New Energy Landscapes of a Post-Oil Alberta

by

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Contents

Abstract

Energy governs the way society has been structured. Oil is currently the dominant framework that connects society's political and socio-economic narratives. This framework, the 'Petroleum Grid', organizes society around efficiency and promotion of fossil fuels; continuing society's dependency on an unsustainable and environmentally damaging energy. This thesis, situated at the beginning of the post-petroleum state, explores how remnants of the oil industry can regenerate new energy landscapes, in Edmonton, to reconnect ecology, energy, and community. The *Rhizome Logic* is used as an ecological and socio-spatial generator to reorganize and translate existing infrastructural components (fields, lines, and points) and landform systems into a new energy landscape. It develops new connections within the existing oil landscape through phasing, remediation, and closed feedback loops. By harnessing site generated biofuel and new programs, the architecture of the Rhizome facilitates the social and geospatial reconfigurations to rewrite the site and city's relationship with energy.

Acknowledgements

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Chapter 1: Introduction

Economy of Energy

Human civilizations have always revolved around the economy of energy. Moving away from energy intensive hunting and gathering towards energy stockpiling through agriculture towards energy allocation and distribution in the development of urban centres. Each of these social restructurings is paired with a new medium of energy consumption and exploitation: from wood to coal to oil. When society relied on wood, forests were clear cut to fill this need. When society needed coal, it was extracted out of the ground and exhausted into the air. Now society is oil based. This is fueled largely because of society's ever growing need for energy. The amount of energy that society consumes has been increasing to meet the demands of development; most other fuel sources are not capable of keeping up with the anthropogenic metabolism of the twenty-first century (Brunner and Rechberger 2002). The material and energetic needs of society are increasing to accommodate a growing global population, middle class, and overall increasing quality of life and health. Thus, access to energy is a fundamental pillar of modern society. Oil, the current dominant energy source, has therefore become one of the most valuable resources because of society's intrinsic reliance on energy.

The Age of Oil

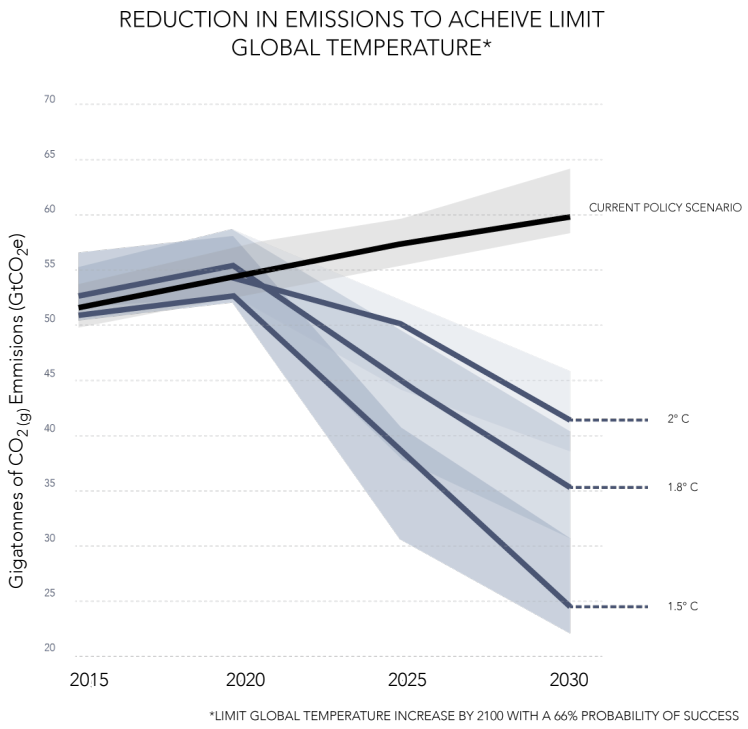
In a similar way to how the rise of human influence on the Earth defines a geological epoch, the rise in oil and gas has defined human history (Maugeri 2010). Society currently exists in the Age of Oil – an energy paradigm that outlines and exists within its own feedback loop of efficiency and capitalism (Iturbe 2019). Oil and gas are universally valued resources because of their enormous energy potential. One of the most important factors in qualifying energy resources is the measure of its energetic potential– the amount of energy stored within it. Fossil fuel products carry high energy potential and because of this it has positioned itself as one of the most valuable energy resources. It provided the energetic and economic means to build nations into superpowers and is revered for this ability. Unlike any other energy type, oil has distinguished itself with its energy potential, its ease and inexpensive cost in extraction and distribution, its transportability and full retention of its potential in travel, its tangibility, and it's already existing, well maintained infrastructure system. In the current context there is truly no resource as pragmatic as oil (Goodstein 2005). Leonardo Maugeri, an Italian oil and gas executive, echoes the same notions of petroleum dominion of global energy industries many theorists, across different political spectrums, voice: "Petroleum possesses these features to an unequal degree, for which reason it has become the 'King' of Energy." (Maugeri 2010).

	BIOFUEL	GEOTHERMAL	HYDROELECTRIC	NUCLEAR	OIL/GAS	SOLAR VOLTAIC	TIDAL	WIND
HIGH ENERGY POTENTIAL		●		●	●	●		
RENEWABLE	●	●	●			●	●	●
CARBON NEUTRAL	●			●		●	●	●
TRANSPORTABLE	●	●			●			
LOW PRICE OF ENERGY	●				●	●		
HIGH COST OF PRODUCTION			●	●			●	●
TANGIBLE COMMODITY	●	●			●			
ACCESSIBLE	●		●		●			

Characteristics of common energy (data from Maugeri 2010)

The End of Oil

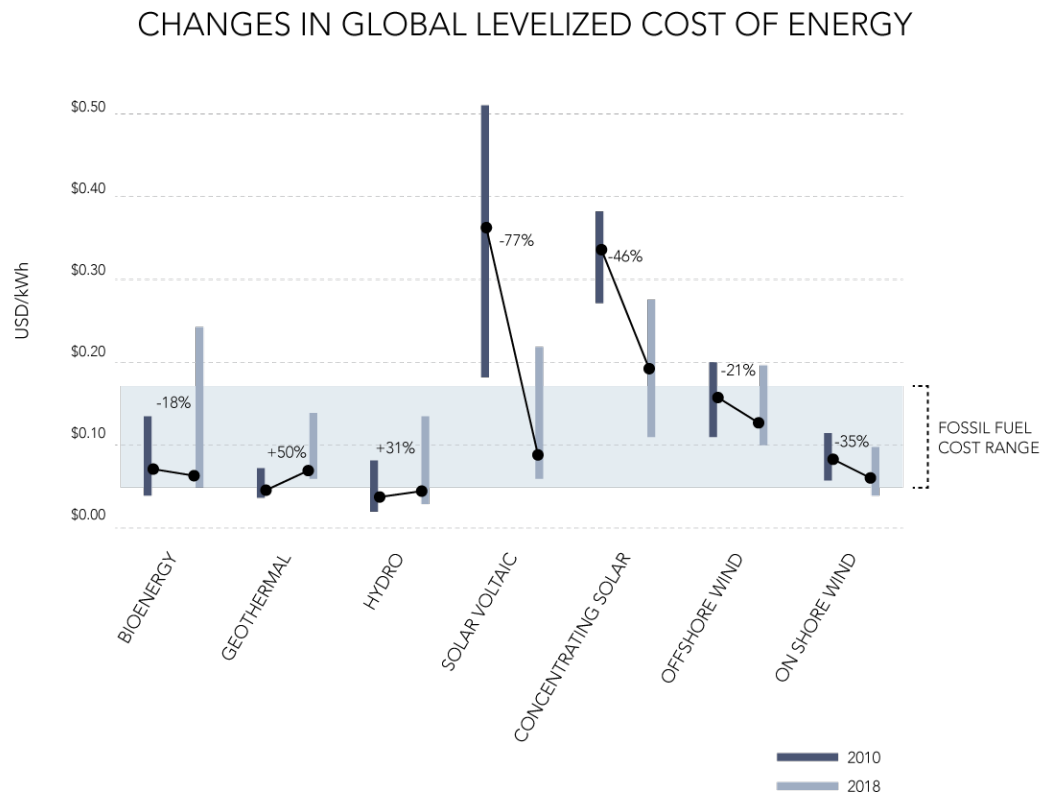
These qualities have secured oil's leading role in the global energy sector. These qualities have, also, subjected society to a continued dependency on this unsustainable resource. Furthermore, this dependency contributes greatly to the current global environmental crisis'. Given the trajectory of climate change, society is now being confronted with the consequences of its exploitation in this energy sector. According to the United Nations the response to our collective environmental negligence, aided by the rise of the oil industry, needs to be swift. The United Nations Emission Gap Report 2019 indicates the need for a 56% decrease of global carbon emissions in the next 10 years to stay within a 1.5°C increase in global temperature. Staying within 1.5°C increase in temperature affords the Earth a 66% chance that it will not reach a wet bulb climate, rendering



Global carbon emissions reduction goals and trajectories (data from UNEP 2019)

habitable parts of the Earth uninhabitable. This fact sits contrary to projected carbon emissions (based on current global policies) which indicate rising emission (UNEP 2019). The urgency to act to reduce oil-dependency lies in the fact that fossil fuel carbon emissions from energy use and industry dominate total greenhouse gas (GHG) emissions. Fossil fuels carbon emission constitute approximately 68% of total GHG emissions. In addition to environmental concerns, the ‘King of Energy’ has been also impacted by the multinational struggle for control of petroleum supplies. Given its universal value, petroleum products, specifically oil, have been at the center of international conflicts. The turbulent political and economic climate surrounding oil create instability in the industry and subsequent fall out in the broader oil-dependent communities. Recent global

petroleum price wars have exemplified the instability of an oil-dependent society. In March of 2020 the disagreements between Saudi Arabia and Russia over production levels directly lead to plummeting oil prices and a subsequent, currently ongoing, global stock-market crash (Ambrose 2020; Bostock and Perper 2020.) This is one of many cases of intentional market oversaturation and subsequent global recession; this demonstrates that a continued dependence on oil is unstabilizing and unsustainable economically. Though oil has afforded numerous benefits to a society it has also brought about a continued dependency on an unstable and damaging energy source.



Changes in cost of energy (data from UNEP 2019)

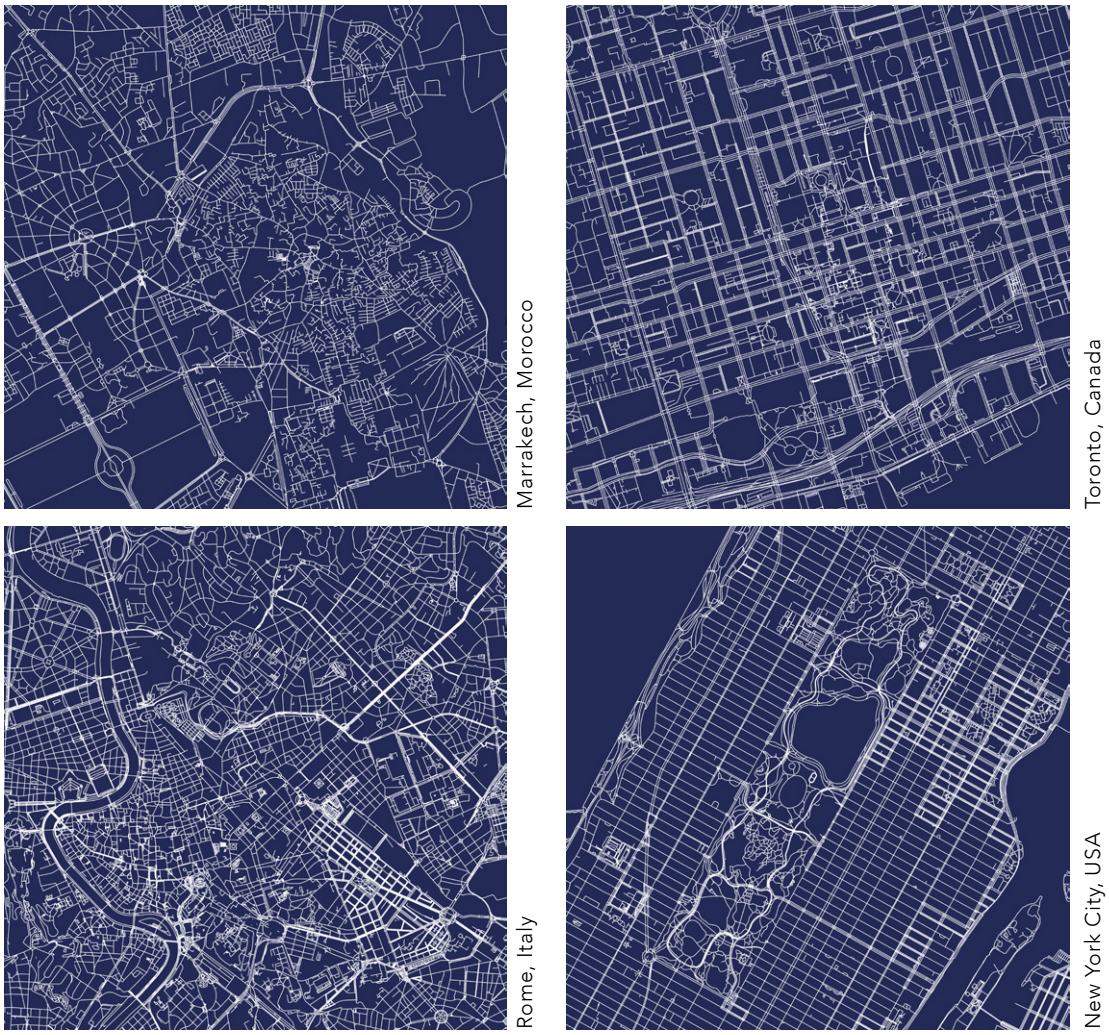
Chapter 2: Energy Based Social Structures

Current Energy Paradigm

Leonardo Maugeri, an oil and gas executive and energy expert, and Elisa Iturbe, an architectural designer and writer, both suggest that society exists within the confines of the social system devised to be reliant on and, therefore, supportive of the current energy model. Rather than people being the active sculptors of the physical and social environments, society has become paralyzed within the rigidity of an unsustainable energy system. Iturbe suggests that in adopting fossil fuels it has reorganized society around the abundance of energy petroleum can afford. With its many lucrative qualities, petroleum has constructed the contemporary city under an implied social and fiscal contract/guise of continued cheap and abundant oil. This contract sets up a framework that defines the social and spatial organizations of which it builds. Given the intersectionality of modern societies, this energy based framework seeps through the cultural, economic, political, and environmental layers of society. The “current energy paradigm is the driver of urban and architectural form” (Iturbe 2019, 12) thus organizing the city into a machine for petroleum consumption.

When comparing cities developed prior to the exploitation of oil there are evident differences in priorities with respect to urban planning. The orthogonal grid of contemporary petroleum cities, such as Toronto or New York City, sit in

opposition to the more natural flows of cities developed prior to industrialization and subsequent exploitation of petroleum, such as Marrakech and Rome. The urban strategy and organization of these cities express two distinct priorities: one of efficiency of production and the other civilian comfort. While the utilitarian grid organizes society around productivity and repetition, the natural organizations of pre-oil cities are more conducive to social exchange and connections. The rigidity that structures many contemporary cities opposes the biomorphic patterns of circulating ‘natural’ to social beings. The contemporary



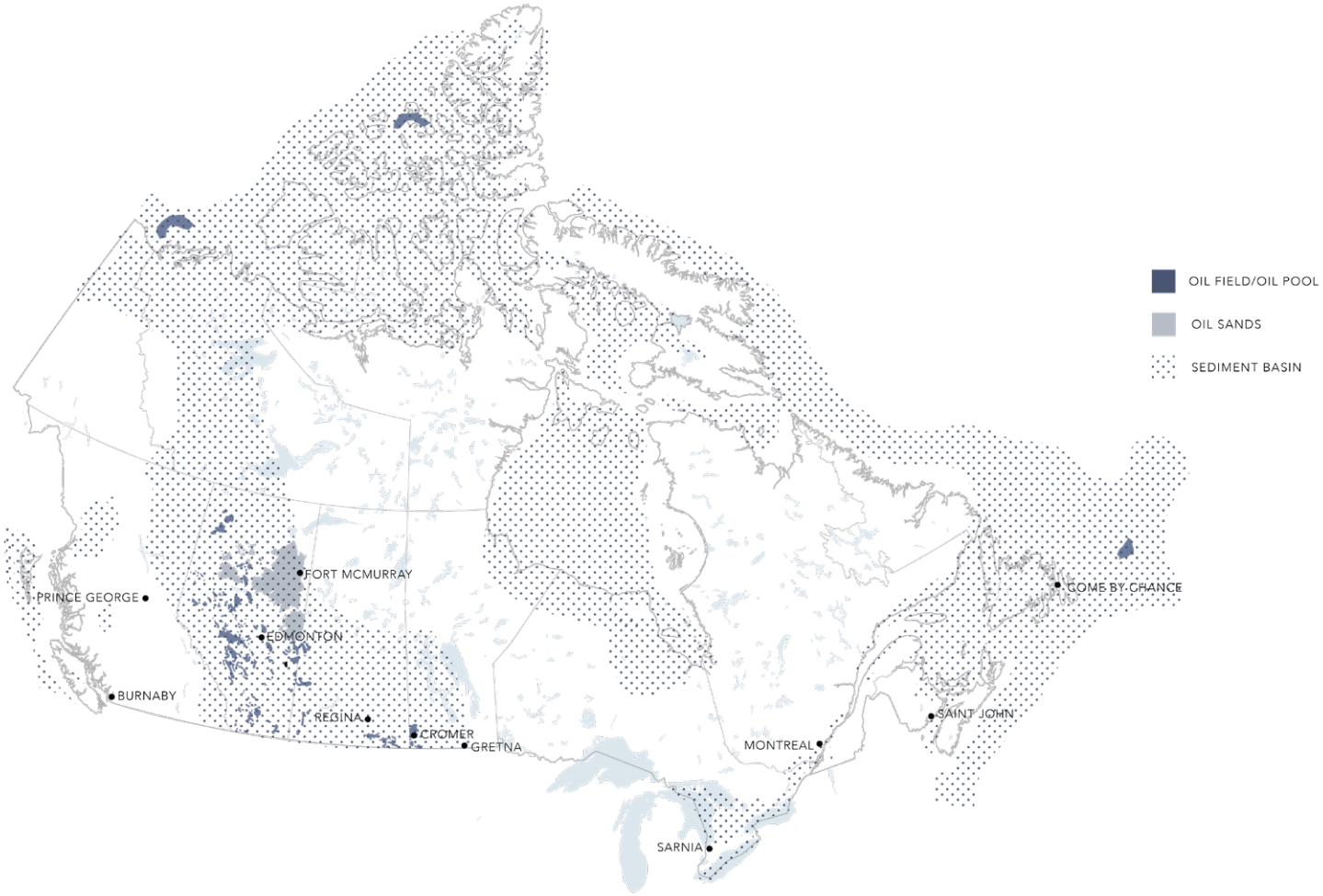
Energy grid comparison of the ‘Pre-Oil’ cities with ‘Post-Oil’ cities.

energy grid is, rather, structured for supporting the continued consumption of petroleum products. This thesis will use the term ‘Petroleum Grid’ or ‘Petrol-Grid’ in reference to these notions of physical and social frameworks which stem from societies’ reliance on petroleum based energy. Though the current energy paradigm is at odds with society’s continued survival, oil supports our social and fiscal needs. The Petrol-Grid restricts society the ability to contribute to a healthy future. Climate and environmental science suggest that in order to maintain survivability on Earth society needs to act immediately to rectify the environmental negligence of many decades’ past (UNEP 2019; Choi et al. 2008; Johnson and Miyanishi 2008; Canada Energy Regulator 2019a).

Canada and the Petroleum Machine

Canada, like every ‘developed’ nation, is predominantly petroleum based. Not only is fossil fuel based energy the primary energy source in Canada, Canada is involved with the extraction and distribution of oil and gas. Its role in the global energy market is not just one of the consumer but also as a producer. Canada hosts the third largest oil reserves with an estimated 170 billion barrels of oil in the oil sands. Though the resource is found in the northern territories and prairie provinces (CAPP 2019) oil is a country wide phenomenon. The oil that exists in these areas takes its form as bitumen: a heavy, low-grade, fraction of hydrocarbon often mixed in with sand. Due to the quality, relative difficulty in extraction, as compared to other oil producers, and consequential environment contamination it carries a high cost of production– $30 to $35/barrel as opposed to $5 to $7 in Venezuela and $2 to $5 in the Middle

OIL RESOURCE FIELDS

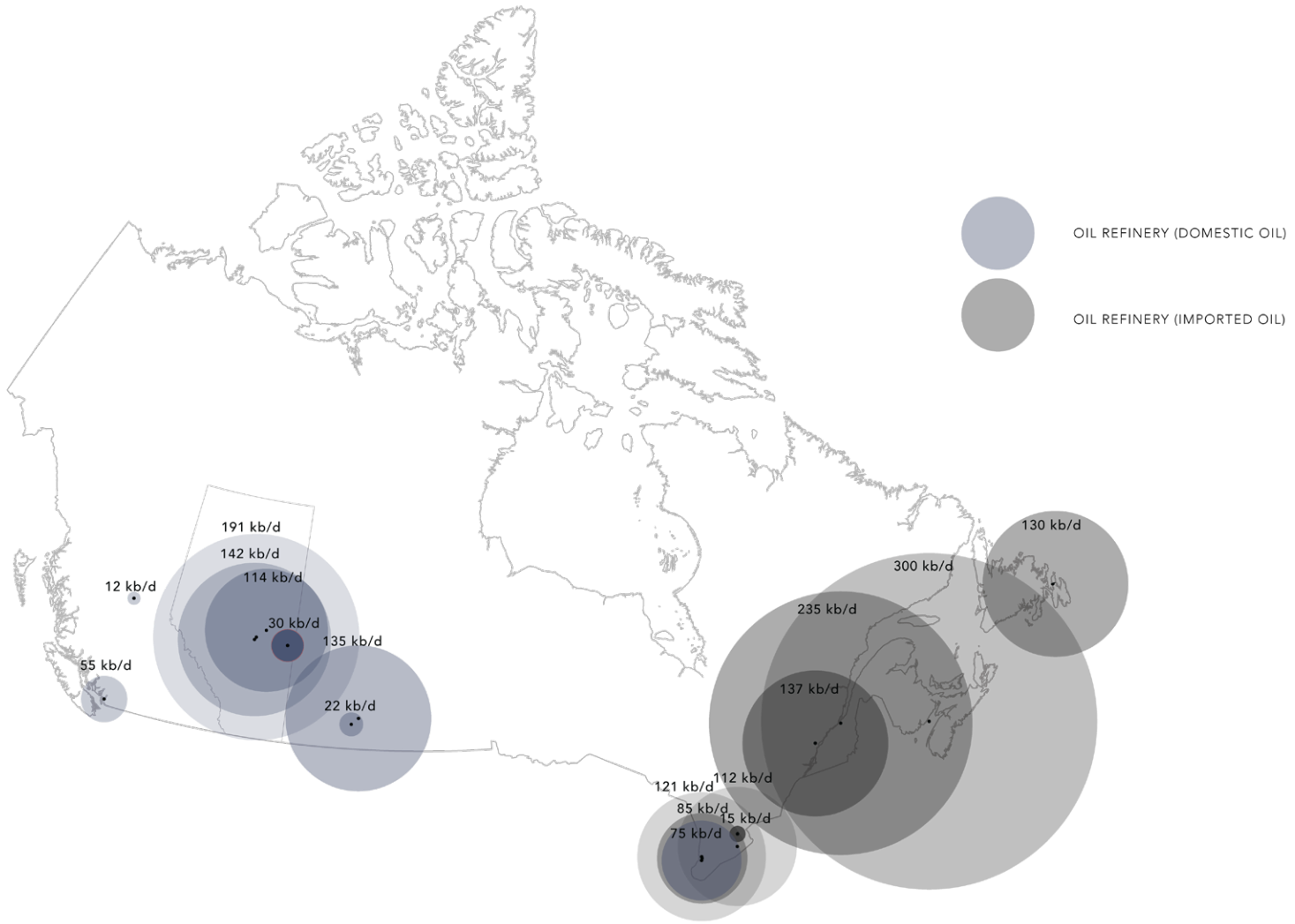


Oil resources in Canada (data from CAPP 2019; Canada Energy Regulator 2019b)

OIL INFRASTRUCTURE LINES

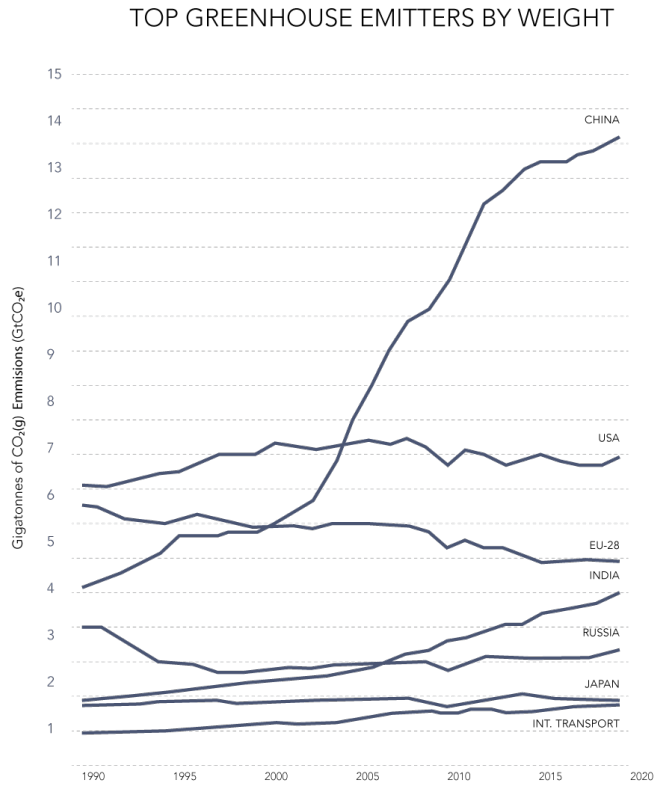
Selection of major and minor pipeliens in Canada (data from CAPP 2019; Canada Energy Regulator 2019b)

OIL REFINERIES

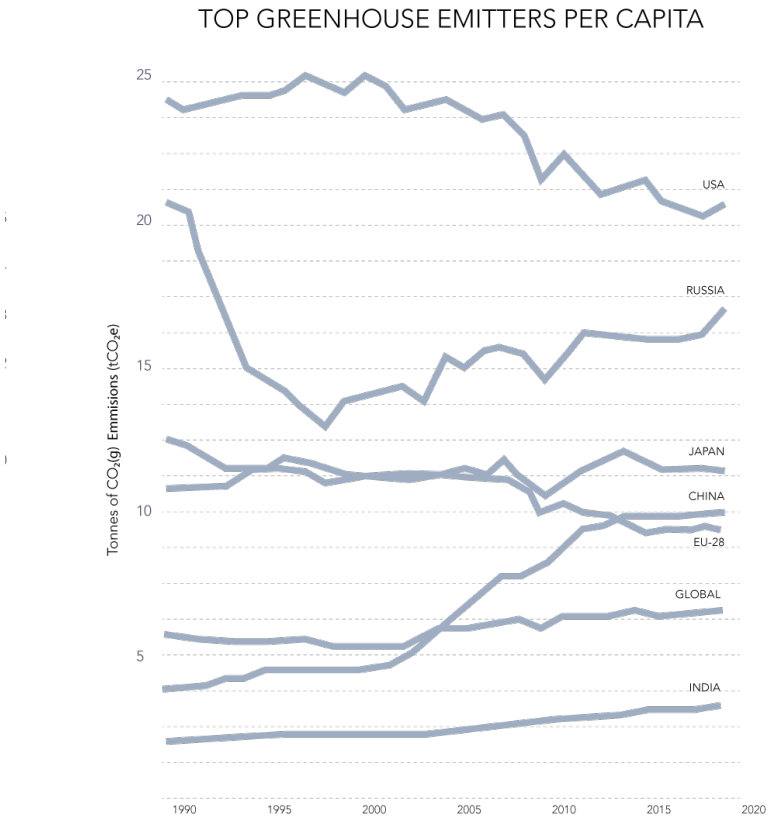


17 Canadian oil refineries (data from CAPP 2019; Canada Energy Regulator 2019b)

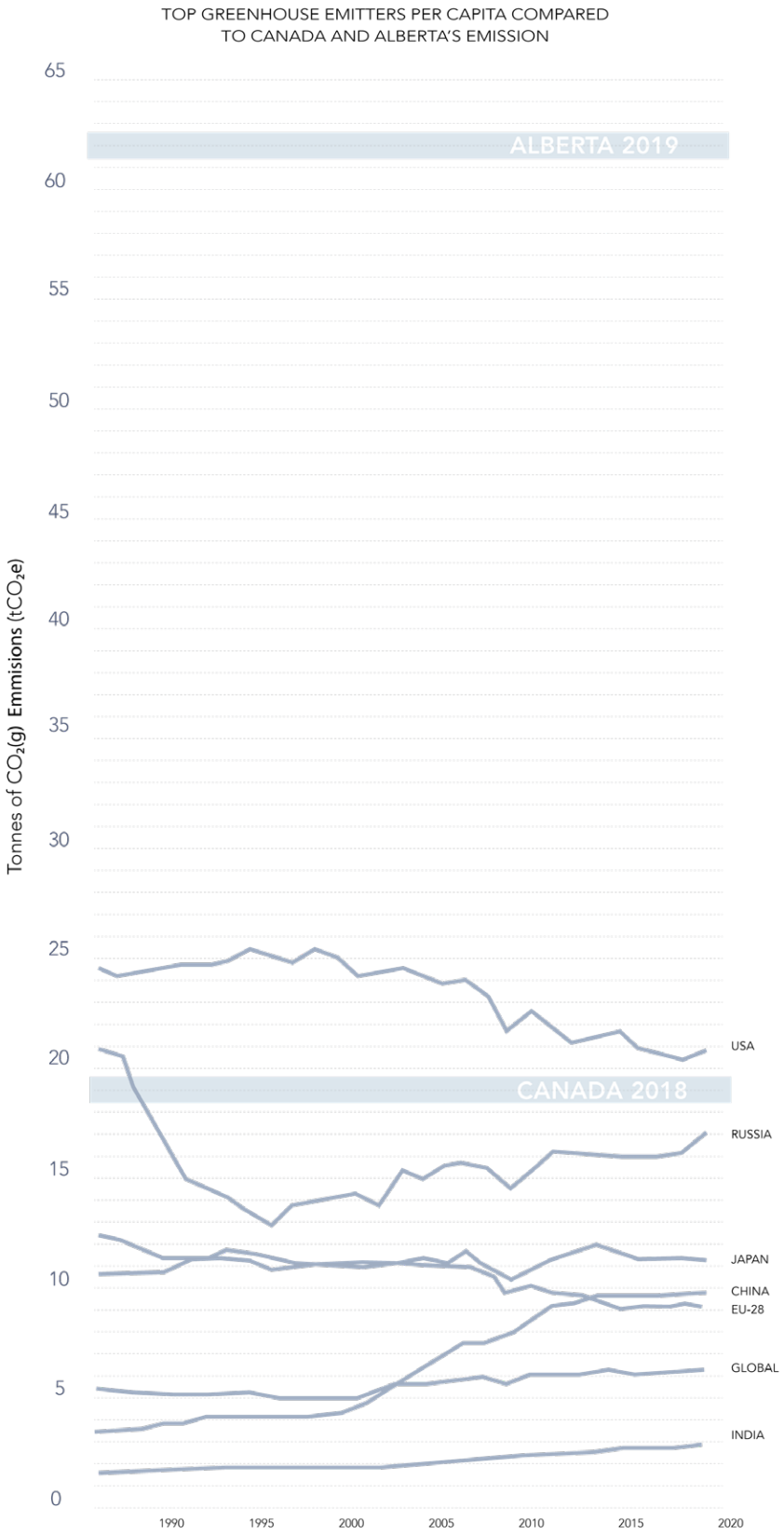
East (Maugeri 2010, 25). Though comparatively more expensive to produce, the demand, for oil globally, has been high enough to facilitate a successful oil industry in Canada. The oil-rich regions of the northern territories and the prairie provinces have helped support the development of Western Canada but are also at the heart of the current carbon emission problems in Canada. Most G20 members, including Canada, took part in the 2020 Cancun Pledges: the largest collective effort in history to reduce carbon emissions. Based on the current projections, the G20 members who have signed onto the pledge are collectively projected to reach their goal, however, this is not the case on a country to country analysis. Canada is projected to miss its goal of a 17% carbon emission reduction (UNEP 2019). Furthermore, according to the World Economic Forum, in 2016, Canada has one of the highest carbon emissions per capita rates: 19.4 tonnes (Bewicke 2019). Canada's emissions per capita is four times higher than the global average and nearly three times higher than the average of other G20 members (UNEP 2019; Canada Energy Regulator 2019a). Alberta's carbon emission per capita is even higher: 62.4 tonnes (Canada Energy Regulator 2019b). The disparity between the global to Canadian to Albertan emissions per capita rates describe national and provincial profligate energy use. The disparity, however, is more accurately an indicator of the magnitude of the oil industry across these three regions. These numbers also hone into where intervention and change can be most effective in addressing greenhouse gas emission rates.



Top greenhouse gas emitters by weight (data from UNEP 2019)



Top greenhouse gas emitters per capita (data from UNEP 2019)



Top greenhouse gas emitters per capita compared to Canada and Alberta emissions (data from UNEP 2019; Government of Alberta 2019b)

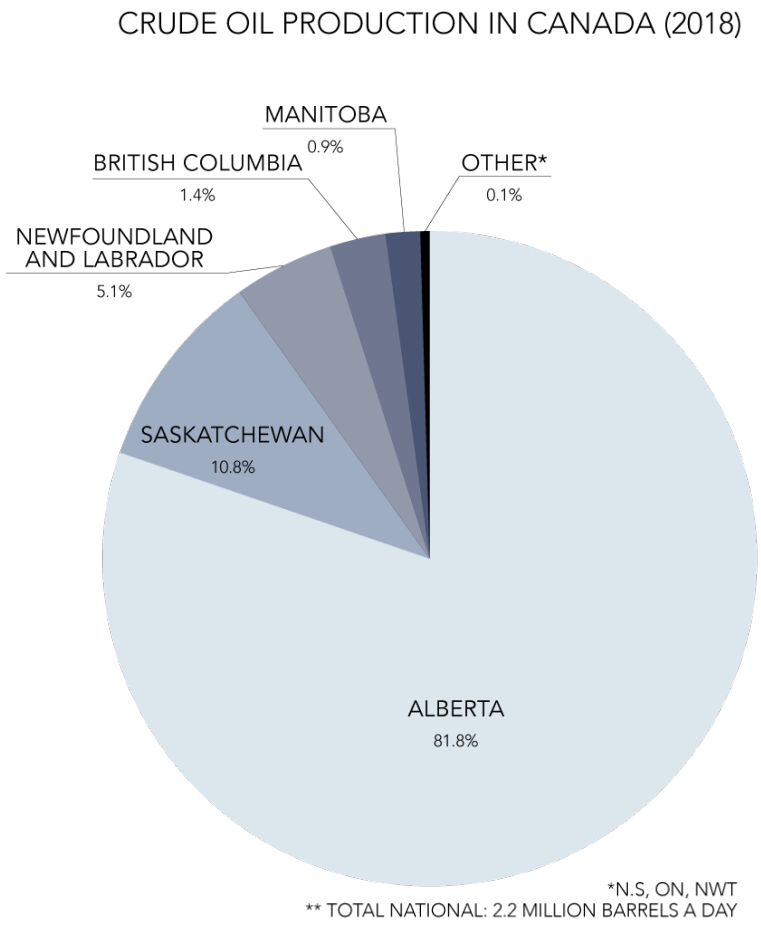
This thesis assumes the call to action is heeded and investigates a future where society eliminates its oil-dependency. The remnants and environmental conditions left in place of this destructive industry plants the seeds of change for a new energy landscape to take root in. The impetus of energy production shifts from economic development to remediation and sustainability.

Alberta and the Reinforced Petro-Grid

‘Alberta’ has become synonymous with the oil industry in Canada. The first commercial production of oil in 1967, by the Great Canadian Oil Sands Company (now merged into Suncor Energy), was the inception of Alberta’s commercial oil industry (Johnson and Miyanishi 2008). Most mineral resource rights are owned by the province, who create lease agreements for mineral extraction and distribution to private companies (Johnson and Miyanishi 2008, 122). Private companies, in turn, have built the province into an extraction and distribution machine. This machine’s networks connect Alberta’s oil sands to Edmonton to the United States and global market. It is this machine which has redefined Canada’s role in the international oil industry and outwardly visualizes the Petrol-Grid.

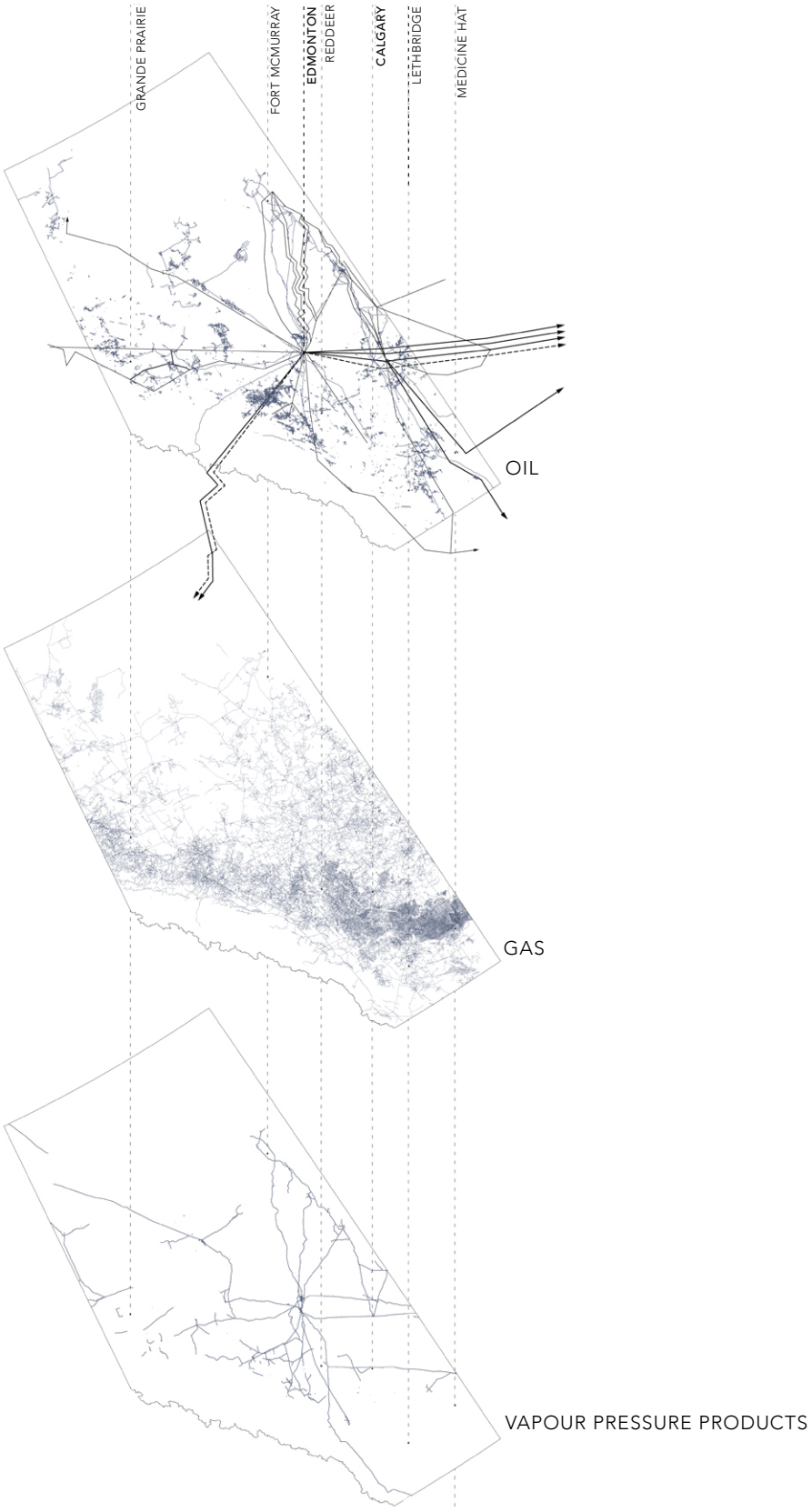
Albertan society has been weaned on this machine and all of its industrial offshoots for more than 50 years. The machine has greatly benefited both provincial and national economies and has, subsequently, become a driver of collective identity in Alberta. This industrial titan hosts the world’s third largest oil reserve, contributing to roughtly 82% of the total crude oil production in Canada (NRCan 2018), and covers approximately 144,000 km^2 of land, or 23% of

the province. Its network of pipelines measure 422,000km (Government of Alberta 2018) which constitutes 50% of all the pipelines in the country (NRCan 2019). Alberta also hosts four of the nineteen oil refineries in Canada– including the largest and second largest domestic oil refining facilities. The physical magnitude of the oil industry is illustrative of the magnitude of influence in economy, politics, identity, culture, and environment. The oil industry has defined both the physical and socio-economic landscapes of the province. In order to shift the energy landscape towards a more sustainable future, one needs to address the social implications surrounding a highly divisive and controversial industry.



Crude oil production in Canada (data from UNEP 2019)

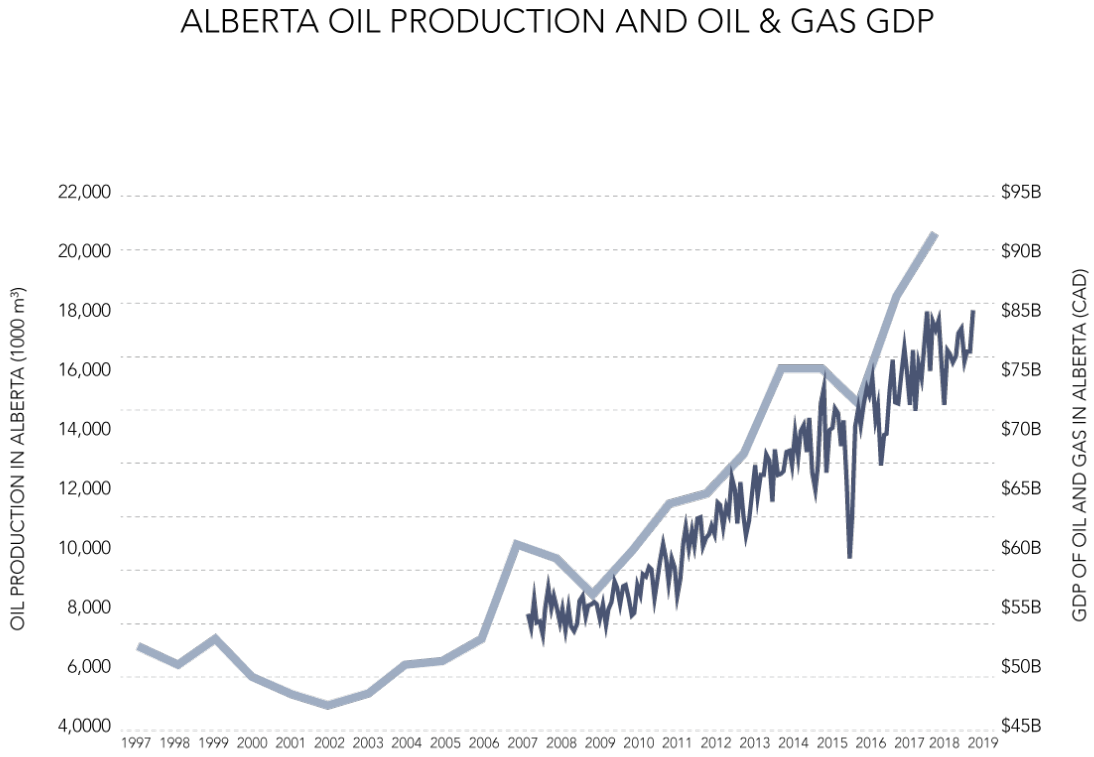
Oil resources and infrastructures of Alberta (data from Government of Alberta 2019b)



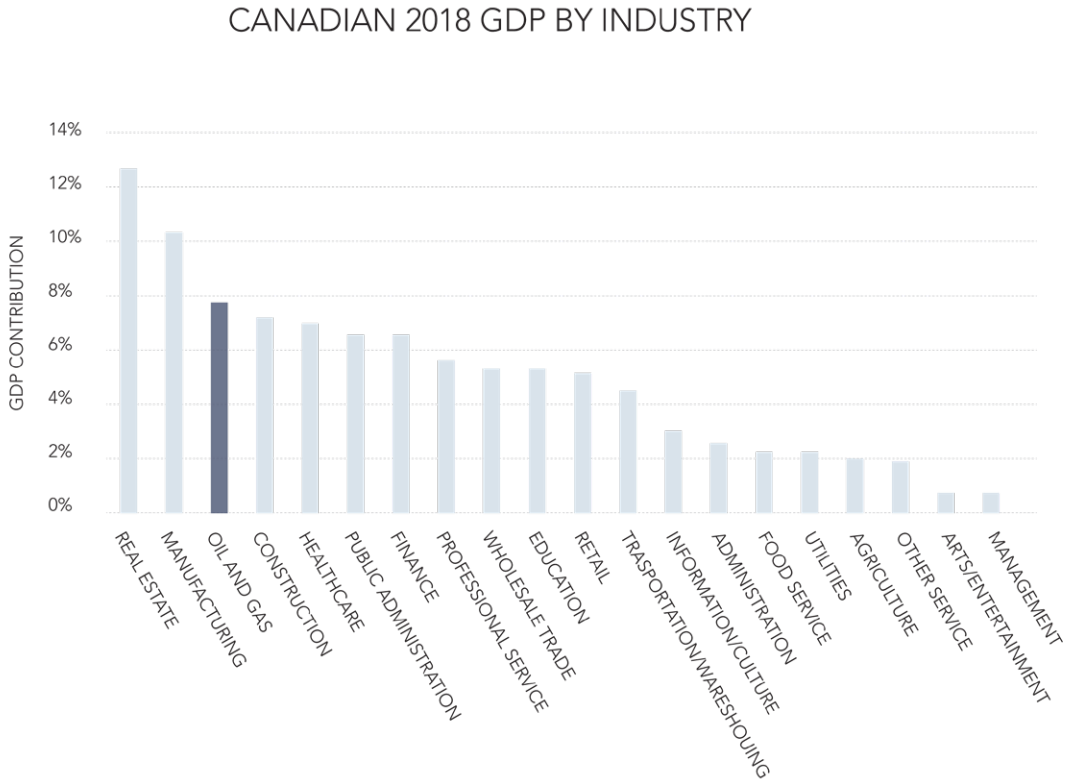
Oil infrastructure systems (data from Government of Alberta 2019b)

As evidenced, in the parcellation of the Oil Sands, there is strong adherence to the notion of the Petrol-Grid. It is not only defined in how Alberta addresses oil, but also how it distributes the resource. The way that society builds in relation to the petroleum resources exemplify the extent to which society prioritizes and relies on this form of energy. The density and position of infrastructure in Alberta underlines the geospatial dominion of the Petrol-Grid. It supports and is supported by the political socio-cultural layers of society which then feed back into the cycle of oil dependency.

Identity and pride have long been associated and directly tied to the growth and success of the oil industry in Alberta. The success of the oil industry has, historically, generated great wealth for Alberta and Canada contributing more than $230 billion to Canada's nominal gross domestic product (GDP) in 2018, accounting for more than 11% of Canada's national GDP (NRCan 2019; Fletcher 2018). The pride in Alberta's premier industry lies in the continued exponential growth of the economy – an unsustainable level of achievement. This definition of success in the oil industry feeds into an ideology of 'petro-patriotism': an ideology that centers one's identity with the success of the oil industry. This ideology stems from the inclination to protect and expand this volatile industry. However, as significant as oil and gas has been in developing the economy and identity of Alberta, it is a precarious sector because of the capricious nature of the global industry. The speed and magnitude of change which Alberta's economy is susceptible to bolsters this group's inclination to protect a homogenous economy.



The influence of oil on the Albertan economy (data from Government of Alberta 2019a)



The influence of oil on the Canadian economy (data from Statistics Canada 2019)

When addressing the future of an oil-dependent society, it is with the understanding and acceptance of where the province's roots lie. There is great power in collective memory and the remnants of a dominant part in Alberta's history are recommissioned to build a new collective future. Aldo Rossi theorizes that the city is a composition of urban artifacts: a monument which can act as a vessel of collective memory that quantifies experiences and shapes identity. The oil industry embodies this notion that "history exists so long as an object is in use; that is, so long as a form relates to its original function. However, when form and function are severed, and only form remains vital, history shifts into the realm of memory" (Rossi 2007, 7). The infrastructure left behind in the move towards new energy will serve as landmarks of collective memory and become catalysts for new growth.

The oil infrastructure, that is so prevalent in Alberta's landscape and so strongly tied with collective identity, becomes the driving force behind long term changes. This thesis is situated in a place where oil has been the longstanding economic and, subsequently, socio-cultural driver. The fossil fuels industry has embedded itself into the definition of what constitutes an Albertan; it is the unifying factor for which people have dedicated more than one hockey team to, protested, convoyed, and picketed to protect, and appropriated as an insignia of a prosperous Alberta. By pairing oil infrastructure with new transformative programming industrial relics become the driving force behind recovering a polluted landscape and new energy. This forms new connections between a nostalgic industrial past with new sustainable futures.

EDMONTON'S NHL TEAM

LAST DAYS OF THE FEDERAL ELECTION

24 HOURS AFTER COMPLETION OF GRETA THUNBERG MURAL

EDMONTON OIL KING'S - MAJOR JUNIOR HOCKEY TEAM

GLOBAL PETROLEUM SHOW

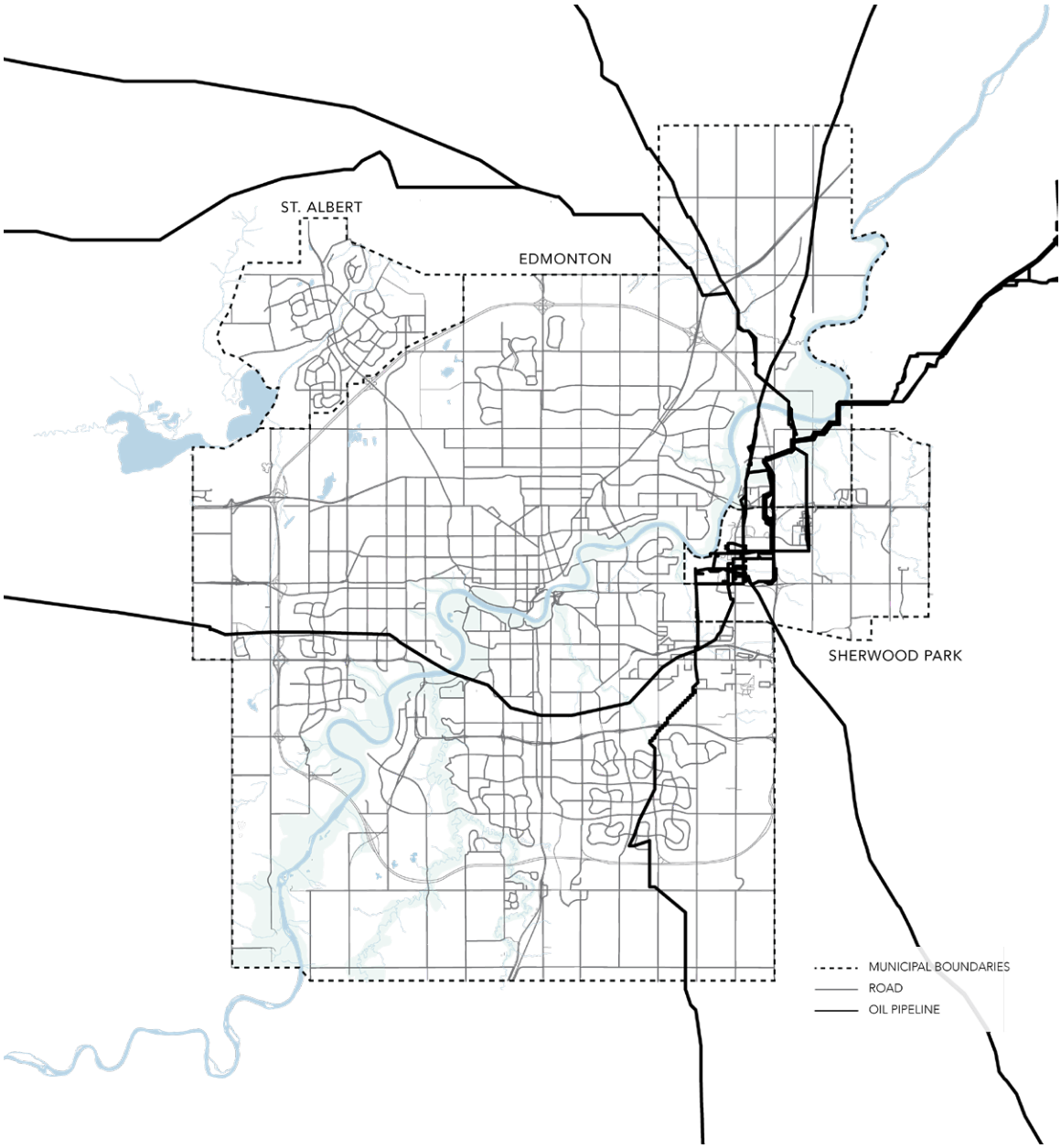
UNITED WE ROLL CONVOY

Examples of Alberta 'petropatriotism'. (Base images from left to right and top to bottom: photographer unknown (The Canadian Press, 2017); photograph by Brendan Miller/Postmedia (Liang, 2019); photograph from Andreane Williams/CBC (CBC, 2019); photographer unknown (Graham, 2017); photograph by Guillaume Nolet (Markusoff, 2019); photograph by Chris Eakin, (Shokeir, 2019))

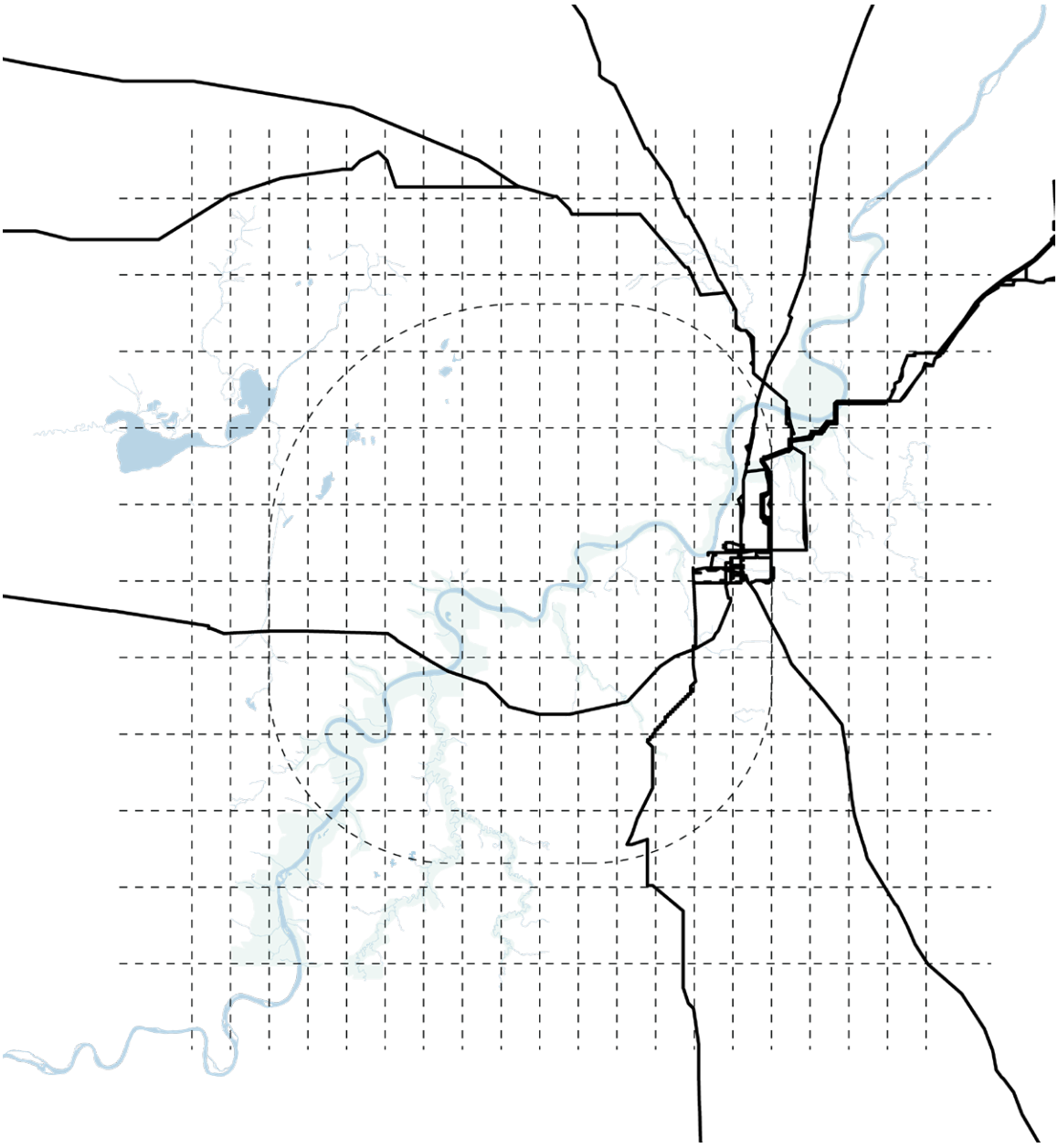
By incorporating new use with existing infrastructure, this thesis attempts to rewrite the public user's role as active participants in establishing new relationships with energy. By bringing forth systematic restructuring through re-envisioning oil infrastructure progressive changes works in tandem with memory and heritage. This allows "oil country" to pay homage to its industrial roots while providing pathways towards environmental reconciliation and new energy.

Gateway to the North

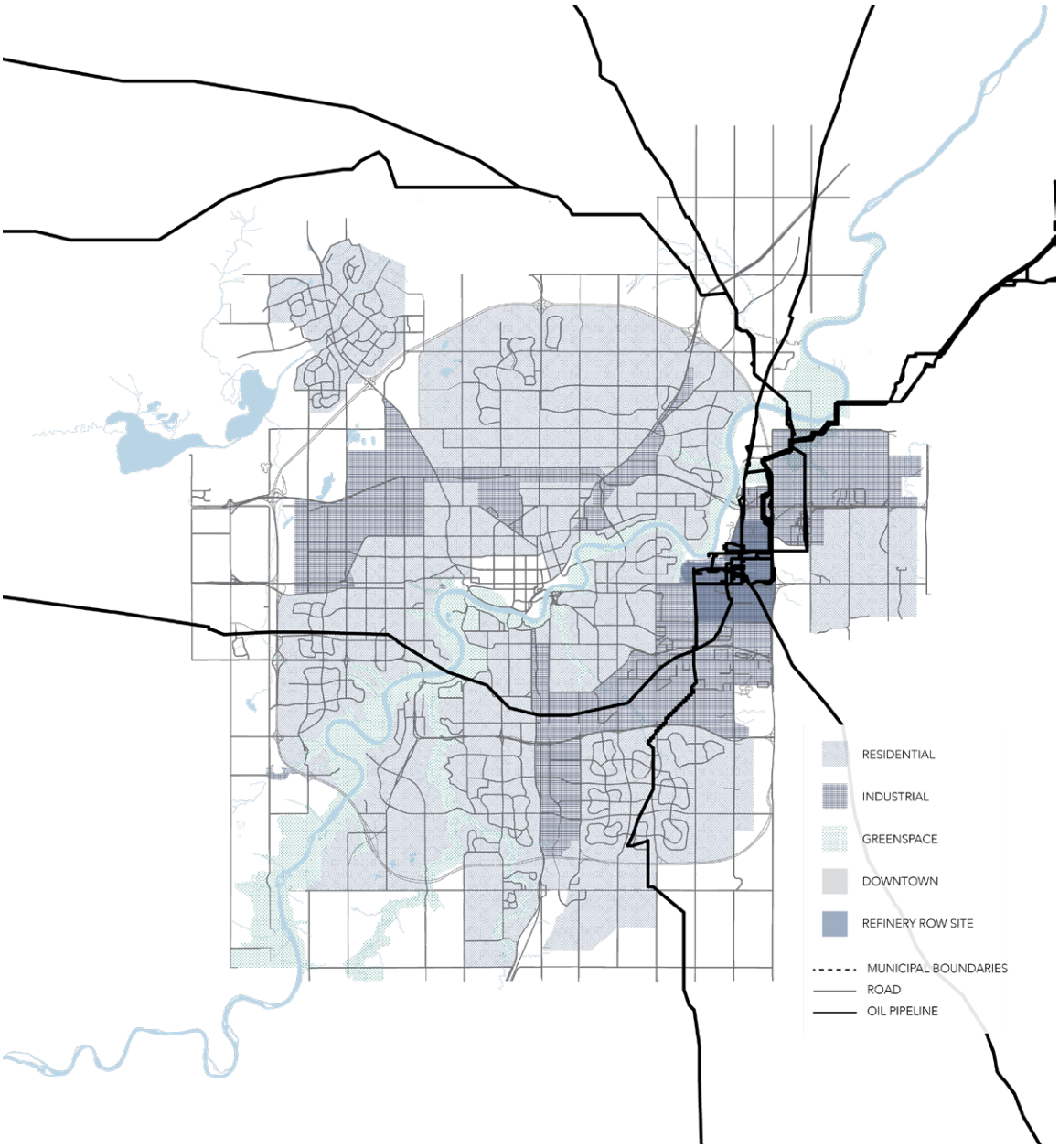
Tracing the movement of oil through Alberta's distribution networks indicates that almost all lines will feed into or out of Edmonton, the "Gateway to the North". Edmonton, as with the rest of the province, is organized within the "Petrol-Grid" but notable for this city is that within these grid lines is an intersection point. This intersection point or junction is where the resources of the Northern bitumen mines meet southern transportation lines meet domestic refining operations. Edmonton is situated at the intersection of these three main sectors of the oil industry: mining, refining, and transportation; therefore, more than any other city in Canada, Edmonton has the oil industry woven into its genetic makeup. When "you're in oil country", an unofficial slogan of the Edmonton Oilers, the influence of petroleum is visible through all geospatial and social dimensions of the city. Due to its strong co-dependencies, Edmonton and the energy sector are deeply rooted within each other.



Edmonton, the “Gateway to the North”, and the major crude lines that run into the city (data from City of Edmonton 2019; Government of Alberta 2019b)



Edmonton's 'Petrol-Grid' and major crude lines (data from City of Edmonton 2019; Government of Alberta 2019b)

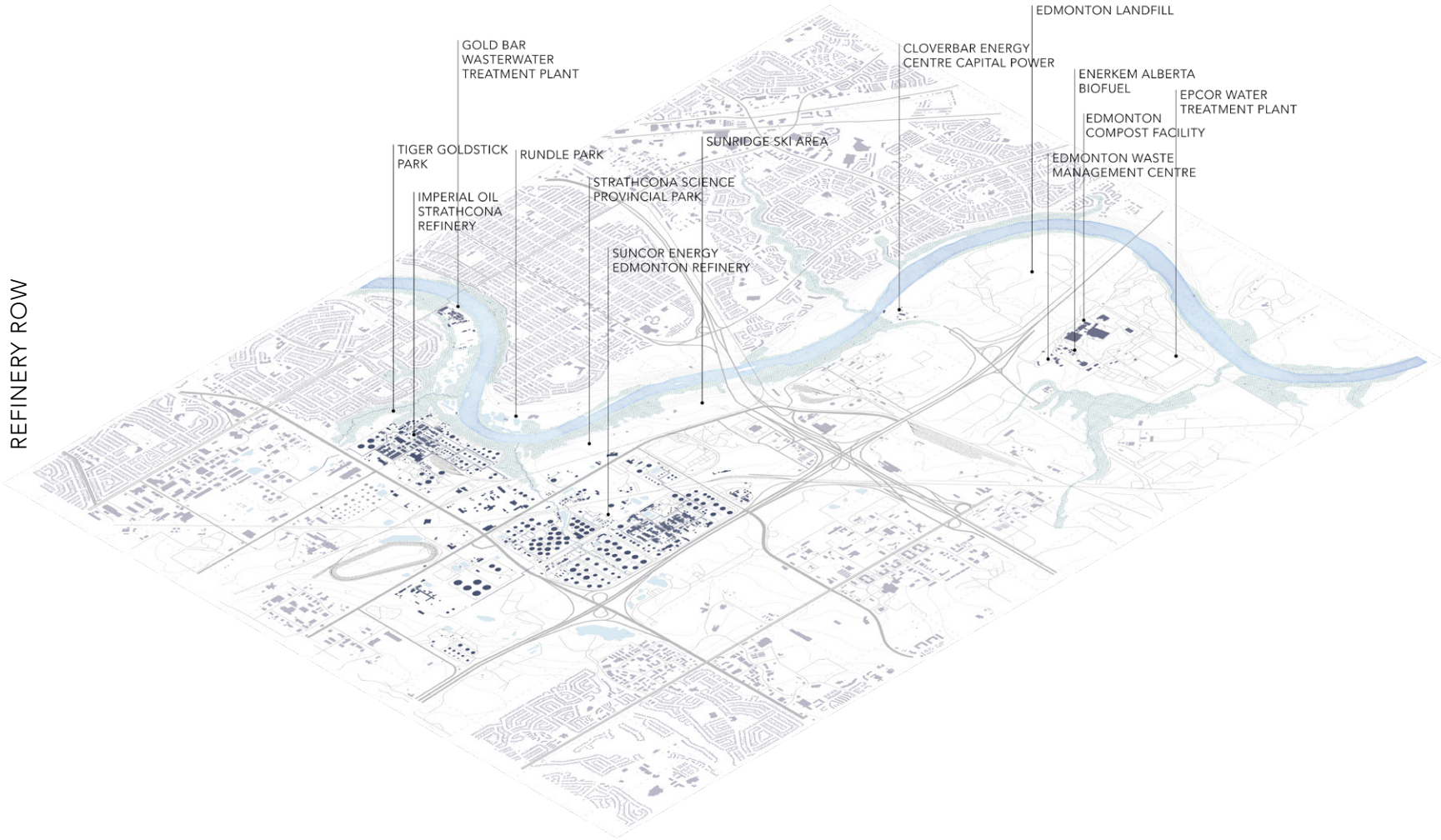


Edmonton's land use and major crude lines (data from City of Edmonton 2019; Government of Alberta 2019b)

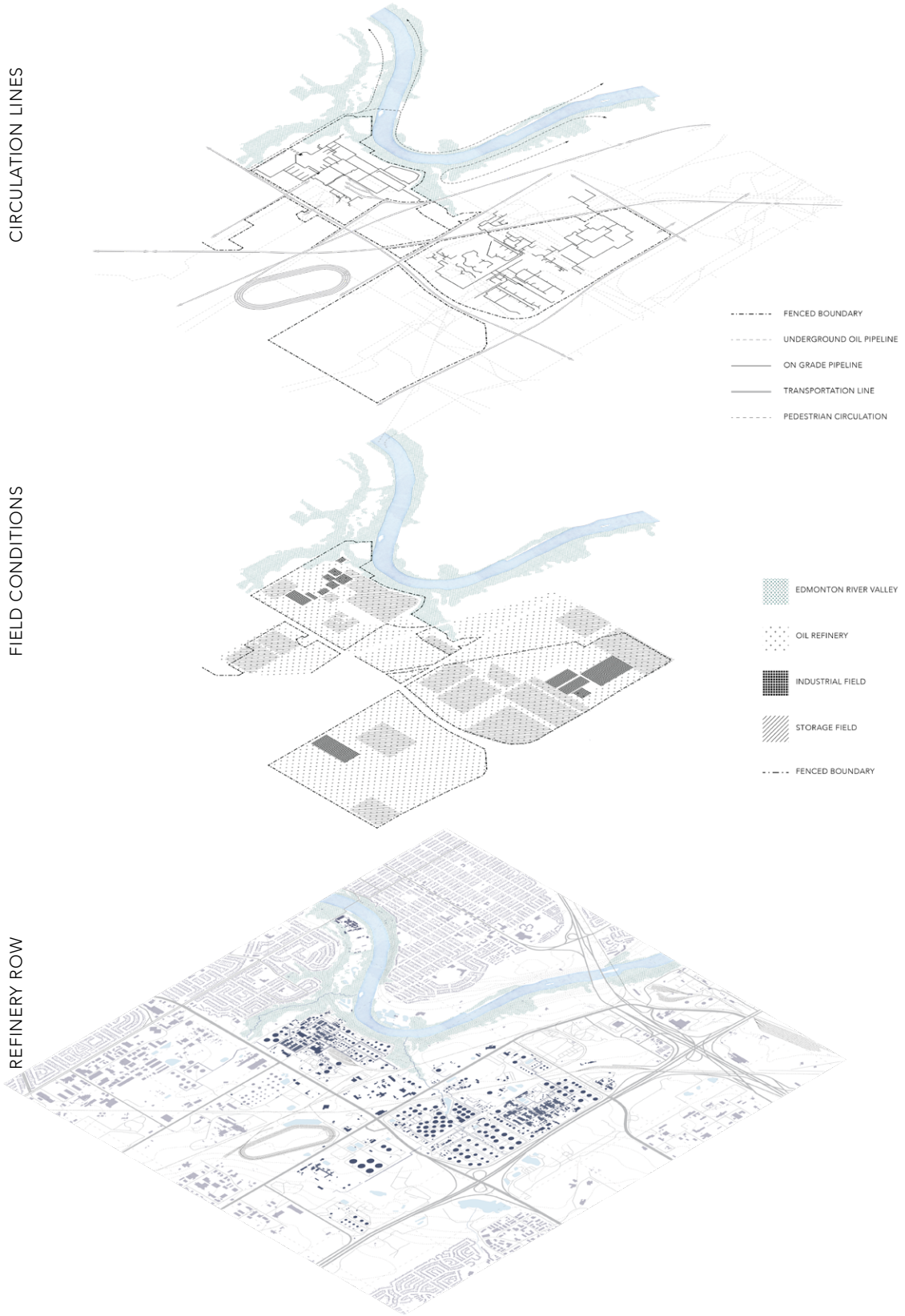
The intersection of three sectors of the petroleum industry, is a distinguishing point in the Canadian oil and gas industry. This singular event occurs in ‘Refinery Row’: a site named for the two oil refineries where the three components of industry converge. Notably, Refinery Row is where many of the hundred thousand kilometers of pipelines feed into and out of. The site is additionally benefited by the train lines that bisect the site, another transportation line which the oil industry is reliant on, and the highways that bound the site on three sides. The oil refineries are defined by the variety of transportation lines that begin, terminate, or intersect the site– the same transportation lines that bring Alberta’s oil into the global market. Another defining characteristic of Refinery Row is its proximity to the North Saskatchewan River. The city’s connection with the river has always been important. Indigenous peoples of the prairies have always found significance in amiskwacîwâskahikan, “beaver hills house” the Cree name for Edmonton, and its relationship with kisiskâciwanisîpiy, the North Saskatchewan River. The river valley has always been considered of great cultural and traditional importance to Indigenous and colonial communities; it has historically served as traditional burial grounds, a trading post, and a meeting point. In the contemporary city, there is great emphasis in maintaining the River Valley as a ‘natural’ green space, void of buildings or new development. Edmonton’s River Valley has become a space for decompression and recreation for the city; it connects the city’s most well used parks with hiking trails. The refineries currently exist in a position where it cuts off connection between Tiger Goldstick Park and Strathcona Science Provincial Park which bookend either side of Refinery Row. This effectively divides the vegetative stripe

of the River Valley that extends across the city. By returning this privatized space back to the people, the new energy landscape is able to offer 1.58 kilometers of River Valley back to the city. This thesis examines this junction point between the city, public, and industry as a testing ground for a new energy landscape, one which acknowledges the multidimensional relationship the city has with energy and environment.

The theory is tested on the Imperial oil site however the processes and strategies are not limited to this particular site. The Imperial Oil site is used to test the reconciliation of industry with landscape through appropriating and transforming old oil infrastructure to create new and sustainable energy from the toxic land it sits on. By utilizing phytoremediation as the mechanism to address the contamination on the site alternative energy sources are able to be derived from the by-product of remediation. An adaptive and phased approach sets up the means and incentive to reimagine new programs and architecture that can support energy generation. At its core the design focuses on remediation of land and reconciliation with its urban context. By actively sculpting a new energy framework, prioritizing the public users, the new energy system opposes the rigidity of the Petrol-Grid. These are principles that can readily be applied to all oil refineries and many industrial sites– in the hopes that through remediation and growth society may develop a healthier relationship with energy, the environment, and our collective future.



Refinery Row and its surrounding context (data from City of Edmonton 2018; City of Edmonton 2019)



Refinery Row and the layers of the land (data from City of Edmonton 2018; City of Edmonton 2019; Government of Alberta 2019b)

> If man had to acquire the conditions of survival in order to live… he must acquire the conditions of life in order to survive (Bookchin 1982).

This thesis argues that these ‘conditions of life’ are not those set out by the Petrol-Grid nor those which attempt to promote change from within the confines of its rigidity. The ‘conditions of life’ are those natural inclinations which have been pushed aside in society’s quest for industrialization and development. These conditions must be reinstated to actively promote the social freedom to pursue a healthy collective future and, subsequently, survival.

New Change

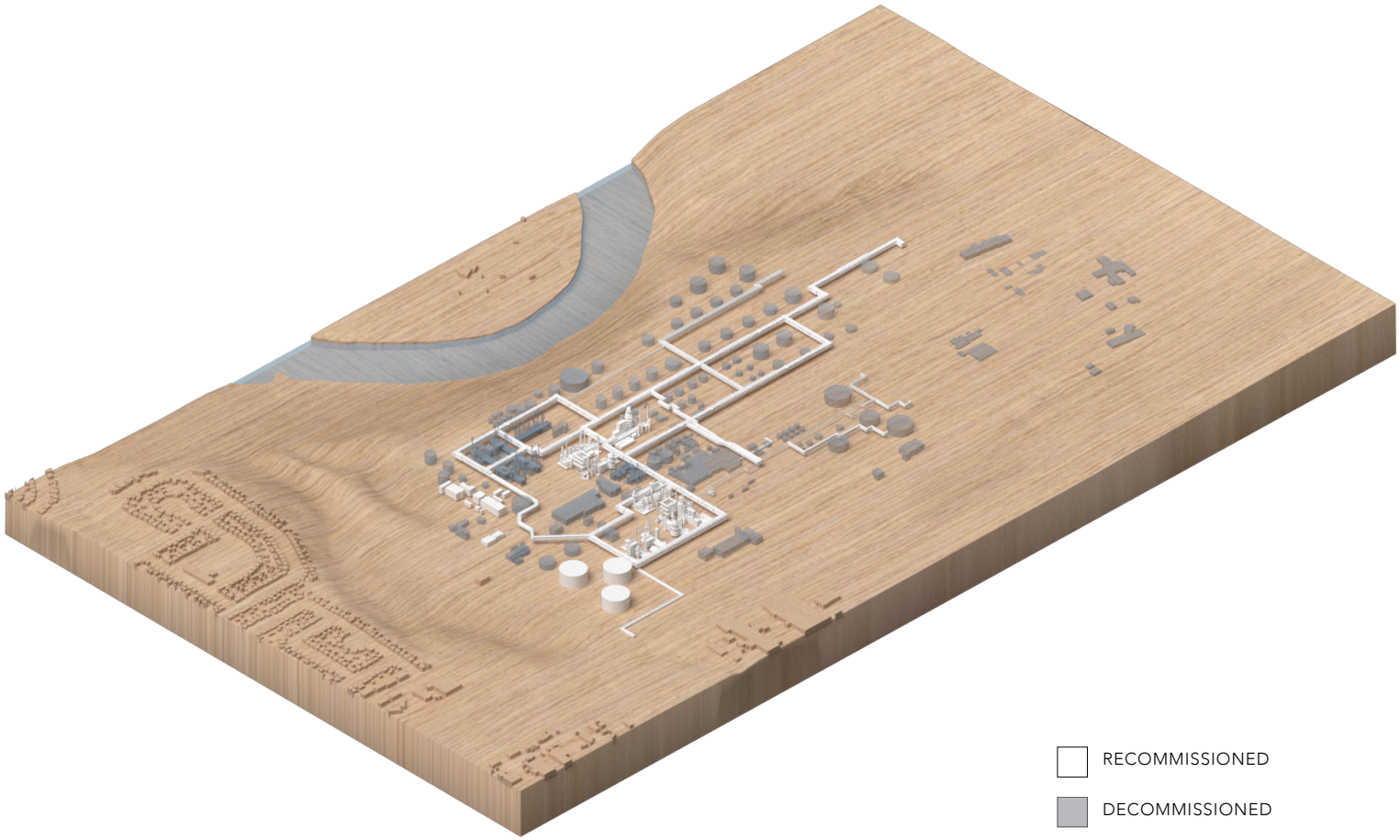
Although infrastructure and ecology currently exist in an antagonistic relationship, they are not mutually exclusive systems. In many scenarios they exist together and exist symbiotically. The strategy to do so begins with healing the land. The intention of the design is to develop a framework to remediate and reintegrate industrial oil spaces back into the public realm in a post-oil world. This involves making space, both physically on the site and also in the social and cultural environment. New sustainable development will require the decommission and removal of certain pieces of infrastructure on the site. Though a contentious first gesture for many it is not an attempt to erase the memory of oil on the site. The legacy of oil in Alberta will be embedded into the new energy that it carries forward. New development will not be able to take away the history of a former oil city and province; a new energy system retains the memories of the past yet moves society into a healthier future. In large,

the infrastructure of the oil refinery will be retained and recommissioned to serve a new purpose. The monumentality and character of the refinery is carried through time with “propelling permanence”– permanence in form throughout the passing of time because of its adaptability (Rossi 2007, 34). Oil refineries are the physical manifestations of a, soon to be fleeting, industry but marks a time in human history where oil was “King”. As society transitions into oil-independency the refineries will remain as both a reminder of the past as an urban artifact but also a catalyst for the future.

> It [urban artifacts] tends not to differentiate permanence but to focus entirely on them, since they alone can show what a city once was by indicating the way its past differs from its present. (Rossi 2007)

Chevron oil refinery at night. Burnaby, British Columbia. (Oil Sands Magazine 2019)

This thesis examines the change in the energy landscape as the function of growth; growth in the system at large (Rhizome) and the different components which make up the Rhizome. The methodology that this thesis uses to reclaim oil landscapes involves categorizing different elements, fields, lines, and points, and translating into the new energy landscape. The following chapter explores these elements of the system in both the oil landscape and how they are transformed into the new energy landscape. These components are used to inform a circulation model, based on Craig Reynold's flocking behavioural model, which is used as a method to spatialize circulation and devise architecture to support the growth of the new system. Acknowledging time as a leading factor in the growth and development of the system, the programs and architecture of the Rhizome Logic is then evaluated as an iterative phased system not restricted by the physical, imposed, boundaries of the Strathcona Imperial Oil site.

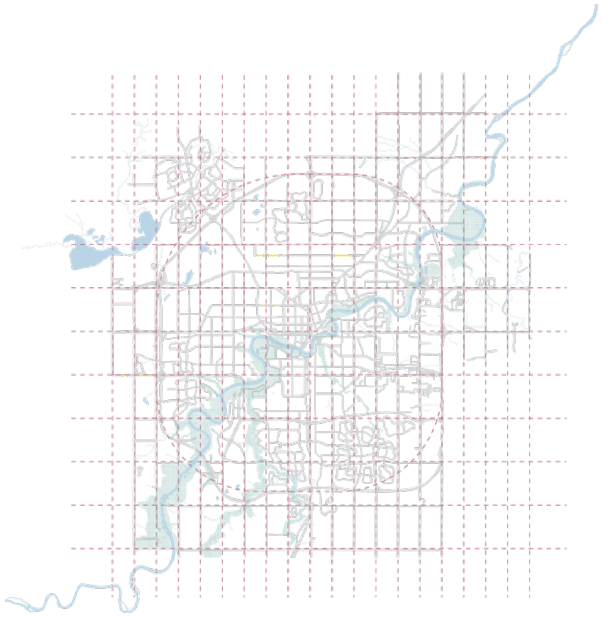


Infrastructural changes in the landscape: infrastructure recommissioned and infrastructure decomissioned

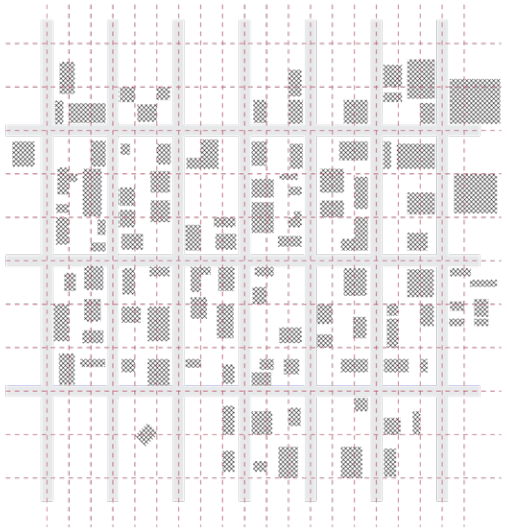
Chapter 3: The Rhizome Energy System

Rhizomatic Transformations in the Orthogonal

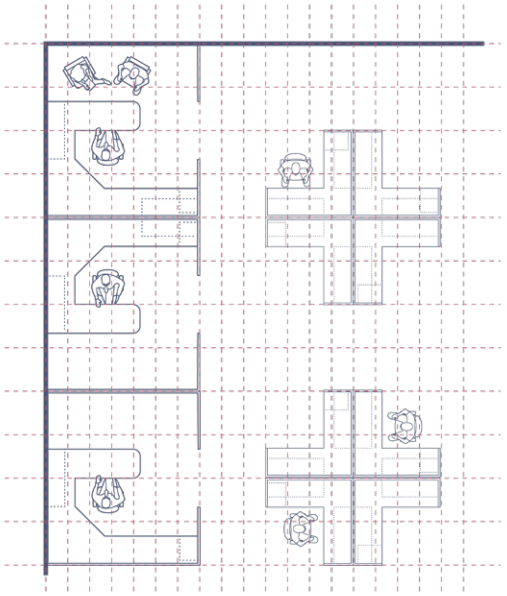
Many energy experts, including Elisa Iturbe suggest that carbon is the building block of the contemporary city, sets up the hierarchical perception where oil is “King” (Maugeri 2010). The Petrol-Grid, derived from this idea, frames and shapes the built environment and is based on the efficient rectilinear grid. Carbon logic grid can be defined by the regularity and repeatability of the orthogonal. Through every scale of reference, in petroleum based societies, the forms that exist support the notion that the Petrol Grid shapes the built environment– that without society’s active opposition to the Petrol-Grid the energy system in power will continue to be “King”. The monotony of oil-dependent society’s architecture is complacent to the dominion of oil. Evidenced in the way cities are gridded out, how city blocks are merely subdivisions of the former, and how buildings are further divisions of the same grid. Though the need to shift away from oil dependencies has been well documented, the system does not support transgressions of the irregular on the orthogonal. Therefore, this thesis suggests actively distorting the Petrol-Grid adopting the approach that “If solutions within the system are so impossible to find, maybe we should change the system itself” (Greta Thunberg quoted in Mesey 2018).



CITY SCALE



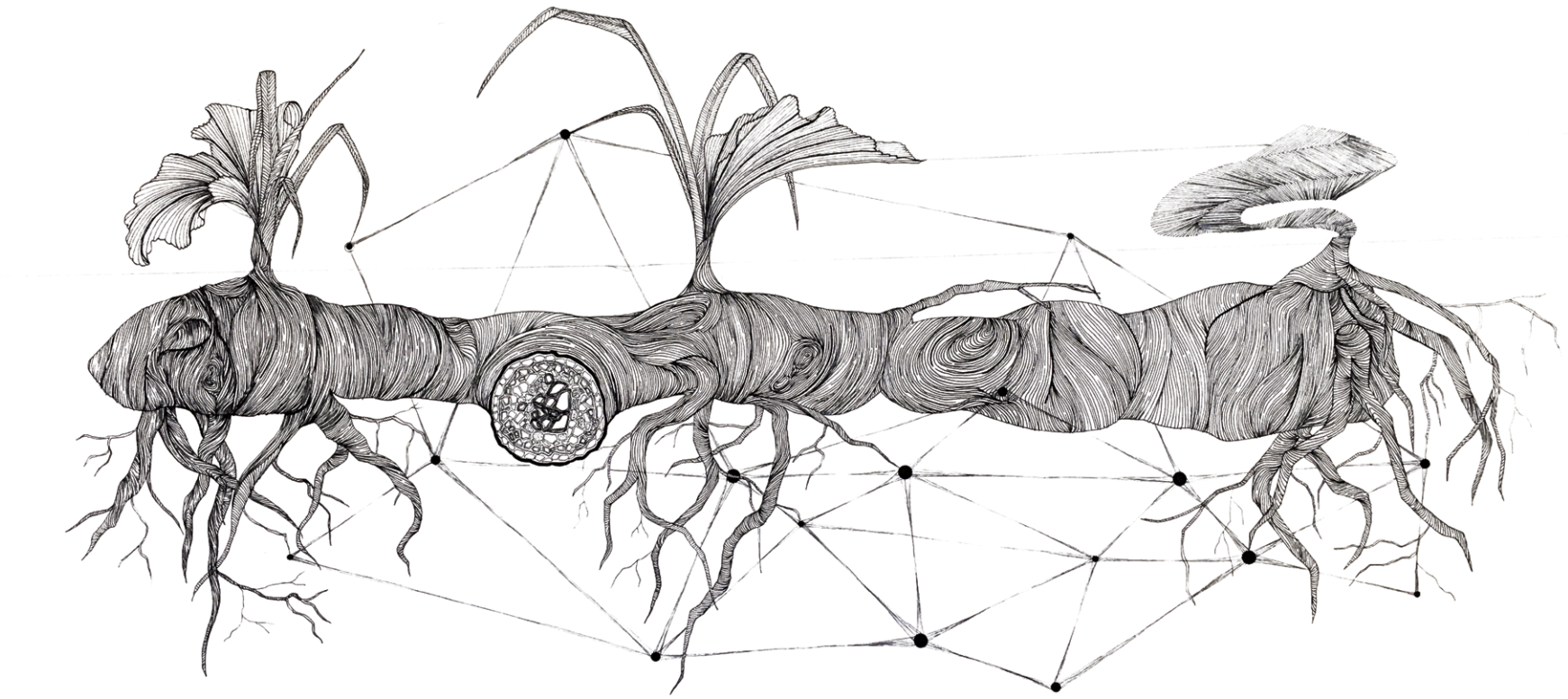
BUILDING SCALE



HUMAN SCALE

The Petroleum Grid persists throughout all scales of the built environement.

The Petrol-Grid represents that of the ‘regular’, where the same ‘kit of parts’ affords you repeatability and monotony. Contrary to the development with a ‘kit of parts’ is the idea of development through growth. This thesis proposes the idea of Rhizome Logic as a strategy of dismantling the Petrol-Grid. Rhizome Logic uses and facilitates development through biomorphic patterning and generative growth. The “rhizome” is both a botanical and philosophical term. It refers to a system of interconnectedness, multiplicities, and accentrality (Deleuze and Guattari 1983). Rather than defining a structure or framework, as the Petroleum Grid does, the Rhizome Logic is named such as it is non-prescriptive in its ‘structure’. Rather than presenting itself as a structured framework, the Rhizome Logic is an organizational strategy which is malleable and responsive. The proposed Rhizome Logic is a new system of points connected by lines which both exist within the fields. It takes precedent from traditional urban planning strategies that predate the oil industry, which favour the public user and facilitates the biomorphic patterns of circulation.



The Rhizome: a philosophy, a subterraineous stem, a theory.

System of Parts

The complexities of the oil industry, as with any energy industry, are numerous. In order to quantify and analyze the system this thesis has broken down the energy system into its elemental components– fields, lines, and points. Based on Stan Allen's definitions of these conditions, components of the oil landscape are identified and organized by these typologies and reconstituted to address the needs of the new energy system. The points, lines, and fields of the new energy landscape share the same function and definition as the components had in the oil landscape but serve a new purpose.

Stan Allen proposed that "a field condition could be any formal or spatial matrix capable of unifying diverse elements while respecting the identity of each. [. . .] Interval, repetition, and seriality are key concepts." (Allen 1999). One of the most sublime conditions of the Strathcona Imperial Oil Refinery, as with any oil refinery, is the fields of massive oil storage drums. They stand to serve as storage containers or vats to mix hydrocarbons in and can collectively be defined as spaces that retain energy potential. Translated in the new energy landscape these field conditions are transformed into remediation fields– fields which host crops which embody energy as feedstock.

Lines or 'corridors' as defined by Stan Allen are "Infrastructural pathways that contain movement of services and function" (Allen 1999). The lines of the oil refinery landscape exist in the pipelines; they are both a visual connector and

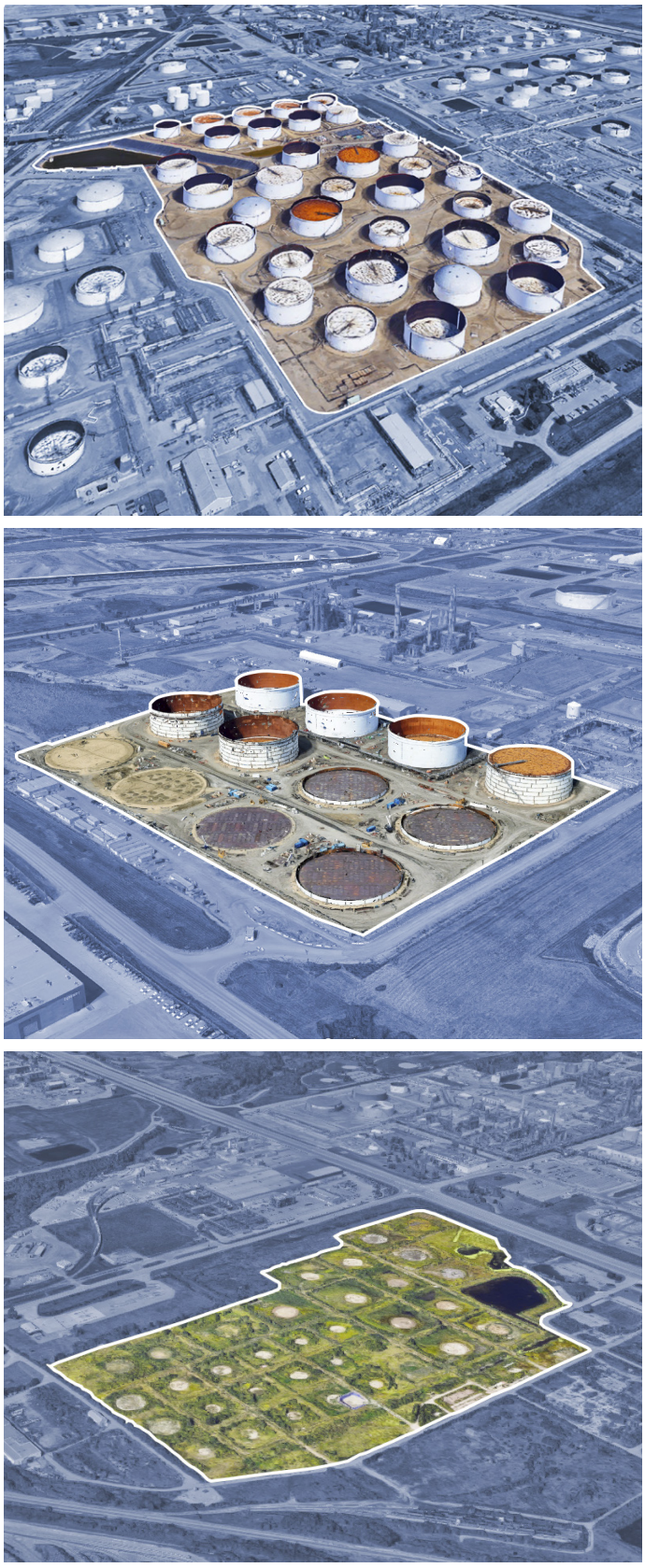
a descriptor of movement. Pipelines are often grouped together and elevated off the ground plane in oil refineries– these piperails circulate oil throughout the site and act as the lines of the oil landscape. The lines of the new landscape share this same function, a circulator of energy, either in the same shared paths or as a derivative of the piperail. The lines of the new landscape also act as a circulator of the public user, existing as the piperail or circulation lines complimentary to the piperail.

The oil refining towers act as the point in the oil refinery, they exist at the terminus end of the pipelines and relate flow of the lines to the potential of the fields. In the new energy landscape, the activation points take on this role. The architecture of the new energy landscape embodies the lines of circulation and activate these lines by organizing flows of users across the site while spatializing form from flow. The points of the new landscape take on similar roles as the points of the former oil landscape in their function as connectors of line to field.

Remediation [Fields]

The oil drums in oil refineries are used vats to mix higher value products, from various fractions of oil, as well as store hydrocarbon products in anticipation to be refined or distributed. The largest of drums on the site span 90m and across Strathcona Imperial Oil Refinery there are more than 50 containers. The aggregate of behemoth containers defines the field and collectively share their role as retention of energy potential. Strathcona Imperial Oil Refinery covers

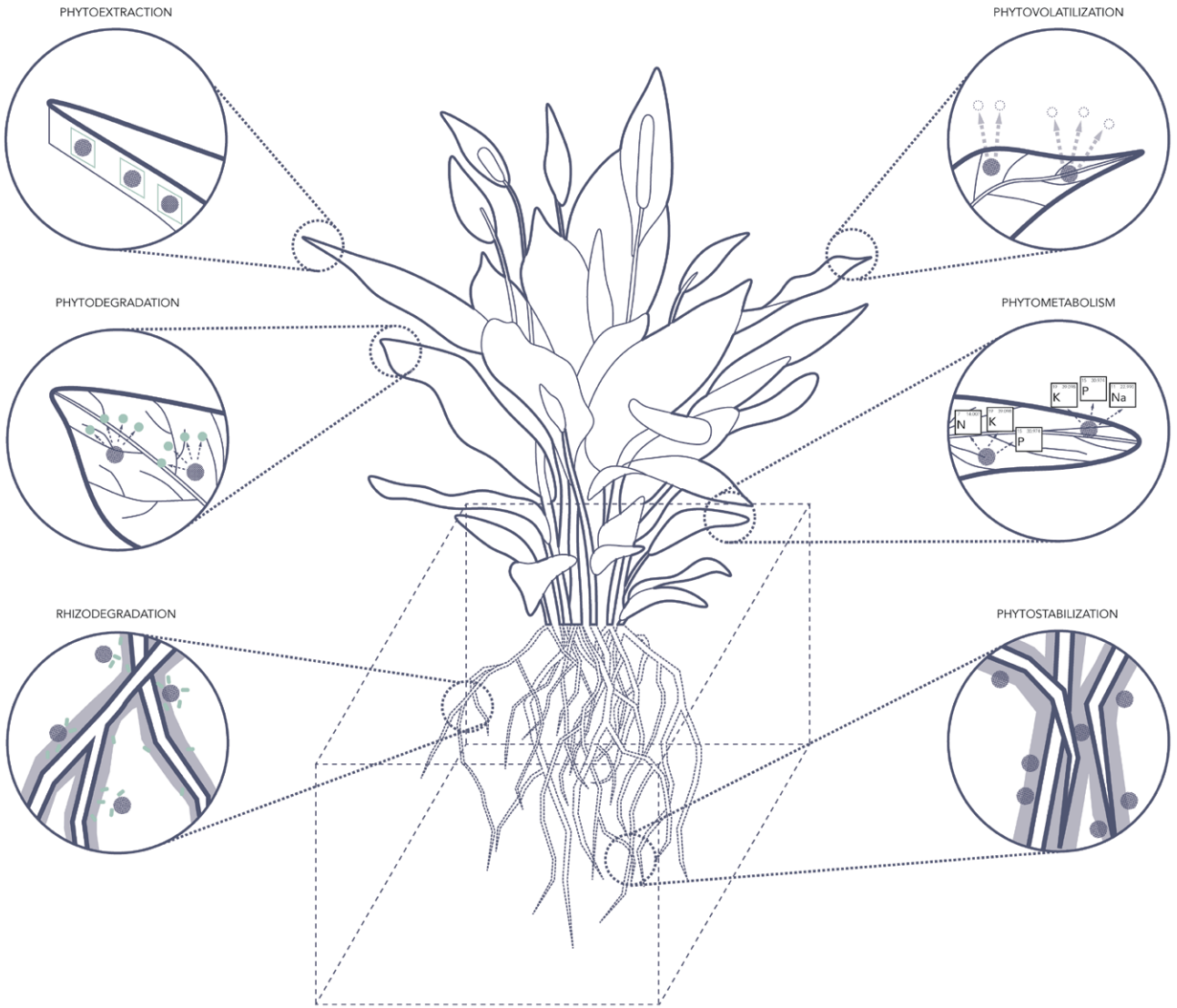
over 200 acres and they inhabit the majority of the site; therefore, it is paramount to address these spaces and their contamination. With a site of this magnitude, both in physical size and level of contamination, not much can be done until the contamination across the entire site is addressed. This scenario, though a problem, also presents itself as an opportunity for new energy. The oil drum fields, when decommissioned and removed, can make space for phytoremediation crops to be planted. The industrial rhythmic patterning of the oil drums lends itself well to radial irrigation systems typical of grain farming. The new field condition developed which retains the visual patterning of the former oil site and embodies new energy potential in a progressive but identifiable manner.



Oil *fields*: Oil drum of Strathcona Refinery. (Google Earth 2018)

Traditional remediation strategies regarding brownfield sites have typically been to excavate the contaminated soil and regrade and/or cap the site in concrete. New soft remediation techniques such as bioremediation allows the site to embrace a gentler and more effective long term strategy that, through phasing, can invite the public back at a greater capacity.

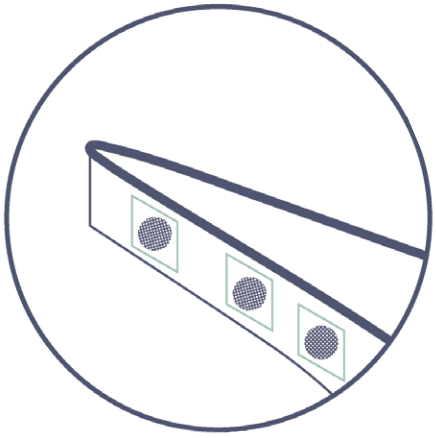
Bioremediation is the method, rapidly being adopted by the oil and gas industry, of decontaminating soil and water with biological processes in order to break down pollutants (NRCan 2019). Examples of bioremediation include phytoremediation and bioaugmentation, both of which have been used in a variety of petrochemical polluted sites. Phytoremediation involves using plants and their associated microorganisms to contain, remove, or render toxic environments harmless. This tool takes advantage of the ability some plants, hyperaccumulators, have to concentrate pollutants or metabolize molecules in their tissues (Kennen and Kirkwood 2015). It is a relatively new method of decontaminating soil that is economic, effective, and environmentally friendly. Petroleum contaminants, because of their organic composition “account for many of the success stories within the phytoremediation field” (Kennen and Kirkwood 2015, 67). Across many different sets of trials, positive results have been found in reducing oil-contaminants with bioremediation.



Phytotechnology: the mechanics of phytoremediation (data from Kennen and Kirkwood 2015)

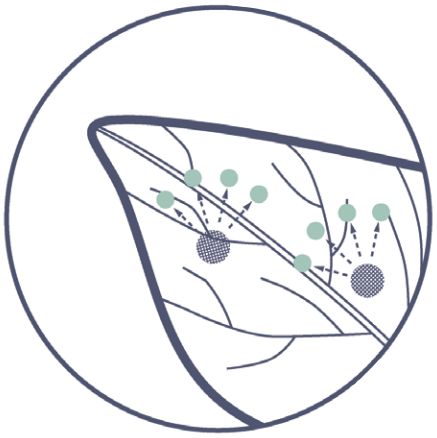
PHYTOEXTRACTION

The process of moving the contaminant into the plant tissue. The contaminant can either undergo phytodegradation and be removed or be stored in its tissue. The plants must be extracted from the site to remove the contaminants. The harvested plant material can be put into landfills, burned, used as biomass, or undergo phytomining.



PHYTODEGRADATION

Mechanism where the contaminant is absorbed into the plant and broken down into smaller parts organic compounds. In most cases these smaller parts, metabolites, are non-toxic and used in plants growth process. Works in tandem with phytometabolism.

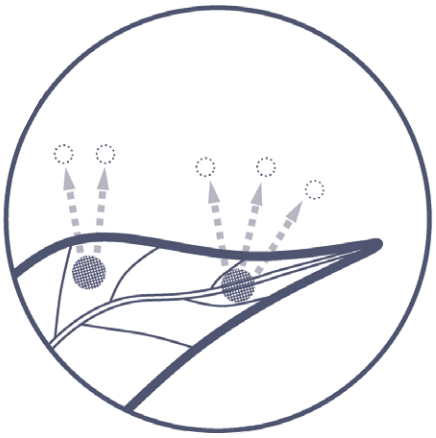


RHIZODEGRADATION

The root exudants released by the plant and/or the soil microbiology around the root breaks down the contaminant. The plant roots create and sustain a micro ecosystem by releasing phytochemicals and sugars for the microbes to thrive in. The microbes metabolize the contaminant.

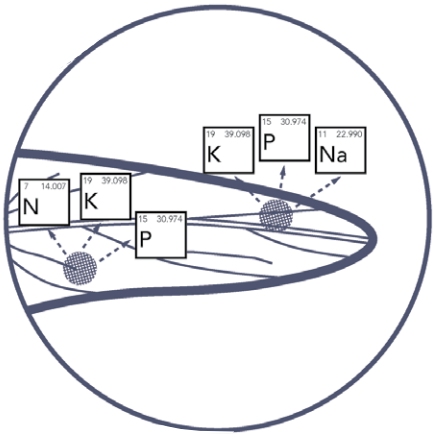
Phytoextraction, phytodegradation, rhizodegradation (data from Kennen and Kirkwood 2015)

PHYTOVOLATILIZATION



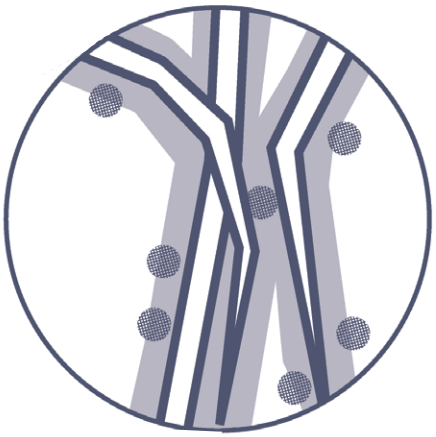
Mechanism where the plant takes up the pollutant from the ground in transpires it into the atmosphere as a gas. Gas is released slowly enough that the surrounding air quality is not significantly impacted. Net benefit of removing the contaminant from the ground is typically better than the effect of releasing pollutant into the air.

PHYTOMETABOLISM



Plant metabolizes the contaminants' inorganic elements and used in its growth. The inorganic contaminants are incorporated into the plants biomass. Works in tandem with phytodegradation.

PHYTOSTABILIZATION



Plant holds the contaminant in place so it doesnt move off site. Vegetation releases phytochemical into the soild that bind the contaminant and decreases bioavailablitity.

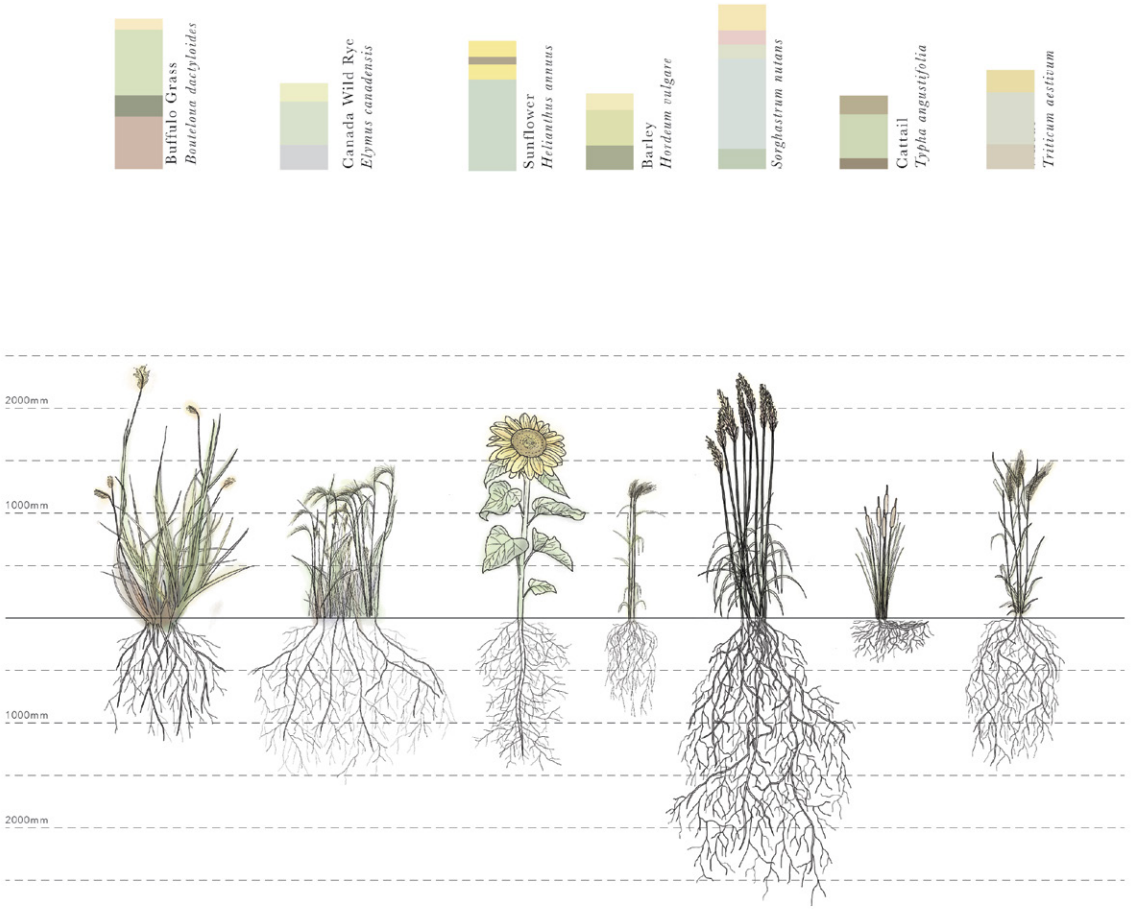
Phytovolatization, phytometabolism, phytostabilization (data from Kennen and Kirkwood 2015)

In petrochemical polluted sites the primary measure of pollutants is the measure of Total Petroleum Hydrocarbon (TPH). TPH is a catch-all term to describe the large family of chemical compounds found in crude oil (Environmental Protection Agency 2017). Many scientific trials have been done to examine the efficacy of phytoremediation on petrochemical polluted sites and, generally, measure in TPH reduction (however some trials focus on one chemical/ pollutant). Liste and Alexander found 74% reduction of pyrene in 8 weeks (Liste and Alexander 2000), Hutchinson et al. found 68%-64% reduction of TPH (Hutchinson et al. 2001), Peng et al. found a 41%-63% reduction of TPH in 127 days (Peng et al. 2009), Asiabadi et al. found a 52%-64% reduction in TPH in 127 days (Asiabadi et al. 2014).

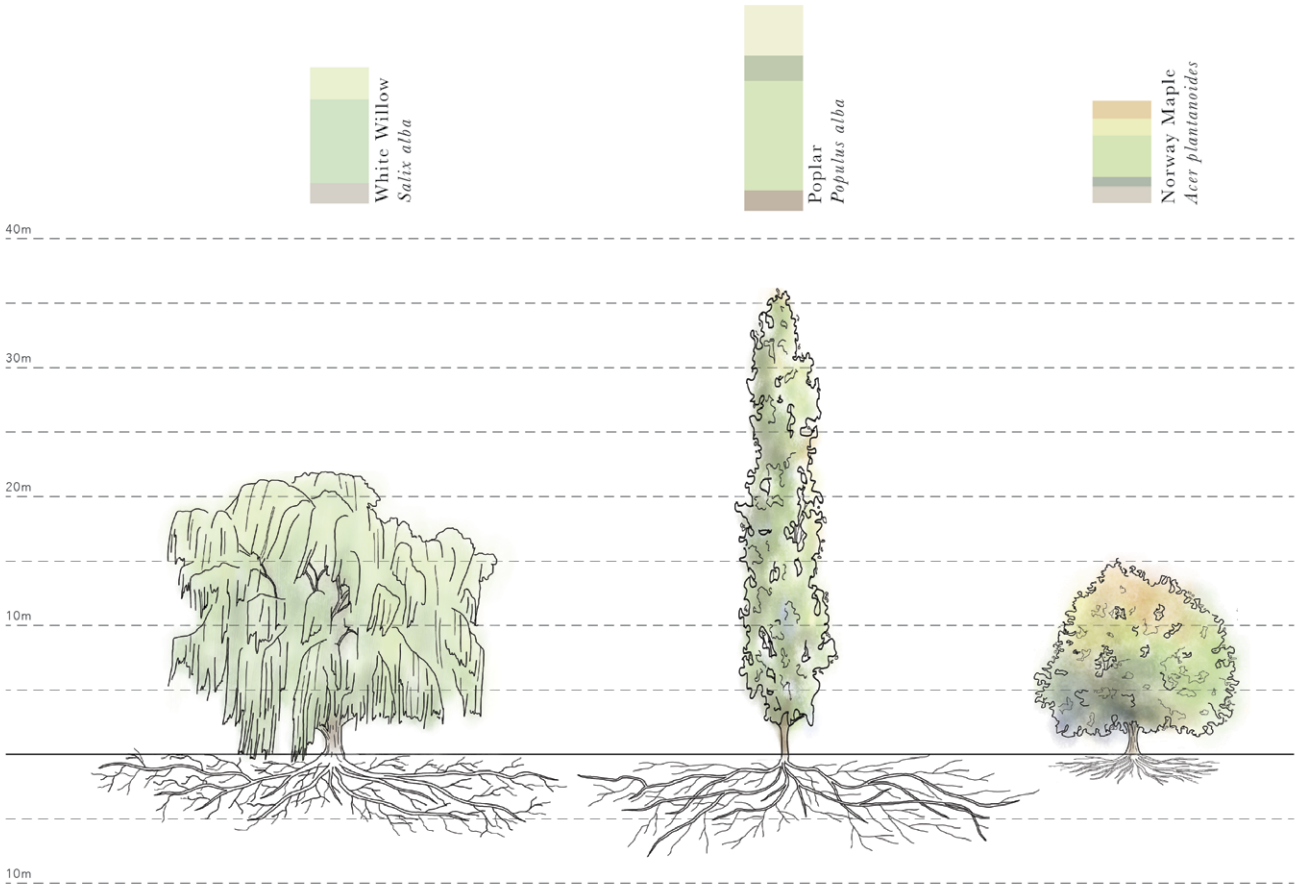
Another bioremediation technique that has found success in situ is bioaugmentation: the process of supporting the endemic petrochemical metabolizing archaea and bacteria to speed up the rate of degradation. This process can involve engineering endemic organisms to metabolize under less optimal conditions, such as anaerobic conditions, engineering these organisms to become more resilient, or stimulating the environmental conditions in which these organisms metabolize pollutants, such as tilling to soil for aeration, fertilizing the soil, etc. (Kulakow and Pidlisnyul 2009; Khayati and Barati 2017). One study in the Kaltag School Oil Seep introduced petroleum industry microbes to an oil pit and reduced the TPH from 44880 ppm to 10,000-6484 ppm in 47 days (Bailey 2017).

These two bioremediation techniques are often used in tandem to increase efficacy. Remediation at Strathcona Imperial Oil Refinery employs both techniques to account for the severity of contamination. Similar to the techniques used in Gasworks Park (Way 2013), the fertilizers will be tilled into the soil aerating and increasing the productivity of bioaugmentation. Remediation crops will then be planted and harvested every growing season rotating through a variety of endemic, high biomass, remediation crops. The combination of the two techniques will be carried out and monitored by a group of agriculturalists, farmers, ecologists, and remediation scientists– the first wave of users of the site.

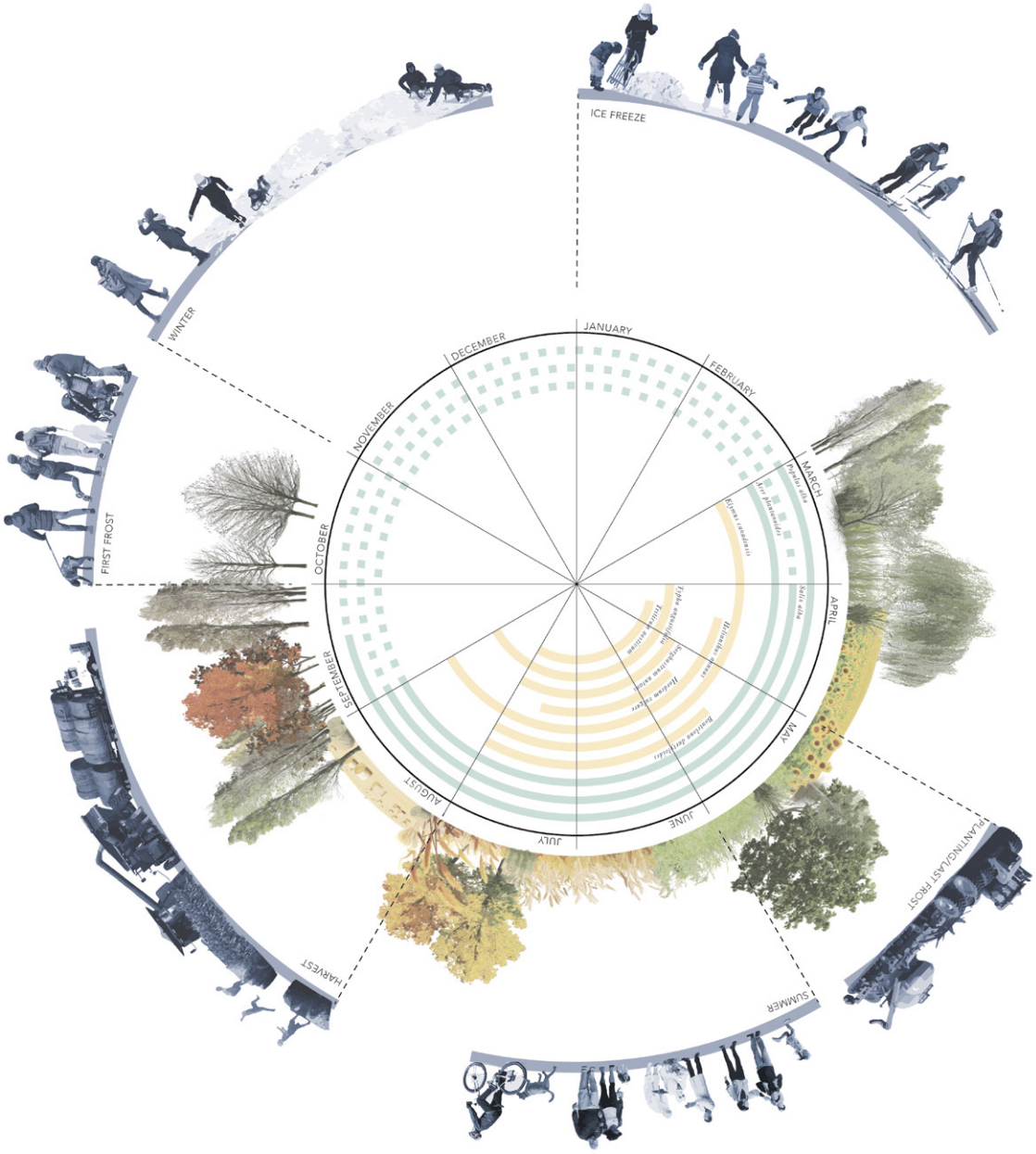
Sensitive to Edmonton's northern climate, USDA Hardiness Zone 3b, a selection of plants has been chosen for Refinery Row, with considerations given for endemic species and biomass production. Literature suggests that heavier fractions of petroleum, compounds of longer hydrocarbons and those that contain ring structures (which are prominent in crude oil sites like Refinery Row), are most effectively addressed with deep rooting grasses (Kennen and Kirkwood 2015). Different vegetative types have different remediation strengths and cycling through different crops on the same land improves the efficiency and rate of remediation.



A selection of phytoremediation plants (data from Kennen and Kirkwood 2015)



A selection of phytoremediation trees (data from Kennen and Kirkwood 2015)



Cycles of growing, seasons, and programs in the Rhizome

This cycle system provides opportunities for both land remediation and biomass cultivation on the site. Based on a conservative rate of contaminant degradation of 50% TPH degradation per season, the site will have experienced a 99.9% decrease of TPH over ten years (Cocârţă, Stoian and Karademir 2017; Asiabadi et al. 2014; Kennen and Kirkwood 2015). During this decade of remediation, various programs are able to be introduced to the site in phases. Utilizing elevated lines of circulation, public visitors are able to engage safely with the site. As the land continues to become less contaminated the lines of the new energy landscape are able to bring public visitors closer to the ground. In year eight, the contaminants, although are still in the landscape, are degraded and stabilized to a point that they should pose little risk to human health, satisfying the 10^{-6} individual risk factor proposed by the World Health Organization (World Health Organization n.d.; Cocârţă, Stoian and Karademir 2017). With every new season of plantings, soil and water contamination decrease; thereby, increasing the embodied potential of the site and ability to host more extensive programming.

Growing and harvesting high biomass vegetation, although addresses the concerns of land remediation, sets up a dynamic where there is an abundance of, what can be considered, waste products at the end of each harvest cycle. This dynamic is the basis of a closed loop waste to energy system devised for the site. This system of harvesting phytoremediation crops lends itself well to be used as biofuel. The fields of a former oil landscape generate the energy potential for a new system of sustainable energy.

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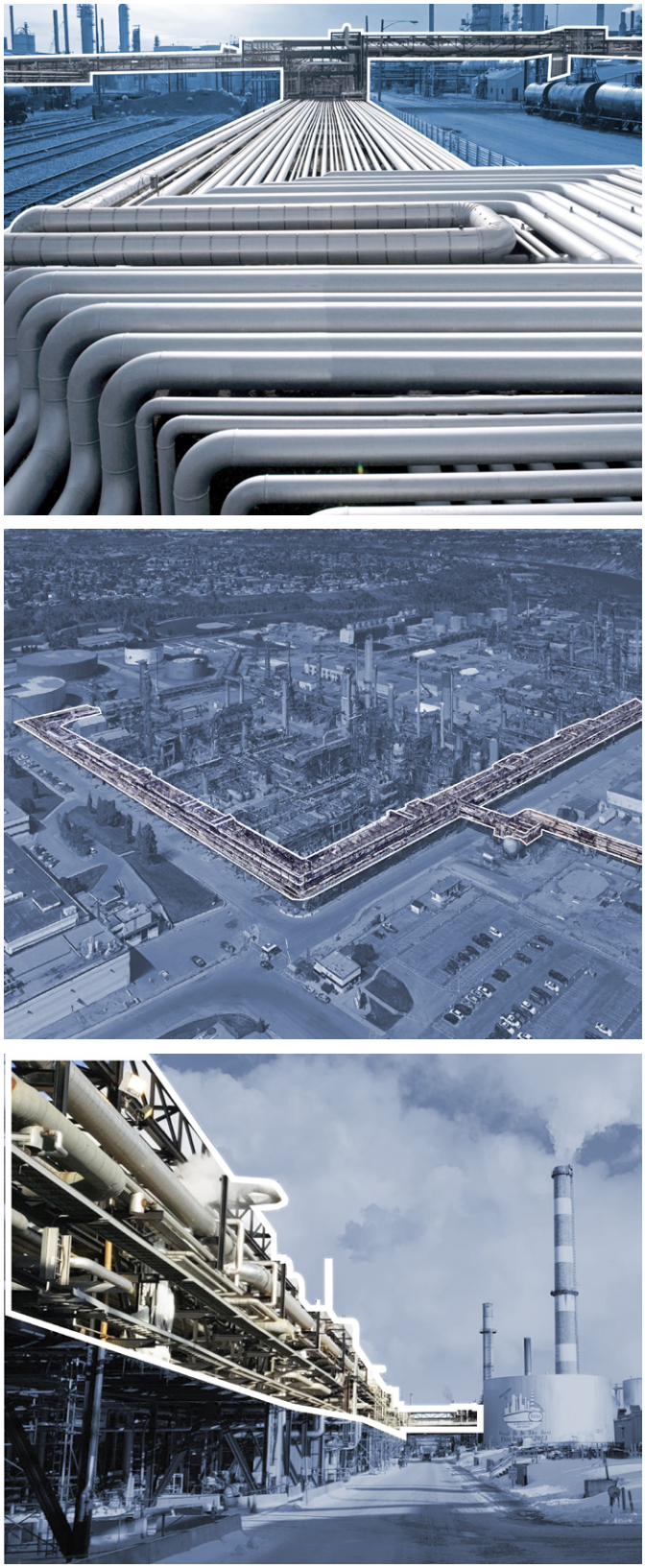
Infrastructure [Lines]

The pipelines, that are characteristic of the site, constitute ‘lines’ as described by Stan Allen in the oil landscape. They are the infrastructural components that contain movement and function and maintain this position as they are translated into the new system. However, in addition to these conditions which define ‘line’, the lines of the new energy system elaborate upon and spatialize notions of biomorphic circulation patterns. Derived from the attractive monumentalism of refinery infrastructure a new set of lines are mapped into the landscape and set up the beginnings of the Rhizome Logic.



Oil *lines*: pipelines Strathcona Refinery (base images from Google Earth 2020)

In redeveloping the infrastructure from an oil refinery to a biofuel refinery some select pieces of the former oil refinery will be decommissioned and removed. The majority of the infrastructure is readapted. In the retention of these pieces is the intent to preserve heritage and memory and adaptive reuse. The grandeur and draw of an oil refinery lies in social interest in the industrial sublime. The lines of the former oil refinery manifest as bundles of pipelines, elevated 6m from the ground and stack another 5m above that point. The utilitarian lines run across the site and jog up and down denoting the passage of vehicles. The density in bundles turns very singular, tectonic lines into monolithic masses. It is for their industrial monumentalism that they are identified as an object of attraction. Similar to, yet fundamentally opposite of, the monumentalism of the refinery infrastructure is the ‘natural’ setting of the Edmonton River Valley. The city of Edmonton uses the River Valley as a green connector. It provides reprieve from the pace of the city in its relatively natural setting void of industry. For opposite reasons these two objects of the landscape, industrial monument and River Valley, along with current entrances to the site are designated as objects of attraction. They inherently draw visitors to them, a quality that is harnessed in the development of the Rhizome Logic. These ‘landmarks’ create areas of social influence, affecting the way that visitors of the site will circulate– this phenomenon is used as an environmental influencer in the development of the Rhizome with flocking behaviours.

Object of attraction: Infrastructural attractor and elevated piperail structure. Oil refinery at night. (Imperial Oil Limited, 2019)

Object of attraction: Edmonton's River Valley. Photograph by Ken Greenberg. (Ken Greenberg, 2019)

Craig Reynolds, an artificial intelligence theorist, analyzed the behaviours of flocking species and created a computer program that simulates the actions of the flock. The model is a representation of the complex natural phenomenon of flocking, herding, and schooling behaviours. The aggregate motion of the flock is created with a distributed behavioural model. Every particle, or actor, is independent and operates as an individual that follows basic behavioural rules of moving. In the most basic rendition of this theory there are three rules of motion (Reynolds 1987, 31):

1) Collision Avoidance: Avoid collisions with nearby flockmates

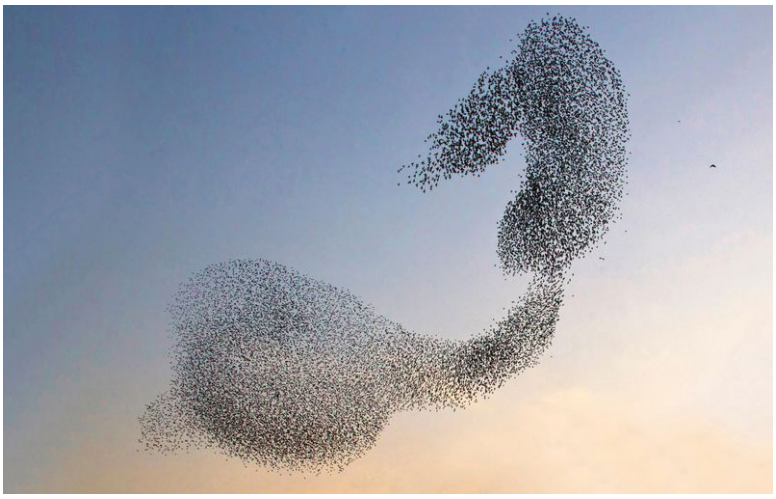
2) Velocity Matching: Attempt to match the velocity of nearby flockmates

3) Flocking Centering: Attempt to stay close to nearby flockmates

This basic set of parameters created the flocking behaviours that biologists attribute to many species across different Phylum and Kingdom. Each individual in the flock navigates based on its localized perception of its dynamic environment and response accordingly– therefore the motion of the aggregate is relative to the motion of the individual (Reynolds 1987, 30). A ‘flock’ is thus made up of discrete, independent actors who act with common social behaviours. This imparts the impression upon the viewer that there is intentional, centralized control over the flock when in reality the aggregate motion is the direct result of the localized perception of the individual.

> What is striking about these rules is that none of them said “Form a flock”... the rules were entirely local referring only to what an individual boid could do and see in its own vicinity. If a flock was going to form at all, it would have to do so from the bottom up, as an emergent phenomenon. And yet flocks did form, every time. (Waldrop 1994, 240)

It is through the influence the individual has on their space that forms are able to take shape: this theory aligns with and is utilized to visualize and create space for the public user in the Rhizome Logic. The theory that the individual has the means to inform their space and those around them form the basis of the emergent space in the new energy landscape.

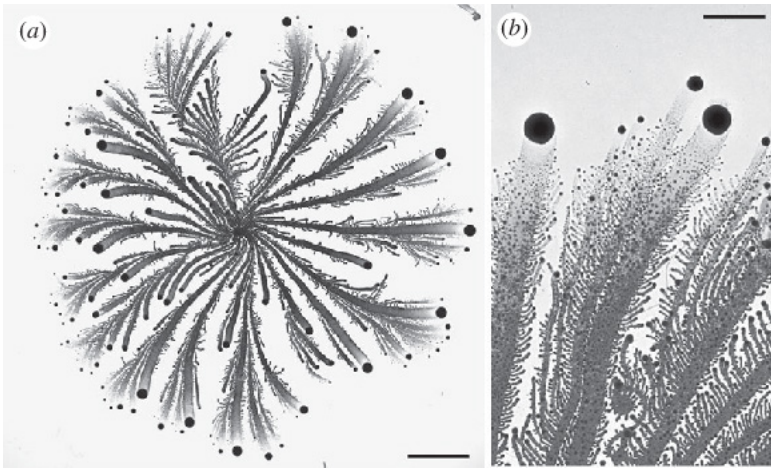


Murmuration of starlings. Photograph by Jan van der Greef. (Fessenden 2015)

Stigmergetic behaviour in humans. Photograph by Matthias Clamer. (Davies 2017)

Fish swarm through the kelp forest. Photograph by Oliver Dodd. (Jones 2017)

Stigmergetic behaviour in driver ants. (Encylcopaedia Britannica 2017)



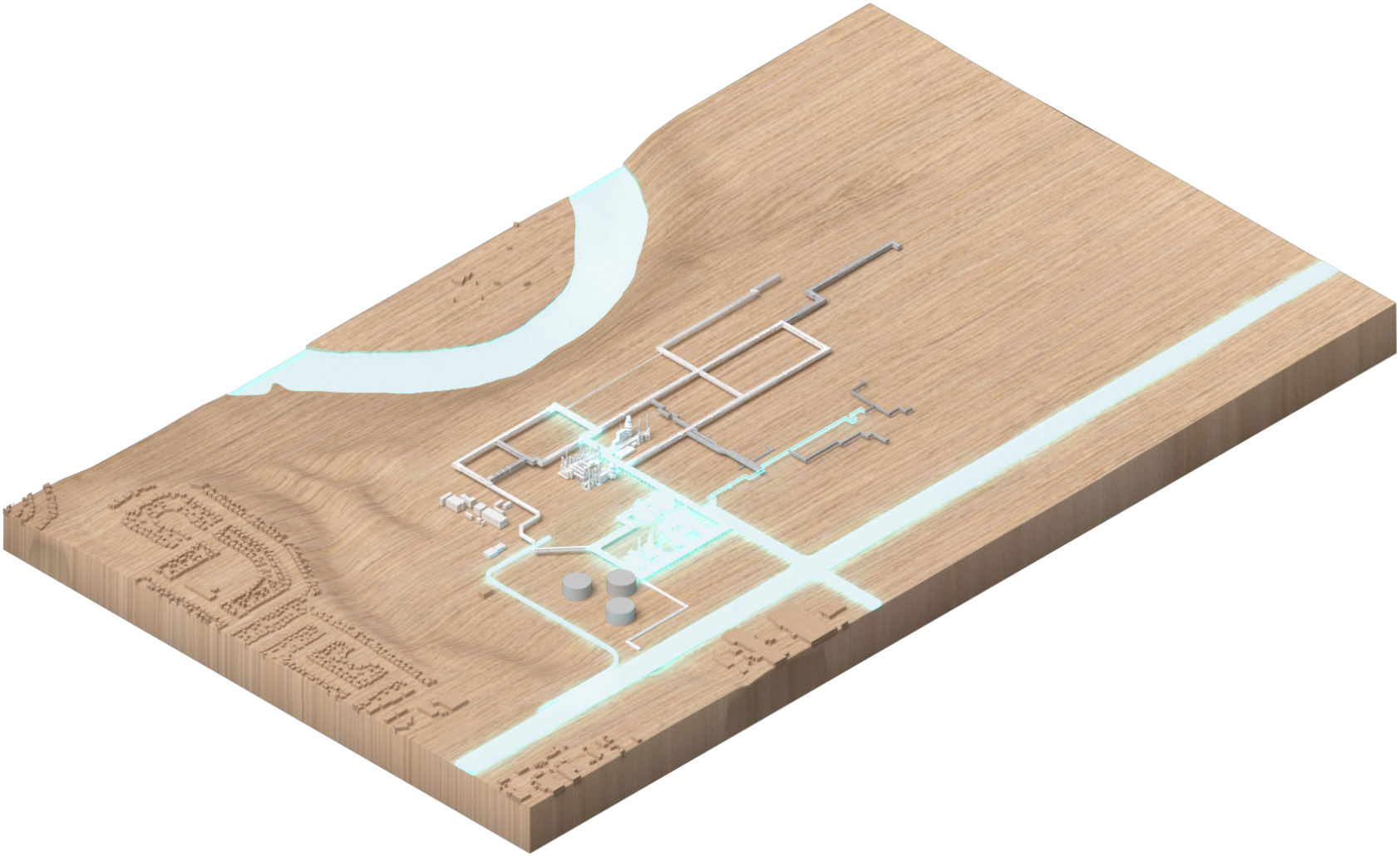
Bacteria colony as a community of cooperating swarming cells. (Kearns 2010)

This thesis explores Reynolds' flocking model and the related theory of stigmergy (mechanism of indirect coordination through the environment, between agents or action) as a design strategy. The remnants of the oil landscape, those that form the new refinery as well as those retained as memorials of past industry, as well as other 'attractors', such as the River Valley and the entrances to the site are designated to pull individuals in. These areas are programmed to have higher 'pull' or 'attraction' on each particle of the system. The self organization of the particles and the paths they 'choose' is otherwise determined by their own 'random' motion and their local environment. The paths that they follow are mapped and used as a trace of which areas of the site are most frequently activated. The patterns that are generated through this type of stigmergic behaviour was initially studied by biologist Pierre-Paul Grassé in his study of termite behaviour. These biomorphic patterns of circulation operate with similar behaviours as the flocking patterns however have the additional variable of environmental obstacles.

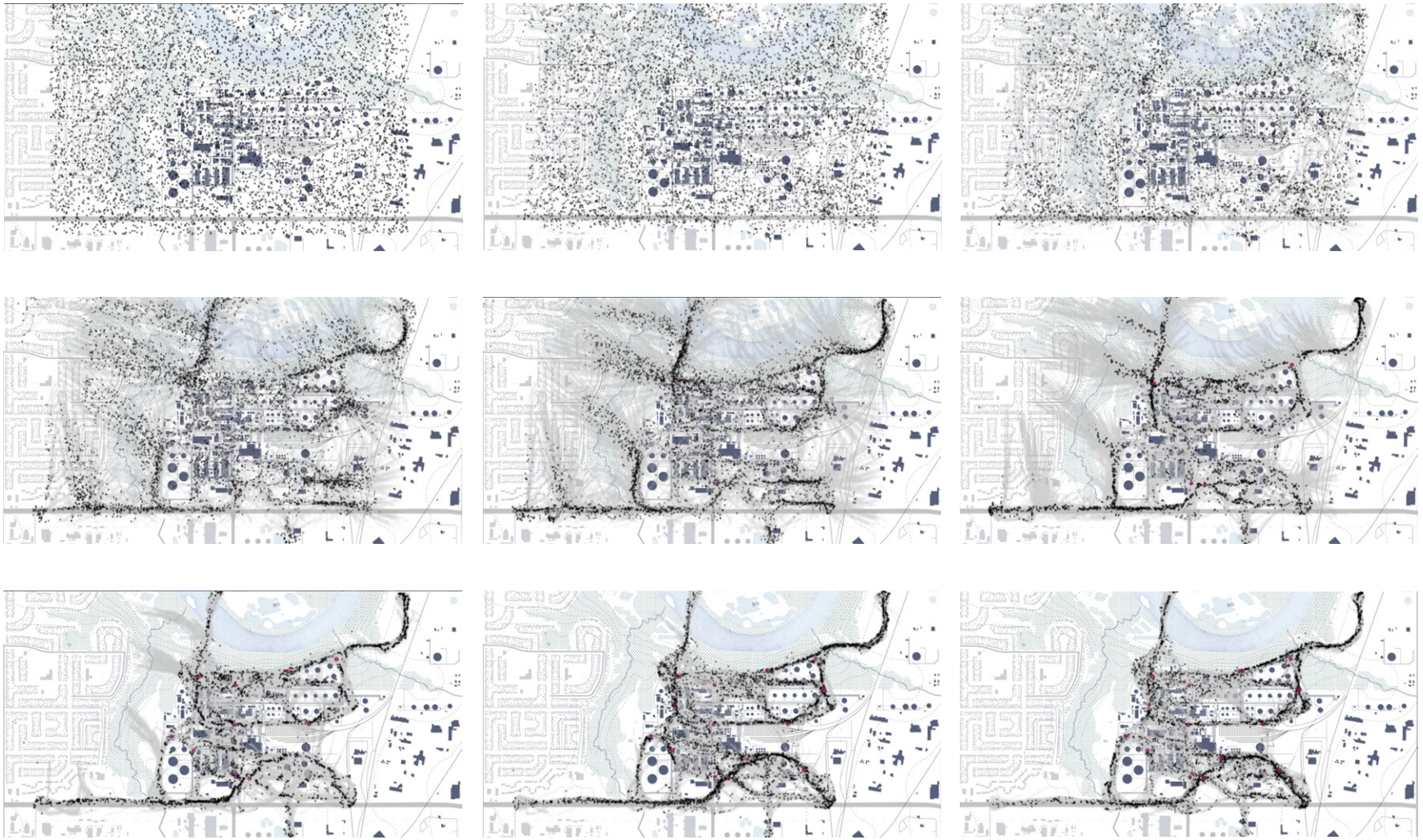
A particle system is organized by the rules of flocking behaviour and applied over Strathcona Refinery. The parameters of movement used in the system are the three outlined in Craig Reynold's flocking behavioural model; in addition to these parameters external, or environmental, factors defined as objects of attractors are used to influence the random motion of the particles. Infrastructure retained but hold little or no influence are shown in grey. Infrastructure pieces with some influence are highlighted in white. Infrastructure pieces with the greatest influence are illuminated. Each particle is influenced by both how adjacent

particles in its immediate context move and by the pull of the objects of attraction. This system's script, which runs the motion, is iterated 50,000 times whereby each iteration moves the set of 5000 particles relative to the last iteration. The paths of motion of each particle is mapped in order to record the trails of flocking. These lines map the paths that the particles took and are used in defining the new built environment of the Rhizome.

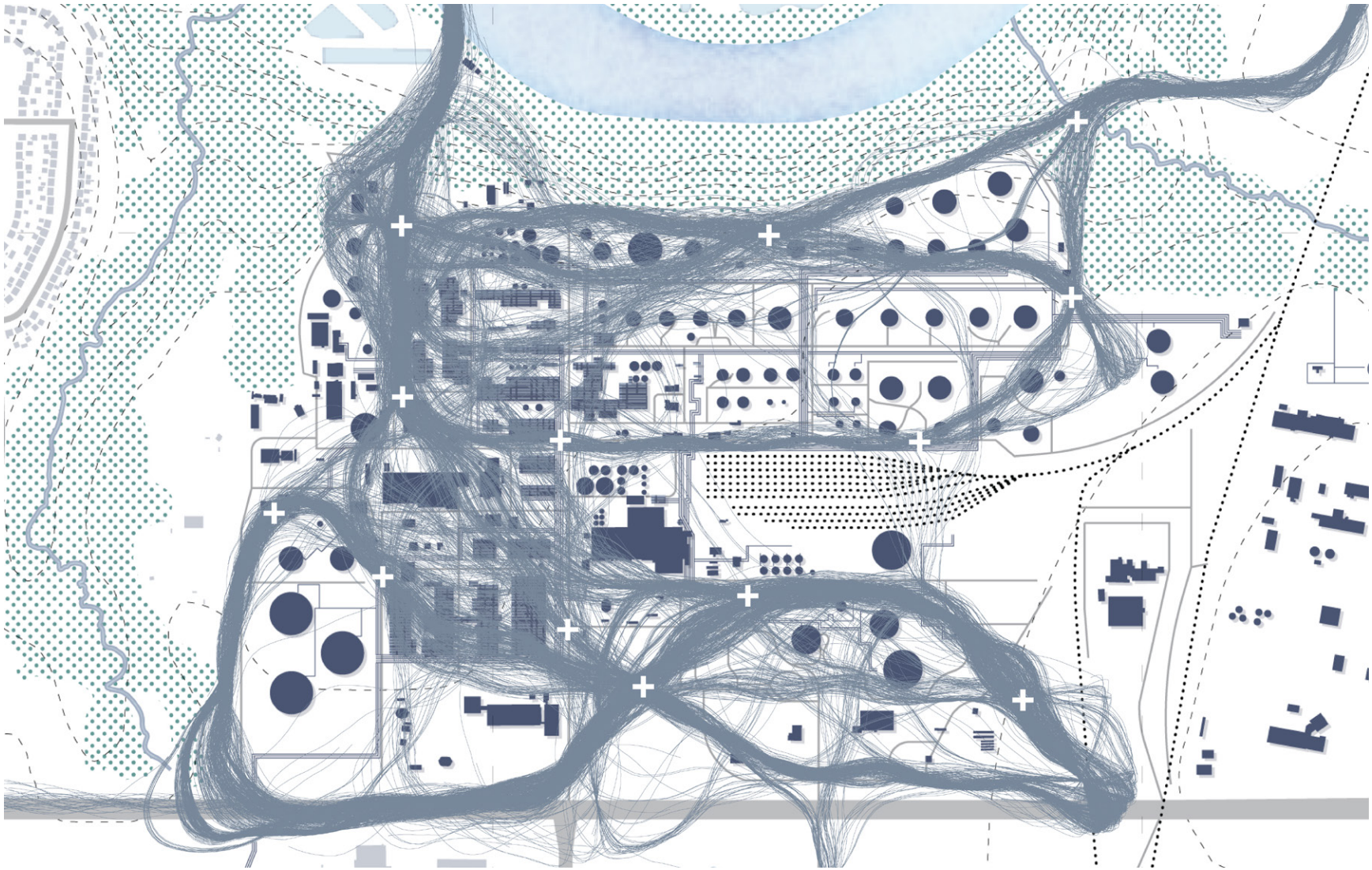
The lines created in the behavioural model from the users of the new energy landscape directly relate to the infrastructural lines of the site. This method of analysis supports the development of the Rhizome. Areas of intensity within the paths of the individual are identified and used to facilitate the growth of the Rhizome as required. With the understanding that the densification of lines is only possible as the system iterates, the Rhizome is defined as a system of growth rather than an object of development. Since the system is rooted in the relationship of people with new energy, the Rhizome only generates emergent forms for the new built environment. The branching of its lines represents the densification of user paths and identifies where points might take root.



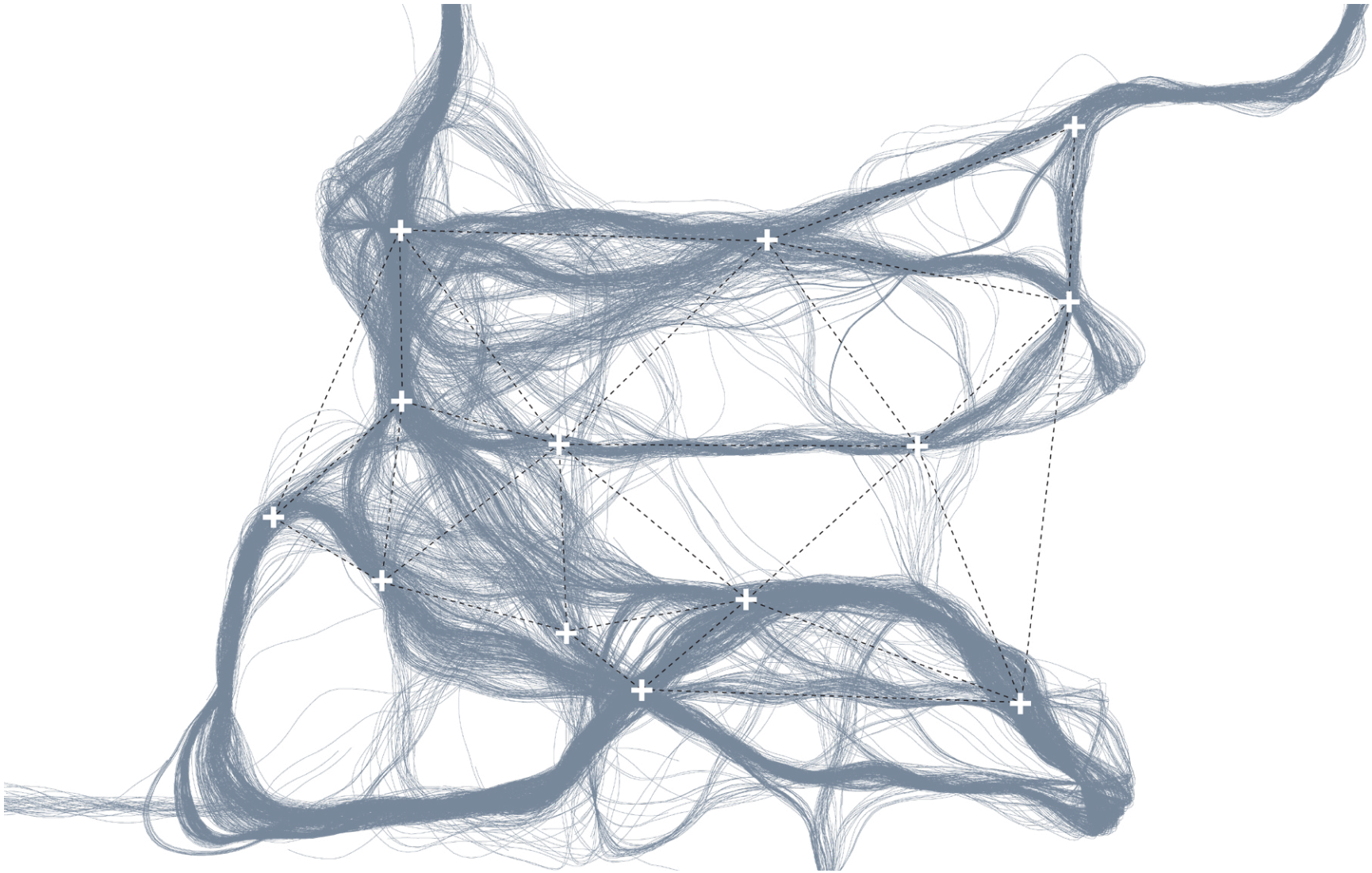
Attractors of Strathcona Imperial Refinery and their intensity of influence represented in luminosity of infrastructure.



Nine video stills outlining the organization of the Rhizome from the particle system at Strathcona Refinery.



The 5000 paths of the particles which organize the Rhizome lines and the points, subsequently, identified.

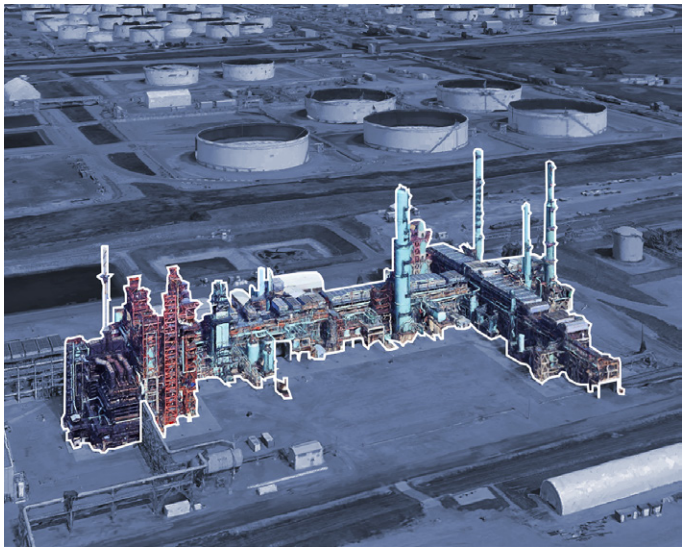


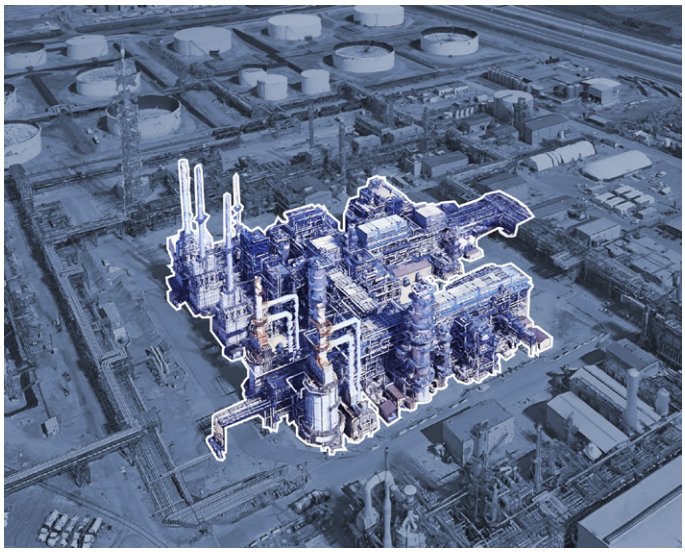
The geometry of the Rhizome: points, lines, and connections

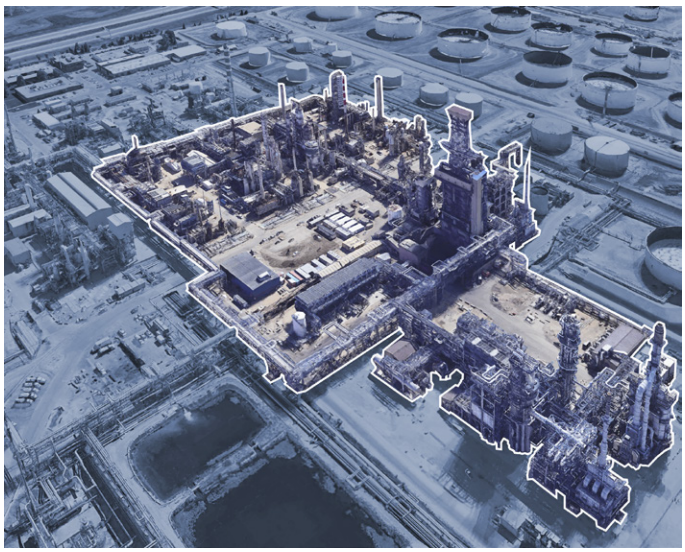
Activation [Points]

The lines of the Rhizome are determined by the user and are influenced by the existing oil infrastructure; the points of the rhizome are determined by the intensity of these lines. There are distinct points of intersection where flows of one group of lines collide with the flow from another direction. There are also distinct points of intersection where flows of one group of lines collide with the lines of the existing infrastructure. In both these scenarios the intensity of activity is heightened and constitutes a point of the new landscape, as described by Stan Allen. The oil refineries which once held this position are no longer the single defining characteristic of the site. Though their forms carried through into the new landscape they no longer, by themselves, constitute a point. The new landscape is activated through its integration with the community and the symbiotic relationship of people with new energy– this culminates in the points of intersection found in the density of circulation lines in the Rhizome.

The refinery towers, though not a point themselves, help facilitate the productivity of the Rhizome through refinement of new energy. The infrastructure of the oil refinery becomes a resource that the community is able to use to harness greater potential of the fields. The remediation biomass generated in the fields is able to be refined in the former oil infrastructure to generate biofuel.







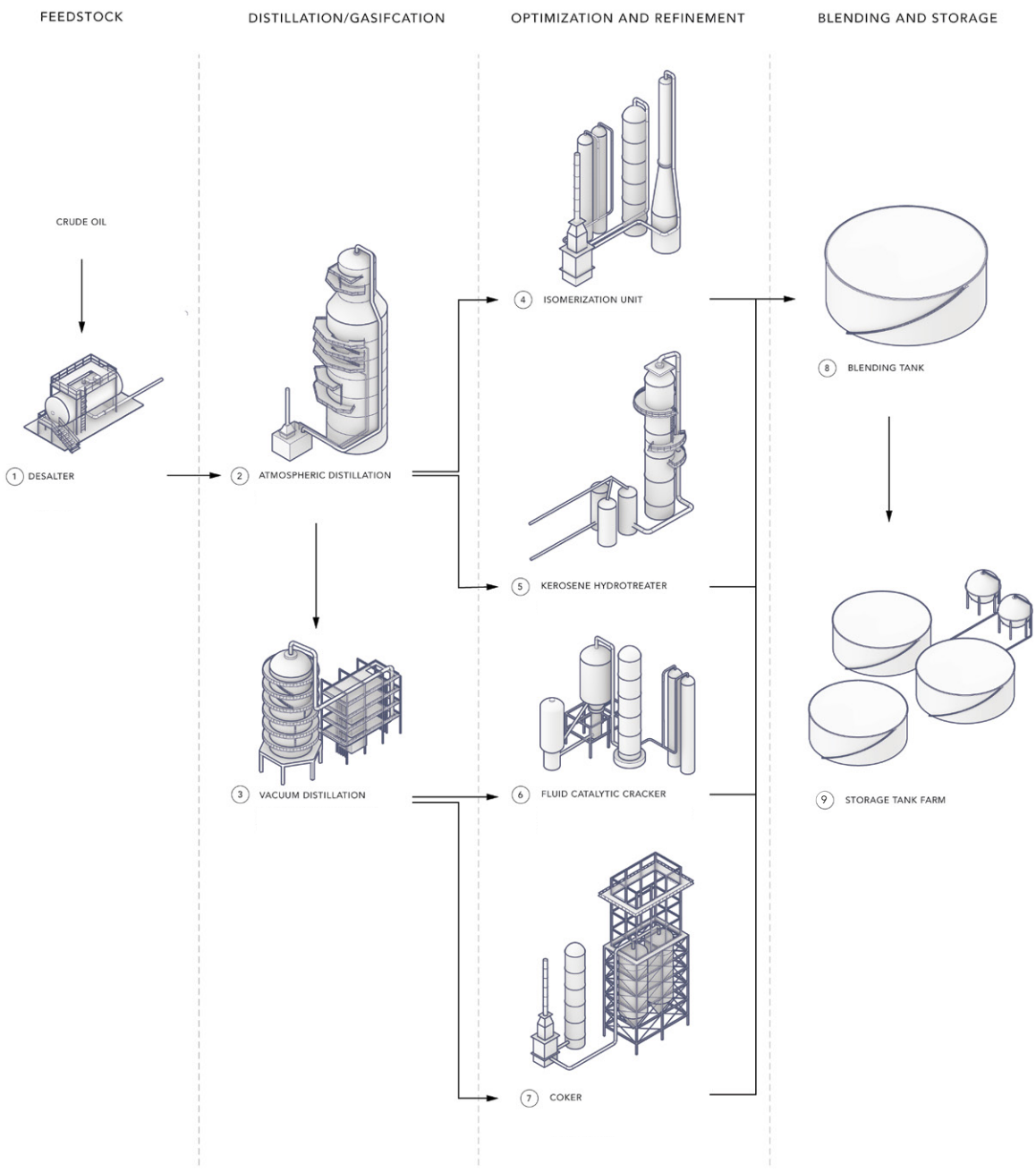
Oil refinery towers: points of a former energy landscape (base images from Google Earth 2020)

The biofuel industry is a renewable energy industry that generates energy through processing biomass, which includes organic waste material, agricultural waste products, and plants. Although the carbon neutrality of this industry is more nuanced than other renewable energy sources because it traditionally generates energy through combustion, releasing CO_2(g), it is still considered a renewable energy source by the legal frameworks of the United Nations, European Union, United States Environmental Protection Agency (US EPA), and Natural Resources Canada (NRCan 2016) because photosynthesis cycles the CO_2 back into new crops. Furthermore, this industry is often powered by the waste products of other processes, therefore adding value to the feedstock's origins. The carbon sequestration in the energy crops must compensate for all above grade emissions, including building infrastructure, land use changes, and transportation (Lovett, Sünnenberg, and Dockerty 2013); thus, in most scenarios, only high-yield crops have the capability to sustain a carbon-neutral or carbon-negative biofuel industry. This is, in large part, due to the high carbon cost of setting up biofuel refineries and corresponding transportation lines. As in the case of Refinery Row, the industrial infrastructure and transportation lines already exist mitigating the high carbon expenditures.

The technology behind the commercial biofuels industry is derived from the fossil fuels industry, resulting in similar processes which the two different types of refineries use (NRCan 2016). Biofuel end products vary from electricity generation, ethanol and methanol production, and bio-gas/bio-diesel/aviation biofuel production. The existing infrastructure in Refinery Row sets itself up well to generate

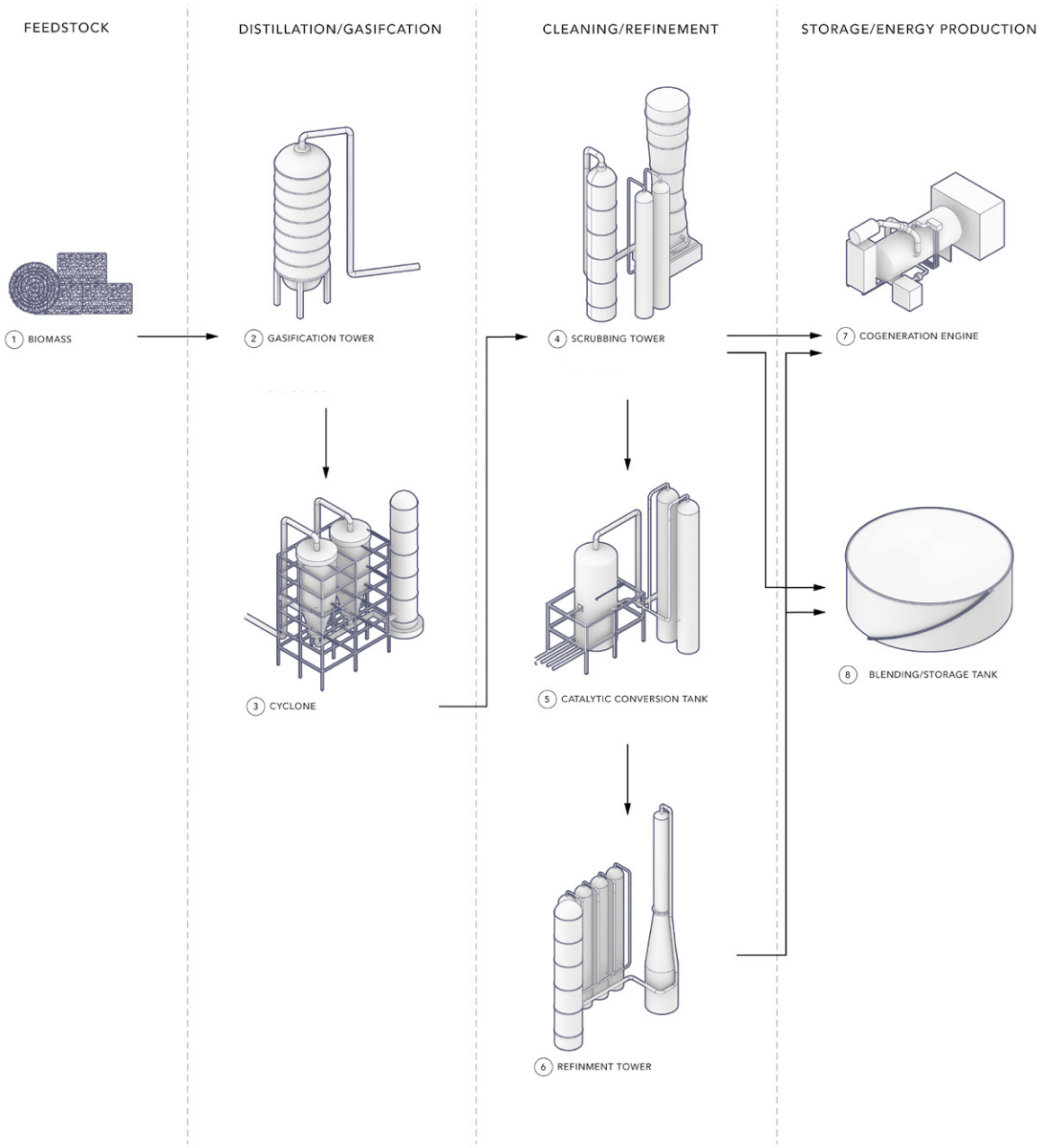
both electricity and fuel products. Not only are biofuel hydrocarbons “nearly indistinguishable” from petroleum-based hydrocarbons, the research and development of the conversion between oil refineries and biofuel refineries is already underway, with commercial scale facilities in Canada and the United States (Karatzos, McMillan, and Saddler 2014). Refinery Row’s existing conditions provide not only the land on which the feedstock can be harvested from but also the resources to refine the biomass into energy and transportation for the end products.

In addition to the energy that the refineries are able to produce, the process of distillation generates thermal waste energy. This thermal waste can be captured and recycled as thermal heat for the points of the site. Using a waste product of this new landscape, additional opportunities arise in being able to transfer this thermal energy into productive components of the site. By harnessing the thermal by-product of the new biofuels industry, the site is able to cycle the energy into its new buildings and walkways. Edmonton experiences some of the longest and coldest winters of any major city in Canada, therefore by being able to recycle thermal energy, a valuable resource in northern communities, there is significant value added in the site.



1. REMOVES HIGH SALT CONTENT PRESENT IN CRUDE OIL
2. HEAT EXCHANGE VAPOURIZES CRUDE OIL INTO DIFFERENT CRUDE OIL FRACTIONS
3. "LOW TEMPERATURE DISTILLATION": DISTILLATION IN A VACUUM WITH LOWER TEMPERATURE
4. CONVERTS LINEAR MOLECULES INTO HIGHER OCTANE, BRANCHED MOLECULES
5. REMOVES SULFUR AND OTHER IMPURITIES IN KEROSENE
6. 'CRACKS' OR BREAKS HEAVIER, HIGHER BOILING POINT LIQUID FRACTIONS INTO SMALLER FRACTIONS WITH HIGH TEMPERATURE AND PRESSURE
7. BREAKS HEAVY OILS INTO SMALLER HYDROCARBONS THROUGH THERMAL AND CHEMICAL CRACKING
8. VARIOUS FRACTIONS ARE BLENDED TO CREATE HIGH VALUE PRODUCTS
9. CYLINDRICAL TANKS AND SPHERICAL TANKS, FOR VAPOUR PRODUCTS, HOLD REFINED PRODUCT BEFORE TRANSPORTATION

Oil refining process and infrastructure.



1. WASTE OR VEGETATION SHREDDED, CHIPPED, OR DRIED
2. OXYGEN POOR CONDITIONS WITH HIGH HEAT. CRACKS MATERIALS INTO BASIC CHEMICAL COMPONENTS. CREATES 'SYNGAS'
3. SPINS GAS TO REMOVE SOLID PARTICULATES. SEPERATES SYNGAS AND DEBREE.
4. WATER TREATMENTS CLEANS AND COOLS SYNGAS
5. CATALYSTS BLENDED WITH CHEMICALS IN SYNGAS TO CREATE VALUE ADDED PRODUCTS
6. UPGRADES AND PURIFIES CHEMICALS
7. CONVERTS CHEMICALS INTO ENERGY THROUGH INTERNAL COMBUSTION
8. VARIOUS FRACTIONS ARE BLENDED TO CREATE HIGH VALUE PRODUCTS

Biofuel refining process and infrastructure.

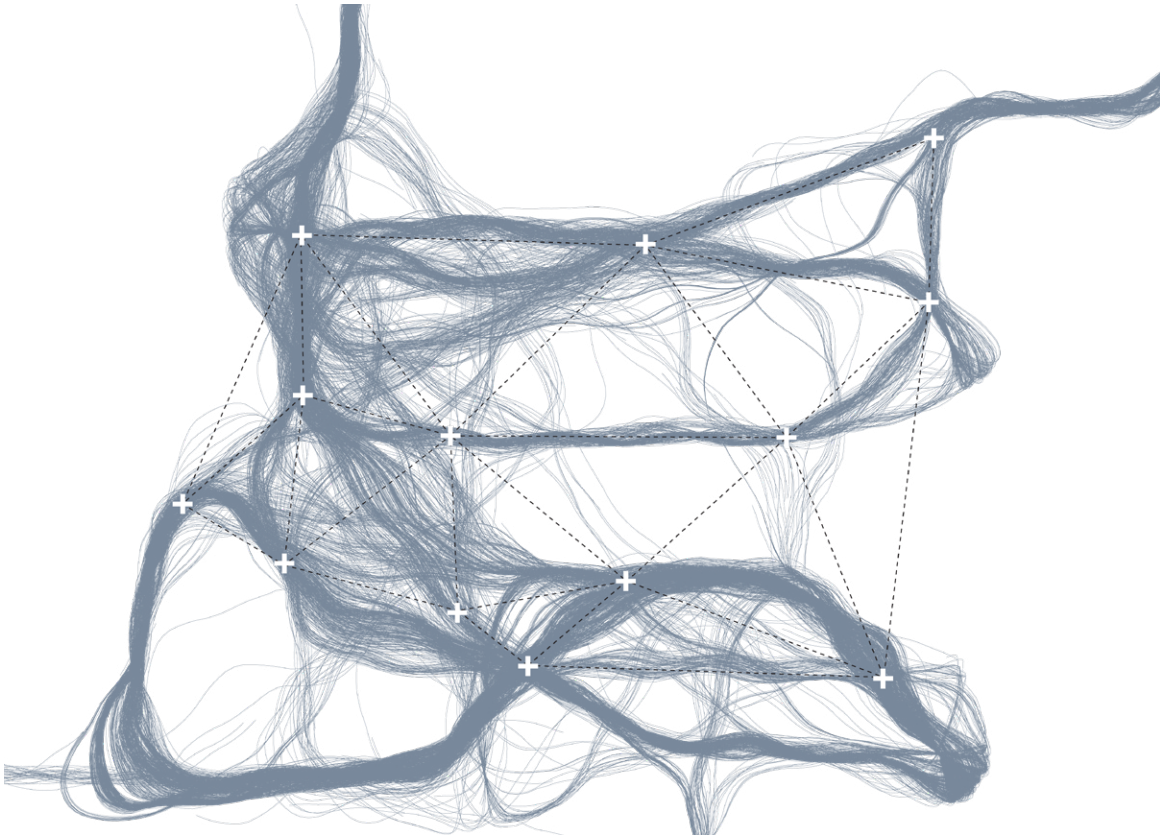
Coincidentally, adjacent to Refinery Row is the Edmonton Waste Management Centre and Enerkem Alberta Biofuels, the world's first major city waste to biofuels producer (NRCan 2019). This pioneering biofuel plant redirects 90% of Edmonton's waste into productive green chemicals, ethanol and methanol (Enerkem 2019). Demonstrating that this strategy is feasible in-situ, Refinery Row will function similarly to the waste-fuel relationship between the Edmonton Waste Management Centre and Enerkem; Refinery Row will both produce its own feedstock, through phytoremediation crop harvests, and refine this by-product on site.

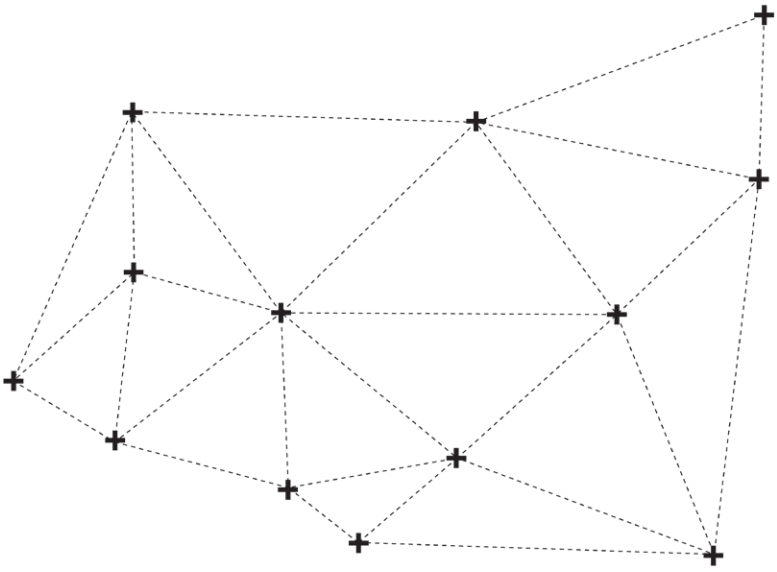
There are concerns over land use and sustainability in energy sectors that are using arable lands to grow energy crops (Alternative Fuels Data Center 2019). This is not the case in Refinery Row where biomass is generated as the by-product of a reclamation system on land which is not considered arable and not suited for most other programs. Furthermore, phytoremediation plants, by their nature, are high yield in biomass forgoing concerns of inadequate carbon sequestration. Canadian energy crop plantations are able to produce 10-15 oven dry tons of biomass per hectare (NRCan 2016). Across the 550 hectares that Refinery Row sits upon, over 8000 tons of oven dry biomass can be harvested equating to approximately 43.5GW to 50.4GW of electricity (Alternative Fuels Data Center 2019; Canada Energy Regulator 2019; OMAFRA 2011).

The refining component remains an important and valuable asset to the site but it no longer serves as a defining

character of the site. The biofuels refinery takes a supporting role to the remediation of the fields and the revitalization of a community's relationship with energy. The points of the site become spaces that intend to take advantage of the intersectionality of the lines which represent the people. They, like field conditions, become vessels of embodied potential which are used to activate the site through additional programming and infrastructural supports. The number of points on the site becomes a measure of time, as they account for the number of iterations the system undergoes. As the result of an emergent method of analysis and design the points of the site adopt this bottom up approach in responding to the variety of users that may use the site. For energy operations of this magnitude, teams of people will be needed to ensure the system functions as a closed loop system. The variety of points that emerge at different times across different locations across the site are adapted to serve the needs of the many workers that require resources on site.

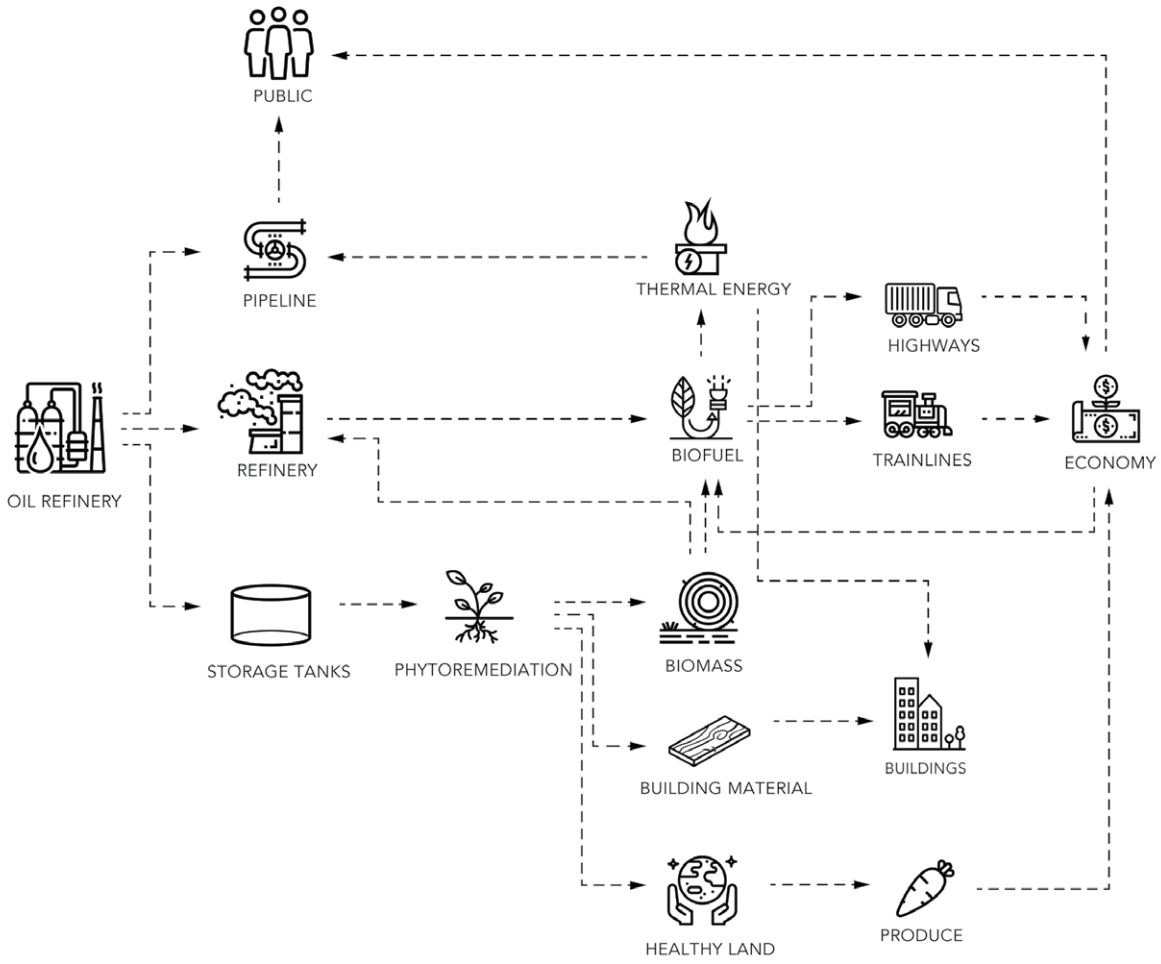
Across the site there are 13 identified points that emerge through the mapping of the lines. These points are varied in programs and time of construction. This thesis uses the southern cluster of three points as a case study in how a point can emerge, how the point relates to the lines and fields, and how subsequent points are developed. Every point is governed by the same overarching intention of remediation, sustainability, and connectivity. However, every point emerges as a response to activity.



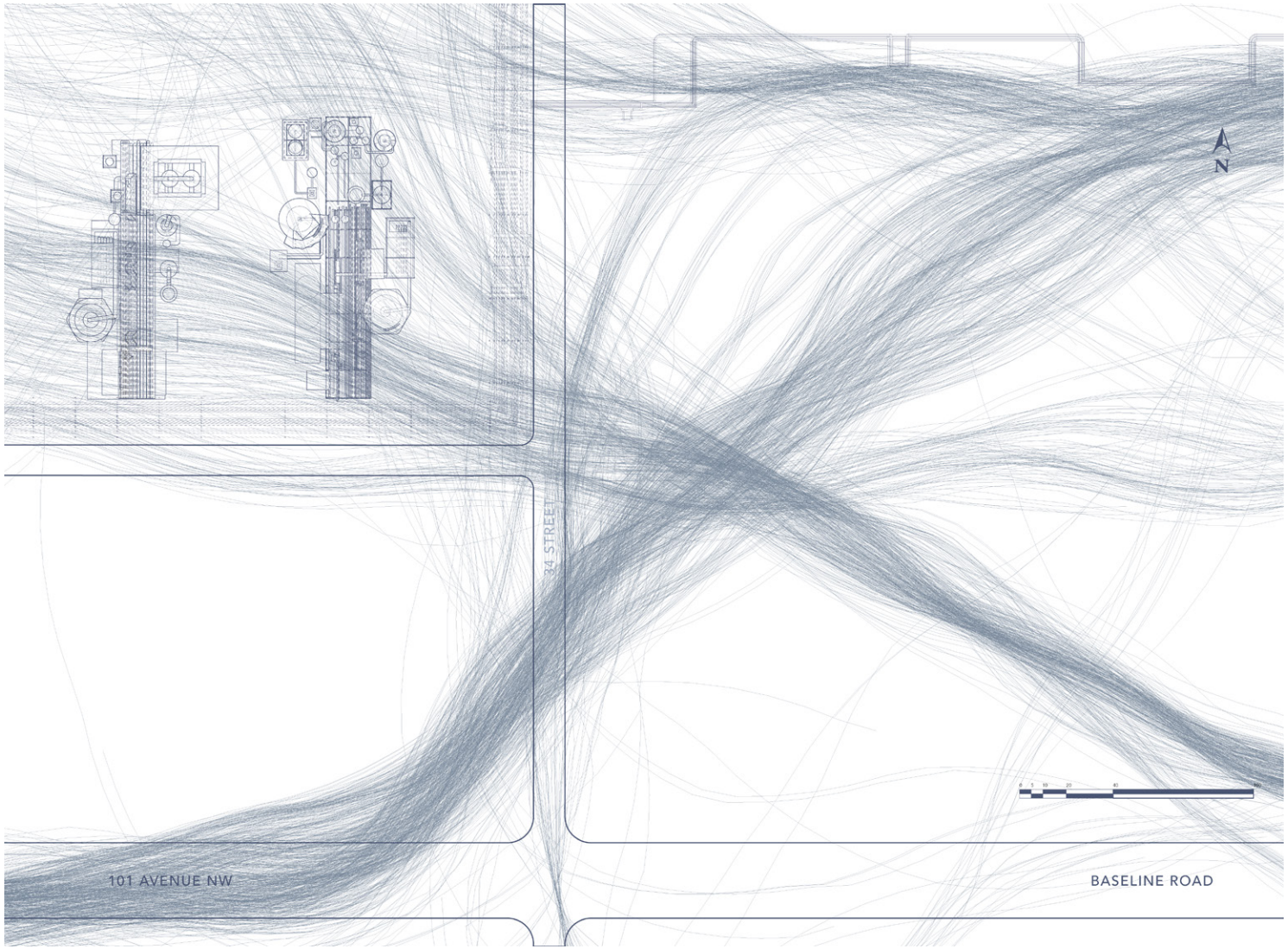


The lines and points of the Rhizome.

It is intended that through the development of points, the energy system is continuously rejuvenated by the resources and innovations that root from these areas of activity. Energy and circulation tie into the systems approach of the project, reengaging/reinterpreting different parts of the former oil refinery for a new future. The site will be powered by the remediation process that the project focuses on and uses its waste products in a productive manner. This closed loop system intends to evaluate the site as an organism where energy, people, and biology all factor into the organization of the new energy landscape.



Closed loop systems diagram of the Rhizome.



Rhizome lines of the first point

The Variable of Time

The mark the energy industry has imprinted on the land cannot be erased; it has been embedded in the soil and has changed the constitution and definition of landscape in Alberta. Anthropogenic events, such as the Age of Oil, have triggered and accelerated the global rate of change to an extent that ecologists and engineers are no longer able to predict the outcomes of future ecology (Choi et al. 2008, 53). Given the magnitude of industry and severity of contamination addressing revitalization and new development requires time.

Ecologists have moved away from traditional notions of restoration, and now focus on reclamation and engineering resilient landscapes for the future. This shift in perspective stems from the premise that “valuing the past when the past is not an accurate indicator of the future may fulfill a nostalgic need but may ultimately be counterproductive in achieving realistic and lasting restoration outcomes” (Harris et al. 2006). Furthermore, the rates of change that are currently experienced have never been applied to any environment in the last thousand years therefore “an ecosystem that is restored for the past environment is not likely to be sustainable in the changing environment of the future” (Choi et al. 2006, 53). The scale of landscape that the oil industry has disrupted is beyond any restoration project previously undergone. Thus, recreating landscapes of this scale is a long-term construction project considering the magnitude of contamination (Johnson and Miyanski 2008). Refinery Row’s decontamination strategy employs

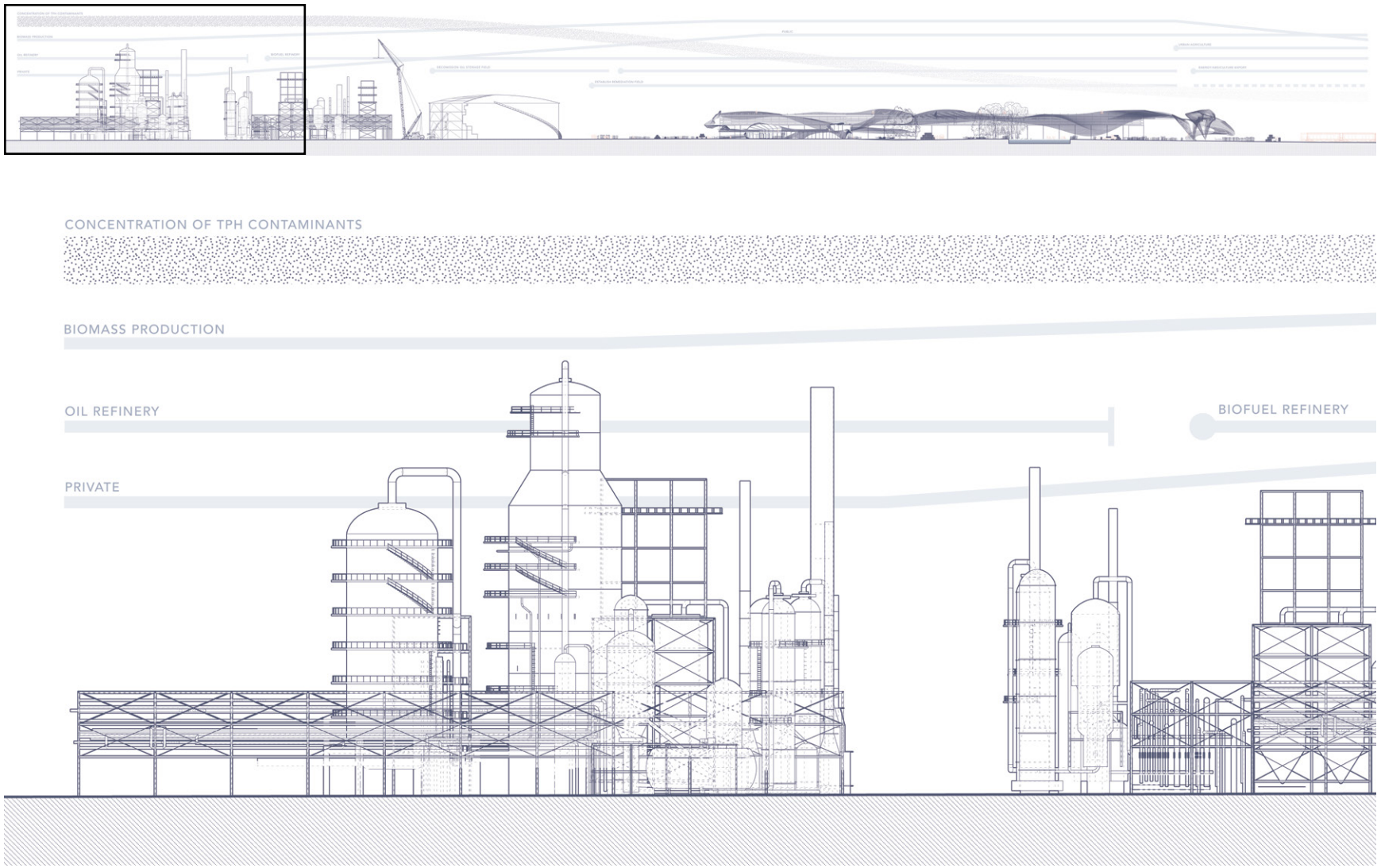
notions of resilience in its remediation in order to account for a changing climate.

The infrastructure in Strathcona Imperial Oil Refinery is the product of the contemporary notion that with new technology and the unlimited energy resources available, time is a negligible variable in development. This encapsulates the lack of environmental foresight shown by society, lead by the energy industry. The speed at which modern society operates in the Petrol-Grid is disjointed from the reality because the Petrol-Grid is designed for and proliferates through efficiency and rapidity of growth. Inherent in the principle of bioremediation is the element of biological time, which cannot be accelerated through technological advancements. Using the timeline outlined by Kennen and Kirkwood regarding the efficacy of phytoremediation the new energy landscape is developed over ten years. This timeline is based on plant growth and the natural seasons. This thesis assumes a, relatively conservative, rate of TPH degradation of 50% TPH degradation per season. Given this rate of degradation in 8 years the contaminants will be reduced and stabilized to a level which satisfy the World Health Organization human risk factor (World Health Organization 2019).

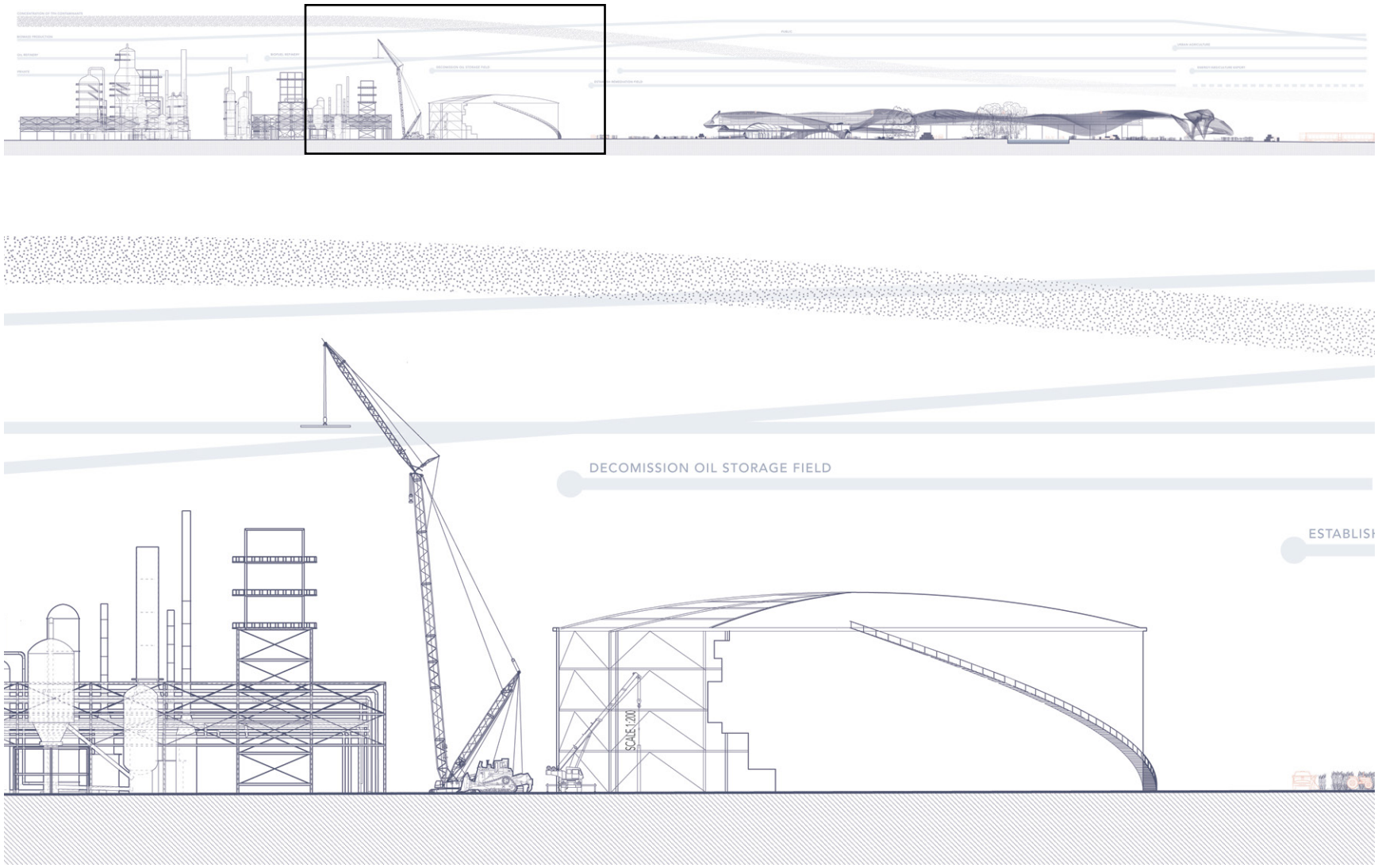
However, this supposed rate of decontamination can only be used as a hypothesis. The rate of decontamination is regulated by the efficacy of the remediation plants; the remediation plants are at the whim of the changing seasons and climate, as well as other external factors. Therefore, since, future development of the site is dependent on the soil

being decontaminated time is the most important variable in this project. Time regulates the rate of decontamination in the fields, the growth rate of the lines in the Rhizome, and the propagation frequency of the points. The Rhizome is a function of time, its components manifest as the physical representation of movements through time.

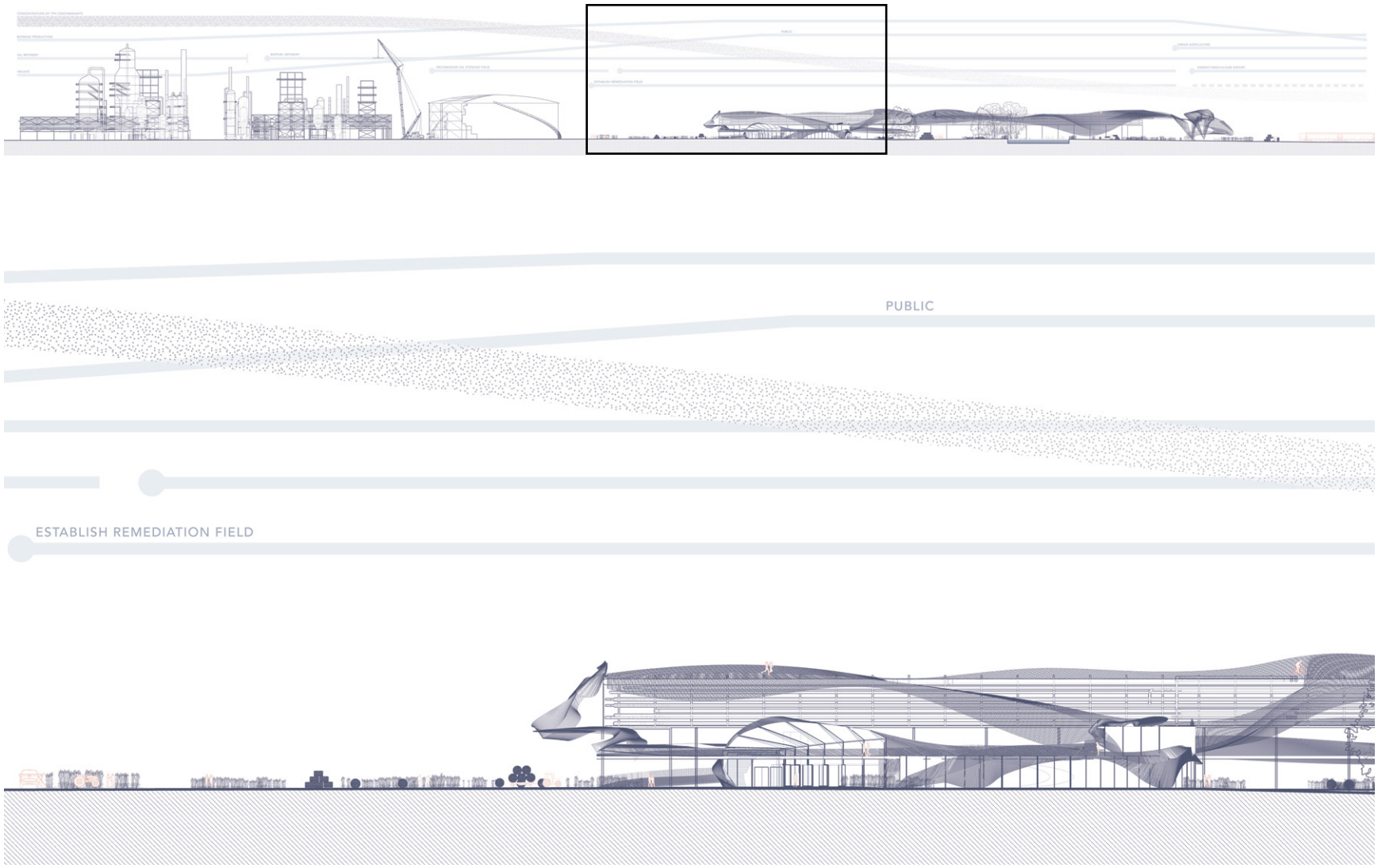
The development of the Rhizome Logic is an emergent one, it is one that is responsive to the users of the group. Though its core tenants, remediation and reconfiguration of the Petrol-Grid, the methodology is flexible and non-prescriptive. The variable of time is one that is often forgotten in the Petrol-Grid (as it minimally affects the rate of development) but is the regulating factor of this test site. There is no realistic development suitable for this site unless the heavy contamination is addressed; the contamination is addressed through remediation which requires time.



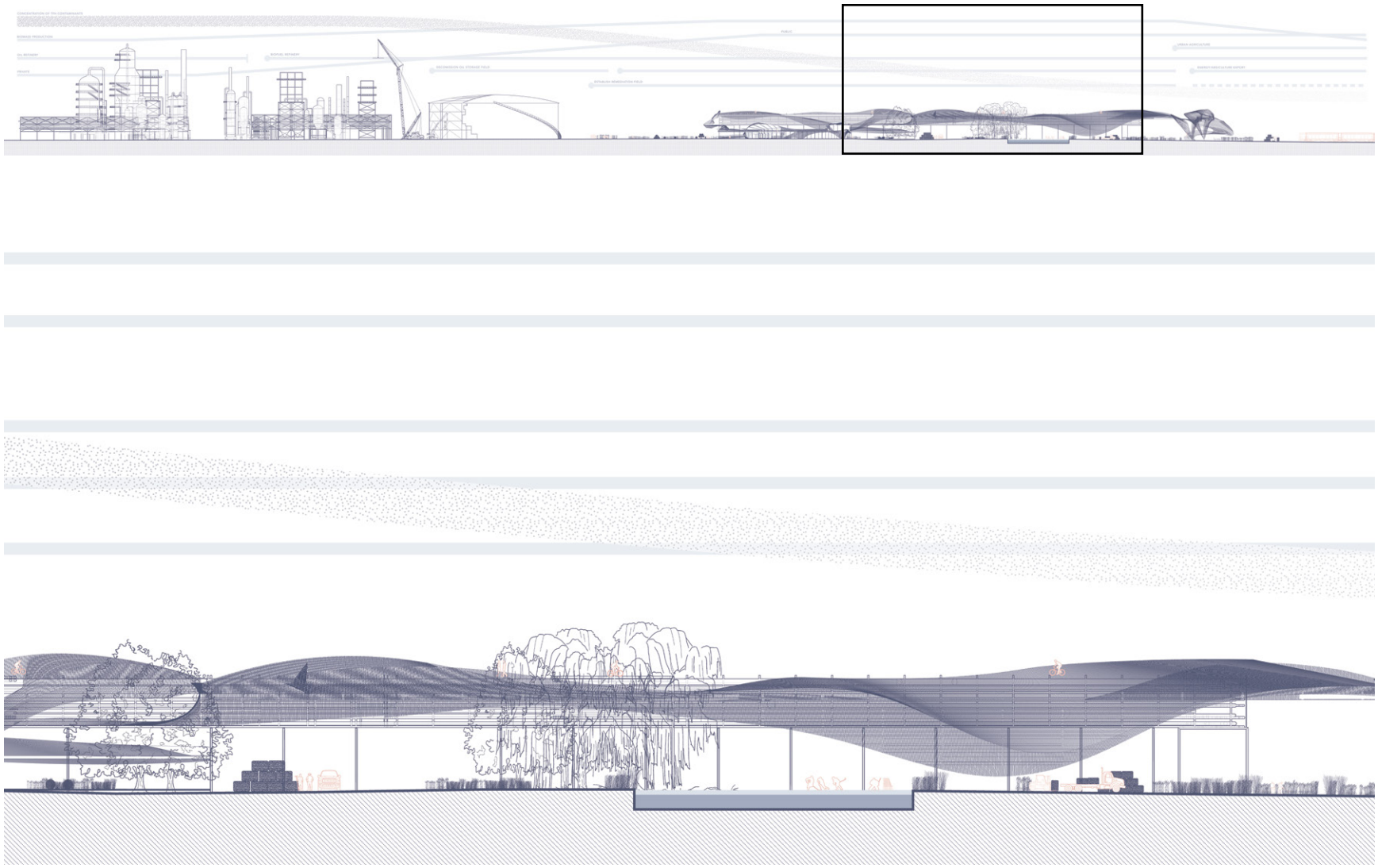
A section through time: the oil refinery



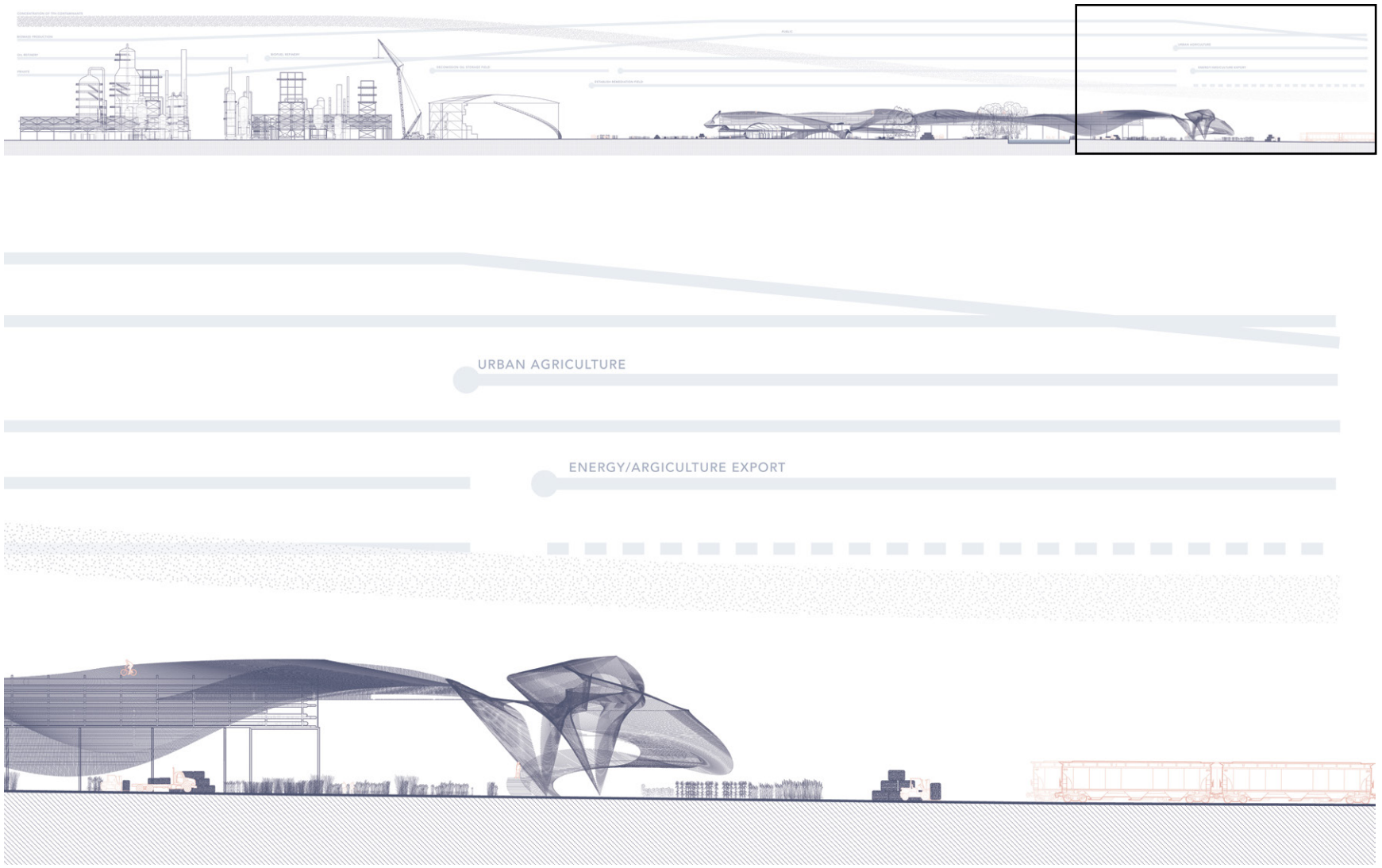
A section through time: the beginnings of a biofuel refinery by recommissioning oil infrastructure



A section through time: the beginning of remediation plants and new energy



A section through time: connecting with the community through recreation and acess



A section through time: transitioning into urban agriculture and new energy futures

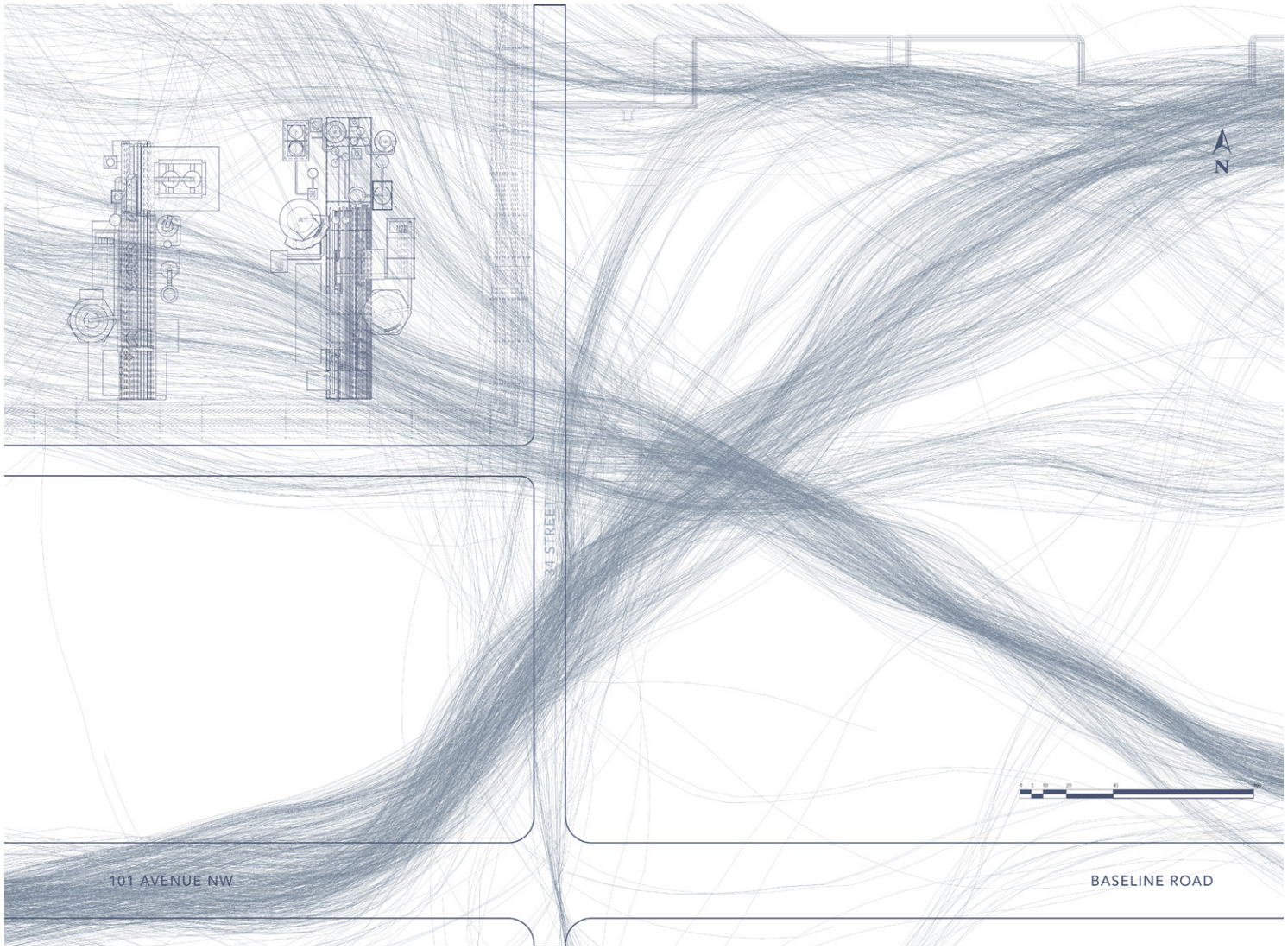
Chapter 4: The Architectonic Point

Initial Point

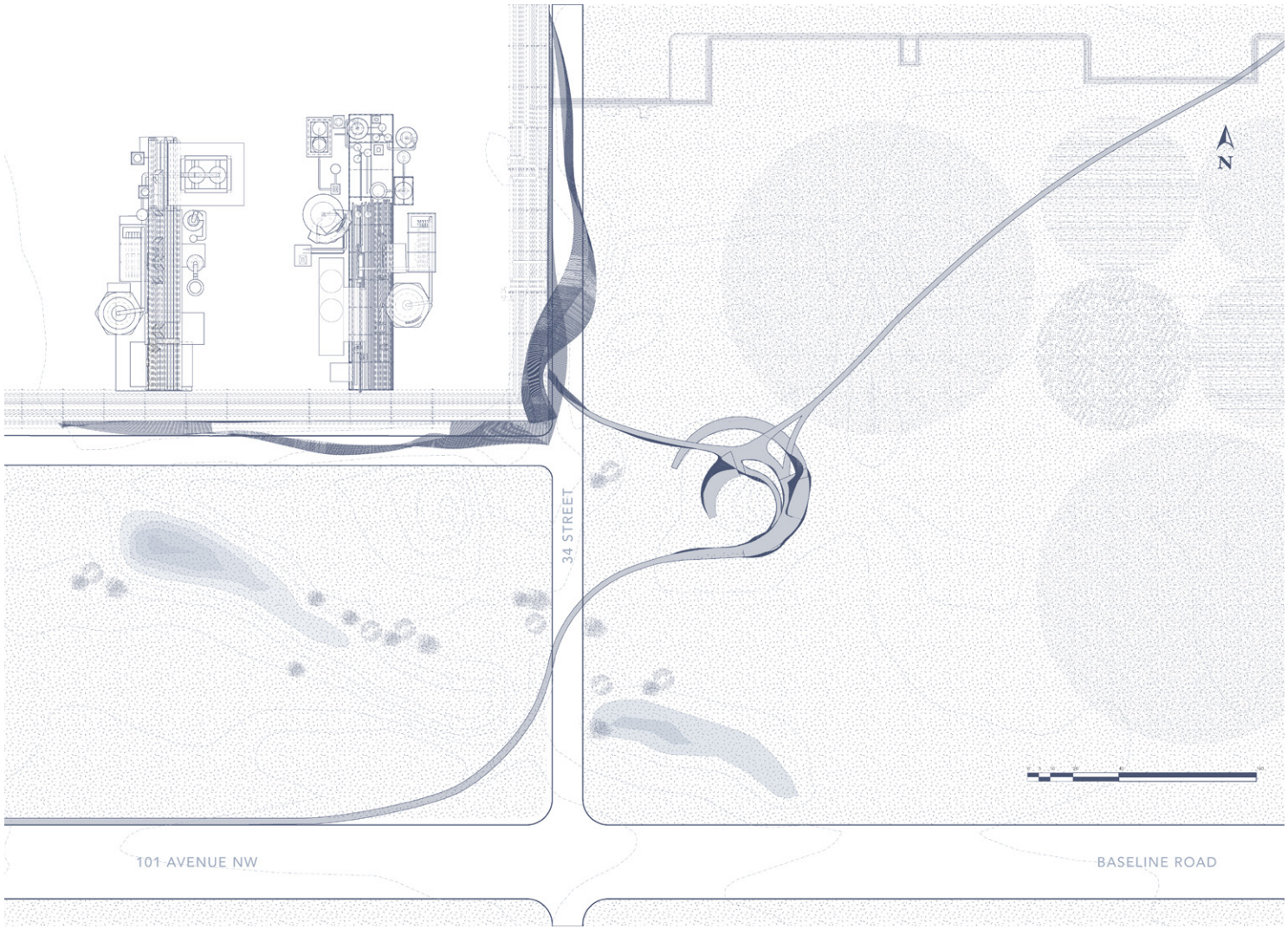
The initial ‘Seed’ of the Rhizome emerges as the intensity of the circulation highlights points of intersection. The ‘Seed’ refers to the intersection near the southern entrance to the site– the first knot of lines to emerge as a point. The initial point, the seed, is established as the first piece of engagement with the users. The seed is intended to be the first point of activation in the Rhizome Logic and is developed in relation to the first prominent cluster of lines, at one of the largest intersections of the site. The point intends to capture the kinetic energy of the user groups that gave rise to the point– this would predominantly be of public users, researchers, and farmers. This initial set of three actors on the site establish and support the program of the Seed. As the seed of the rhizome it sets up the initial relationships of the users with the subsequent points, lines, fields.

Located near the southern entrance of the site, the point positions itself to address the public front of the new landscape and in contrast with the former oil refinery. The first point, or Seed, acts as a dialogue between the active working remediation and the casual public visitation of the site. The Seed assumes its role as a point in the Rhizome through encapsulating and supporting the intersection of users of the site. The architecture reflects these notions of emergence and circulation; it describes the movement of the users while juxtaposing itself from the utilitarian rigidity

found in oil forms. The first point, as with all elements of the Rhizome, are developed to visually express the circulation across the site. The paths of individuals are spatialized and become the structure of the system. These undulating lines carry forward the language of the oil refinery in their similar use of pipes as circulators. These new pipes form the structure of the new architecture and also connect with the piperails of the former oil refinery, this creates the opportunity to carry the thermal by-product of the biofuel refinery into the points to be used as the heating strategy of the entire system. The points share the same visual expression of movement in the oil refinery, directional repetition, however, additionally uses this strategy as enclosure. Taking precedence in the billowing undulations of prairie grasses the architecture ribbon throughout the fields enclosing spaces and forming both line and point acting as thermal regulator, structure, and circulation. The circulation lines of this intersection culminate as two pieces of architecture woven together and into the site at the first point: the Ostium and the Arura. This point brings together the public, the researcher, and the farmer by connecting each actor with a similar entry sequence. This initial point connects the different actors of the site through interwoven spaces at the Seed and then redirects each actor through different paths to corresponding parts of the Rhizome. The Ostium acts as the public face of the first point, enclosing public amenities and programmatic supports for the system. The Arura compliments the public face with dedicated, semi-private, remediation research space.

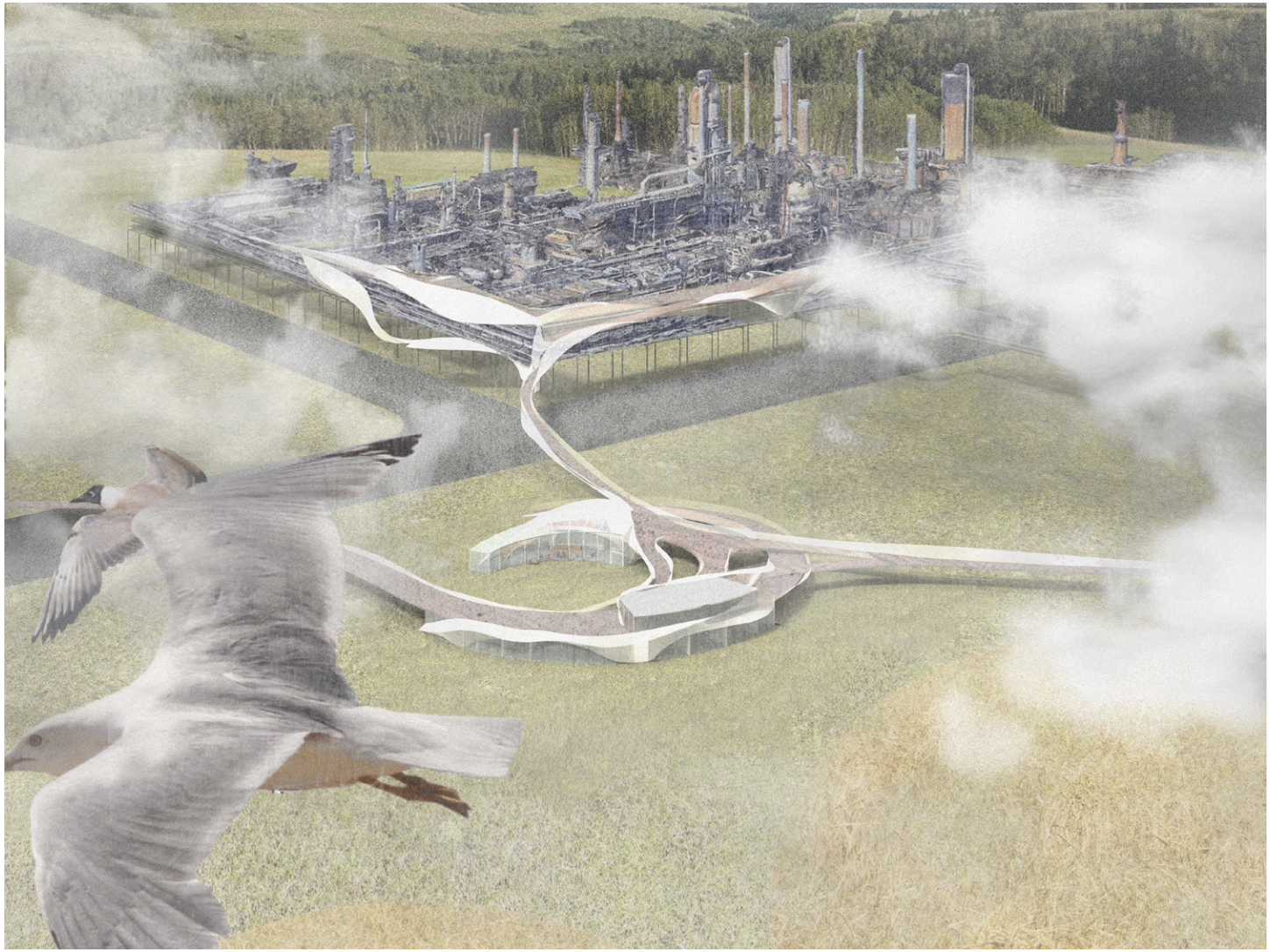


Circulation lines of the first point.



Site context of the first point.

Given the position of the point, in a comparatively less contaminated area of the refinery, the Seed is developed as both a threshold and a microcosm of the site. This allows the public visitors to experience and engage with the remediation process in a controlled and safe way. The two buildings enclose a courtyard space terraformed into an amphitheater of remediation vegetation. The rising slope of the courtyard provides room for vertical layering of the remediation plants and more optimal views from the Ostium. The remediation across the entirety of the site is condensed into an experiential biome ‘contained’ within the first point. The remediation amphitheatre creates space for the summertime visitors of the site to learn about new energy and the wintertime visitors to enjoy tobogganing– activating the space through different means year-round.



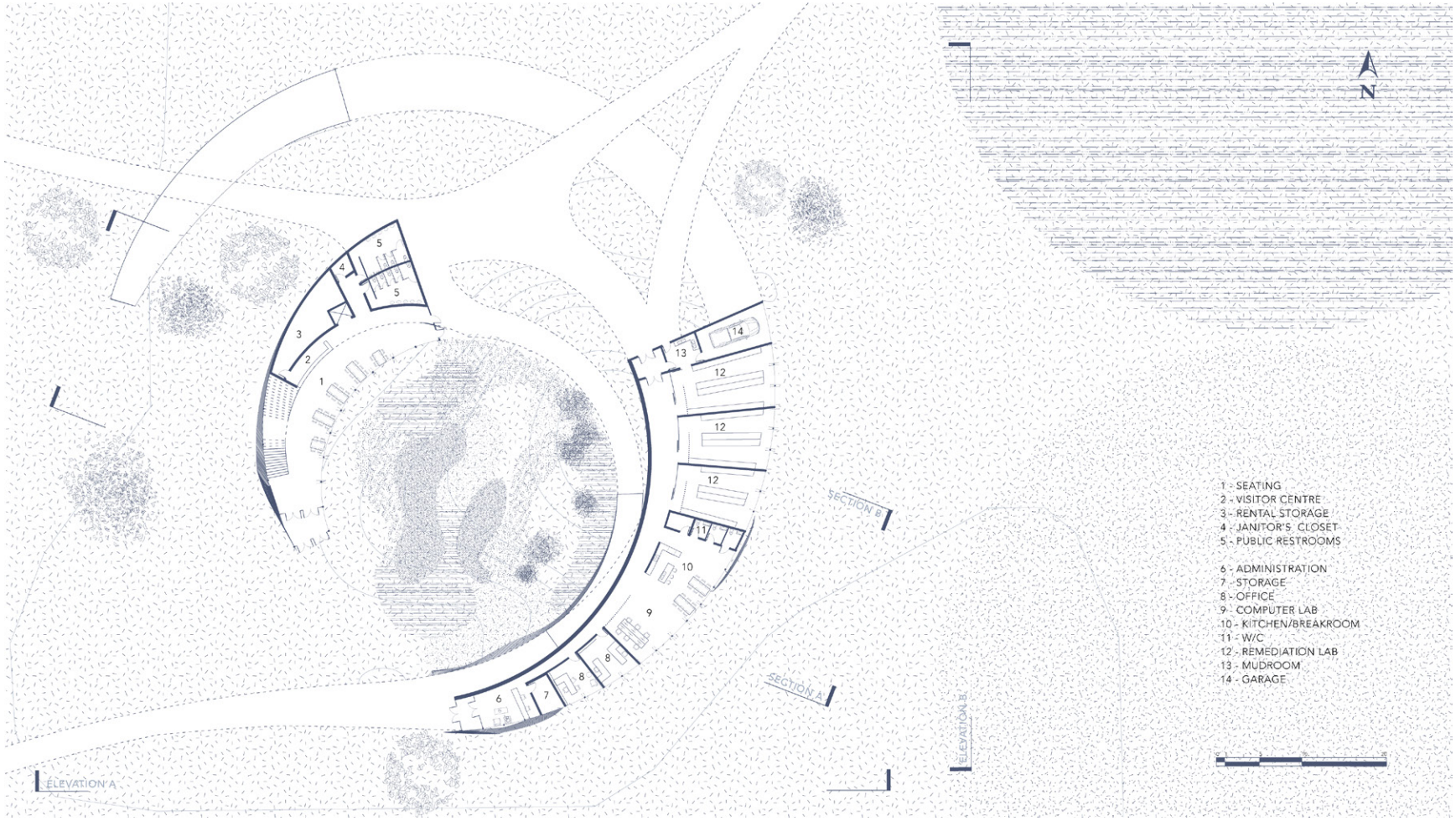
Aerial view of the first point and Strathcona Refinery | summer

Ostium and Arura

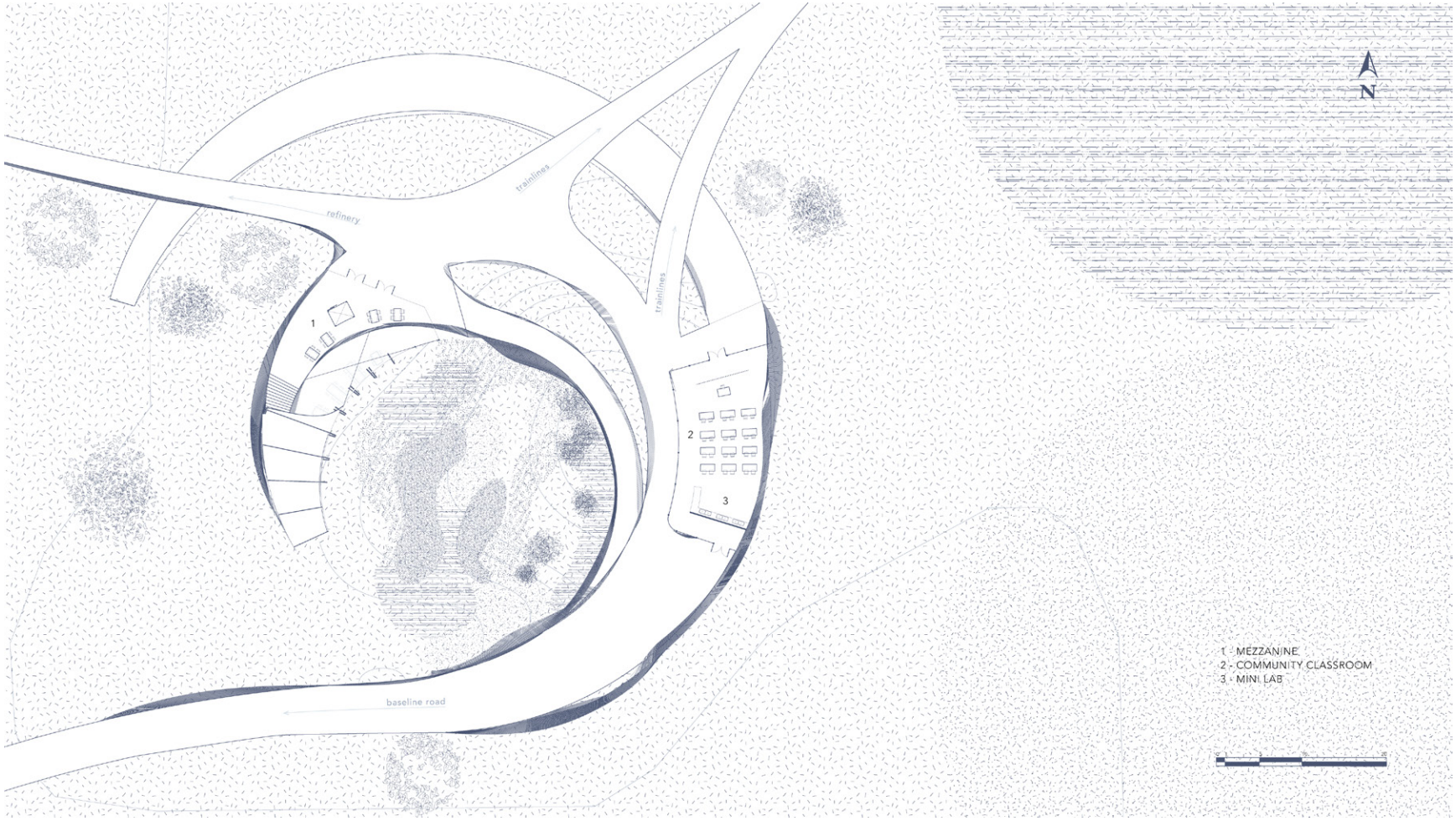
The public component of the first point wraps around the western side of the amphitheatre. The Ostium stands as a welcome to the public onto a previously private site. Similar to the new infrastructure of the Rhizome, the form of the Ostium reflects the circulation that runs through the building; it connects directly into the Arura and the rest of the Rhizome. Its spatial composition is derived to be directly complimentary to the field conditions it exists within and the amphitheatre field it defines.

Visitors to the site arrive either through the elevated walkway or on the on-grade paths. Upon arriving at the first point the user experiences the emergence of sinuous weaving lines of the new built forms, they act as visual directional cues and markers of paths. The entrance into the Ostium is translucent on one side and transparent on the other, directing the public visitor's gaze towards the remediation amphitheatre. The seating area that follows the inside curvature of the building sits next to the transparent Eastern wall. In the warm summer and fall seasons this wall opens into the outdoor space, encouraging the seating space to spill out, erasing the delineation between indoor and outdoor spaces. In the snowy winter and spring months these walls are closed to provide refuge and warmth. With the gentle gradation of the remediation hill at the foot of the building, there is high porosity from the Eastern face of the building and the outdoors. Along the outside curvature of the Ostium is the staircase leading to the upper mezzanine and elevated paths. The pipes that form the building wrap around its form creating an enclosure with a continuous

floor-wall-roof system. The ribbon of pipes that create the facade also flow into the Ostium structuring the staircase and organizing the programs within. To accommodate the public's use of the site, the Ostium provides a visitor's centre where the community have access to rental bikes, skates, toboggans in order to maximally use the site. The mezzanine overlooks the seating area of the Ostium but more intentionally, provides perforated views of the refinery. The industrial monumentalism of the refinery only reveals itself once exiting the building onto the elevated paths. Whereas the first level directed the visitor's views internally towards the vegetation, the second level directs the visitors' view externally towards the main refinery and Edmonton's skyline. This space opens up outside into the active networks of the circulation lines. The indoor spaces of the Ostium are not intended to facilitate long term gathering but rather a 'starting point' or 'entry point' and occasional 'refuge point' to the Rhizome. The Ostium acts as the public portion of the point, complimentary to the semi-private Arura.

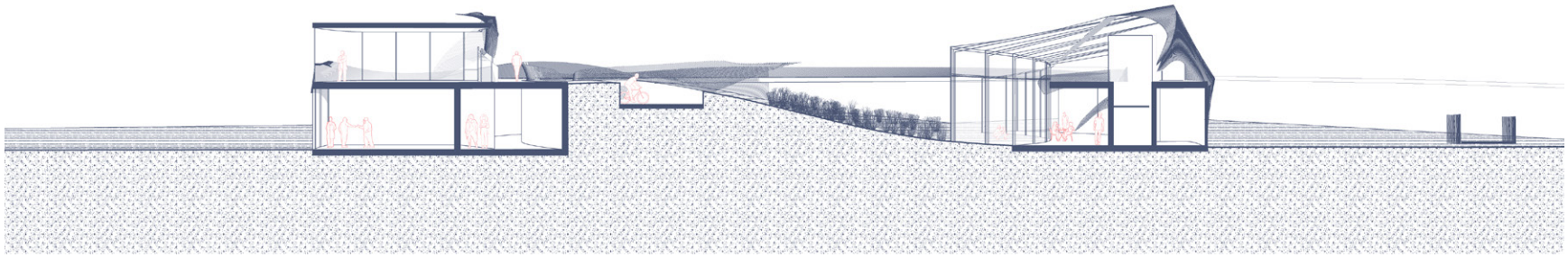


Level one floor plan. The Ostium, remediation amphitheatre, and the Arura in relation to the nearest fields

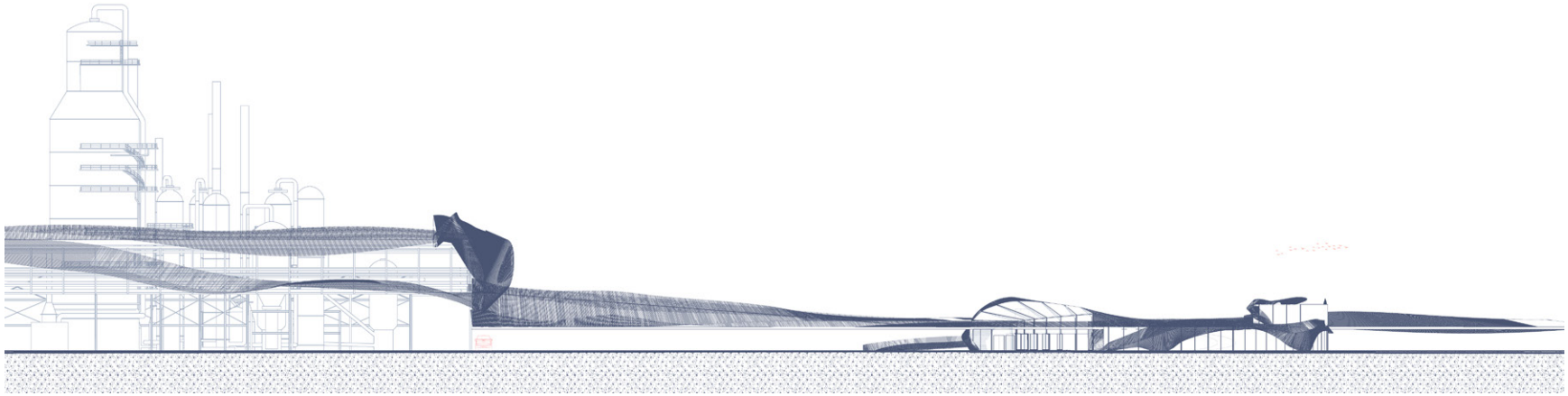


Level two floor plan. The elevated pathways and where they lead to from the first point

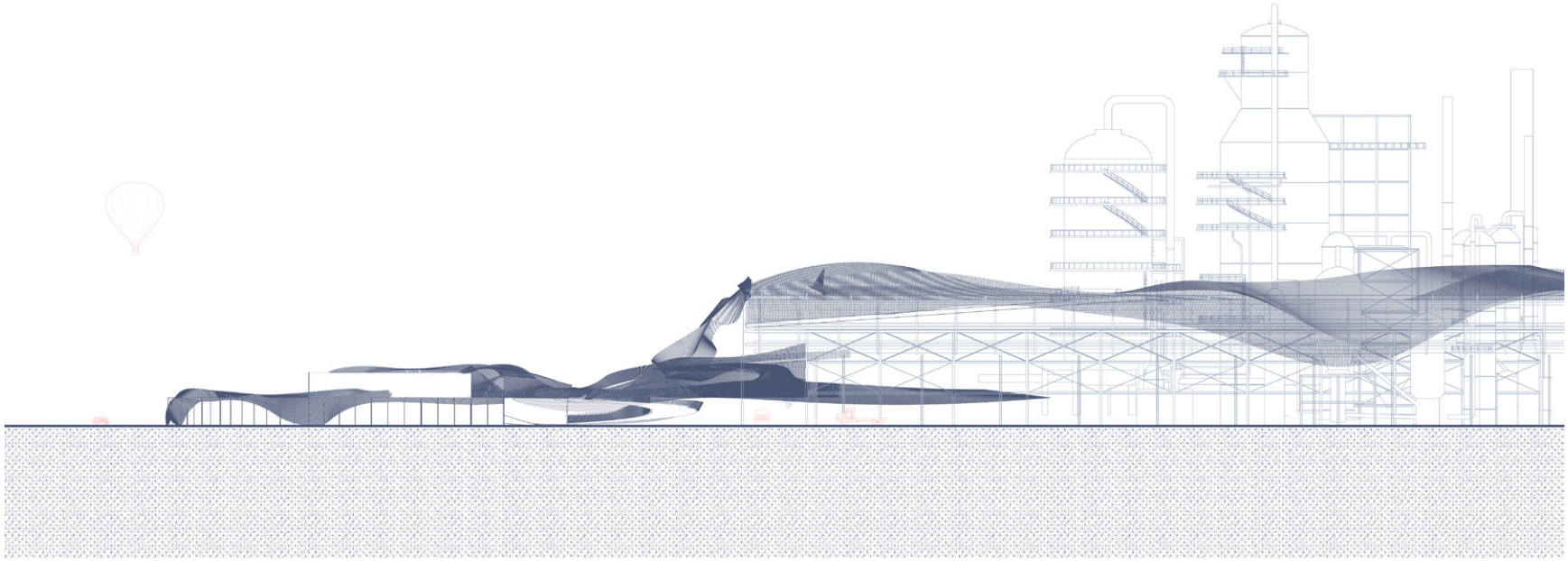
Section A. A central remediation space enclosed by a public side and a private side.



Section B. The gradation of the remediation amphitheatre



Elevation A. The point and its relationship to the refinery through its lines.



Elevation B. The point and its relationship to the refinery through its lines.

Views from inside the Ostium | spring

The Arura wraps the Eastern edge of the point. The building itself leans into the remediation hill and therefore reflects the duality of transparency seen in the Ostium. Entry into the Arura is intentionally more subdued than its public counterpart. The entry foyer faces the administrative front desk and waiting area. The circulation of the laboratory starts from the front desk and hugs the inside, opaque wall of the building connecting all the programs along the single-loaded corridor. The eastern facade of the Arura, similar to the eastern facade of the Ostium, and has the same system of operable walls. This transparency gives the researchers expansive, convex views of the fields they are tasked to monitor and remediate while providing the same porosity and outdoor space as that of the Ostium. The break room/kitchen divides the two spaces of work and employs the same strategy of indoor/outdoor space additionally providing entry into the building through this common space. The northern end of the building is serviced with a garage, for vehicle access into the fields, and a wetroom/mudroom. Primary entrance into the labs are through the single loaded corridor, though there is an additional entrance to the North lab from the mudroom for ease of transportation of samples.

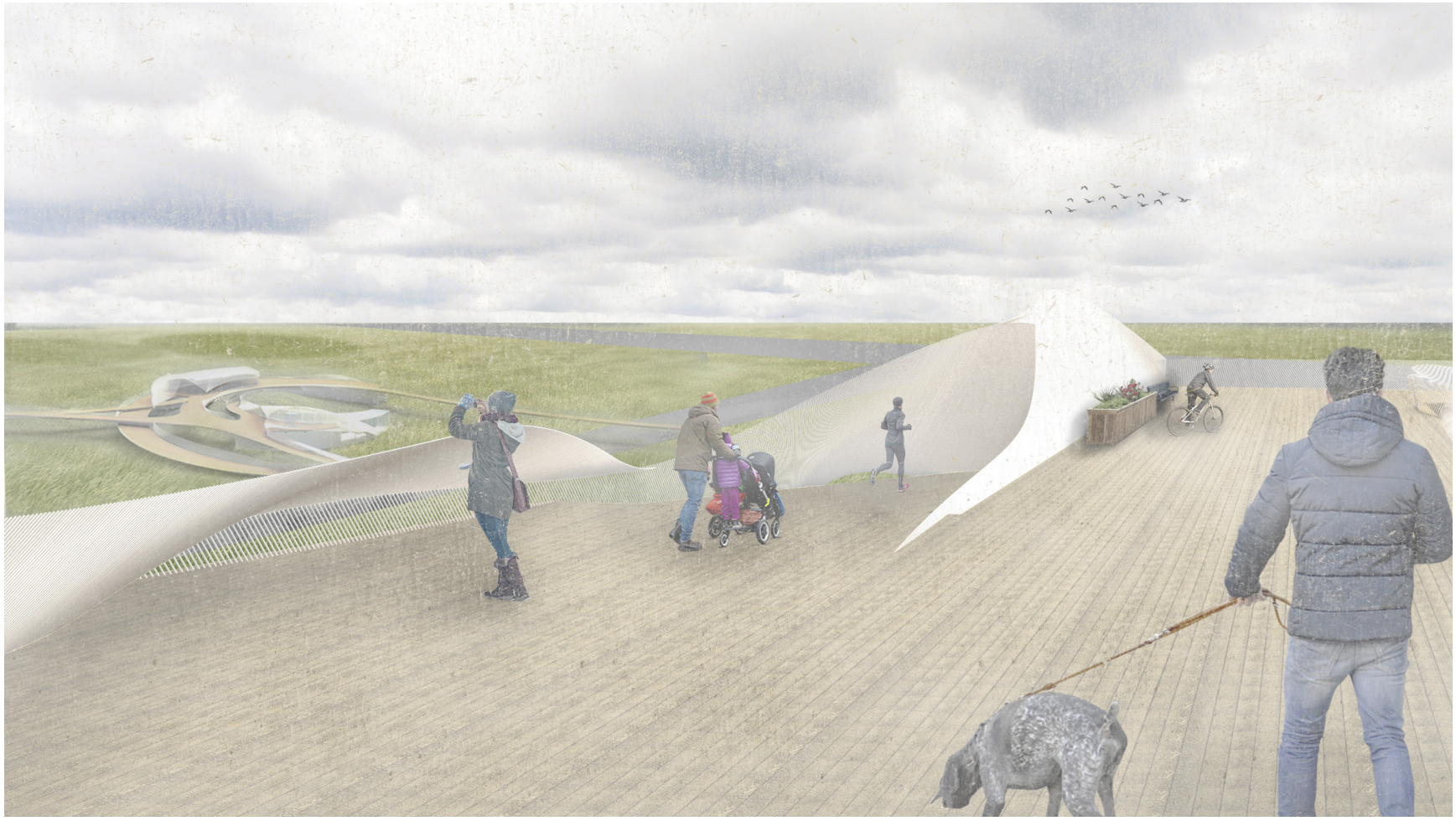
The intention of having two separate spaces for different actors of the site is to optimize user experience however their forms blend together along the second level. The two buildings are designed to act in unison creating collective unity through intertwining circulation and programming. Just as the second level of the Ostium offered connection with the circulation lines so too does the second level of the Arura. The elevated walkway from the entrance of the site directly feeds on to the roof of the Arura. The second level

offers both a generous walkway on the inside curvature and community classroom along the outside curvature. The community classroom offers the ability to host educational programs to foster new innovation on the site. This community classroom acts as the connector between the research in the labs and the community. It provides views to the working remediation fields and educational opportunities to engage with the science in its mini lab. As a space designed for the community, the classroom is willfully flexible in program. This gives freedom in use allowing the community to engage with the Seed as a room in the city.

Views from the second level towards the refinery | winter

Point Propagation

Time in the Rhizome is the regulating factor of growth. Unlike the development under industrialization, where time has become a negligible factor, development in the Rhizome is relative to the rate of remediation - which is relative to the productivity of the plants. The development that exists in the Petroleum Grid often operates with time as a negligible factor, because of the energy and resources oil is able to afford. However, when it comes time to address the aftermath of this unregulated strategy of development time becomes one of the most important variables in society's new collective future. Rather than continuing a regressive strategy of uncontrolled development the Rhizome utilizes contemporary notions of system-based growth and generation as strategies of development. The Seed of the Rhizome sets up the social infrastructure to support the growth of the Rhizome Logic. The new lines of the Rhizome which extend from the Seed connect the users with the remnant oil infrastructure and organizes different paths of different users into different areas of the refinery: further expanding areas of influence. By acknowledging the Rhizome as a system of growth, whereby the expansion of the Rhizome is regulated by the productivity of remediation, the development of new built infrastructure is implemented in phases: in accordance to the needs of the system.



Views from ontop of the piperail | autumn

The lines which extend from the first point annex the space above the former oil piperail in order to circulate people across the site. The public, recreational users of the site have access to the entirety of the site through the elevated pathways which sit on top of the main piperail. These protected spaces, above the contamination, branch out and access wide swaths of the site. In addition to the above-rail paths are a variety of paths that run along the face of the piperail which provides an alternative to users of the site who have a more intimate and immediate role in managing the contamination. The lines of the piperail become an instrument to organize and regulate the proximity of the contaminants with the actors of the site based on their role. As these initial lines of the Rhizome establish themselves in the system, points emerge at the section of intensity along these lines.

The variety of users who work in the Rhizome and facilitate the production of new energy inhabit the various subsequent points propagated from the Seed. The subsequent points take form in a variety of typologies along the lines. The Seed takes place as a standalone bundle of connections however, along the lines, points are also identified as the thickened, tuberous portion of a line and the nodal junctions of intersections. Points ‘naturally’ identify themselves as they propagate along the lines of the Rhizome in areas of intensity. These nodes of programs orient themselves around the intersectionality of use; they provide supporting social and physical infrastructure for the continued development of the system as a whole. Taking precedent in the botanical understanding of the Rhizome these areas of intensity also provide resources for the system and ‘root’ in

the earth. The new points which propagate along the lines provide opportunities to develop greater relationships with the ground plane by creating access points to the ground. These point propagations introduce areas where the sterility of the on-rail experience mixes with the on-grade remediation experience. The points of the system provide vertical circulation to connect the different users, which operate in different areas of the Rhizome, to each other and to the ground. The points also serve as a regulating mechanism for the amount of access the general public are able to experience.

Ephemerality: The Rhizome as a Function of Time

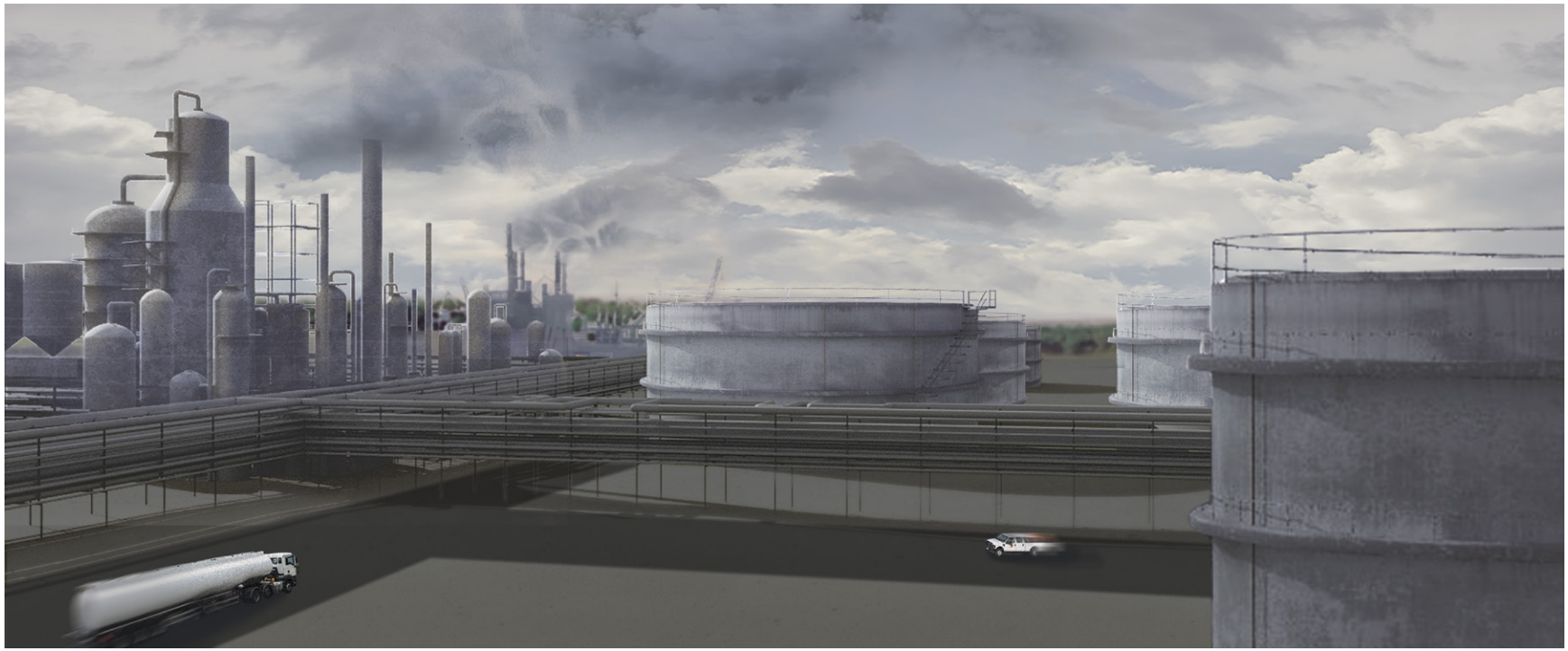
The three different components of the Rhizome (fields, lines, and points) are a measure of time. These infrastructural pieces are ‘grown’ rather than developed. They represent the compounded interest of the community in new energy and respond accordingly. As a reflection of the circulation and use, the Rhizome connects with the lines of the oil landscape tying in new energy with heritage. The pipes which form the structure of the Rhizome lines ribbons alongside the structure of the oil lines. It encloses volumes which building are able to inhabit, as needed, and extends above the top of the piperail to act as railing to the elevated walkways. The form of the Rhizome lines ties into and wraps around the existing structure, which elevates the piperail above grade, to blend to lines of two systems into one. The sinuous forms of the new lines break the horizontality of the piperail as they flow around the old structure with little regularity– only defined by the user and function of

use. As intensity of use increases, points are propagated along the lines to accommodate for the users of the space; therefore, the built environment changes and acclimatizes to the needs of the system and grows. The volumes defined by the pipe ribbons create spaces of possibility as each propagated point is another step in fulfilling the needs of a self-sustaining system. In mapping the points of the system, following the Seed, it can be ascertained that the system will require a Refinery Operations.

This thesis investigates the growth and development of the Rhizome in its inception and initial stages however the Rhizome is a function of time and thus continues beyond this thesis' description of its parts. With energy generation in mind, the next milestones of growth in the Rhizome look towards recommissioning the oil refinery into a biofuel refinery. This, therefore, brings about the need for a space for refinery operations to take place. In addition to more working spaces the Rhizome will eventually support an increase social investment the community brings into the system. Once the system grows into maturity and the remediation fields are no longer a product of necessity, the site should be healthy enough to support a variety of programs including community gardening and urban agriculture. Community greenhouses and market spaces are able to be introduced to the system. As a former oil refinery in the 'Gateway to the North', there are strong transportation connections that Strathcona Refinery has; these connections are easily translated and commodified in the new energy landscape to distribute the products of the Rhizome throughout the city and province.

Inherent to the concept of the botanical and philosophical ‘rhizome’ is the notion of ephemerality. Rhizome plants are often perennials, hibernating and holding reserves in their rhizomes in the winter, in order to re-emerge every spring. The temporality of the plant itself arises as a reflection of the passing seasons. The Rhizome Logic embraces the ephemeral in its built form, placing little emphasis on the permanence in program and function. The rise of the Petroleum Grid dominance can be assumed to be a product of unwavering faith in petroleum’s ability to provide for the world and/or a simple disregard for the consequences of society’s continued environmental negligence. In either case, there is the emphasis on the permanence of the current state of energy and maintaining the status quo. The unwavering, idolization of petroleum has secured petroleum’s role as “king” and it is one of the traits of fossil fuels that the Rhizome Logic aims to negate. The points, lines, and fields of the Rhizome arise as a function of time and use; each component of the Rhizome operates with no obligation to maintain the program it was built to serve because it recognizes that the Rhizome is designed as a product of the people. With each growing season the field conditions shift, and the system is constructed to correspond to the immediate environmental conditions. Opposite to the monumentalism of the oil refineries, the Rhizome is constructed as tectonic, reinterpreted composition of the oil industry parts which can be assembled and disassembled in accordance to the needs of the system and its whole life cycle.

For example when remediation in the fields is no longer needed, because the decontamination has been completed, the remediation lab in the Arura is no longer required. The space is designed to be as flexible as possible to respond to the uncertainties of the future. Points that exist along the lines exist because of their sustained use however, as the system changes and evolves so too do each point, including, perhaps, the complete dissolution of points entirely. The pipe ribbon that creates the Rhizome is constructed of the same diameter of straight, titanium oxide pipe; though organic and undulating in form it is the aggregate of straight sections of pipe: there is no customization in the materials of the pipe ribbon. The intention of the Rhizome Logic is not to persist as the legacy of another energy industry but rather as an intervention for society's fossil fuel reliance. The Rhizome Logic positions itself as the antithesis to the Petroleum Grid, it takes its form from the relationship that the community builds with new energy. The life cycle of the Rhizome and its components, though could stand the test of time, are centered around the transformation and rejuvenation of the socio-cultural phenomenon of petroleum dependency. The new built architecture on the site, whether or not its forms are fleeting, possess, at its core, the explicit ability to redefine new energy.



Oil landscape

Grain landscape

Chapter 5: Conclusion

New Energy Landscapes

When addressing contamination and remediation, Choi et al. states that successful ecological restoration must acknowledge the social context of the project because humanity has reserved the right to determine goals of restoration based on the perceived social hierarchy of place (Choi et al. 2008). In the Petroleum Grid, hierarchy of place is determined by potential monetary value in production therefore detracts motivation for ecological action on industrial spaces. Though petroleum has helped construct the economy of Alberta and Canada, society is facing a global climate crisis; a shift in priorities will need to see that society's collective future and environmental reparations be of greater priority than industry. Given the social context of "Petro-Patriotism" rejuvenating the oil refinery as a monument and legacy of Alberta's industrial heritage reinforces the high position in the hierarchy of place the site already possesses. This strategy to deploy the Rhizome Logic is derived from Delueze and Guatarri's philosophical Rhizome theory; it describes a non-hierarchical, heterogeneous, multiplicitous, and a-centred understanding of network in media theory. This alternative understanding of "Rhizome" positions this thesis as the antithesis of the Petroleum Grid. The new energy landscape utilizes this Rhizome to dismantle profit driven priorities; its components, the fields, lines, and points, grow in relation to and as a reflection of the motions of the people rather than fiscal incentives.

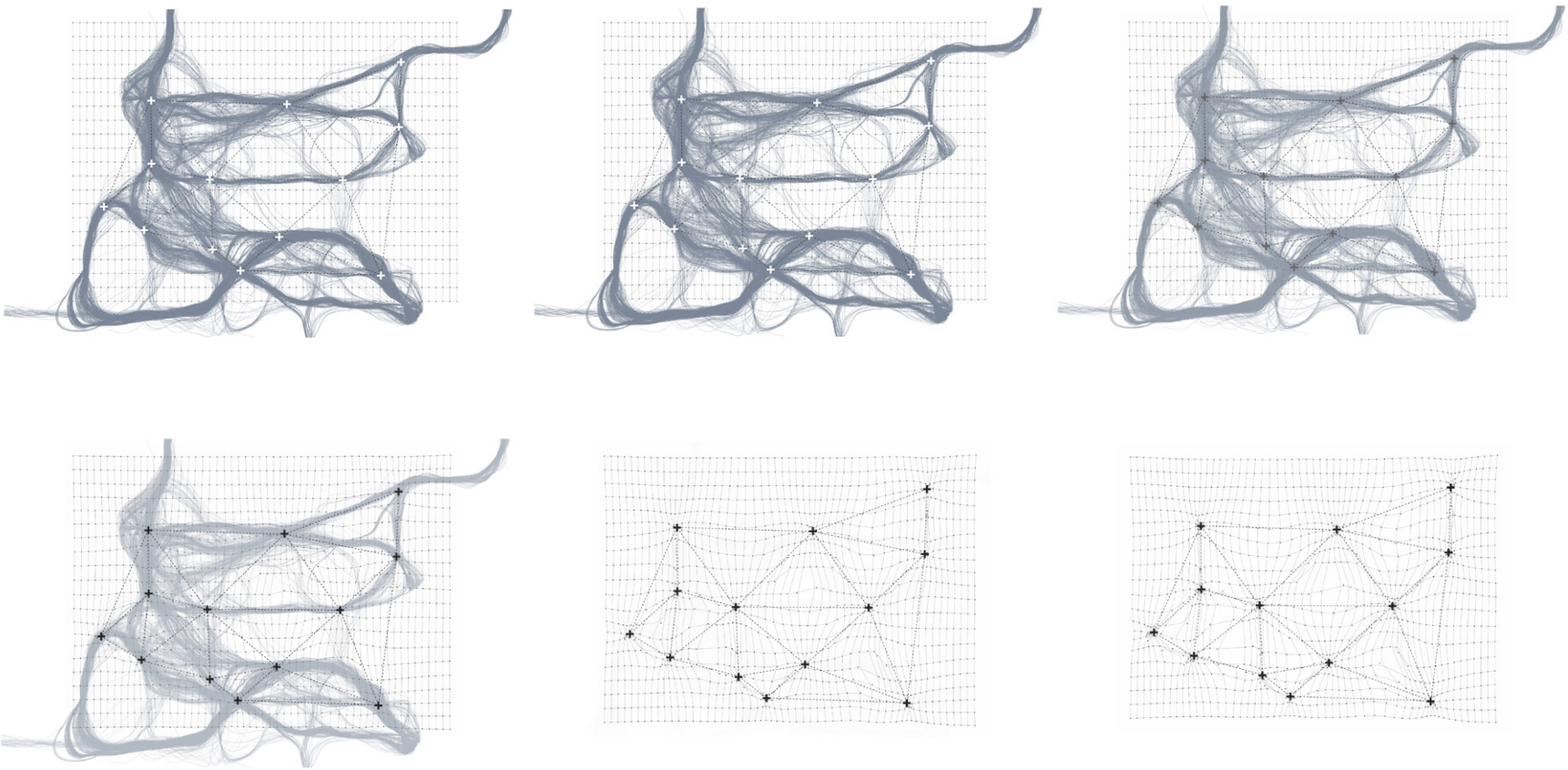
The implementation of the Rhizome Logic at Strathcona Refinery is the beginning of a new energy landscape within Alberta. It represents a shifting ideology at the core of Canada's energy industry. Though the Rhizome, as described in this thesis, investigates the development of a logic in one industrial site, Strathcona Refinery, the growth in this one site is the microcosm of what could be large, city-scale or nation-scale grid distortions of the Petroleum Grid. The biomorphic patterns used for form finding in the Rhizome are found in nature, across a vast selection of species, and form the building blocks of the Rhizome. Not only have different social oriented species adopted flocking behaviours but these patterns of the aggregate are seen to permeate through a variety of scales. Taking precedent in 'the natural' the Rhizome also embodies these aggregate geometries through a multitude of scales. These biomorphic patterns of circulation are found at the human-scale, building-scale, and site-scale; the architecture at each scale strengthened by the unifying and common flocking behaviours shown at other scales. Therefore, carrying this logic forward, if these general biomorphic patterns of circulation have been a successful model in a variety of species, including humans, and they are successfully able to be implemented as method of generating new architecture and energy systems there is no reason to assume that these patterns would not hold true in scales larger than the Strathcona Refinery site. Thus, the biomorphic patterns of circulation which generated the Rhizome at Strathcona Refinery could be the first step to transforming the Petroleum grid on a city, provincial, or national scale. New patterns and connections, which arise from the new circulation created, are able to shift the dynamic of flow in the city. The rules of biology do not

end at the boundary of the site. The same logic in flocking and biomorphic patterns, that exists on the site, permeate across site boundaries distorting the adjacent orthogonal Petroleum grid.

The most simple and direct permeation of the Rhizome occurs in the adjacent oil refinery. The strategies applied in Strathcona Imperial Refinery can be used to transform Suncor Energy Refinery. Its immediate physical distance makes this the easiest transition as the points developed on the Strathcona site influence the operations of the Petroleum Grid. With most refineries, the components of the oil refineries hold the same historic and economic significance within its context. These monumental artifacts of previous industry represent historic economic successes and are memorialized as such; however, they are also a vehicle to transform the social and cultural approach to industrial memorialization. These are characteristics that make Strathcona Imperial Oil Refinery so attractive to root the Rhizome Logic within. These are the same characteristics that are common in Suncor Energy Refinery. The physical relationship between Strathcona Imperial Refinery and Suncor Energy Refinery and programmatic similarities allow the Rhizome Logic to easily permeate from one to the other or even be developed in tandem.

When evaluating Edmonton as a mosaic of land uses, it is evident that the city is still heavily an industrial city with large swathes of the city dedicated to oil. The logic behind the Rhizome is, again, easily able to penetrate the fabric of the city. Though Edmonton has been brought up on

petroleum, there are no physical limitations barring the logic of the Rhizome from influencing the Petroleum Grid on a city-scale. These notions of transforming a landscape through energy-based social reconstructions bring into light the current strained relationship society has with energy and the environment. The Rhizome Logic is the anti-thesis of society's contemporary fossil fuels dependency. As a function of time the Rhizome begins as an idea or test, in the contaminated grounds of a former oil refinery, which grow in size and influence. Its transformative qualities come from the social attractiveness of both the historic monumentalism of old energy and the progressive innovations of new energy. Growth and form of the Rhizome are perpetuated by the communities' use of the space. In other words, in the Rhizome, the people activate the system and the system is rooted in the people as opposed to the Petroleum Grid domineering over the function of society.



Distortion of the Petroleum-Grid by the Rhizome Logic: permeating, large scale distortions of the energy landscape.

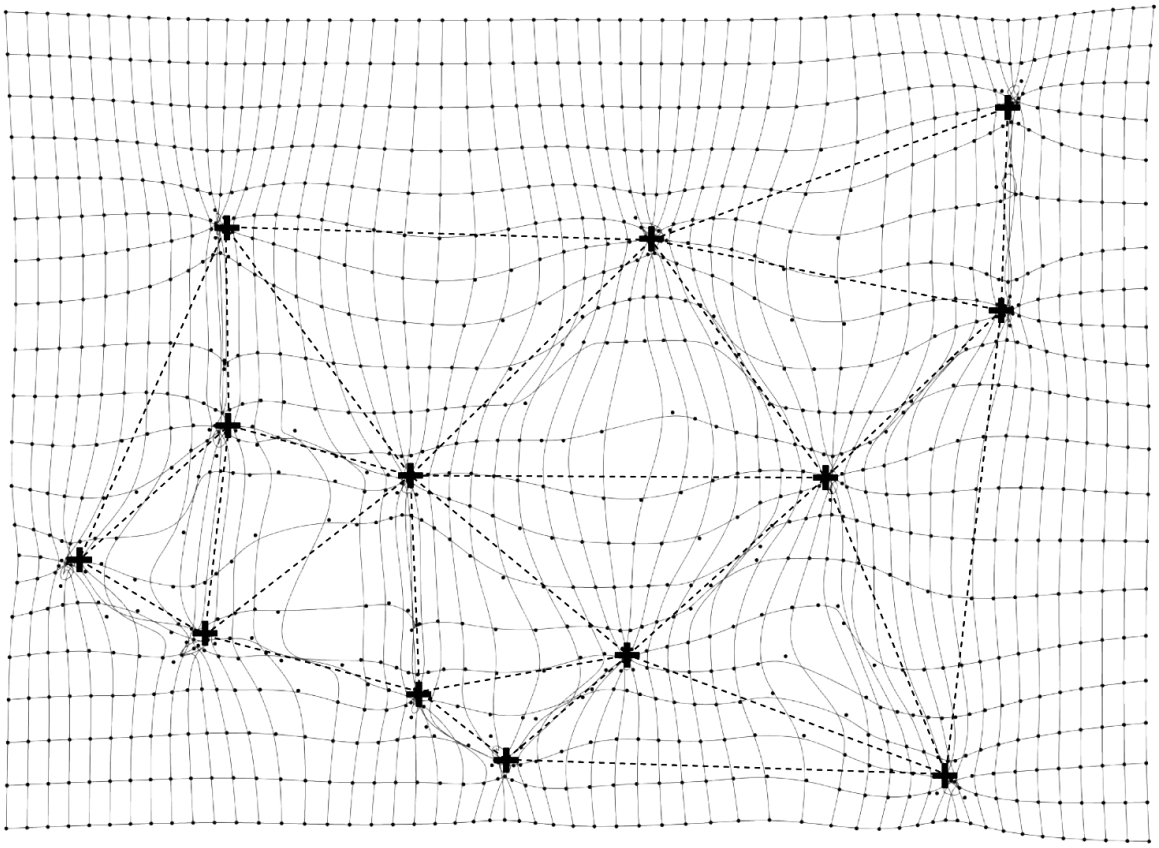
New Energy Futures

The need for ecological and restorative landscapes motivates this endeavour to develop a new Albertan landscape. The system of oil dependency must come to an end to ensure the survival of a collective future. When it comes time to acknowledge the ecological negligence of decades worth of oil exploitation new generative strategies must be implemented to begin healing the land. Oil has built up the identity of those that benefited from it and generates pride for those that capitalize upon it however, its consequences are not limited to any one group of people. It affects every single person, regardless of which side of the issue they are on. This thesis aims to remember an industry so vital to a nation's economy by retaining its monumentality as a vessel of collective history. By embracing ecological strategies of remediation, it intends to reclaim destructive spaces as generative ones. Oil refineries lend their infrastructure to catalyze new growth as a component of a larger system. They will work with the land to redefine new energy landscapes in Alberta and support visions of an urban agricultural oasis connected with the city and people it intends to serve.

Refinery Row is a site which hosts two oil refineries– Strathcona Imperial Oil and Suncor Oil Refinery. The intention of the design is to develop a framework to remediate and reintegrate industrial oil spaces back into the public realm in a post-oil world. The design is tested on the Imperial oil site however the processes and strategies are not limited to this site. At its core the design focuses on remediation of land and reconciliation with its urban context. The process of

remediation and reintegration begins with healing the land and then giving it back to the city and finding new value.

The many components of this new landscape redefine the identity of a former oil site layering, onto an oil refinery, systems of ecology, remediation, memory, and agriculture to propel this energy landscape into a healthier future. The Rhizome Logic acts as new eco-industrial organism that is a conduit for public engagement with the land and a symbol new energy in Alberta. The Rhizome activates and reinvigorates a previously contaminated site with new, generative, biomorphic patterns; influencing the community and pushing the city and province towards dissolving the rigidity of the old system in power. By reforming the built environment, the foundations of this new energy system hold weight in society's changing relationship with energy. The role of the Rhizome Logic, in society's tumultuous journey with energy, is to shift the narratives of how energy influences the framework of society and restore power in the landscape.



The Rhizome Logic influencing the Petroleum Grid: new energy futures

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