Recycling for Resilience

A proposed Recycling Buy Back, Upcycling and Community Centre for Social and Ecological Resilience through Green Infrastructure Design Principles.

(Author 2022)

Studios: Regenerative and Resilient Cities: Future-Proofing cities through complex adaptive systems and ecosystem thinking.
Green Infrastructure Principles (GRIP Studio)

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Site: *Open Green Space, Atteridegville, Pretoria, Gauteng, 0006*
GPS: *25°45'31.825"S 28°5'4.496"E*
Programme: *Community Recycling and Upcycling Buy Back Centre .*
Client: *Waste Pickers of Atteridgeville, Residents of Atteridgeville, Department:Forestry, Fisheries and the Environment: Republic of South Africa.*

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Keywords & Definitions:

Open Space Dumping: Indiscriminate dumping is regarded as the unlawful, deliberate disposal of waste and refuse on public and private land which has not been designated as a site on which waste may be deposited (Liu *et al*. 2017; UNEP 2018; Lu 2019).

Resilience (In the Built Environment) : Resilience is a strategy to enhance the ability of a building, facility, or community to both prevent damage and to recover from damage (Wbdg.org. 2022).

Urban Green Infrastructure (GI) : Urban GI planning is understood as a strategic planning approach that aims at developing networks of green and blue spaces in urban areas that are designed and managed to deliver a wide range of ecosystem services (Pauleit *et al*. 2017:5).

Ecosystem Services: outputs, conditions, or processes of natural systems that directly or indirectly benefit humans or enhance social welfare (Johnston & Robert 2018).

Ecological Design: Ecological design is an art by which we aim to restore and maintain the wholeness of the entire fabric of life and is neither efficiency nor productivity, but health, beginning with that of the soil and extending upward through plants, animals, and people (Orr 2002:29).

Acknowledgement:

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Finally I wish to thank my friends and above all else my family for supporting and loving me through the challenges and successes of studying Architecture.

DECLARATION

In accordance with Regulation 4(c) of the General Regulations (G.57) for dissertations and theses, I declare that this thesis, which I hereby submit for the degree of Master of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I further state that no part of my thesis has already been, or is currently being, submitted for any such degree, diploma, or other qualification.

I further declare that this thesis is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

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Page No.

Chapter 01: Atteridgeville and Resilience

Chapter 02: Design Research

ABSTRACT

This dissertation is an architectural exploration into informal waste picker upgrading, at the open green space between Atteridgeville Township and Lotus Gardens. The project is a community Buy Back Centre, designed following principles stipulated in the Waste Picker Integration Guidelines (DoEF & DoSI 2020) and the Neighbourhood Planning and Design Guide (DoHS 2019). This scheme provides a testable product that can be reviewed by the community to continue developing waste picker upgrading. This community Buy Back Centre is part of a proposed framework designed with the principles of green infrastructure which are connectivity, social inclusion, ecosystem services and green grey infrastructure integration (Pauleit 2017). This is to bolster the overall resilience of Atteridgeville and the waste pickers. The waste pickers are vulnerable, and work in harsh conditions salvaging recycling of value from surrounding neighborhood bins and open space dumps, returning to the open green space. They sort, store and dispose of invaluable materials (waste) by burning it on site. The waste pickers are illegal immigrants and refugees who live in communities in the open green space, to guard their waste from authorities, as well as there is nowhere else for them to reside. The presence and operation of the waste pickers is damaging the ecology of the open green space as well as is a threat to the Skinnerspruit river running through the site. This dissertation provides an architectural solution that bolsters resilience through firstly providing a safe platform for recycling to take place, separated from sensitive ecologies on site. It seeks to change more than work conditions, via creating a recycling identity and landmark to change perceptions of “waste picker” to “recycler”. Through the creation of a building, a landmark is established and this project aims to be a community hub providing an educational platform to learn about waste. The building manifests the principles of resource circularity through utilizing passive and ecological design strategies to increase human wellbeing through connection with nature, natural light and ventilation. The buildings follow circular resource principles, as they are composed around concrete frame structures, with reclaimed materials such as bricks, rammed earth and local handmade concrete block as infill wall materials.

Chapter 01: Atteridgeville and Resilience

1 Introduction:

Open space dumping is a challenge most of the global south is facing. This phenomenon is more common in developing countries due to the fact that there is rapid urbanization and densification taking place (Niyobuhungiro & Schenck 2022). The increase in population along with insufficient municipal infrastructure leads to the practice of open space dumping. The practice of open space dumping is common and not stigmatized which is a product of the lack of education towards waste management and the impact waste has on our environment.

Open space dumping leads to ecological damage, which impairs our ecosystem services. This is due to vegetation dying back as a result of top soil and groundwater contamination, air pollution from waste burnings and natural habitats being disturbed with littering (Tsheleza *et al*. 2019). This decreases the resilience of an area with the decline of vegetation which increases

the threat of climate change and its associated intense weather impacts (Lindley *et al*. 2006). Due to our current receding ecological systems, there is less ecology to withstand the intense heat waves, droughts and flooding predicted with climate change. Our environments need to be rehabilitated and designed to withstand these future situations.

This is the case in Atteridgeville, Pretoria. Ecological damage is taking place due to open space dumping throughout the town from residents and particularly in the Open Green Space located between Atteridgeville and Lotus Gardens by the waste pickers,as seen in fig 1.0 below. Waste pickers use the vacant land to stockpile their waste to sell to Buy Back Centers and third party entities. Waste picker communities in South Africa are responsible for the 57% overall recycling rate in the country and contribute to 80% - 90% of paper and plastic recycling respectively (WISA 2022). This recycling saves the government approximately R750 million a year, in landfill waste divergence costs and associated waste management labour and infrastructure costs (WIEGO 2022). All while the waste picker service is provided for free without government support or compensation.

Although the waste pickers are contributing to the recycling industry as well as providing much needed waste management support informally in Atteridgeville, they have unsustainable living habits, which undermine their recycling efforts' support of resilience. The waste pickers gather their waste in the central open green space as well as live there. They are illegal undocumented immigrants who need to protect their waste from thieves as well as they can't afford to stay elsewhere and pay to store their materials safely. The waste pickers living in the open green space have no access to basic infrastructure and pollute their environment through their basic living needs. They use the storm water drains flowing through the site towards the Skinnerspruit as their ablution facilities and communal cleaning space. The waste pickers get potable water from a broken municipal pipe in Monroe park, 300m south of the open green space.

There is a leverage opportunity within the waste pickers business model as it is an under-appreciated value chain within recycling and waste management. This research project aims to develop a framework recognizing the waste pickers needs as well as benefiting the community economically and ecologically. This has led to a scheme designed with green infrastructure principles aimed to rehabilitate the landscape as well as connect the community to local recycling practices.These centered on connecting the community with the waste management through desirable cross programmed public functions, such as food gardens, media centers, and neighboring sports facilities. This interaction between waste and the public is to educate the community around the issues of waste and integrating the waste pickers into the waste management sector as community supported recyclers.

The aim of the study is to provide a platform of dignity that integrates waste pickers into our waste management schemes to reduce open space dumping and rehabilitate the landscape through an Ecologically Integrated Material Reclaim Facility (MRF).

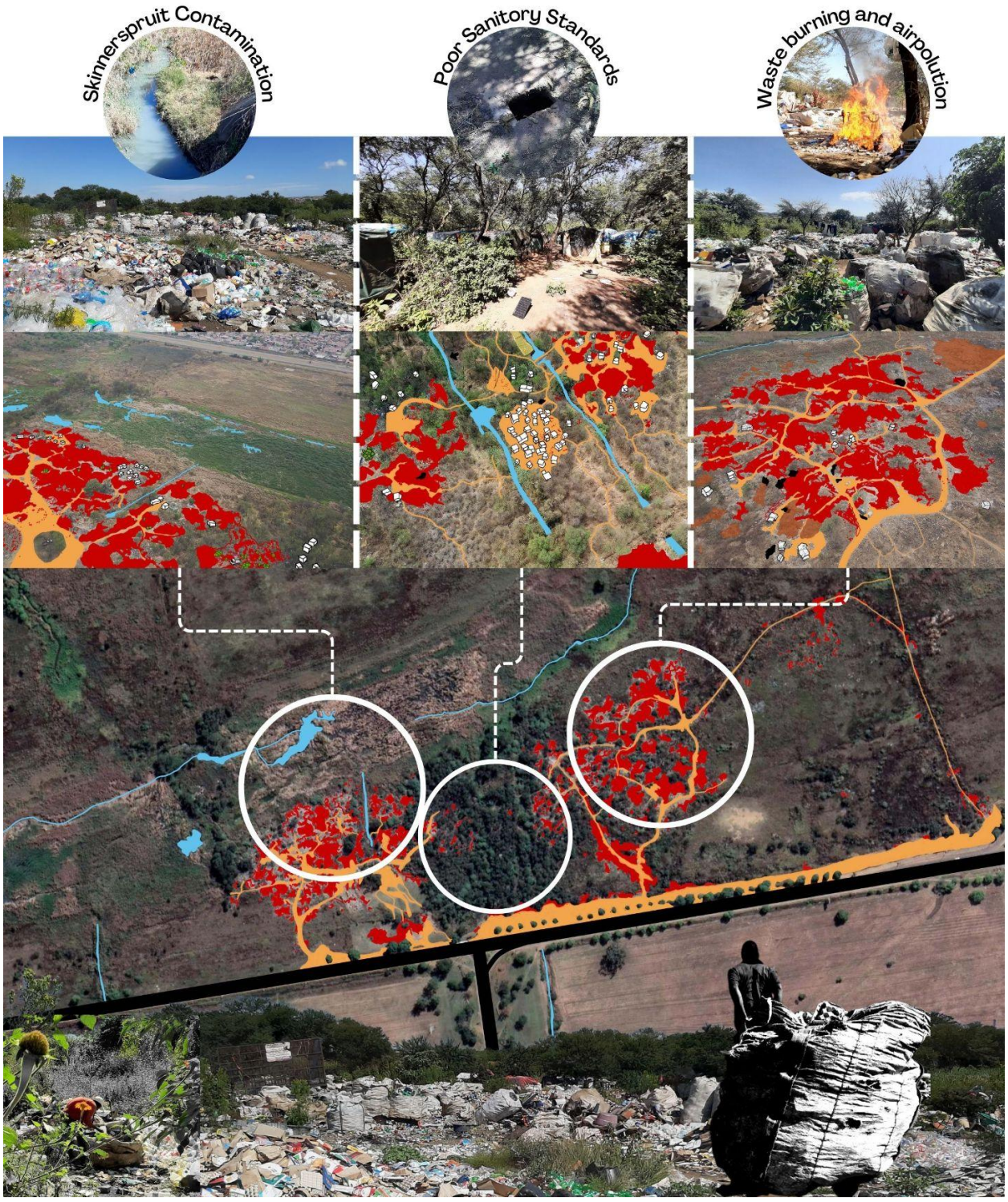

Figure 1.0 - The open green space where the waste pickers are occupying in Atteridgeville. The red indicates waste piles and the beige indicates erosion and soil damage from vehicular access and trolly activity. This image shows their living conditions along with the associated environmental impacts the waste picker community has on the open green space and blueway (author 2023)

1.1 Atteridgeville:

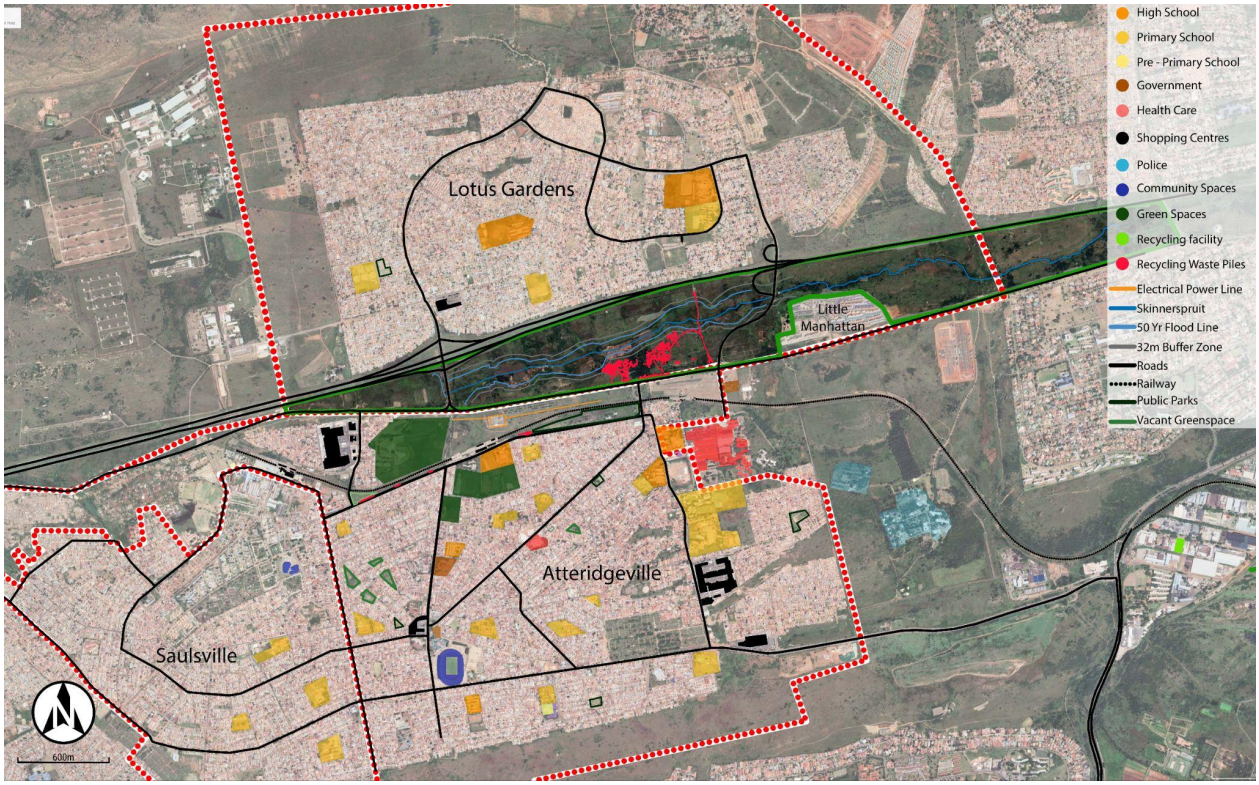

Figure 1.1 - A site plan of Atteridgeville highlighting important public infrastructure in the town relative, to the central green space (GRIP Study Site - highlighted in green) and the waste piles (Pink)(Author 2023)

Atteridgeville was established in 1939, intended to be called Motsemogolo (large township) for Africans however it was named after Mrs. M.P. Atteridge who was a Black Sash activist as well as the chairperson on the City's council committee for Non European Affairs at the time (SAHistory.org 2022). Saulsville was planned as a residential area for whites to the west of Atteridgeville, however it was bought by the city council as an extension of Atteridgeville (SAHistory.org 2022). Under the Group Areas Act of 1950 locations were established for the four defined racial groups in South Africa. These were situated on the outskirts of cities with "buffer zones" in the form of Industry and/or green belts between white and black residential areas (Davies 1981). There is a green belt separating Atteridgeville from Lotus Gardens to the North, which is currently left as open green space with the Skinnerspruit running through it.

There are ecological benefits to the community with the green space providing ecosystem services, however this area is under threat. This ecologically sensitive space is where the waste pickers have established their base of operations. Since their presence starting in 2013 (Fig 1.2) their disturbance of the ecology has been growing, see Figure 1.3, with waste piles and increased anthropogenic pollution. This is due to the growing numbers of waste pickers increasing every year utilizing the open green space. Following investigations around the waste pickers operations it was found that they are living in the open green space where they are

gathering their waste. This is to ensure the waste they have gathered is guarded from thieves or the authorities. Living in small communities of 3 or 4 households within the larger open green space dumping community. In total there are approximately 120 residents living as micro communities of fellow Zimbabweans, Malawians, Mozambicans and South Africans on site. Their informal shelter is situated roughly 100 meters from Church Street, protected by the trees allowing less conspicuous living conditions from the Atteridgeville authorities.

Figure 1.2 - Open Green Space October 2013 (Google 2022)

Figure 1.3 - Open Green Space February 2021 (Google 2022)

The waste pickers collect waste, stockpile waste and live amongst the waste. These living habits have a negative impact on the environment as seen in figure 1.0. The waste pickers damage the environment through mass waste piles, burning undesirable waste, human solid waste contamination of the Skinnerspruit from ablutions and cleaning of clothes, littering and vegetation removal for fuel. These practices are damaging the sensitive Skinnerspruit Blue Way and the greater Arpies River system in Pretoria by damaging the biodiversity and ecology of the river system and banks. This Green Space and Blue Way are essential to maintaining the ecosystem services in the area which ensure resilience against future climate change conditions in Atteridgeville.

This places ecology as a precursor for how well a community can adapt to environmental and social issues in the future. This proposal seeks to understand how waste management being dealt with at a community level can increase the resilience of Atteridgeville socially and ecologically. A contributing solution to mitigating open space dumping is through educating the community as to the negative impacts of dumping and changing attitudes towards waste pickers and their contribution to waste management services of Atteridgeville. The waste pickers are predominantly illegal immigrants that recycle as their only source of income. Due to their illegal status they are exploited and given unfair prices on their waste, making it harder for them to climb out of the poverty line. There is value in waste and creating a fair platform that can provide reliable prices ensures improved earning potential for waste pickers. Through appropriate infrastructure upgrades on site, greater recycling volumes and quality of recyclables can be received and managed while not harming the environment.

2 Statement of Problems:

2.1 General Issue: Resilience and Climate change

A general issue identified in Atteridgeville is the threat to the resilience of the settlement through the impacts of the inhabitants' poor waste management practices. There is evidence of mixed material open space dumping from the community throughout the settlement causing social and ecological issues (Desa *et al*. 2012).

Atteridgeville contributes to the larger Green and Blue ways of Pretoria with the Apies River system as well as the open space green belt separating Atteridgeville and Lotus Gardens. Raising awareness surrounding the implications of open space dumping and its associated negative impacts to ecosystem services is required to inspire participation from the community to consider alternative methods of waste management.

Question: How can architecture contribute to the resilience of Atteridgeville? Through providing a platform for waste pickers and the public edification around waste management.

Figure 1.4 - A diagram to show the general issue facing Atteridgeville and the threat to resilience can be mitigated through rehabilitation of the green space.

2.2 The Urban Issue: Limited integration of waste management and waste pickers

The suburb of Atteridgeville is densifying over time while the municipal service delivery capacity is decreasing. Open Space Dumping is associated with an increase of the local population and density which is evident in Atteridgeville with the increase of backyard rentals and informal settlements expanding in the area. The current municipal waste management services are not being met to serve the area as a single entity (Godfrey *et al*. 2019). An answer to this issue is the presence of the Waste Pickers operating in Atteridgeville and its surrounds. The waste

pickers source valuable materials for recycling from local business', resident's bins, and pick from the open space dumps throughout town, see fig.1.4

Figure: 1.5 - Highly frequented Waste Picker Route through Atteridgeville (Author 2022)

The waste pickers are assets to the recycling industry however general attitudes towards them are misunderstood. They are perceived as a problem rather than a solution as they are unrecognized entities within the waste management process. As noted in various literature sources, waste pickers require the acceptance and engagement of the community to improve their operations.

A massive contribution to waste management efforts, particularly in the case of the waste pickers, is with source separation. Source separation is an essential aspect for waste management to improve overall bulk as well as the quality (contamination from food scraps) of the recycling items received (Desa *et al*. 2012).

Question: How can architecture educate and integrate the public about waste management elevating the waste pickers status?

Figure 1.6 - The urban issue facing Atteridgeville and the waste pickers is their lack of education towards waste management, recycling and their impact on the open green space and ecology.

2.3 The Architectural Issue: Rehabilitate the Landscape, Empower the Community

The waste pickers are positively affecting the recycling industry. However they are disengendered members of society and live illegally in the open green space between Lotus Gardens and Atteridgeville. They lack basic infrastructure, and use the landscape naturally for their ablution and waste management habits, such as using the Skinnerspruit storm water channel to remove solid human waste. This negatively affects the sensitive Blue Way of the Skinnerspruit which further contributes to the resilience threat of Atteridgeville. The waste pickers concentrate waste in massive piles left uncovered in the open green space. The waste pickers have built informal homes on site to guard their waste piles until quantities are worthy of selling to third party members. These open air waste piles contribute to environmental degradation through littering, air pollution with waste burning, and contaminating groundwater with micro plastics infiltrating the ground, top soil quality is being degraded through littering as well as erosion taking place with large volumes of trolleys being moved across the site.

Question: How can architecture rehabilitate the landscape and inspire waste management consciousness?

2.4 Research Question:

- How can architecture designed with Green Infrastructure principles rehabilitate and improve the resilience of Atteridgeville Open Green Spaces?

2.5 Sub-Questions:

- How can resilience be bolstered with the integration of waste management architecture?
- How can the value chain of waste management be showcased to inspire social changes?
- How can architecture respond to social and ecological resilience needs?

Figure 1.7 - The architectural issue is how can architecture lead to the rehabilitation of the landscape along with promoting the waste pickers and their operations.

3 Theoretical Framework:

Grassroot action (Facilities in lieu of payment), community upliftment, recycling, dignity, recycling value chain, stakeholder involvement, incremental design.

3.1 Green Infrastructure: Rehabilitation

The theoretical approach will be following the principles that Green Infrastructure (GI) lays out. In her paper “Urban Landscapes and Green Infrastructure”, Pauleit (2017) explains how GI contributes to conservation as well as enhancing environmental quality and adapting cities to climate change. GI stipulates four primary design objectives for the success of a project, to unlock the potential of our site. GI promotes social inclusion, connectivity, green-gray integration and multifunctionality of our structures within urban planning (Pauleit *et al*. 2017:3). These core values are supported by more theoretical governing principles focused on interdisciplinary action and integration at governance and stakeholders levels of government. As a designer I will be focusing on promoting green-gray integration with contact with nature facilitating social interaction as the vehicle to improve resilience of Atteridgeville.

Promoting Social Inclusion, which is understood as the extent to which a community shares values and interacts with itself (Beckley,1994), is essential where the public is divided over an issue such as the waste pickers. Public parks have the capacity to facilitate intercultural exchange which is an important tool to integrate immigrants and locals (Peters *et al*. 2010:13). The type and location of green spaces are important to consider when designing for social inclusion, where there is a diversity of facilities, such as shared facilities, and activities to ensure longer visits of higher quality (Kemperman & Timmermans 2014). Urban gardening has the potential to bring people together for a common purpose and to interact across cultural and ethnic backgrounds as well as providing food (Colding & Barthel 2013).

Green Spaces can reduce the risks of damage from natural hazards such as flooding with functional flood plains or securing food sources from urban agriculture in times of crisis. These are “insurance values” which are important particularly in the global south as they are characterized by a high degree of poverty, informality and weak institutional capacities (Herslund *et al*. 2016). Green-Grey integration requires careful planning with other urban infrastructures in terms of physical and functional relations. This has the potential to enhance conventionally monofunctional infrastructures to increase the likelihood of usability, aesthetics and habitat values of green spaces (Hoyer *et al*. 2013; Loperfido *et al*. 2014). Multifunctionality speaks to the ability that urban GI can provide ecological, sociocultural as well as economic benefits simultaneously (Kambites & Owen 2006). This concept extends beyond providing multiple ecosystem services such as biodiversity conservation, climate change adaptation and social inclusion, in an optimal order rather than having multiple functions taking place at different times with one infrastructure addition.

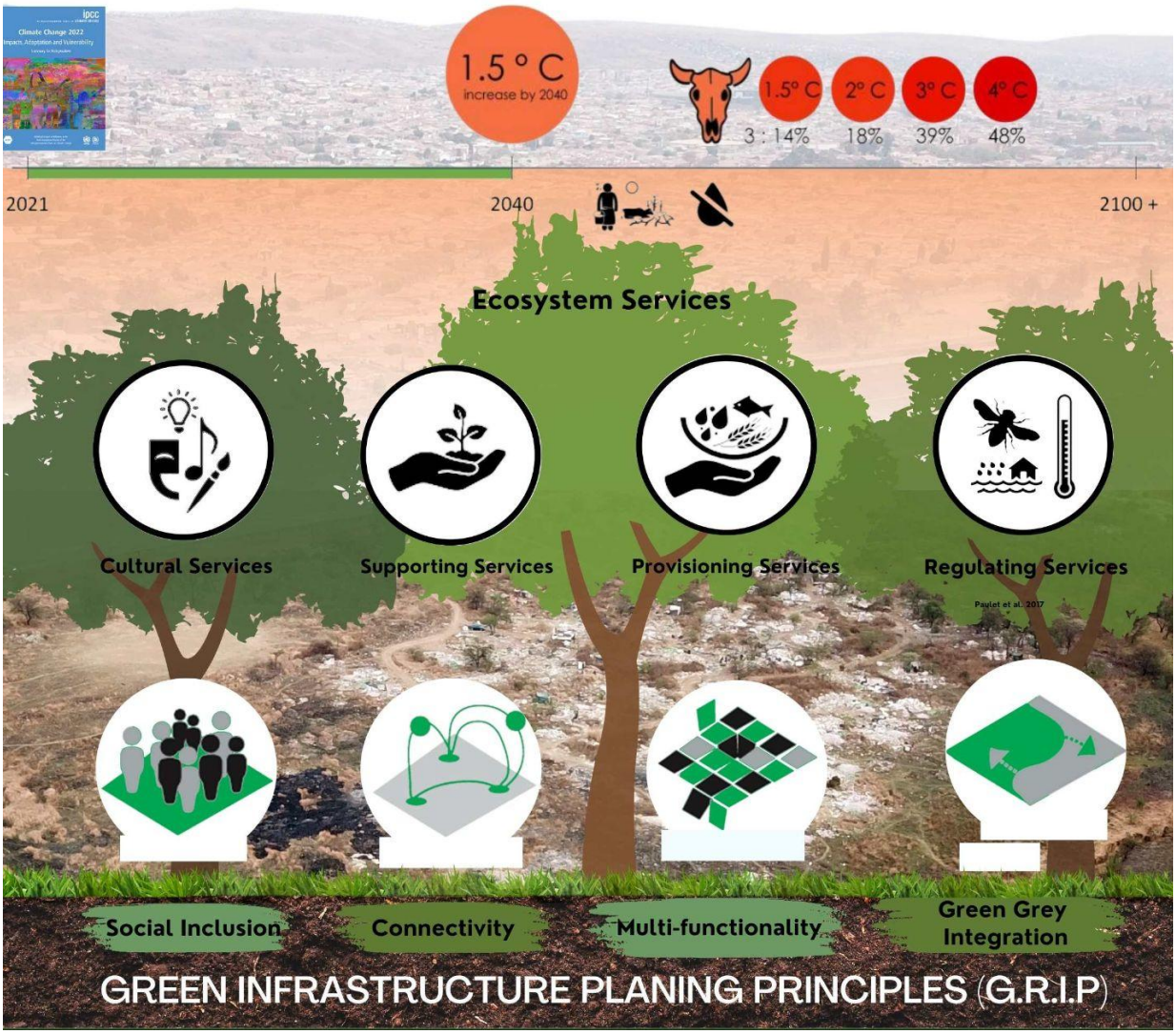

Figure 1.8 - The principle of Green infrastructure benefits and strengthens our relationship to Ecosystem Services which increases our resilience against the threats of Climate Change as presented by the IPCC climate change report from 2021 (Author 2023).

Green infrastructure principles are an urban design approach and for effective results the larger systems of Atteridgeville need to be considered. There have been postulations towards an ecologically and socio-economic sensitive framework suggested by the G.R.I.P studio in 2021 and 2022. In figures 1.5 and 1.6 the open green space has been protected from the Skinnerspruit and peripheral programmes have been proposed to activate the edge conditions.

Figure 1.9 - 2021 Framework (Honours 2021)

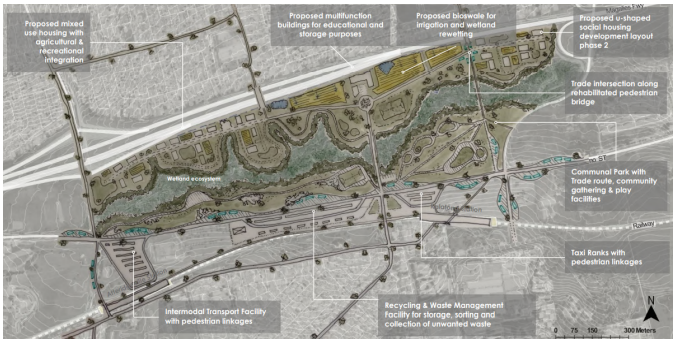

Figure 1.10 - 2022 Framework (Honours 2022)

Within these frameworks waste management zones have been indicated and this research project will evaluate the site selection process and the proceeding functions surrounding the facility to support green infrastructure planning principles of multifunctionality, green-grey integration, social inclusion and connectivity.

3.2 Waste Opportunities: Economic Value in the “undesirable”

There is a large component of waste which has no value in traditional recycling. However, in of itself, has value. Cultivating an economic benefit to organic waste and alternative plastics to be burnt in a “waste to energy plant” provides value to these currently disregarded waste streams. This is a massive economic leverage opportunity for waste management to harness. The addition of a “waste to energy” rail way station stop is being proposed to allow waste that is currently being burnt with no economic or ecological benefits to be sent to Johannesburg or Cape Town to be incinerated to make electricity. In addition single use plastics can be used in the production of eco-bricks (2 litre plastic bottles stuffed with single use plastic). This can be used in construction as void fillers in concrete slabs for instance- (*Commercial: The Ridge 2023)*.

4 Research Methodology:

Following a research by design methodology with this project, the outcome is to design a testable architectural intervention that contributes insights into desirable waste management solutions that are community orientated. The method of research by design follows a critical

inquiry into current projects, proposals, possible realities and alternatives to produce an outcome that is accessible and discussible to peers and others (Hauberg 2011:47).

My research began with a rigorous desktop analysis being undertaken of Atteridgeville to acquaint myself with the site, using Google maps and Google earth along with research into Atteridgeville's history to better understand spatial composition we see today. The expansion of Atteridgeville was understood through reflecting on historical photos from 1939 to today. Showing the land use changes and the gradual increase in densification over time. Evidence for open space dumping, which is my focus, began in the green belt between Lotus Gardens and Atteridgeville in 2013 (fig 1.9) and steadily grew to the site conditions seen today (Fig 1.10).

In conjunction with the desktop analysis physical on the ground investigations were conducted. These included site walks, photo documentation, videos and sketches being taken on site. The explorations in Atteridgeville took place on the following dates:

1. 28/02/2022 - Investigate Atteridgeville,
2. 14/03/2022 - GRIP Studio Exploration & Council Meeting,
3. 23/05/2022 - Open Green Space Dumping Exploration + Lotus Gardens,
4. 25/05/2022 - Waste Picker/ Open Green Space Site Walk,
5. 30/05/2022 - Waste Picker/ Open Green Space Site Walk ,
6. 01/06/2022 - Atteridgeville and Pretoria West's Recycling Network.
7. 02/09/2022 - GRIP Outreach Recycling Flyer Handout

These investigations started broadly looking at the social and infrastructural issues of the town, and with each subsequent visit a deeper exploration into waste pickers were followed. This began with informal interviews with community members where I asked questions about their waste and feelings towards waste pickers. These community members as well as council members on the 14th of March '22 confirmed that the municipality is failing to collect the residents' waste regularly enough, with glass not being collected at all. Certain residents separate their waste for the waste pickers, however many mix their recyclables with organics and non recyclables. The waste pickers retrieve and collect recycling from communities separated waste and contaminated bins, as well as having arrangements with certain businesses, such as taverns, to collect their separated waste.

There is a lack of education and a general distrust towards waste pickers and their benefits are largely unrecognized. They are foreign and illegal residents to South Africa, and are subject to xenophobic prejudices. Due to their illegality, the waste pickers reside in the same open green space that they mass their waste on. These waste piles as well as the waste pickers living on site, in small communities of approx. 120 people are damaging the environment. The waste contaminates the natural water systems, soil, groundwater and contributes to air pollution with waste burning. The illegal squatters cause anthropogenic damage as the waste pickers have no municipal connections and therefore use the stormwater channels leading to the skinnerspruit to ablute and wash themselves, clothes and items.

An in-depth understanding of the social and environmental issues experienced in Atteridgeville and the open green space were gleaned from the desktop and site investigations. This helped inform the direction of our literature intentions. These included research into rehabilitating ecological damage through design and addressing social issues with the misunderstood relationship between waste pickers and the community. These social and economic issues are addressed in Green Infrastructure principles, where social change, education, economic growth take place where people meet with needs being met within natural ecological settings. A better understanding of Green Infrastructure principles need to be explored to address systems where waste pickers and the community can engage and share spaces for integration, education and relaxation. Exploring successful green infrastructure geared projects which rehabilitate the landscape along with providing new areas for residents will ensure the success of this project.

A reflection on current projects and recycling business models and structures will be reviewed to understand the current literature and designs utilized with waste management upgrades. These developing countries share similarities where waste pickers are prevalent in all these countries to varying degrees. The economic, political and social issues faced in these countries also will share valuable lessons learned when incorporating and upgrading waste pickers operations and what this may look like.

5 Postulation of Programme:

The programme seeks to link the community to waste management systems to understand the importance of waste and the negative impact it can have. This scheme will follow the principles defined in green infrastructure of green-gray integration, multifunctional, social inclusion and connectivity that require a framework to achieve its goals. This framework will require a phased approach with the common end product as seen in figure 1.11.

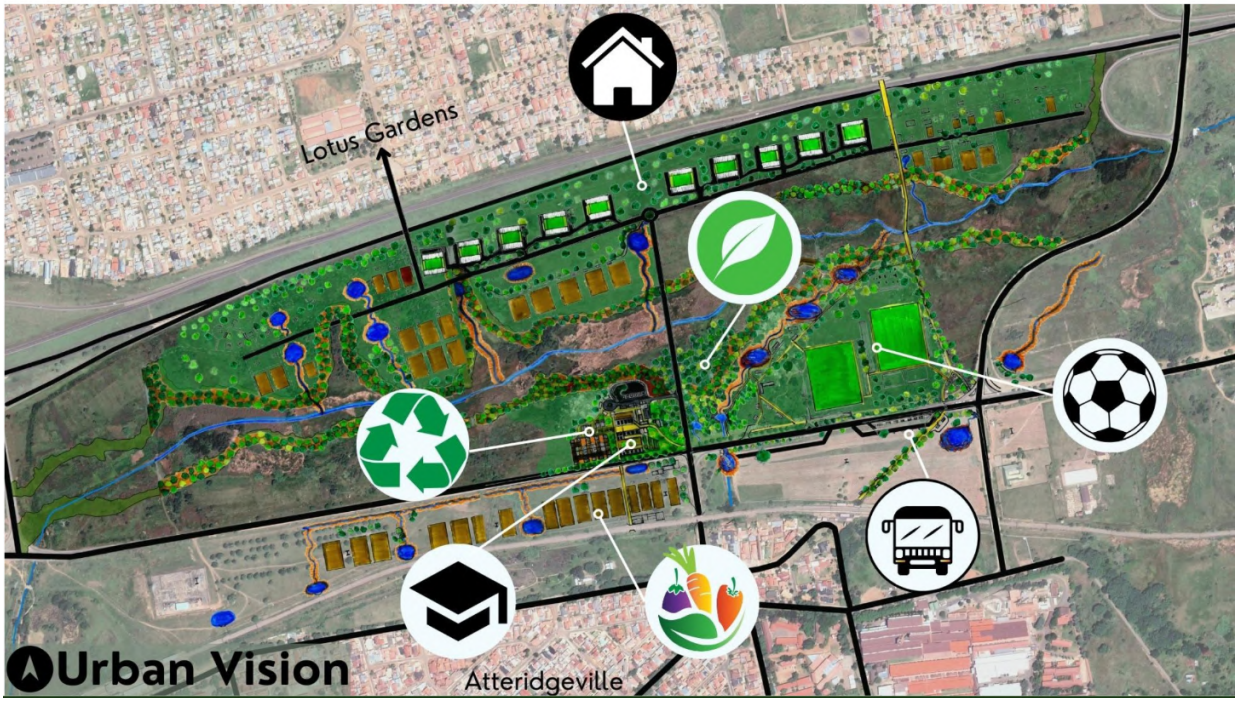

Figure 1.11 - Proposed Revised Framework for Atteridgeville following Green Infrastructure Planning Principles (Author 2022)

Concentrating on the waste pickers and waste management I will be focussing on establishing facilities that accommodate their needs and separating themselves and their waste from the environment. This separation is to protect the environment from future damage from waste as well as allow an opportunity for architecture to work as a frame for nature to grow over and through to rehabilitate itself. This waste facility will accommodate the waste pickers both with their waste and living abode which will be community orientated. Primarily the facility will have its own educational spaces to teach school children, tours and cross disciplinary professionals about the procedures at this facility and the benefits of recycling and the environment as a whole. These spaces will act as hot desks and meeting spaces when not hosting educational tours. Other communal spaces found on site will be the urban food gardens, media centre, hot desk work spaces, meeting rooms, restaurant, retail stores, upcycled store, recycling Buy Back centre, or to enjoy the cafe' in the natural environment linked to the upcycling museum's plaza.

The architecture is focusing on educational and socially functional spaces for the public with the waste management activities being physically segregated from them with visual permeance into its world through visiting the upcycling workshop or retail space. Further subtle connections will be established through cross programme visual connections, educational walkways through the waste operations as well as public participation in recycling with circular systems being displayed. These systems include solar schemes, biogas digesters being used for cooking, water harvesting and appropriate vegetation planting and screening with benefits to the environment such as food or microclimate establishment. The aim is to maximize the displays of resource circularity possibilities which in turns benefits our site and hopefully inspires others to try this themselves.

The waste pickers require basic infrastructure for water and sanitation to healthily continue their work. They require safe storage for their waste piles, sorted waste, condensed waste as well as for their trolleys. Accommodation on site will be offered as compensation for labor rendered as well as waste contributions. In a newsletter from the South African Waste Pickers Association (SAWPA) it is suggested that programmes can be set up around compensating waste pickers for their labour through access to basic facilities such as change rooms, ablution facilities and accommodation (SAWPA 2022). I believe this is a great asset to the scheme as waste pickers require adequate rest in a safe environment, with access to sanitation, water and appropriate nutrition to do their labor intensive work of collecting recycling.

These facilities require vehicular access for both cars and trucks to collect waste from the waste pickers. In future phases a weighbridge may be necessary for large volumes of recycling being sold and collected at the site. The underutilized aspect of the Waste value chain is the burning of undesirable waste on site. This waste has the potential to be used in Waste to energy facilities which have added benefits of generating electricity as well as removing harmful carbon emissions through the use of scrubbers. This facility would gather undesirable waste and

prepare it for collection at a proposed train stop in Atteridgeville. This train station would collect waste and freight it to Johannesburg or Cape Town's “waste to energy” facility. This would create an economic incentive to remove our waste in healthier useful channels.

6 Essay 01 Conclusion:

The conditions of Atteridgeville Open Space dumping following site investigations identify the strengths and weaknesses of the recyclers. The waste value chain of reclaiming materials has the potential to be a solution to improve the economic status of these marginalized waste pickers. However serious social issues revolve around these people as they are illegal foreign nationals partaking largely within an underground economy of waste management. This has allowed others to take advantage of the waste pickers efforts via paying low prices for large quantities of valuable recyclable materials. Through establishing a dignified solution to their issues and upgrading their recycling efforts it invites opportunities for the community to interact closer with waste.

The community needs to be involved with the upliftment of the waste pickers as they, the community, are the source of waste initially. Through education as to the value of waste management and ecosystem services social acceptance and upliftment will begin for the waste pickers. This rehabilitation of social relations will concurrently take place with the rehabilitation of the landscape of which waste has been damaged. Creating a facility that displays the power of integration of ecology and circular resource economy will be key to upgrading the resilience of Atteridgeville from social and environmental issues in the future.

Chapter 02: Design Research

7 Design Research

7.1: Ecological Design:

In Daniel Williams book Sustainable Design, Ecology, Architecture, and Planning David W. Orr forewords important lessons for sustainable design and place making. He refers to place making as the “careful attention to the effects of building on the ecological health of a site and the site occupants’ health” (Williams 2007:iv) and how buildings and landscapes would be ideally blended. Altering place making strategies to embody sustainable mindsets requires designers to change how we provide ourselves with shelter, energy, materials, food, and water. This will revolutionize economies and foreign policies alike with the catalyst beginning with a shift from “energy inefficiency towards hyper efficiency now technically possible and economically feasible (Williams 2007:ix).

The guideline Orr emphasizes is that place making should not impair some other place with negative environmental impact in the long term which would be an act of intergenerational

tyranny (Williams 2007:x). This “shift in energy” David Orr is referring to, in his foreword, is for renewable energy or natural sources to be the foundation we build upon for sustainable design. Shifting from air and water polluting fossil fuels to harnessing natural energies on site such as solar, wind, hydrological, tidal and gravitational energies (Williams 2007:xxii). These naturally occurring energies are referred to as resident energies, which are site specific, in context, as they change from region and location. Studying the site’s specific climatic conditions and capturing its natural energy and resources therein, is critical to developing a sustainable design process (Williams 2007:xxiii).

7.1.1: Sustainable Design

This process of sustainable design follows the principles that naturally power our ecology. This would be to create sustainable designs that use and reuse only the energy and resources that reside on site within the bioregion (Williams 2007:xxiii). This is to ultimately move our designs to be unplugged from the non renewable grid and to rather be self sufficient operating with the natural energies found on site. To achieve this, designs must capture, store and distribute these sustainable energies and resources throughout the scheme (Williams 2007:xxii). Daniel Williams uses the term ecological model and ecological design to describe the approach to architecture and planning that is based on the understanding of environmental,biological, and natural processes (Williams 2007:xiiv).

Sustainable design extends past the fact of designing integrated green and grey infrastructure but also the choice of materials used. There is a growing concern for the ecological impact that buildings have contributing towards 40% of all greenhouse gas emissions and substantial ecological damage through the extraction of materials (Williams 2007:ix). Sustainable design principles can be derived from how organisms collect, store, and manage resources, clean and distribute waste products. This has massive implications particularly in the case of Atteridgeville’s Open Space dumping where waste can be processed to benefit the community.

7.1.2 Ecological and Sustainable design strategies

Ecological and sustainable principles advocated by David Orr and Willams, are effective resilience design strategies (Williams 2007). To begin rehabilitating the open green space requires the blend between landscape and the buildings being the governing principles of design. This requires changing the way we approach designing our shelters, gathering energy, materials, food and water to align closer with how ecology operates. In addition, the operation of resource circularity which is when residential energies are harnessed with resources being used and reused to the benefit of the system is critical to sustainable design.

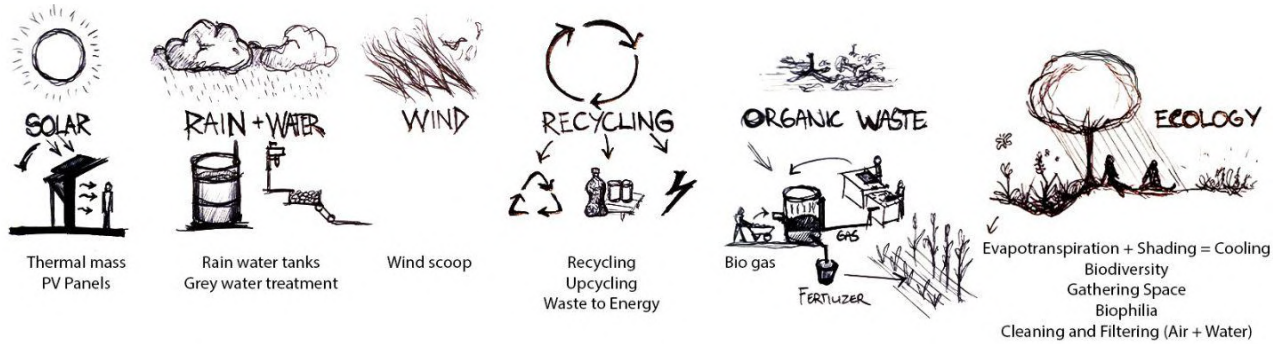

Figure 2.0 - An understanding of residential energies, as described in Daniel Williams book Sustainable Design, Ecology, Architecture, and Planning, and their potential benefits found in the open green space. These occur naturally as well as a by-product of the waste pickers operations. These energies from left to right are; Solar, Rain & Water, Wind, Recycling, Organic Waste, and Ecology.

7.2 Understanding Solid Waste Management: Waste Picker Upgrading

In Phakoe's article "Reclaimers Organizing the Future ", he speaks about the Brazilian national solid waste policy being implemented to eliminate waste picker repression (Dias 2011). This policy included healthy working conditions, housing and health care benefits for waste pickers. With the benefits of waste pickers in South Africa saving the government approximately 750 million rand (SAPRO 2019) through landfill divergence costs and labor costs and contributing to 90% plastic recycling in South Africa's overall 57% recycling rate. Further justification for Government subsidization of waste picker operations and upgrades is that according to the National Environmental Management Act 107 of 1998, that every South African Citizen has the right to an environment that is not harmful to their wellbeing (Government Gazette, 1998). The Waste pickers contribute greatly to this act and therefore integrating them as service providers and recognizing them as important members of our society is a necessity.

In The Neighborhood Planning and Design Guide for Solid Waste Management: Section M, developed by the department of Human Settlements of the Republic of South Africa, highlights the important role waste management plays in the interconnected components of neighborhoods as building blocks of settlements (Department of Human Settlements 2019:m2). It stresses the need for integrated waste systems, such as inclusion for waste pickers, as settlements develop with urbanization, population growth, economic growth and life style changes more waste is generated. The additional waste places further strain on the municipality's service delivery and landfill sites. When waste is left unchecked it can pollute soil, air, and water resources as well as health implications. "Sound Solid waste management practices and the the appropriate and efficient storage, collection, transport, treatment and disposal of waste can potentially prevent or mitigate these impacts."(Department of Human Settlements 2019:m2)

7.2.1 Legislation and Waste Picker Upgrading

In the instance of Atteridgeville where population and density is increasing with growing informal settlements, waste management issues are a growing concern. According to Women in Informal Employment: Globalizing and Organizing (WIEGO), Waste Picker upgrade programmes, organization is the foundation to build awareness in the community (Wiego.org 2022). Organization leads to professionalism which improves reputability and improves the opportunity for valid recognition in legislation(Giz 2015:32). Currently waste pickers are not occupationally recognized by the law and therefore have no job security and workers rights (WIEGO 2013). When addressing informal Open Space Dumping upgrading, illegal dumps are considered as viable established spaces where formal waste management facilities can be located (Department of Human Settlements 2019). In the case of Atteridgeville, upgrading the open green space dumping site and establishing an organized system where waste is processed for the community and accepted will improve their contributions in national policy.

The objective of the National Environmental Management: Waste Act, 2008 (NEM:WA) is to improve waste management in South Africa. The NEM:WA introduces the waste management hierarchy (discussed in Section M.2.3) as the basis for waste management decision-making. According to the act, each municipality must develop an Integrated Waste Management Plan (IWMP) that should be included in the municipal Integrated Development Plan (IDP). Among others, the act also describes the licensing requirements of certain waste management activities, provides guiding principles for waste management charges and makes provision for the classification and assessment of waste for disposal. (Department of Human Settlements 2019:m4)

The National Domestic Waste Collection Standards (2011) This document sets national standards for equitable, affordable and practical waste collection services and includes standards for separation at source; the collection of recyclable waste; receptacles; bulk containers; communal collection points; frequency of collection; drop-off centres for recyclables; collection vehicles; health and safety; communication; awareness creation and complaints; and waste collection customer service standards for kerbside collection. These standards are uniformly applicable to all municipalities (Department of Human Settlements 2019:m5).

There is adequate precedent to the positive impact of the recyclers and the governments slow legislative approach to helping with the waste pickers upgrading. Independent reports have been compiled highlighting the benefits of the waste pickers arguing the fact that government funding should be available for projects such as upgrading informal recycling operations seen in Atteridgeville(WIEGO 2013; Giz 2015; SAPRO 2019). This dissertation aims to address the concerns raised towards waste picker compensation, health and safety standards in the workplace. Creating a plan in which the government and community can critique to help address growing service delivery issues and waste pickers.

7.3 Recycling Support and Benefits:

7.3.1 Bophelo Recycling

Looking at the case study of Bophelo Recycling - PETCO, in Ermelo, Mumpumalanaga. This community start up was established by Johanna Leshabane in 2007. The project focuses on collecting recycling materials such as plastics, cardboard, paper, cans and glass from the the informal settlement, households and schools in the community (PETCO, 2022). PETCO and Safripol joined a partnership with Bophelo recycling in 2019 and donated R500 000 worth of infrastructure to support Johanna's business. This sponsorship included a secure double carport roof shelter at the facility, a branded shipping container to store reclaimed recycling materials, a 4-meter trailer to transport baled recycling to buy-back centres/recycle facilities and a branded baling machine to bale waste and save on transport costs. With this the sponsorship also installed a 3-phase electrical meter, electricity cables, extended the fence, business signage and 5 branded trollies used when collecting waste. Since their investment into Bophelo recycling the recycling facilities there has been an increase in recycling volumes collected with double the output volume of recycling. This has led to an increase in the number of new jobs available at the facility which now employs 11 permanent employees and 20 part-time collectors who assist when needed with sorting and buying of recyclable materials (Pillay C 2022).

7.3.2 Waste Education for Resilience

In the paper "A global literature review of the drivers of indiscriminate dumping of waste: Guiding future research in South Africa" indiscriminate dumping has been highlighted as a product of lack of awareness and education (Niyobuhungiro & Schenck 2020). This includes the perceptions that waste has no value and is not treated as a resource. Furthermore there is a lack of responsibility and knowledge in consumers that their waste mismanaged damages the environmental, socio-economic and health of a space (Niyobuhungiro & Schenck 2022). This further bolsters the need for a space where waste can be managed safely and provides a space where the community can engage with waste and see the benefits of the work recyclers do. This would be provisioned in the scheme through educational programmes to ensure that young pupils are exposed to waste management and the effects of waste as well as to the community at large.

Additional support for community based resilience projects in regards to waste and open space dumping is provided by the Department of Forestry , Fisheries & the Environment of the Republic of South Africa. The Greening and Open Space Management office of the department seeks to upgrade poorly managed open spaces and illegal dump sites into community spaces. This is ultimately to improve the well-being of the members of the community. This can be achieved in various ways that they stipulate, such as creating recreational parks, nurseries to act as a home base to grow plants for the community, tree planting for fruits and biodiversity, constructing Environmental education centers and Green Technology sourced projects (Department of Forestry, Fisheries and the Environment 2022).

7.3.3: Waste Collection Diversification

Extraction of organic materials from the waste stream is receiving increasing attention in the country as a way to further decrease waste going to landfills, obtain more and cleaner recyclables, and prepare for expected implementation of requirements and targets regarding organic waste. Particularly due to the limited commercial value of organic waste, municipalities will need to pay for service providers to collect the organics. In this context, the collection of organics by waste pickers should be considered as a component of waste picker integration that would generate benefits for waste pickers, municipalities, industry and the environment. The collection system would need to be designed to meet the needs of the municipality as well as waste pickers, and would require formal agreements specifying the work to be conducted and the support to be received (Department of Environment, Forestry and Fisheries & Department of Science and Innovation 2020:13).

The Sustainable Development Goals are intrinsically linked with solid waste as where there is mismanagement can lead to climate change, public health, food and resource security, and sustainable consumption and production (Department of Human Settlements 2019:m6) Thus Infrastructure and service provision related to solid waste management at a neighborhood level should lower the risk to human health, minimize adverse impacts on the environment, grow the waste sector's contribution to the economy and contribute to a better life for all (Department of Human Settlements 2019:m7).

Section 03 of the National Domestic Waste Collection Standard asks to grow the waste sector's contribution to the economy maximizing the possible value extracted from solid waste. Waste that is currently disposed of at landfills has potential to benefit communities economically. For instance, by reintroducing recycled materials to the economy, new markets can be developed (e.g. for energy or for compost). Waste collection (including recycling services) is labor intensive and could contribute to job creation in the waste sector. Waste management services should therefore be planned to involve informal recyclers (local entrepreneurs) as part of the formal waste management system (Department of Human Settlements 2019).

7.4 Atteridgeville Waste Picker Upgrading and Legislative Support:

The waste pickers do a great service for our country, with diverging landfill waste and saving the government R750 million rand in 2019 (Department of Human Settlements 2019:m2). New legislation is proposed towards integrated waste systems including waste pickers in the system which makes a case for government funding for the project. Further support in favor of upgrading waste pickers facilities is that their productivity has been seen to double with infrastructural support as noted in the Bophelo Recycling center (Pillay C 2022). The programme calls for adjustment to include organic waste collection via waste pickers to be used in nurseries ecological public spaces for the community which is in alignment with Green infrastructure principles of green spaces as connectors (Department of Forestry, Fisheries and the Environment 2022). In addition it calls for education spaces for the waste pickers and

community to better understand the impact their waste has on their environment (Niyobuhungiro & Schenck 2022).

8 Precedent Study:

Following the literature review a precedent study was conducted to better understand typologies and solutions to waste picker upgrading, affordable accommodation, ecological projects and recycling buy back centres.

08.1 Waste Picker Landfill Scheme:
Designer: Blake Smits (MProf Student)
Site: Arlington Landfill, Port Elizabeth
Year: 2021

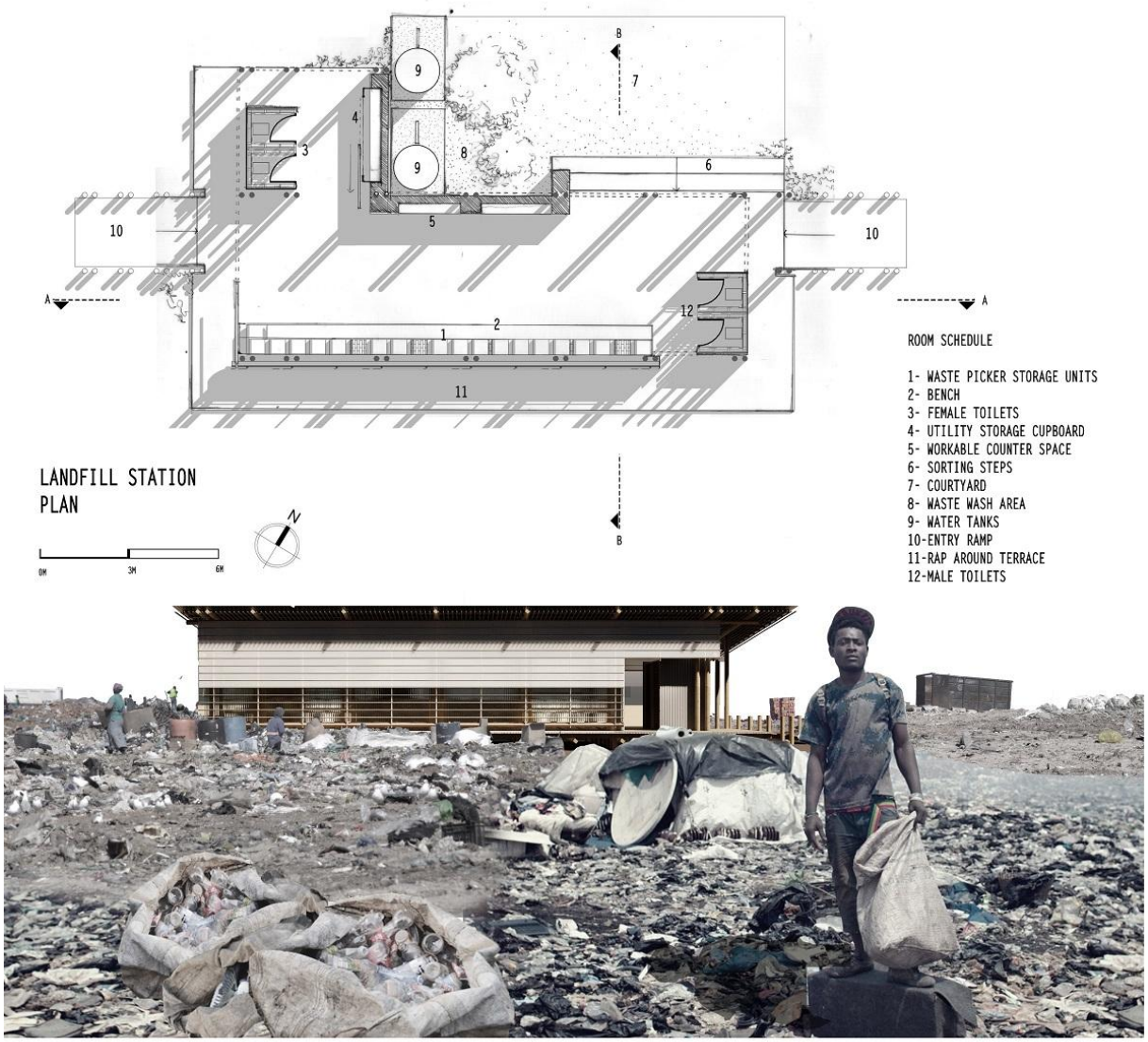

Figure 2.1 - Blake Smits' Waste Picker landfill scheme (B2B Central 2021).

This project was the regional winner of the 34th Corobrik Architectural student of the Year Award in 2021. This project's intention was to establish a dignified space where the Arlington landfill recyclers can work in Port Elizabeth. The project incorporated building materials sourced from the site and upcycled such as waste building materials and building rubble. The two predominant reclaimed materials were brick and clay products(B2B Central 2021).

8.1.1 Lessons Learned:

The project touches on many elements which can be incorporated into my own project. Firstly the provision of a sorting bench along with temporary storage is linear with only space for a few waste sorters and receptacles to be placed. The design also speaks about making more habitable working spaces, however the lack of solar protection to the North will lead to uncomfortable thermal comfort levels. Also there was lack of ecological integration within a landfill setting to establish microclimates as well as combat smells and pests with ecology and diversity.

8.2 Empower Shack

Designer: Urban-Think Tank
Site: Cape Town
Year: 2016

Figure 2.2 - Empower Shack showing the robust and simple design with future use renders (Above) (De zeen 2017) with a section to show the shell and how one may appropriate the space over time (Left to Right, Below) *(Architizer 2020).*

This project by Urban-Think Tank was listed on the RIBA international Prize winners of 2018 which is for projects that benefit their community. The Empower shack is an answer to the housing crisis South Africa is facing with approximately 7.5 million people living in informal settlements in 2017 (De zeen 2017).

The empower shake addresses the issues facing current informal settlement in regards to communal taps, and ablution facilities. This project uses the communal services of ablutions and water provision as the core block of the development on site. The residential spaces surround this core and allow for expansion vertically as well as horizontally to accommodate different users' family needs. The project takes less floor space than a traditional slum dwelling footprint with fire breaks that give emergency services early access in emergencies. The density of the housing blocks allows for more stable connections to be made where residents are stakeholders in the project preserving community ties (De zeen 2017).

8.2.1 Lessons Learned:

A flexible and scalable approach to the housing issues where the users can adapt the spaces to their needs is an important driver for my own accommodation needs on site. Further the utilization of a central service core with the residential components surround it allowing for ease of access to the services. Finally the robust and cost effective material palette along with the sensitive design needs of the users as well as adhering to the problems experienced in informal settlements such as fires and designing adequate fire protection is necessary.

8.3 Real Goods Solar Living Centre

Designer: Sim Van der Ryn
Site: California, The United States of America
Year: 1996

Figure 2.3.1 - 1996 (Left) (Real Goods Solar living Centre, 2020)
Figure 2.3.2 - 2007 (Centre) Showing the ecological growth on site in 11 years (Real Goods Solar living Centre 2020).
Figure 2.3.3 - (Right) An interior photo displaying the clerestory windows and fly ash concrete columns (Post 2020)

The Real Goods Solar Living Centre in California was designed by Van der Ryn as a showroom and educational facility to teach about sustainability for Real Goods Solar Living company. The project is highly sustainable with the use of earth-plastered straw bale walls, fly-ash concrete columns and sustainably sourced timber. The project has innovative passive heating and

cooling techniques with the use of the high thermal mass straw bale walls. The building also utilizes photovoltaic and wind energy generation on site.

The project also has a close relationship with water in terms of its cooling effects with an evaporative cooling oasis outside as well as grey-water irrigation. The project focussed on restoring the damaged ecosystem and creating a distinct landscape ecosystem where water features were used for cooling, noise dampening, water rentions for sustainable design (Post 2020).

8.3.1 Lessons Learned

This project is an expert example of sustainable building material construction along with passive design and ecological integration. The sustainable energy production systems of solar and wind, which generate electricity for the site as well sell excessive energy back into the grid. These systems are inspirational along with the effects of evaporative cooling oasis, water harvesting and grey water recycling to promote sustainable design are essential for my project.

8.4 Thanda Early Childhood Development Centre

Designer: AOJ (Architects of Justice)
Site: Qwabe, Nyangwini, KwaZulu-Natal
Year: 2019

Figure 2.4 - Thanda Early Childhood Development Centre (SAIA 2020)

The Thanda Early Childhood Development (ECD) project is a beacon for sustainable architecture and holds its own identity to the community and learners for education. This strengthens the relationship between architecture and education giving dignity to the learners as well as the community. The composition of the facility is centered around the community's water source tap which is a stunning composition of architecture and social programming. The programme allows schooling and the community to interact daily enhancing social cohesion creating resilience within the community (SAIA 2020). The architecture hopes to inspire others with the simple tectonic materiality of the roof structures acting as parasols protecting the classrooms below as Francis Kere's roof structures inspired them (AOJ 2019).

8.4.1 Lessons Learned

The close relationship between the community and the learners is seen as a resilience strategy where learning is passively taken on to community and the scholar. The impact of proximity is important for my recycling facility with appropriate architectural language which identifies the Recycling space as well as the ECD project acts as a beacon for learning in the community. The simple use of construction materials using tectonic parasols to shield from the sun to create climatically comfortable spaces is essential for cost effective building strategies.

8.5 Cyberjaya Recycling Centre
Designer: ATSA Architects
Site: Cyberjaya, Malaysia
Year: 2014

Figure 2.5 - Cyberjaya Recycling Centre showing recycling (Top) and rock (Bottom) infill walls in steel frame. (ATSA 2017)

The Cyberjaya Recycling Centre operates as a Buy Back Centre for the community members to deposit their recyclables for economic incentive. The programme allows for a waiting lobby with chairs before selling the recycling, a playground for children, a public restroom, a prayer room as well as a mezzanine level where reclaimed clothing is sold. The Buy Back Centre also collects waste from local businesses as a service offered (Ng 2022).

The architecture is cost effective with a large roof plan allowing the roof to absorb maximum solar radiation and reducing heating effects in the internal spaces of the facility. The gabion wall structures either reflect or absorb heat depending on their position on the site. The low trafficked areas of the site have permeable paving to allow water to penetrate the soil. The overall project is designed to enhance well being where the centre is situated in a park in the community to encourage walking in the city (Ng 2022)

8.5.1 Lessons Learned:

The project utilizes a simple steel frame structure with gabion infill walls, of which materials are chosen for the desired internal effects. This is an innovative design system incorporating an identity of waste management as well as utilizing waste of little value to have value as insulation in gabion walls. The project is a community based Buy Back Centre that encourages users to come to the park as well as to recycle. There is also an Identity established with the energy efficient roof system spanning the structure and protecting the centre below. The passive design techniques along with alternative use of recycling as sustainable building materials can be translated to my scheme.

9 Design Development:

9.1 Design Introduction:

The project takes a social and environmental justice stance where Resilience is being achieved through two ways, firstly the environmental impacts of open space dumping, recycling sorting and processes require separation from the natural ecology on site to restore lost biodiversity. The building acts as the barrier to waste on which ecology can take back, bringing a closer relationship between building and landscape. The second form of resilience upgrading is through providing educational components for the public to learn about the importance of circular resource management. Long term resilience for the waste pickers and the environment requires education and changing mindsets of the community to what sustainable practices are. This will be encouraged at the facility with the public spaces design displaying circular resource and passive design strategies. Ecological Design integration will achieve these goals through microclimate comfort, ecological functions displayed such as water harvesting, and provision of resources. This is to increase contact time with nature, and actively displaying the merits of simple sustainable design to improve personal and community lived experience.

The programme was developed following the Waste Pickers Integration Guidelines (Department of Environment, Forestry and Fisheries and Department of Science and Innovation 2020), section E, where the needs of the waste picker, municipality and stakeholders are listed, refer to appendix 01 Department of Environment, Forestry and Fisheries and Department of Science and Innovation (2020). Therefore a recycling space with a buy back centre is needed. It is planned for the general public of Atteridgeville as well as ensures that the waste pickers have fair access to the recycling economy. The waste pickers will be provisioned with temporary

accommodation on site, communal ablution and change room facilities, communal kitchens and relaxation spaces. There is an upcycling workshop, to repurpose waste of no value in the recycling network. This has its own retail space to sell items made on site. There is a community center, with a community hall, media centre with private workspaces, offices and boardrooms. These spaces will have different users during the day, from non-governmental organization (N.G.O) consultants helping waste pickers process their necessary legal documents, and further acts as classrooms to scholars learning after school. Finally following the waste pickers integration guidelines providing a creche is recommended for children to attend during the day while their parents work with recycling. Finally there is a canteen with public spaces to sit in the gardens and share a meal, recycler and community member alike.

9.2 Design Concept - Resilience

The concept of Resilience requires multiple levels to be achieved, from community education towards waste management to on the site rehabilitation of the damaged ecology. The concept of resilience in buildings is explored in figure 2.6 which shows the intentions of biodiversity traversing the building and establishing microclimates in the building. The public is encouraged to interact with the waste pickers both passively with visual connections (right) as well as active participation and learning as seen on the left. The project therefore aims to integrate biodiversity, gray infrastructure,the built environment and multiple users.

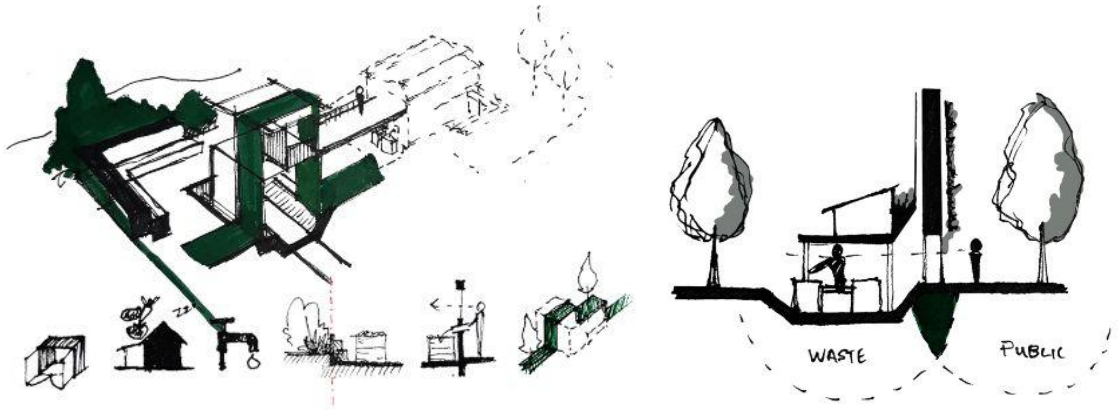

Figure 2.6 - The intentions of the architecture for Ecological integration and Passive design of spaces (Author, 2022).

9.3 Design Informants

9.3.1 Capturing Resident Energy Captures:

Resident energy, referred to by David Willams, are the naturally occurring systems and energies found on site (Williams 2007:xxii). These energies of solar, rain, gravity and wind along with harnessing them, go hand in hand with the principles of passive design. Systems of water harvesting, solar massing for thermal comfort, photovoltaic energy harvesting, bioswale filtration systems, indoor natural lighting, evaporative cooling towers and thermal flushing roof systems

allow maximum residential energies to facilitate mechanical functions needed on site as seen in figure 2.0.

9.3.2 Incorporating Local Materials and Skills:

Utilizing recycled materials in the construction process, such as glass bottles for illuminating walls, invaluable plastics as gabion infill walls, rammed earth walls from excavated earth works on site as well as enhancing the local production of brick making. This will be done through harvesting building materials from building rubble dumped at the recycling facility.

9.3.3 Enabling Ecological Design:

The intimate design of ecology and green infrastructure is to bolster the local microclimate and increase biodiversity. This is in an effort to rehabilitate the landscape and to provide sanctuary to biodiversity which supports the life of our site. As a recycling hub, ecological design requires sensitivity and clear separation between waste and ecology to allow both to prosper.

9.4 Initial design explorations:

Following the operations on site of the waste pickers was explored through bubble diagram explorations as can be seen in figure 2.7. The various programmes of the site were grouped between public and private spaces where the Buy Back Centre needed to be the visual representation of recycling. The community centre and Upcycling workshop with adequate public green space is provided as seen in figure 2.8, and the recycling sorting yard and accommodation is to the west of the site to denote a semi public and private space.

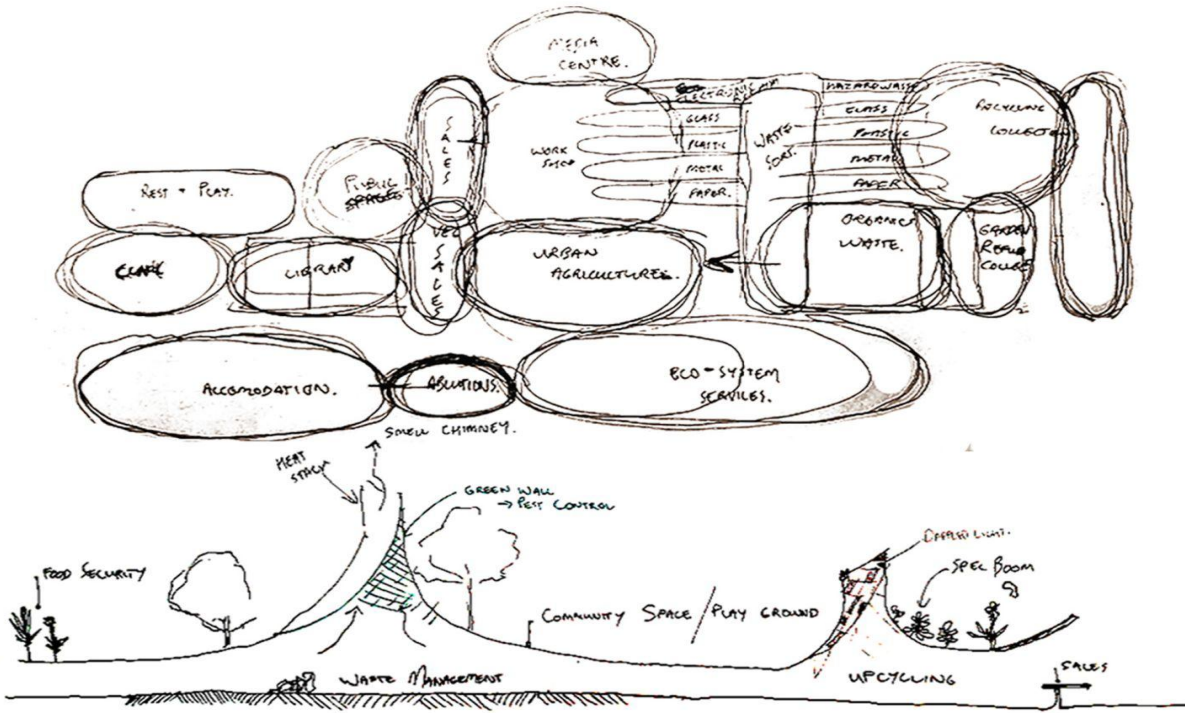

Figure 2.7 Initial Site Bubble Diagram illustrating the various functions of the Recycling centre, Waste Sorting Yards, and the relationships shared between them (Author, 2022).

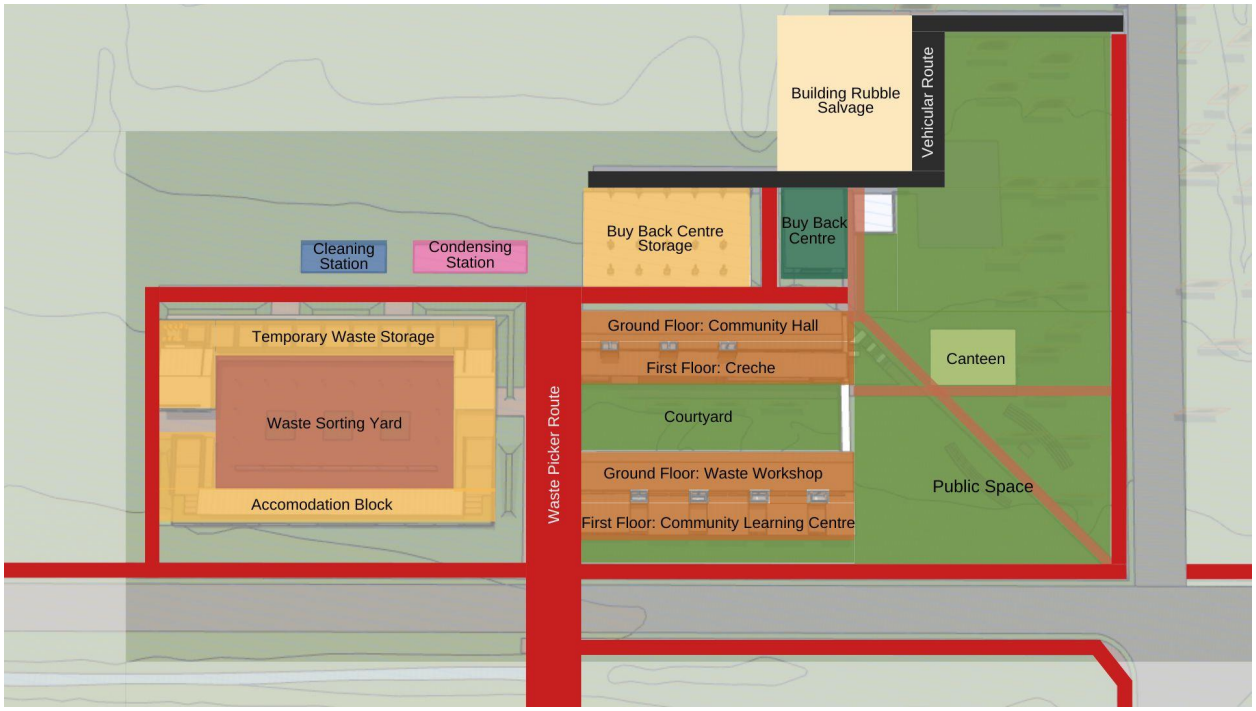

Figure 2.8 Final Site Organization where public and private functions have been separated with ecological barriers and plenty of accessible green space for the community (Author 2022).

Figure 2.9 Understanding the site composition through sketches and marquettes for spatial and design explorations (Author 2022).

9.5 Chapter 02 Conclusion:

Following the principles of ecological design and the tenants proposed by David Orr in Daniel Williams book to harness resident energies and to promote ecologically integrated is the cornerstone for my design (Williams 2007). The idea of sustainable design incorporates sustainable materials and local skills which is where the design has focused its attention into systems thinking and material composition.

Chapter 03: Synthesis

10 Design Development

10.1 Introduction: Design Strategies - Green-Grey integration and Resource Circularity

The design integrates the interface between green and grey infrastructure. Where the balance between the programme, and systematic functions of the building can be enhanced with the benefits of ecology. By following the green infrastructure principles and utilizing green spaces as an asset to public space making, these strategies are articulated from site level scale down to individual building solutions. The site-specific strategies focused on green boulevards to protect the waste pickers and establish comfortable microclimates. Furthermore the GRIP principles encourage site connectivity through green boulevards linking green spaces and promoting the connectivity with the local community. Water sensitive design is imperative with the site's proximity to the Skinnerspruit which will aim to manage storm water and waste water leaving our site. Water filtration through bioswale or stone gabion structures remove micro plastics as well as cleaning water exiting our site and before it enters the Skinnerspruit tributary. Bioswales are an ecological intervention which filter and clean water as well as improve biodiversity and microclimatic conditions as additional ecosystem benefits, which are important design considerations.

On a building scale strategies employed involve green screens, which protect the users, promote biodiversity and contribute to the microclimate. Further considerations are the utilization of residential energies to capture solar energy, wind for ventilation, and rainwater. This manifests in the design through key strategies including photovoltaic panels, enabling water harvesting and biophilic influences with contact time with nature.

FIGURE 3.0 - The site strategies employed which consist of greenboulevards, bioswales and detention ponds (Author 2023)

FIGURE 3.1 - The building strategies employed on site; green screens (shielding western light), photovoltaic panels, light shelves to the north, ambient lighting from southern clearstory windows and green roofs (extensive) (Author 2023)

10.2 Design Iterations

The design focused on integrating ecosystem services and building services to build a closer relationship with green and grey infrastructure. The project followed three distinct design iteration developments. The iterative process explored ideas and ultimately hones the design down into succinct and clear goals.

The architectural resolution has been through various design considerations where the intentions of the project have remained constant with the goal to integrate ecology, economy and community to improve resilience of Atteridgeville.

10.2.1 Iteration One

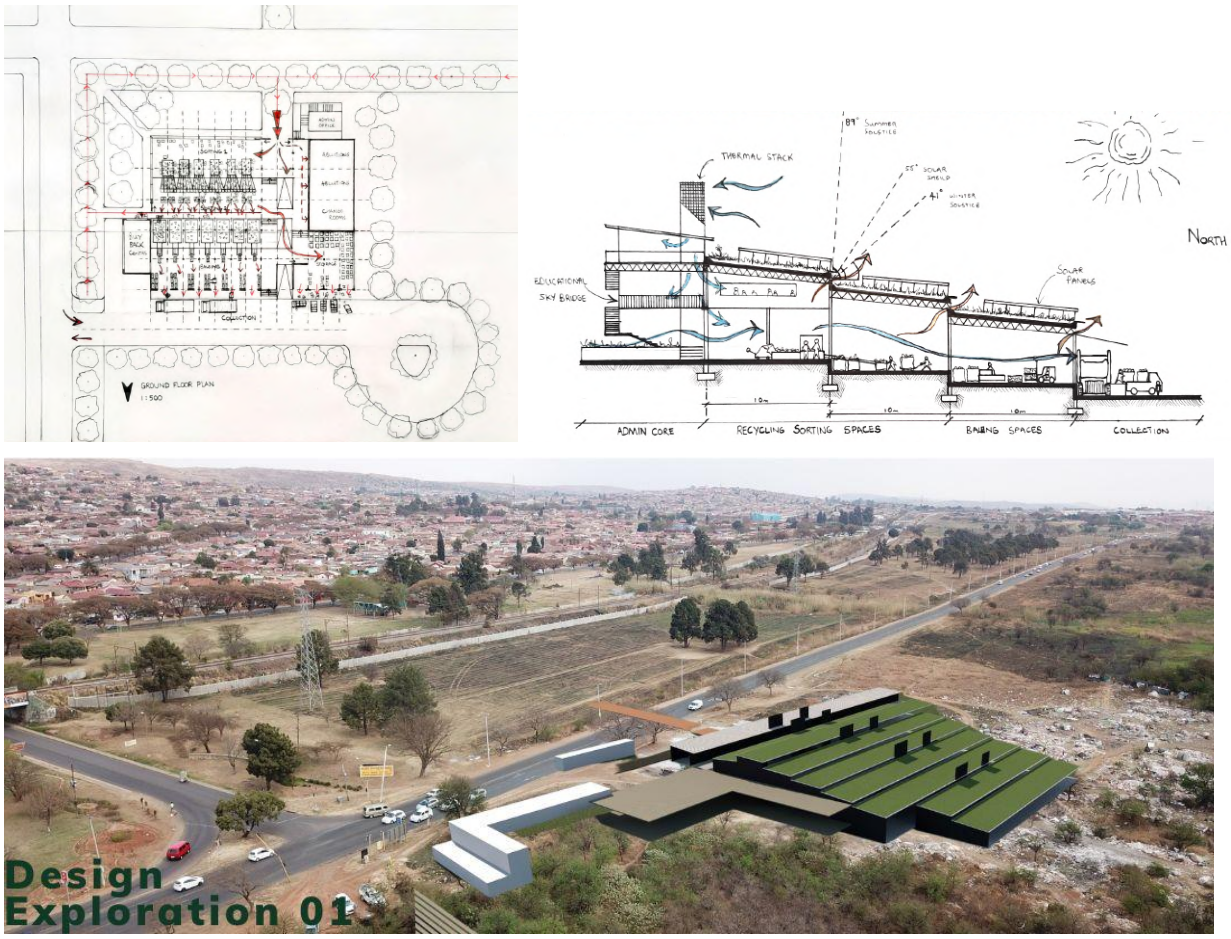

Figure 3.2 - The First Design Iteration, Floor Plan showing movement of waste to and through the site. The Section displays passive systems which were considered with the first iteration (Author 2022).

The first iteration, manifested the intentions of the project into one central large warehouse structure. The overarching goals were for efficiency and the improvement of the recycling process. The floor plane steps down by a meter every ten meters to allow for easier recycling sorting between levels. This design also focused heavily on future expansions where automated machines can sort recycling. This is following the examples of the first world's Material Reclaim Facilities (MRF's) such as seen in Germany which was the best recycling nation in 2021 (Igini 2022).

10.2.1.1: Critique of Iteration One:

The issues when reviewing the first design, was that the functions were being achieved however the experience for a user visiting the site, lacked programmes for the community to remain on site. The green roof structure that had been suggested requires maintenance and the weight of the vegetated soil would be an extremely costly exercise. The automated production line failed to utilize the resources on site, which is an abundance of labor. This first iteration also missed an opportunity to allow for housing of the existing Recyclers living on site. These observations were further extrapolated in the later iterations.

10.2.2 Iteration Two

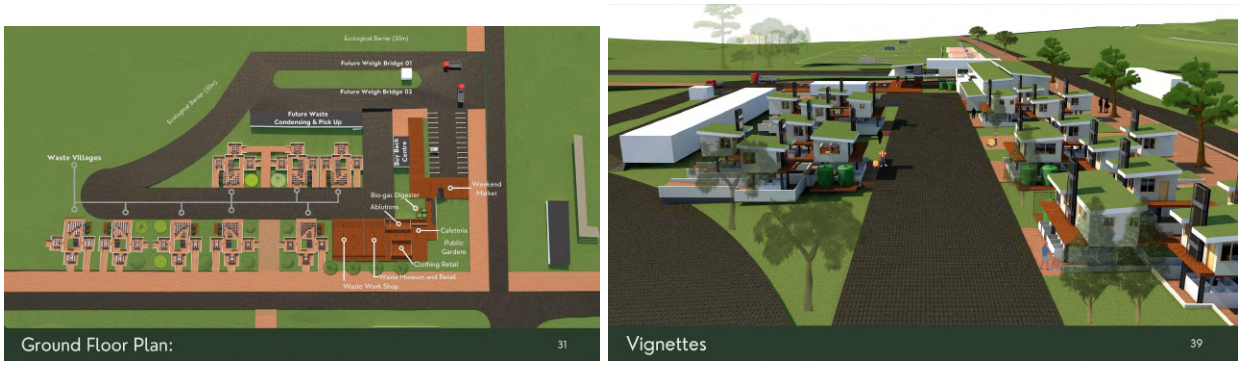

Figure 3.3 - Ground Floor Plan of Iteration 02 (left) along with the vignette of the atmosphere (right) of the Recycling Centre (Author 2022).

Iteration Two, focused on the public and the private experience of the users on site. The programme planning incorporated upcycling workshop additions, as well as a public media/learning centre. This was firstly to encourage the public to have more contact time with the site, as well as add economic opportunities to the public with the upcycling sales. The upcycling workshop is an important addition to the scheme because it allows the waste which has little to no value in the recycling economy to be adapted, changed, used in conjunction with other items to be sold at high values such as: Chappies Paper Welcome Mats, Ecobricks etc. It was noted during interviews with the waste pickers that they can't afford highly nutritional food, where most food is bought from garage shops and small spazas in the area. The site plan in part 5 of chapter 01, figure.1.7, incorporates community urban agricultural services. The food grown there will be used at the on site canteen to allow the passing public to buy local organic foods at affordable prices. This canteen is also an opportunity for the waste pickers to purchase healthy, nutritious food at cost effective prices' as well.

The waste process also adapted with this iteration, where the warehouse processes, such as sorting, compressing waste, and cleaning waste were separated into their own individual spaces. The sorting yard was broken into sorting courtyards, where four units were positioned around a central green space. These courtyard units incorporated temporary storage on the ground floor and individual housing above it, with communal kitchens and bathrooms per courtyard unit. These structures were designed for biodiversity routes to climb on the east and

west vegetated screens and along a strip of a green roof. Along with these microclimate strategies, trombe chimneys were introduced for ventilation in the waste storage below. The storage structure on the ground floor allowed for opening and closing of the structure to allow for secure storage at night and plenty of ventilation during the day, with the trombe chimney on each housing unit ensuring constant upwards air flow.

10.2.2.1 Critique of Iteration Two:

Iteration 02 developed the phase approach of the scheme where the Buy Back centre was shifted to start as a small facility rather than the overall process, and relied on manual labour processes. The future expansions into buyback storage and baling machines become a later phased operation. The major concern for this development was with the waste courtyards/villages. The development required extensive paving areas along with major road networks which are not ecological and not aiding to my design intentions of ecological protection and promotion for resilience. The communal living spaces also isolate the interaction of the waste picker community. The individual bathrooms and communal kitchen facilitated 10 people per unit which removed the original communal spirit seen in the original open space dumping villages.

The community contact spaces, such as the non-governmental organization (N.G.O) offices, media centre, upcycling sales and the canteen were a great improvement from the original design as well as dumping facilities for the community to park cars and utilize the Buy Back centre. The design was flexible and open to allow for flea markets on the weekend and additional uses. The integration of ecology and grey infrastructure unfortunately was still lacking and not adhering to the true intention of this project, however resource management had been incorporated with biogas digesters that the public can add their food scraps to help generate gas for the canteen cookers. Water harvesting needs to be bolstered and natural water filtration through bioswales are needed to clean and store water.

10.2.3 Iteration Three

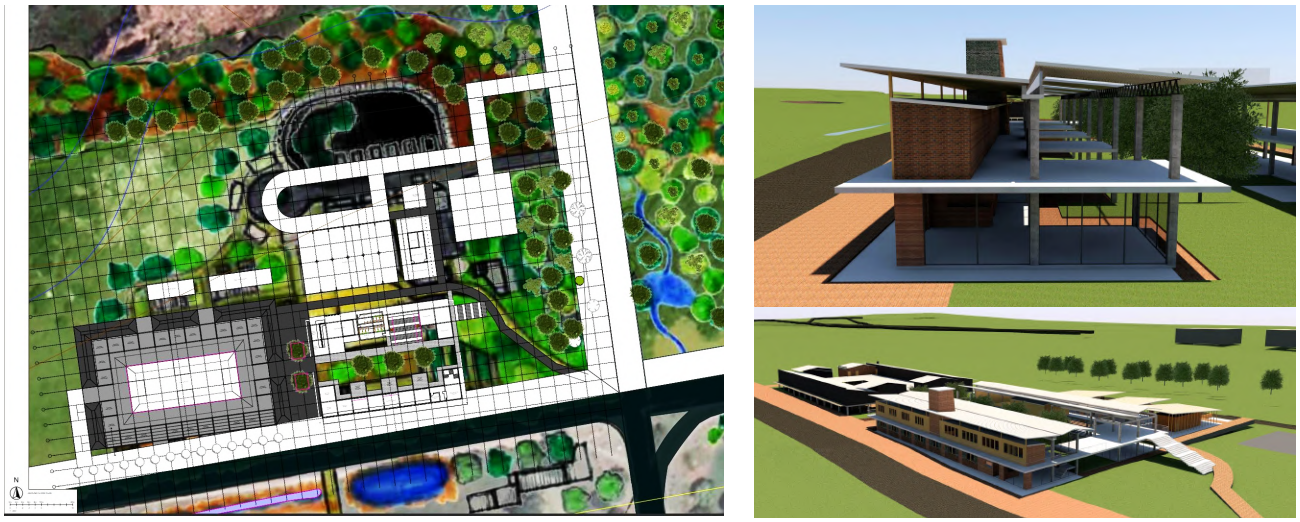

Figure 3.4 - Third design iteration and the final iteration for Recycling for Resilience (Author 2022)

The third iteration of the project arrived at a more organized and integration of the public and private domains, where the arrival on site was considered as a journey to either the Buy Back centre or to the learning centre. The learning components were bolstered where there is an outdoor auditorium for presentations to scholars touring the centre. The project learnt from the previous iteration where the phased approach needed to be developed which led the project to being a framed concrete structure which can easily expand or be altered as time goes on. The Waste village becomes one large sorting yard, which is under cover. These roof structures capture water and store it for waste washing. The development also allows for the recyclers to condense their own waste by crushing and shredding the waste, to allow for denser loads of waste to be sold at the Buy Back center. The Buy Back center would then handle the waste storage, baling and sales to members of the community.

The road network was also reduced to allow for less ecological disturbance with the additional roads, as well as the organization for dumping improved. This iteration recognized the severe and extensive building rubble dumping taking place in town and on the ecological green space in which we are working. This scheme incorporated rubble collection, while providing spaces for sorting of the materials into their designated sizes. This is to harness the natural resources moving through our site, which would be reclaimed building materials such as bricks and stones for infill walls and paving. The unaesthetic building rubble can be used for foundation infill and gabion structures. The finer sands can be used in the local brick making.

The project focused on wind scoops as the natural ventilation system, where evaporative cooling takes place in these towers, cooling the air and bringing it into the offices and upcycling workshop spaces.

10.2.3.1 Critique of Iteration Three

Iteration three requires technical development to achieve the intentions set out by the project. Maintenance of the green roof gutters, becoming a feature along with being a movement route. The hierarchy of spaces needs to be articulated so the experience on site is one of intuition to find the public spaces, and moving into the semi-private spaces of the upcycling workshop. Displays of natural systems on site are also an area in which further development can take place to allow the community to learn about water harvesting and bioclimatic architecture through experience and seeing the systems on display.

The wind scoop requires refinement as well as to be duplicated a few times across the site, to be a structural member of the design as well as to allow for better ventilation.

10.3 Iteration Three Development

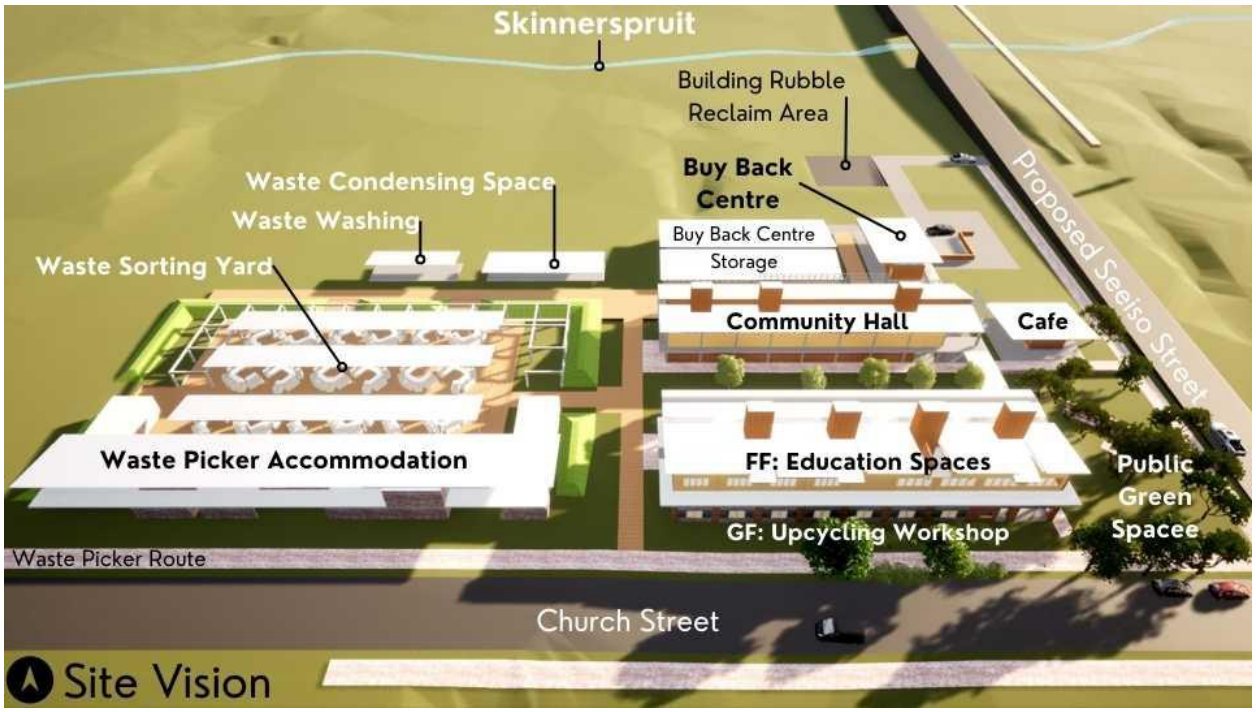

Figure 3.5 Site Vision of the Community Buy Back Centre (Author 2023).

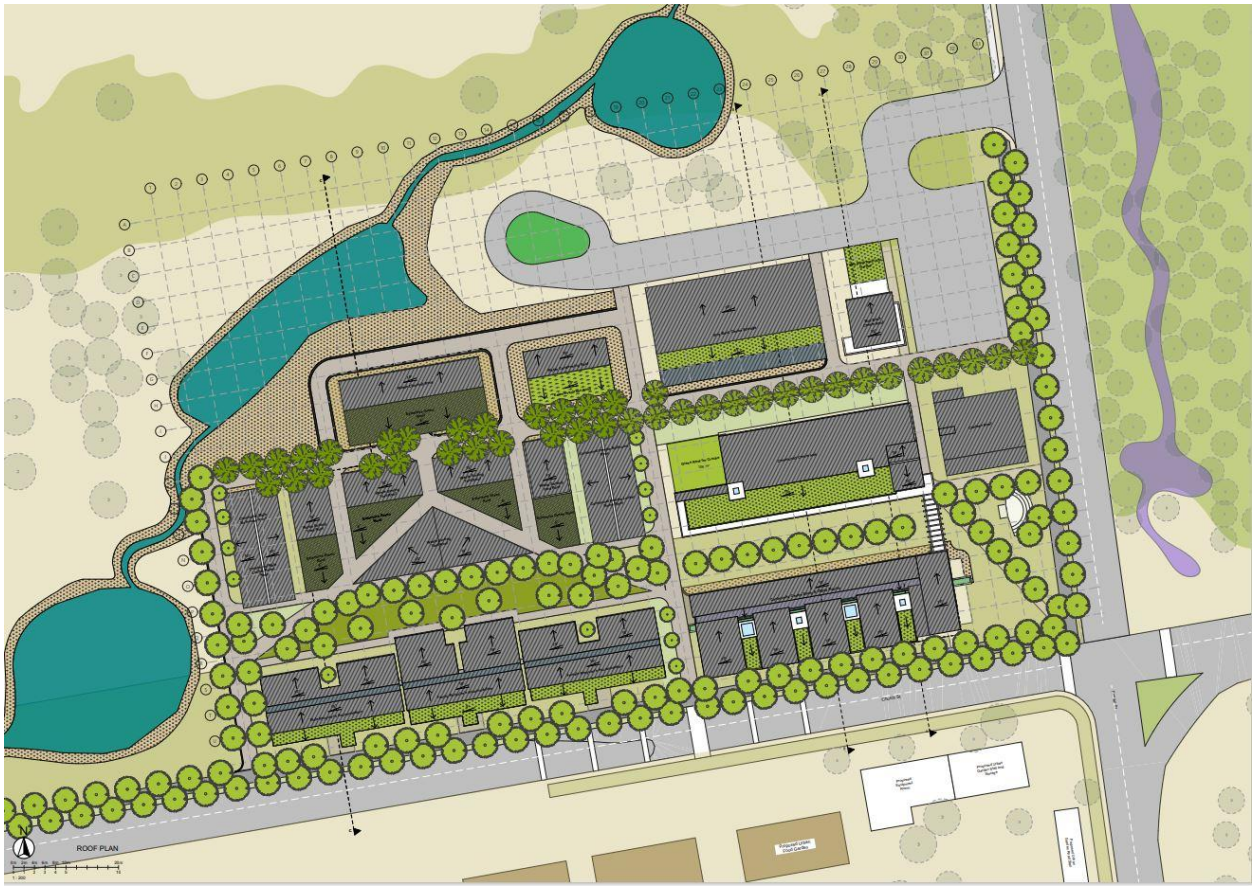

Figure 3.6 - Site Plan of the Community Buy Back Centre (Author 2023).

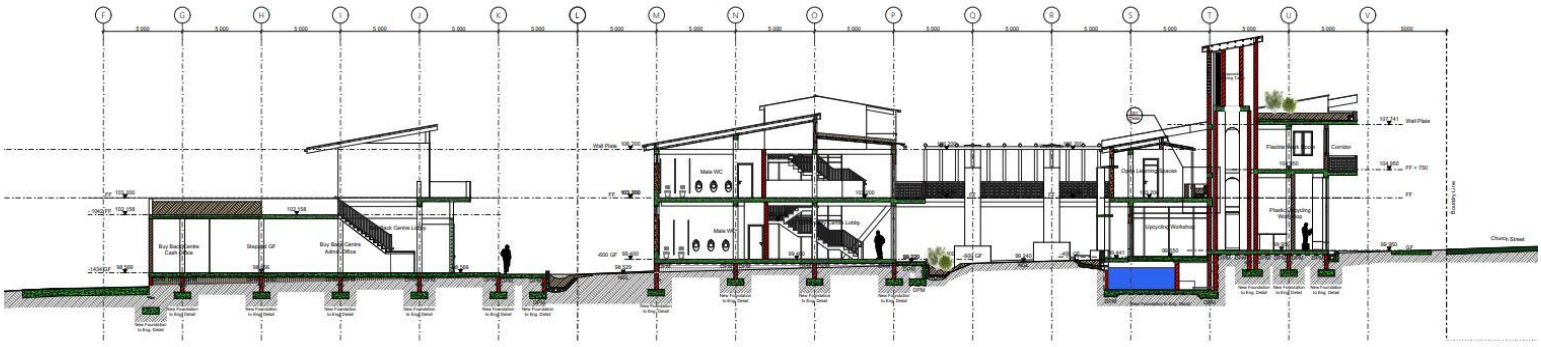

Figure 3.7 - Section through the Community Recycling Buy Back Centre (left), the community centre (middle) and the upcycling workshop (right) (Author 2023).

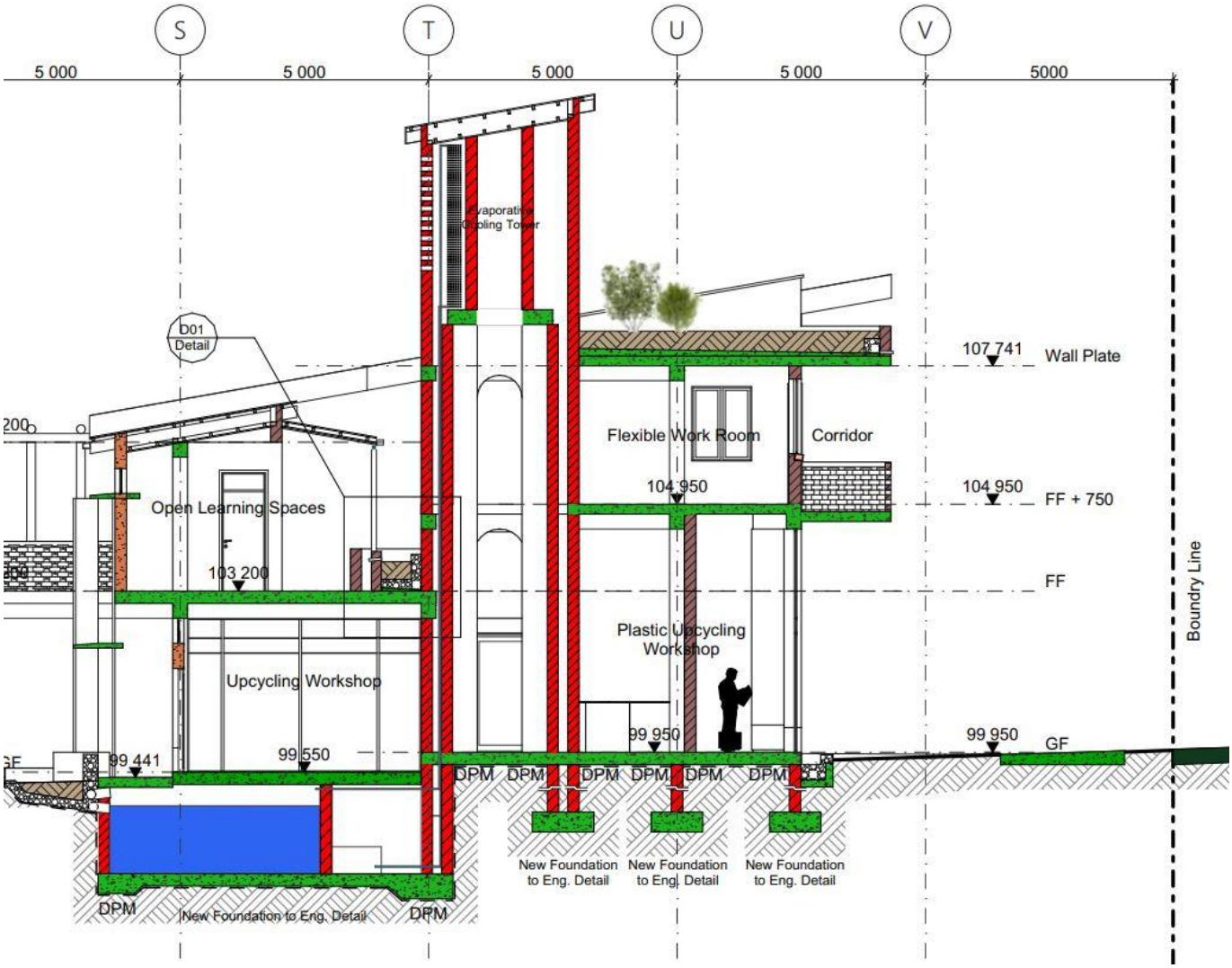

Figure 3.8 - Detail section through the upcycling workshop (ground floor), the thermally assisted building service (TABS) tower and the education spaces (first floor). The bioswale gutter runs through the first floor as a water filter and biophilic intervention (Author 2023).

10. 4 Final Design Iteration:

The final design iteration built on the previous principles and extended the ecological systems required for the project into landscape development. With the introduction of a central bioswale through the centre of the site to filter and clean water which can then be used on the site in either in the cooling towers and the waste washing units. Lastly the Northern buildings on site are portal framed structures as when the projects life span of recycling is concluded the portal structure can be removed and allows the landscape to return to its natural state.

Figure 3.9 - Ground floor (above) and Sections (below) (Author 2023)

Figure 3.10 - Perspective of Site showcasing the green strip and bioswale. (Author 2023)

Figure 3.11 - Perspective of Upcycling Workshop and Community Centre with green infrastructure. (Author 2023)

11 Technical Development:

11.1 Technical Intentions

The technical intentions add to the project intentions of resilience through building materials and systems being selected that are ecologically sourced materials. Sustainable building materials as well as utilizing local skills such as welding and bricklaying with the intention to upskill where possible with functional skills such as developing rammed earth construction techniques and concrete work, and building from recycled building materials.

11.1.1 Green-Grey Infrastructure Integration ie: Ecological Design.

The integration between green and grey infrastructure is at the centre of this project's technical intentions. This is to promote design that establishes micro climate controls with vegetation, biodiversity and water filtration through bioswales is important. This informs the design to which materials and systems can be used that support vegetation. This includes creating biodiversity routes that traverse the building through the use of green walls and roofs. With vegetation comes maintenance, so a key design factor around technification is having the correct maintenance spaces in place such as walk ways which allow access to this green-grey infrastructure to coexist harmoniously while benefiting all users and the building.

11.1.2 Resource Circulation

Resource circulation encompasses the natural energies on site, such as solar, wind, water, vegetation, soil and gravity. The technical development maximizes residential energies, building materials and skills which are found on site and the local area. This helps inform the technical concept which is to use what we have locally to lower ecological impacts through carbon footprint as well as to maximize the resources we currently have. With organization and strategy, harvesting reclaimed building materials and upcycling waste can cut building costs as well as clean our environment.

11.2 Technical Concept

The technical concept is **resource circularity**, where local materials, skills and found objects can be upcycled, incorporated and utilized to lower embodied energy costs, financial costs and outsourced materials for construction. Resource circularity extends further than structural implications, as well as designing to utilize resident energies found on and moving through the site. This means to maximize solar capture, thermal massing, natural ventilation and lighting, water harvesting, energy generation, composting, vegetated microclimates, and biodiversity. This is to ensure the passive capture and harnessing of these above mentioned opportunities of resource conservation.

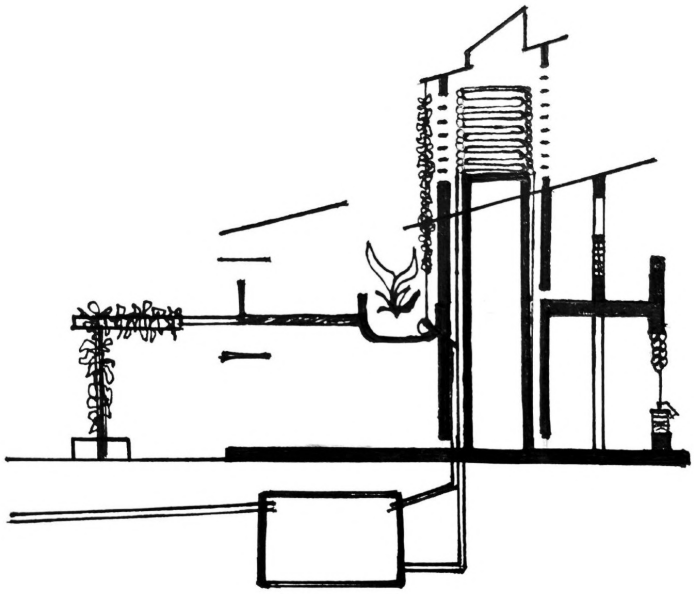

Figure 3.12 - The technical concept of resource circularity combined with ecological and passive design techniques (Author 2023).

11.3 Technical informants

11.3.1 Sustainability - Passive Design

Sustainability not only takes into consideration locally sourced materials during construction which have lower embodied energy costs and carbon footprints than outsourced materials. It extends into the lifespan of the project and creates passive design solutions that harness the residential energies found naturally on site (Williams 2007). This design approach works in harmony with the existing systems taking place on site such as natural lighting, ventilation, water harvesting and gravity. These processes can be maximized through simple systems where material choices are based on thermal mass for heating and cooling, orientation and weather proofing as well as capturing natural light in indoor spaces.

Passive ventilation, water harvesting and filtering, microclimate establishment and good indoor natural light qualities are project requirements which bolster well being of the users ensuring a better working conditions and quality. These systems will lower the overall operational costs of the scheme through these passive systems of cooling, lighting and heating.

11.3.2 Green and Grey Integrated Services:

A strategy to deal with ventilation in the project is introducing passive cooling towers. The cooling towers will be utilizing a Thermally Assisted Building system (THABS), which is traditionally water pipes cast into the slabs which run cool or warm water through to passively condition the building to desired temperatures. This system has been adapted to our project to

utilize water harvested on site, from the central bioswaleto, storing water in subterranean tanks. This cool water is to be pumped into the cooling towers through a series of coiled copper pipes. This cool subterranean water tank keeps water chilled at approximately 16 degrees celsius. This cool water is pumped to the top of the tower which acts as a wind scope. The wind passes into the cooling room and the warm air passes over the cool pipes in the tower, which in turn cools the air, allowing it to sink through the hollow columns of the tower acting as a duct to allow cool air into the building on the first and ground floor. This air will be extracted with small fans to allow the air to move through the building correctly. The heat exhaustion strategies are designed from space to space, utilizing cross ventilated window systems aswell as operable clerestory windows to allow warm air rising to escape.

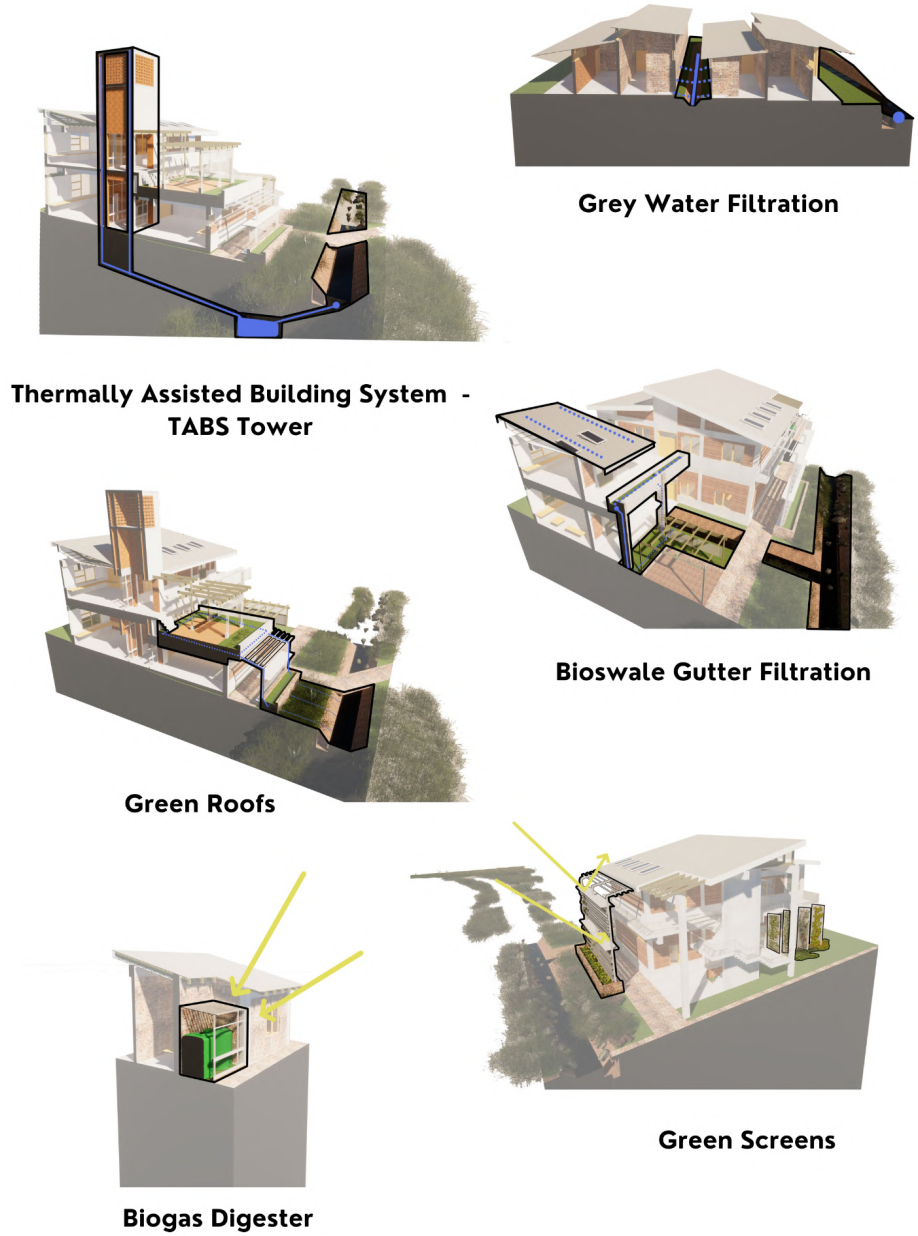

FIGURE 3.13 : Green-Grey Integration strategies employed in the design of the Buy Back, Upcycling and Community Centre.

Electrical energy will be generated on site with the use of photovoltaic panels. These panels along with battery storage and inverters will be housed in the upcycling workshop, community centre, creche and the accommodation for the waste pickers. This energy will firstly be used to power the pumps necessary for the THABS cooling towers on site. Further energy will be used to supplement the baling machines in the recycling storeroom and finally for general exterior and internal lighting. During the day, use of light shelves, and light wells along with the appropriate orientation of openings will allow for daylit interior spaces. This passive design along with the solar panel supplementation collectively will help to reduce municipal electricity dependence and lower utility bills.

Biogas will be harvested from the Biogas Digester situated by the communal canteen. This biogas digester will not only display the possibilities of harvesting your organic waste into methane gas for cooking, yet it will also provide compost for the facilities bioswales, biodiversity routes and vegetated screens.

11.3.3 Reclaimed Building Materials

The technical concept is resource circularity, with a large unutilized resource of dumped building rubble. The evidence of building rubble dumping on site is extensive along the green spaces perimeter as well as in the Town of Atteridgeville. This can be seen in figure 3.11 where rubble dumping is found in the open green space of our site. Further maintenance issues involving building rubble and removal can be seen in the town of Atteridgeville. This is a large untapped resource waiting to be harnessed and a readily found material in the area as seen in figure 3.12.

Figure 3.14 - Open Green Space Rubble dumping, of which there are mixed aggregates, bricks, stones, concrete blocks and sand as well as more valuable items such as broken tiles and Granite pieces (Right). These can be used for infill walls, or as aesthetic pavers and spaces in the project (Author 2022).

Figure 3.15 - Derelict Beerhall in Atteridgeville, with broken bricks that can be upcycled into non-load bearing walls (infill walls), pathways, gabion structures, landscaping and foundation infill (Author 2022).

These bricks can be reclaimed and used in the building of the Community Buy Back Centre as infill walls. The bricks will require maintenance where excess mortar and concrete is chipped off and then the bricks can be used in non-load bearing walls. Brick reclaiming requires adequate space to allow rubble to be dumped on our site along with salvaging operations. This programme was identified later in the project allowing for a more diverse circulation of resources to flow through the site that are being dumped in the area already. Further reclaimed building materials can be used in making foundations on site as well as used in gabion structures in the future framework developments suggested in figure 1.7 in chapter 01.

11.3.4 Local Brick Making:

Figure.3.16 - A local entrepreneur making his own concrete blocks on the Open Green Space (Author 2022).

The application of home made bricks is excellent for our scheme however his practices are damaging the natural blue way and green way of the Open Green Space. This local brick manufacturer harvests the sand needed for the bricks from the Skinnerspruit river bed and uses water collected from the river as well. His presence has slowly led to the banks of the skinnerspruit retreating and removing the biodiversity in the area. A sustainable solution to this problem is incorporating members of the community such as this man to harvest the building rubble and utilize the sand from the dumping as his mixture to make concrete blocks. These blocks can be used in structural expansions to the project as well as with infill walls in the project.

11.4 Precedent Study

11.4.1 Zhou Shan House of Dreams

Designer: Insitu-project
Site: Zhou Shan Village, China
Year: 2017

Figure 3.17 - House of Dreams construction photos, displaying masonry construction, reclaimed masonry walls and eclectic infill construction methods (Admin 2020).

The House of Dreams project is situated in the Zhou Shan Village, China, where stage one was completed in 2017. It is a rural upgrade where social and cultural development was explored by InsituProjects and the local community. The project brief set out that a training centre and research base was needed for the village. This is to consolidate skills, foster community values whilst exploring bottom up development methods (Insitu-project 2020). The training allows to strengthen skills and share them with the surrounding villages. The programme thus incorporated a guesthouse, communal cooking, event spaces and training spaces. The site and

expansion started with existing caves on site, where new amenities and public spaces were added. Insitu Projects worked with villagers to gather leftover building materials, natural materials and demolished buildings to collectively construct the House of Dreams. The project title was named after the living memory of the villagers using these caves as their childhood homes which remain only in their dreams.

This project demonstrates what can be done when working with the site with local materials and skills. Upcycling and utilizing simple construction methods such as reclaimed bricks in pavers and infill walls, and using new bricks only on key elements such as the new brick arches leading into the cave spaces. The possibility for this project's working methods being translated to Atteridgeville utilizing the local materials and labor to upskill and develop a sustainable scheme is possible and necessary to create opportunities out of the currently disregarded building waste.

11.5 Structural Systems - Primary, Secondary and Tertiary

The primary structural system:

The primary structural system employed is a concrete framed superstructure. The choice of the material is because it is a robust material which can withstand the strenuous process of waste upcycling and sorting. The framed structure also for easy expansion to the development as well as non structural internal and external walls can be used and therefore easily adapted in the future.

The Secondary System:

The secondary systems are infill, non structural elements in the project. These will consist of rammed earth walls, glass bottle infill walls, reclaimed building materials such as bricks, concrete blocks and stones.

Tertiary Systems:

The tertiary systems are the ecological systems taking place on site with water harvesting as a key component of these systems. These are vegetated screens along with biodiversity bioswale gutter systems that allow the water to be filtered before harvesting as well as allowing biodiversity to traverse the building. The vegetated screens will be a mixture between functional planting and aesthetic, biodiversity screens which allow for solar shielding on the North, East and West facade of the building.

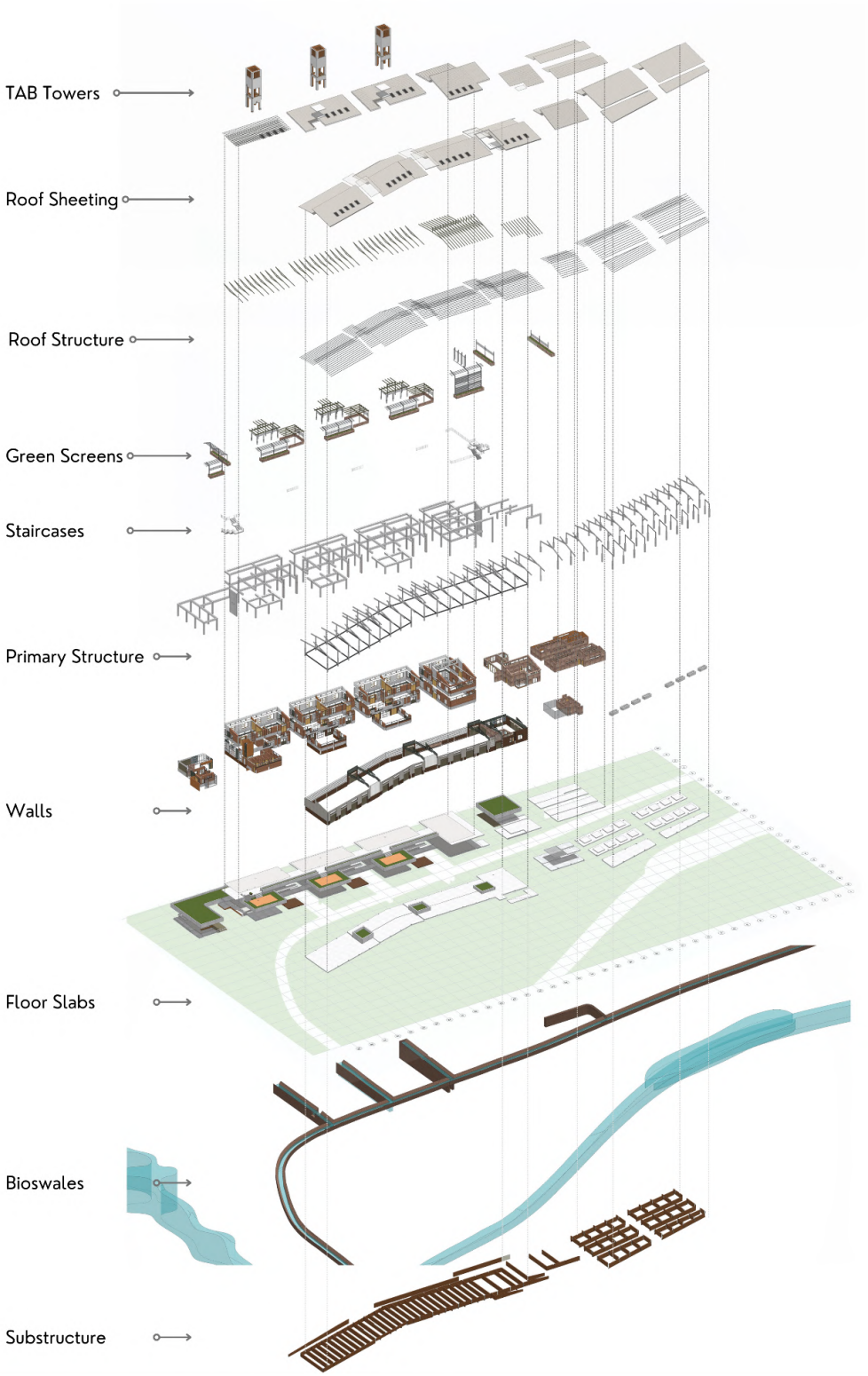

Figure 3.18 - An exploded axonometric showcasing the structural systems used in the project namely: the 5 x 5m Concrete framed structure for the community centre and dismantalable Steel Portal Frame for the Waste Storage Unit. All walls to be infill walls with reclaimed materials. (Author 2023)

11.6 Material Palette

The building is a concrete framed structure, with rammed earth from earth works performed on site, infill walls from reclaimed upcycled materials such as glass bottles, bricks, stones. Refer to figures 3.12, 3.13 and 3.14 for rendered qualities of the material palette composition.

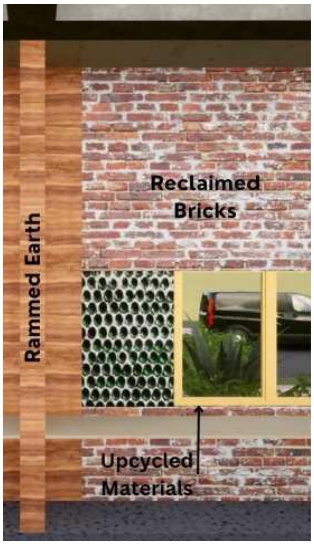

Figure 3.19 Material palette and composition of upcycled materials (Author 2022).

11.7 Technological Perspective of Concept

Figure 3.20 - A perspective section demonstrating ecological and passive design, with an evaporative cooling tower, wind scoop, double insulated roof, bioswale gutter for water harvesting and natural lighting into the rooms from the translucent sheeting allowing well lit interior spaces (Author 2022).

This technical development perspective showcases the passive and ecological design principles being used in the project. The reclaimed building materials can be seen on the ground floor's southern (Left) most infill wall (Fig. 3.14). The wall is made of reclaimed bricks and glass bottle walls to allow soft interior lighting on the Southern Facade. On the first floor, rammed earth walls feature warm natural materials which store thermal energy due to its mass. The first floor circulation is translucently lit to allow natural light into the corridor leading to various offices and workspaces. The bioswale gutter allows vegetation to grow within a controlled space which acts as a filter for water collected from the surrounding roofs. This water is stored in tanks behind the perspective section seen in Fig 3.14 which is used to clean waste before upcycling in the workshop.

11.8 Part 03 Conclusion:

The development of the project and intentions has grown from iteration one to iteration three. Starting with efficiency and programme issues, to a holistic ecological design where the public interact with waste in various manners. The project highlights the importance of recycling and learning actively and passively around biodiversity, water harvesting and the recycling economy.

With the technical development enforcing the project's intentions to achieve resilience through green-gray infrastructure integration. This led to the technical concept promoting resource circularity, which ensured that design decisions were guided by harvesting residential energies and materials on site. The extensive rubble dumping in the Open Green Space can be harvested for infill masonry work, pathways, and recycling can be upcycled into decorative infill walls with glass bottles and plastic eco bricks. Furthermore resource circularity speaks to a circular systems thinking, which in the case of the Atteridgeville recycling center seeks to use local skills sustainably. The harvesting of materials such as sand can provide safe ecologically appropriate practices to ensure sustainable development of businesses such as concrete block making as seen in figure 3.10.

Chapter 04 : Critical Reflection

12 Conclusion:

12.1 Reflection

The project began by addressing the issues that open space dumping has in Atteridgeville. The ecological impacts of anthropogenic waste impair ecosystem services (Tsheleza *et al*. 2019) which reduce the resilience of Atteridgeville to the effects of climate change (Lindley *et al*. 2006). The open space dumping was occurring throughout the town of Atteridgeville, as well as the dumping was intensified in the Open Green space between Atteridgeville and Lotus gardens by the waste pickers operating in the area. These waste pickers are illegal foreign nationals, who reside in the open green space and pick the bins and open space dumps in Atteridgeville. They salvage recycling of value from the town and return to store and sort their waste in the open green space and sell their waste to interested third parties.

The issues identified at three levels as seen in figure 4.1, were the general issue of resilience and climate change, then the urban issue of the lack of education and integration towards waste management and waste pickers, then finally the architectural issue to rehabilitate the landscape and to empower the community. These issues were addressed through using the principles of Green infrastructure Planning structured around social inclusion, connectivity, green-gray integration and multifunctionality (Pauleit *et al*. 2017:3).

Figure 4.1 - The three Identified issues, The General Issue being addressed with Rehabilitation (Left), Education Addressing the issues surrounding waste dumping (middle) and finally the Architectural Issue of green-grey integration uplifting the Waste Picker creating an identity of Recycler (right) (Author 2022).

The programme of the project was geared towards economy, ecology and education where recycling is the intersection of these parts. A Buy Back Centre was selected to establish the recycling identity in Atteridgeville. Surrounding the Buy Back Centre is an Upcycling Workshop for currently invaluable recyclables to be repurposed and sold at the Upcycling Store. The waste

pickers operating in the area are also provided with a recycling yard, temporary storage of materials, access to recycling condensers and shredders, communal change rooms and bathrooms, break spaces, creche for their children, accommodation, communal kitchens and bathrooms. The public amenities offered at the centre include the community hall, play spaces, media centre spaces, offices and boardrooms. These boardrooms can be used by non-governmental organizations for instance to aid waste pickers in legal issues and teach classes to the community. This diverse scheme is to bolster the resilience of waste pickers and the community through social inclusion and opportunity to learn and play in a safe and healthy community space.

The architectural approach followed the principles of Ecological design where landscape and buildings would be blended together. This extends to the notions of harnessing resident energies that occur on site, such as rain water, gravity, wind and thermal mass as landscapes do (Williams 2007). The architectural solution responds to these resource flows through passive design solutions and merging architecture with ecological functions. This is to ultimately liberate the design from current dominant anthropogenic reliant designs to one as self-sufficient as possible. This culminated into the concept driving the design decision process, being that of circular resource management.

12.1.1 Green Infrastructure Framework Improvements

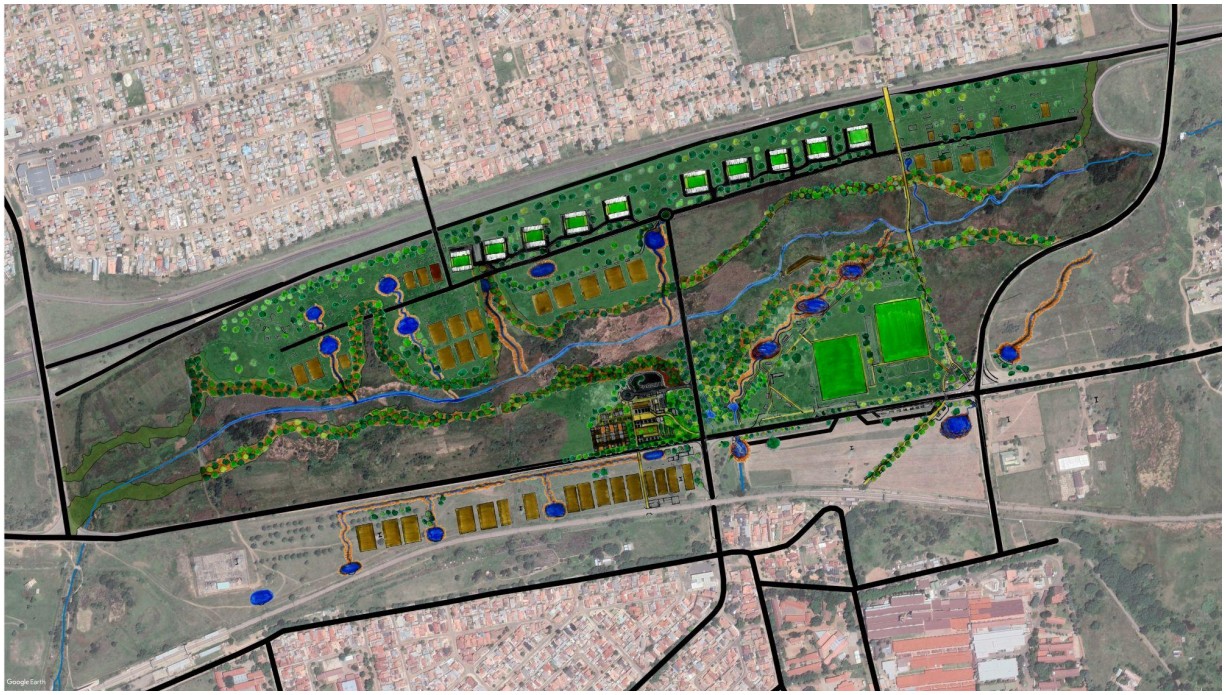

Figure 4.2 - Proposed Revised Framework for Atteridgeville following Green Infrastructure Planning Principles (Author 2022)

Upon reflection and taking into consideration the Green Infrastructure (GI) principles require further development in the framework for Atteridgeville in figure 4.2. This framework identifies that there are missing links in the connectedness of existing green spaces and a new green space network. The benefits of this green network would be microclimates working together to combat climate change. Additional green spaces actively influence users' wellbeing who are in contact with nature, as well as providing potential areas for recycling receptacles for citizens to use as a destination anchors in the parks. The interconnectedness of green spaces was explored in the project, however further attention was paid to the development of the community buy back centre.

12.1.2 Challenges with Waste Pickers

This project aimed to uplift the waste pickers as they are essential agents in the recycling industry saving South Africa approximately 750 million in 2019 through landfill divergence costs (SAPRO 2019). However engaging with the Waste Pickers was challenging as they are illegal immigrants at large who are fearful of authoritative figures. During site investigations and informal interviews it was hard to ascertain the desired spaces the Waste Pickers would ideal like to help with recycling operations. They were concerned with economic returns, access to vehicles and accommodation. This aided in formulating the ideal framework for the waste pickers coupled with information gathered by the Waste Picker Integration Guideline for South Africa (DEFF & DoSI 2022). However, improving the Waste Pickers operations efficiency was designed through case study integration. Further engagement with the waste pickers is required to create the appropriate spaces and structures for the waste pickers. I believe the scheme proposed is a great place to start the liaison process with the waste pickers gauging from their feedback on what can be improved and what does not work in this proposal.

12.2 Lessons Learned and Future Development

12.2.1 Sustainable Design through Ecological & Passive Design

David Orr (2007) speaks to the challenge of the 21st century is for designers to design "Organisms for living". This challenge through the dissertation process has proven to be an incredibly layered system approach. Sustainable designs are system designs which can solve economic, social, and environmental issues simultaneously (Williams 2007). Which is the case in terms of Green Infrastructure planning as well, however the manifestation in architecture requires in-depth planning detailing for the success of the project. Once research into ecological design and passive design began selected systems were used in the project however the design process never ends, rather milestones are met in this project and experience and knowledge improves regarding design techniques and approach into your next project. This is the case with Recycling for Resilience, many systems were explored to bolster and protect the environment, however with the time given and the nature of the project deeper understanding into systems such as plastic brick making, large scale biogas digestion plants, waste production to diesel fuel, waste picker organic collection, solar smelting can be researched to create more innovative economic uses of waste with further development.

12.2.2 Sustainability: Sustainable Building Materials

The material study in the project can allow for further exploration into reclaimed building materials as well as using natural materials found on site, such as branches for battens and trunks for columns. I purposely avoided building with materials which don't meet the South African Building Standards (SABS), as this is a public facility. However further exploration into cob and bale building methods could be explored due to the fact the grass can be harvested on site and the area. It would bolster the resource circularity intentions of the project. However the project was successful through harvesting the excavated soil and used in rammed earth structures, as well as providing rubble dumping spaces where building materials can be upcycled into usable members in building structures. Further application for recycling to be upcycled into building elements such as insulation layers (polystyrene) and waterproofing, melting plastic labels together/ironing foiled plastic paper into low cost water repellent sheets, requires scientific studies as well as practical tests to the usability of these systems. However the Recycling for Resilience Upcycling Workshop will hypothetically at this stage provide spaces for the exploration and testing of low cost building systems. This further bolsters the resilience thinking where the community of Atteridgeville can cost effectively aid its own community by providing alternative cost-effective building materials for the township.

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14 List of Figures:

15 Annexure:

WASTE PICKER INTEGRATION GUIDELINE FOR SOUTH AFRICA Building the recycling economy and improving livelihoods through integration of the informal sector August 2020

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Section E: Some Typical Stakeholder Needs Related to Waste Picker Integration

Section E

Overview of Section E

Section E presents some typical needs identified by waste pickers, municipalities and industry related to waste picker integration.

Outcomes

After reading this section the reader will:

- be aware of some of the typical challenges and needs of different stakeholders;
- understand some possible actions to respond to these needs;
- be aware that Annexure 2 includes detailed ideas of how to address many key challenges;
- understand the Ten Basic Actions to Kick-start Integration that can be undertaken immediately while preparing to develop a comprehensive Waste Picker Integration Plan (see Section H).

This section presents some key needs related to integration frequently identified by waste pickers, municipalities and industries. Annexure 2 presents some ways in which each need identified here could be addressed. It is, however, important to remember that the challenges and needs of each stakeholder must be identified in each specific context and sector, and must be prioritised within collaborative processes with waste pickers. Section H presents a participatory process that can be followed to identify and prioritise needs, and to agree on how they will be addressed as part of the implementation of waste picker integration plans.

1. Municipalities

Some issues frequently raised by municipalities include the need for the following:

1. registration of waste pickers;
2. waste picker organisations to engage;
3. stronger relationships with waste pickers and ways to work with them;
4. improved safety and cleanliness in landfills, streets and parks;
5. guidance on how to integrate waste pickers;
6. funding for waste picker integration;
7. support and funding to strengthen internal capacity (including knowledge, data, skills and human resources);
8. inclusion of work with waste pickers in key performance indicators (KPIs) so that officials have time to work on integration;
9. guidance on how to engage non-South African waste pickers;
10. guidance on how to meet S@S targets and promote waste picker integration at the same time;
11. supportive legislation, policy and bylaws.

2. Industry

Industry has many of the same needs as municipalities related to waste picker integration. In addition, there are some specific industry needs:

1. increase separation, collection and sale of recyclables;
2. reduce contamination and improve quality of recyclables sold;
3. increase collection of recyclables with low market value;
4. ensure steady supply of recyclables;
5. integrate waste pickers in and up the value chain, and include waste pickers in transformation of the of the industry;
6. expand the industry to utilise increased volumes of recyclables;
7. strengthen relations and engagements with waste pickers;
8. provide relevant support to waste pickers;
9. improve the conditions and incomes of waste pickers;
10. include waste pickers in EPR.

32

3. Waste pickers

Waste pickers working in landfills and the streets share many common needs. These include:

1. **Recognition, respect and social inclusion**:
   - registration and identification cards
   - elimination of stigmatisation, harassment and social exclusion
   - recognition of their occupation
   - appreciation of their contributions.
2. **Engagement as equal partners in participatory decision-making**:
   - partners in design, implementation and revision of waste picker and recycling programmes and initiatives
   - participatory processes
   - access to government officials.
3. **Fair and improved income**:
   - access to materials
   - trucks and other vehicles to transport materials
   - equipment and support to move up the value chain
   - consistent, fair and transparent prices
   - equitable distribution of profits in the value chain
   - payment for collection
   - first preference as S@S providers and inclusion in all S@S
   - contracts and agreements with private and public institutions.
4. **Infrastructure and space**:
   - covered, secure, safe space to sort and store materials and equipment
   - recycling centres and recycling hubs
   - infrastructure for offices, meetings and so on
   - ablution facilities
   - crèches.
5. **Improved health and safety**:
   - reduction of health hazards
   - occupational health and safety coverage
   - medical care
   - access to clean water and ablution facilities
   - safe working conditions in landfills and streets
6. **Gender-specific needs**:
   - commitment to gender equity and gender transformative planning
   - equipment designed for use by women
   - access to clean water and ablution facilities
   - secure access to all materials
   - protection from gender-based violence
7. **Skills development and accredited training**
8. **Needs related to S@S and existing waste picker projects**:
   - elimination of harm
   - social plans and compensation for harm when waste pickers' livelihoods and working conditions are negatively affected by recycling programmes and contracts
   - inclusion in S@S
   - partners in the development, implementation and revision of future recycling and waste picker programmes
   - partners in the development, implementation and revision of future recycling and waste picker programmes
9. **Support for organising, organisations and democratic waste picker cooperatives**:
   - Core funding
   - Funding for organisers
   - Funding for organising campaigns
   - Funding for pilot projects.
10. **Multiple approaches to integration**:
    - support for integration of democratic waste picker cooperatives
    - support for approaches to integrate independent waste pickers

33

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Recycling Flyer for Atteridgeville (Author 2022) :

Final Design for Recycling for Resilience: