to understand how racial and sociodemographic conditions shape such injustices remains central in EJ (Agyeman et al., 2016; Mohai et al., 2009). Sze and London (2008) posit that environmental justice as a field is "on a 'crossroads': rising through the convergence of social movements, public policy, and scholarship" (Sze & London, 2008, p.1331). Today, the EJ movement in Canada has been shaped by the emergence of EJ in the US and Canada's unique history and context. As a transdiscipline in academia, social policy strategy, as well as a social movement(s) (Agyeman et al., 2010; Sze & London, 2008), environmental justice continues to expand to include climate change, health equity, issues of food and energy, the Indigenous land rights movement, and various social and economic justice movements (Agyeman et al., 2016; Schlossberg & Collins, 2014), with a growing demand for the integration of an environmental justice lens in decision-making processes (Giang et al., 2022).

Distributional, Representational and Recognitional Dimensions of Environmental Justice

The three core interdependent dimensions of EJ include 1) distributive justice, the distributions of benefits and burdens; 2) representational justice, the full participation of those most impacted by environmental exposures in processes of decision making and 3) recognitional justice, the recognition of the cultural and power structures that perpetuate the unjust distribution of harms, benefits, and resources (Schlosberg, 2004) (see Figure 1). These three dimensions emerge from foundational perspectives and theorizing on justice from Fraser (2000 and 2008), Young (1990), and Schlosberg (2004 and 2007) and help to identify and analyze environmental injustices to guide a way forward towards justice-informed recourses (Blue et al., 2021; Fraser, 1996; McGregor, 2018; Schlosberg, 2004; Whyte, 2011).

Distributional justice examines the inequitable distribution of resources and harms, where collecting evidence to enact change and bring justice to the impacted communities has been a core aspect of EJ (Bullard et al., 2008). For example, collecting evidence of the systemic placement of hazardous waste disposal sites near communities of colour and/or living in poverty has led to communities becoming empowered to seek more just resource distributions and protections from decision-makers (Schlosberg, 2004). A question for distributive justice would

be: “How are injustices distributed among historically marginalized and dominant groups?” (Blue et al., 2021).

Representational justice, also sometimes referred to as procedural justice in the literature, emphasizes the need for a fair process during decision-making to allow for greater inclusion and integration of people, ideas, and perspectives beyond the limitations of institutional structures during the decision-making and policy processes (Agyeman et al., 2016; Blue et al., 2021). Fair community inclusion and participation within decision-making processes and access to information are examples of representational justice (Blue et al., 2021; Giang et al., 2022). A question for representational justice would be: “How is decision-making authority shared between historically marginalized and dominant groups?” (Blue et al., 2021).

Recognitional justice, also sometimes referred to as cognitive, cultural, or epistemic justice in the literature, emphasizes the importance of understanding and acknowledging how environmental injustices, structures of power, and structural inequities are deeply assembled by cultural identity and practices, worldviews, and knowledge (Blue et al., 2021; Fraser, 1997; Schlosberg, 2012). It focuses on how human language, norms, and values inform narratives and ways of knowing and why some ways of knowing and being are valued over others (Blue et al., 2021). Recognitional justice allows for the culture, identity, worldviews, and intangible power structures that drive the mechanisms of research, mainly when driven by quantitative data, to be more visible and allow more space for these worldviews to coexist (Blue et al., 2021; Walker et al., 2018). A question for recognitional justice would be: “What culture, worldview and knowledge is structuring this way of knowing that is directing the decision-making process, and how is this driving structures of power and structural inequities?” (Blue et al., 2021).

Environmental Justice in Canada

Canada’s environmental justice movement is characterized by social justice and human rights advocacy movements and is composed of interdisciplinary research and policy fields (Agyeman et al., 2010). Haluza-Delay (2007) contends that the focus of EJ as both a movement and in areas of academic research is not as with a clear identifiable history as that of the United States or as “discernable” (p.557), given the complex intersection of contexts in Canada that include a vast geography, multiculturalism, racial dynamics, history of resource development as well as a variety of social movements, social policies, and programs (2007).

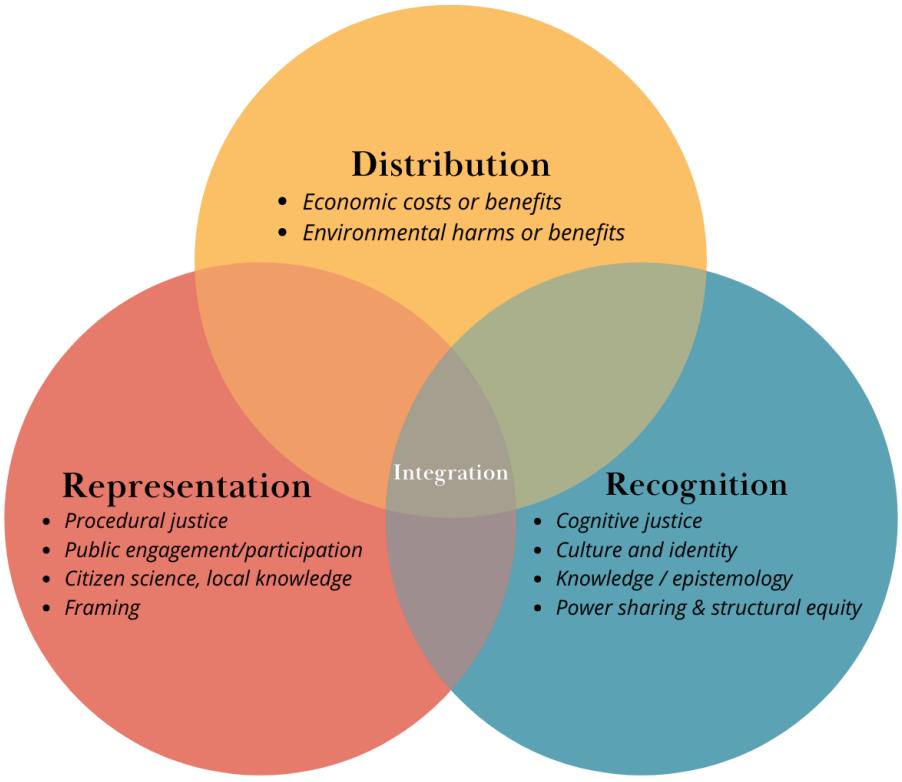
However, ongoing injustices perpetuated by Canada's complex history, including colonialism, ongoing reconciliation with Indigenous peoples, immigration and forced migration, and continued economic dependence on resource extraction, make Canada, according to Giang et al., an "archetypal site of environmental injustice" (2022, p.437). Injustices include resource extraction projects such as logging, mining, oil and gas extraction, pipelines, and hydroelectric projects, as well as disproportionate impacts of climate change that disproportionately impact Indigenous peoples (Giang et al., 2022), as well as other groups of people including Black Canadians, recent immigrants, migrant workers, women, children, individuals with compromised immune systems or environmental sensitivities, persons with disabilities, and people experiencing social and economic disadvantages such as poverty and homelessness (Agyeman et al., 2016).

Canadian environmental justice literature has grown in quantity and scope, and inquiry into this topic has become more interdisciplinary and integrated in the past decade (Giang et al., 2022). Although research focusing on biophysical dimensions of exposures and health outcomes represents the most significant number of publications out of all topical EJ categories, these publications also frequently address collaborators and community participation issues, environmental governance systems, and underlying systemic inequities. However, the literature notes the need for more robust applications of environmental justice principles to laws, policies, and research (Giang et al., 2022; Masuda et al., 2008). For instance, a meta-narrative review from 2006 - 2017 identifies gaps in EJ scholarship, which include a disproportionate focus of studies on Ontario, Quebec, Alberta and British Columbia; a profound need to understand and alleviate environmental racism and their drivers, particularly anti-black racism (Waldron, 2018); and, a disproportionate focus in EJ research is focused on distributional justice related to environmental hazards, neglecting other dimensions of justices including recognitional and representational (Blue et al., 2021; Giang et al., 2022). Moreover, according to Masuda et al. (2008) and supported by Giang et al. (2022), there is a need for more research looking into the interconnections between economic and social outcomes and environmental justice, particularly relating to the policies and practices driving environmental inequities (Masuda et al., 2008, p. 429). A notable gap in relation to Canadian environmental justice research is the need for greater inclusion of recognitional justice, given that a disproportionate focus on distributive justice remains in research and policy spaces (Blue et al., 2021; Giang et al., 2022). Core characteristics

of recognitional justice include recognizing and adequately valuing different bodies of knowledge and understanding communities that often suffer environmental injustices but have not been recognized beyond the communities themselves (van Uffelen, 2022). Representational justice relates to engaging in fairer decision-making processes while questioning who is involved and has influence in decision-making. However, the recognition and inclusion of people, values, and knowledge that are traditionally omitted in the decision-making process are not enough to alleviate injustices. McCreary & Milligan (2018) assert that how recognitional and representational justice are practiced must be inclusive of the deep histories and geographic processes connected to colonial history and the structures of power that shape them; if racial and colonial difference is labelled as vulnerability without ontological recognition of these histories, policies "bypass decades of struggle for justice," (p.738) obscure power relations, and risk not disrupting systems that perpetuate environmental racism and territorial displacement.

Figure 1

Interrelated Dimensions of Distribution, Representation, and Recognition in Relation to EJ



Note. Figure adapted from Blue et al., 2021; Fraser, 1996; Gillingham et al., 2016; Schlosberg, 2004.

While each dimension is distinct on its own, it is purported in the literature that the focus of EJ processes should integrate and engage in all three dimensions wholistically and not in isolated silos to engage in EJ with greater depth (Blue et al., 2021; Fraser, 1997; Masuda et al., 2010; Schlosberg, 2004). Scholars and practitioners increasingly call for a multi-dimensional approach to comprehensively engage with and work toward EJ instead of the usual over-focus on distributional justice or an omission of representational and/or recognitional justice (Blue et al., 2021; Schlosberg, 2012; Fraser, 1997; Youngblood, 2019). After all, there is a purported growing awareness that various concrete manifestations of environmental injustice are symptoms of a broader relationship between social inequity and sustainability that is complex, multi-faceted, and evades conventional boundaries (Sze, 2018).

To date, there is scant critical discussion on how to fulsomely operationalize all three dimensions (distributional, recognitional, and representational) in practice and in relation to socio-spatial tools (Blue et al., 2021; Giang et al., 2022). For example, environmental assessment processes in Canada still primarily value distributive justice and secondarily representative justice, if at all, with scant recognition of recognitional elements (Blue et al., 2021; Giang et al., 2022). As such, EJ scholars urge those in impact assessment spaces to enhance recognitional justice by embracing "new ways of thinking and new theoretical frameworks (...) that address political, social and cultural contexts" for greater integration of recognitional justice beyond solely distributional and representational foci of justice (Blue et al., 2021, p.6). Without epistemological questioning of what drives our distributional and representational justice processes, there remains the risk of perpetuating discriminatory structures of thought and ways of being and knowing at individual and institutional levels (McCreary & Milligan, 2018).

Environmental Justice-Focused Socio-Spatial Mapping Tools — Examples, Trends and Processes

Following the inception of EJ grassroots movements in the United States in the 1980s, environmental justice research was primarily concerned with the toxic and hazardous waste impacts on low-income and communities of colour to advocate for policy changes (Sze & London, 2008). This early and seminal focus identified trends of an essential dimension of EJ, distributive justice, charting the unjust distribution of harms and benefits across time and space (Blue et al., 2021). As such, using mapping and socio-spatial tools to clarify the distribution of inequities and support changes to policy and community health have been seminal in the field of

environmental justice and is a vital subfield of EJ research, particularly in the United States (Bullard & Johnson, 2000; Haluza-Delay, 2007), and increasingly in Canada (Blue et al., 2020; Johnson et al., 2016). As a reminder, in the research presented herein, reference to mapping and spatial identification methods are called "integrative socio-spatial mapping tools," which is a term that refers to digital tools, including maps, that integrate spatial data to assess, visualize, and understand negative and inequitable cumulative impacts and ultimately guide action and decision-making (Huang & London, 2016; Buse et al., 2019).

Based on a literature review, I have identified ten examples of relevant socio-spatial tools from recent literature in the US and Canada (see Table 1 and Appendix F). To characterize recent research on EJ-focused socio-spatial mapping tools, the following paragraphs summarize: 1) the main goal and rationale driving the development of socio-spatial EJ tools, 2) overall indicator selections and focus, 3) trends in data sources, 4) geographic unit and scope, and 6) knowledge gaps in the reviewed literature.

Table 1

List of Socio-spatial Tools Identified in the Literature Review

Name	Authors	Location	Spatial Unit	Summary Description
Eco-intersectional Multilevel Modelling	Alvarez & Evans, 2021	USA wide	Census tracts nested under neighbour-hoods	• **Description:** Using eco-intersectional multilevel modelling (a novel spatial analysis and quantitative approach) to evaluate intersectional environmental health risks to communities: levels of disproportionate exposure to environmental health hazards (cancer risk from air toxics) about demographic data (e.g. racial/ethnic composition, female-headed households, educational attainment, median household income, urbanicity) across the United States. • **Conclusion**: Environmental hazards contribute to cancer risk inequalities based on race, ethnicity, socioeconomic status, and location. • **Relevance**: Policies and enforcement mechanisms regulating emissions near residential areas

				determine the presence of these hazards in neighbourhoods and need to shift.
BC EnviroScreen	Buse et al., 2022	British Columbia, Canada	Local Health Areas (LHA)	• Screening tool informed by the CalEnviroScreen method, which standardizes the data and calculates the percentile rank of each indicator specific to identify potential environmental health injustices related to industrial land uses in British Columbia. The tool measures four dimensions of impact: environmental exposures, environmental effects, socioeconomic conditions, and sensitive populations. • The BCEnviroScreen scores reveal potential racial inequities in cumulative exposures, as visible minority populations may be disproportionately exposed to cumulative impacts in BC. • The implementation of EnviroScreen tools presents a significant opportunity to shape and influence environmental health policy in Canada.
Alberta Enviroscreen	Buse et al., 2021	Alberta, Canada	Local Geographic Areas (LGA)	• Developed a geospatial interface to understand changes to land use over time and quantitatively shows the cumulative environmental, socioeconomic, and health impacts. Each indicator was standardized through composite scoring and given a percentile rank of each indicator per region. This tool integrates 34 indicators representing four dimensions of the EnviroScreen model: environmental exposures, environmental effects, sensitive populations and socioeconomic characteristics. • A team from the University of British Columbia's Centre for Environmental Assessment Research was contracted by Environment and Climate Change Canada to evaluate cumulative effects in the Alberta Foothills to develop this novel methodology assessment tool. • EnviroScreen scores suggest the need for more robust management, conservation, protection, and

				remediation in the three LGAs with comparatively lower scores.
Maryland Environmental Justice Screening Tool (MD EJscreen)	Driver et al., 2019	Maryland	Census tract	• In partnership with the National Center for Smart Growth, the University of Maryland School of Public Health, this interactive tool assesses environmental justice risks specific to residents in Bladensburg, Maryland. Formed by methodologies from the U.S. Environmental Protection Agency's (USEPA) EJSCREEN tool and California's tool, CalEnviroScreen 3.0, indicators are based on four primary categories: pollution burden, including exposures and effects, and population characteristics, including sensitive populations and socioeconomic factors. • National Air Toxics Assessment (NATA) air toxics cancer risk is concentrated in communities of colour. • The tool offers improvements to public health and advances more equitable policies by empowering residents to advocate for new policies and better enforcement of existing ones while also providing government officials with valuable insights into the most pressing concerns.
A Cumulative Framework for Identifying Overburdened Populations under the Toxic Substances Control Act: Formaldehyde Case Study	Fedinick et al., 2021	USA wide	County	• The country-wide map identified populations with a heightened risk for adverse health outcomes (respiratory cancer) from exposure and susceptibility to formaldehyde. The authors also conducted statistical analysis to discern correlations between formaldehyde emitting sites and vulnerability indicators (e.g., single-parent households, minority status, primary language, housing type). • Findings showed that 647 counties across the USA were at risk of formaldehyde exposure due to formaldehyde and respiratory carcinogen-emitting sites and areas with populations with higher vulnerability indicators.

				• It is helpful to develop strategies for mitigation and evaluation at the country, state, and county levels to address disproportionate chemical exposures and environmental health inequalities.
EJ SCREEN	Kuruppuarachchi et al., 2017; US EPA, 2014	USA wide	Census tract	• A country-wide, interactive, and publicly available screening and mapping tool that can generate reports and maps at the scale of the census block, state, EPA region, or nation that displays potential risk areas based on environmental and demographic indicators developed by the EPA. • The tool combines national-level data, including twelve environmental indicators (e.g., particulate matter, ozone, traffic proximity and volume, air toxic cancer risk, proximity to treatment storage and disposal facilities, etc.) and two demographic indicators (low-income and minority populations) into EJ Indexes that calculates percentiles for each census tract of the combined effect of environmental and demographic indicators. • The goal is to discern the distribution of environmental benefits and burdens and inform decision-making for better environmental policies and planning for disproportionately burdened communities in certain areas.
U.S. Environmental Protection Agency's Risk Screening Environmental Impact Tool (RSEI)	Lewis & Bennett, 2013	New York State	Census tract	• Focused on four counties in New York, the RSEI tool identifies areas (not populations) of increased environmental risk from 433 air and water-borne chemicals linked to cancer released in toxic release sites. • Results were contrasted with current state-declared environmental justice areas and showed many toxic release sites were outside these areas. • The tool can inform strategies at the state level to manage and address toxic releases in areas with higher risk as part of their environmental justice programs and policies and enhance community-targeted programs in areas deemed to be most at risk.

Washington Environmental Health Disparities Map	Min et al., 2019	Washington State	Census tract	• A publicly available cumulative environmental health impacts assessment tool created by a community-academic-government partnership in Washington State. They used spatial analysis techniques to rank the risk from pollution and vulnerabilities relative to census tracts by calculating composite scores between 19 regularly updated environmental and population indicators based on environmental exposures (e.g. diesel emissions, toxic release traffic, ozone PM 2.5), environmental effects (lead risk, hazardous waste, wastewater discharge, etc.), sensitive populations (cardiovascular disease and low birth weight) and socioeconomic factors (e.g., educational attainment, poverty, race/ethnicity etc.). • Findings showed significant correlations between environmental health disparities in different state regions, mainly based on race and income. • This project offers evidence for policymakers and community-based organizations to make informed decisions about strategic public health programming and inform future environmental and social justice mapping efforts.
Environmental Justice Screening Method (EJSM)	Sadd et al., 2014	Los Angeles	Neighbour-hood	• The EJSM identifies communities of concern for cumulative impacts from environmental and social stressors (e.g. air quality hazards such as industrial sites and manufacturing facilities using air toxics concerning sites of social vulnerability such as community centers, churches, schools, senior homes, and libraries). • By partnering with a community organization called Los Angeles Collaborative for Environmental Health and Justice, technical tools (EJSM) and local knowledge were strengthened by ground-truthing through community-based participatory research to better assess unjust distribution patterns and advance preventive policy.

Detroit Case study: Mapping social and physical environmental risk	Schulz et al., 2016	Detroit, Michigan	Census tract	• Community, academic and health service provider organizations collaborated to quantitatively assess the extent to which communities of colour experience excess burdens of environmental exposures and associated health risks (i.e. hazardous facilities and land uses, diesel PM, cancer risks, respiratory hazards, etc.). They contrasted this information with economic and age-related vulnerabilities (median home value, education level, age, linguistic isolation, etc.) and vulnerabilities of sensitive populations (childcare facilities, schools, etc.) across census tracts in Detroit, Michigan. • Findings indicate that census tracts with higher proportions of people of colour disproportionately experience cumulative risk and heightened physical environmental exposures and socioeconomic vulnerabilities. • Opportunity to promote environmental justice and health equity at legislative, regulatory, policy, and community levels that prioritize communities with heightened cumulative risk.

Main Goal Driving Socio-Spatial Tool Development

All examples of socio-spatial mapping tools reviewed herein aim to collect evidence to represent the spatial distribution of environmental harms through discerning sources of impacts that disproportionately impact certain areas and populations over others. As such, each socio-spatial tool's major goal is to illustrate and collect evidence to identify harms and achieve better distributive justice (Bullard et al., 2008; Bullard & Wright, 2008; Huang & London, 2016).

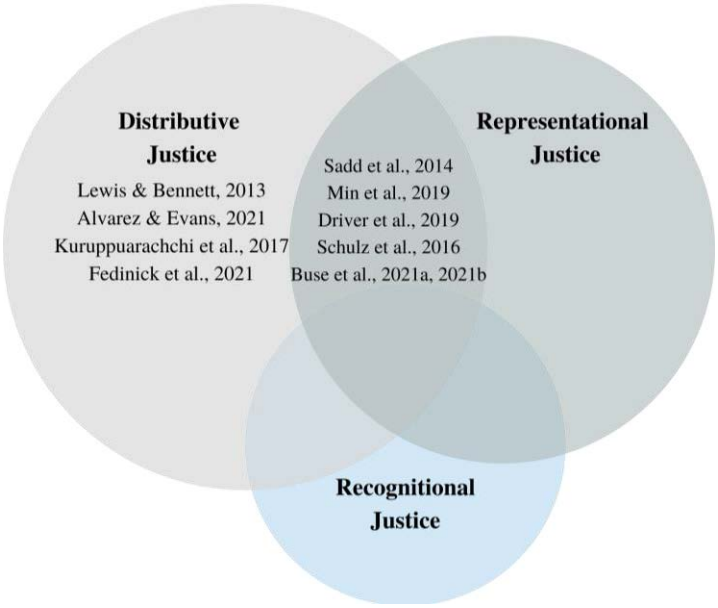
While distributive justice motivates the development of socio-spatial tools, every article has outlined a distinct rationale for focusing on distributive (in)justice. For instance, specific authors focused on the benefits of being able to visualize spatial patterns of distribution, which include enhancing sustainability, understanding complex legacies of land use, identifying communities, exposures, and areas of concern, improving decision-making at all collaborator levels, and enhancing future as well as current processes of representational justice.

Some scholars also presented a broader rationale for their socio-spatial tools. For instance, Buse et al. (2021a) discussed how the ABEnviroScreen assesses changes in the landscape that include multiple land uses related to ecosystems, communities, and human health to assess the "negative implications for sustainability in its broadest sense" (p.6). Moreover, a broader rationale was also discussed in the development of the BCEnviroScreen, which discussed how it is useful to better understand "complex legacies of land-use decisions," where the ways in which multiple land uses impacts the socioeconomic systems and human health is vital to assess through a cumulative health lens (Buse et al., 2022, p.1). Similarly, Alvarez & Evans (2021) discussed how their socio-spatial tool would help in "telling large-scale, intersectional stories of environmental injustice" across the USA by coupling the risk of carcinogenic air toxins with socio-demographic indicators (p.269).

Also noteworthy, various authors stated that a key rationale of their work with socio-spatial mapping was to visually represent distributive injustices through improved decision-making by interdisciplinary collaborators (e.g., public, agencies, policy makers and community-based organizations) (Driver et al., 2019; Lewis & Bennett, 2013; Min et al., 2019; Sadd et al., 2014; Schulz et al., 2016). In the examples reviewed, various collaborators were considered, and certain collaborators were prioritized over others. For instance, Driver et al. (2019) prioritized empowering the decision-making among residents of affected communities through the enhanced understanding of "how their health is affected by the built environment" to comprehend impacts on their health and create "long-lasting change in their community" (p.15). Sadd et al.'s (2011) socio-spatial mapping work in Los Angeles sought to remediate cumulative impacts and environmental inequities and focus regulatory action at the neighbourhood level. Ultimately, the goal of their work was to develop a tool to inform regulators and policymakers to reduce the exhausting "burden of proof" that is disproportionately placed on communities experiencing EJ impacts (2011, p.1455). On the other hand, Lewis and Bennett (2013) focused on enhancing decision-making at the state level specifically to improve state effectiveness in addressing toxic releases and exposures as part of EJ programs and policies through a top-down approach, without discussing the need for servicing and/or including communities. As such, Sadd et al. (2011) focus on the responsibility of regulatory and state officials to act with the aim to limit responsibility commonly and disproportionately placed on communities, which was a unique perspective among the reviewed literature.

Figure 2

Visualization of EJ Dimensions of the Reviewed Literature on Socio-spatial Mapping Tools



In summary, the primary goal behind the development of each socio-spatial tool reviewed here is to identify and illustrate the spatial distribution of chosen indicators and patterns of impact and harm across space. At the same time, some socio-spatial tools reviewed here specifically and exclusively focused on distributive justice (Alvarez & Evans, 2021; Fedinick et al., 2021; Kuruppuarachchi et al., 2017; Lewis & Bennett, 2013). Meanwhile, a select few stated that they also intended the future use of the tool to help enhance procedural justice (Alvarez & Evans, 2021; US EPA, 2014). Additionally, through community sessions (Buse et al., 2022; Driver et al., 2019) and interdisciplinary collaborations (Min et al., 2019), scholars sought feedback from community members and shared their progress throughout the research to help ensure that the socio-spatial tool adequately reflected the lived realities of communities and the challenges they faced. Overall, the ancillary rationale behind screening tool development was enhancing and engaging in procedural justice either by including explicit processes of procedural justice in the research design (Driver et al., 2019; Min et al., 2019; Sadd et al., 2014) or by advocating for greater procedural justice with the future use of their developed socio-spatial tool (Alvarez & Evans, 2021; US EPA, 2014).

Indicator Selection

Overall, the literature illustrates an evolution from a singular focus on toxic impacts on human health towards integrating a greater diversity of cumulative indicators. For instance, earlier socio-spatial tools were developed with a singular toxicity focus (Lewis & Bennett, 2013; US EPA, 2014; Sadd et al., 2014), while a more cumulative approach expanded to include the interrelationships between environmental and socioeconomic indicators (Driver et al., 2019; Min et al., 2019; Schulz et al., 2016). There has been a shift in the manner of assessing the spatial exposures of health disparities from an earlier focus on the proximity of toxic exposures and risk of individual hazards to health (Lewis & Bennett, 2013; Mohai et al., 2009; Sadd et al., 2014; US EPA, 2014), towards developing methodologies that comprise cumulative methods of assessment through composite scoring which are largely inspired by the CalEnviroScreen methodology (Buse et al., 2021; Buse et al., 2022; Driver et al., 2019; Min et al., 2019; Liévanos, 2018), except Schulz et al. (2016).

For instance, earlier iterations of EJ socio-spatial tools generally focused on identifying the distribution of hazards related to projects and harmful land uses to identify possible proximity and impacts to nearby communities (Lewis & Bennett, 2013; Sadd et al., 2014; US EPA, 2014). This is in line with more traditional methods of EJ, prioritizing distributive justice through identifying spatial patterns of toxic facilities and proximity to communities and socio-demographic information (Bullard & Johnson, 2000; Mohai et al., 2009). Fedinick et al. (2021) is the exception to this temporal relationship, given that in their formaldehyde case study, the developed screening tool is singularly focused on the risk of health impacts from individual sources of toxic emissions and air carcinogens from chemical plants. For more details on the chosen indicators of these examples, see Table 1.

More recent examples of EJ-focused socio-spatial mapping tools include an orientation to cumulative impacts, thus using composite scoring techniques and expanding their indicator selection. The MD EJScreen (Driver et al., 2019), the Detroit Case Study (Schulz et al., 2016), the Washington Disparities Map (Min et al., 2019) and the CalEnviroScreen (Liévanos, 2018) seek to capture a greater multitude of dimensions of vulnerability related to health disparities that include socio-economic and environmental exposures. Composite scoring illustrates the magnitude of environmental justice concerns in an area by calculating smaller data units (indicators) in relationship to one another (Liévanos, 2018). Most socio-spatial tools reviewed

used the CalEnviroScreen method with localized indicator selection (Driver et al., 2019; Min et al., 2019; Buse et al., 2021, 2022) except for Schulz et al. (2016) (see Table 1).

Another relevant trend in the examples of socio-spatial tools reviewed is the lack of asset-based or positive indicators — indicators used in these tools represent deficits and are outlined as harmful impacts, hazards, and risks with negative consequences. Min et al. (2019) and Buse et al. (2022) discussed this, arguing that current socio-spatial tools do not model strength/asset-based indicators or resilience. However, it is important to note that all chosen indicators for these socio-spatial tools were selected through the backing of a strong body of literature illustrating their relevance to assessing the health status of communities and individuals (e.g., ozone, diesel, drinking water pollution, asthma, cardiovascular disease, low birth-weight infants, educational attainment, poverty etc.) (Schulz & Northbridge, 2004).

Trends in Data Source

In terms of data, all reviewed socio-spatial tools used publicly available data from a variety of regional, statewide, and federal sources. As such, certain authors outlined two major reasons why publicly available data was prioritized. Firstly, they stated that it allowed an inexpensive, accessible, and replicable approach that allows for local governments and community-based groups to use the tool and apply it to different contexts and areas (Driver et al., 2019; Min et al., 2019; Sadd et al., 2014; Schulz et al., 2021). Secondly, it was discussed that identifying publicly accessible data that was routinely maintained ensured greater future longevity of the tool by facilitating the addition of new data as needed (Buse et al., 2022; Sadd et al., 2014). However, it was noted that the range and comprehensiveness of chosen indicators were limited due to data limitations. As such, it was discussed that other datasets should be explored to better represent the local and community-level experience (Buse et al., 2021; Min et al., 2019; Sadd et al., 2014; Schulz et al., 2016).

While a few authors used community knowledge to better guide and inform indicator and data selection, as discussed above (Buse et al., 2022; Driver et al., 2019; Min et al., 2019; Schulz et al., 2016), only Sadd et al. (2014) collected specific neighbourhood data to better inform the tool's design. Thus, there is a distinction between incorporating community-collected and community-informed data, while others rely solely on the predetermined publicly available data.

Main Focus of Geographic Unit and Scope

Each tool reviewed had a different geographic scope of analysis and a spatial unit (see Table 1). The spatial unit of analysis used by most reviewed tools was the census tract because of the data available at this scale (Driver et al., 2019; Fedinick et al., 2021; Kuruppuarachchi et al., 2017; Lewis & Bennett, 2013; Liévanos, 2018; Min et al., 2019; Schulz et al., 2016). While Sadd et al. (2014) focused on the neighbourhood level, collecting their own data through community-based participatory research allowed them to chart out their own spatial units of analysis and the area of each neighbourhood was determined by community collaborators. In another example, Alvarez and Evans (2021) used census tracts as their main spatial unit of analysis using publicly available data but nested this data within large neighbourhoods across the USA. Another exception to census and neighbourhood data was Fedinick et al. (2021), who used county-level aggregated data while assessing the risk of sites of exposure and pollution of formaldehyde and its socio-demographic risk. Meanwhile, the Alberta EnviroScreen used Local Geographic Areas (LGAs), which are "boundaries defined by Alberta Health Services in order to provide detailed information for planning, monitoring, and management" (Buse et al., 2021, p.8). Further, the BC EnviroScreen used Local Health Areas (LHAs) as their unit of analysis as that is the lowest order of geographical unit that publicly available health information is available for the province (Buse et al., 2022).

Overall, the selection of the spatial unit for each socio-spatial tool was limited by the geographic boundaries of their study and the availability of public data. See Table 1 for descriptions and Appendix F for visual examples of each socio-spatial tool reviewed.

Regarding the scope and location of the analysis, two tools focused on the city level: Los Angeles (Sadd et al., 2014) and Detroit, Michigan (Schulz et al., 2016). Otherwise, the purview of the other tools included the state or provincial level, such as the RSEI limited to four New York states (Lewis & Bennett, 2013); Washington State (Min et al., 2019); Maryland (Driver et al., 2019); California State (CalEnviroScreen); Alberta, Canada (Buse et al., 2021); British Columbia, Canada (Buse et al., 2022); while the others expanded their scope across the USA (Alvarez & Evans, 2021; Fedinick et al., 2021; Kuruppuarachchi et al., 2017).

All in all, socio-spatial mapping tools are tangible ways to make what is often invisible more visible, particularly distributive patterns of inequities and cumulative impacts, to better understand, interrogate and address inequities. In this thesis, I interviewed participants about

how they engage in dimensions of EJ doing this work, which illuminated processes and practices that do or could situate them towards engaging in EJ in their work using and developing socio-spatial tools (see findings). Also, I intentionally made space to make my own role as a researcher constructing this thesis more visible and tangible through a woven tapestry as a representation of the process I underwent analyzing the data, as an artifact for knowledge translation (see methodology and Figure 3) and as an experimental process. This arts-integrated methodology was an experimental space for me to explore a different way of connecting to knowledge, using weaving as a modality for engaging in more sensorial, embodied, tacit and affective dimensions, as well as the cerebral connection to and analyzing knowledge. I decided to experiment with connecting to and constructing knowledge differently (i.e., learning through doing using "busy hands" (Elke, 2022, p.63)), inspired by the notion that to engage in recognitional justice requires expanding our capacities to be able to acknowledge what we might not already include in our scope of knowing, including the "plurality of people's values, identities, cultures, rights, institutions, knowledges, and capabilities" (Schlosberg, 2007).

In this vein, arts-related research is a rife area of research that explores places that are often invisible and intangible, including how we construct, connect to, and understand knowledge. In the following paragraphs, we will explore this further to better contextualize this thesis.

Arts-related Research

Art has the potential to provoke, inspire, educate, and move its participants to deeper levels of engagement on a topic (Leavy, 2018, p.3). While fine art is a distinct discipline and field of study, there are many fields of research shaped by varying epistemologies, methodologies, and artful modalities that utilize art (Sameshima et al., 2019). For the sake of clarity, I will be using the term *arts-related research* as a broad umbrella term to identify the numerous types of research paradigms and methodologies that use the arts to advance knowledge (Knowles & Promislow, 2008). After all, research that employs art to advance knowledge is highly varied and difficult to distill into one single or prescriptive definition (Chilton & Leavy, 2014); types of arts-related research follow a more nuanced, emotive and empiricist process of research (Finley, 2008) and exists across a multitude of disciplines and contexts (Chilton & Leavy, 2014; McNiff, 2013). The following section is a broad synthesis of arts-related research to enhance conceptual clarity and to better contextualize art-integrated research in relation to my

thesis. It is not intended to be a thorough historical or detailed account of this vast field of study. In the following sections, I will briefly describe the epistemology of arts-related research and its relevance to the health sciences, and I will describe three major arts-related research types to situate this thesis.

Epistemology of Arts-Related Research

To begin, arts-related research composes a vast array of research forms and methodologies that are widely defined and applied, including arts-informed (Cole & Knowles, 2008c), arts-based (Finley, 2008; McNiff, 2018), creative arts inquiry (Barrett & Bolt, 2014), a/r/tography (De Cosson & Irwin, 2004), creative artistic practices (Richardson & St. Pierre, 2005), arts-based educational research (Barone & Eisner, 2012) and arts-integrated research (Sameshima et al., 2019) to name a few. These research types have differing epistemological assumptions, theoretical frameworks, methodologies, procedural focus, and unique elements that are specific to the context of the research, researcher(s), participant(s), and intended audiences (Knowles & Cole, 2008a).

In the 1980s, arts-related research grew out of a desire to disrupt the long-standing preference in academia to seek knowledge using prescriptive, linear, and rigid processes (Eisner, 2008), which Eisner describes as the tendency to "seek what we already knew how to find" (Eisner, 1997, p.7). Researchers from various disciplines began to wonder how they could better explore elements of the human condition through a multiplicity of forms, given that "we know more than we can tell" (Polanyi, 1967) and that there are many ways to connect to various knowledges, many of which are not reducible to language nor linear metrics (Eisner, 2008). Since then, arts-related research has continued to span disciplines such as anthropology, psychology, women's studies, social work, education, nursing, health sciences and disability studies (Knowles & Cole, 2008b), with a particularly strong presence in education research (Knowles & Cole, 2008c).

Arts-related research can cultivate dynamic processes towards meaning making. Engaging with art in research can stimulate curiosity towards more diverse and wholistic tapestries of knowledge that we cannot see directly nor encapsulate fully with words (Eisner, 2008; Hayes et al., 2015). Artful processes in arts-related research can also help us connect to a variety of ways of knowing a singular or a multiplicity of topics, depending on the research in question, while stimulating emergence, ambiguity, curiosity, and comfort with uncertainty. As

Eisner writes, arts-related research allows researchers to ask: "What does it mean to know?" (Eisner, 2008). As we all have relationships to knowledge (Wilson, 2008), arts-related research makes space for those engaged in the research to shift this relationship by creating new ways to see, think and communicate through processes of inquiry that stimulate our imagination and engage a broadened variety of our senses (Hayes et al., 2015; Sameshima et al., 2019). Such shifts in our relationship to knowledge can allow the person engaging in the research — researcher, participant, and audience member alike — to continue to arrive at new avenues of knowing and being in unforeseen ways (Eisner, 2008; Hayes et al., 2015; Harris et al., 2011). For instance, arts-related research can utilize methods and meaning making systems that honor diverse ways of knowing: personal, narrative, embodied, artistic, aesthetic (Cole & Knowles, 2008b; Finley, 2008), important elements of recognitional justice (Engen et al., 2021).

As such, arts-related research engages a broader spectrum of meaning making, which is useful given that humans impose meaning and learn about the world through sensory, subjective, emotional, and aesthetic ways (Conrad & Beck, 2015). The human experience and the research topics we pursue to further explore the human condition include subjective and nuanced elements, given that we come to know the world in many ways. Thus, scholars assert that arts-related research is a valuable addition to qualitative or mixed methods research, as a stand-alone paradigm as well as a distinct method of engaging in research (Knowles & Promislow, 2008) and can be an important thread to practices of recognition (Sze, 2015).

Arts-Related Research in Health Sciences

In the discipline of Health Sciences, there is a growing interest in including arts-related research in various capacities **(**Boydell et al., 2012). After all, many elements of the lived human experience and health include subjective, contextual, dynamic, and tacit elements, which are often left out by quantitative modes of health sciences research that explore topics involving human life, health, and illness (Lapum, 2018). As such, there is a growing desire from some health researchers to expand the inclusion of more tacit and unfathomable elements, where varying types of qualitative and arts-related research are increasingly prevalent (Pope & Mays, 2006). This drive for more processes and methodologies that include more subjective ways of meaning making disrupts the long-standing history in the health sciences of assuming knowledge to be "objective, observable, measurable, predictable and verifiable" (Lapum, 2018, p.526) and where pre-charted methods of research are favoured (Eisner, 2008; Harris et al., 2011). Among

this growing field of arts-related processes and methodologies in the health sciences includes arts-based (Boydell et al., 2012; Lapum, 2018), arts-informed (Coles & Knowles, 2008c), and arts-integrative research (Sameshima et al., 2019). Next, I will outline these three research types' general definitions and core characteristics to elucidate why I have characterized my thesis under an arts-integrated methodological process.

Exploring Three Major Arts-related Research Types

Arts-Based Research. Arts-Based Research (ABR) is an umbrella methodology as well as a paradigm of research that can be used to develop, explore, analyze, collect data and/or represent results (Boydell et al., 2012). Arts-based research is a "hybrid form of action research based in art processes, and/or art based in action research processes," suggesting a way to gain new perspectives via art (Keifer-Boyd, 2011, p.5).

ABR is not restricted to any specific methodological approach (Barone & Eisner, 2012) and has been used in many fields of research and contexts (Finley, 2008; McNiff, 2018; Chilton & Leavy, 2014). In a scoping review, Boydell et al. (2012) identified ABR methods in a vast array of disciplines and modalities in the health sciences including nursing, nutrition, midwifery, occupational therapy, rehabilitation science, social work, health policy, public health, medicine, psychology, and psychiatry, involving art forms such as photography, theatre, drawing, film/video, poetry, dance and more than one type of art form used at a time (Boydell et al., 2012). In fields of environmental justice, arts-based methodologies and modes of inquiry have helped disrupt and reimagine narratives of justice in fields of research (Fawcett and Johnson, 2019; Keifer-Boyd, 2011; Sze, 2015) as well as in spaces of community-based research (Abma et al., 2019). Three core characteristics of ABR appear in the literature: 1) the primacy of arts in the inquiry process, 2) the fluid and dynamic features of the methodological design, and 3) its epistemic tendency to seek action-oriented impacts. Firstly, although art can comprise one or more phases of the research process (Barone & Eisner, 2008; McNiff, 2008), the arts foundationally shape the inquiry process within ABR (Conrad & Beck, 2015; McNiff, 2008). Secondly, a distinguishing feature of ABR in the health sciences is the "organic and responsive" feature in the methodological design; the data collection and/or interpretation is influenced by the elements of the research, including the researcher(s) and participant(s) themselves (Lapum et al., 2012; McNiff, 2008). Thus, there is a creative element of meaning making and construction of knowledge throughout the research process that is not prescriptive (2012). Thirdly, while

ABR is not restricted to action-based or socially transformative research (Gullion & Schäfer, 2018), it is discussed in the literature that ABR often has an epistemic pursuit towards action-oriented and transformative results during or because of the research process (Boydell et al., 2012; Finley, 2008). A typical action-oriented inclination is to make scholarship accessible to a wider audience beyond the academy (Finley, 2008). Additionally, ABR can be theoretically situated in critical race, indigenous, queer, and feminist critical methodological lenses as a means of exposing social inequities or oppression (Finley, 2008); in these ways, an aptitude to explore "multiple, new, and diverse ways of understanding and living in the world" can be garnered, with a commitment to social transformation (Keifer-Boyd, 2011, p.82).

Arts-informed research. Knowles and Cole (2008c) define arts-informed research as "a mode and form of qualitative research in the social sciences that is influenced by, but not based in, the arts broadly conceived" (p.68). Arts-informed research can include processes and representational forms of inquiry in one or several art modalities (Knowles & Cole, 2008c; Nguyen, 2018) and can be a stand-alone qualitative method as well as an enhancement to other research approaches that enrich the potential of gathering, analyzing, and representing data (Knowles & Cole, 2008c). Overall, it is a methodology that supports inquiry with artful processes, including visual, literary, or performing arts (Knowles & Cole, 2008c). Defining features of arts-informed research share similar elements to ABR. For instance, arts-informed research seeks to engage in different types of knowing (oral, literal, visual, embodied); enrich understanding around the human condition that includes physical, emotional, spiritual, social, and cultural elements; and, often has both theoretical and socially oriented transformative potential (Boydell et al., 2012; Chilton & Leavy, 2014; Finley, 2008; Knowles & Cole, 2008c). Moreover, Knowles and Cole (2008c) assert that "good" arts-informed research seeks to dissolve barriers between participants, community members, and academic research while arousing audiences to new responses and action. Moreover, a critical pedagogy often infuses the basis of the research design, where a transformative potential is sought during or resulting from the research, and thus, there is often a participatory element between the researcher and the participants themselves where knowledge is co-created (Knowles & Cole, 2008c; Nguyen, 2018).

Arts-Integrated Research. In the next couple of paragraphs, I will define the core characteristics of arts-integrated research, provide examples of how arts-integrated research can

be used during different phases of research, and the value of its epistemic fluidity. To start, **arts-integrated research** is a research design "that includes creative or generative making as part of the research design" without requiring the arts to be at the core of the research methods or mode of inquiry (Sameshima et al., 2019, p.2). Moreover, the research design is led by one or a combination of the following: an individual researcher, a team of researchers working with an artist, or an artist-researcher working with a team (2019). Art-making processes can happen at any point throughout the research process, including data collection, data analysis, and/or as a method for disseminating data and findings (Cole & Knowles, 2001 in Sameshima et al., 2019).

Throughout these stages, "artifacts" or "renderings" can be created through artful processes to generate data, enhance the analysis process, or generate models of theories, to name a few (Cole & Knowles, 2001 in Sameshima et al., 2019). Renderings as end products allow findings or elements of the study to be represented, while renderings as process allow the researcher(s) and sometimes participants to collect, view and investigate data through different lenses, modalities, and sensibilities — both allow "for different ways of enhancing knowledge and understanding through the enhancement of generative possibilities" (Sameshima et al., 2019 p.18). It is in these ways that art-integrated processes and the created renderings "provoke further rhizomatic understandings, challenge conceptions, and generate the emergence of more questions" (Sameshima et al., 2009, p.9).

An example of an arts-integrated process during the data collection and analysis processes is a research project illuminating the experience of methamphetamine addiction and recovery by Sameshima et al. (2019). Three artist researchers used interview transcripts to create artifacts that helped represent and interpret each participants' narratives through art that expressed more subjective and challenging elements of their lived experience that could not be fully expressed into words. For instance, Sameshima created raku ware pottery bowls that represented and embodied the tacit, emotional, and affective elements found in a participant's experience of addiction and recovery (2019, p.106). Ultimately, the authors found that this arts-integrated element enhanced the collected data and strengthened the quality, meaning, and rigour of the findings (Sameshima et al., 2017). Additionally, it provided a way to disseminate the data in a meaningful way to larger audiences outside of academia (Sameshima et al., 2009).

During the data analysis stage, artful processes can be generative and increase the rigour of analysis (Sameshima et al., 2019). For the researcher, arts-integrated processes can stimulate

different connection points of, and deeper engagement with, the collected data during analysis through the making of an artifact/rendering either as a process, product, or both (Sameshima et al., 2019). According to Sameshima et al. (2019), a typical arts-integrated process during the data analysis stage is to first engage in data collection (e.g., qualitative interviews), then transcribe the interviews verbatim and next undergo the process of creating the rendering/artifact while reviewing the data collected using one or more modalities (e.g. poem, poster, graphic, painting, paper etc.) (Sameshima et al., 2019).

As such, an arts-integrated approach often combines traditional research methods, such as qualitative interviews, with an artful process of translating and shifting data into a confluence of perspectives and connections (Sameshima et al., 2009); thus, a plurality and an enhancement of interpretation and understanding is fostered, and a wider tapestry of meaning is provided through different art modality types depending on the skills and interests of the researcher(s) and perhaps the participant(s) as well (Sameshima et al., 2019).

Moreover, arts-integrated research allows scholars to engage in "new lenses for viewing, analyzing, representing, and disseminating research" without relegating the research design to a specific discipline or epistemological alignments (Sameshima, 2019, p.2). For instance, examples of epistemic alignments among art-related research include the expectation of a transformative potential of the research, a primacy of artful processes structuring the research design, or a certain engagement with participants and/or community members to co-create meaning in the research, all of which are commonly found in ABR or arts-informed research as previously discussed (Finley, 2008; Cole & Knowles, 2008c).

Summary, Compare and Contrast

Overall, situating arts-related methodologies within research is a challenging exercise, given that arts-related processes often defy a prescriptive definition and are dynamic and context-specific. Conceptual clarity is a consistent challenge among arts-related research, given the emergent nature of the research and the fluidity of methods depending on the context, elements, and actors engaged in the research process (Finley, 2008). While arts-related research includes a broad umbrella of definitions and applications, they offer multi-modal ways of knowing and shifting perspectives to unforeseen avenues of thinking and being, which are important dimensions of recognitional justice (Sze, 2015). Discerning the appropriate arts-related research to the research topic, the researcher must decide the appropriate skills and strengths of

the researcher(s), the art form appropriate to the researcher(s) as well as the research context, and deeply consider how such processes will illuminate, inform, and shape the research (Sameshima et al., 2019). Such decisions are context-specific and subjective, adding to conceptual obscurity for researchers new to arts-related research (Chapman & Sawchuk, 2012).

In summary, here are the main similarities and differences identified in the literature between arts-based, arts-informed, and arts-integration research. On account that arts-informed research has been understood by some scholars to be nested under ABR or used interchangeably as a synonym (Chilton & Leavy, 2014), it is, at times, very hard to distinguish between arts-informed research and arts-based research. The largest differentiation of arts-informed research from ABR is that art does not form the basis of research but is part of the process of inquiry (Knowles & Cole, 2008c). Otherwise, as Sameshima et al. (2019) noted, some features are similar between arts-based research and arts-informed research, particularly in their "epistemological alignments," meaning that there is an expectation that the research will lead to a specific relationship to knowledge (p.2). For instance, it is noted in the literature that among ABR and arts-informed research, there are epistemic alignments that can be common including 1) a transformative potential during or following the research, 2) a certain engagement with participants and/or community members to co-create meaning in the research, 3) a primacy of artful processes structuring the research design, in the case of ABR, 4) a presence of critical pedagogy (Finley, 2008; Knowles & Cole, 2008c). Moreover, arts-integrated research can be used as a complement to research that blends a wider range of disciplines, including multidisciplinary teams of researchers (Sameshima et al., 2019), while ABR and arts-informed are more often narrowed to artful processes within a narrower range of disciplines. In arts-integrated research, there are no expectations of epistemological or disciplinary alignments (Sameshima et al., 2019). Instead, artful-making processes can be infused at any point of the research process (data collection, analysis, dissemination) without expecting participatory or transformative consequences (Sameshima et al., 2019). Yet, all three dissolve expectations of what it means to convey knowledge and conduct research and make space for types of knowledge that defy linear, textual, and perspective ways of knowing. All three of these arts-related research types seek to engage in artful processes in the social sciences that seek new ways to engage with different ways that connect to, represent, and disseminate knowledge that is less conventional in the academy.

As such, this research seeks to engage in and experiment with a novel arts-integrated practice that enriches data analysis and knowledge dissemination, using weaving as a modality. An arts-integrated approach will be used given that this approach does not relegate the research design to a specific discipline or epistemological alignments (Sameshima et al., 2019), nor the ambition to provide transformational praxis (Knowles & Cole, 2008b), nor the necessity for artful processes to shape the foundation of the research (Finley, 2008). Arts-integrated research is supportive of reflection on, investigation into, and visualization of the many facets that are brought up in the interviews, many of which are implicit, tacit, and difficult to express in words alone, and an apt method to render such facets into a tangible artifact as part of this thesis — helping to make visible the relationship between the researcher and the research itself, and a representation that we are all threads in a vast network of relations. Moreover, it seeks to experiment with a mode of data analysis that engages with more embodied, sensorial, creative, and affective dimensions of knowledge creation, given that "we know more than we can tell" (Polyani, 1967) and that there are many ways to connect to various knowledges, many of which are not reducible to language or linear metrics (Eisner, 2008). This thesis is a novel contribution to the arts-related literature and the arts-integrated literature through its threading interdisciplinary explorations between environmental justice, health sciences, and socio-spatial tools while also using weaving as a modality (an uncommon practice).

Knowledge Gaps — What Is Missing?

In the following section, two core knowledge gaps in the reviewed literature will be summarized, including 1) general trends in socio-spatial mapping and data limitations and 2) the need for greater representational and recognitional dimensions of EJ in policy and assessment spaces in Canada. Next, I will offer reflections on the latter gap, based on my understanding of the literature review, and finally, introduce opportunities and gaps in the arts-related literary fields that support this thesis.

General Trends in socio-spatial mapping and data limitations

Firstly, among the reviewed examples of EJ-focused socio-spatial mapping tools, key knowledge gaps in the literature include major data limitations. For instance, a major gap identified in these tools is the lack of publicly available rigorous, recent, and relevant health data at various scales (e.g., local, regional, and regulatory levels). This lack of data limits the possibility of using diverse and localized health indicators and environmental disparities in

socio-spatial tools that help to represent the local context more accurately, thus impeding the accuracy of the results of each tool in representing existing cumulative health impacts. The authors stated that health indicators should be chosen to reflect localized EJ issues, social vulnerabilities, and health impacts, albeit this data was not always available. For example, additional vulnerability indicators that authors in the reviewed literature suggested would strengthen the depth of analysis of certain tools were asthma, cardiovascular disease, water quality, or effects of inequality by the built environment, to name a few (Driver et al., 2019; Fedinick et al., 2021; Min et al., 2019).

The Need for Greater Representational and Recognitional Dimensions of EJ in Policy and Assessment Spaces in Canada

Secondly, a major gap in the literature reviewed reflects the need for enhanced engagement and advances in more wholistic applications of EJ. For instance, scholars identified the need for better integration of local knowledge for enhanced engagement and advances in recognitional justice (Alvarez & Evans, 2021; Buse et al., 2022; Driver et al., 2019; Min et al., 2019; Sadd et al., 2014). Additionally, scholars identified the need for continuous and consistent processes of community engagement and inclusion in the tool's development and future use to enhance the accuracy of the tool (Min et al., 2019; Driver et al., 2019; Sadd et al., 2014). Without processes such as ground-truthing (Sadd et al., 2014), meaningful community symposiums and feedback workshops (Driver et al., 2019), and continued input from a greater number of communities (Min et al., 2019), the efficacy and accuracy of the socio-spatial mapping tool were discussed to be less likely to represent the local community context and thus impede applications of representational and recognitional justice. Overall, a salient gap identified in socio-spatial literature is the need for better and more recent data that encapsulates localized and community-specific indicators of health, as well as deeper and more numerous processes in representational justice and recognitional justice.

As scholars widely note recognitional and representational justice to be essential dimensions of EJ (Fraser,1997; Schlosberg, 2012; Blue et al., 2021), after a review of the literature, I find it unclear what it means to meaningfully engage in more wholistic applications of EJ, particularly of recognitional justice concerning EJ-focused socio-spatial mapping. In Canada, while headway has been made to broaden the scope of EJ research, scholars assert an overemphasis on biophysical dimensions of exposures and health outcomes and distributive

justice in applications laws, policies, and research (Masuda et al., 2008; Giang et al., 2022). Meanwhile, scholars assert that an existing gap in EJ scholarship and applications is for improved decision-making processes to tackle EJ issues, which should include greater recognitional and representational dimensions of justice, such as prioritizing community knowledge in various ways (Blue et al., 2021; Giang et al., 2022; Schlosberg, 2007). However, while scholars increasingly recognize the need for greater integration of various dimensions of justice (distributive, representational, recognitional) (Blue et al., 2021; Fraser, 1997; Johnson et al., 2016; Schlosberg, 2004), there is scant discussion of how to engage in recognitional justice in data collection processes and practices or support of socio-spatial mapping work even though scholars corroborate that there is a limitation in systemic and critical analysis while assessing environmental inequities in processes of assessment in Canada (Giang et al., 2022; Masuda et al., 2008). Considering these literary gaps, how might researchers and practitioners engage in assessment and decision-making processes that meaningfully integrate all three dimensions of justice (distributive, representational and recognitional)? How do researchers and practitioners practically engage in meaningful practices and processes of recognition, particularly if it is "not only the right of different practices to co-exist but entails an active engagement across (...) knowledge systems" (Coolsaet, 2016, p.165)?

Opportunities and Gaps in the arts-related literary fields

Given the vast nature of this line of questioning, arts-related methods offer a unique opportunity to support my role as a researcher in exploring how researchers and practitioners develop integrative socio-spatial mapping tools to implement and engage with environmental justice in their work. Such practice-led and creative spaces can help a researcher to become "unclosed" to new possibilities, knowing and building a capacity towards recognition of differences (MacGill, 2023, p.510) while cultivating a tolerance for ambiguity (Abma et al., 2019).

In the arts-related literature, there exists a wide variety of examples of participatory and community-based projects in connection to human health and social justice (Abma et al., 2021; Sameshima et al., 2017; Keifer-Boyd, 2011; Fawcett & Johnson, 2019), and a growing interest in incorporating the arts in the field of Health Sciences (Lapum, 2018). As discussed in the previous section (see arts-related research), arts-related research offers methodologies, through a wide variety of modalities and practices, to analyze, connect to, distill and represent knowledge

in affective and non-linear ways outside of our current realm of knowing (Sameshima et al., 2019; Lapum, 2018) and thus, is well suited to exploring topics of EJ, such as recognitional dimensions of justice (Sze, 2015). After all, making our relationships to knowledge more visible and known "presents a unique possibility to engage with recognition" (Sze, 2015, p.108), where the researcher can explore more recognitional capacities to connect and understand the data, and represent it through more creative and affective capabilities, and thus be more open and adaptable to recognizing values, knowledge, and cultures outside of their current lens of thinking and being (Sze, 2015). However, based on the reviewed literature, scant research utilizes arts-related methodologies in the Health Sciences in connection to environmental justice. Additionally, there are no discernable projects that use arts-integrated methodologies in the health sciences at the Master's level that seek to engage in data analysis through creative and experiential deep listening and knowledge translation practices in connection to how key informants operationalize socio-spatial tools and EJ in Canada in theory and practice.

All in all, these gaps and trends inform, in large part, the context of my research, which seeks to explore how researchers and practitioners who are developing integrative socio-spatial mapping tools are implementing and engaging with environmental justice in their work, including engagement with recognitional, distributional and representational dimensions of justice and experiments with an arts-integration methodology to engage with data analysis and knowledge translation.

Chapter 3: Methodology

In the following paragraphs, I will outline my positionality as it relates to this work, summarize my overall research design, describe pragmatism as my interpretive framework, outline my research methods, including data collection and analysis, as well as the arts-integrated process that enriched data analysis and knowledge translation. Finally, I will discuss this thesis's ethical considerations, study limitations, and challenges.

Positionality

Positionality situates the researcher's worldview and socio-political position and how it relates to their research, given that research is not separate from the studied social processes (Holmes, 2020). In the following section, I explore my positionality through my ancestry and individual traits and describe some key experiences that have shaped my current ontological and epistemological position.

I am an able-bodied, cis-gendered, white woman born into class and educational privilege. My ancestors come from Norwegian, French, French Canadian, German, and Mennonite roots as both victims of poverty and religious persecution as well as benefactors and perpetrators of settler colonialism. I am a maker and a weaver living on the shores of *Gichigami* (Lake Superior) in what is now called Thunder Bay, Ontario, the traditional territory of the Fort William First Nation. I use creative modes of making to reflect, process, imagine, mourn, and problem-solve. I aspire to be a perpetual life learner who values curiosity, relationality, and reciprocity. A core question I hold is how do we exist, live, and work in ways that are deeply in line with core values of honesty, integrity, love, equity, and action? I continue to learn and reflect on my position, privilege, and relationship to land and place. In my research, my privilege allows me to sift through and be curious about social, environmental and health impacts without my health being severely impacted by EJ issues such as resource extraction, limited health services, and environmental racism, to name a few.

Before attending the Master of Health Sciences (MHSc) program at Lakehead University, I worked as a science educator with various communities, schools, and youth of diverse ages and backgrounds across Northwestern Ontario, from Kenora to Attawapiskat to Wawa. Through this experience, I gleaned that true objectivity is not possible, given that we all have different relationships to knowledge. As a privileged guest in these northern communities, I had a firsthand glimpse of how human health is deeply shaped by the socio-historical legacies of the

land and its communities and how such legacies manifest in deep distributional health injustices across the North. Through this experience, I started to unsettle a positivist epistemology — where true knowing is gathered and understood through scientific rigour, facts, and verifiable observation — towards a more relational and qualitative worldview.

The social realities and lived experiences of the folks I was privileged to work with exist in many pluralities and cannot be fully captured quantitatively or in words. However, that is no less important to understand. Wilson (2008) suggests, “Stories go in circles; they don’t go in straight lines. It helps if you listen in circles because there are stories inside and between stories, and finding your way through them is as easy and as hard as finding your way home” (Tafoya, 1995, as cited in Wilson, 2008, p.6). My epistemological shift towards a relational worldview informs how I design and approach my research. My ontology, that is to say, my beliefs about the nature of social reality and what is knowable about the world (Creswell & Poth, 2018), is that knowledge is socially constructed and consists of a multiplicity of truths and that there is no one truth to be found on a given subject.

I pursued a MHSc at Lakehead to deepen my learning; to broaden a wholistic understanding of our health and justice, keep reflecting on my position and responsibilities living and working within these systems, and inquire how and why our relationships to knowledge matter. I hope my research contributes to the scholarly work in the intersections of health sciences, environmental justice, and arts-integrated research and offers reflections on new ways we might investigate, understand, and operationalize dimensions of justice in processes of using or developing socio-spatial tools.

Research Design

This research uses pragmatism as a framework of inquiry, environmental justice as a guiding theoretical framework, and an arts-integrated process that enriches data analysis and knowledge dissemination. This research aims to explore how researchers and practitioners developing integrative socio-spatial mapping tools implement and engage with environmental justice in their work. Sub goals of the research include investigating how researchers and practitioners developing socio-spatial mapping tools understand and engage with environmental justice in their work; describing the major challenges and limitations in applying environmental justice dimensions experienced by researchers and practitioners developing integrative mapping tools; identifying opportunities to deepen engagement with environmental justice dimensions in

the context of integrative mapping; and, to engage in and experiment with a novel arts-integrated practice that enriches data analysis and knowledge dissemination, using weaving as a modality.

Eight semi-structured key informant interviews were collected as the major data collection form, followed by verbatim transcription, an arts-integrated weaving process, and a thematic analysis method of coding the data into themes and sub-themes (Braun & Clarke, 2022) (see Figure 3).

Pragmatism

Since the resurgence of the popularity of qualitative inquiry in the 1980s (Morgan, 2007), pragmatism was established to bridge quantitative, qualitative, and mixed methods realms of research and advance ossified and traditional ways of thinking (Morgan, 2014). Pragmatism is generally used in more practical topics of study, which is highly dependent on the research context (Dillon et al., 2000). Ontologically, it is a framework that accepts that there is no single truth to reality (Creswell & Poth, 2018), where reality is seen as fluid and "in a constant state of becoming" (Kaushik & Walsh, 2019, p.255) and where truth is "provisional, grounded in history and experience or context, not fixed in the nature of things" (Dillon et al., 2000, p.17). Pragmatism asserts that previous experiences shape the researcher's beliefs and actions and thus impact the choices and direction of the inquiry process and our overall experience of reality (Kaushik & Walsh, 2019, p.17). All in all, pragmatism aligns with my proposed topic of study as it aligns with my methodological choices and my own onto-epistemology as a researcher.

For instance, my methodological choices include two concurrent processes: semi-structured interviews and an experimental arts-integrated approach. Such a combination of processes attempts to elucidate and connect the participants' beliefs and actions while understanding that these are shaped by previous experiences and the researcher's interpretation of them (Morgan, 2007). Using a multitude of methodological processes along with an understanding that a researcher's and participants' experiences are "grounded in history and experience or context and not fixed in the nature of things" are key features of pragmatism (Dillon et al., 2000, p.17). Moreover, it is important to outline and understand how and why researchers make decisions that direct their research (Morgan, 2014). For instance, Morgan (2007) states that pragmatism should not only prioritize methodology but researchers' epistemology as well by stating that it is important to focus on methodology as a tool to connect our thoughts about the nature of knowledge and our efforts to produce it, rather than separating

our existing philosophical threads from the research design (Morgan, 2007, p.68). Incorporating an arts-integrated methodological process helps show my role as the researcher in interpreting the data and the context of the participants shared through a tangible artifact woven and sewn into a tapestry, partly as a commitment to exploring and representing how we each have relationships with knowledge.

Finally, the mode of data analysis — thematic analysis — is congruent with the key characteristic of pragmatism that asserts that truth is context-specific, not fixed and impacted by previous experiences (Dillon et al., 2007; Morgan, 2014). In this vein, King (2004) explains that in thematic analysis, there is an assumption that any perceived phenomenon or theme could have multiple interpretations, depending on the lens(es) of the researcher and the context of the research (King, 2004). As such, thematic analysis is ontologically aligned with pragmatism; rather than an emphasis on "reliability" or generalizability of the findings, there is a greater focus on 1) engaging with the topic from various perspectives, 2) focusing on the richness of the interviews and narratives, and 3) the reflexivity of the researcher (King, 2004). Additionally, the arts-integration process of weaving and the final artifact created (see Appendix G) is a physical manifestation of my position as a researcher concerning producing and synthesizing knowledge, which is a value in line with pragmatism (Morgan, 2007, p.68). Overall, my research is well suited to pragmatism given key characteristics, including the use of more than one methodological process (arts-integrated and thematic analysis) and the epistemological and ontological understanding that the nature of knowledge is not generalizable nor fixed.

Methods

Study Population

Using purposeful sampling, eight participants were identified as researchers or practitioners with extensive expertise and experience with integrative, socio-spatial mapping tools relevant to environmental justice in Canada. Purposeful sampling is an effective method to maximize efficiency, validity, and understanding in instances with limited resources, such as time, and a depth of knowledge and expertise, such as a Master's student-led project (Palinkas et al., 2015). Additionally, it helps identify participants with a greater willingness to participate, which is necessary to allow for rich data collection among these limitations (2015).

To start, I developed an initial list of interviewees based on my literature review and participants who attended a webinar and panel called an "Enviroscreen Engagement session"

(November 21st, 2022) held by scholars and Environment, Community, Health Observatory (ECHO) Network members, as well as Health Canada employees. The panel was curated to talk to researchers and practitioners who were identified as deeply knowledgeable with salient experience in the interdisciplinary field of cumulative health impacts, socio-spatial tools, and data management. From there, snowball sampling was utilized (Ungvarsky, 2017). Key informants were selected to represent different mapping tools and organizations connected to EJ (e.g., governmental, academic, self-employed, etc.) and to allow for greater representation and knowledge.

Key characteristics of informants included researchers or practitioners that play a key role in developing or supporting integrative socio-spatial mapping tools geared towards understanding and addressing equity that use a range of data sources through their work across various sectors (e.g., academia, government, not-for-profit and self-employed) across Canada. Three participants were working in academia, three were self-employed, one was working in the federal government, and one was connected to both not-for-profit and academia in their work. Participants hailed from across Canada: four were based in British Columbia, one was in Alberta, one was in New Brunswick, and two were in Ontario. When asked about their gender identity, three participants identified as women and five as men. All participants were given an alias (see Table 2).

Table 2

Participant Profiles

Alias	**Gender**	**Work Sector**	**Location**
James	Man	Academia	British Columbia
Andrew	Man	Self-employed	British Columbia
Morgan	Woman	Self-employed	British Columbia
Riley	Woman	Academia	British Columbia
Lucas	Man	Self-employed	Alberta
Rowan	Man	Federal government	Ontario
Charlie	Man	Academia	Ontario
Alexis	Woman	Not-for-profit and academia	New Brunswick

Participants have been using and developing various socio-spatial tools in many interdisciplinary capacities. As a reminder, in the context of this research, "integrative socio-spatial mapping tools'' refer to digital tools, including maps, that combine socio-spatial data to better assess and address cumulative impacts on human health (Huang & London, 2016). Such impacts result from complex, overlapping and cumulative interactions between various health determinants that occur within and between layers of environmental, socioeconomic, and physical determinants and health disparities (Huang & London, 2016; Schulz et al., 2016).

For instance, five participants were or had been working on four socio-spatial mapping tools, similar in methodology, that merged environmental, socioeconomic and health data to better understand cumulative impacts using a method of standardizing data to illustrate an indicator's percentile rank among all units of analysis in three different provinces and contexts. Two participants were also heavily involved in various biology-based land use projects, working with First Nation communities in land reclamation, logging, and mining projects. Another participant was developing a national tool to identify which communities and individuals experience a higher risk of extreme heat events by merging health indicators and existing environmental and infrastructure resources. One participant was involved in a wide variety of international projects using socio-spatial tools, photovoice, and agent-based modelling to mobilize community change and shape policy, to name a few. Another participant utilized various socio-spatial tools and applications, including environmental assessments and bioaccumulation, merging ecological health and engineering fields through contaminant modelling, data analytics, and collaborative, community-based air modelling studies.

This research sought to investigate how researchers and practitioners developing socio-spatial mapping tools are understanding and engaging with environmental justice in their work given that: 1) designing such tools is highly complex work, often utilizing a range of data at various geographic and population scales (Parkes et al., 2019); 2) the literature points to the need for more tools and processes that capture the interconnecting and cumulative impacts stemming from environmental injustices that deeply impact human health in a multitude of ways (Buse et al., 2013; Parkes et al., 2019; Tuncak, 2020); 3) there is a growing interest in developing more socio-spatial tools across Canada at this time (Buse et al., 2018; Blue et al., 2021; An Act to amend the Canadian Environmental Protection Act, 2022); and, 4) the need to explore and

operationalize dimensions of EJ more wholistically (Fraser, 2008; Schlosberg, 2008; Blue et al., 2021).

Data Collection

Eight key informant interviews were conducted using semi-structured interview questions (see Appendix E) that lasted between 60 and 90 minutes from February to April 2023. Participants were invited through email and sent a consent form and information letter before the interview. Verbal and/or written consent was obtained before initiating the interview. At the beginning of the interview, participants were asked to speak about their current work within socio-spatial tools and environmental justice. Interviewees shared their experiences and reflections on why, why not, and how environmental justice was operationalized within their work, and the significant challenges and opportunities they saw going forward to deepen engagement with environmental justice. Finally, the interview concluded with optional demographic questions, inquiring if they would recommend anyone else to speak to, as well as questions to tie into the arts-integrated woven piece of the project (i.e., summarize your work in one colour and one word). Interviews were largely conducted in English, apart from one interview that was done bilingually (English and French). All interviews were recorded via Zoom, transcribed verbatim, and sent to participants for member checking. Aliases were assigned to each participant to maintain confidentiality (see Table 2).

Data Analysis

I utilized two core processes in data analysis: coding the collected data using Braun & Clarke's (2022) six-step framework of thematic analysis and engaging in and experimenting with an arts-integrated practice using weaving as a modality (see Figure 3). Both processes are described in more detail in the following paragraphs.

Figure 3

Summary of Data Collection and Data Analysis Processes

Thematic Analysis Process. Concurrently with the arts-integrated process of weaving, I started the process of thematic analysis, a practical and clear method that allows for flexibility and rigour in analyzing interview data (Braun & Clark, 2022). I used an inductive and emergent approach to coding where the data content directed the development of themes and sub-themes (Braun & Clark, 2022). I started the data analysis process with the important step of becoming familiar with the data, which included weaving, transcription, reading and re-reading the transcripts and noting early impressions and rough notes (see Figure 3). Once I became familiar with the entire body of data (Maguire & Delahunt, 2017), I uploaded the transcripts in NVivo software 14 (QSR International, 2023). Here, I reviewed each interview and organized them into preliminary codes. Following this process and the third stage of thematic analysis (Braun & Clark, 2022), I searched for themes, defined as "a pattern that captures something significant or

interesting about the data and research question" (Maguire & Delahunt, 2017, p.6). At this stage, I analyzed the preliminary codes to identify connections and patterns between the data and grouped them into themes and sub-themes. Then, I reviewed these themes, modifying, developing, and distilling them further to ensure their relevance to the research question. After becoming familiar with the data using an inductive approach, I underwent three core iterations of these steps (initial coding, search for themes, and review). Then, the themes were defined in a codebook, including salient quotes (see Appendix E). Finally, the sixth and final step of the thematic analysis process was completed as I wrote the findings in this thesis (Braun & Clark, 2022). To note, I had numerous conversations with Dr. Galway to help with theme and sub-them delineation.

Arts-integrated Data Analysis Process. Before transferring the transcripts to NVivo and once all interviews were transcribed, I began my experimental arts-integrated process using weaving as a modality. Before weaving, I set up my warp and materials on a 7-yard-long warp made of 'natural' coloured cottolin (a 60% and 40% mix of Cotton and Linen) (see Appendix G). As "we learn better, listen better, with busy hands" (Elke, 2022, p.63), I began by re-listening to each interview as I wove on my floor loom over one week. For each interview, I wove continuously for its full duration, stopped once the interview ended and only used colours identified by participants. During the interviews, participants were asked: "If you had to choose one **colour** and one **word** to summarize how you feel about engaging in this work, what would it be?" As such, while some participants noted similar colours, each participant's interview is represented in a distinct block of woven material (see Figure 5). During the 10 minutes following this process, I wrote out ideas and reflections that had emerged, including potential preliminary codes, themes, ideas, questions, and reflections. Such a chronicling during my weaving can be touted as a "dynamic creative process" (Richardson & St Pierre, 2005, p.924) within itself, and allowed a systemic returning and chronicling of my reflections as I wove that I referred to in my thematic analysis and as I wrote my final thesis. I took pictures and videos chronicling the process (see Appendix G).

Overall, weaving as part of data analysis allows a process of engaging with the data through different sensibilities that are more affective and corporal (Sameshima et al., 2019). Re-listening to the interviews while emergently weaving invokes a deep listening that is auditory, aesthetic, intuitive, and engaging an affective felt sense of my hands, heart, and body —

processes that Irwin touts as liminal spaces where new ways of knowing and understanding might be discovered (2013) and allows for "new lenses for viewing, analyzing, representing, and disseminating research" (Sameshima, 2019, p.2). Through an arts-integrated approach, space within engagements with the data can allow "indwelling" between and through the cracks of the data that can disrupt normative methods of engaging in knowledge production that engages more tacit, emotive, and affective sensibilities rather than privileging the cerebral above all else (Sameshima et al., 2019) without relegating the research design to a specific discipline or epistemological alignments (Sameshima et al., 2019); nor the ambition to provide transformational praxis (Knowles & Cole, 2008); nor the necessity for arts-integrated processes to shape the foundation of the research (Finley, 2008). Overall, it allows new lenses for viewing, analyzing, representing, and disseminating the study's findings, represented in the final created artifact as part of the knowledge translation component of this research.

Process of Crafting Findings, Discussion & Knowledge Translation. Once I underwent the final stage of thematic analysis and wrote up my findings, I re-visited my woven textile to undergo a process of creating a final artifact that could be shared as a final product for knowledge translation and to enrich and support my findings (Sameshima et al., 2019) (see Findings and Figure 5). The created artifact is a tapestry, a tangible representation that makes visible the tacit expressions of people across Canada working on threading environmental justice and socio-spatial tools and my role as the researcher in synthesizing these narratives. As Sameshima et al. (2019) note, an artifact is a form of knowledge creation. It provides another way of comprehending the data and sharing meaning by providing a mirror to see the data through a different modality. An artifact can help the viewer weave a grander tapestry of connections between understanding, conceptions, and emerging questions and is an articulation of the tacit (Sameshima et al., 2009). The creation process experimented with the potentialities of analyzing and translating knowledge in a qualitative study, utilizing an arts-integrated methodology and emergent weaving.

Ethical Considerations, Study Limitations and Challenges

Before engaging with data collection, approval from the Lakehead University Research Ethics Board was received on February 2nd, 2023. Prior to conducting interviews, all participants signed the information letter and consent form (see Appendix A, B and C). In the information letter, participants were informed of the potential risks and benefits of the study and

were informed that there were no foreseeable costs (aside from time) or harm to participating in this study. It was explained that while there was minimal risk in participating in this study, some answers might have made confidentiality harder if specific instances or situations were traceable. Only my supervisor, Dr. Galway, and I knew who had participated in the research, and no names nor any information that could potentially lead to the identification of research participants was used in any use of the outputs, such as employer information or community names. Additionally, participants were informed that they had the right to only share what they were comfortable disclosing, that participation was voluntary, and that they could end the interview or withdraw from the study at any time without giving a reason and without repercussions until the defence of the final thesis.

Following the interviews and the subsequent transcription process, participants were allowed to member-check and edit their transcripts to ensure I correctly captured their intended meaning. Data will be stored for seven years after the completion of the study, at which time it will be destroyed by removing computer files from the hard drive and shredding hard copies of data. A summary of the research will be synthesized and distributed to participants following the completion of the project. Several limitations and challenges to this research should be considered and recognized related to data collection, analysis, and interpretation.

To begin, this study does not offer generalizable conclusions, as the sample size was small, and participants hailed from various geographic and social contexts across Canada. Participants were largely educated in post-graduate programs in traditional Western universities at the Master's and Ph.D. levels and living in mostly metropolitan areas, largely excluding those directly experiencing or contending with environmental injustices. The sample of participants lived across Canada yet did not cover all provinces and territories: two were in Ontario, four were in British Columbia, one was in New Brunswick, and one was in Alberta. All in all, the findings of this research were generated from a small sample of participants whose wisdom was collected, analyzed, and interpreted by one researcher, whose background and experience undoubtedly impacted the interpretation and analysis of the data.

Second, this project is largely a theoretical contribution to academic literature and does not engage with EJ movements and activism, which forms a seminal and foundational facet to environmental justice, which also includes transdisciplines in academia and social policy strategy (Agyeman et al., 2010; Sze & London, 2008). Additionally, this research misses important

voices actively pushing back on ongoing injustices at grassroots and policy levels, including First Nation and community-based organizers. As Lucas summarizes, “Environmental justice is an academic discipline, but a really important part of it is the community level and activism level, and that’s just not something that I engage with in my work.”

Third, the broadness of the topic was a major limitation. Participants shared many ideological and conceptual notions of health and justice as well as affective, personal, and lived experiences across many contexts that could not be fully captured in words nor within the confines of a Master’s thesis. Given that this research targeted key informants who were highly specialized in using and developing socio-spatial tools that engaged with equity or environmental justice, not only did participants have various understandings and connections to environmental justice, but for some, it was a core element driving their work, while others focused more specifically on equity rather than environmental justice. As such, applications, conceptualizations, and definitions of EJ shared by participants are not distillable into easy and generalizable conclusions in this project and otherwise, given the intersecting places, people and socio-political conditions that shape each context (Schlosberg, 2007; Fraser, 1997).

Fourth, the types of work related to socio-spatial tools and participants' geographic contexts were vast. Participants’ professional contexts differed, as well as the quantity and type of socio-spatial tools and processes they engaged in; three participants were self-employed socio-spatial developers working on a very wide variety of projects; three were professors and academic researchers utilizing a variety of tools and processes, including various projects surrounding policy, environmental assessment and participatory community-based research; while two participants (one in the not-for-profit sector and the other working for the federal government), spoke to one particular tool relevant to their work.

Fifth, given that the lived experiences of participants shared in understanding and operationalizing equity and environmental justice spanned a lot of different spatial and social contexts, distilling what they shared into a salient written narrative for this thesis was challenging. For instance, some explained that the core motivations for doing this work of using and developing socio-spatial tools and processes were due to their personal experiences of witnessing first-hand environmental injustices or discrimination as young people or due to experiences in higher education and differing professional experiences. Participants shared evocative stories that are foundational to why and how they do this work of using tools and

processes to understand and shift distributional, recognitional or representational injustices, including the contexts, lands and places that shaped them and continue to shape their work operationalizing socio-spatial tools and processes and environmental justice. As such, the formative stories that contextualized why and how participants connected to justice and equity in the ways that they do were left out in this thesis, given the limited space and time to articulate them.

Finally, setting myself up to undergo an arts-integrated process was a major challenge, given the emergent nature of an experimental arts-integrated practice. While I found examples and literature to substantiate my arts-integrated method and validate its methodological and conceptual value (Eisner, 2008; Irwin, 2013; Leavy, 2018; McNiff, 2013; Sameshima et al., 2019), there was no example of research that combined weaving as a modality to support a data analysis process during a qualitative research project through embodied listening nor to disseminate knowledge that I found at the time of my research.

This thesis was a practice of what Fischer (2015) aptly describes as juggling both "the beauty of risk and the necessity of graduation" (p.48). Engaging in an emergent process where the final artifact for knowledge translation is not known at the outset, risking a new method of creative practice, and centring oneself in uncertainty for sustained periods required perseverance (Loveless, 2019). Moreover, explaining the validity and relevance of including an arts-integrated approach while navigating the plethora of definitions, contexts, and applications of arts-related research required additional time and effort to build trust and understanding of my project with my committee members, which is a usual challenge noted in projects in academia utilizing an 'unconventional' creative approach that is less commonly used in academia (Chapman & Sawchuk, 2012; Voarino et al., 2019).

All in all, participants shared many ideological and conceptual notions of health and justice as well as affective, personal, and lived experiences across many contexts that could not be fully captured in words or within the confines of a Master's thesis. The findings presented herein are the product of my interpretation of the data as a researcher with my relationship with knowledge and my best attempt to make meaning of and represent the participants' shared perspectives into salient narratives.

Chapter 4: Findings

The findings of this research project are represented by four key themes that emerged through thematic analysis (Braun & Clarke, 2022) and an arts-integrated process (Sameshima et al., 2019) and in relation to the core research question of **how are researchers and practitioners who are developing and using integrative socio-spatial mapping tools implementing and engaging with environmental justice in their work?** A visual summary of these four themes is provided below (see Figure 4), and a complete overview of the themes and sub-themes can be found in the codebook (see Appendix E). Four themes and 11 sub-themes are explored below, including an image showing the final woven artifact from my arts-integrated process (see Figure 5). As a reminder, refer to Table 2 for participant characteristics, including aliases, which will be used to cite participant quotations.

The first theme, *shining a light on distributional patterns*, explores how researchers and practitioners operationalize socio-spatial tools in connection to environmental justice by illuminating inequitable distribution patterns through cumulative and integrative approaches to inequity and inequality. The two sub-themes of this first theme include *(in)equity/(in)equality* and *cumulative approach(es) and integration*.

The second theme, *creating change through processes and power*, describes how these tools and processes related to the tools can create change in both decision-making and within communities. It also reflects the importance of developing deliberate and context-relevant process(es) and recognizing the role of power in making such changes. The three sub-themes of this second theme are *tools guiding decision-makers & policy, engaging communities, and recognizing power*.

The third theme, *acknowledging challenges and tensions*, names the technical challenges, including data quality and availability, as well as other tensions, such as institutional funding, the need to recognize bias, and decision-makers longing for certainty in operationalizing socio-spatial tools. The four sub-themes of this third major theme are *technical challenges in data quality and availability*, *institutional funding*, *complexity & longing for certainty*, and *recognizing bias*.

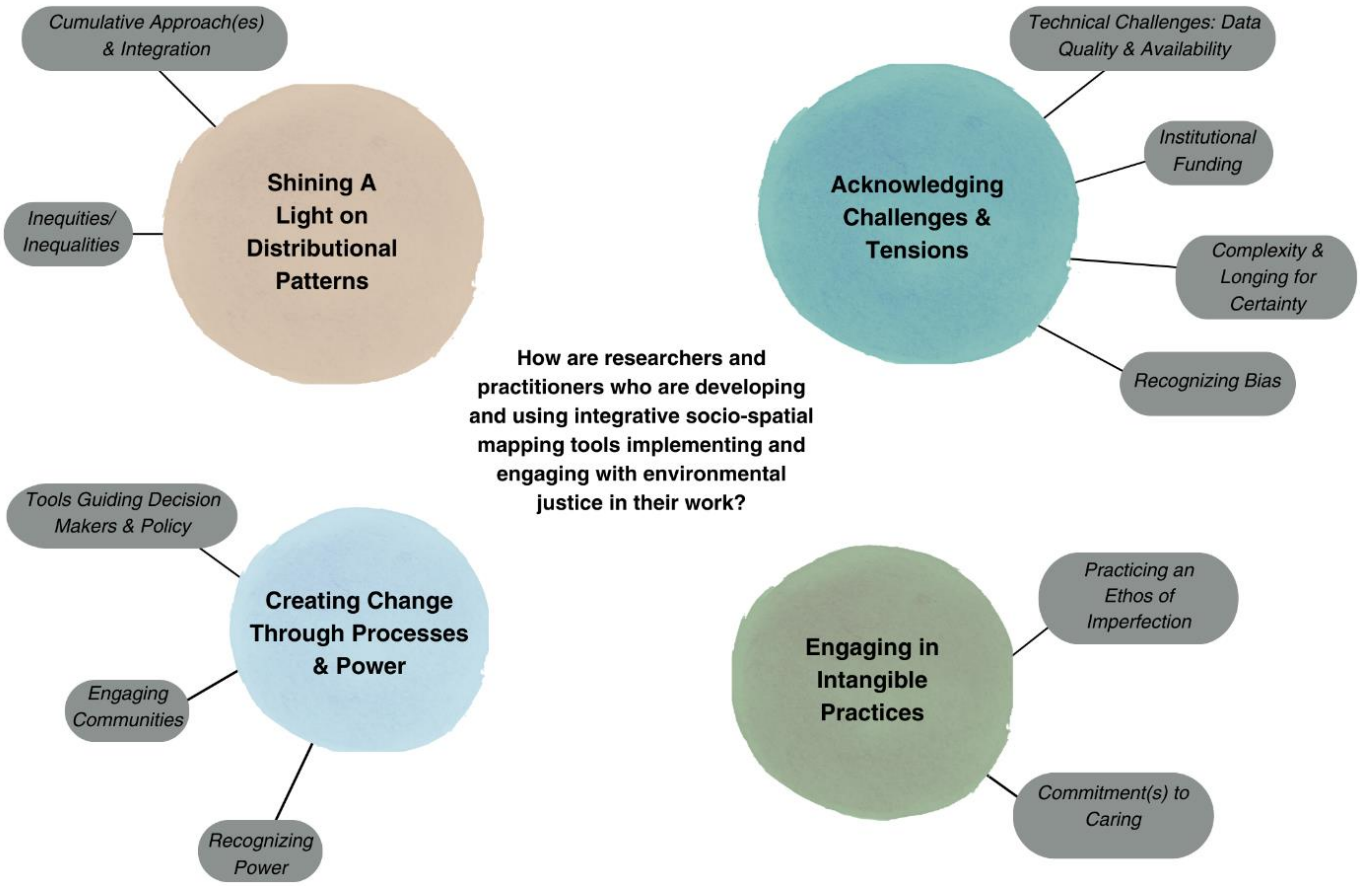
The fourth theme, *engaging in intangible practices*, encapsulates how individual practices that participants utilize help them to better engage in their work of using or developing socio-spatial tools. Although these practices can be difficult to name, they reflect alignment with

dimensions of environmental justice, including two sub-themes: *commitment(s) to caring* and *practicing an ethos of imperfection*.

Finally, I provide an image of the handwoven tapestry as a tangible manifestation of the elements that participants shared during the interviews and my process of listening, interpreting, and finding meaning in their interviews (see Figure 5).

Figure 4

Major Themes and Sub-themes



Theme 1: Shining A Light on Distributional Patterns

In conversations about the value of participants' work with socio-spatial tools, a core theme that emerged was the central role of these tools in illuminating inequitable distributional patterns. As Riley states, understanding "spatially and temporally distributed impacts can allow us to ask questions about distributional impacts, who are being impacted and why, and explore different scenarios around that." The name for this theme was inspired by conversations with participants, as expressed in the following quote by James: "Part of what these tools, these socio-spatial mapping tools or otherwise do, they are the flashlight, they are shining the light." In relation to the theme of *shining a light on distributional patterns,* two significant sub-themes surfaced: (*in)equities/(in)equality* and *cumulative approaches and integration*. This first theme provides a necessary foundation to elucidate the value of operationalizing socio-spatial tools in connection to the core concepts of equity, inequality, and environmental justice, thereby laying the foundation for understanding and explaining the second theme, *creating change through processes and power*.

(In)equity/(in)equality

When discussing motivations and their experiences working with and/or developing socio-spatial mapping tools, all participants asserted that equity was a central concept guiding their work. For many, the socio-spatial tools are particularly beneficial in assessing, analyzing, and illustrating the cumulative impacts of resource extraction across various geographies. If they are used in this way, equity is often "at the center of the tool" (Alexis) or, as Rowan explains, "important and foundational to the work that we do." In the following paragraphs, I explore more specifically how the participants conceptualized inequity, inequality, and environmental justice while providing key examples of how participants use socio-spatial tools to *shine a light on distributional patterns*.

To begin, it is important to note that for some participants, environmental justice was a strong theme guiding their work that was deeply connected to equity: "When you start talking about justice, you start talking about equity, really" (Riley). That said, while other participants had not explicitly considered environmental justice in their work, most believed it plays or should play an essential role in identifying and alleviating inequitable distribution of benefits and harms in socio-spatial tools after discussing it in the interview setting.

In conversations about environmental justice and socio-spatial tools, many participants highlighted the distinction between equality and equity, describing them as distinct yet interconnected concepts, where "inequalities are a visceral manifestation of (in)equity" (James). Notably, discussions of (in)equity and (in)equality highlighted that socio-spatial tools can point to evidence of (*in)equalities* across geographies and scales by showing differences between individuals and population groups. However, most participants distinguished how inequities perpetuate such inequalities and that the inequitable distribution of benefits and harms that are often intangible or invisible. As Riley explains,

> As opposed to just doing the distributional work of asking who is more impacted or are those outcomes equal or unbalanced (...) — the types of things that we can see and count and touch and hear about — inequities are these kinds of amorphous structural, kind of invisible forces at play that guide, and shape (in)equality. (In)equity is important because it asks intentional choices about what's right, fair, and just.

Some examples of inequitable distribution discussed by participants about their work included access to services and amenities such as health care programs, green space, education, economic opportunities, as well as exposure to cumulative impacts of resource extraction like bioaccumulating water and air pollutants and health outcomes such as rates of cardiovascular disease, to name a few.

Participants shared a variety of examples illustrating the value of socio-spatial mapping tools to show inequitable and unequal distributional patterns caused by industry and resource extraction projects such as forestry, mining, smelters, pulp mills, hazardous waste facilities, and oil refineries, to name a few. Some related impacts described by participants included air pollution (e.g., excess carbon dioxide, odour, and cardiovascular disease) and water quality (e.g., mercury, lead, and cadmium). More frequently discussed impacts included socioeconomic factors such as the distribution of socioeconomic impacts related to education, income, government investments, gender, and language. In the following paragraphs, I will provide more examples of how socio-spatial tools are used to illuminate distributional patterns in connection to equity, equality, and environmental justice, with the support of quotes.

To begin, two participants provided lengthy explanations of the relationship between gender and income as an example of the benefit of socio-spatial tools for illustrating inequitable

distribution: for shining a light on inequitable distribution patterns in other words. Lucas described his experience,

> We don't often talk about how income is concentrated, how equally distributed income is, or the gender income inequality. The Canadian average gender income gap is about 80 cents to the dollar, but in Alberta, it's about 67 cents to the dollar. When you map it and get granular, there are places where it's 50 cents to the dollar. It's shocking when you see it because we are not used to seeing or thinking about inequity.

Another example of socio-spatial tool applications was expressed by Charlie, who used agent-based modelling as a socio-spatial simulation to illustrate the distribution of government subsidies and extension programs in connection to the costs incurred by organic and non-organic farmers (e.g., crop yields and revenue, fuel, and labour costs). Using a similar method, another project showed how the distribution of development might impact the health and well-being of population groups on both sides of the Green Belt in the Credit River watershed in Toronto. Health outcomes between the developed and undeveloped sides were compared by the number of dollars saved by avoiding health concerns. Alexis described the utility of a socio-spatial tool she was involved in developing to illustrate the cumulative impacts of natural resource extraction on community health and the environment in New Brunswick. Specific inequities illustrated by the tool included the distribution of socio-economic investment across the province, where the quality of health of communities in proximity to high levels of industrial projects, and thus pollution, was shown to be highly dependent on the level of socioeconomic investment by the province and the history of colonization and language dominance (e.g., education, green infrastructure, access to quality health services and whether communities were French-speaking etc.). Riley emphasized the value of socio-spatial tools in relation to climate change, air pollution, water pollution, and health equity, given that "…impacts are absolutely not equal everywhere; there are huge distributional patterns."

> The other pollutants I work with, like air pollution or water contaminants, have strong temporal and spatial gradients in terms of who is experiencing it and where…So, distribution is a huge part of the field of people who study air pollution, exposure and health risks right now, recognizing that if you are interested in understanding, especially health impacts, you really need to get at those questions of distribution; who is bearing

> the burden of air pollution, what are the activities that drive that pollution and who is benefiting from those.

Relatedly, Andrew described his experiences in the context of a project he was working on connected to Alberta's climate change and industry impacts. He describes how including climate variables in a tool could theoretically help to show the inequitable distribution of harms and benefits, but practically was very hard to do so, given the spatial and temporal nuances of climate change variables to each location and community (e.g., forest fires, rain, etc.).

Overall, and in diverse ways, *shining a light on distributional patterns* was a central facet and important contribution of socio-spatial tools related to environmental justice for all participants in this research. Equity proved to be a key factor in illuminating distribution patterns and engaging with environmental justice in the work of researchers and practitioners. In general, participants discerned how tools helped to illuminate patterns of inequity and inequality (two related yet distinct concepts) and discussed specific examples of where socio-spatial tools can help illustrate distributional patterns, including health outcomes and environmental impacts from resource extraction, industry, and climate change.

Cumulative Approach(es) and Integration.

The second sub-theme connected to *shining a light on distributional patterns* is *cumulative approach(es) and integration*. Many participants described how socio-spatial tools are invaluable for illuminating distributional patterns, given their unique ability to achieve integration and illustrate and understand cumulative impacts. More specifically, integrating data and diverse indicators within and through these tools, or "bringing together the triad of environmental, community and health data...to make sense of the whole. (James). Many participants expressed that engaging in environmental justice demands consideration of environment, community, and health issues together as part of a whole, which in turn requires integration. As James noted, "You can't do environmental justice without considering [environmental, community, and health] in conversation (...) For me, the three of them are conversing with one another; that's at the core of environmental justice." Another participant explained that if you only look at one factor without others, you "cannot call that environmental justice because you are missing the other important elements." Other participants, like Alexis, noted that integration of data, perspectives, and factors were essential facets of enacting environmental justice, stating: "For me, environmental justice means taking into consideration

all the things: governance, equity, and bringing socioeconomic factors, health and environment together."

In addition to *integration,* a *cumulative* approach was an important concept for most participants in illustrating distributional patterns using socio-spatial tools. All participants understood a deep interconnection between the state of the environment, human health, and (in)equities. Each participant expressed that the environmental and health impacts and inequities are shaped by multiple intersecting and interconnected factors, such as the combination of exposures to hazards and access to social and ecological services (e.g., health care, education, and green space) as well as structural elements (e.g., impacts from colonialism, systemic discrimination, etc.). A common thread in the interviews was that integrating data and indicators representing environmental, community, and health is essential for the use and development of socio-spatial tools in connection to environmental justice, given that the health of humans and the environment is cumulative and interconnected. This approach is supported by definitions of environmental justice which seeks to "redefine environmentalism as much more integrated with the social needs of human populations" (Pellow & Brulle, 2005, p.3).

Many participants emphasized value of socio-spatial tools for shining a light on distributional patterns related specifically to human health given that health is influenced by numerous intersecting social and ecological factors. Lucas explains how exposures to stressors and hazards are cumulative: "People are not just experiencing one thing at a time. I'm not just experiencing one pollutant or one stressor. I am experiencing the sum of a bunch of different chemicals, different sources, and social, environmental, and other stressors." Lucas went on to explain that applying a cumulative approach through integrative socio-spatial tools, instead of a single source approach, is more effective in terms of understanding inequity and in alignment with environmental justice:

> You can look at those things individually, and they are inequitably distributed; we know that. You can see to what extent it is inequitable. And then, you can layer all those things on top of each other [using a socio-spatial mapping tool] and see what and where these intersections are. These most vulnerable places intersect with the most at-risk places because those things exacerbate each other, and those are the places that we should focus on first or at least be aware of for management or intervention.

Relatedly, James explains that socio-spatial tools are particularly valuable as they can "measure the confluence of those systems," where "we can think about and tailor and scale up multiple cumulative pressures across time and space," ultimately illustrating how distributional patterns of inequities intersect with one another.

When describing her involvement with socio-spatial tools as related to environmental justice, Riley noted that many existing health impact assessment tools do not account for the intersecting factors impacting human health and do not account for the cumulative impacts of diverse factors across space and time in other words. She explained that many existing tools, which are looking at the impacts of a single pollutant or stressors of resource extraction and industry on individuals and communities, "aren't necessarily designed to get at distribution…for example, if you have one representative actor, or you are just averaging across the whole province or something like that; from a technical perspective, that's not enough to speak to distributional questions."

James echoes the same idea, emphasizing that most impact assessment tools do not account for "social impacts and health impacts." He asks: "[how do we] make sense of the confluence of these socioeconomic, environmental and health systems more comprehensively and wholistically? Not only about impacts on ecosystems, but impacts on communities and impacts for human health?" Without a cumulative perspective and socio-spatial tools that enable integration across diverse data and indicators, you "miss out on a huge swath of a lot of health risks that communities are facing" (Riley). Beyond this, Riley reflects on current limitations and describes how a cumulative and integration approach to impacts is helpful in discerning distributional patterns across space and time:

> If you look at Chemical Valley in Ontario, each facility is following its permit, but the burden that the people are experiencing is, for lack of a better word, ridiculous. And so, it leads you to ask, how can everyone be in compliance and it does not match up with the health burdens or the impacts people face? What is not being captured in this? One of those things is integrating many of these different and multiple kinds of dangers, stressors, sources, and a wider range of impacts. Of course, as much as cardiovascular is important, and we focus on those because it is really important, so much other stuff impacts well-being and quality of life and can drive additional cycles that I think are not captured.

Overall, the data illustrate how cumulative approaches and integration are understood as unique and important strengths of socio-spatial mapping and central themes in the conceptualizations used by researchers and practitioners developing socio-spatial tools connected to environmental justice. As James summarizes, tools "can do the work of bringing together environment, community and health, and if they are equity and justice informed, then there is an understanding that environmental inequalities are social inequalities." Finally, participants described how cumulative and integrative approach is needed to better illuminate distributional patterns, shine a light on inequities, and engage in environmental justice.

Theme 2: Creating Change Through Processes & Power

In this section, I discuss the key theme, *creating change through processes and power,* using the following three sub-themes: 1) *how tools guiding decision-makers and policy*, 2) *engaging communities,* and 3) *recognizing power*.

Tools Guiding Decision-makers & Policy

Participants discussed how tools, as well as outputs (i.e., maps) and processes associated with those tools (i.e., community engagement workshops), can help to create change by facilitating more informed decisions and policies through better evidence-based information. Many participants, such as Morgan and Alexis, noted that the impacts of socio-spatial tools were not necessarily illuminating to communities and individuals who were already living with impacts and inequities in everyday life and were most beneficial to decision-makers to bridge a missing gap in knowledge and perspectives. Rowan summarizes this sentiment well when he said, "I think something like this [socio-spatial tool] is going to be most useful for local, provincial, and federal governments. It will be useful for communities, but I think especially having it in the hands of decision-makers who want to make better decisions is going to really help." Many participants echoed the notion that socio-spatial tools can allow inequities or the lived realities of communities to "become visible," as Morgan notes, to those who are not experiencing them and those who are in a space to create change at levels of policy (i.e., decision-makers). Morgan typifies this when she says,

> I think that is the place where tools are useful because it is people who are not living those experiences so that they can see it. So, the tools and the maps and all those things are not a big shock for those living those experiences, but it is the people that are in

> decision-making that need to be convinced; they need to become visible, and they also need to be in a space where they are looking for those answers.

James, Andrew, Morgan, and Rowan each explicitly noted that socio-spatial applications help direct resources more equitably. However, many participants also suggested that making inequitable distribution of harms and benefits visible through socio-spatial tools and maps is not enough and that concrete action and community engagement are also necessary, particularly when it comes to environmental justice. For participants, meaningful change requires that decision-makers and policymakers "drive concrete action, both from a policy side and practically on the ground' (Rowan). Or as Andrew comments,

> A big part of what I do is about trying just to show what is the state of the environment and people in relationship to the environment, hoping that it makes the world a better place; that happens only if people take it and use it for policy work or make decisions.

In this way, participants described the potential role of socio-spatial tools to influence decision-making and policy through processes of working with various collaborators in a participatory way and to question what is fair by providing evidence. For example, Alexis explained how creating change across levels of government, given current policy gaps in New Brunswick, was a direct motivation for creating a socio-spatial tool illustrating the cumulative impacts of resource extraction:

> We don't have a law that can protect people, the community and the environment, so that's why we decided that it's a good thing to have more quantitative tools that can help us understand the impacts of natural resource extraction that will help us to take action and for more intersectoral policy for New Brunswick (…) Integrative tools are so important to make a big difference. I think that would help the government to take more concrete action…when we talk about natural resource development, we need to consider many things that need to change and to challenge the government, to make things better for the community.

Participants suggest further that the visual and evidence-based nature of such tools can help to facilitate dialogue for decision-makers to engage in processes of questioning what is and is not fair, in a way that is most reflective of the lived realities of communities and individuals. As James notes,

> If part of the justice work is to recognize that there is this unjust distribution of resources, part of the solution needs to be questioning, well, what is fair? Given what we know, given what we've mapped, what would a fair allocation of resources to these particular spaces look like? How do we raise the tide for those particular areas, and those particular communities, and for those particular populations based on what we know?

In conversation about the role of environmental justice in her work using socio-spatial tools and processes related to those tools, Riley posits that these can create dialogue at decision-making and policy levels and engage in recognitional components of environmental justice:

> Also linked to environmental justice is a strong recognition dimension of recognizing the diverse histories and lived experiences of different groups and communities. (…) Even when we ask about the fair distribution, what are different ways of thinking about different communities, and how does that link to different sorts of histories? Whose knowledges are we recognizing and using and incorporating in this? So, things that exacerbate or further cement harms for communities that have experienced historical or ongoing marginalization, for instance, is something that I think normatively as a society is not fair. There can be unequal distributions, but the ones we are concerned about can really drive or further reinforce these sorts of pernicious cycles.

Overall, participants discussed the value of socio-spatial tools to guide decision-makers and policy by providing evidence and making inequities more visible to enhance decision-making. The next section will focus on *engaging communities* as an example of how participants engage in *creating change through processes and power*.

Engaging Communities

Participants discussed why and how engaging with communities was essential in creating meaningful change in relation to EJ-focused socio-spatial tools, mainly through 1) mobilizing local knowledge to inform researchers and practitioners while using and developing tools and 2) engaging in interdisciplinary and community-centred processes to decenter the loci of knowledge from "western trained experts" (Charlie) towards the greater inclusion and valuing of community knowledge. Importantly, these elements are connected to representational and recognitional justice and will be explored in the following paragraphs and supported with quotes.

Many participants discussed how mobilizing local knowledge before, during, and after the development of socio-spatial tools is an opportunity to support researchers, practitioners, and

decision-makers in interpreting geospatial data and mapping outputs in ways that reflect the lived experiences of communities. Community sessions and workshops were specific processes that participants used to "ground truth" (James) by seeking out local knowledge and to create socio-spatial tools that better align with community interests, experiences, and contexts. In discussions on the value of community sessions and mobilizing local knowledge, James noted that,

> Doing that ground truthing allows you to do some of that tailoring to the local context, but also to capture kind of local perspectives in terms of what the particular tool is. So, we've always thought about that, those kinds of community dialogues and those engagement sessions as opportunities to tap into local priorities and local needs, and then kind of going back to the drawing board and say, well, based on the data we know is available, what are reasonable proxies, how can we actually be tending to those concerns.

Participants also described how local knowledge and stories can help researchers and practitioners to identify gaps or issues with socio-spatial tools. Alexis described how "the types of stories that are shared in spaces when we're presenting these tools become really powerful, and they bring data to life in a fundamentally different way that a score from 0 - 100 ever would." Riley shared similar ideas in the following quotation:

> There are a lot of things that aren't represented in regulatory standards and monitoring - odour is one of those things, and it tracks with some of these other exposures or risks that are not well captured and a lot of communities that aren't being heard from. So, what are some ways that we can paint a richer picture by using community science or collaborative mapping? Yesterday actually, one of my students hosted this community data co-interpretation event. She had just done a six-month community-based air quality study, and in terms of when you're looking at such a fine spatial scale, the sources of data that the government misses so much, right? The land use data from the government is from 5 years ago, or there are all these things that aren't represented but that local knowledge can really speak to - like there's a huge construction site here, where the trucks idle. Or there's a huge industrial fire, like at this point. And it's with that knowledge that it's a lot easier to interpret the data.

Overall, participants noted that representing the interests and diverse experiences of all individuals and communities in decision-making, tools, and processes is a challenging yet essential task in creating change. James states "It's really challenging to make good decisions

that everybody sees their own self-interest reflected in… I'm of the mindset that there is no such thing as a truly representative engagement process." Morgan speaks to this tension and describes a socio-spatial tool they helped develop that did not adequately reflect the lived experiences of communities they were working with: "At a local scale, it wasn't helpful. It was not representative. Often, we went and did those community meetings, and every community was like, 'Wait, that is not reflecting our reality.' So, I guess that's sort of the challenge of seeing how it can relate to environmental justice."

Also connected to these dimensions of justice is Charlie's description of valuing local knowledge in decision-making practices. He argues that "Mobilizing local knowledge is a means of involving people in the process of decision making, not just mobilizing their understanding but having people sort of come together and agree on what things actually look like in that space and using that in conversations on making change." Charlie went on to emphasize that the value of the work he does in terms of creating change and addressing inequities lies in the processes of engaging communities in relation to socio-spatial tools, more so that the tools themselves are outputs of the tools themselves. As Charlie succinctly shared, the "…process is more valuable than the output".

Some participants also discussed interdisciplinary and/or intersectoral processes related to socio-spatial tools that aim to bring together various collaborators (e.g., community, academic, municipal, or governmental partners) as essential to creating change reflective of community interests. Many participants expressed responsibility for better community engagement and inclusion as they recognized their limited knowledge, as exemplified by Charlie when he says, "You need a team of people, including local partners, not just academics parachuting themselves in and saying hey, I have this expertise, and we are going to do it this way." Both Riley and James also recognized their limited knowledge and the need for community engagement to address these limitations. For example, Riley asserted, "I am not representative of a lot of the communities I am working with and serving and working with and for," and James noted, "We cannot, as researchers, assume that we know what the best data points are." In a similar vein, Charlie saliently speaks to the importance of decentering expertise and the importance of community engagement processes as socio-spatial tools are developed and used tools to prevent misrepresentation:

> The perspective you're building in is not the perspective of some remote expert; it's the perspective of the people in the situation themselves, and it can be used in a process of empowerment. And if you don't do that and the planners are doing it, and they're representing other people's communities, for example, they can instead marginalize those people. Because it's not those people's views that aren't being represented; it's the view of some Western-trained planner or someone like that.

He goes on to explain:

> We have some expertise in some things that we can offer, and so do they. They know themselves, their communities, their families, and their place a lot better than we do. It's dangerous to go into these places thinking we're the experts and that we can take a look around, measure some things, collect some data, and come up with an idea that we think would be beneficial for them, and then go back to Canada. I think the real challenge is meaningfully and honestly engaging with people we work with on an equal level.

Overall, the meaningful inclusion of community members in developing and using socio-spatial tools was widely described by most participants as an important element of environmental justice. For example, in discussions around the utility of socio-spatial tools and using integrative data, Riley notes that "there's an important procedural dimension, where access to process and meaningful involvement of all communities" is an important element of environmental justice. Moreover, Riley explains below how having adequate resources to engage with the procedural and recognitional aspects of environmental justice is an important element of her work:

> For me, the procedural and recognitional parts are also important and a big part of our work; how can we draw on ways of knowing and sources of knowledge that traditionally have not been as big a part of that kind of environmental assessment or risk assessment, especially in more of a policy contexts? That includes some projects we work with, for instance, Inuit knowledge holders on environmental assessment in the arctic and arctic contaminants. Or, that project trying to incorporate local community knowledge as part of that process with community science approaches where the data source is the experiences of people because that just isn't represented in the other data sources we have.

Additionally, some participants discussed the importance of utilizing a diversity of processes to work within and adapt to diverse needs and contexts. For instance, a couple of participants made specific suggestions about what these could be based on their experience:

> It's about the process, not about the tools, but we need to have a lot of things available to us so that we can put together an appropriate, beneficial process to engage with our community partners. Those might be transect blocks; they might be photovoice, they might be community meetings, they might be statistical analysis, it might be GIS.

Overall, the above section emphasizes the importance of engaging communities as EJ-focused socio-spatial tools are developed and used; not doing so limits the potential of these tools to effect positive change for communities experiencing environmental injustices. Specifically, participants experiences highlight the importance of 1) mobilizing local knowledge to support practitioners and researchers in the use and development of socio-spatial tools to be most representative of community nuances and 2) decentering the loci of knowledge from "western-trained experts" to valuing and integrating community knowledge dialogues and decision-making practices, aspects which are essential to achieving recognitional and representational justice.

Recognizing Power

The final sub-theme in creating change through processes and power is about recognizing power and the influence of power. Many participants identified structures of power as core drivers of inequity and an essential concept in environmental justice and decision-making practices that lead to meaningful change. Consequently, power must be recognized in relation to the development and operationalization of EJ-focused socio-spatial tools.

To start, many participants broadly highlighted the connection between power and equity in conversations about socio-spatial tools and their associated processes in connection to environmental justice. Andrew explained that while tools do not "really address the cultural and the power aspect of why these [risks and impacts] are distributed the way they are," he is mindful that the inequities illustrated in these tools are shaped by power: "In this type of work, you see a lot of links between people without a lot of power being more exposed to things like air pollution and neighbourhoods being located along freeways and schools, you know it can become pretty evident in those pieces." Interestingly, Lucas describes power and equity as "invisible" forces that shape the inequalities or distributional issues illustrated through the socio-spatial tools he has used:

> I think power and equity are always something I'm thinking about and trying to bring because that's part of the problem as well. Inequity in human societies is part of the

> driver of these problems, and it's part of why they are also hard to solve. Because if there are inequities, there are people who don't have the power and agency to be able to do the things that they want to do, and they can't address environmental problems. If all the power and money are concentrated among a small number of people who don't care about the environment, how will we do anything about it?

Concerning the relationship between power and equity, participants noted that creating change "requires someone to be in power to make decisions to collectively move the needle on equitable distribution of resources and harms" (Andrew), especially because the tool(s) itself was not enough to create change. Riley notes, "Decisions are made by people, and these should be inputs into deliberative processes." Andrew also discussed the importance of socio-spatial tools, power, and action, emphasizing the relationship between tools and power:

> Tools are very limited, and they require human beings with connections, audiences and power, whatever type of power: social networking power, political power, economic power…The tool can only go so far as the person who is using it has the power to implement what they are seeing in the data to further progress in these ways. I think those types of people need to engage with these tools for these tools to have any sort of meaningful impact across these types of justices.

Participants also commonly noted the relevance of power in connection to decision-making practices and representational justice (i.e., who is involved and has influence in decision-making) as well as recognitional justice (i.e., recognizing and adequately valuing different bodies of knowledge and understanding) (van Uffelen, 2022). For example, power is central to how community knowledge is unfairly ignored or omitted through exclusionary decision-making practices, as Riley describes in the following quotation:

> There is so much power in decisions made behind these doors, with very little representation from many other perspectives. So, it made me interested in working in that intersection of trying to uncover and reimagine some of those historically expert-driven processes, where who gets defined as an expert is also very narrow.

Participants further discussed how power distribution impacted the self-determination, agency, and autonomy of communities, constituting an essential element in recognitional justice (van Uffelen, 2022), as typified by Lucas, who states that "power and (in)equality contribute to

creating these problems and affect our ability to respond to these challenges." Most participants noted that an essential value of socio-spatial tools and processes was to empower communities. For example, Lucas notes that he hopes that using socio-spatial tools might "Shift the needle a little bit [on inequities] and move some of the power from corporate interests towards community interests and give them more tools and more power to be able to advocate what's right for their community." Alexis makes a point to say that socio-spatial tools are helpful to "challenge the government and to make things better for the community" (Alexis).

Participants described how fostering greater self-advocacy and self-determination among communities requires increased access to otherwise inaccessible information. For example, Andrew and Riley describe how increasing local knowledge empowers communities and enhances self-autonomy and self-determination: "The power of some of these tools is to lead the user to be able to make their own decisions, which I think is much more impactful in the end when somebody decides for themselves to do something" as Andrew notes. Riley notes the value of knowledge access to self-determination when she says,

> Empowering and making sure that people have access to the knowledge and the tools to make their own decisions about well, are we affected? And in what ways are we affected? Can I ask my own questions about this while recognizing that there's something about self-recognition, too, enabling more people to determine for themselves to ask what this means for me?

Finally, data collection and organizational practices impact participants' ability to create and use socio-spatial tools representative of community interests. "One of the manifestations of that power imbalance is data injustice," as James notes, given that the ways that governments collect and gatekeep data limits the ability of those who develop and use socio-spatial tools to engage in representational and recognitional elements of justice. For example, Lucas discussed how governmental data collection practices limit data availability: "When building a tool like this, we are beholden to whatever data has been collected, usually by a government agency. And so, if it's not a priority for a government agency to collect data about something, it will not be there." Often, certain data, such as environmental or community data, get omitted or are not recognized as valid data, which can be a recognitional injustice which consequences on how well a given socio-spatial tools to captures community experiences. Lucas offers an example of the omission of certain environmental and community data in collection practices, stating:

> In Alberta, we have very limited water data, and understanding water quality and how developments affect people's water is essential for environmental justice. That's just not data that we have. Community-wise, there are major limitations that relate to, like, data that is disaggregated by sex, gender, sexual orientation, race, that kind of thing. We almost have no data for sexual and gender minorities, like LGBTQ people, so that's a major limiting factor that relates to power and policy. You know, these communities have not been a priority for governments to collect data about. And so that data is not there for us to use. We just kind of get what we get.

In connection to recognizing power in creating change, an important concept to engage with community knowledge and information in a context-appropriate way is governance, which three participants specifically noted in their interviews. Questioning power through practices of governance is an important part of environmental justice, as James notes in the following quote:

> Procedural justice is really a question of governance, and how we govern, and who we govern for, and who's involved in that decision making and who's allowed to participate and make decisions…So, really asking the question, who gets to decide, who's involved, to what end, and how do we hold people accountable?

In addition to governance, Riley noted that data applicability is highly context-dependent, given that indicators are "going to mean different things in different places," such as racialization, gender, or immigration status; it is important to be mindful of the data users influence and power in applying certain data to certain contexts. She goes on to say,

> Regarding data governance, it is not like more sharing is always good. Right, there's this idea like you put this knowledge out there, and you put it in a GIS layer, and then it travels and gets used in ways that maybe it shouldn't have been used for. And so, I think that's also a question too; if you put data in that form, what does that mean for data sovereignty and so, I think there's all sorts of tensions and questions around that that really need to be navigated and negotiated on a case-by-case basis.

This issue of data availability and Indigenous data sovereignty is discussed more fully in the sub-theme below, *technical challenges: data quality and availability*. Overall, power was a central concept discussed by participants with important links to the recognitional and representational justice dimensions of EJ. In summary, participants discussed how socio-spatial tools help illustrate, but not explain, distributional inequities that manifest unjustly because of power.

Moreover, they noted that creating change requires people with power to meaningfully apply their power toward addressing inequities, including the inclusion and engagement of community knowledge in decision-making processes as part of representational and recognitional justice. Finally, participants emphasized that socio-spatial tools and processes associated with these tools can be valuable in empowering communities to engage in self-advocacy and self-determination. However, institutional power, namely governments in control of what data gets collected and shared, was recognized by participants to profoundly impact their ability to use and develop socio-spatial tools representative of community realities in connection with environmental justice, thus also impacting communities and decision-makers' ability to create change.

Theme 3: Acknowledging Challenges and Tensions

While socio-spatial tools are positively beneficial because of how they *shine a light on distributional patterns* and can *create change through processes and power*, several key challenges and tensions also emerged through interviews with key informants. In the following section, the challenges and tensions particularly salient to EJ-focused socio-spatial tools are presented through three sub-themes: 1) *technical challenges: data quality and availability*, 2) *institutional funding*, 3) *complexity and longing for certainty,* and 4) *recognizing bias*.

Technical Challenges: Data Quality & Availability

Participants described numerous data-related factors as significant challenges for their work with socio-spatial tools with important implications for environmental justice. Factors impacting data quality included its availability, scale, and temporality, each of which is affected by data collection and governance practices. Moreover, these factors directly influence the efficacy of furthering environmental justice (specifically representational or procedural justice), as illustrated below.

Finding and accessing appropriate data that was both publicly available and of high quality was a major obstacle in developing socio-spatial tools. As Lucas expressed, “Once you look at the limited data out there, and all the indicators that can (...) pass all those tests [e.g., appropriate spatial scale, quantitative and continuous, good quality, publicly accessible] and work together, you are not often left with that much data.” Similarly, nearly all participants encountered significant challenges in their work with socio-spatial tools in relation to selecting indicators that represented the diverse interests of the community and other collaborators with significant consequences on representational justice. As James noted, “What it raises is that

representational element of — are people going to see their concerns reflected in this tool by what data is currently available? And what can we feasibly collect and include in a tool like this?" The data that is available may not align with local contexts or with the experiences, priorities, and beliefs of the communities that these tools intend to support and engage with. Trying to ensure that indicators used in socio-spatial tools (and therefore the tools and outputs from the tools) are grounded in local priorities and meaningfully represent local realities is a challenge when data is not available, as Morgan explains:

> The variables we selected are because we have data that exists and because the researchers have notions of what an impact is. For example, we have communities that were like, that's great if we have more traffic on main street. Traffic is not an appropriate indicator because we are incredibly slow; nothing happens here that's not relevant to us.

Most participants who are developing socio-spatial tools generally sought open-source and publicly accessible data, which compounds the data availability challenges: "Access to data is always a big deal. I mean, we have open-source tools that we can access for free, so if we need to then we can do that. The data that could be relevant to communities" (Charlie). Making this task more difficult is the fact that some data types are more limited than others due to data collection practices in Canada or because data is not shared publicly. For instance, James described how some data types, such as environmental indicators (e.g., water quality) and certain health indicators, are not captured by the census, which makes creating integrative tools that represent cumulative impacts particularly challenging.

James, Lucas, and Riley also describe the history of colonization in Canada as another reason why some data will not be collected or, if it exists, is not made public or available, which limits what can be integrated into socio-spatial tools and how well the tools represent the lived realities of the communities and individuals that the tools seek to support and empower. Particularly problematic with respect to EJ and socio-spatial tools is that Indigenous communities are often excluded from data collection practices, or communities have their own data collection practices and are reticent to share community data. Lucas explains in his experiences that sometimes, "Indigenous communities will have their own data, but they, for many good reasons, don't want to share that with government organizations because of history. So that's not data that we can use in our tool." James goes on to explain more gaps in data availability connected to Indigenous communities, given governmental data collection practices,

> If we want to look at anything related to Indigenous communities, like access to traditional foods, cultural indicators, like traditional territories, and even the Canadian Community Health Survey, which is an important data set that we use for socioeconomic data and some health data, it doesn't sample on Indigenous reserves, so we just don't have that data on Indigenous reserves. The census does, but sometimes those sample sizes are so small that the data doesn't get published publicly. So, there are just lots of gaps.

Data limitations have significant implications for what can and cannot be mapped and represented in socio-spatial tools, thus, which (in)equities can and cannot be made visible. As a result of this, James described at length how prioritizing Indigenous data sovereignty has become a priority in their career as a settler person as one way they could best "be of service" and offset these data availability gaps and missing links in data collection practices, which are deeply tied to the history of colonialism in Canada. (The name of the community is left out to maintain the anonymity of the participant):

> I've been in this multi-month process with the community, sharing the tool, talking about its potential and exploring their data needs. They see this as an opportunity to engage in data sovereignty. It's a nation thinking about conducting its own census; it recognizes the shortcomings of colonial practices and procedures around collecting information on populations and how Indigenous people are often unintentionally omitted and, therefore, invisible from major data collection processes like the Canadian Community Health Survey and the census. And so, they're asking some really provocative questions about how do we do a better job collecting data about our people and our land, and how do we do that in a way that manifests OCAP principles and leads to data sovereignty for our people? So, here's a tool that has the potential of actually doing some of that work in relatively short order, which is quite exciting.

Another significant data limitation was scale: three participants identified scale as the most significant technical limitation while developing socio-spatial tools, such as Morgan explaining it as "the biggest challenge." Participants stated that it is challenging to find data at the appropriate scale when doing integrative work and across various spatial and regional contexts. As Lucas explained, "Every variable we use in this tool must be at the same spatial scale. All the data must

be able to somehow fit into that unit of geography. Usually, it's like a health region or local health region (...) Otherwise, we can't use it at all."

Not only does the scale of available data impact socio-spatial tools and the efficacy of representing community realities, but the uniformity of data to the appropriate scale is also important, as Lucas typifies. He explains how selecting indicators and data types that are important to many communities, such as access to traditional foods, might not be available to use in a socio-spatial tool created at a larger geographic scale due to how it was collected, uniformity of data and whether it is publicly available:

> Another one of those filters is we might have several communities measure access to traditional foods for their community. If they are all measuring it in a different way, that might be useful for their communities, but it's not going to be useful for a tool like this because they all must be measured in exactly the same way in order for us to make good quantitative comparisons. So, the data has to be uniformly collected across an area. This is especially true for some of these marginalized communities that either don't have data, or the data is basically being collected by the communities themselves, and it's not always going to be comparable to other communities, and it's most often not going to be public.

Finally, participants noted that temporality is another critical challenge related to data and quality availability and, ultimately, how well socio-spatial tools represent community realities. As Lucas noted,

> Ideally, all these variables need to be measured in a similar time frame. So, you don't want to be using something collected in 2005 and comparing it to something collected in 2022. But sometimes, that's the reality of our data. There are data sets that we would like to use, but the last time it was collected was in 2005.

All in all, issues related to data recurred as a central challenge in the interviews generally and as an issue limiting the utility of these tools for understanding and addressing environmental injustices specifically. Adequately representing community interests, concerns, and priorities requires data to be of good quality, including public availability, and be of the appropriate scale and temporality. Otherwise, the efficacy of the tools to apply environmental justice is greatly hindered and will not adequately represent local realities. As James notes, "We can't do EJ work,

and we can't move the needle on those injustices" without high-quality data that meaningfully represents lived experiences.

Institutional Funding

In addition to core challenges around data and indicators, institutional funding presented by academia and funding agencies was noted as a significant barrier to developing socio-spatial tools that ultimately have the potential for creating change and engaging with environmental justice in more wholistic ways. Various participants noted that funding restraints, including rules and timelines on how funding was dispersed and to whom, impacted the potential for researchers and practitioners to involve community members adequately in socio-spatial tool processes. For example, engagement with community members throughout the development of socio-spatial tools was often limited by funding. Andrew noted,

> It is very difficult to do [engage community members] and nearly impossible to do in a lot of cases with tight timelines and small budgets. Somebody who builds the tool by themselves can come up with a pretty decent tool, but if it doesn't have that engagement in feedback with people that would make it much more grounded in reality, then it also doesn't have the ability to have an impact.

From Charlie's experiences, "policies from certain funding agencies limit researchers' ability to reimburse people for their time and their expertise and the costs that they have, even just moving around to go be with community members." Riley described the difficulty of engaging communities to receive feedback and the impacts on academic projects:

> Some of the communities we need to hear from the most; it's also really hard to hear from them because people don't have time to participate in a workshop because they're working a lot of jobs, for example. Or if we don't have the resources to compensate people adequately for their time, it's really hard to hear from some of the groups that we need to hear from the most.

Various participants also discussed how the length of funding (often only spanning one to a few years) is a major barrier and does not foster opportunities for meaningful engagement nor adequate relationship building with community members to create meaningful change, given that it "takes years to develop relationships with communities and local partners, not just a few months" (Charlie).

Meanwhile, James explains that procedural justice means that, while "the table is not set evenly for everyone," it is necessary to "ask who is involved and who is allowed to participate and make decisions," which, of course, is deeply impacted by funding limitations, human resources, and timelines. Such inclusion and recognition of community knowledge and participation in projects requires relationship building. As Charlie notes:

> Relationship building is going to take a lot of time and energy to build, maintain, and foster those networks of trust and reciprocity amongst different people. That's a huge challenge in this particular space, especially when we're talking about land use decision-making, and we're talking about populations that have been literally disenfranchised and, often cases, forcibly removed from the land and the territories which they call home. So that's always going to be challenging, and that's a huge structural force.

Complexity & Longing for Certainty

Most participants understood that their work developing and using socio-spatial tools and processes for identifying, assessing, or working with collaborators to create change is highly complex. As Lucas noted, "A big challenge is the complexity of the problem…" Below, I discuss how participants expressed this complexity alongside the need for advances in more wholistic decision-making practices that engage with recognitional elements of EJ as related to socio-spatial tools.

A major theme in the interviews was that developing and using socio-spatial tools in line with environmental justice is complex and full of tensions. One such tension was when participants discussed complexity in relation to decision-makers and decision-making, specifically that decision-makers tended to seek certainty and more definitive solutions. James explained that even though "There is always going to be a degree of uncertainty whenever we are modelling and displaying these particular types of risks [using socio-spatial maps]…decision-makers are going to want certainty." Riley explained, "Decision-makers really want to use these socio-spatial tools to be like — give me a number, we will collapse all of this into a number, and then based on that, we'll decide, and that will tell us what to do." Given this longing for certainty by decision-makers, quantitative and effable data is favoured over qualitative and narrative types of data and community knowledge, which Riley explains by saying: "In a lot of decision-making, things that are quantified get taken into account more seriously often. …if you can show it and spatialize it and visualize it in that way, it can be taken into account more seriously."

While Riley, Charlie, Alexis, and Andrew explicitly note the value of quantitative, definable data in specific contexts, they contend that engaging in processes that include "sitting in that tension" (Riley) with other data types that might not yet be known or identified is essential to do, especially in order to include community knowledge. Riley explains further that,

> …Sitting in that tension of like, ok, we have these other sources of data, like I said, that we can spatialize. We can say that this experience happened here, but we don't have to turn it into a number; we don't have to turn it into an indicator. Are there ways where we can still use these spatial, interactive tools for doing that?

Following this complexity, participants discussed the need for a plurality of processes that prompt people, namely decision-makers, to make more wholistic decisions, which socio-spatial tools and processes can support. James notes, "Diverse groups of problem solvers will always outperform experts. We need as many minds working on this as we possibly can because those different perspectives are going to think differently about a problem and therefore can offer generative and more helpful solutions." James explains, "I think we need more and different initiatives and types of engagements with environmental justice to paint a fuller picture. Like, [name of specific socio-spatial tool] is pretty good at doing what it's meant to do, but it can't do everything and be everything to everyone."

Some participants noted the need for technical advancements to address the complexity. For example, Riley explained, "We need some technical advances, like we need tools that allow you to get at heterogeneity and spatial and temporal resolutions. So, that is one part of it," while other advancements to help push the boundaries might "encompass a more fluid experience," where the "richness of the data really comes from people sharing narratives about their experience." More importantly, she goes on to explain the need for "innovation in decision processes," describing that complexity,

> So, I guess for me, that's kind of where I would like to see these tools being used, and so that's why it's not just about innovation for these methods. But we're really talking about innovation in decision processes towards things where it's harder, in some ways. It's going to make everyone more uncomfortable. I think we all must be more accountable, and I would say some of this reliance on single indicators or quantitative tools; it doesn't just come from academics like me. A lot of it comes just from decision-makers who are like great, this made our decision for us, and not have to be accountable by saying, well,

> this is why, and these are the values we are trying to kind of put forward with that. That's such a real tension and something I really struggle with.

The above section highlights the longing for certainty among decision-makers, preferring more definitive and quantitative outputs from socio-spatial tools. At the same time, researchers and practitioners express the difficulties of this tendency, given that distributional patterns of (in)equity and the structural reasons that they are perpetuated are inherently complex and challenging to distill simply. As such, participants noted the need for enhanced socio-spatial tools and decision-making processes to hold more uncertainty, avoid overly simplified solutions, and use more heterogeneous approaches, including heterogeneous and qualitative data types.

Recognizing Bias

Some participants described the importance of recognizing bias and limitations imbued within their socio-spatial tool and the final outputs/illustration(s) from these tools. As Riley noted, making biases and limitations explicit is important to be "really clear about what it [the tool] does not show..." An important value of developing and using socio-spatial tools for environmental justice includes "recognizing both the diverse histories and lived experiences of different groups and communities," as Riley noted. Riley further explained why data limitations are important to make explicit:

> Even if we don't have the data to do that completely, it's important that we acknowledge that (as) a limitation, that these categories that we're drawing from are incomplete. The categories that we're getting from the census might not actually be recognizing important histories and experiences that play out at a structural level. And sometimes that means that we don't have the data, but we can at least acknowledge and push back, like acknowledge what we're not recognizing, and that's not part of it.

Charlie also emphasized why it is essential to be aware of biases and limitations of the tool and data used given potential biases, saying: "If you are not aware of those kinds of things, you can misrepresent a lot of things, you can use it in a way that's not appropriate. I think people need to know about that and need to be aware of it."

Likewise, a few participants noted how their own biases were built into the tools and reflected in the processes associated with the development and implementation of the tools. Moreover, some participants noted that without acknowledging and articulating limitations and biases, they ran a risk of operationalizing tools and their processes in inappropriate ways that

were harmful to those experiencing environmental injustices. Charlie described the trickle-down effect of bias, if unacknowledged:

> You have the first set of people who are basically embedding their Western scientific perspective, their way of knowing about things, into the data model itself. And then you have another set of people that are going to manipulate that data for statistical analysis or deciding on what colour schemes are available to the user in order to represent that data and their biases and their education and their views of the world and their experiences are all embedded in what they do. And they get somebody else who is using that data and using those tools, and they are using it for a purpose, so why are they using that data? Their own interests are represented there, and their biases are creeping in at that point, so they have a set of tools, and somebody has gone out and collected data for some reason. Why is that happening, and for what purpose? Who does it serve? Who is making the choice on how you measure those kinds of things? Who is making the choice on how often, what is the periodicity that you collect data, and why does it serve their purpose? What is behind that? And then somebody is going to go and find that data and use that data and use those tools using a spatial data model, all of which incorporate the biases of everybody else along that line of communication. And they are going to have their own reasons for doing that. So, they have got some reason and taking that data and doing a particular kind of analysis, or representation, cartographically, and somebody else is going to be looking at the map, and maybe they are not the ones that made it or did the analysis, but they have their own reasons for looking at it and trying to use that information. So, it's basically the whole thing is embedded in societal bias in different ways, just like everything else we do."

This sub-theme underscores the important practice of recognizing biases and limitations in relation to socio-spatial tools and associated processes to ensure that tools are operationalized by researchers, practitioners, and tool users in the appropriate context and apply to dimensions of environmental justice through recognitional justice.

Theme 4: Engaging in Intangible Practices

A final and important way that practitioners and researchers engage with environmental justice in their work with socio-spatial tools is by engaging in what I have chosen to call *intangible practices*. In this context, intangible practices reflect the ways that participants worked

to engage with environmental justice through the implicit values of accountability, responsibility, limiting harm, having integrity, privileging process over product, and expressing care. I use the term "intangible" because interviewees did not emphasize this aspect as much as they did the previous three themes, and yet they recurred throughout our conversations, often in subtle ways. Below, I describe this key theme of *engaging in intangible practices through* sub-themes of 1) *commitment(s) to caring* and 2) *practicing an ethos of imperfection*.

Commitment(s) to Caring

Overall, numerous participants shared how caring was a major value and practice in their work with socio-spatial tools and efforts to support environmental justice. Pointedly, Riley says, "I guess what I mean is that if you are doing this sort of work, it is because we have commitments to care and justice."

As one participant noted, a major motivator in their work developing and using socio-spatial tools was to find ways "to do better for each other because we need to take care of each other" (Lucas). A few participants expressed a keen awareness of the potential for further harm while trying to create change and address inequities using socio-spatial tools and the need for accountability to make mistakes and keep trying. For Riley, this means that "you are really aware of harm and missteps that you might make," which leads to an approach that "is not the kind of work for purity" but instead is able to accept complicity and entanglement and make mistakes. In particular, Riley is aware of the potential for harm when she describes how the value of care is central to her work:

> I worry a lot about the harm that we might be doing in our work when we are not taking sufficient care. Everything is so partial; it is like you might do this thing that we hope is pushing us in the right direction, but what if it is just cementing and just making stronger this thing that we are trying to change?

Several participants discussed how caring was a practice that helped them to contribute to something greater than themselves and their specific work with mapping tools, as Morgan says: "Part of it is that it is contributing to something…this is a place for me to improve and help something out there." James also characterized this sentiment as doing "research as service":

> This 'research is service' is important to me, and it is something that I have cultivated expertise in and something that I see that can potentially add value and be helpful. So that is what I try to do: offer research and service to different partners and collaborators with

> the recognition that there are a whole host of limitations and a whole host of challenges to do that work really, really well.

Many participants expressed care not only for other people but for the environment and saw both as major drivers of their work to limit harm and create change, particularly Lucas, Andrew, Morgan, Rowen, and Alexis. As Lucas notes,

> I also just care about social justice; most of my work I bring back to people because, as I said, I recognize the intrinsic value of the environment, but I just think it is more tangible to talk about people, and that is kind of like, you know, selfishly it is easier to appeal to people and be like oh this actually impacts our health, this is why it is important. I care about economic equality, gender (in)equality, sexual (in)equality, and, all of that, racial (in)equality.

As illustrated above, participants expressed different implicit and often intangible practices of caring as a major driving force in their work in discussions around using and developing socio-spatial tools as part of engaging in environmental justice through practices of caring, an element of recognitional justice (van Uffelen, 2022).

Practicing an Ethos of Imperfection

In discussions about using and developing socio-spatial tools and processes in connection to environmental justice, half of the participants recognized the nature of their work as being incomplete, imperfect, and slow. The other half of the participants did not make any mention of this. Conducting themselves with an ethos of imperfection was a notable practice among participants that helped them recognize the inherent complexity and imperfect nature of their work and helped them stay reflective and keep going in their work. For instance, James says,

> I think the work is always incomplete and always ongoing, and it is something that we must be mindful of constantly, and constantly reflect on in terms of that process…and continue to come to that question - this was great, what perspectives were missing from this particular dialogue? Whose view and perspective were not captured in this space? What does that mean in terms of the limitation on how we represent data on this particular tool?

For example, one way that James stayed engaged in his work was by recognizing that the longstanding legacies and histories perpetuating inequity in our social systems, such as colonialism, were formed long before his lifetime:

> Recognizing that this work is so challenging to engage in because it is always going to be incomplete. This is a very incremental process — it is not like you can just flip a switch and say, ok, great, we have addressed (in)equity. We are talking about systems that have persisted for thousands of years because they have benefited powerful people in different ways. And so, for me, there is a recognition that we are not necessarily going to resolve these things overnight. This is one way we can start drawing attention to these dynamics.

Additionally, two participants made a specific connection with how these tools are always imperfect and iterative due to the vast diversity of perspectives involved while developing the tool. As Lucas states, "We are never going to be able to be mindful of everything that's going on in every individual's life and encourage and engage that full participation, but at a minimum, we can be mindful of those things and recognize the limitations of our own process." All in all, practicing an ethos of imperfection kept participants on the course of doing work using and developing socio-spatial tool(s), given the uncertain and highly imperfect processes of engaging in environmental justice through socio-spatial tools and processes.

Knowledge Translation Artifact

In the interviews, participants were asked to select one colour and one word to summarize how they felt about engaging in this work. They shared various colours and words, including re-imagining, mission, pragmatic, life, and co-construction in various hues of green. The other respective colours and words were integrate (white), thriving (gold and green) and learning (blue and red).

Using an emergent, practice-led, and arts-integrated approach of weaving both as an experimentation of data analysis and knowledge translation is a tool of reflection, investigation, and visualization where I, as the researcher, used weaving as "a tool for developing knowledge, of 'being in' or 'being with' rather than observing from outside" (Sampson, 2018, p.55). While weaving, I incorporated the multiple colours they selected as I relistened to the interviews as a first step in data analysis (see methodology). Meanwhile, the chosen words were sewn onto the final tapestry for artifact-making and knowledge translation (Sameshima et al., 2019) (see Figure 5 and Appendix G). Through the act of making, the intent was to deeply listen through embodied, rhythm processes of making and engaging with knowledge using "busy hands," where knowledge is "as much an art of doing as an art of knowing" (Polanyi, 1958, p. 54). A practice-led process of making helps "examines those unspoken things: knowledges and experiences that

sit outside words". As Polyani famously stated, "We can know more than we can tell" (1967, p.4), and to paraphrase him, we, as researchers, sense more than we can write (see discussion section called Woven Reflections for more information).

Figure 5

The Artifact Rendered From the Emergent Arts-Integrated Process Titled 'Threads Of Care; We Are All Entangled'

Chapter 5: Discussion

The overall goal of this research was to explore how researchers and practitioners who are developing and using integrative socio-spatial mapping tools are implementing and engaging with environmental justice in their work. The first three objectives connected this overall goal were: 1) To **investigate how** researchers and practitioners developing socio-spatial mapping tools are understanding and engaging with environmental justice in their work; 2) To **describe the major challenges** and limitations in applying environmental justice that are experienced by researchers and practitioners developing integrative mapping tools; 3) to **identify opportunities** to deepen engagement with environmental justice dimensions in the context of integrative mapping; and, 4) to **engage in and experiment with a novel arts-integrated practice** that enriches data analysis and knowledge dissemination, using weaving as a modality.

This concluding chapter will offer key reflections and pointed questions related to the research objectives of this study, focusing on how best to facilitate a more wholistic application of EJ to the use and development of socio-spatial mapping tools and associated processes. The following discussion is separated into two sub-sections: 1) conceptualizations and 2) processes and practices — and supported by weaving together findings from this thesis's findings with existing literature. Herein, practices can be defined as the application or use of an idea through action, while processes are a series of actions carried out to achieve a particular end. To further enrich these discussions, I will describe my experience experimenting with a novel arts-integrated practice using weaving as a modality, including my general experience and reflections on knowledge translation or artifacts in connection to the significant findings of this research. Finally, I will also outline key recommendations for others working with socio-spatial tools and associated processes, recommendations for decision-making processes connected to EJ, redress disproportionate community impacts, socio-spatial tools and associated processes, and possible future research.

Conceptualizations

Multi-dimensional Environmental Justice

In the EJ literature, scholars increasingly argue for greater multi-dimensional approaches to EJ (Fraser, 1997; Schlosberg, 2007), which refers to a simultaneous application of all three dimensions of EJ: distributional, representational, and recognitional (Fraser, 1997; Giang et al., 2022; Schlosberg, 2007). In Canada, scholars assert that an overly dominant focus on

distributional justice exists in research, assessment, and policy spaces concerning EJ (Blue et al., 2021; Giang et al., 2022; Masuda et al., 2008;). Applying distributional justice — defined as the fair distribution of benefits and burdens (Engen et al., 2021) — is integral in research and community projects that attempt to identify unjustly distributed inequities through the gathering of evidence to move decision-making processes toward creating effective change, as reflected in the findings section and the literature of this thesis. However, while representational and recognitional justice are lesser-practiced dimensions of EJ, both are interconnected and are essential for addressing inequitable distribution patterns. Representational justice (also referred to as "procedural justice" in some cases) — has important links to decision-making processes, including questioning who is involved and has influence, where and when decisions happen, and making these more accessible. Recognitional justice is defined as the acknowledgement of "the plurality of people's values, identities, cultures, rights, institutions, knowledge(s), and capabilities" (Schlosberg, 2007, p.130). Recognitional justice is often the lesser valued principle of EJ, and yet it is described as a prerequisite for addressing representational and distributional justice (Fraser, 1997; Schlosberg, 2012), given that issues of distribution are exacerbated by vulnerability and the economic inequalities generated by cultural and political exclusions (Schlosberg, 2012). Core characteristics of recognitional justice include recognizing and adequately valuing different bodies of knowledge and understanding communities that often suffer environmental injustices but have not been recognized beyond the communities themselves (van Uffelen, 2022). According to Schlosberg (2007, p.157), many theorists and advocates for social justice agree that rectifying misrecognition involves removing values and practices that hinder participation, consequently increasing inclusivity in political and social decision-making institutions and practices, as well as expanding the scope of acceptable communication within research and decision-making processes.

Despite the call for more multi-dimensional applications of EJ in theory and practice (Blue et al., 2021; Giang et al., 2022; Schlosberg, 2007), there are scant discussions of how to meaningfully put more wholistic dimensions of EJ into practice, including what individual and institutional processes and practices are necessary to engage with, particularly in the case of researchers and practitioners attempting to merge data, socio-spatial tools, and EJ in the Canadian context. Expanding our conceptualizations and understanding of justice and being clear about how this shapes our work and engagements — from data collection practices to socio-

spatial applications and community engagements — is vital to move towards more wholistic applications of EJ in theory and practice (Randall, 2023; Schlosberg, 2007). In the next section, drawing on the findings presented herein and existing literature, I explore critical conceptions, processes, and practices necessary to expand individual and institutional capacities for more multidimensional engagements of EJ in spaces that use and develop socio-spatial tools in Canada. This is not a comprehensive list, given that EJ is shaped by many conceptualizations, processes, and practices outside of this thesis's purview.

A Cumulative Lens

To start, participants noted the importance of understanding distributional inequities through a **cumulative lens** while developing or using socio-spatial tools, where such tools were uniquely designed to understand and document cumulative impacts to help make sense of "the confluence of these socioeconomic, environmental and health systems more comprehensively and wholistically" (James), as corroborated by Huang and London (2016). Cumulative impacts can be defined as the intersections of environmental, socio-economic, and human health effects caused by the combined effect of past, present, and future human activities and natural processes, where people and communities are not experiencing the impacts of one singular pollutant or stressor, but the sum of various environmental, socio-economic and health stressors and pollutants (Huang & London, 2016). Scholars assert, as did the participants in this research, that regulations, policies, and decision-makers tend to work in silos in single sectors (e.g., oil, gas, mining) and individual indicators (e.g., health and environment) (Gillingham et al., 2016), resulting in a singular approach towards engaging in inequities and limiting integrative work (Blue et al., 2021).

A unique strength of socio-spatial mapping is that it enables the integration of diverse data, such as environmental, socio-economic, community, and health data, where cumulative thinking can be applied through practical applications. Moreover, a cumulative approach while developing and using socio-spatial tools is essential for applications of distributional justice, as participants made clear. Tools can help illustrate inequitable distributions of benefits and harms, offer evidence for further questioning why such impacts are inequitably distributed, who is being impacted, and why, and inform more effective resource allocations to rectify existing injustices. Of note, some of the challenges outlined by participants were related to the limited availability of data, which limited cumulative applications of data in practice. The value of a cumulative

approach while assessing inequities, particularly regarding socio-spatial tools, is well noted in the literature (Blue et al., 2021; Gillingham et al., 2016), and the findings of this thesis will not be explored further in this discussion.

Plurality and Wholistic Conceptions of Interdependencies

While socio-spatial tools can facilitate the application of a cumulative lens and help to illustrate distributional inequities, it is also worth questioning how researchers and practitioners were engaging in other dimensions of justice in their work if they did. I argue that an essential conceptual foundation for participants understanding and engaging in broader elements of environmental justice is their conceptual engagements with 'plurality,' as Schlosberg (2007) terms it.

According to Schlosberg, a pluralistic approach to EJ acknowledges the existence of diverse and overlapping definitions, experiences, and applications of justice that are highly dependent on the situational context, including place, time, and people (Schlosberg, 2007, p.167). As such, a pluralistic conceptualization of justice allows space for more expansive engagements across the broad construction of discourses and applications of EJ while avoiding uniformity or rigid definitions (2007). Plurality requires an understanding of, and a continual engagement among, difference, where working within and through difference is "essential to tie together conceptions of misrecognition (...), discussions of maldistribution and, importantly, participation" (Schlosberg, 2007, p.167). For instance, the practice of straddling two or more perspectives, paying attention to empirically extant differences, engaging them, and understanding them as parts of the whole, each comprising the broader understanding and discourse of justice, is important to a pluralistic conceptualization of EJ.

One way that participants characterized the nature of their work as pluralistic was in how they continually described and understood **using and developing socio-spatial tools and the inequities the tools made visible in connection to EJ as highly complex, lacking finite solutions, imperfect, iterative, and partial**, where one tool or process would never adequately be enough to solve social problems like inequity. Participants understood that issues of inequity manifest at multi-scalar, temporal, and geographical levels for reasons that span the individual, community, societal, and systemic.

As part of this inherent complexity and an essential element of plurality and applications of justice, participants expressed robust conceptions that human health and the environment are

inextricably linked, where the flourishing of humanity was seen as mutual and deeply interconnected to nature's vitality. Scholars assert that this **recognition of our mutual interdependencies**, which Quinless names "an expansive notion of kinship" (2022, p.33), is essential to name and center our engagements with justice (Quinless, 2022; Randall, 2023; Schlosberg, 2007). Schlosberg (2007) explains that acknowledging such interconnections between nature, humans, and society as a whole is vital for a more expansive notion of justice to be understood and then engaged more wholistically with recognition, representation, and distributive dimensions of justice (2007). Other scholars support this claim, explaining that naming and centering this commitment to these mutual interdependencies is foundational to building a more just, caring, and equitable society (Quinless, 2022; Randall, 2023; Schlosberg, 2007) and shaping the conditions and our capabilities for a thriving and just society (human and nonhuman) both at the individual and collective level (Schlosberg, 2007).

In connection to this recognition of a pluralistic conception of interdependencies between human health and nature was **participants' commitment to caring**, which was a significant motivator in how they applied socio-spatial tools and associated processes in their work. Participants cared about bringing about change for the betterment of society, utilizing socio-spatial tools to encourage people (decision-makers and communities alike) to think and expand their notions of interdependencies where human health and well-being depend on the environment. Coupling conceptions of the "mutual interdependencies between nature, humans and society as a whole" with caring, specifically the desire to create better conditions where all may thrive (environment, planet, human) through political, social, material, and emotional conditions (Chatzidakis et al., 2020 p.5), is an essential element in creating better societal conditions and build the infrastructure and capacity for a more caring and just society (Chatzidakis et al., 2020; Randall, 2023). Moreover, participants were attentive to the responsibility of their role in perpetuating harm and how they might do their best in their work using and developing socio-spatial tools, their associated processes, and the change they lead to. In their assertions, they often named their accountability and responsibility to other human beings, themselves, and the greater whole of society in the knowledge-generating processes they created, which Wilson (2008) contends is an essential element of engaging communities and generating knowledge respectfully, which I will explore further in the following paragraphs when I discuss engaging communities. As such, the acknowledgement of mutual

interdependencies, commitments to caring well, and acknowledgement that this work of using and developing socio-spatial tools was highly complex and devoid of simple answers and solutions are essential elements of a pluralistic conceptualization of justice.

Recognizing Power Dynamics and Structural Inequities

Another important conceptualization that participants employed in their work was acknowledging the power dynamics embedded in systemic and structural inequities that their work engaged in making sense of, which influences representational justice (i.e., who is involved and has influence in decision-making) as well as recognitional justice (i.e., recognizing and adequately valuing different bodies of knowledge and understanding) (van Uffelen, 2022). For example, participants recognized the role of power in shaping a community's ability to respond to inequities and how community knowledge is unfairly ignored or omitted through exclusionary decision-making practices. Additionally, they recognized the structural and systemic limitations of data collection and community partnerships impacted by national institutional funding policies and settler colonialism, to name a few (see findings).

In this way, participants expressed that socio-spatial tools and associated data are seen as what Dencick et al. explain as "something that is situated and necessarily understood in relation to other social practices" (2019, p.874). Such recognitions are essential for researchers and practitioners to question "how we understand knowledge, how this knowledge is generated, and how it is used" (Quinless, 2022, p.74) to continually reflect on how knowledge is being built and the responsibility we have to one another (Randall, 2023 p.29). After all, socio-spatial tools and how data is generated, collected, analyzed, and utilized result from various interests and societal factors that "shape how and on what terms society is increasingly being datafied" (Dencick et al., 2019). Moreover, the long-standing social, political, economic, and cultural issues that shape data utilization "can fundamentally shape social relations, the kinds of information valued and what is 'knowable' and therefore acted upon" (2019).

In their book *Decolonizing Data,* Quinless (2022) agrees with participants' assertions that our social structures (e.g., education, access to health services and programs, housing conditions, social coercion, employment, physical environment, personal health practices, parenting and life skills, and gender, etc.) have been and continue to be profoundly shaped by our histories, particularly settler colonialism and thus, the ways we think, behave and conduct ourselves and our research are still continuously shaped by such histories. As such, caring about how

institutional contexts and long-standing histories of inequities are essential to shift the legacies of these histories (Quinless, 2022) and require reimagining what "a just distribution of benefits and burdens should look like" while maintaining "good caring relations" and (Randall, 2023, p.3). After all, utilizing socio-spatial tools and their associated processes and outputs requires attentiveness to cultural responsibility and the dimensions unique to the community and context of the project at hand, which is most likely already limited in efficacy based on "the conceptual design and the lack of available and robust data sources" which pose many challenges to utilize these tools in culturally responsible ways (Quinless, 2015, p.74). Such limitations to data collection and availability, which hinder the development of the socio-spatial tools we create to help alleviate such inequities, are also well noted in participants' experiences.

The Tension Between Pluralism and Seeking Certainty

All in all, participants' pluralistic view was an active antidote against decision-makers tendency to covet singularity, singular approaches, and absolutes, or as Schlosberg names it, "an insistence on singularity or uniformity" (2007, p.169). As a reminder, a widespread assertion and frustration among participants were decision-makers' tendencies to "want certainty" (Riley) and value more quantifiable, straightforward, and distillable data that can lead to straightforward solutions (see findings p.90). Scholars agree that there is a widespread 'desire for numbers' (Kennedy, 2016, p.221) and a tendency to prefer straightforward and distillable data, information, and engagement methods with inequities (Schlosberg, 2007).

Yet, to engage in more wholistic dimensions of EJ means broadening our conceptual and processual capacities to engage with a multiplicity of truths and definitions of EJ through plurality. Given that the "principles of justice themselves are pluralistic in form," our practices, processes and engagements with justice must be attentive to this plurality and the multiplicity of contexts that shape our societies and our injustice — including what we value, our experiences, our knowledges, and cultures (Schlosberg, 2007, p.168). How are we to engage with recognitional justice, and thus representational and distributional justice, if we are not adept at holding the existence of difference and the multiplicity of truths that come with it?

Practices and Processes

Engaging Communities

Various community engagements were essential to putting procedural and recognitional dimensions of environmental justice into practice for participants, particularly to inform researchers and practitioners while using and developing tools and to engage in interdisciplinary and community-centred approaches to help lead to meaningful change.

Firstly, in many of the examples discussed by participants, community knowledge supported the development, use, and efficacy of socio-spatial tools. Ground-truthing methods and community engagement sessions were essential to engage in distributive justice more effectively. Community knowledge helped inform the tool's developmental process by identifying existing data gaps and by supporting the interpretation of the represented data. Additionally, practices where community knowledge is amplified and actively shape the development and use of tools and their eventual decision-making processes are essential elements of both representational (i.e., who is involved and influences decision-making) and recognitional justice (i.e., recognizing and adequately valuing different bodies of knowledge and understanding) (van Uffelen, 2022).

Participants emphasized that a significant motivator in developing socio-spatial tools was to make information more accessible and increase engagement opportunities from impacted communities to best create change and empower communities. Participants were hopeful for tools to help facilitate communities “to make their own decisions” (Andrew) and determine what the represented data means for them and their communities. van Uffelen (2022) notes how a critical aspect of recognitional justice supports the self-determination and autonomy of individuals and communities; this is clearly important in the context of EJ-focused socio-spatial tools. Moreover, Huang and London (2016) also assert the importance of operationalizing socio-spatial tools through ways to support community empowerment as autonomous agents rather than mere subjects.

Secondly, participants described a community-centered and process-focused approach where a community’s needs, knowledge systems, and values drove the direction of the project or research in question to creating community change instead of solely using their knowledge to inform or mobilize efforts, where tools and data were only used if appropriate and supportive in the community context. This research underscores that socio-spatial tools are only as effective as

the processes they are paired with, describing that the most valuable element in building relationships, understanding, and alleviating inequities are engagement processes and that these processes are essential in terms of EJ. Such processes were described as adaptable, pluralistic, interdisciplinary, and intersectoral and sought to bring together various collaborators (e.g., community, academic, municipal, or governmental) to create change reflective of community interests and build relationships beneficial to the community while considering their dynamic contexts. Scholars contend that such actions are essential elements for community-centred projects (Abma et al., 2019), requiring interdisciplinary collaborators to work to find appropriate approaches to the context at hand, given the indeterminacy of cumulative impacts where a plethora of solutions and consequences to those solutions, exist (Huang & London, 2016).

While the purview of this thesis does not engage fulsomely with community-centred research (Abma et al., 2019; Strega & Brown, 2015), participants spoke about the importance of the quality and shape of community engagement processes while seeking to address inequities as well as using and developing socio-spatial tools. I argue that infused within their community engagements are essential individual practices that participants exercised conducive to more wholistic engagements with EJ, namely 1) decentering their expertise and recognizing their biases, and 2) being highly attentive to the context of the community in question, with a process-centred approach.

When engaging with communities in the context of developing and/or using socio-spatial tools, many participants expressed that it was important to **decenter their expertise,** which I explain as an active engagement in centering the inclusion and valuing of community knowledge rather than privileging their knowledge system and skills that lead the project. For instance, participants expressed discernment between contributing their skills and expertise when needed or necessary, making sure not to make assumptions about the community's needs and privilege their knowledge above the community they worked with, intentionally refusing the role of the Western-trained expert towards a "power-with" instead of a "power-over" approach (Abma et al., 2019). Abma et al. (2019) contend that frameworks of research and projects idealizing the distanced researcher as the expert and leader are perpetuated because it is expected, known, and comfortable. Engaging in research in more participatory ways requires developing "a way forward that is forged by allowing ourselves not to know," cultivating a tolerance for ambiguity,

being open to the unexpected, the new and different, which will undoubtedly be less comfortable, tense, or awkward (Abma et al. 2019, p.152).

Participants exercised a context-specific approach as well, providing skills (e.g., photovoice, facilitating dialogues, statistical analysis, etc.), tools and data as supportive supplements if well-suited to the context (e.g., people, place, time, knowledge, and culture). Additionally, they recognized the limitations of the collected data, what the tool(s) can and cannot show, and the limitations of their lens of knowing and being. Strega and Brown (2015) contend that refocusing the process away from a uniquely and "specially skilled individual towards a process grounded in a web of relationships" (p.269) where the knowledge and values of the community in question create the project's foundation is essential to avoid extractive research. In this way, they implore researchers to 1) take responsibility for their own education in the context at hand to best support the community and 2) accept that mistakes will be made and take accountability for them when they arise with humility.

In line with Strega and Brown, participants recognized the potential harm they could cause if they did not acknowledge and decenter their expertise and consistently acknowledged their limited lens and biases. As such, **decentering their expertise** and recognizing their own biases were essential elements in making space for additional recognitional and representational elements of justice, which includes questioning "whose knowledge (and expertise) do we recognize that should be a part of this discussion?" (Riley). Being responsive, as a researcher and practitioner, to the current context, community, culture, and knowledge base is vital to both representational (i.e., who is involved and influences decision-making) and recognitional justice (i.e., recognizing and adequately valuing different bodies of knowledge and understanding) (van Uffelen, 2022).

Such attentiveness allowed participants to make space for what they were missing, to recognize who are the people that need to be included in representational as well recognitional processes, and to move towards a more wholistic engagement with environmental justice and active intervention best suited to the context they worked within while situating themselves as active agents in these processes. Participants expressed what Randall (2023) describes as a 'sensitivity' to the multiple relevant considerations in particular contexts that helped them be more attentive to the multiple contexts they worked within, enhance the quality of their engagement with communities and create knowledge in ways that limited harm, and was

responsive to their needs, cultures, and knowledge systems (p.30). Such an approach and an attentiveness to context made them more responsive to the needs of the communities they worked with and more reflective of the harm and the good that their involvement had with all those involved, including the impact of their applied tools and processes. After all, “The recognition of heterogeneity is central to understanding the future of justice, where we must understand the individuals as existing in a complex fabric of relations” (Lyotard in Schlosberg, 2007, p.15).

Quinless corroborates participants' experiences when she states, "It requires that a person witness themselves as a researcher in the research process and ponder reflective questions about research transparency in the context of positionality, intentionality, power relationships and accountability: “Who are you?” Why are you here? What is the direct benefit of your research to the community?” (2022, p.78). After all, questioning what we know and how we engage in constructing knowledge is essential to foster ways to work in ‘relational allyship’ and to galvanize ways of understanding that shift the deeply-rooted structures of inequity that shape Western thinking and research practices (Quinless, 2022, p.118).

After all, if we are to engage with more wholistic dimensions of EJ, including recognitional justice, which “emphasizes the importance of understanding and acknowledging how environmental injustices, structures of power, and structural inequities are deeply assembled by cultural identity and practices, worldviews and knowledge” (Blue et al., 2020, p.9), we need to grow the capacity to acknowledge what we know, what we do not know, and to make space for unknowing rather than expertise — where we are amenable to learning amongst a multitude of definitions, applications and experiences of environmental injustices, and are accountable to ourselves and others and can take accountability for when we inevitably make mistakes.

Recognizing Data Justice, Governance, and Power

While a deep exploration of data governance and data justice is beyond the scope of this thesis (Dencik et al., 2019; Quinless, 2022; Shaw and Sekalala, 2023), I briefly discuss it in the following section, as more than half of the participants emphasized issues of data justice and governance as important considerations for future use and development of socio-spatial tools and associated processes and these issues also intersect with EJ in important ways.

Data governance refers to how data is managed through authority and control, including the processes and practices that delineate what actions are taken, who can take those actions,

under what circumstances and through which methods (Abraham et al., 2019). Data justice — defined here as "fairness in the way people are made visible, represented and treated as a result of their production of digital data" — (Taylor, 2017 p.1) recognizes the relationship between data and power dynamics linked to data-driven processes (Dencik et al., 2019).

In line with data justice principles, participants noted the importance of recognizing that data is never neutral, as it relates to larger institutionalized oppression systems shaped by long-standing and historied power dynamics that lead to who is valued and made visible through data collection practices and how it is operationalized through socio-spatial tool use and decision making. For instance, participants were mindful of how governmental data collection practices are shaped by longstanding histories and structures of power, such as colonialism, that lead to recognitional injustices where data, and the people, place, and culture it is linked to, might not be valued, recognized, or collected, particularly regarding Indigenous communities (see findings). Making this more relevant is that the political landscape in Canada is increasingly adopting environmental justice into its legislative actions, exemplified by Bill C-226 and Bill S-5. Particularly, Bill C-226 calls for enhanced data and information to reduce adverse health outcomes related to environmental justice issues and inequities and amendments to federal laws, policies, and programs, and improved community involvement in policy-making (National Strategy Respecting Environmental Racism and Environmental Justice Act, 2023).

Scholars explain that to apply data governance mechanisms in ways that are responsible and accountable to the communities that data represent, questions around data ownership, control, accessibility, and sharing (Dencik et al., 2019), as well as examining the structural power dynamics that shape these (D'Iganazio & Klein, 2016), are important to consider all together; particularly given that data applications are not neutral but context-dependent and, as such, should be used with great intention (Quinless, 2022).

Moreover, participants noted the importance of what Vera et al. (2019) refer to as the 'situatedness' of data (p.1017), which calls attention to the relations and responsibilities we have to critically engage with data, which is formed by information that is being pulled from people, bodies and lands; ignoring this situatedness can lead to extractive approaches, processes, and practices of data use that risks replicating hierarchical structures without ameliorating or truly addressing the problems communities face. As such, continual and critical attention to the 'situatedness' of data, the ways that tools are being used in the specific contexts they are being

applied (place, people and culture), how data is being shared and collected, and the institutions and histories that contribute to data collection and governance practices are important considerations for more wholistic applications of EJ (Dencik et al., 2019; Quinless, 2022; Shaw & Sekalala, 2023).

After all, how data are used, collected, and shared impacts the quality and availability of data, the efficacy of socio-spatial tools to reflect communities comprehensively, inclusively, and equitably, and subsequent decision-making processes where this data is used (Dencik et al., 2019; Quinless, 2022); allocating resources and engagements in inclusive decision-making processes cannot be extended to those we do not know to exist, ignore, and continue to exclude (Schlosberg, 2007). As such, just as data and governance practices are connected to the production of social inequalities, they are also sites of possibility to alleviate the invisibilization of people in data collection processes and decision-making processes — particularly Indigenous communities in the Canadian context — to rectify recognitional, and thus representational and distributional injustices (Gangadharan & Niklas, 2019).

To best support representational and recognitional processes leading to tangible change in policies, decision-making, and community outcomes requires attentiveness and questioning of who is included (and excluded) in processes of decision-making, how they are included (and excluded) and to what degree (Dobbin & Lebell, 2021) and in what ways our institutions (connected to power dynamics and longstanding histories of oppression) do, or do not, recognize, value, or include diverse communities, knowledges, and value systems (Schlosberg, 2007), and how data are collected and operationalized in 'situated' contexts and mechanisms. The concepts, approaches, and practices we engage in to collect, share, and use data are incredibly important in pursuing justice, alleviating inequities, and shaping just and sustainable futures (Dencik, 2019). Data collection and the structural and institutional power dynamics that shape them are worthy of investigation and critique (Quinless, 2022; Dencik et al., 2019) and are key to responsible data governance mechanisms (Dencik et al., 2019). As such, greater attention to and further explorations of appropriate mechanisms and applications of governance are called for, particularly to support a more wholistic application of environmental justice (distributional, representational, recognitional) in processes of operationalizing socio-spatial tools and associated processes.

Weaving Reflections

In the following paragraphs, I will reflect further on why I engaged in an arts-integrated practice, my general experience in doing so, and explore the meanings woven into the created artifact and knowledge translation component of my thesis in connection to the significant findings of this research.

Reasons Why and Major Reflections

With the generous support of Dr. Galway, my supervisor, who took a risk and learned through this process with me, I experimented with an innovative arts-integrated method using weaving as a modality. This materializing practice, where the researcher arrives at new perspectives and ways of thinking and being through a creative process (Barrett & Bolt, 2014), was emergent, meaning that the process of weaving and creating the artifact was not pre-determined but rather came into being during the data analysis process (see methodology section).

My choice to incorporate an arts-integrated method was a thoughtful response to my societal context as a graduate student and artist. I conceptualized my thesis as the world unravelled sharply in "postnormal" times (Porter, 2021, p.67) during the coronavirus pandemic and several environmental, global health, and sociopolitical crises. Meanwhile, in the societal context of growing complex inequities that lack finite solutions, I continually encountered scholars' call for new approaches to research and knowledge co-creation that span disciplines and approaches as the usual ways of thinking, being, and working (Porter, 2021; Quinless, 2022; Vereijken et al., 2022). My choice to incorporate an arts-integrated method within this work was also influenced by the environmental justice literature and context of this thesis. The literature review identified scholars' assertions that more wholistic engagements of EJ (distributional, recognitional and representational) are needed within research projects, organizations, and levels of decision-making (Schlosberg, 2007; Blue et al., 2021). Specifically, scholars asserted that recognitional justice, defined as "acknowledging the plurality of people's values, identities, cultures, rights, institutions, knowledge, and capabilities" (Engen et al., 2021), is often neglected or omitted dimension of EJ (Schlosberg, 2007; Fraser, 1997). Yet, discussions and reflections on mechanisms, practices, and experiences of researchers engaging or attempting to engage in more wholistic applications of environmental justice in their research and at levels of decision-making remained limited or nonexistent (see literature review). In response, my research questions how

researchers and practitioners engaged with environmental justice, if they did, in their work developing or using socio-spatial tools (see findings).

Yet, as a future professional in the interdisciplinary fields of health sciences bound to engage in the "complex and multifaceted" societal inequities (Vereijken et al., 2022, p.1771), it seemed important as a practice of valuing integrity and creativity to include a component of my research that explored practices suitable to supporting dimensions of EJ in my own research process. For example, scholars' assertions that more wholistic engagement with environmental justice necessitates plurality and greater engagements with recognitional justice (Schlosberg, 2007; Fraser, 1997), which requires acknowledging knowledge, values, and worldviews of others that are most often omitted and likely outside of one's current realm of understanding and lived experience (Engen et al., 2021).

Additionally, scholars urge future professionals and graduate students to be effective agents of change and to work within complex, multi-faceted problems of our era productively and to help shift the needle of inequities towards a more life-affirming future (Vereijken et al., 2022; Porter, 2021), necessitating certain competencies and skills including values, attitudes and beliefs, interpersonal skills, and skills-based knowledge (Vereijken et al., 2022 p.5). These include harnessing the ability to know differently, be adaptable in a diversity of settings and expand capacities for "holistic, multi-perspectival, flexible, creative, and empathic understanding" (Porter, 2021, p.67), as well as "learning how to think within, across and beyond disciplinary perspectives" (Marins et al., 2019). Moreover, I was struck by the wisdom of fractals that adrienne marie brown emphasizes in her book Emergent Strategy; the practices we engage with at the individual level and the values that shape the foundation of those practices refract outward in our larger systems and institutions (2017).

In this vein, I wondered how practices at smaller and individual scales might benefit researchers, practitioners, and future professionals like me to keep fostering skills and competencies necessary for more wholistic engagements with EJ and to engage in the growing inequities of our epoch with adaptability, curiosity, and integrity.

As such, how might individual practices and spaces of engagement help us attempt to reweave new ways of thinking and being and become more acquainted with unlearning and getting lost, to build the capacity to "start to sense what you do not know" (Myer, 2020, p.128), "to make the unknown real, the invisible visible, to being the far away near…" (Solnit, 2015

p.53), and to recognize the unexpected (LeBlanc, 2018), where our roadmaps to knowledge are not pre-charted? Might creating rigorous yet emergent and creative containers of practice help us see or acknowledge what we currently do not, might help us expand our tolerances for uncertainty, and might these refract back to the larger scale of our learning institutions, organizations, and governments? Are such practices and competencies useful to continually contend with and work within complex, multi-faceted problems of our era with integrity and the fulness of ourselves (minds, body, heart and spirit) while avoiding perpetuating systemic inequities in our tools and processes (Shaw & Sekalala, 2023); to disturb the familiar in our thinking, being and ways of engaging in research, to open up new considerations and capacities of knowing that were previously unavailable?

Yet, to engage in more wholistic dimensions of EJ means broadening our conceptual and processual capacities to engage with a multiplicity of truths and definitions of EJ through plurality. Given that the "principles of justice themselves are pluralistic in form," our practices, processes and engagements with justice must be attentive to this plurality and the multiplicity of contexts that shape our societies and our injustice — including what we value, our experiences, our knowledges, and cultures (Schlosberg, 2007, p.168). How are we to engage with recognitional justice, and thus representational and distributional justice, if we are not adept at holding the existence of difference and the multiplicity of truths that come with it?

Given that the process in which knowledge emerges and is expressed guides us to what is known (Borgdorff & Schwab, 2014), I saw an opportunity to catalyze new forms of reflection, investigation, and visualizations brought up in the interviews that are more tacit and subjective, processes traditionally less valued in the academy through an arts-integrated methodology using weaving as a modality (Myers, 2020, p.118), while helping to make known the relationship between the researcher and the research itself more visible.

In the following section, I will reflect on how I experienced weaving an arts-integrated practice into my thesis to not only support the data analysis and knowledge translation (Sameshima et al., 2019) but to grow my competencies as a future professional engaging in 'postnormal' times, requiring various competencies and skills to productively work within complex, multi-faceted problems of our era necessary in shifting the needle of inequities towards a more life-affirming future (Porter, 2021; Vereijken et al., 2022).

Woven Reflections

Using weaving as a modality with an arts-integrated method was an experimental process. Without a clear example of a thesis on this topic, I sought to practice connecting to the data (re-listening to the interviews while weaving) and creating a tapestry without a pre-determined output as a form of knowledge rendering and translation. At the beginning of this project, I wondered whether this process would benefit the data analysis and knowledge translation process and how, if it did, might help make more visible elements that participants shared. Below, I offer reflections on the value of engaging in this process that was creative and non-prescriptive, links to major themes shared by participants, and elements of the tapestry and potential meanings. On this later point, the interpretations of the tapestry I offer below are not static or rigid. I invite the viewer to notice and make their own connections.

To begin, weaving and working slowly is not inherently revolutionary, and simply taking longer does not add value to the object itself. However, crafting an intentional practice of deep listening during the re-listening process through intentional and physical movements is connected to knowledge acquisition, where there is a cognitive, affective, and aesthetic connection to forming knowledge (MacGill, 2023). Creative processes and practices can be, as Irwin (2013) reminds us, liminal spaces where new ways of knowing and understanding may be discovered and can, as Sameshima expresses, allow for "new lenses for viewing, analyzing, representing, and disseminating research" (2019, p.2). Such spaces can help the research and researchers to become "unclosed" to new possibilities and for building relationality and recognition among difference (MacGill, 2023, p.510), while cultivating a tolerance for ambiguity (Abma et al., 2019). Moreover, Ungunmerr-Baumann et al. (2022) argue for the need for active embodied engagement with deep listening as an enactment of reciprocity and mutuality, where deep listening allows for a greater attunement towards new ways of thinking, "ways that must themselves be newly cultivated" (Kompridis, 2013, p. 21).

In my experience, this process shaped a container of practice, or a liminal space as Irwin (2013) names, that allowed me to connect to and make sense of the themes and findings through a different way of understanding that included deep and embodied listening while engaging in a practice of listening and learning through "using busy hands" (Elke, 2022, p.63) and through a creative practice of making that utilized "rhythm and process" (Riley, 2008, p.63). For instance, thinking back to my interviews and during the process of distilling my themes, I can recall a felt

sense and memory of the participant, their quotations, their voice, as well as the tacit dimensions of their interview that I experienced as I wove, such as the pace I was weaving at while they were speaking (e.g., did it feel rushed, vibrant, slow, messy?) as well as the section of the tapestry of their interview and the feel of the threads in my hands.

Additionally, it reminds me of the tension shared by participants in their work of using and developing socio-spatial tools between pluralism and seeking certainty felt among many decision-makers (see findings). In the data analysis process, I sifted through large amounts of data to distill participants' narratives into themes. This process often felt cyclical, ambiguous, and messy. At times, I wanted to arrive faster at straightforward themes and desired straightforward answers. This arts-integrated approach helped me stay engaged in the process of sifting through the messy and complex topics discussed by participants and engaging with multiplicity to make transparent relationships between themes, which are multifaceted and complex. Here, while the tapestry is a finished deliverable and outcome of my thesis, the emergent process (i.e. weaving and making the tapestry throughout the research process without an endpoint in mind) was a way for me to keep making sense of the many mechanisms and contexts, communities, and methods that participants spoke of (Chapman & Sawchuck, 2012). As such, this arts-integrated process allowed me a tangible processual anchor in affective, sensorial, and tangible ways to help make sense of the data while reminding myself to tolerate this uncertainty, center my attention towards a process-focused approach, and not rush to find themes.

Artifact Reflections and Meaning. There are a variety of details and potential meanings that shape the finished tapestry (see Figure 5). Each word participants shared with me is sewn into the cloth: thriving, re-imagining, mission, integrate, pragmatic, life, co-construction, and learning. A block for each interview represents each colour they chose including various greens, blue, gold, and red. It is worthy to note that there is a longstanding significance and history between weaving cloth and constructing ideas and words that is outside the purview of this thesis. For instance, according to St Clair in their book chronicling the history of textiles, *Golden Threads*, the words 'text' and 'textile' have a shared origin in the Latin word 'texere,' which means 'to weave.' Similarly, 'fabrica,' meaning 'something skillfully produced,' gave rise to both 'fabric' and 'fabricate' (St Clair, 2019, p.17).

With the connective power of weaving in mind to fabricate both idea and cloth, this tapestry is not a representation of accumulative knowledge but instead a weaving of relationality, a tacit reminder that there was movement or a fabrication between the maker and the crafted object, as there was between the researcher and the themes being distilled into this thesis. Throughout the tapestry, there are many small details woven into it that reflect the interview itself as well as my role in witnessing and listening — skipped threads, colour changes, or extra tension — and I can remember what it was like not only through cognitive memory of their words but also through a felt sense in my hands and limbs as well as visual imagery of the artifact. In this way, this tapestry is not static but dialogic; the artifact created is a long piece of cloth, a tangible representation of the nuances and meanings of the data collected, my role as a researcher bringing it together, and many implicit elements of the interviews and the process itself. While the socio-spatial tools participants spoke of help make spatial distributions of inequities more known and help make what is often invisible more visible, this tapestry makes visible my process of building meaning through the data analysis process. What is more, this tapestry evokes Polyani's famous statement that, "We can know more than we can tell" (1967, p. 4) and shares implicitly, through the cracks of the threads, the stories, narratives and lived experiences participants shared with me that were left out in this thesis due to constraints in time and page limitations.

Through the tangible skill and metaphorical weaving of words and ideas with cloth, this artifact is a woven map of co-created meaning that represents elements of the participants' motivations and affective orientations toward their work. Inspired by a quotation from a participant, this tapestry is called "Threads of Care; We are all entangled." As discussed in the findings, participants shared strong commitments to do better in connection to nature, humans, and society as a whole's betterment, and all the affective dimensions and lived experiences that shape them, their work, and their continued commitments to environmental justice and equity as well as the multitudes of all that was said and unsaid, known, and unknown that still shape this work. This textile is a practical form of tacit knowledge, infused with meaning, and is a product of the context of the materials, time, place, and maker (Riley, 2008), and complements the text of this thesis (St Clair, 2019).

The tapestry looks unfinished yet complete, with hanging threads and space for additional blocks of fabric to be added, showing that this work is rife with untrimmable uncertainty, always

incomplete, always partial and that we are all entangled in a tapestry of relations. While each block exists distinctly on its own, small details of hand-sewn yarn of all various colours from either side of the tapestry were added to represent and track some of the intersecting themes, ideas, and conceptions that existed between the participants that were made visible in the process of distilling what participants shared into themes.

In its completed form, the tapestry evokes the importance of plurality while discussing EJ, connecting back to the notion that justice is not a formula but composed of a plurality of conceptions, definitions, and applications, one that we are all entangled in that comprises a tapestry of relations, and that is forever shifting and expanding. It reflects that our conceptions, experiences, and definitions of justice cannot be entirely distilled into words; it is a tapestry forever being rewoven together through diverse strands of experience and meaning, where each thread retains its integrity while also essential to the strength of the textile's entirety, the small refracting into the large.

Moreover, I believe that I engaged in fostering competencies that Vereijken et al. (2022) contend that there are essential competencies and skills for future professionals working in interdisciplinary fields contending with societal inequities, where they listed seventeen core competencies and skills. Out of this list, I identify eight core competencies relevant to my work, my context and my experience as an individual graduate student at the Master's level engaged in qualitative research and not working collaboratively on a transdisciplinary team. These included adaptability, risk-taking, curiosity, openness, humility, creativity, deep listening, and knowledge translation (Vereijken et al., 2022, p.5) through a practice-led approach that "does not simply study what already exists but acts by bringing something new into the world" (Couillard, 2020, p.15).

While this project could be endlessly worked on as an iterative work, similar to the iterative processes of engagements in EJ and socio-spatial tools, looking at the finished artifact, I feel a greater sense of "arriving" at my findings as I am satisfied that I engaged with the data and represented the themes as respectfully, fulsomely, and with as much integrity as I could have within the limits and timeline of my thesis. The intentions and practices we weave into our thinking processes can lead us to the types of knowledge we generate. Through my own practice of being open to the unexpected, the new and different (Abma et al., 2019) and letting go of certainties, I diligently and slowly created space to listen without pre-charted themes, outputs, or

outcomes and attempted to hear what the participants shared and weaving them into themes as best as I could, which felt at times slow and frustrating but nonetheless worthwhile.

Reflections On Next Steps

The findings presented in this chapter elucidate several reflections to inform potential directions forward for more wholistic engagements with environmental justice while operationalizing socio-spatial mapping tools for 1) individual researchers and practitioners, 2) policy, processes, and practices in the growing environmental justice field in Canada, and the increasing use of socio-spatial tools and processes, and 3) graduate-level education programs. I will outline possible steps to support the growing field in the following subsections.

Community-centered, Process-focused, and Pluralistic Conceptualization of EJ

Based on this research's findings and in the growing legislative context of environmental justice in Canada, conceptualizing environmental justice through a **lens of plurality** — where EJ is understood to be shaped by a variety of definitions, applications, and experiences — is recommended from the onset of decision-making processes and while designing community-based and/or research projects (Blue et al., 2021; Fraser, 1997; Schlosberg, 2007). A pluralistic conceptualization of EJ applied to processes of engagements that steer away from seeking singular or fixed solutions holds greater potential for more wholistic applications of EJ, particularly for weaving in recognitional and representational dimensions as well as distributional dimensions.

Moreover, a **community-centered approach** is recommended, where there is an attentiveness to the people, land, place, power structures, and cultures of those involved and using various tools and processes appropriate to that context (Abma et al., 2019; Quinless, 2022). Here, a greater emphasis on the processes and practices that galvanize knowledge and create change rather than technocratic tools and solutions themselves is called for, where, as participants of this research underscored, the tools are only as good as the processes they are used with. Such an approach is crucial to limit the perpetuation of extractive or harmful research and move towards transformative community engagement methods (Quinless, 2022). More research is needed on individual and organizational best practices, which can reciprocally inform each other, to utilize socio-spatial tools and associated processes in line with engaging communities suitable to their unique context of people, land, and place.

Individual Practices

Embedded within processes of engagements (decision-making, socio-spatial tool use or development, etc.) exist individual practices that galvanize the efficacy of those processes to create change and engage with more wholistic dimensions of EJ. I recommend that in processes of engagements with communities, researchers and practitioners consider contributing their skills, expertise, socio-spatial tools, and data when appropriate to the context, but decenter their expertise as a practice, allowing local community values, culture, and knowledge to shape the direction of the project, research, or decision-making process (Abma et al., 2019); essential recognitional elements of environmental justice (Engen, 2021), and ensure that there is accountability when mistakes are made (Quinless, 2022). Moreover, this research's findings suggest that commitments to tolerating and continually making sense of complexity and ever-shifting dynamics of cumulative inequities intersecting at the environmental, socio-economic conditions, and human health levels are imperative to engage in this work. Moreover, given this complexity, upholding humility, and a commitment to caring while articulating the multifaceted variables that cause vulnerability to environmental injustices in clear and publicly accessible ways while using and developing socio-spatial tools is valuable to meaningfully move this work forward, reflections also purported by Huang and London (2016).

A Greater Diversity of Tools and Technical Advancements, Governance and Data Sovereignty

Participants discussed the need for a plurality of processes that prompt decision-makers to expand wholistic decisions, which socio-spatial tools and processes can support. As such, advancements in socio-spatial tools can allow for heterogeneity, and more suitable spatial and temporal resolutions that reflect social, environmental, and socio-economic complexities are necessary. An additional reflection inspired by participants discussion on topics of environmental justice, socio-spatial tools and data collection practices is the potential for more exploration of best governance practices, pertinent considerations for operationalizing social and environmental data noted in the literature by Dencick et al., 2019 and Quinless, 2022.

Structural and systemic considerations in data collection and sharing practices, as well as mechanisms for governance and data justice, in light of using, sharing and collecting data and applying them in decision-making processes appropriately at individual and organizational levels, are worthy of more exploration and future research (Quinless, 2022; Shaw & Sekalala,

2023), particularly in the context of the growing legislative interest in EJ applications in connection to socio-spatial tools in Canada (Bill C-226 and Bill S-5).

Funding

An additional reflection for consideration is for institutions and departments that give funding, it is recommended to shift funding parameters towards approaches, priorities, and strategies of projects that allow greater engagements in research, projects, and decision-making processes that are responsive, attentive to power structures and systemic inequities, context-specific, and community-centred priorities, reflections noted by participants and supported by scholars Abma et al. (2019) and (Quinless, 2022). Investments of time and energy over the long term are necessary to build trustworthy, meaningful, interdisciplinary, and collaborative partnerships with community members and other collaborators, and includes incorporating accountability mechanisms between collaborators, shaping projects that align with community timeframes rather than funding parameters (Quinless, 2022) through *present and future planning* (Shaw & Sekalala, 2023). It is practical and ethical to engage with communities to identify their priorities and goals first, rather than the common practice of outlining pre-determined research and project goals necessitated by funding parameters before any community involvement takes place (Abma et al., 2019). Restrictive timelines, budgets and policies imposed by certain funding agencies limit the project's ability to involve and be involved with community members in meaningful ways and reinforce limitations on building meaningful community relationships that take years to develop; important institutional procedures to consider for more wholistic applications of EJ, particularly recognition (Schlosberg, 2007, p.172).

As such, flexibility and adaptability around rules and policies such as timelines and budget allocations are recommended to allow for more meaningful community engagement processes and more wholistic engagement with EJ in these processes, particularly recognitional and representational dimensions.

Graduate Education Considerations

The broad umbrella of arts-related research, including arts-integrated research, is an apt research type as a foundation and as an enrichment of research in general if suited to the researcher(s), their skills and interests, and context(s) (Chilton & Leavy, 2014). My thesis project is not prescriptive as it is specific to my creative skill set, context, and ontology (see positionality and discussion). However, it is an example of what a Master’s thesis in the Health Sciences can

look like that utilizes an emergent and practice-led approach to analyzing, exploring and generating knowledge that prioritizes learning and knowledge generation through artful making.

Such methodologies can be a valuable practice for current and future researchers to foster necessary competencies and sensibilities to be responsive to the growing societal inequities of our times (Vereijken et al., 2022) and to challenge themselves to do research "in different ways" across disciplines (Quinless, 2022, p.102). Vereijken et al. (2022) highlight such skills and competencies necessary for future professionals working in interdisciplinary fields, including realms of environmental justice, that contend with societal inequities as curiosity, openness, risk-taking, humility, creativity and adaptability, deep listening, and knowledge translation, to name a few (Vereijken et al., 2022). Expanding capacities as students and future researchers to practice engaging with plurality, tolerate the discomfort of multiple truths and risk expanding our thought capabilities are worthwhile efforts in our current epoch, characterized by rising uncertainty and intersecting inequities. Through this research, it struck me that if we are to engage with environmental justice through more wholistic applications, we must foster the capacity and competencies to make mistakes and to shift our longing away from fixed truths towards more adaptable ways of thinking and being, where we can admit what we do know, what we do not, and make space for what we cannot yet fathom given our current lens of viewing the world.

As a person who learns through doing and values exploring different ways of connecting to knowledge and knowing that includes more tacit and sensory knowledge, an arts-integrated approach was a deeply valuable thread to the line of scholarly inquiry during my graduate degree that has and will support my continued learning in the vast and interdisciplinary field of the health sciences in explicit (see discussion section) and implicit ways that extend outside of this thesis. As such, mentorship and support in our graduate programs can create apt and safe containers for students to foster such competencies if structured in suitable conditions and contexts (Ramachandran et al., 2022). For instance, there are opportunities for supervisors and committee members to provide additional support and resources to students who risk attempting to develop a thesis that merges social research and the arts using atypical creative modalities. Specific suggestions include flexibility, compassion, curiosity and adaptability from departments and faculty regarding thesis restrictions and expectations, as research outputs can still look different, have methodological rigour, and offer valuable academic contributions.

Strengths and Contributions

There are key strengths and contributions to this project. A key strength is that it is an example of a Master's thesis in the Health Sciences that seeks to experiment with an emergent and practice-led approach to engaging in data analysis and knowledge translation in a novel way. Moreover, it is the first example of research learning about EJ in relation to socio-spatial tools from those engaged in this work and trying to do it in practice in Canada.

While various limitations of this thesis exist (see ethical considerations, study limitations and challenges), this thesis offers valuable reflections for theoretical and processual applications of environmental justice at various levels: i) individual considerations for current or future researchers and practitioners developing or using socio-spatial tools or engaged in associated processes that are seeking more wholistic engagements with EJ and ii) reflections that can inform considerations for municipal, community, provincially or federal levels of decision making that engage with dimensions of EJ using socio-spatial tools and data.

Despite limitations, this study contributed to the interdisciplinary fields of environmental justice research and the use and application of socio-spatial tools, particularly in the Canadian context, both methodologically and theoretically, and points to implications for policy and practice for current and future researchers and practitioners in the interdisciplinary field that use and develop socio-spatial tools and their associated processes, as well as graduate student programs.

Methodological Contributions

This research demonstrates the utility of incorporating an arts-integrated approach in interdisciplinary research. To my knowledge, this is the first time that an arts-integrated approach, using weaving as a modality, was applied in a qualitative study centered around environmental justice and socio-spatial tool applications in Canada, and also the first time it is applied in a Master's thesis.

An arts-integrated approach allowed an enrichment of data analysis, where the researcher engaged in 'deep listening' through connections with the data that engaged a wider variety of senses that did not only privilege cerebral knowing (Sameshima et al., 2019) but experimented with a learning by doing approach, where the process of engaging learning and listening is enhanced by using "busy hands" (Elke, 2022, p.63) and creative making complimented the thematic analysis approach while listening back to interviews. Furthermore, such an approach led

to the creation of an artifact, sharing the findings of the research through a tapestry that allowed the researcher to practice knowledge-translation competencies (Vereijken et al., 2023) and share elements of the study that allowed for "new lenses for viewing, analyzing, representing, and disseminating research" (Sameshima, 2007). As a researcher, it was a beneficial individual practice to engage with the data with integrity and center unknowing through a dialogical movement of weaving, where the artifact became a tacit reminder that there was movement between the maker and the object being made, as there was between the researcher and the themes being distilled into this thesis. Moreover, the created artifact is a tangible reminder of the importance of plurality in EJ, connecting back to the notion that justice is not a formula but composed of a plurality of conceptions, definitions, and applications, one that we are all entangled in that comprises a tapestry of relations and one that is forever shifting and expanding.

This research offers an example in the field of the Health Sciences, where there is a dearth of examples of what an innovative Master's thesis can look like that integrates an arts-integrated approach. Moreover, it is an example of what a project can look like using an arts-related practice where the art-based methodology does not form the basis of the whole research (Sameshima et al., 2019), yet is a valuable contribution to the overall project, including the data analysis process, knowledge translation piece and as a practice of enhancing integrity for the researcher.

Contributions to Knowledge Generation

This is the first example of research exploring EJ in relation to how researchers and practitioners develop and use integrative socio-spatial mapping tools from those engaged in this work. The range of conceptions, processes, and practices that arose as findings in this research offers useful learnings and reflections for a more wholistic engagement of EJ in their work using and developing socio-spatial tools and the associated processes that they applied at the individual level that are also connected to institutional levels. For example, conceptions of interdependencies between nature, human health, and society as a whole; community engagement and prioritizing local knowledge; decentering their expertise; and, often favouring a process-focused approach and engaging in plurality, avoiding the allure of simple and straightforward solutions were all notable elements explored in this thesis's discussion. Naming and articulating participants' notions of equity and justice and their processes and practices, as well as the tensions that exist in this work, is beneficial to continually weave ourselves as current

or future researchers and practitioners in this growing, multiscalar, complex and interdisciplinary field.

Additionally, to better advance EJ-focused socio-spatial mapping, it is beneficial to learn from those already applying dimensions of EJ in practice to move towards more wholistic engagement(s) of EJ to be applied in the Canadian context where environmental justice is increasingly being used and applied at levels of research (Blue et al., 2021; Giang et al., 2022; Masuda et al., 2008) and in federal legislation with Bill C-226 and Bill S-5 (An Act to amend the Canadian Environmental Protection Act, 2022; National Strategy Respecting Environmental Racism and Environmental Justice Act, 2023).

All in all, scholars assert the need for wholistic and simultaneous applications of distributional, representational and recognitional justice theoretically (Fraser, 1997; Schlosberg, 2007) as well as specifically for socio-spatial tool use and development in Canada (Blue et al., 2021; Giang et al., 2022). These findings offer useful conceptions, practices, and processes for researchers and practitioners to consider while using, developing, or engaging in processes with socio-spatial tools in connection to the growing EJ discourse in Canada.

Chapter 6: Conclusion

Environmental justice is not a formula, nor can it be restricted to a simple definition or linear conversation; it is part of a vast and dynamic tapestry shaped by many communities, individuals, cultures, and geographies across movements and scholars. Based on the experiences of a small sample of researchers and practitioners engaged in using and developing socio-spatial tools associated with EJ in Canada across various sectors (i.e., academia, government, not-for-profit, self-employed), this thesis offers some threads that shape this tapestry of multitudes through the naming and exploring of relevant notions, processes, and practices among participants in their work developing and using socio-spatial tools. While there has been a plethora of advances in EJ and socio-spatial tools in the last few decades, the findings in this thesis suggest that we must also advance and innovate our processes of operationalizing such tools that align with wholistic dimensions and pluralistic conceptualizations of EJ, particularly given that we are connected, in relationship, and accountable to one another. As participants made clear, socio-spatial tools are only as good as the people using them.

There are opportunities for researchers and practitioners involved in this work as Canada's federal policy increasingly shifts to include environmental justice and scholars continue to call for more theoretical and pragmatic applications of dimensions of environmental justice that are more wholistic (i.e., simultaneous and more effective application of distributional, representational and recognitional justice) (Fraser, 1997; Schlosberg, 2007). While pragmatic and systemic questions remain on how best to collect, share, and apply data to socio-spatial tools in culturally respectful ways that recognize data justice, governance and power structures to limit perpetuating nefarious settler colonial histories in Canada, questions also remain on what processes might best utilize socio-spatial tools to deepen EJ work, support community-based action in ways that uplift our human dignity, while resisting the urge to rush to simple technocratic solutions. After all, stark uncertainty and rising inequities characterize the Anthropocene, where inequities span geographies and disciplines, seldom occur in isolation, and require adaptive and accountable problem-solving on behalf of decision-makers, as well as an increased tolerance for ambiguity.

Opportunities worthy of our attention include critically exploring and reshaping our research processes and practices to enhance new ways of thinking and being and foster interdisciplinary relationships while contending with cumulative impacts and inequities.

Additionally, individual and organizational practices that help us meaningfully move towards a more wholistic engagement of EJ as researchers, practitioners, future professionals, and human beings, such as decentering our expertise, commitments to caring, and meaningful community engagements, are worthy of our attention, particularly as what we do as individuals ripple out into the larger community and institutions.

How are we tending to grow our perspectives towards meaningful inclusion and active valuing and applications of recognitional and representational justice without only privileging distributional justice? While this thesis identifies commitments towards care, integrity, and accountability to ourselves and others as necessary in this work connected to EJ and socio-spatial tools for researchers and practitioners, what other commitments, values, practices and processes exist that move us towards a more just and equitable future? Moreover, how might we put these practices at the small, individual, institutional, and systemic levels, especially if we are in positions of power to do so?

Many threads compose the tapestry of environmental justice and the equitable futures we long for, continually being rewoven in messy tangles where it is not enough to understand the world but to actively weave ourselves within in. For such a tapestry to be vibrant and structurally sound requires meaningful, context-specific action where we use the fullness of our humanity, care, skills, tools, and processes while being accountable when we make a mistake to be good agents of change in ever-shifting societal conditions of our time. Our attention and responsiveness to our growing contexts are required, alongside our willingness to unravel and reweave ourselves and each other into new potentials that strengthen the whole.

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Lakehead UNIVERSITY

Appendix A - Information Letter

Perspectives in Environmental Justice and Mapping Tools: Learning with/from key informant interviews and an emergent arts-integrated inquiry

Thank you for your interest in this research project. Your time and help are truly appreciated. This sheet gives some basic information on the research, what you can expect, and how the data will be handled and used in the future. If anything is unclear or you want more information, please feel free to ask any questions you have. Our contact details are at the end of this document.

What is this research about?
This research project seeks to explore how researchers and practitioners developing socio-spatial mapping tools are understanding and engaging dimensions of environmental justice in their work. The broader goal of this research is to describe and identify major challenges, opportunities and limitations in applying environmental justice dimensions experienced by researchers and practitioners engaged in mapping tools. Furthermore, a novel arts-integrated practice will be employed to enrich data analysis and knowledge dissemination, using weaving as a modality.

Why is this research relevant?
Human health impacts are shaped by various systemic, historied and multi-scalar conditions that disproportionately impact marginalized communities (Huang & London, 2016). While tools and processes are increasingly being developed to better assess these impacts, there is much work to be done given the cumulative nature of social, economic, and environmental impacts to human health (Buse et al., 2013; Parkes et al., 2019; Tuncak, 2020). A growing number of scholars and federal legislation have called for research to advance our understanding around developing more integrative tools and processes that engage in more fulsome elements of environmental justice and equity in practice; to better inform opportunities for better addressing cumulative health impacts in Canada. In this context, the overarching goal of this research is to explore how researchers and practitioners developing integrative socio-spatial mapping tools implement and engage with environmental justice in their work.

What is being requested of me?
You are being invited to participate in this research because you are a researcher or practitioner who 1) plays a key role in developing or supporting integrative socio-spatial mapping tools geared towards understanding and addressing equity that use a range of data sources, and 2) is working in Canadian contexts. **As a key informant, I am asking you to participate in a Zoom interview approximately 60 to 90 minutes in length to share your knowledge and perspectives about your work related to mapping and environmental justice.** With your permission, the interview will be audio and video-recorded. Your participation is completely voluntary; you may refuse to answer any questions, or withdraw from the study.

After you have read this information letter and before the interview begins, we will ask you to sign the electronic consent form accompanying this letter. Please ask any question you may have before signing.

Are there any benefits or risks I should be aware of?
Conducting this interview will help us understand how environmental justice dimensions are being implemented, understood and operationalized in environmental justice mapping by researchers and practitioners. This research will allow for a dialogue around major challenges, limitations and opportunities involved in engaging in environmental justice among researchers and practitioners engaged with a variety of different mapping tools across various spatial and social contexts. There are no foreseeable costs (aside from your time) or harm to participating in this study. While there is minimal risk in participating in this study, some answers might make anonymity harder if specific instances or situations are traceable. You have the right to only share what you are comfortable disclosing with us, and you can end the interview or withdraw from the study at any time without giving a reason and without repercussions until the defence of the final thesis. Your participation is voluntary, and you are only being asked to offer information you feel comfortable sharing with us.

How should I expect to be treated?
This research aims to maintain the highest standards of ethical conduct and integrity. Centrally, this means that in participating in this research, you should feel that you and your contribution to this research have been treated with respect. Participation is entirely voluntary, and all information offered will be treated in good faith. You are welcome to refuse to participate, withdraw from the research and refuse to answer any of the questions asked without any negative consequences for yourself up until the thesis is written. All questions about the research, its aims and outcomes will be answered openly and honestly.

What if I want to withdraw from the study?
If you decide to participate, you may still choose to withdraw for whatever reason up until the thesis is written. There are no consequences to withdrawing. In cases of withdrawal, any data you provide will be destroyed. You can withdraw by contacting us (see below for contact information).

Who will know what I said or did in the study?
Should you agree to participate in this study, you will be participating confidentially. We will not use your name or any potentially identifying information in any study materials or reports. You will be assigned a unique study number as a participant in this study. Only this number will be used so that your identity (i.e., your name or any other information that could identify you) will be kept confidential. Only the researchers will know if you participated in the study and what you said during the interviews.

What will happen to the data after it is collected?
Data collected during this study will be kept on a password-protected computer in a locked and secure office space in Lakehead University's Department of Health Sciences. De-identified data will be stored in a secure online environment. Data will be stored for seven years after the

completion of the study, at which time it will be destroyed by removing computer files from the hard drive and shredding hard copies of data.

What will the data be used for?
This research will fulfill the requirements of a Master of Health Sciences for *Brigitte Champaigne-Klassen* and may also be used for a peer-reviewed publication in an open-access academic journal. Also, we anticipate that collected data will be 1) represented in a tangible woven piece of fabric as a form of knowledge translation that will visualize, explore and represent key elements brought out in the interviews in a textural and nontraditional way and 2) represented in woven form at a Lakehead University research-based exhibit curated by Dr. Sameshima.

How do I find out what was learned in this project?
A copy of the final research findings will be summarized in an infographic to summarize key findings in a visual manner that is easy to interpret and will be sent out to key informants following the completion of the thesis.

If you have further questions about these processes or need more information about the study, please contact us.

Thank you again for your time and assistance,

Brigitte Champaigne-Klassen - MHSc Student
Specializing in Social-Ecological Systems, Sustainability, and Health
Health Sciences Department, Lakehead University
bchampai@lakeheadu.ca

Lindsay Galway
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Chair in Social-Ecological Health
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807-343-8010 ext. 7280; lgalway@lakeheadu.ca

This study has been approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team, please contact Sue Wright at the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

Appendix B - Recruitment Text

To be used in emails or verbally, the text will be adapted to address individual participants.

Email subject line: Request for participation in a research study on mapping tools and environmental justice

Dear [name of potential participant],

I hope you are well. I am contacting you about potentially participating in a research study titled *Perspectives in Environmental Justice and Mapping Tools: Learning with/from key informant interviews and an emergent arts-integrated inquiry.*

This research seeks to explore how researchers and practitioners developing socio-spatial mapping tools are implementing and engaging dimensions of environmental justice in their work. The broader goal of this research is to describe the major challenges, opportunities and limitations in applying environmental justice dimensions experienced by researchers and practitioners in this work. Results from the study are intended to expand our knowledge of how environmental justice is and could be better operationalized within the field of mapping tools and to inform researchers and practitioners of these major findings to best support their work.

This research will fulfill the requirements of my Master of Health Sciences and may be used for a peer-reviewed publication. Results from the study are intended to stimulate conversation and deepen understanding around engaging with environmental justice through the use and development of mapping tools across various social and spatial contexts across Canada. I also intend to engage in and experiment with a novel arts-integrated practice that enriches data analysis and knowledge dissemination, using weaving as a modality.

Given your knowledge and lived experience in working with and/or developing socio-spatial mapping tools, I am writing to invite you to participate in this project. **This study will involve a one-on-one Zoom interview, approximately 60 - 90 minutes in length, during the winter months of 2023.**

Your participation is **completely voluntary**. If you consent to have the interview recorded, I will send you a transcript after the interview is complete for you to review. After the project is complete, a copy of the final research findings will be summarized in an infographic to summarize key findings in a visual manner that is easy to interpret and will be sent out to key informants following the completion of the thesis.

If you are interested in participating, please respond to this email to receive more information about the project and to set up an interview time. If you know of anyone in your circles that you think would be a good fit for this project, I would very much appreciate this referral.

Sincerely,

Brigitte Champaigne-Klassen - MHSc Student
Specializing in Social-Ecological Systems, Sustainability, and Health
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Appendix C - Consent Form

Perspectives in Environmental Justice and Mapping Tools: Learning with/from key informant interviews and an emergent arts-integrated inquiry

- I freely consent to participate.
- I have discussed the details of this research project and agree to participate in the research.
- I understand that the purpose of the research is to **participate in key informant interviews exploring how researchers and practitioners developing socio-spatial mapping tools are implementing and engaging with environmental justice in their work.**
- I understand the potential risks and/or benefits of the study.
- I understand that my participation in this study is voluntary and that I may withdraw (before or until the submission of my thesis) for any reason and without negative consequences
- I understand that I can choose not to answer any questions asked as part of the research and that I do not have to give a reason.
- Unless explicitly agreed to otherwise, I understand that the information I provide will never be attributed to myself individually.
- I understand that I will be explicitly asked for consent before recording the Zoom interview.
- I understand I may ask questions of the researcher at any point during the research process.
- I understand that all potentially identifying information will be kept confidential.
- I understand that the data provided will be securely stored at Lakehead University for a minimum of 5 years following completion of this study.
- I agree to have this interview audio or video-recorded (please circle one):
  □ Yes □ No
- Would you like to receive a summary of the research results? (please circle one):
  □ Yes □ No

I am fully aware of the nature and extent of my participation in this project, as stated above.

Name of Participant _____
(please print)

_____ _____

Participant's Signature Date

If you have any questions or concerns about this study, please contact Dr. Lindsay Galway (lgalway@lakeheadu.ca). If you have questions about your rights as a research participant in general, please contact Sue Wright at the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

Appendix D - Interview Guide

Prior to starting the interview guide:

Interview Guide

- Information letter and consent form reviewed
- Consent obtained for interview (All blank fields filled)
- Introduce myself
- Participants asked if they had any questions
- Consent obtained to begin recording
- Remind participants that there are no "right answers" and to feel free to ask for clarification
- Remind participants what I am researching and why
- Remind participants about the estimated time for the interview
- Give a high-level summary of what to expect in an interview (we will start with a set of questions about the context of who you are and where you work, and then I will ask specifically about EJ and its major challenges and limitations based on your personal experience as well as future opportunities …)
- **RECORD**

A. <u>Introductory and contextual questions</u>

What we hope to elicit here: These first questions of the interview will be used to start the conversation, build trust and rapport, and begin to understand the interviewee's work in relation to EJ mapping tools, including details of the mapping tools and related processes that people have/are working on.

- Can you tell me about yourself?

- Can you tell me about the work you do and your involvement with developing/using mapping tools?
    - Can you elaborate on that?
    - Why is this work generally relevant/important?

    - Why were you interested in participating in this research, or how do you see your work relevant to this research?
    - Anything else that is important for me to know about the tool and how it was developed?
    - How is equity and/or inequity measured and visualized in the tool?

B. <u>Understanding of and engagement with environmental justice</u>

What we hope to elicit here: A general understanding of how you think about and engage with environmental justice. Investigate how environmental justice dimensions have been implemented in socio-spatial mapping by researchers and practitioners.

Environmental Justice has been defined as "*the fair treatment and meaningful involvement of all people regardless of race, colour, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies*" (Mohai et al., 2009 p.4).

- What does environmental justice mean to you, and how does it relate to your work, if it does?

- Can you describe your past or current engagement with EJ?
- How have you addressed EJ through action in your work?
- Do you have any examples to better describe what you've just shared?

- How do socio-spatial maps support EJ, if it does?

Engaging with all three dimensions of justice (distributive, recognitional and representational):

- Recognitional justice can be defined as "the recognition of the cultural and power structures that perpetuate the unjust distribution of resources" (Schlosberg, 2004). Does your work engage with recognitional justice? If so, how?

- Representational justice can be defined as "fostering the full participation of those most impacted by environmental exposures in processes of decision-making" (Schlosberg, 2004). Does your work engage with representational justice? If so, how?

- Distributional justice can be defined as "the equitable distribution of resources and harms" (Schlosberg, 2004). Does your work engage with distributional justice? If so, how?
  - Can you share a story or experience that exemplifies what you just shared about engaging with (distributional, recognitional or representational) justice?
  - Can you share an example where this type of justice was necessary and whether or not it was being engaged in fully?
  - Thanks for sharing. What do you think is necessary to integrate these dimensions of justice further?

- What do you think about the need to engage with these three dimensions of justice in more integrated ways?

- What are the ways in which these dimensions of justice are not being engaged?
  - What is the gap that you see that exists in your work or the collective work, if relevant?
- From your perspective, what is the importance of integrating various environmental, community, and health data in the context of socio-spatial tools?

C. <u>Major challenges and limitations</u>

What we hope to elicit here: To describe the major challenges and limitations in doing EJ mapping work and in applying environmental justice dimensions experienced by researchers and practitioners engaged in integrative socio-spatial mapping tools.

- Can you describe what is most challenging in this work?
  - Are there any systemic factors such as policies, processes, or other institutionalized forces that impacted the tools' efficacy in engaging in environmental justice?
    - How have these challenges or limitations impacted you generally? Could

you describe an example?
- What is it like engaging in this work?
- What are the major tensions that exist in engaging in this work?
- Are there aspects of the 'bigger picture' that you feel are not being captured/addressed in your work/tool?

D. <u>Future opportunities</u>

What we hope to elicit here: Identify opportunities to further deepen engagement with environmental justice dimensions.

- What are opportunities for mapping tools to support environmental justice, if they do?
  - How can we do this right now?
  - How can we do this in the future?
  - Can you elaborate on any future possible opportunities to support environmental justice in your personal role, in the field, in the tools themselves, or in the use of the tools?
  - What lessons have you learned in this experience?

- What resources or supports would help to improve the use of mapping tools?
  - How can you best engage with these opportunities to further deepen engagement with environmental justice?

E. <u>Conclusion, weaving and demographic questions</u>

What we hope to elicit here: Wrapping up the conversation and threading in elements from the participant for the arts-integrated materializing practice of weaving.

- What is your favourite thing about engaging in this type of work?
  - What are your hopes for where this work will go?

- What are your personal motivations or aspirations to address environmental justice in your work?
  - Has any personal experiences influenced how you engage in this work of developing EJ mapping tools? If yes, can you elaborate?

- IF you had to choose one **colour** and one **word** to summarize how you feel about engaging in this work, what would it be? There is no wrong answer!

As part of the data analysis process through an arts-integrated approach, I will be engaging in the practice of weaving. Once our interview is complete, I plan to listen to this interview and weave as I listen back to begin the data analysis process. The colour you identify here will represent your specific interview as a block of woven cloth.
The end result of this process will include a long piece of fabric encapsulating every single interview. Each block of colour will represent each distinct interview, and the word you identify above will be embedded in the cloth in a creative fashion.

- Is there anything else you'd like to add before we finish?

- Are there other colleagues or organizations you can think of that may be interested in participating in this research?

E. Conclusion and demographic questions

To tell the participant: Before signing off, I have a few short demographic questions. We are asking
these questions to get a sense of the people and voices that we are hearing from and those that we are not
hearing from, as we would like to gather a diversity of experiences and recognize that our social locations deeply impact how each one of us see, act and exist in the world. You can decline to answer any
of these questions.

● Name of community where you live (*likely noted above)
● What year were you born?
● What is your gender identity?
● We know that people of different races do not have significantly different genetics. But our race still has important consequences, including how we are treated by different individuals and institutions. Which race category or categories best describe you? Select all that apply.
▪ Black
▪ East/Southeast Asian
▪ Indigenous (First Nations, Metis, Inuk/Inuit)
▪ Latino
▪ Middle Eastern
▪ South Asian
▪ White
▪ Another race category
▪ Do not know
▪ Prefer not to answer
● What is the highest level of education that you have completed?
● Would you consider you/your family as having low, medium or high socioeconomic status?
● Any other folks that you think we could/should talk with?

Thank participant!

Appendix E - Codebook

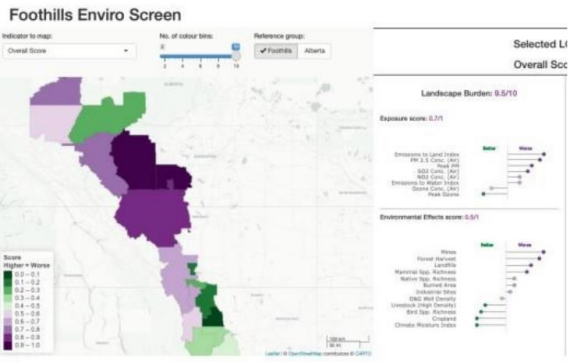
Theme	Subtheme	Description	Illustrative Quote
Shining a Light on Distributional Patterns	(In)equities / (In)equality	Equality and equity are core concepts used by participants as they operationalized socio-spatial mapping tools to make sense of distributional patterns. Includes examples on how tools help show unequal and inequitable distributional patterns in connection to environmental justice, including health outcomes and environmental impacts from resource extraction, industry, and climate change.	"Inequity is really important, because it's asking really intentional choices around what's right, what's fair and what's just. As opposed to just doing the distributional work of asking who's more impacted, or more impacted, or are those outcomes equal or unbalanced (...) The types of things that we can kind of see and count and touch, uh, and hear about - inequities are these kinds of amorphous structural, kind of invisible forces at play that guide, and shape inequality" (Riley).
	Cumulative approach(es) & Integration	Integrating environmental, community, and health data together (i.e., integration) was an essential concept for most participants as well as cumulative impacts between environment and health in illustrating distributional patterns with socio-spatial tools and processes. Includes current gaps in assessment processes and how future socio-spatial tools can benefit by applying a cumulative and integrative approach.	"In reality, people are not just experiencing one thing at a time, like I'm just experiencing one pollutant or one stressor, I am experiencing the sum of let's say a bunch of different chemicals, a bunch of different sources and a bunch of social, environmental and other stressors" (Lucas). "I don't think you can do environmental justice data without considering environment, community and health from those conversations (...) For me, the three of them in conversation with one another — that's at the core of environmental justice" (James).
Creating Change Through Processes & Power	Tools Guiding Decision-makers & Policy	Tools and processes help to create change by enhancing decision-makers understanding of existing inequities through evidence to facilitate more informed decisions and policymaking.	"Mapping helps us find those populations most at risk visually and help inform decision-makers on the ground to drive concrete action, both from a policy side and practically on the ground…to prioritize and target their interventions so that they are helping those people most vulnerable" (Rowan).
	Engaging Communities	Community engagement was essential in creating meaningful	"The perspective you're building in is not the perspective of some remote

		change, mainly through 1) mobilizing local knowledge to inform researchers and practitioners while using and developing tools and 2) engaging in interdisciplinary, community-centred processes to decenter the loci of knowledge from "western trained experts" towards the greater inclusion and valuing of community knowledge; important to representational and recognitional justice.	expert; it's the perspective of the people in the situation themselves, and it can be used in a process of empowerment. And if you don't do that and the planners are doing it, and they're representing other people's communities, for example, they can instead marginalize those people. Because it's not those people's views that aren't being represented; it's the view of some Western-trained planner or someone like that" (Charlie).
	Recognizing Power & Context	Concept of power as a core driver of inequity, as well as an essential concept in environmental justice and in decision-making practices that lead to meaningful change.	"It (tools) do play a small role from an information standpoint. But it's very limited, and it can only go so far as the person who's using it has power to implement what they're seeing in the data to further progress in these ways (...) They require human beings with connections, with audiences and with power, whatever type of power, whether it's social networking power, whether its political power, economic power - there's all sorts of different types of power, but I think those types of people need to engage with these tools in order for these tools to have any sort of meaningful impact on these types of justices" (Andrew). "Decisions are made by people, and these should be inputs into deliberative processes" (Riley).
Acknowledging Challenges and Tensions	Technical Challenges: Data Quality & Availability	Factors impacting data quality included availability, scale, and temporality, which are affected by data collection practices and, thus, impact the efficacy of engaging with environmental justice, namely representational (or procedural) justice.	"Once you use it, you look at the limited data that are even out there, and all the indicators that can pass through those things and pass all those tests (e.g. appropriate spatial scale, quantitative and continuous, good quality, publicly accessible) and work together, you're not often left with that much data. Especially environmental data, I find

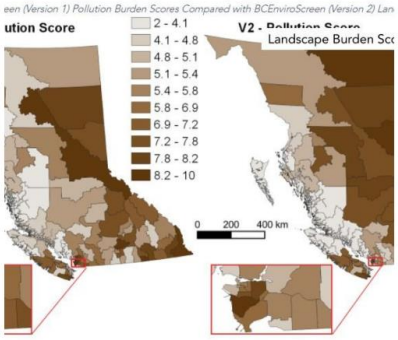
			tends to be pretty limited" (Lucas).
	Institutional Funding	Barriers from funding rules impacted ways participants could develop and use socio-spatial tools and processes to create meaningful change in line with environmental justice. Limitations included how these tools can (and cannot) shine a light on inequities and important implications for how they can (and often cannot) engage with the representational and procedural dimensions of environmental justice work (e.g., community engagement and knowledge inclusion).	"It is very difficult to do and nearly impossible to do in a lot of cases with tight timelines and small budgets. Somebody who builds the tool by themselves can come up with a pretty decent tool, but if it doesn't have that engagement in feedback with people that would make it much more grounded in reality, then it also doesn't have the ability to have an impact" (Andrew).
	Complexity & Longing for Certainty	How participants understand their work using socio-spatial tools and processes identifying, assessing or working with collaborators to create change is highly complex and cannot be solved simply. Such conceptions are often at odds with decision-makers' tendency to seek certainty and more definitive solutions.	"There is always going to be a degree of uncertainty whenever we are modelling and displaying these particular types of risks…decision-makers are going to want certainty" (James).
	Recognizing Bias	Being transparent and aware of existing limitations was noted to judiciously shine a light on inequities through processes of using and developing socio-spatial tools and limiting harm, such as the misrepresentation of communities.	"Even if we don't have the data to do that completely, it's important that we acknowledge that (as) a limitation. That these categories that we're drawing from are incomplete — like the categories that we're getting from the census might not actually recognizing important histories and experiences that play out at a structural level. And sometimes that means that we don't have the data, but we can at least acknowledge and push back, like acknowledge what we're not recognizing, and that's not part of it"

			(Riley). "If you are not aware of those kinds of things, you can misrepresent a lot of things, you can use it in a way that's not appropriate. So, I think people need to know about that and need to be aware of it" (Charlie).
Engaging in Intangible Practices	Commitment(s) to Caring	Caring is a major driver in participants' work as a practice while trying to engage with environmental justice using socio-spatial tools and processes and is noted as an important part of recognitional justice (van Uffelen, 2022).	"I worry a lot about the harm that we might be doing in our work when we're not taking sufficient care. Everything is so partial; it's like you might do this thing that we hope is pushing us in the right direction, but what if it's just cementing and just making stronger this thing that we're trying to change? What if, given our limited and partial view in academia of lived experiences that we all bring…What I mean is that if you're doing this sort of work, it's because we have commitments to care and justice" (Riley). "I would be happy if the work I did resulted in simply just caring for the environment better. By having a healthier environment because there's this relationship between the environment and health, it will, no matter what, come back into the social piece even if it's in a roundabout way" (Andrew).
	Practicing an Ethos of Imperfection	Recognition and practice of the nature of their work as being incomplete, imperfect, and slow. Practicing an ethos of imperfection was a notable practice among participants that helped them recognize the inherent complexity and imperfect nature of their work and helped them stay reflective and keep going.	"I think the work is always incomplete and always ongoing, and it is something that we must be mindful of constantly, and constantly reflect on in terms of that process…and continue to come to that question — this was great, what perspectives were missing from this particular dialogue? Whose view and perspective were not captured in this space? What does that mean in terms of the limitation on how we represent data on this particular tool?" (James).

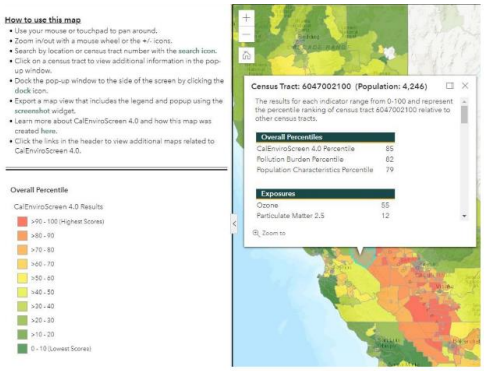
Appendix F - Reviewed Socio-spatial Tool Visual Examples



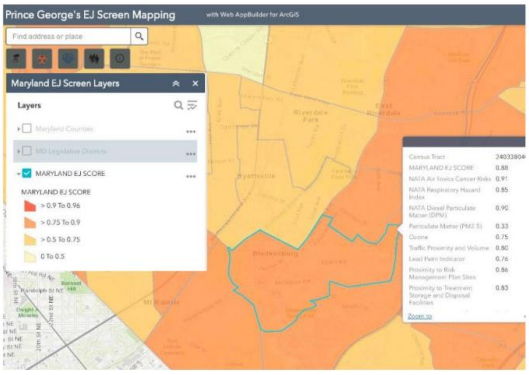
Buse et al., 2021a



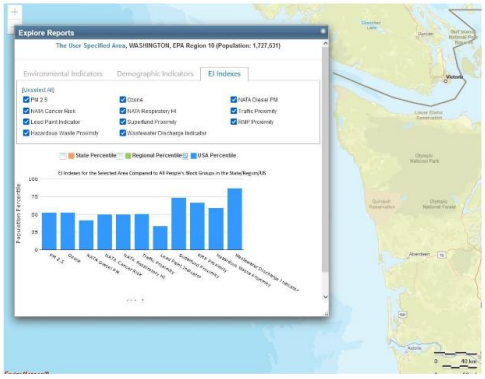
Buse et al., 2021b



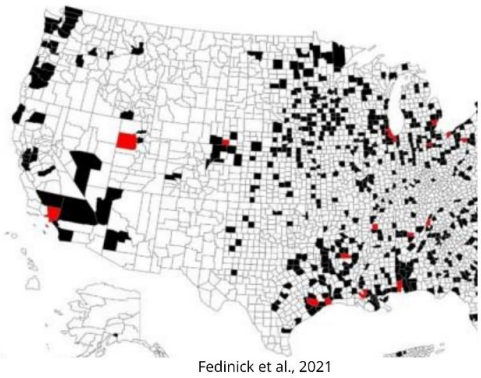
Calenviroscreen, 2022



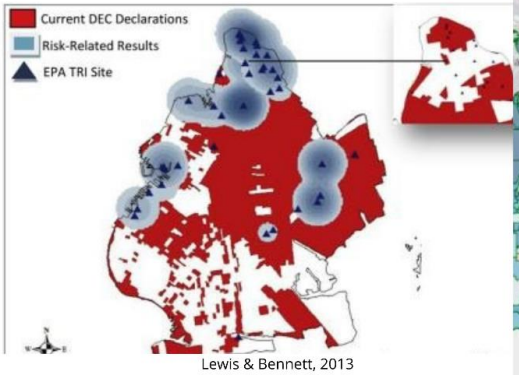
Driver et al., 2019



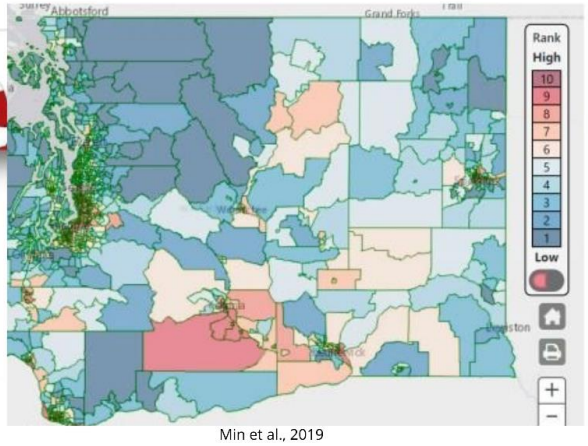
EPA EJ Screen



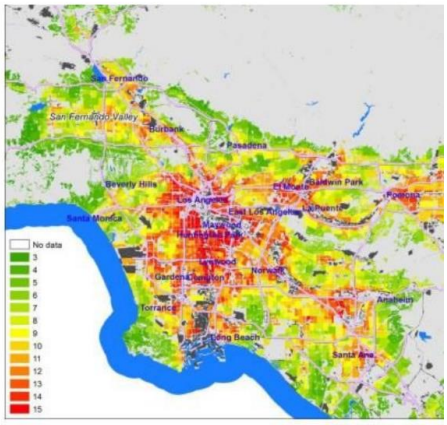
Fedinick et al., 2021



Lewis & Bennett, 2013



Min et al., 2019



Sadd et al., 2011

Appendix G - Setting Up Floor Loom and Arts-integrated Weaving Practice

Setting up the Warp on the loom

Weaving Fabric

Final Artifact

Note. These images do not represent an exhaustive account but an overview of how I dressed the loom, wove, and assembled the tapestry.