

IMMERSED IN COMMUNITY:

*Environmental remediation of a mining-impacted township
through collective, participatory agricultural research and production.*





Figure 01 : Image overlooking Braamfischerville from mine dump (Image by author).

ACKNOWLEDGMENTS



Being confident in this, that he who began a good work in you will carry it to completion until the day of Christ Jesus, Phillipians 1:6 (Bible, 1984)

. To my mother, Khensani, thank you for your unwavering support, encouragement and assistance throughout all these years and your input. To my sister, Tshegofatso, thank you for your help and assistance when I would rope you into my work. Thank to my family and loved ones. To Tshepo, thank you for all your words of encouragement. To all my lecturers who helped me through this journey, thank you. To all my peers who used to pull all-nighters together, thank you for always lending a helping hand.

ABSTRACT

The term Witwatersrand translates to “the ridge of white waters”. It derives its name from the low sedimentary hills that stretch east-west across the southern part of Gauteng Province. The Witwatersrand mining belt encompasses areas from the East Rand to the West Rand of Johannesburg, including Soweto, and is mainly characterised by its “West”, “Central”, and “East Rand” sectors. The mining of gold in South Africa, particularly in Johannesburg, has been a primary driver of economic development in the city since its inception. Gold production has influenced Johannesburg’s economic, social, and political histories and left detrimental mining waste evident along the Witwatersrand ridge.

This mine waste is produced during the extraction and processing of mineral resources. It often includes waste dumps, slime dams, and other waste storage facilities, which continue to impact the region and the health of communities residing near these waste storage facilities. Issues such as acid-mine drainage and soil pollution, amongst many others, persist even long after the closure of many of these mines. Decades of mining activities have drastically altered the natural landscape and continue to pose environmental and public health risks. Braamfischerville, an RDP settlement situated in the southwest of Johannesburg, is affected by mine tailings that are a stark reminder of gold mining. These tailings are hazardous, posing risks to the health and well-being of residents, the natural environment and livestock within this area through soil contamination, acid mine drainage, and air pollution.

In this challenging environment, small-scale community farming has emerged near the mine dump and within residents’ backyards. However, this commendable initiative is overshadowed by the danger it poses due to exposure to harmful dust from the tailings, exacerbating the risks of such agricultural endeavours. Additionally, Braamfischerville grapples with high unemployment, a lack of formal skills development, insufficient communal spaces, and poorly constructed RDP housing, which often lacks partition walls, ceilings, and proper ventilation. These concerns highlight the urgent need for holistic community interventions to address the socio-economic issues prevalent. The proposed intervention aims to repair the toxic landscape by establishing an experimental remediation centre that utilises hemp, a fibrous plant, to remediate the environment. This centre will also provide spaces for research, the manufacturing of hemp into wall and ceiling panels, training, and social interaction, ultimately contributing to the local and township economy.

DECLARATION



I, Katleho Shiburi 2089782, am a student registered for the course Master of Architecture (Professional) in the year 2024. I hereby declare the following: I am aware that plagiarism using someone else's work without permission and proper acknowledgement is wrong. I confirm that the work submitted for assessment for the above course is my own unaided work except where I have stated explicitly otherwise. I have followed the required conventions in referencing thoughts, ideas, and visual materials of others. For this purpose, I have referred to the Graduate School of Engineering and the Built Environment style guide. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my unaided work or that I have not acknowledged the source of the ideas or words in my own work.

[This document is submitted in partial fulfilment for the degree: Master of Architecture (Professional) at the University of the Witwatersrand, Johannesburg, South Africa, 2024.]

A handwritten signature in black ink, appearing to be 'K. Shiburi', written over a dotted line.

08 February 2025

CONTENT PAGE

Acknowledgements	pg 3
Abstract	pg 4
Declaration	pg 5
Foreword	pg 7

CHAPTER 01: MINERAL EXTRACTIONS

- Mining in the Witwatersrandpg 10
- Impact of Miningpg 13

CHAPTER 02: BRAAMFISCHERVILLE CONTEXTUALIZED

- History of Braamfischervillepg 24
- Urban design and housing typologies.....pg 25
- Housing in Braamfischervillepg 26
- Present-day Braamfischervillepg 28

CHAPTER 03: INTERVENTION

- Identification of Sitepg 32
- Mapping / Site Analysispg 33
- Proposed Interventionpg 46
- Material Usagepg 52
- Technical Intentionpg 53

CHAPTER 04: PHYTOREMEDIATION

- Defining phytoremediationpg 57
- Industrial Hemppg 58

- Manufacturing of Hemp..... pg 59
- Experimental Farming pg 61
- Use of Hemp within the project..... pg 62

CHAPTER 05: ECOLOGICAL CIRCULARITY

- Introductionpg 64
- The Anthropocenepg 65
- Defining Circularitypg 66
- The circular economypg 67
- Circularity in the context of South Africapg 68
- Circularity in the context of Sowetopg 69

CHAPTER 06: PRECEDENT STUDIES

- Precedent Studiespg 71

CHAPTER 07: DESIGN DEVELOPMENT

- The Briefpg 77
- Viability Reportpg 78
- Design Developmentpg 80

CHAPTER 08: DESIGN

- Final Design and Technical Drawingspg
- Renderspg
- Conclusionpg

FOREWORD

This thesis focuses on the impact of mining residues on the natural environment in Braamfischerville, a township in Johannesburg, South Africa, situated within the Witwatersrand mining belt. The aim is to explore how these mining wastes affect the environment and suggest solutions to empower the community to take an active role in their environmental, economic, and social well-being. The main aim is to propose an architectural intervention that considers Braamfischerville's current challenges and addresses multiple issues within the community.

The thesis takes a circular approach to remediation, from the initial phase through to the manufacturing and use of the products. It seeks to contribute to the local economy, mitigate the harmful health and environmental impacts of mining, and create economic opportunities for the community.

The thesis is organised into eight chapters, each building upon the previous one to offer a comprehensive analysis of the topic. Chapter 1 initiates the exploration by delving into the history of mining in Johannesburg, specifically focusing on the impacts of gold mining. Moving on to Chapter 2, the location, history, urban and housing typologies, and present-day conditions of the thesis site are discussed in detail, highlighting crucial aspects of the

township that are essential for understanding and consideration. Subsequently, Chapter 3 evaluates the site through an array of maps, photographs, and diagrams, culminating in the development of a concept influenced by the township's current conditions. This concept also encompasses an exploration of potential materials. Chapter 4 then intricately examines phytoremediation, providing a theoretical framework for its application. The notion of circularity is then scrutinised in Chapter 5, particularly within the context of South Africa and Braamfischerville.

Chapter 6 analyses precedent studies to draw relevant insights, which informs the subsequent chapter, Chapter 7, where the project brief, viability report, and design development are meticulously detailed. Ultimately, the final chapter, Chapter 8, concludes with presenting the final design, technical drawings and renders.



Figure 02 : Image from Braamfischerville mine dump overlooking Braamfischerville and subsistence farming by residents . (Natural Sapphire, no date).



Figure 03 : Braamfischerville tailing sand layers (Mamabolo, 2024).

CHAPTER 01: MINERAL EXTRACTIONS

- Mining in the Witwatersrand
- Impact of Mining :
 - Environmental
 - Settlement of people
 - Social
 - Human Health

ORIGINS OF MINING IN WITWATERSRAND

The term Witwatersrand is translated as “the ridge of white waters”. It derives its name from the low sedimentary hills that stretch east-west across the southern part of Gauteng Province (Bobbins, K., & Trangos, G., 2018). The Witwatersrand mining belt encompasses areas from the East Rand to the West Rand of Johannesburg, including Soweto, and is mainly characterised by its “West”, “Central”, and “East Rand” sectors. The ridge acts as the boundary in the north for a vast plateau called the Highveld, which increases elevation from the sea level towards its eastern border, approximately 400 km away from Johannesburg (Bobbins, K., & Trangos, G., 2018). The mining of Gold in South Africa, particularly in Johannesburg, has been a primary driver of economic development in the city since its inception.

Although what is now known as Johannesburg has existed far beyond the mining era and has been settled by many different people ranging from the Bushmen from 1,000 years ago, as well as The Sotho-Tswana people who had already established various small settlements near the present

site of Johannesburg (Davie, no date). It was not until the 1880s, specifically 1886, when Gold was discovered by An itinerant prospector, George Harrison, who stumbled on surface outcrops of gold-rich conglomerate on an old farm —that is now near the centre of Johannesburg which had sparked the development of the city (Sutton et al., 2006).

After the news spread, miners from various countries rushed to the region, establishing the bustling city of Johannesburg. The local village of Ferreira’s Camp quickly became the Ferreira Township as miners arrived, seeking to find Gold. Within a decade, the town surpassed Cape Town, which had held the title of the largest city in South Africa for more than 200 years (Natural Sapphire, no date).



Figure 04 : Langlaagte Farm where Gold was discovered in 1886 (Natural Sapphire, no date).



Figure 05 : Johannesburg 1890 (Natural Sapphire, no date).

The majority of the gold reserves in the country are situated in the Witwatersrand Basin, among the world's largest gold placer deposits. From 1887 until 2018, 1.7 billion ounces of gold were extracted from the South African mines, mainly in the Witwatersrand (Natural Sapphire, no date). Currently, the Witwatersrand reef falls part of the "Golden Arc," an inland lake with rich alluvial deposits. This goldfield is 100 kilometres long and 3.6 kilometres deep in certain areas. It is the source of over 40% of the gold extracted from the Earth. It is also why the country attained the moniker "Rand" in 1961 (Natural Sapphire, no date).

The production of gold in the city has not only influenced Johannesburg's economic, social, and political histories but has also left vast volumes of detrimental traces of mining waste evident along the Witwatersrand ridge. These traces include waste dumps, slime dams, and other waste storage facilities, which continue to impact the region and the health of communities residing near these waste storage facilities. Issues such as acid-mine drainage and soil pollution, amongst many others, persist even long after the closure of many of these mines. Decades of mining activities have drastically altered the natural landscape and continue to pose

environmental and public health risks. Historically, mining companies often established mine dumps in sensitive areas and employed no pollution control (Sutton et al., 2006).

The mine tailings contain a variety of harmful chemicals, including heavy metals such as arsenic, lead, mercury, cadmium, and chromium. Cyanide, sulphides, polycyclic aromatic hydrocarbons (PAHs), radioactive materials, and chemicals used in the gold extraction processes are present. These substances contribute to water pollution through acid mine drainage, air pollution, and soil contamination.

In South Africa, individuals have the right to an environment that does not pose a risk to their health and overall well-being and the right to environmental protection, which are fundamental constitutional rights (Constitution of the Republic of South Africa, 1996). It is essential to comprehend the scope and varieties of pollution and the potential hazards linked to various land uses, both on former mining sites and other impacted areas (Sutton et al., 2006).

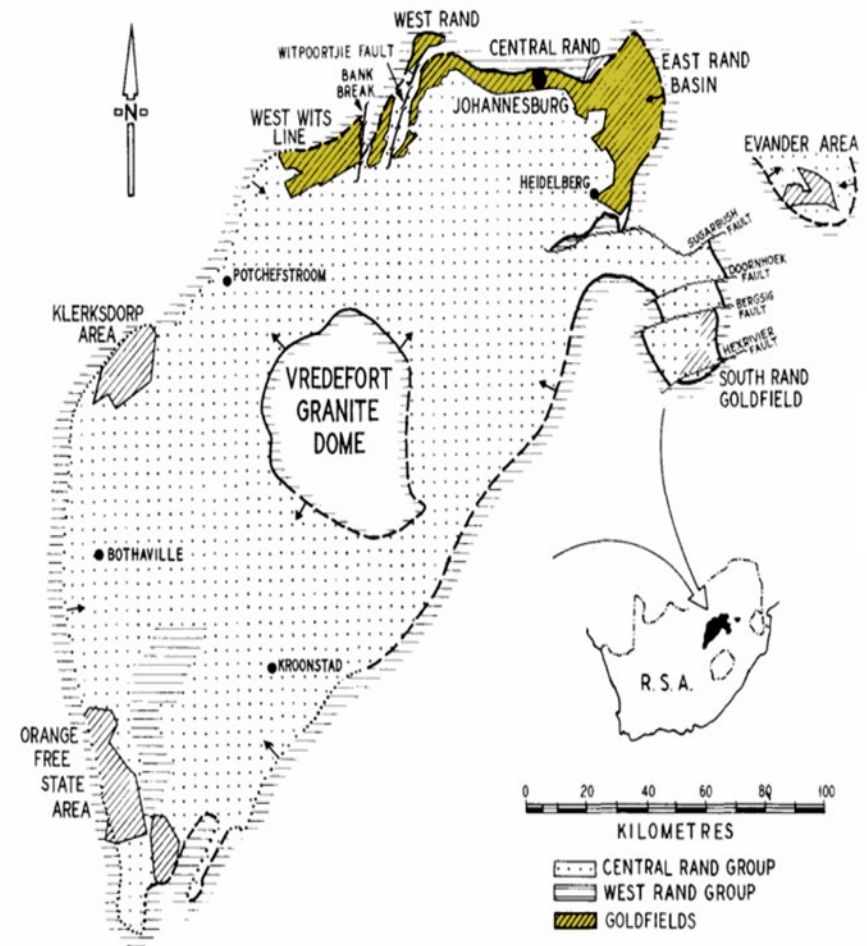


Figure 06 : Gold fields highlighted in the Johannesburg Region, image adapted (Basson,2014).



Figure 07 : Mine tailings along the Witwatersrand mining belt (Image by author).

IMPACT OF MINING [ENVIRONMENTAL]

As mining activities expanded and towns along the Witwatersrand grew, the Highveld landscape became indiscriminately used for large-scale mine waste disposal, often at the expense of natural ecosystems (Bobbins et al., 2018). The extractive processes resulted in engineered mine-residue areas identified by their yellowish colour. These mine dumps negatively impact the surrounding environment's water, air, and soil quality. In particular, mine waste affects the quality and quantity of the region's potable water (Bobbins et al., 2018). Upon contact with water and oxygen, certain minerals in mine waste produce acidic water with high sulphate content, known as acid mine drainage (Bobbins et al., 2018).

The presence of these mine dumps also significantly affects air quality. They encompass radioactive materials and heavy metals that, when airborne, degrade air quality due to dust being blown in these areas. Poor air quality in Johannesburg, is attributed to mining operations that

have occurred since the city's inception, contributing to the increasing dust emissions in the area (Bobbins et al., 2018).

According to research, approximately 250 mine tailings cover about 44,000 hectares (Bobbins et al., 2018). When these mine tailings were first established, they contained fine traces of gold that could not be extracted due to the lack of technology at the time (Bobbins et al., 2018). However, advances in mining technologies have made it possible to re-mine these tailings (Bobbins et al., 2018). Remining exacerbates contamination, leading to further air pollution from dust emissions (including the release of uranium), soil contamination and increased soil toxicity, affecting natural ecosystems, and water contamination through acid mine drainage.

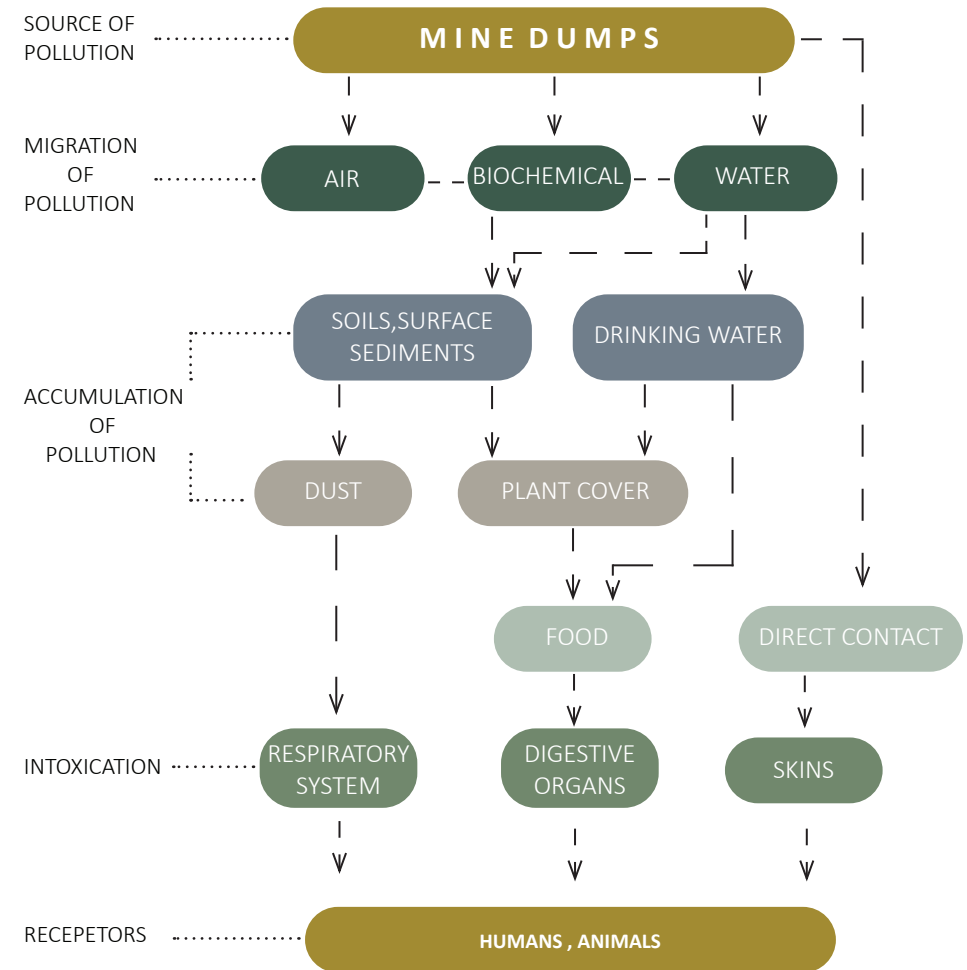


Figure 08 : Enviromental Impacts of Gold Mining ,image adapted (Pashkevich, 2017).

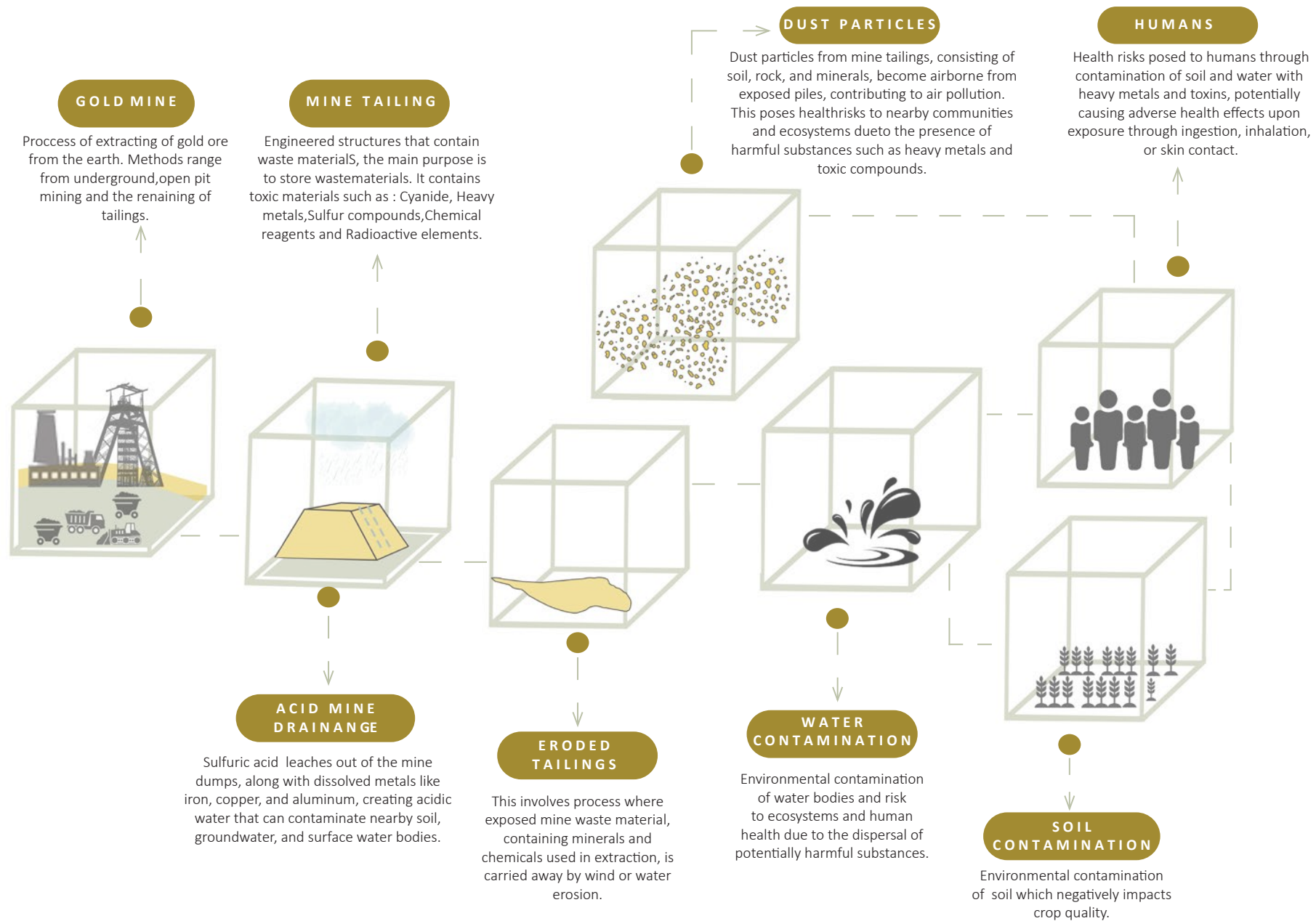


Figure 09 : Impact of Mine Tailings (Image by Author).

IMPACT OF MINING [**SETTLEMENT OF PEOPLE**]

The development of urban areas, as well as the settlement of people within Johannesburg, was heavily influenced by the changes in the mining dynamics as well as the spatial planning enforced by the apartheid government. The first significant shift was seen in the influx of people into the mining industry, which resulted in the establishment of a mining camp in 1886, which ultimately evolved into a village, then a town, then the metropolis of Johannesburg, and what is now the Gauteng city region (Mubiwa and Annegarn, 2013).

After the establishment of the gold mining, rural Indigenous African groups were made to provide labour to the new mining towns through the imposition of government-levied compulsory head taxes, payable in cash, on all adult males in the South African Republic (Mubiwa and Annegarn, 2013). This compelled rural dwellers to seek paid employment within the mines and supporting industries, which further increased population growth in the Witwatersrand (Mubiwa and Annegarn, 2013).

The development of land beside the mining belt resulted from the political pressure to build low-cost housing in Johannesburg (Bobbins et al., 2018). Land filled with slime dams and mine dumps was chosen for development by the City Council. The land development within the mining footprint allowed the profits from post-active mining to continue in the Witwatersrand. Furthermore, several township areas were established during this period (1999- 2000) to the northwest of Soweto, intersecting the mining belt – Bram Fischerville, Thulani, Slovoville, Matholesville, Tshepisong, and Lerato Village (Bobbins et al., 2018). It was common knowledge that these settlements housed “a lower level of servicing than other townships and an impoverished population” (Bobbins et al., 2018).



Figure 10 : Early Image of Johannesburg before mining (1889), (Pretorius, no date).

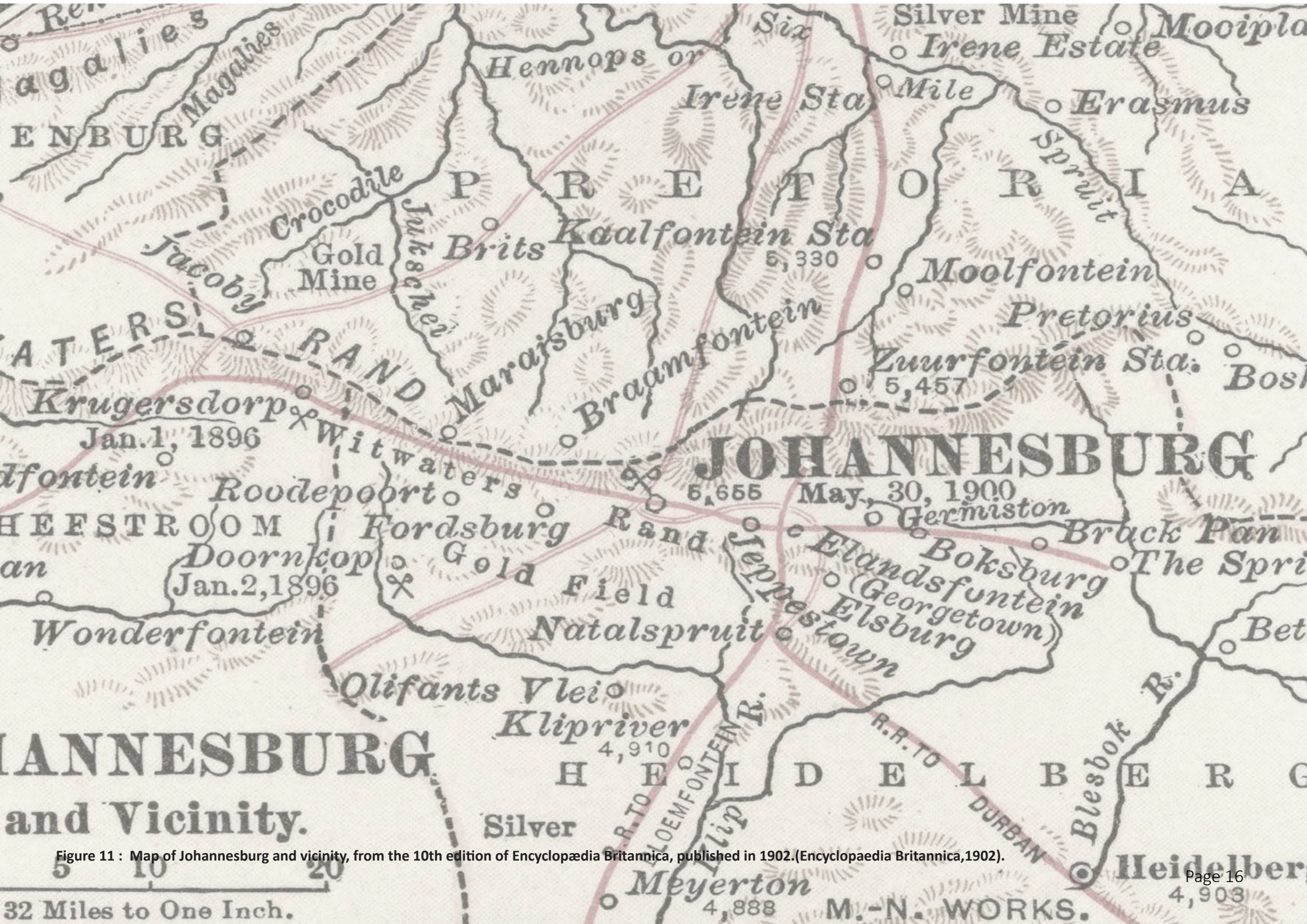


Figure 11 : Map of Johannesburg and vicinity, from the 10th edition of Encyclopædia Britannica, published in 1902.(Encyclopaedia Britannica,1902).

The legislation enforcing racial segregation (apartheid), such as the Bantu Urban Areas Consolidation Act 25 of 1945 and the Group Areas Act 41 of 1950, introduced by the Nationalist Party after gaining power in 1948, significantly reshaped the land-use structure into the apartheid city (Frescura, 1993; 2000). Residents were segregated into designated 'White', 'Bantu', 'Coloured', and 'Asian' areas, with buffer strips of at least 100 meters wide or separate industrial or environmental buffer zones, such as the tailings in Soweto, keeping them apart (Mubiwa and Annegarn, 2013).

The ongoing construction of formal affordable housing and the spontaneous settlement of people along the mining belt have perpetuated the unfair environmental effects of mining. Although the land designated for formal development meets the national standards for rehabilitating mining waste, the sites chosen for these developments may still be within or near mining waste footprints (Mubiwa and Annegarn, 2013). The high demand for housing, particularly in Johannesburg, has led to informal settlements being established on

open land between mining waste sites due to their proximity to the inner city. Those living in these areas often face multiple hardships: they are compelled to reside on unsafe or unstable land in inadequate housing, and they have limited access to essential services like social, health, and educational facilities (Bobbins et al., 2018). As is the case in Braamfischerville.



Figure 12 : Social Housing in Orlando,Soweto (Getty, no date).



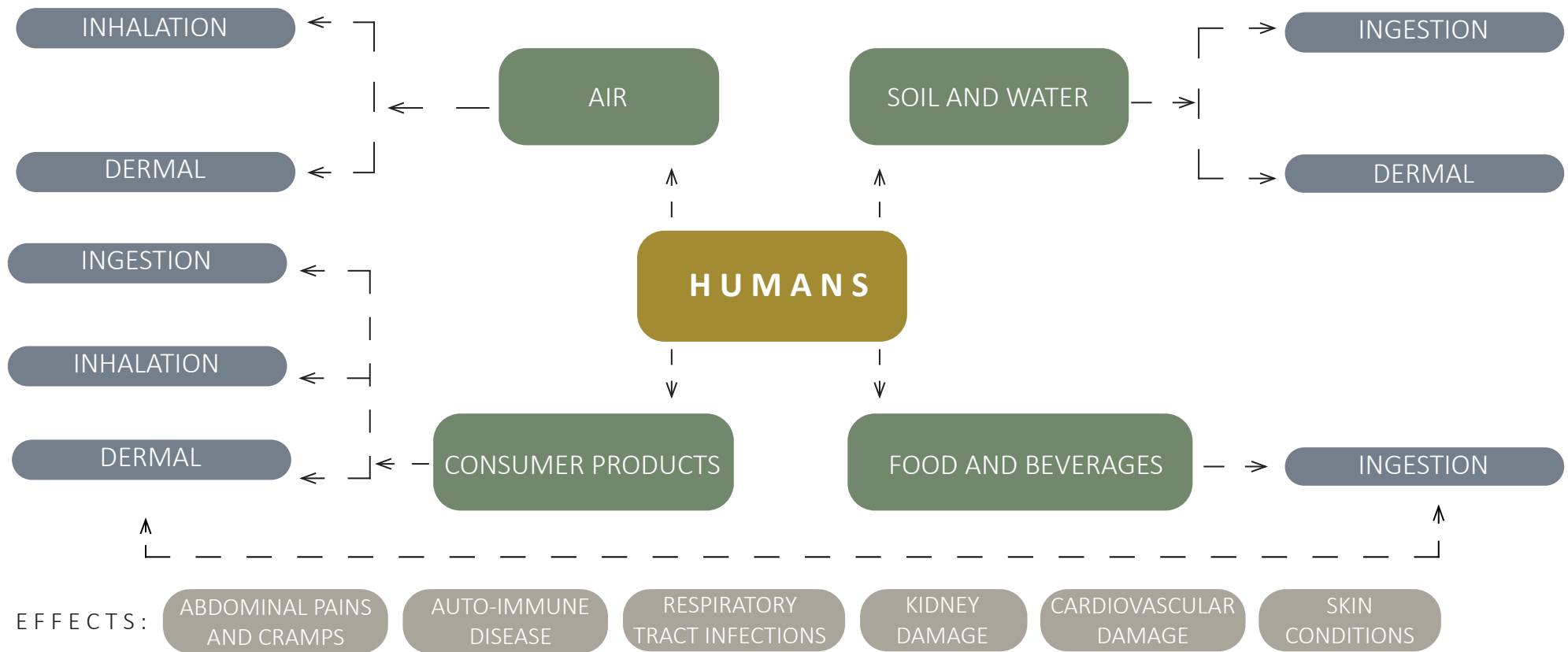
Figure 13 : RDP settlements in Braamfischerville before roads were built (Nico Kotze, 2011).

IMPACT OF MINING [**SOCIAL**]

Mining in Johannesburg has profoundly shaped the city's social and economic fabric. While it has historically built Johannesburg and generated wealth, it has also deepened social divides, creating an unequal socio-economic geography that persists today. Many residents, particularly in urban peripheries, remain marginalised with limited access to resources and opportunities (Bobbins et al., 2018). The discovery of gold spurred a massive influx of migrant workers, leading to the establishment of the

Johannesburg mining camp (Mubiwa and Annegarn, 2013). The situation intensified after 1994 when the repeal of discriminatory laws and South Africa's new political dispensation prompted a surge in rural-to-urban migration, particularly among the Black population previously barred from cities (Mubiwa and Annegarn, 2013).

IMPACT OF MINING [**HUMAN HEALTH**]



Individuals residing near mine tailings frequently face an increased probability of direct exposure to mine waste, including inhalation, ingestion, eye and skin contact, and direct physical contact (Bobbins et al., 2018). The effects of mining waste on humans often unfold as non-communicable diseases such as respiratory conditions – bronchopneumonia, pneumonia, lower respiratory tract infections, neurological

conditions, cardiovascular concerns, and kidney damage (Bobbins et al., 2018). Other impacts include sickness through consumption of food and water contaminated by mining waste; this often happens through the occurrence of acid-mine drainage as well as air pollution due to the dust particles blown from the tailing (Bobbins et al., 2018). The Human Rights and the Environment section of the Bill of Rights

it highlights the fact that everyone has the right to an environment that is not harmful to their health or well-being of which the presence of mine wastes on human health contrasts and infringes on the rights of people.

Figure 14 : Impact of mining on human health (CSIR, 2013).

IMPACT OF MINING [**FARMING**]

Residual areas from mining activities present a significant hazard to nearby agricultural operations, primarily due to acid mine drainage (AMD). When taken up by plants, this harmful runoff has the potential to compromise the quality of crops and create serious food safety concerns. A recent study has brought to light that acid mine drainage has profoundly impacted urban agriculture in Soweto (Khomo, 2024). If mining companies do not effectively address the issue, acid mine drainage has the potential to contaminate land and water sources within a 20-kilometre radius of a mine. This contamination threatens river water, plants, and animals and can permeate entire food chains (Khomo, 2024).

Contaminated water significantly impacts agricultural systems as it introduces harmful substances that affect crops and soil quality. Using polluted irrigation water leads to the accumulation of toxic elements in crops, which poses health risks to consumers and further diminishes the quality of the crops. According to environmental scientist Khomo, many residents of Soweto rely on

small vegetable gardens to supplement their income and meet nutritional needs. In Braamfischerville, where subsistence farming is common, the proximity to mine tailings puts crops at risk of contamination from acid mine drainage.



Figure 15 : Farming in Braamfischerville Extension 12 (Image by author).

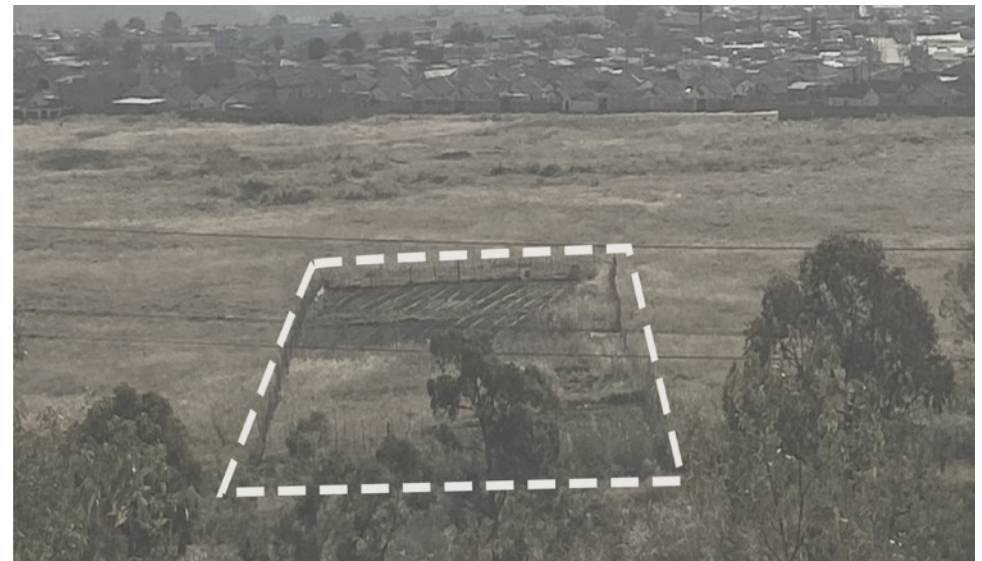


Figure 16 : Subsistence farming in Braamfischerville taken from the top of the mine tailing (Image by author).



Figure 17 : Braamfischerville Extension 12 (Image by author).

CHAPTER 02: BRAAMFISCHERVILLE CONTEXTUALIZED

- History of Braamfischerville
- Urban design and housing typologies
- Housing in Braamfischerville
- Present-day Braamfischerville



Braamfischerville, located on the far western edge of the Witwatersrand mining belt, lies northwest of Soweto and is bordered by Roodepoort. As an RDP (Reconstruction and Development Programme) area, it is primarily a residential township. Its proximity to a mine tailing exposes the community to the associated negative impacts. Braamfischerville is divided into multiple sections, specifically

Extensions 1 through 12, each contributing to the township's overall structure.

Figure 18 : Braamfischerville highlighted in the mining belt context (Image by author).



Figure 19 : Houses and Cattle in Braamfischerville (Image by author).

HISTORY OF BRAAMFISCHERVILLE

Braamfischerville, named after Bram Fischer, an attorney who represented Nelson Mandela and others at the Rivonia Trial, was one of South Africa's first major post-1994 RDP (Reconstruction and Development Programme) developments and the largest in Johannesburg's Soweto area (Harrison, Todes, and Weakley, 2015). The new area's planning began shortly after the first democratic elections, held in 1994. The settlement was intended to provide housing for households living in overcrowded houses, informal settlements and backyard shacks in and around Soweto, but beneficiaries came from all over (Harrison, Todes, and Weakley, 2015). Braamfischerville was built in four phases, with the first phase beginning in 1996 and being completed and fully occupied by 1999. The final phase of the housing development was completed and occupied in 2002 (Moolla, Kotze, and Block, 2011) (Harrison, Todes, and Weakley, 2015).

The period during which Braamfischerville Phase 1 was developed was problematic for the RDP programme. Housing subsidies remained set at a fixed level despite rising construction costs. Consequently, during the first phase of the Braamfischerville

development, some of the lowest specifications were used throughout the first ten years of democracy. Each unit was a 36 m² unplastered maxi-brick structure with an asbestos roof and had no internal partitions except for a small bathroom (Harrison, Todes and Weakley, 2015).

Braamfischerville is relatively isolated from its immediate surrounding areas. The rest of the settlement is effectively land-locked by the surrounding topography, apart from one main entry point to Soweto's transport network on its western edge and an access road northwards onto Main Reef Road. Large open areas of the land border the whole settlement, comprising a tailings dam, low-lying and wetland areas, difficult-to-traverse concrete-lined water channels and open grassland areas. Footpaths traverse most of these areas, but vehicular and public transport access is limited to two major access routes (Harrison, Todes and Weakley, 2015).

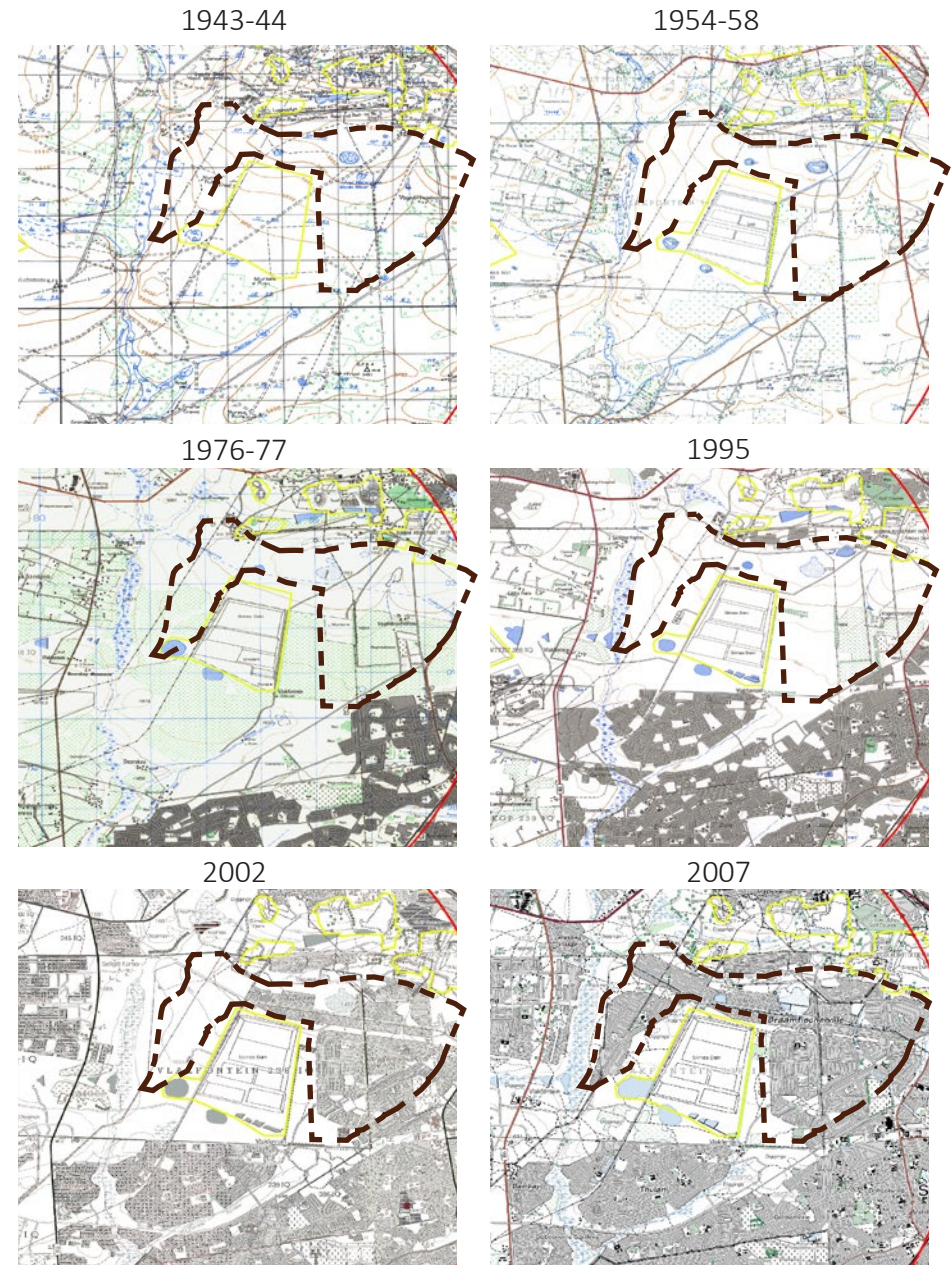


Figure 20 : Development of Braamfischerville over a series of years (Favaro,2024).

URBAN DESIGN AND HOUSING TYPOLOGIES

Similar to numerous other government-subsidised housing areas, the ongoing issue of unfinished public infrastructure continues to plague Braamfischerville, creating a sense of unfulfilled promises within the urban landscape (Harrison, Todes and Weakley, 2015). Inadequate urban management worsens this problem by allowing uncontrolled littering, overgrown grass and weeds. While some schools, parks, and public facilities have been established over time, the neighbourhood is far from fully serviced by essential public investment, considering its population densities (Harrison, Todes and Weakley, 2015). All subsidised dwellings constructed in the community conform to fundamental RDP criteria (Harrison, Todes and Weakley, 2015).

However, in contrast to many subsidised settlements, three alternative design options were built, including the typical free-standing (detached) house, a semi-detached unit with a shared wall on the property boundary, and what is colloquially known as a “drive-in” that consists of four houses nearby, with two in the front and two behind, sharing partitioning walls (Harrison, Todes and Weakley, 2015). Although spatially similar, these options have given rise to varying levels of public, semi-public, semi-private, and private spaces within the settlement, contributing to the diversity and complexity of Braamfischerville as an urban area (Harrison, Todes and Weakley, 2015).

Renovations, extensions and, in several cases, complete redevelopment of residential spaces over the last decade have changed the urban form significantly. The introduction of extensive boundary walls in various areas, coupled with expanded living space and numerous secondary structures (both formally and informally built), can sometimes pose challenges in identifying the original subsidised structures (Harrison, Todes and Weakley, 2015). In certain areas, the original buildings persist without any updates or maintenance, precisely as they were built over ten years ago. In contrast, some streets have a distinctly suburban feel, while others give off a prevailing sense of unkempt abandonment (Harrison, Todes, and Weakley, 2015).

HOUSING IN BRAAMFISCHERVILLE

A typical house built in South Africa under the Reconstruction and Development Plan has an area of 36 m² and is located on a 250 m² lot (Moolla, Kotze and Block, 2011). Each of the units consists of an open-plan bedroom, lounge and kitchen, with a separate lavatory. Generally, these homes are built with brick and mortar with galvanised iron roofs, metal doors and usually two or three small. Not all RDP homes are the same; some are bigger and can measure up to 45 m²(Moolla, Kotze and Block, 2011).

In a 2008 research study focused on Braamfischerville, it was revealed that a significant number of residents in the housing developments were dissatisfied with the construction quality. Complaints

ranged from poorly built roofs and walls due to inadequate workmanship to doors that didn't function properly. Moreover, the absence of air bricks in the housing units was a major cause of discontent as it necessitated keeping windows open for ventilation, leading to the entry of mine tailing dust into the houses (Moolla, Kotze and Block, 2011). Many of these homes were built without partition walls, leading residents to use furniture to divide the space in an attempt to create privacy between areas.



FIGURE 21: Inhabitants try to create privacy within the housing units (Nico Kotze, 2011).

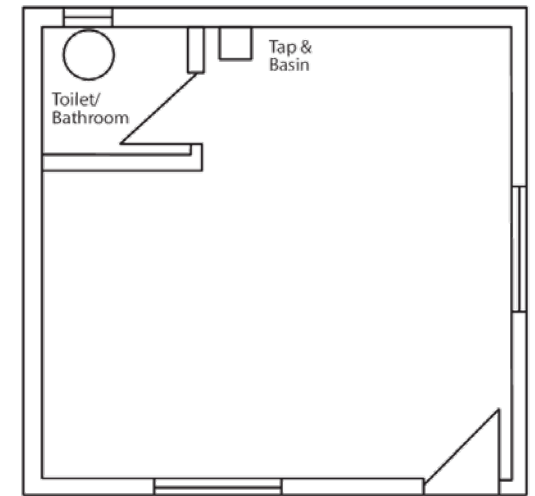


FIGURE 22 : Floor plan of RDP housing unit in Braamfischerville (Nico Kotze, 2011).



Figure 23 : Image of Dirt Road in Braamfischerville adjacent to thesis site (Chen, 2024).

PRESENT-DAY CONDITIONS IN BRAAMFISCHERVILLE

Urban densification is one of the main reasons why Braamfischerville consists of many different housing typologies. Various informal businesses have also developed in the area, such as Spaza shops, Hair Salons, Carwashes, and Fruit and Vegetable Vendors, which are prevalent throughout Soweto. These businesses have significantly influenced the township economy within Soweto as a whole.

The South African township economy primarily comprises informal small businesses that operate within the informal sector (A Guide to South African Township Economy, 2023). These businesses include spaza shops, street traders, hair salons, shebeens, and other informal activities operating from people's homes (A Guide to South African Township Economy, 2023). Most employment opportunities in these areas are informal and unstable, exacerbating the issue of high urban poverty and unemployment, particularly among the youth population.

In addition, Braamfischerville has witnessed the resurgence of subsistence farming, with some community members implementing

it as a means of being self-reliant. It is more affordable to buy only things that cannot be grown and produced. The township also houses cattle that graze within its borders.



Figure 24 : Backyard hair salon in Braamfischerville (Hooimeijer, 2024).



Figure 25 : Cattle grazing in Braamfischerville with wetland in the background (Chen, 2024) .



Figure 26 : Backyard spaza fast food shop (Hooimeijer,2024).



Figure 27 : Community subsistence farming Braamfischerville (Image by author).



Figure 28 : A housing typology type in Braamfischerville (completely redeveloped RDP), (google maps,2024).

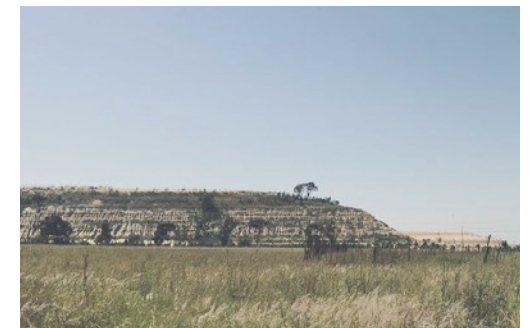
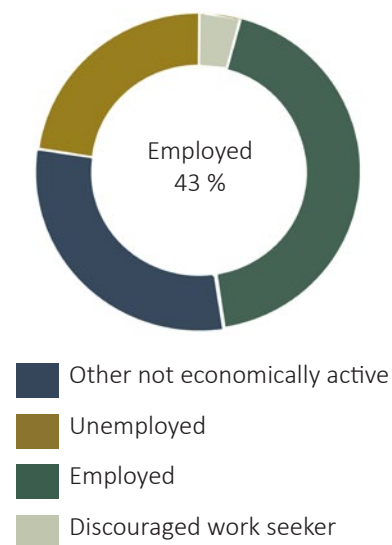
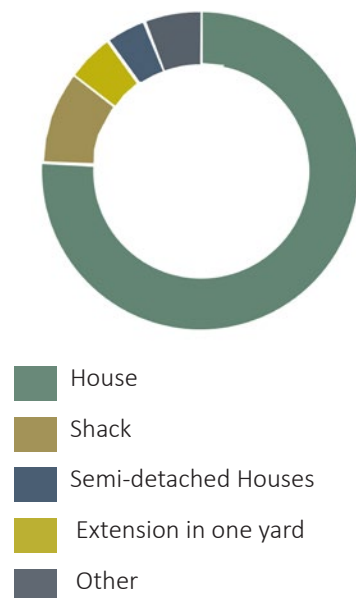


Figure 29 : Mine tailing in Braamfischerville (Image by author).

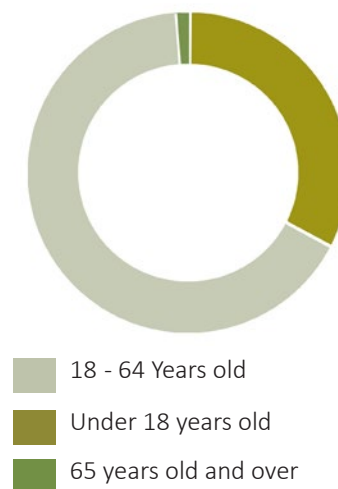
**POPULATION BY
EMPLOYMENT STATUS**



**HOUSEHOLD BY TYPE
OF DWELLING**



**POPULATION
BY AGE**



**POPULATION
BY GENDER**

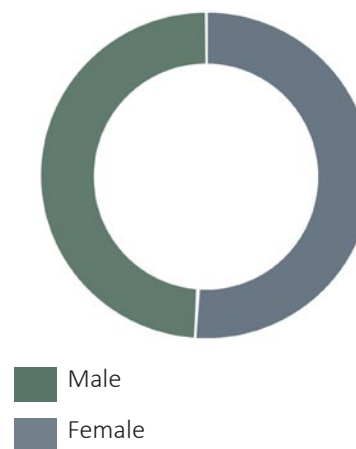


Figure 30 : Ward 49 Braamfischerville statistics, Image adapted (Wazimap,2011).

Braamfischerville faces a significant unemployment challenge, with only 43% of its residents employed, according to data from 2011. Educational attainment is also a concern, as around 40% of the population has completed Matric, but only 2% have pursued tertiary education. Introducing a skills development program could greatly benefit the township, helping to bridge these gaps and improve opportunities for its residents.

Beyond the existing township economy, which often also has challenges due to the lack of infrastructure, which has resulted in a hindrance to the growth of the, with business owners having to service customers without the basic services required for the day-to-day running of the business, such as reliable access to water and electricity (A Guide to South African Township Economy, 2023).

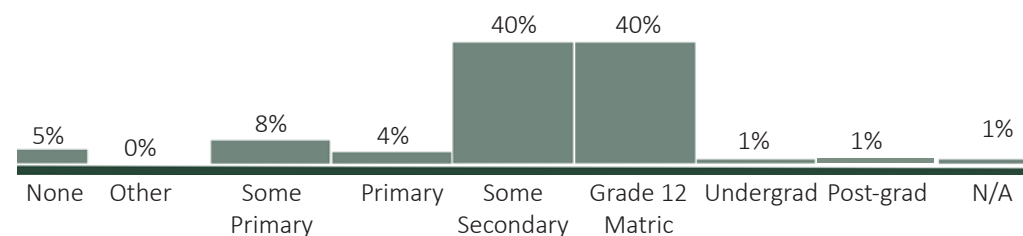


Figure 31 : Schooling level within Braamfischerville ,Image adapted (Wazimap,2011).



Figure 32 : Open land between residential area in Braamfischerville and mine tailing (Image by author).



CHAPTER 03: INTERVENTION

- Identification of Site
- Mapping / Site Analysis
- Proposed Intervention
- Material Usage

Figure 33 : Braamfischerville extension 12, Image adapted (google earth , 2024).

SITE LOCATION - SOWETO, BRAAMFISCHERVILLE, EXTENSION 12



Figure 34 : Site within the broader context of Soweto, image adapted (Google earth, 2024).

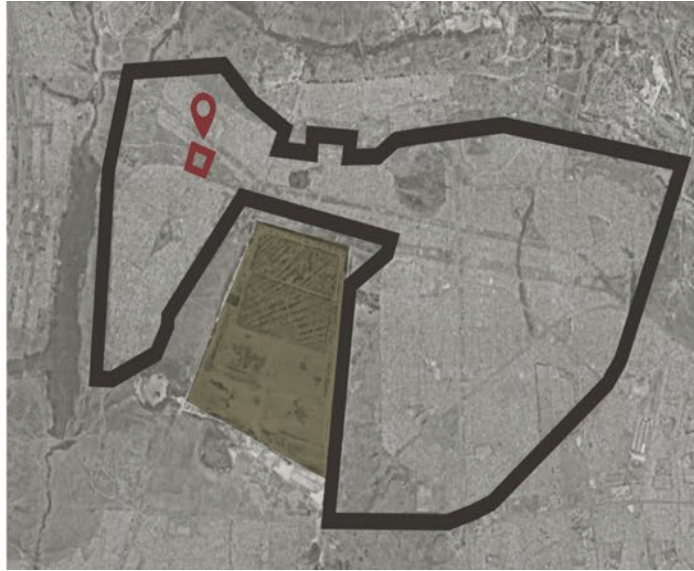


Figure 35 : Site within the broader context of Braamfischerville, image adapted (Google earth, 2024).



Figure 36 : Site within the broader context of Braamfischerville, image adapted (Google earth, 2024).

The thesis site is located in the north-western portion of Soweto, specifically in Braamfischerville, within extension 12, which marks the final stage of Braamfischerville's development. This area is to the west of the township. As previously mentioned, the township is next to a mine tailing, which has a negative impact on the citizens who live there. A community advocate from Doornkop, south of Braamfischerville,

expressed concerns about the impact, stating, "The dust contaminates our food. We ingest and inhale this dust, contributing to the ill health of many residents in the area" (Azunui, 2016). Additionally, it's noted that Doornkop is situated at a greater distance from the tailing than Braamfischerville.

SITE ANALYSIS - LAND USE

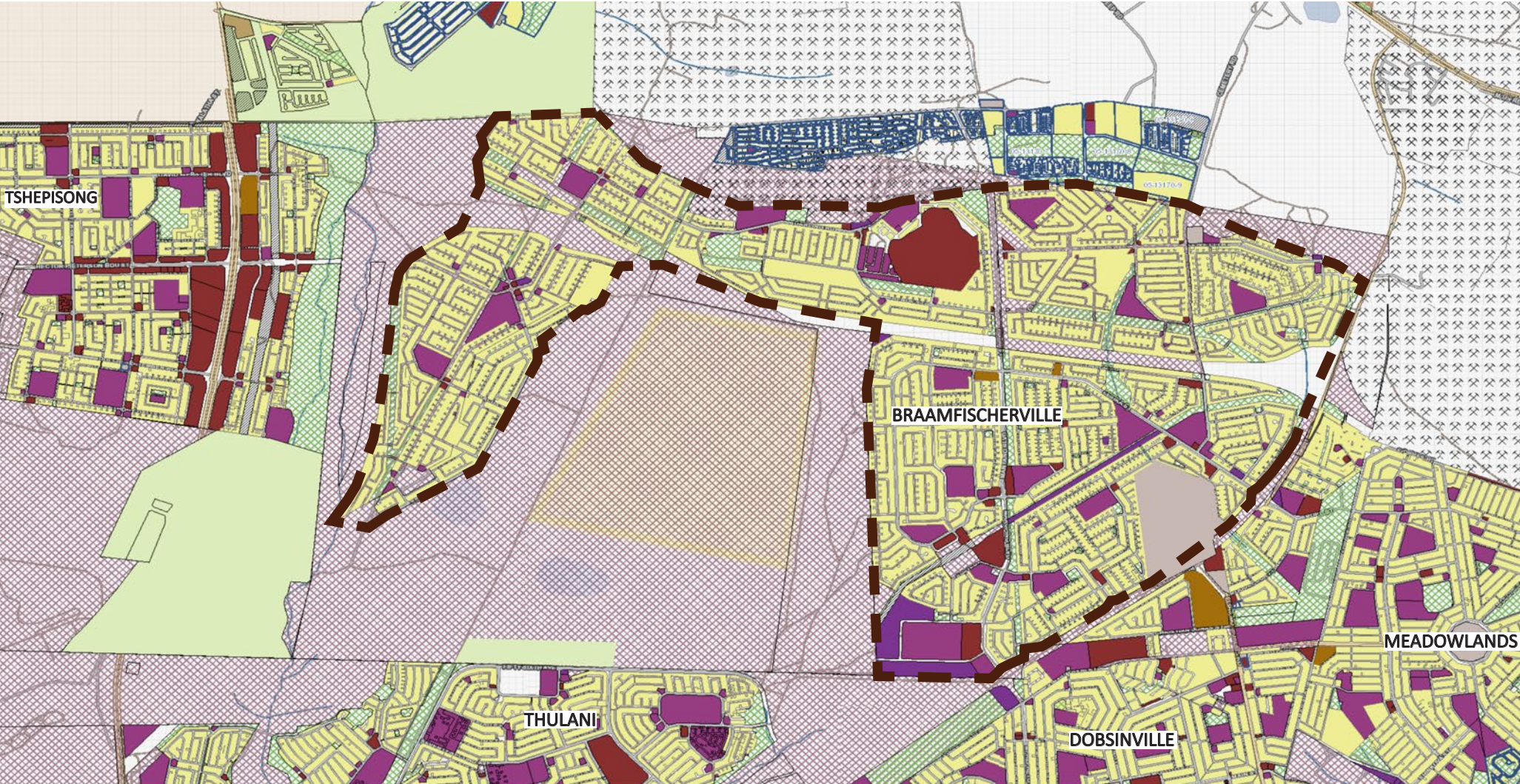


Figure 37: Zoning Map , image adapted (Joburg Gis,2024).

According to the map, Braamfischerville is mostly a residential region, with a few institutional buildings, such as schools, serving as focal points within the community. Braamfischerville has

a limited number of public spaces and structured shopping areas. The principal retail locations are spaza stores, which are recognized for having a smaller selection of things than more formal shopping centres.

- | | | |
|--------------|---------------------|------------------------|
| Institutions | Shopping Centres | Industrial |
| Business | Agricultural | Private Open Space |
| Residential | Undetermined Zoning | Demarcated Mining Land |
| Cemetery | | |

SITE ANALYSIS - MAJOR ARTERIAL AND SECONDARY ROADS



Figure 38 : Major arterial and secondary roads (Image by author).



SITE ANALYSIS - FORMALISED SHOPS IN BRAAMFISCHERVILLE

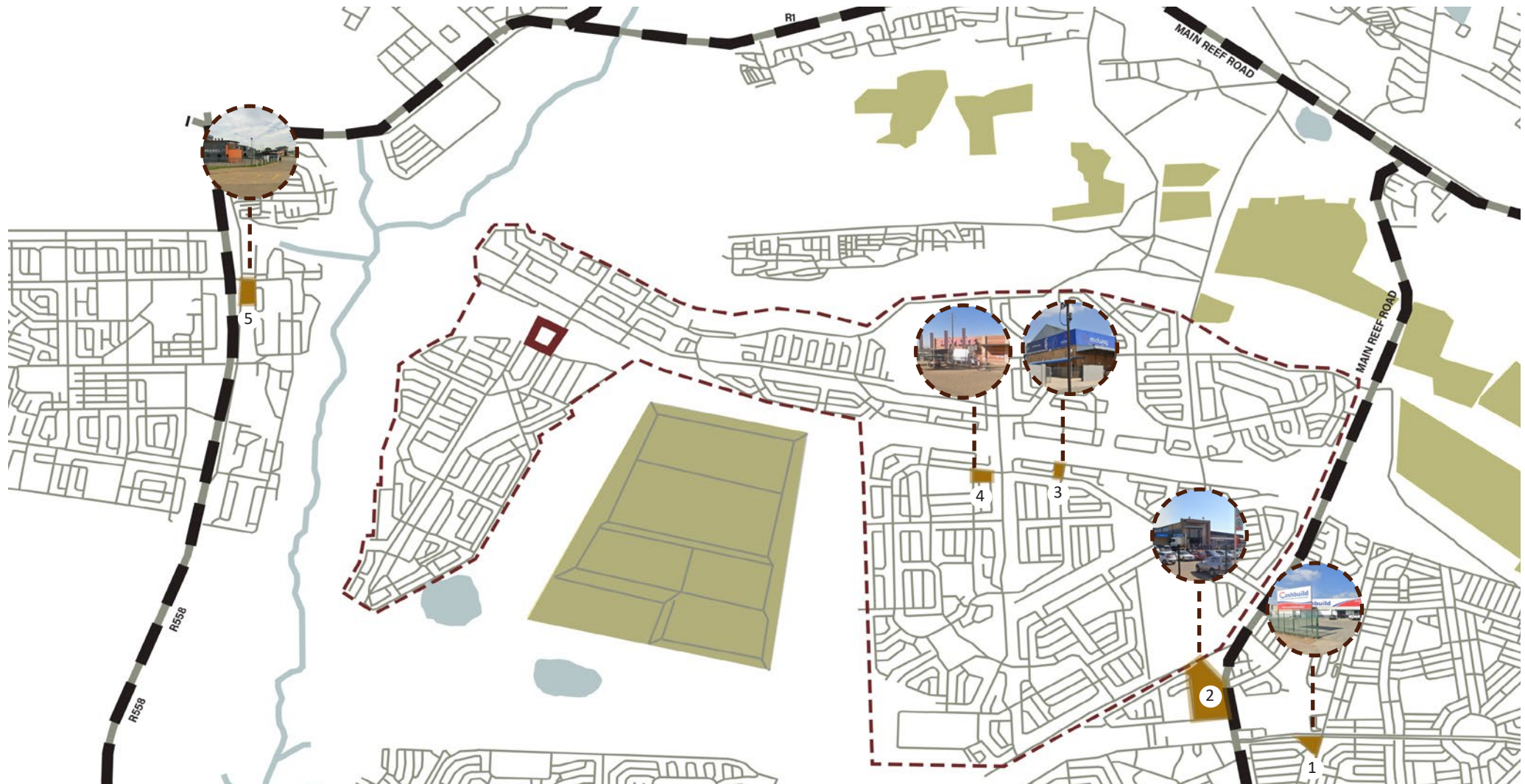


Figure 39 : Formalized Shops in Braamfischerville (Image by author).

The nearest shopping centre (with several stores) to Braamfischerville is located in the neighbouring township of Dobsonville. This implies that residents of Braamfischerville must travel to the adjacent township

to get to stores with a wider range of food and household items that are not available at spaza shops, or the nearby Shoprite located within the township.

- 1 - Cashbuild (Dobsinville)
- 2 - Dobsinville Mall (Dobsinville)
- 3- Midway Liquor (Braamfischerville)

- 4- Shoprite Mini (Braamfischerville)
- 5- Shopping Centre (Braamfischerville)



SITE ANALYSIS - RETAIL TYPOLOGY IN BRAAMFISCHERVILLE

Based on the analysis, street vendors are the most common retail type in Braamfischerville, selling largely fruits, vegetables, and snacks. There are also several spaza shops, which are informal small-scale convenience stores that operate from a room in someone's home or yard. These spaza shops are smaller in size and sell a limited range of home products and snacks. Furthermore, some supermarkets sell similar items to spaza stores, but on a larger scale and with more variety. Braamfischerville has only one formal shopping facility, Shoprite. However, for access to a wider range of items, residents would have to travel to the adjacent township of Dobsinville and visit the Dobsonville Shopping Mall.



Figure 40 : Street vendor selling fruits and Vegetables (Image by author).



Figure 41 : Hair salon, extension in yard (Google Maps,2024).



Figure 42 : Local shoprite in Braamfischerville ext (Google Maps,2024).



Figure 43 : Local hardware store in Braamfischerville (Google Maps,2024).



Figure 44 : Local supermarket in Braamfischerville (Google Maps,2024).

SITE ANALYSIS - MINING



Figure 45 : Mining Map (Image by author).

The site is located on land owned by DRD Gold Mine. A significant portion of the adjacent land is also owned by DRD Gold, presenting potential opportunities for future expansion. Given the ownership of the land by DRD Gold Mine, a proposed

strategy would involve integrating the centre into DRD’s Corporate Social Responsibility program and its post-mining remediation plan. The strategy also involves working with the local government to restore areas affected by mining operations.

LEGEND :

Land owned by DRD Gold Mine

Location of DRD Gold Mine

Demarcated Mining Land

Site Location

SITE ANALYSIS - CRITICAL BIODIVERSITY



Figure 46 : Critical Biodiversity Map (Image by author).

The key biodiversity areas represented in Figure 45 are terrestrial landscapes that must be protected in order for species and ecosystems to survive and operate properly, as well as provide ecosystem services. Failure to manage these

habitats will impede the accomplishment of biodiversity aims (Milnex ,2017).

LEGEND :

- Critical Biodiversity Area
- Wetland



Site Location



SITE ANALYSIS - WETLAND



Figure 47 : Proposed long-term wetland intervention (Image by author).

LEGEND :



Wetlands are highly productive and ecologically varied systems that improve water quality, manage erosion, keep stream flows stable, trap carbon, and support at least one-third of all vulnerable and endangered species. Wetlands are also known to enhance water quality, give wildlife habitat, and help to sustain ecosystem productivity, to mention a few functions (National Park Services, 2016).

Acid mine drainage, as previously stated in the document, happens when sulfide minerals in exposed rocks mix with water and oxygen, resulting in sulfuric acid. This toxic heavy metal run-off penetrates into nearby regions, including the wetland, causing low pH and vegetation damage, resulting in diminished biodiversity and compromised ecological functions. Not only does this negatively impact animals that rely on wetlands for food and habitats, but these conditions also disrupt the balance of microbial communities essential for the organic matter decomposition within the wetland. As a part of the long-term remediation efforts, the wetland could be rehabilitated through the placement of clean sand and sediments within the wetland, treatment of invasive species as well as seeding, planting, maintenance and monitoring (Hogan, no date). The site long term could a proposed green corridor, which provides green infrastructure.

After the wetland has been resorted it could then be utilised in the treatment of acid-mine drainage as wetlands are renowned for their potential to improve water quality by eliminating heavy metals and increasing PH levels (Pat-Espadas et al., 2018). This can be addressed as a part of the project's future plan to deal with acid-mine drainage run-off.

SITE ANALYSIS - BROADER ENVIROMENTAL CONSIDERATIONS



Figure 48 : Broader Enviromental Considerations (Image by author).

LEGEND :

	Wetland		Wetland
	Mine Dumps (associated impacts)		Water bodies

SITE ANALYSIS - BRAAMFISCHERVILLE MINE DUMP

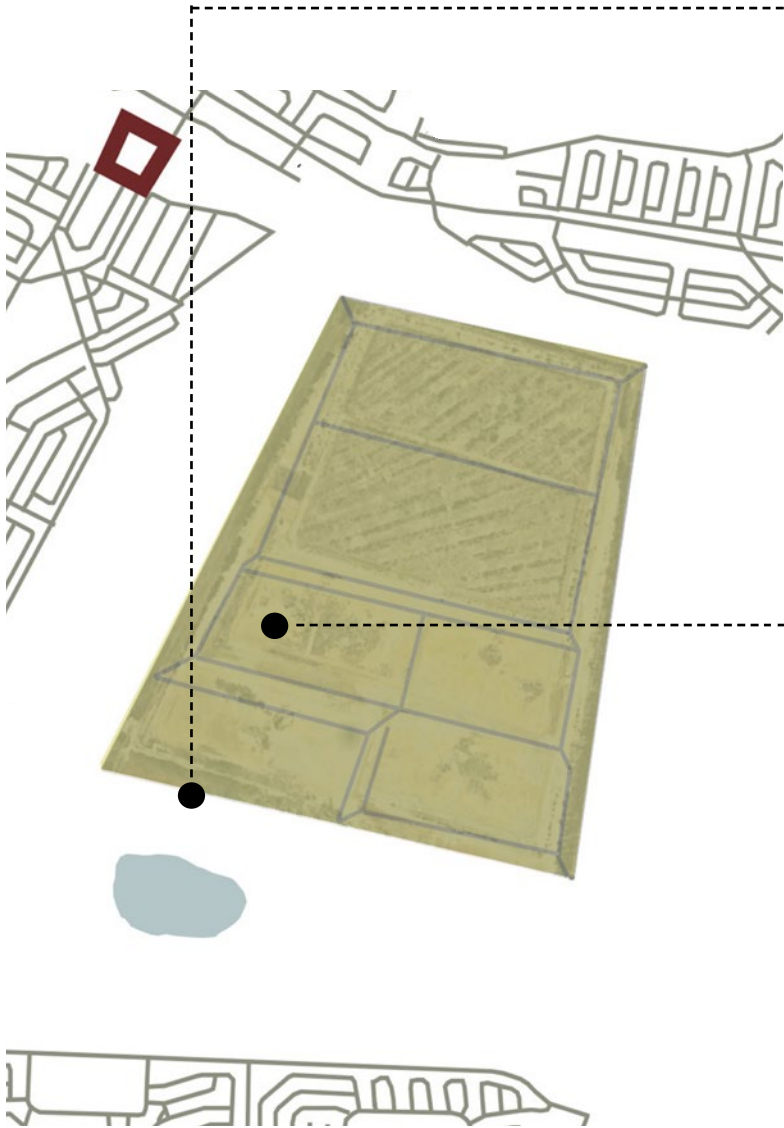


Figure 49 : Braamfischerville mine tailing (Image by Author).

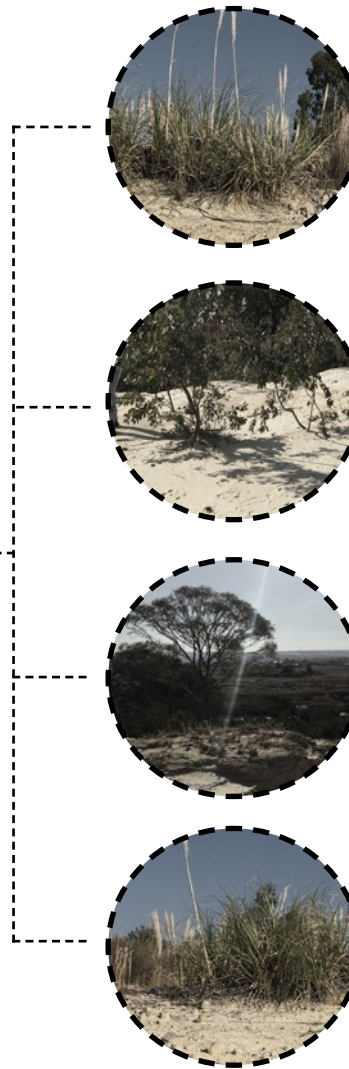


Figure 50 : Vegetation on mine tailing to combat soil erosion and limit dust dispersion (Images by author).



Figure 51 : Soil erosion is visible on the southern side of the mine tailings, where there is a noticeable lack of vegetation. (Image by author).

SITE ANALYSIS - SITE INFORMATION



Figure 52 : Thesis site highlighted in Extension 12 (Image by author).



Figure 53 : Thesis Site (Image by author).

OWNER : DRD Gold Ltd

ZONING : Undetermined

STAND NO. : RE/1/238-IQ

REGION NAME : Region C

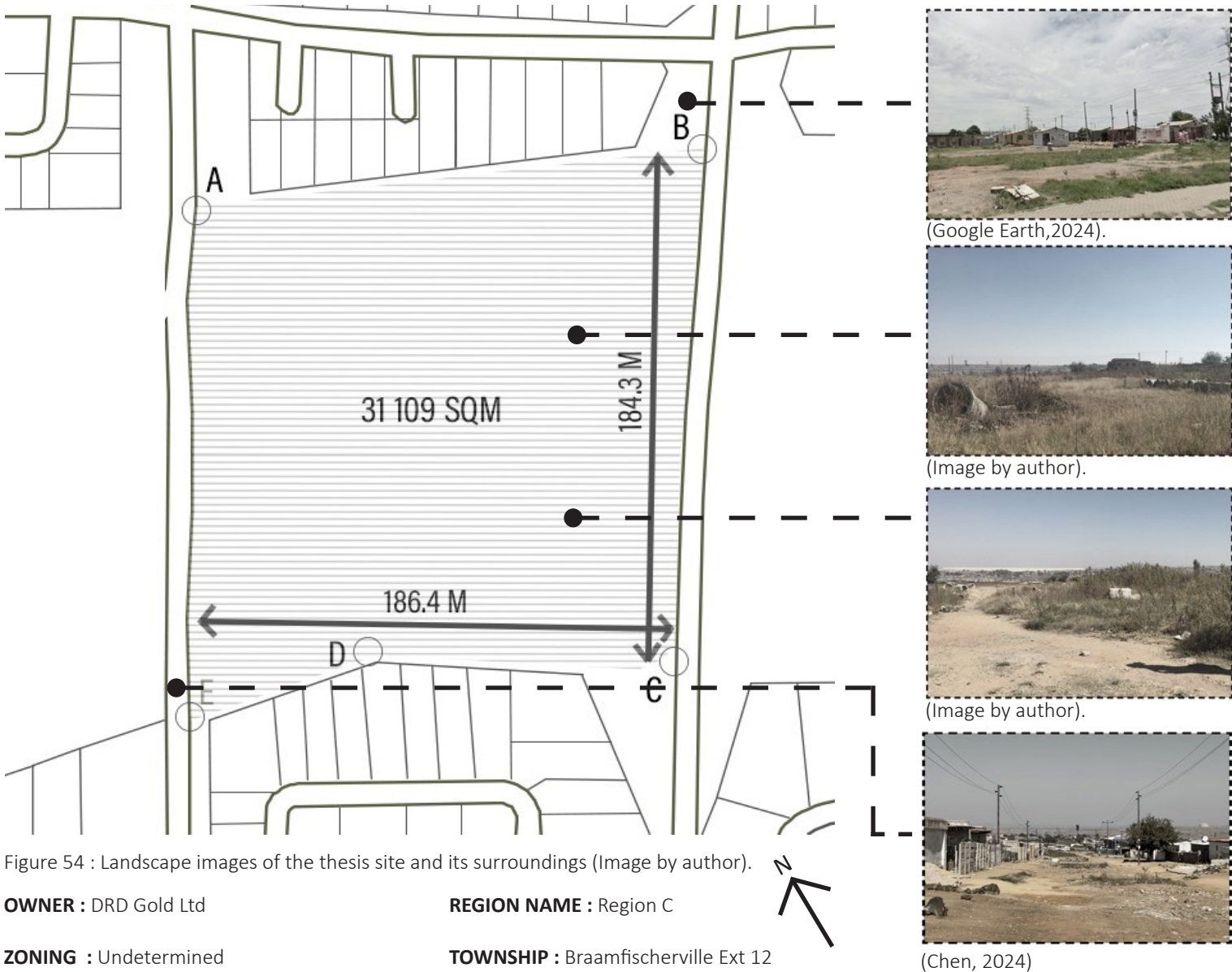
TOWNSHIP : Braamfischerville Ext 12

STREET ADDRESS : Abbess Drive



SITE ANALYSIS - SITE IMAGES

Currently, the site is vacant and characterised by desire lines, which people use as shortcuts. It remains largely unoccupied, except when people are passing through. The gravel road adjacent to the site is primarily used by pedestrians. A formal road, Abbess Drive, serves as the main commuting route on the right side of the site. It is clear from first-hand observation that public vehicles, including taxis, frequently use this road.



SITE ANALYSIS - EDGE CONDITIONS

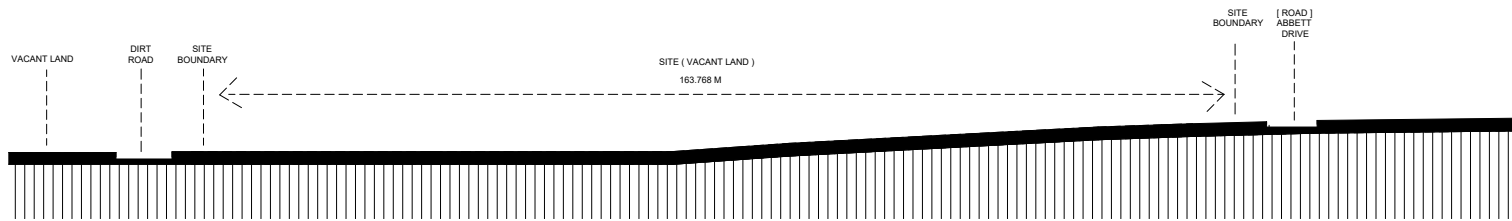


Figure 55 : Section AA (Image by author).

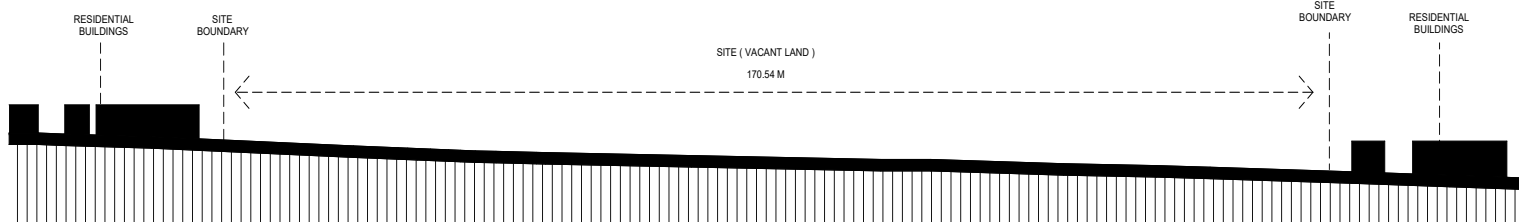


Figure 56 : Section BB (Image by author).

Residential dwellings are located along the site's northern and southern boundaries (these are the backs of the houses). A dirt/gravel road borders the western side of the site, and an official tar road borders the eastern side of the site.

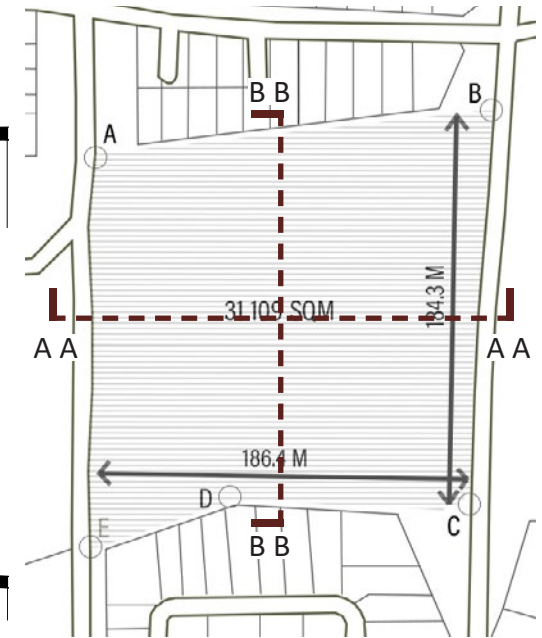


Figure 57: Section locator plan (Image by author).

SITE ANALYSIS - PEDESTRIAN AND VEHICULAR MOVEMENT



Figure 58 : Pedestrian Movement
(Image by author).



Figure 59 : Vehicular Movement
(Image by author).



Figure 60 : Desire Lines, image adapted
(Google Maps,2024).



Figure 61 : Walking distance across site
(Image by author).

SITE ANALYSIS - WIND MOVEMENT



Figure 62 : January 1991-2020,image adapted (South African Weather Services, no date).



Figure 63: April 1991-2020, image adapted (South African Weather Services, no date).



Figure 64 : July 1991-2020,image adapted (South African Weather Services, no date).

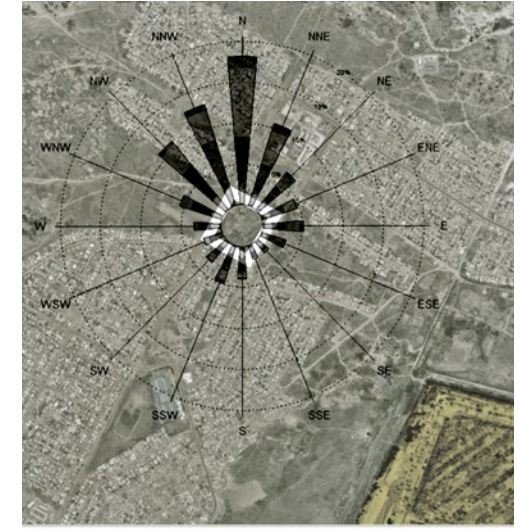


Figure 65 : October 1991-2020, image adapted (South African Weather Services, no date).

The average yearly winds in Johannesburg come from the north (South African Weather Services, no date). However, this fluctuates slightly throughout the autumn and winter seasons. Due to mine tailings and the potential for dust-polluted emissions, these factors are to be carefully considered. A multi-faceted approach has been proposed to mitigate

dust impact. This includes the installation of air-filtering screens to minimise dust infiltration into internal spaces. Additionally, the proposal of courtyard spaces would be strategically designed with surrounding buildings acting as windbreakers. The orientation of these spaces is also intended to reduce the impact of dust further.

SITE ANALYSIS - TRAFFIC FLOW ALONG ABBESS DRIVE

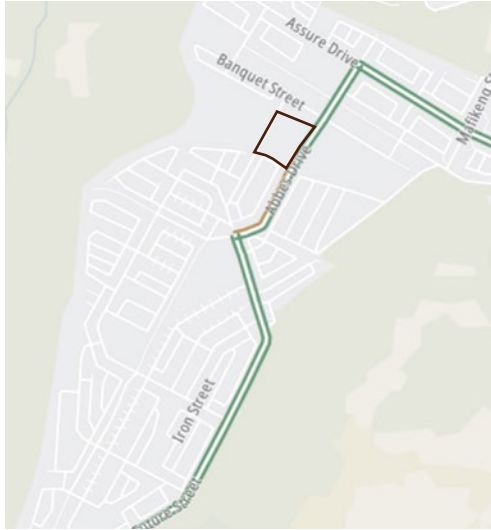


Figure 66 : Traffic Analysis along Braamfischer-ville main road (Abbess Drive) : 8am 16 August 2024 (Tomtom,2024).

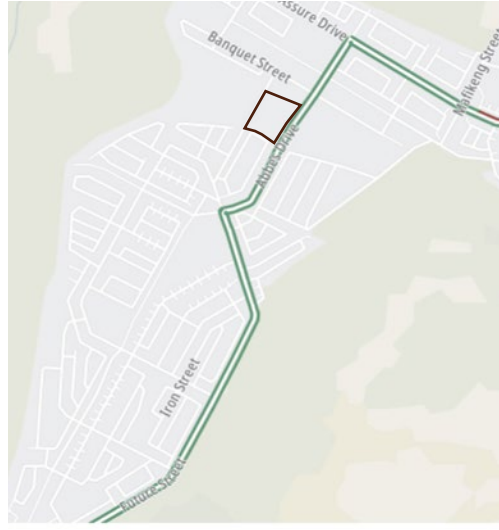


Figure 67 : Traffic Analysis along Braamfischer-ville main road (Abbess Drive) : 10am 15 August 2024 (Tomtom,2024).

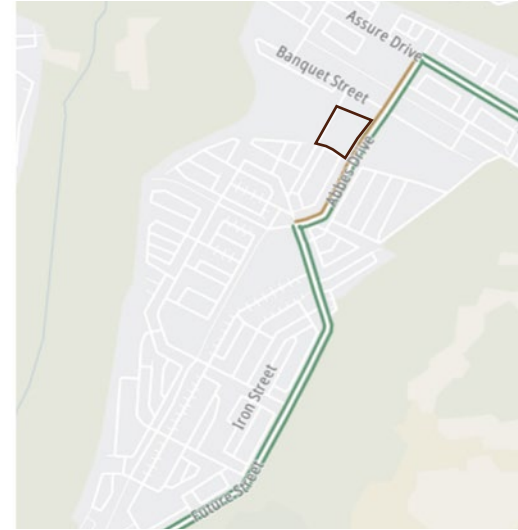


Figure 68 : Traffic Analysis along Braamfischer-ville main road (Abbess Drive) : 14 pm 15 August 2024 (Tomtom,2024).

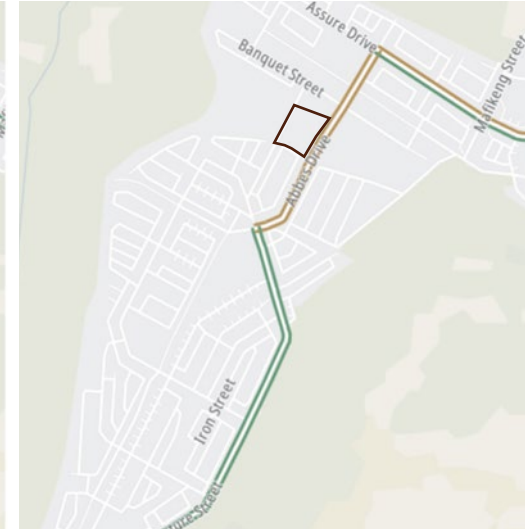


Figure 69: Traffic Analysis along Braamfischer-ville main road (Abbess Drive) : 16pm 16 August 2024 (Tomtom,2024).

The property is located along a primary commute route, and while traffic volume is normally mild, slight delays occur around 8 a.m., 2 p.m. and 4 p.m. These delays are most likely caused by the large number of commuters who go to and from school and work during these times of day.

SITE ANALYSIS - SOIL PROPERTIES

Suitable soils for agriculture are balanced in contributions ranging from various mineral components (sand: 0.05–2 mm, silt: 0.002–0.05 mm, clay: <0.002 mm), air, organic matter (SOM) and water (Parikh 2012). Hemp grows best in well-drained loam soil with a pH of between 6 and 7.5 with abundant organic matter

- at least 3.5 % (Louw, no date). According to the analysis of information on soil properties within this thesis site provided by the ISDA the soil PH in the thesis site lies between 6-6.2 and the required pH to grow hemp is between 6 - 7.5, it can be assumed that the hemp would be able to be grown within the context.

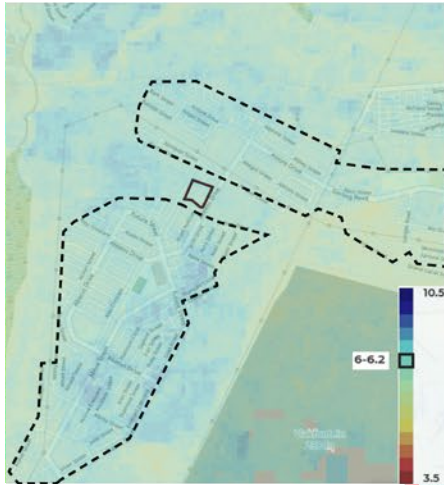


Figure 70 : Soil PH (Isda,2024).



Figure 71 : Silt Content (Isda,2024).



Figure 72: Fertility Capacity Classification (Isda,2024).

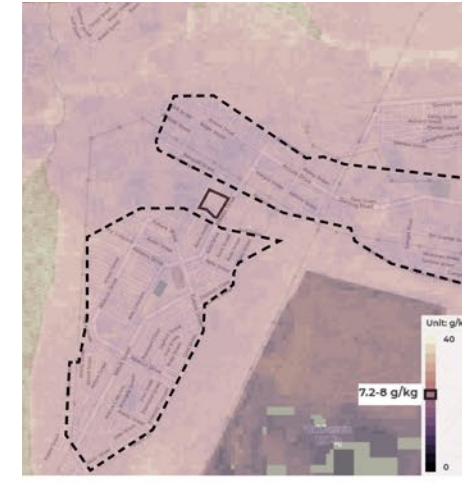


Figure 73 : Carbon Organic (Isda,2024).



Figure 74 : Sandy Loam (Isda,2024).

CONCEPT - CONCEPT DIAGRAMS

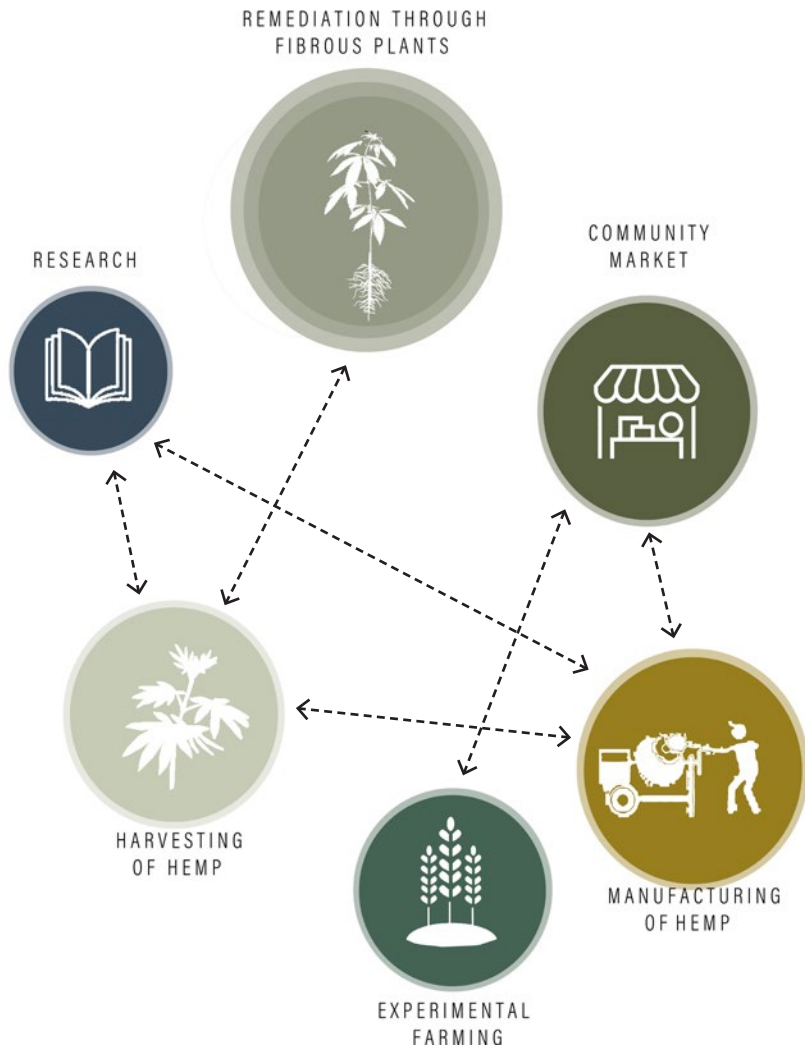


Figure 75 : Concept Diagram (Image by author).

The proposed concept is to use hemp for the remediation of the natural landscape, with design serving as a catalyst to aid with the process. This approach revitalises the landscape while allow the community to connect through the market and

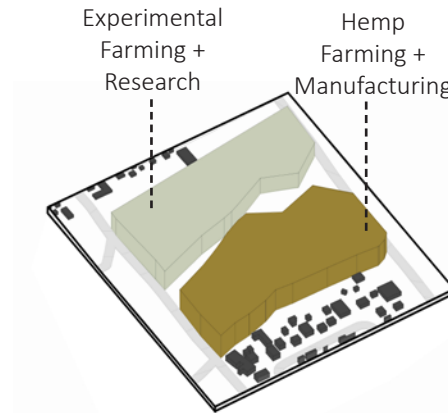


Figure 76 : Division of Function Space (Image by Author).

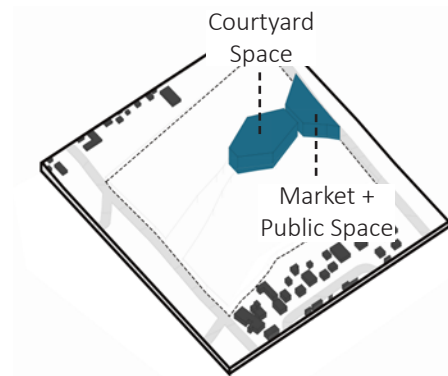


Figure 78 : Connection spaces / gathering spaces (Image by Author).



Figure 80 : Concept Informants (Image by Author).

public space. It also provides an opportunity for community members to upskill through the training programme. This proposal draws on existing desire lines on-site, creating a pedestrian spine, allowing people to move through the site .

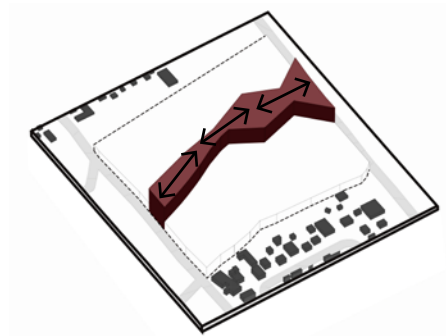


Figure 77 : Movement of People (Image by Author).

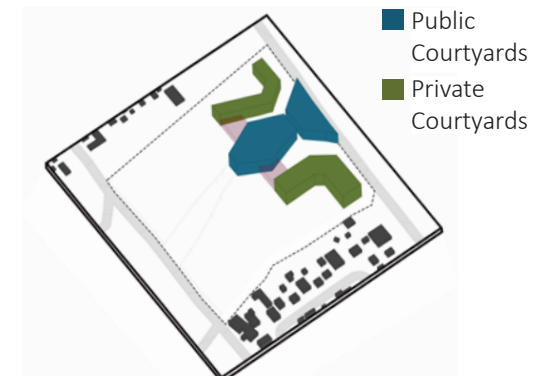


Figure 79 : Moments of pause (Image by Author).

CONCEPT - PROGRAMMING

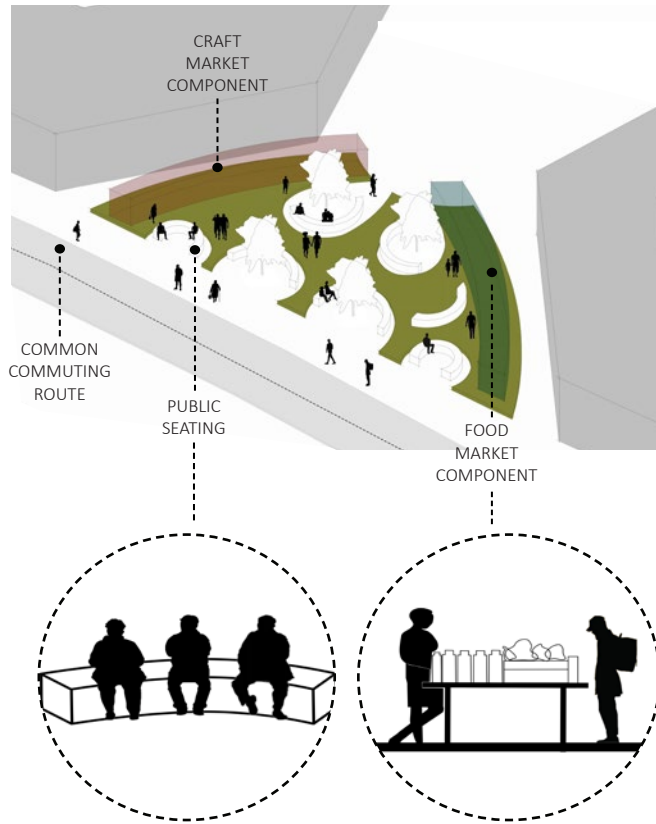


Figure 81 : Market Space (Images by author).

The Market is designed to provide an opportunity for community members interested in selling food to sell on specific days; some of the food items sold within the market will include some fresh produce grown on-site from the experimental facility. The market space also features a crafts section where community members are able to sell various kinds of handmade and craft items. Products made on-site will also be available and sold in the market. The market is not only designed to be a space for commerce but also as a public space where people can connect, gather and interact.

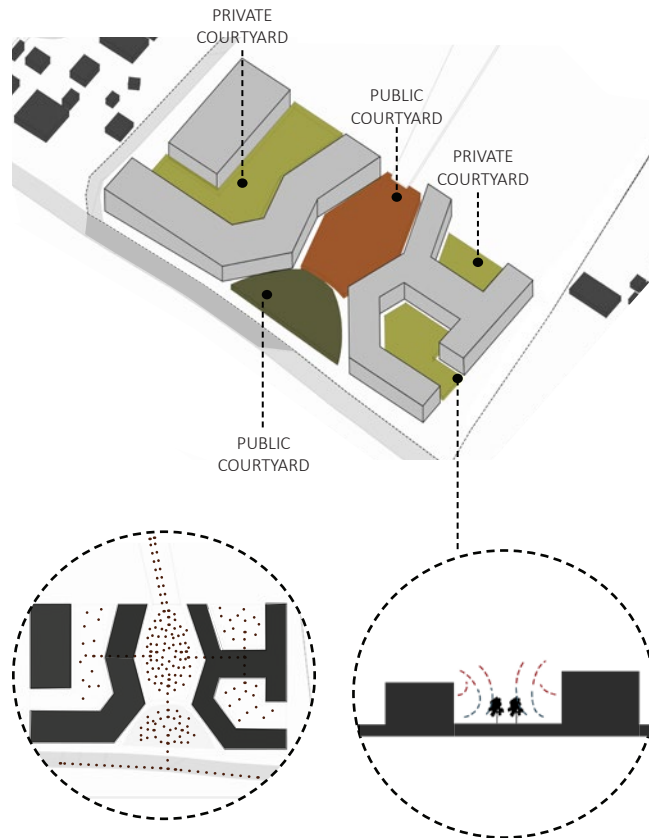


Figure 82 : Public and Private Courtyard (Images by author).

The projects includes courtyard spaces that are aimed to encourage social interaction as well as act as spaces for gathering. The public courtyards provide opportunities for social interactions with members of the public, whilst the private courtyards are envisioned as spaces for people who work in the facility to serve as peaceful spaces for taking breaks and outdoor work within the manufacturing side, Additionally these spaces are to provide comfortable micro-climates and offer a reprieve from mine tailing dust.

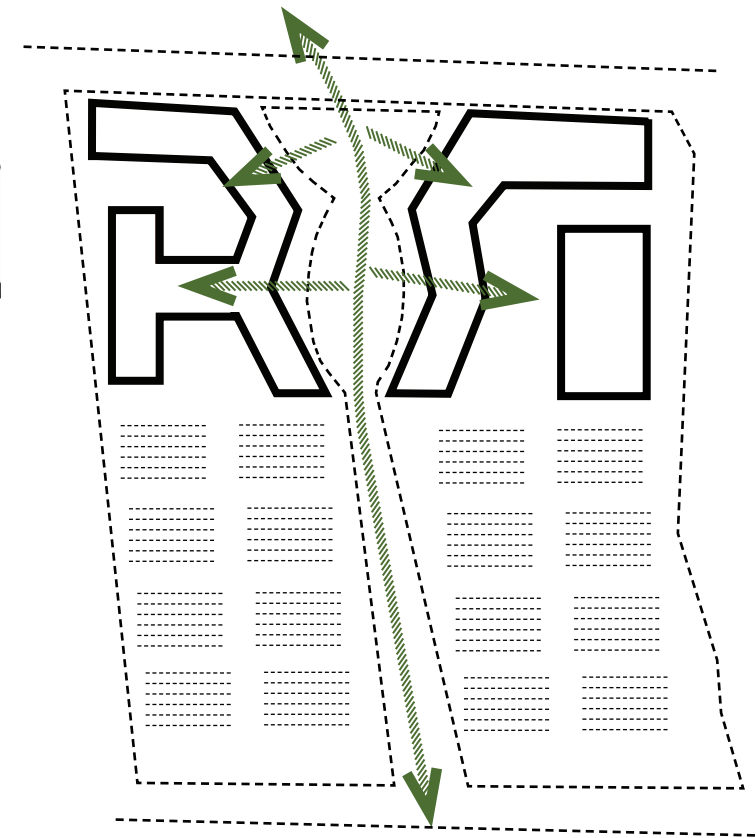


Figure 83 : Pedestrian Spine (Images by author).

The pedestrian spine is based on the idea of utilising existing desire lines at the site. It provides pedestrians with access to walk through the site, allowing them to witness the farming activities. The pedestrian spine is designated as a pedestrian route that stays open 24/7 the clock, while the built facilities can be secured at night.

CONCEPT - PROGRAMMING

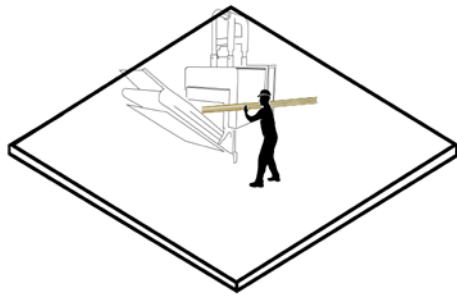


Figure 84 : Manufacturing Space (Images by author).

The manufacturing spaces are aimed to function as dynamic working environments that ensure efficiency in the manufacturing process from beginning to end. They are to be envisioned to facilitate and support the smooth conversion of hemp into finished wall and ceiling panels. This process would include the preparation and the handling of raw materials as well as the implementation of processing techniques to produce durable building components.

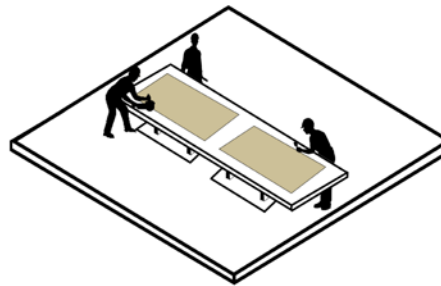
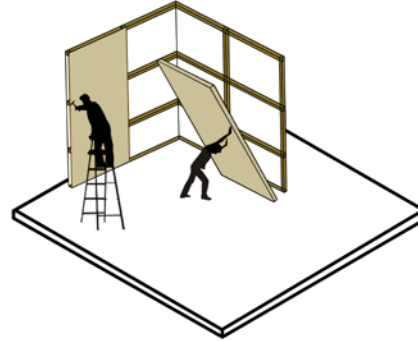
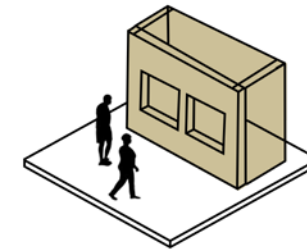


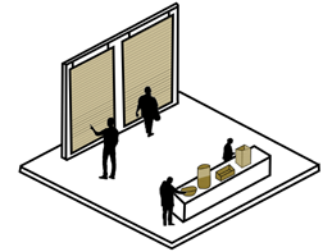
Figure 85: Training Space (Images by author).

The training facility is to function as an instructional hub for people within Braamfischerville who want to acquire skills in the creation and application of hemp panels. This part of the programming seeks to provide a training program for the production and utilisation of the panels. Participants involved in this programme would gain hands-on experience with the entire panel production process, including the handling of raw hemp, processing and the manufacturing procedures.

Sight



Touch



Read / learn



Enquire

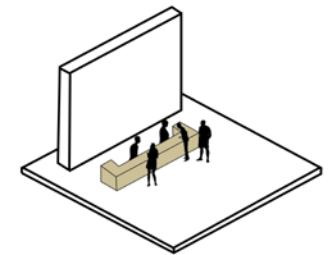


Figure 86 : Exhibition Space (Images by author).

The exhibition space is a designated space that is to provide visitors with an informative and engaging experience. This space aims to provide more information on the design and manufacturing processes. It seeks to take visitors through a journey of explaining what the entire site is about. This facility also aims to provide visitors with the opportunity to interact with the materials (hemp and woven items) to enhance the visitors' understanding and appreciation of the craftsmanship involved.

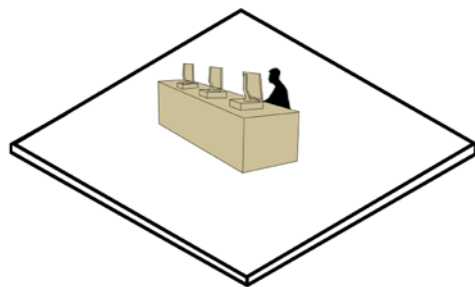
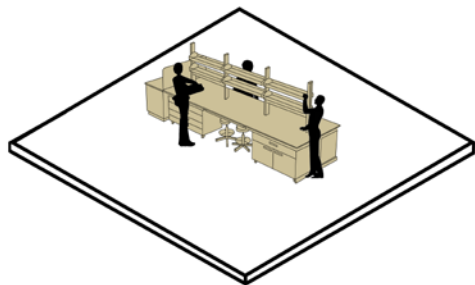


Figure 87 : Research Space (Images by author).

The research space is dedicated to the investigation of different kinds of remediation plants to identify which plants would best be suited in this context for expansion purposes and the development of the centre in the future. It seeks to explore plants that can withstand environmental extremes such as drought and other environmental challenges. The research component aims to contribute to sustainable practices in ensuring long-term environmental stability within the region and the exploration of alternative crops as well as food crops to enhance future resilience.

SERVICE PROGRAMMING

Rainwater Harvesting: Rainwater harvesting is a crucial component of on-site service programming. This system collects rainwater for multiple uses within the site, including irrigation, and supplies it to the built areas. The harvested rainwater supports irrigation and provides essential water within the site. Incorporating rainwater harvesting within the project enhances sustainability and reduces reliance on external water sources.

Solar Energy Harvesting: The generation of solar energy is another key component on-site, this would provide facilities with the power needed to run manufacturing and research activities. This sustainable approach not only provides power but it decreases the reliance on non-renewable energy sources and instead enhances energy efficiency. The utilisation of solar power showcases the centre commitment to environmental stewardship and self-sufficiency.

Parking: The on-site parking is primarily reserved for employees and visitors to ensure convenient access for those directly involved with the site. This approach considers that most of the population relies on public transportation in the area.

Recycling: Recycling within the centre seeks to support the processing and repurposing

of various products and materials. This process transforms recyclable materials into items that can be used for composting and other applications. Through the introduction of recycling into the program the site is able to promote environmental sustainability, waste reduction as well as resourced recovery. This approach ensures that materials are managed effectively, participating in a circular economy and overall reducing the environmental footprint.

Ablutions: The site requires both private and public ablutions. Public ablutions are required for individuals using or accessing the market space as a public area. These facilities will need to be access-controlled to ensure adequate management and security. Private ablutions are available to those working on-site or those visiting the private portion of the facilities.

According to SAN 10400 standards, for a population of up to 90 people, the following provisions are required: For females: seven WC pans and five wash basins. For males: three WC pans, six urinals, and five wash basins. These specifications ensure that the ablution facilities are adequate to efficiently accommodate the needs of both public and private users.

CONCEPT - PASSIVE DESIGN STRATEGIES

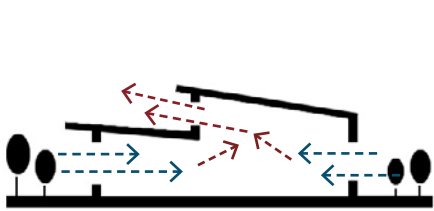


Figure 88 : Cross Ventilation (Image by author).

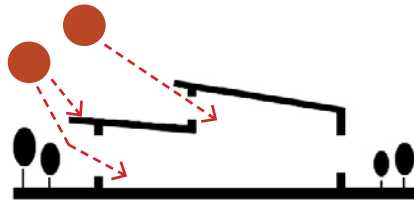


Figure 89: Passive solar heating (Image by author).

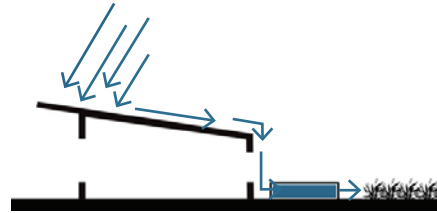


Figure 90 : Water Collection for Irrigation (Image by author).

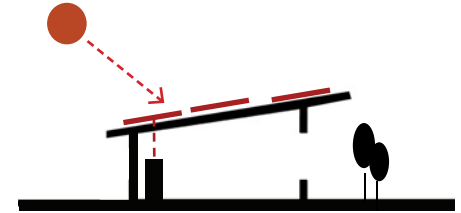


Figure 91 : Energy Generation (Image by author).

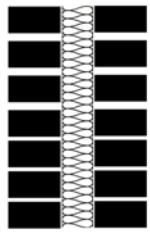


Figure 92 : Thermal Comfort (Image by author).

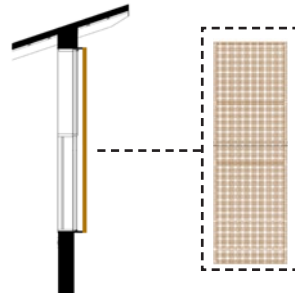


Figure 93 : Filtered Screens (Image by author).

Passive design solutions are used to mitigate harmful environmental effects. These solutions use natural measures to regulate the building's temperature. Rainwater harvesting and on-site energy generating are used to reduce the need for municipal resources. Filtered screens are regarded as a viable option for purifying potentially contaminated air. These screens filter out pollutants and particulates, ensuring that the air quality within the space is safe

and clean. Thermal comfort is also a vital concern. This is accomplished by carefully selecting construction materials that are not only durable and sustainable, but also capable of regulating temperature effectively. The selection of materials is critical in maintaining a comfortable indoor climate, avoiding the need for extra heating or cooling equipment.

CONCEPT - PROGRAMMING

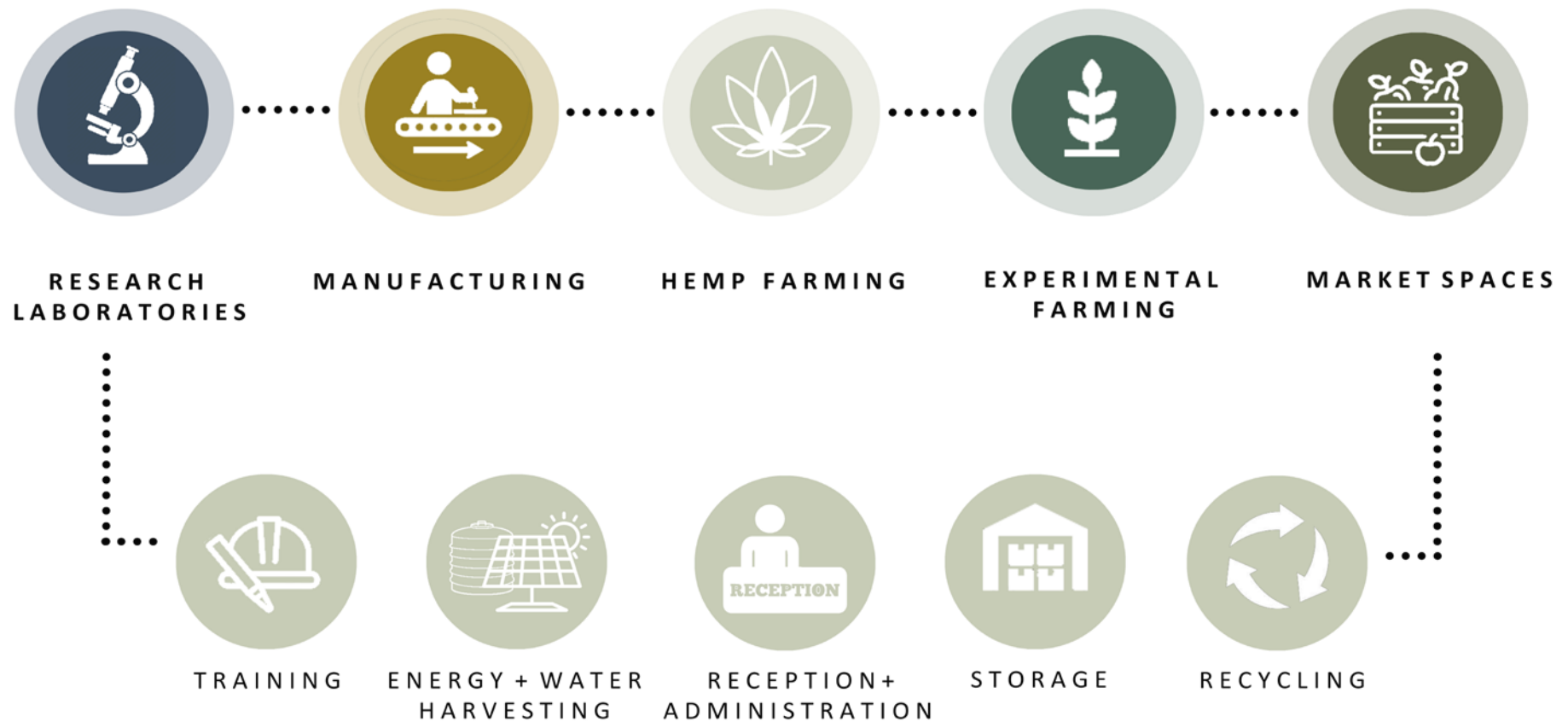


Figure 94 : Design Programming (Image by author).

The thesis project involves programming for hemp farming, experimental farming with different fibrous plants, manufacturing spaces for making hemp wall and ceiling panels, research areas which would relate to the experimental farming component. These research spaces will be dedicated

to analysing and identifying other fibrous plants that might be better suited for expansion on site. Additionally, the project encompasses market and communal areas, exhibition spaces, training facilities, and rentable retail stores open to the public.

CONCEPT - MATERIAL USAGE

Materials are selected based on their availability, energy efficiency, cost-effectiveness, and compatibility with the site's programming.

By utilising materials that require little maintenance, maintenance expenses can be kept to a minimum, allowing revenues to be diverted to more pressing on-site concerns.

An intentional feature of the project is the use of hemp and wooden partitions within the building's interior in order to create a modular internal structure. With the help of these features, the indoor spaces can be easily adapted to meet the needs of the occupants at any time.

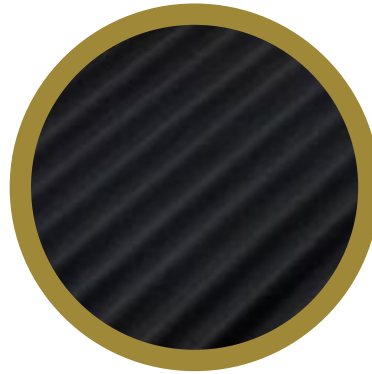


Figure 95 : Corrugated iron sheeting (Cite).



Figure 96 : Hemp (Material district, 2017).



Figure 97 : Brickwork (Corobrick, no date).



Figure 98 : Curtain walls (Mart, 2024).

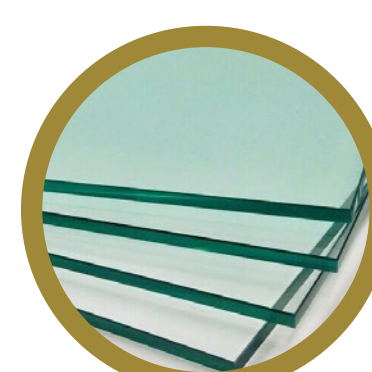


Figure 99 : Glass (Balastrades direct, no date).



Figure 100: Concrete (Freepik, no date).

TECHNICAL INTENTION

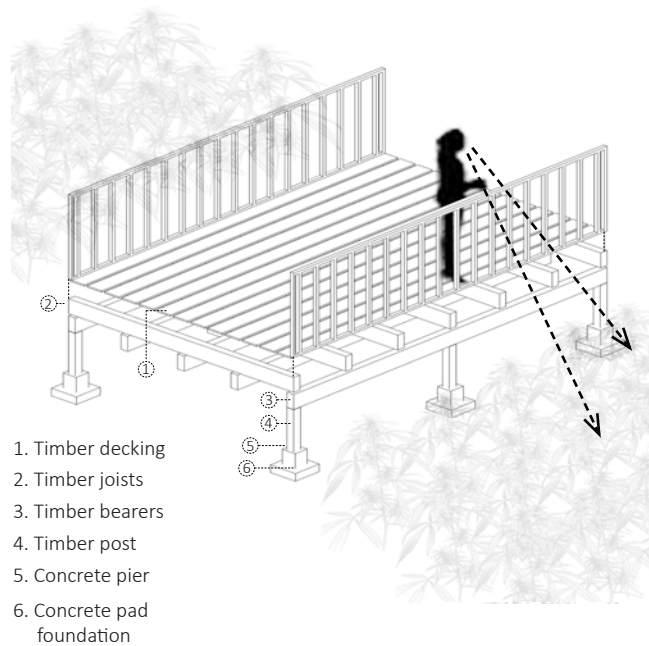


Figure 101 : Raised Platforms (Image by author).

Within the learning and making spaces of the facilities, certain structural and non-structural elements are exposed, reinforcing the concept of learning from one's environment. The idea is for people to interact with and learn through the architecture of these spaces. A lightweight mesh screen would be introduced to function as both a filter for polluted air and can provide visual interest creating an aesthetic

Figure 102 : Exposed timber detailing image adapted (Aston , no date).

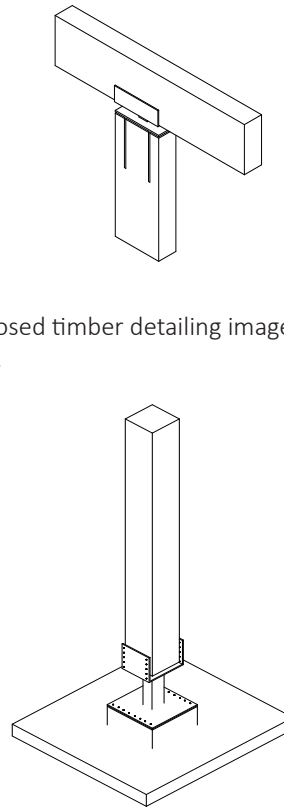


Figure 103 : Exposed timber coloumn detail (Image by author).

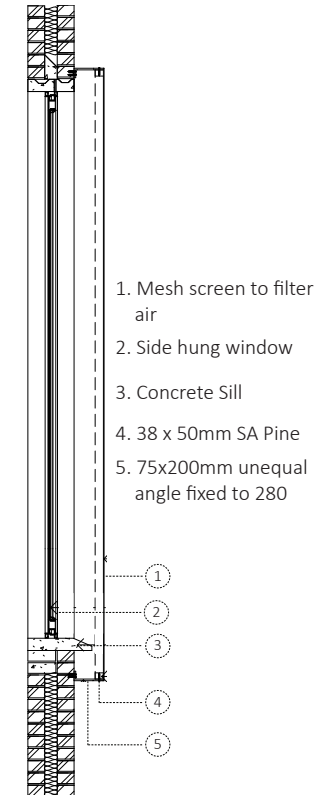
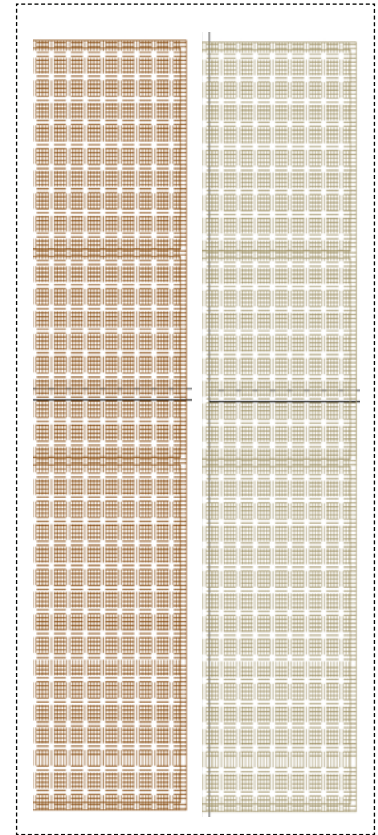


Figure 104: Filtering Screen device (Image by author).



TECHNICAL INTENTION - ARCHITECTURAL LANGUAGE

The project's architectural language is designed to respond to the materiality of its residential context, where material choice is often limited. Given the site's location in a residential township, the goal is to develop a material palette that is not foreign but relates to the surrounding residential environment to create and strengthen the contextual relationship with its surroundings. This intentional choice allows the building to be associated in a natural and appropriate way with its context.

However, to subtly begin exposing innovation and bring an element of sustainability to the project, certain areas of the facility will feature hemp as one of the materials. This choice of materials will continue to allow relatability to the context while including an aspect of sustainability. The inclusion of hemp will be a subtle yet intentional departure from the expected choices of material, exemplifying a broader sustainability practice while still adhering to the established architectural context.

Moreover, the architectural expression is shaped by the functionality of the spaces within the project. This functional approach

creates a purposeful differentiation between the manufacturing areas and office spaces. The distinct architectural language of each area reflects its specific function, ensuring that the building is contextually grounded and functionally responsive. This strategy allows the nature of each space to dictate its unique character and architectural expression, resulting in a project that is both contextually integrated and thoughtfully designed to meet the needs of its users.

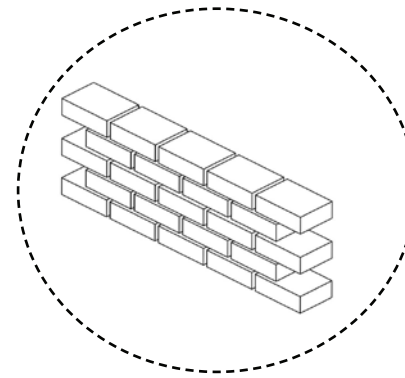


Figure 105 : Brickwork image adapted (Ylivdesign, no date).

MANUFACTURING
Brick, Mortar and Cement
[Heavier Structure]
(Vectorstock, no date)



Figure 107 : Francis Kere Cultural Centre (Baan, no date).

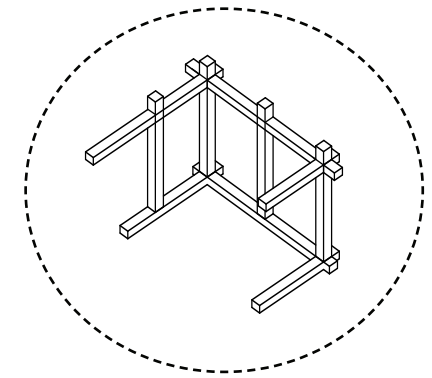


Figure 106 : Timber Frame (Cite).

INTERNAL SPACES + RESEARCH FACILITIES
TIMBER FRAMED
[Lighter Structure]
Image adapted (Kreo, no date)



Figure 108 : Timber framed resident (Mairs , no date).

TECHNICAL INTENTION - SHEARING LAYERS

Drawing on Steward Brand's book "How Buildings Learn: What Happens After They're Built," this project aims to incorporate key components of permanence and adaptability in architectural design. In the book Brand highlights idea that the external skin is often the most permanent and durable, designed to withstand environmental changes. In contrast the internal spaces within buildings are more adaptable and flexible, enabling for the adaptation of spaces to meet the evolving needs of the occupants.

The conceptual and technical approach of this thesis draws on these ideas, recognizing that, as the remediation of the natural landscape progresses, the function of the centre may need to evolve along its function. The internal

spaces of a building can be easily adapted to accommodate changing requirements, this project takes into account that certain aspects the centre's purpose may shift in response to the ongoing restoration of the environment. This adaptability is central to the project's design philosophy, ensuring that the built environment remains responsive to the dynamic relationship between the landscape and its use.

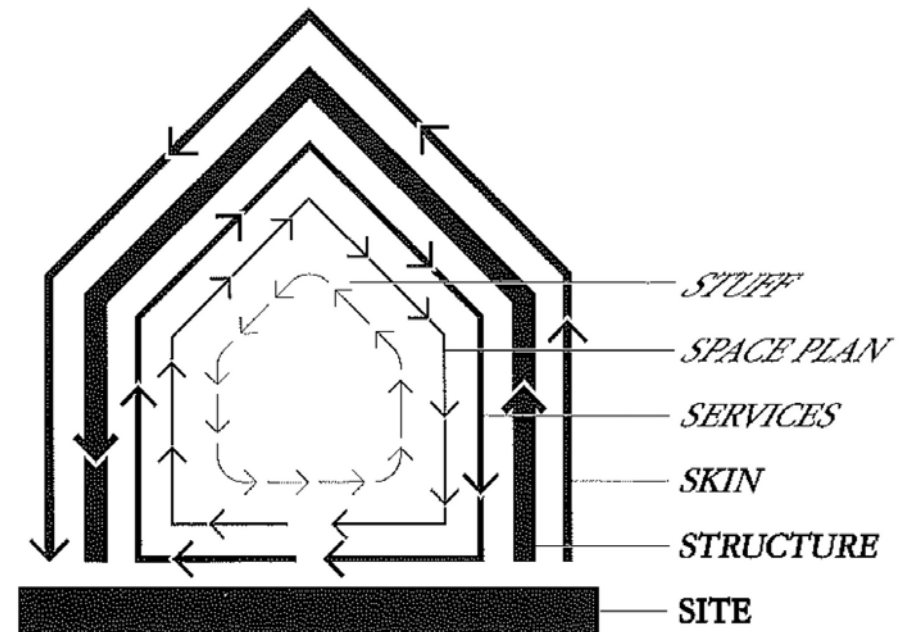


Figure 109: Shearing layers (Brand 1994).



Figure 110 : Remediator plant on top on Braamfischerville mine tailing (Image by author).

CHAPTER 04: PHYTOREMEDIATION

- Defining phytoremediation
- Industrial Hemp
- Manufacturing of Hemp
- Experimental Farming
- Use of Hemp within the project

PHYTOREMEDIATION

One of the leading causes of soil contamination, heavy metals are hazardous to both human and environmental health. There are several methods for achieving environmental remediation of a natural landscape, but many of them are expensive and may harm the landscape. These methods include chemical oxidation, soil washing, biological treatment, dig and haul, and many more. However, there are safer, easier, and more affordable ways to clean up contaminated landscapes, like phytoremediation. In essence, this is the utilisation of plants to detoxify dangerous contaminants from the soil and remove heavy metals from the landscape (Placido and Lee, 2022). A workable, affordable, and environmentally friendly substitute for clearing contaminated soil is phytoremediation. As opposed to more destructive remediation methods, it is an ecologically responsible method of removing soil. Organic and inorganic contaminants may be remedied by remediation plants, many of which have a fibrous root system and deep roots that have the capability of absorbing pollutants from the soil.

Large volumes of pollutants can be absorbed and/or broken down by plant species and the bacteria that live with them without

impairing the plants' ability to perform essential tasks (Bartucca, Forni, and Cerri, 2023). Plants suitable for phytoremediation must be able to cope with the adverse effects of toxicants, which could otherwise adversely affect their vital functions. Usually, these species constitutionally express high amounts of antioxidant or detoxifying molecules and enzymes (Bartucca, Forni, and Cerri, 2023).

Metal-accumulating plants generally are small shrubs with shallow roots that require specific conditions to grow. For soil remediation to be effective, more than just the top layer of soil must be cleaned of pollutants (Placido and Lee, 2022). Industrial hemp has been selected as the plant to be grown for heavy-metal extraction at this thesis site. This plant has been recognised and taken into consideration because of its lengthy roots, which work as an assistant in the extraction of heavy metals from contaminated waste sites. It has also been recognised because of its commercial potential and capacity to produce a wide range of by-products. Other plants are, however, introduced on a smaller scale as part of this project's experimental character in order to test what might work better for future development and what by-products may be generated from that.

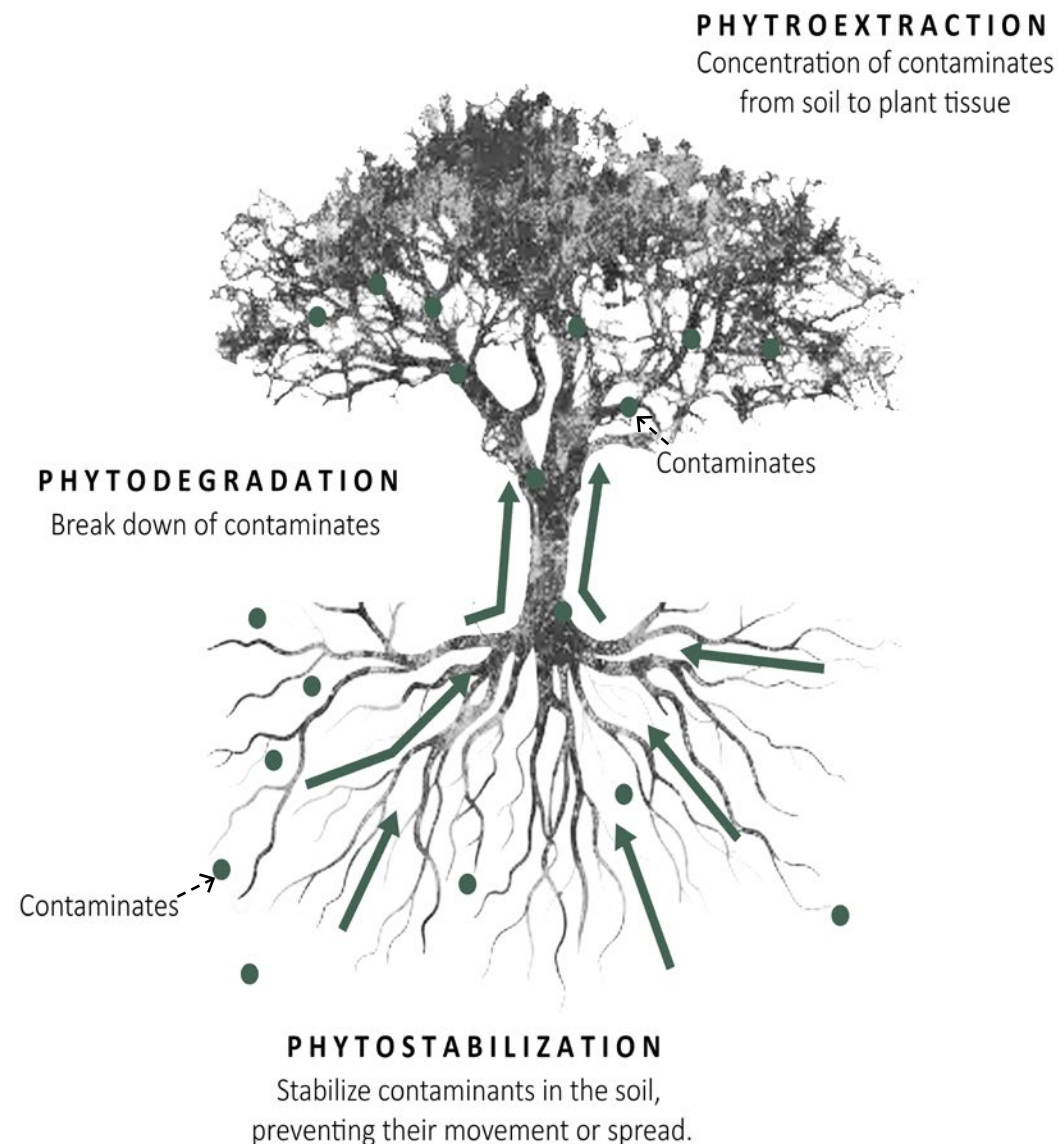


Figure 111 : Hemp Manufacturing Process for Building Material Diagram (Image by author).

INDUSTRIAL HEMP

A strain of *Cannabis sativa* L known as "Industrial Hemp" has a dry weight concentration of less than 0.3% delta-9-tetrahydrocannabinol (THC). Hemp has long been employed in the manufacturing sector. Moreover, hemp is utilised and well-known for its phytoremediation properties. The plant can be grown in contaminated areas, and it can also be used to make a variety of commercially viable goods, including pulp, animal feed, wall and ceiling panels, and wood fibre among many other goods. The principal rationale behind the designation of hemp as the primary fibre plant within this thesis project is due to its capacity for phytoremediation; also, its versatility allows for the production of a wide variety of products, from wall and ceiling panels to (Placido and Lee, 2022).

However, since the plant accumulates potentially toxic metals in all parts, it will not be explored as a raw material for clothing or for use in the project. Therefore, the leaves are not harvested for food or used for personal care. However, the stalks can be utilised for building materials, paper, cloth, and biofuel (Placido and Lee, 2022). This project primarily explores the manufacturing

of wall and ceiling panels from the hemp used to remediate the soil. Additionally, the weaving of household elements is also being explored. Hemp wall and ceiling panels have been identified as a key focus due to the demand for easily installable construction materials. As previously highlighted, many RDP housing settlements in Braamfischerville were constructed without internal partition walls and ceilings, making the production of this by-product particularly fitting for the context. Additionally, ongoing redevelopment of RDP housing and the presence of multiple dwellings in single yards, where residents frequently extend their homes, present an opportunity for these panels to be sold within the surrounding settlements. The nearby informal settlement could also benefit from these adaptable and easy-to-install construction materials, as their current building technologies would be enhanced by such innovations. Hemp has been identified as a highly favourable plant in this setting due to its rapid growth, adaptability to various soil conditions, and ability to thrive in different climates (Placido and Lee, 2022).

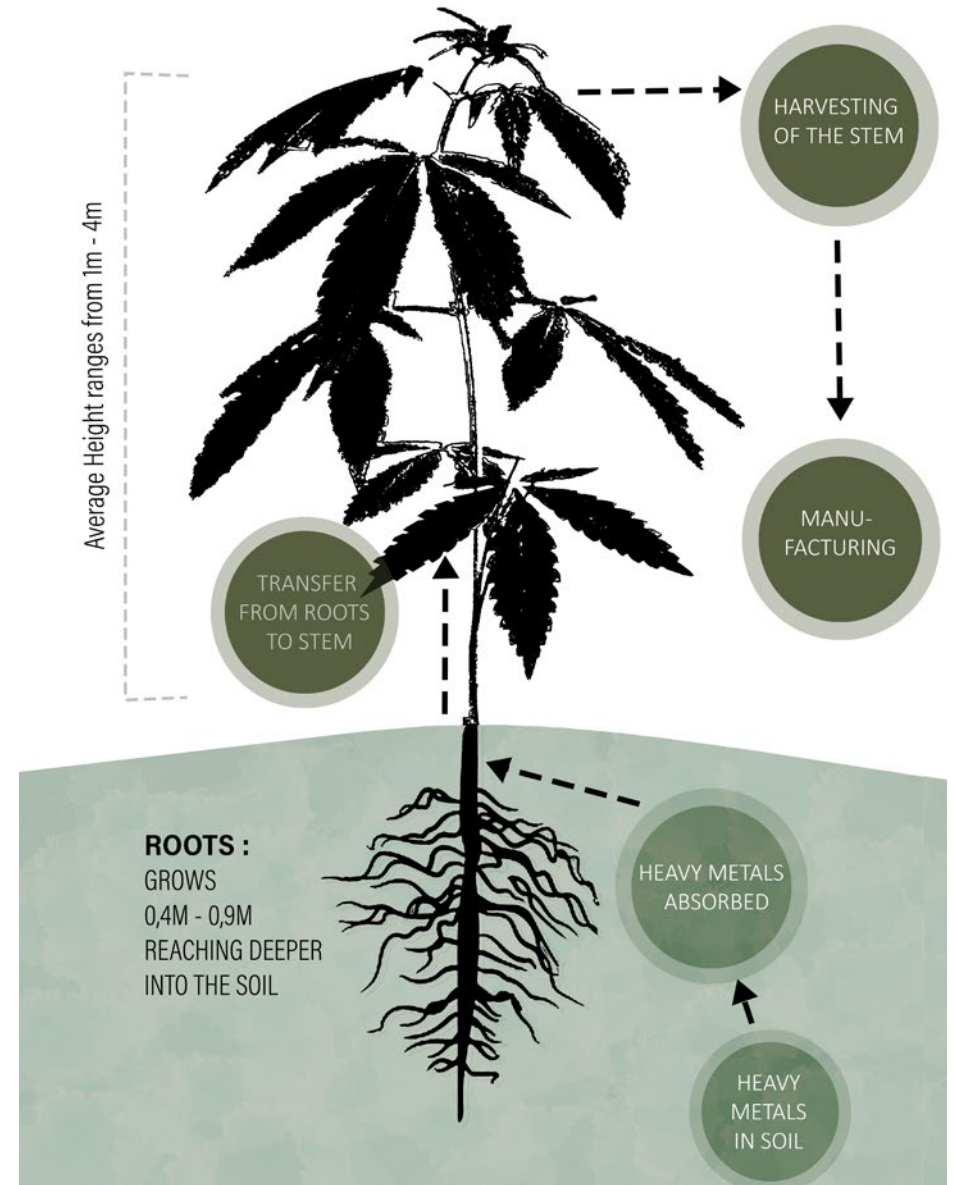


Figure 112 : Diagram of hemp plant absorbing heavy metals from soil (Image by author).

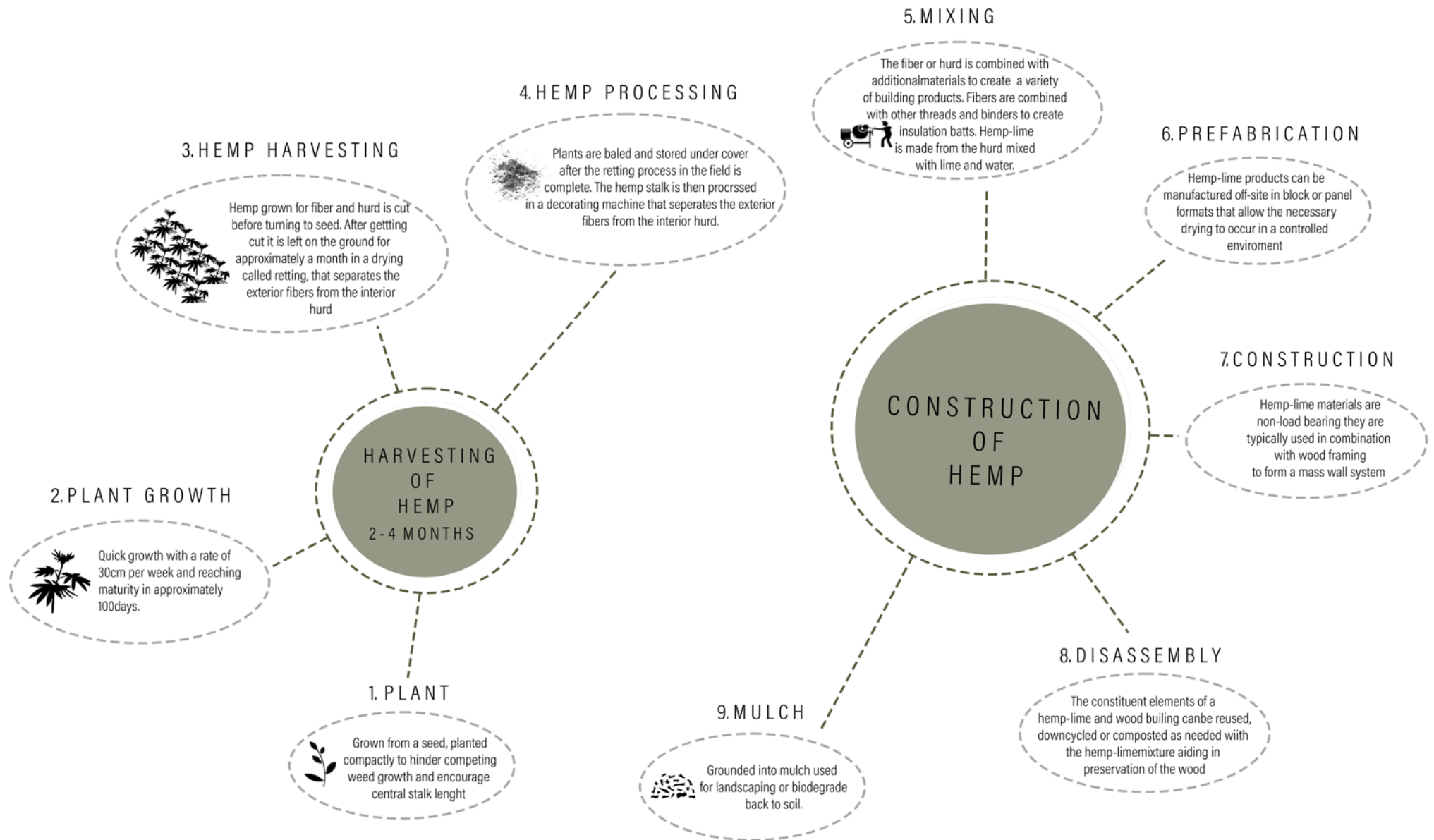


Figure 113 : Hemp harvesting and manufacturing process for building materials diagram, Image adapted (Lewis and Tsurumaki ,2022).

HEMP PANEL MANUFACTURING PROCESS

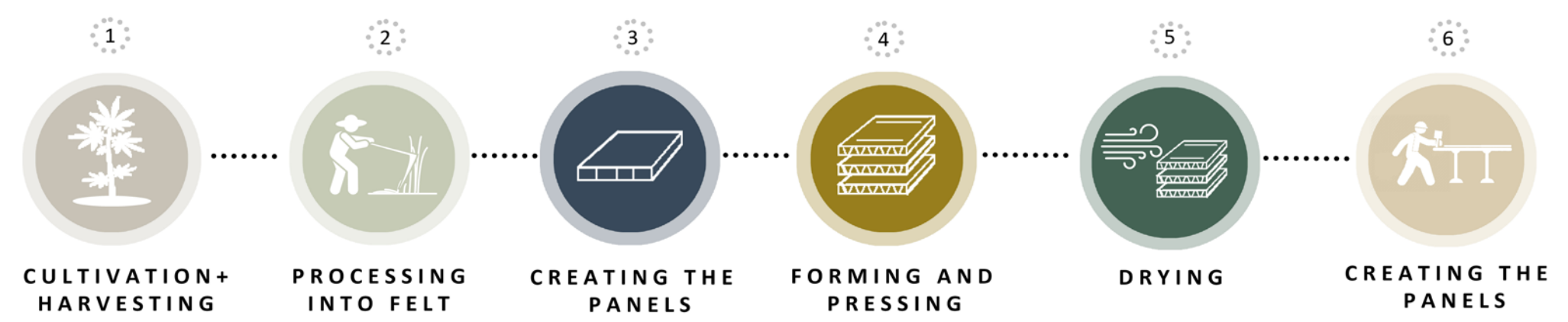


Figure 114 : Hemp Manufacturing Process for Building Material Diagram (Image by author).

- Hemp plants grow rapidly, reaching up to 4 meters in height, and are typically harvested after 8 to 10 weeks. Once they reach this height, they are ready to be cut down (Swart, no date).
- Once harvested, the hemp is transformed into hemp felt through a detailed process. This involves separating the fibers from the woody core, known as hemp hurds, and then crafting the fibers into felt sheets (Swart, no date).
- Next, the hemp felt is mixed with a natural binding agent, usually a glue made from eco-friendly ingredients. In some methods, such as the one created by designer Jory Swart, the layers of hemp felt are manually pressed together with the binding agent to create sheets (Swart, no date).
- The sheets are layered, with one often having a wave structure for added stiffness. They are pressed together to form the final hemp panel. In some processes, like those by Dunagro Hemp Group, panels are filled with a hemp hurds and lime binder mixture before pressing to ensure consistency (Swart, no date).
- The panels are allowed to dry naturally, a process that can range from several days to a few months depending on the method used. This drying phase is essential for ensuring the panels achieve strength and durability (Swart, no date).
- After drying, the panels might go through further finishing processes to ready them for construction use. This could involve trimming, applying protective coatings, or other treatments to enhance their moisture resistance and durability (Swart, no date).

EXPERIMENTAL FARMING - PLANTS EXPLORED

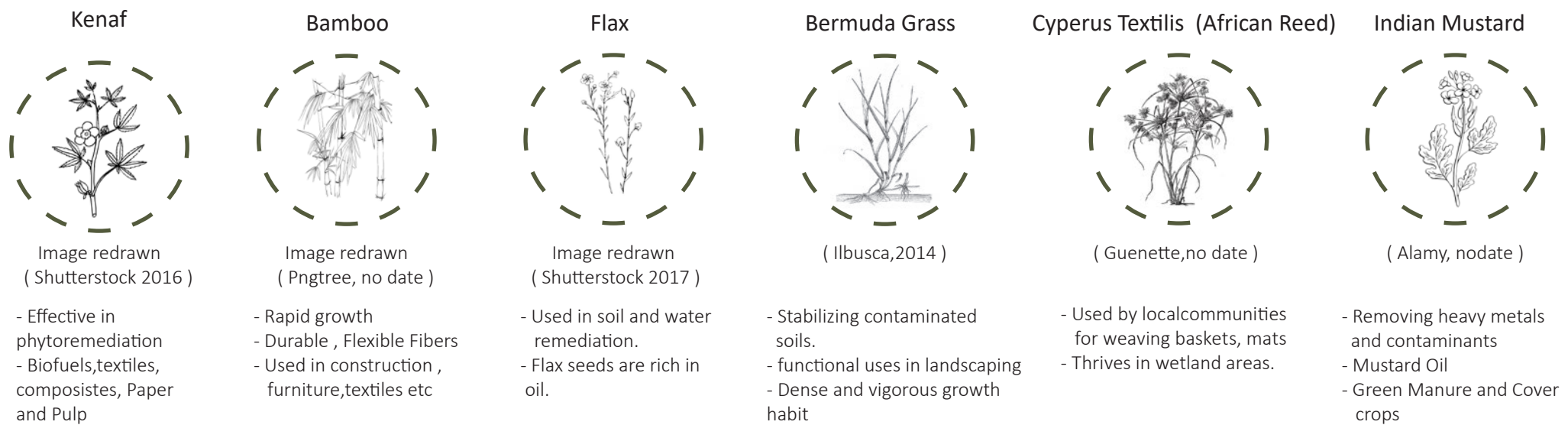


Figure 115 : Various kinds of remediatory plants .

This project extends beyond solely focusing on hemp but instead embraces a more experimental approach through the introduction of various kinds of remediatory plants. The objective is to investigate and find the most suitable plants for remediation that would yield the most significant economic benefit to this and neighbouring sites. This part of research is devoted to the

research of fibrous crops aiming to provide educational opportunities for current and future farmers who will work with such plants. This part of the research investigates plants used in phytoremediation and seeks to promote understanding about the use of various plants for remediation purposes among the communities and scholars.

By investigating a variety of plants, the project aims to discover which plants can best support expansion efforts and deliver the most economic benefits. This research component aims to serve as a valuable resource for providing education and the training of future farmers, equipping them with the necessary skills and knowledge needed to effectively utilise these plants.

The focus of the project on education and involvement of the community indicates its commitment to environmental stewardship as well as sustainable development promoting a deeper understanding of the benefits and applications of various fibrous plants in soil remediation within toxic post-mining sites.



USE OF HEMP WITHIN THE PROJECT

The use of hemp within the project aims to showcase the material's potential to community members and building users. It is chosen not only for its educational value but also for its effectiveness in reducing the building's carbon footprint. By adopting a circular approach, hemp is utilised not only for soil remediation but also to extend the lifecycle of materials within the project. This demonstrates a sustainable model that maximises the utility and environmental benefits of hemp.

Given the project's remedial nature, the goal is to create a modular system within the building, allowing for the repurposing of functions after the land has been remediated. This system allows for easy adaptation and modification of spaces, as the hemp panels can be assembled and disassembled as wall partitions. This internal modular system provides flexibility for inhabitants or owners to adapt the spaces to meet changing functional needs. Such adaptability ensures that the building can evolve with its users, accommodating different purposes and requirements over time. This approach highlights the

practical and versatile applications of hemp in modern construction, reinforcing its role in sustainable development. As a building material, hemp offers numerous benefits, including its exceptional thermal insulation properties, making it a valuable resource for enhancing energy efficiency in buildings. Additionally, hemp effectively regulates moisture, helping to maintain optimal indoor air quality (Louw, n.d). Over time, hemp's strength increases, contributing to the long-term durability of structures (Louw, n.d). Furthermore, hemp is resistant to microbes and insects, which enhances its durability and longevity in various building applications.

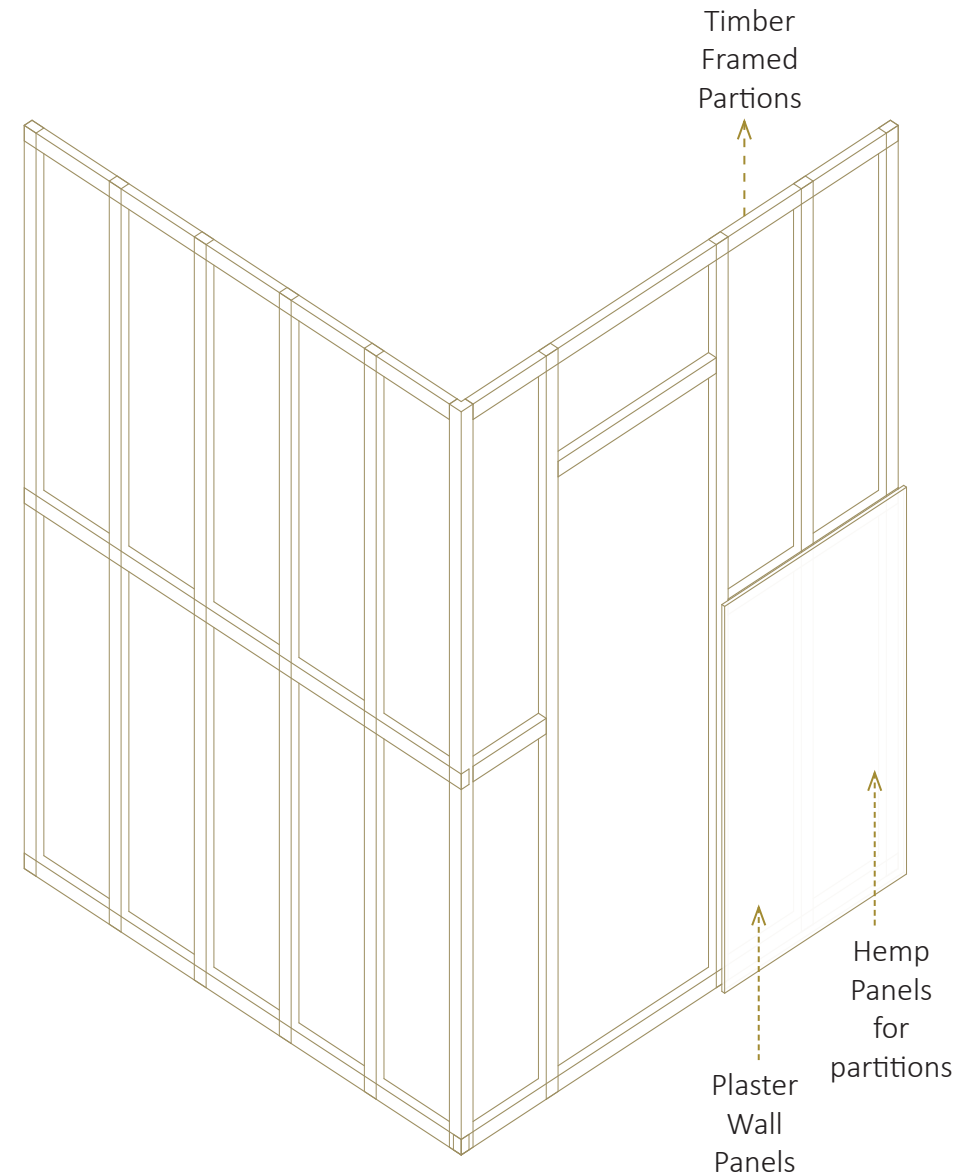


Figure 116 : Interior modular partition (Image by author).



Figure 117 : Circularity (Image by author).

CHAPTER 05: ECOLOGICAL CIRCULARITY

- Introduction
- The Anthropocene
- Defining Circularity
- Circular Economy
- Circularity in the context of South Africa
- Circularity in the context of Soweto

INTRODUCTION

The world we live in, especially its natural landscape, is ever-changing. These changes have seen exponential growth at the speed at which they occur since the Industrial Revolution. This exponential rate of changes since the Industrial Revolution has resulted in incidents such as global warming, the effects of which have been more apparent and more evident than before. Numerous years of extractions have been performed on our landscapes, leaving them “scarred” and in a hazardous state and making self-repair extremely challenging. This degradation and the results of these extractive processes have negatively affected the health of those living in these areas, especially in heavily extracted landscapes, which are more challenging to rehabilitate, impacting the residents and other living organisms and ecosystems within these landscapes as is the case in Braamfischerville. A significant transformation is essential to enhance the functionality of these natural landscapes, catering more effectively to the needs of the people residing in these areas and the environment. This can be achieved through various means, such as the remediation of natural landscapes through natural processes, the optimisation and promotion of sustainable agricultural practices, the protection of natural landscapes, reduced carbon emissions, and effective waste management and other strategies. The built environment sector is a significant contributor, responsible for 40% of global carbon emissions. Thus, there is an urgent imperative to prioritise the restoration of natural ecology and landscapes. This section

explores the concept of circularity as a primary method for mitigating the negative impacts on the natural environment and combatting waste. This approach will be applied and examined within Braamfischerville, an RDP (Reconstructive Development Programme) housing development in Johannesburg, South Africa. The rationale behind using this concept in the Braamfischerville context lies in the remedial nature of the proposed intervention of this master’s thesis and the approach taken by the intervention that aims to close loops and reuse products throughout their lifecycle. The goal is to minimise the impact on the natural environment while remedying the landscape rather than extracting more resources. This section investigates the effectiveness of circularity within Braamfischerville, examining ongoing practices of material reuse and their favourable environmental outcomes. It will also explore concepts like designing for disassembly, the Anthropocene and the challenges inherent in circularity. Furthermore, it will assess the application of circular practices within the South African context, including critiques and challenges associated with the theory.

THE ANTHROPOCENE

Some researchers contend that human influence on the Earth, encapsulated by the Anthropocene, might have commenced earlier than the industrial era (Strand et al., 2023). Over the past two centuries, human activities have left a profound negative imprint on the environment, prompting some scientists to characterise it as a new geological age—the Anthropocene (Strand et al., 2023). This era is characterised by unparalleled environmental degradation and climate change, particularly since the pre-industrial era, with a dramatic acceleration observed in the latter half of the previous century (Strand et al., 2023).

Much like fossil fuels, plastic pollution has become increasingly prominent in our current age. Each year, millions of tons of plastic are produced, and unlike natural materials, plastics do not biodegrade. Instead, they accumulate in soils and ocean beds. This persistent pollution is a significant marker of the Anthropocene epoch, characterised by substantial human impact on the Earth (Strand et al., 2023). Evidence of this impact includes the rising plastic deposits observed since the 1940s. These deposits are considered a potential “golden spike,” a vital indicator of the Anthropocene era.

The Anthropocene thus represents a historical period highlighting humanity’s failure to live harmoniously with the environment. Instead, we have imposed negative externalities upon it, leading to significant environmental degradation. This degradation results from industrial activities, deforestation, pollution, and the overexploitation of natural resources. There has been a stress on the need for transformative changes in human activities to achieve sustainability. Such changes are essential to preserve natural landscapes for future generations and ensure a safe environment for current inhabitants (Strand et al., 2023). Preventing toxic conditions is crucial for protecting human health and the well-being of other living organisms. These organisms are vital in maintaining

ecosystem balance, providing essential resources like food, oxygen, and water. The interconnectedness of all life forms means environmental degradation has far-reaching impacts, underscoring the urgent need for a more harmonious relationship with the natural world. The adverse effects of this concept are evident within the context of this thesis-identified site, where both the natural landscape and the residents of Braamfischerville have been adversely affected, posing risks to human health and other living organisms.

While an increasing human population was once perceived as one of the leading causes of environmental pressures, this perception has drastically changed at the turn of the new millennium. Now, instead of the human population being the main contributing factor, increasing consumption is the most significant driver of global environmental impacts (Strand et al., 2023). Despite the irreversible impact of human activity on the planet over the years, it is possible to implement measures to slow down, restrict, and potentially repair natural landscapes to mitigate environmental damage. An important question is whether creating an environment where social and economic practices can coexist with nature rather than just constantly extracting from it (Strand et al., 2023). This is a question that the intervention within Braamfischerville aims to address through remediation.

Focusing specifically on the Anthropocene, with an emphasis on mining in Johannesburg, South Africa, the proposed intervention targets the remediation of toxic mine land. The production of gold in the city has influenced the economic, social, and political histories of Johannesburg. Still, it has also left vast amounts of mining waste along the Witwatersrand ridge. These waste traces include dumps, slime dams, and other waste storage facilities, which continue to cause issues such as acid-mine drainage and soil pollution long after the mines have closed.

DEFINING CIRCULARITY

The concept of circularity focuses on the reduction of waste. Circularity focuses on reducing waste through adopting sustainable practices, offering a solution to existing environmental challenges mainly caused by the Anthropocene (Ogunmakinde et al., 2022). Unlike the conventional use-and-dispose approach, circularity promotes the recovery and reuse of materials throughout their entire life cycle (Ogunmakinde et al., 2022). It underscores the importance of prolonging the life cycle of materials and buildings by repurposing or re-adapting waste. This concept emphasises extending the life cycle of materials and structures by reusing or re-adapting waste. It involves extracting resources from the natural environment, processing them into products, and then returning discarded materials to the environment sustainably (Ogunmakinde et al., 2022). The proposed approach differs from the traditional

linear economic model, which follows the take-make-consume dispose cycle, which depends on large quantities of inexpensive, readily accessible materials and energy (Ogunmakinde et al., 2022). A circular economy focuses on closing loops on systems that encourage the use of items only once. This practice minimises waste and closes resource loops, reinforcing the principles of a circular economy. Several environmental benefits are associated with this approach, including reduced emissions, reduced raw material use, improved eco-efficiency, and a reduction in greenhouse gas emissions. (Ogunmakinde et al., 2022).

This approach proposes that humans and nature can coexist, with extraction occurring alongside a reciprocal exchange that avoids leaving the environment in a state of disrepair.

THE CIRCULAR ECONOMY

There are three main components of the circular economy. These include designing out waste and pollution and emphasising intentional design to eliminate as much waste and pollution from processes as possible (Godfrey, 2021). The second principle is keeping materials in use to the maximum extent possible, and the third principle is regenerating natural systems, which can be accomplished by replacing or repairing what has been extracted (Godfrey, 2021). The CSIR has identified five main sectors where circularity could be implemented successfully: mining, manufacturing, the built environment, and transportation (Godfrey, 2021). As a result of a more regenerative and restorative approach to both production and consumption, which closes the input and outflow cycles of the economy, the circular economy is proposed as a means of mitigating the challenges of resource scarcity, climate change, and biochemical flow disruptions, as well as revitalising local and regional economies (Calisto Friant et al., 2020). Although sustainability and circularity may appear very similar, they differ slightly. The pursuit of sustainability involves addressing environmental and socio-economic issues

today to ensure that future generations still have resources. It can also be interpreted as avoiding the depletion of resources so that future generations will have the ability to use those resources and maintain an ecological balance. The United Nations describes sustainability as the current generation's ability to use resources to meet its needs while ensuring that future generations can also meet theirs (Nations, n.d.).

The Sustainable Development Goals provide a blueprint for enhancing global quality of life and addressing the detrimental impacts of climate change caused by human activity (Nations, n.d.). The circularity model, on the other hand, focuses on reuse and waste elimination and is rooted in the Technosphere—a human-made system designed to transform raw materials for consumption beyond necessities like food and water. Implementing sustainability and circularity, particularly within the built environment and manufacturing processes, could make a significant difference. This is to be explored and implemented within the intervention in Braamfischerville.

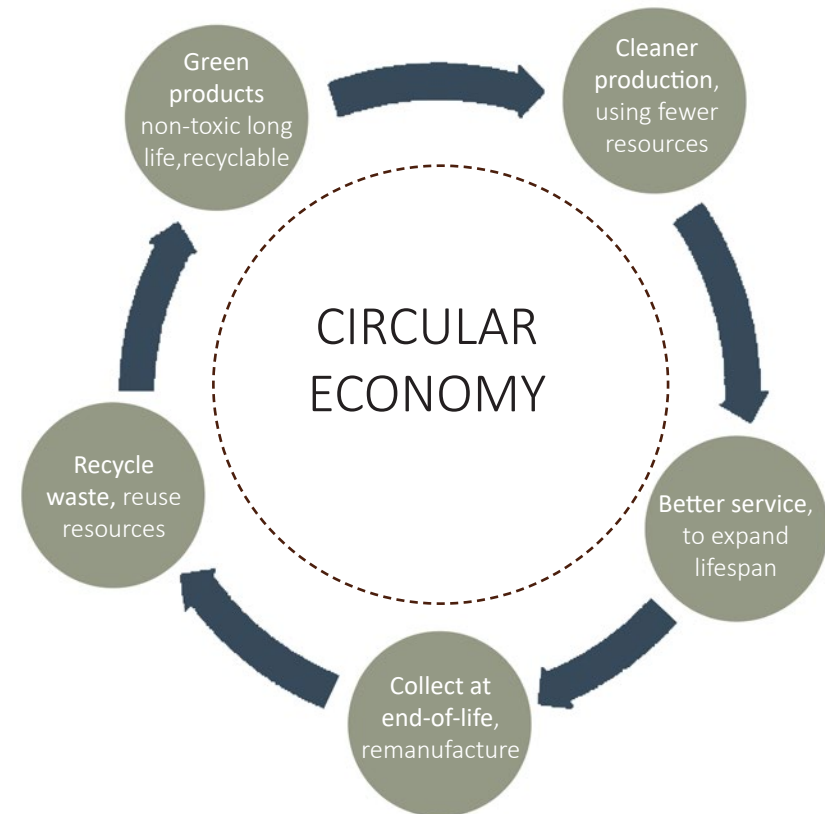


Figure 118 : Circular economy , image adapted (UNIDO,2017).

CIRCULARITY IN THE CONTEXT OF SOUTH AFRICA

South Africa is a country facing multifaceted challenges including high unemployment rates, inequality, and poverty. These challenges are exacerbated by the country's economic structure, which heavily relies on resource extraction. According to Lazarevic and Valve, South Africa's economy is characterised by high resource throughput, meaning that a significant number of resources are extracted, processed, and exported for international consumption (Lazarevic and Valve ,2017). This export-oriented approach results in minimal investment in local resource stocks, further perpetuating the country's reliance on external markets for economic sustenance.

Furthermore, the reliance on resource extraction and exportation contributes to the phenomenon of low returns to the domestic economy, as highlighted by Lazarevic and Valve (Lazarevic and Valve ,2017). This means that a considerable portion of the profits generated from resource extraction activities does not circulate within the local economy but instead benefits external entities. This situation not only perpetuates economic dependency but also exacerbates issues of inequality and poverty within the country. The linear economic model adopted by South Africa poses significant risks in terms of resource depletion and overexploitation (Godfrey, 2021).

As mentioned in the text, the country's resource-extractive-based economy is highly susceptible to depleting natural resources, which are essential for sustaining economic activities and livelihoods (Godfrey, 2021). This overreliance on resource extraction without adequate sustainability measures in place threatens the long-term viability of South Africa's economic development efforts (Godfrey, 2021).

In essence, the economic structure of South Africa poses considerable challenges to its sustainable development goals. Without addressing the underlying issues of resource dependency and low returns to the domestic economy, the country risks further exacerbating socio-economic disparities and hindering its prospects for future development (Godfrey, 2021). Therefore, it is imperative for policymakers and stakeholders to adopt strategies that promote sustainable resource management, diversification of the economy, and equitable distribution of wealth to ensure a more resilient and inclusive economic future for South Africa.

CIRCULARITY IN THE CONTEXT OF SOWETO

In many South African townships, such as Braamfischerville, there is active participation in circular economy practices. Firsthand observations reveal that residents are making significant efforts to recycle waste materials found within the township, as depicted in Figure 117. Such recycling efforts not only generate income for the individuals involved but also strengthen the informal waste economy, leading to the creation of job opportunities. Additionally, several entrepreneurial ventures have emerged within the township, all built on the foundation of waste recycling. For example, the Zondi buy-back centre is located in Zondi, Soweto, which, as of 2015, employs 62 members (Chiweshe ,2015).

The informal sector plays a crucial role in the circular economy of townships. Informal waste pickers, also referred to as reclaimers, make significant contributions to recycling by collecting and sorting recyclable materials. This process reduces waste and provides a livelihood for numerous individuals in these communities. The informal sector's

recovery of post-consumer packaging is a crucial aspect of circularity in South Africa, where an estimated 7% of the economy operates within this circular framework (Govender, Govender, and Whyte, 2023).

In some instances, waste is transformed into art, as evidenced by Ubuhle Bobuntu, an artist collective in Soweto. The group employs recycled materials and experimental techniques to portray their lives in present day South Africa (HT Correspondent, 2015).

The intervention in Braamfischerville, as described in this thesis, adopts a circular approach. Not only does the intervention seek to remediate the natural landscape, but it also aims to maximise the use of hemp throughout its life cycle. The goal is to reuse and recycle as much of the hemp as possible, particularly through the creation of panels and other related activities.



Figure 119 :Recycling efforts in Braamfischerville (Image by author).

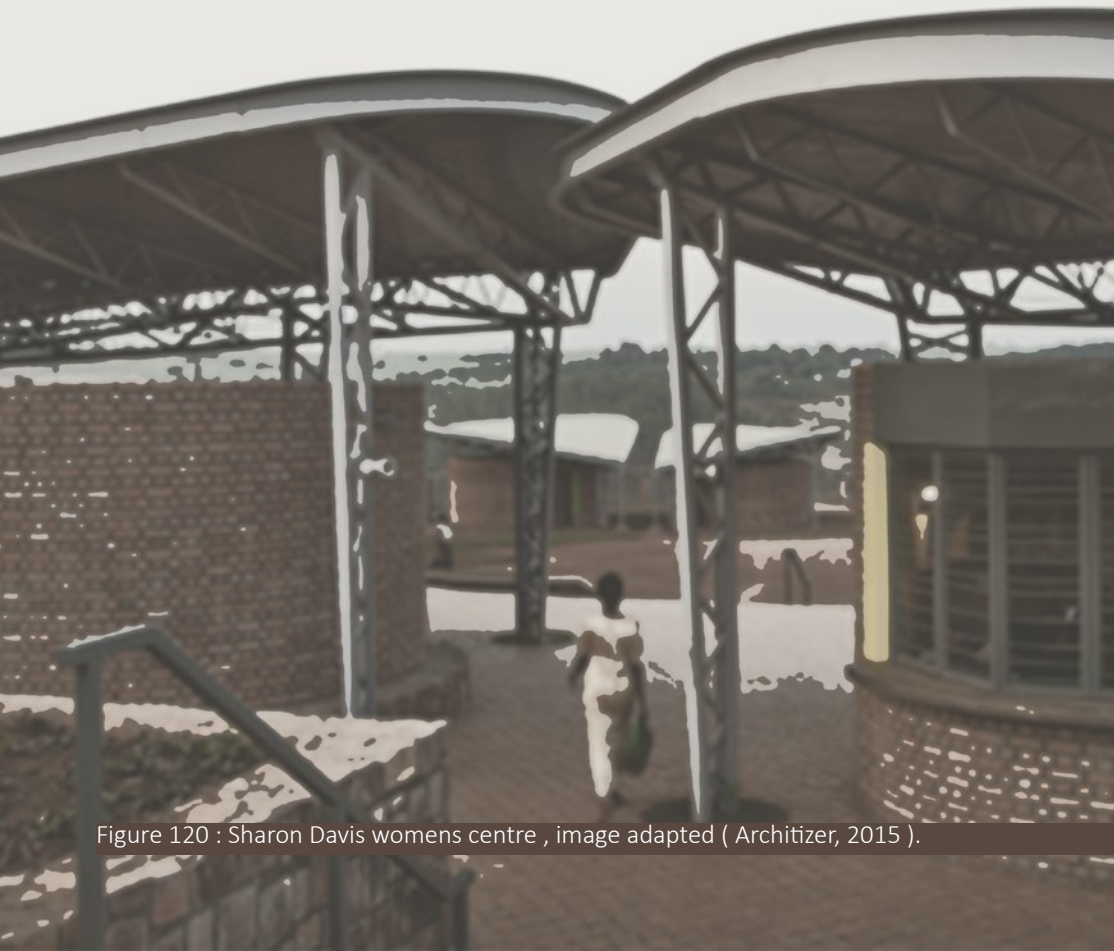


Figure 120 : Sharon Davis womens centre , image adapted (Architizer, 2015).

CHAPTER 06: PRECEDENT STUDIES

- PRECEDENT STUDIES

HARRISBURG PRODUCTION ENGINEERING CENTER

LOCATION: HARRISBURG, UNITED STATES

SQUARE METERAGE: 7376 SQM **YEAR:** 2021

ARCHITECT : ARCARI+IOVINO ARCHITECTS,
RYUICHI ASHIZAWA ARCHITECTS & ASSOCIATES

The project focused on enabling a harmonious coexistence between humans and the woodland by integrating architectural elements with a forest environment. The initial step involved designing for the site to enable rainwater to permeate the ground evenly. Fourteen swales were strategically planned across the site to allow rainwater to permeate the ground evenly, following the natural contours of the terrain. These deep swale grooves were integrated with

TAKE AWAY : My takeaway is how seamlessly the integration of architectural elements with the natural environment was achieved. The central spine effectively linked all spaces, allowing users of the space to observe

the branch-like structure of the building footprint. Subsequently, in consideration of the interaction between roofs and rainwater, gutters were omitted to encourage water distribution across a larger surface area. This design enables building users to engage more directly with light, air, and water while observing the seasonal transformations of the gardens nestled between the architectural branches (Abdel, no date).

seasonal changes in the gardens while engaging with light, air, and water internally. I plan to incorporate these concepts into my own designs to enhance the user experience.



Figure 121 : Site Plan, image redrawn (Abdel, no date).

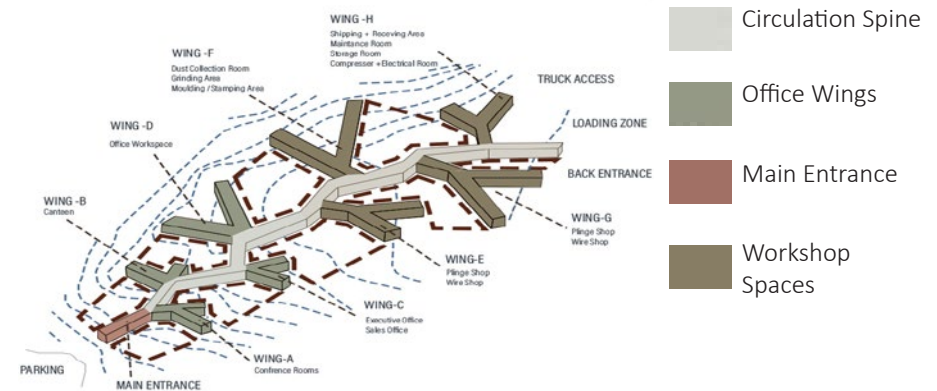


Figure 122 : Programme arrangement , image redrawn (Abdel, no date).



Figure 123 : Gardens on site , image redrawn (Abdel, no date).

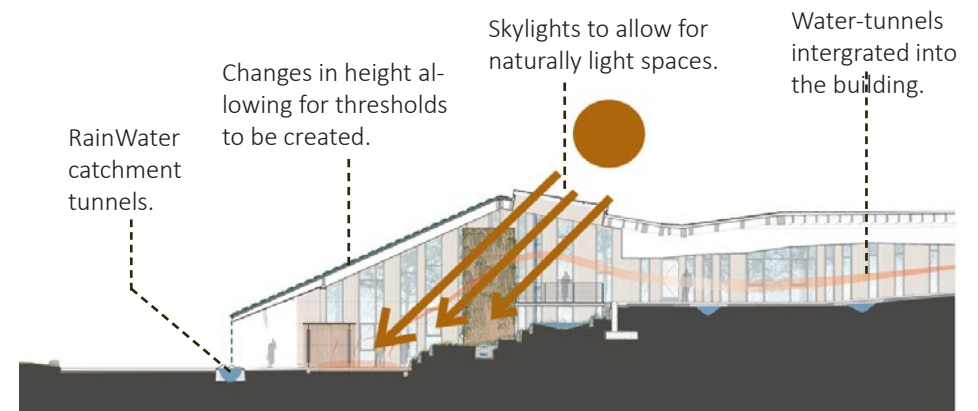


Figure 124 : Water collection and lighting section, image redrawn (Abdel, no date).

BRAGA MUNICIPAL MARKET

LOCATION: BRAGA, PORTUGAL
SQUARE METERAGE: 9343 SQM
ARCHITECT: APTO ARCHITECTURE

The 1956 city market was revitalised to maintain its architectural heritage while adding a new roof and a new enclosed wing. The functional layouts were revamped and the public spaces were centralised to enhance the overall market experience. A generative process was used to create the canopy roof design with steel trusses, wooden slats and glass. This approach enhanced production, technically precise, quicker and economically sustainable building (Moreira,2023).

Takeaway: From the Market, my takeaway was the need to design spaces for the public in which there is flow and movement; I was also intrigued by the use of the double roofing system which allowed for natural light and ventilation whilst shielding the users from the weather elements. Moving forward into the design, I plan on implementing these aspects of circulation and environment consideration in my design to create comfortable spaces for the public.

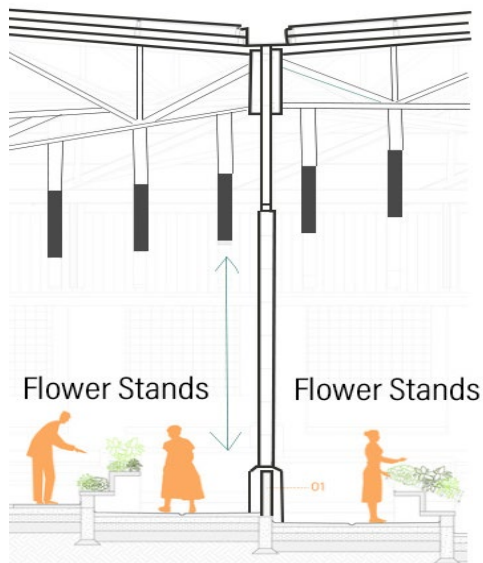


Figure 125: Market place section(Moreira, 2023).

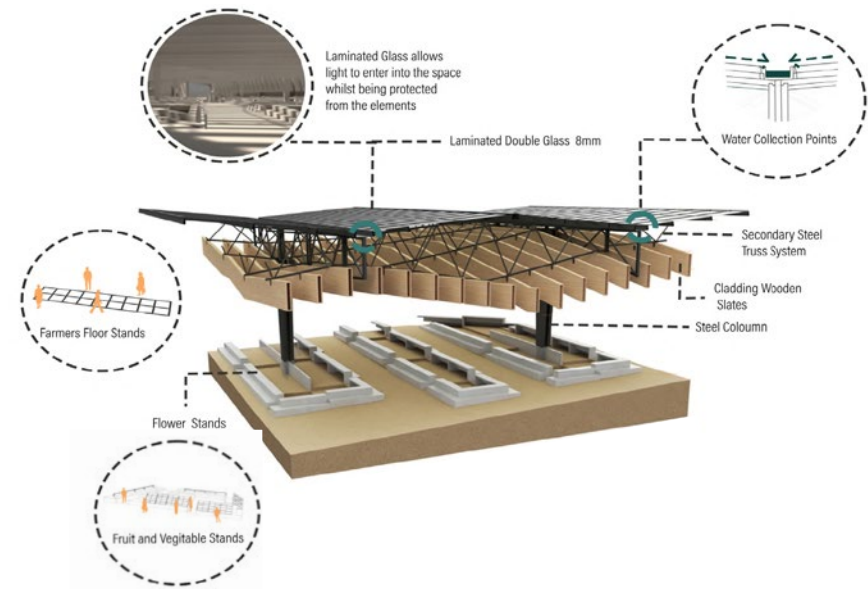


Figure 126: Double roof system (Moreira, 2023).

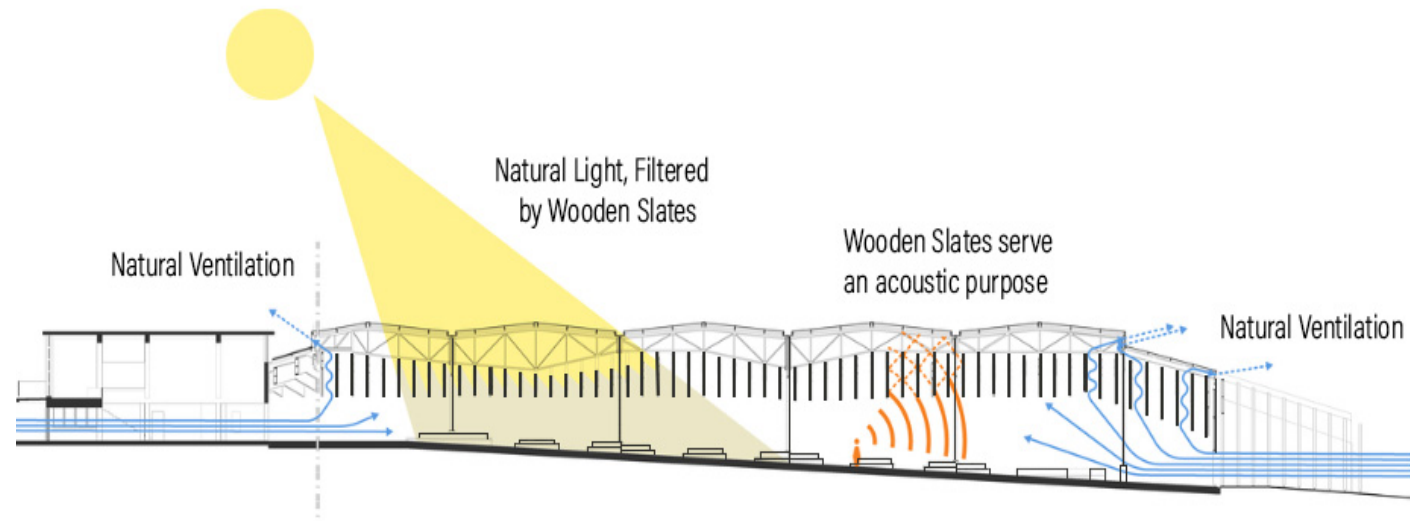


Figure 127 : Passive design measures (Moreira, 2023).

THE MUNGO MILL

LOCATION: 6600 N2, PLETTENBERG BAY, 6600

SQUARE METERAGE: 900 SQM

YEAR: 2017

ARCHITECT: ANDREA CRISTOFORETTI

The Mungo Mill specialises in crafting woven textiles and is known for its dedication to sustainability and ethical manufacturing. The mill blends traditional techniques with contemporary design. Visitors can explore the mungo building through guided on-site and online tours, witnessing the evolution of weaving techniques. The tours also provide an insightful glimpse into the Mungo production process, from warping and weaving to the meticulous CMT (cut, make,

trim) stages. The central space features 16 restored looms visible from an elevated deck, offering a captivating view of the mill's heart. Designed by architect and land artist Andrea Cristoforetti, the mill was designed with a special focus on utilising local materials and contractors ('The Mungo Mill- come and see how we make the fabric you love, no date).



Figure 128 : Exterior View of Mill , image adapted (Ras, 2018).

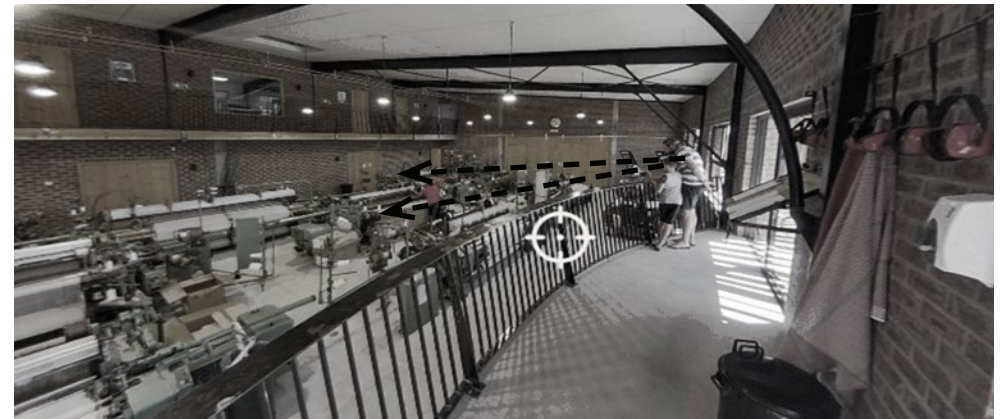


Figure 129 : Interior Production Area , imaged adapted (Ras, 2018).

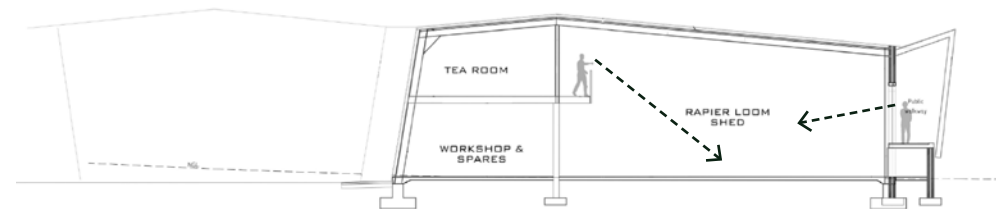


Figure 130 : Section depicting double volume production area (Poise design, 2016).

WOMENS OPPORTUNITY CENTRE

LOCATION: KAYONZA RWANDA

SQUARE METERAGE: 2200 SQM

YEAR: 2013

ARCHITECT : SHARON DAVIS DESIGN

The Women's Opportunity Center is revitalising a small community's subsistence-agriculture economy by empowering women. It serves as a hub where women can acquire income-generating skills, such as animal husbandry and processing techniques essential for sustaining food cooperatives. At any given time, a maximum of 300 women participate in training activities. Designed like a traditional Rwandan village, the project is composed of 17 human pavilions arranged in suitable clusters, fostering a

sense of familiarity and community among the occupants. Constructed using clay bricks, the buildings are centred around a welcoming, publicly accessible plaza where students sell a variety of products, including food, textiles, and baskets crafted on-site. Rainwater is collected from the pavilions' corrugated roofs, and vegetation planted on two structures provides additional insulation to their interiors (Women's Opportunity Center / Sharon Davis Design, 2013).

Take away : Drawing inspiration from the spatial arrangement of spaces and vegetation on-site, as well as the landscaping, I plan to incorporate these elements into my design to

create a harmonious and visually appealing environment that seamlessly integrates the built structures with the natural surroundings.

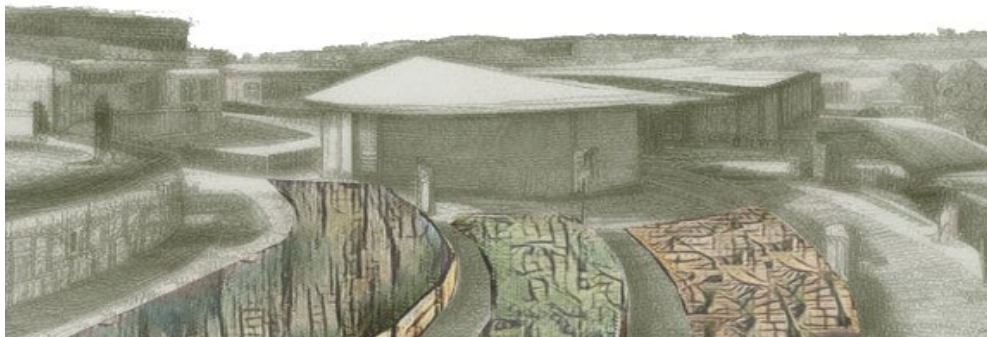


Figure 131 : Perspective of farming on site, Image adapted (Felicella, no date).

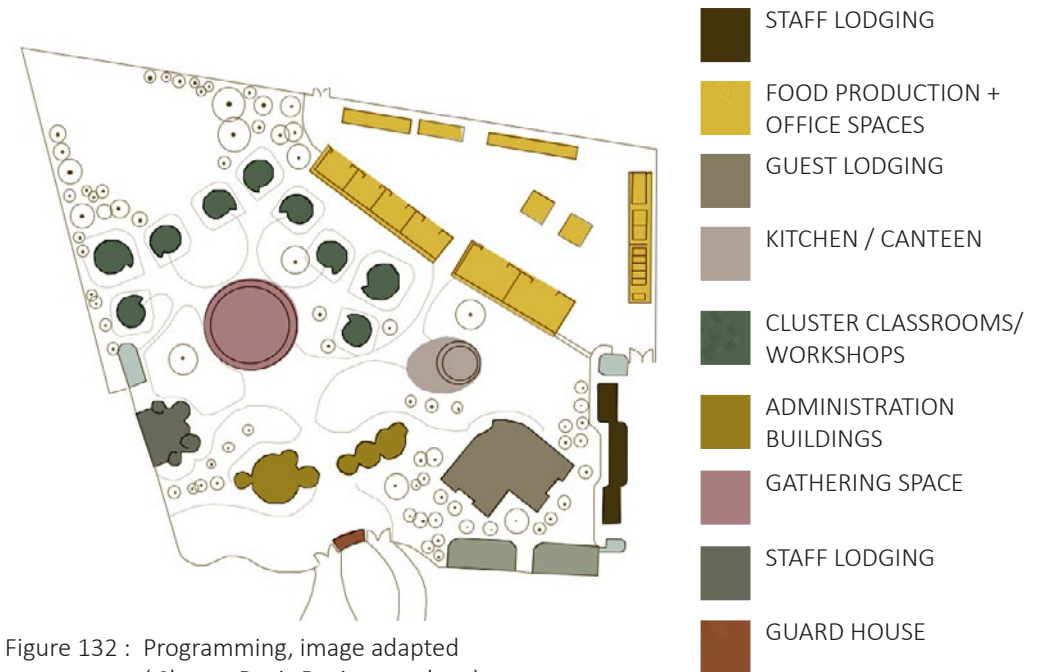


Figure 132 : Programming, image adapted (Sharon Davis Design, no date).

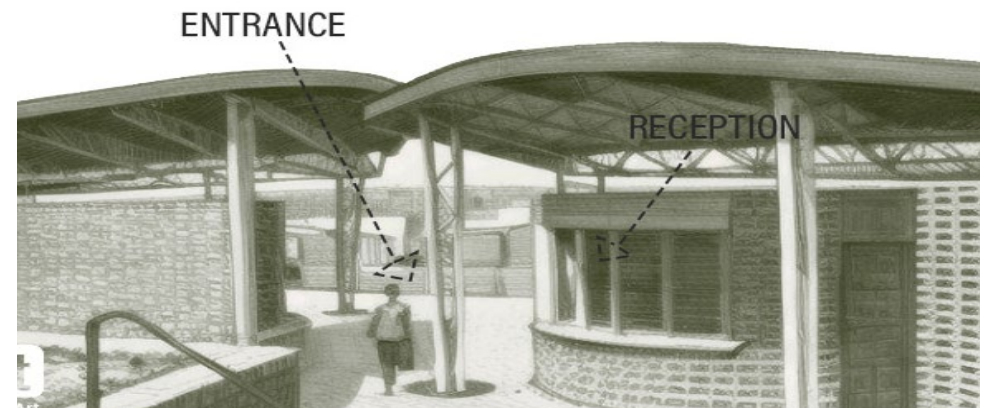


Figure 133: Perspective of Site Entrance (Architizer, 2015).

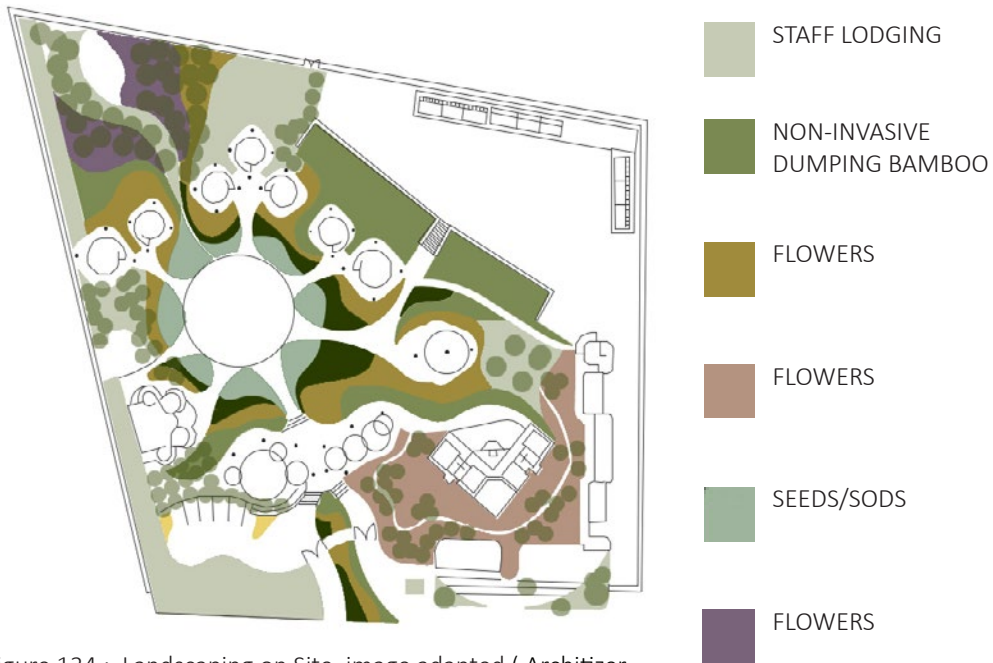


Figure 134 : Landscaping on Site ,image adapted (Architizer, 2015).

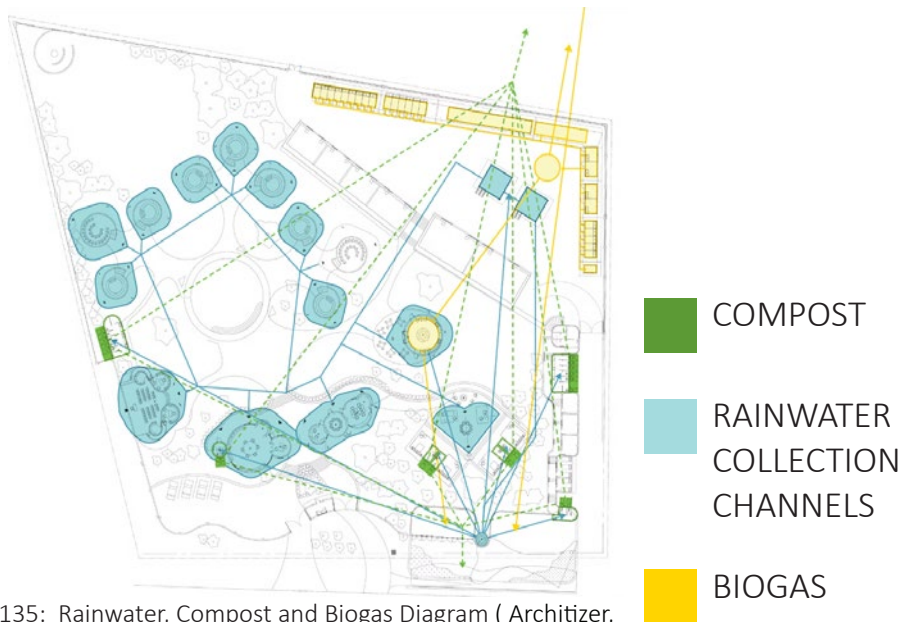


Figure 135: Rainwater, Compost and Biogas Diagram (Architizer, 2015).

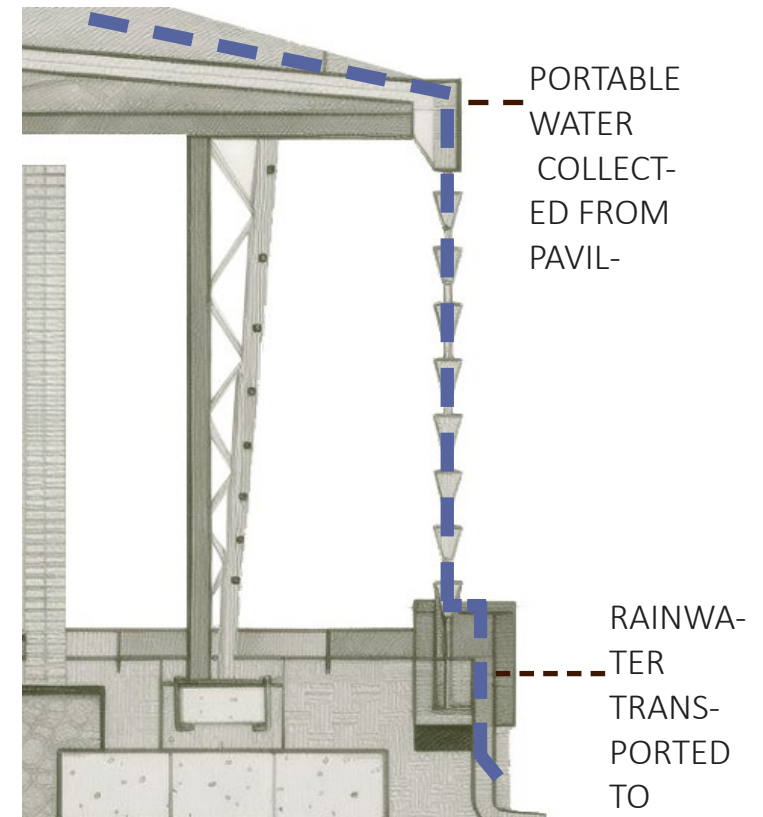


Figure 136 : Rainwater collection, image adapted (Cite).

The potable water gathered in the collection system could then be sold by women at the center's market.

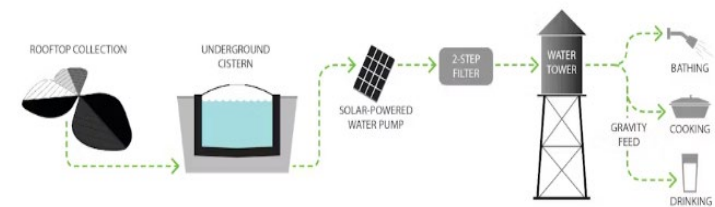


Figure 137 : Rainwater collection process to storage (Architizer, 2015).

UPCYCLE-CENTRUM-ALMERE

LOCATION: ALMERE, NETHERLANDS

SQUARE METERAGE: 1000 SQM

YEAR: 2018

ARCHITECT : LKSVDD ARCHITECTS

The Upcycle-Centrum-Almere is a modern pavilion that offers space for all facets of the circular economy (Royal Institute of Dutch Architects, no date). The main programming entails waste processing, workshops, and business incubators. The building itself is also circular. It was constructed using waste materials from Almere (locally) and is fully demountable and energy-neutral (Royal Institute of Dutch Architects, no date). The centre itself is also an upcycled product. It was built using materials from the demolition material of a swimming pool, as well as the sports hall and the municipal yard in Almere

(Royal Institute of Dutch Architects, no date). The building displays recycled material, without compromising on the architectural quality and craftsmanship. The Upcycle Center allows people to look at waste differently through the re-use of items within the centre: car tyres were repurposed into bicycle racks, bicycle wheels have been transformed into fencing and galvanized air ducts have been reused as facade cladding of the management building (Royal Institute of Dutch Architects, no date). The wooden facade has been partly made using cleared trees from Almere (Royal Institute of Dutch Architects, no date).



Figure 138 : Facade of the The Upcycle Center in Almere (Royal Institute of Dutch Architects ,nodate).



Figure 139 : Repurposed steel roof construction (Anteagroup,2020).



Figure 140 : Facade of Centre constructed using cleared trees from sustainably managed forests, (Modulo,2019).

TAKEAWAY: The takeaway from this precedent study is the extent to which circularity can be implemented within the construction of a new building and how the building can enable items that would have been thrown away to be used in a much more meaningful way minimising waste giving these items a second life and opting for more sustainable solutions/measures.



Figure 141 : Rainwater stored and collected under recycling platform used for cleaning and flushing toilets, (Modulo,2019).

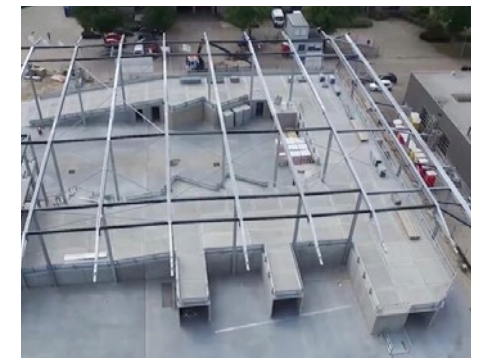


Figure 142 : Recycling platform (U shaped platform made from eco-granulate from old asphalt roads (Modulo,2019).



Figure 143 : Charette clay exploration (image by author).

CHAPTER 07: DESIGN DEVELOPMENT

- The Brief
- Viability Report
- Design Development

DESIGN BRIEF

The design program has been shaped by the various needs involved in producing hemp, from farming to selling the final products, as well as the needs of the community and research associated with or needed in addition to that.

RECEPTION

A reception space has been included to ensure a smooth experience for visitors. This space is the first point of contact to help guide visitors through the centre, particularly those exploring areas beyond the retail spaces.

RETAIL

The retail spaces, which form an essential part of activating the street edge, comprise of internal and external components and exterior market space that operates predominately over the weekend.

OPEN SPACES

The centre's open spaces are designated for either public use or for farming or landscaping on-site.

RESEARCH FACILITIES

Research facilities cater to various needs, featuring meeting rooms, offices, and computer labs for researchers who study hemp and other fibre plants' remediation potential in mining areas and their agricultural applications.

MANUFACTURING AND PRODUCTION

Manufacturing and production spaces are included for processing hemp.

TRAINING SPACES

Training spaces have also been provided, where people are trained on how to grow hemp, how to manufacture hemp panels, and how to assemble and use these products.

AGRICULTURAL SPACES

Agricultural spaces form the base of this centre and are crucial in the remediation process. These include hemp farming and experimental farming.

DESIGN BRIEF :

RECEPTION	Approx Unit Size	No. Of	Approx Total Size
Entrance Foyer	50 sqm	2	100 sqm
Exhibition Space	150 sqm	1	150 sqm
Reception and Info Desk	20 sqm	2	40 sqm
Admin Offices [Open Plan]	65 sqm	1	65 sqm
Security Office	20 sqm	2	40 sqm

RETAIL	Approx Unit Size	No. Of	Approx Total Size
Resturant Internal	100 sqm	1	100 sqm
Resturant External	60 sqm	1	60 sqm
Rentable Retail Store	50 sqm	5	250 sqm
Kitchen and Service Area	50 sqm	1	50 sqm
Storage	40sqm	2	80 sqm

RESEARCH FACILITIES	Approx Unit Size	No. Of	Approx Total Size
Printing and Computer Facility	50 sqm	1	50 sqm
Training Workshop	200 sqm	2	400 sqm
Large Meeting Room	114 sqm	1	114 sqm
Meeting Rooms [8 Seater]	40 sqm	2	80 sqm
Storage	40 sqm	2	80 sqm
Ablutions	45 sqm	2	90 sqm
Kitchenette	40 sqm	1	40 sqm
Offices [Small Offices]	12 sqm	4	48 sqm
Office [Open Plan]	65 sqm	1	65 sqm
Greenhouse [Crop Farming]	150 sqm	1	150 sqm

MANUFACTURING AND PRODUCTION	Approx Unit Size	No. Of	Approx Total Size
Manufacturing Facilities	1 076 sqm	1	1 076 sqm
Storage Facilities	100 sqm	1	100 sqm
Changing Rooms	17 sqm	2	34 sqm
Meeting Rooms	50 sqm	2	100 sqm
Offices	14 sqm	4	56 sqm
Shared Workspace	100 sqm	1	100sqm
Ablutions	80 sqm	1	80 sqm
Kitchnette	30 sqm	1	40 sqm

WASTE + RECYCLING SPACES	Approx Unit Size	No. Of	Approx Total Size
Material Sorting Area	40 sqm	1	40 sqm
Shredding Area	40 sqm	1	40 sqm
Composting Area	40 sqm	1	40 sqm
Storage Area for Recyclables	30 sqm	1	30 sqm
Control Room	20 sqm	1	20 sqm

SERVICES	Approx Unit Size	No. Of	Approx Total Size
Water Collection and Purification	50 sqm	2	100 sqm
Solar Energy Equipment Storage	50 sqm	2	100 sqm
Tool Shed	30 sqm	4	130 sqm

TOTAL SQM	4 008 SQM		
------------------	------------------	--	--

PUBLIC SPACE	Approx Unit Size	No. Of	Approx Total Size
Market Space	700 sqm	1	700 sqm
Public Courtyard	1000 sqm	1	1000 sqm

VIABILITY REPORT

INTRODUCTION

This project aims to address the environmental challenges faced in Braamfischerville, mainly caused by toxic gold mine residues areas, predominantly known as mine dumps. Proposed is the establishment of an experimental Urban Farming Centre of Fibrous Plants [Hemp]. This centre will serve as both a research hub and a production facility of construction materials made by using Hemp, utilizing fibrous plants as a remediation measure, while simultaneously training people in the community on how to manufacture the hemp panels and how to assemble them.

SCOPE OF WORKS

This project focuses on the environmental remediation of a post-mining landscape in Braamfischerville, Soweto. This is to be carried out through the creation of an experimental urban farming centre of fibrous plants, a remediation measure that combines research and production at its core. The main aim of this centre would be to remediate the toxic landscape while incorporating research, production, and training of the community working within the centre.

SITE

The proposed site is located in Braamfischerville, Soweto, which is situated southwest of Johannesburg. This township lies on the border of Soweto and Roodepoort and serves as an RDP (Reconstruction and Development Programme) housing settlement. Similar to other mining-impacted townships, Braamfischerville lies within very close proximity to a mine tailing, located approximately 350 meters away from the first three phases, falling outside of the dust zone. However, the last development is situated much closer to 100 meters, placing it within the hazardous dust zone. My specific site is located within the fourth Phase (the last development) or extension 12.

My identified site is on vacant land along Abbess Drive, known for its considerable public transportation and commuting traffic. Surrounding the site are primarily residential dwellings and schools, reflecting the area's predominant institutional and residential nature.

Ownership: The site's current owner is DRD Gold Mine Limited, previously known as Durban Roodepoort Deep Limited, along with ownership of the two adjacent vacant sites.

Land rights: It is reasonable to assume that the land rights are currently held by the plot's current owners, DRD Gold Mine Limited. Therefore, it would be necessary to obtain rights from them.

Site Restrictions: As per the City of Johannesburg Land Use Scheme, building line restrictions range between 3.0 and 1.5 metres. Access to the site is primarily via vehicle through Abbess Drive, emphasising the need to carefully plan entry and exit points for vehicles on the site.

Zoning: Currently, the zoning remains undetermined, but there's a proposal to apply for rezoning the site to a multi-zoned designation, primarily for agricultural, small-scale industrial, educational, and retail purposes.

Utilities: The site has direct access to municipal water, municipal electrical, and the central sewage system.

Coverage: For a height zone of up to 3 stories, 50% coverage would apply for shops, business purposes, institutional and educational facilities, while 70% coverage would apply for industrial purposes, and also 70% for other purposes.

F.A.R Requirements: The floor area ratio for shops, business purposes, institutional and educational facilities, and industrial purposes would be 2.1.

CLIENT

The proposed client would be the Department of Agriculture, Land Reform and Rural Development (DALRRD) or the Department of Mineral Resources and Energy (DMRE), in collaboration with the private entity DRD Gold Mine, serving as a partnering client.

ACCESS TO LAND

Since DRD Gold Mine presently owns the land, the approach entails incorporating this project and plot of land into DRD's Corporate Social Responsibility program and its post-mining remediation plan. Additionally, collaborating with local government to remediate areas where mining activities have adversely affected the environmental landscape is part of the strategy.

FUNDING/FINANCING

The project's funding will involve multiple parties, including DRD Gold Mine, which is part of its corporate social responsibility, alongside contributions from the local government. Government involvement in this initiative could yield significant benefits, particularly if the project proves successful. It has the potential to serve as a blueprint for revitalising post-mining townships impacted by mine closures. Moreover, it could generate employment opportunities while facilitating the extraction of toxins from the land.

FINANCIAL SUSTAINABILITY

The project's future financing would primarily rely on revenue generated by the site itself, supplemented by collaboration and funding from the local government. Operational income generated within the facility would sustain the centre's operating costs, covering expenses such as full-time staff salaries and maintenance costs.

MATERIALS

The materials required for constructing the centre will be locally sourced to mitigate unsustainable practices associated with acquiring materials from distant locations. The primary materials will align closely with those commonly used in the area, such as brick and concrete, supplemented by steel on a limited scale.

ACCESS TO LABOUR

Labour will be sourced from the surrounding community, driven by the prevalent unemployment in the area. This presents an opportunity to employ individuals possessing the requisite skills within the community, contributing to lessening unemployment in the area. Given that the materials used are locally sourced and commonly used in construction within the community, the required skill set for working with these materials will be readily

PROGRAMMING

The site's primary programming spaces will include small-scale agricultural activities, research facilities, waste management facilities and spaces, retail areas, exhibition spaces, and public areas.

CONSTRUCTION [PROFESSIONALS INVOLVED FROM DESIGN PROCESS TO FINISHED PRODUCT + RESPONSIBILITIES OF EACH INVOLVED]

The professionals needed for implementation of the construction of this centre and their respective responsibilities would include:

The Architect, who in the instant also serves as the principal agent, is responsible for designing and creating technical drawings for the building. Their role encompasses stages 1 through 6 of the project. Additionally, as the principal agent, the Architect is tasked with leading and coordinating all other consultants regarding design and technical aspects on behalf of the client.

The Engineers (Structural, Electrical, Mechanical) each have distinct responsibilities within the project. The Structural Engineer is accountable for all structural works and associated documentation, while the Electrical Engineer oversees electrical installations and related documentation. Similarly, the Mechanical Engineer handles mechanical aspects and documentation. In this instance, the principal agent, the Architect, is responsible for coordinating all these drawings and documentation.

The Project Manager oversees and manages all aspects of the construction process until the building's completion. This includes managing the procurement process of contractors, communicating the project brief to other consultants, and monitoring the development of the concept and its feasibility. Additionally, the Project Manager facilitates timely technical coordination among various other responsibilities.

The Quantity Surveyor is responsible for the cost estimation, cost estimation, management and the procurement for the construction project. The surveyor is also tasked with the preparation of the bill of quantities and overseeing the costs to ensure that the project stays within the allocated budgetary limits. Additionally, the surveyor manages the change processes, provides financial reporting to enhance the project efficiency as well as assess risks.

The contractor is the driving force of the building construction project, responsible for overseeing, executing, guiding and inspecting the project until completion. The contractor has the authority to appoint subcontractors that are to be tasked with fulfilling specific project tasks, ensuring smooth progress throughout the lifecycle of the project.

The Town Planner is tasked with rezoning the current site, which is currently designated as undetermined in terms of zoning.

The Land Surveyor's responsibility is to measure and map the land boundaries and topographic features accurately. Their role is crucial in providing essential information and data for the centre's on-site development.

SUSTAINABILITY

Maintenance and sustainability measures will be prioritised to ensure the centre's sustainability. This includes utilising local materials and labour, incorporating low-maintenance materials to minimise upkeep costs, and implementing rainwater harvesting for building use and irrigation. Additionally, on-site energy generation will be achieved through solar panels to maximise the project's sustainability measures.

DESIGN DEVELOPMENT

CHARETTE EXPLORATION

The charette exploration delved into utilising materials resembling hemp, investigating diverse methods to intertwine spaces or incorporate hemp. Clay emerged as another significant material, facilitating the exploration of organic forms on-site. These two materials were examined in collaboration to explore their potential applications.



CLAY



Clay was utilised to explore organic forms for various spaces within the centre. This material provided greater fluidity for experimentation in the shapes and textures of these spaces, offering a much

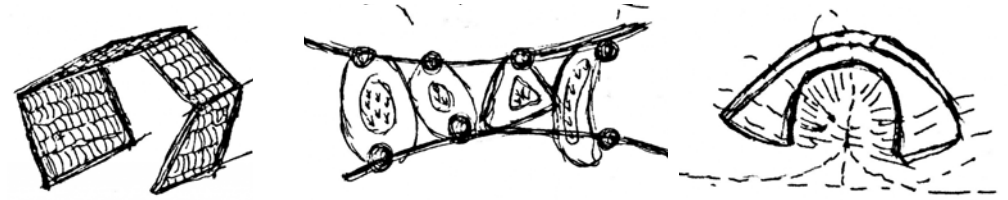
more liberating departure from more rigid materials that often have many constraints. .

Figure 144 : Charrette clay explorations (Images by author).

DESIGN DEVELOPMENT

String was employed to investigate weaving techniques that could be integrated into diverse design elements, from tighter fits to more open weaves. The string material was selected due to its similarity to the properties of loose hemp in string form. Wool was used to explore the sectional experience of

the different spaces. Wooden components represented the more rigid structural aspects likely to be incorporated into the project.



STRING



Figure 145 : Charrette string explorations (Images by author).

DESIGN DEVELOPMENT

THE DESIGN IN ITS EARLY STAGES

This first iteration of the design explored and attempted to define a pedestrian path that allowed pedestrians to walk through the site and experience the buildings on either side. This design iteration proposed having the market space within the pedestrian spine, having a more linear market space. However, this iteration did not quite work due to the looseness/fluidity of all the spaces, making it a bit difficult to define them.

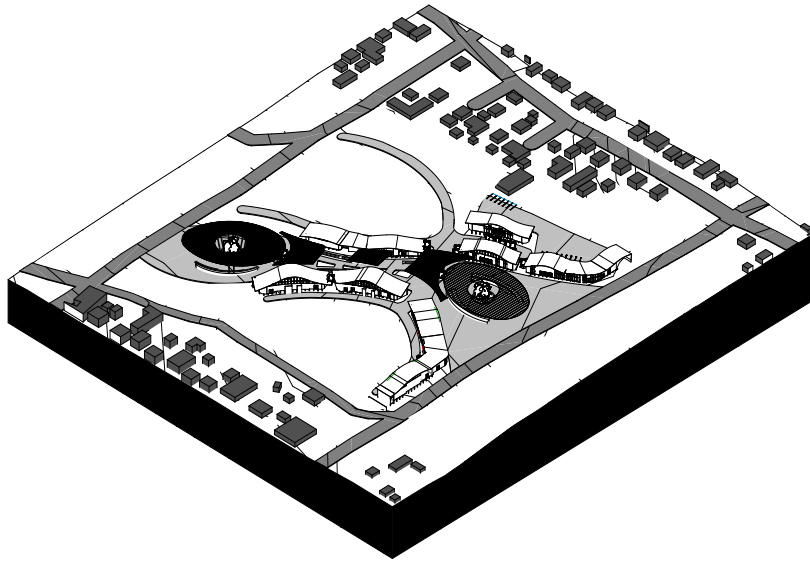


Figure 146 : 3D view of model (Image by author).



Figure 147 : Ground floor plan (Image by author).

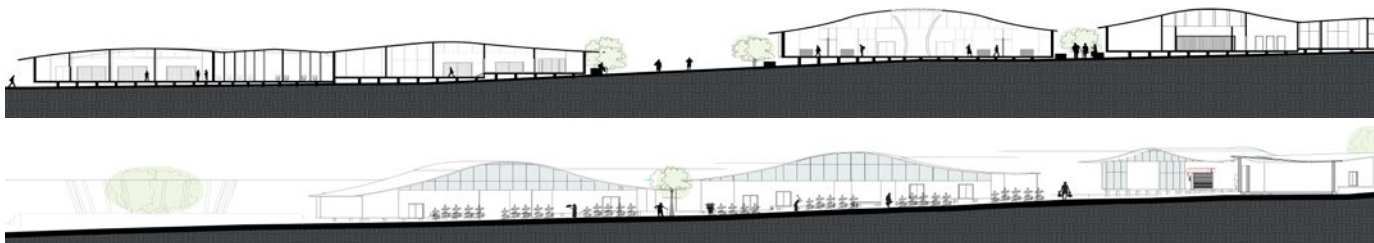
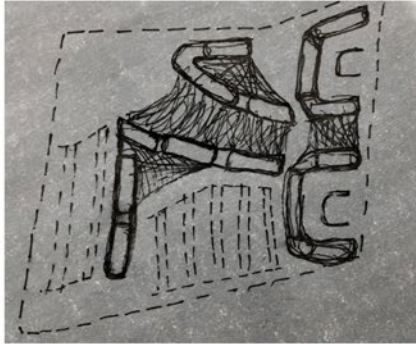


Figure 148 : Sections through the model (Image by author).

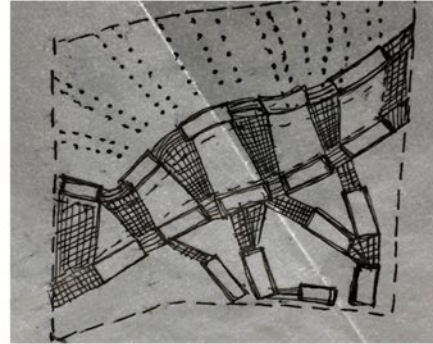
DESIGN DEVELOPMENT [CONCEPT SKETCHES]

These concept sketches highlight the process in which the exploration of the design unfolded; the design maintained its spine influenced by the desire line on-site as one of the main concept influencers. The design was explored based on that spine. As well as where on that spine could agricultural works better suited to be placed.

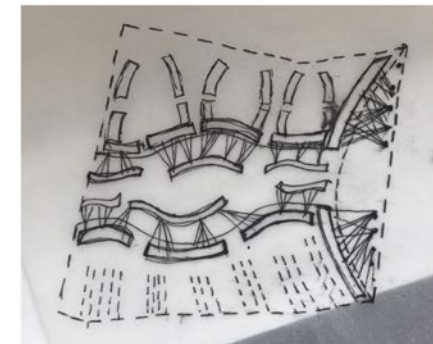
Figure 149 : Sketch iterations (Image by author).



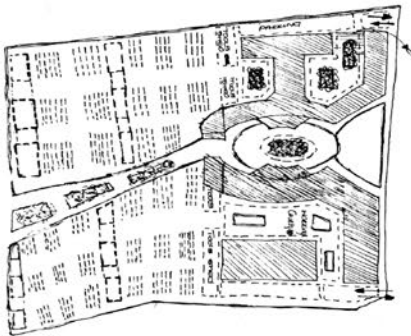
The preliminary sketch exploration focused on crop placement and massing arrangements.



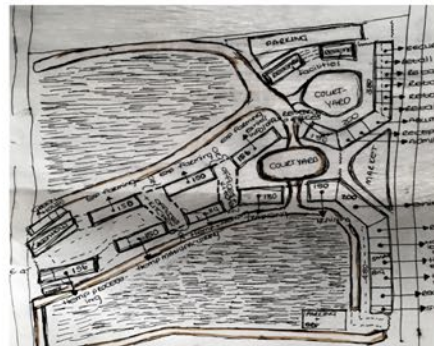
Sketch exploring the integration of a pedestrian path with the building massing.



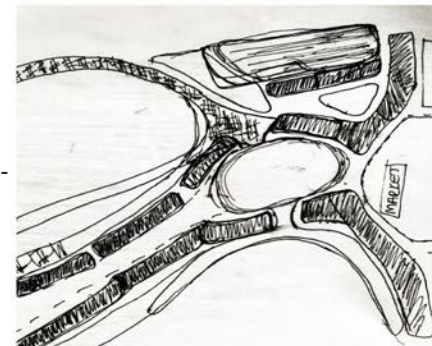
Sketch exploring the welcome threshold space and defining the pedestrian pathway.



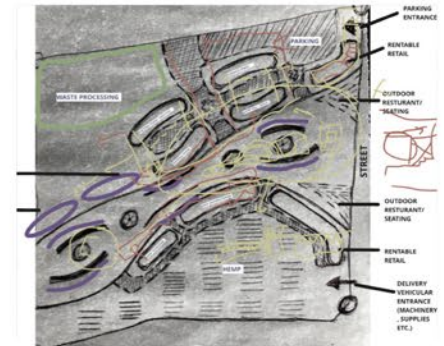
The site's built components were consolidated into one area, resulting in defined courtyard areas. This design keeps the spine open 24 hours a day, with only the constructed facilities lockable at night.



This sketch iteration explored and defined the courtyard spaces created in the pedestrian spine. It proposed closing the site at specific points at night while keeping the most public spaces open.



In this sketch iteration, the market space was moved along Abbess Drive and located in one central space. A public courtyard was also introduced as a public/gathering space.



This sketch iteration investigated the creation of a pedestrian path that enables visitors to walk through the site and experience the surrounding buildings on either side. It proposed a linear market within the pedestrian spine.

DESIGN DEVELOPMENT

BUILDING ITERATION

The building's design evolved to consolidate the built spaces to one side of the site, allowing all built facilities to be locked and secured at night while keeping the public route open. The two separate wings are dedicated to research and manufacturing, with all farming activities placed on the opposite portion of the site. The space between the two wings is explicitly dedicated to the public, serving as a public space and a pedestrian commuting route; this central public space would enable pedestrians to pass through and branch off to either the manufacturing or research wing. Additionally, this area could also be used as a versatile gathering space, suitable for events that the centre would host as an assembly area.



Figure 150 : Ground floor plan (Image by author).



Figure 151 : Research Component (Image by author).

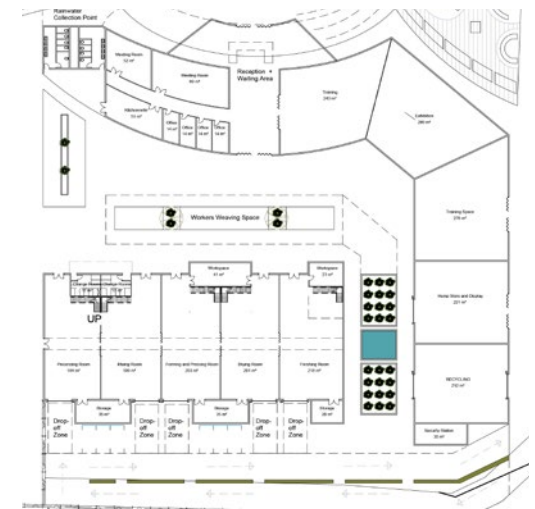


Figure 152 : Manufacturing Component (Image by author).

DESIGN DEVELOPMENT

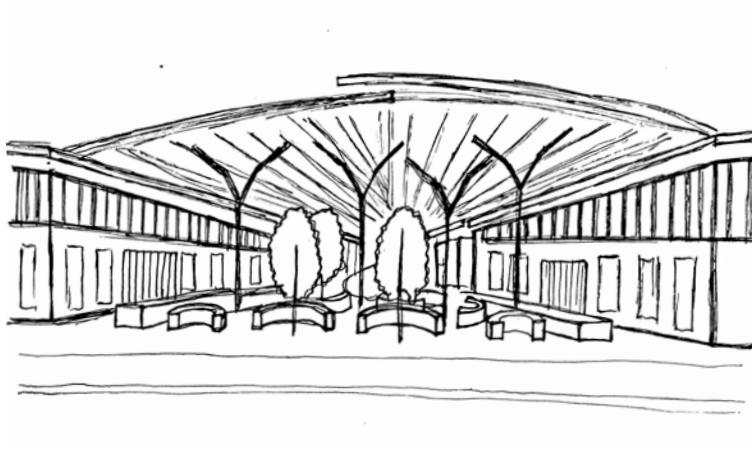


Figure 153 : Market Space, progress perspective (Image by author).

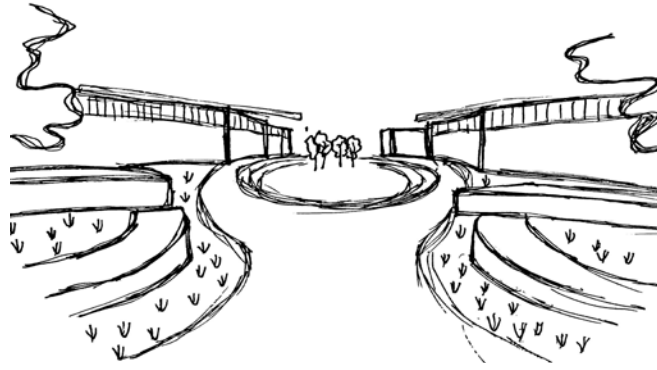


Figure 154 : Communal Space, progress perspective (Image by author).

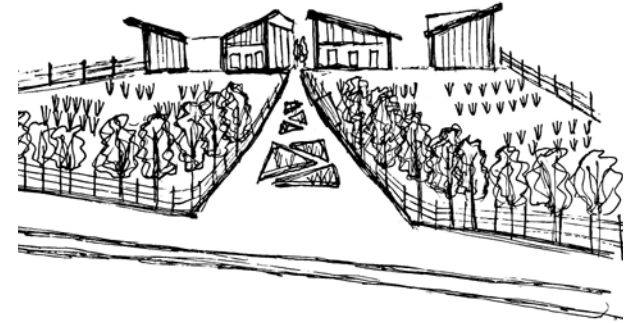


Figure 155 : Pedestrian Spine, progress perspective (Image by author).

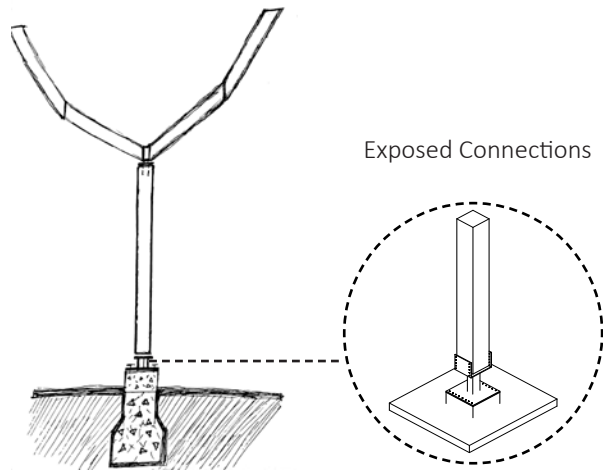


Figure 156 : Market Space column exploration (Image by author).

DESIGN DEVELOPMENT [PROCESS SKETCH EXPLORATIONS]

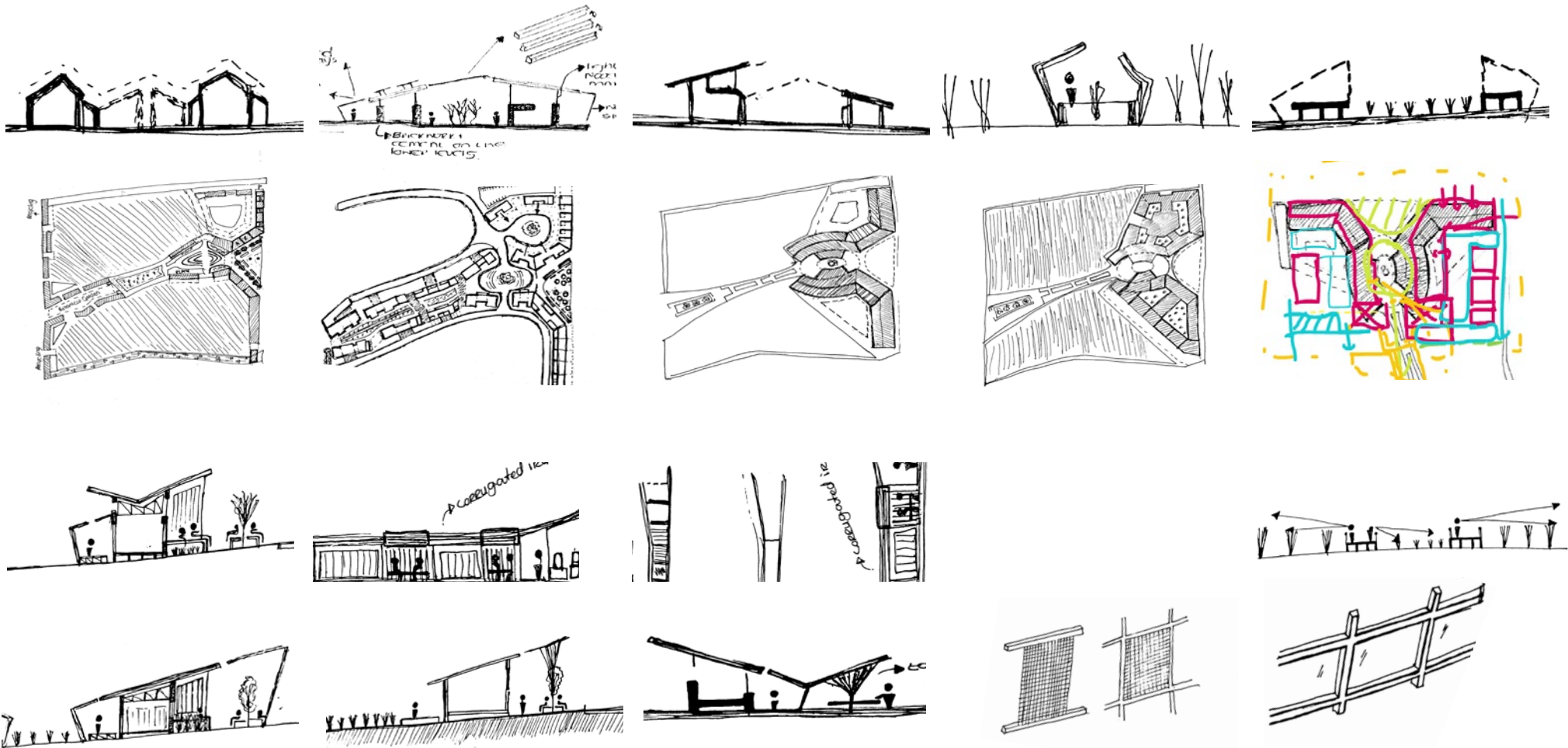


Figure 157 : Sketch explorations (Images by author).

DESIGN DEVELOPMENT [PROCESS TECHNICAL EXPLORATIONS]

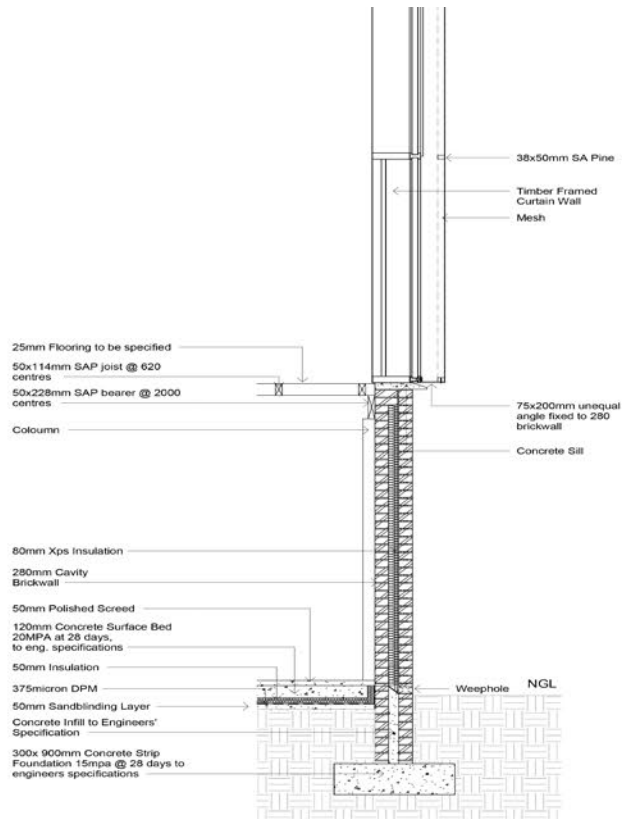


Figure 158 : Manufacturing Space sectional exploration (Image by author).

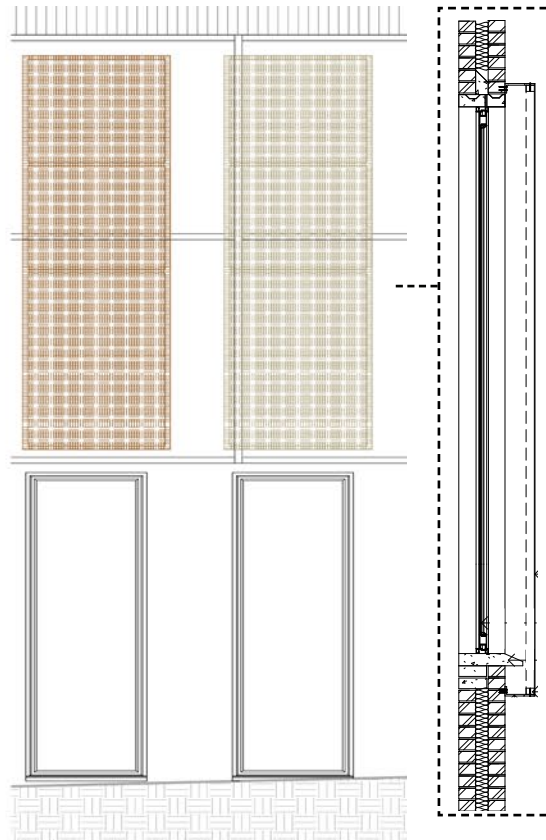


Figure 159 : Exploration of elevation materiality (Image by author).

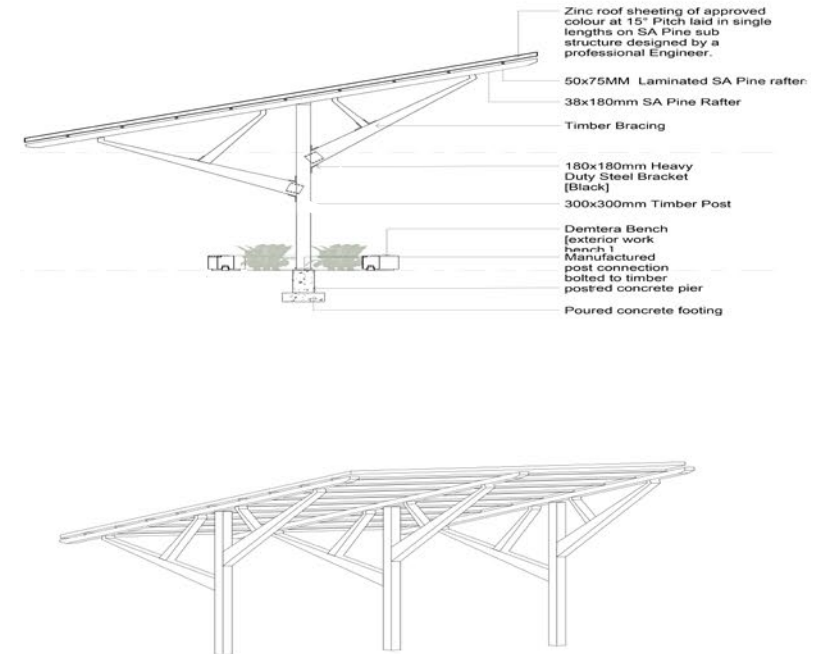
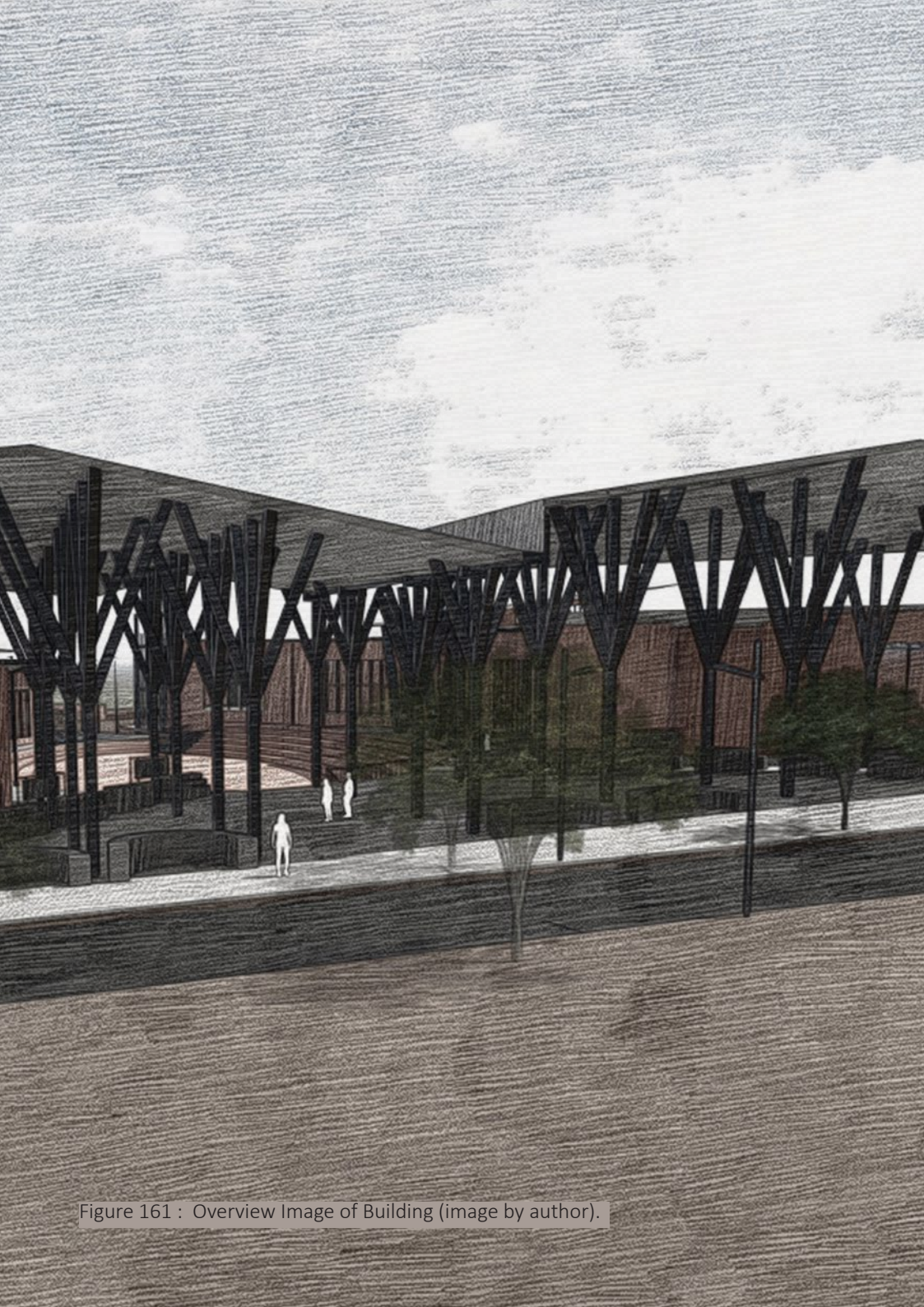


Figure 160 : Exploration of working shed (Image by author).



CHAPTER 08:

FINAL DESIGN

- Final Design, Technical Drawings and Perspectives

Figure 161 : Overview Image of Building (image by author).

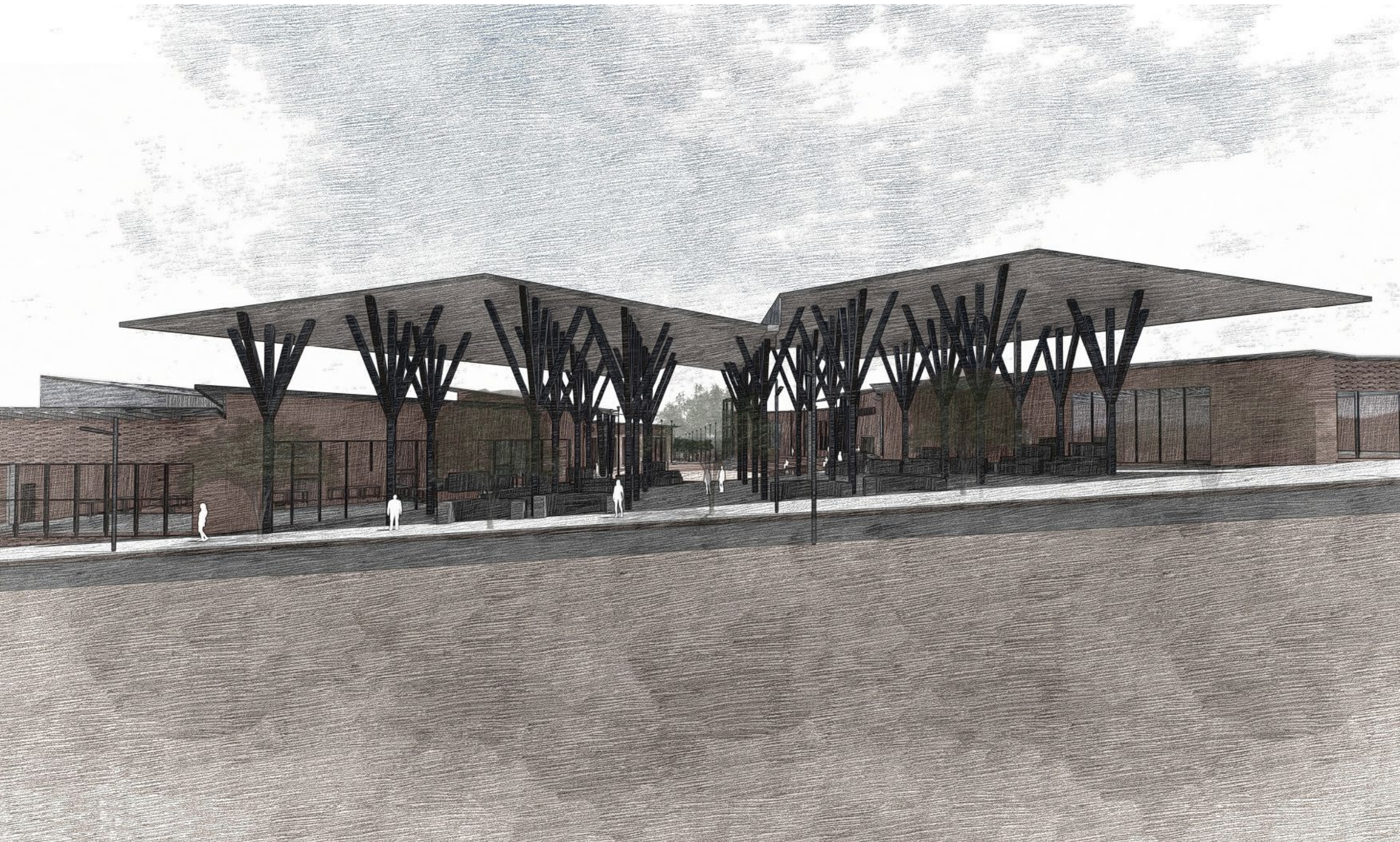


Figure 162 : Market Space Overview along abbess drive (Image by Author).



Figure 163 : Context Overview (Image by Author).

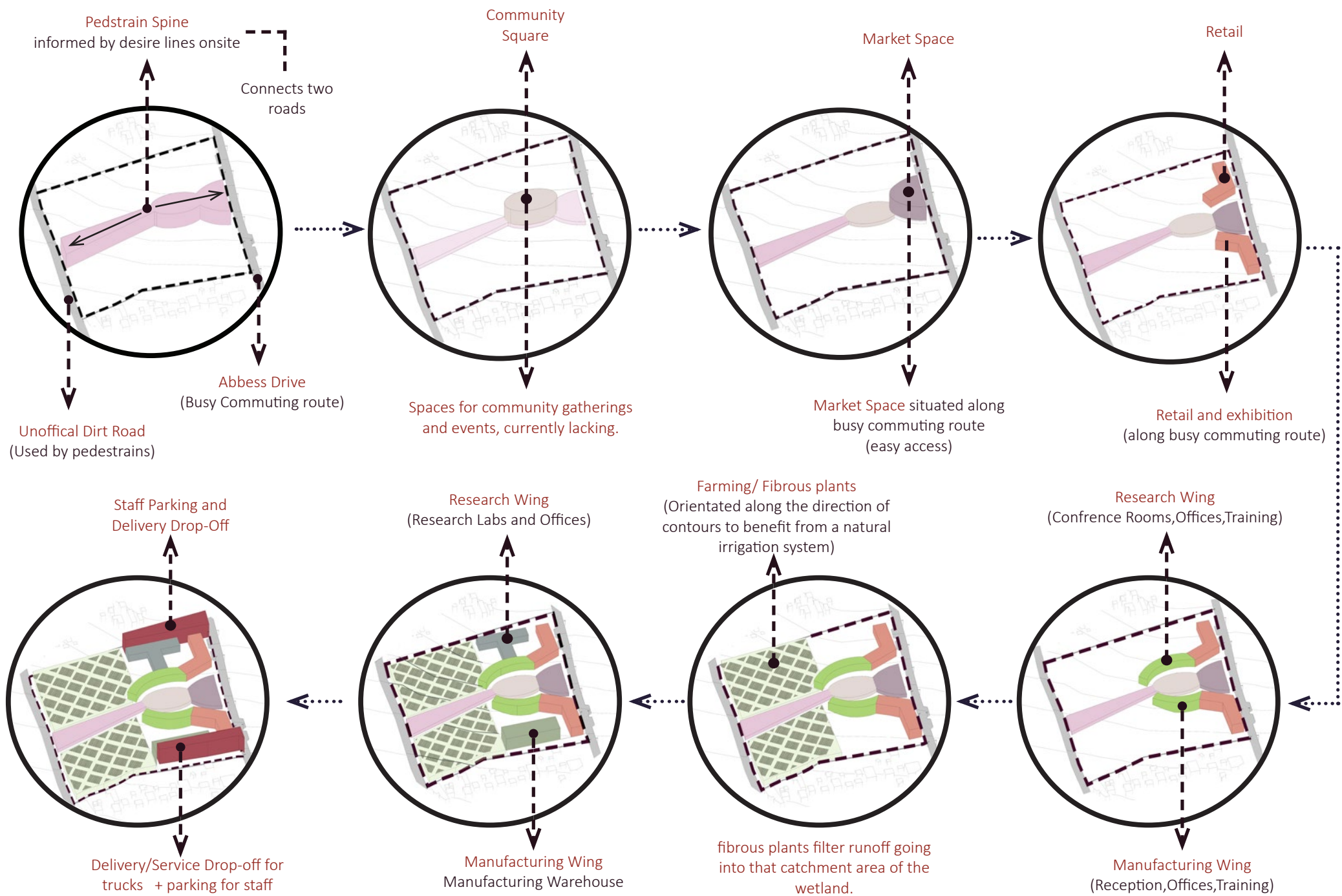


Figure 164 : Placemaking/Spatial Informants (Image by Author).

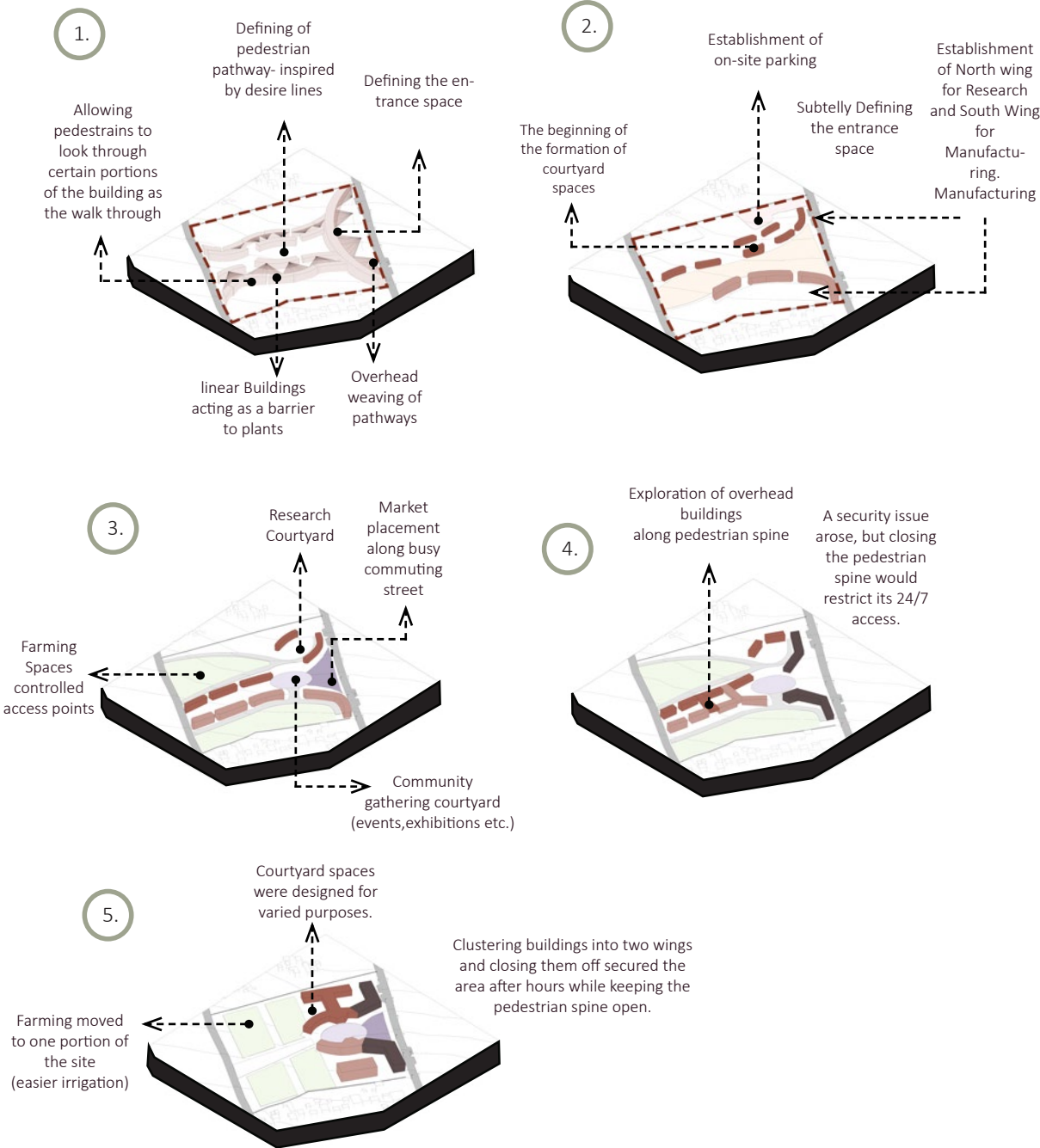


Figure 165 : Evolution of Form / Design Development (Image by Author).

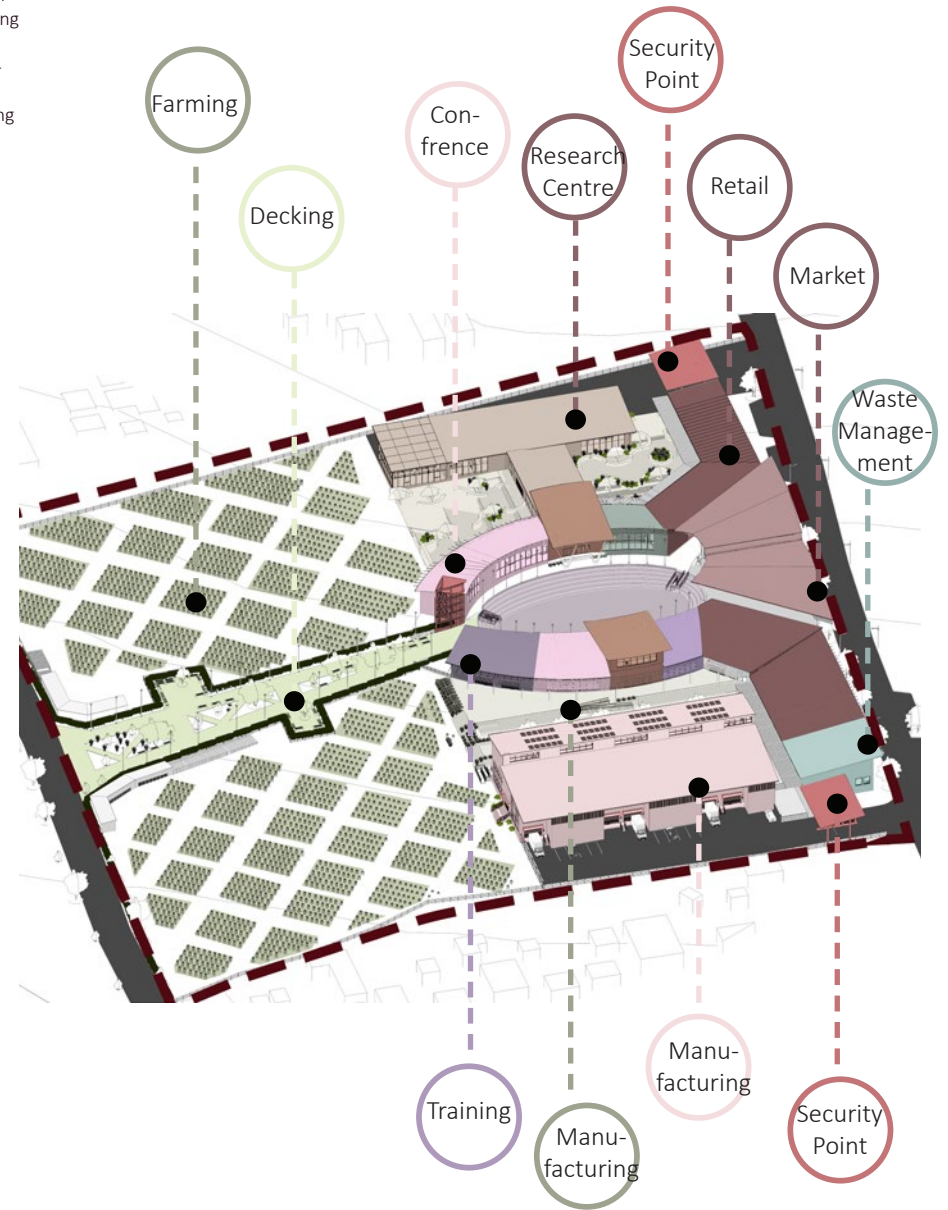


Figure 166 : Site Functions (Image by Author).

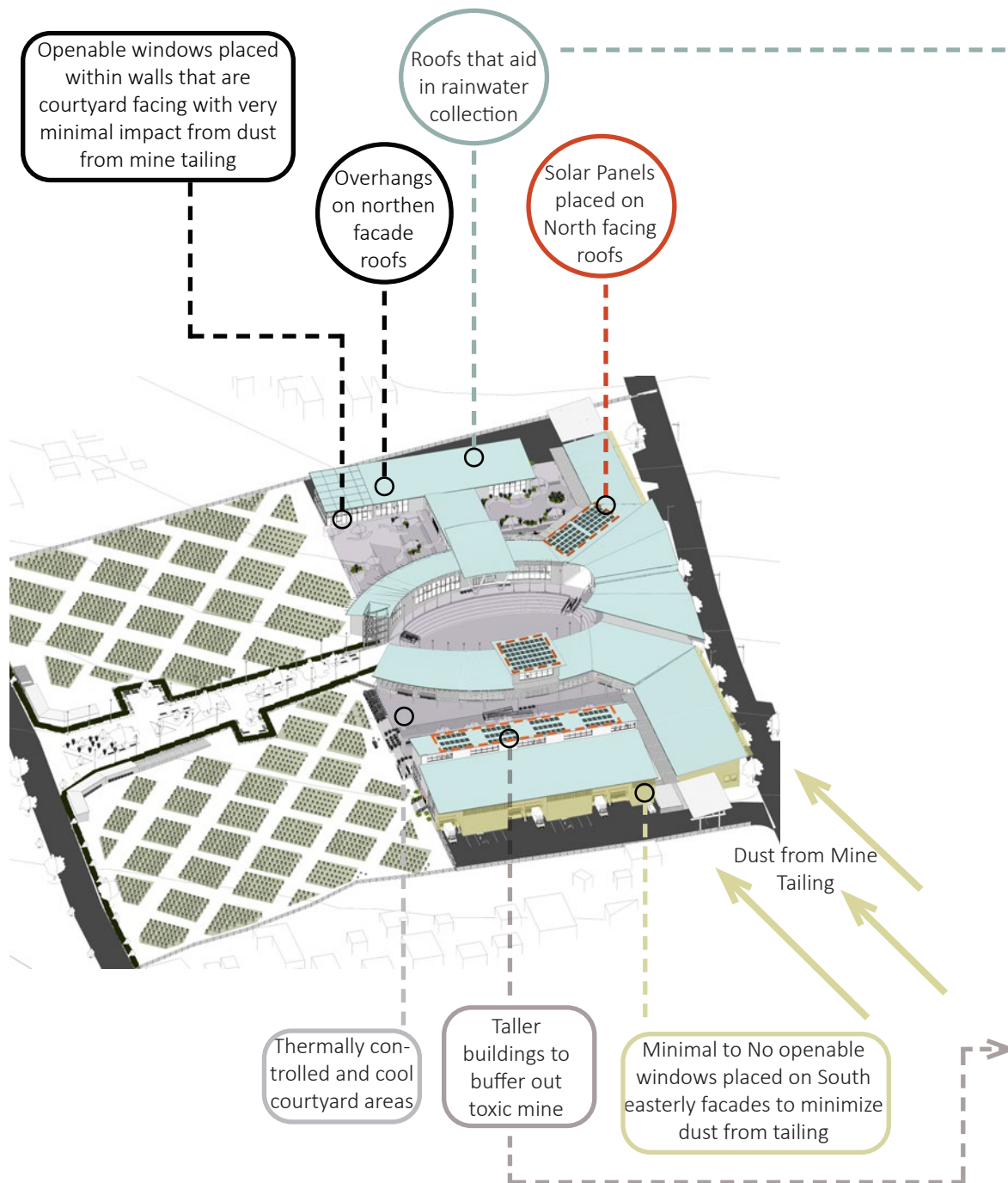


Figure 167 : Water and Energy Harvesting Systems and Dust Mitigation Solutions for Healthier Indoor and Courtyard Climates ,(Image by author).

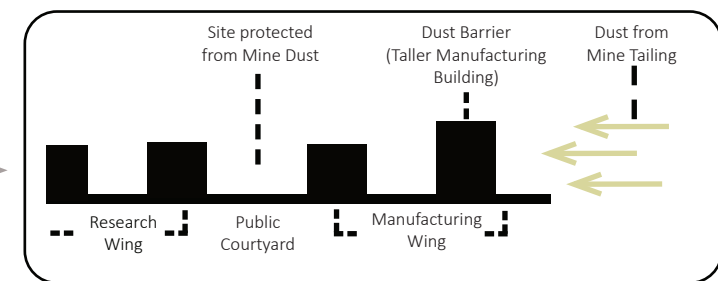
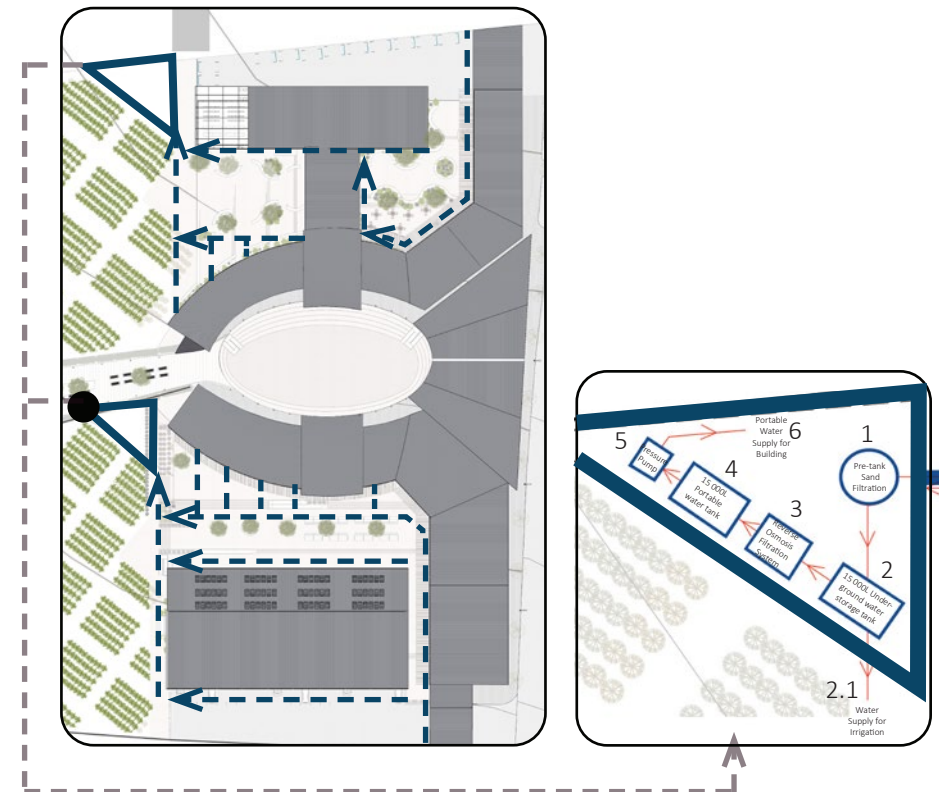


Figure 168 : Dust Mitigation , (Image by author).

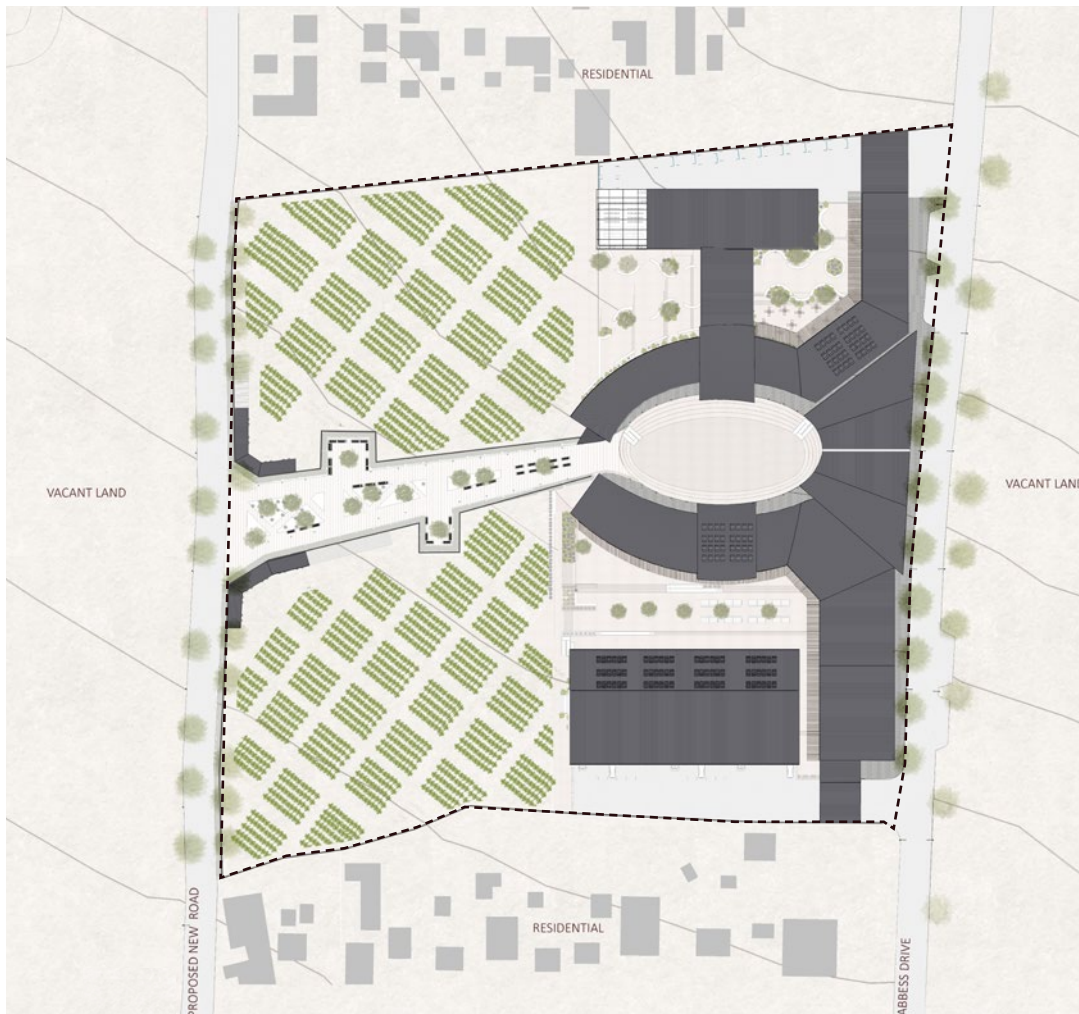
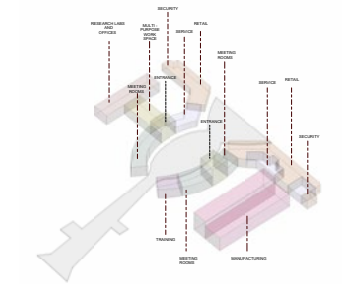
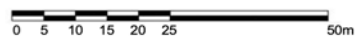
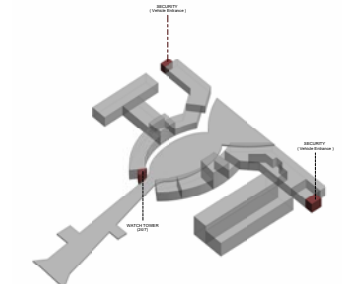


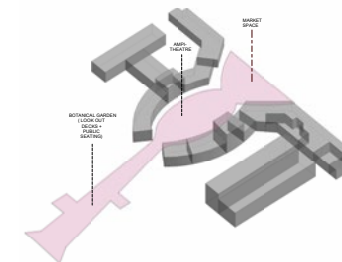
Figure 169 : Site Plan 1:500 (Image by author)
1:500



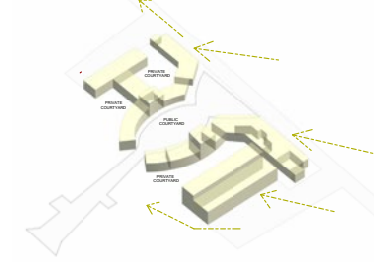
Building Programming



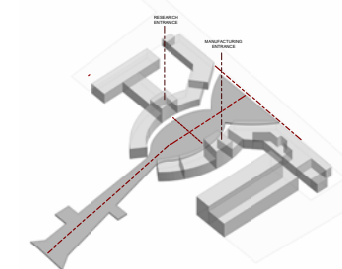
Security Points



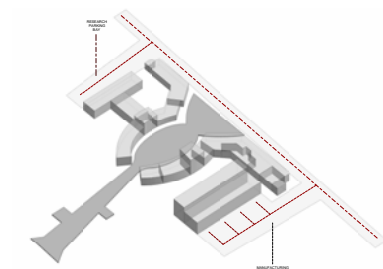
Pedestrian Spine (Open 24/7)



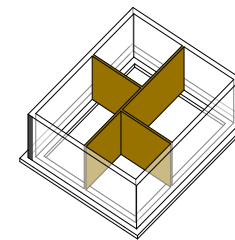
Building as Buffers from Toxic Dust



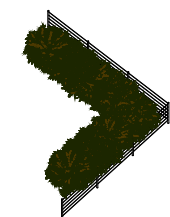
Pedestrian Movement



Vehicle Movement

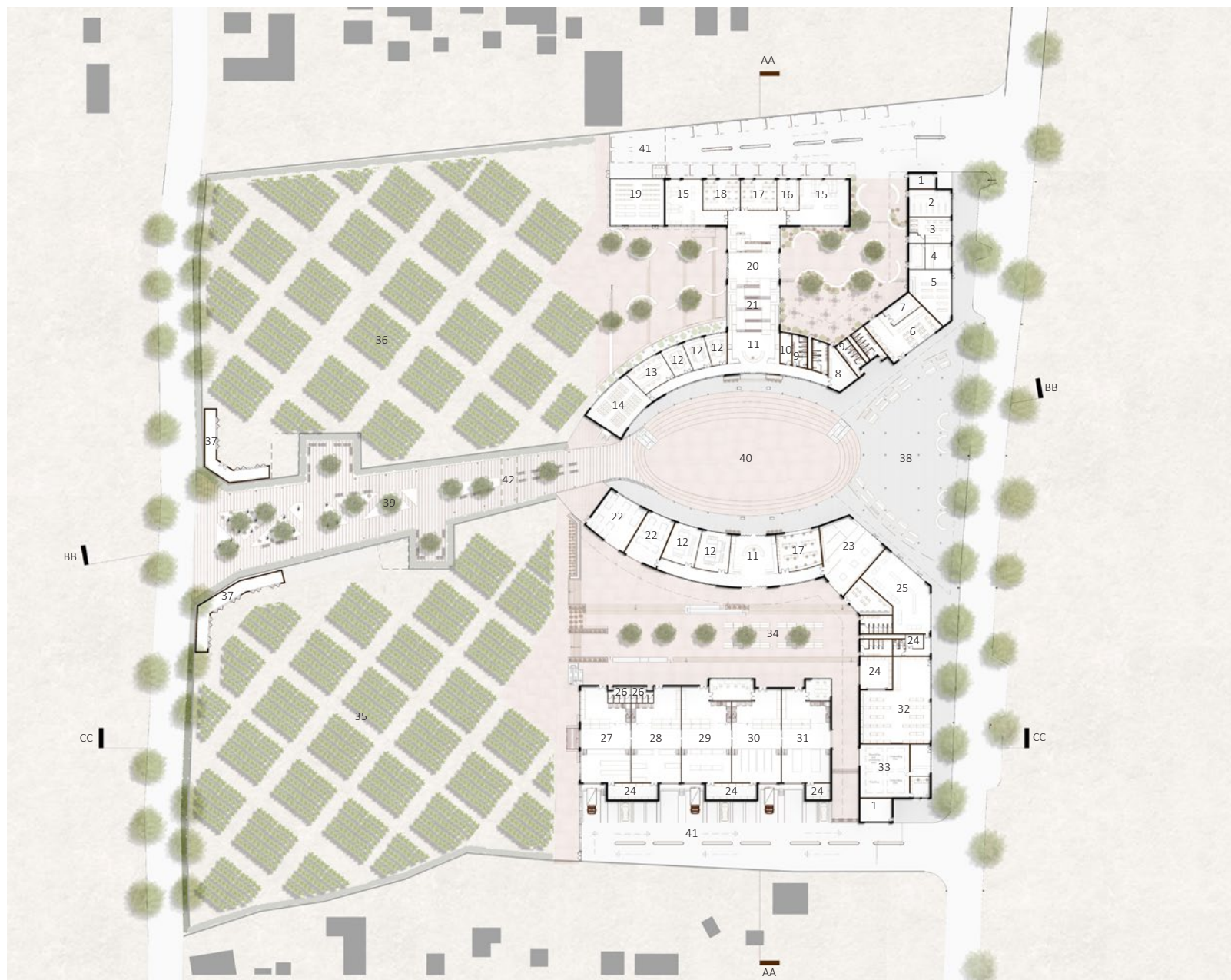


Use of Hemp within building



Electric fence and thorn bush
barrier protecting plants grown

Figure 170 : Building Diagrams (Image by author).



1. Security
2. Rentable Hardware Store
3. Rentable Hair Salon
4. Rentable Fast Food Store
5. Rentable Supermarket
6. Resturant
7. Kitchen
8. Staff Kitchen
9. Ablutions
10. Solar Equipment Storage
11. Reception and Lobby
12. Meeting room
13. Computer Facilities
14. Conference Room
15. Research Lab
16. Research Storage
17. Admin Office
18. Research Office
19. Experimental Greenhouse
20. Multifunctional Workhub
21. Walk-through Exhibition
22. Training Facilities
23. Exhibition Space
24. Storage
25. Internal Market Space
26. Change Room
27. Processing Room
28. Mixing Room
29. Forming and Pressing Room
30. Drying Room
31. Finishing Room
32. Hemp Store
33. Waste By-product Management
34. Makers/Craft Space
35. Hemp Farming
36. Experimental Farming
37. Tools Storage Shed
38. Market
39. Botanical Garden
40. Ampitheatre
41. Drop-off Zone
42. Draw Bridge

Figure 171 : Ground Floor Master Plan (Image by author).

1:500

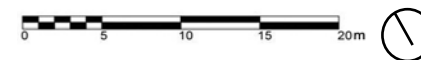




Figure 172 : Ground Floor Plan_Research Wing (Image by author).
1:200



Figure 173 : Ground Floor Plan_Manufacturing Wing (Image by author).
1:200



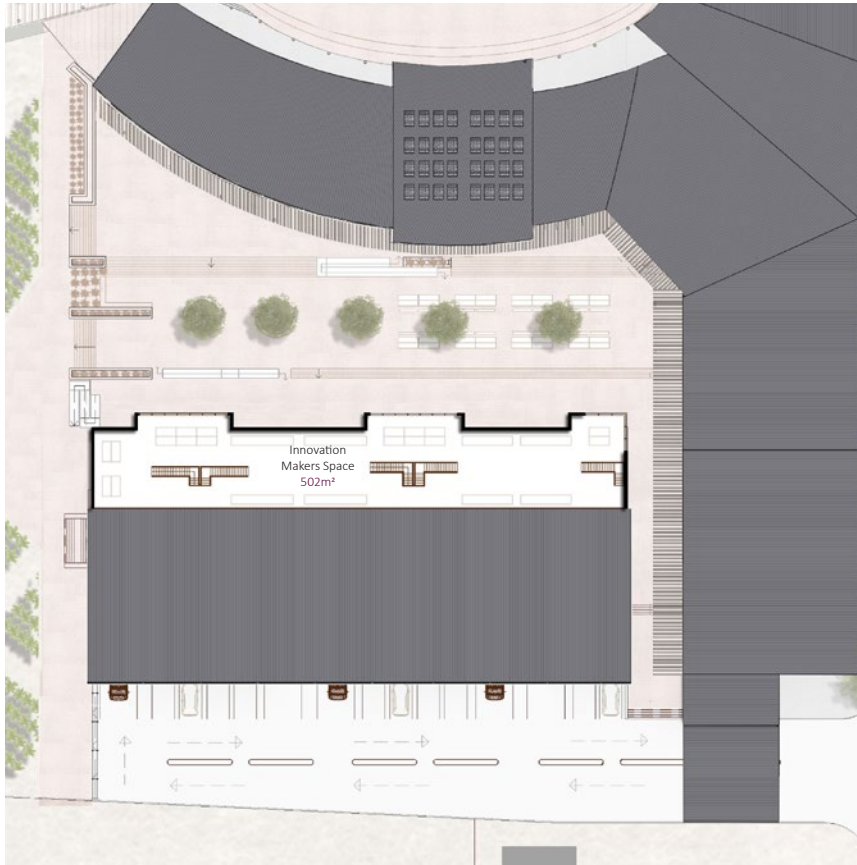


Figure 174 : Manufacturing Mezzanine Level (Image by author).
1:200

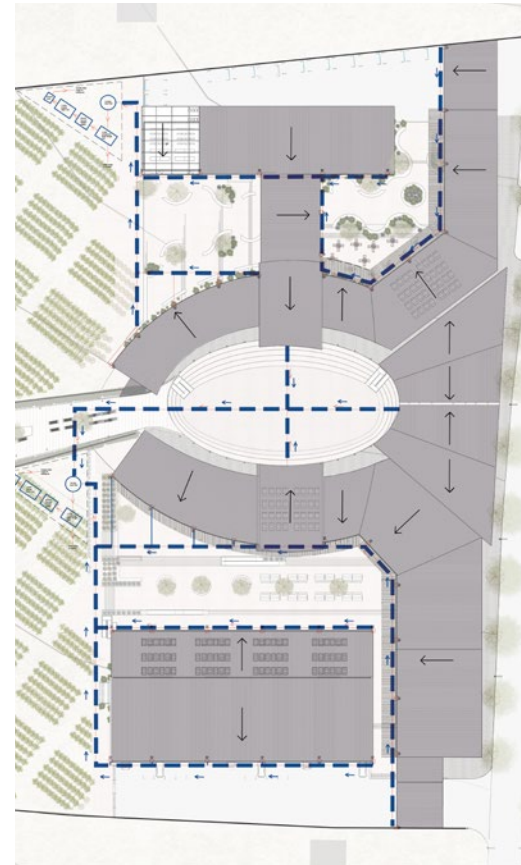
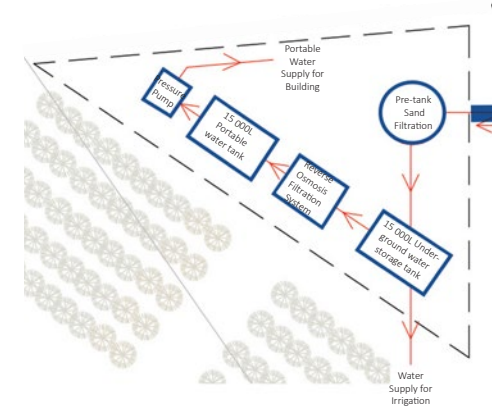


Figure 175 : Water Collection for Irrigation and Portable water use_Diagram (Image by author).



WASTE MANAGEMENT PLAN

WASTE GENERATED ON SITE

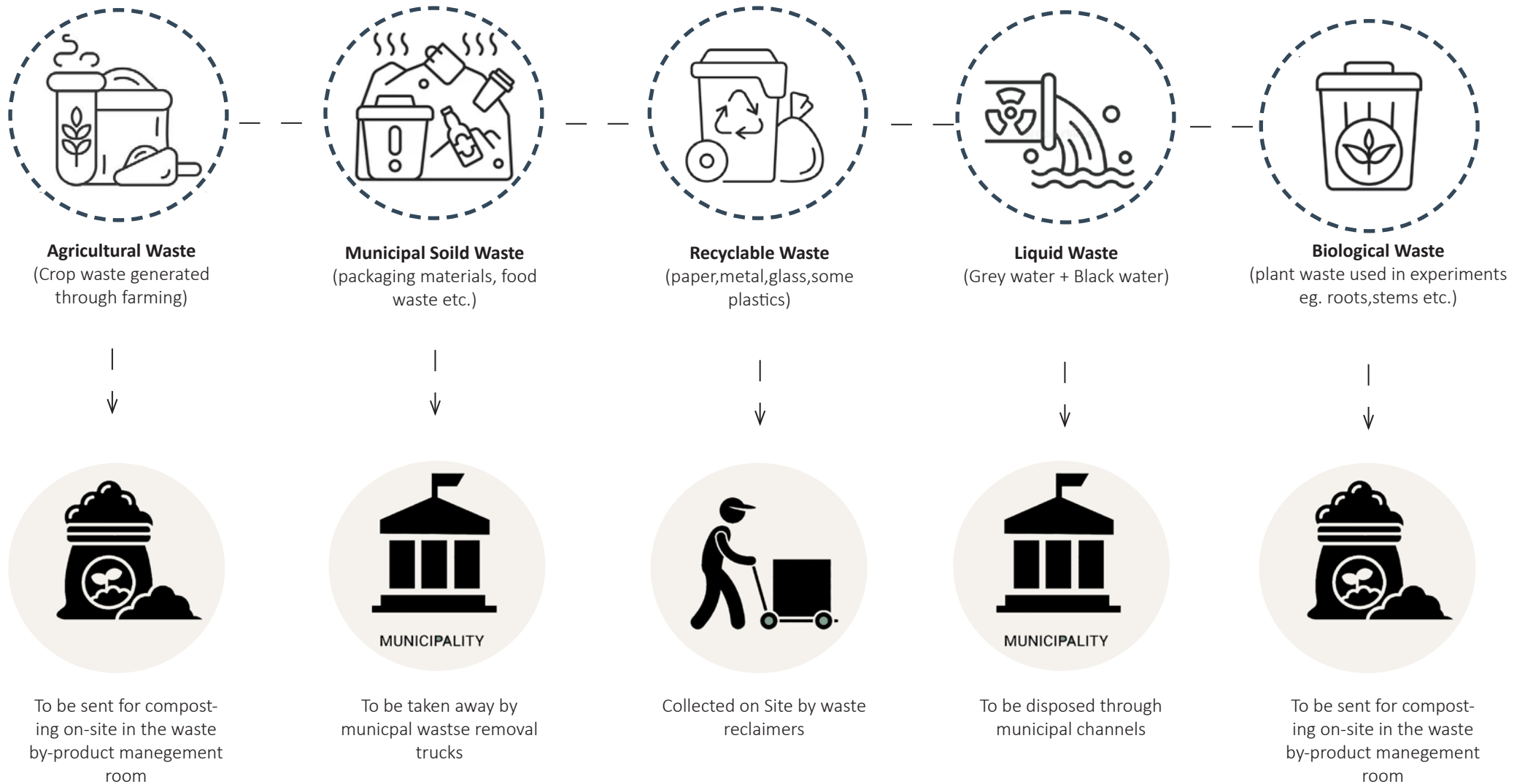


Figure 176 : Waste Management Plan (Image by author).

WASTE MOVEMENT AND COLLECTION POINTS ON SITE

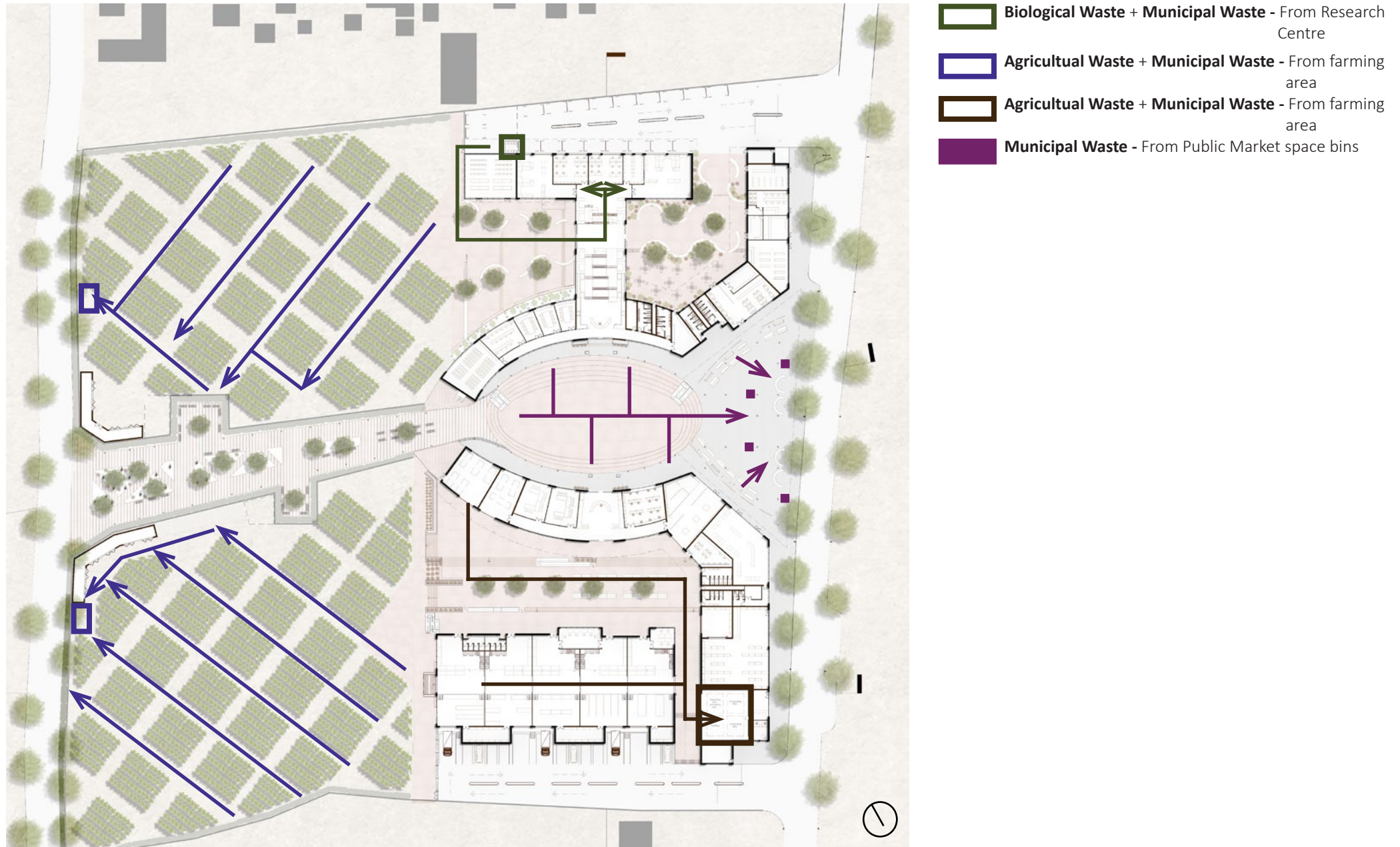


Figure 177 : Movement and collection of waste (Image by author).



Figure 178 : Ampitheatre_ Day View (Image by author).



Figure 179: East Elevation (Image by author).
1:200



Figure 180 : Section AA (Image by author).
1:200



Figure 181 : West Elevation (Image by author).
1:200



Figure 182 : View from pedestrain deck_Pedestrain spine (Image by author).

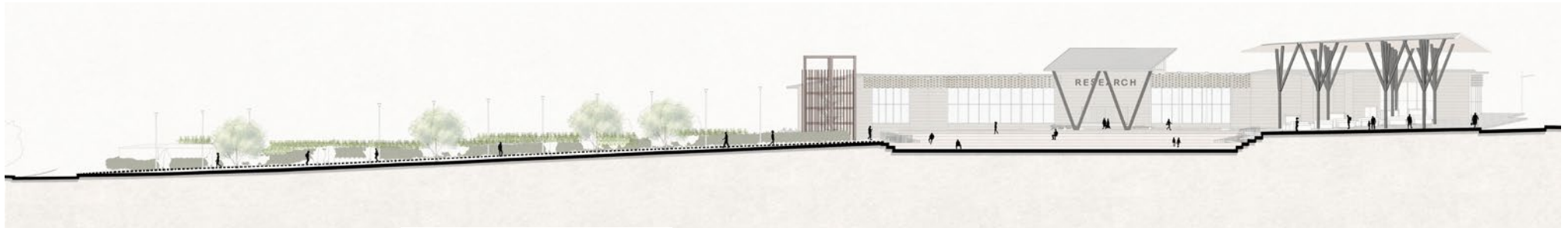


Figure 183 : Section BB (Image by author).
1:200



Figure 184 : South Elevation (Image by author).
1:200

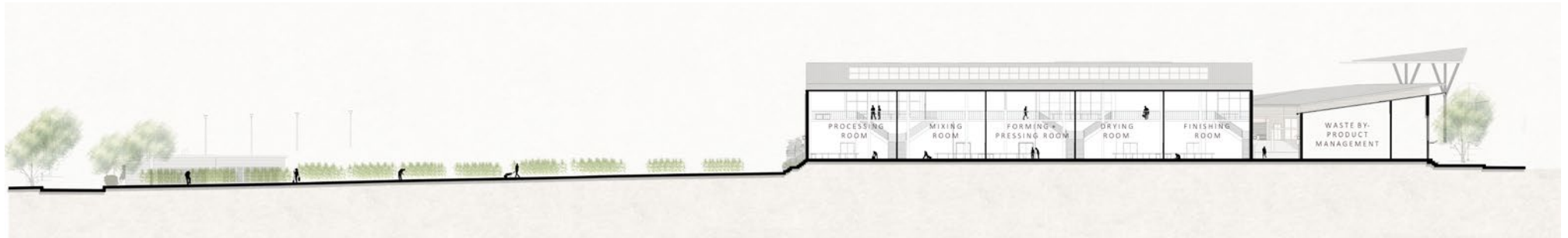


Figure 185 : Section CC (Image by author).
1:200



Figure 186 : North Elevation (Image by author).
1:200

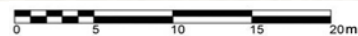




Figure 187 : Manufacturing warehouse_processing room (Image by author).

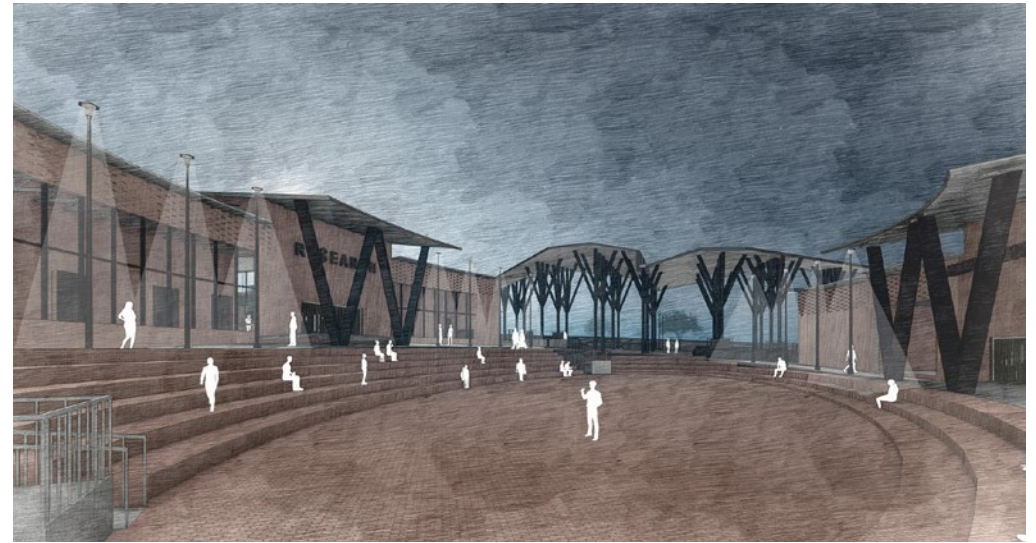


Figure 188 : Ampitheatre_Night view (Image by author).



Figure 189 : Research reception and lobby (Image by author).



Figure 190 : 3D Overview of building (Image by author).

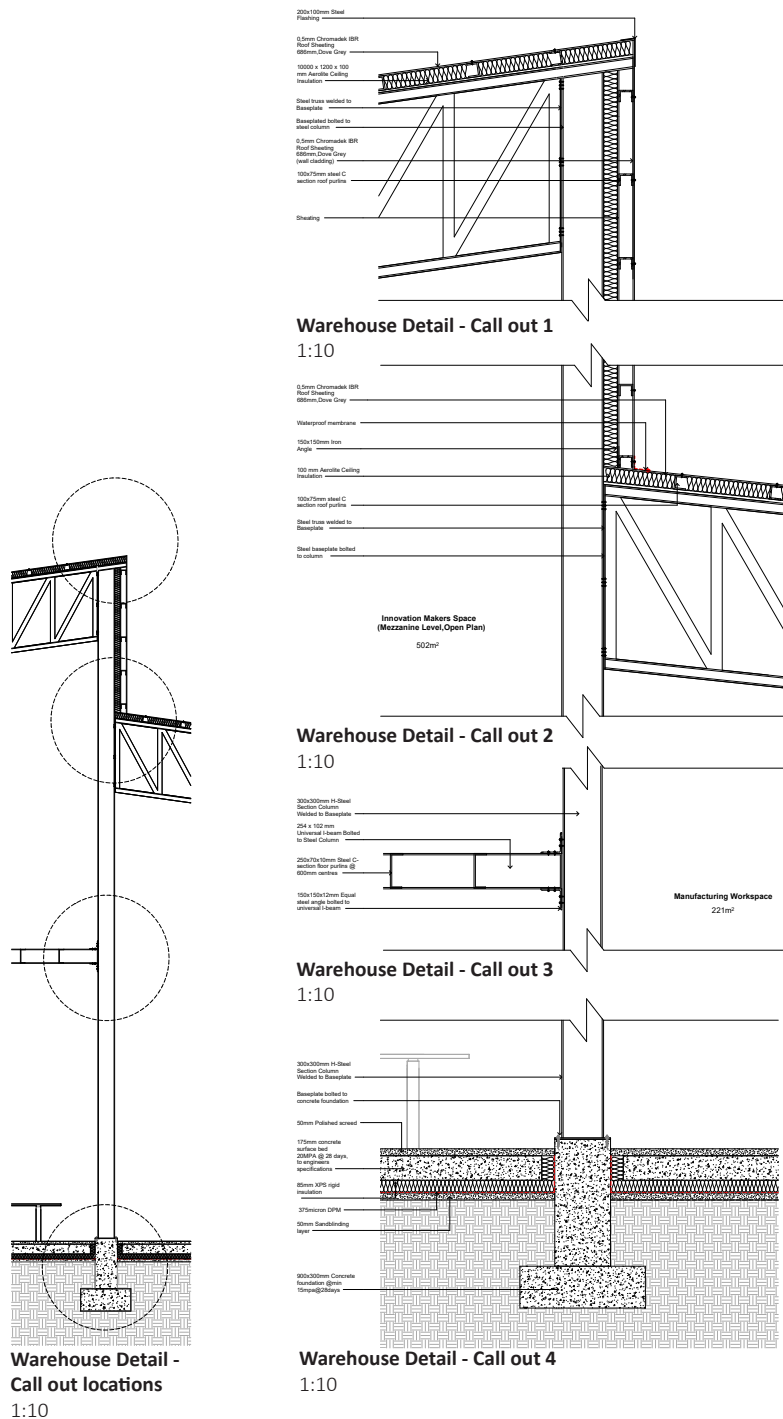


Figure 191: Manufacturing warehouse technical detail (Image by author).

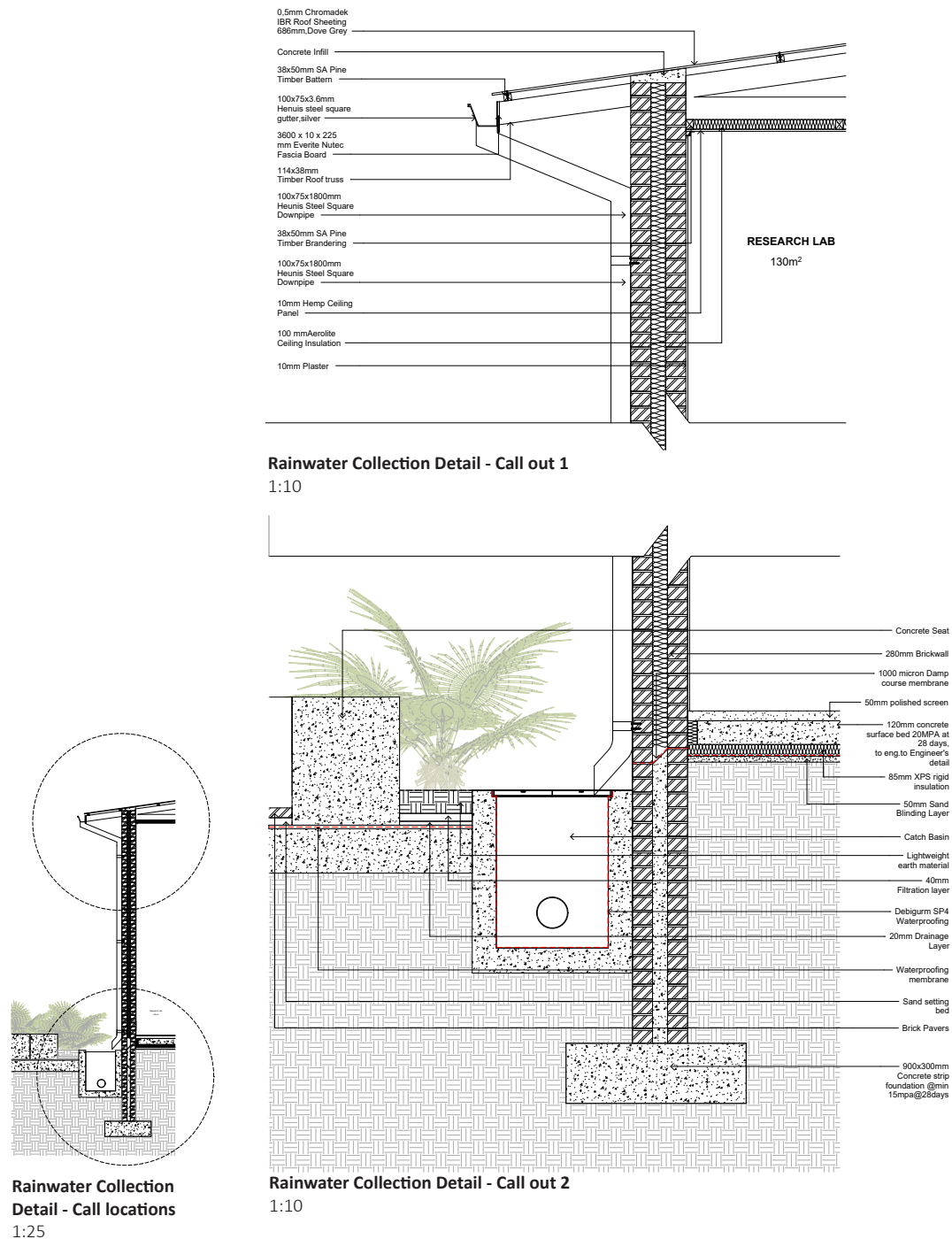
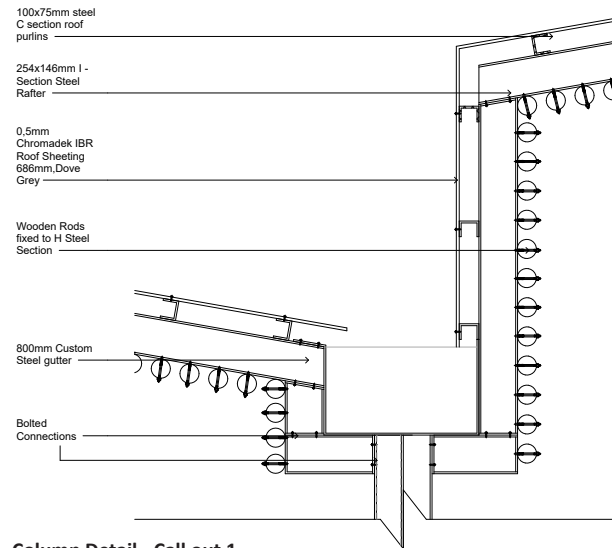
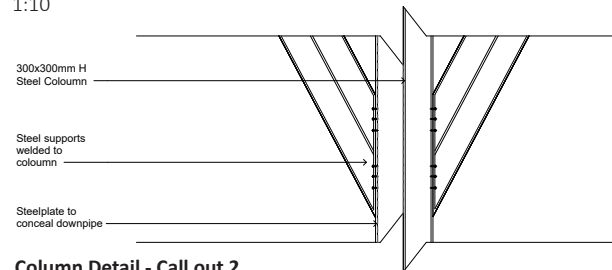


Figure 192: Rainwater catchment detail (Image by author).



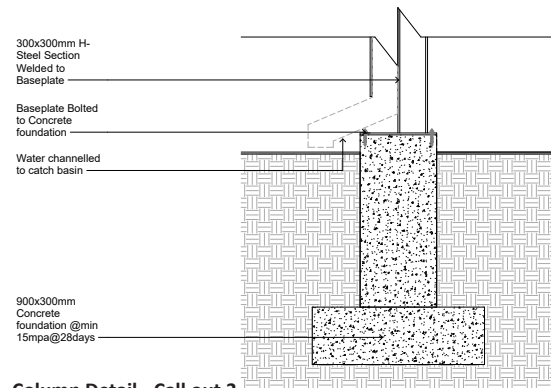
Column Detail - Call out 1

1:10



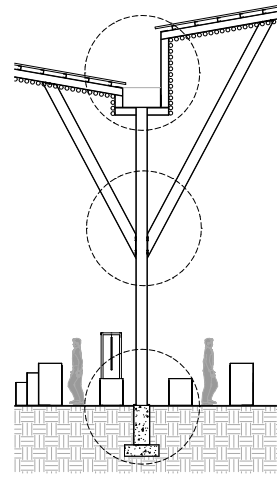
Column Detail - Call out 2

1:10



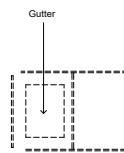
Column Detail - Call out 3

1:10



Column Detail - Call out locations

1:25



Gutter Placement in I-Section Column Diagram

Figure : Warehouse Details

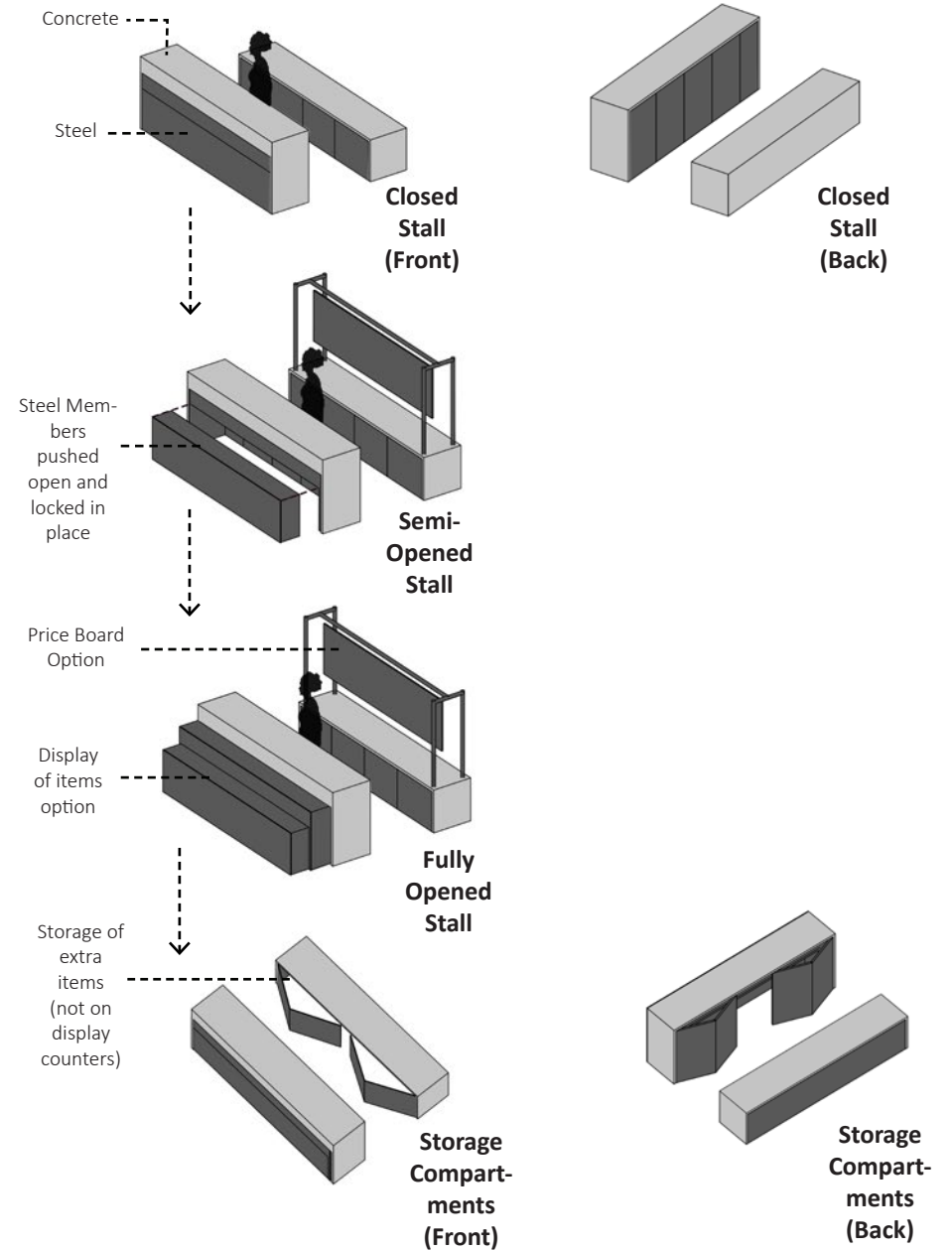


Figure 193 : Market column detail (Image by author).

Figure 194 : Market Stall Exploration (Image by author).



Figure 195: Market Space Perspective (Image by author).



Figure 196: 3d view of building on site (Image by author).



Figure 197: 3d Model of building_01 (Image by author).

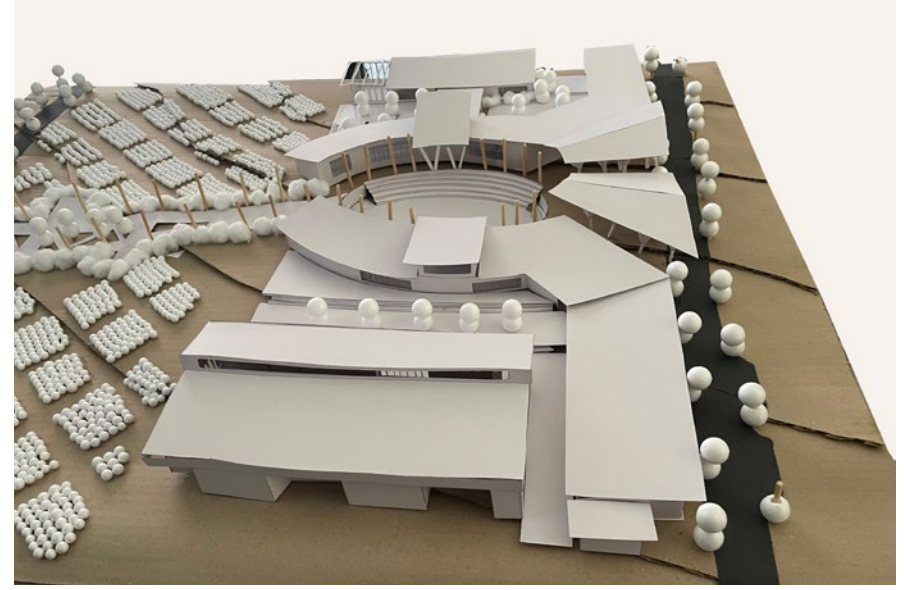


Figure 198: 3d Model of building_02 (Image by author).



Figure 199: 3d Model of building_03 (Image by author).

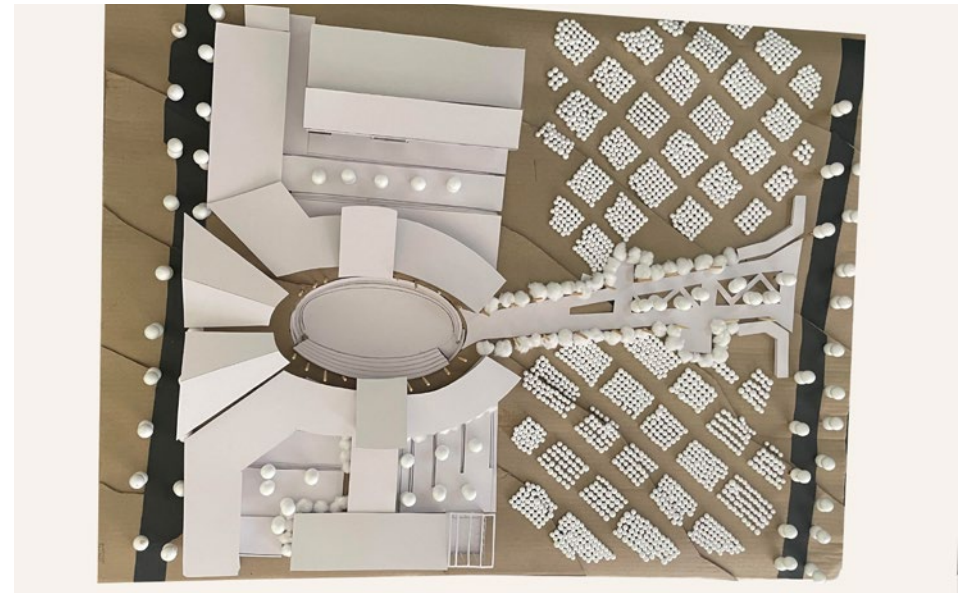


Figure 200: 3d Model of building_04 (Image by author).

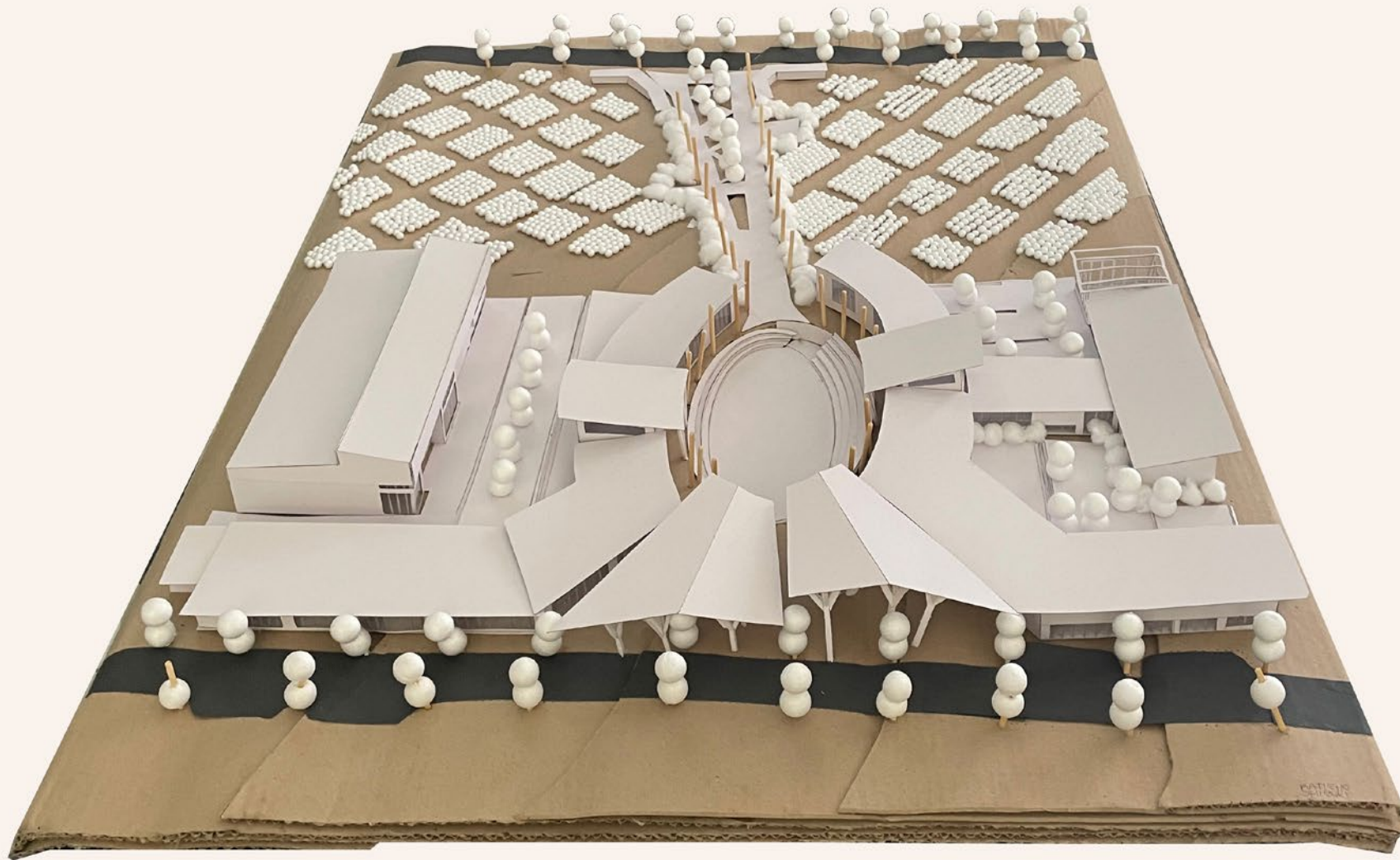


Figure 201: 3d Model of building_05 (Image by author).



Figure 202: Oral examination 2024 (Image by author).

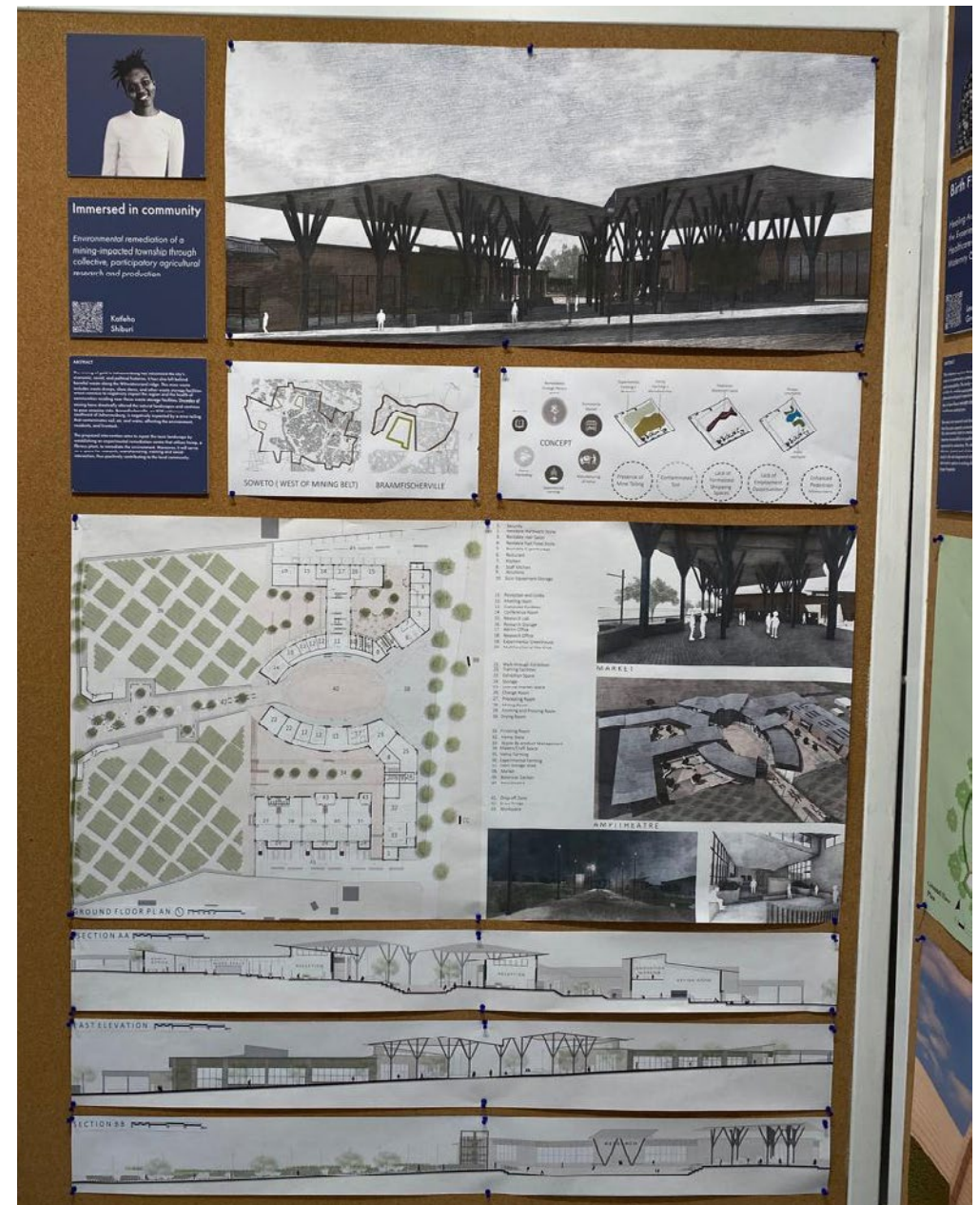


Figure 203: Exhibition 2024 (Image by author).

CONCLUSION

In conclusion, the Immersed in Community Centre has been established to challenge conventional approaches to how architecture can contribute to environmental remediation in a mining-impacted township. This initiative is driven by collective and participatory agricultural research and production, utilizing available land as a productive landscape. The centre not only seeks to rehabilitate the land through the cultivation of hemp but also integrates the community into this remediation process, creating diverse employment opportunities that support the socio-economic development of the area.

Furthermore, the centre holds potential for future expansion, as a significant portion of the adjacent land is owned by DRD Gold. This presents an opportunity to integrate the initiative into DRD Gold Mine's Corporate Social Responsibility program and post-mining remediation strategies. Collaboration with local government is also a key aspect of the proposed strategy, ensuring the restoration of areas affected by mining activities. These partnerships, alongside researchers, farmers, and other stakeholders within the centre, would closely monitor and support its success.

As the centre grows, the types of remediation plants cultivated could also evolve, adapting to the climate and the needs of the land post-remediation and re-mining of mine tailings. This adaptability extends to the centre's functions, allowing it to respond dynamically to the environmental and socio-economic needs of the community over time.

Immersed in Community [English Translation]

In the heart of Braamfischerville's bustling township,
There is a place where community is built,
Where connections are stitched with care,
A place where a person like Jabu,
with hands worn from toil,
can finally showcase the products
he worked so hard on,
dreams of growth once stifled, now set free,
No longer wandering, seeking space to be seen.

Here, Thandi, a mother with tired eyes and tender love,
Can swiftly find the missing ingredients of her children's
meal, no need for taxis to a different extension,
In this space, convenience meets compassion,
And home feels closer than ever.

A place where Thabo can learn and thrive,
Gaining skills through the hands of the community,
Walking just a few steps, and not having
to travel long distances to seek employment,
To turn skills aquired into a job, into a future.

Where Malume (Uncle) Jacob and his friends find solace,
A place to laugh, to sit, and to simply just be.
Here, community leaders and members
can meet, talk, and find solutions together.

A place for communitiy—
It is not just a place, but a commitment.
To repair, to uplift, to offer.
To provide, to empower,
To weave the people and the land together,
Without harm, without greed.
A space where the community thrives,
Where the environment and humans meet in harmony,
That is what Immersed in Community is.

A place for community.
A place where the heart of the township beats strong,
Where people find more than a connection—
They find home.

Ugxila Emphakathini [Zulu Translation]

Enhliziyweni yelokishi eliphithizelayo laseBraamfischerville,
Kukhona indawo lapho kwakhiwa khona umphakathi,
Lapho ukuxhumana kuthungwa ngokucophelela,
Indawo lapho umuntu ofana noJabu,
onezandla ezikhandlekayo,
ekugcineni engakhombisa imikhiqizo
abesebenza kanzima ukuzenza,
amaphupho okukhula ake avinjwa, manje asekhululiwe,
Akasazuli, efunana nendawo yokubonwa.

Kulapho, uThandi, umama onamehlo akhathele nothando
oluthambile, angathola ngokushesha izithako ezishodayo
zokudla kwezingane zakhe, asikho isidingo samatekisi aya
kwesinye isandiso,
Kulendawo, ukunethezeka kuhlalana nozwelo,
Futhi ikhaya lizizwa liseduze kunangaphambili.

Indawo lapho uThabo angafunda aphumelele,
Azuze amakhono ngezandla zomphakathi,
ahambe izinyathelo ezimbalwa nje, kungekho isidingo soku-
hamba amabanga aqhelile ukuyofuna umsebenzi,
Ukuze aguqule amakhono akhe ukuthola umsebenzi, abe
nekusasa.

Lapho uMalume Jacob nabangane bakhe bathola khona
induduzo, indawo yokuhleka, ukuhlala, ukuncebeleka.
Lapha, abaholi bomphakathi namalunga
bangahlalana, baxoxe, futhi bathole izixazululo ndawonye.

Indawo yomphakathi-
Akuyona nje indawo, kodwa ukuzibophezela.
Ukulungisa, ukuphakamisa, ukunikeza.
Ukuhlinzeka, ukunika amandla,
Ukweluka abantu nomhlaba ndawonye,
Ngaphandle kokulimala, ngaphandle kokuhaha.
Indawo lapho umphakathi uphumelela khona,
Lapho imvelo nabantu behlangana khona ngokuzwana,
Yilokho Ukucwiliswa Emphakathini okuyikho.

Indawo yomphakathi.
Indawo lapho inhliziyho yelokishi ishaya ngamandla,
Lapho abantu bethola okungaphezu kokuxhumana—
Bathola ikhaya.

BIBLIOGRAPHY :

- A Guide to South African Township Economy (no date) SME South Africa. Available at: <https://smesouthafrica.co.za/sme-guides/a-guide-to-south-africas-township-economy/> (Accessed: 11 August 2024).
- Abdel, H (2021) Swales jst Harrisburg Production Engineering Centre / Ryuichi Ashizawa Architects & Associates in collaboration with Arcari + Iovino Architects | ArchDaily. Available at: <https://www.archdaily.com/972836/jst-harrisburg-production-engineering-center-ryuichi-ashizawa-architects-and-associates> (Accessed: 10 May 2024).
- Abdel, H. (2023) Metallic Bellows Factory Office / KSM Architecture | ArchDaily. Available at: <https://www.archdaily.com/1010184/metallic-bellows-factory-office-ksm-architecture> (Accessed: 10 May 2024).
- Bobbins, K. et al. (2018) Mining landscapes of the Gauteng City-Region. Gauteng City-Region Observatory. Available at: <https://doi.org/10.36634/TIAJ2187> (Accessed: 18 May 2024)
- Brand, S. (1994) How Buildings Learn: What Happens After They're Built.
- Chiweshe, M. (2015) Travelling development diaries part 1: Waste makes wealth: Case of recycling in Soweto, South Africa. Available at: <https://manasekudzai.wordpress.com/2015/08/01/travelling-development-diaries-part-1-waste-makes-wealth-case-of-recycling-in-soweto-south-africa/> (Accessed: 24 August 2024).
- Davie, L (no date) The history of Joburg, City of Gold (ZA). Available at: <https://www.southafrica.net/za/en/travel/article/the-history-of-joburg-city-of-gold> (Accessed: 19 July 2024).
- Domingo, G (2019) Agricultural Hubs, An Ambitious Architectural Approach Towards Economic Development. Available at: <https://futurearchitectureplatform.org/projects/de72ab49-878e-464b-9526-516855ff5700/> (Accessed: 10 May 2024).
- 'Farm & Garden National Trust – Micro-farming community projects' (no date). Available at: <https://farmgardentrust.org/> (Accessed: 22 March 2024).
- Gauteng's water crisis now threatens food sustainability (2020) Food For Mzansi. Available at: <https://www.foodformzansi.co.za/gautengs-water-crisis-now-threatens-food-sustainability/> (Accessed: 21 March 2024).
- 'Garden Centres' (2017) Abalimi Bezekhaya . Available at: <http://abalimibezekhaya.org.za/garden-centres/> (Accessed: 21 March 2024).
- Godfrey, L. (2021) The circular economy as development opportunity- Council for Scientific and Industrial Research (CSIR). Available at: [CSIR-2021-Circular-Economy-As-Development-Opportunity.pdf](https://www.csir.co.za/Portals/0/CSIR-2021-Circular-Economy-As-Development-Opportunity.pdf) (Accessed: 18 May 2024).
- Govender, D., Govender, T. and Whyte, C. (2023) '2023 Market Study of the Circular (& Waste) Economy of South Africa'. Available at: <https://www.rvo.nl/sites/default/files/2023-10/SA-Circular-Economy-Opportunities.pdf> (Accessed: 20 August 2024).
- Harrison, P., Todes, A. and Weakley, D. (2015) Resilient Densification: Four Case Studies from Johannesburg.
- 'Harvest of Hope – Connecting the farmers to the customers' (no date). Available at: <https://abalimiharvestofhope.org.za/> (Accessed: 22 March 2024).
- Industrial hemp as a building material (no date) Hemp Gazette. Available at: <https://hempgazette.com/industrial-hemp/building-construction-hemp/> (Accessed: 8 August 2024).
- Iyaloo, S. et al. (2020) Respiratory Health in a Community Living in Close Proximity to Gold Mine Waste Dumps, Johannesburg, South Africa. Available at: <https://doi.org/10.3390/ijerph17072240> (Accessed: 8 August 2024).
- Kennen, K. and Kirkwood, N. (2015) Phyto: Principles and Resources for Site Remediation and Landscape Design. London: Routledge. Available at: <https://doi.org/10.4324/9781315746661> (Accessed: 11 August 2024).
- Kéré Architecture (no date). Available at: <https://www.kerearchitecture.com/work/building/centre-for-earth-architecture> (Accessed: 11 August 2024).
- Khomo, L (2024) Gold mine pollution threatens Soweto's urban farms- Food For Mzansi. Available at: <https://www.foodformzansi.co.za/gold-mine-pollution-threatens-sowetos-urban-farms/> (Accessed: 24 August 2024).
- Louw, M (no date) Hemp as Building Material- Field Crops in South Africa. Available at: <https://southafrica.co.za/hemp-building-material.html> (Accessed: 8 August 2024).

BIBLIOGRAPHY :

- Mabaso, S.M. (2023) 'Legacy Gold Mine Sites & Dumps in the Witwatersrand: Challenges and Required Action', *Natural Resources*, 14(5), pp. 65–77. Available at: <https://doi.org/10.4236/nr.2023.145005> (Accessed: 8 August 2024).
- Metoh, A. (no date) Urban agriculture and society : the benefits of urban agriculture at Doornkop Informal Settlement in Johannesburg, South Africa- University of Johannesburg. Available at: <https://ujcontent.uj.ac.za/esploro/outputs/graduate/Urban-agriculture-and-society--the/9913275307691> (Accessed: 11 August 2024).
- Milnex (2017) EIA182- Ecological Desktop Study. Available at: <https://sahris.sahra.org.za/sites/default/files/additionaldocs/EIA182%20-%20Ecological%20Desktop%20Study%20rev00.pdf> (Accessed: 14 August 2024).
- Moolla, R., Kotze, N. and Block, L. (2011) 'Housing satisfaction and quality of life in RDP houses in Braamfischerville, Soweto: A South African case study', *Urbani izziv*, 22, pp. 138–143. Available at: <https://doi.org/10.5379/urbani-izziv-en-2011-22-01-005> (Accessed: 21 March 2024).
- Moreira, S. (2023) Braga Municipal Market / APTO Architecture, ArchDaily. Available at: <https://www.archdaily.com/994445/braga-municipal-market-pto-architecture> (Accessed: 20 July 2024).
- Mubiwa, B. and Annegarn, H. (2013) Historical spatial change in the Gauteng City-Region. Occasional Paper. Gauteng City-Region Observatory. Available at: <https://doi.org/10.36634/LTUC2194> (Accessed: 8 August 2024).
- Natural Sapphire (no date) Witwatersrand Gold Rush | The Famous South African Gold Mine | Education. Available at: <https://www.thenaturalsapphirecompany.com/education/additional-precious-metals-information/witwatersrand-gold-rush/> (Accessed: 19 July 2024).
- Pashkevich, M. (2017) 'Classification and Environmental Impact of Mine Dumps', in *Assessment, Restoration and Reclamation of Mining Influenced Soils*, pp. 1–32. Available at: <https://doi.org/10.1016/B978-0-12-809588-1.00001-3> (Accessed 11 July 2024).
- Placido, D.F. and Lee, C.C. (2022) 'Potential of Industrial Hemp for Phytoremediation of Heavy Metals', *Plants*, 11(5), p. 595. Available at: <https://doi.org/10.3390/plants11050595> (Accessed 11 July 2024).
- Reinventing art with cow dung, plastic and waste material- Hindustan Times (no date). Available at: <https://www.hindustantimes.com/art-and-culture/reinventing-art-with-cow-dung-plastic-and-waste-material/story-HwkpWWhidXXP2pkVP40ZLK.html> (Accessed: 24 August 2024).
- Sutton, M. et al. (2006) Australian Centre for Geomechanics | Conference Paper: A GIS-Based History of Gold Mine Residue Deposits and Risk Assessment of Post-Mining Land-Uses on the Witwatersrand Basin, South Africa. Available at: https://papers.acg.uwa.edu.au/p/605_58_Sutton/ (Accessed: 24 August 2024).
- Assessment of Post-Mining Land-Uses on the Witwatersrand Basin, South Africa. Australian Centre for Geomechanics, pp. 667–678. Available at: https://doi.org/10.36487/ACG_repo/605_58 (Accessed: 24 August 2024)
- Swart, J (no date) Hemp panels- The Exploded View. Available at: <https://theexplodedview.com/materialbb/hemp-panels/> (Accessed: 1 September 2024).
- 'The Mungo Mill- come and see how we make the fabric you love' (no date) Mungo. Available at: <https://www.mungo.co.za/about-us/our-mill/> (Accessed: 10 May 2024).
- Tom, S. (2020) 'Gauteng's water crisis now threatens food sustainability', *Food For Mzansi*, 20 June. Available at: <https://www.foodformzansi.co.za/gautengs-water-crisis-now-threatens-food-sustainability/> (Accessed: 10 August 2024).
- TomTom Traffic Index – Live traffic statistics and historical data (no date). Available at: <https://www.tomtom.com/traffic-index/> (Accessed: 1 September 2024).
- Tsurumaki, M., Lewis, P. and Lewis, D.J. (2022) *Manual of Biogenic House Sections*.
- Women's Opportunity Center, Rwanda by Sharon Davis Design (2015) Architizer. Available at: <https://architizer.com/projects/womens-opportunity-center-rwanda/> (Accessed: 11 August 2024).

LIST OF FIGURES :

Figure 01 : Image overlooking Braamfischerville from mine dump (Image by author).

Figure 02 : Image from Braamfischerville mine dump overlooking Braamfischerville and subsistence farming by residents . (Natural Sapphire, no date).

Figure 03 : Braamfischerville tailing sand layers (Mamabolo, 2024).

Figure 04 : Langlaagte Farm where Gold was discovered in 1889
(Natural Sapphire, no date).

Figure 05 : Johannesburg 1890 (Natural Sapphire, no date).

Figure 06 : Gold fields highlighted in the Johannesburg Region, image adapted (Basson,2014).

Figure 07 : Mine tailings along the Witwatersrand mining belt (Image by author).

Figure 08 : Environmental Impacts of Gold Mining ,image adapted (Pashkevich, 2017).

Figure 09 : Impact of Mine Tailings (Image by Author).

Figure 10 : Early Image of Johannesburg before mining (1889), (Pretorius, no date).

Figure 11 : Map of Johannesburg and vicinity, from the 10th edition of Encyclopædia Britannica, published in 1902.(Encyclopaedia Britannica,1902).

Figure 12 : Social Housing in Orlando,Soweto (Getty, no date).

Figure 13 : RDP settlements in Braamfischerville before roads were built (Nico Kotze, 2011).

Figure 14 : Impact of mining on human health (CSIR, 2013).

Figure 15 : Farming in Braamfischerville Extension 12 (Image by author).

Figure 16 : Subsistence farming in Braamfischerville taken from the top of the mine tailing
(Image by author).

Figure 17 : Braamfischerville Extension 12 (Image by author).

Figure 18 : Braamfischerville highlighted in the mining belt context (Image by author).

Figure 19 : Houses and Cattle in Braamfischerville (Image by author).

Figure 20 : Development of Braamfischerville over a series of years (Favaro,2024).

FIGURE 21: Inhabitants try to create privacy within the housing units (Nico Kotze, 2011).

FIGURE 22 : Floor plan of RDP housing unit in Braamfischerville (Nico Kotze, 2011).

Figure 23 : Image of Dirt Road in Braamfischerville adjacent to thesis site (Chen, 2024).

Figure 24 : Backyard hair salon in Braamfischerville (Hooimeijer, 2024).

Figure 25 : Cattle grazing in Braamfischerville with wetland in the background (Chen, 2024) .

Figure 26 : Backyard spaza fast food shop (Hooimeijer,2024).

Figure 27 : Community subsistence farming Braamfischerville (Image by author).

Figure 28 : A housing typology type in Braamfischerville (completely redeveloped RDP), (google maps,2024).

Figure 29 : Mine tailing in Braamfischerville (Image by author).

Figure 30 : Ward 49 Braamfischerville statistics, Image adapted (Wazimap,2011).

Figure 31 : Schooling level within Braamfischerville ,Image adapted (Wazimap,2011).

Figure 32 : Open land between residential area in Braamfischerville and mine tailing (Image by author).

Figure 33 : Braamfischerville extension 12, Image adapted (google earth , 2024).

Figure 34 : Site within the broader context of Soweto, image adapted (Google earth, 2024).

Figure 35 : Site within the broader context of Braamfischerville,
image adapted (Google earth, 2024).

Figure 36 : Site within the broader context of Braamfischerville, image adapted (Google earth, 2024).

Figure 37: Zoning Map , image adapted (Joburg Gis,2024).

Figure 38 : Major arterial and secondary roads (Image by author).

Figure 39 : Formalized Shops in Braamfischerville (Image by author).

Figure 40 : Street vendor selling fruits and Vegetables (Image by author).

Figure 41 : Hair salon, extension in yard (Google Maps,2024).

Figure 42 : Local shoprite in Braamfischerville ext (Google Maps,2024).

Figure 43 : Local hardware store in Braamfischerville (Google Maps,2024).

Figure 44 : Local supermarket in Braamfischerville (Google Maps,2024).

Figure 45 : Mining Map (Image by author).

Figure 46 : Critical Biodiversity Map (Image by author).

Figure 47 : Proposed long-term wetland intervention (Image by author).

Figure 48 : Broader Environmental Considerations (Image by author).

Figure 49 : Braamfischerville mine tailing (Image by Author).

Figure 50 : Vegetation on mine tailing to combat soil erosion and limit dust dispersion (Images by author).

Figure 51 : Soil erosion is visible on the southern side of the mine tailings, where there is a noticeable lack of vegetation. (Image by author).

Figure 52 : Thesis site highlighted in Extension 12 (Image by author).

LIST OF FIGURES :

Figure 53 : Thesis Site (Image by author).

Figure 54 : Landscape images of the thesis site and its surroundings (Image by author).

Figure 55 : Section AA (Image by author).

Figure 56 : Section BB (Image by author).

Figure 57: Section locator plan (Image by author).

Figure 58 : Pedestrian Movement (Image by author).

Figure 59 : Vehicular Movement (Image by author).

Figure 60 : Desire Lines, image adapted (Google Maps,2024).

Figure 61 : Walking distance across site (Image by author).

Figure 62: January 1991-2020,image adapted (South African Weather Services, no date).

Figure63 : April 1991-2020, image adapted (South African Weather Services, no date).

Figure 64: July 1991-2020,image adapted (South African Weather Services, no date).

Figure 65: October 1991-2020, image adapted (South African Weather Services, no date).

Figure 66 : Traffic Analysis along Braamfischerville main road (Abbess Drive) : 8am 16 August 2024 (Tomtom,2024).

Figure 67 : Traffic Analysis along Braamfischerville main road (Abbess Drive) : 10am 15 August 2024 (Tomtom,2024).

Figure 68 : Traffic Analysis along Braamfischerville main road (Abbess Drive) : 14 pm 15 August 2024 (Tomtom,2024).

Figure 69: Traffic Analysis along Braamfischerville main road (Abbess Drive) : 16pm 16 August 2024 (Tomtom,2024).

Figure 70 : Soil PH (Isda,2024).

Figure 71 : Silt Content (Isda,2024).

Figure 72: Fertility Capacity Classification (Isda,2024).

Figure 73 : Carbon Organic (Isda,2024).

Figure 74 : Silt Content (Isda,2024).

Figure 75 : Concept Diagram (Image by author).

Figure 76 : Division of Function Space (Image by Author).

Figure 77 : Movement of People (Image by Author).

Figure 78 : Connection spaces / gathering spaces (Image by Author).

Figure 79 : Moments of pause (Image by Author).

Figure 80 : Concept Informants (Image by Author).

Figure 81 : Market Space (Images by author).

Figure 82 : Public and Private Courtyard (Images by author).

Figure 83 : Pedestrian Spine (Images by author).

Figure 84 : Manufacturing Space (Images by author).

Figure 85: Training Space (Images by author).

Figure 86 : Exhibition Space (Images by author).

Figure 87 : Research Space (Images by author).

Figure 88 : Cross Ventilation (Image by author).

Figure 89: Passive solar heating (Image by author).

Figure 90 : Water Collection for irrigation (Image by author).

Figure 91 : Energy Generation (Image by author).

Figure 92 : Thermal Comfort (Image by author).

Figure 93 : Filtered Screens (Image by author).

Figure 94 : Design Programming (Image by author).

Figure 95 : Corrugated Iron Sheeting (Cite).

Figure 96 : Hemp (Material district, 2017).

Figure 97 : Brickwork (Corobrick,no date).

Figure 98 : Curtain walls (Mart,2024).

Figure 99 : Glass (Balastrades direct, no date)

Figure 100 : Concrete (Freepik, no date).

Figure 101 : Raised Platforms (Image by author).

Figure 102 : Exposed timber detailing image adapted (Aston , no date).

Figure 103 : Exposed timber column detail (Image by author).

Figure 104: Filtering Screen device (Image by author).

Figure 105 : Brickwork image adapted (Ylivdesign, no date).

Figure 106 : Francis Kere Cultural Centre (Baan, no date).

Figure 107 : Timber frame (Image by author).

Figure 108 : Timber framed resident (Mairs , no date).

Figure 109 : Shearing layers (Brand 1994).

LIST OF FIGURES :

Figure 110 : Remediator plant on top on Braamfischerville mine tailing, (Image by author).

Figure 111 : Hemp Manufacturing Process for Building Material Diagram (Image by author).

Figure 112 : Diagram of hemp plant absorbing heavy metals from soil (Image by author).

Figure 113 : Hemp harvesting and manufacturing process for building materials diagram, Image adapted (Lewis and Tsurumaki ,2022).

Figure 114 : Hemp Manufacturing Process for Building Material Diagram (Image by author).

Figure 115 : Various kinds of remediatory plants .

Figure 116 : Interior modular partition (Image by author).

Figure 117 : Circularity (Image by author).

Figure 118 : Circular economy , image adapted (UNIDO,2017).

Figure 119 :Recycling efforts in Braamfischerville (Image by author).

Figure 120 : Sharon Davis womens centre , image adapted (Architizer, 2015).

Figure 121 : Site Plan , i mage redrawn (Abdel, no date).

Figure 122 : Programme arrangement , image redrawn (Abdel, no date).

Figure 123 : Gardens on site ,image redrawn (Abdel, no date).

Figure 124 : Water collection and lighting section, image redrawn (Abdel, no date).

Figure 125: Market place section(Moreira, 2023).

Figure 126: Double roof system (Moreira, 2023).

Figure 127 : Passive design measures (Moreira, 2023).

Figure 128 : Exterior View of Mill , image adapted (Ras, 2018).

Figure 129 : Interior Production Area , imaged adapted (Ras, 2018).

Figure 130 : Section depicting double volume production area (Poise design, 2016).

Figure 131 : Perspective of farming on site, Image adapted (Felicella, no date).

Figure 132 : Programming, image adapted (Sharon Davis Design, nodate).

Figure 133: Perspective of Site Entrance (Architizer, 2015).

Figure 134 : Landscaping on Site ,image adapted (Architizer, 2015).

Figure 135: Rainwater, Compost and Biogas Diagram (Architizer, 2015).

Figure 136 : Rainwater Collection, image adapted (Archdaily, 2013).

Figure 137 : Rainwater collection proccess to storage (Architizer, 2015).

Figure 138 : Facade of the The Upcycle Center in Almere (Royal Institute of Dutch Architects

,nodate).

Figure 139 : Repurposed steel roof construction (Anteagroup,2020).

Figure 140 : Facade of Centre constructed using cleared trees from sustainably managed forests, (Modulo,2019).

Figure 141 : Rainwater stored and collected under recycling platform used for cleaning and flushing toilets, (Modulo,2019).

Figure 142 : Recycling platform (U shaped platform made from eco-granulate from old asphalt roads (Modulo,2019).

Figure 143 : Charette clay exploration (image by author).

Figure 144 : Charrette clay explorations (Images by author).

Figure 145 : Charrette string explorations (Images by author).

Figure 146 : 3D view of model (Image by author).

Figure 147 : Ground floor plan (Image by author).

Figure 148 : Sections through the model (Image by author).

Figure 149 : Sketch iterations (Image by author).

Figure 150 : Ground floor plan (Image by author).

Figure 151 : Research Component (Image by author).

Figure 152 : Manufacturing Component (Image by author).

Figure 153 : Market Space, progress perspective (Image by author).

Figure 154 : Communal Space, progress perspective (Image by author).

Figure 155 : Pedestrian Spine, progress perspective (Image by author).

Figure 156 : Market Space column exploration (Image by author).

Figure 157 : Sketch explorations (Images by author).

Figure 158 : Manufacturing Space sectional exploration (Image by author).

Figure 159 : Exploration of elevation materiality (Image by author).

Figure 160 : Exploration of working shed (Image by author).

Figure 161 : Overview Image of Building (image by author).

Figure 162 : Market Space Overview along abbess drive (Image by Author).

Figure 163 : Context Overview (Image by Author).

Figure 164 : Placemaking/Spatial Informants (Image by Author).

Figure 165 : Evolution of Form / Design Development (Image by Author).

Figure 166 : Site Functions (Image by Author).

LIST OF FIGURES :

Figure 167 : Water and Energy Harvesting Systems and Dust Mitigation Solutions for Healthier Indoor and Courtyard Climates ,(Image by author).

Figure 168 : Dust Mitigation , (Image by author).

Figure 169 : Site Plan 1:500 (Image by author).

Figure 170 : Building Diagrams (Image by author).

Figure 171 : Ground Floor Master Plan (Image by author).

Figure 172 : Ground Floor Plan_Research Wing (Image by author).

Figure 173 : Ground Floor Plan_Manufacturing Wing (Image by author).

Figure 174 : Manufacturing Mezzanine Level (Image by author).

Figure 175 : Water Collection for Irrigation and Portable water use_Diagram (Image by author).

Figure 176 : Waste Management Plan (Image by author).

Figure 177 : Movement and collection of waste (Image by author).

Figure 178 : Ampitheatre_ Day View (Image by author).

Figure 179: East Elevation (Image by author).

Figure 180 : Section AA (Image by author).

Figure 181 : West Elevation (Image by author).

Figure 182 : View from pedestrain deck_Pedestrian spine (Image by author).

Figure 183 : Section BB (Image by author).

Figure 184 : South Elevation (Image by author).

Figure 185 : Section CC (Image by author).

Figure 186 : North Elevation (Image by author).

Figure 187 : Manufacturing warehouse_Processing room (Image by author).

Figure 188 : Ampitheatre_Night view (Image by author).

Figure 189 : Research reception and lobby (Image by author).

Figure 190 : 3D Overview of building (Image by author).

Figure 191: Manufacturing warehouse technical detail (Image by author).

Figure 192: Rainwater catchment detail (Image by author).

Figure 193 : Market column detail (Image by author).

Figure 194 : Market Stall Exploration (Image by author).

Figure 195: Market Space Perspective (Image by author).

Figure 196: 3d view of building on site (Image by author).

Figure 197: 3d Model of building _01 (Image by author).

Figure 198: 3d Model of building _02 (Image by author).

Figure 199: 3d Model of building _03 (Image by author).

Figure 200: 3d Model of building _04 (Image by author).

Figure 201: 3d Model of building _05 (Image by author).

Figure 202: Oral examination 2024 (Image by author).

Figure 203: Exhibition 2024 (Image by author).

This project received support from the National Research Foundation grant
UID: 138235

20 August 2024

Katleho Shiburi

2089782

TO WHOM IT MAY CONCERN

RESEARCH ETHICS APPROVAL

Immersed in Community: Environmental remediation of a mining-impacted township through collective, participatory agricultural research and production.

This letter serves to confirm that the Ethics application for the above titled study has been approved. The researcher has been granted clearance to proceed with the research study or project.

Protocol/clearance number is: **S0AP035/03/2024**

Yours sincerely

Motsei Choabi

Senior Administrative Manager | School of Architecture and Planning

E: motsei.choabi@wits.ac.za

T: +27 11 717 7727

W: www.wits.ac.za/soap/