SUSTAINABLE LIVING

an exploration into the sustainable adaptation of Tembisa's human settlements

Morongwa Emmy Moloto

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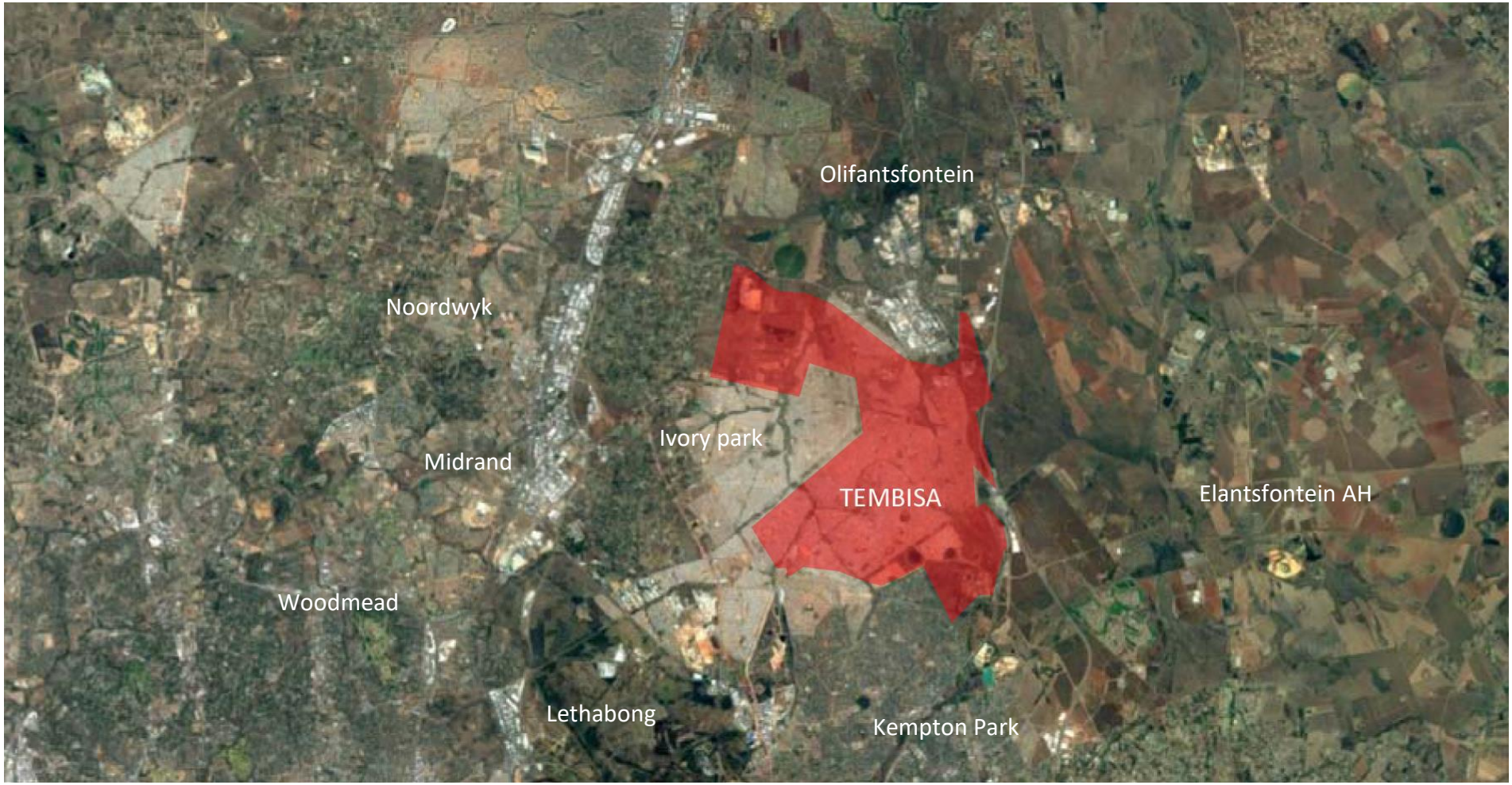
482649

Research Report Document

This document is submitted in partial fulfilment for the degree: Master of Architecture (Professional)
at the University of the Witwatersrand, Johannesburg, South Africa, in the year 2017



Tembisa. (Google Earth, 2016)

DECLARATION

I, Morongwa Emmy Moloto [482649] am a student registered for the course Master of Architecture (Professional) in the year 2016. I hereby declare the following:

I am aware that plagiarism [the use of someone else's work without permission and/or without acknowledging the original sources] is wrong. I confirm that the work submitted for assessment for the above course is my own unaided work except where I have stated explicitly otherwise. I have followed the required conventions in referencing thoughts, ideas, and visual materials of others. For this purpose, I have referred to the Graduate School of Engineering and the Built Environment style guide. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my unaided work or that I have failed to acknowledge the source of the ideas or words in my own work.

ABSTRACT

The housing crisis is a global problem, however, the issues faced in South African settlements largely stem from the colonial system which enforced separation by violating specific groups of people's rights to adequate housing: *"The right of every woman, man, youth and child to gain and sustain a safe and secure home and community in which to live in peace and dignity".* This system contributed to the low densities found in South African cities today, and although we are more than two decades out of the colonial regime and its laws, our urban landscape is still characterised by a limited range of housing types, unequal accessibility to urban opportunities, and a lack of social integration. The urban quality of our cities today makes housing in well-located areas unaffordable for the urban poor, thereby displacing them to the urban peripheries, far from employment opportunities and important social amenities.

Tembisa (established in 1957 for black South Africans who were forcefully removed from areas in Edenvale, Germiston, Midrand and others) is an example of such townships. The housing projects in these areas have continued to perpetuate the colonial urban form by creating large settlements of low quality mass housing. Unfortunately, this pattern has strengthened the income and racial lines that solidify the segregation still experienced today, consequently, the disadvantaged remain confined in poverty situations and long term social costs. The daily commute to economic and social urban opportunities comes at a great cost to the residents as access to transport systems is limited and often expensive, even private car ownership has become expensive as these commutes often need to be taken every day of the week.

Analysis of the study area revealed that beyond the provision for families, there is an emerging class of singles and childless, young couples who are seeking well-constructed, smaller homes in pleasant walkable communities. However, they don't want to relocate due to the affordability of lifestyle and existing social networks. Currently, Tembisa is missing the housing types, amenities and urban opportunities necessary to meet these people's housing needs.

In this report, an innovative approach in the processes of planning our human settlements in such peripheral townships was explored. Principles were mainly derived from international and local precedents, and the preceding sustainable design guidelines such as the Comprehensive Housing Plan (CHP) for the development of Integrated Sustainable Human Settlements Breaking New Ground (BNG). These policies emphasise the re-integration of cities through the densification of existing infill, well-located areas for mixed-income classes in an aim to develop integrated human settlements. Internationally, vital guidelines were adopted from Bioregional's One Planet Living concept: *"A vision of a world in which people enjoy happy, healthy lives within their fair share of the earth's resources."* This concept developed from their experiences at BedZed ecovillage in London, a project which ultimately influenced their national building regulations.

A combination of the different policies, design principles and guidelines was linked to the end-user preferences expressed during the analysis, in an aim to meet the needs of the people more efficiently. The link revealed that integrating a variety of tenure options and housing types (rental, bonded, and subsidized); various densities; a higher level of services and commercial opportunities will meet larger groups of people's needs, and encourage social interaction in housing developments. Furthermore, implementing the principles expressed in these policies emphasises community participation, social and economic development throughout the project. This research report bridged the gaps between policy, principles and implementation by adapting global sustainable principles to a specific context, thereby creating a new and improved neighbourhood character to be proud of.

DEDICATION

I dedicate this book to all my family and loved ones, especially to my mom and dad.
Thank you for your faithfulness to me and for fully supporting my passions and dreams throughout this architectural journey, you are the best and you're completely irreplaceable.

I Love You so much!

ACKNOWLEDGEMENTS

Thank you Lord God for seeing me through every challenge I faced throughout this degree, you are faithful and I would not have been able to do anything without you.

I would like to express my gratitude to Hilton Judin for believing in my project and for all your support, advice and being there for each of us, as big a group as we were, your faithfulness to us is highly appreciated.

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Mrs Betty Moloto; Manager at "Butle Buhle" Pty(Ltd) for her speedy responses whenever I needed information regarding the study area.

Finally, I'd like to extend a big thank you to Wits University and the School of Architecture and Planning (SOAP) for giving me a chance to explore the talents God gave me and showing me how I can use them to affect others positively while adding value to my own life.

Thank you so much!

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DEFINITIONS

ADAPTATION: The process of alteration in the structure or function of an organism or any of its parts by which the organism becomes better fitted to survive and multiply its environment. (www.dictionary.com)

SUSTAINABILITY: Supportable, manageable, rare. The ability to be upheld or defended; the ability to be maintained at a certain rate or level of economic activity, development, agriculture etc; not personal resources by altering methods of transportation, energy consumption and diet. (The Oxford Dictionary)

SUSTAINABLE DEVELOPMENT: Meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. (1992 Rio "Earth Summit")

SUSTAINABLE LIVING: A lifestyle which attempts to reduce an individual's/society's use of the earth's natural resources

UNSUSTAINABLE: Not sustained. Not supported materially or as valid or correct. The quality of not being sustainable. (The Oxford Dictionary) leading to depletion of resources or degradation of the environment. (The Oxford Dictionary)

URBAN SPRAWL: The expansion of human populations away from central urban areas into low-density, mono-functional and usually car-dependent communities, in a process called suburbanization. In addition to describing a particular form of urbanization, the term also relates to the social and environmental consequences associated with this development. ("Urban sprawl", 2016)

LOCAL AUTONOMY: Independence or freedom, as of the will or one's actions; the autonomy of the individual; a self-governing community

"The building sector has the highest potential for sustainability improvements, they deliver environmental, social & economic benefits.."

UNEP: Sustainable Solutions

ACRONYMS:

AC ·RO ·NYM

noun (pl. -ries)
A word formed from the initial letters or groups of letters of words in a set phrase or series of words.

UN:	United Nations
UNEP:	United Nations Environment Programme
SUSHI:	Sustainable Social Housing Initiative
RDP:	Reconstruction and Development Programme
EMM:	Ekurhuleni Metropolitan Municipality
TOD:	Transit Oriented Development
NMT:	Non-motorised transport
CPT:	Connected Public Transit
CMU:	Concrete Masonry Unit
BNG:	Breaking New Ground

Figure 1: Design Question:

Is there an Architecture that can, through design, facilitate the learning and unlearning process necessary in the global transition to sustainability living? *(Moloto, 2016)*

1. SUSTAINABILITY

1.1 Introduction to Sustainability

1. SUSTAINABILITY

1.1 Introduction to sustainability

Sustainability as described in terms of development can be defined as: "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs." (1992 Rio "Earth Summit"cited in Golubchikov and Badyina, 2004:4) The key concepts contained in this definition are firstly identifying the 'needs' of the wold's poor and giving priority to them, and the unavoidable limitations brought about by the environment's ability to meet the needs of the present and future generations.

The term sustainability has been challenging to define over the years as it is generally perceived in different ways and in some cases, it is said to be "ill" defined. "Increasingly anyone would perceive sustainability as though its meaning was self-evident. What exactly is demonstrated to be sustainable, and what needs to be sustainable, generally is not specifically addressed." (Holmes, 2007:155 cited in Gwavvu, 2015:11). Further research on the concept lead to defining sustainability as it relates to development. Although it stemmed from the mitigation of climate change, sustainable development consists of self-sufficient "green buildings" which are environmentally friendly; socially enhancing; and are integrated into the greater context and its systems, i.e transportation, important social amenities etc.

Although sustainable buildings impact the natural environment at a reduced capacity to conventional buildings, they have important social implications as well. Through urban integration and planning, residents

can benefit from the economic opportunities generated by sustainable housing units, in addition to improved comfort, health and well being. This shift to sustainability in housing developments has a high economic value and will result in financial savings for the residents, building managers and even the country. ("Sustainable Social Housing", 2013)

Naturally, housing is to be addressed as the priority, as it is as much an issue in Tembisa as other parts of the world. The new approach to the design however, also places an equally great emphasis on the daily lifestyles of the client community and options of meeting those needs can be explored. Issues such as waste management, water treatment and energy efficiency have always been pressing concerns in Tembisa. One of the solutions explored in waste management, for example, is that of creating informal dumping sites for excess human and animal waste. However, these areas are oftentimes located between residential blocks thereby creating an unhealthy and uncomfortable air quality for the environment. Innovative solutions must be explored.

Architects can begin to design buildings and communities which can influence an individual to empower him/herself by taking responsibility for their own wellbeing or that of their dependants into their own hands, and improving their own qualities of life through simple daily choices directed toward sustainable living. I have undoubtedly faced challenges which appear overwhelming at times during the development of this design, but dealing with issues which stem from the decisions made during the unjust apartheid era have never been easy to attack.

When approaching environments with a great need of change, unforeseen complications are sure to arise, it is therefore important to read this research report with the mindset of on-going transformation. The ideals expressed in the report might not be achieved during this generation, but they aim to populate the minds of the upcoming generations with information that suggests an improved approach to designing for residential communities.

PART 1: Community characteristics

2. HUMAN SETTLEMENT DEVELOPMENT

2.1 The development of human settlements in the study area

2.2 Housing densities in study area

2.3 Urban sprawl

2.4 The need to adapt

2. HUMAN SETTLEMENT DEVELOPMENT

2.1 The development of human settlements in the study area

Although the lack of housing is a global crisis, the need to provide adequate affordable housing is most prominent in developing regions of the world. Areas such as South Africa develop rapidly due to the large growth in population and migrations from underdeveloped areas, increasing urbanization. This places a higher demand on the governance of such areas to provide affordable housing and the infrastructure required to meet their service needs, as a result, the cities struggle to cope with this demand. This ongoing cycle eventually leads to the development of slums and informal settlements, countries like South Africa, Asia and South America suffer from this pattern. Such areas have shelters built with little knowledge of building regulations, sanitary provision and basic infrastructure.

The formation of slums provides us with an important mechanism for the accommodation of many poor and disadvantaged people, but both the present and future generations can be affected dangerously by today's slums. The effects include risking the health of the residents due to poor construction and overcrowding; the deterioration of the environment in terms of pollution and sanitation; and the possibility of environmental hazards caused by poor drainage or flooding for example. (Golubchikov and Badyina, 2004:5)

It is not yet common practice in developing countries to address the social, cultural, environmental, and economic factors of housing in a cohesive approach. Integrating these different approaches will lead to affordable housing which is not only low on construction costs, but also addresses the environmental and social issues present in the community. A design intervention which aims to avoid the accumulation of precarious housing situations will require more time for design and planning before implementation begins.

2.1.1 Subsidized housing

The study area targeted has a variety of housing typologies and designs, but the settlement did not begin this way. Most of the homes built in the study area before the liberation in 1994, weren't attached row-houses like what we find in Soweto, they were standalone homes built on stands without boundary walls. As the years progressed people built their own boundary walls and fences for security and demarcating thresholds, they personalized their yards and made those houses homes. After the apartheid regime came to an end, the government sourced private development companies to build houses which would be partially or fully subsidized by the government. Unfortunately, the design and construction of post-apartheid housing was not visibly different from the colonial houses, and the dissatisfaction persisted.

Among these schemes was the Reconstruction & Development Programme (RDP), introduced in the segregated areas such as townships/rural areas, to contribute to the development of human capacity, in other words, it was intended to ultimately improve the residents' quality of life. Upon identifying these systems in some areas of Tembisa, I had to investigate the following in order to best avoid whatever inefficiencies arise from dealing with housing needs for a community such as this one.

The purpose of RDP implementation

The RDP was put in place to address many of the social and economic issues that the country has been facing as a result of the damage caused by the segregation. Amongst these issues is the global housing crisis. The programme also refurbishes existing buildings, particularly in the inner city, to provide low cost housing for the poor, but in townships such as Tembisa, Soweto & Alexandra, it is often in the form of new buildings. Fundamentally they hope to alleviate poverty and build a stronger economy by building housing units for the poor, thereby improving their lives. However, these units are usually small and constructed with relatively inefficient building materials, making it uncomfortable to live in them.

End-user response

Over time, the protests around post-apartheid housing moved from being common among shack-dwellers only, to protesting alongside RDP recipients, the same people they envied when they were on the waiting list to receive a subsidized house. The recipients (who aren't necessarily highly educated) took note of the walls made of large, light grey concrete bricks left un-plastered and un-insulated, and openings in the roof structure and window joints. The air leakage results in unfavourable indoor temperatures at any given time. An example of an unexpected outcome, was when a recipient's newly received RDP house in Pelican

Park, Cape Town, blew off her house during a strong wind a couple of hours after she received it ("'We are Humans and Not Dogs,'" 2014).

Although the publicised complaints are directed towards the structure of the houses, one must consider why the recipients who have moved back into shacks (and rent out the RDP house) aren't as complainant, after all, the structural integrity of a shack is worse than that of an RDP house. This begins to shift our focus and reveals a different need that might need to be addressed, a bigger more constant one, one which relates to their well-being, the sustainability of a high quality of life, in other words, we need to focus on their sustainable living.

Causes for dissatisfaction

The Minister of Housing, Tokyo Sexwale announced in 2010 that South Africa is only second to China in the delivery of houses. If we assume that the average size of a household is 3.6 people, it means that nearly a quarter of the South African population have been recipients of this housing programme, yet "two decades later the number of informal settlements has increased more than nine-fold" ("'We are Humans and Not Dogs,'" 2014). This means that about a third of the country is living in some type of informal housing. It is often in the form of informal settlements, or in most cases around Tembisa, "it means that people erect shacks in the backyards of formal houses and pay rent to the homeowner" ("'We are Humans and Not Dogs,'" 2014). Therefore, our urban fabric became more informal as our housing delivery programmes increased over the two decades. We can attribute a bulk of this to the post-apartheid increase in our city's densities. The underdevelopment of the Bantustans also made it easier and quicker to inhabit, this led to the multiplication of shacks in a short amount of time. A common occurrence is that the recipient of an RDP house might have to travel far for work, transportation subsidies or jobs, as these aren't provided with the house. Eventually they sell the the house for a fraction of the price to meet immediate needs, these actions are often linked to the quality of the house as well.

According to the National Home Builder Registration Council's (NHBRC) figures, of the large number of RDP houses built by 2010 (over 3 million) more than 2.6 million of them are "high risk", nearly 610,000 of them need to be demolished and rebuilt. "Twice that number have workmanship related issues, which the NHBRC estimated (in 2014) will cost on average R12,000-00 per house, the combined cost of remedying structural defects, minor defects, and non-compliant construction is estimated to be R58.7 billion."

These structural issues are said to be due to the inefficient construction companies who seem to always acquire the social housing tenders, probably due to the reportedly low profit margins that discourage reputable companies from pursuing such tenders. This cycle forces people to look for alternative means of satisfying their housing needs.

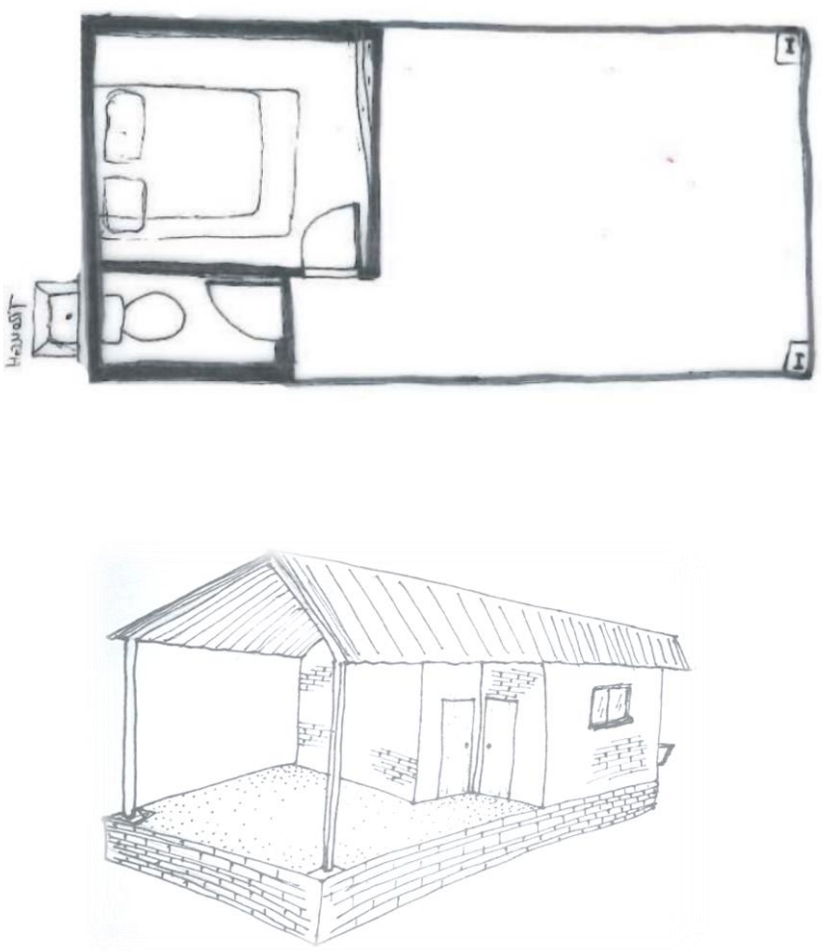


Figure 2: The RDP house 1990's to mid-2000's (Moloto., 2016)
The home consists of one room (to be used as a bedroom, living and kitchen space); one toilet and a trough outside the back of the house.

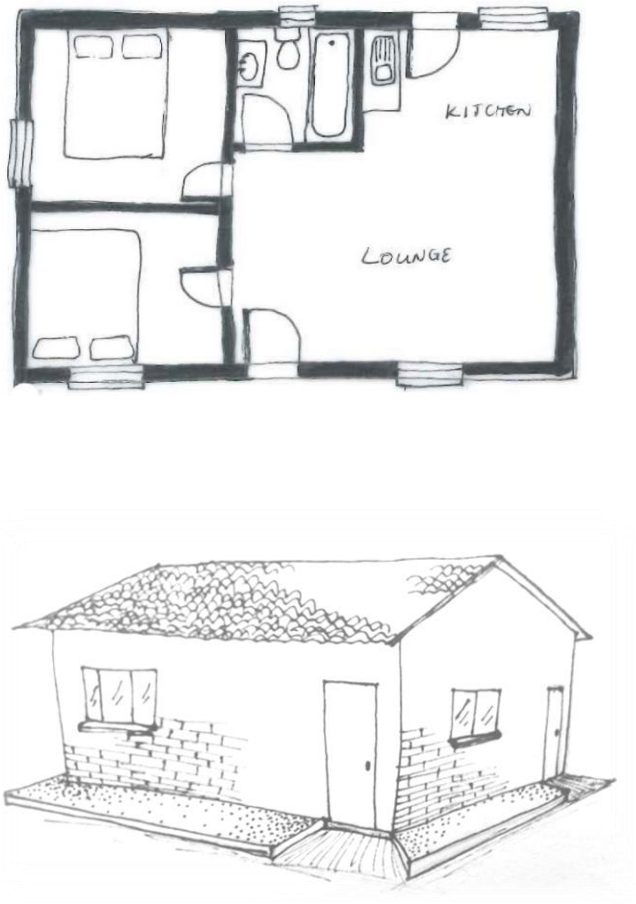
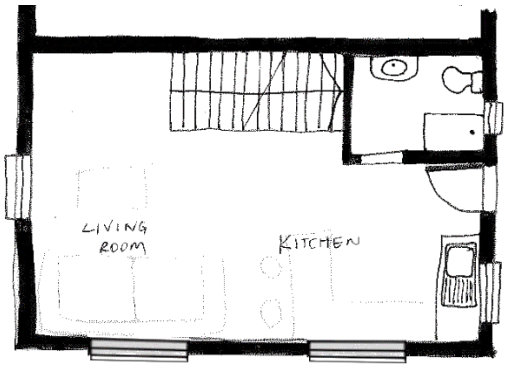
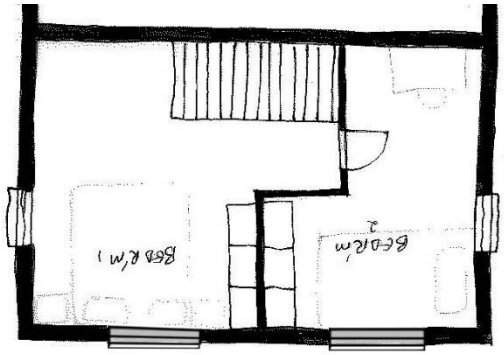
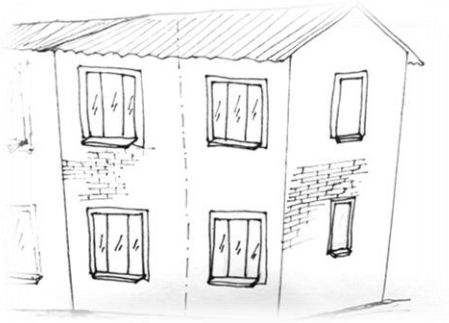


Figure 3: The RDP house late 2000's (Moloto., 2016)
The house consists of two bedrooms, a full bathroom and open plan kitchen and living spaces, an upgrade from previous models.







Quick case study

Upon receiving the subsidized houses, most of the households began extending them and expressing their identity and experimenting with style; the boundary walls also vary in size and style from house to house. The crippling effect of duplicating homes is lost here because the homeowners began to take the construction of their individual homes into their own hands. Below is an example of a household of 6 living in the study area, they received a subsidy for a new house with four rooms altogether. The homeowner worked in the file room of a mechanical company (Alfa Laval (Pty)Ltd) which shut down almost immediately after they received the house. He used money he had saved over the years to extend the house gradually as finances fluctuated.

Skills & training: The homeowner learnt from labourers involved in the ongoing construction projects in the neighbourhood, and used drawing skills he observed at the company to design and provide all the technical documentation required for the construction.

Materiality & labour: The homeowner walked around the neighbourhood in search of construction sites, as this was big at the time, and he hired young skilled labourers who lived and worked in Ivory Park. Building supplies were purchased from a local company (Mathabane Building Supplies), less than a kilometre from his house.

Additional income: Over the years the garage extension has been rented out to small-business owners (internet café/salon); rental for residential use; a workshop/storage for their family business (tableware sales). In their backyard, a peach tree and vegetables have been planted to sell locally, and a chicken hen was built for breeding and selling of live chickens and eggs.

Figure 5: The subsidized house as provided: Two bedrooms, a bathroom, a kitchenette and a sitting room. Boundary walls were provided on three sides only. (Moloto, 2016)

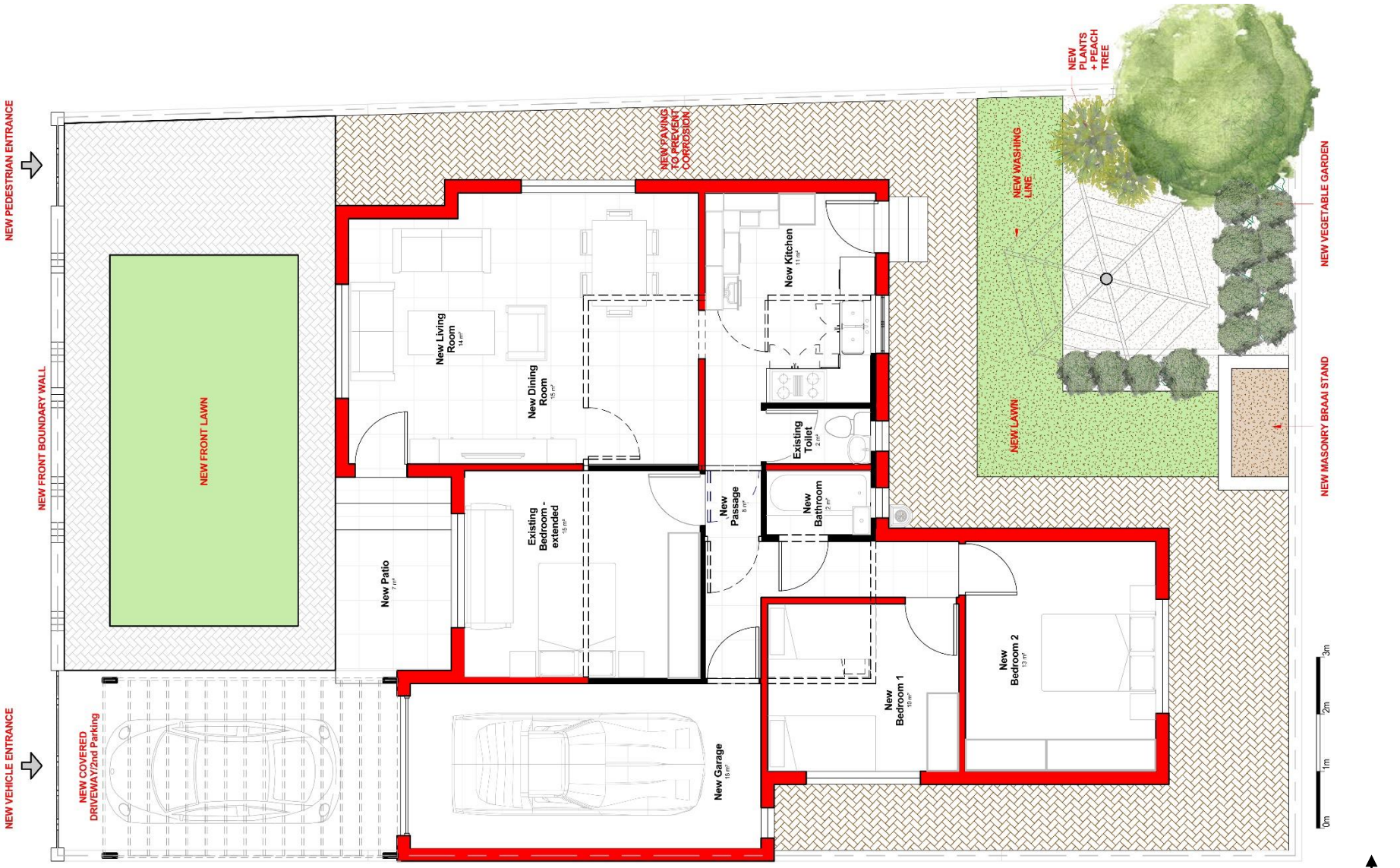


Figure 6: The extension: Three bigger bedrooms, a car garage/rental space; bigger open-plan family room & dining room also used as study area; a bathroom and kitchen; a backyard with small animal and vegetable farming for selling and consumption (Moloto, 2016)

2.1.2 Bonded housing

Although the study area has numerous communities built with subsidized homes, there are several pockets of bonded housing that add a level of pleasantness to the township. An example of such communities is Friendship Town, a gated community located in Commercia Extension 9 in Tembisa.

Figure 7: Map of Friendship Town, Tembisa (Google Maps, 2017)

The project emerged out of an agreement between the Chinese government and the South African government, handed over as a 'gift' project in any sector of priority to the incoming ANC government after the liberation. The funds were initially earmarked for low cost housing, as the need was at an estimated 18 000 houses at the time, however, it was noted by the council that there hadn't been any provision made for individuals who weren't poor, but couldn't afford the cost of living outside of the township, thus it was agreed upon in 1998, that 664 lower to middle-income units of variant typologies were to be built on the same site. The community was to be gated with a security post at the entrance, to add a level of safety and security for the "better off" township residents. Unlike the RDP houses provided freely, these houses were to be bought and sustained by the household owner.

Community involvement

The site was initially zoned for mixed use commercial, and before subsidized housing was even considered, the site was to be developed for employment opportunities. The council communicated their intentions to the community members and they preferred to rather have housing developed there. The community was informed of this decision in an open public assembly of the Chinese government's grant, and that the China National Corporation for Overseas Economic Co-operation (CCOEC)expertise would be utilized to benefit them. The steering committee that was formed met with two community representatives every fortnight to discuss the progress and issues of the project. Subcontracting was also open to the community members for equal tendering opportunities and employment. (Dent, 2010)

On-site skills and development

Direct building skills: The CCOEC and project manager transferred direct building-related skills and business operation skills to the local subcontractors by providing on-site training and developing emerging entrepreneurs. A builder could begin by building a single storey small house to building triple storey apartment buildings upon passing quality checks based on what they had been taught.

Technology transfer: A majority of the builders had never owned bank accounts prior to this project, the project manager helped them initiate the processes and begin using cashless technology for payments, they were also trained on starting and running successful businesses.
Quality control: The CCOEC engineers and project managers introduced the NHBRC to the builders while closely supervising the processes on site, this taught the subcontractors to prioritise quality. (Dent, 2010)

A mixed tenure of house types

Apartments of varying size & affordability (www.Ithembaproperty.co.za)

Figure 8: Map of Friendship Town (Google Maps, 2017)

Figure 9: Map of Friendship Town (Google Maps, 2017)

Bonded houses of varying size and affordability, plus extended units (www.property24.com)

Mixed use industrial and commercial

Figure 10: Map of Friendship Town (Google Maps, 2017)

Figure 11A: Extensions to provided houses (Moloto,2017)

An illustration of a typical street within the study area and how it has been adapted to community needs over the years. (Moloto, 2016)

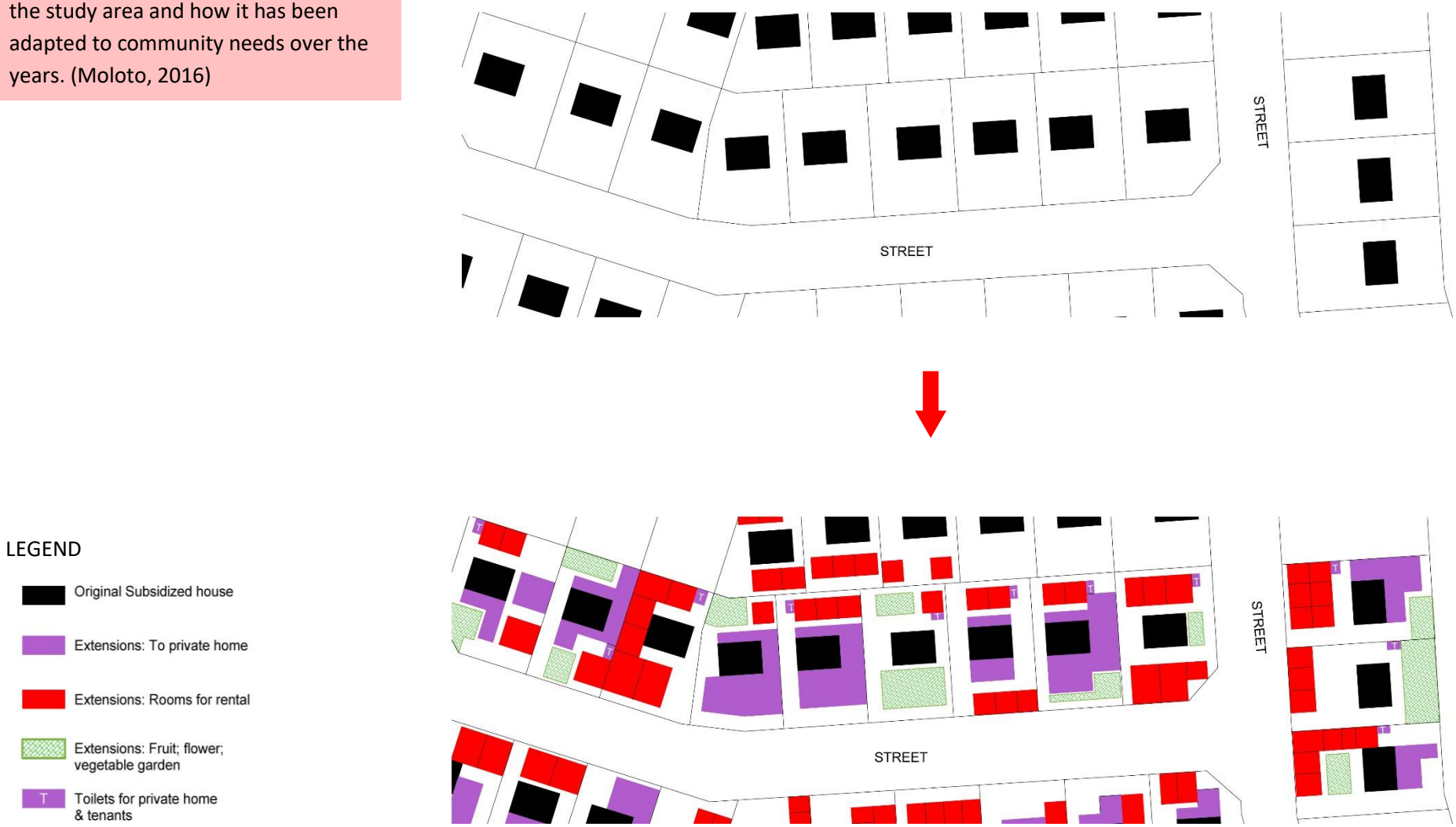
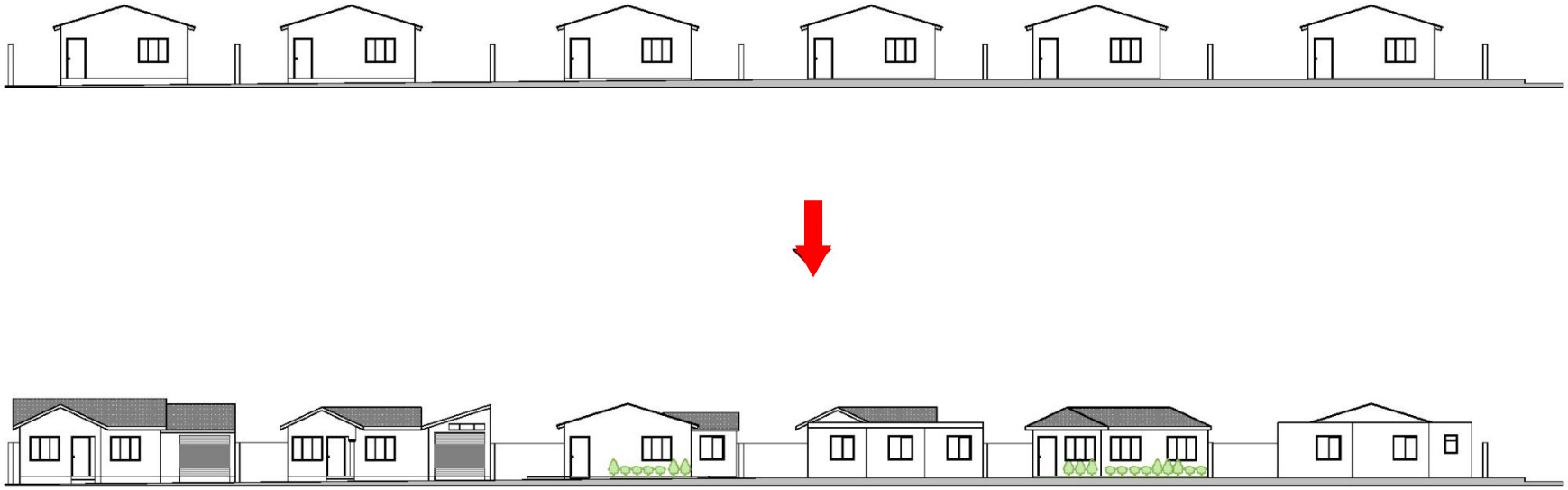


Figure 11B: Extensions to provided houses (Moloto,2017)



2.1.3 Informal settlements: Shack dwellings

Case study: New Hani Park

The settlers of this site have been occupying it illegally since mid-1998, after people followed one man's act of erecting a shack in an undeveloped, empty piece of land. These dwellings emerge on empty infill plots between residential blocks, and often add to the lack of hygiene, increased pollution and overcrowding of unpleasant spaces.

Community characteristics

- Shacks erected as the primary home
- One tap serves the entire community with water,
- No electricity supply
- Multiple shacks on one plot of land (overcrowding)
- Outdoor formal & informal toilets
-

Entrepreneurial opportunities:

- Trade along street edge
- Growing their own vegetables
- Trade using network marketing
- Majority of hair salons are erected from shack material

Adaptation

There are a number of skills and developments taking place within the community. Some residents have taken advantage of the Main Transportation Route by advertising their goods & services along that route, as well as outdoor spaces that encourage the use of the street edge for social interaction.

The residents have adapted to their limited means by seemingly efficiently personalising their homes & businesses to add some Dignity & functionality to them. However, trade in this neighbourhood is often short-lived because of the rapid decay of goods due to the harsh weather conditions affecting the structures, damaging the goods, & adding dust and debris to them

Figure 12: New Hani Park context (Moloto, 2016)

A research & design opportunity

Survival: How have they made provision for shelter, income opportunities, and other socio-economic factors?

Figure 13:

Boundary walls created from available resources, for increased safety & security of the site. (Moloto, 2016)

Figure 14:

Outdoor Social spaces which support community interaction & street use (Moloto, 2016)

Figure 15:

Because of the limited supply of water to the individual plots, residents walk to periphery of site to collect water from public tap with buckets. (Moloto, 2016)

Figure 16:

Outdoor waterless toilets have been created from available materials, and government provided mobile toilets. (Moloto, 2016)

2.2 Housing densities in study area

The settlement issues resultng from South Africa's colonial systems of apartheid have cemented the economic deprivation and segregation still experienced today, this is the reason for the recurring limitations in housing types, class integration and urban opportunities.

By neglecting to radically change the way in which communities are planned, we are compromising the housing rights of people living in areas like Tembisa because urban sprawl, low density and a lack of well-located affordable housing opportunities are an inevitable result. The practice of architecture and town planning, in conjunction with government policies, must be radically changed for transformation to take place. The traditional free standing house on a large piece of land must be revised by creating awareness of the ecological footprint imprinted by such systems. Urban sprawl can be mitigated by reducing the amount of land used for the support of an individual's consumption, thereby increasing urban densities and reducing land use requirements. Moreover, "Studies have shown that when residential density was doubled, private transportation could be reduced by as much as 20-30%" (*Sustainable Medium Density Housing*, 2008).

It is reported that the total global resources are consumed most by citizens of developed countries (about 80%), the municipal and industrial waste (about 75%) and carbon dioxide emissions (about 80%) (*Sustainable Medium Density Housing*, 2008). The statistics prove the lack in addressing the real cause of the problem, that production and resource consumption has been, and continues to be, unequally distributed.

Figure 17: Low density housing developments in study area (www.gov.za and Moloto,2016)

2.3 Urban sprawl

The perception of density

The perception of density differs between countries, among different social groups within countries. Factors such as gender, age, occupation, income and other social factors cause further differences within social groups as well. (*Sustainable Medium Density Housing*, 2008)

Measuring density

There are three components used to measure density, these are interrelated and dependant on each other, they are also determined by other factors and can be calculated. They are known as building density, occupancy density and population density.

Building density

The number of dwelling units per area, also considering the space between buildings, building width, building configuration and building height. Gross residential density falls under this category and is defined as the total number of dwelling units divided by the total site area, net residential density can be measured as being higher than gross residential density as it can be increased by decreasing the unit size; increasing vertically in height and increasing the coverage. Row housing and flats can be compared using net residential density, due to the increasing social needs of the number of people needing more space and lowering gross density.

Occupancy density

The number of people per dwelling unit, calculated by measuring income, the cost of floor space and a family's spatial needs.

Population density

Persons per hectare, it is therefore the product of building density and occupation density as it is expressed as the number of people divided by the site area. This has perceived density and crowding as sub-categories, the first refers to the cultural and social backgrounds of an individual, influencing how dense an area feels, it is unique and differs from person to person. Crowding typically depends on how large groups of people could be considered as too many by certain people.

Competing theories on density

Research indicates that the use of density as an absolute measure for the quality of an environment is limiting and can have greater, long-term negative consequences than good. Density should rather be used as one of the different factors contributing to environmental quality, others include spatial planning, the standards of amenities and liveability of homes. Research indicates that if density isn't varied for different places and for different times, it might frustrate human activity economically and environmentally due to its irrelevance when copied from one environment to the other.

Density Extremes

The individual free standing residential unit has been used as a housing typology for housing developments in South African cities due to the negative light associated with higher density development. The low standard of government subsidized high density residential developments in Tembisa, such as Ehlanzeni Hostel, have contributed to this perception. On the one extreme, higher densities can overload services and supporting infrastructure which could result in crowded and unsatisfactory environments. On the other extreme, low densities tend to increase the cost of land and infrastructure is further limited, thereby decreasing social integration, so there cannot be absolute standards of density. (*Sustainable Medium Density Housing*, 2008)

Effects of urban sprawl

Low densities tend to separate activities and uses of land, and orientate neighbourhoods inwardly, placing a great dependence on private motorised transport. Tembisa, and other suburb neighbourhoods surrounding it, are examples of such sprawling neighbourhoods. The low levels of residential densities affect the neighbourhood negatively as small-scale economic activities are limited due to expense, and larger enterprises tend to dominate the economic sector as they can afford the higher rental rates. Low densities result in lower levels of support for facilities, thereby increasing costs for social and service units to a largely unaffordable level. For pedestrians, access to opportunities is inconvenient as public transportation is often unreliable, expensive and inefficient. Land is consequently expensive to buy and maintenance of large plots is minimal resulting in dangerous and unused areas.

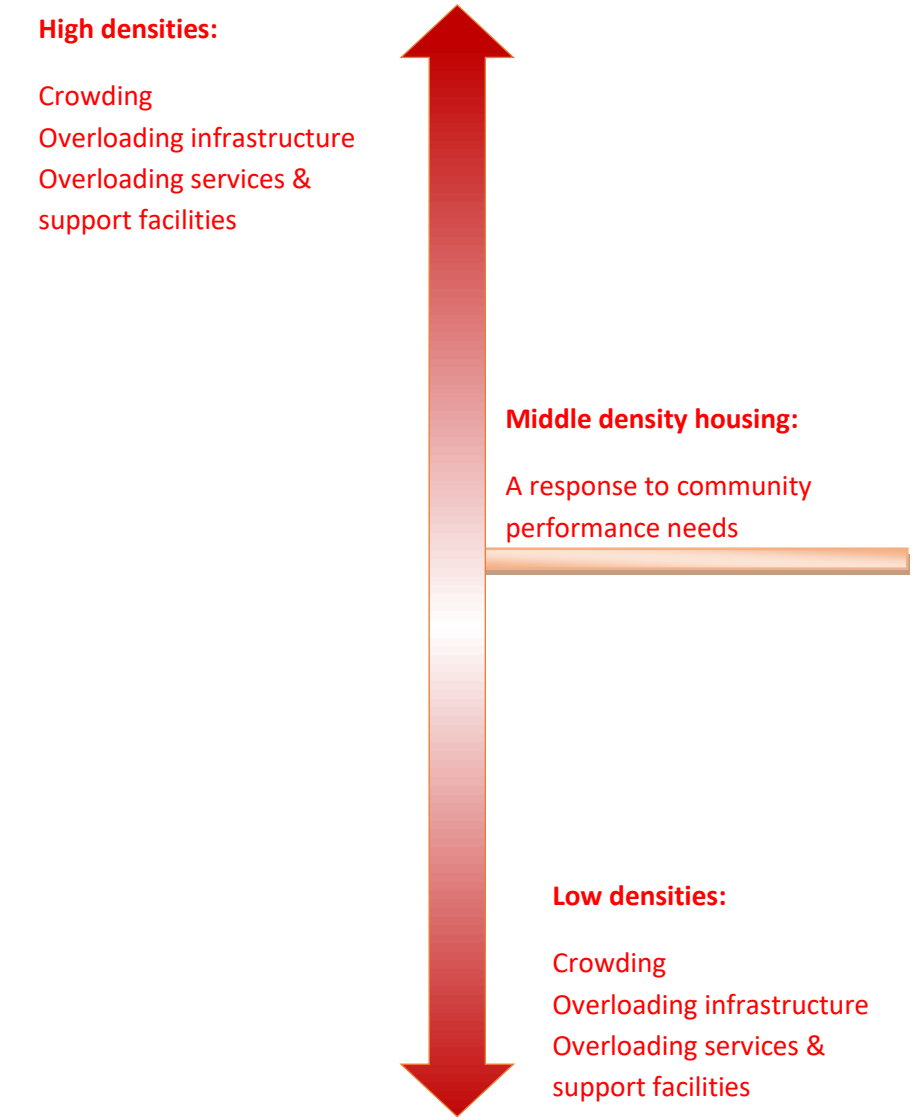


Figure 18: Density extremes (Moloto,2017)

Figure 19: High Quality well-located medium-density housing: Donkin Street houses, Port Elizabeth (www.nmbt.co.za/listing/donkin street)

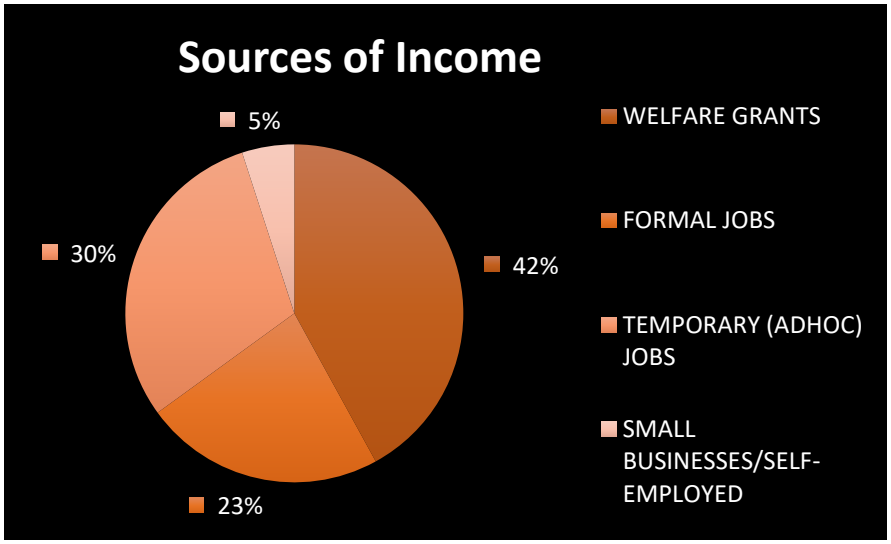
Figure 20: Low Quality medium-density housing on urban periphery: Ehlanzeni hostel, Tembisa (https://gis.ekurhuleni.gov.za/EMMViewer4 /)

2.4 Community characteristics

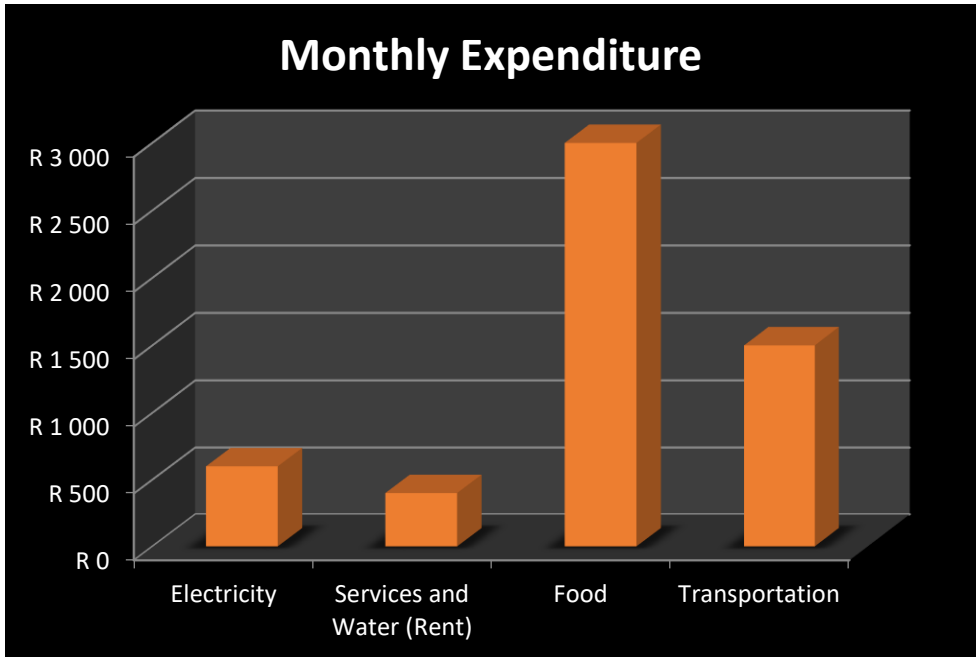
The site analysis involves investigating the different factors of sustainability that cause lack in the study area, it also determined the consequential conditions which make living there unsustainable.

2.4.1 Employment sectors in study area

A summary of the different sources of income, what people in the study area spend money on each month in terms of resources used for daily living, and how much is allocated to which function was investigated. This data was retrieved from surveys, questionnaires and informal interviews which were conducted anonymously with a group of 20 homes, 14 of the material was returned with answers and they are given as an average in each case.



Pie chart (Left): Pie chart showing average sources of income in study area. (Moloto, 2016) Refer to Appendix A for survey.



Bar Graph (Above): An average of selected items and their monthly cost to a typical household family of four to six (4 – 6 people) living in the study area. (Moloto, 2016) Refer to Appendix B for survey.

R3000 on food

R1500 on transport – per person in household

R600 on electricity

R400 on services and water

Although households in the study area cannot be numbered among the poorest of areas in South Africa, the employment rate as we measure it today is considerably low. Most households rely solely on the welfare grants which currently stand at an average of R350 per child per household. The high rate of teenage pregnancy in the area coupled with the high rate of unemployment is a major cause for this reality. There is also a rise of people who use their abilities and skills to do a lot of adhoc jobs which would be considered of a low level for most people. There are a few young professionals who get good employment opportunities and move to more developed suburbs, there is a small percentage of people who decide to empower themselves by running small businesses from their homes and using mobile trade.

The purpose of this analysis is to investigate what infrastructure needs to be put in place to assist the lack in job opportunities, i.e small business rental units and social amenities such shops/restaurants/retail can make it easier for the people of that community to make an income within the same community and not need to commute so far for the same opportunities. There is also a need to make it easier for people to learn/research/train in various arms of industry in order to improve themselves and empower their communities, as travelling far to varsities and colleges is costly and as a result is not enjoyed by all.

This calls for work centres to be established within housing developments, where people can learn and work using the advantages offered by technology.

This also provides us with information on where money gets spent the most, and should therefore be considered for innovative cost saving solutions, i.e municipally supplied electricity, transport costs to work and grocery stores etc. The design intervention should therefore propose design and infrastructure facilities to address these issues.

2.4.2 Lack of water saving and treatment strategies

Water retention and rainwater harvesting strategies are not common practice at a domestic scale, the study area is thus heavily reliant on municipal water. The issue with this system is that the municipality cannot efficiently supply for all households within the community, they are overwhelmed, much like the electricity crisis we have been facing as a country, the water connections are disconnected almost daily for hours at a time without prior notice. Additionally, methods for storm water retention have become overwhelmed with surface run-off that accumulates due to storms.

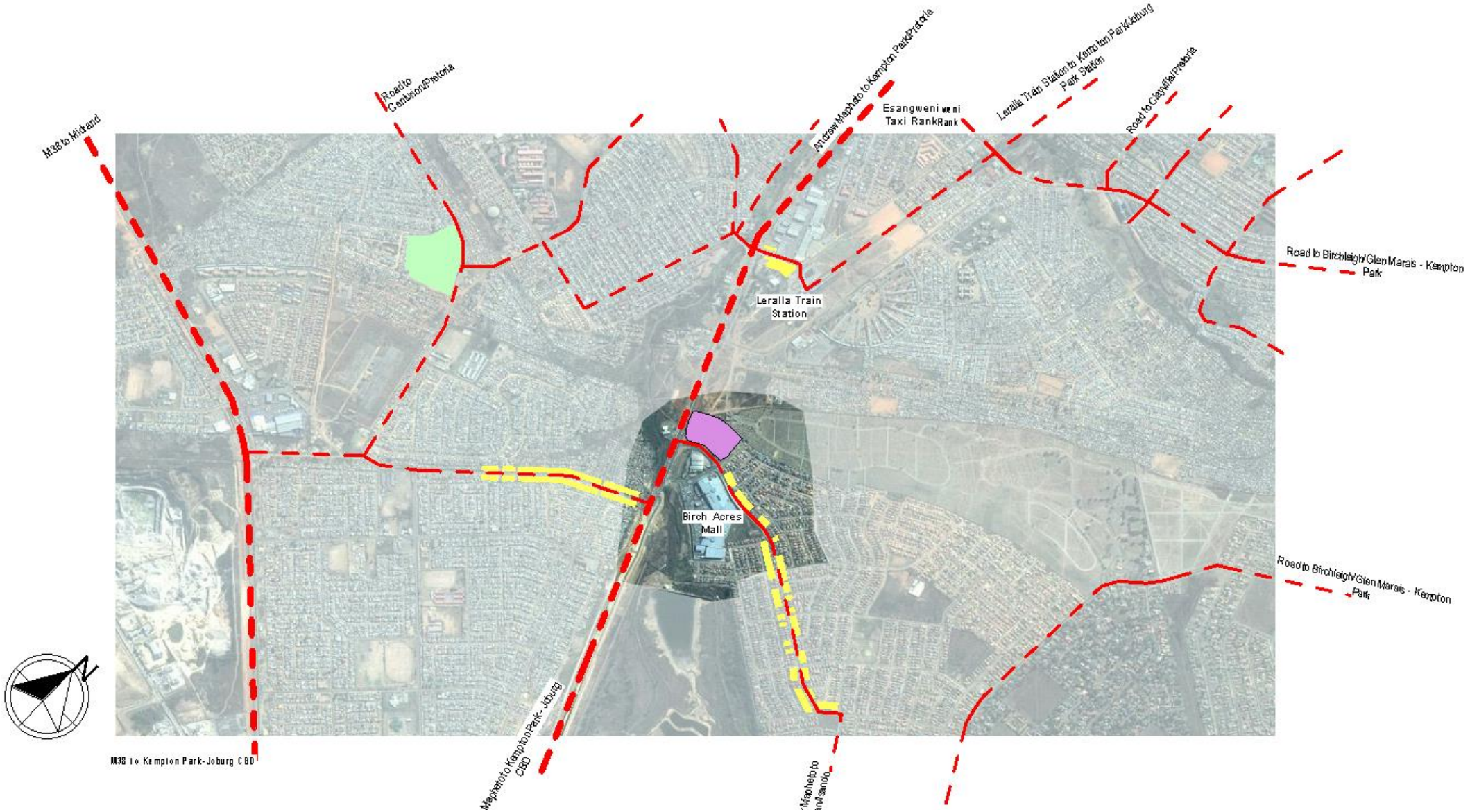


Figure 21: Map of commuter network, the main roads used to commute to and from work outside the township (https://gis.ekurhuleni.gov.za/EMMViewer4 /)

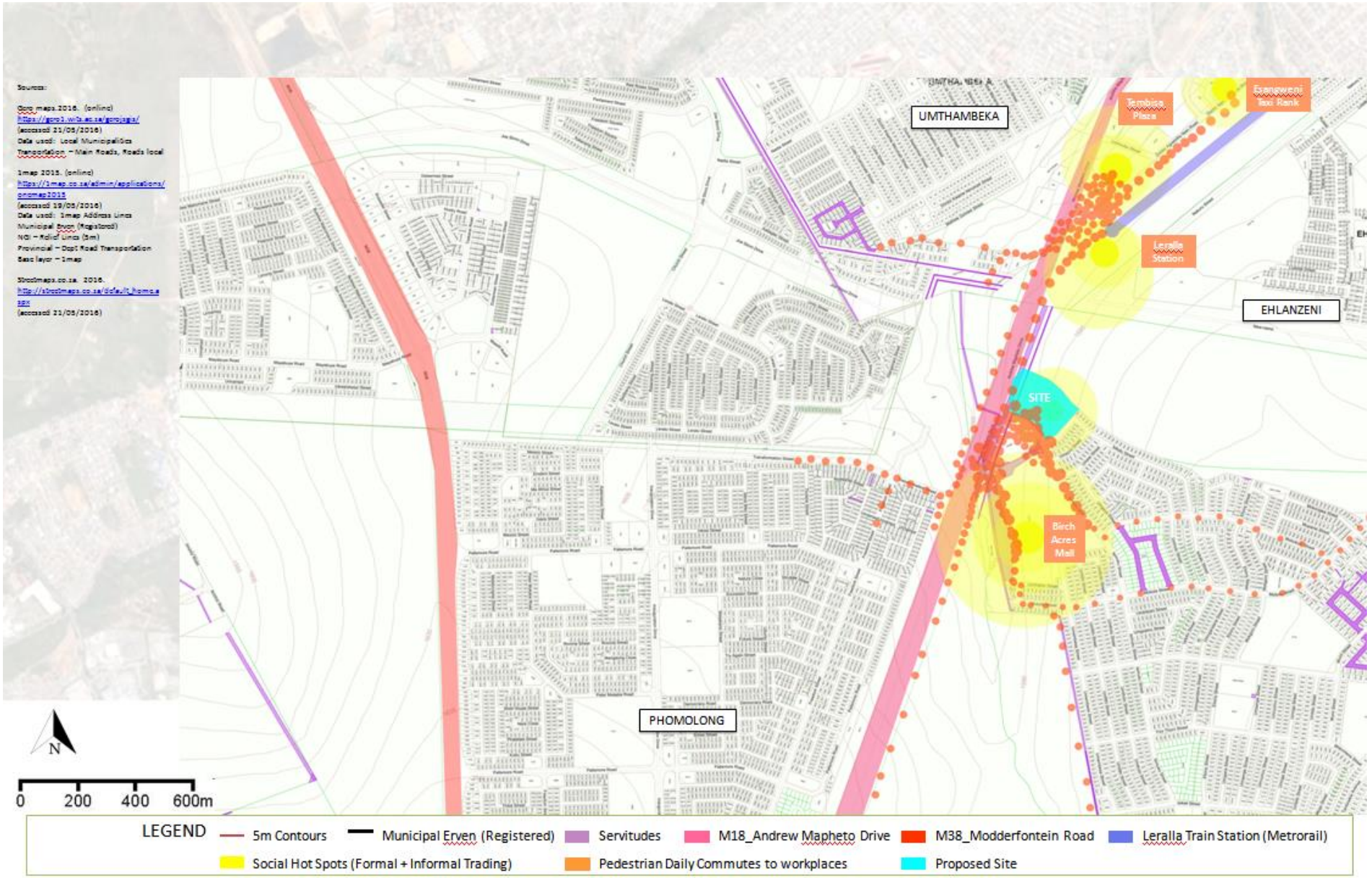


Figure 22: Hierarchical road system offers limited connection to the surrounding areas as there aren't any direct through-routes in and out of Tembisa (Moloto, 2016)

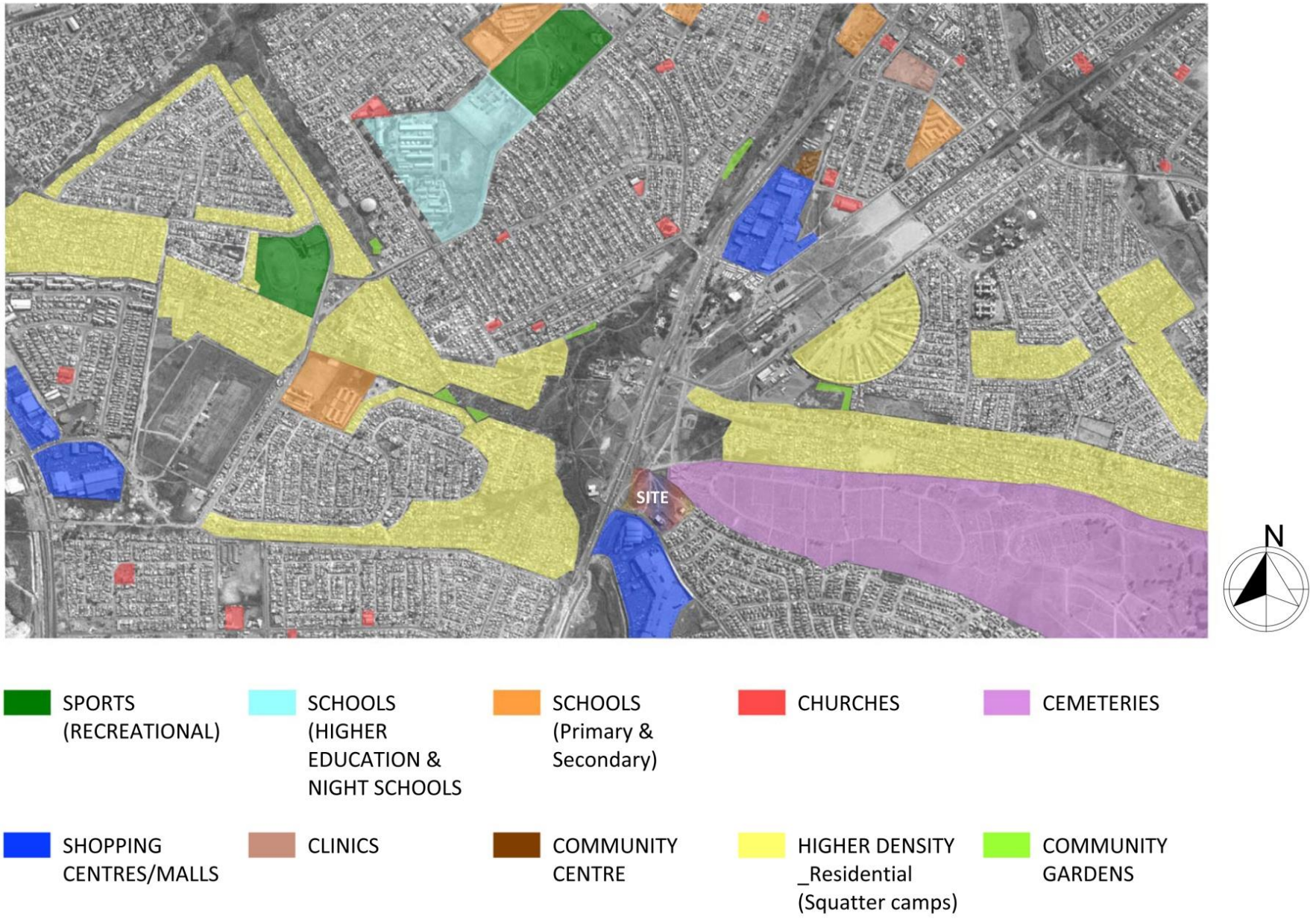


Figure 23: Map of the local autonomy in the area. (adapted from: https://gis.ekurhuleni.gov.za/EMMViewer4 /)

Figure 24: Municipal Services. (https://gis.ekurhuleni.gov.za/EMMViewer4 /)

2.4.3 Lack of waste management strategies

Waste in this area is not treated or sorted, it is treated as waste. Each household has the opportunity of having their waste collected from a common point on each street. Areas like New Hani Park do not have that option so waste ends up on public land which is meant to cater for the recreational needs of the community such as parks and playgrounds (See **Figure 29**).

There is currently no waste recycling system strictly implemented in the study area, but waste management is important in this area. Research shows that a significant amount of landfill waste is created by the waste caused by demolition and building works, (Energy Research Group, 1994:4 cited in Schefermann, 2008:39). There is a huge opportunity for the reuse of building materials and the lack of this knowledge results in unnecessary pollution. Ultimately, this causes only two options to exist for the treating of waste; which are taking the waste to landfills or; disposing of it in a public space meant for other recreational activities. Essentially the waste leaves the site having not yielded any value for the occupants of the dwelling, this must be explored in the design intervention at a neighbourhood scale.

Figure 25: Household waste discarded in the park (Moloto, 2016)

Figure 26: Open public green space becomes wasteland for construction and human waste (Moloto, 2016)

Figure 27: Pedestrian pathways polluted and unmaintained (Moloto, 2016)

Figure 28: Waste from demolition projects in the park (Moloto, 2016)

Figure 29: Playground is polluted and unsafe (Moloto, 2016)

Figure 30: Public park seating is underutilized (Moloto, 2016)

2.4.4 Inefficient use and specification of building materials

Due to the lack of using sustainable design principles when planning housing developments in the study area, the selection of building materials is often not carefully considered to its full effect. Scholars reveal that the "off-the-shelf" price of a material cannot be used as an indicator for its overall cost, as it only covered transport and manufacturing costs; the social and environmental costs however, are not included. It is important to consider the long-term costs of materials, as they will not only be paid by the client, but by the owner, the environment and the end-users. The long-term cost of a building material, include the analysis of the product from its "gathering of raw materials" phase; the manufacturing; distribution; the installation down to the ultimate disposal thereof (Kim and Rigdon,1998:7).

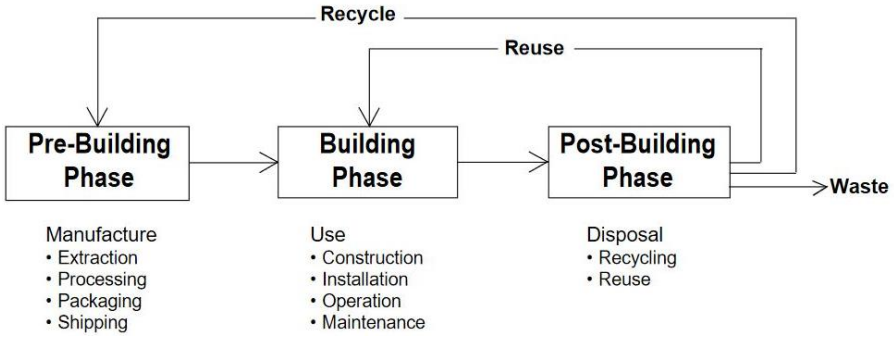


Figure 31: The three phases of a building material's life cycle. (Kim and Rigdon,1998:8)

It is reported that of all the CO2 emitted in the atmosphere globally, 50% of it is as a result of building construction and operations. The average house is said to consume five to ten tons of cement, "and of every ton of cement manufactured, a ton of C02 is released" (Department of Local Government and Housing. 2007 cited in Roux and Alexander, nd:30).

Embodied energy is defined in "Embodied Energy" [AUD],2013 as "the energy consumed by all of the processes associated with the production of a building, from the mining and processing of natural resources to manufacturing, transport and product delivery. Embodied energy does not include the operation and disposal of the building material, which would be considered in a life cycle approach."

Material	PER embodied energy MJ/kg
Plasterboard	4.4
Fibre cement	4.8*
Cement	5.6
In situ concrete	1.9
Precast steam-cured concrete	2.0
Precast tilt-up concrete	1.9
Clay bricks	2.5
Concrete blocks	1.5
Autoclaved aerated concrete (AAC)	3.6
Glass	12.7

Figure 32: Embodied energies of materials. ("Embodied Energy" [AUD],2013).

The conventional clay bricks are fired at high temperatures with coal or oil in clamp kilns for a long period of time, even up to three days; they also carry a significant amount of embodied energy, yet a majority of houses are built using this material. Unfortunately, the conventional building method of binding bricks with mortar makes the re-use of clay bricks inefficient in the long run, brick walls are therefore demolished and sent to landfills as opposed to being recycled and re-used (Roux and Alexander, nd:30). Low cost housing developments in the area tend to

use concrete blocks, as they carry a relatively lower embodied energy than clay bricks, others include adobe bricks, mud bricks, precast concrete etc to name a few.

Description	Service life (years)	Replacement factor
Bricks & blocks	50	1
Concrete	50	1
Paint	10	5
Plaster	20	2.5
Polystyrene	Indefinite	none
Rebar	50	1
Screed	20	2.5
Thermal Insulation	50	1

Figure 33: Life cycle of materiality. (Kim and Rigdon,1998:8).

Un-sustainability of conventional building & material use

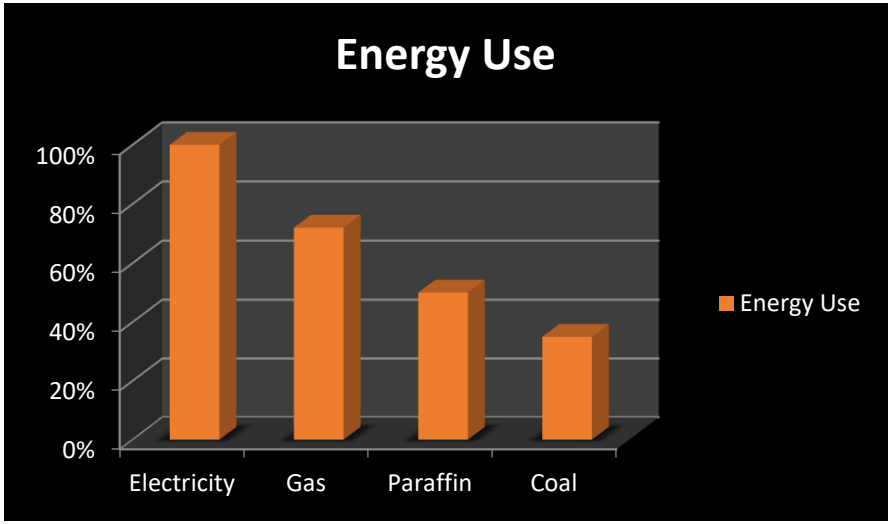
New developments are often not designed to create employment opportunities for the client communities in Tembisa yet, and if they are, it is only limited to the duration of the project. There are no skills and development training programmes implemented during construction projects, and this adds to un-sustainability of new developments in such areas. The use of local materials is also minimal, although there are material companies, and brick-making companies emerging in the area. The sustainability of the employment opportunities could be obtained by using the community participatory process to transfer knowledge and skills through on-site experience with trained craftsmen and masons. The skills acquired from the construction process of new developments will add experience to their resumes, and beyond that, it adds motivation and empowerment to the previously disadvantaged community, because they would have taken the power to create sustainable structures for their future into their own hands, as opposed to depending on external governmental forces to do it for them.

2.4.5 Continued dependence on municipally supplied electricity

Municipally supplied electricity is the primary use for lighting, using power appliances such as TV, kitchen appliances and computer gadgets. Gas and coal are used as an alternative to electricity for cooking and heating of internal air. Many households use wood to host braais and make homemade Zulu beer, which is a smart alternative, it does however cause thick pollution in the air during peak house (mornings and evenings) which is unsustainable to a large extent. The majority of the households use modern appliances such as microwaves, kettles and refrigerators, very few homes have dishwashers and washing machines as the majority of clothes and kitchen-ware are washed by hand.

All the houses in the study area use electricity from Eskom as their main energy source, with the exception of the informal settlements that use alternative means. The 'squatter camps' in the area use paraffin as a primary energy source, alternatively, they rig the electricity lines for the illegal use thereof. Some formal homes use paraffin stoves as an alternative to electrical stoves, what is even more popular however, is the use of gas stoves both for heating bath water; cooking and warming the internal air during the cold months. There are homes that were originally built with coal stoves as the primary source for heating and cooking, this causes thick air pollution over a large portion of the study area during peak hours (mornings and evenings) which is unhealthy for the

environment. The habit of using multiple types of fuel suggests that the majority of households cannot afford to pay for electricity for an entire month. There is a municipal subsidy of R100 worth of electricity per household provided they spend a maximum of less than R400 for the entire month, this motivates some to spend less electricity. Refer to Appendix C for short questionnaire issued to 20 households.



Bar Graph 2: An average of the different forms of energy used in the study area. (Moloto, 2016)

100% of the homes use electricity for many functions; lighting and appliances

72% of the homes use gas for cooking and heating

50% use paraffin for cooking and heating

35% use coal for cooking and heating

2.4.6 The neighbourhood street edge condition

An analysis of the study area revealed different relationships between the buildings, the streets and the people using them. I am referring to the vibrancy of some streets compared to the quiet, often empty streets in some of the residential neighbourhoods. The study area was chosen based on its proximity to the main public transportation web used to commute in and out of Tembisa. Three of the major social hubs in the area are also located in this area, namely the Esangweni Taxi Rank, Leralla Train Station and Birch Acres Mall, all accessible from Albert Mapheto Drive (See Figure 37). I observed the relationship between these facilities and the people using the streets, each of them are lined with informal trading stalls; Leralla Station for example, have trading stalls permanently erected along the pathway leading up to the station platform (See Figure 35).

Although the specific use of land, scale and quantity has changed over time, Tembisa's layers of diversity and complexity remain. Some of the patterns that we see repeated from observing the different streets include:

- Original homes are extended, i.e. re-used and recycled, not demolished or destroyed
- Ground floor used for retail with residential units behind or above, thus an owner could live above a shop he owns, financially beneficial
- Corner sites modified to form landmarks

- Corners of streets are used for retail at smaller scales, i.e. informal traders and roadside hairdressers (See Figure 36)

- Pedestrians lack space to commute outdoors safely (See Figure 34)

Figure 34: The sidewalk of Nyathi Street across the road from Birch Acres Mall (https://gis.ekurhuleni.gov.za/EMMViewer4 /)

Figure 35: Permanently installed trading stalls along the pathway towards the train platforms at Leralla Station, (Moloto, 2016)

Figure 36: An example of a street edge treatment in the study area, at the foot of Tembisa Plaza (Moloto, 2016).

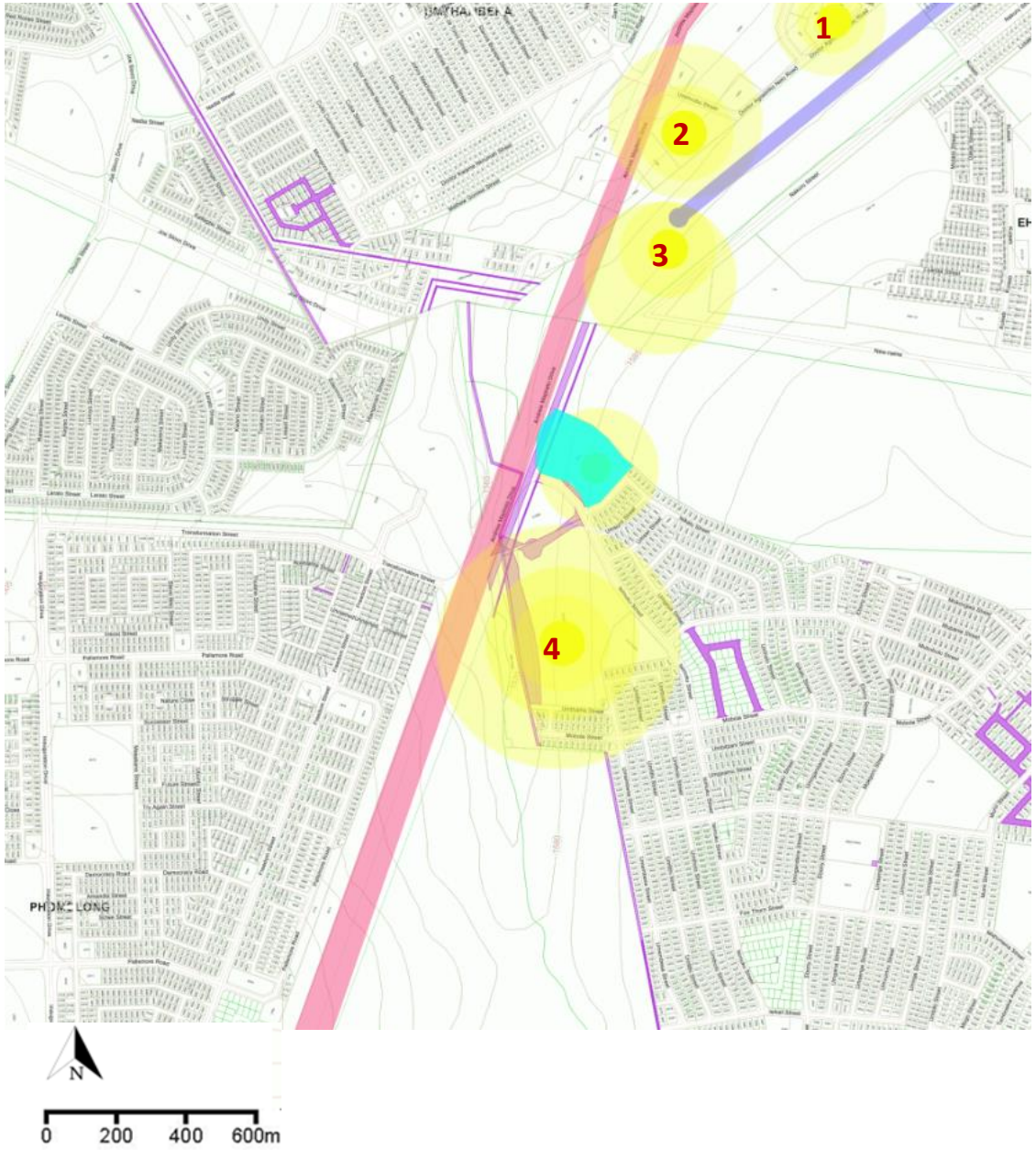


Figure 37: Main social hubs along Andrew Mapheto Drive (Moloto, 2016)

1. Esangweni Taxi Rank
2. Tembisa Plaza
3. Leralla Station
4. Birch Acres mall

2.5 The need to adapt

It cannot be disputed that there is a need for housing developments to facilitate compacted, better-located, mixed income, environmentally sustainable housing. In determining the way forward, the different roles played by industry professionals need attention: Is there an Architecture that can, through design, facilitate the learning and unlearning process necessary in the global transition to sustainability living?

The term "adaptation" is defined as: The process/behaviour/feature of changing the function of an organism to become better suited to its environment and multiply (www.dictionary.com).

The adaptation proposed in this research report is of the planning and design processes used in the implementation of housing developments in Tembisa. The lower income subsidized model was analysed in conjunction with the lower to middle-income housing developments to determine what makes human settlements in this area unsustainable. Therefore, the adaptation is meant to contrast with the design and planning processes that resulted in the dormitory mass housing developments found in Tembisa and other townships.

The approach to designing for such communities needs to be radically improved upon, based on the principles outlined in sustainable living practices and national policies of city-reintegration such as the BNG and Bioregional's One Planet Living concept.

Because human settlements don't only consist of houses (like RDP houses), the approach to communities should be an integrated one, with contributions from the different sectors involved, including the client community also. The livelihoods approach, which involves assessing the needs of the community, their everyday lifestyles, household cost saving measures and access to economic & urban opportunities must be initiated to propose an appropriately adapted human settlement model.

The adapted human settlements must take end-user preferences and link them with sustainable living principles in order to best meet the needs of different income groups in a new, healthier neighbourhood environment. This approach to the housing development model can be learnt from and adapted in other areas of Tembisa, other townships, and radically different context as well.

End-User Livelihoods + Sustainable Living Principles

=

Sustainable Adaptation

PART 2: Sustainable living guidelines

3. FUTURE DEVELOPMENT – MOVING FORWARD

3.1 Sustainable housing

3.2 Densification and sustainability

3.3 Sustainable design guidelines

3.4 Precedent studies

3.5 Tenure options and housing types

3.6 An integrated approach

3.7 Community participatory design

3.8 The neighbourhood ecosystem

3.9 Technical investigations

3. FUTURE DEVELOPMENT - MOVING FORWARD

3.1 Sustainable housing

Many scholars argue that for urban development to be sustainable, three distinctive spheres must be sustainable, these are set out beow:

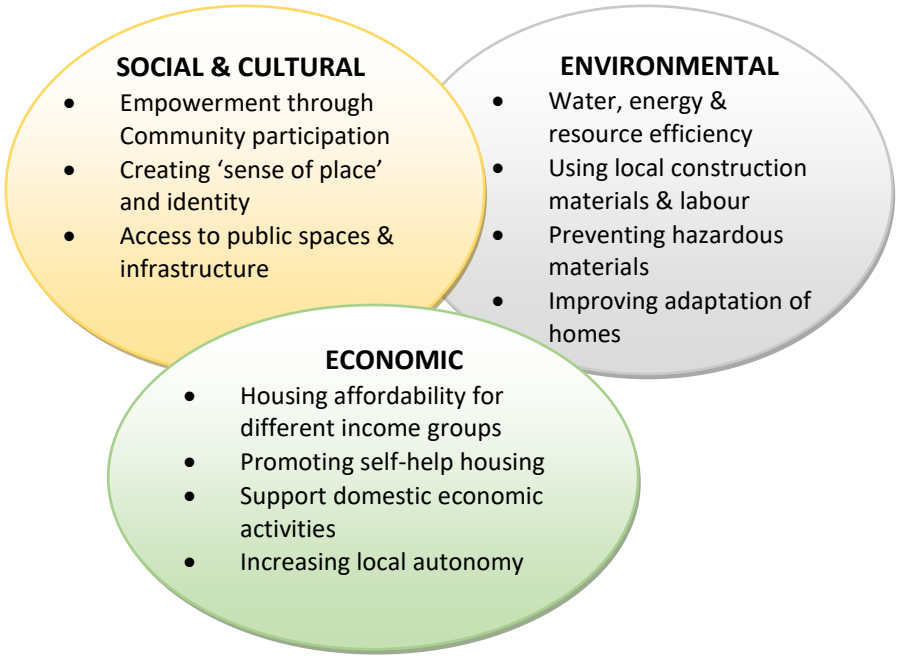
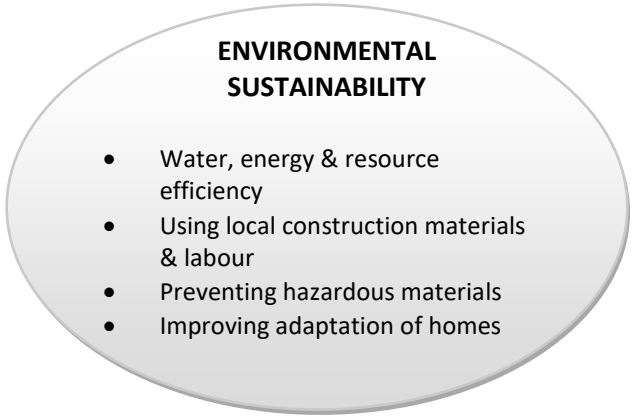


Figure 38: Facets of sustainability (Gwavvu, 2015;12)

3.1.1 Environmental sustainability



The relationship between a built house and the environment is crucial in determining the environmental sustainability of that house. In *Sustainable housing for sustainable cities,* Golubchikov and Badyina, (2004) separate the different factors affecting the relationship between housing and the environment into the following:

- The construction of housing requires various resources which need to be extracted from the environment, i.e materiality, energy and water etc;
- The everyday activities carried out by the residents impacts the surrounding areas ecologically by polluting the air, water and lack of waste treatment and management;
- Households are at risk in terms of their health and well-being due to various daily activities which contribute to environmental hazards, i.e poor sanitation; micro-climate change etc;

The strategies which can be applied by designers and planners in an effort to reduce the negative relationship between housing and the environment are listed by Golubchikov and Badyina, (2004) as the following:

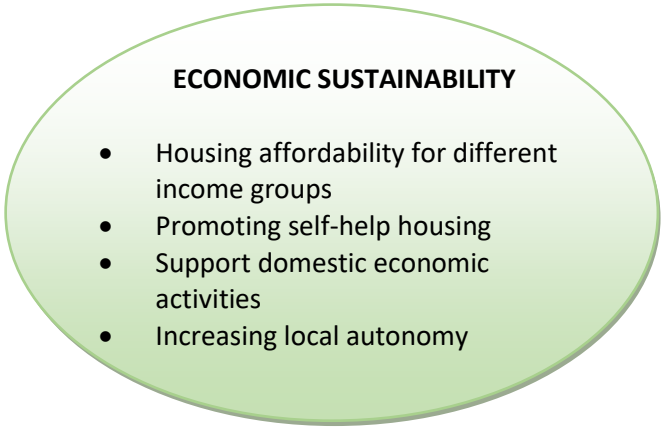
- The reduction of the negative effects housing can have on the environment in relation to energy, land use, waste and water management etc;
- Improving the health of the household and the surrounding neighbourhoods to ensure that pollution is reduced and the public isn't affected negatively;
- Adapt sustainable living concepts to any context with resilience, i.e robust design; greening etc.

When design on the new intervention began, a number of factors relating to the environment of the study area were considered when spatial planning and site design was first conceived. These include the efficiency of land use, relating to the "residential densities and urban mobility in the neighbourhoods" (Golubchikov and Badyina, 2004:13). The improvement of public green spaces will mitigate environmental hazards; the use of local construction materials and labour; the efficient use of energy and resources; as well as determining the lifecycle of the homes.

The design of a new housing project at a community scale should rather not begin with the architecture of the houses, but with the selection of an appropriate site location if sustainability is to be obtained. Architects should recognize the relationship which the household will have with the

neighbourhood; settlement; or city. Organising a sustainable development requires linkages to transportation routes and infrastructure. The scattering of residential neighbourhoods causes urban sprawl for example, and this adds to the pollution emitted into the air by CO2 and other pollutants from motorised transportation. The site chosen for the design intervention was therefore chosen to have strong linkages to the metropolitan public transportation system, that is the train station; the existing bus systems; the new BRT bus system; and the most commonly used mini-bus taxis.

3.1.2 Economic sustainability



A house affects a variety of economic factors in a homeowners' life as well as that of his neighbours in the community. The expenditures in a household for example, are required for the basic running of daily activities in and around the house, so if it is unaffordable, it creates accumulative socio-economic issues. Although the home is a good platform for home-based activities and small business establishments, it is also beneficial in its construction stages, because building houses, fitting in services as well as real estate markets all contribute to job creation and entrepreneurship.

The design intervention identifies some of the income-generating opportunities available in housing, and explores them in order to make the housing development economically sustainable. The construction of the house has been planned in such a way that the locals get preference in terms of materiality and labour. This decision wasn't made due to the abundance in skills and training in the area, however, investing in some of the numerous building supply and contractor companies located in the neighbourhood will impact the economy of the community positively. In addition, the provision of social amenities and decent housing will make the area more attractive to skilled workers and investments. This is not to differentiate the less expensive units from the more expensive in a dramatic way, because the lack of housing oftentimes delays the economic development of that area, while areas with expensive housing get "surrounded by slums which create social tensions and sub-optimal local economies." (Golubchikov and Badyina, 2004:46)

At a national level, the aforementioned implications are largely unrecognised when strategies for national growth are planned. According to the aims outlined in the Reconstruction and Development Programme, affordable housing is provided to alleviate poverty, amongst

other goals, it is not provided as a system which will increase the economic development of the client community.

3.1.3 Social and cultural sustainability

Although housing plays a critical role in the provision of shelter and other basic human needs, it also plays an important role in the social development of communities and societies (Golubchikov and Badyina, 2004:33). An architect's approach to social sustainability deals with the provision of quality homes which are affordable and award the homeowner freedom to express their identity through their design style. It is also important to note that an area such as Tembisa does not only consist of homes which were freely provided by the government, like most townships in the context of South Africa today, it has developed into a mixed-tenure and mixed-income community. The social and cultural issues however, affect the whole community; these issues include safety and security, health of dwellings etc. It is equally important to provide infrastructure that celebrates the street culture of that community, there are various customs which are unique to a given neighbourhood, and these should be accommodated accordingly.

In *Sustainable housing for sustainable cities,* Golubchikov and Badyina, (2004) categorized the aspects which relate to the social and cultural sustainability of housing into the following:

- The provision of housing that is affordable, decent, dignified and healthy.
- Social justice in the spatial planning of the sustainable house
- Including the client community by empowering them through community participatory design
- The provision of social amenities and community facilities
- Using the design and spatial planning of a house as a strategy of decreasing poverty and reliance on municipally provided services
- The provision of housing that can adapt in similar contexts all over the region, to meet the needs of both current and future needs.

In Johannesburg, at the World Summit on Sustainable Development (WSSD), held in September 2002, it was agreed that the greatest challenge of our time was dealing with poverty, and we agreed on a negotiated outcome, the Johannesburg Plan of Implementation (JPOI). The JPOI sets out targets for achieving sustainable development, inclusive of the Millennium Development Goals

This decision revealed the importance of government entities' involvement in the overall sustainable development of our communities, and their influence on effecting successful change in our environment. An Argentinean scholar, Adriana Allen, argues that a fourth sphere of political sustainability links all the above-mentioned spheres and their sub-categories. This refers to "the quality of governance systems and frameworks guiding the relationship and actions of different actors among the environmental, social and cultural, and economic sustainability dimensions. This includes the democratisation and participation of civil society in all areas of decision-making". (*Sustainable Medium Density Housing*, 2008)

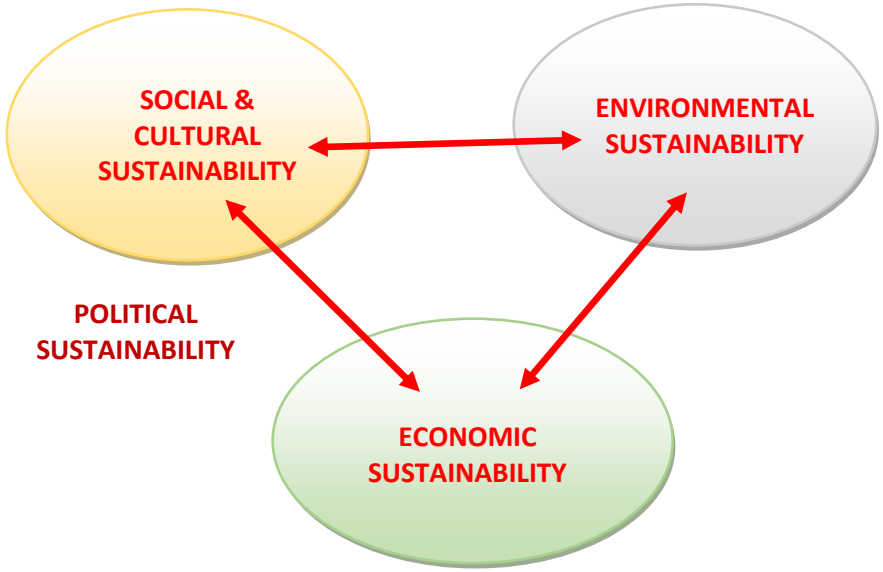


Figure 39: Link between spheres. (Adopted from Gwavvu, 2015;12)

3.2 Densification and sustainability

"The human right to adequate housing is the right of every woman, man, youth and child to gain and sustain a safe and secure home and community in which to live in peace and dignity" (*Sustainable Medium Density Housing*, 2008)

3.2.1 What is medium density housing?

There is an opportunity for issues of equity and sustainability to be addressed by providing medium-density housing as it creates opportunities for using land efficiently and locating the housing in areas which provide access to urban opportunities.

Traditional residential areas usually have densities of approximately 8 to 15 dwellings per unit (du/ha), but medium density housing ranges from 25 to 80 du/ha, in practice, it is commonly 30/40 du/ha. The increased number of dwellings is not the only improvement with medium density housing, this housing usually consists of a range of housing types i.e. detached; semi-detached; multi-unit housing; dual occupancy buildings of 2 to 4 dwellings. Such developments are usually low rise, with a maximum height of 10m and usually have access to multimodal transportation systems ("Medium-density housing", 2016).

3.2.2 The missing middle

"Missing Middle is a range of multi-unit or clustered housing types compatible in scale with single-family homes that help meet the growing demand for walkable urban living" ("Home Page - Missing Middle Housing", n.d.) Many young singles and couples are emerging with unique needs for safe and healthy rental and 'for sale' homes accessible to transport and amenities in walkable distance. Car ownership is also not popular among this age-group as they would rather build their careers first, however, this keeps them active and healthy physically thus their need for walkable communities (See Figure 40.).

It is believed that medium density housing has borrowed important principles from ancient cities, whereby housing was comprised of mixed-use developments of higher density, located near markets, main transportation routes and other important social amenities. (*Sustainable Medium Density Housing*, 2008)

In the aim of designing neighbourhoods which are healthy and satisfactory to residents, Jane Jacobs in her manifesto *The Death and Life of Great American Cities* (1961) outlines four qualities to be considered, namely mixed primary users, short blocks, aged buildings and high density, thereby emphasising the need to build and plan such environments in a timeless fashion.

The issue of densities appropriate for cities is a contentious subject as these are conditioned by performance. The ideals of land quantities allocated to a specific number of people can often be unrealistic, these specifications can frustrate city diversity as they tend to be too high or too low. The densification needs of different environments should be looked at in terms of how that environment performs, because residential density is complex due to the different parts which interact with each other and with other systems. There cannot therefore, be a single definition of medium-density because it is not possible to establish all these components. (Jacobs, 1961)

Figure 40: The missing middle ("Home Page - Missing Middle Housing", n.d.)

3.3 Sustainable design guidelines

Due to the ongoing challenge of apartheid urban form, and the consequential livelihood issues it brings, there is emphasis placed by municipalities on "integrated human settlement" when approaching the design of housing for townships. Tembisa is one of the areas suffering from the ongoing neglect to mitigate apartheid urban form in the light of all the housing developments taking place in the area. Several national policies have been approved in the hope of being implemented at a large scale, they focus on "facilitating denser, better-located, mixed-income, environmentally sustainable government-assisted housing in line with the Breaking New Ground strategy" (*Sustainable Medium Density Housing*, 2008:xi)

3.3.1 Breaking New Ground (BNG) policy

The national department of housing released its Comprehensive Housing Plan for the Development of Sustainable Human Settlements entitled 'Breaking New Ground (BNG) in 2004, in order to reinforce its vision.

The Breaking New Ground strategy aims to promote an integrated society by developing sustainable human settlements and quality housing within a subsidy system for different income groups.

" … The new human settlements plan reinforces the vision of the Department of Housing, to promote the achievement of a non-racial, integrated society through the development of sustainable settlements and quality housing". (*Sustainable Medium Density Housing*, 2008:43) Specific objectives put forward in BNG include, but are not limited to, the following five areas:

"1. Promoting densification and integration"

"2. Enhancing the location of new housing projects"

"3. Supporting urban renewal and inner city regeneration"

"4. Developing social and economic infrastructure"

"5. Enhancing the housing product"

The policy provides us with objectives to aim for when designing for new housing developments which will offer a range of infrastructure which supports and accommodates variations in affordability, tenure options (rental, bonded, and subsidized); a higher level of services and commercial opportunities to be provided throughout the township; and the combination of different housing types and densities at different scales (single stand, two-storey, and attached homes). Furthermore, the CHP is being implemented in informal settlements throughout all provinces to emphasise community participation, social and economic development for all housing projects. ("Sustainable Human Settlements - Breaking new ground | South African Government", n.d.).

BNG at unit scale

For households earning less than R3500 a month, the government aims to provide homes of an overall area of 40m² minimum, a toilet with a shower and hand basin in a separate room, a combined living and kitchen area with a wash area, and an electricity connection. ("Sustainable Human Settlements - Breaking new ground | South African Government", n.d.).

3.3.2 The One Planet Living concept

Bioregional, founded in 1992, is “an entrepreneurial charity which has invented and delivered practical solutions for sustainability” (Bioregional developed the One Planet Living concept in 2003 after their experiences during the work carried out at BedZed ecovillage in London: *“A vision of a world in which people enjoy happy, healthy lives within their fair share of the earth’s resources..”* (“One Planet Living - Bioregional”, n.d.).

The concept concludes that “to achieve sustainability, we need to make it easy, attractive and affordable for people everywhere to lead whole sustainable lifestyles – not just green buildings…”The following ten principles have simplified the planning, delivery and communication of sustainable development, they have been summarised in the context of Tembisa. (“One Planet Living - Bioregional”, n.d.).

Figure 41: One Planet Living principles (www.bioregional.com)

1) Health & wellbeing: Communities need to be encouraged to lead healthy lifestyles which actively benefit them.

2) Local autonomy: The creation of smaller controlled economies that support a range of local employment and small businesses will increase the local autonomy.

3) Culture & diversity: The celebration of the unique identity of Tembisa, from its vibrant street life to the diversity in street frontages, will encourage the communities’ involvement in shaping their own culture of sustainability.

4) Land use: Land should be efficiently used to integrate natural habitats with the built environment, in an effort to restore and protect biodiversity.

5) Water efficiency: Design for buildings must take water efficiency into account, as well as the prevention of water damage (soil erosion due to floods) or the lack thereof (droughts).

6) Local food generation: There is a trend of food gardening (communal and private) in Tembisa due to the lower cost associated with it. This should be promoted in all new housing developments by improving the existing model with the guidance of sustainable living principles.

7) Materiality: The use of locally sourced building materials of low embodied energy, healthy products and recycled materials from demolished buildings will create employment opportunities which offer on-site skills and training to local builders, thereby empowering them through engagement.

8) Sustainable mobility: It is important to design for the reduction of travel time and dependency on motorised transport for daily commutes to work and other important amenities, as well as for the promotion of low carbon modes of transport.

9) Waste management: Waste must be minimised, and re-used innovatively to benefit the community where possible. Ultimately the disposal of waste to landfills should be limited to none.

10) Efficient building design: Buildings should be built efficiently enough to save energy and use renewable resources and technologies to generate energy for usage, without harming the environment.

Figure 42: One Planet Living concepts (www.sustainable-lifestyles.eu)

3.4 Precedent Studies

Purpose of precedent studies:

- To explore the underlying conditions explored in existing housing communities that were designed to improve their communities.
- To identify the important factors that contribute to these conditions as well as the different aspects which will be viable in the context of Tembisa today.
- To explore the contributions that medium density, integrated community design of mixed typologies, mixed use and mixed tenure for mixed-income households can have on the sustainability of housing settlements in South Africa.

Research conducted into international and local medium-density housing projects helped to generate some guidelines to be used in providing sustainable medium-density housing. The selection criteria used to investigate the housing projects included housing typology, location, area (size) of dwellings, tenure type, household income and housing typology, to name a few.

3.4.1 Local precedents

Figure 43: Context of Green Street project. (www.wdccapetown2014.com)

<u>The case study of Cato Manor "Green Street"; Durban, South Africa</u>

This project was aimed at educating the users and the public on the socio-economic, health and environmental benefits of sustainable design and using resources efficiently. To demonstrate this, thirty low cost houses (existing RDP dwellings) were given a retrofit and sustainable improvements were made to the existing homes without demolishing any existing structures. The interventions were meant to communicate a simple yet workable solution to the problems created by the RDP house model. Each household received solar water heaters, insulated ceilings, efficient lighting, heat insulation cookers and a very important community participatory aspect of community food gardens. It is recommended to incorporate public communal areas into their designs at neighbourhood scale as well, because townships like this one have very few parks and efficient outdoor facilities. (www.wdccapetown2014.com)

Figure 44: Safe electrical wiring; heat retention cookers. (www.wdccapetown2014.com)

Figure 45: Community food gardens. (www.wdccapetown2014.com)

Figure 46: Example of housing from Klarinet Phase 1 (Clean Stream Environmental Services,2015:31)

Figure 47: Aerial view of site (Google earth, January 2014 cited in (Clean Stream Environmental Services,2015:31)

Klarinet integrated housing, Emalahleni, South Africa

Absa Property Development intended to develop a new large scale housing development in line with the Breaking New Ground (BNG) policy, which was to be the first of its scale in Mpumalanga.

Tenure options

The project consists of policy principles of providing integrated sustainable homes (mixed use units) of different options for tenure (subsidized houses; rental units; bonded units) within the same development; business/commercial zones; facilities for education and training; religious facilities/churches; a variety of public open green spaces; the consistent accessibility of municipal services across the township; and typologies which can range from semi-detached multiple storey units and row-houses.

Community involvement

Advertising to recipients was carried out by placing an advert (in compliance with the Environmental Impact Assessment Regulations, 2010) in the local newspaper in English and Zulu. Notices compliant with the same regulations were placed at various strategic locations on site. The same notices were pinned up on a notice boards of the local supermarket and the public library, a copy of the notice as well as a Background Information Document (BID) were loaded onto the www.cleanstreamsa.co.za website for free downloads by interested and affected parties. The feedback from interested and affected parties was supposed to lead to a public meeting, but only two persons registered thus a meeting was no longer required. (Executive Summary of the environmental..[AUD], n.d.)

Figure 48: Houses and play parks (A high density Housing..[AUD], n.d.)

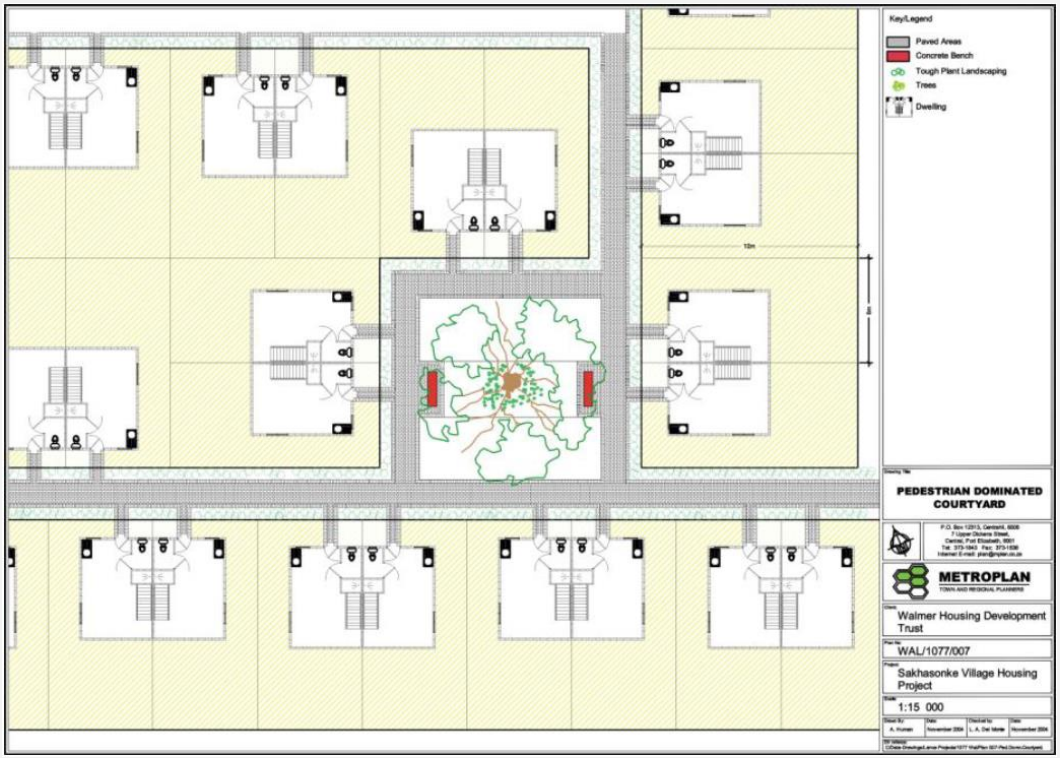
Policy meets implementation

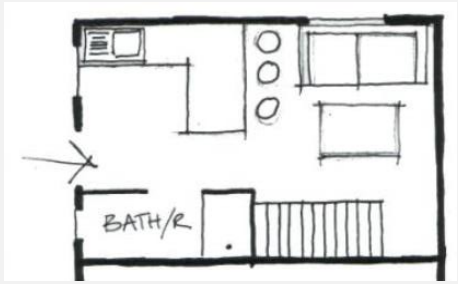
This project is the manifestation of some of the goals and principles which initiated policies such as the Urban Development Strategy (1995); Housing Act (1997); Breaking New Ground (2004); National Social Housing Policy (2005) etc. which support city re-integration through residential densification and developing existing land for compactness and integrated communities. The location makes it easier for people to link into the public transportation systems, moreover, community facilities and small business zones were provided in the development to support the livelihood of residents. (A high density Housing..[AUD], n.d.)

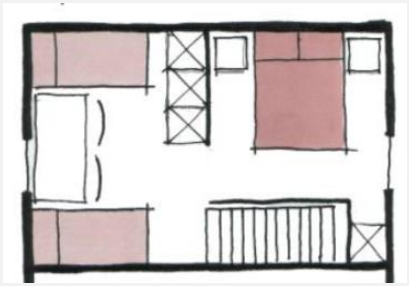
Sakhasonke village, Port Elizabeth, South Africa

A fully subsidized housing project that was aimed at the lowest income class (household earning of less than R1,500 monthly). The project demonstrated the benefits of higher density housing by providing 337 semi-detached two-storey units which total a density of 76 units/ha at reduced land and service costs, the increase in the size of subsidized homes and typologies, and the reduction of urban sprawl by the integration of the poor with the urban environment. The semi-detached typology chosen was determined by looking at the best way to create "maximum floor space relative to cost" (SOURCE), thus saving costs by sharing walls and services. Building materials were used in their most original state with no customised elements to minimise waste, interior walls were concrete blocks bagged and painted to the residents' taste, and insulated ceilings were installed in all units. Each unit is fully serviced with electricity, water, and sewage. (A high density Housing..[AUD], n.d.)

Figure 49: A community engagement approach (A high density Housing..[AUD], n.d)







Cluster design

The average size of each plot is 72sqm and 3 metres of walkways separate the different rows of sites. The walkways provide a sense of privacy as the units won't seem to close to one another, as well as adequate exposure to sunlight. Parking was provided at 0,5 bays per erf as car ownership was low in the area, and public squares of greenery (trees, grass and public seating) are located at various intervals throughout the complex. This creates pleasant outdoor communal areas for gathering and social coherence. (*Sustainable Medium Density Housing*, 2008)

Community participation

Residents were informed of the project through flyer distribution, and public meetings were held regularly as the project progressed. Contractors and builders emerging from the surrounding areas undertook the construction with supervision from a representative from the NMM ((Nelson Mandela Metropolitan) University Institute of Building Research and Support.

Figure 50: (Top left)Site plan of cluster; (Bottom left) plan of unit design, ground and first floor, house size =48sqm (A high density Housing..[AUD], n.d)

Figure 51: View from parking lot (*Sustainable Medium Density Housing*, 2008)

Newtown urban village, Johannesburg, South Africa

The well located, affordability and perceived safety and security of this project added to the end-user satisfaction. The complex consists of affordable rental units for low to medium-class families and individuals, and Social amenities and transport interchanges are not located too far from the development. The residents are given the opportunities to be sub-contracted for the general maintenance and cleaning of the complex, this empowers them economically and a sense of ownership is created. In engaging with the client community, leaders were elected democratically before the project went under way to ensure its sustainability even after the construction was complete.

Additional Sustainability features

Good location and affordability of units made the development added to the overall satisfaction of the environment. There were various housing typologies used (three) and the gross residential density was 192 du/h. The close proximity to important amenities and urban opportunities encouraged walking and cycling as opposed to depending on the use of motorised transport to get around. The family unit sizes were in line with the Breaking New Ground (BNG) strategy in providing two bedroom units of 45 – 48.3m² areas. (*Sustainable Medium Density Housing*, 2008)

Figure 52: View from internal courtyard (*Sustainable Medium Density Housing*, 2008)

Figure 53: View from internal courtyard (www.property24.com)

Carr Gardens, Johannesburg, South Africa

The project aimed to address the three spheres of sustainability (environmental, economic and social) through high residential densification and city re-integration. The three to four-storey walk-ups consists of 211 units of various layouts (single rooms with shared facilities; 1 bedroom; 2 bedroom apartments), a crèche, homework centre, secure parking and playgrounds on site. This has taken the needs of vulnerable people (children, women, the disabled and elderly) into the design. The solution to accommodating different income brackets has been provided in the mixed tenure housing typologies (subsidized and rental housing). They have used good materials that require little to no maintenance in the long run, this has reduced construction costs.

Additional Sustainability features

The decent street edge creates a good sense of place for residents and the passive surveillance from balconies has created a sense of safety and security. The housing development houses two housing types, providing opportunities for a variety of household groups. The gross residential density is 80 du/h and the floor area of the units is in line with the BNG strategy of 33.5 to +55m² for low income households, resulting in a safe, affordable compact medium density environment in close proximity to urban opportunity. (*Sustainable Medium Density Housing*, 2008)

3.4.2 International precedents

Figure 54: unit development over time. (www.arcspace.com)

Quinta Monroy by Elemental, Chile

This project was faced with the challenge of accommodating 100 families using a subsidy of $7,500 introduced serious constrictions for the location and layout of the provided homes. Elemental came up with an innovative design strategy which involved empowering the community, this was achieved by giving them the infrastructure to build half of their homes by themselves. The designers described it as providing "half of a good and comfortably sized home" rather than a full smaller and inefficient home. (www.arcspace.com)

Community Participatory Design

This approach in design successfully enabled the community to express their identities in the design and construction of their homes, something which is lacking in the methods used by the government subsidiary programmes which don't strive to empower the client community.

Good location

I also found this to be a good precedent of the use of limited funds, additionally; a large part of the budget went to the land chosen by the design team to design the housing development on. This was because they chose a site closer to the inner city amenities in order to maximize on the sustainable mobility options available there. This led to my chosen site location along one of the busiest links of the main public transportation route.

Figure 23: (Left) Street views of the initially provided subsidized units and how they were personalised by the residents over time. (www.arcspace.com)

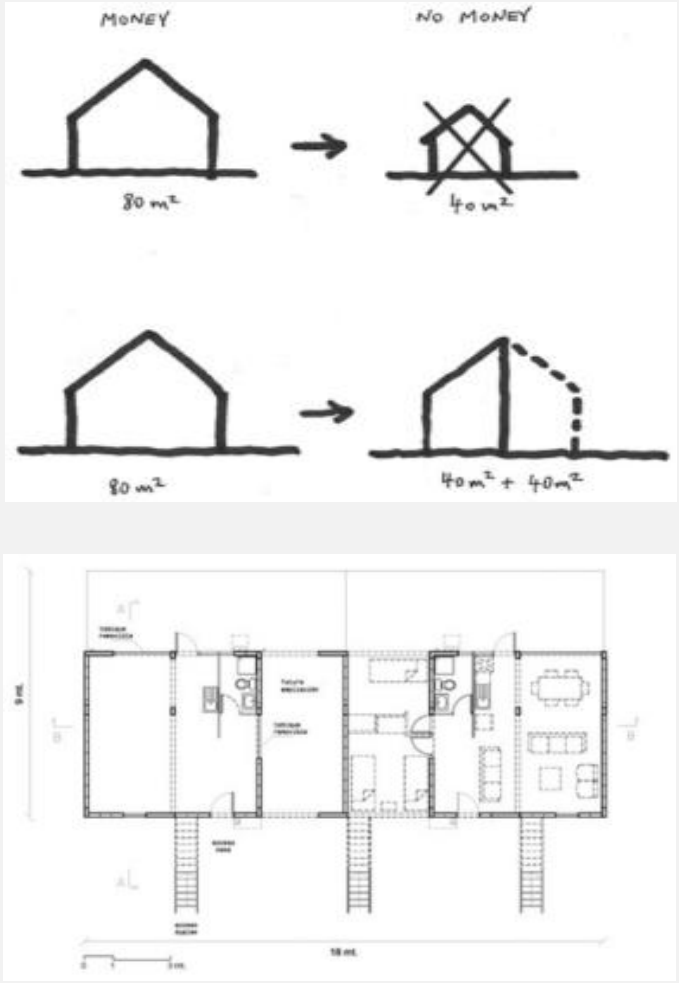


Figure 55: Sketches by designers & anticipated unit development over time. (www.arcspace.com)

Figure 56: BedZed (www.alamy.com)

The case of BedZed by Zedfactory, London, England

BeZed is the UK's first large scale mixed-use sustainable community design to be carbon neutral and support a sustainable lifestyle. This development sought to achieve big reductions in climate changing greenhouse gas emissions and water usage, it was meant to make living here greener and have a lower impact on the environment. It has been designed to promote walking and cycling, as well as the use of public transportation so as to reduce people's reliance on cars. ("One Planet Living - Bioregional", n.d.)

Mixed use development

The development includes 100 homes, a college and community facilities. Between the residential homes are commercial buildings; an exhibition centre; a children's nursery and regular visitations by the public take place in order to educate the public on the principles of sustainable living practiced in their context.

Influencing government policy

This project successfully influenced the building policy of the country in that all new build homes had to be designed to be carbon neutral as of 2016.

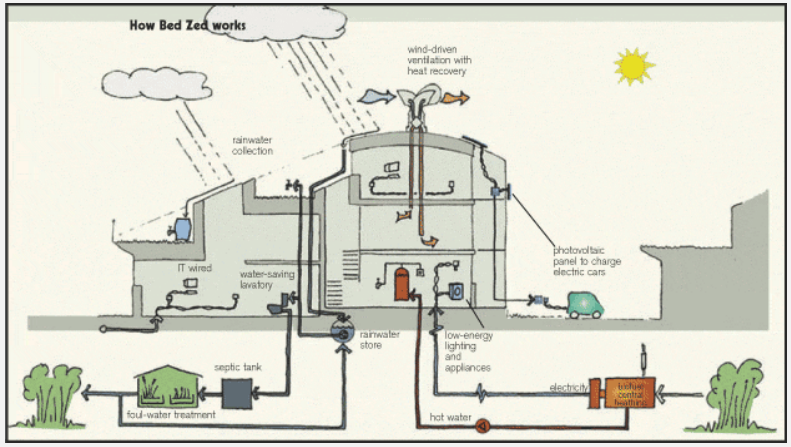


Figure 57: Section through a BedZed rowhouse (www.ourplanet.com)

Considering the needs of vulnerable people
Amenities have been placed within comfortable walking distances from the residential units and the sidewalks have been personalized to meet the special walking needs of the community, i.e the dropping of the curbs for wheelchair-bound pedestrians.

Mixed tenure
One of the most important lessons to pick up from this project is the mixed tenure of mostly affordable housing, rental opportunities and small business opportunities have been created to increase the local autonomy of the community.

Sustainable strategies

The site has developed into a neighbourhood of sustainable living concepts expressed in one community; the programme consists of living spaces as well as 120 workspaces per hectare and over 4000 m² of green space per hectare.

Building orientation
The orientation of the homes ensures that sufficient light reaches each home without shadowing another unit severely. For this reason, workspaces faced the side of the house which didn't receive as much direct sunlight during the day, in South Africa that would be facing south.

Density
They were able to build 50 dwellings per hectare which all have well insulated roofs, floors and walls.

Passive design
The thermal mass achieved in the thickness of the floors, walls and roof store enough heat to avoid overheating of the internal air or air leakage during the cold months. The objects seen on the roofs in different colours facilitate the stock effect, achieved by the custom rooftop wind cowls which use the wind to draw fresh air from the exterior down the passive heat exchanger into the internal space and let out the exhaust internal air.

Materiality
The material use was also sustainable as they used locally available building materials

Urban interventions

Figure 58: (Top) Dutch concept of street design by Hans Monderman encourages alternate modes of movement and inhabitation of the street-scape, which in this street means utilizing trees to create varied spaces (https://.ecotownpenang.com).

Figure 59: (Right) High quality NMT lanes & public transport options, Amsterdam. A compact, mixed use, vibrant city where non-motorised forms of transport are the primary form of access and CARS are limited to the periphery of the neighbourhood, internal roads are made exclusively for pedestrians and bicycles (https://.ecotownpenang.com).

Transit Oriented Development (TOD)

A TOD neighbourhood is centred on a rail or bus transit station and extends to an easy walking distance radius of 400-800m. A smart town is one considered to provide linkages between various public transportation networks, this is to minimize walking distances between residential areas with surrounding places. Another principle in the concept is that the area within walking distance of frequently bus transit should contain a mix density of residential, commercial, high pedestrian activity and focal point for transit trips. It is expected to take about four minutes to walk from the edge of a district to its centre where the transport halt ad the majority of shops are located. (https://.ecotownpenang.com)

Mobility alternatives: Connected Public Transit (CPT)

CPT services are intended to encourage efficient travel and consumer behaviour is expected to shift from driving automobiles to using different modes of transportation and mobility substitutes. Intended to Increase the use of mobility options and reduce traffic congestion; road and parking costs, accidents and carbon emissions.

Figure 60: (Top Left) The Connected Bus, San Francisco.

The San Francisco Municipal Transportation Agency (MUNI) & CISCO produced a 95-percent emissions-free hybrid public bus, with Wi-Fi and digital screens for each passenger. They will implement 800 of these into their transit system in the near future. Each screen has bus schedules, routes, times, advertising and a “green meter,” showing the environmental impact from the bus. (https://.ecotownpenang.com).

Figure 61: (Bottom Left) Bus Rapid Transit System (BRT).

The aim of the BRT system is to link the major parts of the city into a working network. The government aimed that by 2020 a majority of residents wouldn’t be living more than 500m away from a BRT system. It currently runs for 18 hours a day but the plan is to make it a 24 hour safe, comfortable, well maintained and reliable mode of public transportation. Thankfully a BRT system began to be constructed along Andrew Mapheto Drive in the study area in 2014. (https://.gov.za)

Mobility substitute: Smart Work Center.

This concept was developed to reduce physical travel such as commuting and business trips. The aim is to improve the productivity of mobile and home workers by providing full business support, including shared office equipment, and various services. It is sustainable to change mobility patterns by providing citizens with an accessible, secure, convenient, and shared mobile-working infrastructure.

Figure 62: Smart Work Centres (SWCs), Singapore. The centres have been officially launched at the Jurong, Geylang East and Toa Payoh Public Libraries. Conveniently located in residential hubs and complete with private workstations, meeting spaces, high-speed Wi-Fi, video-conferencing services as well as printing and copying facilities. (https://.ida.gov.sg).

Vitas Manila, Philippines

The project is an example of the long term effects of having no community engagement, development and a sense of control for the residents at any point in the process of the project. Drivers for architectural design and planning were not motivated by the end-users needs and livelihoods, which kept residents on the outside of their own housing resolution programme. Moreover, the different income classes were physically separated which prevented the opportunities for social cohesion and re-integrating the poor with the urban environment thereby empowering. Due to the poverty state of many of the residents, one would expect economic and capacity development or community support programmes to be initiated, but there were none.

Figure 63: (Left) Vitas Manila view from street (*Sustainable Medium Density Housing*, 2008)

Principles learnt from precedent studies

1. Increase residential density on well-located sites (close to social amenities and busy links to main public transportation routes/interchanges)
2. Aim for integrated developments
3. Engage with the community in the planning phases, initiate ongoing capacity building and community support programmes
4. Provide housing and services which are affordable
5. Take the needs of vulnerable people into consideration
6. Provide various options for tenure (public rental housing and subsidized housing)
7. An integrated design and efficient (affordable) use of construction material and labour should be localised
8. The ability to measure and capture value from the perspective of the end-user
9. A sustainable livelihoods approach: Investigating the residents' daily lifestyles, their different sources of income and the differences present between the different households of a given community

3.5 Tenure alternatives and housing typologies

There are a range of housing typologies which designers can explore when designing a house, this is because a house does not only refer to a physically built structure, but includes various elements which make up a human settlement. Communities need to be designed in a way that displays quality private spaces; public spaces which serve the community; accessibility to recreational facilities; and many more elements which improve the character of the community. (*Sustainable Medium Density Housing*, 2008)

Factors which contribute to the frequent usage of a design intervention should be considered when designing housing at a community scale and the built; social and cultural environment can create a 'sense of place' for the residents. Tembisa is in need of a positive perception of sense of place, the scarcity of social amenities and dark unlit streets decreases the quality of the urban environment and this makes it an unwelcoming place to visit. Improving the quality of the urban environment will result in satisfied homeowners who are proud to express their identity through their homes.

It is important to not only consider the availability of land when making decisions for the appropriateness of housing typologies, but also the socio-economic factors affecting the end-users. Neglecting these factors might result in unanticipated consequences which will decrease the quality of the community environment. The apartheid era affected the country in many ways, and the residents of such areas are still suffering from the consequences of it, decisions were made over 2 decades ago by government to mitigate these issues, but families who were separated by the unjust segregation and placement of people on the outskirts of the city is a by-product which the residents still have to deal with. The new design intervention therefore encourages and facilitates family life, this is important in the global transition to sustainable living and South Africa's sustainable development of human settlements.

The appropriate form of higher density housing should provide:

- A range of housing types
- Associated densities and tenure
- A variety of urban opportunities and activities
- Higher levels of support and services

In attempting to achieve sustainable human settlements, designers and planners should provide a variety of compacted land uses, and housing which secures tenure for ownership housing and rental housing. The scope of planning should be aimed at achieving "urban design; environmental performance, social, affordability and safety objectives rather than numerical restrictions on setback, height, plot ratio and density." (*Sustainable Medium Density Housing*, 2008)

The social opportunities provided by providing a range of housing typologies include:

- Equal opportunities for different income groups
- Opportunities to extend/move up (in housing) without relocating
- The creation of a unique sense of place and ownership
- The encouragement of social equity

Semi-detached housing (Duplex & triplex units)

Semi-detached housing encompasses the attaching of two dwelling units joined by a common wall, but are owned individually. The units oftentimes have the spatial layout mirrored across a common wall. The public open spaces are usually in the front of the house and/or at the back, as well as on one side of each dwelling. This housing can be achieved by sub-dividing existing plots that still include sufficient private yard space on the ground floor for the individual units.

Advantages

- Lower costs for construction due to shared structure and facilities;
- The possibility of a range of densities yet still offering unit identity, and open spaces which are private,
- Direct access to the street (public and communal spaces)
- Shorter runs for services (sewage, water, waste disposal and collection
- Personal identity can be maintained as residents can extend or personalise their homes on three sides of the house.

Disadvantages

- Limitations for extensions or planting on all four sides of the plot,
- The desired level of privacy might be lowered
- Shared walls increase the amount of noise heard from neighbours.

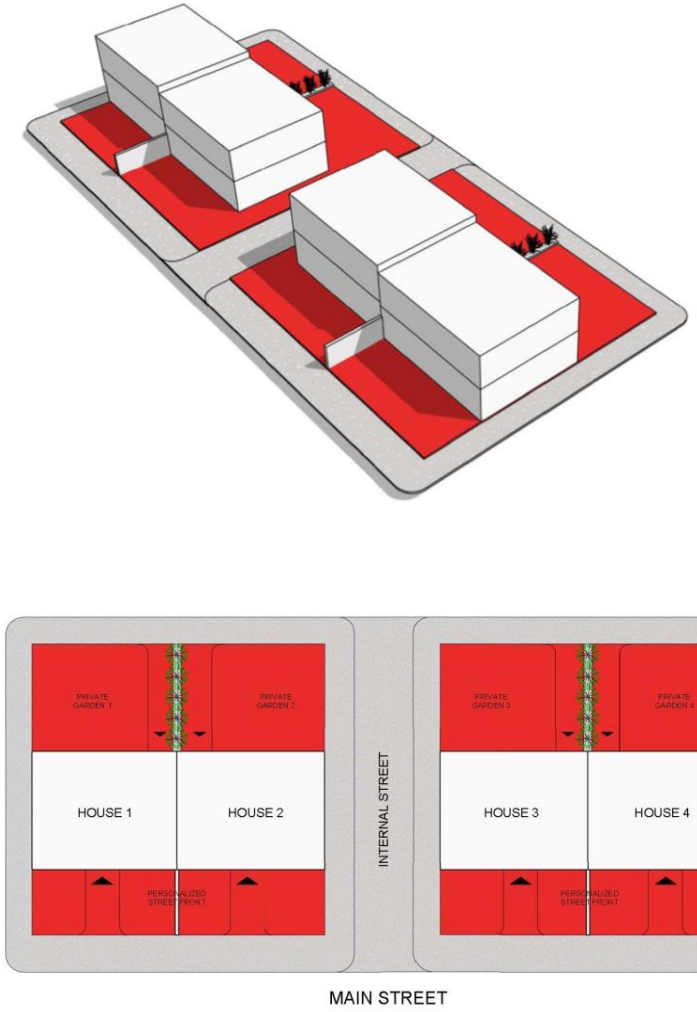


Figure 64: Semi-detached housing (Moloto, 2017)

Row-housing

Row-housing constitutes a continuous row of houses with internal common walls shared; in some areas it is considered the most accepted form of medium density housing as it can accommodate more dwellings per erf than semi-detached housing. It also provides opportunities for private yard space in front and at the back of each unit.

Advantages

- The advantage of using multiple shared walls limits the exposure to the elements for the individual elements.
- The service runs are even shorter than for a semi-detached house, and higher densities can be achieved through efficient land use.
- There is direct access to the ground floor public amenities with sufficient private, unshared space.

Disadvantages

- The limitations for extensions or planting on either side of the plot;
- The need to walk through the unit to access the backyard;
- Personal identity in the architecture and façade treatments is also limited in such complexes;
- Noise levels are higher than for semi-detached housing.

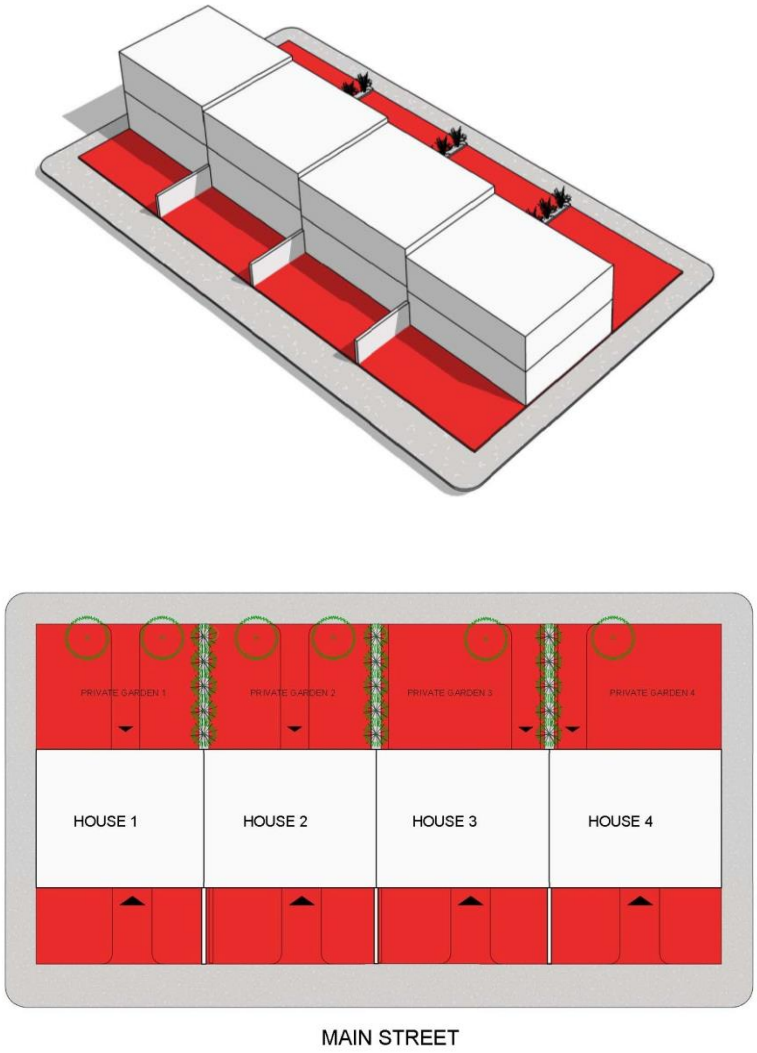


Figure 65: Row-housing (Moloto, 2017)

Apartments

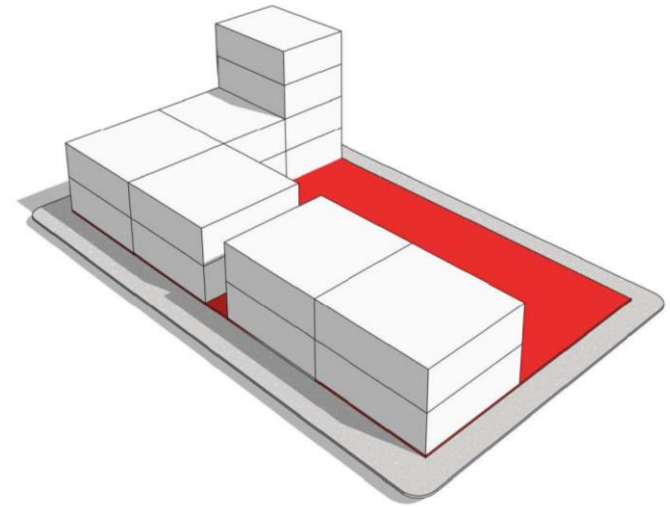
Low-rise urban housing is usually configured using these three to four-storey walk-up buildings. The upper floors are usually accessible using staircases and shared landings, this is a major determinant for the four-storey limit. For healthy adults, climbing up three storeys is considered the maximum, but is considered too much for young children and the elderly. (*Sustainable Medium Density Housing*, 2008)

Advantages

- Access to shared facilities, i.e. laundry facilities, gyms, gardens, security monitoring, at a reduce cost due to the communal sharing factor. ("Advantages And Disadvantages Of Apartments Living", 2016)
- Density scales allow for economic development, new transport systems and higher service levels
- Sense of ownership and identity from maintenance of communal areas
- Communal shared facilities can form social & cultural networks

Disadvantages

- Upper units don't have direct street access
- Sharing of internal public spaces, i.e stairways; walkways; landings
- Lack of sufficient maintenance of communal spaces can result in neglected, dangerous areas
- Noise levels are higher than for semi-detached housing.



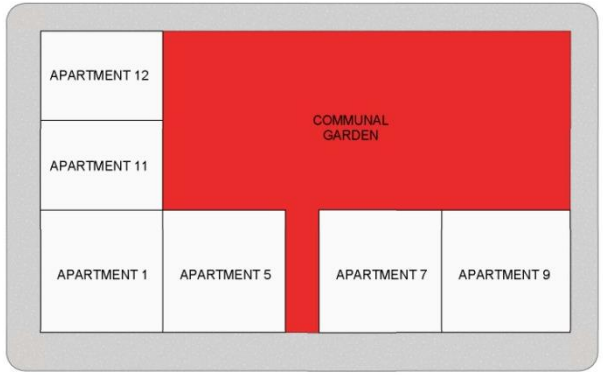


Figure 66: Apartment rental housing (Moloto, 2017)

Courtyard housing

Housing made of apartments, single storey units or detached housing encompassing a communal open outdoor space. The outdoor space can be gardens or just paved land, it is often through this courtyard that the houses are accessed. The courtyard, usually quiet and shaded, offers a pleasant transition from the street to the individual residential unit.

Advantages

- Gives the surrounding residents a private outdoor space that isn't overlooked by too many neighbours.
- Open courtyards allow natural light to penetrate the properties, making it easier to provide windows for every window facing the courtyard. ("Contemporary courtyard houses", n.d.)
- Sense of ownership and identity from maintenance of public areas
- Communal shared facilities can form social & cultural networks

Disadvantages

- If a courtyard is too small, it has the disadvantage of feeling claustrophobic.
- The units might have a limited view to the outside.
- For bedrooms facing the courtyard, privacy might feel compromised if the bedrooms can be seen by neighbours across the courtyard
- Drainage for rainwater falling from roofs facing the courtyard needs to be carefully designed for ("Contemporary courtyard houses", n.d.)
- The opportunity for extending the living space horizontally is limited

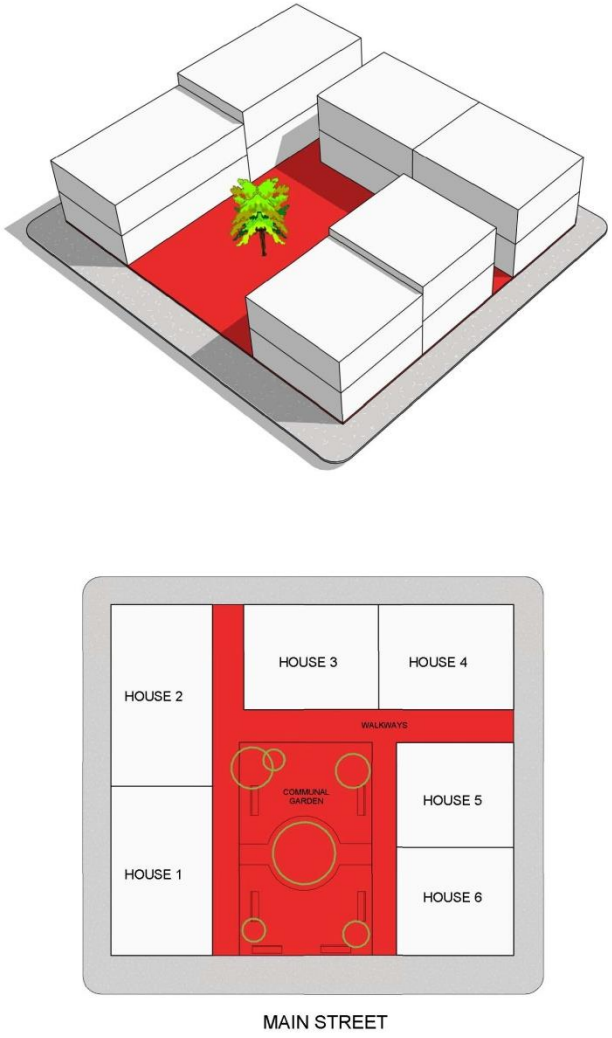


Figure 67: Courtyard housing (Moloto, 2017)

Rental rooms

Rental rooms can be provided in the dormitory form of hostels, communal and transitional housing. Privately owned homes also provide rooms for rent within the home and/or in their backyards. The backyard rental rooms can be made of shack material or more sustainable materials. A full bathroom is not always provided with the backyard rental rooms, however, a toilet and a tap is usually made available. The rental rooms within the house share communal spaces such as the living room, bathroom and kitchen with residents of the main house, they also share an entrance to reduce construction cost and space. This form of accommodation is reported to be in high demand (approximately 1/3 of the population).

Advantages

- People with a low income; migrants and young singles/couples are able to afford decent housing with basic services at affordable rates
- Extended family members can have accommodation and maintain social networks
- Extra income for the homeowners
- An efficient way of accommodating increasing densities
- Usually well located with shared adequate security

Disadvantages

- Can be negatively perceived as crowding of yards
- Some hostel aren't managed well resulting in undesirable environments
- The use of unsafe materials reduces good light and ventilation
- Landlords can disregard building regulations, as well as exploit tenants

Figure 68: Typical apartheid-era hostel accommodation: Physical manifestation of discrimination and economic exploitation

3.6 An integrated approach

Appropriate development interventions

This approach refers to the need for cooperation between the private sector, government departments and residents in an aim to address the wide variety of community and household needs. The needs of households in areas such as Tembisa are often complex and multi-faceted. An all-inclusive approach to these needs will yield better results in improving the social, economic and physical conditions of households. Successful Integrated development plans (IDP's) are laced with "good inter-government relations, collaboration between key role players, and active civil society participation in urban processes" (*Sustainable Medium Density Housing*, 2008:20). The provision of a variety of social infrastructure and facilities (such as social amenities; recreation; leaning and homework facilities for the young) together with housing is a vital component of this approach. Spatial planning should therefore be designed to integrate access to urban opportunities, facilities and amenities across the different racial and income groups.

Therefore, a mixed-income development has a greater chance of successfully re-integrating the city, as opposed to enforcing the segregation, however, this can be difficult to achieve. An understanding of individual citizen needs must be levelled not only with environmental sustainability, but also against the interests of the wider community. Interventions in largely poverty-stricken areas such as Tembisa must respond to the livelihoods of households by providing a wide range of interventions, not only housing. A community of compact, medium density housing provides better opportunities for the development of skills and capacity for locals, as well as economic development.

A holistic understanding of the development issues of a client community can be obtained by assessing their livelihoods in order to implement suitable interventions, therefore, households of the same community are important stakeholders in the planning of housing developments. If we aim to address the housing issues faced by lower-income households, we must initiate community programmes and activities to be implemented in partnership with other communities and organisations to ensure that the projects are a success. Research recommends the key actors involved in urban developments as:

- Government (national, provincial and local government initiatives)
- Interested groups (community bases, development agencies etc.)
- Broader stakeholders (citizens, business, architects, planners)
- The development industry (property; construction sectors etc.)
- The formation of partnerships (public/private)

Collaboration between these different role players within the contexts of operation will achieve sustainable and integrated community settlements. Some opportunities presented by integrating medium-density housing in good locations are access to urban opportunities of employment and entertainment; public transportation and pedestrian friendly environments, and healthy efficient buildings that don't harm the environment. (*Sustainable Medium Density Housing*, 2008)

3.7 Community Participatory design

Community Participation in Architectural Design is defined as “The active involvement of a committee consisting of elected (or self-appointed) members of the client community in need of assessment, establishment of the brief, fundraising (if applicable), design of the building, construction, maintenance & management of the completed structure. (Marschall; 1996;6) Turner (1976: 128) cited in “Architecture as Empowerment: The Participatory Approach in Contemporary Architecture in South Africa”, (1996), based on research in the United States, Peru and other Latin American countries, contended that “the central issue is that of control or of the power to decide”. The aim of engaging with the client community from the planning phases of development projects is to get them to take responsibility for their own developments (Turner: 1976) by shifting control towards the people who actually do the work (Farouk: 1996: 286) in order to transform the people’s consciousness by leading them through “a process of self-actualisation and empowerment.” (Marschall: 1996: 104)

Dana M Silvers analysed the community participatory design objectives by a few international public projects and formed the following “kit list” of five simple principles to consider when approaching communities with this process.

1) It is important to build relationships with the community for a while before beginning the construction process; there is an option to use storytelling as a method of communing with them. Grants and fundraising opportunities should be explored, as this will catalyze the progress of the project. Weekly meetings can be held with key members of the community and resistance should be anticipated. (Silvers, 2015)

2) The client community must be involved in the development of the design from concept phase, this is where community participatory design is practiced in its real sense because the community feels that they had control over the building to be erected in their neighbourhood. This is particularly effective not only when it has to do with a house but also with public projects such as malls or community parks. Frequent usage and visitation to the buildings will be increased because a sense of ownership was established during the design phase of the project. (Silvers, 2015)

3) During the process of engaging with community, respect for the individuals’ time and effort will solidify the trust with community members. Interested sponsoring companies can compensate the members for their contributions, as well implementing programmes that will keep them employed throughout the project. Learning opportunities can also be rewarded to interested parties. By hosting building and construction sessions at the community support centre & community halls, authentic on-the-job learning opportunities can develop the people professionally. Exposure to other neighbourhood settings can inspire the members, as well as building full-scale prototypes of the different elements of the project for increased knowledge and capacity. (Silvers, 2015)

4) Community ambassadors can be democratically chosen by the client community to represent their interests in all liaisons with the professional team. It is important for the drivers of the project to hold weekly meetings with the trusted members of the society, where differences could be discussed and explored in a controlled smaller group of leaders of the community. (Silvers, 2015)

5) The homes are most paramount in this project as these will house the small business units on the ground floor; it is therefore advisory to begin with the construction of the semi-detached houses. The next phase is the construction of the new community recreational amenities and community garden sites. The aim is to build lasting relationships with the community to ensure their involvement in all public projects. There are numerous projects in Tembisa which began without community consultation and they are now mostly bare and unused, such projects were unsustainable because they wasted money, construction material, and labour. In order to avoid this, my design will be implemented in stages which will keep constant communication with the community members, meetings might move to once a month but their involvement shouldn't be excluded. (Silvers, 2015)

3.8 The neighbourhood ecosystem

This ecosystem recognizes the diverse needs of a locality, the cultures, family groups, income brackets, ages and lifestyles vary greatly making it invalid to generalise these needs. Theory on ecosystems emphasise that people are responsible for the satisfaction of their own needs but spatial and urban planning and design of neighbourhoods and urban fabric can either contribute positively towards this by supporting it or negatively, thereby frustrating it. Scholars have divided this model into 5 main features:

1) Stakeholder involvement, from private, public, community as their interests are at stake;

2) Diversity, of housing typologies, tenure, local work and service opportunities;

3) Increasing local autonomy, providing for the everyday needs of the community by providing for the everyday needs of the residents, i.e energy generation and waste management centres at community scale while increasing local employment;

4) Connectivity, between and within neighbourhoods increasing choice and vibrancy, social and leisure facility together with openness of street network, even dependence on neighbouring communities;

5) Densification closely located to public transport access can connect large groups of people with many places, but should be planned to be maintained properly as higher densities can result in crowding, pollution and other negative effects. (*Sustainable Medium Density Housing*, 2008)

Connectivity in terms of sustainable urban planning is meant to be created between people and places as well, a 'sense of place' is what distinguishes a person's perception of his/her locality. The provision of a range of green spaces adds to the opportunity to capitalise on the resources of the area to create this connectivity. These include public parks, playgrounds, picnic areas, gardens and multi-purpose open spaces which have added benefits of reducing pollution for example. People change and so do places as time unfolds, therefore, a sustainable area needs to adapt with the change in the environment with time as well, this must be considered with building forms, the extendable nature of buildings, the fixed edges or barriers of streets and so forth. (*Sustainable Medium Density Housing*, 2008)

3.9 Technical investigations

3.9.1 Passive design options

Passive design aims to reduce the dependence on electrical energy to make the home comfortable, and takes advantage of the climate to affordably produce as much energy as the home consumes. (admin_666, 2013) Maintaining good indoor temperature, humidity and air quality is reported to account for 30% - 40% of a building's energy use. Passive design maintains the same good quality of indoor environments without the use of purchased energy.

Solar shading

Passive design works with the external weather temperatures, not against them. Design features such as roof overhangs, building orientation etc. can help use the sun's heat in winter and avoid it in summer

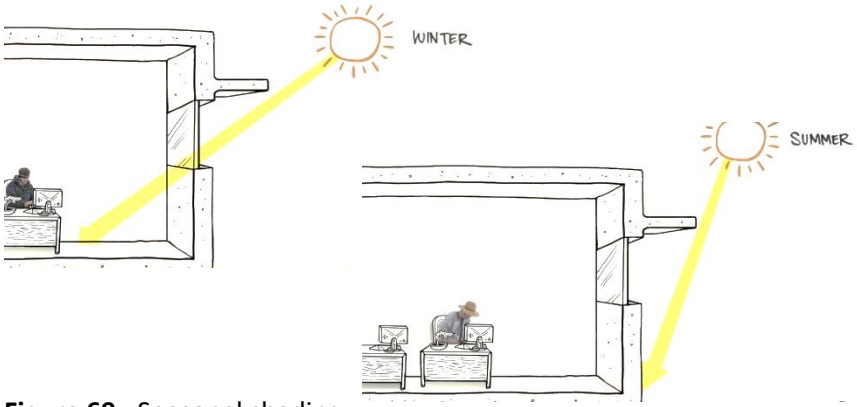


Figure 69: Seasonal shading ("Passive Design Strategies | Sustainability Workshop", n.d.)

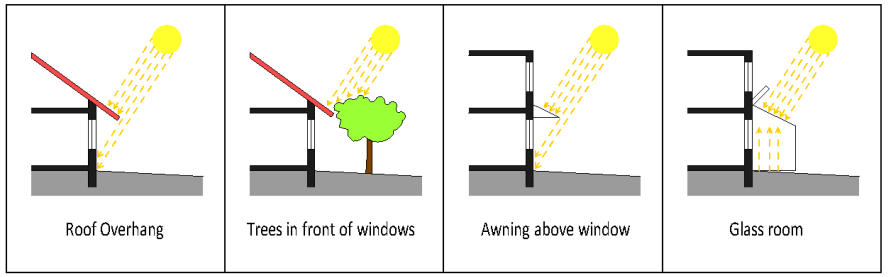


Figure 70: Solar shading options (Moloto, 2016)

Surface treatment

Buildings build up heat through exhaust air produced by occupants and equipment, but the sun's heat can also be absorbed by buildings, especially by pavements and dark roofing materials. This can be minimised by the use of more reflective surfaces (corrugated iron roofing) or vegetation (green roofs, planting on roof or balconies).

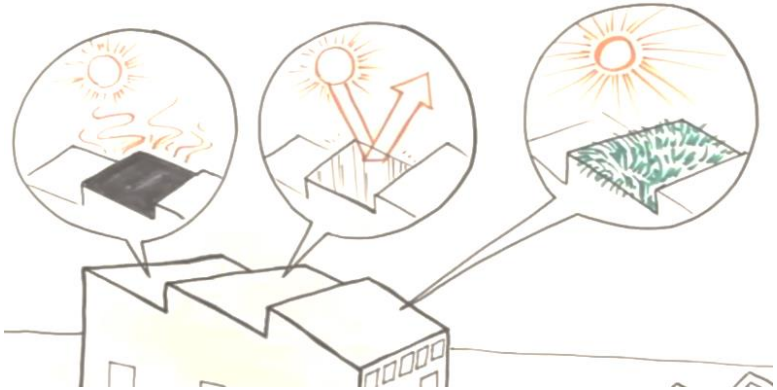


Figure 71: Surface treatments. ("Passive Design Strategies | Sustainability Workshop", n.d.)

Natural (cross) ventilation

Windows can be strategically placed to allow the movement of fresh air (wind) into the building for cooling, without the use of fans or air-conditioning. This can be controlled with the size and orientation of window openings.

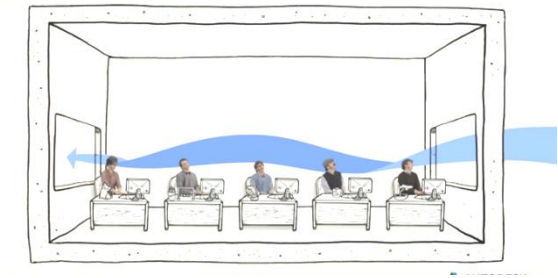


Figure 72: Natural ventilation. ("Passive Design Strategies | Sustainability Workshop", n.d.)

Wind and heat make air pressure lower the farther you are from the ground, higher pressure air naturally moves higher from the ground, placing windows at the top and the bottom of the building will allow the high pressure air to move upwards naturally, cooling the space inside.

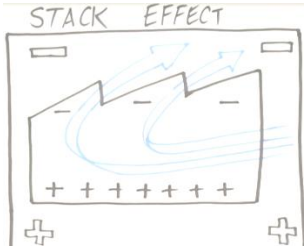


Figure 73: Stack effect. ("Passive Design Strategies | Sustainability Workshop", n.d.)

It is good practice to design buildings with more than one side directly exposed to prevailing winds, in the form of window openings or doors. "Dwelling layout and building depth determine the ability of a dwelling to be naturally ventilated. Generally, as a building gets deeper, effective airflow reduces." ("Department of Planning and Environment - Medium Density Housing", n.d.)

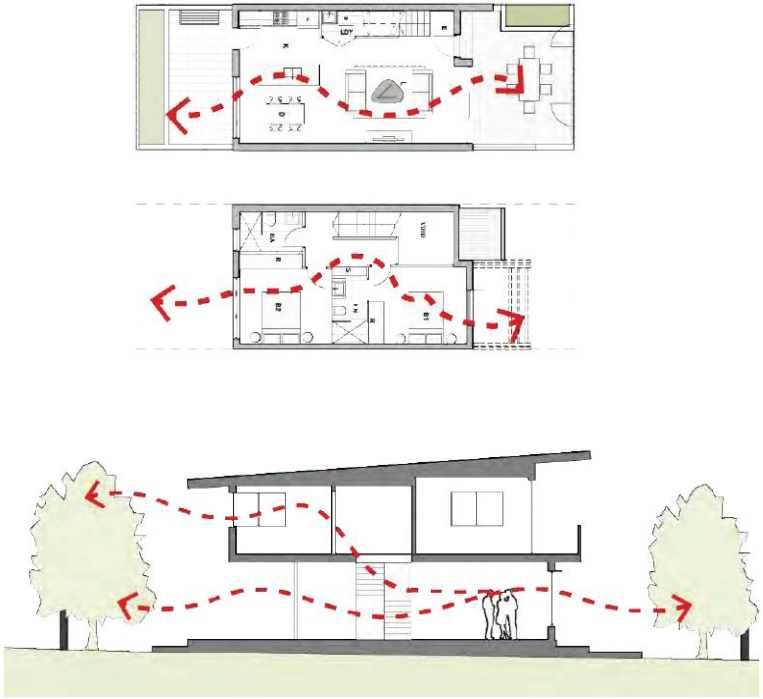


Figure 74: Cross ventilation ("Department of Planning and Environment - Medium Density Housing", n.d.:40)

Siting and orientation

The position of a building and its internal spaces in relation to a given site, street, neighbourhood and weather factors is referred to as orientation. A building's orientation affects exposure to sun, visual privacy and acoustics. Buildings should therefore be orientated to take advantage of daylight access into living rooms and bedrooms.

Figure 75: Site and orientation ("Department of Planning and Environment - Medium Density Housing", n.d.: 34,35)

Buildings should be stepped to follow the fall of the site, the proposed ground level must be as close as possible to the existing ground level. Kitchens should have good daylight access, and living rooms should be orientated towards the primary outlook. Spaces for study/work purposes should be provided with the option of adapting them to other uses. Vulnerable groups (older persons/disabled persons) should be accommodated by increasing circulation spaces around furniture.

Ceiling heights

Ceiling height affects the natural ventilation and daylight access of habitable rooms. Increased ceiling heights ensure the adaptability of rooms on the ground floor and the first floor. Therefore, daylight access, ventilation, and overall comfort of habitable space can be significantly improved by higher ceiling heights.

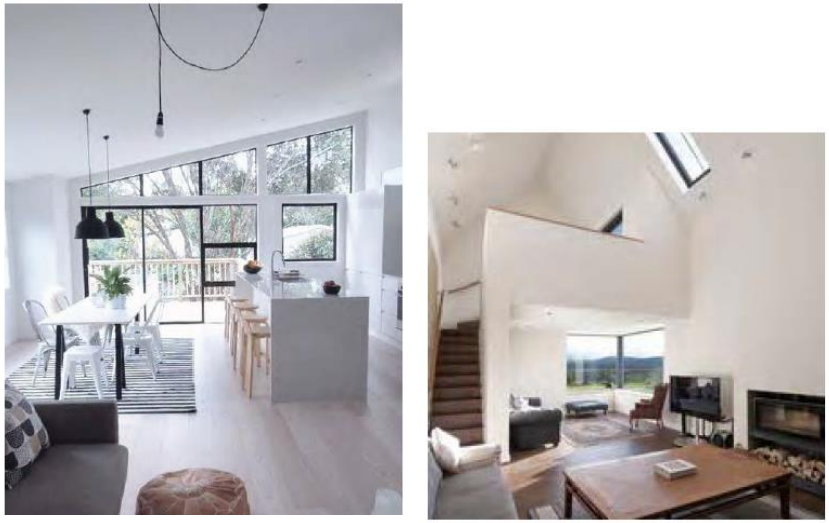


Figure 76: Sloped ceilings ("Department of Planning and Environment - Medium Density Housing", n.d.:42,43)

3.9.2 Resource management

Water treatment and conservation

"Water sensitive urban design includes the integrated management of water in urban areas. It takes into account all of the elements of the urban water cycle including potable (drinking quality) water, rainwater, wastewater, stormwater and groundwater." ("Department of Planning and Environment - Medium Density Housing", n.d.:74)

Recommended design solutions:

- Rainwater runoff should be collected from open surfaces (roofs, balconies) and plumbed into toilets, laundry and irrigation.
- Open paving materials should be porous
- Rain gardens and street tree pits should be used to filter stormwater
- Rainwater should be used for the landscape

Figure 77: Rain garden ("Department of Planning and Environment - Medium Density Housing", n.d.:74)

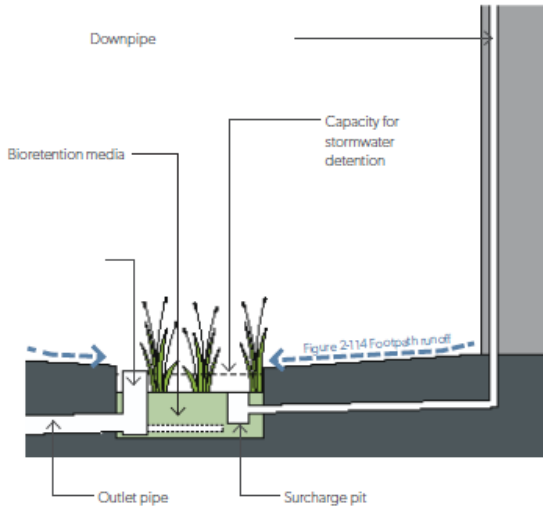


Figure 78: Bio-retention garden ("Department of Planning and Environment - Medium Density Housing", n.d.:75)

Figure 79: Swales ("Department of Planning and Environment - Medium Density Housing", n.d.:74)

Waste management strategies

The proposed alternative to complete reliance on municipally supplied electricity and burning of coal for cooking is the anaerobic bio-gas digester.

Anaerobic digestion (small-scale)

"A small-scale *biogas reactor* or *anaerobic digester* is an *anaerobic* treatment technology that produces (a) a digested slurry (*digestate*) that can be used as a *fertilizer* and (b) *biogas* that can be used for *energy*. *Biogas* is a mix of *methane*, carbon dioxide and other trace gases which can be converted to heat, electricity or light." ("Anaerobic Digestion (Small-scale) | SSWM", n.d.) At household or community level, the required biogas is typically produced by small-scale biogas reactors.

IN	OUT
Human faeces Organic solid waste Food industry organic waste Beverage industry waste Blackwater Brownwater Industrial products	Biogas. Sludge, compost/biosolids

Figure 80: Details ("Anaerobic Digestion (Small-scale) | SSWM", n.d.)

The reactors are airtight, and can receive kitchen waste; garden waste; animal manure; and toilets can be linked to the reactor directly, for the treatment of urine and faeces. The gas produced can be used for cooking and lighting, transformed into heat, or for a combined heat and power (CHP) system. The burning of gas will leave residue of nutrient rich slurry (digestate) which can be reused upon separating it into liquid and solid fractions. The liquid substance remaining after the anaerobic digestion can be used in the gardens as a very good fertiliser, the solid material can be used to condition the soil.

Why bio-gas?

This system aims to decrease the amount of untreated waste illegally dumped in public areas across Tembisa, by extracting value from waste. The proposed system will also ensure a more efficient method of human disposal, and clean energy that doesn't pollute the environment for cooking and lighting. When replicated in other parts of the township, it will address the issue of open defecation.

Digester types

"The main design elements of small-scale biogas reactors are: an inlet, an airtight reactor chamber, a vessel for biogas collection (e.g. upper part of the reactor) and an expansions chamber. Optionally, there are connections from the toilet(s) and a grinder for the kitchen and garden wastes." ("Anaerobic Digestion (Small-scale) | SSWM", n.d.)

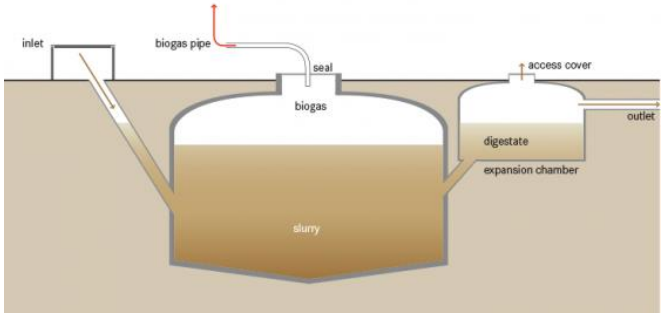


Figure 81: Schematic of a biogas reactor (TILLEY et al. (2014 cited in "Anaerobic Digestion (Small-scale) | SSWM", n.d.)

1. Floating Drum Digester

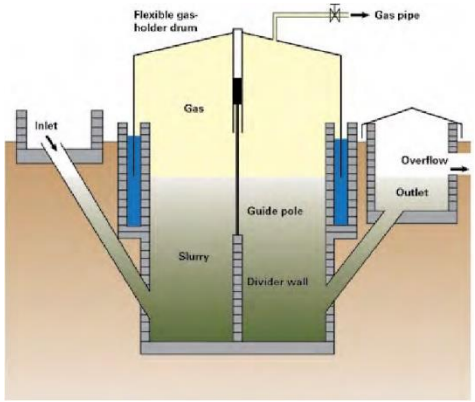


Figure 82: Floating drum digester ("Scheme of floating-drum digester (Estoppey, 2010). - Figure 4 of 10", n.d.)

Advantages

- The digester is mainly underground, so the loading and unloading feed can be done easily at ground level
- The temperature of the digester is generally stabilized. (ENEG110011 Project 2 EWB, n.d.)
- "The gas pressure remains constant as it depends on the weight of the gasholder". ("Anaerobic Digestion (Small-scale) | SSWM", n.d.)

Disadvantages

- Building the structure on the ground can be complex.
- The drum can corrode or rust, needing high maintenance.
- The structure is permanent and requires a high initial cost for construction, making repairs and maintenance expensive as well. (ENEG110011 Project 2 EWB, n.d.)

2. Rubber-balloon biogas plant

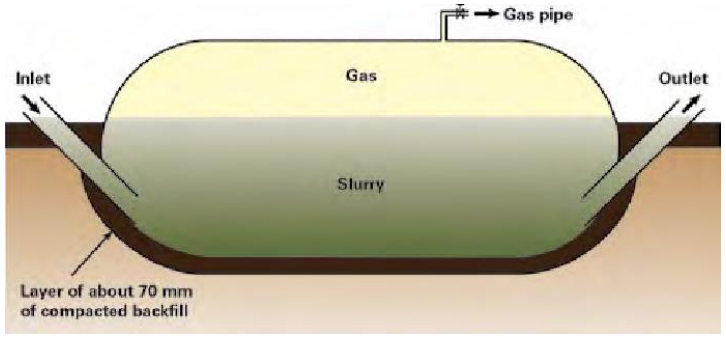


Figure 83: Rubber-balloon biogas plant("Scheme of balloon digester. - Figure 5 of 10", n.d.)

Advantages

The loading can also be done at ground level, and temperature is stabilized.
It is also the cheapest and simplest type to construct
Easy to clean and empty out.

Disadvantages

It is a closed system, with lower gas pressure
The polyethylene can degrade relatively quicker than other materials.
The life span is relatively short due to the easy construction and degradable material used.

3. Fixed dome digester

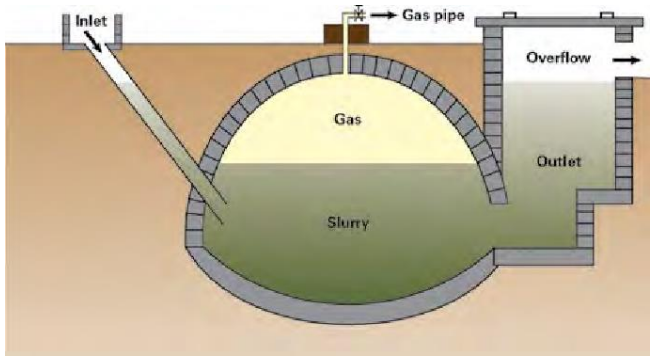


Figure 84: Fixed dome digester ("Scheme of fixed-dome digester - Figure 3 of 10", n.d.)

Advantages

- The digester can be loaded at ground level, and the temperature of the digester is stabilized due to this.
- The seal is airtight, and the materials don't include rusting steel like the floating dome type.
- The construction cost is relatively low but complex, thereby creating local jobs to community members, with expert supervision
- The life span is relatively longer if constructed well, due to materiality and protection underground.

Disadvantages

- Due to the closed system, maintenance will be difficult
- The brickwork gasholder can cause cracking that results in biogas loss
- The gas pressure fluctuates

Notes to remember when designing for a Bio-gas digester system:

- A bio-digester at this (community) scale needs to be cast underground with concrete using a steel mold. The fixed dome gasholder fits within It is important that the bio-digestor be fed with organic material only.

- All feedstock material should ideally be in the form of a runny slurry when fed into bio-digester, thus will travel at a slope from the homes in pipes

- Recyclability of non-degradable materials can be put in place to get the community used to seperating the matter. i.e Seperating glass from plastic and so on. I have thus strategically placed recycle bins nearby various entrances to the site, to create awareness about the importance of waste management.

- Local garbage-collecting company can collect recyclables from the Waste Management Centre
  after all the matter has been sorted into the different categories of waste.

- ...Local garbage-collecting company can offload degradable matter at this centre for biomass production for the community

Renewable resources for electrical power

Solar power

The use of the freely available power of the sun's rays, if used efficiently, the initial high cost of installing solar photovoltaic panels for electrical power will save household money for decades with little or no maintenance.

Advantages of solar photovoltaic panels

- No pollution is created in the process of generating electricity. Solar energy is clean, renewable (unlike gas, oil and coal) and sustainable. Unlike traditional forms of creating electrical energy, releasing carbon dioxide, nitrogen oxide, sulfur dioxide or mercury into the atmosphere.
- There is no on-going cost for the power it generates – as solar radiation is free everywhere. Once installed, there are no recurring costs.
- It can be flexibly applied to a variety of stationary or portable applications. The panels can be made small enough to fit pocket-size electronic devices, or sufficiently large to charge an automobile battery or supply electricity to entire buildings.
- It offers much more self-reliance than depending upon a power utility for all electricity.

Disadvantages of solar photovoltaic panels

- The initial installation cost is usually high and the return on the investment varies
- It takes a large amount of space on the roof
- Might require electricity or gas backup for colder months

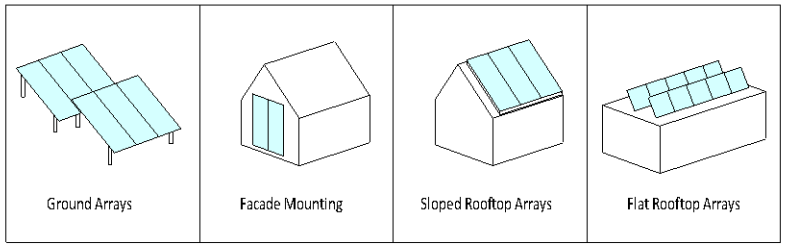


Figure 85: Options for solar array mounting (Moloto, 2016)

Solar hot water geysers

One of the most expensive ways to heat water is with the use of electricity, and this is the most common method used in the study area. The direct solar geyser system is the most commonly used alternative water heating system used in South Africa. For effectiveness, panels are placed facing north. Warm water is transferred through evacuated tubes form the panel to the geyser, forcing the colder water in the panel for heating. ("Solar Thermal Heating versus Solar PV | Benefits of Solar", n.d.)

Figure 86: Solar heating can save up to 40% on water heating costs ("Solar Thermal Heating versus Solar PV | Benefits of Solar", n.d.)

Efficient use and specification of construction materials

Bricks and CMU's:

The envelope of the building structure combines framing and infill. Stone, masonry and concrete masonry units (CMU's) are commonly used to provide the structural strength of the building.

Advantages

- Clay for bricks is readily available from surfaces
- They're locally manufactured, thereby reducing cost for transportation and air pollution.
- Bricks and CMU's are long lasting and have good thermal mass
- If discarded in a landfill, they don't emit harmful toxins

Disadvantages

- The embodied energy of bricks is high, and the process of creating the lime used in mortar and cement consumes large amounts of energy.
- If the foundations are not built correctly, water can leak and damage the ground floor structure. ("Advantages and Disadvantages of Concrete Block House Construction", n.d.)

Figure 87: Concrete block construction. ("Advantages and Disadvantages of Concrete Block Foundation", 2014)

Rammed earth construction:

Considered an ancient technique comprising mainly of sand, gravel, silt and clay.

Advantages

- The material is beautiful and has creative possibilities
- High thermal mass, compressive strength
- Able to modify humidity naturally
- Facilitates job creation for community labourers

Disadvantages

- The construction is labour intensive and requires proper training and supervision, and only certain types of soil can be used.
- The material is not efficient in insulating, on its own
- Construction process is longer, thus buildings are usually small in size
- Not very durable in extreme weather conditions

Figure 88: Rammed earth construction ("SIREWALL System – SIREWALL | Structural Insulated Rammed Earth", n.d.)

Adobe bricks:

Also known as mud bricks "made of earth with a fairly high clay content and straw. The earth mix is cast in open moulds onto the ground and then left to dry out. Adobe bricks are only sun-dried, not kiln-fired. Bricks are bound with earth mortar. Before drying out, the finished walls are smoothed down." ("Adobe Brick Technique (Mud Bricks)", n.d.)

Advantages

- Sufficient thermal mass
- Low transmission of sound through walls
- Building technique is simple enough to be acquired through on-site experience – thus suitable for owner builders
- Can be cast from a wider range of soils than other techniques, low cost
- Good water resistance
- Can be easily cut to fit spaces, and create holes for reinforcement and services

Disadvantages

- Can be damaged by extreme weather conditions
- Walls tend to crack in harsh summer weather
- Requires regular maintenance

Figure 89: Adobe construction ("5 Other Materials To Build a Home | Homes", n.d.)

Insulation:

An alternative to using plastics with potential hazardous chemicals is the use of organic insulation and insulation made of recycled newspaper or textiles, available in batting, loose-filled, or spray-on applications. Cotton insulation is also made from recycled textiles and fabrics. The recycled material used in these products would have ordinarily been discarded in landfills. (Kim, 1998)

Figure 90: Insulation from recycled newspaper (Kim, 1998:35)

(Below) **Figure 91:** Spray polyurethane foam ("Spray Foam | Ecofoam", n.d.)

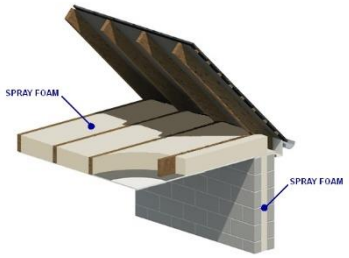


Figure 92: The spray-on application of the insulation provides thermal properties that can easily fill cavities, in and around pipes, tanks, electrical outlets etc. It is also applicable to roofing, providing waterproofing and preventing leaks. ("Spray Foam | Ecofoam", n.d.)

End-User Livelihoods + Sustainable Living Principles

=

Sustainable Adaptation

PART 3: Design Intervention

4. DESIGN INTERVENTION

4.1 Design Brief

4.2 Site selection

4.3 Community integration

4.4 Adaptation at urban scale

4.6 Community livelihoods

4.7 Adaptation of unit

4.1 Design brief

The objective is the design of a new development of integrated (mixed mode) sustainable housing (subsidized; rental units; and entry level bonded houses) associate infrastructure (amenities and commercial facilities) within the Tembisa area. The target groups for this development are lower and middle income groups (families, childless couples and singles) who wish to improve their lifestyles by living in pleasant homes in walk-able communities. A mixed income community will allow people to move up and down the financial ladder without having to move out of Tembisa.

The initiatives introduced in this development must all be guided by the principles of sustainable living. The daily lifestyles of the residents must be observed to inform programs best suited to accommodate their needs in a community.

The design intervention aims to involve the community from the concept stage to the construction and overall management of the design intervention. It is important to keep this in mind when designing in terms of scale, availability of building material, local labour etc.

*"A Sustainable Community Development built **for** the Community, **by** the Community!"*

4.2 Site selection

Site options

Southern neighbourhoods, Tembisa

The study area chosen for the analysis covers a large residential area in the southern parts of the township of Tembisa, which consists of a number of smaller communities; some streets in this area still don't have street names. This area was chosen due to the diverse development of its human settlements, more specifically, the informal settlements.

Good location

The selection of good locations for housing development can be a complicated process and is often not prioritised as it should be. However, there are useful determinants such as access to employment, transport and urban opportunities and facilities. The development of integrating housing settlements should take place on infill areas near economic opportunities, main public transport interchanges connecting a lot of people to different places urban opportunities and a variety of social networks. (

The area has experienced a huge influx of illegal immigrants and unemployed individuals from other provinces in South Africa over the years, there isn't usually shelter or help for them in this area, so they tend to settle in remote parts of land which are either empty or already occupied by other disadvantaged people. This solution was initially meant to be temporal but the difficulty of finding employment as well as maintaining it forces the disadvantaged to remain in these living conditions, this is the most common cause of the informal settlements found in the study area. Although these communities are illegally formed, the residents survive by living almost completely off the municipal grid because the land which they occupy isn't zoned for habitation, such as New Hani Park (site option 1).

Site option 1: New Hani Park

The residents have been occupying this long stretch of land, living in temporary shelters built from available material (shacks) for a little over a decade and they have not been forcefully removed. It is true that living off the grid saves them some money, however, the improvements on their quality of life is not that much greater than if they were living in complete reliance on the municipal grid. This is not due to the impracticability of living in a decent home in today's modern society which sustains itself and even gives back to the grid when it can; it is due to the lack of adequate and correct knowledge of what elements make a home sustainable.

This site presents an opportunity of demolishing the shelters and replacing them with a new housing development with sustainable features that will improve the lives of the residents. The site faces public transportation routes which aren't as frequently used and the lack of electricity in the area leaves it dark and usually unsafe for pedestrians. There is also an informal dumping site used by the residents in the neighbourhood which makes the area unhealthy and uncomfortable to occupy. This site can be transformed into a playground for both the homes and schools in the area, as community facilities are lacking.

It is the pride and joy of a homeowner in this area to extend a government subsidized house and make it their own home, with their unique identity expressed outwardly. These diverse styles and diverse people form a community with a rich street culture of celebrating our

differences; this led to the second site option which is closer to the main transportation link in Tembisa, the Andrew Mapheto Drive.

Site option 2: Farm portion 6907

The proposed site is along the M18 Andrew Mapheto Drive – a long stretch of a main road across the length of Tembisa – the main public transportation route. There are various public buildings along this road which serve as active social hubs in the area. These include retail, transportation and social spaces. The Birch Acres Mall across the street to my intended site, is a building which has the most enviable frequent visits to one building from people all over the lower parts of Tembisa, it also serves Birch Acres, the suburb west of the proposed site, pedestrians and motorists us it daily for essentials.

The aim of the design is to transform the way design has been practiced in the area, specifically in the housing typologies. The subsidized house is only one of the initiatives made by the government in an effort to deal with the poverty crisis. My design intervention takes an existing site big enough to accommodate a dense, efficiently planned out housing development which meets the needs of the community; providing a variety of house types and sizes, gives additional yard space for gardening, food generation or extending; as well as additional rental space for small businesses in the larger homes, all in an effort to improve their quality of life.

By establishing the housing development across the street from Birch Acres mall, the location on the edge of Tembisa where people cross over on foot to get to the suburb areas of Birch Acres, Norkem and Kempton Park, there is an even greater opportunity for accessibility and exposure to residents living and working there. It also awards us the opportunity of educating the general public about sustainable living using architecture, as well as entrepreneurial opportunities for the residents of Tembisa. There is a McDonald's franchise at the top of the site which can be demolished for the intervention.

Site selection: Site option 2

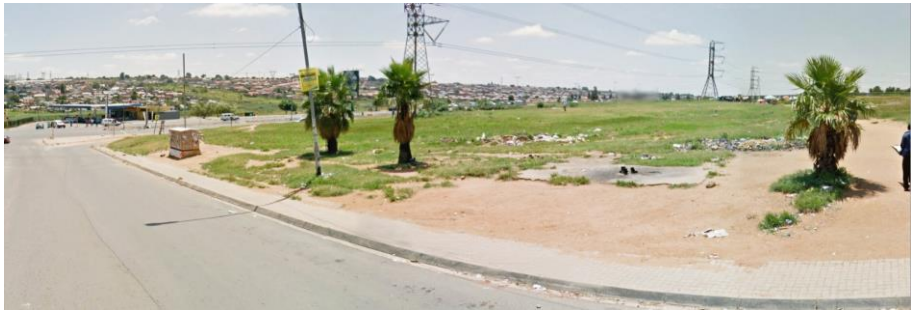
The second site option provides better opportunites for a housing development of this scale for the following reasons:

- Andrew Mapheto Drive – Main transportation link (Note that private car ownership is scarce in study area, a ratio of 5 households to 1 car was approximated by residents, public transport usage is high and relatively efficient)
  - An existing bus stop in front of the mall and at the Sasol petrol station is used by pedestrians to travel out of Tembisa;
  - A new BRT Bus system, with new station in front of the mall is currently under construction;
  - Leralla train station (the first stop) is one traffic light away from the site, so is Tembisa Plaza;
  - Birch Acres mall has a taxi rank for local trips inside the complex;
  - Esangweni taxi rank is two traffic lights away from the site, for trips out of Tembisa as well;
  - There is a rich, vibrant street life laced with informal traders between these interchanges and social hubs
- Site is located on the edge of Tembisa, and lines the beginning of the Birch Acres suburbs, thus is currently being used to access

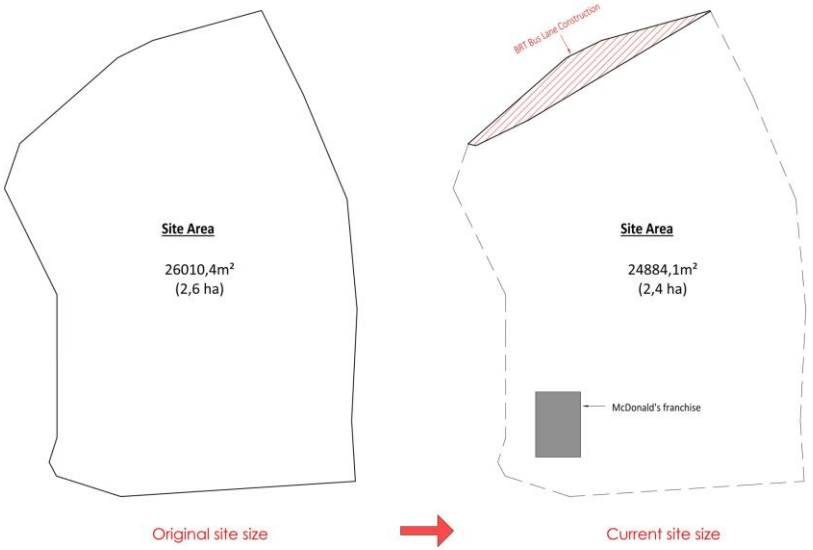
eastern suburbs for work and economic opportunities, it is easily accessible;

- Scale, the design can maximise on sun exposure at a suitable height of 2 to 3 storey buildings due to the low scale of surrounding buildings;
- The site is largely vacant with access to the municipal water and electricity grid, we can feed excess back to the grid where possible;
- The site has a steep slope, this will assist in obtaining optimum sun angles; terrace roofs; surveillance and peripheral views without obstruction

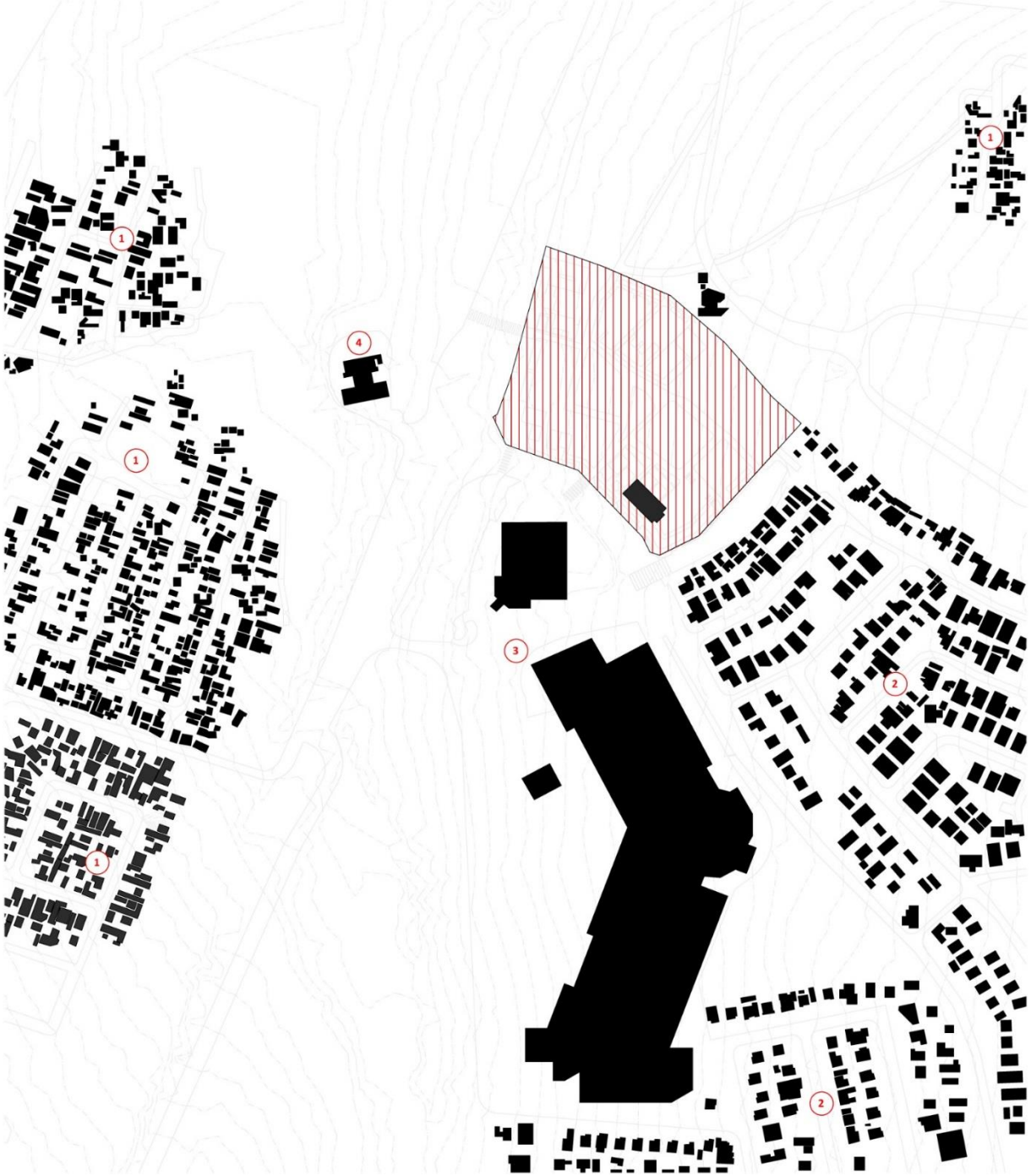
Design aims at urban scale: 2-way cycle path & floating bus stop in Mass DOT's Separated Bike Lane Guide



Site Option 2

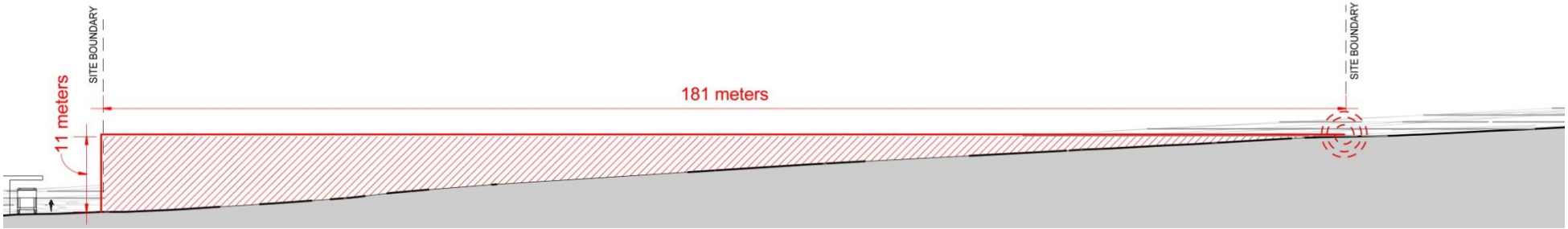


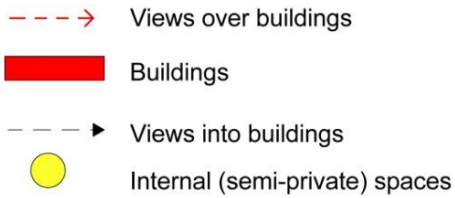
Map of study area: Figure ground



1. A mix of subsidized houses & Informal settlements (shack dwellings)
2. Bonded housing (extended)
3. Shopping Mall complex
4. Petrol station

Site sections





Terraces and courtyard opportunities

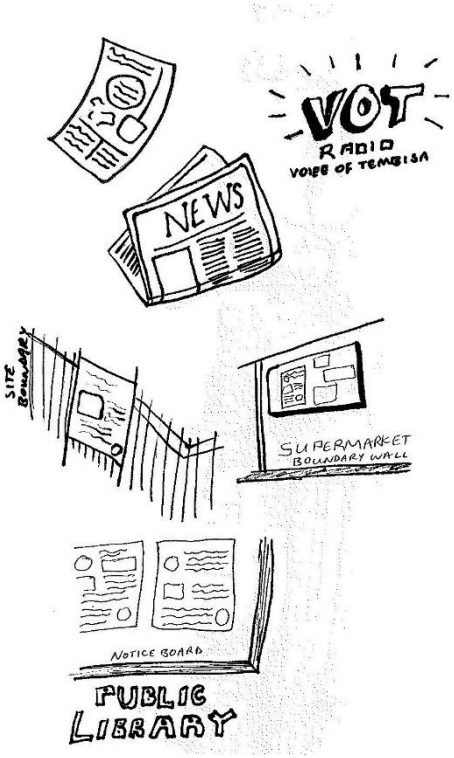
4.3 Community integration

> "Sustainable housing promotes the safety and dignity of residents and results in more vibrant human settlements which meet human and environmental needs." (*Sustainable Medium Density Housing*, 2008)

The proposed shift from the free-standing house of private spaces that aren't shared with anyone else with large amounts of land between neighbours could result in conflict when presented to a community such as Tembisa. This is where including the community in the process of design and building becomes crucial, as well as in the details of design and construction. Participation by the community will bring about community cohesion and ownership of the environment that is shared with others. Another crucial aspect of integrating the community is the initiatives of skills and development which will empower the community to not only be able to build their own community, but to extend this transformative way of building to other parts of Tembisa as well.

The provision of community spaces for public gatherings, as well as offices (for elected community leaders) and work spaces is necessary to engage with the client community as the project progresses. Workshop and warehouse spaces are also proposed for skills transfer and training sessions to be offered to the community in order to ensure the continued functioning of this new integrated housing environment.

a) Advertising the project
   - Flyer distribution
   - Newspaper article
   - (VOT) Voice of Tembisa radio station announcements
b) Notices
   - On-site boundary notice
   - On a notice board of local supermarket
   - On notice board of local library
   - Tembisa's Online Social media pages
c) Feedback from adverts
   - Public meetings to be held with respondents to advertising
   - Key leaders to be chosen democratically by public
d) Ongoing involvement
   - Weekly meetings with key leaders as project progresses
   - Initiating community support

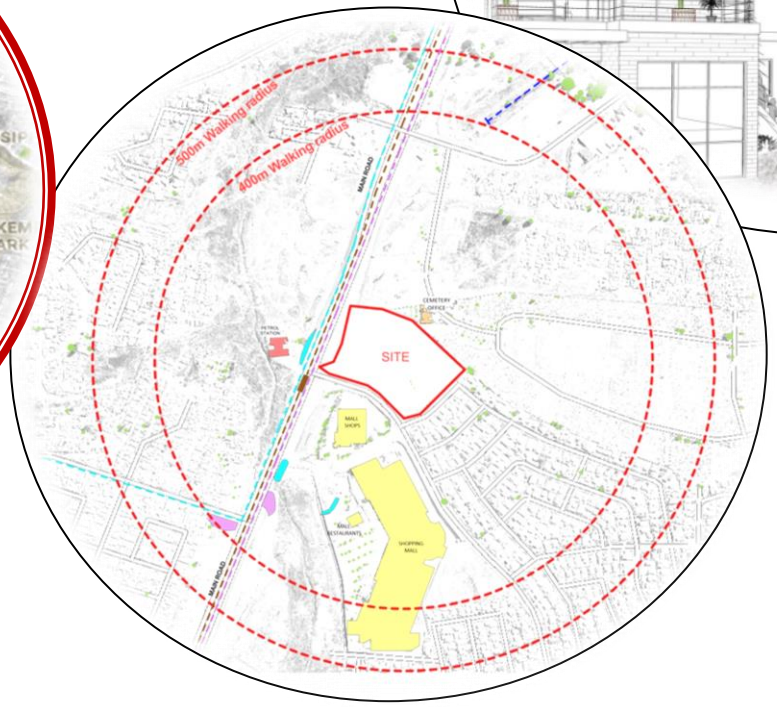


Building relationships with the community

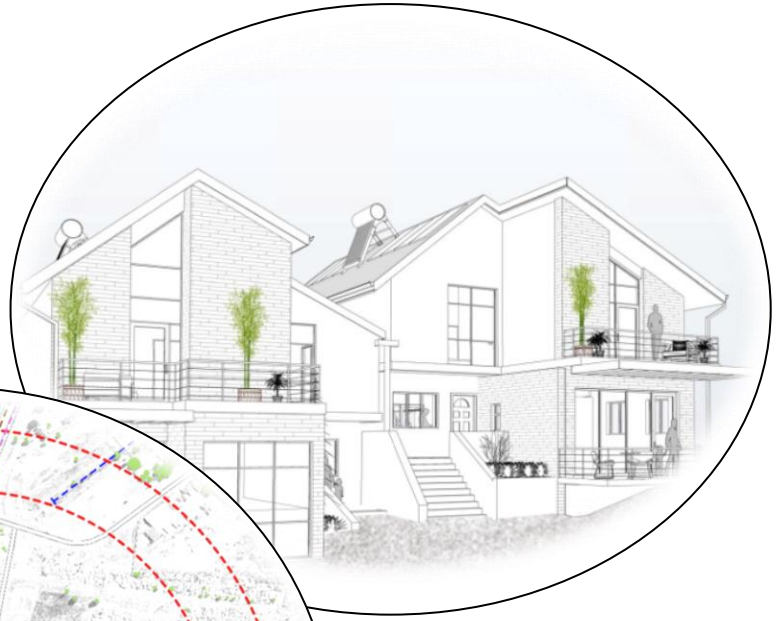
Figure 22: Different cost-effective ways of engaging the community in the implementation of the new housing development. (Moloto, 2017)

4.4 Adaptation at urban scale

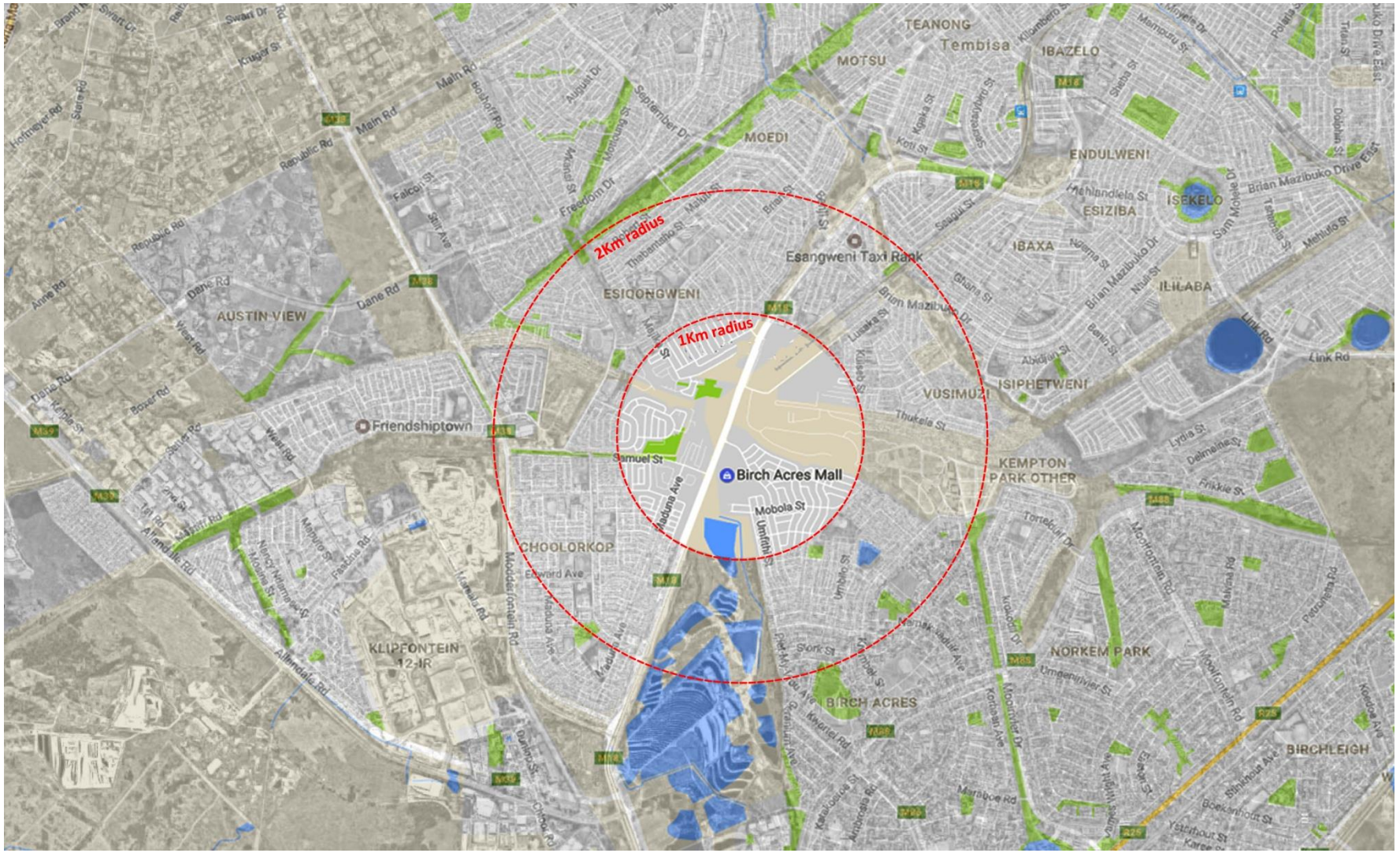
A. URBAN SCALE



B. NEIGHBOURHOOD SCALE



C. UNIT



The wider scale analyses the urban structure and broader landscape setting and identifies the site's proximity to centres, transport and major public open spaces. Proposals for larger precincts and redevelopment sites should address this scale. (Adapted from Google Maps, 2017)

4.4.1 Urban Issues

What issues need to be addressed at urban scale, within the context of Tembisa and the study area surrounding the site?

Lack of public space and greenery
The site has already been eaten into by development which was meant to increase the sustainability of the area, however, green areas have not been replaced or established in the study area. Provision hasn't been made for tree shaded green areas for relaxing outdoors, safely. The parks, playgrounds and picnic areas lack greenery due to poor maintenance thereof. Children oftentimes play on the busy streets which is highly dangerous.

Lack of safe pedestrian walkways and crossings
There are currently no pedestrian walkways or paved areas along the entire periphery of the site. Pedestrians are often prone to jaywalking to get from the site to the mall or petrol station across the street where the bus stop for mini-busses and taxis is.

Lack of vehicle street parking and bicycle lanes
Vehicles have no street side parking options along the street facing edges of the site, and although many people have moved to bicycles for efficient travel due to the traffic congestion caused by vehicles, there are no allocated bicycle lanes on any of the major transport routes round the site.

Lack of street lighting and sufficient surveillance
The site is flat and mostly vacant, the additional lack of sufficient street lighting adds to the unsafe use of the surrounding streets of the site.

4.4.2 Design guidelines and objectives

Connect – restore – diversify - recreate

Residents tend to form a sense of place and ownership in a safe community which is well lit and well- surveyed with well-maintained communal areas. Car ownership is low in the area, smaller alternative routes that are cyclist and pedestrian friendly must connect to the public transport networks. In the book *A Pattern Language: Towns; Buildings; Construction* by Christopher Alexander et al (1977), a new approach to architecture and planning is introduced:

1. *"Connect communities to each other by encouraging the growth of the following networks:"* (Alexander et al;1977)
   - Public transportation web
   - Network of learning
   - Web of shopping
   - Mini busses
2. *"In neighbourhoods and communities; between them; in boundaries, encourage formation of:"*
- Activity nodes; shopping street
3. *"Around these centres; provide for growth of housing:"*
   - Household mix, adapting the homes to different functions (work-live options)
4. *"In each work community, provide smaller bits of common land, to provide for local versions of the same needs:"*
   - Common land
   - Local sports
   - Connected play & Adventure Playground

Local amenities

SPORTS (RECREATIONAL)

SCHOOLS (HIGHER EDUCATION & NIGHT SCHOOLS

SCHOOLS (Primary & Secondary)

CHURCHES

CEMETERIES

SHOPPING CENTRES/MALLS

CLINICS

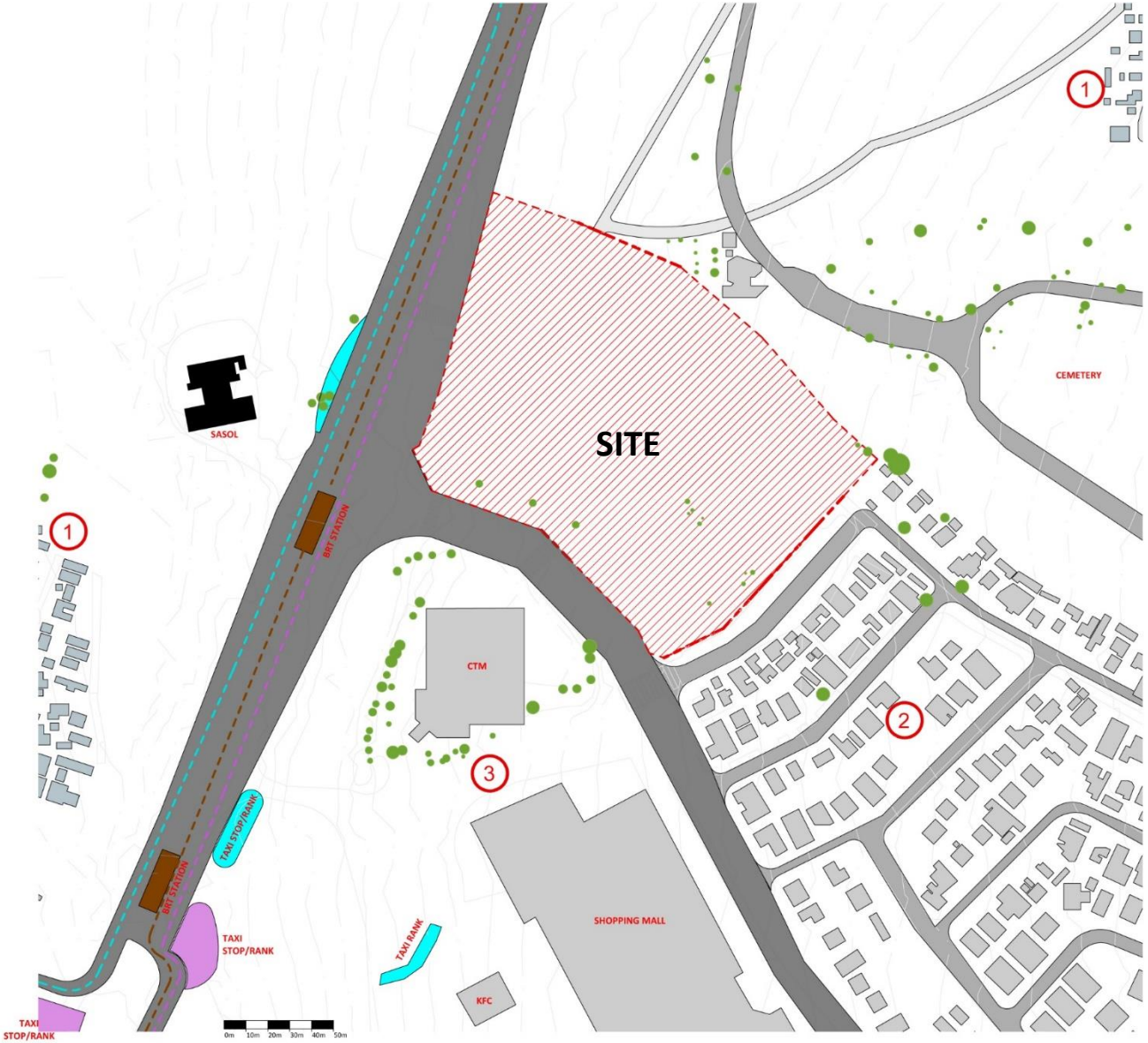
COMMUNITY CENTRE

HIGHER DENSITY _Residential (Squatter camps)

COMMUNITY GARDENS

Public transportation web

	LEGEND
	Taxi stops (LOCAL TRIPS)
	LOCAL Taxi routes
	Mini-bus Taxi stops (OUT-OF-TEMBISA TRIPS)
	OUT-OF-TEMBISA Taxi routes
	Railway Station (Last stop - Johannesburg)
	Railway Lines
	BRT Bus Station
	Bus Routes
1	A mix of subsidized houses & Informal settlements (shack dwellings)
2	Bonded housing (extended)
3	Shopping Mall complex
	Trees



Travel distances from study area

Approximate Travel Time: From study area to places of work using motorised vehicles

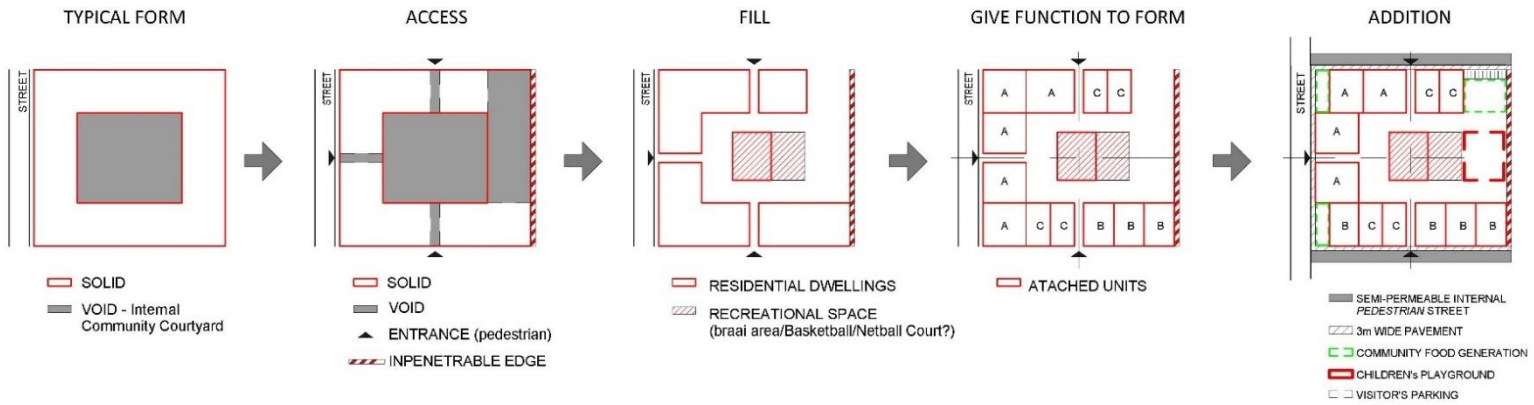
11.6km to Kempton Park CBD via M57	15km to Spartan factories via M18	40.1km to Pretoria CBD via R21
13.3km to Midrand CBD via Main Rd	34.3 to Centurion via Olifantsfontein Rd	47.3km to Johannesburg via R21

Layout studies

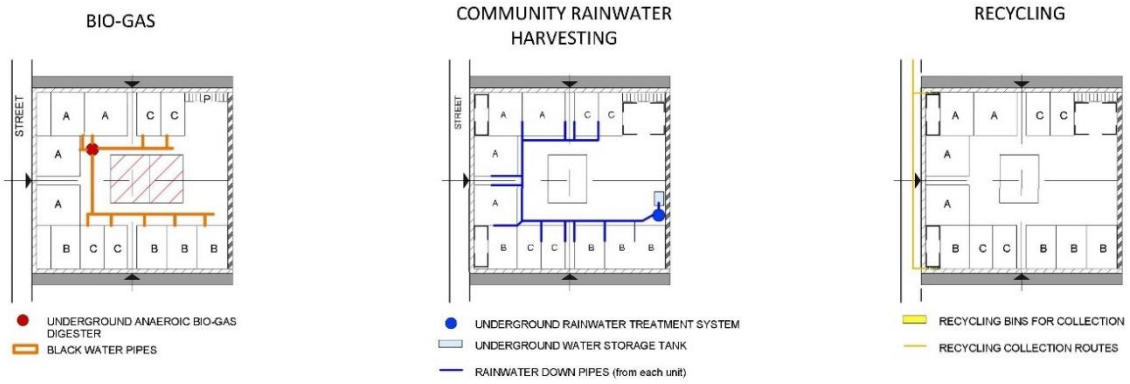
Land use: Land should be efficiently used to integrate natural habitats with the built environment, in an effort to restore and protect biodiversity.

LAYOUT_concepts

TYPICAL HOUSING CLUSTER DEVELOPMENT



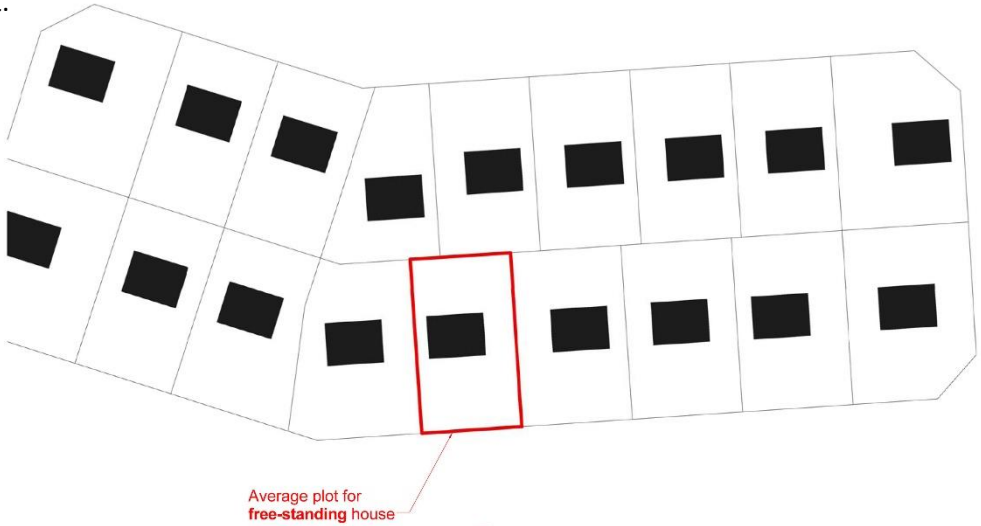
SERVICES_concepts

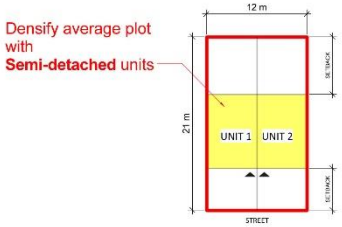


4.4.3 Intervention outcomes

Densify

The general plot size in the area has been adapted for higher density units of different housing typologies which will allow for various income brackets to live and benefit from the opportunities present in such a development.





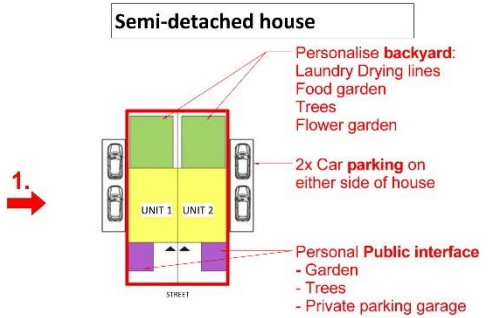
Chosen housing types:

1. **Semi-detached** units of varying configurations & sizes:
   Duplex (2-3 storey)
   Triplex (2 storey)

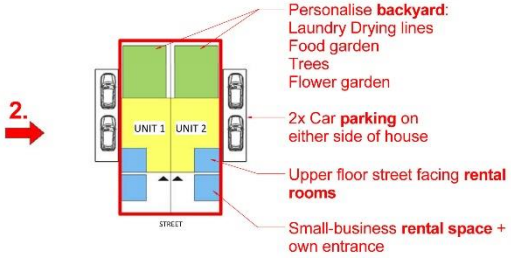
2. **Rental rooms** - privately owned within owned house

3. **Courtyard Apartments for Rent (3 storey)** - affordable bachelor + family units

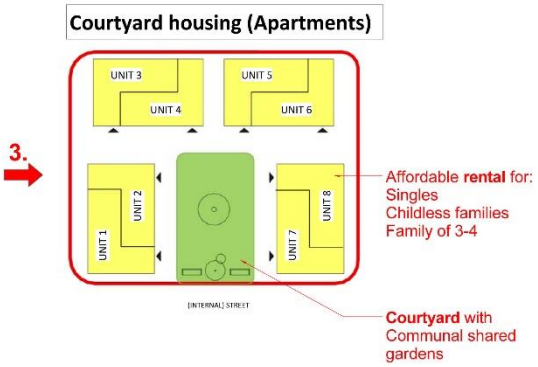
Semi-detached house



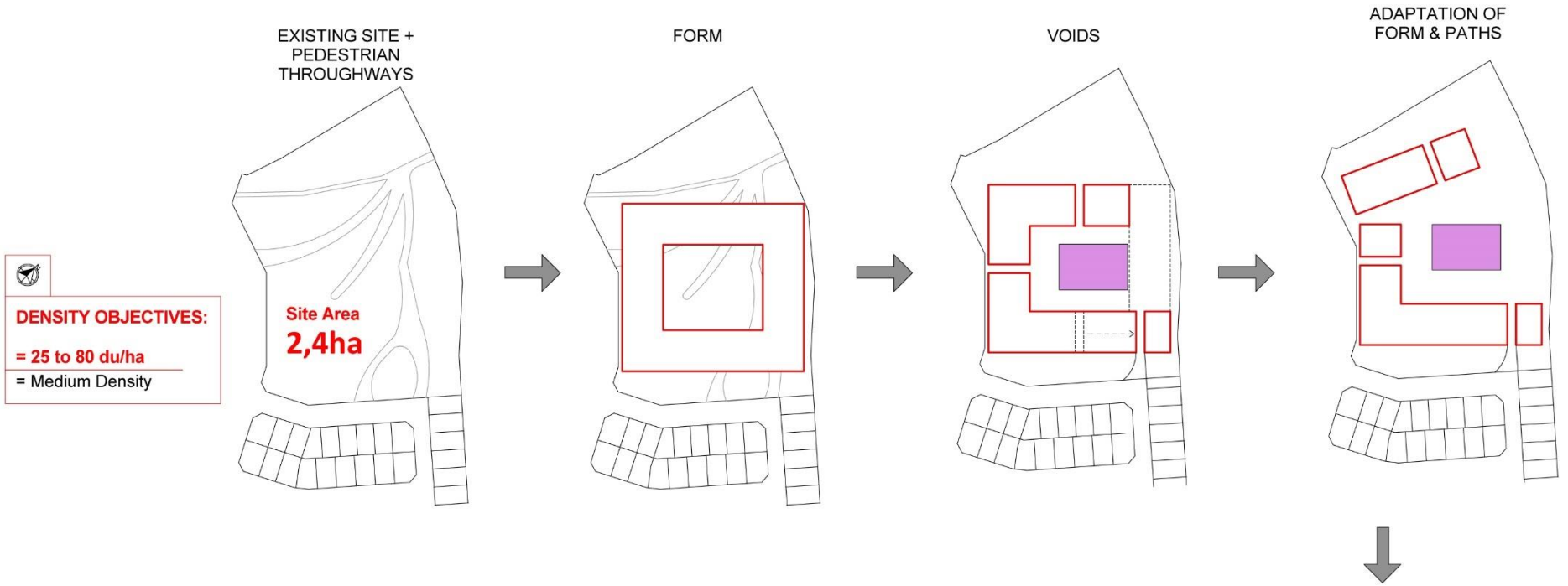
Rental rooms (Private owned)



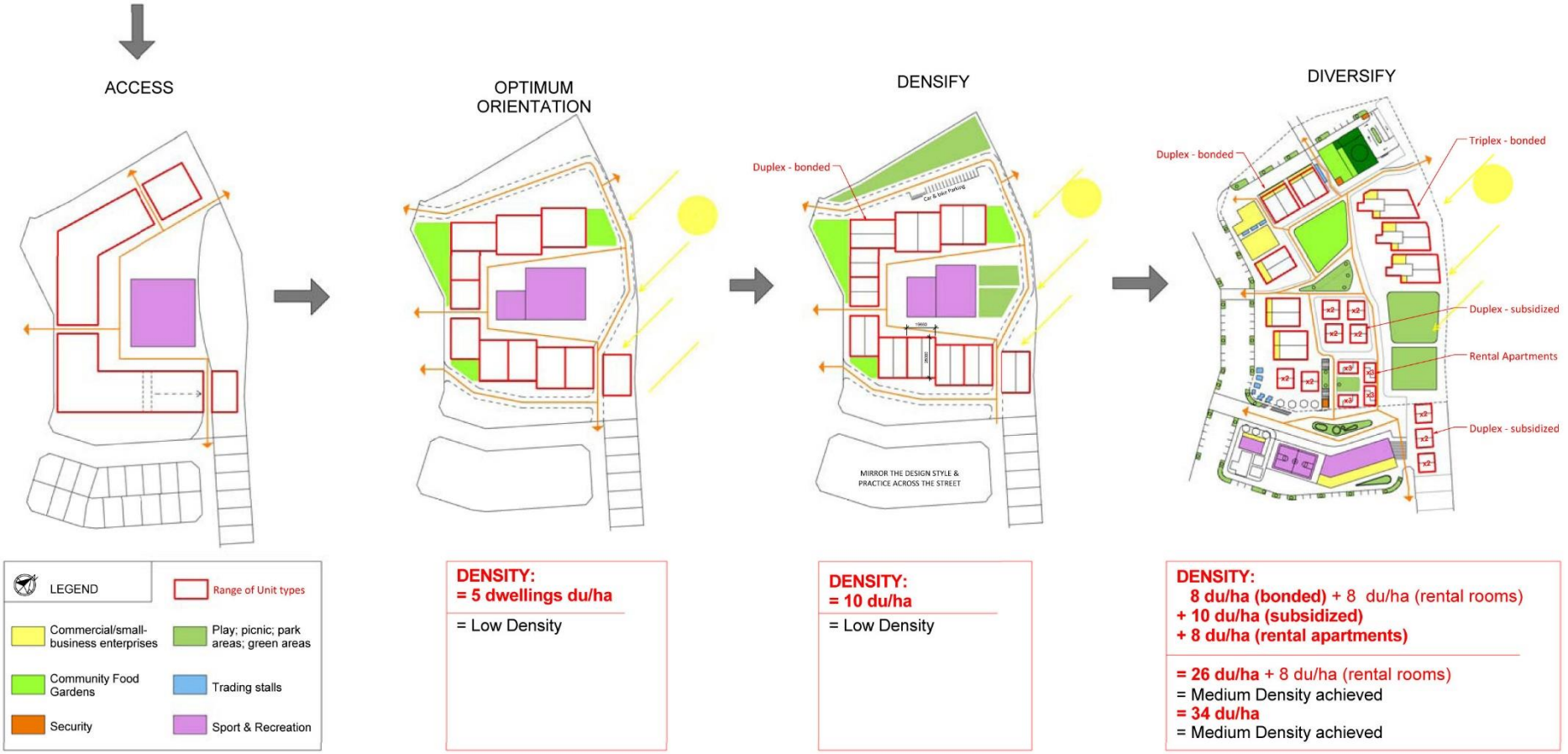
Courtyard housing (Apartments)



Density & layout studies_1

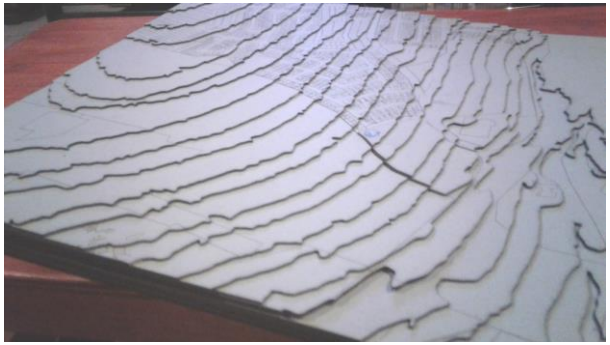


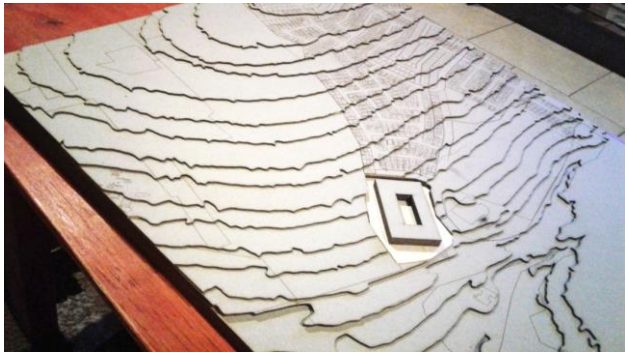
Density & layout studies_2



Density & layout studies_models

Scale 1:1500

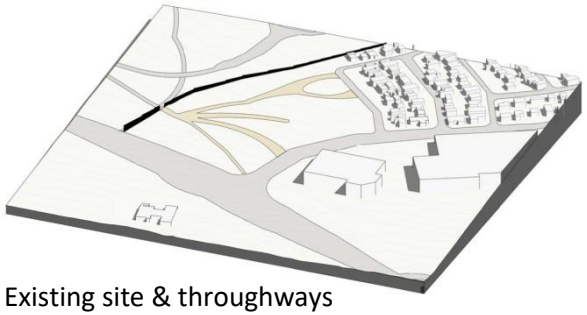




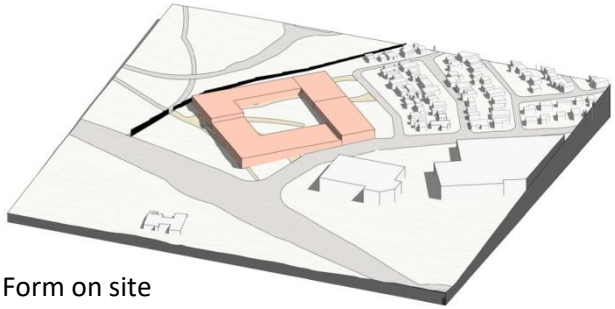
Context model

Scale 1:750

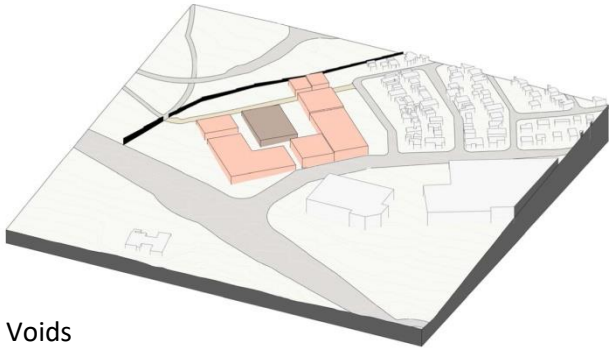
Density & layout studies_Massing



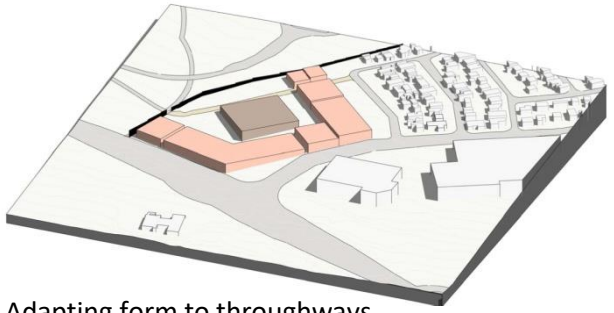
Existing site & throughways



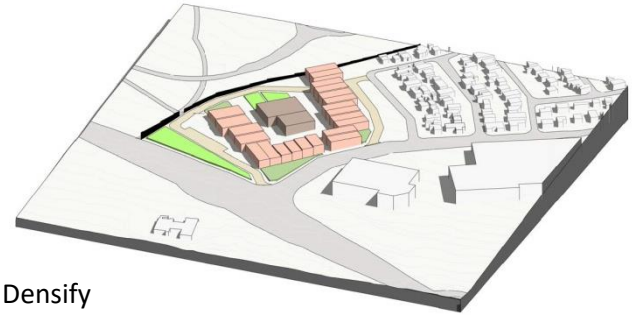
Form on site



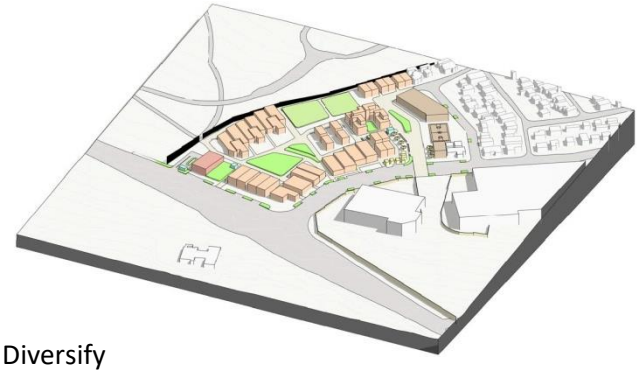
Voids



Adapting form to throughways



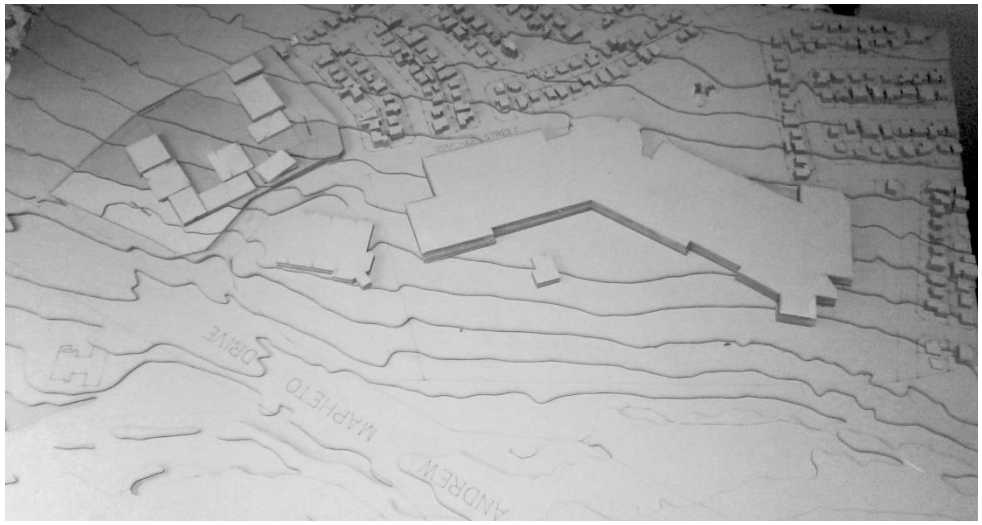
Densify

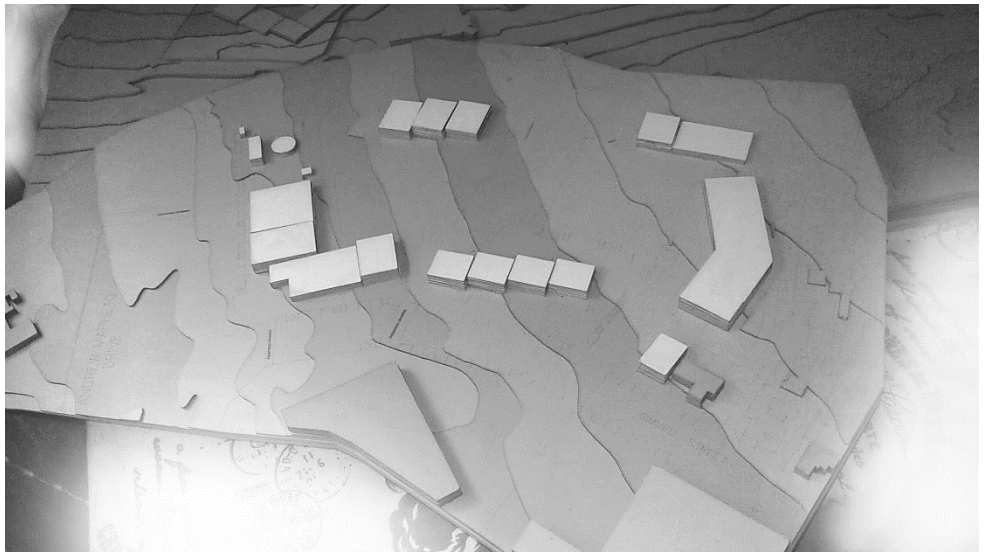


Diversify

Density & layout studies_models

Scale 1:750





Adaptation of unit type

FRONT FACADE

1. Main Residence
2. Small business rental
3. Upper rental room
4. Laundry drying line
5. Private food gardening
6. Private lawn

BACK FACADE

Programme development

Household needs

Medium density, mixed tenure housing for mixed-income community (Bonded, subsidized, rental)

Community facilities

Security = 134m²

Community food Gardens = 1470.50m²

Corner Grocer & Local Restaurants = 650,6m²

Homework, learning & smartwork centre = 950m²

Community Gym = 170 m²

Basketball/Netball Court

Community Waste Management Centre = 1400m²

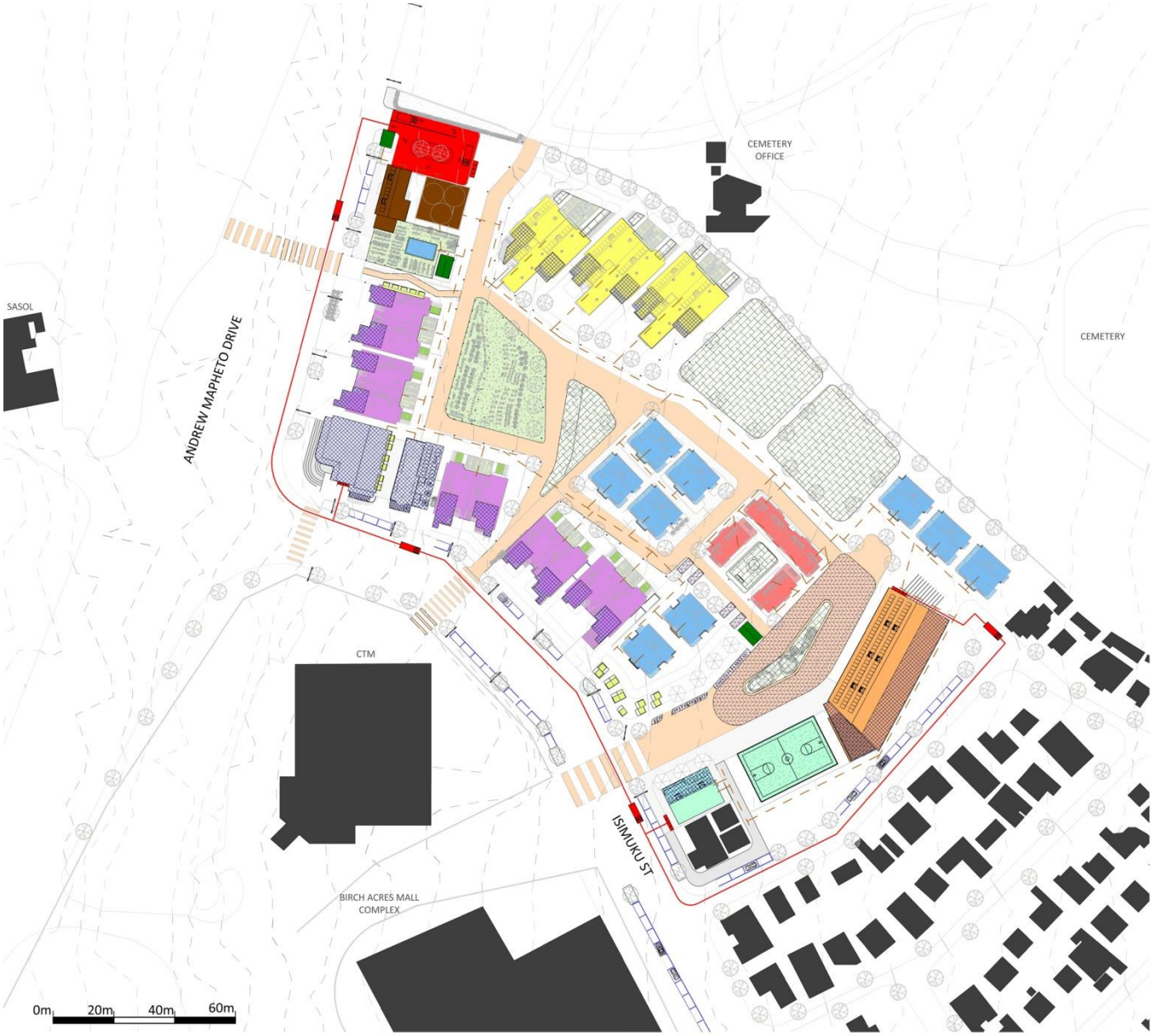
Public space

Public greenery

Playground & picnic open space

Areas designated for Informal trading stalls

Zoning Map

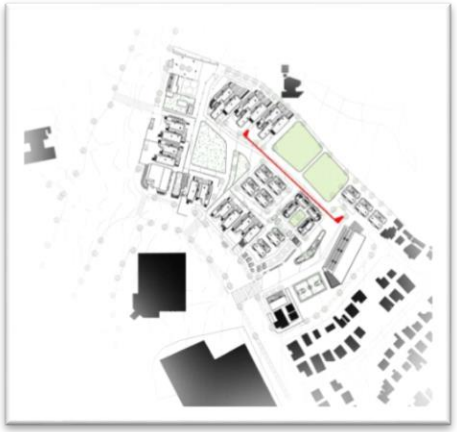


LEGEND

Duplex Units [bonded housing + rental units]	
Triplex Units [bonded housing + rental units]	
Duplex Units [subsidized housing]	
Triplex Apartments [rental housing]	
Business 1 [Corner grocery & small business rental space	
Community resource centre [Smartwork, learning & homework centre]	
Paved internal street [bikable and pedestrian friendly]	
Landscaped Area [Grassed playground & picnic area]	
Landscaped Area [Food & vegetable gardening]	
Bike racks [bicycle & motor bike parking]	
Public sport & recreational space [fitness gym and basketball/netball court]	
Parking bays [street parking]	
Proposed Services	
Community Waste Management Centre [Community scale Bio-gas digester for electrical power]	
Proposed sewer pipes	
Recycling Collection Routes	
Refuse + recylcing Collection Points	

4.4.3 Intervention outcomes

Forestation: A growth of trees and other plants covering a large area.
Public green pause areas; boxes of grass between street parking bays adds oxygen and beauty, also, it teaches the community about the importance of planting trees as these will continuously be planted and maintained by the client community. Recreational areas of greenery include playgrounds, picnic areas, and general open green spaces



STREET SECTION - Internal street facing playground & picnic spaces

Safe pedestrian walkways and crossings

Accidents between pedestrians and vehicles will be addressed by providing paved pedestrian walkways along the street facing edges of the site, as well as safe pedestrian street crossings on the street

Vehicle street parking and bicycle lanes

Off-street parking for vehicles have been introduced along the street facing edges of the site. Bicycle lanes are provided parallel to the
The use of bicycles around the new developed will be encouraged by limiting vehicle movement and vehicle access on the site. For this cause, bicycle lanes have been parallel to the vehicle street parking bays, and bicycle parking sheds have been established at the major entrances to the site with the most surveillance due to street activity and house balconies.

Street lighting and sufficient surveillance

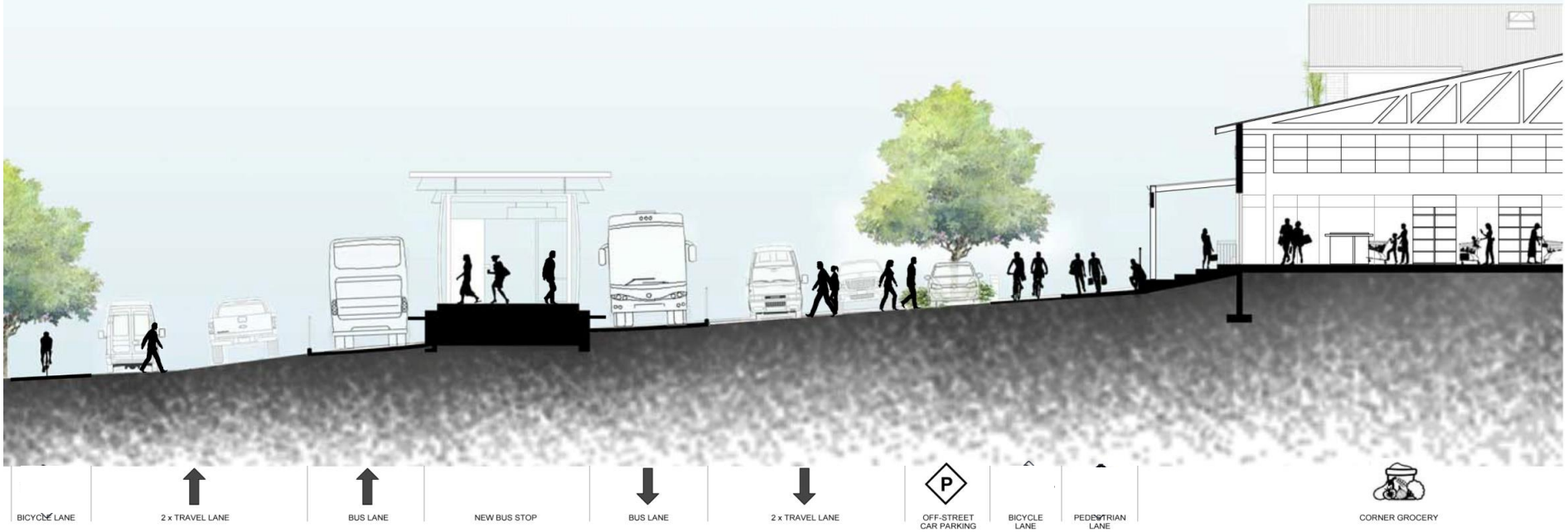
Street lighting is a common issue in the area, these will be implemented at regular intervals of the streets surrounding the site to add a level of safety and security for pedestrian walking to the surrounding areas. The residential and commercial units facing the streets have been designed to provide surveillance over the streets by implementing balconies, green roof areas and flat habitable roof spaces.

New shorter street lighting at the base of swales for increased surveillance of vehicles and pedestrians

STREET SECTION - Through bus stop and commercial zone

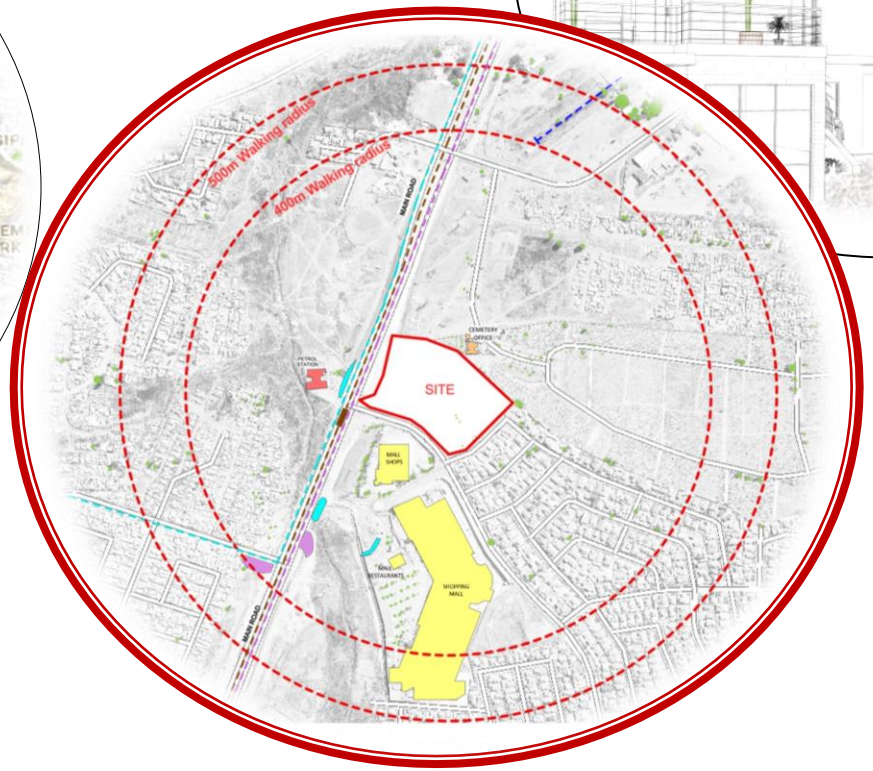
Applied design guidelines:

- Positive outdoor space
- Stair seats
- Corner grocery
- Vibrant, active street edge
- Connection to public transport web

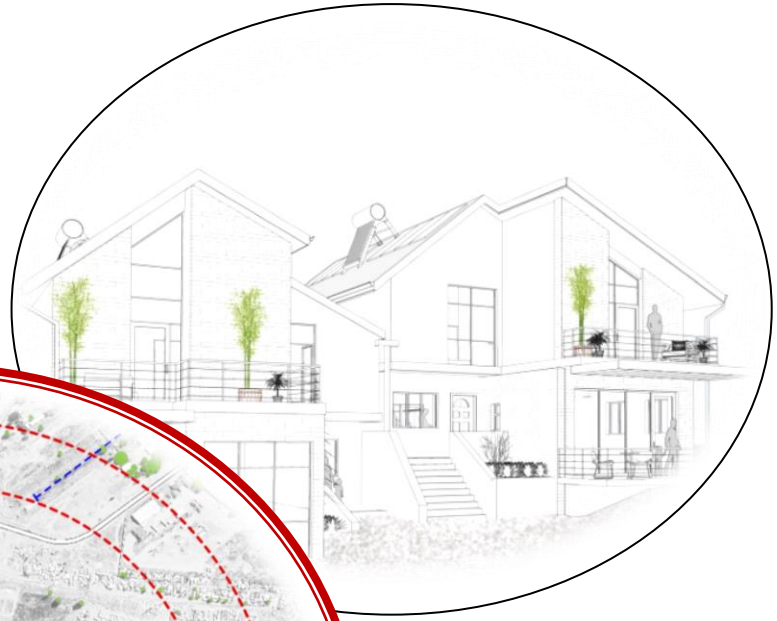


4.5 Adaptation at neighbourhood scale

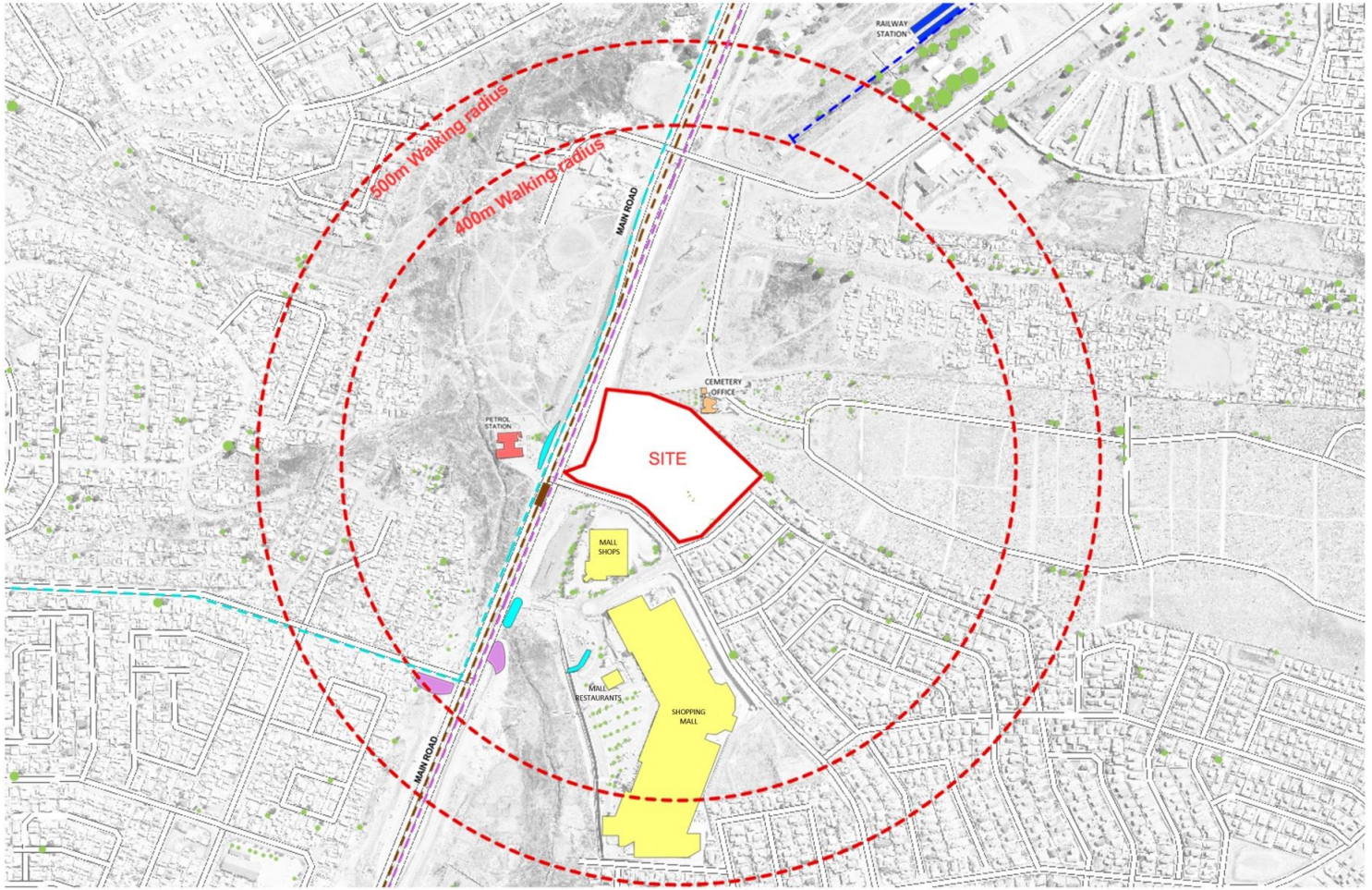
A. URBAN SCALE



B. NEIGHBOURHOOD SCALE



C. UNIT



The neighbourhood scale outlines the urban grid and block structure including streets and open spaces, significant topography, heritage and civic and community uses. Proposals for individual or small groups of low rise medium density developement sites should address this scale. (Adapted from Google Maps, 2017)

4.5.1 Neighbourhood Issues

Street edge conditions
The high rate of crime has caused hard edges of high barrier walls and solid gates, this leads to an undesirable and dangerous street edge which repels investors and buyers.

Lack of Rainwater recovery strategies
The current surfaces don't absorb rainwater, runoff erodes the soil, resulting in flooding of streets and eroding of soil.

Sewer reticulation and waste recycling
All the human waste produced in the area is directed towards the main sewer lines and the system overflows due to the increasing high densities in the area. There are currently no waste recycling or re-use of waste systems in place.

The lack of local important social amenities
Only two shopping malls with the necessary outlets serve the study area (southern part of Tembisa and Birch Acres), causing crowding and leading most residents to travel to other areas for daily shopping needs.

Lack of local sports and recreational facilities
Although sport is popular in the area, sports facilities are limited, and there are any publicly accessible fitness gym facilities in the study area. Sport is generally played on the streets which has proven dangerous.

Lack of local smartwork/learning facilities
Scholars and young professionals have to travel to Kempton Park or other suburbs for computer and internet facilities. There is one library not in walking distance to site and some costly home internet cafes.

4.5.2 Design guidelines and objectives

Connect – recover – densify - integrate

The next phase in the patterned language shapes groups of buildings and individual buildings on site:

1. *"Laying out the overall arrangement of a group of buildings: height and number of buildings; entrances to the site; main parking; and lines of movement through the complex"*
    - Pedestrian Street
    - Family of entrances
    - Small parking lots
2. *"Fix individual buildings on site, according to the nature of the site; trees; sun"*
    - South facing outdoors; sufficient shading is provided on north-facing
    - Positive outdoor space; assigning functions to front and back yard space
    - Connected buildings;
    - Long thin house; using the existing plot size to fit two long houses attached with common walls
3. *"Within the buildings' wings, lay out entrances; gardens; courtyards; roofs; and terraces:*
    - Main entrance
    - Entrance Transition
    - Car Connection
    - Hierarchy of open space
    - Courtyards which live

Public domain interface

The transition space between the housing unit, the space at the street edge and the public space is referred to as the public domain interface. This interface influences the character of the street. The public domain can be treated in various ways to create a high quality and active pedestrian-friendly interface, i.e through subtle flowers and plants.

- Casual interactions between residents and the public should be accommodated through public seating, courtyard seating etc.
- Boundaries facing internal roads should be treated similarly
- Community developments encompassing multiple dwelling units should have clear differences in thresholds, using the following design suggestions:
  - Variation in materials;
  - Plant species; and
  - Changes in colours.

The overall perception of the public domain relative to safety and security can be shaped by deliberate treatment of the following elements of a dwelling unit:

- Unit entries
- Private balconies
- Changes in level
- Services locations
- Planting
- Opportunities for social interactions
- Identity

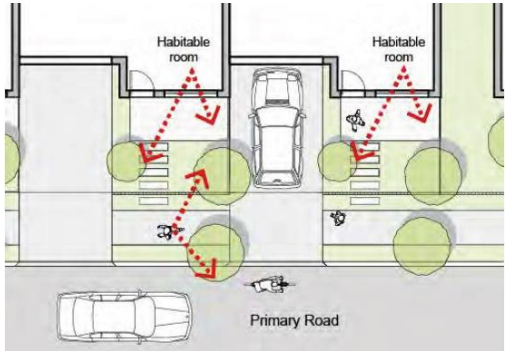


Figure 93: Windows and porches should be included in the street elevation to increase passive surveillance. ("Department of Planning and Environment - Medium Density Housing", n.d.:30)

Figure 94: Communal space ("Department of Planning and Environment - Medium Density Housing", n.d.:62)

Internal Streets

Pedestrian crossings and vehicle access must be clearly differentiated, , this can be done using the following design solutions:

• Changes in surface materials; paving textures
• Changes of level; and
• Landscaped barriers/planting

Communal spaces

Larger medium density developments can have communal spaces for recreation, circulation internally or externally. Residents can share outdoor communal spaces; this makes the development more attractive and accommodating of different people's amenity needs. It is less confusing if communal spaces are dedicated for public use, making the development more vibrant and accessible to everyone in the context. The overall perception of safety and security of a given development is improved when communal spaces accommodate social interactions among residents. Social integration is also achieved easily with the frequent use communal spaces.

The design of communal open spaces will vary in size and location based on the context of the site, as well as the scale of the development. However, the design should provide for the following:

- Social interaction
- Group and individual recreation and activities
- Water conservation and management
- Increased surveillance of residents
- Landscape design; open space for public land use

Figure 95: Low walls can be used for public seating. ("Department of Planning and Environment - Medium Density Housing", n.d.:60)

4.5.3 Intervention outcomes

SITE PLAN - Surfaces

Recovering rainwater

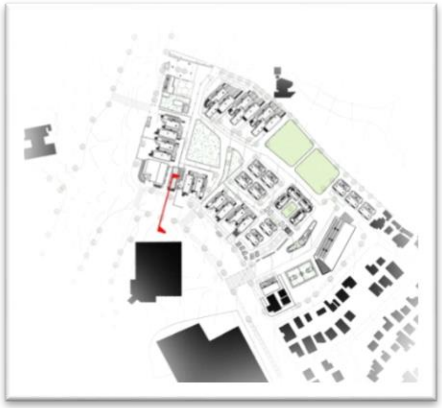
The internal streets are designed for pedestrians and bicycles, these surfaces are softer and slower. The semi-permeable material used in these paved areas allow for plants to grow in between the bricks while allowing rainwater to flow through the pavement to the water table.

Applied design guidelines:

- Changes in materials for thresholds
- Safe bicycle parking
- Enhance social integration
- Vibrant, active internal street
- Increased surveillance and security

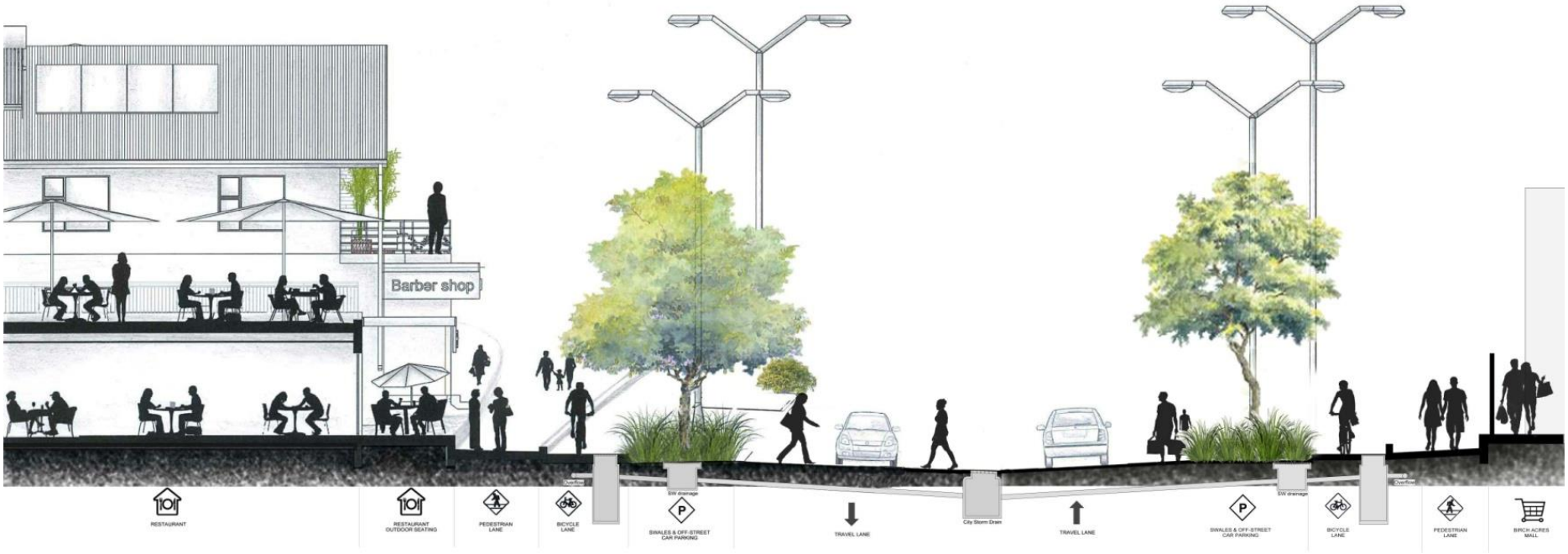
Internal street view

1. Bike racks
2. Subsidized housing
3. Bonded housing
4. Internal bikable street
5. Private vegetable garden

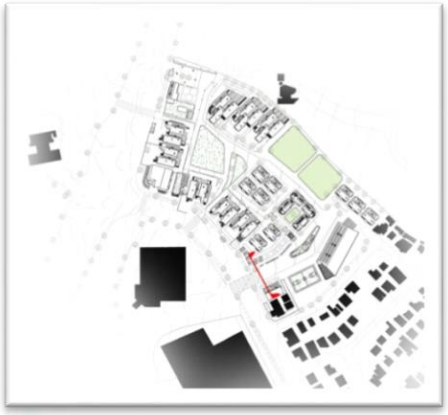


Restoring the street edges & rainwater recovery

Commercial zones housing small businesses i.e restaurants with balconies look onto the street and have sufficient surveillance of the pedestrian paths; increasing safety and security. Water conservation and management has been integrated into the landscape.



STREET SECTION - Through commercial zone and shopping mall



Reduce the community's need to travel far for important social amenities

The proposed development utilizes the main corner and major entrances to the site to the advantage of the greater context by establishing grocery and food outlets, formal trading stalls with sufficient-on-site storage, restaurants, small business rental units and areas for sports and recreation.

STREET SECTION – Facing public open space

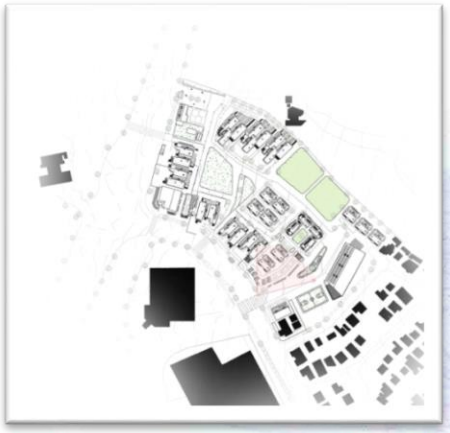
Applied design guidelines:

- Clear pedestrian crossings
- Corner grocery
- Enhance social integration
- Vibrant and active street edge
- Appealing street character
- Increased safety and security

View of commercial zone on Andrew Mapheto Drive

Applied design guidelines:

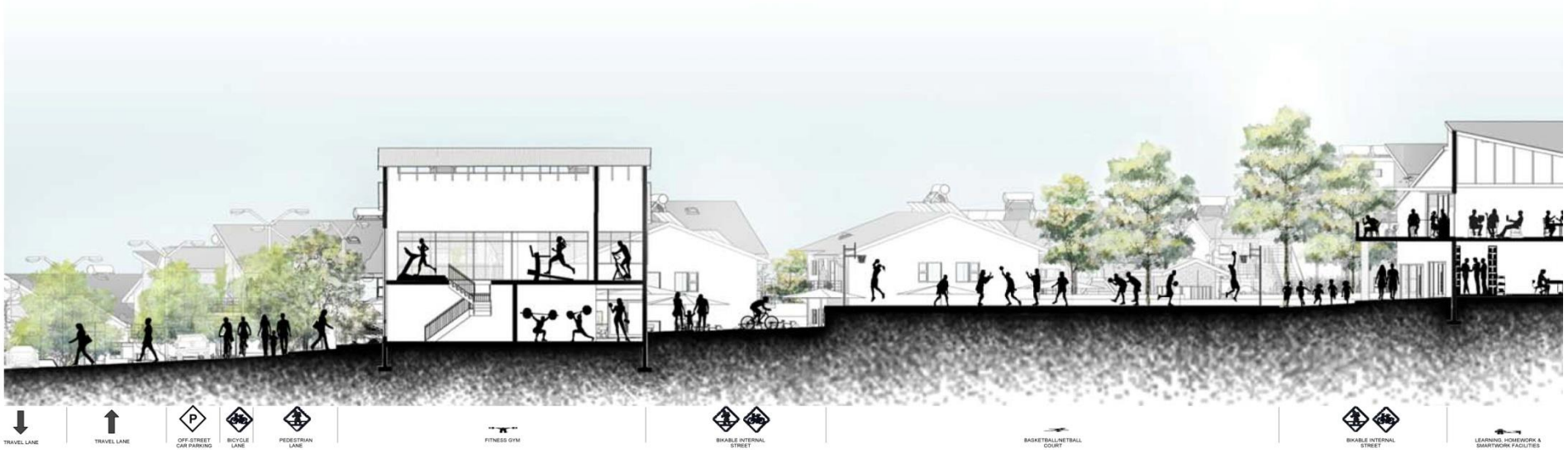
- Public pedestrian-friendly space
- Shopping street
- Enhance social integration
- Surveillance from residential units



View of street traders and bike racks

Applied design guidelines:

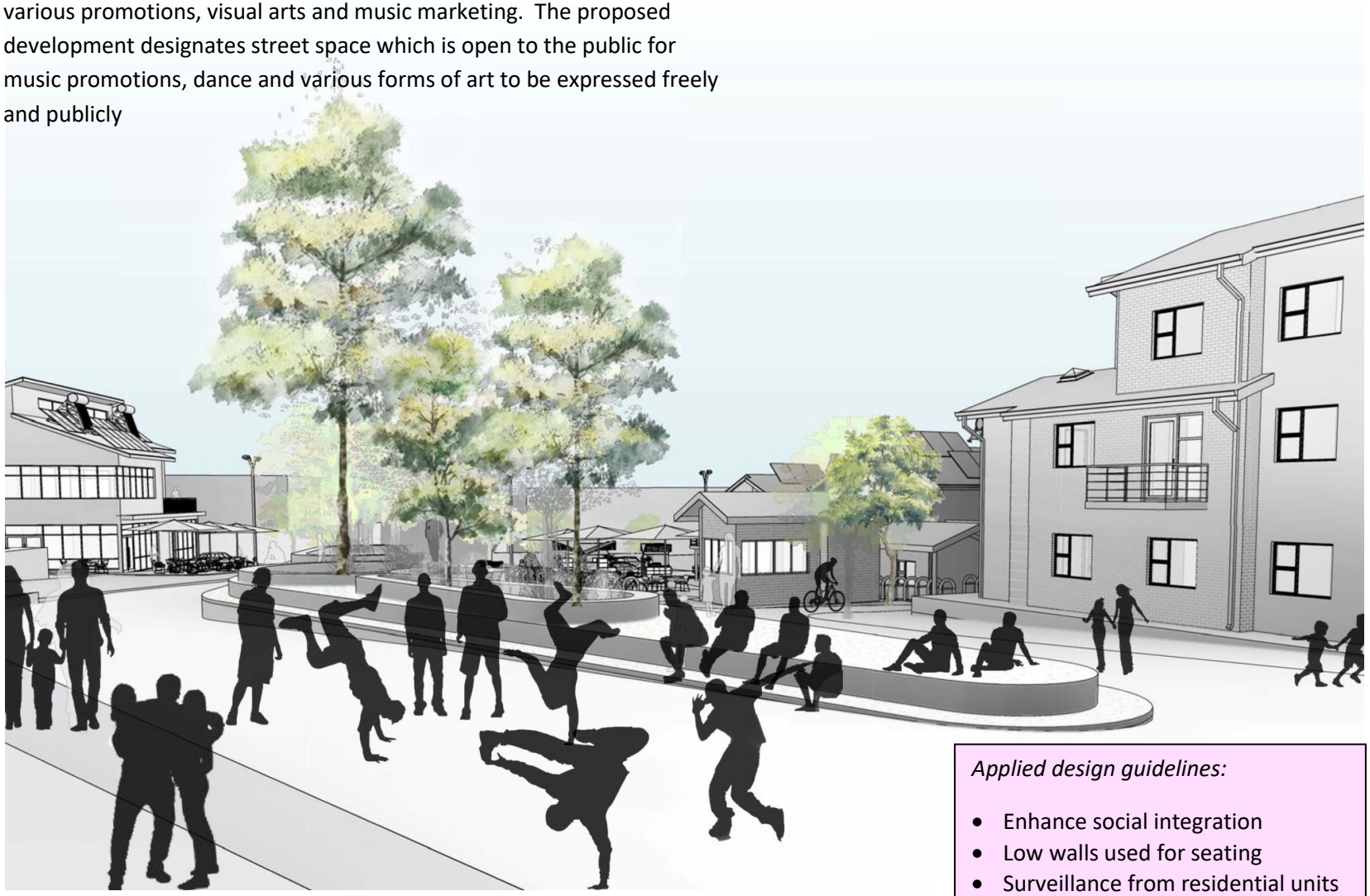
- Public space for recreation activity
- Group and individual recreation and activities
- Enhance social integration
- Surveillance from residential units



STREET SECTION – Through sports & recreation spaces

Celebrating the street culture of Tembisa

Creatives currently use the parking lots of busy shopping centres for various promotions, visual arts and music marketing. The proposed development designates street space which is open to the public for music promotions, dance and various forms of art to be expressed freely and publicly



Applied design guidelines:

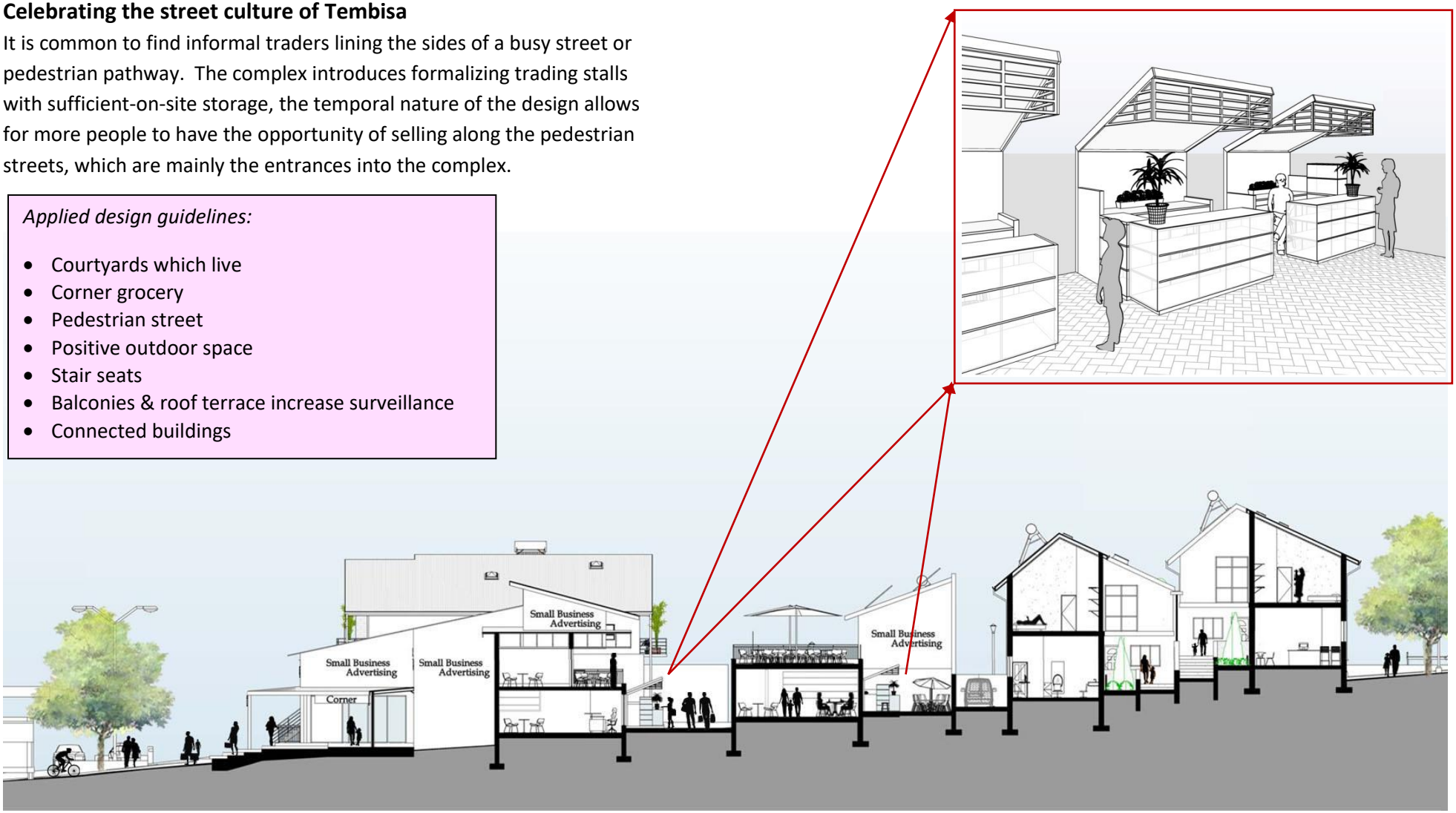
- Enhance social integration
- Low walls used for seating
- Surveillance from residential units
- Internal roads for circulation
- Group recreation and activities

Celebrating the street culture of Tembisa

It is common to find informal traders lining the sides of a busy street or pedestrian pathway. The complex introduces formalizing trading stalls with sufficient-on-site storage, the temporal nature of the design allows for more people to have the opportunity of selling along the pedestrian streets, which are mainly the entrances into the complex.

Applied design guidelines:

- Courtyards which live
- Corner grocery
- Pedestrian street
- Positive outdoor space
- Stair seats
- Balconies & roof terrace increase surveillance
- Connected buildings



Street Section - Isimuku Street

Waste recycling proposal

The main sewer runs alongside the southern edge of the site, if the community can generate their own electricity from their waste it could be done in the form of a bio-gas digester. This would need to be located at the lowest point of the site and this is where Albert Mapheto drive is located, making it the perfect opportunity to expose this innovative system to the general public. Due to the scale covering an entire community, the solution has materialized as a Community Waste Management Centre.

Proposed Community Digester:

The digester options investigated in part 2 are viable for an integrated community of 90 households (approximately 4-7 people in each household) with the option of including one ancillary facility such as a school, it is not as popular in South Africa as it is in other developing countries, such as India. The advantages and disadvantages are taken into consideration in each case. The proposed housing development encompasses 26 households, and added infrastructure such as the commercial small businesses and community recreational facilities. The main sources of organic wastes available in the study area are municipal solid wastes, the sludge from Birch Acres Mall restaurants and butcheries, and green waste from the private and communal garden areas. The biogas yields from the input will be sufficient to supply 26 households, the cooking needs for the restaurants, and sell the excess power to the grid. The placement of the WMC (Waste Management Centre) will make it easier for the sludge to flow downward by following the slope of the site.

Community Digester plant size:

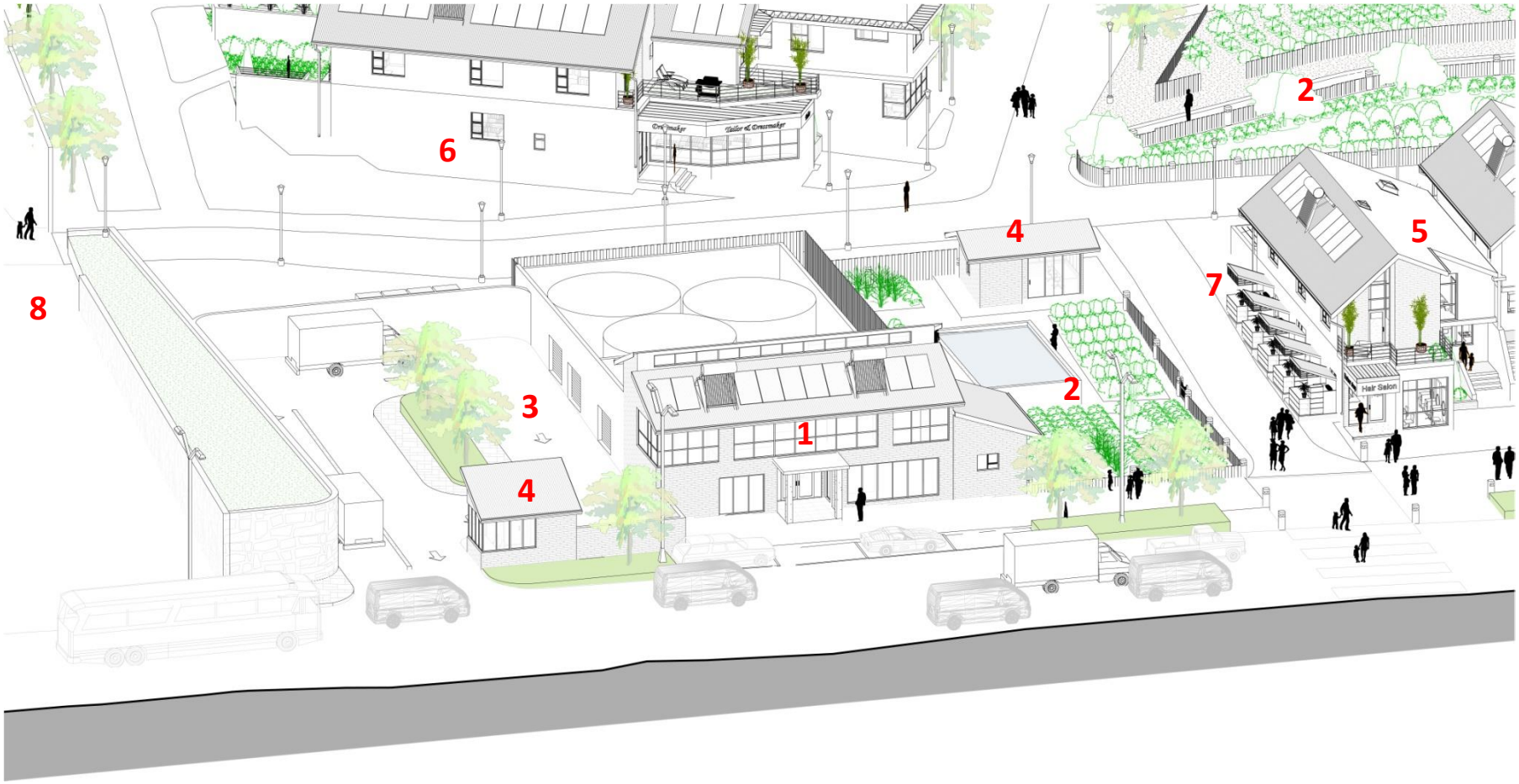
- Domestic household (1m3)
- Small farm (3-10m3)
- Integrated community (10-100m3)
- Agro-industrial plant (100-2000m3)

Advantages of community digester

- One system supplies multiple houses
- Shared responsibility
- Proper maintenance schedule can be implemented
- Construction and maintenance provides job opportunities
- The system can be connected to the household toilets for solid waste
- Reducing costs for the transportation, treatment and disposal of organic waste from the mall's restaurants and municipal waste
- The reduced electricity load on Eskom for the given community
- The production of fertilizers
- The increase of local employment: The local community will be encouraged to participate in solutions to their issues with waste management, and other emerging sustainability issues.

An opportunity to educate the environment around you

By strategically positioning the proposed Waste Management Node along Andrew Mapheto Drive, the building has immediate exposure to the public, and information on the adapted system can be projected in this direction during peak traffic hours. School trips can be organised to educate the community about communal food gardening, using waste to generate energy and saving money from alternative solutions to electricity. Experts on the system will provide skills and training courses for groups of people wishing to implement this system in other areas.



1. Waste Management Centre
2. Community food & vegetable garden
3. Waste collection yard
4. Security
5. Duplex bonded housing
6. Triplex bonded housing
7. Street trading stalls
8. Existing pedestrian throughway

New Community Waste Management Centre

Community Bio-gas digester system

Black water pipes for human and organic waste

Community Bio-gas digester with fuel cell technology

Recycling Network

Recycling collection route

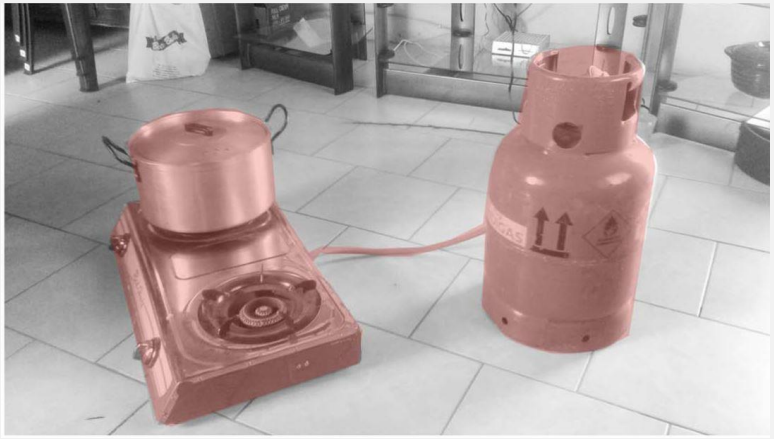
Recycling Collection Points

4.6 Community livelihoods

A summary of the observed sustainable living practices in the study area, which is residents exploring other means of carrying out the same functions they used to, without depending completely on government to make it easier for them, these include, but are not limited to:

4.6.1 Lessons learnt from the existing

1. **Alternative resourcs for power**: For their household functions (cooking, cleaning, bathing etc.) such as solar hot water geysers, gas cookers, solar photovoltaic panels on roofs
Densification of private land is carried out by erecting habitable structures in their backyards for rental to small businesses and residents.



2. **Urban food gardening:** In the form of private (back yard) and community food gardens where fruits and vegetables are grown for consumption (reduce costs of travelling to grocery stores as often) and for selling (extra income). Breeding chickens is also common as it saves costs on purchasing meat and eggs, some homeowners sell them for an extra income.

3 **Local autonomy**: Increased by homeowners who rent out the street facing portion of their homes for small-businesses (or use it for their own business) thereby capitalizing on the exposure and immediate public access.

4 **Sustainable mobility:**
Motorists and pedestrians have also shifted to cycling in order to move easier between neighbourhoods at a smaller cost, shorter time, and less harm to the environment.

5 **Local autonomy**: Brick manufacturers utilize vacant land for the creation of concrete blocks to sell and use for local construction projects.

6 **Sustainable mobility:** Self-employed individuals are able to work for companies without travelling to an office daily, they can sell goods/services on foot within their communities. These individuals eventually run their own companies in this way, this increases productivity by reducing travel time, and transport costs.

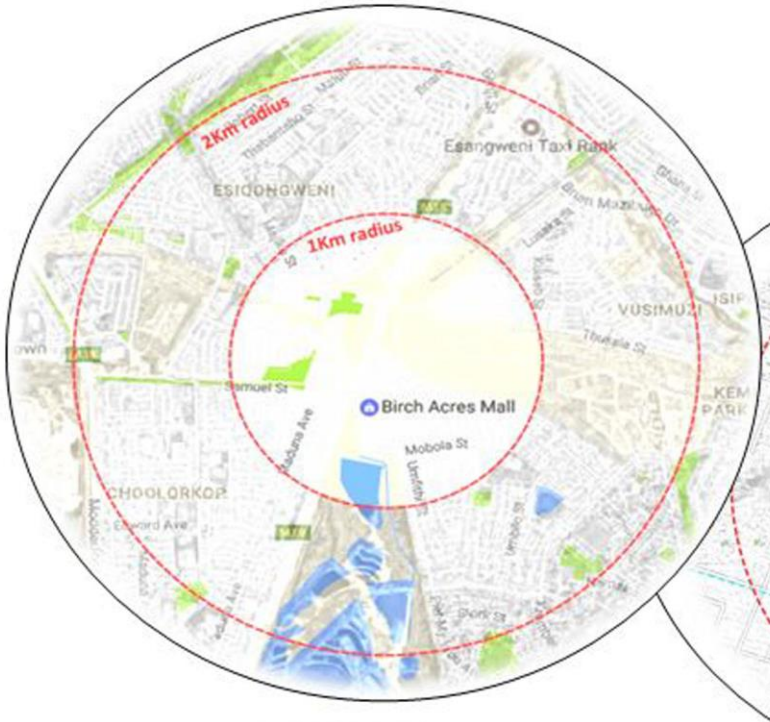
7 **Densification:** Additional dwelling units are built on infill spaces between the low density subsidized homes. The homeowner can receive additional income from renting out either the provided house (approx. R1000 – R1500 pm) or the smaller unit.

8 **Personalization:** Homeowners express their individual identity in the street facing facades of their homes by using various plants and gardening.

End-user preferences

- **Densify:** Compact, medium density communities offer better opportunities for residents than low-density developments.
- **Vibrancy:** Housing should provide opportunities for mixed mode, mixed-use buildings for additional income and house extension possibilities.
- **Identity:** Allow for the personalization of street frontages and backyard spaces by the homeowner, i.e planting, laundry drying lines, private lawns, private food gardening space.
- **Community & sharing:** Shared spaces for gardening and food generation should be accommodated in a cleaner, safer environment
- **Empower:** Give priority to local companies and builders for the construction of new developments, by involving the community in decision-making while experts supervise and train the builders.
- **Public interface:** Increase surveillance on the streets by adding street lights; balconies overlooking pedestrian lanes; placing small-business rental units on the ground floor to increase street activity.

4.7 Adaptation at unit scale



A. URBAN SCALE

B. NEIGHBOURHOOD SCALE

C. UNIT

4.7.1 Unit Objectives

Passive design
The use of simple and thoughtful cost-effective solutions for the ventilation and indoor air quality of homes has been implemented in the different units.

Efficient energy use
Low embodied energy materials have been used wherever possible for each unit, as well as minimising material waste where possible by using materials in their most standard, un-customised form.

Job & skills creation
Provided the local municipality (EMM) partners up with the main funding foundation of the project, teams of local labour will undertake the construction under contractors and project managers emerging from the community with supervision from the official representation and support agent from the Ekurhuleni Metropolitan Municipality (EMM).

Adaptability
The units have been designed with the ability to be re-arranged internally to suit tenants. Entrances have the ability to be modified to the home-owners satisfaction. Roof spaces can be used as private roof terraces; extended for more house area; or adapted for rental.

Using your house to save money and/or add to your income
The backyards of the units have been designed to allow for food and vegetable generation, which can be used for consumption or trade. Additionally, all units have street facing small-business rental spaces of varying sizes for additional income, or to be used as office spaces by the owners.

4.7.2 Design guidelines

Comfort – adapt - empower - save

The next phase in the patterned language shapes groups of buildings and individual buildings on site. These patterns coupled with the site analysis informed the design and layout of the buildings in relation to the spaces between them. The pattern is summarised as follows:

1. *"Now, with the paths fixed, we come back to the buildings; within the various wings of any one building, work out the fundamental gradients of space, and decide how the movement will connect the spaces in the gradients 3"*

- Intimacy gradient
- Indoor Sunlight
- Common areas at the heart
- Short passages
- Views to the outside

2. *"Within the framework of the wings and their internal gradients of space and movement, define the most important areas and rooms. First, for a house"*

- Couple's realm
- Private Terrace on the street
- A room of one's own
- Sequence of sitting spaces
- Bathing room
- Storage

3. *"Add those small outbuildings which must be slightly independent from the main structure, and put in the access from the upper stories to the street and gardens;"*

    - Rooms to rent; a room on first floor can be rented out
    - Home workshop; ground floor room for small business/workshop/garage
    - Flexible office space; study can be store/small bedroom/office rental unit
    - Communal eating
    - Half-private office

4. *"Prepare to knit the inside of the building to the outside, by treating the edge between the two as a place in its own right, and making human details there"*

    - Building edge
    - Sunny place
    - Flexible office space
    - North face
    - Street windows
    - Opening to the street
    - Balconies

5. *"Decide on the arrangement of the gardens, and the places in the gardens;"*
    - Fruit trees
    - Tree places
    - Vegetable garden

Private Open Space

Open spaces such as balconies, roof terraces, courtyards reserved for private use can enhance the lifestyles of residents, both indoors and outdoors. The new housing development can provide opportunities for outdoor activities and backyards can provide opportunities for extended living rooms. Balconies can be used for private outdoor leisure and social integration.

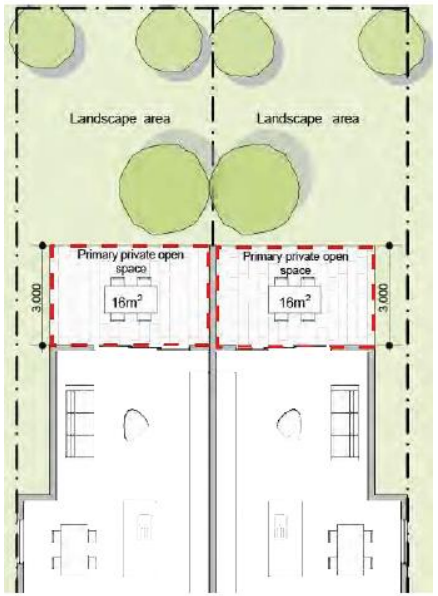


Figure 96: Private backyard outdoor space. ("Department of Planning and Environment - Medium Density Housing", n.d.:46)

4.7.3 House types

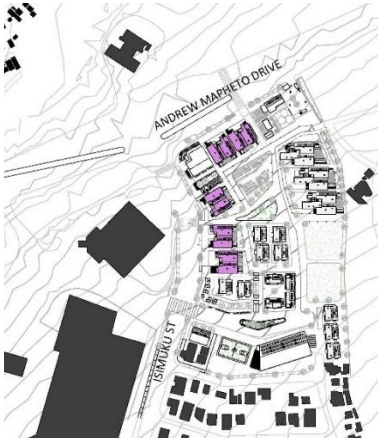
LEGEND	
Duplex Units [bonded housing + rental units]	
Triplex Units [bonded housing + rental units]	
Duplex Units [subsidized housing]	
Triplex Apartments [rental housing]	

End-User Livelihoods + Sustainable Living Principles

=

Sustainable Adaptation

Duplex Units – bonded housing + rental units



Site Plan

- Bonded units for family of 5-6 + Possible extension of 2 additional rooms upstairs

- 1 additional upper room with balcony
- Possible extension of 1 bedroom upstairs OR
- Possible rental space for bachelor/couple/small family

Applied design guidelines:

- Housing for the "Missing Middle"
- Housing for higher income bracket
- Mixed-use & mixed tenure housing
- Safe bicycle & pedestrian lanes
- Vibrant, active street edge
- Increased surveillance and security

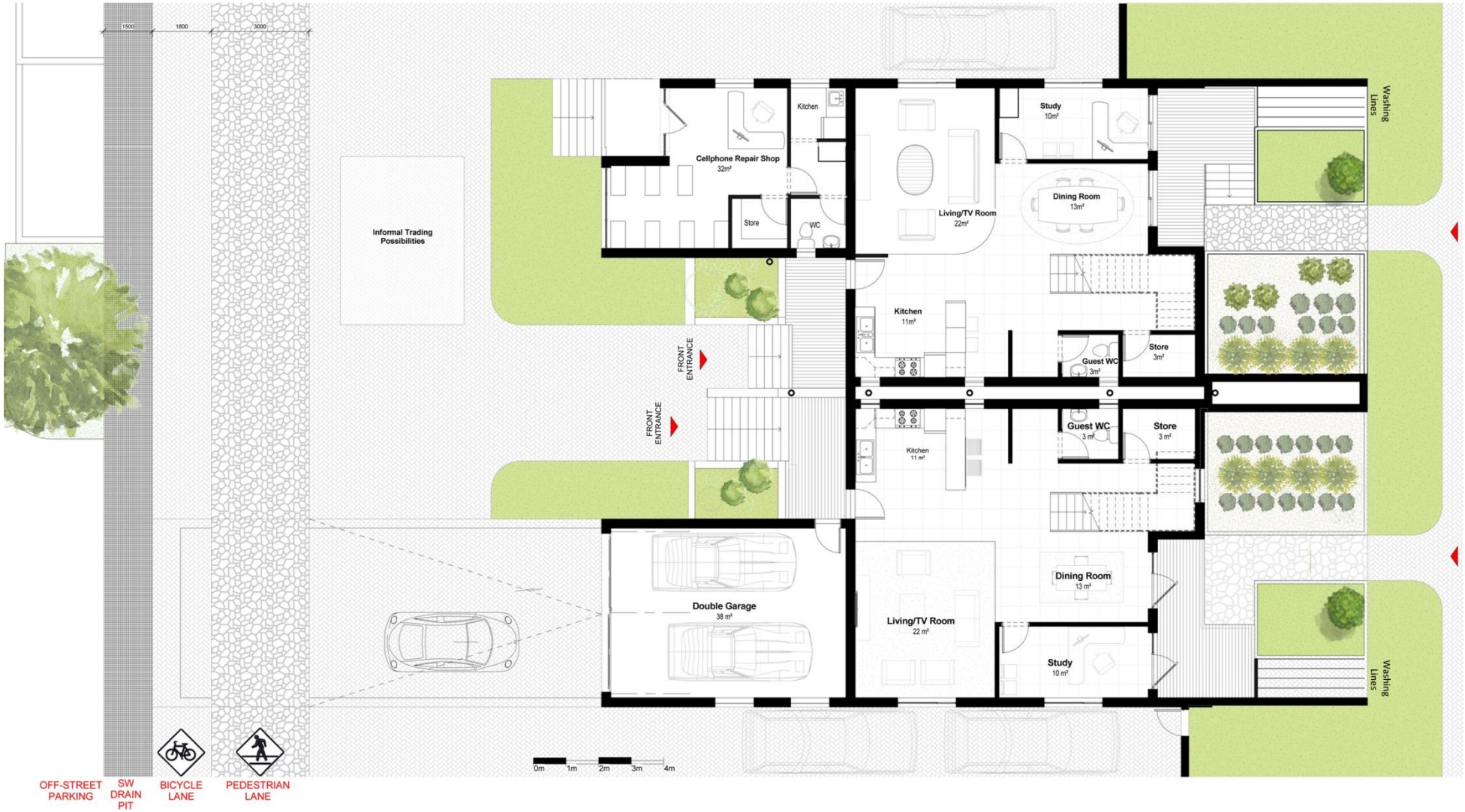
PLUS

Single Man

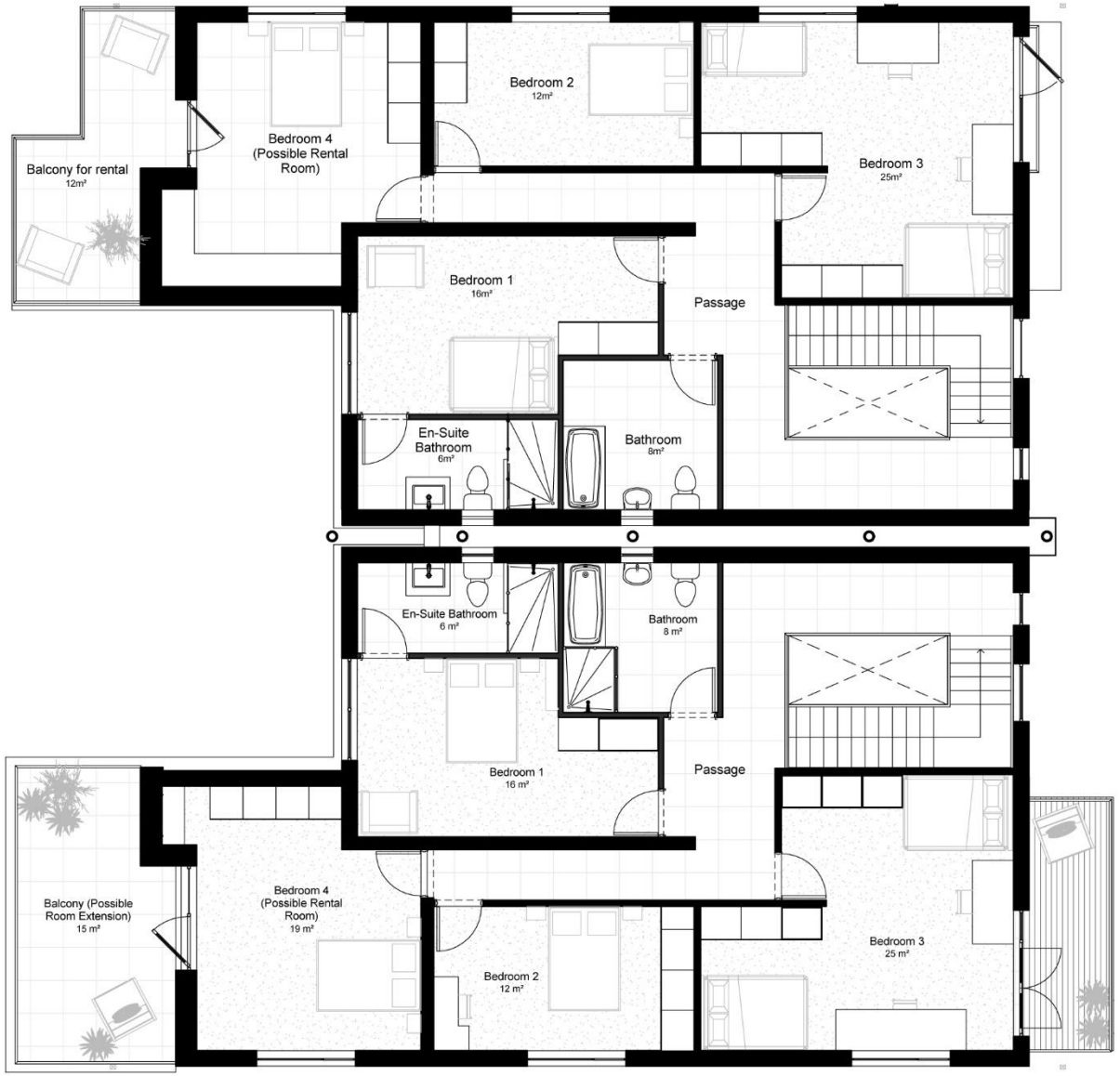
Single Lady

Childless Couple

Small family



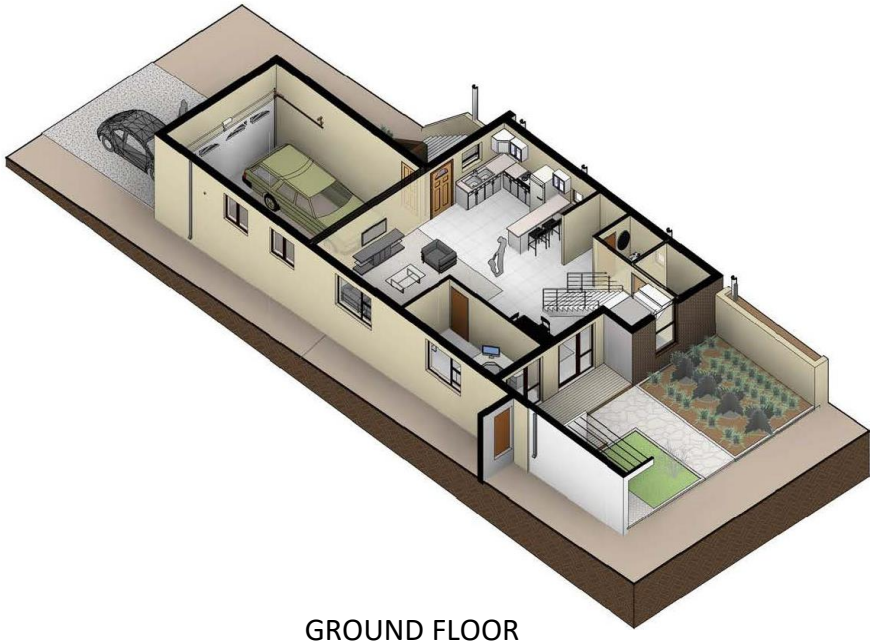
GROUND FLOOR PLAN



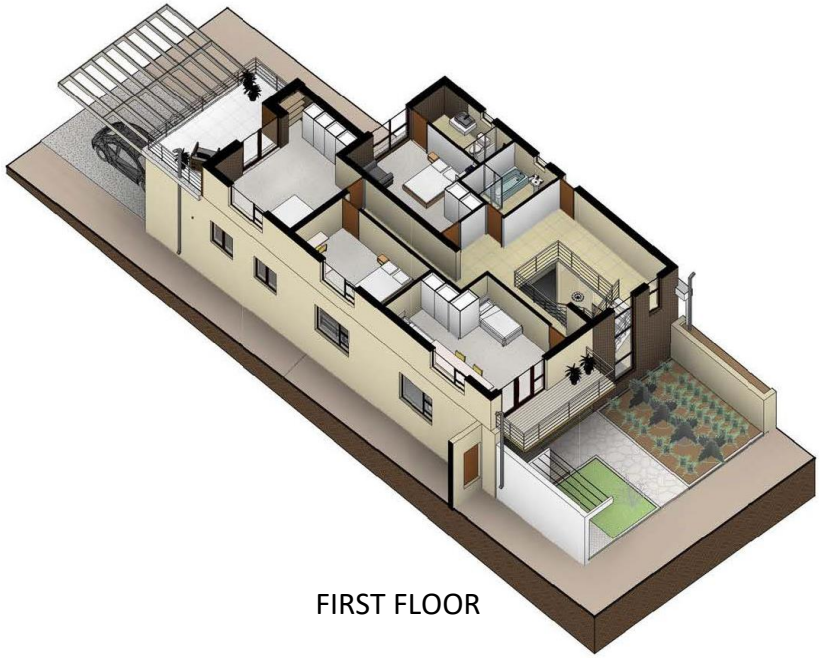
FIRST FLOOR PLAN

FRONT (STREET) ELEVATION

BACK INTERNAL (STREET) ELEVATION



GROUND FLOOR



FIRST FLOOR

OPTION 1

Small business space to let 23m²

@R90 per m² = R2,070 extra pm

Upper room to rent 22m²

@R90 per m² = R1,980 extra pm TOTAL: R4,050

OPTION 2

Bigger office/workshop space to let 35m²

@R90 per m² = R3,150 extra pm

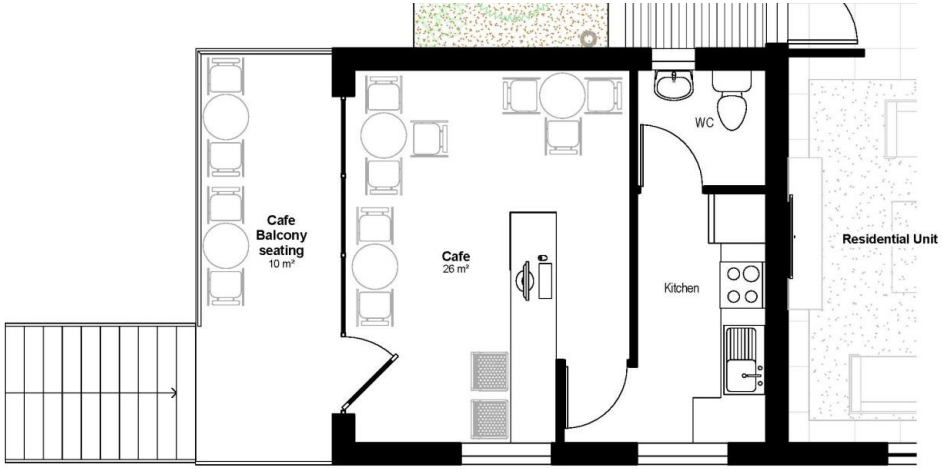
Upper room to rent 22m²

@R90 per m² = R1,980 extra pm TOTAL: R5,130

RENTAL OPPORTUNITIES (OPTION 1): *Cafe/Fast food*

Problem situation:
Fast food restaurants are a popular amenity in Tembisa, due to the quality of food and affordability thereof, rental spaces for small restaurants is often unavailable or too expensive for small-business owners.

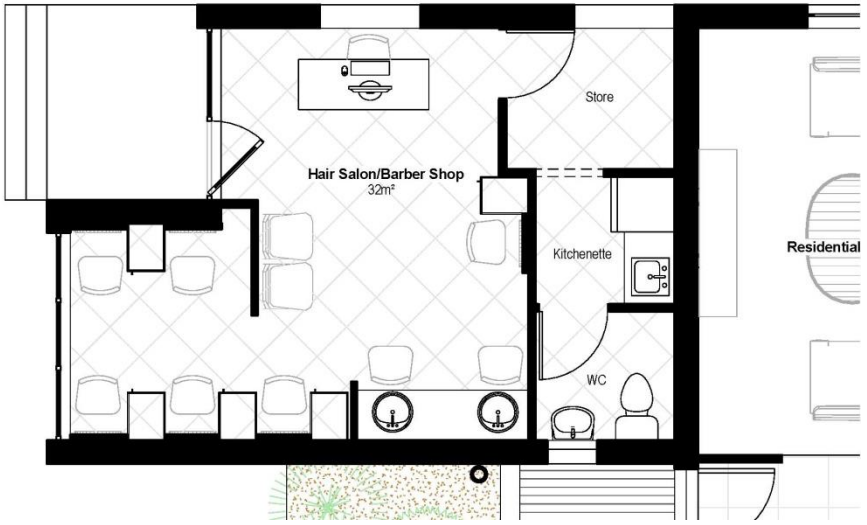
Proposed solution:
Increase local autonomy by providing clean, structurally sound affordable rental space with ablution facilities.



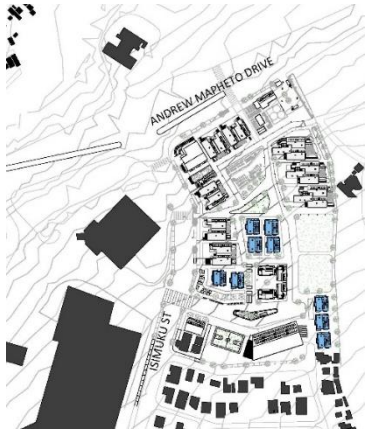
RENTAL OPPORTUNITIES (OPTION 2): *Hair salon/Barber shop*

Problem situation:
Hair salons are popular in the area, they are frequently used due to affordability, network connections and quality of services. There is a lack of pleasant, healthy rentable spaces affordable enough for hairdressers in the study area.

Proposed solution:
Increase local autonomy by providing clean, structurally sound affordable rental space with ablution facilities.



Duplex Units – subsidized housing



Site Plan

- Subsidized units for family of 3-4(/5 for small families)
- Possible use of dining room space for additional bedroom

- Additional bedroom for additional person/couple

Applied design guidelines:

- In accordance with BNG principles:
  [min. 40m² house + full bathroom + shared kitchen and living]
- Providing housing for the "Missing Middle"
- Mixed tenure housing (subsidized + rental)
- Safe bicycle & pedestrian lanes
- Vibrant, active internal street, Increased street surveillance

PLUS

Single Man

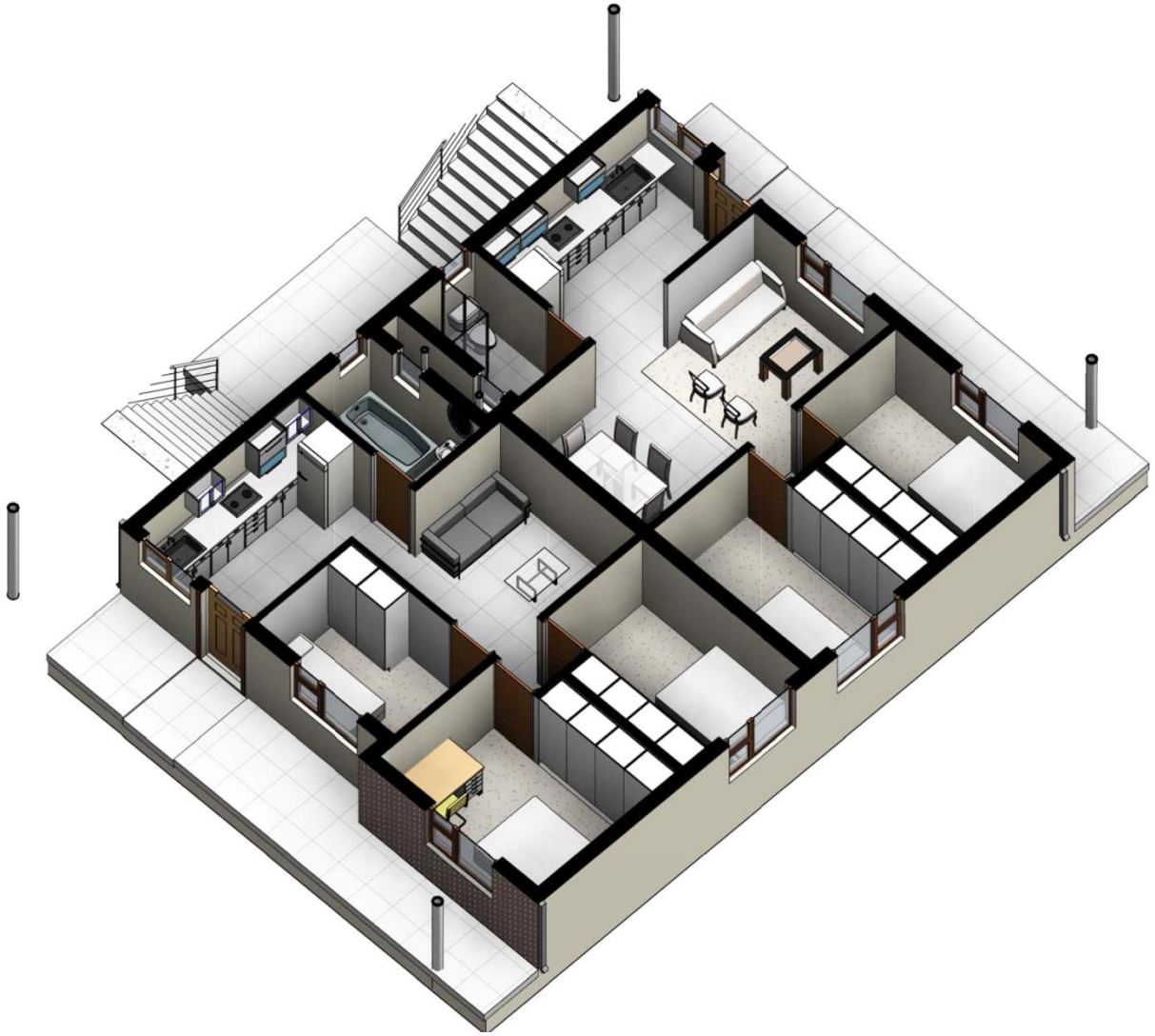
Single Lady

Childless Couple

GROUND FLOOR PLAN

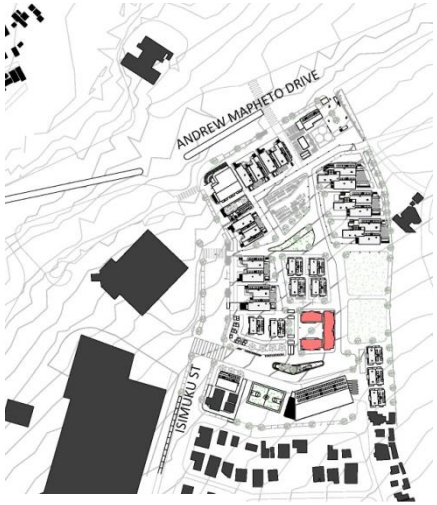
FIRST FLOOR PLAN

FRONT (STREET) ELEVATION



FIRST & SECOND FLOOR

Apartments + rental units



SITE PLAN

- Rental units for one person/couple
- 2nd floor Rental units for a family of 3-4

Applied design guidelines:

- Providing for the "Missing Middle" by providing courtyard housing
- Rental apartments according to BNG principles:
  [min. 40m² house + full bathroom + shared kitchen and living]
- Safe bicycle & pedestrian lanes
- Vibrant, active street edge
- Increased surveillance and security

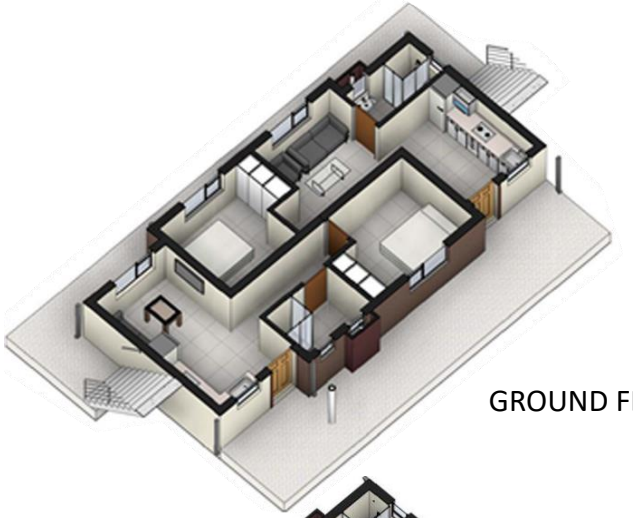
GROUND FLOOR PLAN

FIRST FLOOR PLAN

SECOND FLOOR PLAN

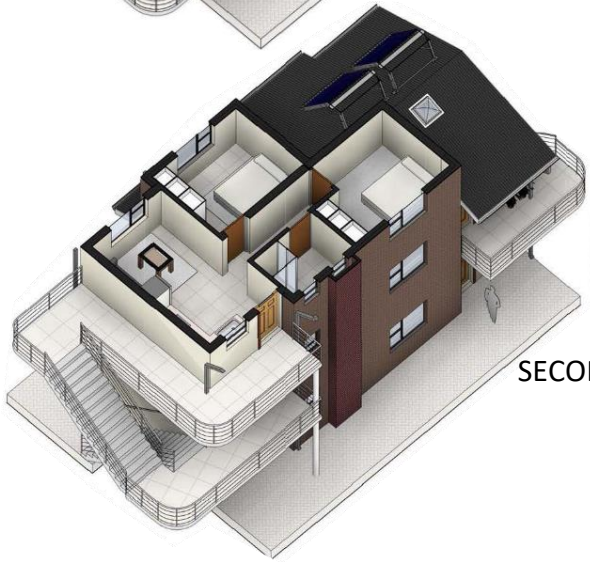
FRONT (STREET) ELEVATION

BACK (STREET) ELEVATION



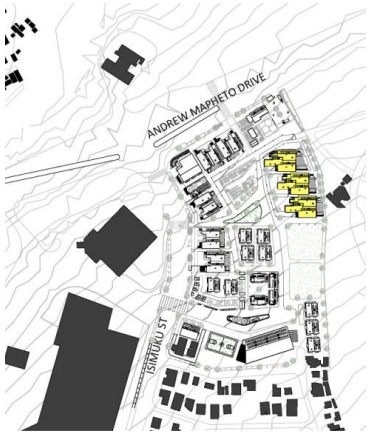
GROUND FLOOR

FIRST FLOOR



SECOND FLOOR

Triplex Units – bonded housing + rental units



Applied design guidelines:

- Housing for the "Missing Middle"
- Housing for higher income bracket
- Mixed-use & mixed tenure housing
- Safe bicycle & pedestrian lanes
- Vibrant, active internal street edge
- Increased surveillance and security
- Communal public open space

- Bonded units for family of 5-6 + Possible extension of 2 additional rooms upstairs

- 1 additional upper room with balcony
- Possible extension of 2 additional rooms upstairs
- Possible rental space for bachelor/couple/small family

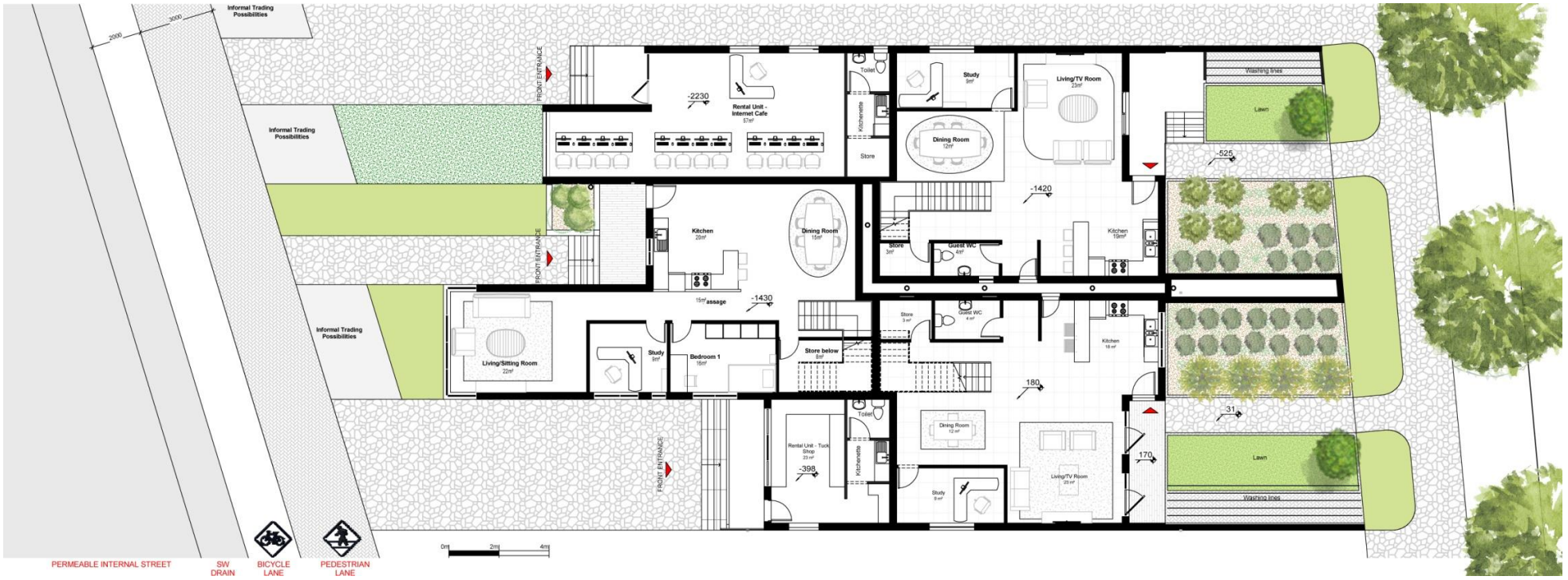
PLUS

Single Man

Single Lady

Childless Couple

Small family



GROUND FLOOR PLAN

FIRST FLOOR PLAN

FRONT (STREET) ELEVATION

BACK (STREET) ELEVATION

EXTRA INCOME

Bigger office/workshop space to let 42m²

@R90 per m² = R3,780 extra pm

Upper room to rent 26m²

@R90 per m² = R2,340 extra pm TOTAL: R6,120

RENTAL OPPORTUNITIES: *Gp & Dentist*

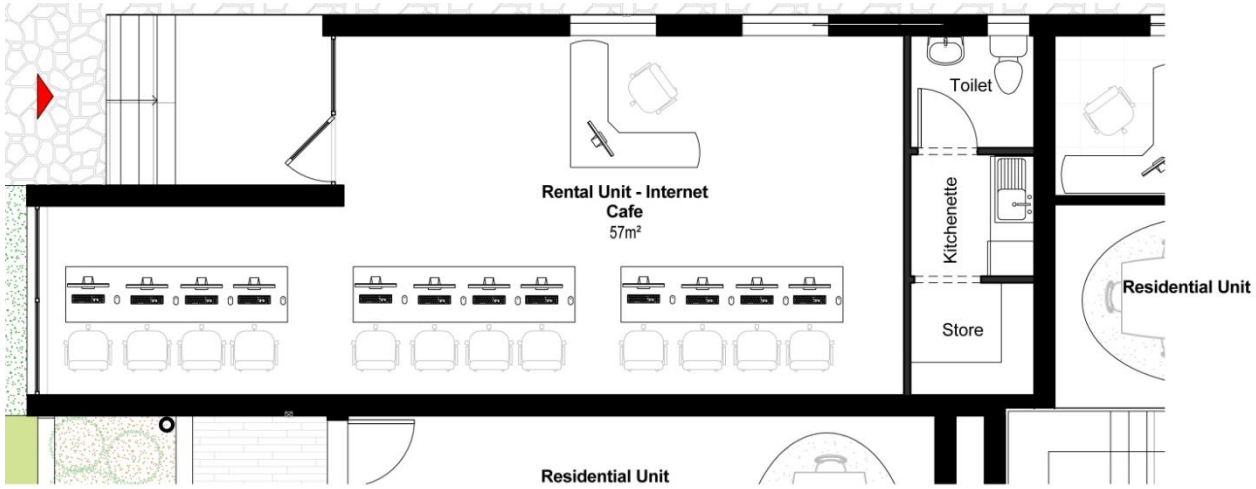
Problem situation:
A number of qualified general practitioners and doctors in various medical specialities have trouble finding well located rentable space that is safe and healthy for patient consultations.

Proposed solution:
Increase local autonomy by providing clean, structurally sound affordable rental space with ablution facilities.

RENTAL OPPORTUNITIES: *Internet Cafe*

Problem situation:
There is a lack of internet/learning facilities in the study area, and there is currently one internet cafe within walking distance of the site, in the Birch Acres mall complex. However, the rental space is costly, resulting in expensive internet usage rates, thus it is inaccessible and unused to a great extent.

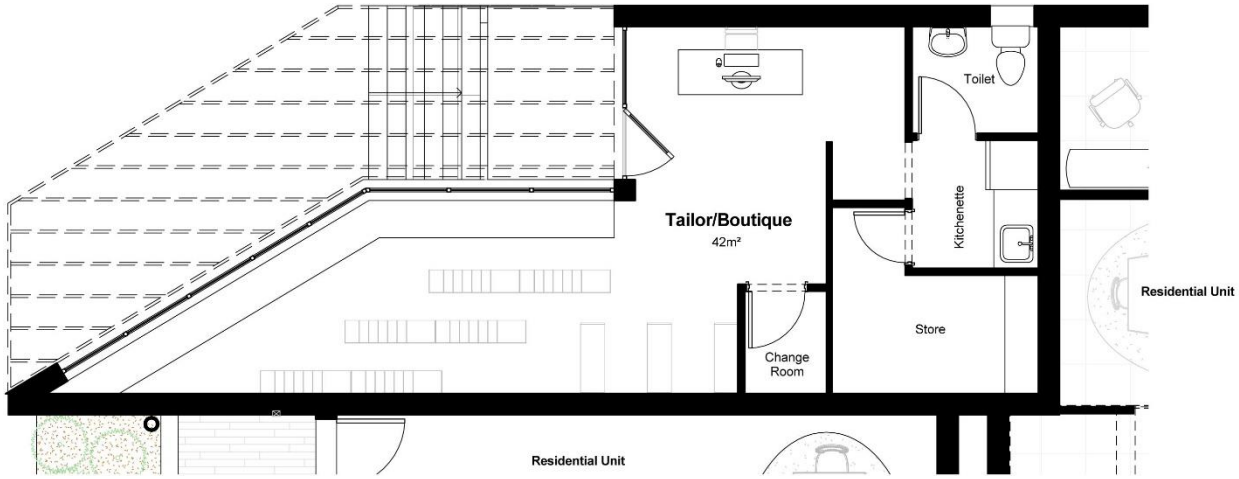
Proposed solution:
Increase local autonomy by providing clean, structurally sound affordable rental space with ablution facilities.



RENTAL OPPORTUNITIES: *Clothing store*

Problem situation:
The majority of clothing stores in the study area are found in the mall and Tembisa plaza, also, the majority of the them belong to big corporations due to the high rent, discouraging the small business owner from affording that space.

Proposed solution:
Increase local autonomy by providing clean, structurally sound affordable rental space with ablution facilities.



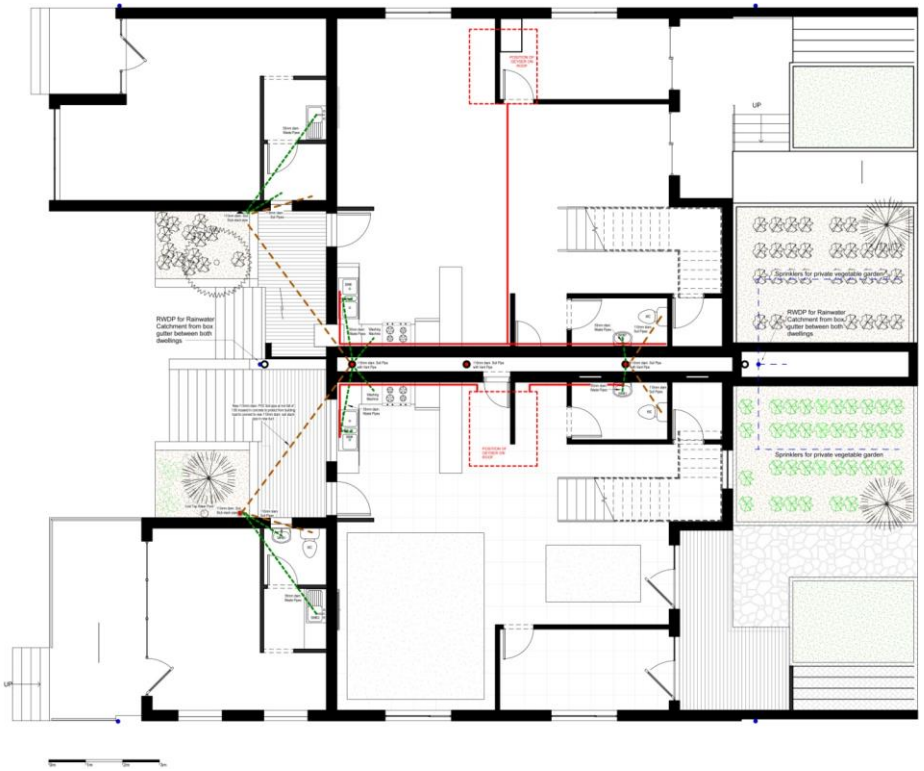
RENTAL OPPORTUNITIES: *Cellular phone repair shop*

Problem situation:
Cellular phone repair shops are well within walking distance, but are often in unhealthy unpleasant rental spaces such as rusted shipping containers or shacks.

Proposed solution:
Increase local autonomy by providing clean, structurally sound affordable rental space with ablution facilities.

STREET SECTION – Through housing

4.7.4 Services



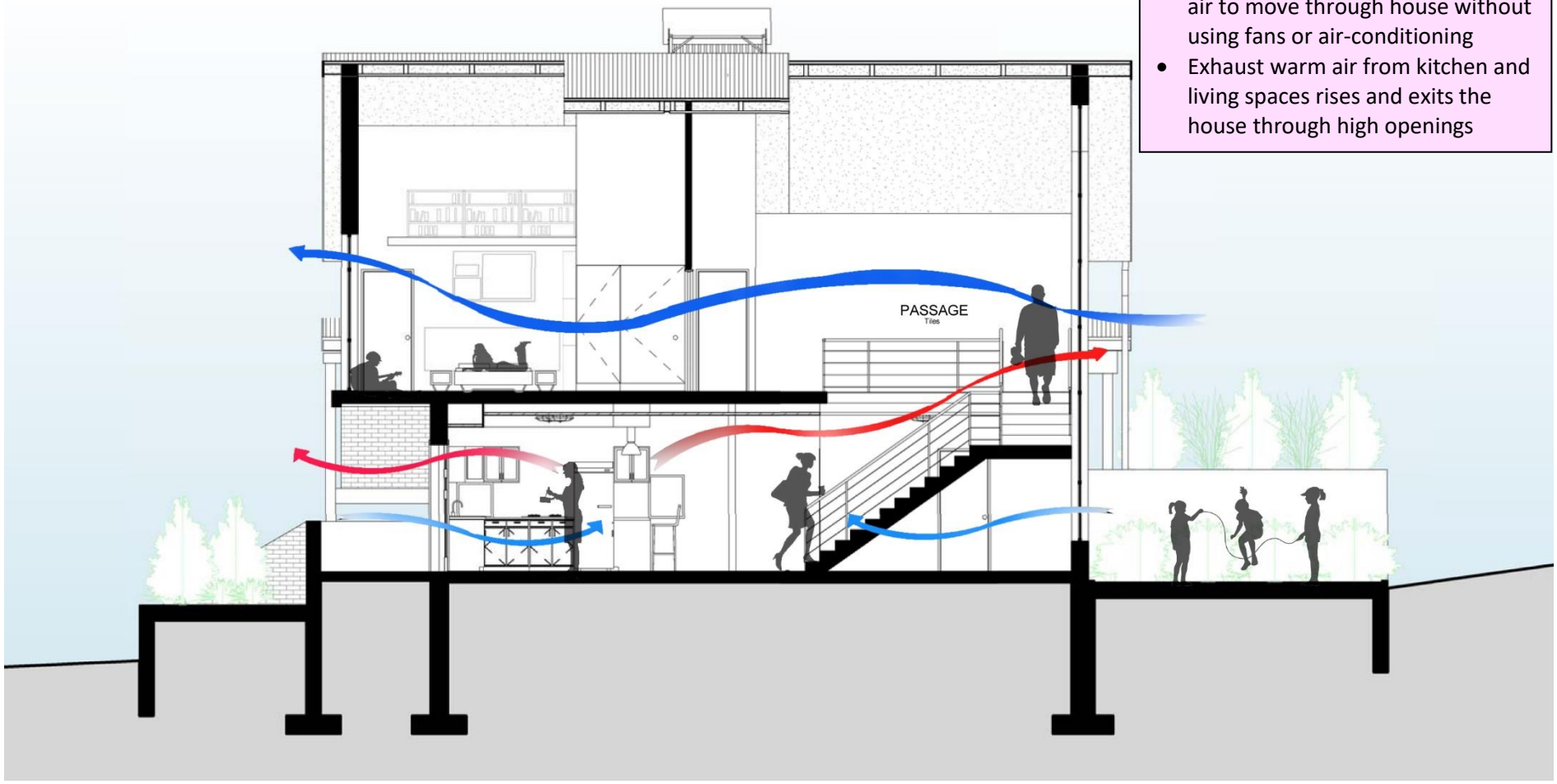
UNIT GROUND FLOOR PLAN_Typical service runs

UNIT FIRST FLOOR PLAN_ Typical service runs

CROSS VENTILATION

Applied design guidelines:

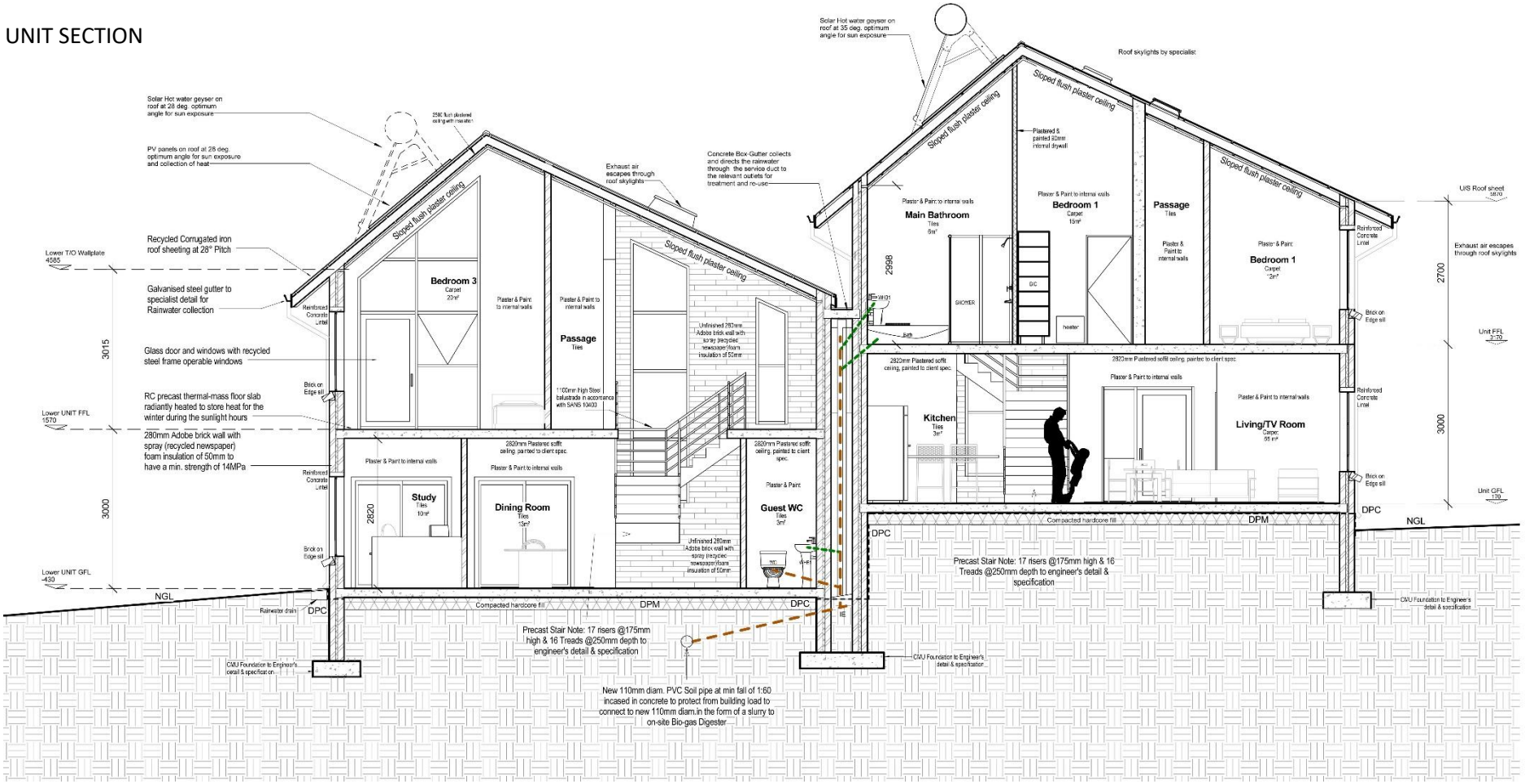
- Long thin house
- Building allows movement of fresh air to move through house without using fans or air-conditioning
- Exhaust warm air from kitchen and living spaces rises and exits the house through high openings

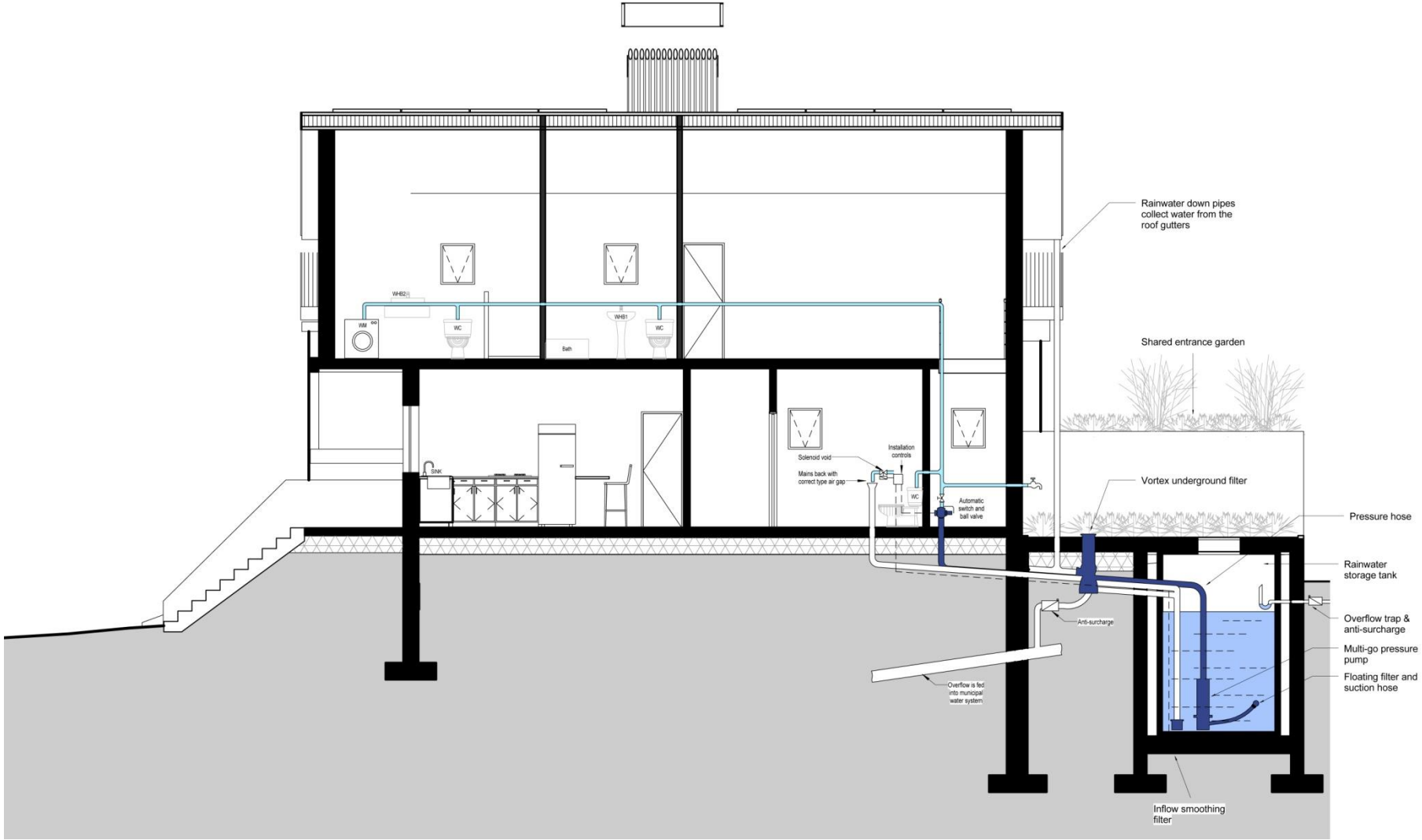


Applied design guidelines:

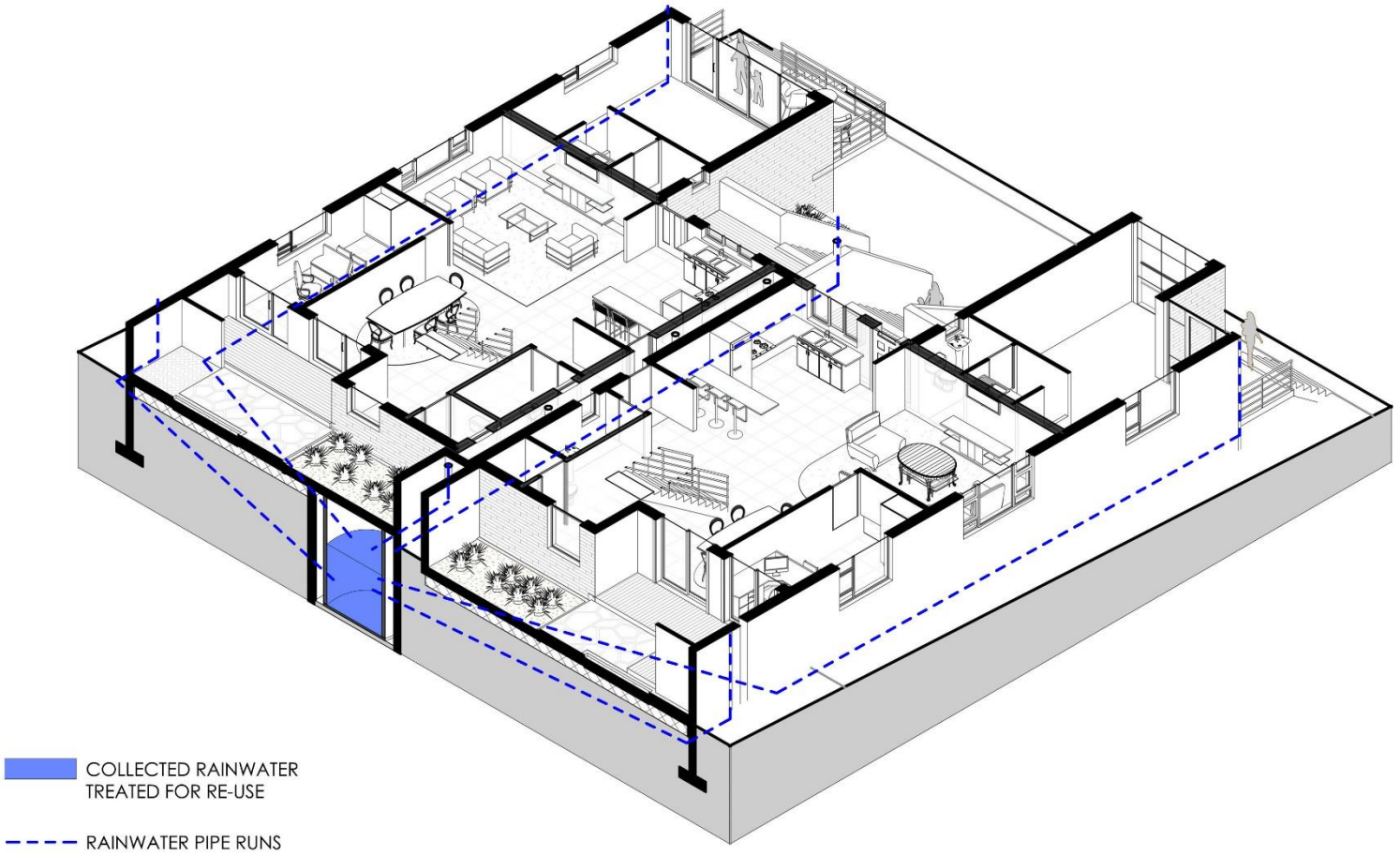
- Housing for the middle/higher income class
- Step the building to follow slope of land, reduce cut and fill areas
- The use of sustainable and affordable materials
- Aesthetic buildings responding to the context of Tembisa (brick homes of maximum 2 storeys)
- High ceilings provided by following slope of roof framing
- Services have been concealed from public by using semi-detached housing common walls
- Common walls are 280mm thick and spaced for noise reduction and service runs.

UNIT SECTION





UNIT LONG SECTION_Rainwater harvesting



UNIT 3D SECTION_Rainwater harvesting

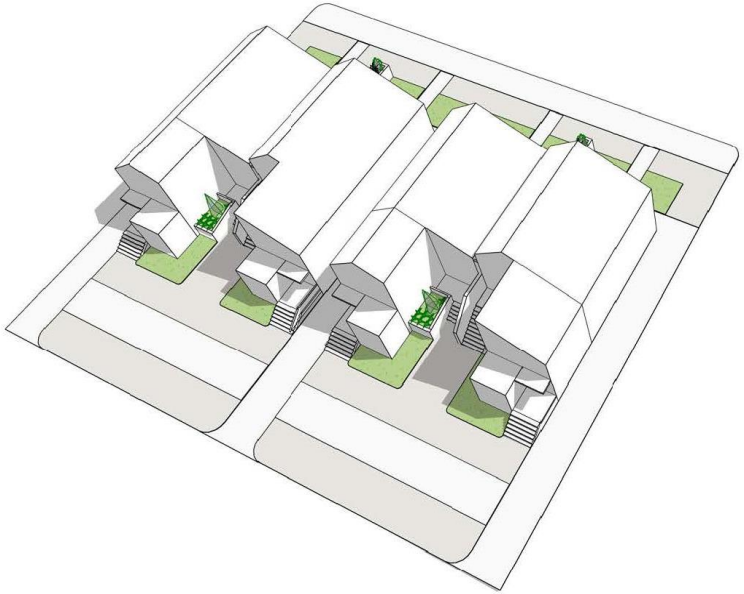
Discussion

Variety of housing types

Tembisa has developed tremendously since its establishment in 1957, it therefore requires a transformation in the design and planning of its human settlements. Research shows that a housing development consisting of a variety of housing types and sizes will serve the client community to a greater extent than a similar development populated with identical houses designed for one specific income class would.

Bonded housing

Principle Development Controls	
House type	Semi-detached
Minimum dwelling size (Gross)	Duplex & Triplex units 250m² incl. Rental space
Landscaped area	20 – 50% increases with lot size
Building height	6m (2 storey)
Front setback treatment	Private dwelling entrance to dwelling set further back Landscaping & trees
Rear setback treatment	Private food & vegetable garden Private lawn Laundry lines

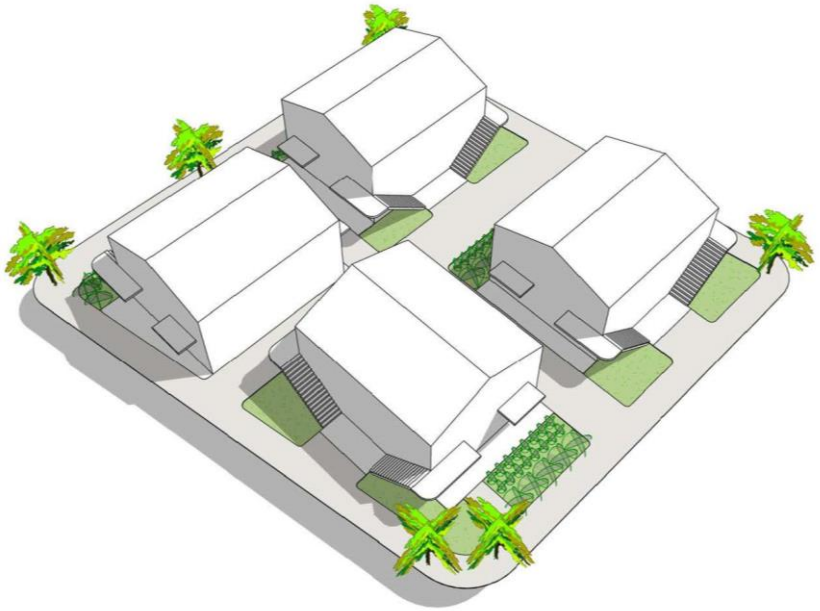


Subsidized housing

The subsidized units have been designed in accordance with the new BNG principles:

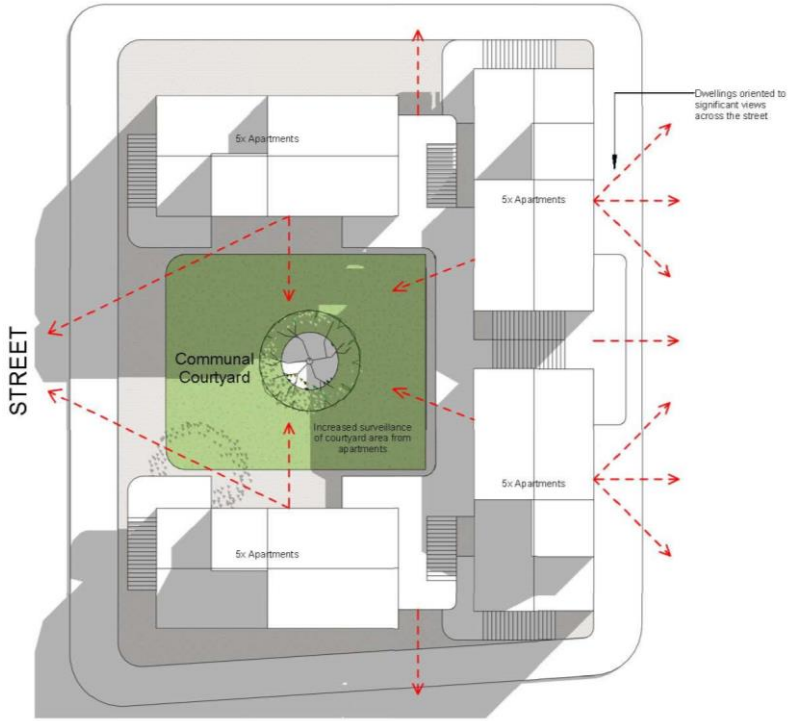
A minimum gross area of 40m² house; including a full bathroom; open plan kitchen and living areas, and an optional dining room space that can be adapted to an additional bedroom.

Principle Development Controls	
House type	Semi-detached
Minimum dwelling size (Gross)	BNG principles: 40m²
Landscaped area	20 – 50% increases with lot size
Building height	6m (2 storey)
Front setback treatment	Direct access to dwelling entrances on ground floor Upper floor entrances overlook street Landscaping & trees
Rear setback treatment	Shared food & vegetable garden Shared lawn Shared & private laundry lines

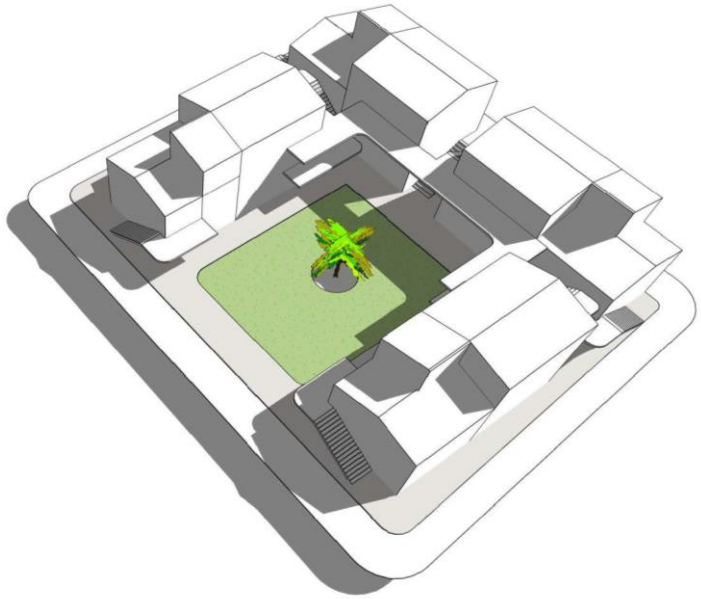


Rental units

The apartments have been designed around a courtyard to be maintained and enjoyed by the residents of the apartments. Landscaping, public seating and tree shaded areas give the residents a sense of place due to the pleasant environment in which they live.



Principle Development Controls	
House type	Apartments
Minimum dwelling size (Gross)	BNG principles: 40m²
Landscaped area	20 – 50% increases with lot size
Building height	6m – 9m (2 – 3 storeys)
Front setback treatment	Direct access to dwelling entrances on ground floor Landscaping & trees in Curtyard
Rear setback treatment	Pedestrian Pavement Upper floor balconies overlook street

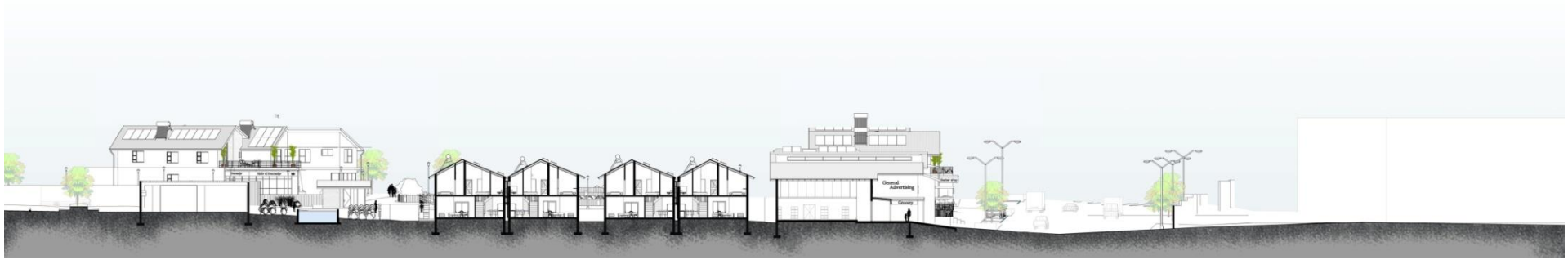


SITE PLAN - Context

Applied design guidelines:

- Housing for the “Missing Middle”
- Housing for mixed income groups
- Mixed-use & mixed tenure housing
- Safe bicycle & pedestrian lanes
- Vibrant, active street edge
- Increased surveillance and security

STREET ELEVATION – Albert Mapheto Drive



Waste Management Centre Mixed tenure housing Commercial Zone: Corner grocery

STREET SECTION – Albert Mapheto Drive

Applied design guidelines:

- Housing for the “Missing Middle”
- Housing for mixed income groups
- Mixed-use & mixed tenure housing
- Safe bicycle & pedestrian lanes
- Vibrant, active street edge
- Increased surveillance and security

STREET ELEVATION – Isimuku Street

Commercial Zone: Corner grocery

Commrcial Zone: Small-business rental

Mixed tenure, mixed use, range of housing types

STREET SECTION – Isimuku Street

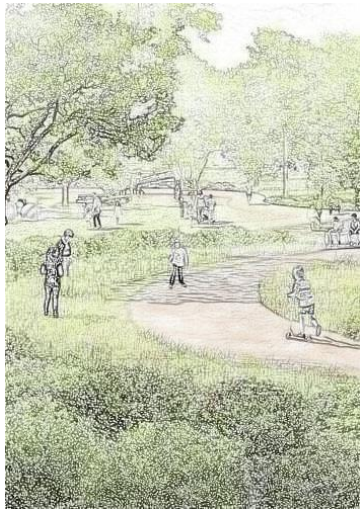
Why do people move from Tembisa to suburb/city areas?

1. **Clean, healthy environments**

   Efficient service runs
   Less pollution and dusty air
   Well-maintained streets & landscapes
   More trees and plants in pleasant environments
   General expectation of better quality construction of homes

2. **Walk-able communities**

   Close proximity to essential amenities i.e. shops; recreation and sports facilities
   Public parks and good playgrounds
   Security office/guards guarding public areas
   Connection to transportation links



3. Increased public safety and security

Surveillance from balconies overlooking the streets
Multiple street facing shops
Surveillance from
Well-lit streets

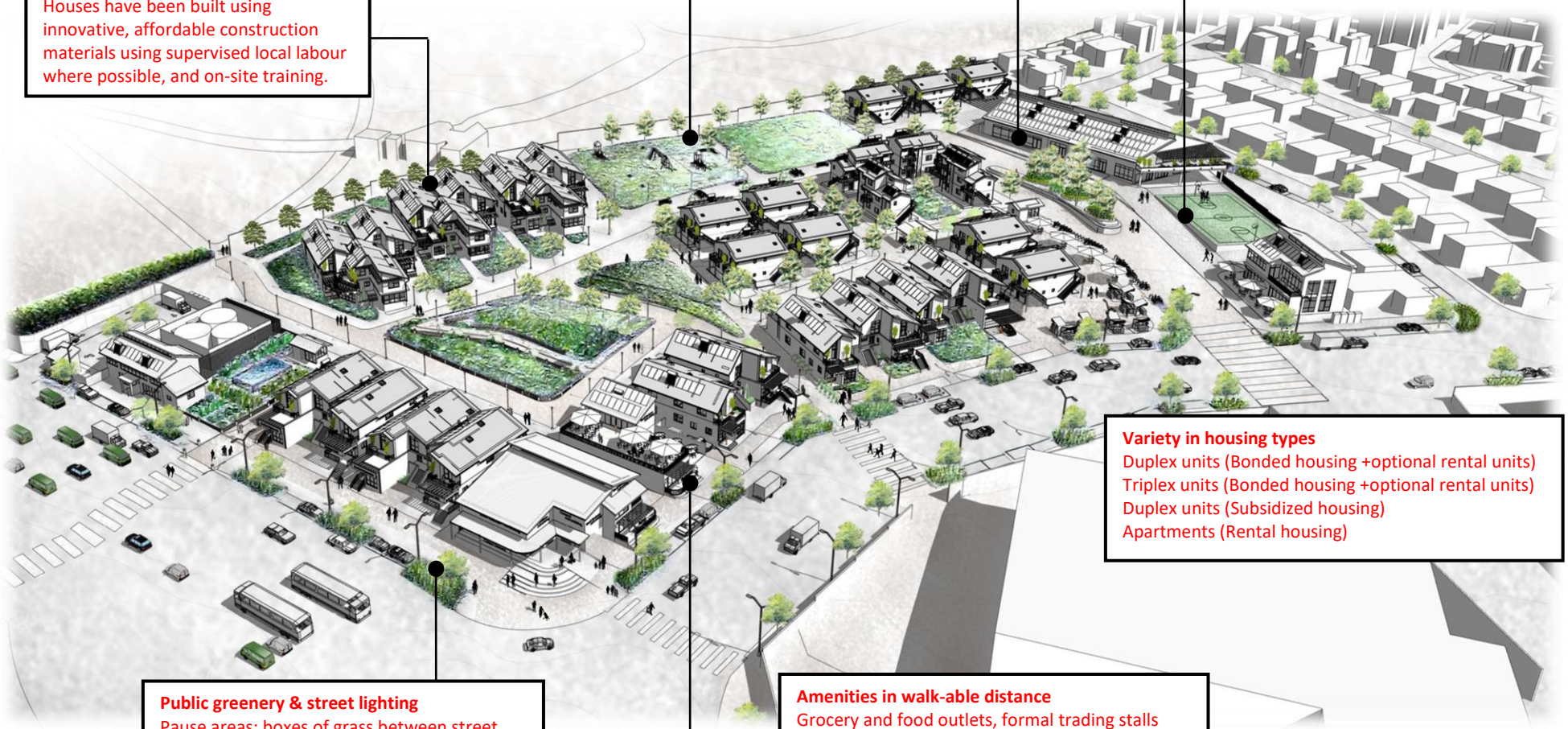
4. Vibrant streets

More variety in housing types
Shopping pedestrian streets between buildings
Courtyards that live
Quality street trading

How does the proposed design intervention respond to these needs?

Local sports and recreational facilities
Recreational areas of greenery include playgrounds, picnic areas, and general open green spaces.

Good quality building construction
Houses have been built using innovative, affordable construction materials using supervised local labour where possible, and on-site training.



Variety in housing types
Duplex units (Bonded housing +optional rental units)
Triplex units (Bonded housing +optional rental units)
Duplex units (Subsidized housing)
Apartments (Rental housing)

Public greenery & street lighting
Pause areas; boxes of grass between street parking bays adds oxygen and beauty, also, it teaches the community about the importance of planting trees.

Amenities in walk-able distance
Grocery and food outlets, formal trading stalls with sufficient-on-site storage, restaurants, and small business rental units line the streets facing the frequently used perimeters of the site.

4.8 Renders of development

View from Isimuku street

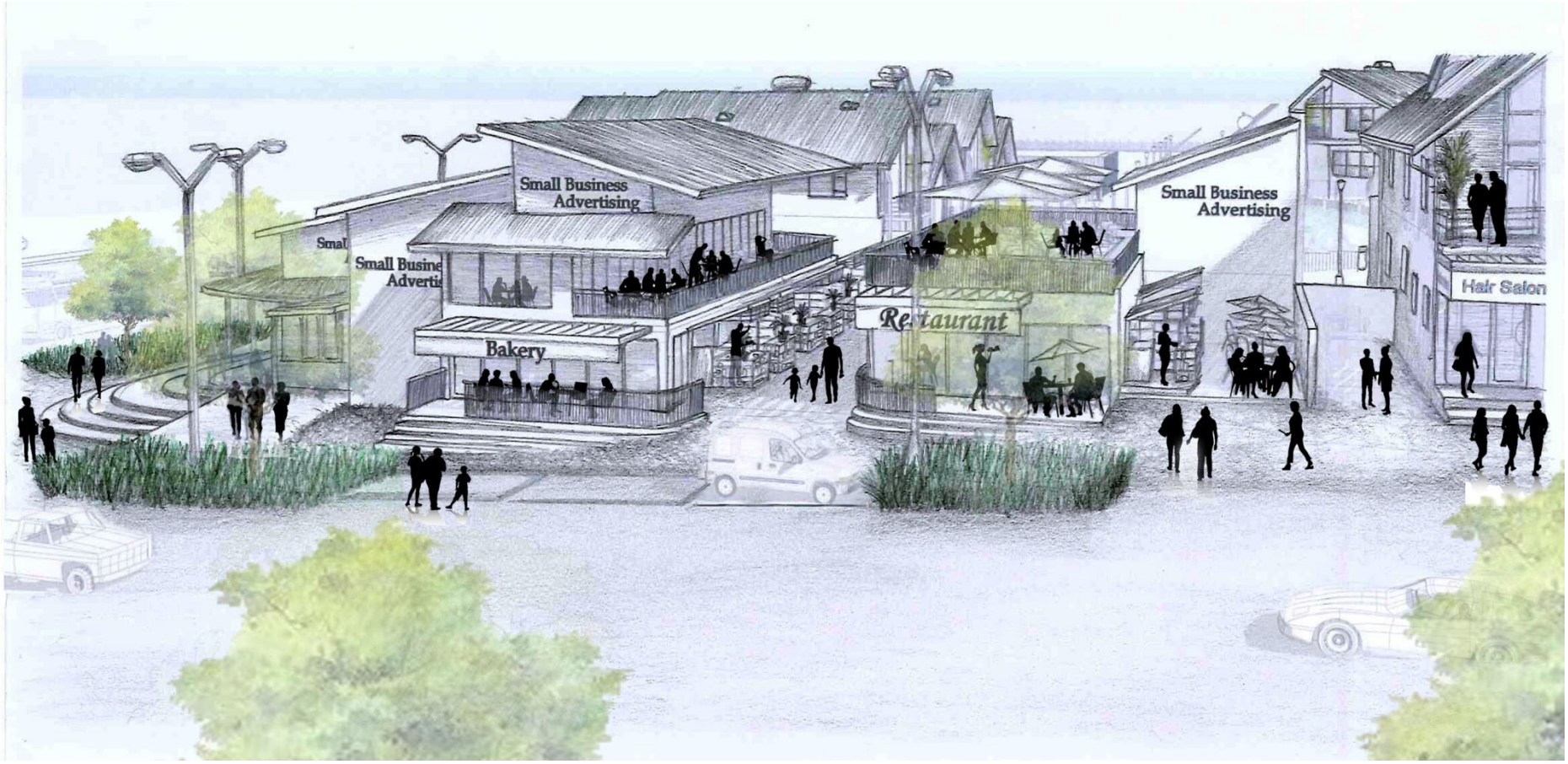
View of communal (shared) food and vegetable gardens

View of public green open space

View of bonded duplex housing units from street

View of internal street - triplex housing units

Aerial view of housing development, facing playground and picnic spaces



Aerial view of commercial hub, Isimuku Street

5. CONCLUSION

Design question: Is there an Architecture that can, through design, facilitate the learning and unlearning processes necessary in the global transition to sustainability living?

The question that spear-headed this research report questioned whether or not planners, architects and designers could affect the overall needs of communities that will support sustainable living. Bioregiional's definition of sustainability as it relates to residential communities sums up my intentions with this design intervention quite accurately: "…a world in which people enjoy happy, healthy lives within their fair share of the earth's resources. ("One Planet Living - Bioregional", n.d.).

Tembisa has evolved since the establishment of the township over 60 years ago, and will continues to do so. The question designers and planners for such areas need to ask themselves is whether their solutions meet the needs of Tembisa today, and ensure that their product is open to pivoting when it needs to, as today's solution might be seriously outdated tomorrow. The success in eliminating the uncertainty associated with this seemingly daunting question lies in establishing a process around the development of the "product" whereby the vision is tested continuously. ("The Lean Startup | Methodology", n.d.) This method makes continual engagement with the community (more specifically the representatives) a priority, eliminates chaos and brings order to this integration. With commitment and smart decisions, this can be applied to literally any context.

Design answer: Yes, there is an architecture that can facilitate the learning and unlearning processes necessary in the global transition to sustainability living, through the sustainable adaptation (continual alteration and restructuring) of the design and planning processes preceding new housing developments.

As architects we are continually learning, the profession is designed in that way, the link is to apply this learning, unlearning and re-learning approach to the context in which we will design. Tembisa is not a township populated with unintelligent groups of poor people who are incapable of change. There are people who would love to live out the rest of their lives in Tembisa, due to the affordability of lifestyle and social networks, however, due to the poor construction and environmental conditions, they feel forced to move to better areas. There are also households that have grown financially, and wish to remain in Tembisa.

This research report revealed that the design of new housing developments in this context must take the housing needs of these groups of people into consideration as well. Below is a list of the design principles that motivated the design decisions made in this new development, as well as how they link with end-user preferences.

Happy & healthy lifestyles

Residents are encouraged to lead healthy lifestyles which increase the pleasant character of the development by maintaining homes which they built to sustainable standards.

Equity & local autonomy

The local autonomy has been increased through the provision of commercial zones for small business rental spaces, as well as smaller rental units in street facing dwellings to add to the homeowners' monthly income.

Culture & community

The celebration of the unique identity of Tembisa has been accommodated through spaces allocated to street traders, fast food street restaurants and seating, as well as the unique street performance space for promotions and arts.

Land use

Land has been used efficiently to densify (medium-density housing) and accommodate different income classes (lower, middle/higher income) within the same development, encouraging social integration

Water Conservation

Street surfaces have been adapted to absorb rainwater, street swales and integrated rain gardens have been provided to avoid soil erosion and flooding.

Local & sustainable food

The existing trend of sharing food gardens has been accommodated in safe and clean portions of land throughout the development. Public visual access will encourage the replication of this practice in other neighbourhoods

Sustainable materials

Locally sourced building materials of low embodied energy, healthy products and recycled materials from demolished buildings have been specified, to create employment opportunities which offer on-site skills and training to local builders, thereby empowering them through engagement.

Sustainable transport

The reduction of travel time has been ensured by providing important amenities within 400mm walking distance, as well as access to existing transportation networks within walking distance. Bicycle lanes have been provided alongside pedestrian lanes to encourage the use of non-motorised transport.

Reduce waste

Disposal of waste to landfills has been limited through recycling bins and routes implemented at various corners of the site, as well as the new waste management centre using an innovative system of bio-gas to power their homes and heat the water systems.

Reduce carbon

The buildings have been integrated with the environment, and long houses enable sufficient cross ventilation and passive design systems, this will reduce the dependence on electrical systems to heat and cool their homes.

Limitiations & areas of further research

As with most empirical research, this study was limited to the chosen study area due to time constraints. The study area limited the research to places of high visitation and frequent usage, which is not necessarily characteristic of all streets in Tembisa or other such townships. This means that the proposed treatments of the street facing facades of the houses might not yield the same results if repeated on streets with very little usage, if for example, it is not lined with amenities or along a public transportation route. The treatments will therefore need to be adapted for that street, in order to best suit that context. This also refers to the treatments of corner sites, for example, in a quieter residential neighbourhood, a park or a church might be more appropriate than a huge corner grocery store. This also means that rental spaces for retail might not be the best solution for all areas, street trading is also best suited for frequently used transport routes.

Further research must include the estimation of building costs for each housing type, this will be compared to the affordability of these units, based on how much the client community can afford. This will further solidify the viability of the study, and allow for changes to be implemented if the gap is too great. It is crucial to test the processes used in the design of this housing development in other areas of Tembisa, those of different densities and cultures. Researchers will find that there are various end-user livelihoods and preferences which could be different to what was found in this study area. Due to the limitations of the sample size used in this research, it would also be beneficial to approach this inquiry using larger populations. The topic of housing is complex both in research and design solutions, this research is thus only a it is encouraged that designers apply other methodological approaches to address this important subject.

Sustainable living in Tembisa

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7. APPENDIXES

APPENDIX A

ANONYMOUS SURVEY

(You will remain unnamed in the use of these survey results)

What is your employment OR primary source of income?

✓ *(please tick in the box below)*

- ☐ Small business owner (self-employed)
- ☐ Formal job
- ☐ Temporary (Adhoc)
- ☐ Welfare grant

APPENDIX B

ANONYMOUS SURVEY

(You will remain unnamed in the use of these survey results)

How much money do you spend (on average) on the following items monthly?

✓ *(please tick in the box below)*

R ..... Food

R ..... Electricity

R ..... Transportation (private/public)

R ..... Water & Lights (Rates)

APPENDIX C

ANONYMOUS SURVEY

(You will remain unnamed in the use of these survey results)

What energy source do you use in your home, primarily?

✓ *(please tick in the box below)*

☐ Electricity

☐ Gas

☐ Coal (malahla)

☐ Paraffin

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