

Healing the Land:

*A Proposal for the Former
Pine Falls Paper Mill Site*

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degree of

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Department of Landscape Architecture

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I'd first like to acknowledge that this research was conducted on the territory of Treaties 1, 3, and 5 and on the homeland of the Red River Métis. I acknowledge and honour that our drinking water is sourced from Shoal Lake 39 & 40, on Treaty 3 Territory.

ABSTRACT

Prior to the arrival of Europeans, Sagkeeng Anicinabe First Nation resided on, cared for, and utilized the lands and waters in what is now Fort Alexander #3. Following the industrial movement in the area, including the establishment of the Pine Falls Paper Mill, the lands, once rich in sustenance, slowly became exploited for capital gain. The Pine Falls Paper Mill opened in 1927 and operated until 2010. Since its closure and the demolition of its infrastructure, the land that once supported the mill operations has been left vacant, contaminated, and in need of healing.

The purpose of this practicum is to propose a remediation plan for the former Pine Falls Paper Mill site. Furthermore, it suggests a plan to transform the site into a place that supports native medicinal plants as its long-term goal. The sites' design and supporting research propose a phased planning process to achieve the long-term goal.

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To my partner, Jus, thank you endlessly for your constant love and support throughout my undergraduate and graduate degrees. I would not be here today without your gentle advice and encouragement through this practicum.

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PERSONAL NOTE

My positionality will be essential to ground the research. Growing up, I didn't know much about my family's heritage or where we came from, I was always told that we are "Canadian," or "the most Canadian you can get." For a while, I was content with this identity, content with being Canadian. As I got older, I began critically reflecting on who I was, acknowledging how little I knew about my ancestry. When I was fourteen years old, I learnt that I was a Red River Métis citizen. Since then, I have always questioned where I fit into this identity. I was raised in a very privileged lifestyle, with no allusion to the experiences generations of my family went through to get me to this place. I come from a mixed Indigenous background with Anishinaabe roots tied to the Traverse Bay area, Nakota roots tied to the Cypress Hills area and Métis heritage connected to the Fort Alexander area, as well as English, Scottish, and French descent. As such, it has been difficult for me to discern which of these I feel the most

connected to. I have been making a conscious effort to rekindle my Métis identity over the last number of years through conversations with family and integrating certain aspects of Métis culture into my schoolwork and lifestyle.

Through my practicum work, I wanted to combine these personal connections with my interest in native Manitoban plants that can be used for medicinal purposes. This has always been an underlying thought in many of my projects throughout my undergraduate and graduate degrees. I became inspired by this topic in the third year of my undergraduate degree when I was introduced to a book called *Plants Have So Much To Give Us, All We Have To Do Is Ask* by Mary Siisip Geniusz. From that moment forward, I developed a deeper interest and curiosity in the topic. It has always fascinated me to think about this idea in landscape architecture and how our discipline can contribute to designing with traditional

ways of living in mind. That said, I acknowledge that most methods cannot surpass the value of Western medicine, nor is this research intended to suggest that. I like to think of it as rekindling the presence of these teachings in our heavily Western-emphasized society.

Within the last few years, my family has discovered that part of our ancestors' history is connected to Sagkeeng First Nation, which is a part of our lives that was never talked about in my upbringing. However, my family became disconnected from the community following my grandmother's attendance at Fort Alexander Residential School. These pieces of our family history are so important to me, and although they have been lost, I am hopeful of rekindling connections with the community my gramma grew up in. I have begun to establish personal connections with the Sagkeeng community during the process of my practicum, and I hope for it to continue following the completion. With

these connections and through this research, I have been discovering small pieces of my identity on a personal level, which has been extremely valuable to me.

Although the process of my practicum was not directly a conventional method of community engagement, due to the nature of its evolvement and the direction the work took, I hope to use my work as a tool to begin a conversation with the community of Sagkeeng First Nation. As I share my work with the Chief and Council following the completion, I intend for it to be a starting point, with ongoing conversations continuing following the completion of my academic requirements. I genuinely hope there can be pieces of this work, even if it's a mere idea that sparks a conversation, that the community can use and benefit from.



Fig. 1. Vegetation at the mill

Many of my ancestors' stories have been left untold through generations. Through this work, I hope to rekindle some of the memories that may have been lost. I am grateful for all my ancestors—specifically my gramma, granny, and great-grandmothers—who experienced unthinkable hardships that allowed me to live privileged and freely. As your legacy lives on, I am dedicating this work to you.





Lake Winnipeg

Sagkeeng First Nation

Powerview-Pine Falls

Lac Du Bonnet

Winnipeg

20km

1.0

INTRODUCTION

Prior to Europeans establishing themselves on Turtle Island, the shores along the Winnipeg River near the mouth of Lake Winnipeg were inhabited by the Anicinabe people since time immemorial. Historically, the area was also home to some Saulteaux Cree and Sioux peoples, most of whom have now migrated to other places (Manitoba Hydro, 2009). The Anicinabe people have had a relationship with this landscape through generations of ancestors residing on and connecting with the land that is now Sagkeeng First Nation, also known today as Fort Alexander Indian Reserve #3. Every part of the landscape was maintained to harmonize with their traditional ways of living, and resource management was a part of everyday practices (Sagkeeng First Nation, 2019). Through the process of colonization, many First Nation communities' traditions and harvesting practices

have been lost, with Sagkeeng First Nation being one of countless communities that has experienced this firsthand. This research will focus on, in particular, industrial development and settlement to support the Pine Falls Paper Mill.

It was only shortly after Treaty 1 was signed in 1871 that many changes in the community began to arise. In 1891, a small part of the traditional land of the Anicinabe was designated for reserve lands, confining the community to the boundaries of an invisible line (Sagkeeng First Nation, 2019). The establishment of the reserve boundaries came along with many other hardships for the community, such as the Indian Act, Fort Alexander Residential School, which opened in 1905 and ran for nearly seventy years (Sagkeeng First Nation, 2019), and the

Sixties Scoop. These monumental changes for the community were detrimental and one of the many ways colonialism had a negative impact on Sagkeeng's traditional ways of living (Daywalker, 1994).

Shortly after colonial conditions had been established in Sagkeeng, the extent to which First Nations could enact and uphold their rights began to change, and slowly, the landscape started to change. For decades, the Indian Act required people to get permission to leave the reserve, affecting harvesting practices and land management (Joseph, 2018). The area of the Pine Falls Paper Mill was once part of Sagkeeng's traditional harvesting lands for fishing, trapping, and harvesting medicine and food, with most of this land supporting and sustaining the community's lifestyle (Daywalker, 1994). Following the arrival of settlers in this area, invasive species began to overwhelm the native landscape, hydroelectric development

transformed the natural patterns of the river, deforestation destroyed the dense forests to support the Pine Falls Paper Mill, and the land that was once familiar to Sagkeeng members slowly transitioned into an unfamiliar landscape (Sagkeeng First Nation, 1995).

The overall purpose of this research is to develop a design proposal to heal the former Pine Falls Paper Mill site of contamination and to create a designated space for members of the Sagkeeng First Nation to harvest medicinal plants. This work will be supported by addressing the following questions: How can phytoremediation technologies transform the Pine Falls Paper Mill site into an uncontaminated landscape? Furthermore, how can the ultimate goal of creating a designed landscape incorporating native Manitoban plants with medicinal benefits be achieved following contamination removal?



TRAVERSE BAY

SAGKEENG FIRST NATION

WINNIPEG RIVER

FORMER PINE FALLS PAPER MILL
POWerview-PINE FALLS

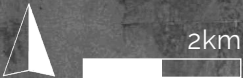
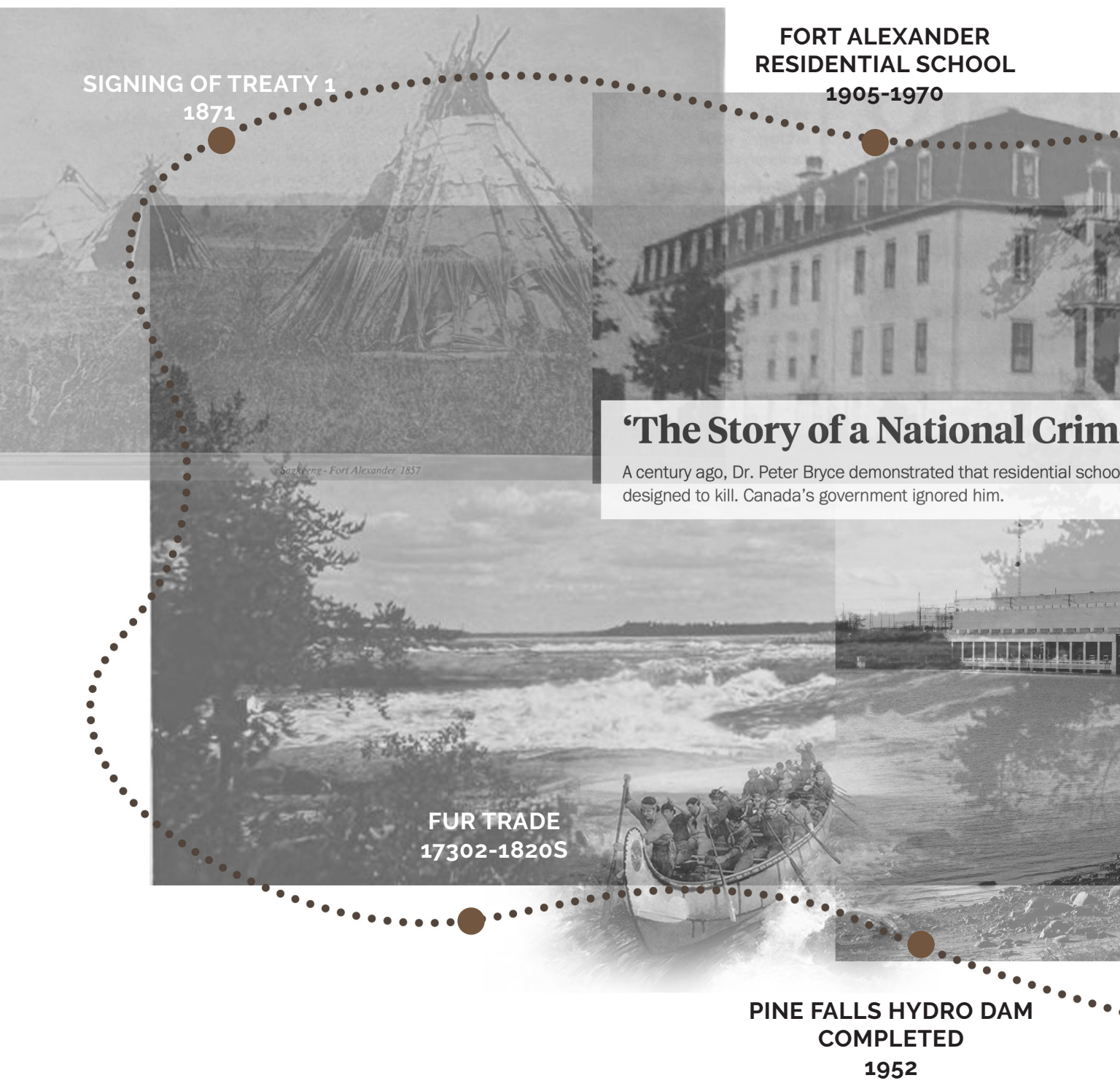


Fig. 3. Sagkeeng First Nation Reserve Boundaries 05



SIGNING OF TREATY 1
1871

FORT ALEXANDER
RESIDENTIAL SCHOOL
1905-1970

'The Story of a National Crime'

A century ago, Dr. Peter Bryce demonstrated that residential schools were designed to kill. Canada's government ignored him.

FUR TRADE
17302-1820S

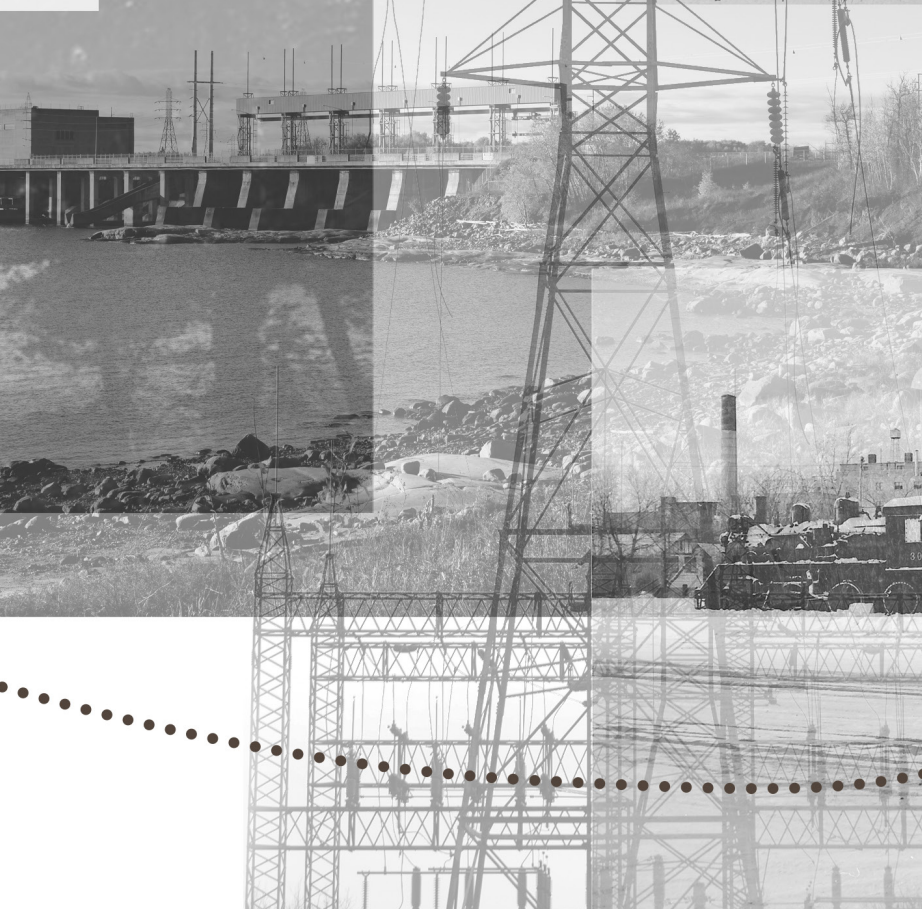
PINE FALLS HYDRO DAM
COMPLETED
1952



Canada's Residential Schools Were a Horror

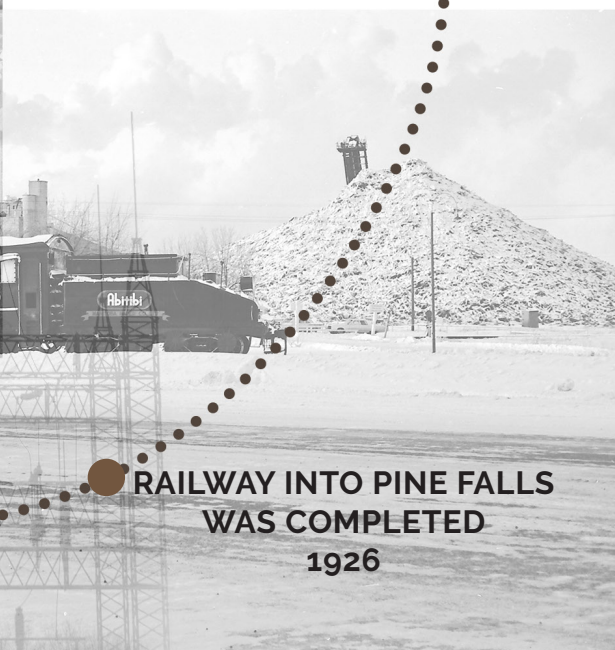
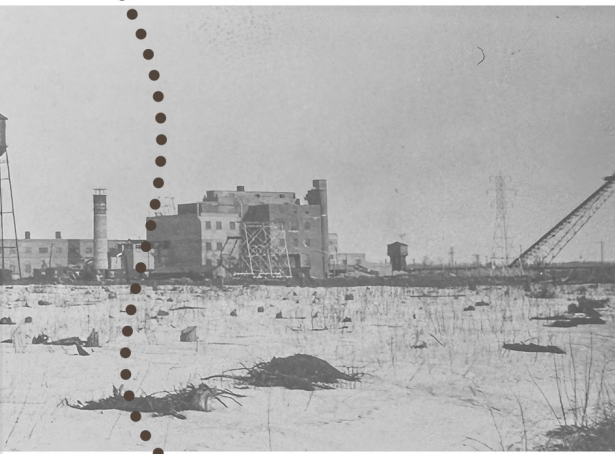
Founded to carry out the genocide of Indigenous people, they created conditions that killed thousands of children

e'
ls were



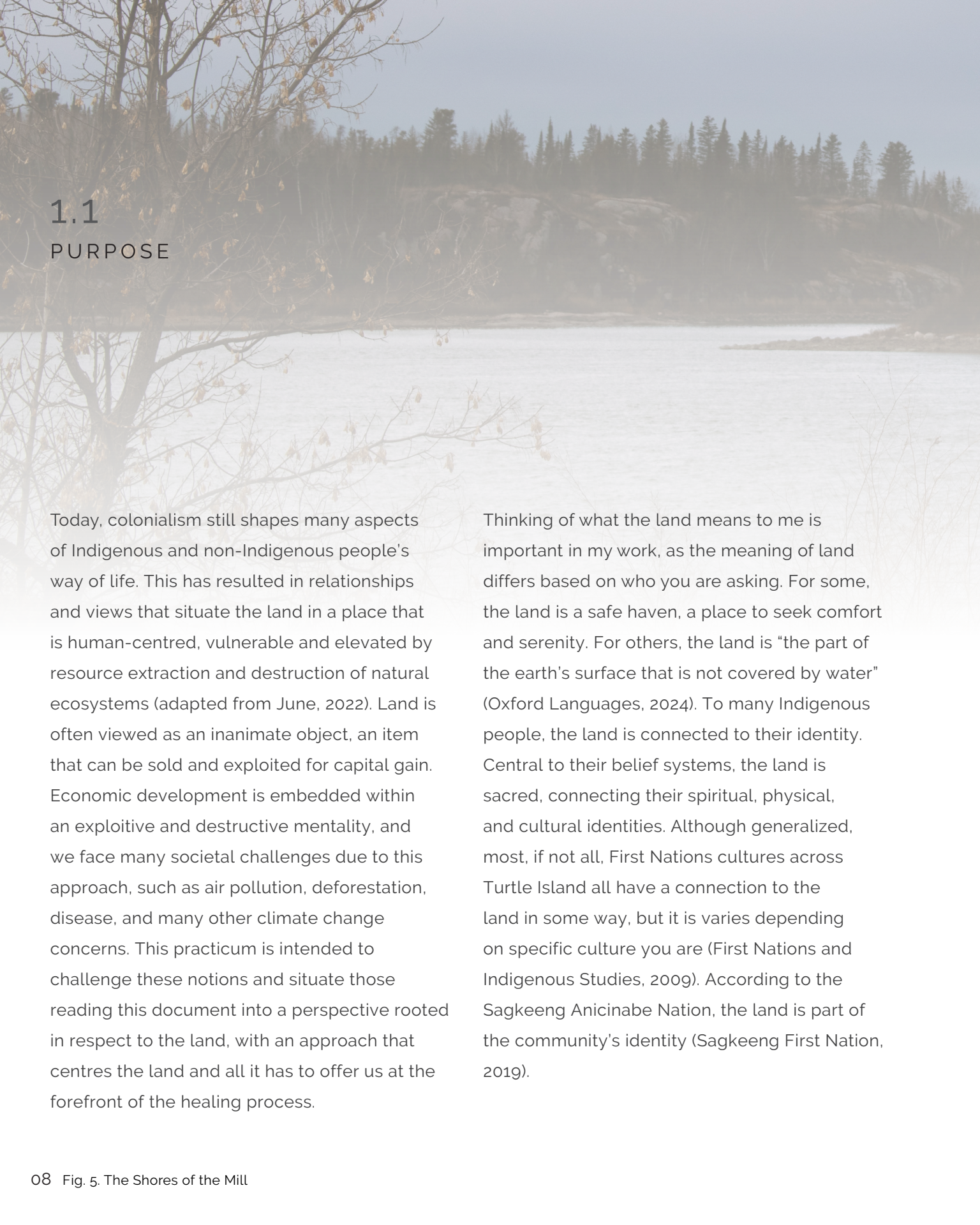
**PINE FALLS PAPER MILL
OPERATIONS BEGAN**

1927



**RAILWAY INTO PINE FALLS
WAS COMPLETED**

1926



1.1

PURPOSE

Today, colonialism still shapes many aspects of Indigenous and non-Indigenous people's way of life. This has resulted in relationships and views that situate the land in a place that is human-centred, vulnerable and elevated by resource extraction and destruction of natural ecosystems (adapted from June, 2022). Land is often viewed as an inanimate object, an item that can be sold and exploited for capital gain. Economic development is embedded within an exploitive and destructive mentality, and we face many societal challenges due to this approach, such as air pollution, deforestation, disease, and many other climate change concerns. This practicum is intended to challenge these notions and situate those reading this document into a perspective rooted in respect to the land, with an approach that centres the land and all it has to offer us at the forefront of the healing process.

Thinking of what the land means to me is important in my work, as the meaning of land differs based on who you are asking. For some, the land is a safe haven, a place to seek comfort and serenity. For others, the land is "the part of the earth's surface that is not covered by water" (Oxford Languages, 2024). To many Indigenous people, the land is connected to their identity. Central to their belief systems, the land is sacred, connecting their spiritual, physical, and cultural identities. Although generalized, most, if not all, First Nations cultures across Turtle Island all have a connection to the land in some way, but it varies depending on specific culture you are (First Nations and Indigenous Studies, 2009). According to the Sagkeeng Anicinabe Nation, the land is part of the community's identity (Sagkeeng First Nation, 2019).



"The Anishinaabe person is inseparable from the land; identity, sense of place and history is intimately related to the land. We originated here. The North American Indigenous person did not migrate from anywhere else, nor originate from any other peoples. The Creator took four parts of Earth and molded the form of the first human person. Since then, all of humankind has been related to the Earth in a very intimate way -- the Earth, in fact, is our Mother. The human person is a relative to all other persons of the Earth, and, along with all creatures call the Earth, Mother" (James Dumont, as cited in Foushee and Senogles, 2010, p. 37).

I often think about the moments I've spent on the land creating a deeper connection between myself and the surrounding natural environment. I cherish moments with Elder Valdie Seymour that have opened my eyes to how deeply connected he and many Indigenous

people are to the land. During my first semester in the MLA program, before I knew Elder Valdie well, I visited the Forest School with an undergraduate class and Elder Valdie. We were lucky to hear Elder Valdie share stories and teachings about the land, which allowed me to realize and appreciate how vital land-based learning is in our education. Moreover, I discovered how important it is to go onto the land to appreciate how it supports us as individuals, as well as how it supports our profession. Valdie shared a teaching that has stuck with me – and always will – and I think about it when I explore new landscapes. He talked about how the land is living and that everything is interconnected. Everything in nature was born with a role, a purpose. Each tree, each plant, everything down to the tiniest speck of dirt knows what their purpose is, whether it is a medicinal purpose or rather a functional purpose, they



all help one another to achieve their purpose (Elder Valdie Seymour, Hollow Water First Nation, personal communication, September, 2022). Valdie shared how he feels what the land feels when you walk through and advised us to be conscious of where and how you walk through it. When you walk off the pathway onto a fresh layer of moss, possibly a piece of the land that was untouched, the whole forest feels it (Elder Valdie Seymour, Hollow Water First Nation, personal communication, September, 2022). Valdie shared this in a way that did not discourage us from exploring the land but was merely a way of making us conscious of who is affected by these actions. Understanding these notions is something I felt was important to share, as it is an underlying thought in my mind when approaching the land, which is a common practice in the realm of landscape architecture.

As the Pine Falls Paper Mill site comes with many challenges, I wondered how to approach a highly disturbed landscape with the teaching Valdie shared in mind. The site of the Pine Falls Paper Mill has experienced an extreme amount of abuse and neglect. While the mill was operating, the landscape supported the community through resource extraction and capital gain. The purpose of this work is to understand how these notions of respect towards the land translate into a large, exploited landscape. Although the answer might be indirect and unclear at this time, it will be essential to keep these objectives as the overarching element throughout the design proposal.

"Our responsibility is not only to restore the land, but also to **heal** our relationship with land, restoring the covenant of respect, responsibility, and reciprocity."

Robin Wall Kimmerer, 2018, p. 43.





1.2

GOALS AND OBJECTIVES

While colonial conditions persist, this proposal aims to provoke conversations about what our world could look like if we prioritized the land first and gave it time to heal. Many landscapes within central and northern Manitoba face issues similar to those at the Pine Falls Paper Mill site. Similarly, these landscapes are left vacant, past the point of exploitation and profit, and no longer useful for economic development. With the many open, wild, and overgrown landscapes containing contaminated soils and groundwater, there are also vulnerable ecosystems on precious landscapes that have the potential to be restored into meaningful places. Landscape architecture has the ability to propose an approach that could enable the land to heal and create spaces that benefit the environment and our future society's health and well-being.

The main objective of this practicum is to create a space for healing for the Pine Falls Paper Mill site, with the end goal of designing a naturalistic landscape that mimics native riparian and upland zones. By providing a place for Sagkeeng First Nation community members to harvest plants for medicine, the landscape will also transform into a place where

people in Sagkeeng and other surrounding communities can use the site for leisure, gathering and harvesting. However, due to the nature of the site and the complexities of its current conditions, the site needs to experience a phase of healing in itself. The site currently consists of a variety of groundwater and soil contaminants. Therefore, it must undergo an extensive phytoremediation process to transform the landscape into a place that is safe for harvesting.

Lastly, the site and the design proposal for the site must allude to the palimpsest of histories embedded within the landscape. The site has emotional significance for both the communities situated adjacent to it, Sagkeeng First Nation and Powerview-Pine Falls. As there are many interconnections between these communities, a clear line cannot be drawn. With the proposal gearing more towards the desires of the Sagkeeng community, it will also be important to allude to the importance of the mill's existence for the town of Pine Falls.

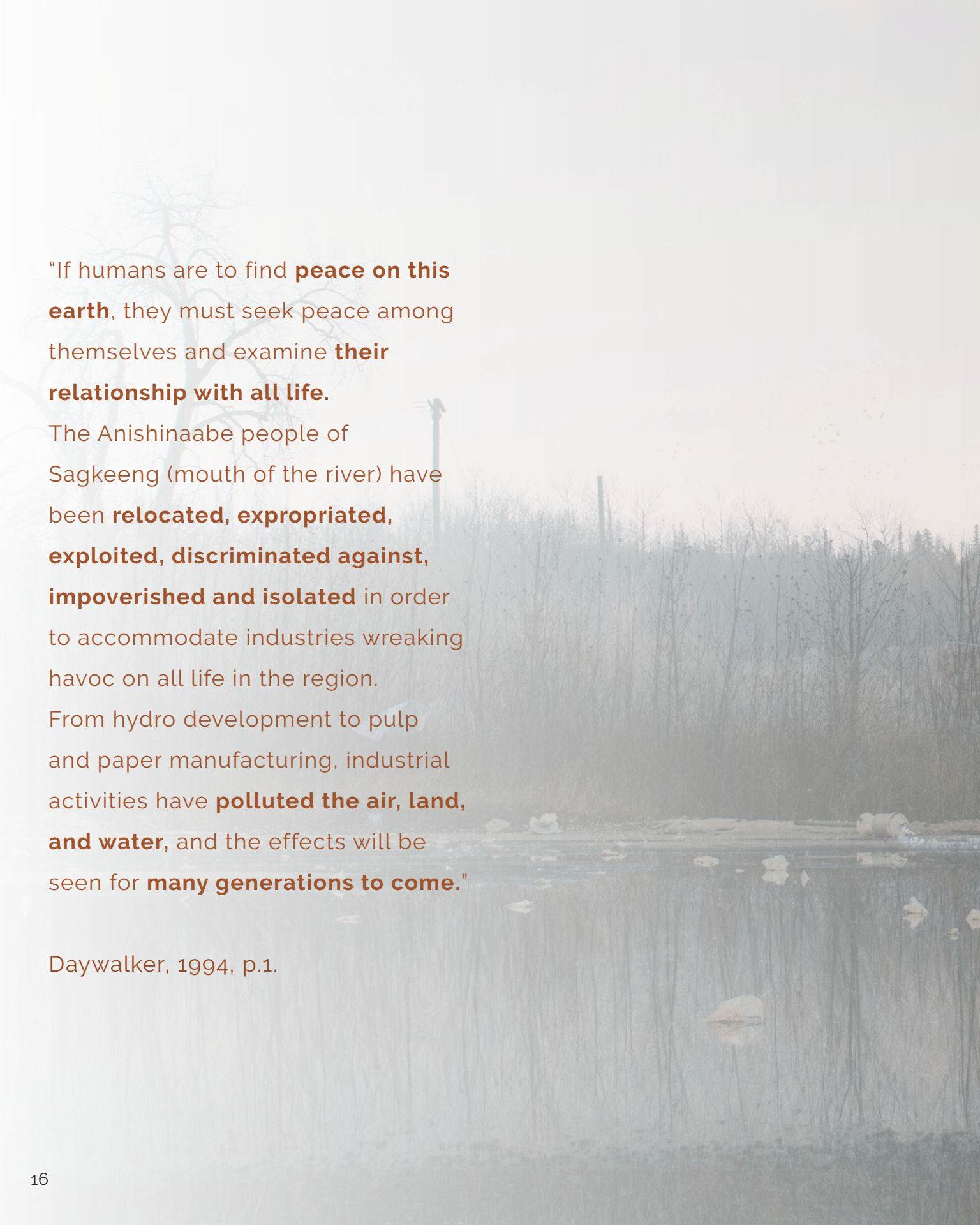


1.3

COMMUNITY ENGAGEMENT EFFORTS

It was important to me to conduct this work in a good way, and my intention has always been to create a proposal that can benefit the community of Sagkeeng. However, one piece of my practicum work that will always be missing is direct community engagement to influence the direction of the design proposal. As my practicum was produced to fulfill academic requirements, it was difficult for me to engage with the community in a way that guided my work through traditional knowledge and teachings, as the knowledge I would have liked to guide this work didn't feel like mine to share. Having said that, I have still made efforts to go

to the community and engage with people on a personal level, creating personal connections outside the academic realm. Following the completion of this work, I plan to present my practicum to the community and discuss if there are any pieces that can be taken from and expanded on to fit the community's needs. As I share my work with the community, I hope to continue having conversations, creating relationships, and sharing the knowledge and experience I have obtained through this journey.

The background image shows a desolate landscape. In the foreground, a body of water is covered with floating debris, including white plastic cups and other trash. The water reflects the overcast sky. In the middle ground, there is a line of bare, leafless trees. Behind the trees, several tall, thin industrial smokestacks or chimneys are visible against a pale, hazy sky. The overall tone is somber and environmental, suggesting the impact of industrial activity on nature.

"If humans are to find **peace on this earth**, they must seek peace among themselves and examine **their relationship with all life**.

The Anishinaabe people of Sagkeeng (mouth of the river) have been **relocated, expropriated, exploited, discriminated against, impoverished and isolated** in order to accommodate industries wreaking havoc on all life in the region.

From hydro development to pulp and paper manufacturing, industrial activities have **polluted the air, land, and water**, and the effects will be seen for **many generations to come.**"

Daywalker, 1994, p.1.



Fig. 9. Hydro station 17



Fig. 10. Sunset on the mill (Credit: Allan Peden)



Fig. 11. Film from Pine Fall Memories (Credit: Allan Peden)

2.0

BACKGROUND

The Pine Falls Paper Mill development started in the early 1920s, with production officially beginning in 1927 (Strassel, 2022). A 99-year lease was negotiated between Sagkeeng First Nation and Manitoba Pulp and Paper Company for the 520-acre mill site. The Manitoba Pulp and Paper Company also purchased 200 additional acres of land adjacent to the mill site to establish a town specifically for its workers, Pine Falls, which is now known today as Powerview-Pine Falls (EGM Heritage, 2022). The mill operated at its peak capacity until 2001, but due to the difficulty of sustaining ever-changing environmental standards, and the decline of print demands, it officially closed in 2009. The mill and its surrounding buildings and infrastructure were demolished in 2011 (Goldsborough and Kotak, 2023), and the land has been vacant ever since.

It is unclear what the details of the negotiation agreement were related to the lease of the land

as some say the land was purchased outright from Sagkeeng First Nation and other owners by the late John D. McArthur, who was responsible for the establishment of the mill (Author Unknown, 1976). Others state that the land was leased and taken from Sagkeeng improperly (Strassel, 2022; Chambers, 2012). However, when comparing the typical patterns of colonialism around this, such as land dispossession and displacement of communities, it is safe to make the assumption that the First Nation people did not get a fair part of the negotiation. It is evident when comparing Figure 12 and Figure 13 that the mill site was initially part of the reserve land following the Treaty 1 negotiation and signing in 1871 (Sagkeeng First Nation, 2019). There are many ambiguities concerning the true ownership of the land and who was to inherit the site subsequent to the lease agreement expiring. However, it has now passed the date of expiration in 2023 (Strassel, 2022).

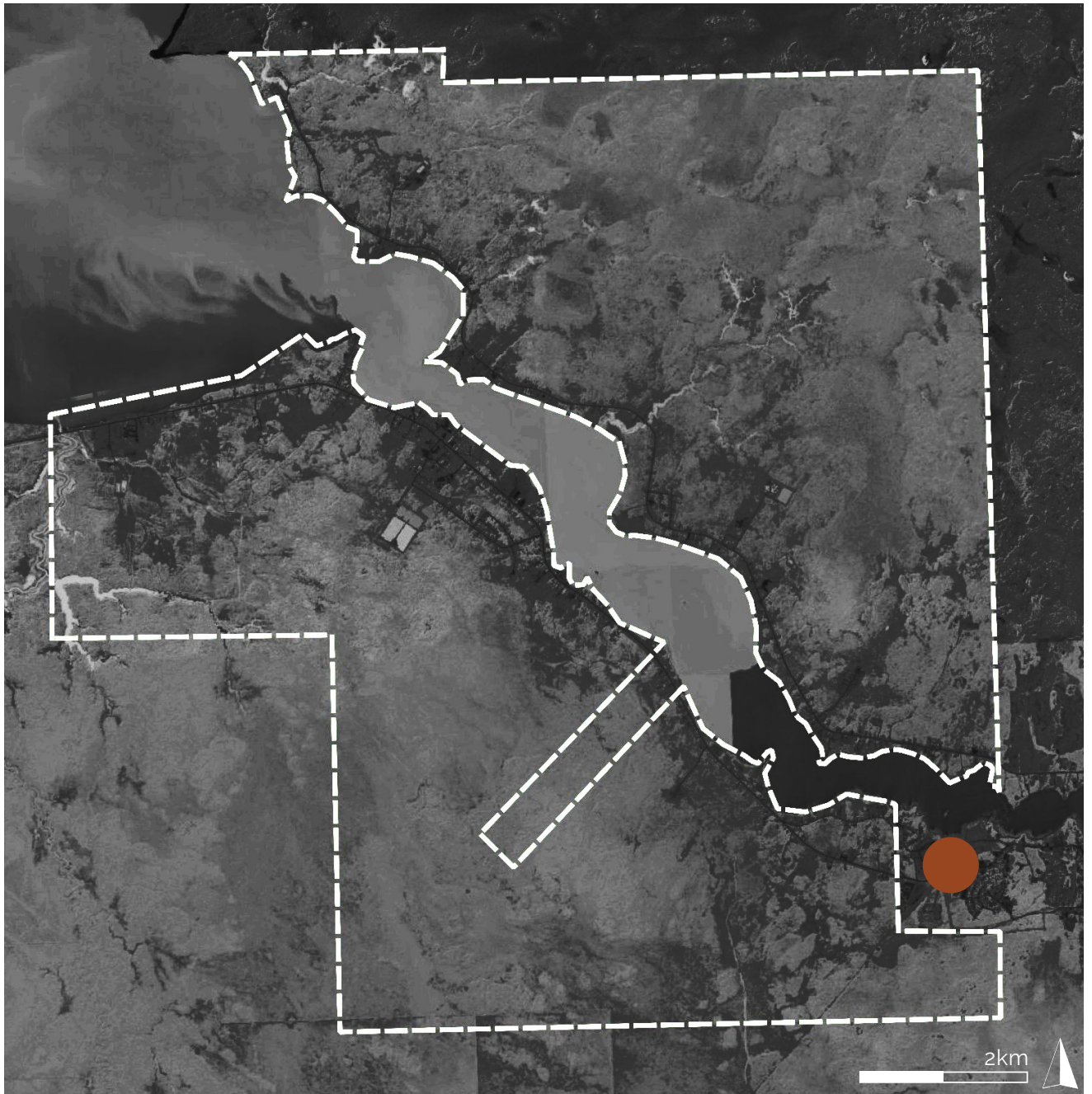


Fig. 13. Plan of Present Day Reserve Boundary at Sagkeeng First Nation

- Pine Falls Paper Mill Site
- Present Day Reserve Boundary

2.1

SUSTAINING A PULP AND PAPER TOWN

The mill operations were immensely successful in supporting the town of Pine Falls during its early years of establishment. The town was built through the late 1920s to support the mill and its workers. Apart from its closure during the Great Depression in 1932 to 1935, the town was sustained by the mill operations up until the mill was sold to Tembec in 1998 (Goldsborough and Kotak, 2023). Moreover, the mill successfully profited from its operations during this time. The success of the mill was able to sustain all the town's amenities, from sewer and water services to a school and hospital (Goldsborough and Kotak, 2023). The mill provided jobs to the people of Pine Falls while also attracting people from across North America as it promoted employment and affordable living (St. Godard, 2017).

Although the Pine Falls Paper Mill Company was loyal to its employees and people who resided in the town, Indigenous people from surrounding communities had different experiences. People from surrounding First Nation and Métis communities often could only secure jobs that were seasonal, either logging or tree planting, but it was quite difficult for

local Indigenous peoples to be employed at the mill and surrounding woodland operations (Chambers, 2012). The mill operations are a prime example of benefiting from the land in an exploitive manner, land that was once a delicate and precious part of the larger ecosystem that the people of Sagkeeng First Nation cherished and valued. The people of Sagkeeng shared no advantages from the mill operations. "The people whose lives, livelihoods, and traditional lands were most directly affected have received the least benefits" (Chambers, 2012).

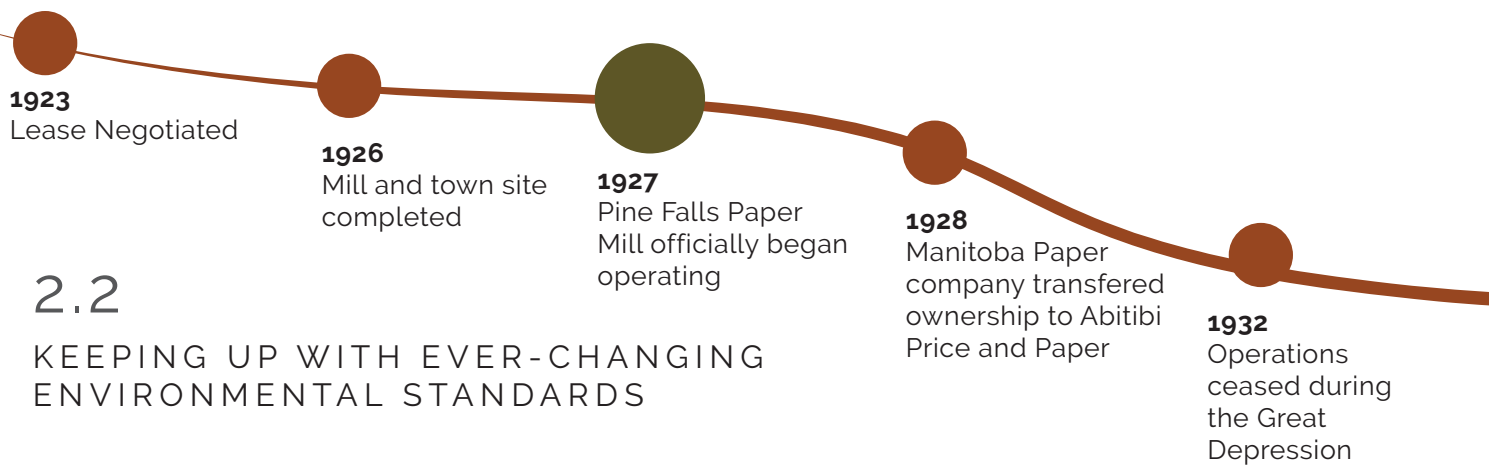
The mill transitioned through various ownerships within the last two decades of operations. As the environmental standards increased, Abitibi-Price had difficulty maintaining the mill to keep up with the ever-changing standards. Abitibi-Price owned and operated the mill from the time operations began in 1928 up until 1994. On September 1st, 1994, the mill was sold to its employees, who negotiated a 10-year agreement with Abitibi-Price. The mill workers negotiated terms ensuring that Abitibi-Price were still responsible for 80% of newsprint sales (St. Godard, 2017). As the Pine Falls Paper Company, the employees oversaw the



Fig. 14. Pine Falls (Credit: Alan Peden)

operations until early 1998, who, in turn, sold all shares and operations to Tembec. It was under Tembec's operation that the town of Pine Falls was forced to transition into a self-sufficient town as it could no longer depend on the mill operations for sustenance (Goldsborough and Kotak, 2023). Shortly after Tembec made this announcement, Pine Falls was forced to join the municipal system. However, due to the size of the town and population, Pine Falls could not sustain itself as an independent municipality, resulting in the merger between Powerview and Pine Falls, known today as Powerview-Pine Falls (St. Godard, 2017). The mill operated under Tembec's ownership for another twelve years before it officially closed down in 2009. During this time, Tembec made

many efforts to comply with environmental standards, investing 125 million dollars into upgrading the pulp technologies (Goldsborough and Kotak, 2023). Shortly after this system was set in place, a decline for newsprint began, and the land was then sold to the Pine Falls Development Corporation in 2011, who quickly deemed it ready for demolition in the same year (St Godard, 2017). The vacant land is currently owned by the Pine Falls Development Corporation, which, as of 2011, "had finalized a plan to remediate the site in an approach that allows for investment recovery, development, and assured environmental closure" (Matthis, 2011). However, there is no known progress on the plan being implemented.

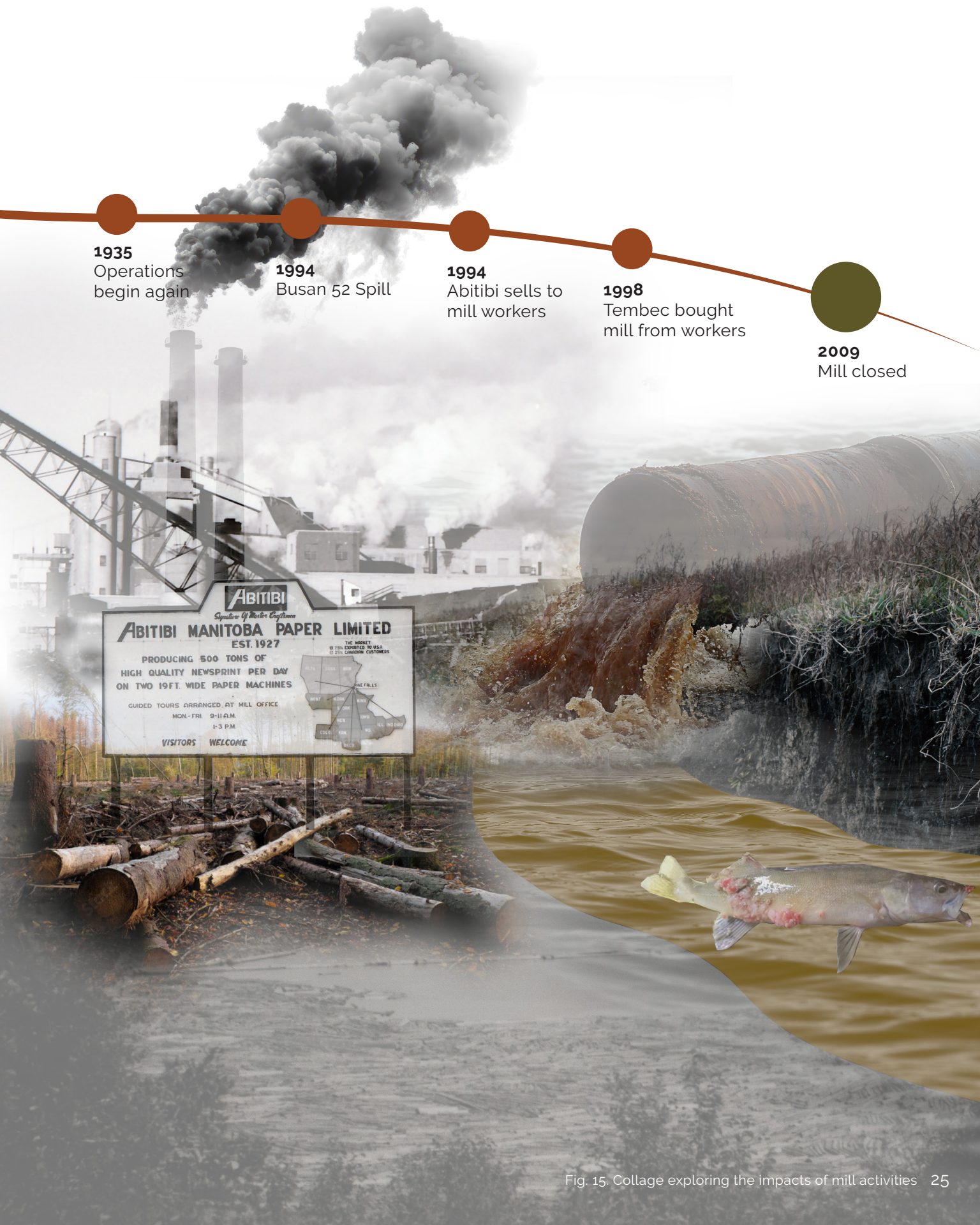


The Pine Falls Paper Mill was known for violating numerous environmental standards during its peak operations. For example, the Pine Falls Paper Mill operated without an environmental license until 1996, and during this time, there were numerous unreported chemical spills. Additionally, it was reportedly the only paper mill in Canada that did not submit reports for the Environmental Effect Monitoring programs through the Federal Fisheries Act (Chambers, 2012). In fact, Pine Falls argued in favour of their environmental impact, stating their effluent treatment system “improved the quality of the Winnipeg River,” though they didn’t have a proper system in place until 1979 (Chambers, 2012).

While still under the ownership of Abitibi-Price, in March 1994, nearly a tonne of Busan-52, a toxic pesticide, was released from the mill operations and overflowed into the Winnipeg River (Sagkeeng First Nation, 1995). As the mill is only a few kilometres upstream from

Sagkeeng First Nation, this was very concerning to the community. However, the people of Sagkeeng were not informed about the toxic spill into the water until three days after the occurrence, knowing that the community uses the river as drinking water (Sagkeeng First Nation, 1995). Health Canada deemed the “long-term health risks of drinking the water to be ‘minimal,’” yet the community of Sagkeeng did not consider this acceptable (Sagkeeng First Nation, 1995).

Although the Busan-52 spill was in many respects the “last straw” for the Sagkeeng community, it was also seen as just one more stage in the environmental deterioration that the older members of the Sagkeeng community have witnessed during the 20th century. These older members of the Sagkeeng community clearly believe that this has translated into a deterioration in the quality of their lives. (Sagkeeng First Nation, 1995, p. 7).



1935

Operations
begin again

1994

Busan 52 Spill

1994

Abitibi sells to
mill workers

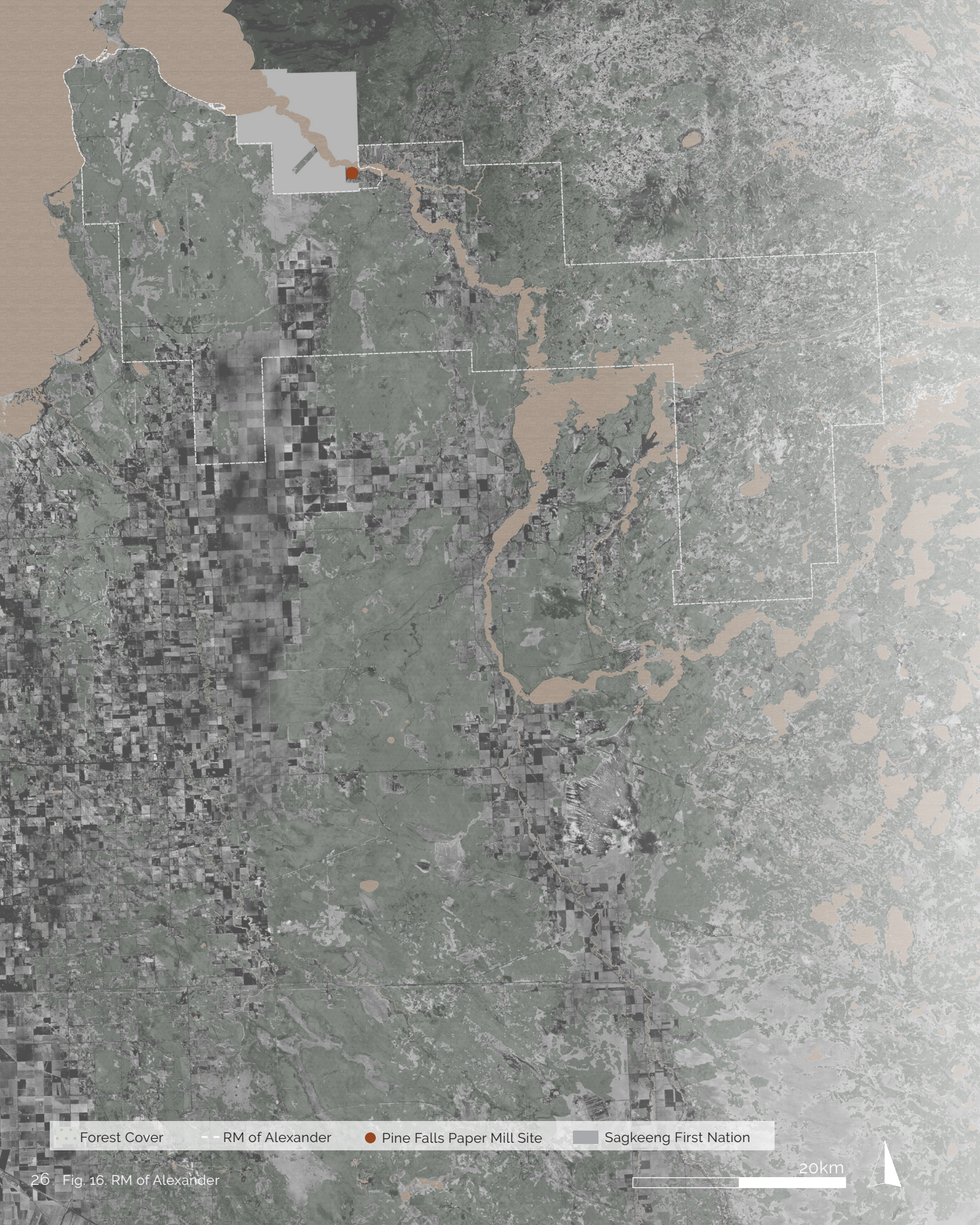
1998

Tembec bought
mill from workers

2009

Mill closed





2.3

REGIONAL CONTEXT

Although this proposal will focus on the land within the 520-acre boundary, it is important to note that the mill operations, along with other industrial activities, had a detrimental impact on the natural landscape within this region. Once dense riparian edges and heavily forested areas now consist of open fields with little resemblance to the native landscape. The spruce, fir, and jack pine forests significantly deteriorated due to the unsustainable deforestation rates supporting the mill's operations. (Adapted from Daywalker, 1994; Smith, et al. 1998). Not only did the mill contribute to damaging the waterways, forests, and the ecosystems connecting the natural landscape, but it also destroyed the ability of the Anishinaabe to hunt, fish, harvest and trap on lands that were once rich sustenance.

"For the sake of progress, human and natural resources were extensively exploited for profit. Untreated wood fibre and toxic waste were poured directly into the mighty Winnipeg River, contaminating a fundamental source on which all life depends. Trees in their once majestic surroundings that could tell stories of fifteen human generations have either been reduced to newsprint or destined for clear-cutting." (Daywalker, 1994, p.2).

2.4

ECOZONE, ECOREGION, ECODISTRICT

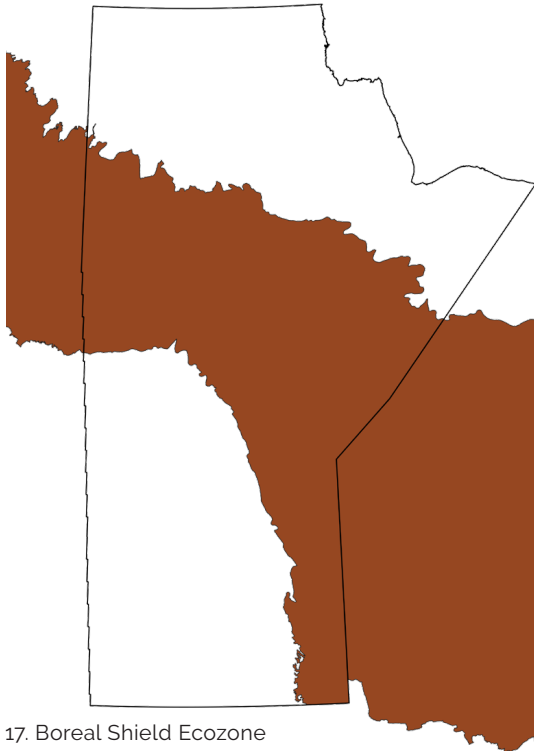


Fig. 17. Boreal Shield Ecozone

BOREAL SHIELD ECOZONE

The site is located within the Boreal Shield Ecozone. The boreal shield ecozone runs across Northern Saskatchewan, spreads east into Newfoundland, and is the largest ecozone in Canada (Smith et al., 1998). Within Manitoba, the Boreal Shield Ecozone covers most of eastern Manitoba and stretches north of Lake Winnipeg and Lake Manitoba. Within this vast ecozone, there are many landscape conditions containing different soil types, flora and fauna, and land uses (Smith et al., 1998).



Fig. 18. Lake of the Woods Ecoregion

LAKE OF THE WOODS ECOREGION

Within the Boreal Shield Ecozone, the site is located in the Lake of the Woods Ecoregion, which spans across southeastern Manitoba and southwestern Ontario (Smith et al., 1998). This region contains five distinct eco-districts that vary in landscape characteristics based on soil types, vegetation species, and land use, depending on the specific district location within the larger ecozone (Smith et al., 1998).

STEAD ECODISTRICT

The Stead Ecodistrict is the westernmost ecodistrict in the Lake of the Woods Ecozone. This ecodistrict is unique as it transitions between dense boreal shield, grasslands, meadows, and mixed coniferous and deciduous forests (Smith et al., 1998).

Vegetation

The vegetation native to this ecodistrict includes meadow grass, sedges, meadow prairie grass, tall prairie grass, and forest areas. In present-day conditions, much of the native vegetation in this ecodistrict has been overcome by agricultural crops, with little grassland species remaining (Smith et al., 1998). Existing tree species in this district include jack pine, white poplar, paper birch, balsam poplar, bur oak and white spruce (Smith et al., 1998).

Soils

The soils in this ecodistrict vary from peat, calcareous, sandy, loamy, and clayey. These different types of soils developed from the various drainage conditions within this ecodistrict (Smith et al., 1998).

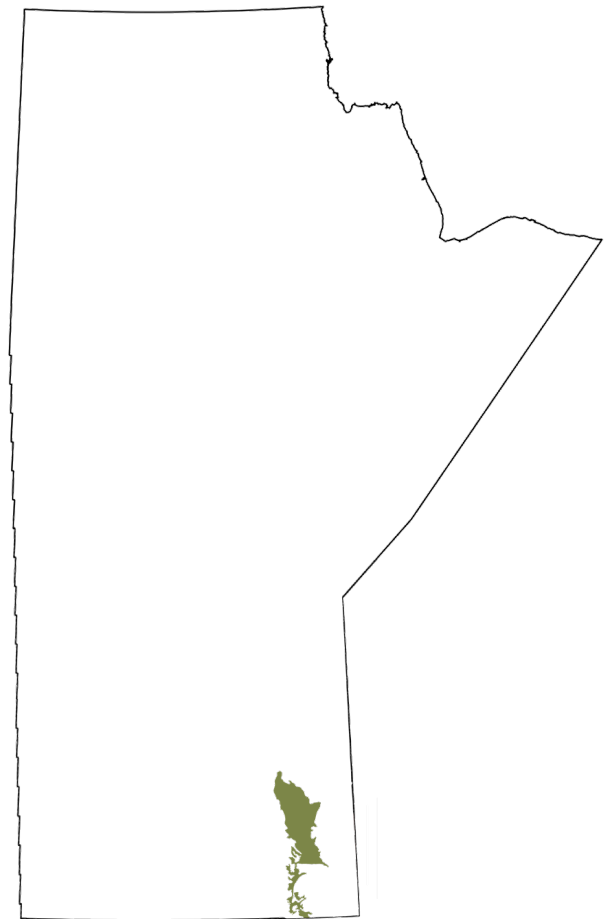


Fig. 19. Stead Ecodistrict

Land Use

During the time of mill operations, this area supported pulpwood extraction and forestry-related activities. The ecodistrict contains various agricultural activities and supports fishing and hunting practices. Additionally, it is home to many cottagers and camping activities (Smith et al., 1998).



3.0

ADDITIONAL IMPACTS

On a site-specific scale, the land alone contains many challenges and barriers in order to remediate and establish a native planting area. However, it is also crucial to consider some of the larger regional factors that currently affect site-specific conditions and their ecological gradient. Prior to the European settlement into this area and long before the industrial movement, the natural landscape consisted of densely forested areas, as well as upland and grassland conditions. Containing a wide variety of flora and fauna, the landscape supported Sagkeeng in many different ways. Additionally, the Winnipeg River is a significant feature in the

landscape and has been for centuries. Although today we understand this vast river system as a source of electricity, many historic and present-day settlements rely on this water source for everyday usage. Specifically, Sagkeeng First Nation has made known their sacred connection to these waters. "For centuries, they have depended on the river for sustenance, transportation, recreation and support of their traditional economy" (Sagkeeng First Nation, 1995, p.1). The following pages will describe the impacts on the land, and how they have heavily impacted Sagkeeng directly.



3.1

HYDROELECTRICITY ON THE WINNIPEG RIVER

The Winnipeg River is the final output within the larger watershed that flows into Lake Winnipeg. Currently, there are eight active hydroelectric dams along the Winnipeg River, which inevitably drastically alter the natural course of the waterway. The river is 260 kilometres long and runs from the north section of Lake of the Woods in Ontario and drains into the southeast section of Lake Winnipeg. The river was a central point of settlement for First Nation communities prior to colonization. Following the arrival of settlers, it became a main fur trading route for the Hudson's Bay Company and the Northwest Company (Winnipeg River Heritage Museum, 2023).

Historically, the river system consisted of a series of waterfalls. These natural and significant topographic changes made ideal conditions for hydroelectric development. Years later, following settlement, the Manitoba government acknowledged the potential of the river for hydroelectric development, with the construction of the first dam beginning in 1908. As shown in Figure 23, the construction of the dams progressed quickly during the early to

mid-1900's (Winnipeg River Heritage Museum, 2022).

The hydroelectric dams are relatively evenly spread out along the river system. Manitoba Hydro controls most of the influx of water entering from the southeast side of Manitoba into Lake Winnipeg. Due to the constant fluctuations in water levels, the riverbanks along the shores of Sagkeeng and the adjacent areas have endured drastic erosion and species loss. This is a heavy concern within the community (Sagkeeng Ancinabe Government, 2024).

As Sagkeeng First Nation is located near the mouth of the river, past the last hydroelectric dam in the system, the site and adjacent communities are vulnerable to many different physical and biological changes as a direct result of Manitoba Hydro's operations (Sagkeeng First Nation, 1995). Although the problems related to the Winnipeg River are not the direct focus of this work, it is paramount to highlight the issues and factors of the regional context as they directly impact the site.



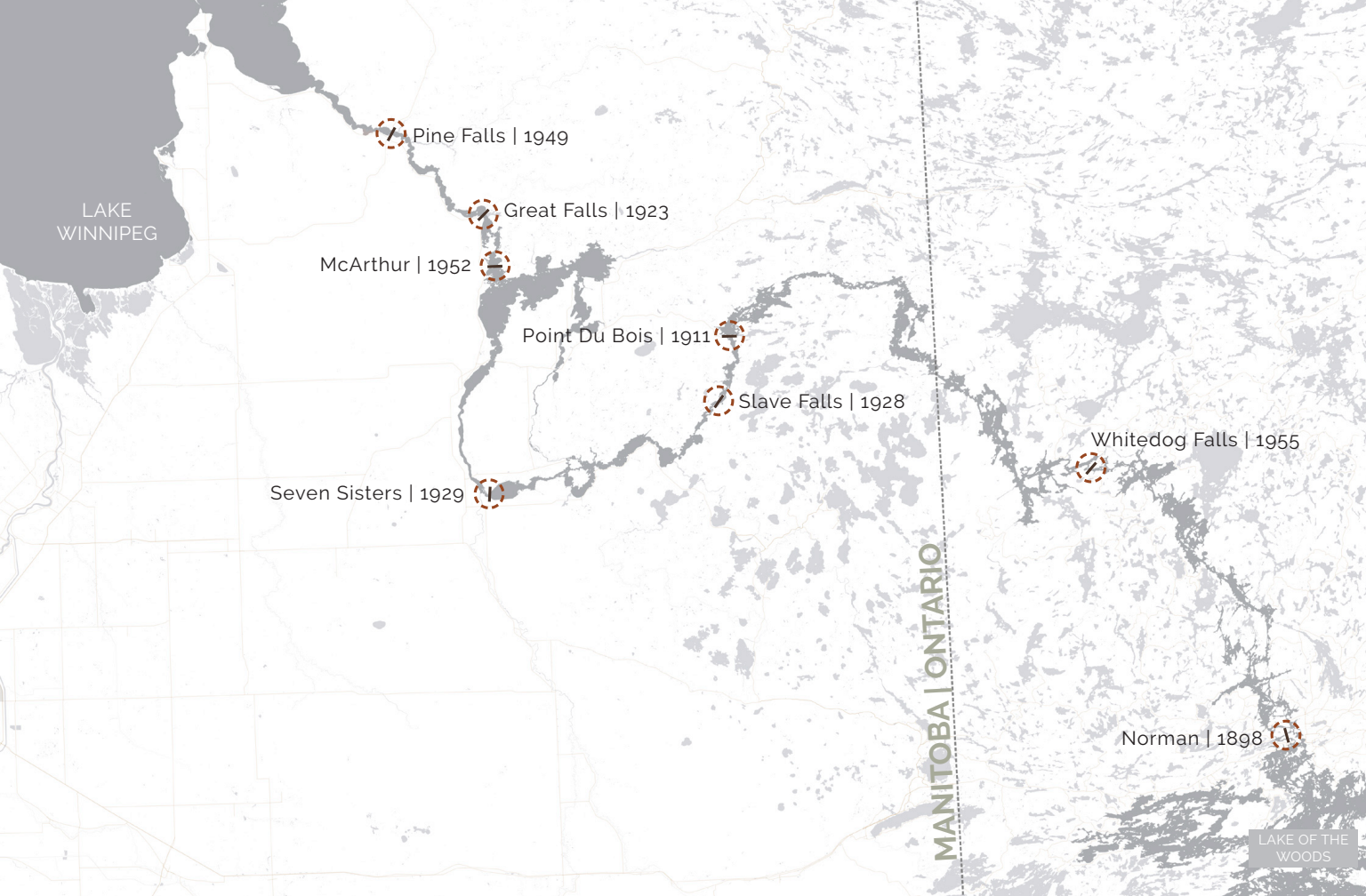


Fig.23. Hydroelectric Dams Along the Winnipeg River

"The river was only half as wide as it is now. There were no steep cliffs on the river banks. When I look at the shoreline now, there are steep banks all over/ the banks used to be sloped and had nice trees. We could enjoy the river anytime. Today I don't even feel like looking at it." (Clara Letander, 1995, as cited in the Sagkeeng First Nation, 1995, p.9).

"The land erosion began in the 1950's right after the Pine Falls dam was built. Ever since, ... the land has continuously been eroding ... The people of Powerview and Pine falls got some rip-rapping along their shoreline. We should too." (Joe Boubard, 1995, as cited in the Sagkeeng First Nation, 1995, p.9).



3.2

DEFORESTATION

A large portion of the dense forests in the Fort Alexander area were harvested to support the mill during its peak. From 1940 to 1965, the mill received lumber through annual log drives on the Winnipeg River (Government of Manitoba, 2000). The log drives were typically 50 kilometres long and took approximately ten days to complete. In the 1960s, as transportation means began to boom, lumber became more economical via train or truck, sourced from all across northern Manitoba (Government of Manitoba, 2000). As the Pine Falls Paper Mill was one of many companies sourcing lumber and contributing to deforestation, Manitoba's

forests, particularly old-growth forests, began to deteriorate. In the 1970s, the Government of Manitoba developed a 20-year forest management plan to control forest usage, with reforestation responsibilities falling on the Manitoba Government (Government of Manitoba, 2000). As the Province claims sole jurisdiction off-reserve, First Nations had little say in what happens off-reserve (Fryer and Leblanc-Laurendeau, 2019). Later that decade, in 1979, the Government of Manitoba established an agreement with the Pine Falls Paper Mill company for the mill company to accept stronger responsibilities for the future



of Manitoba's forest management in this area (Government of Manitoba, 2000).

Since the closure of the mill in 2009, there have been no forestry-related operations occurring in the eastern part of Manitoba near the Pine Falls Paper Mill site (Cash, 2019). On February 28th, 2019, the province of Manitoba announced that the Pine Falls Forest management license was transferred to local First Nation communities. These include Hollow Water, Black River, Sagkeeng, and Brokenhead, who currently oversee all decisions related to forest management in the area (CDEM, 2019).

"As First Nations people, we have always been excluded from the decision-making table on the Pine Falls forest, even though it's in our backyard. Tembec had all the forest rights, got all the contracts, and pulled all the strings." (Sheldon Kent, 2019, as cited in CDEM, 2019)



3.3

REFLECTIONS AND PRESENT DAY CONDITIONS

The outlined impacts strongly suggest that the establishment of the mill and the industrial activity needed to support the mill drastically impacted the lives of community members in Sagkeeng First Nation. The mill operations, deforestation, and eight hydroelectric dams along the Winnipeg River system have changed the natural ecosystems forever. The presence of these industrial operations will always exist within the regional scale, and the impact of the mill operations continues to have a significant effect on the site-specific scale. However, there are ways to make small changes to transform how the land of the former Pine Falls Paper Mill is viewed moving forward. From here, a shift in perspective is suggested to view the land as a living entity. The palimpsest of histories embedded within the site are all a part of its story, and everything within this story has a role and a purpose in the transformation of the site.

There is little published information related to the current plan for the future of the Pine Falls Paper Mill site. The now decommissioned mill and the surrounding site are owned by the Pine Falls Development Corporation (PFDC) and are deemed an "impacted site" as per Section 7 of the Manitoba Contaminated Sites Remediation Act (Terrapex Environmental, 2016). As the site has sat vacant for over a decade, it is unclear how the PFDC plans to utilize it in the near future.

Numerous reports have been published highlighting the current state of the land, the environmental impacts, and the considerations for future uses of the site, which include an open public greenspace and commercial development. However, there is no published documentation outlining if the site will be developed to support either of these uses.



4.0

A PHASED PROCESS

The long-term goal of this project is to transform the Pine Falls Paper Mill site into a healthy, native medicinal ecosystem that mimics natural forest succession. However, there are many considerations and barriers to achieving this goal. In order for the site to be transformed into a native healing landscape, the site itself needs to undergo its own healing process, as the soil and groundwater currently contain various contaminants from the mill operations. Additionally, a palimpsest of history is embedded within the land that is important to preserve—spatial cues that represent the mill activity, the flora and fauna that now call this site their home, and the sentimental emotions related to the memories at the mill. These barriers will be addressed through a phased planning process.

Phase I will address the contaminants of concern, requiring an extensive remediation process, which will be addressed through phytoremediation technologies. The second

phase will slowly introduce native plants that are known to have been used for medicine from the surrounding Métis and Anishinaabe communities. The two phases are structured to ensure the site is clean of contaminants before people are encouraged to harvest medicines. Phase I will include regular soil testing to analyze the success or need for further remediation.

The relationship between Phase I and Phase II is unique as the intention is to have a slow, progressive transition once the contaminants have been removed. As the plants selected, both medicinal and phyto, all grow in similar conditions, the Phase II plants will be introduced into the mature, established ecosystem of Phase I. There will be exceptions to this for the phytoremediation plants that need to be harvested so that the contaminant can be fully removed from the site.

4.1

PHYTOREMEDIATION – WHAT IT IS

Most information used for this research has been referenced through *Phyto: Principles and Resources for Site Remediation and Landscape Design*, as this source relates directly to the field of landscape architecture. It is important to note that phytoremediation technologies are constantly evolving. Experts and phytotechnology scientists should be consulted prior to any site-specific phytoremediation project in professional practice.

Phytoremediation has become widely used in landscape architecture as a way to restore contaminated landscapes in open green spaces and parks. First, this section will provide a brief overview of phytoremediation and what the process entails. Additionally, it will outline the current contaminants existing on the site and note which are a concern to human health. Lastly, the types of phytoremediation will be described in detail as different plants take in contaminants through many different mechanisms.

"Phytotechnology is the use of vegetation to remediate, contain or prevent contaminants in soils, sediments and groundwater, and/or add nutrients, porosity and organic matter. It is also a set of planning, engineering and design tools and cultural practices that can assist landscape architects, site designers, engineers and environmental planners in working on current and future individual sites, the urban fabric and regional landscapes." (Kirkwood and Kennen, 2017, p.3).

In simple terms, phytoremediation utilizes various plants to remove or contain contaminants in soils and groundwater. The type of phytoremediation will always depend on the variety of contaminants and how well they are established in the soil or groundwater (Todd, 2013). Phytoremediation has the ability to transform contaminated landscapes that are viewed as economically and socially dysfunctional due to them being inhabitable for the general public (Kennen and Kirkwood, 2017).

According to The Contaminated Sites Remediation Act (CSRA), post-industrial and brownfield sites within Manitoba are categorized into two different distinctions:

"Contaminated: means a site that has been designated as a contaminated site. A site determined to be contaminated at a level which poses a threat to human health or safety or to the environment" (Government of Manitoba, 2021).

"Impacted: means a site that has been designated as an impacted site. A site determined to be contaminated at a level that **may** pose a threat to human health or safety or to the environment" (Government of Manitoba, 2021).

The Pine Falls Paper Mill site is deemed as an impacted site by the Province of Manitoba (Government of Manitoba, 2021). As there are many contaminants within the soil and

groundwater that may be a risk to human health, the site continues to sit vacant. Numerous reports have been published relating to the site investigation outlining the current conditions, interim remediation plans, and remediation plans. However, no action has been taken to address the site's concerns.

Currently, the area of the former Pine Falls Paper Mill contains multiple BTEX, PAHs, and various metals within different areas of the soil and groundwater (Government of Manitoba, 2021). Multiple Environmental Site Assessments (ESAs) were completed following the years of the mill closure. The assessments of impacts for this practicum are based on the 2016 and 2017 reports, which are the most recent publications on soil conditions and are outlined on page 49 and 51.

4.2

TYPES OF PHYTOREMEDIATION

Phyto: Principles and Resources for Site Remediation and Landscape Design categorizes contaminants into two different groups: organic and inorganic pollutants (Kennen and Kirkwood, 2017). Organic compounds, typically human-made, consist of carbon, nitrogen, and oxygen. Organic pollutants are often more successfully treated using phytoremediation technologies (Kennen and Kirkwood, 2017). Inorganic pollutants consist of natural elements that have toxic components which are released into the environment following industrial human activity. Inorganic elements cannot be degraded (Kennen and Kirkwood, 2017). However, oftentimes, they can be extracted by plants. It is important to note that if an inorganic plant is using phytoremediation to *extract* contaminants, the plant must be collected from the site and properly disposed of (Kennen and Kirkwood, 2017). The following will describe the specific type of phytoremediation and how they relate to the site's contaminants.

ORGANIC:

Phytodegradation

A mechanism in which the plants' metabolic processes take up the contaminants and break them down into smaller portions (Kennen and Kirkwood, 2017).

Rhizodegradation

A mechanism in which the plants' roots release their exudates, the surrounding soil microbiology supporting the plant breaks down the contaminant (Kennen and Kirkwood, 2017).

ORGANIC AND INORGANIC:

Phytovolatilization

A mechanism in which the plant absorbs the contaminants in the form of a solid, liquid, or gas and releases it slowly into the atmosphere in the form of a gas (Kennen and Kirkwood, 2017).

Phytohydraulics

A mechanism in which the plant uses its natural ability to pull up groundwater through its roots to prevent contaminants in soil and groundwater from spreading. If used with other phytoremediation techniques, such as Phytovolatilization and Phytodegradation, the contaminants can be removed completely (Kennen and Kirkwood, 2017).

Phytoextraction

A mechanism in which the plants take up the contaminants from both soil and groundwater and spread them across their plant parts. It is important to note that when this mechanism is used in combination with phytodegradation, contaminants are highly more likely to be completely removed from a site (Kennen and Kirkwood, 2017).

Other types of phytoremediation include Phytometabolism, Phytostabilization, and Rhizofiltration. However, these specific mechanisms do not correlate with certain contaminants on the site, and/or the plants selected.

Most examples of successful phytoremediation projects and supporting research have been conducted in other countries. Therefore, the Pine Falls Paper Mill site provides a strong opportunity to develop research plots and support phytoremediation projects and contaminated landscapes across Canada.

RE·ME·DI·A·TION

LATIN
remediare
heal, cure



LATIN
remediatio

ENGLISH
remedy



→ **remediation** →
early 19th
century

early 19th century: from
Latin *remediatio*(n-), from
remediare 'heal, cure'

(Oxford Dictionary , 2025)

4.3

CURRENT SOIL CONTAMINANTS AT THE MILL SITE

Table 1 outlines the contaminants currently present in the soil. As highlighted, many contaminants that presently exist are not of concern to human health. However, these statements are based on the parameters of an open park space, which are acceptable during Phase I, but for the site to be safely transformed into a place for medicine, the contaminants must be addressed and removed completely from the site.

The data outlined in the table is referenced from the *Remediation Plan, Former Pine Falls Paper Mill Site*, published by Terrapex in 2016. "Where available, the evaluation is based on exposure pathways guideline values published by Canadian Council of Ministers of the Environment (CCME) within various Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health fact sheets, supplemented with Component Values published by Ontario Ministry of the Environment and Climate Change (MOECC) for each of the various human health and ecological exposure pathways associated with the development of the risk-based Ontario Site Condition Standards" (Terrapex, 2016, p.5).

Please reference the following definitions in relation to Table 1 and Table 2.

"Exposure is any contact between a substance and an individual who has touched, breathed dust or fumes, or swallowed material or liquid from a contaminated source. Contaminants must follow pathways from the point of release into the environment to the point of contact with humans in order for exposure to take place" (Health Canada, 1995).

"An exposure pathway describes how a contaminant travels through the environment from its source to humans or other living organisms. An exposure pathway consists of the five following elements:

- source of contamination;
- environmental media;
- point of exposure;
- receptor person or population; and
- route of exposure" (Health Canada, 1995, p.4).

Table 1. Soil Contaminants at the mill site

BTEX

Benzene	No known concerns with respect to human health or ecological exposures to benzene in site soils.
Ethylbenzene	The documented ethylbenzene concentrations in soil may not pose an unacceptable risk to human health or ecological receptors.
Toluene	The documented toluene concentrations in soil may not pose an unacceptable risk to human health or ecological receptors.
Total Xylenes	The documented xylenes concentrations in soil may not pose an unacceptable risk to human health or ecological receptors.

METALS

Barium	The maximum barium concentration reported exceeds the Tier II evaluation criteria. This exceedance is a result of Ontario direct contact exposure pathways for ecological receptors (plants and soil organisms and mammals and birds).
Chromium	The maximum chromium concentration reported exceeds the Tier II evaluation criteria. This exceedance is a result of Ontario direct contact exposure pathways for ecological receptors from both CCME and Ontario.
Copper	The maximum copper concentration reported exceeds the Tier II evaluation criteria. This exceedance is a result of CCME direct contact exposure pathway for ecological receptors only.
Nickel	The maximum nickel concentration reported exceeds the Tier II evaluation criteria. This exceedance is a result of CCME direct contact exposure pathway for ecological receptors only.
Selenium	The maximum selenium concentration reported exceeds the Tier II evaluation criteria. This exceedance is a result of CCME direct contact exposure pathway for ecological receptors only.
Sodium	A Tier II evaluation criteria was not determined for sodium. Sodium is a naturally occurring mineral, and significant sodium levels can be present in soil in the absence of anthropological impacts. Sodium is being discounted as a contaminant of concern.
Zinc	The maximum zinc concentration reported exceeds the Tier II evaluation criteria. This exceedance is a result of several exposure pathways, including both CCME and Ontario ecological exposures pathways and CCME soil nutrient cycling checks and off-site migration check.

PAHS

Benzo(a)pyrene	The maximum benzo(a)pyrene concentration reported exceeds the Tier II evaluation criteria. This exceedance is a result of the human health direct contact pathways associated with both CCME and Ontario.
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¹ The following content is directly quoted from the *Remediation Plan, Former Pine Falls Paper Mill Site* by Terrapex, though the presentation has been graphically modified for clarity. All efforts have been made to preserve the original meaning and integrity of the information.

4.4

CURRENT GROUNDWATER CONTAMINANTS AT THE MILL SITE

Table 2 outlines the contaminants currently present in the groundwater. Similar to the soil contaminant table, many groundwater contaminants are not of concern to human health. That said, it is important for Phase II of this project to have clean groundwater to support the new growth of plants on site during Phase II.

The data outlined in the table is reference from the *Remediation Plan, Former Pine Falls Paper Mill Site*, published by Terrapex in 2016.

"The Tier II evaluation is based on Ontario Component Values, discounting consideration of potable use of groundwater and potential vapour intrusions into buildings to reflect current site conditions." (Terrapex, 2016, p.6).

Table 2. Groundwater contaminants at the mill site

BTEX

Benzene	No known concerns with respect to human health or ecological exposures to benzene in groundwater at the site.
Ethylbenzene	No known concerns with respect to human health or ecological exposures to ethylbenzene in groundwater at the site.
Toluene	No known concerns with respect to human health or ecological exposures to toluene in groundwater at the site.
Total Xylenes	No known concerns with respect to human health or ecological exposures to xylenes in groundwater at the site.

METALS

Aluminum	A Tier II evaluation criteria was not determined for aluminum. The aluminum concentrations in groundwater reported are not considered to be significant and aluminum is being discounted as a contaminant of concern in groundwater.
Boron	No known concerns with respect to human health or ecological exposures to boron in groundwater at the site.
Manganese	Concentrations in groundwater are not considered to be significant, and manganese is being discounted as a contaminant of concern.
Sodium	No known concerns with respect to human health or ecological exposures to sodium in groundwater at the site.
Uranium	No known concerns with respect to human health or ecological exposures to uranium in groundwater at the site.

PAHS

Benzo(a)pyrene	No known concerns with respect to human health or ecological exposures to benzo(a)pyrene in groundwater at the site.
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¹ The following content is directly quoted from the *Remediation Plan, Former Pine Falls Paper Mill Site* by Terrapex, though the presentation has been graphically modified for clarity. All efforts have been made to preserve the original meaning and integrity of the information.

Terrapex, (2016), *Remediation Plan, Former Pine Falls Paper Mill Site, Pursuant to Manitoba Contaminated Sites Remediation Act*, Accessed May 2024, https://manitoba.ca/sd/waste_management/contaminated_sites/registry/54271/reports/2016_01_28_interim_remediation_plan.pdf

4.5

OPPORTUNITIES AND CONSTRAINTS OF PHYTOREMEDIATION ON THE PINE FALLS PAPER MILL SITE

It is essential to touch on the potential constraints of applying phytoremediation to a heavily contaminated site, specifically with the large number of metals in the groundwater (Kennen and Kirkwood, 2017). Although they are not impossible to remove, they are often the most challenging type of contaminant to phytoremediate. Oftentimes, contaminants are tightly bound to soils and can be extremely difficult to take into plants. Whenever extraction is possible, plants will have to be harvested and extracted from sites when working with metals, or multiple types of phytoremediation must be used to address them (Kennen and Kirkwood, 2017). The selected plants and types of phytoremediation used are intended to work together to provide the best possible outcome to clean the soil and groundwater and to heal the land.

With the extent of knowledge that I have obtained in this process, theoretically, the types of plants selected should be enough to clean the site of contaminants. Although this work and design scheme are conceptual, it is important to understand that I am not an expert on phytoremediation, and the site could be more complicated to apply phytoremediation technologies outside the scope of my understanding. The site offers an opportunity to act as a test area for phytoremediation technologies. However, progress could take more time than estimated due to the ongoing testing of soils and contamination levels to ensure the contaminants have been safely removed or retained.

METALS

BTEX

PAHS

Site Extent

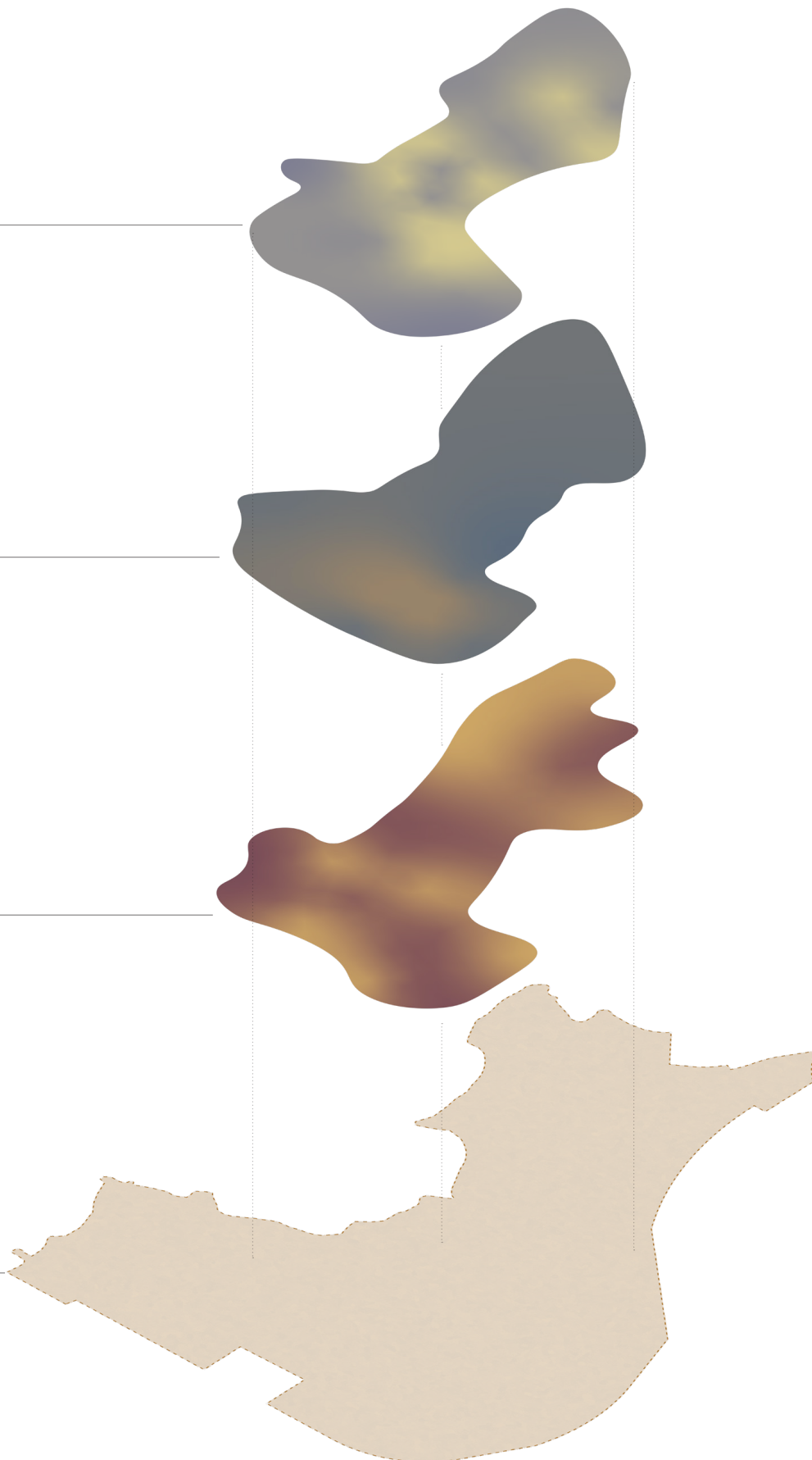
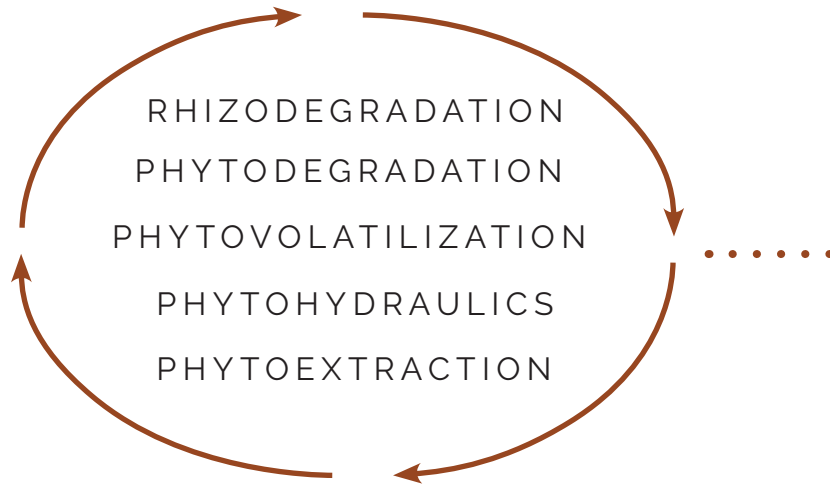


Fig. 28. Isometric diagram showing layers of BTEX, PAH, and metal contaminants on site 53

4.6

METALS



There are numerous metals that currently exist in the soil and groundwater within the site. Some metals, such as copper, are naturally present in the soil, while others may be of larger concern. As metals are inorganic pollutants, they can be drawn up by plants and removed from the site but they can't be broken down completely (Kennen and Kirkwood, 2017). To target metals, different types of phytoremediation will occur simultaneously to remove them from the site. Rhizodegradation, Phytovolatilization, Phytodegradation, Phytohydraulics, and Phytoextraction will all be used together to target the metals on site. As

indicated in Figure 29, the areas of higher metal concentration are shown in yellow. The high concentrate levels are based on the established guidelines in the 2017 SNC Lavalin Report. The levels exceed one or more guidelines for all parameters analyzed. The lower concentrations are shown in purple and are also based on the established guidelines in the 2017 SNC Lavalin Report. The levels meet guidelines for all parameters analyzed.



Canada Wild Rye



Black Poplar



Giant Wild Rye

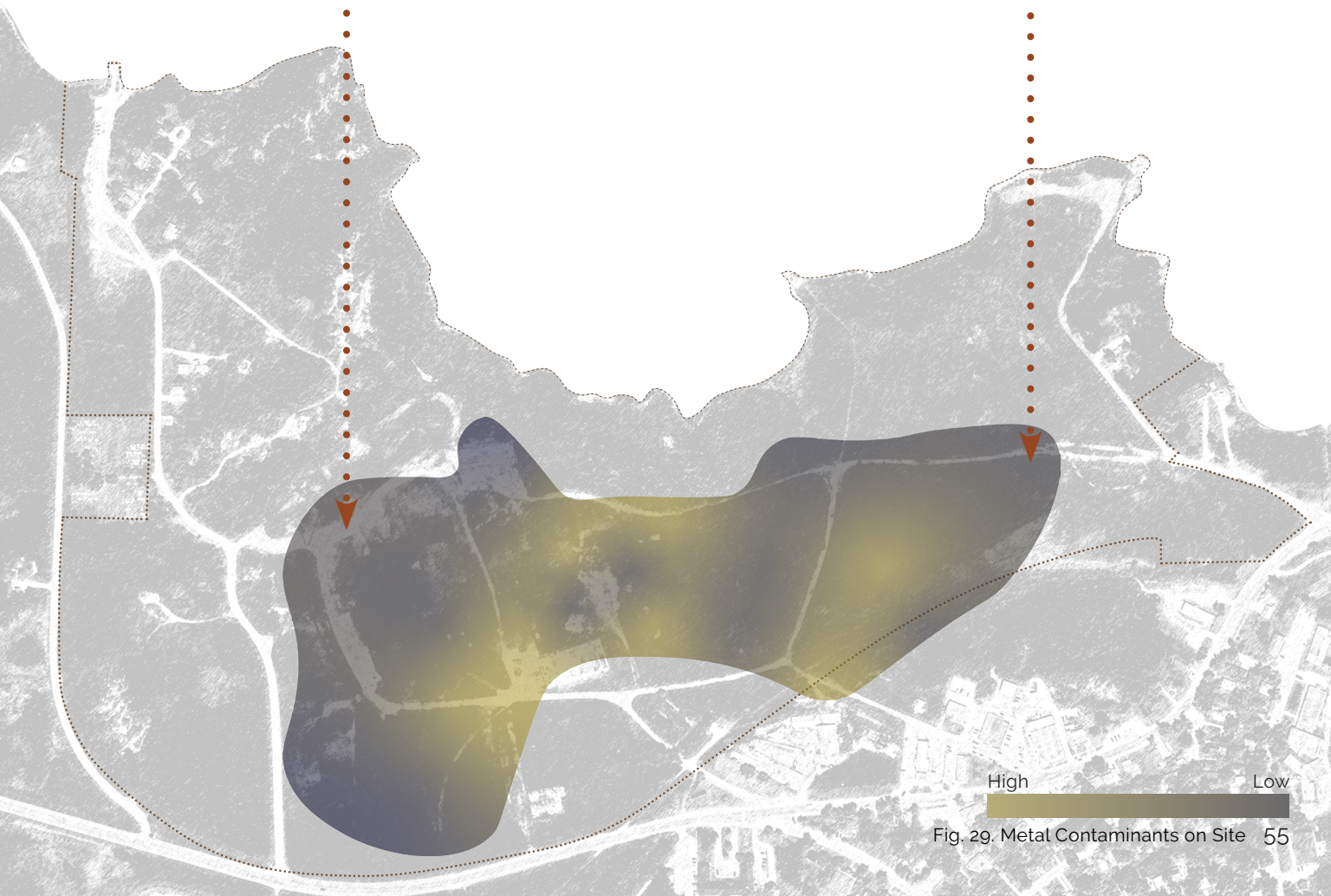
PLANTS USED TO
TARGET METALS:



Side Oats Grama



Hackberry



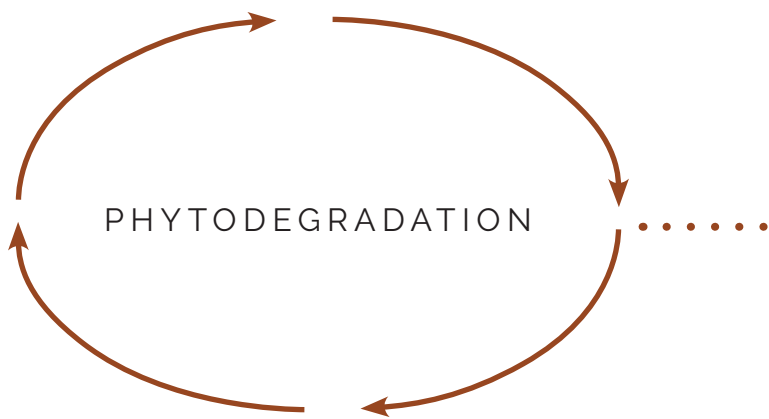
High

Low

Fig. 29. Metal Contaminants on Site 55

4.7

BENZENE, TOLUENE, ETHYLBENZENE, XYLENES (BTEX)



Volatile Organic Compounds (VOCs) are compounds made up of organic molecules which contain high vapour pressure. When this pressure reaches a certain temperature, the compounds are released as gases (Aeroqual, 2016). Industrial emissions are one of the key contributors to the release of these toxic gases and can be dangerous to human health. BTEX (Benzene, Toluene, Ethylbenzene, and Xylene) are a group of VOCs, often categorized and measured together (Aeroqual, 2016).

Phytodegradation will be the only type of phytoremediation used to target the BTEX

on site. As indicated in Figure 30, the areas of higher BTEX concentration are shown in brown, mainly close to where the original mill building existed. The high concentration levels are based on the established guidelines in the 2017 SNC Lavalin Report. The levels exceed one or more guidelines for all parameters analyzed. The lower concentrations are shown in blue and are also based on the established guidelines in the 2017 SNC Lavalin Report. The levels meet guidelines for all parameters analyzed.



Sheep Fescue



Jack Pine



Bur Oak

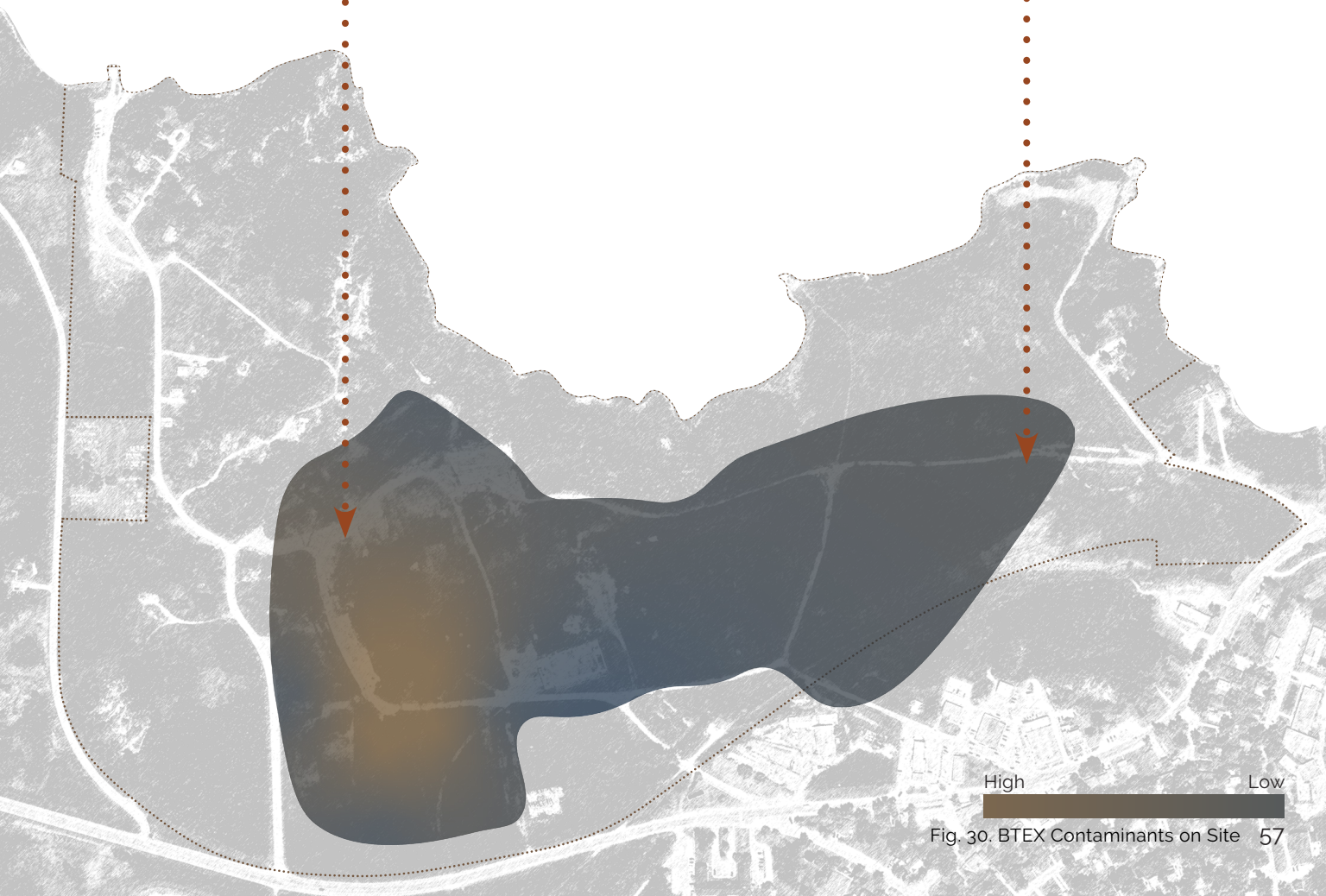
PLANTS USED TO
TARGET BTEX:



Black Poplar



Hackberry



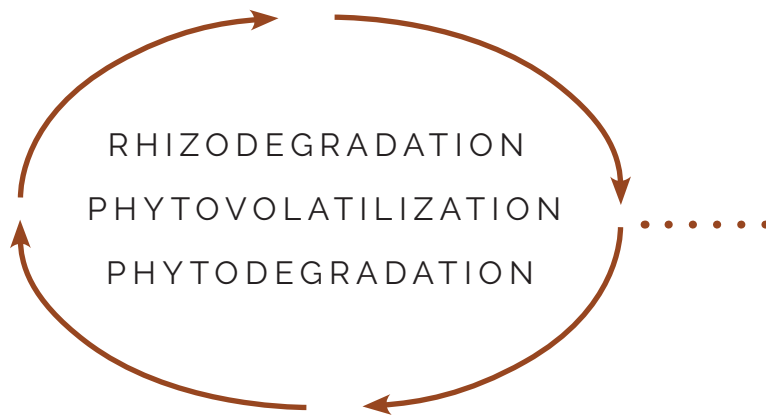
High

Low

Fig. 30. BTEX Contaminants on Site 57

4.8

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)



There are over 100 different chemicals classified as Polycyclic Aromatic Hydrocarbons (PAHs). PAHs are formed when burning fuels such as coal, gas, oil, and garbage. PAHs often consist of heavier fractions, meaning they are typically more difficult to remove during the phytoremediation process (Agency for Toxic Substances and Disease Registry, 2021). Rhizodegradation, Phytovolatilization, and Phytodegradation will be used to treat the PAHs on site. As shown in Figure 31, the areas of higher PAH concentration are shown in dark red. The high concentrate levels are based on the established guidelines in the 2017 SNC

Lavalin Report. The levels exceed one or more guidelines for all parameters analyzed. The lower concentrations are shown in brown and are also based on the established guidelines in the 2017 SNC Lavalin Report. The levels meet guidelines for all parameters analyzed.



Hackberry



Canada Wild Rye



Side Oats Grama



Big Bluestem



Giant Wild Rye



Black Poplar



Sheep Fescue



Jack Pine

PLANTS USED TO
TARGET PAHS:



High

Low

Fig. 31. PAH Contaminants on Site 59



60 Fig. 32. Snowy vegetation

5.0

MEDICINAL LANDSCAPES

The ultimate goal of this work is to heal the site of contaminants in order to introduce a native medicinal landscape back into the site. This section will provide a brief overview of what a medicinal landscape entails for this project specifically, as there are many different definitions of what this landscape could be. Some may view medicinal gardens as areas near hospitals or health centres that are designed in ways that provoke healing for the mind. When thinking about Indigenous medicinal landscapes, others may understand a healing landscape in the form of a medicine garden, incorporating the four Sacred Medicines: sage, sweetgrass, tobacco and cedar. However, the direction I chose looks at healing in a slightly different way. I wanted to look beyond the four

Sacred Medicines and highlight the plants that are less known for their medicinal role. For the purpose of this practicum, I have defined a medicinal landscape as *a landscape that resembles its natural ecological state and incorporates native Manitoban plants with medicinal benefits that reflect traditional Métis and Anishinaabe botanical teachings.*

This work goes beyond the concept of a 'garden'. It focuses on the interconnectedness of the natural landscape, where every element is part of a vast ecological network. This approach, presents a significant opportunity to integrate Traditional Ecological Knowledge (TEK) into the site's programming, fostering growth and learning in Western scientific understanding.



5.1

TRADITIONAL ECOLOGICAL KNOWLEDGE

For the purpose of this research, Traditional Ecological Knowledge (TEK) is defined as culturally transmitted knowledge passed through generations of storytelling about the relationship between all living beings and the natural environment. Grounded in nature, traditional ecological knowledge is a form of knowledge sharing rooted in place (Berkes, 2018). "All Indigenous cultures have a form of Traditional Knowledge unique to the group, their location, and their experiences" (Grosset and Limousin, as cited in North, 2022). The site's design will offer an opportunity to integrate TEK into the site through land-based learning experiences and interpretive planning. As the

phytoremediation aspect of the design involves phytoremediation scientists, soil scientists and other disciplines outside the design field, the site will need to be supported and maintained by parties outside Sagkeeng. As such, the site will be managed by the University of Manitoba, in partnership with Sagkeeng First Nation, and act as a testing ground to promote interdisciplinary work between various faculties within the university. This approach allows for Sagkeeng to regain ownership of the site and oversee the development and progress, while also providing an opportunity to weave aspects of their traditional knowledge with the Western knowledge provided by the university.



5.2

PLACE-BASED LEARNING

The site is unique in the sense of place-based knowledge as the idea of place shifted as it transformed from a gentle ecosystem into a place for industrial activity. However, the histories embedded into the site are important elements when considering place-based knowledge in this context. The idea of place will differ for each individual who has a relationship to the site. However, the commonality between each person's connection to place within the Pine Falls Paper Mill land is that place and thought are never separated. The land here has been and always will be alive and animate. It is connected to the stories and experiences

embedded within the soil, plants, groundwater, and everything in between. The idea of place in this project will come from the stories embedded within the landscape. It will come from past, present and future experiences people create with the land and will always recognize human and non human forms (Adapted from Elder Valdie Seymour et al. 2023).



6.0

EXISTING CONDITIONS

On a regional scale, the Pine Falls Paper Mill site is situated within the boreal shield, with surrounding mixed coniferous and deciduous forests, grasslands, agricultural fields and small towns and cottages.

Although it is not open to the public, the site is still used for various leisure activities by the residents of the surrounding communities. During numerous visits, people were on the site grounds walking, exploring the site's remnants, and driving through the site on quads. It is evident that this vacant piece of land has value to the people of Sagkeeng and Pine Falls.

As shown in the photos on pages 70 and 71, industrial remnants within the site will offer opportunities for use as design features. Demolition of paved areas and disposing of accumulated garbage and rubbish will be required. The lush vegetation growing on the site will be preserved wherever possible, and will co-exist with the plants that will be introduced into the site.

CIRCULATION TO THE SITE

Sagkeeng First Nation is situated on both the North and South banks of the Winnipeg River, which creates a division for the community. In order to travel from one side to the other, one must leave the boundaries of the community, drive through Powerview-Pine Falls, across the hydro dam bridge, and back into the community. The Pine Falls Paper Mill site is a central point for those coming from the North side of Sagkeeng to the south and vice versa. This connection point is an important element as a central gathering place for the community. Additionally, the site will also be an important connection point with Turtle Lodge.

Turtle Lodge, located on the south-western outskirts of Sagkeeng is a place for people to connect with the land, and exchange knowledge in a sacred environment (Turtle Lodge, 2025). The design proposal for the site offers an opportunity to integrate knowledge sharing, and involve Elders and Knowledge Keepers to provide a spiritual component in reclaiming and healing the land of the Pine Falls Paper Mill site.





NORTH SAGKEENG

5km

69



Fig. 37. Paper rollers

Photo Taken August 2024. Pieces of paper rollers used for mill activity. Opportunity to preserve throughout the site as a reminder of mill activity here.



Fig. 38. Gravel Trail

Photo Taken August 2024. Former pathways to support mill activity to be removed to allow for phytoremediation process to be as thorough as possible.



Fig. 39. Vegetated shoreline

Photo Taken August 2024. Lush vegetation throughout the site and along the riverbanks that will be preserved, phytoremediation plants will be added within the existing vegetation.

Photo taken November 2024. An old CN train car sitting abandoned on the site. Potential opportunity to integrate site remnants into the design.



Fig. 40. Abandoned train

Photo taken November 2024. Existing hydro station within the site. This will be preserved and will be connected to the new infrastructure proposed for the site.



Fig. 41. Cut hydro lines

Photo taken November 2024. Concrete foundation of the former de-inking plant. This will be reused as a foundation for the greenhouse.



Fig. 42. Greenhouse foundation



COMMUNAL
BOAT
LAUNCH

RESIDENTIAL
DWELLINGS

CEMETERY

FORMER BLACKSMITH SHOP

FORMER MILL BUILDING
(HIGHER CONTAMINATION)

HYDRO STATION

PINE STREET (HIGHWAY 11)

LEGEND

- • • • • Observed circulation through site (quads and walking)
- Town Amenities (grocery, gas, banks, etc.)

WINNIPEG RIVER
(SLASHER BAY)

FORMER WEIGH SCALE

FORMER WOOD STORAGE

PINE FALLS
RESIDENTIAL HOUSING

200m



7.0

PLANT HANDBOOK

This chapter will highlight different plants that will be used within the design. The plants selected contain either phytoremediation properties or medicinal properties, which will be outlined in the legend on the following page. The intention of this section is to create a guide that readers can use when out on the land. Each entry contains information relevant to its corresponding category, along with drawings, photographs, and basic information related to its characteristics and relationship to the landscape.

Disclaimer: Although the guide is intended for field use, it is important for readers to be cautious of lookalike plants, as some can be highly poisonous. Please cross reference this guide with proper plant identification booklets.

The intent of this plant guide is not to provide medical advice.

6.1

PLANT SELECTION CRITERIA

The phytoremediation plants were selected based on their ability to remove specific contaminants currently present on site and their natural symbiotic relationships. Each chosen plant is native to Manitoba and envisioned to resemble the landscape that existed there prior to the industrial movement in the Fort Alexander area, while also adapting to present-day conditions. This alludes to the project's overarching theme of native naturalistic landscape regeneration. Included in this section will be the type of phytoremediation that each plant will utilize and which contaminants each plant will target for removal.

The medicinal plants were selected and referenced through various sources related to traditional Métis and Anishinaabe botanical teachings. Additionally, they were selected based on their natural symbiotic relationships within their native ecosystems that existed on the site before the establishment of the Pine Falls Paper Mill. Two primary sources were used for traditional Anishinaabe and Métis medicinal information: *Medicines to Help Us: Traditional Métis Plant Use*, by Christi Belcourt

and *Plants Have So Much to Give Us, All We Have to Do Is Ask*, by Mary Siisip Geniusz; both of these resources was cross-referenced with one another to ensure the overlap of uses corresponds similarly. It is important to note that due to this nature of research, the teachings will be generalized based on pre-existing published knowledge. Traditional medicinal teachings may differ slightly depending on the community you are working with. As such, if planning to conduct fieldwork with a specific community, it is always recommended to consult with knowledge keepers from said community.

A majority of the translations were reference from *Medicines to Help Us: Traditional Métis Plant Use*, by Christi Belcourt and are referenced from this source unless noted otherwise. The other references are correlated with symbols and listed below. All translations are referenced fully in the bibliography.

* Julien Tétrault, Michif Language Speaker.

** The Ojibwe People's Dictionary

*** Frances Densmore, *Strength of the earth : the classic guide to Ojibwe uses of native plants*.

LEGEND

Icons:



Phytoremediation Plant



Medicinal Plant

Binomial Nomenclature
ACHILLEA MILLEFOLIUM

Michif-Cree
LARBADEÑ

Anishinaabemowin
AADJIDAMOWANA

Growth Conditions:

Sunlight



Full Shade



Part Sun



Full Sun

Soil Moisture



Dry



Moist



Wet

Growth Rate



Slow



Medium



Fast

Landscape Functions: The functions highlight different values within the landscape. The circles that are filled in represent the correlated function related to the specific plant.



Attract Pollinators



Attract Wildlife



Attract Birds

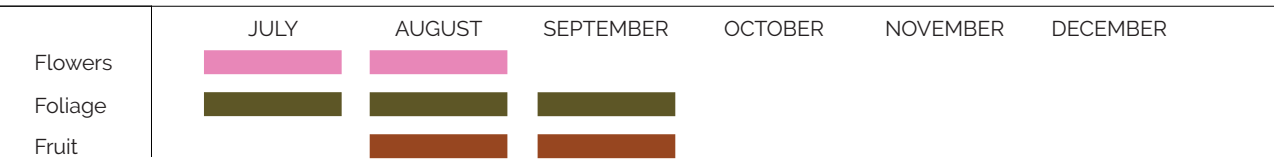


Attract Butterflies



Ornamental Flowers

Phenology Diagram: The phenology chart shows the bloom patterns of foliage, flowers and fruit and its associated bloom colours at the specific times of year.



YARROW

ACHILLEA MILLEFOLIUM

LARBADEÑ

AADJIDAMOWANA



Fig.45. Drawing of Yarrow

Medicinal Properties

- Can be used to stop excessive bleeding by placing the leaves on the open wound.
- To treat headaches, colds, fevers, respiratory alignments, and menstrual pains, one can dry out the plant and make it into a form of tea to treat any of these concerns.
- The plant can also be used to treat rashes and skin infections, reduce swelling from bee stings, and be applied as a poultice treatment (Belcourt, 2007 and Geniusz, 2015).

Habitat and Community

Low prairies, meadows, and open grasslands.
Prefer dry soil conditions (Prairie Originals, n.d.)

Landscape Characteristics

Medium sized straight growing flower with branches only near the top. Dainty small, fern-like leaflets and clusters of flowers (Lady Bird Johnson Wildflower Centre, 2022).

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Flowers						
Foliage						
Fruit						



Fig.46. Photograph of Yarrow

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



SASKATOON

AMELANCHIER ALNIFOLIA

LII-POO AIR

GOZIGWAAKOMIN



Fig.47. Drawing of Saskatoon

Medicinal Properties

- Saskatoon berries are very rich in vitamin C and iron.
- One can eat Saskatoon berries to relieve stomach pains, and earaches. Additionally, mixed with other medicinal plants one can use Saskatoon for a laxative and digestive problems.
- The inner bark and roots can also be harvested to help women who are trying to conceive. It can be taken during pregnancy as well to prevent problems during and after pregnancy (Belcourt, 2007).

Habitat and Community

Saskatoons have a wide range of growing conditions from along moist stream banks to dry hillsides and open woods (Lady Bird Johnson Wildflower Centre, 2013).

Landscape Characteristics

This shrub contains beautiful showy flowers in the spring that slowly transition into delicious blueish purple berries (Lady Bird Johnson Wildflower Centre, 2013).

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Flowers						
Foliage						
Fruit						



Fig.48. Photograph of Saskatoon

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter
--------	--------	------	--------

Growth

Light			
Moisture			
Growth Rate	↑	↑↑	↑↑↑



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



BIG BLUESTEM

ANDROPOGON GERARDI

MÛCKODE'KANÊS***



Fig.49. Drawing of Big Bluestem

Phytoremediation Properties

Rhizodegradation

- Due to the rigorous roots of Big Bluestem, it will be used to target the heavier fractions of contaminants.
- The soil microbes use the Big Bluestem roots to fully break the contaminant down.
- Targets the PAHs within the soil (Kennen and Kirkwood, 2017).

Habitat and Community

Low prairies, meadows, and open grasslands. Prefer moist, acidic or calcareous sands, loams, and clay soil conditions (Lady Bird Johnson Wildflower Centre, 2025).

Landscape Characteristics

Tall bunch grass with unique three part flowers resembling a “turkey-foot”. Stems are a beautiful burgundy / brown colour for most of the year (Lady Bird Johnson Wildflower Centre, 2025).

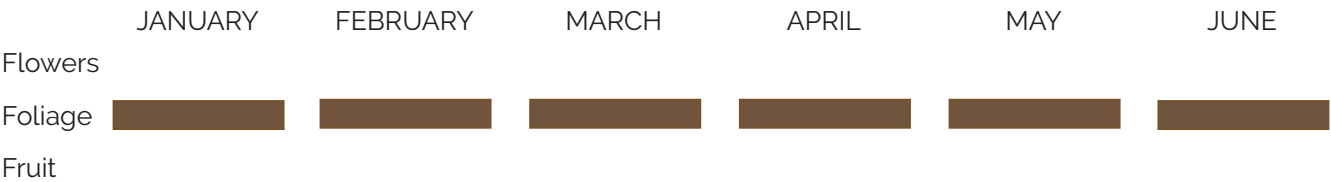




Fig.50. Photograph of Big Bluestem

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



MILKWEED

ASCLEPIAS SYRIACA L.

DILET NARBAAZH

ININIWANZH



Fig.51. Drawing of Milkweed

Medicinal Properties

- Milkweed can be used in many different ways, including treatment of diarrhea and alleviating sore throats. It can also be used to induce milk flow for breastfeeding mothers and can be taken as a contraceptive.
- One can harvest the “milk” from the stem and use it externally to treat warts, ringworms and moles.
- Milkweed’s roots can also be harvested and made into a tea to aid kidney problems (Belcourt, 2007).

Habitat and Community

Often found in open fields, along roadways and in waste places. Grows in medium to fine sand, clay or rocky calcareous soils (Lady Bird Johnson Wildflower Centre, 2020).

Landscape Characteristics

Tall showy plant during bloom period. Fragrant flowers create a unique feature during summer months (Lady Bird Johnson Wildflower Centre, 2020).

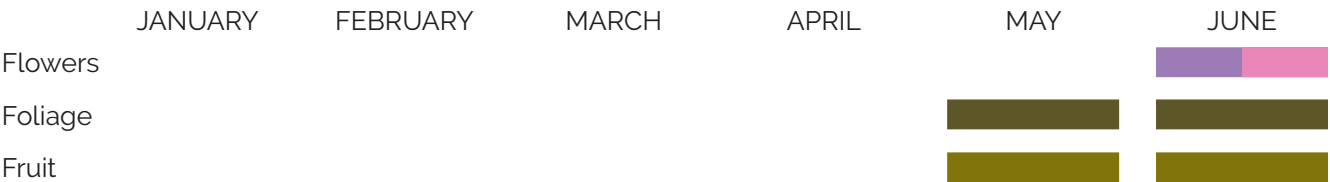




Fig.52. Photograph of Milkweed

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER

SIDE OATS GRAMA

BOUTELOUA CURTIPENDULA



Phytoremediation Properties

Rhizodegradation

- Similar to other grasses, Side Oats Grama will be beneficial due to their roots' depth to target the heavier fractions of contaminants.
- The soil microbes use Side Oats Grama roots to fully break the contaminant down.
- Targets the PAHs and metals within the soil (Kennen and Kirkwood, 2017).

Habitat and Community

Typically grow in open grassland and prairies, open brush, forest openings and on rocky slopes. Prefer medium textured-well drained soils (Lady Bird Johnson Wildflower Centre, 2019).

Landscape Characteristics

A medium sized bunch grass with purple-red oat like seeds. A warm season grass that maintains seasonal interest with its seeds (Lady Bird Johnson Wildflower Centre, 2019).

Fig.53. Drawing of Side Oats Grama





Fig.54. Photograph of Side Oats Grama

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



HACKBERRY

CELTIS OCCIDENTALIS



Fig.55. Drawing of Hackberry

Phytoremediation Properties

Rhizodegradation

Phytovolatilization

Phytodegradation

- The deep rigorous roots of Hackberries enables them to target heavier fractions of contaminants.
- Hackberry will be used to address the main group of contaminants of concern.
- Targets BTEX, PAHs, and metals (Kennen and Kirkwood, 2017).

Habitat and Community

Typically grow along riverbanks, in flood plains, and open woodland areas. Prefer rich moist soils (Lady Bird Johnson Wildflower Centre, 2025).

Landscape Characteristics

Hackberry has distinct leaf structures with a broad crown and are often erratic in shape. The crown can often form a ‘witches broom’ (Lady Bird Johnson Wildflower Centre, 2025).

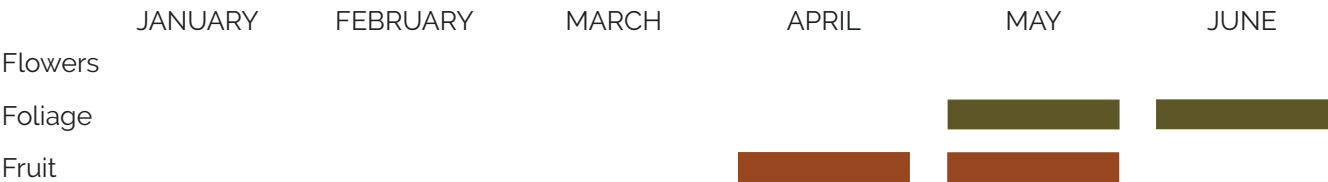




Fig.56. Photograph of Hackberry

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate	↑	↑↑	↑↑↑



JULY

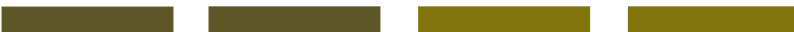
AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



FIREWEED

CHAMERION ANGUSTIFOLIUM (L)

EÑ NARBAAZH DI FEU

OJA'CIDJI'BIK

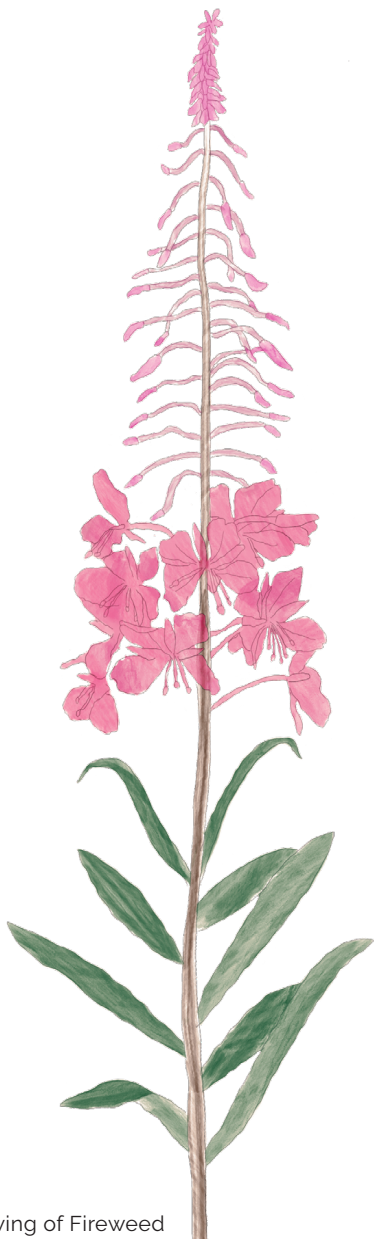


Fig.57. Drawing of Fireweed

Medicinal Properties

- Fireweed contains anti-inflammatory properties and can be used to treat digestive issues, yeast infections, and colds.
- Containing antiseptic compounds, bacterial growth can be minimized by ingesting fireweed and helps to mitigate intestinal worms.
- Externally, it can be rubbed on the skin to treat eczema
- One can apply the root directly onto an open wound to help eliminate or draw out infections (Belcourt, 2007).

Habitat and Community

Typically grow in disturbed soil conditions and along roadways. Will often be found growing in burned areas (Lady Bird Johnson Wildflower Centre, 2023).

Landscape Characteristics

Tall showy pink flowers are distinct. Often grow in large clusters (Lady Bird Johnson Wildflower Centre, 2023).

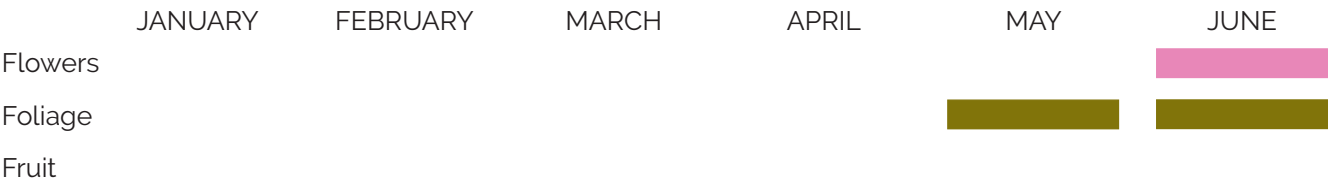




Fig.58. Photograph of Fireweed

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



CANADA WILD RYE

ELYMUS CANADENSIS

LI GRAEN*



Phytoremediation Properties

Rhizodegradation

- Like most prairie grasses, the roots of Canada Wild Rye will be beneficial due to their depth to target the heavier fractions of contaminants.
- The soil microbes use the Canada Wild Rye roots to fully break the contaminant down.
- Targets the PAHs and metals within the soil (Kennen and Kirkwood, 2017).

Habitat and Community

Can be found in grasslands, ravines, open woodlands, ditches and along fencerows (Lady Bird Johnson Wildflower Centre, 2012).

Landscape Characteristics

With unique long oat like-seeds, this cool season grass has beautiful summer interest (Lady Bird Johnson Wildflower Centre, 2012).

Fig.59. Drawing of Canada Wild Rye

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Flowers						
Foliage						
Fruit						



Fig.60. Photograph of Canada Wild Rye

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



GIANT WILD RYE

ELYMUS CINEREUS

LI RYE*



Fig.61. Drawing of Giant Wild Rye

Phytoremediation Properties

Rhizodegradation

- Like most prairie grasses, the roots of Giant Wild Rye will be beneficial due to their depth to target the heavier fractions of contaminants.
- The soil microbes use the Giant Wild Rye roots to fully break the contaminant down.
- Targets the PAHs and metals within the soil (Kennen and Kirkwood, 2017).

Habitat and Community

Typically grows in grasslands, along river banks, ravines, and on moist or dry slopes and plains. Can tolerate salt and drought soil conditions (Lady Bird Johnson Wildflower Centre, 2023).

Landscape Characteristics

This cool season tall grass has unique seed heads that can grow up to 8 inches long (Lady Bird Johnson Wildflower Centre, 2023).

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Flowers						
Foliage						
Fruit						



Fig.62. Photograph of Giant Wild Rye

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



SHEEP FESCUE

FESTUCA OVINA SAXIMONTANA



Fig.63. Drawing of Sheep Fescue

Phytoremediation Properties

Rhizodegradation

Phytovolatilization

Phytodegradation

- The rigorous roots of Sheep Fescue enables them to target heavier fractions of contaminants.
- Sheep Fescue will be used to address the main group of contaminants of concern.
- Targets BTEX and PAHs (Kennen and Kirkwood, 2017).

Habitat and Community

Open short grasslands and prairies. Can tolerate harsh soil conditions (Prairie Originals, n.d.).

Landscape Characteristics

Short clump grass with small subtle seeds that have a beautiful red hue in early season. Blends well with other short prairie grasses (Prairie Originals, n.d.).

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Flowers						
Foliage						
Fruit						



Fig.64. Photograph of Sheep Fescue

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



WILD STRAWBERRY

FRAGARIA VIRGINIANA

LÎ FRRÅS

ODE'IMIN



Medicinal Properties

- The berries of the plant are an excellent source of vitamin C when ingested.
- The leaf and root can also be used to treat upset stomachs, digestive issues, and intestinal disorders.
- One can dry the leaves and boil them into tea to relieve stress (Belcourt, 2007).

Habitat and Community

Low open prairies and fields along edges. Also found in woodlands along edges (Lady Bird Johnson Wildflower Centre, 2023).

Landscape Characteristics

Short ground cover plant that has showy flowers that transforms into sweet edible berries (Lady Bird Johnson Wildflower Centre, 2023).

Fig.65. Drawing of Wild Strawberry

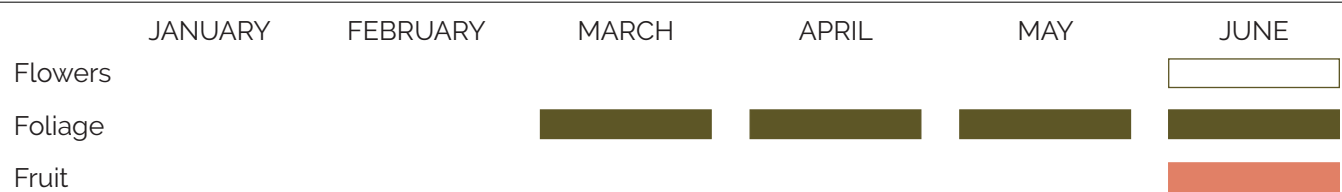




Fig.66. Photograph of Wild Strawberry

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



JACK PINE

PINUS BANKSIANA

LI PINET*

OKIKAANDAG**



Phytoremediation Properties

Rhizodegradation

Phytovolatilization

Phytodegradation

- The deep roots of Jack Pines enable them to target heavier fractions of contaminants.
- Jack Pine will be used in a variety of different ways to address different contaminants of concern.
- Targets the PAHs and BTEX (Kennen and Kirkwood, 2017).

Habitat and Community

Dense mixed coniferous and deciduous forests, with sandy, or acid sand soil conditions. They are intolerant to wet and alkaline soils (Lady Bird Johnson Wildflower Centre, 2015).

Landscape Characteristics

Tall irregular growing evergreen tree. Flat topped and conical in shape (Lady Bird Johnson Wildflower Centre, 2015).

Fig.67. Drawing of Jack Pine

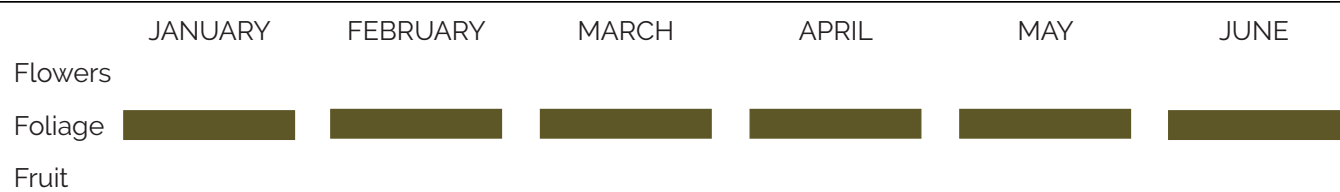




Fig.68. Photograph of Jack Pine

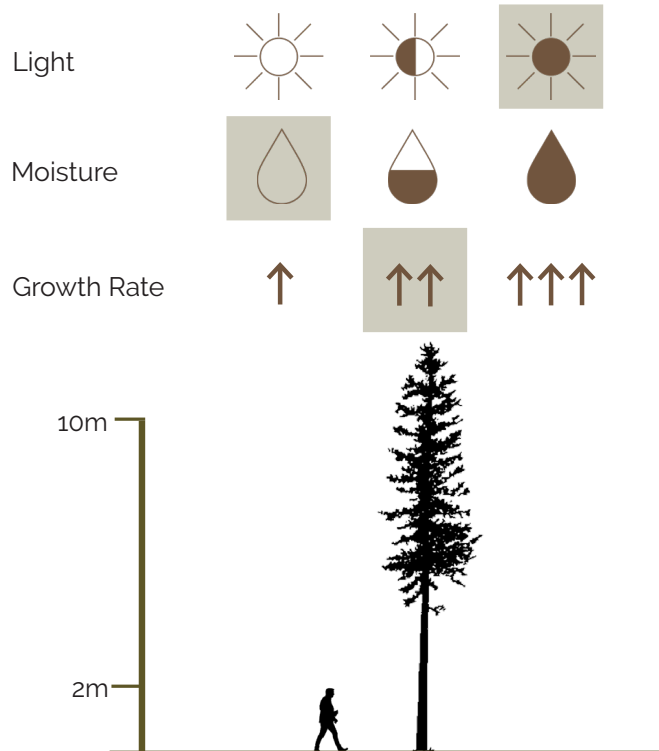
Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter
--------	--------	------	--------

Growth



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



COMMON PLANTAIN

PLANTAGO MAJOR

PLAAÑTEÑ

GINE'BIGWÛK



Medicinal Properties

- Common Plantain can be used internally to relieve ulcers, and treat kidney and bladder issues, and reduce inflamed intestines.
- Externally, the heated leaves can be placed on wounds to reduce swelling, isolate stings, and help the healing process of sores
- The leaves can also be crushed and used as a poultice to treat cuts, burns and insect bites (Belcourt, 2007 and Geniusz, 2015).

Habitat and Community

Typically seen as a weed growing in lawns. It will also grow in fields, along roadsides and other disturbed areas (North Carolina State University, n.d.)

Landscape Characteristics

A low growing ground cover plant with elongated “spikey” flowers. Unique long season interest as flowers typically booms from April to September (North Carolina State University, n.d.)

Fig.69. Drawing of Common Plantain

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Flowers						
Foliage						
Fruit						



Fig.70. Photograph of Common Plantain

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER

BLACK POPLAR

POPULUS BALSAMIFERA

LI TRAAMB NWAYR*

MAANAZAADI**



Phytoremediation Properties

Rhizodegradation

Phytovolatilization

Phytodegradation

- The deep rigorous roots of Black Poplar enables them to target heavier fractions of contaminants.
- Black Poplar will be used to address the main group of contaminants of concern.
- Targets BTEX, PAHs, and metals (Kennen and Kirkwood, 2017).

Habitat and Community

Typically grows along stream banks and within conifer swamps. Needs moist soils (Lady Bird Johnson Wildflower Centre, 2022).

Landscape Characteristics

Typically has a very straight form with white and grey bark. A narrow growing tree with dark shiny green leaves (Lady Bird Johnson Wildflower Centre, 2022).

Fig.71 Drawing of Black Poplar

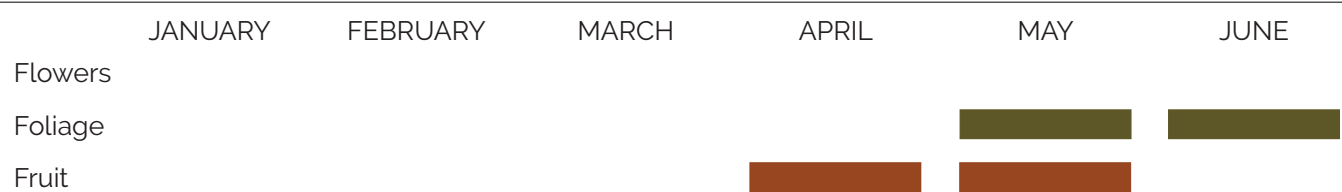




Fig.72. Photograph of Black Poplar

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter
--------	--------	------	--------

Growth

Light			
Moisture			
Growth Rate			



JULY

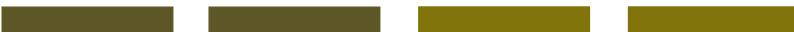
AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



BUR OAK

QUERCUS MACROCARPA

AEN SHENN*

MITIGOMIZH**



Phytoremediation Properties

Rhizodegradation

Phytovolatilization

Phytodegradation

- The deep rigorous roots of Bur Oak enables them to target heavier fractions of contaminants.
- Bur Oak will be used to address the main group of contaminants of concern.
- Targets BTEX (Kennen and Kirkwood, 2017).

Habitat and Community

Typically grows in prairies, open woods, and upland along stream edges. Prefer limestone and calcareous clay soils (Lady Bird Johnson Wildflower Centre, 2015).

Landscape Characteristics

Large, wide tree with deep rigid bark. With a distinct leaf shape and spooky branch structure, Bur Oaks are easy to decipher (Lady Bird Johnson Wildflower Centre, 2015).

Fig.73. Drawing of Bur Oak

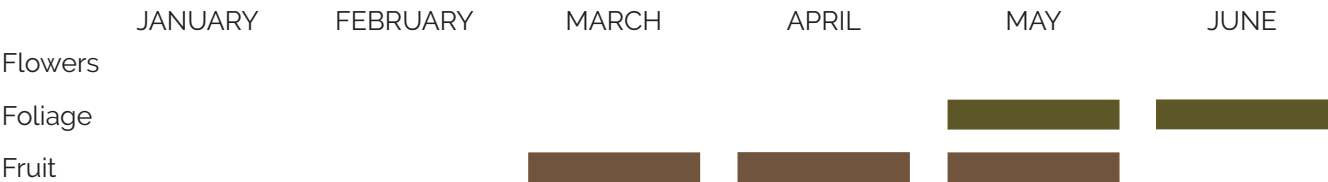




Fig.74. Photograph of Bur Oak

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



WILD ROSE

ROSA ACICULARIS

LI ROOZ DI NO PIYI

OGINII-WAABIGWANAATIG



Medicinal Properties

- Rose hips are high in vitamins C, A, K, and B.
- Its roots, stems, leaves, blossoms, and petals can be used for various medicinal purposes.
- One can harvest the roots and use them as a cold and fever treatment.
- Rose petals can be made into a tonic that is good for heart health and cough syrups (Belcourt, 2007 and Geniusz, 2015).

Habitat and Community

Grows in tall prairies openings, thickets, stream banks and wooded hillsides (Lady Bird Johnson Wildflower Centre, 2023).

Landscape Characteristics

Grows into small shrubs that are showy during bloom season. The pink flowers typically grow in solitary but can sometimes grow in clusters (Lady Bird Johnson Wildflower Centre, 2023).

Fig. 75. Drawing of Wild Rose





Fig.76. Photograph of Wild Rose

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



PUSSY WILLOW

SALIX DISCOLOR

LII SOL

OZIISIGOBIMIZH-ZLIB

Medicinal Properties

- Willows are a popular medicinal species within many First Nation and Métis communities.
- The bark, roots and leaves can made in poultices which can treat open wounds, cuts, and poison ivy rashes and help prevent infections.
- The plant can be crushed into a powder and applied to open wounds to control bleeding
- Willows can also be ingested to help pain relief, as the plant contains acetylsalicylic acid, which is also known as Aspirin (Belcourt, 2007).

Habitat and Community

Low ground, stream banks and moist ditches
Will only tolerate damp soil conditions (Lady Bird Johnson Wildflower Centre, 2023).

Landscape Characteristics

Marshy, low ground areas with lots of moisture.
Beautiful soft flower known as 'pussy fur' is an early season feature (Lady Bird Johnson Wildflower Centre, 2023).



Fig.77. Drawing of Pussy Willow

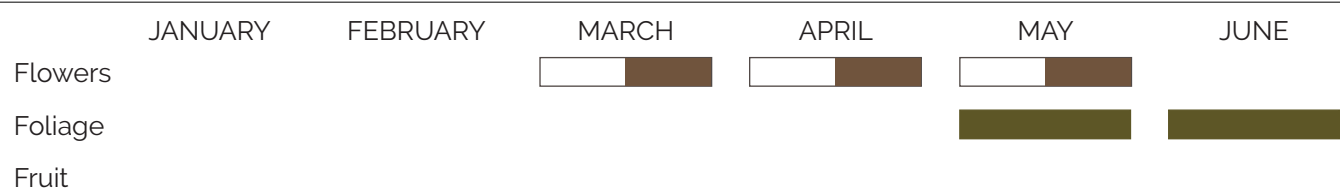




Fig.78. Photograph of Pussy Willow

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER



STINGING NETTLE

URTICA DISCOLOR

MAZHAAN

BEPADJIKANAKIZ'IT



Fig.79. Drawing of Stinging Nettle

Medicinal Properties

- It is said then when used for healing purposes, the hairs will not sting you
- Nettle is known to help treat joint pains and arthritis
- The root can be made into tea, to help with sore stomachs, and digestive issues
- Internally, nettle can be ingested to help strengthen kidneys and prevent bladder stones (Belcourt, 2007).

Habitat and Community

Natural habitat are waste places and along roadsides, open grasslands and along pathways (Lady Bird Johnson Wildflower Centre, 2023).

Landscape Characteristics

Medium sized shrub. The Nettle will be highly irritating to skin if handled without gloves (Lady Bird Johnson Wildflower Centre, 2023).

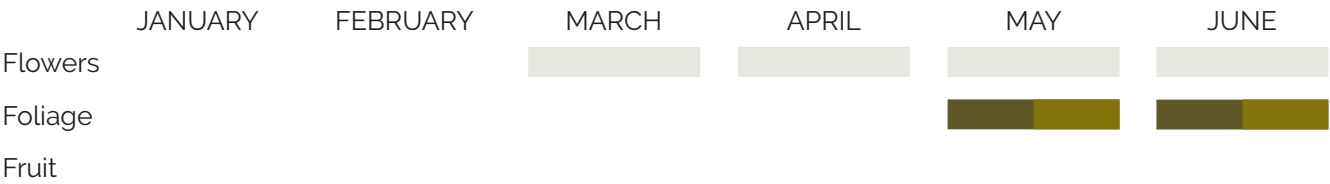




Fig.80. Photograph of Stinging Nettle

Landscape Functions



Seasonal Interest

Spring	Summer	Fall	Winter

Growth

Light			
Moisture			
Growth Rate			



JULY

AUGUST

SEPTEMBER

OCTOBER

NOVEMBER

DECEMBER





A misty landscape with a body of water, bare trees, and a forested hill in the background. The scene is captured in a soft, hazy light, with the water reflecting the pale sky. In the foreground, tall, thin reeds or grasses lean over the water, and a large, leafless tree stands on the right. The background shows a line of evergreen trees on a hill, partially obscured by mist.

"Action on behalf of life transforms. Because the relationship between self and the world is reciprocal, it is not a question of first getting enlightened or saved and *then* acting. **As we work to heal the earth, the earth heals us.**"

Robin Wall Kimmerer, 2013, p.340.



8.0

A NEW FUTURE - INTRODUCING PHASE I

The primary design objectives of Phase I are to implement phytoremediation technologies to clean the soil and groundwater contaminants. Additionally, to create a learning environment for community members of Sagkeeng and Pine Falls, students and staff at the University of Manitoba, and the general public. The design includes various research and learning opportunities related to phytoremediation and the history of the sites' context.

During this phase, the site will be open to the general public to utilize as an open park space, with elevated pathways that allow for separation from the phytoremediation plants. An important factor of this project is to ensure that the site is

safe and accessible for the general public, but specifically Elders from Sagkeeng First Nation to walk leisurely during all seasons. As such, the raised pathway is designed to have minimal gaps in the grate texture, to ensure walkers and canes are not impacted.

The design features different rest areas, gathering areas, and a research facility that will be maintained and run by the University of Manitoba for phytoremediation purposes. The work conducted here will be rooted in working in a good way and provide an opportunity for university students and staff to be good stewards to this land.

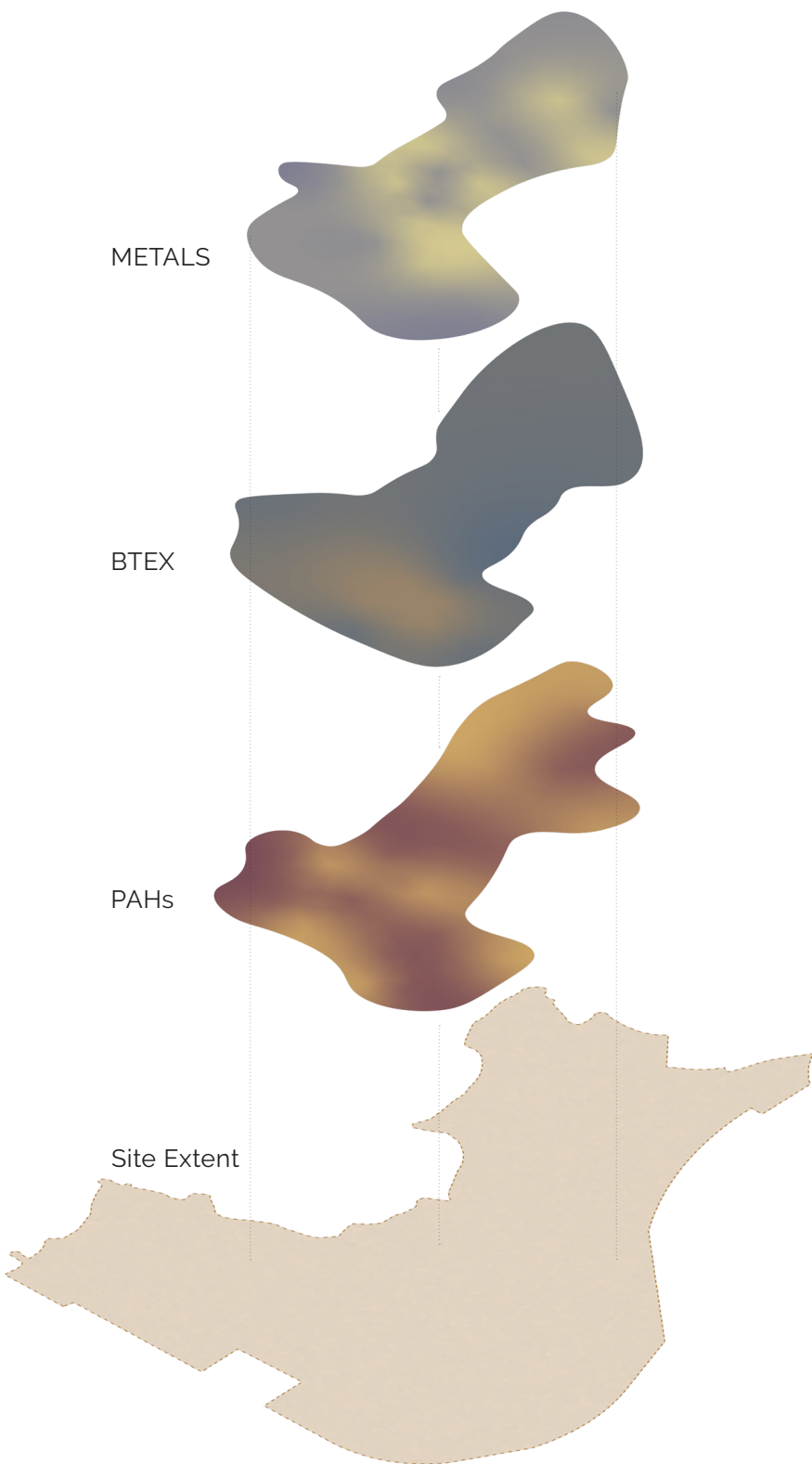
PHASE I DESIGN APPROACH

The design for Phase I directly responds to the contaminant locations as outlined in Figure 83 and Figure 84. As shown in the diagram, heavy forested areas are designed to address the areas containing higher contamination levels. Dense grasslands are designed to address the areas with lower contamination levels.

Trees with phytoremediative properties have been selected to address the areas of higher contamination levels, due to their rigorous root systems and ability to establish and grow quickly. The design takes into consideration natural forest succession, with some species

containing the ability to establish quicker, and build a strong forest foundation.

As prairie grass species tend to take longer to establish they are designed to target lower level contaminants. The prairie grasses selected all have deep, rigorous root systems to take up contaminants from the soils and groundwater. The grass species will not need to be removed from the site following contaminant removal.



Contaminant Concentration Levels



Fig.83. Isometric Diagram of Contaminants on Site



Design Response



Fig.84. Isometric Diagram of Forest and Grasslands



GATHERING AREA

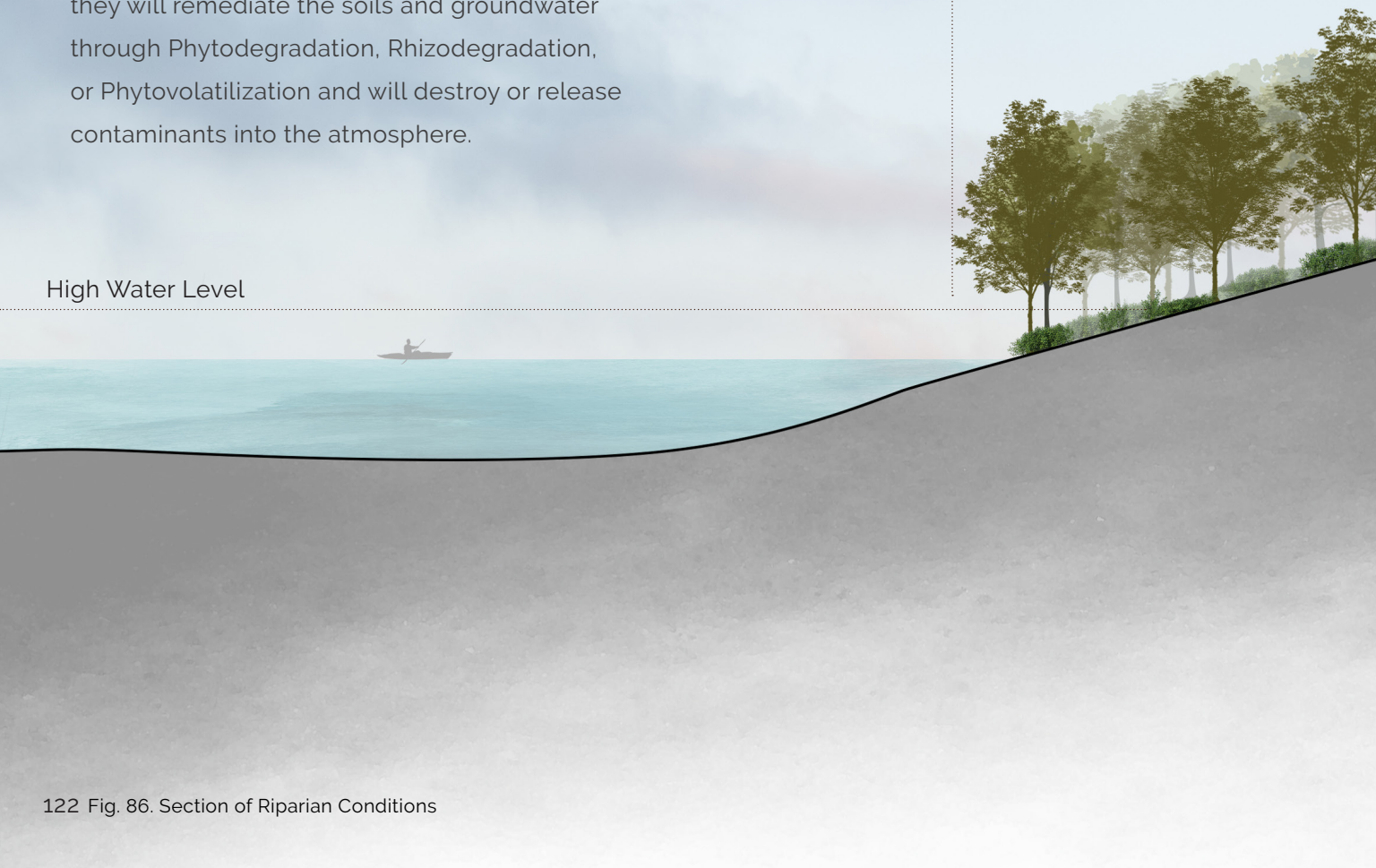
LOOKOUT & REST AREA

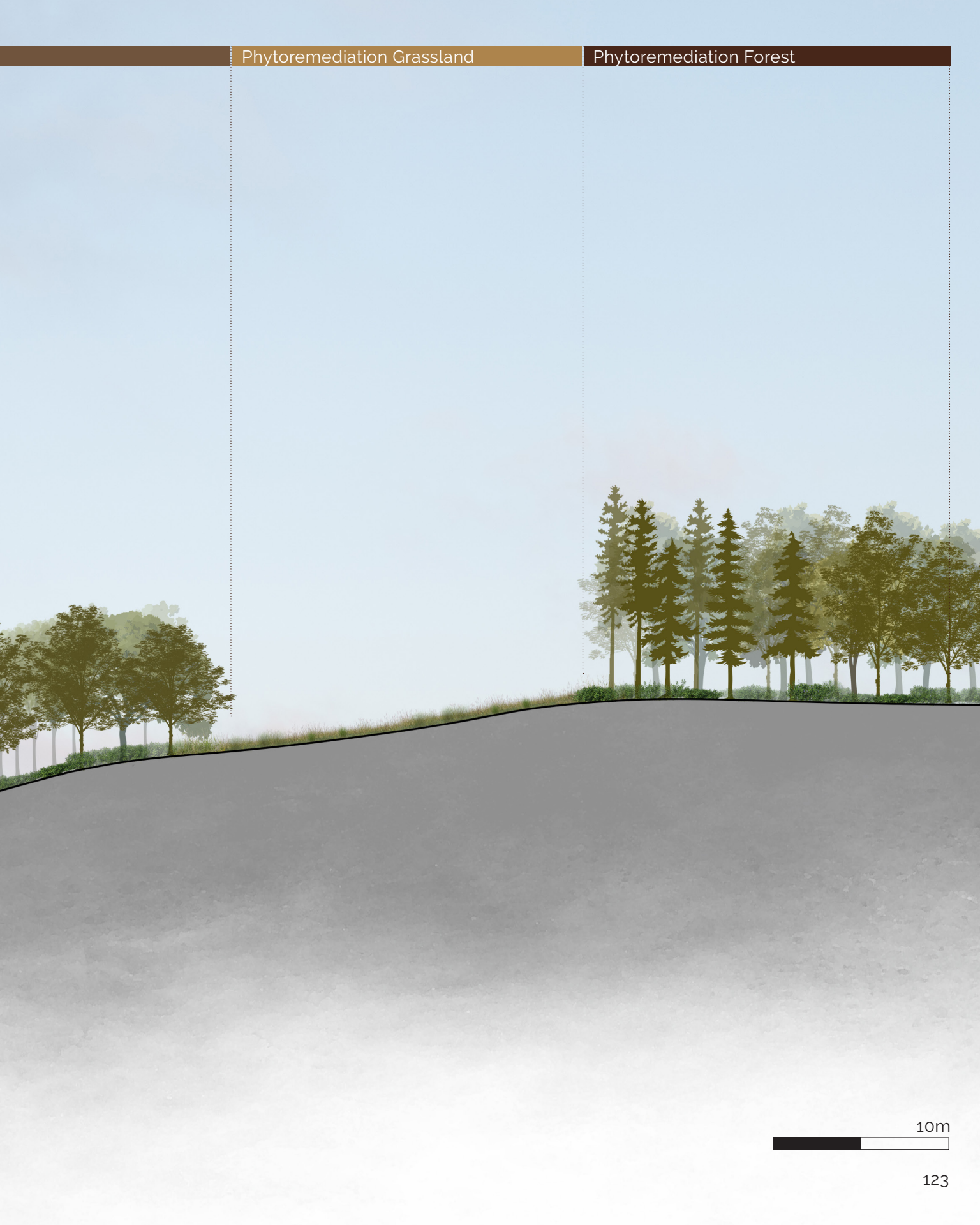


RIPARIAN CONDITIONS

Due to the site being situated on the Winnipeg River and the concerns of riverbank erosion in the area, riverbank stabilization species are important to the long-term preservation of the site. Black Poplar and Hackberry will be the phytoremediation species existing on the river banks, in combination with bank stabilizing under-story species such as dogwood and willows. Black Poplar and Hackberry will not be harvested for removal along the riverbank as they will remediate the soils and groundwater through Phytodegradation, Rhizodegradation, or Phytovolatilization and will destroy or release contaminants into the atmosphere.

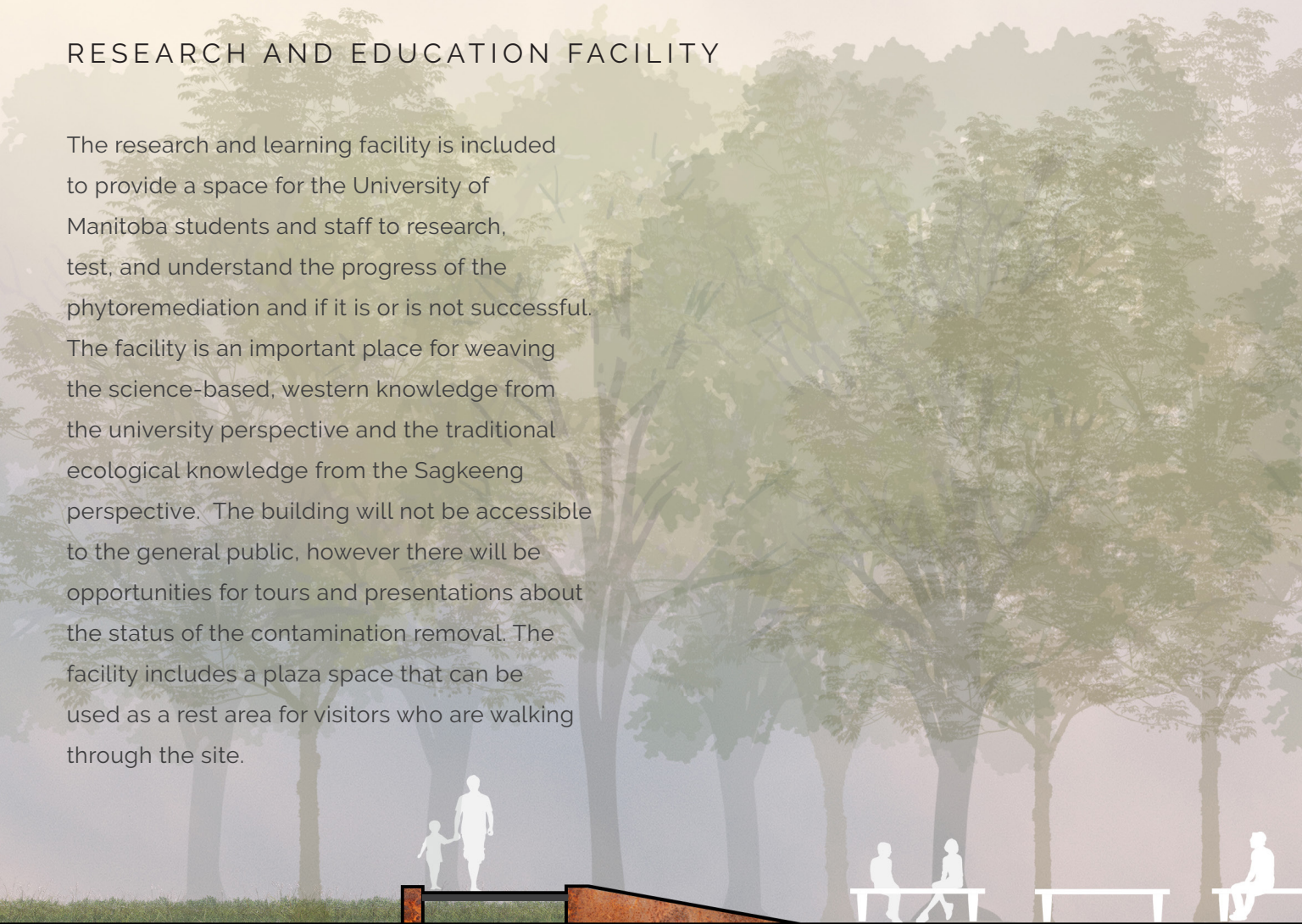
High Water Level





RESEARCH AND EDUCATION FACILITY

The research and learning facility is included to provide a space for the University of Manitoba students and staff to research, test, and understand the progress of the phytoremediation and if it is or is not successful. The facility is an important place for weaving the science-based, western knowledge from the university perspective and the traditional ecological knowledge from the Sagkeeng perspective. The building will not be accessible to the general public, however there will be opportunities for tours and presentations about the status of the contamination removal. The facility includes a plaza space that can be used as a rest area for visitors who are walking through the site.





FOREST AREAS

The forest areas are a unique part of the design and provide a distinctive experience for visitors to the site. As one walks through the grassland and transitions into the forest, the ambiance shifts and creates an entirely different experience. The forest paths provide fewer cues that allude to the history of the site, and are designed to bring back feelings of the landscape that existed prior to the establishment of the mill. People walking through the forest paths are welcomed to guide their own healing journey with the site, and to deeply get a sense of the hopeful future for the new landscape that is developing around them.



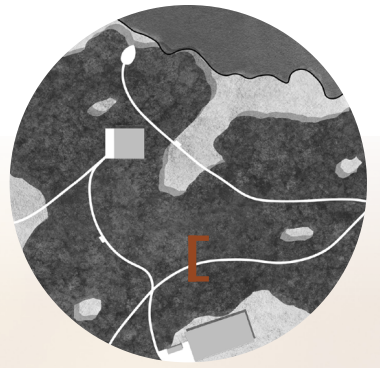


Fig. 89. Section of Forest Pathway 127

INTERPRETIVE SIGNAGE

The interpretive signage in the park will be an important educational component to communicate the remedial efforts happening in the surrounding landscape. Additionally, they provide an opportunity to integrate the different languages and dialects from the surrounding communities. The signs will communicate what phytoremediation is, the types of plants that are involved in the phytoremediation process, and the importance of staying to the designated pathways and not interacting with the landscape. There will be slots at the entrances of the park which will include a place for

printed copies of the plant guide to allow people to bring it with them while they explore the park. Additionally, a QR code will be included on the entrance signs for people who would rather scan and have a digital copy of the guide.

The sign bases are made from corten steel to reflect the material choice of the pathways, with a plastic cover piece to allow for maintenance and changes of the sign content. When and if Phase II is implemented, the signs will be updated to transition out of the phytoremediation content into the medicinal guide information.



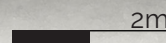
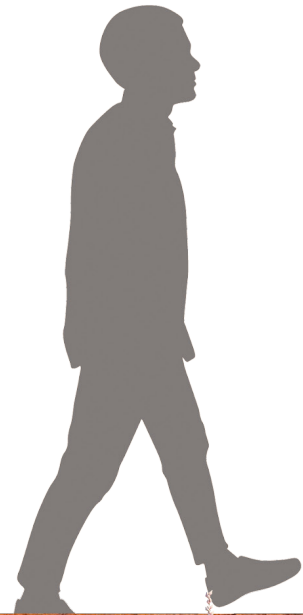


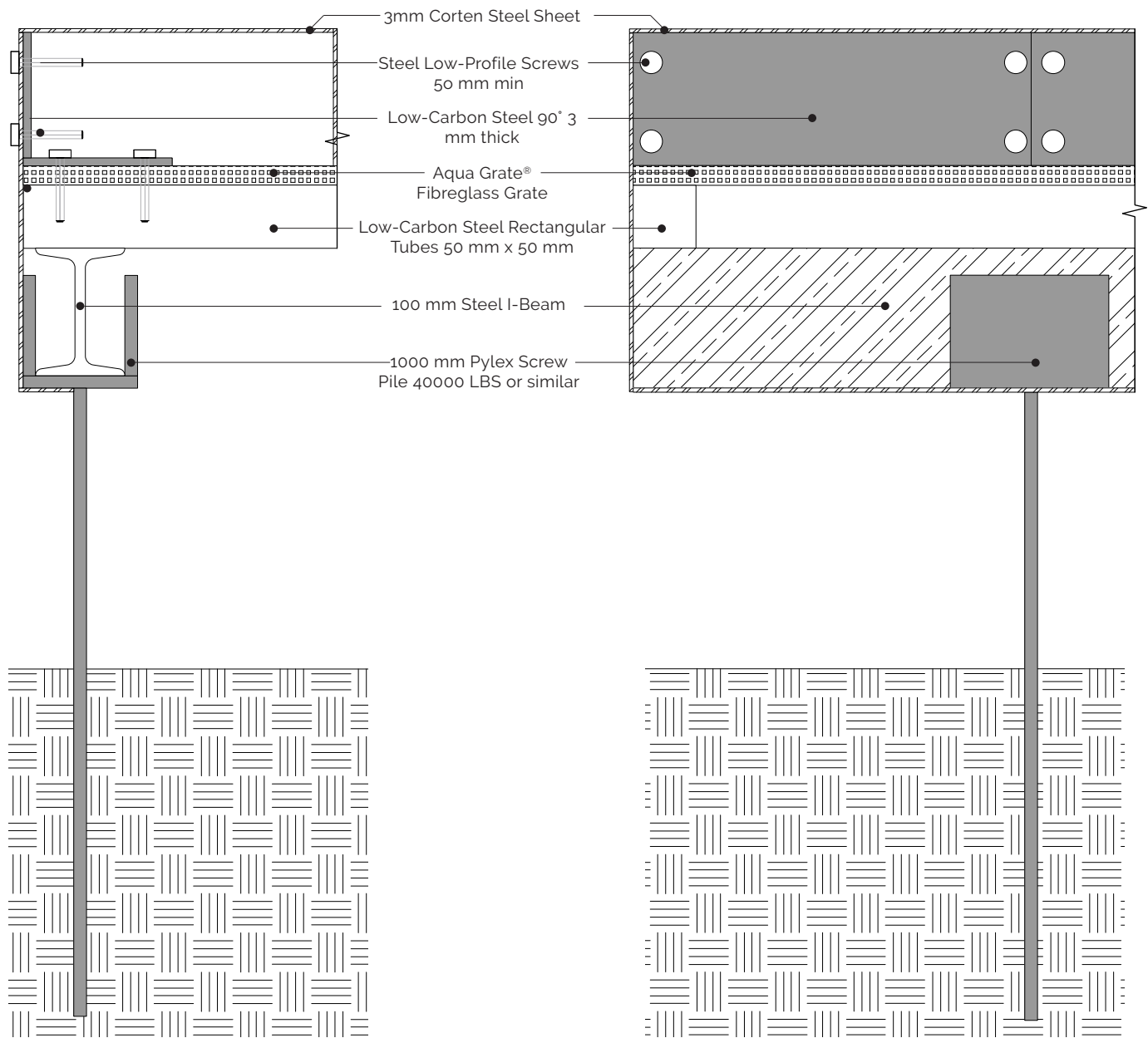
Fig. g1. Section of Interpretive Signs 129

RAISED PATHWAYS

As the raised pathways are one of the main pieces of infrastructure in the design, it was important to understand how they will exist on the site allow for separation between the phytoremediation and visitors to the site. The pathways were designed to be accessible, with the width allowing two wheelchairs to comfortably share the path. Each entrance point will include a ramp with a gentle slope. The materials were chosen to allude to the industrial history of the site, while allowing the plants to comfortably grow beneath the paths.



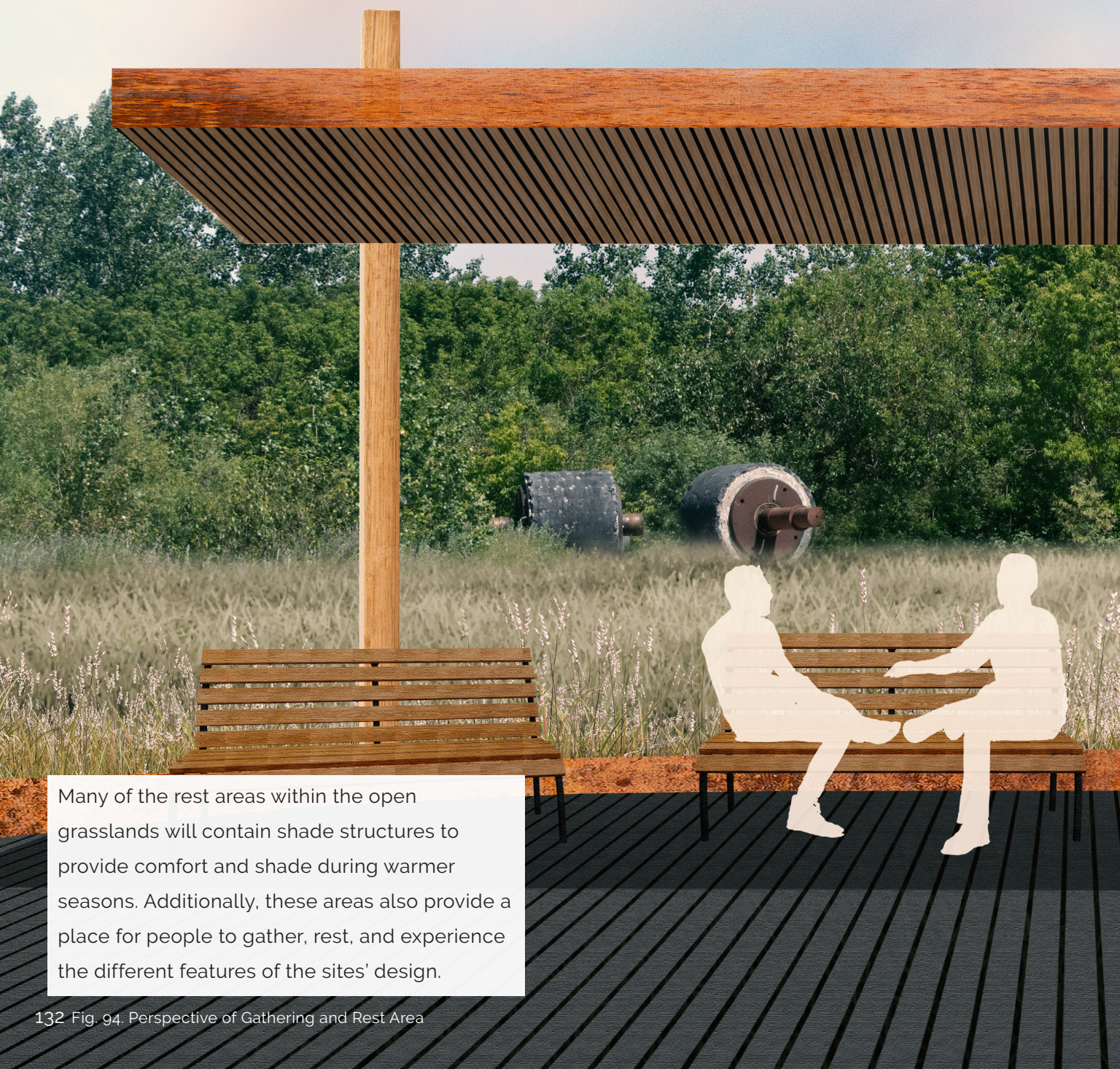
DETAILS



Front Path Detail
Scale: 1:5

Side Path Detail
Scale: 1:5

REST AREAS



Many of the rest areas within the open grasslands will contain shade structures to provide comfort and shade during warmer seasons. Additionally, these areas also provide a place for people to gather, rest, and experience the different features of the sites' design.







GREENHOUSE

The greenhouse is an important feature in the overall design, particularly in Phase I. The design of site is intended to be a safe, accessible place for people to walk through, however the winter months will likely see less traffic due to the harsh climatic conditions. The greenhouse offers a space for people to still be active and enjoy the atmosphere of the site during the entire year, while also being able to integrate medicinal plant species during phase I.

Another important feature within the greenhouse is that it will be growing plants to test throughout the site. As the design is being thought of 10, 50, and even 100 years into the future, the climatic and growing conditions are subject to change due to climate change. The greenhouse provides an opportunity to constantly evolve with the changes and provides learning experiences for those coming to the site.

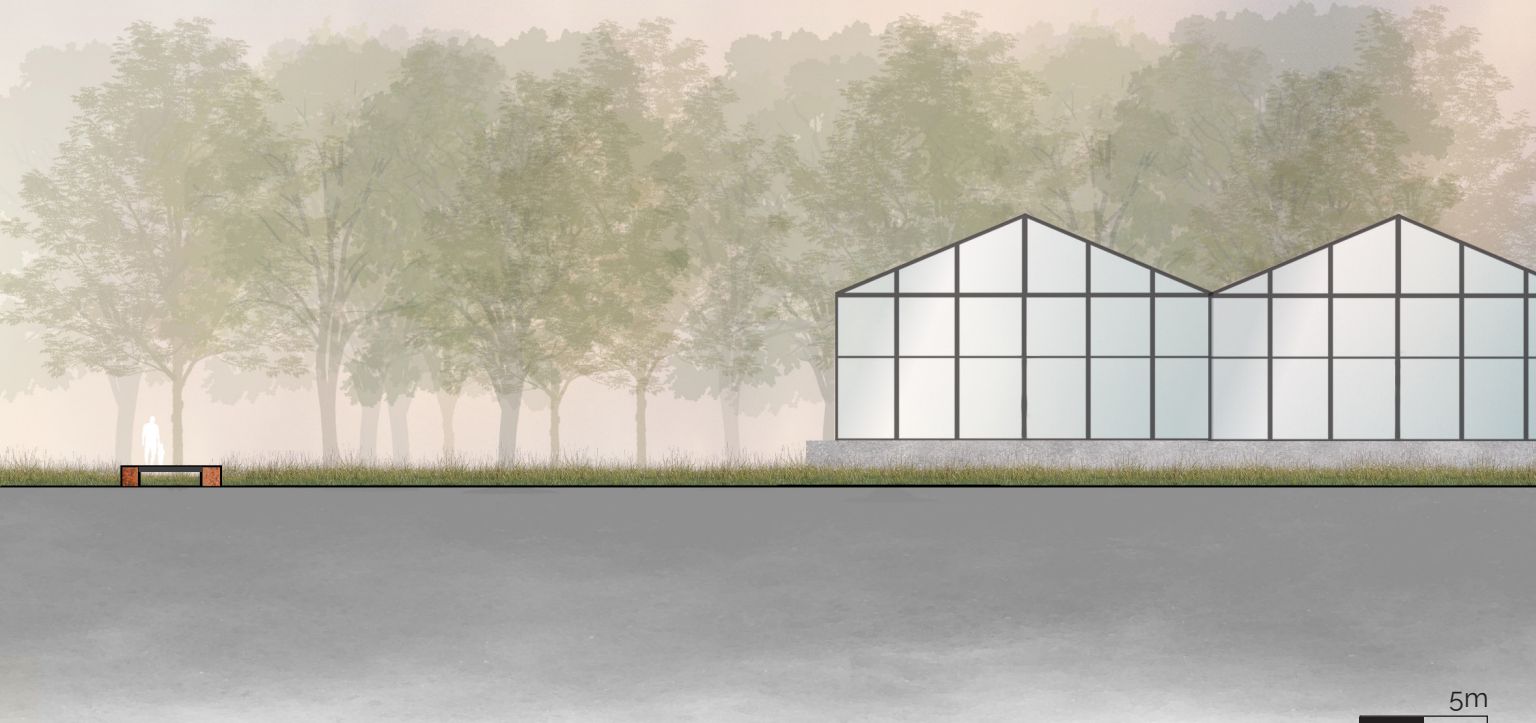


Fig. 96. Section of Greenhouse 135

GRASSLAND AREAS

The grassland areas are a distinct part of the design to create an entirely different atmosphere than the forested areas. The grassland areas allow people to connect with the site's history and get a sense of the infrastructure that existed on this site prior to demolition. Many people visiting this site will remember what the mill looked like, and for those who do not, will be reminded with the remnants that have been preserved as a design feature. The grassland areas encourage a healing connection in a way that differs from the forest areas through subtle reminders of the past, and the resiliency of the landscape that surrounds visitors as they walk through the site.





8.2

PHASE II

The primary design objectives of Phase II are to slowly introduce the medicinal plant species outlined in the plant guide, and to create a space that encourages harvesting. As mentioned previously, Phase II will not be implemented until the soils and groundwater are completely clean of contaminants. Phase II could begin in 10, 50, or 100 years from the beginning of the project, and it is not guaranteed to be implemented depending on the success of Phase I.

If Phase I is successful, the medicinal plants outlined in the plant guide will be planted and slowly established in the landscape. Areas where phytoremediation forest and grassland species are not being removed, medicinal plants will be scattered throughout the established plantings. The areas that will be vacant due to the phytoremediation species have been removed completely from the site will contain denser plantings and will be heavier focused areas.

New programming will be implemented during Phase II to grow a stronger educational component within the park and promote stronger connections with Indigenous knowledge and ways of knowing. One of the main programming features will include guided plant education walks which will be offered through the education centre, organized by multiple generations of Sagkeeng community members.

Phase II will be very important to engage with youth and multiple generations of community members so they can learn about and teach the importance of land tending and stewardship. This notion of planning for the long term future of the park alludes to seven generations thinking and the importance of planning for future generations. Phase II creates a plan for a positive future for the upcoming generations of the communities connecting with and caring for this land.



8.3

THE TRANSITION

The transition between Phase I and Phase II is a unique part of the design proposal. If Phase I is successful, the transition into Phase II will have a slow and discrete flow. Medicinal plants will be planted within the established grasslands and forests, and different healing aspects of the design will gently merge. Visitors of the site may not realize the subtle transition, but it will be evident when harvesting can begin through interpretive signage and new programming for the site. Both phases and the transition in between will allow for people to engage with healing in different ways, whether its physical, emotional, mental or spiritual. The theme of healing will stay the same through the long term future of the site.

The partnership with the University of Manitoba will be crucial in this transition phase to ensure

the Phase II plants have the best chance at establishing in the existing landscape, and to ensure the growing conditions are suitable for the plant species selected. Additional plants may be added depending on the desires of Sagkeeng members and knowledge keepers.

The transition phase is also important for implementing Indigenous ways of thinking in relation to healing. Although some of this comes through in Phase I, these knowledge pieces will be crucial in Phase II. Sagkeeng members will lead the development and future of Phase II. Consultation with the community will be required to understand what should be implemented in order to fulfill the needs of the community and how the park can support their traditions and practices.

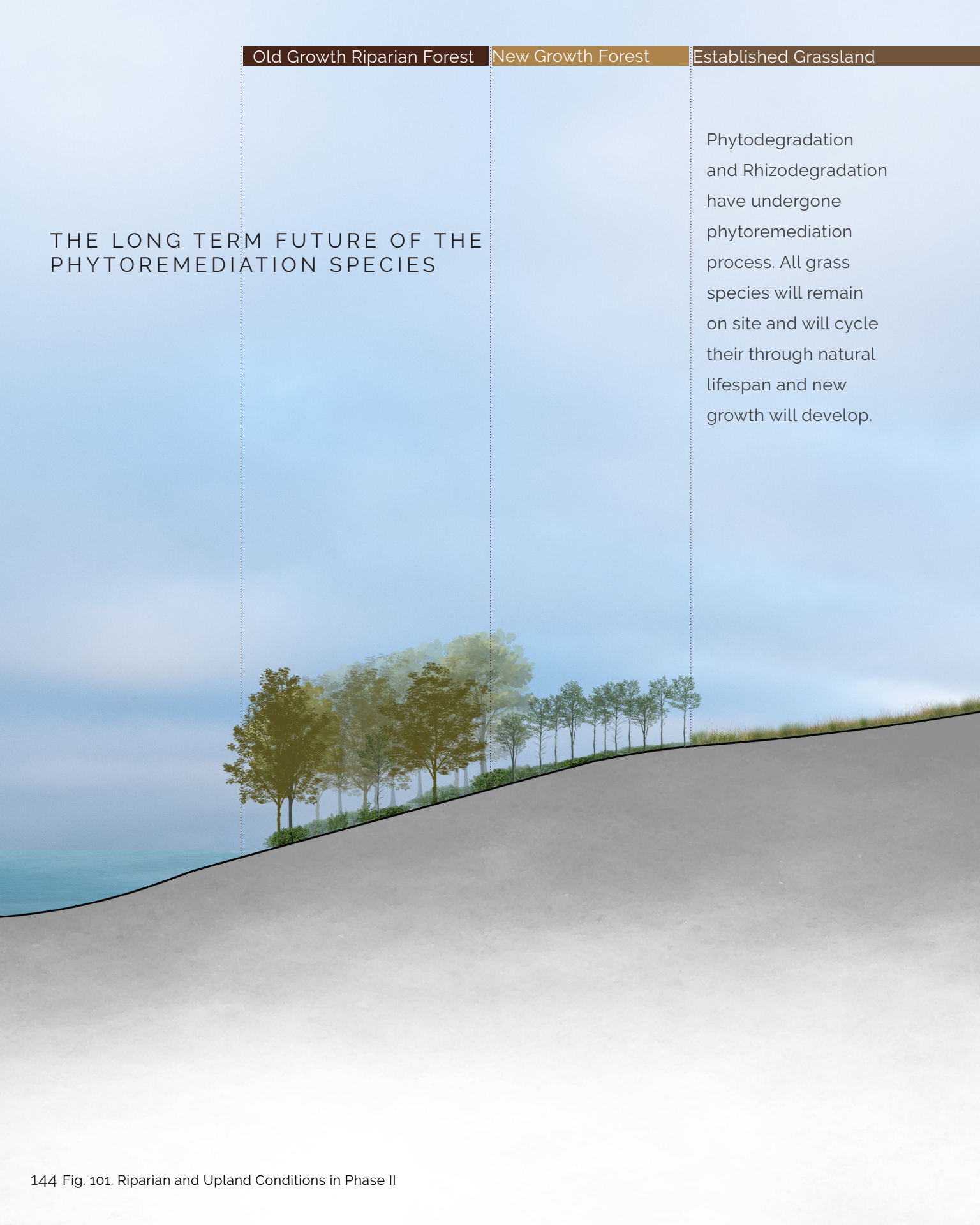


GATHERING
AREA

LOOKOUT &
REST AREA

SECONDARY
PATHWAY





Old Growth Riparian Forest

New Growth Forest

Established Grassland

THE LONG TERM FUTURE OF THE
PHYTOREMEDIATION SPECIES

Phytodegradation
and Rhizodegradation
have undergone
phytoremediation
process. All grass
species will remain
on site and will cycle
their through natural
lifespan and new
growth will develop.

New Growth Forest

Rhizodegradation, Phytovolatilization, Phytodegradation, Phytohydraulics, and Phytoextraction have undergone the phytoremediation process. Black Poplar and Bur Oak species are to be harvested and removed from the site. Natural forest succession will take its course and the a new growth forest will establish.

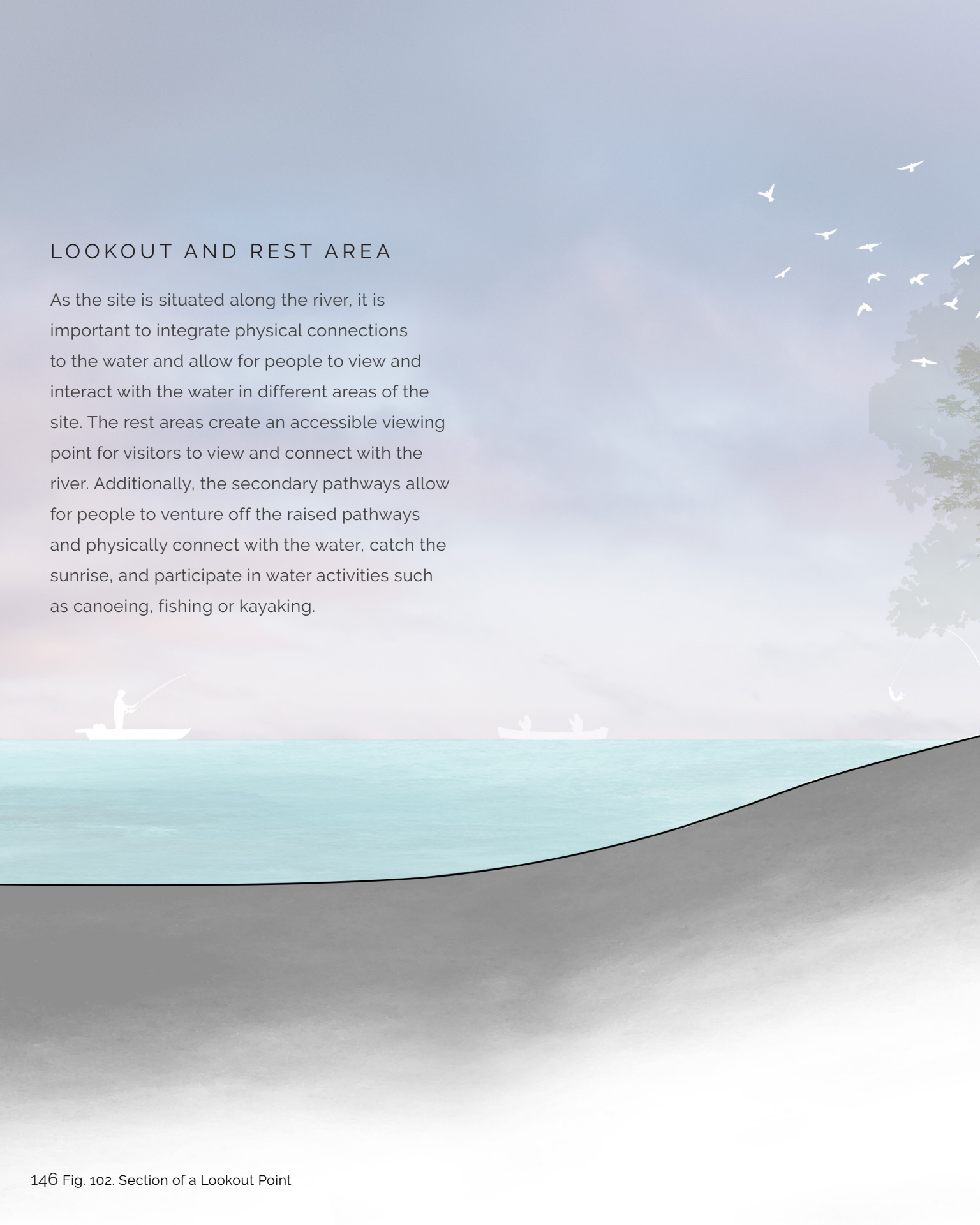
Old Growth Forest

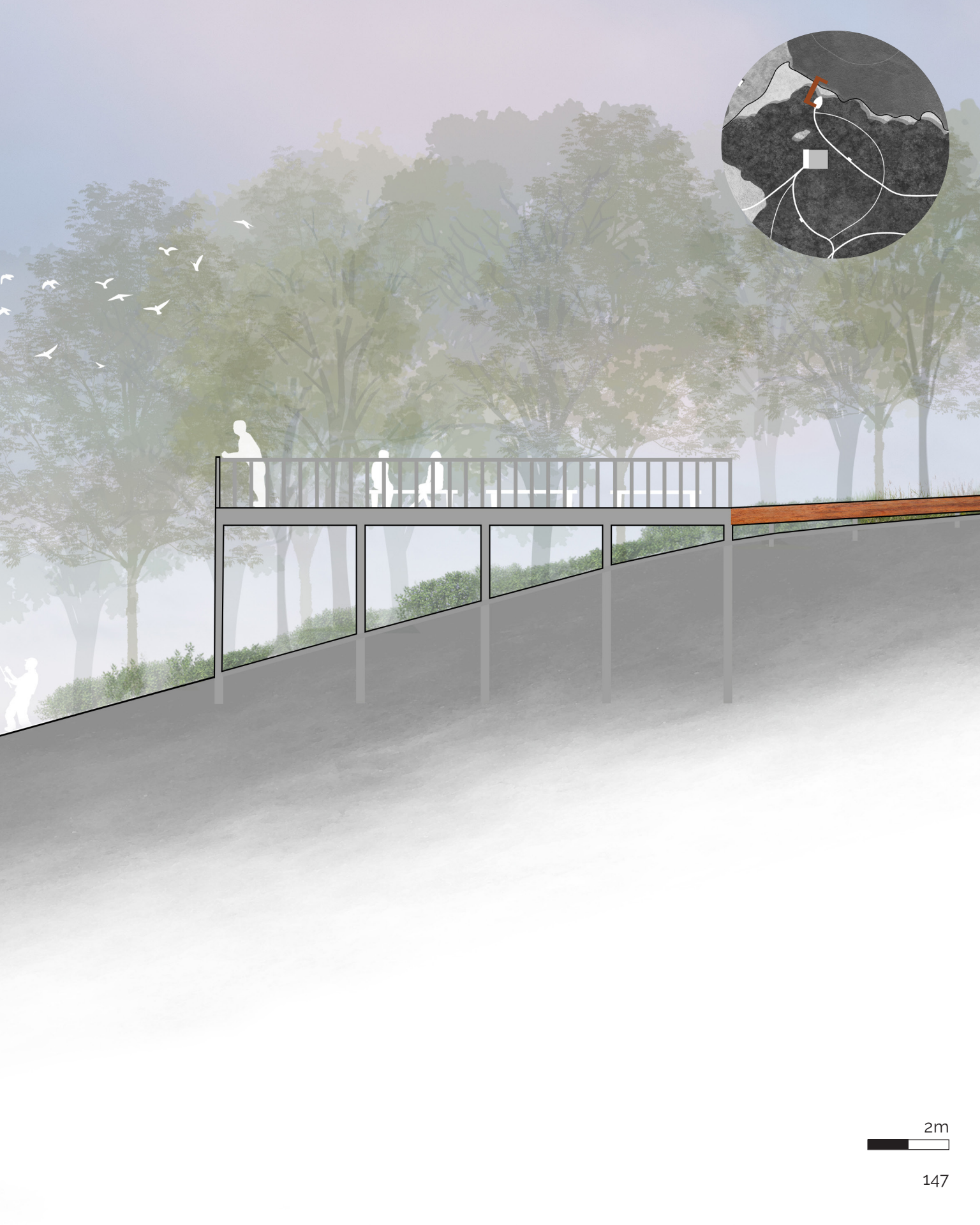
Phytodegradation and Rhizodegradation have undergone phytoremediation process. Jack Pine and Hackberry species will remain on site and will cycle through their natural lifespan.



LOOKOUT AND REST AREA

As the site is situated along the river, it is important to integrate physical connections to the water and allow for people to view and interact with the water in different areas of the site. The rest areas create an accessible viewing point for visitors to view and connect with the river. Additionally, the secondary pathways allow for people to venture off the raised pathways and physically connect with the water, catch the sunrise, and participate in water activities such as canoeing, fishing or kayaking.





2m

LOOKOUT AND REST AREA





A PLACE TO HARVEST

As the main theme of the design for Phase II is to create a place for harvesting medicinal plants, the accessible secondary pathways encourage visitors to venture off the path and engage with and explore the land directly.





A PLACE TO GATHER

The gathering area will be an important element in both phases of the design to allow for multiple generations of community members to gather and share stories and teachings. The space includes tiered seating to accommodate larger groups of people. Many aspects of the design provide a teaching opportunity, and the gathering area provides place for people to share these experiences.







Fig. 106. Palimpsest of layers within the mill site

REFLECTIONS AND CONCLUSION

Since the Truth and Reconciliation Commission of Canada's Calls to Action were released in 2015, many of us have engaged in conversations about reconciliation, what it means, and how to achieve it. I constantly reflect on what reconciliation means to me personally, in my education, and in my professional career, and how I can continually work towards making greater strides. In many ways, this project has been a way for me to reconcile with myself. The design and the journey through this practicum have helped me to build partnerships and foster relationships within myself, with other people and living entities, and with the land.

I feel that, in many ways, reconciling requires healing, and that's what this project is about. The approach I took when conducting this work circles back to what I discussed at the beginning: prioritizing the land, understanding how it connects, and recognizing what it needs to heal. Although there are limitations to this work, the main one being a lack of community engagement to inform design decisions, I

believe that in many ways, the work achieves a positive outcome for Sagkeeng First Nation and provides numerous opportunities for healing.

Understanding the complex relationships within this site, its history, and its future to propose a design plan was a challenge, and this may never fully be understood. There are many different connections and relationships to this site, and the proposed design only deepens these connections further. The proposed plan for the future of the Pine Falls Paper Mill site aims to heal the land of its contaminants while also creating a space for people to heal from and with the layers of history embedded within the landscape.

If there is one key takeaway I could share with people from what I have learnt through this journey, it is that our duty, as individuals and Canadian residents, is to hold ourselves accountable and prioritize ways to learn to reconcile with ourselves, with others, and with the land.

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Image of Spill: Adobe Stock. a water pipe spilling brown dirty waste water into the sea. Open Source Image. Accessed 2025. https://stock.adobe.com/search?k=water+flow+pipe&asset_id=926094684

Image of Logs: Adobe Stock. a tree stump and tree logs and branches lying on the forest ground in a deforested woodland and dried up trees in the background in times of climate change ... Open Source Image. Accessed 2025. <https://stock.adobe.com/ca/images/a-tree-stump-and-tree-logs-and-branches-lying-on-the-forest-ground-in-a-deforested-woodland-and-dried-up-trees-in-the-background-in-times-of-climate-change-and-global-warming-stockphoto/389089384>

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META DATA

1:20,000 Digital Topographic Mapping

Originator: Manitoba Land Initiative

Publication Date: 1998

Title: Manitoba Topographic Base Maps, Scale 1 to 20,000

Edition: 1989 to 1998.

Geospatial_Data_Presentation_Form: map

Publisher: Government of Manitoba

Online_Linkage: <https://www.gov.mb.ca/natres>

Abstract: The 1 to 20,000 scale Topographic Base Map series are digital maps that show lakes, rivers, streams, marshes, contours, and elevations of surrounding land. Additional features such as classified roads, railway lines, towns, villages and buildings are also shown. This data was collected photogrammetrically from 1:30,000 and 1:60,000 aerial photography.

Digital Topographic Mapping - Water

Originator: Manitoba Conservation and Water Stewardship

Publication_Date: March, 2009

Title: World - 1:20,000 DIGITAL TOPOGRAPHIC MAPPING – Water - Waterbodies

Edition: N/A

Geospatial_Data_Presentation_Form: Vector digital data

Publisher: Government of Manitoba

Online_Linkage: https://mli2.gov.mb.ca/t20k/index_seamless_water.html

Abstract: Developed by the Government of Manitoba Conservation and Water Stewardship, this data resource contains perennial lakes, intermittent lakes, indefinite lakes, perennial river/streams, quarry/pits with water, islands in lake or river, islands with indefinite shorelines, marshy islands in lake or river, marshes, swamps, non-marshes in marsh areas, dugouts, throughout Manitoba.

Manitoba Land Use - Forests

Originator: Government of Manitoba - Manitoba Land Initiative

Publication: N/A

Title: land_use_agriculture_wp

Edition: N/A

Geospatial_Data_Presentation_Form: Vector digital data

Online_Linkage: <https://mli.gov.mb.ca/landuse/index.html>

Abstract: Agricultural land use extracted from the general land use files that are provided for Birtle, Brandon, Cedar Lake, Dauphin, Gypsumville, Lac du Bonnet, Minnedosa, Ponton, Riverton, Selkirk, Swan River, Virden, Winnipeg, and Woodridge.

CanVec 250 MB Transport

Originator: Government of Canada CanVec Series

Publication Date: May 15, 2013

Title: 250k – NTDB source at the scale of 1:250 000 (generalization for NRN and NRWN)

Edition: N/A

Geospatial_Data_Presentation_Form: Vector digital data

Publisher: Government of Canada

Online_Linkage: <https://open.canada.ca/data/en/dataset/8ba2aa2a-7bb9-4448-b4d7-f164409fe056>

Abstract: CanVec is a digital cartographical reference product produced by Natural Resources Canada. It originates from the best available data sources covering Canadian territory, offers quality topographical information in vector format and complies with international geomatics standards. CanVec is a multi-source product coming mainly from the National Topographic Data Base (NTDB), the Mapping the North process conducted by the Canada Center for Mapping and Earth Observation (CCMEO), the Atlas of Canada data, the GeoBase initiative and the data update using satellite imagery coverage (e.g. Landsat 7, Spot, Radarsat, etc). CanVec contains more than 60 topographical features organized into 8 themes: Transport Features, Administrative Features, Hydro Features, Land Features, Man-Made Features, Elevation Features, Resource Management Features and Toponymic Features.

Manitoba Provincial Boundary

Originator: GeoManitoba, Manitoba Sustainable Development

Publication: December 2016

Title: bdy_province_py_shp

Edition: N/A

Geospatial_Data_Presentation_Form:

Online_Linkage: <https://geoportal.gov.mb.ca/datasets/manitoba::manitoba-provincial-boundary/>

Abstract: Manitoba provincial boundary originally accessed through Manitoba Land Initiative website: <https://mli.gov.mb.ca/adminbnd/index.html>. A feature layer of Manitoba's provincial boundaries: Manitoba/Ontario boundary, Manitoba/Saskatchewan boundary, Manitoba/Nunavut boundary, International boundary. Excluding the International Boundary, the graphical data was computed from original boundary survey measurements published in respective official boundary commission reports using least squares adjustment software "Manor". The adjustments were constrained to known NAD83 [NAD83 adj.] federal/provincial boundary marker positions. For the International Boundary, the graphics were created by converting the official published NAD27 marker positions for the boundary into NAD83 using datum conversion software NTV2 and interconnecting the plotted marker positions with straight lines using CARIS map software.

META DATA

MG_MUNICIPALITY_POLY

Originator: Data MB

Date: 2007

Title: Municipality

Geospatial_Data_Presentation_Form: Vector digital data

Publisher: Government of Manitoba

Online_Linkage: https://geoportal.gov.mb.ca/datasets/8b64285c3bf6445a8d0d8ea4a1c43849_0/about

Abstract: Municipality, Municipalities, Municipal Boundaries, Manitoba, Government, Province of Manitoba, Manitoba Government, Canada, Public

Abstract: This dataset is comprised of boundary geometry for all of the incorporated municipalities and Northern Affairs Communities within the Province of Manitoba. The boundaries in this dataset represent the descriptions set forth in the Municipal Status and Boundaries Regulation (567/88R) and subsequent amendments, and regulations under The Northern Affairs Act. The geospatial referencing of the Municipal Boundaries is based on the best available land parcel data for each municipality and Northern Affairs Community. Where available, cadastral data based on registered survey plans was used. Otherwise, the Manitoba Property Assessment Information dataset produced by Manitoba Municipal Relations was used. The delineation of the boundaries was established according to the regulation establishing or amending the boundary of a municipality or Northern Affairs Community. Dataset content is subject to: Ongoing changes in municipal status and boundary and Northern Affairs Community boundary alterations that are generated through annexations, amalgamations, dissolutions or formations, all of which are approved by regulations made under The Municipal Act (for incorporated municipalities) and The Northern Affairs Act (for Northern Affairs Communities). This dataset content is current to the most recent effective date of any such regulation amendment. Ongoing development and maintenance of the land parcel datasets. Improvements to the cadastral data are used to improve the positional accuracy of the municipal boundary polygons. As of the publication date of this dataset the following known issues remain: For municipal boundaries and Northern Affairs Communities that include water boundaries, such as in the Lake Winnipeg and Lake Manitoba areas the water boundary portion that best reflects the municipal boundary was used. In some instances, road allowances on a municipal boundary are included in both of the adjoining municipalities.

QGIS Server World Imagery

Originator: Esri Media

Publication: October 2022

Title: World Imagery with Metadata

Edition: N/A

Geospatial_Data_Presentation_Form: Feature Layer

Online_Linkage: <https://www.arcgis.com/home/item.html?id=c03a526d94704bfb839445e80de95495>

Abstract: World Imagery provides one meter or better satellite and aerial imagery in many parts of the world and lower resolution satellite imagery worldwide. The map includes 15m TerraColor imagery at small and mid-scales (~1:591M down to ~1:288k) for the world. The map features Maxar imagery at 0.3m resolution for select metropolitan areas around the world, 0.5m resolution across the United States and parts of Western Europe, and 1m resolution imagery across the rest of the world. In addition to commercial sources, the World Imagery map features high-resolution aerial photography contributed by the GIS User Community. This imagery ranges from 0.3m to 0.03m resolution (down to ~1:280 in select communities). For more information on this map, including the terms of use, visit us online at http://goto.arcgisonline.com/maps/World_Imagery

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