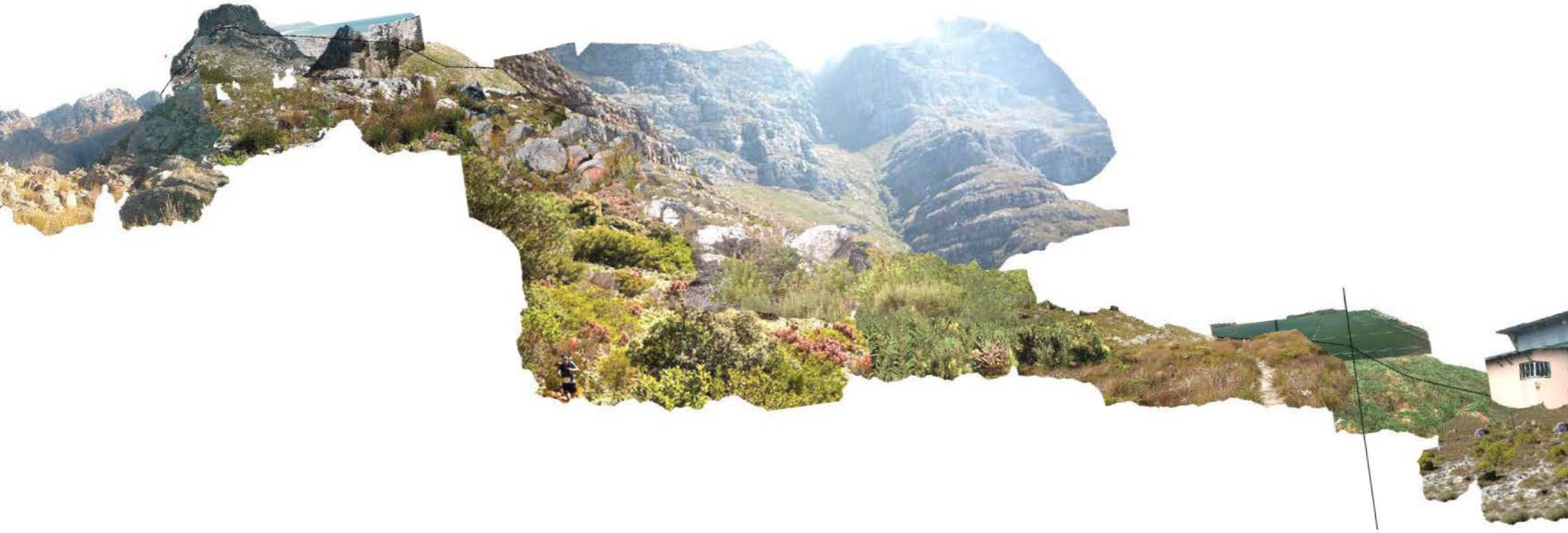
RE[SOURCE]

LOUISE MALAN

M(Arch) Prof



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LOUISE MALAN

M(Arch) Prof

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ii. ACKNOWLEDGEMENTS

I would also like to thank my parents for their constant support, love, and understanding; this year would not have been possible without you.

I would like to thank Piere Siebert for his motivation and encouragement on a daily basis.

I would also like to thank my brother, Adriaan Malan for all his help! I love you all dearly !

iii. PREFACE | My Journey

Entering the small coastal town of Kleinmond, an alienated building caught my eye, standing out against the majestic Kogelberg Mountains. Intrigued by this stark contrast, I embarked on a new journey to explore the ambivalence of this mundane waste-handling centre on the edge of the spectacular Kogelberg Biosphere.

My gaze shifted between the picturesque environment, the waste centre, the adjacent informal settlement and the more affluent community across the main road; four worlds literally within a radius of a few hundred meters. I saw small children playing in the sand next to dumpsite and the older children using the taxi roundabout as a soccer field.

It was evident that no public space was provided for this marginalised community. It moved me; this revealing of the harsh everyday realties. The isolation of the waste centre was evident. The ordinary, static industrial waste structure provided no sense of integration of people, or nature.

I immediately thought that the waste centre needed transformation from a barren industrial space to a space which could alleviate contrasts and isolation.

Paul Coelho's book The Alchemist, that I recently read, stuck with me. Like the alchemist who transforms the ordinary into gold through magical processes of creation and transformation, I could sense how the waste centre could be a living alchemist, transforming something that is marginalised and without value into something that is integrated and valuable. I imagined how the whole waste site could interact with the constant rhythms and movement of nature, waste and the people, and how the existing waste on the site can become a valuable resource.

My journey is, therefore, also a dream: That the waste site will give everybody that comes into contact with it the opportunity to become an alchemist who transforms; either by giving back to earth, making a living from the waste, by giving knowledge, by using knowledge, or just finding a space to be.

As Paulo Coelho writes of the alchemist: "I see the world in terms of what I would like to see happen, not what it actually does".

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iv. ABSTRACT

This dissertation is a case study in revealing value in mundane residual waste infrastructure and waste materials. Our perception of municipal solid waste and drop-off sites is that they are unsightly and non-special parts of our everyday lives. This is evident in their marginalization and seclusion from our urban, social, and natural environments. Alienated and shifted to the peripheries, our perceptions are unable to be challenged. The isolated spatial realities of these precincts reflect our societal ignorance, and the wasted materials our consumerist egos.

The coastal town of Kleinmond in the Overstrand Municipality contains the Kleinmond Waste Drop-Off and Transfer Station (KWDTS), which also serves the neighbouring coastal towns of Rooi Els, Pringle Bay and Betty's Bay. The above-mentioned issues are accentuated by the stark contracts between the KWDTS and its neighbouring picturesque natural environment (Kogelberg Biosphere) and informal and formal residential communities.

It is, therefore, a case study that is adapted to become a Re[Source] centre that acts as an alchemist, who sees potential in these residual mundane spaces and materials and transforms it to become a valuable public resource. It demands re-imagination, as in true alchemic fashion. As stone can be transmuted into gold, the mundane can be transformed into the special. The proposed Re(Source) centre is envisioned to create new relationships with waste and its management, within and around the facility. Focused on urban, social, and environmental connections, a cross-programmed landscape is designed to include the flow of waste, the flow of people, and the flow of nature. The existing will be transformed and adapted through the use of three spatial strategies; openness, movement, and integration. Constantly in motion, the site will become a process in itself. As the spaces and architecture grows on a physical level, people will grow on a mental and socio-economic level.

KEY WORDS

Municipal solid waste, Waste-to-resource, Residual space, Residual materials, Integration, Movement, Transformation, Alchemy, Kleinmond, Western Cape

PROGRAM

Waste Drop-off and Transfer Station, Material Recovery Facility, Knowledge and Education Centre, Job Creation and Skills Development centre, Workshops, Public and Social Space, Reclaimed Material and Second-hand shop.

SITE

Kleinmond, Western Cape - Waste Drop-off and Transfer Station

v. GLOSSARY AND LIST OF ABBREVIATIONS

RE[SOURCE]	The name of the project Re[Source] refers to the idea of seeing value in everyday, mundane waste space and materials.
RESIDUAL	In the context of this paper, residual refers to leftover, alienated or unwanted spaces and materials.
WASTE	Waste refers to garbage, traditionally seen as useless materials from human production and consumption. It can be natural and man-made but is limited to solid waste. This paper views waste a renewable resource for years to come.
ALCHEMY	"A form of chemistry and speculative philosophy practiced in the Middle Ages concerned principally with discovering methods for transmuting baser metals into gold". The process of turning seemingly unvaluable resources into valueable resources.
SEPARATION AT SOURCE	Waste is separated at domestic homes, businesses and industries which is collected and processed at Material Recovery Stations
INTERGRATION	In the context of this paper, it is the opposite of isolation. It is a layered approach, including many processes on a mental and physical (spatial) level.
TRANSFER STATION	A transfer station is a facility for temporary deposition of certain solid wastes. Its volume is reduced and it is relocated to a facility that processes the waste further or most commonly a landfill site.
RECYCLING	It refers to the process of converting waste materials into new materials and objects.
KWDTS	Kleinmond Waste Drop-off and Transfer Station
IWMP	Integrated Waste Management Plan
MRF	Material Recovery Facility

vi. LIMITATIONS AND ASSUMPTIONS

The project's program calls for an interdisciplinary approach. Because it is related to waste management, it will require many professional such as structural and mechanical engineers, as well as waste, transport and environmental specialists. The new nature of the project will also require policy and regulation to change. For the purpose of this dissertation and design of the speculative project, focus will be kept on the architectural aspects of the design.

viii. TABLE OF CONTENTS

SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

Fig 1. A Panorama of the site, Kleinmond. (Source: Author, 2017)

1.1 DEFINING THE ISSUE

Residual Space & Materials

Waste, its management, and infrastructure is not typically associated with architecture and design, even though it plays a vital role in the shaping and planning of our cities and towns. The related residual waste spaces and materials are often marginalised and pushed to the peripheries of our cities and kept away from the broader public eye.

A problem with this practice is that people are unable to recognise the important systems that manage the waste of our cities and we fail to grasp the vast amounts of waste that we produce as a society. We have alarmingly reached our planet's bio-capacity and are constantly dumping millions of tons of waste into our landfills and oceans each year, which have massive environmental and socio-economic implications.

Furthermore, the isolated and unwelcoming 'architecture' of these public waste facilities rarely make an effort to connect to society on a spatial or social level. The solid waste programs seldom stretch beyond their core functions, and offer little or no opportunities for community and public engagement, which evidently create spatially and socially secluded environments.

Literature confirms that architecture can (and should) contribute solutions to the above-mentioned problems, and create new opportunities to transform our negative perceptions, and generate social engagement that surround these facilities (Georgoulias, et al., 2015).

It can therefore be said with confidence that the relationship between waste materials, waste infrastructure, society, and the urban and natural landscape needs critical evaluation. We should strive for a closed loop system where resources can remain within the economic cycle, rather than seeing the outcome of our consumption (waste) as a worthless product that should be excluded from our economic systems.

The objective is to use architecture to add value to these alienated industrial facilities and materials in order to promote healthier urban and natural environments, and social communities. Waste management sites should be transformed into productive cross-programmed landscapes that can connect to their surrounds by becoming an alchemist that reveals the value of these isolated spaces and materials.

"Outsiders are rarely allowed on-site. The design of the plants, which seldom involves architects, only increases this sense of alienation. Their bleak, unwelcoming architecture makes no gesture to connect with the public, visually of socially; they offer no amenities beyond their core function, no opportunities for visitors or communities to engage, and only minimal integration with their build and natural surroundings." (Villoria,Kara,Georgoulias)

1.1.1 Questions

How can residual space, infrastructure, and materials be adapted into valuable resources?

How can architecture change the public's perception and relationship with waste and its infrastructure?

How can architecture reconnect us with waste on a mental and physical level? How can architecture connect the alienated to the urban, social, and natural environments?

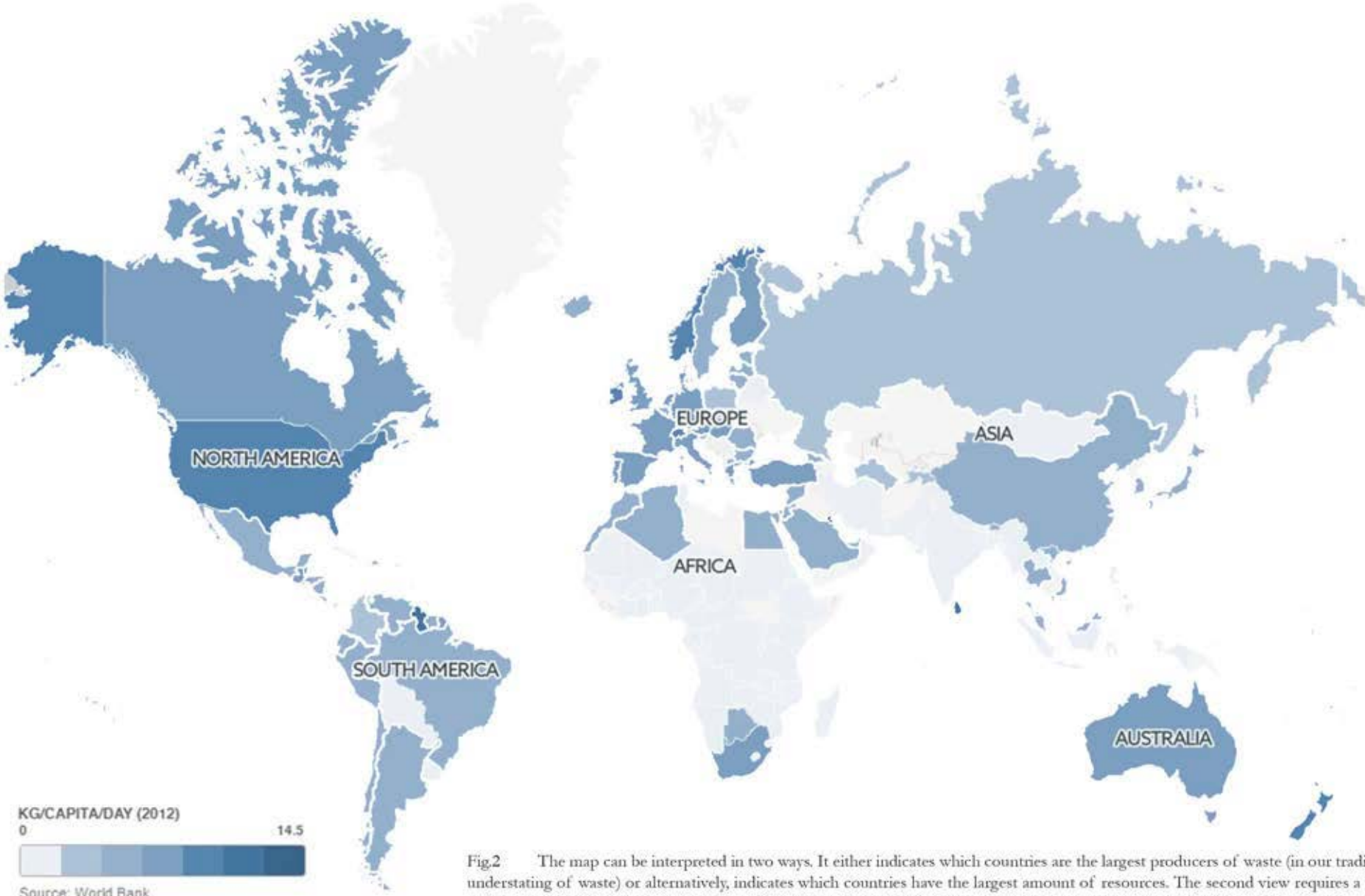


Fig.2 The map can be interpreted in two ways. It either indicates which countries are the largest producers of waste (in our traditional understating of waste) or alternatively, indicates which countries have the largest amount of resources. The second view requires a better understanding and awareness of waste production and management. Waste production should be set free from the stigma that it is filthy materials, and rather be seen as gifts from society to itself. By transforming waste and its handling from a linear to a circular system, waste production can be seen as the return on an investment and can have many economic benefits. Source: (Bahamon & Sanjines, 2008)


BEVERLY HILLS
KLEINMOND
PALMIET
Ps
Clinic
Sandown Bay
Die Preekstoel
KLEINMOND COASTAL NATURE RESERVE
ATLANTIC OCEAN
Hottentotbank
Olivierspan

1.2 MACRO CONTEXT

Landscape, Urban Social Narrative of Kleinmond

The project is located in Kleinmond, a small coastal town with a population ±10000 people. Kleinmond is located ±100 km east of Cape Town, and 33km west of Hermanus, and is part of Overstrand Municipality within the Overberg Region.

The Kleinmond settlement is situated on the narrow coastal plateau between the Kogelberg Mountain range to the north; the mostly rocky coastline to the south; the Palmiet River to the west; and the Bot River to the east. These natural elements have been the main structuring factors that have influenced the urban growth and evolution of the town. The mountains and coast also play an important role in contributing to the livelihood of Kleinmond. The UNESCO-declared Kogelberg biosphere attracts many tourists and holidaymakers, which make up 40% of Kleinmond's residents, and contribute to the economic development of the town (ODP, 2012). The Overstrand Municipality therefore places a lot of emphasis on the protection of the natural landscape.

The layout of the suburban town follows an orthogonal grid pattern, which is divided to the north and south by the R44 thoroughfare. Kleinmond, therefore, has two entrances and exits, which are anchored on the eastern end by the main beach and a business node. Surrounding towns such as Rooi Els, Pringle Bay, and Betty's Bay make use of Kleinmond as a commercial centre. The western part of the town lacks a gateway point, and this is where the Kleinmond Waste-Drop off and Transfer Station is located.

The divided urban nature of the town has been greatly influenced by the group areas act of the 1950s and has evidently created a racially, spatially, and economically divided community. Medium to high, predominantly white income residences are located to the south and northeastern side of Kleinmond. Very low to low income Protea Dorp is situated on the northwestern side of town and includes a rapid growing informal settlement on the western end of Proteadorp.

A 2002 survey revealed Protea Dorp's unemployment rate of a massive 76 %, with residents falling within the low to middle skill range (ODP, 2012). Recent protests in September 2017 highlighted the community's need for local jobs after a cleaning tender was awarded to a company from Hermanus rather than Kleinmond (Hyman, 2017). The protests also highlighted the community's need for housing when residents from Protea Dorp started to occupy the adjacent land on the slopes of the mountain. This evidently reveals the constant tension between the protection of the natural landscape and the urban development of the town. According to the Overstrand Municipality "Biosphere reserves are tasked with becoming role-models of sustainability and demonstrate the balance between people and the environment to the benefit of both" (Overstrand, n.d.).

Fig.3. Kleinmond Site Map
(Source: Author, 2017)

1.2.1 Questions

How can architecture become a role model of sustainability to benefit both people (urban development) and the natural environment?

How can architecture find common ground and attempt to bring together a divided community?

How can architecture contribute to the livelihood of a vulnerable community?

Fig.4. Collage depicting the natural everyday realities of Kleinmond (Source: Author)


KLEINMOND BRAAI &
RECREATIONAL AREA
KLEINMOND LAGOON
KLEINMOND BEACH
DUNES
BOT RIVER

1.3 MICRO CONTEXT

Site choice and location

The project site is located in the north-western side of the town at the Kleinmond Waste Drop-Off and Transfer Station (KWDTS).

The location of the site at the periphery of the town responds to the issue of residual alienated space. It also reflects how the marginalised waste infrastructure is placed next to a marginalised vulnerable community, commonly seen throughout the developing world.

The location of the site between the different natural, urban, and social realities has the ability to reveal the true transformative potential that the adaptation can provide.

The Re(Source) centre has the opportunity to become a fulcrum point where these different realities can come together. As the town is a thoroughfare and the KWDTS is at the entrance and exist and adjacent to the main road, the opportunity exists for the centre to become a gateway and novel landmark in Kleinmond; a community beacon that can be used to educate, inform, and transform perceptions.

The existing function of the Waste-Drop and Transfer Station acts as an important driver in choosing the site. As it already receives waste from the surrounding towns such as Rooi Els, Betty's Bay and Pringle Bay, a new material recovery facility is justified, which in turn becomes a valuable resource for the surrounding communities, and therefore an alchemist.

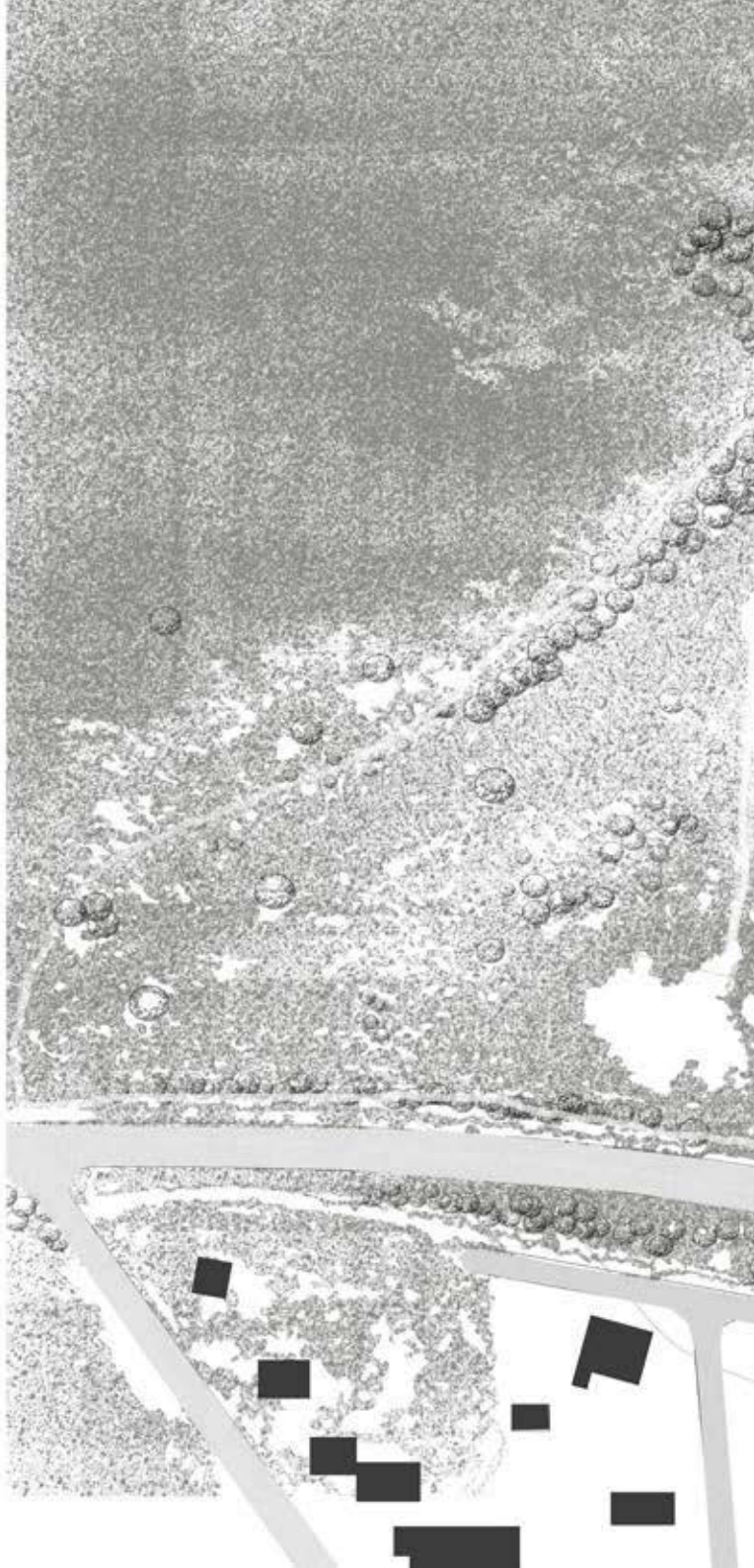


Fig.5. Immediate site context. (Source: Author, 2017)

SECTION 2

DEVELOPING A PROGRAM

2.1 OVERSTRAND WASTE NARRATIVE

In 1998, The Department of Water Affairs & Forestry (DWAF) called for all landfills to close in the Overstrand area in which Kleinmond is located. This required a regional solution, which entailed recycling at the source projects, material recovery facilities, transfer stations, and a Regional Landfill now at Karwydeskraal (IWDP, 2012).

In 2003/4 the Overstrand was the Provincial and National Winner of the Cleanest Town Competition, where they received R1 million from the Department of Environmental Affairs and Tourism (DEAT). The prize money was spent on waste management and infrastructure, cleaner environments, education and awareness, waste minimisation and recycling, publicity, and 'Operasie Mooimaak' (Operation beautification) where funds were used to upgrade public places.

In this process, more than 2000 people were employed. The Overstrand also accepted the nomination to be included in the Western-Cape Youth Jobs in Waste, which employed 12 students and 17 general workers, funded by the Department of Environmental Affairs.

The cleanest town competition is a wonderful opportunity to obtain funds and utilise these for the implementation of a new program at the adapted KWDTS. Zooming into Kleinmond, funds from the cleanest town competition were used to rehabilitate its old landfill into a soccer astroturf and sports facility, located to the north of KWDTS. (Integrated Waste Management plan of 2012.)

The appropriation of waste materials is evident throughout Kleinmond, where small entrepreneurs make products from recycled and reclaimed timber, tyres, geysers, paper and card. This reveals the innovative tactics of the residents of Kleinmond to make a living from reusing and upcycling waste. Most of these entrepreneurs employ a small number of residents from Protea Dorp, and therefore indicate their commitment to support the livelihood of the community. The appropriation of waste is also evident throughout Protea Dorp, where individuals reuse materials to alter and add to their individual dwellings. The second-hand goods market is also very popular in the town, and people from all over Kleinmond queue for hours to enter the popular charity shop, KAWS, which sells donated 'bric-a-brac'.

It is evident that the Overstrand has a strong commitment to waste minimisation, through the implementation of these waste strategies. Alongside this, jobs are created, skills are developed, people are educated, and awareness is raised. Kleinmond is therefore a perfect site to implement the programs of a material recovery facility, composting station, knowledge centre, workshops, second hand shops, and a space where a community can gather.

The Hermanus Material Recovery Facility was established in 2009, and now manages recyclables from the entire Overstrand region. It includes a buy-back where waste pickers from surrounding townships sort kitchen waste and sell it back to the Walkerbay Recycling company. They have also implemented a Swop-Shop that encourages children to swop waste for a rewards such as school supplies. These innovative programs will be implemented at the Re(source) centre, involving the ability to sustain the livelihood of the Protea Dorp community.

RECYCLING AT THE SOURCE PROJECT

Kleinmond have started an initiative where they encourage residence to sort waste in to recyclable and non recyclable waste

CLEANEST TOWN COMPETITION

Overstand won this competition on 2003/2004, 2009/2010 and 2010/2011 and received millions of rands sponsored by the department of Environmental Affairs

DEA YOUTH JOBS IN WASTE

Overstrand accepted the nomination to be included in the western cape – youth in jobs in waste project funded by the department of Environmental Affairs. Capacity of landfill site admin, waste collectors admin, and environmental awareness campaigns for 12 months. Included 12 student workers and 17 general workers

SWOP SHOP - REWARD FOR EFFORT

This initiative is working at the moment in Hermanus and creates awareness ,empowers children , life skill training , reduces waste to the landfill

SUPPORTING RECYCLED GOODS MARKET

Overstrand Municipality bought street litter bins produced by recycled plastic, thereby supporting recycled good market

JOB CREATION

REDUCE LANDFILLING

SKILLS DEVELOPMENT

EDUCTION

AWARENESS

PUBLIC PARTICIPATION

Fig.6. Visual timeline of waste minimization strategies within the Overstrand and surrounding waste facilities (Source: Author, 2017)

PROTEA DORP
Local residents reuse materials in their everyday homes

MTHIMKHULU WORKSHOP
Local entrepreneur make wooden furniture etc. from reclaimed wood whilst training and employing people from the community

PAMPIRI
Entrepreneur training women to make gifts bags and wrapping from recycled paper

KAWS
A very poular charity shop selling donated clothes, books, furniture, and homeware

MARKET SPACE
people selling everyday stuff from their homes, fresh fruit & veg, recycled timber furniure and braai bins.

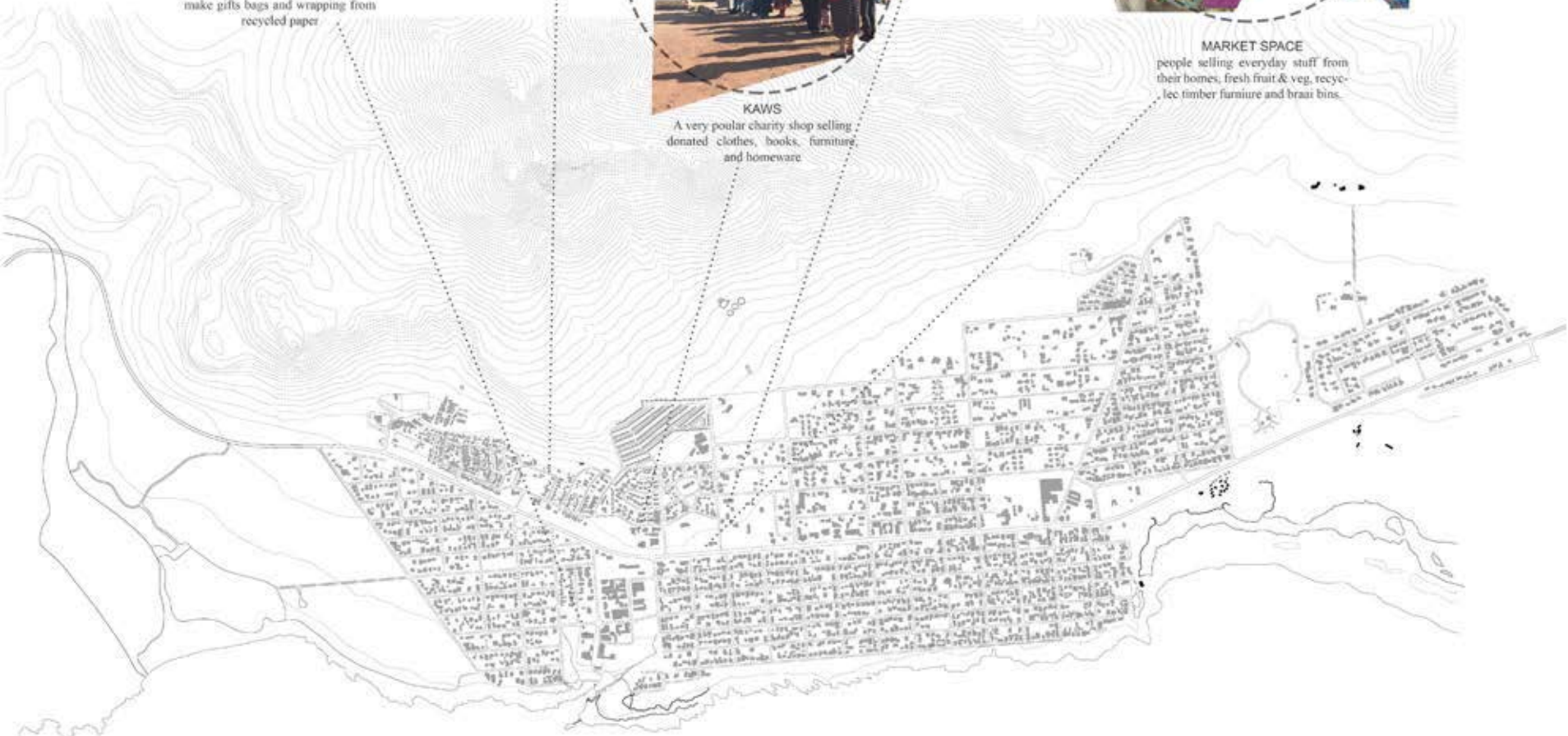


Fig.7. The appropriation of waste materials and the innovation of the community within the Kleinmond context. (Source: Author, 2017)

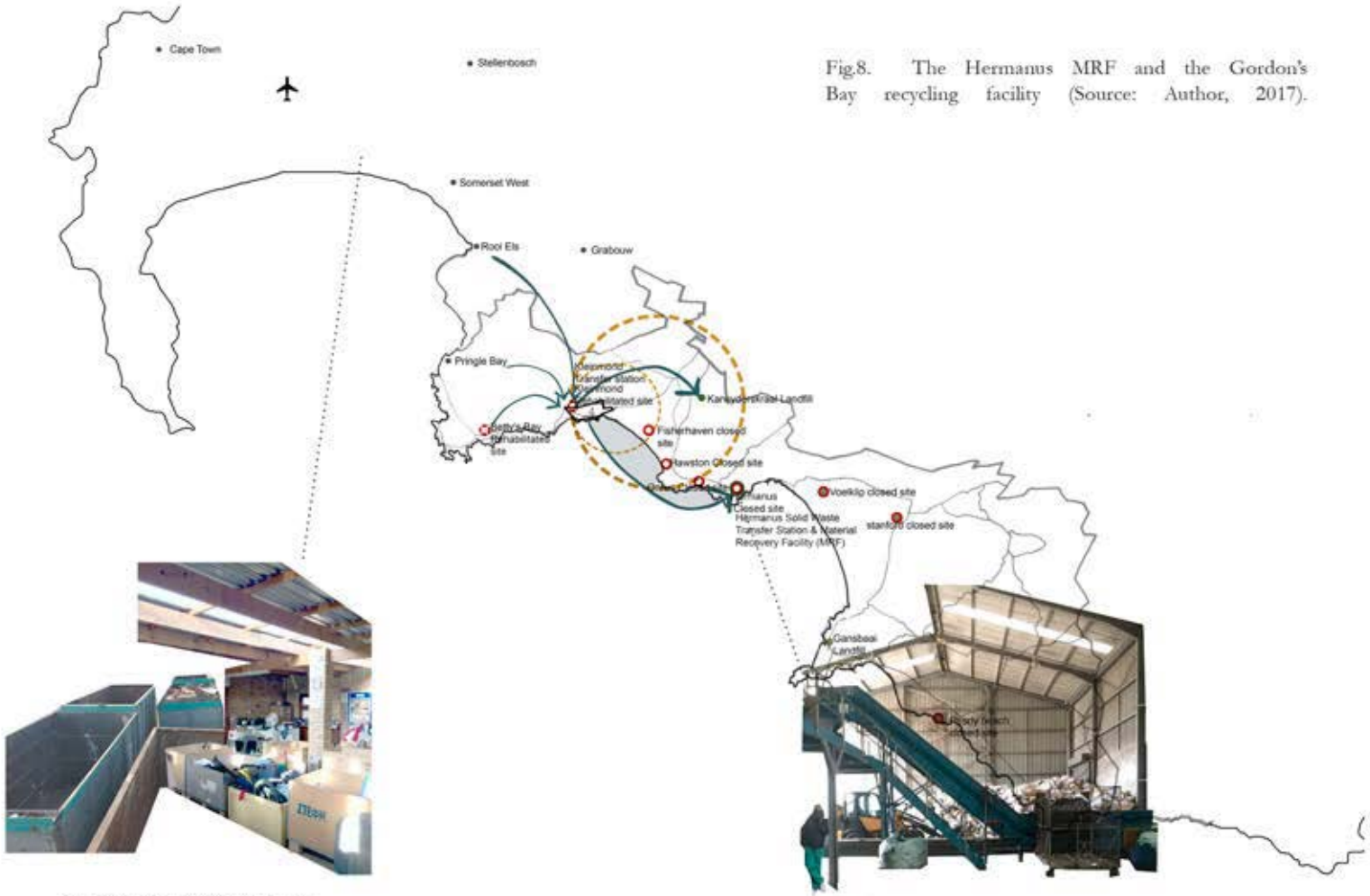


Fig.8. The Hermanus MRF and the Gordon's Bay recycling facility (Source: Author, 2017).

The well-known waste hierarchy, where waste avoidance is the most desirable option and disposal the least desirable. Waste avoidance is a proactive approach at the "beginning of the pipe" to avoid the generation of domestic and industrial waste. The end goal of implementing waste avoidance is a long and difficult process and relies on the awareness and education of people to minimise/cut out waste production. The Re[Source] centre places huge emphasis on awareness and education by making waste processes visible to the public as well as using waste as a building material. The long term plan for the Re[Source] centre is to fully implement a closed loop system. There are two processes of minimising waste in an effort to reach the ultimate goal of Zero-waste presented by the Overstrand Integrated Waste Management Plan of 2012:

1. Separation at the source (Homes/ Business/ Industries)

This process has slowly been implemented in the Overstrand. It starts with the individual, which requires education and awareness. It is therefore important for the re(source) centre to invite the public to participate, facilitated by architecture. Designing a space that is inviting and open can enable the public to learn about their waste production and the utilisation of the new valuable resources.

2. Recovery and recycling for post-collected waste & composing of post collected garden waste.

These are two of the major waste processes that will take place at the Re[Source] centre. A recovery facility to process recycled kitchen waste as well as building rubble, and a composting and biogas function. With regards to the former, it will have two branches leading off from this process in an attempt to reuse the valuable resources. It will either be sorted and collected by recycling companies where it will be processed off site to become new products such as composite plastic decking, furniture etc.

The second stream will utilise the waste in the immediate context of Kleinmond and its nearby surroundings. Recycled and recovered waste can either be used as building materials in the facility or sold and used around the facility by individuals or companies.

The Re[Source] centre will attempt to train people in using waste as a building material, and to develop new systems as an ongoing process, revealed in the architecture itself. After extensive interviews with the councillors of Kleinmond (Fanie Krige and Gran Cohen) as well as residents from Protea Dorp, it was clear that the provision of jobs is a pressing issue.

The Re[Source] centre will address this issue by becoming job creation and skills development facility in its new functions and in the way that it is constructed. Waste materials can also be used by the community of Kleinmond to design new creative products in the workshops located on site. Not only does this encourage creativity and contribute to the ongoing research in using waste as a resource, but it also contributes to the economic, intellectual, and spiritual livelihood of the community.

The residents and councillors enthusiastically supported the idea of artisans making products from waste in workshops, and selling these at the markets and small affordable rentable shops that are provided on site. Tourists making up 40% of the town population are potential buyers and the architecture of the Re[Source] centre attempts to draw in these clients.

As constant development takes place, individuals will have the ability to extend and develop their businesses, and architecture will grow along with it.

Table 1 indicates the average amount of available recoverable materials in the Overstrand waste stream. In conjunction with this this table, one can read Table 2 which indicates that only 10% of the available materials are actually recovered at the Hermanus and Gansbaai Materials Recovery facility which is only 4% of the waste stream.

According to the IWMP, this is a result of lack of awareness and education about waste. This is a programmatic and architectural opportunity that will be addressed in the dissertation.

It is clearly evident that there are vast amounts of waste that are not recovered, and again this highlights the relevance of providing a recovery facility at the existing KWDTS. However, I believe that it is not

only a waste issue but also a spatial, urban, and socio- economic issue. Awareness should be raised, communities should benefit from this system and marginalised spaces should be reconnected with our urban and natural environment by transforming valuable wasted physical and spatial resources.

Main Town	Sub-area	Participating Waste (t/a)	PAPER/ CARD (t/a)	PLASTIC (t/a)	GLASS (t/a)	METAL (t/a)
Kleinmond	-	3565.22	149.74	27.81	94.12	14.26
Kleinmond	Protea Dorp	4.56	0.19	0.04	0.12	0.02
Betty's Bay	-	204.85	8.60	1.60	5.41	0.82
Betty's Bay	Klipkop	58.10	2.44	0.45	1.53	0.23
Betty's Bay	Sunny Seas Estates	92.82	3.86	0.72	2.42	0.37
Pringle Bay	-	534.16	22.43	4.17	14.10	2.14
Rooi Els	-	51.46	2.16	0.40	1.36	0.21
TOTAL		**4511.17**	**188.78**	**35.19**	**119.06**	**18.32**
Hermanus	Hermanus, Mount Pleasant, Voelklip & Zwelihle	6480.16	238.97	44.38	150.21	22.75
Gansbaai	Gansbaai, Blompark, Die Kelders, Groenewaldskema, Perlemoenbaai	2030.62	85.28	15.84	53.61	8.12
TOTAL Overstrand area	Entire Region	**22980.18**	**965.17**	**179.25**	**606.68**	**91.92**

Table 1: Average amount of available material in the Overstrand waste stream. (IWMP, 2012)

Recovery Activity	PAPER/CARD (t/a)	PLASTICS (t/a)	GLASS (t/a)	METAL (t/a)
Gansbaai MRF	23.41	12.45	12.97	26.88
Hermanus MRF	573.55	158.43	421.51	88.71
Walker Bay Recycling	226.48	199.68	47.36	952.39
TOTALS	**823.44**	**370.55**	**481.84**	**1067.98**

Table 2: Table 2: Materials actually recovered at the Hermanus and Gansbaai MRFs. (IWMP, 2012)v

Fig.9. The Hermanus MRF recycling sorting conveyor belt located on the mezzanine level within a shed (Source: Author, 2017).

F ig .10. Cardboard baling process at the Hermanus MRF (Source: Author, 2017).

Fig, 11. Shoots from recycling conveyor belt at the Hermanus MRF (Source: Author, 2017).


AKU

2.2 WASTE: A HUMAN CONSTRUCT

Emphasis on urbanisation, industrialisation, mass production, and the consumerist culture are all man-made systems that have massive destructive environmental impacts. Our natural resources are in a state of depletion, and in 2000, the earth reached 1.2 times its biocapacity, with the construction industry being one of the biggest culprits (Bahamon & Sanjines, 2008).

Not only are we exhausting out natural resources, but we are also producing millions of tons of waste each year. These end up on our landfills and buried underground for centuries to come, kept 'out of sight, out of mind'.

Landfilling waste is a problematic and unsustainable system, as it releases toxins from waste into our soils and ground water, becoming an environmental hazard. The landfilling of organic waste material remains a problem as methane, a greenhouse gas, is released in to the air, which is 25 times more powerful than carbon dioxide.

This contributes hugely to global climate change issue. Landfills also change the natural habitats of our species and have a negative impact on our biodiversity for generations to come. In nature, the concept of waste does not exist, and the processes and organisms that break products down, form nutrients to support the next cycle of production.

'Waste' is valuable and therefore ensures stability and sustainability in natural systems. Man-made systems of waste production and disposal on the other hand, remain in a system where valuable matter and energy is lost forever. This creates massive financial implications and places huge strain on our governments.

In 2016, 1.8 trillion kilograms of waste was generated in the world and will amount to costing more than R494 trillion by 2025 (infrastructurene.ws). According to a report by the World Bank, South Africa produces 108 million tonnes of waste every year, which is the 15th highest rate in the world (infrastructurene.ws). The shocking figure means that each South African produces 25 tonnes of waste in their lifetime (Daily Maverick, Jan 2017)

According to Bahamon (2008), the solution is not to blame and undermine the technological progress that we have made in the past century with reference to industrialisation and the advancement of technology. Rather, we should gain an understanding and awareness of what we produce through our functioning.

We have to try to prevent dead landfill waste through the use of more appropriate systems of placing the waste back into a living and closed loop system that fits into the circular economy. This is not an immediate change and shift, but a process towards the zero-waste life.

The Re[Source] centre will respond to this notion, becoming a phased development with the end goal in mind, to ultimately have no landfill waste. This also means that the spatial reality of waste centres must change, as it will require a more holistic approach to waste management that benefits all levels of social, economic, environmental, urban realities.

2.3 THE LINEAR AND THE CIRCULAR ECONOMY

The Linear economy has been the widespread model for managing waste and uses the "take, make, dispose" approach. It sees the outcome of our consumption (waste) as a worthless product that should be excluded from our economic system, as it does not fall into the natural resource or desired product category.

This is the system that the world has been following for many years. We need a shift in our thinking, perceptions, and spatial realities.

The circular economy is based on a closed loop system where waste materials are reused, recycled, reclaimed, and regenerated to remain within the flow of the system rather than being discarded. It sees waste as a renewable resource and focuses on environmental, social, and economic sustainability: environmental as it reduces pollution and waste; social as it can create low to high skilled jobs through the recovery of waste; and economic as it can create an economic return.

Although South Africa only recycles about 10% of waste it produces, it (recycling) pushes about R8.2-billion worth of resources back into the South African economy every year (V.d. Merwe, 2017). It also has a spatial responsibility to incorporate waste management structures back into our urban environments. Secluded and alienated waste spaces enforce the idea of the linear economy, where waste is kept 'out of sight, out of mind'.

The materials and spaces should be seen as valuable resources for the present and future generations.

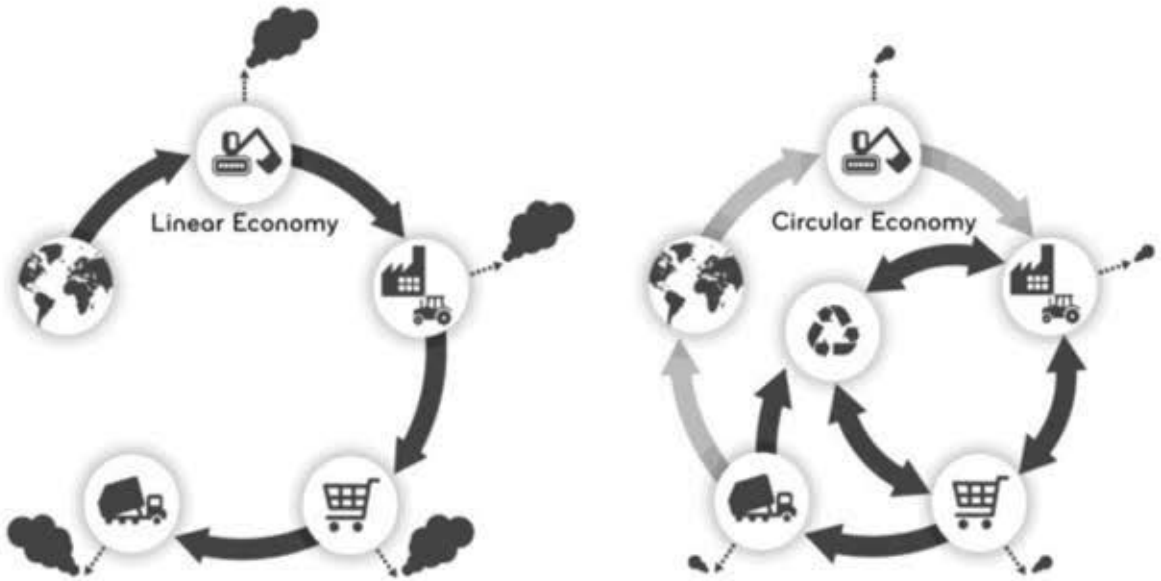


Fig.12 Lefthand diagram indicates the process of the linear economy which sees waste as worthless products to be disposed of while the righthand diagram indicating the process of the Circular economy which sees waste as a resource that can contribute to environmental, social and economic sustainability.

2.4 CHANGING OUR PERCEPTIONS

We relate to waste through our emotions, feelings, and senses. In many cases, these are negative reactions making it hard to think of waste materials and its infrastructure as valuable resources.

Nevertheless, this dissertation seeks to overcome the negative perceptions of waste and to view it as a renewable resource for years to come.

Kevin Lynch in his book Wasting Away talks about our relationship with waste from a poetic and philosophical point of view. Lynch says that the management of waste should become part of our every life and we should remember that waste is necessary for life and forms part of the natural process of deterioration.

Changing our conceptions about waste can open up great possibilities for using this valuable resource. (Bahamon & Sanjines, 2008). This is exactly what this dissertation seeks to implement.

I believe that architecture can facilitate this change by making the process visible to the broader community where everyday waste and residual space is reimagined as a valuable public resource.

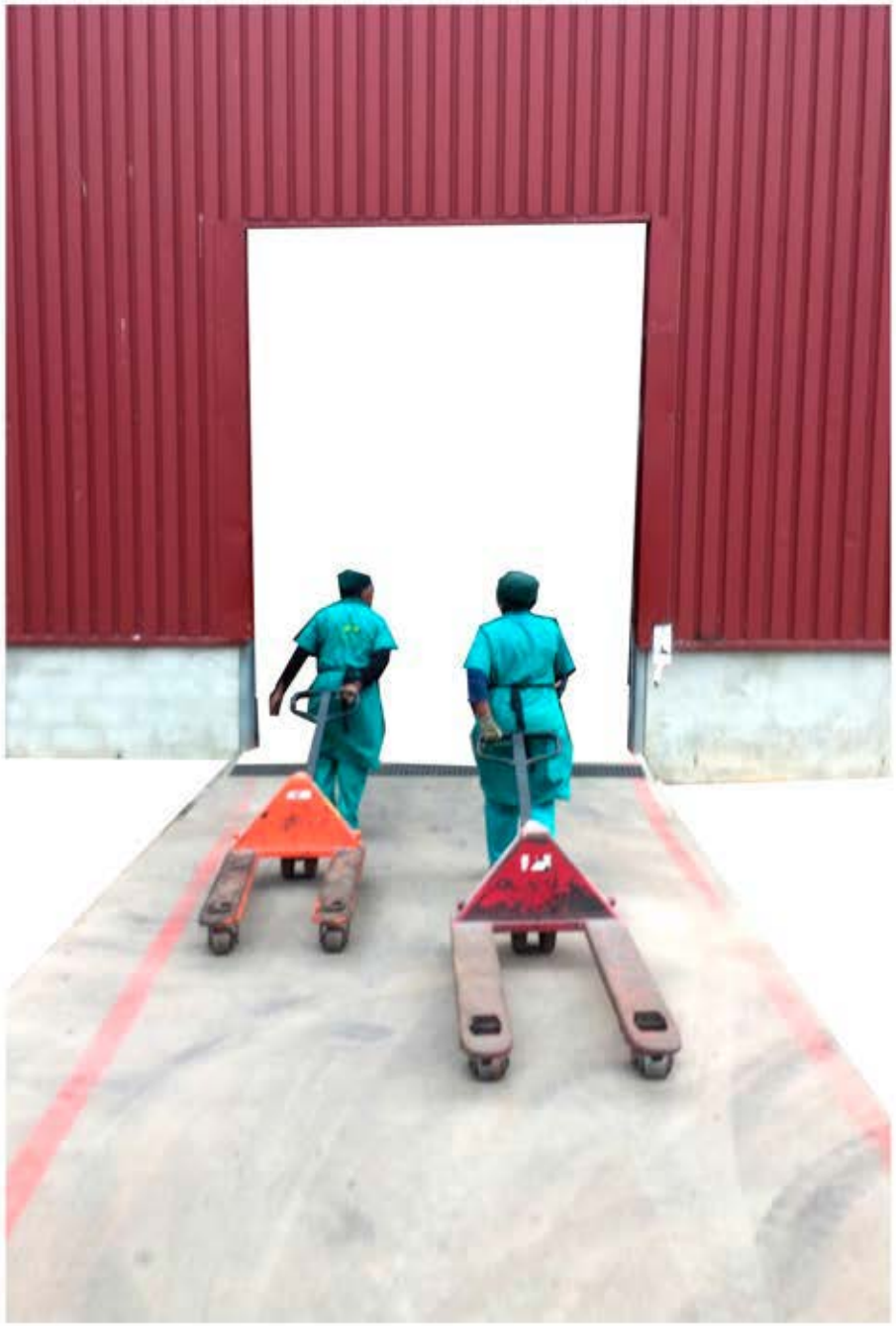


Fig.13. Female workers at the Hermanus MRF (Source: Author, 2017).

2.5 URBAN MINING

Urban mining can be defined as the extraction (mining) of valuable resources from our urban environments and landfills rather than mining our earth for natural resources. It is claimed that today there is more copper found in buildings than in our natural environment, which proposes that our buildings become the new mines (Hebel, et al., 2014).

The process of urban mining works as follows: waste is sorted, collected, transported, and stored, which will then be transformed through recycling or prepared for re-use/waste to energy technology (Van der Merwe, 2017). Although some say that urban mining is a new idea (Hebel, et al., 2014), it is actually is a system that is evident throughout history.

It was the norm up until the 19th century, forming a very important part of society. In areas such as Greece, Rome and Egypt, stone was reused from buildings that were abandoned or affected by earthquakes and wars. This required a lot less energy than extracting new stone from distant quarries. Steel from Roman buildings was reused by the construction industry and weapon manufacturers, and cathedrals in medieval times reused foundations and stones from old churches.

Globally, more emphasis is being placed on urban mining and its potential is being recognised. The UK Green Building Council recently recorded a building refurbishment using 98% recycled materials from urban mining and it has produced the lowest carbon footprint of any building renovation (Balch, 2016).

According to a study by UCT researchers, urban mining has the ability to transform South Africa's green economy, GDP, and create jobs where it is most necessary (Van der Merwe, 2017). "Through economy-wide effects, an increase in the share of recycled products by 18% has the potential to increase real GDP by 0.1% and employ an additional 4,000 workers. If the target of 100% of all waste recovered and recycled were achieved, real GDP could increase by 0.5% and an additional 13,661 jobs could be created" (Van der Merwe, 2017).

It is evident that waste minimisation becomes a massive responsibility of the built environment. Architecture should respond to this notion by using processes of urban mining to reimagine how and what materials we use for construction and what spaces we are able to construct. It is our responsibility as architects to be the trendsetters for these systems, as it is us that constructs the examples for the world to see.

We have the ability to bring together the challenges of materiality and space. Our work is a prototype for generations to come. We should be contributing to the conversation through trial and error, rather than stagnating and throwing a blind eye to our global waste issues and the impact that they have on our spatial, social, economic, and natural environments.

Fig.14 A male worker chipping glass at the Hermanus MRF (Source: Author, 2017).

SECTION 3

THEORETICAL EXPLORATION

Fig.15 Model built in the Adapt! Studio. The linearity of the individual strips creates a holistic rhythm, which represents the rhythms of The Everyday. These rhythms can become a tool to understand everyday life which forms part of the public tapestry of our urban environments. The undulating lines create a dynamic public landscape where spatial moments are formed under, over, and around the expressed strips. Some of these moments are emphasised by means of waste surfaces, generating a point of interaction between space, waste, and the user. The strips show individual structures and programs, but where they are lifted, programs and spaces have the ability to cross over and create a hybrid typology (Source: Author, 2017).

3.1 THE EVERYDAY:

Rhythmanalysis, Strategies and Tactics

This dissertation draws from a personal interest in the everyday, mundane structures that contain vital processes for the functioning of our cities such as waste infrastructure. Using architecture to reveal the value in mundane residual space and materials is the intention of this dissertation. Philosophers such as Henri Lefebvre and Michael de Certeau, theorised the concept that the everyday has the potential to reveal the extraordinary in the ordinary (Coleman, 2015).

Everyday life, although sometimes seen as the repetitive, banal, and trivial part of our human activity, is also the core of our self-realization, creativity, and spontaneity, exhaling the lived experience of the everyday. Even though the concept of the everyday seems extremely basic and extremely complex at the same time, it holds the ability to act as a facilitator for change (Schilling, 2003).

For Henri Lefebvre, the everyday is not static, but part of the active life of the cities. He therefore claims that its space and time should be understood through its rhythms and pace (Harris & Berke, 1997). He provides a method of recording the rhythms through "Rhythmanalysis" that locates the body in three categories of time, namely the cyclical, linear, and festival.

The cyclical refers to cycles of natural and social time such as the change of seasons, day and night, and even desire and fulfilment that supports the need for creativity. The linear refers to repetition in our daily lives, for example, the notion of consumption or production. The festival refers to brief exceptional moments such as death, celebration, and riots.

For Lefebvre, these festival moments and small breaks from the everyday are necessary to provide a glimpse of what revolutionary transformation can look like. Lefebvre compared everyday life to fertile soil, which can easily provide the nourishment for creative moments to blossom. The 'soil' of the city has the potential to display and become the ideas, innovation, and transformation of future (Papanicolaou, 2015).

The project uses Rhythmanalysis to record the existing linear flows of waste at the existing KWTDS, and used it to inform the new cyclical flows of waste and people around the site. The productive and systemic nature of the program is, therefore, both cyclical and linear.

The facility will operate at different day/night/ weekends times, accommodating employees and the public at both times. The design of the facility is also aimed to respond to the change of seasons in a passive and sustainable manner. The linear mode of repetition will be evident in its intended job creation and skills development program, which entails people working at the facility on an everyday basis.

Having said that, the program of waste recovery and utilisation is imagined to be a fully cyclical and closed loop process in the future. An interesting relationship exists here as both modes of repetition will be at the core of the programmatic functioning of this facility.

The Re[Source] centre will respond to Lefebvre's concept of the festival. Although the festival cannot be forced, I believe that spaces for public gathering can allow for different communities to congregate and convene one space and possibly allude to the festival to take place.

This is especially important to comment of the issue of the divided community of Kleinmond. As idealistic as Lefebvre's concept of the festival is, so is the idea that the broken community of Kleinmond can be healed spiritually through the social space that allows the festival and break from the everyday.

Michel De Certeau believed that the festival happens within and during everyday life, rather than specific moments that completely break away from it (Certeau, 1984). De Certeau recognised the potential in how people appropriated product in everyday life. The appropriation becomes a resistant action/

non-action and therefore a secondary production of the product/space by a non-passive user.

De Certeau embarked to understand the actions of use and appropriation of products and spaces, which he defined as 'strategy' and 'tactics'. Strategy functions within rules and regulations usually by governing bodies such as the state or an institution. It finds itself in specific locations, with borders, time, and ownership. Strategy's information is ordered to a specific logic, uses evidence, and hides contradictions.

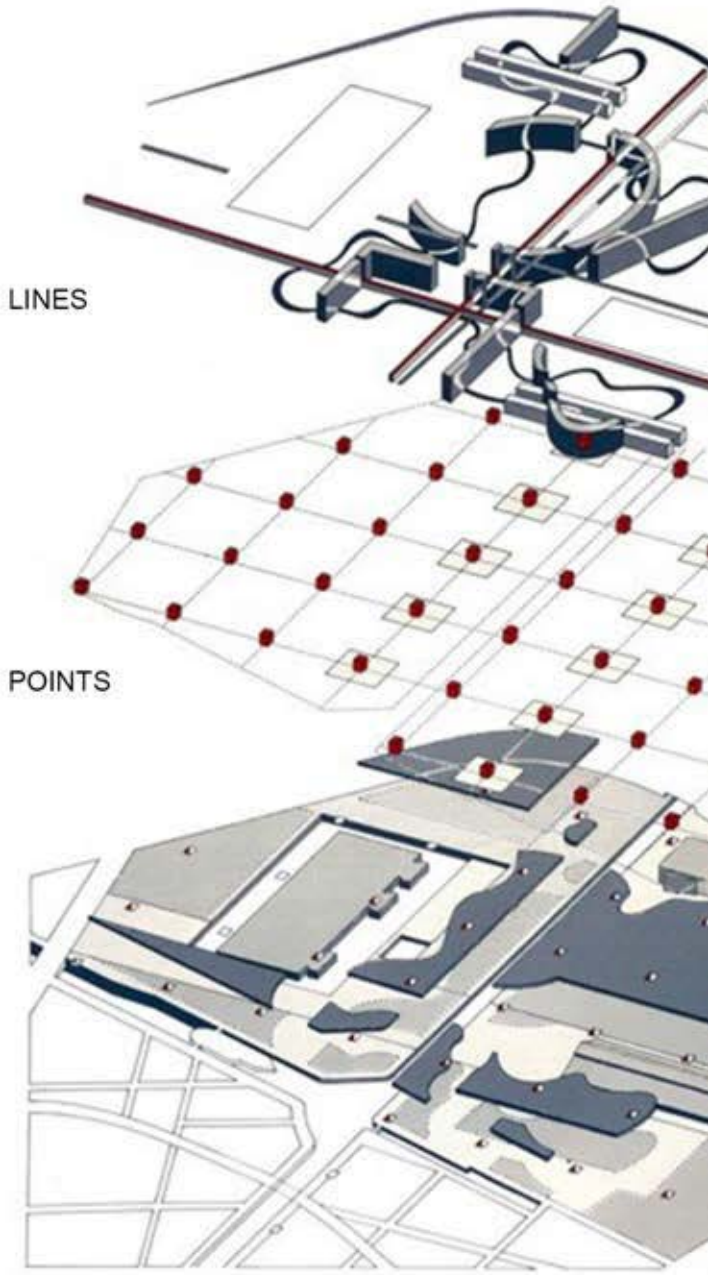
In spatial terms, it is the obvious physical place. Tactics, on the other hand, are mobile, 'in the moment', and therefore not obvious. They use opportunities within strategic locations in a creative way and leave traces that needs surfacing.

Appropriation requires participation and therefore needs tactics to make architecture strongly focused on public engagement. The aim is to guide and stimulate new forms of interaction, development, and output through the design and modification of strategic and tactical systems. It should have the ability to motivate creativity and expression through participating towards a common goal.

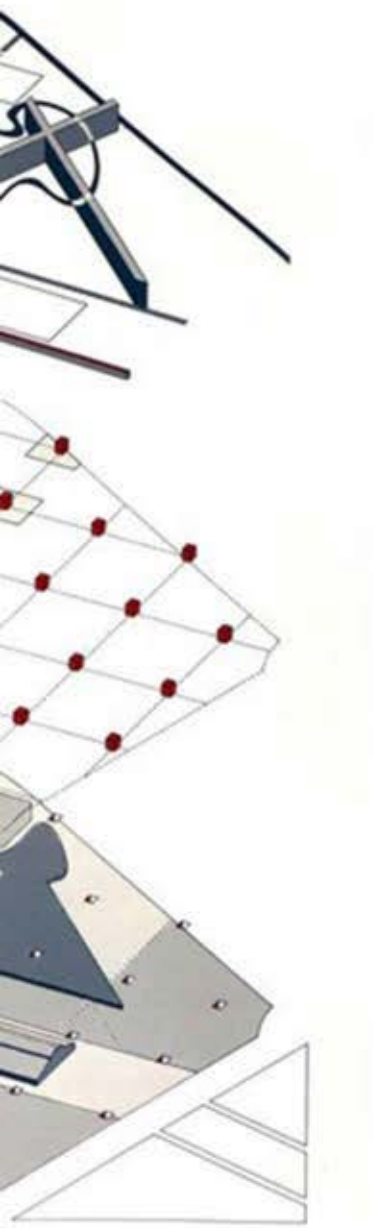
The Re[Source] centre as an alchemist finds value in everyday materials and space and allows it to be appropriated. An example is the appropriation of conventional plastic PET bottles to become a building material. The Re[Source] centre as an alchemists also values the existing waste site and adapts and transforms it to become a multifunctional landscape that can be appropriated by the users.

The Re[Source] centre will allow the architecture to grow through appropriation and will therefore be a process rather than just a finished built form. The tactical appropriation will become the special/festival. The participants have the opportunity to engage with each other during creative processes of design and construction, which in turn become the event. The goal is to shift the power to the community by using limited resources in residual but controlled areas and to build public, shared and ultimately their own spaces.

I hope that these strategies and tactics will be able to influence long-term planning and encourage unforeseen tactical innovations to grow. The everyday is the fertile soil of our daily lives that can provide nourishment for spatial and social development and transformation.



3.2 CROSS-PROGRAMMING



The adaptation of the KWDTS into a Re[Source] centre calls for a conceptual and practical design approach that can allow for multiple programs to co-exist. Bernard Tschumi reconceptualised the boundaries of program to incorporate numerous arrangements of space as well as the simultaneous inclusion of more than one program within form and space namely cross-programming (Lawrence & Schafer, 2006).

Tschumi saw his programmatic theory manifest in practice. The design of Parc de La Villette is a great example of how an architect adapted the old program and landscape to become a new cultural precinct. Tschumi did not design a conventional park but rather superimposed and juxtaposed various layers, to create a cross-programmed landscape.

Bernard Tschumi established the argument that there can be no architecture without space and event (Tschumi, 1994). Tschumi emphasises the importance of the experience of the body in space, and how architecture can be designed through our senses and the desire to explore (Aksu & Turhan, 2015).

Space is therefore seen as the surrounds in which the body moves, and the event as the action of the body in space (Tschumi, 1994).

Fig.16 Tschumi's organisational systems for Parc de La Villette including points, lines, and surface which are superimposed to create new relationships and experiences between space, waste, and the user. The strips show individual structures and programs, but where they are lifted, programs and spaces have the ability to cross over and create a hybrid typology (Source: https://www.archdaily.com/92321/ad-classics-parc-de-la-villette-bernard-tschumi. Accessed: 4 November 2017).

Architecture becomes a tool to direct movement and experience, and create a dialogue between the events and the spaces. Tschumi's approach to the design of Parc de La Villette focused on the idea of the park becoming a cultural landscape, driven by human interaction and interpretation by encouraging exploration as a method of constantly reconfiguring the park.

Tschumi's design of Parc de La Villette incorporates three organisational systems that are superimposed to create new relationships and experiences. These three systems include Points, Lines and Surfaces which are located amongst the existing functions in the park.

The Alchemist will also use a series of systems which includes points/nodes, lines/movement routes, and a surface that are superimposed to create a cross-programmed landscape.

Points/ Follies:
The points contain a series of small installations or follies that facilitate different cultural activities and experiences such as kiosks and viewing platforms. Structures across the park allow for exploration and movement whilst acting as a point of reference to enable a sense of direction.

Lines:
Tschumi created a series of demarcated paths across the park, which unlike the grid-point systems, do not follow a rigid organisational structure. They intersect and lead to different nodes in the park and its surrounds, creating a visitor experience.

Surface:
Space was devoted to become areas where visitors can have a variety of free experiences, either as individuals or in a group, which will then become a space of event.

What is useful from Tschumi's work is his emphasis on people's experience/movement as the event/ program which is an important part of the Re[Source] centre. In the Re[Source] centre a series of points are connected with ramps and walkways, which gives a sense of direction, without being dictatorial.

The lines (ramps and walkways) allow the precinct to be experienced as a whole through the movement of the body. The paths and movement routes are also an important method of connecting the series of interventions and allows one to experience the surface as a whole.

Through the movement and appropriation of these three arrangments, an activated and cross-programmed precinct can exist. The superimpositions and juxtaposition of the various waste, social and natural layers in the Re[Source] centre allows a whole precinct to be cross-programmed as well as individual units to be cross-programmed.

It is therefore a series of interventions and layers that make up a whole.
In an environment of radical urban growth and limited space for development, it is necessary to think about the concept of cross-programming in practical terms in both new and existing buildings and landscapes. For me, it is a relevant concept in the adaptation of existing buildings/landscapes to accommodate more than just their intended purpose. It allows people to engage with a programme and precinct rather than an isolated unit. It has the opportunity to allow human activity to appropriate space.

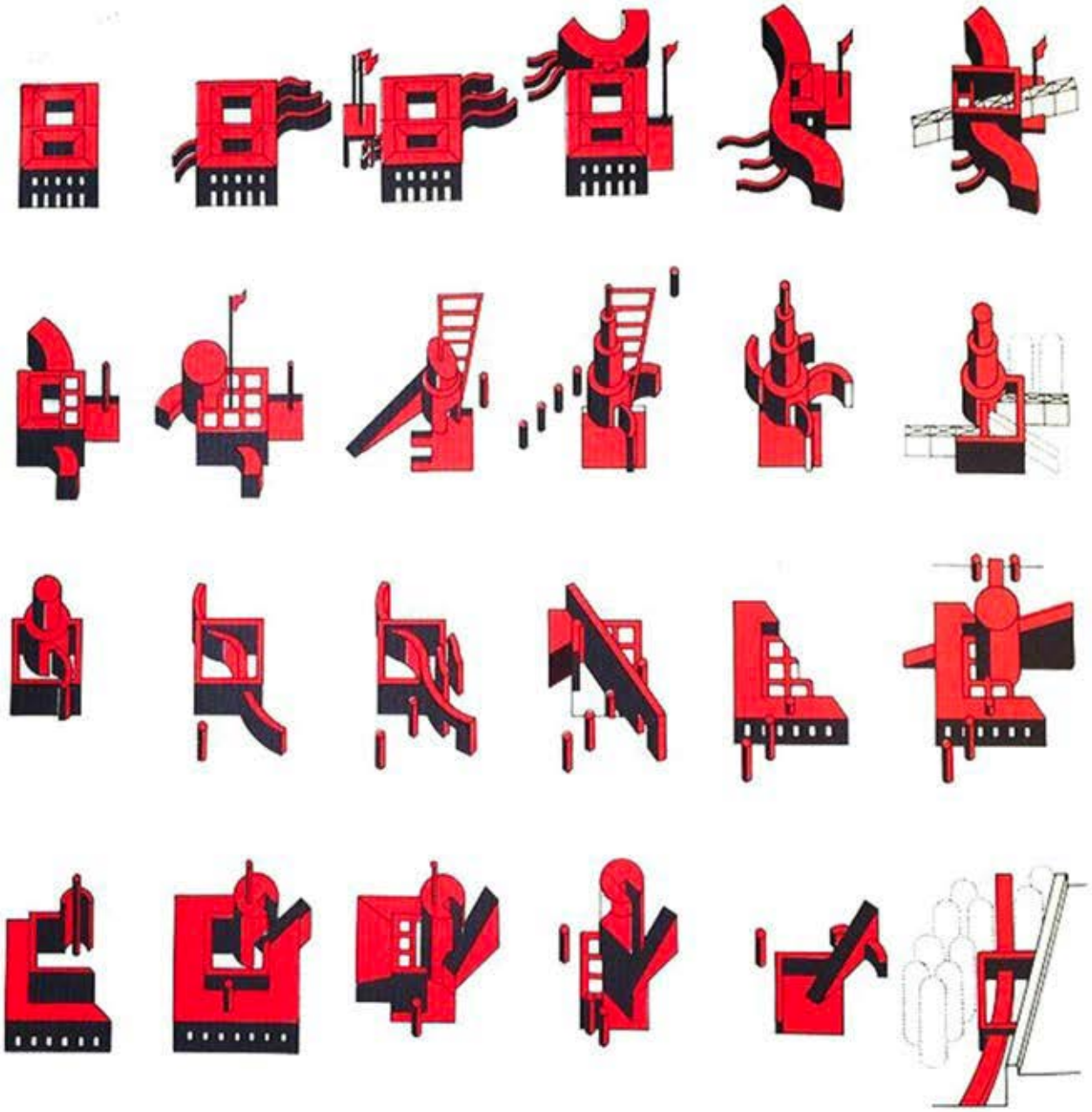


Fig.17 Eight of Tschumi's 35 Red steel follies in Parc de La Villette (Source: http://lifesansbldgs.tumblr.com/post/76484845056/bernard-tschumi-parc-de-la-villette-1987. Accessed: 4 November 2017).

SECTION 4

CONTEXTUAL ANALYSIS

4.1 SITE LOCATION AND ZONING

The project site is located in the north-western side of the town at the Kleinmond Waste Drop-Off and Transfer Station (KWDTS). As the town is a thoroughfare and the KWDTS is at the entrance and exist and adjacent to the main road, the opportunity exists for the centre to become a gateway and novel landmark in Kleinmond; a community beacon that can be used to educate, inform, and transform perceptions.

The KWDTS site is zoned as Open Space Zone 1: Environmental Conservation (OS1). The OS1 zone provides for the conservation of environmental resources, although cultural heritage resources may also be included. Provision is made for limited, low-impact uses associated with conservation, such as environmental education, associated infrastructure, and facilities for tourists and visitors with the approval of Council.

The following use restrictions apply to property in this zone:
(a) Primary uses are environmental conservation use.
(b) Consent uses are harvesting of natural resources, environmental facilities, tourist accommodation, tourist facilities, utility service, rooftop base telecommunication station, freestanding base telecommunication station, wind turbine infrastructure and cultural and social ceremonies. 'Cultural and Social ceremonies' means the practice of cultural and social ceremonies by any person belonging to a cultural, religious or linguistic community, provided that such ceremonies are lawful.

The adjacent area next to KWDTS is zoned as Open Space Zone 3: Special Open Space (OS3) The OS3 zone provides for active or passive recreation and open spaces on land that is not designated as public open space. This land may be owned by private or public bodies, but does not have the status of public open space which requires particular protection. The OS3 zone is appropriate for relatively large areas where open space has special characteristics that require a separate zone to ensure that the purpose and function of the open space is maintained.

The following use restrictions apply to property in this zone:
(a) Primary uses are open space, private road and environmental conservation use.
(b) Consent uses are environmental facilities, tourist facilities, place of instruction, place of assembly, place of entertainment, plant nursery, utility service, cemetery, rooftop base telecommunication station, freestanding base telecommunication station, wind turbine infrastructure, cultural and social ceremonies, urban agriculture, informal trading and harvesting of natural resources.

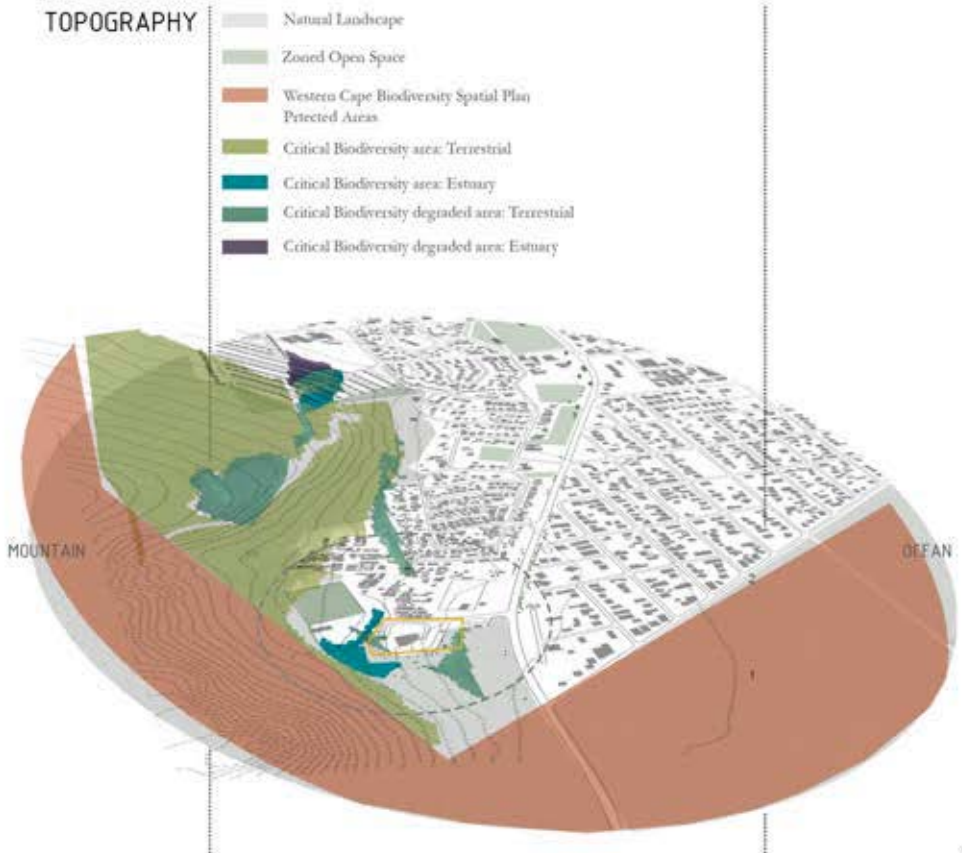
The program of the Re[Source] centre will apply for consent use, arguing that it will harvest waste resources, encouraging sustainable building development that protects the natural environment. It will be an environmental facility with an educational component; a tourists attraction as the site is located 'on' the mountain and at the gateway of the town; contain urban agriculture; and will be able to accommodate social and cultural ceremonies.

This comes back to the relevance of the program to the site, emphasising the protection of our natural, social, and economic resources. (Information from City of Cape Town Zoning Scheme Regulations)

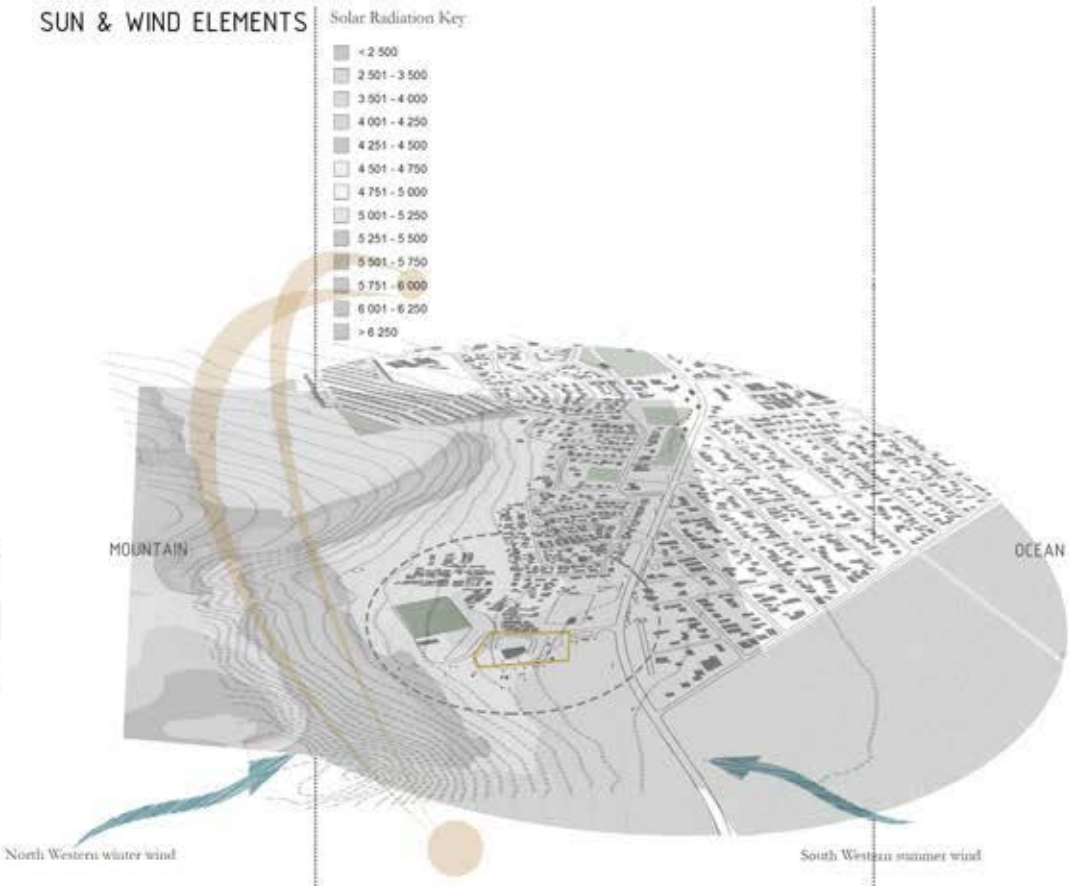
Fig.18 Zoning scheme of Kleinmond (Source: Author, 2017).


Agricultural Zone
Public Open Space
Open Space Zone 1: Environmental Conservation (OS1)
Civic Space: Authority Usage
Community Facilty
Economic Activity

4.2 TOPOGRAPHY, SUN & WIND, WATER, MOVEMENT ROUTES

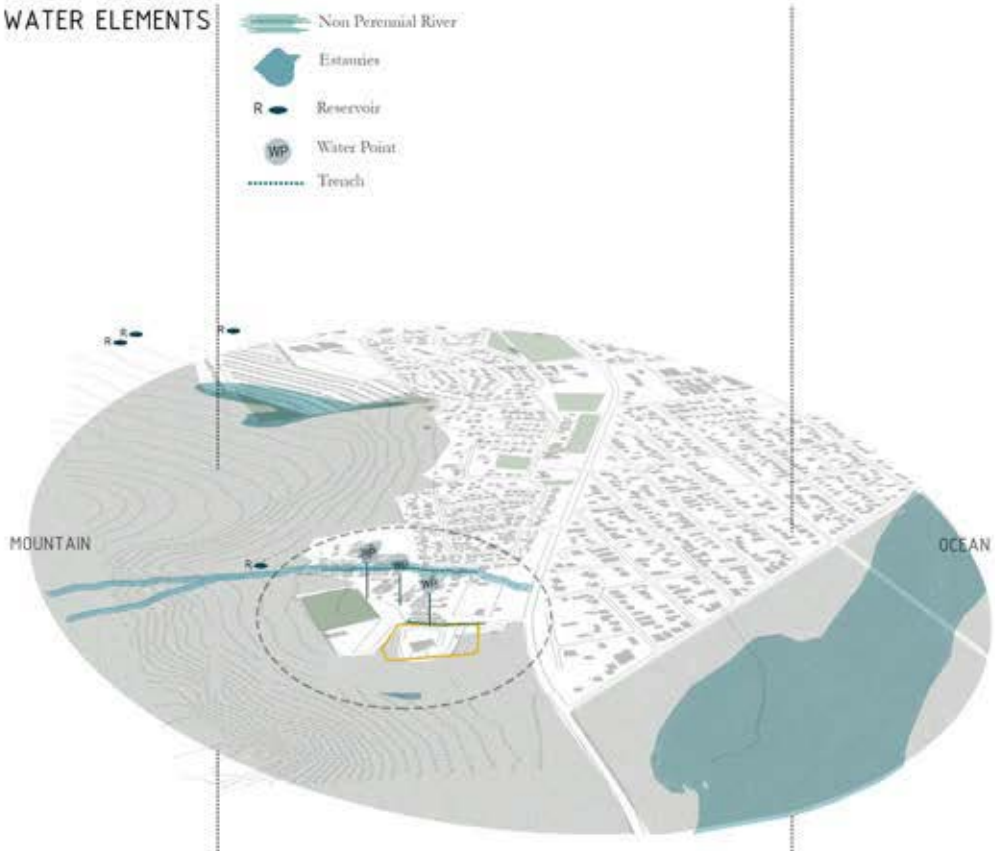


The sloping KWDTS site is surrounded by the natural landscape with the mountain as the backdrop. New spaces should take advantage of the views of the mountain and take the slope in consideration for spatial planning. Architectural methods such as platforms for pause and and ramps for movement is a way of taking advantage of the slope. A critical biodiversity estuary sits to the north that can be used as a valuable water resource in the site.



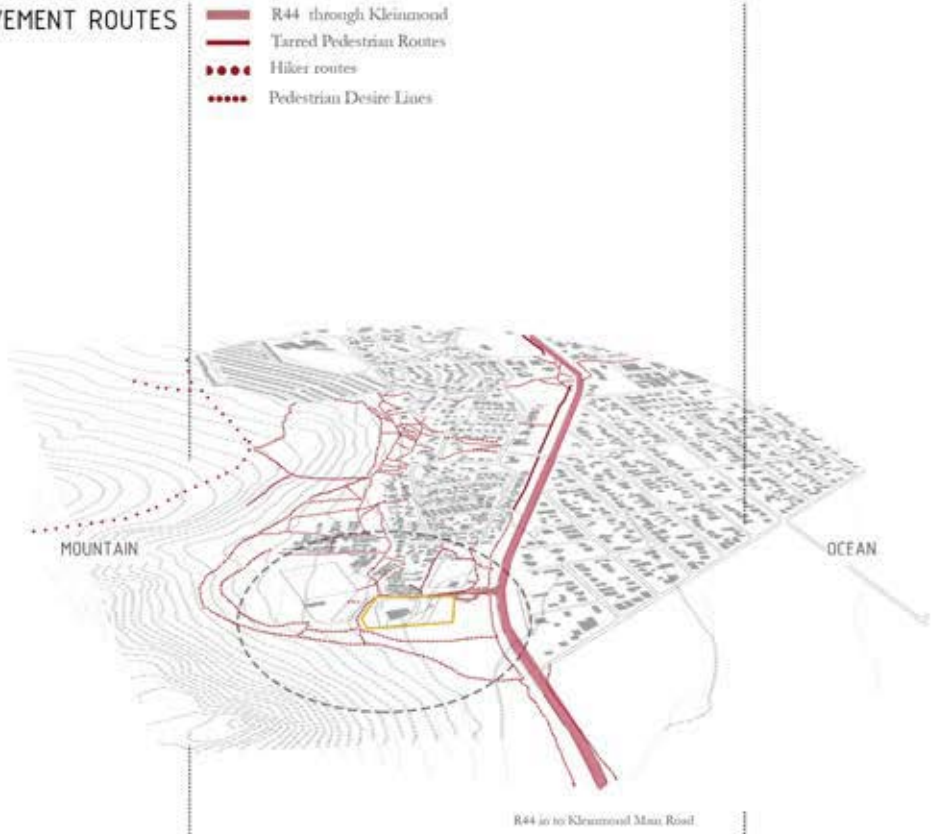
The medeterian climate of Kleinmond has warm summers with an average maximim temperature of 23 degrees Celsius, and cool winters averaging on 16 degrees Celisius (en.climate-data.org). The South Western wind is prominent in the summer averaging on 10km/h, and the North Western wind in the winter averaging on 21km/h (.windfinder.com). The new Re[Source] centre will respond to the sun and wind through the use of passive design strategies, such as thermall mass and cross ventilation.

WATER ELEMENTS



The average rainfall in Kleinmond in 747mm per year. This presents opportunity for rain water harvesting, which can be used at the Re(Source) centre. There is a water point for residents of Protea dorp adjacent to the site, and could be upgraded as a further public amenity for the nearby taxi rank. Storm water management in Protea Dorp is a massive issue, especially due to the non-perennial river shown in the diagram above. The trenches, shown in the dotted line, regularly overflows due to pollution and poor infrastructure.

MOVEMENT ROUTES



The site is located just off the R44 thoroughfare, and sits at the exit but also the entrance of the town. It therefore has the potential to become a gateway/landmark to the town. Desire lines are evident around the site, indicating pedestrian activity. Pedestrians from Protea Dorp often walk to the edge of the town to hitch hike out of town. They also often wait for passer-by motorists who can offer a job, generally in construction. The the taxi rank is located to the south of the site, creating more pedestrian presence. There is a tarred road up to the Re(Source) centre, which then changes into a gravel road to the informal community, and again changes to a cobbled road leading the astro-soccer field.

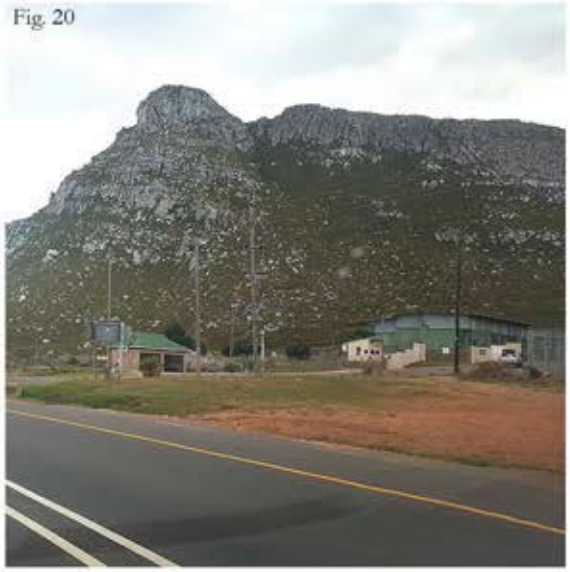
4.3 URBAN ANALYSIS

4.3.1 Urban Issues

Fig.19

View Point 1 revealing the harsh everyday realities surrounding the site. The KWDTS makes no gesture to connect to the urban, social, and natural environment.

Fig. 20



View Point 2 revealing the residual space.

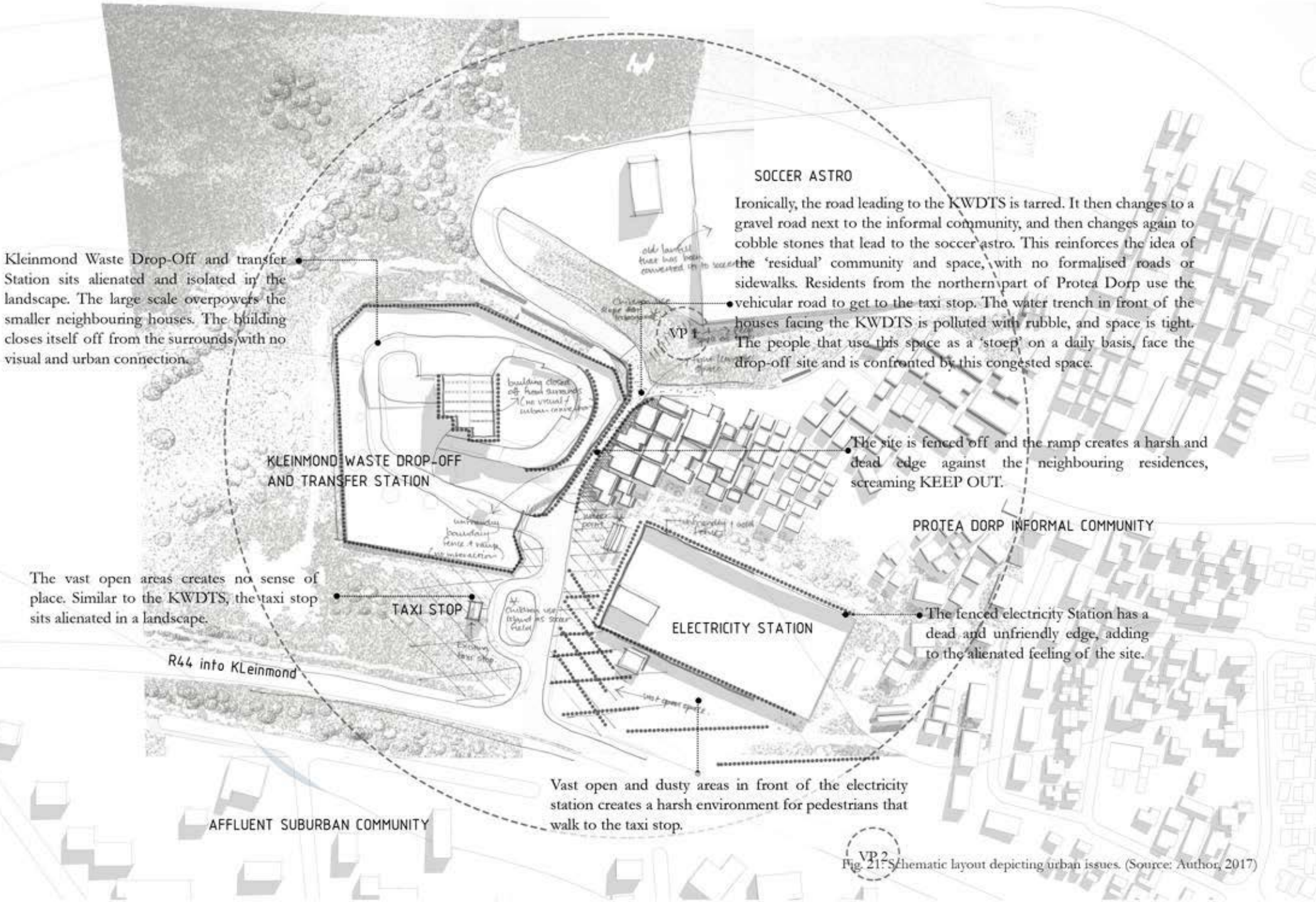


Fig. 21: Schematic layout depicting urban issues. (Source: Author, 2017)

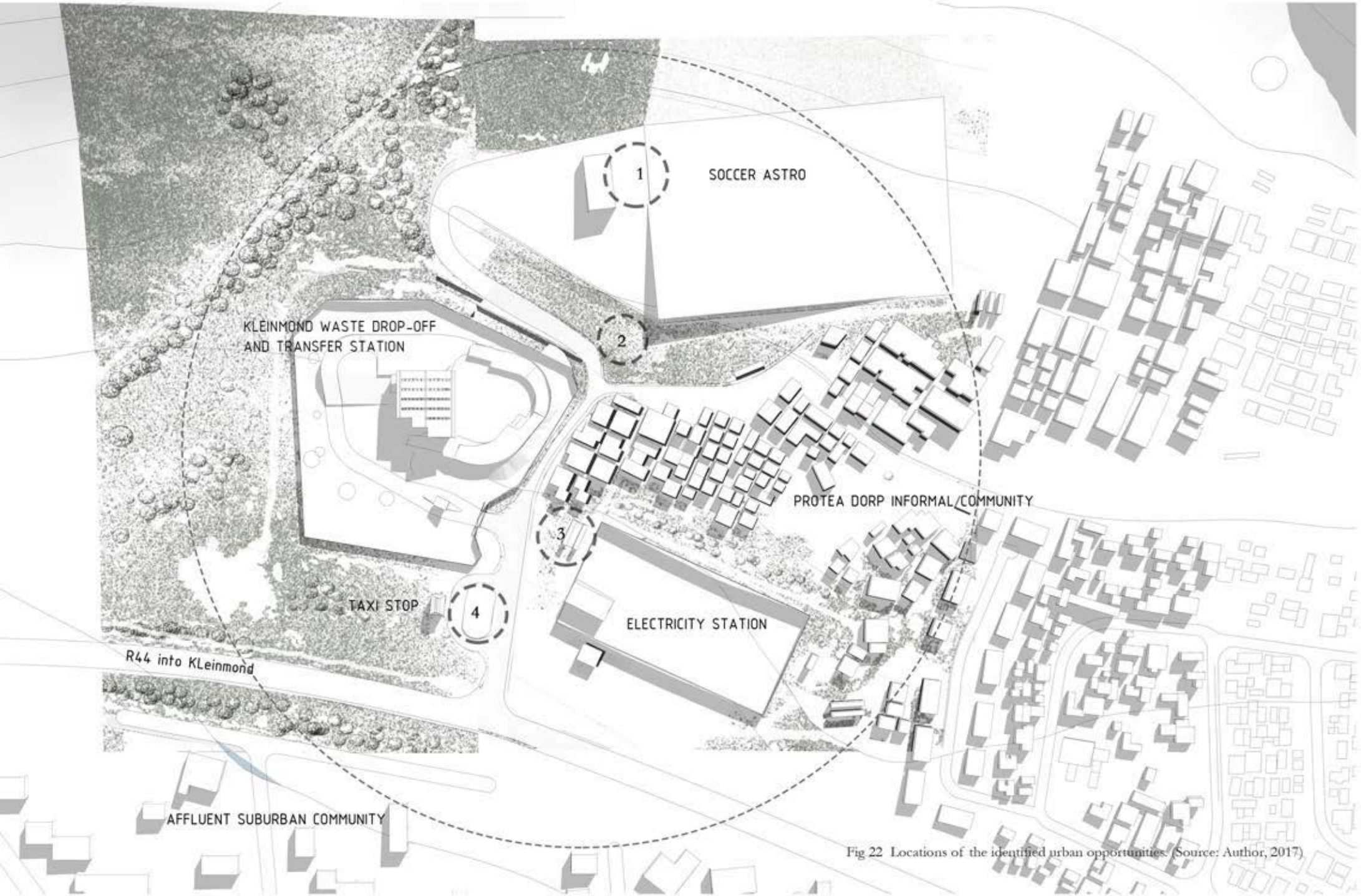


Fig 22 Locations of the identified urban opportunities. (Source: Author, 2017)

4.3 URBAN ANALYSIS

4.3.2 Urban Opportunities

Fig. 23

The rehabilitated landfill site houses a soccer astro and ablution facilities. The opportunity exists to connect it to the Re[Source] centre . The spectators will be able to use the public facilities at the Re[Source] centre and pedestrians passing through and around the site become potential economic support for the shops. Through this, awareness and knowledge can be shared and experienced.

Fig. 24

Children appropriating the slopes for cardboard tobogganing, and residents often use this area as a lookout point appreciating the view. A new walkway from the Re[Source] centre will make this point more accessible, whilst encouraging informal play and socialising.

Fig. 25

Community water point and ablutions can be upgraded and used by the new taxi stop. A new play-park adjacent will be built from recycled materials becoming a safer area for children.

Fig. 26

Children playing soccer on the the taxi stop island. This evidently reveals the need for public recreational facilities.

4.4 THE FOUND

KLEINMOND WASTE DROP-OFF AND TRANSFER STATION

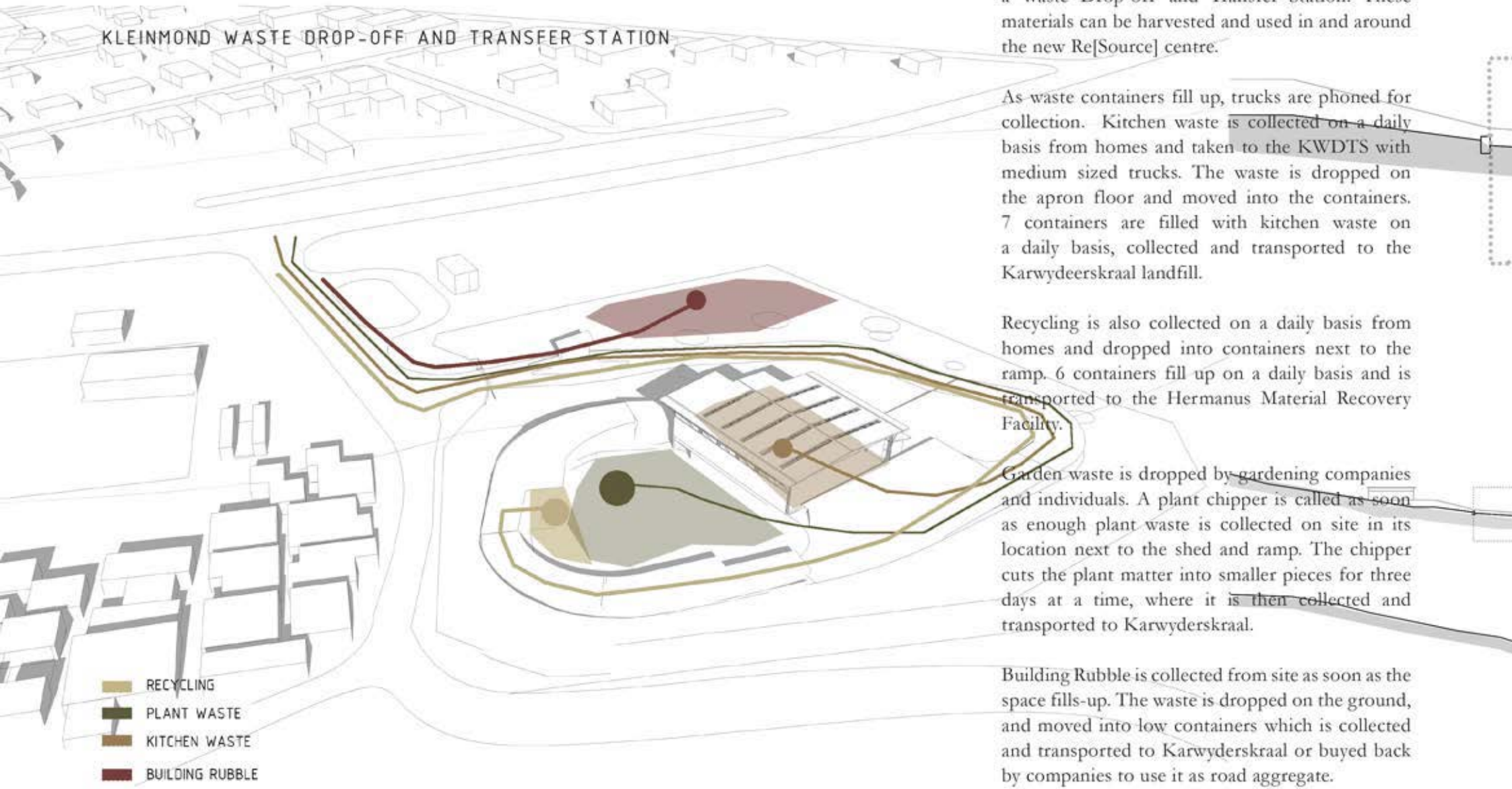


Fig 27 Flow of waste at KWDTS (Source: Author, 2017)

The found is valued for its existing function as a Waste Drop-off and Transfer Station. These materials can be harvested and used in and around the new Re[Source] centre.

As waste containers fill up, trucks are phoned for collection. Kitchen waste is collected on a daily basis from homes and taken to the KWDTS with medium sized trucks. The waste is dropped on the apron floor and moved into the containers. 7 containers are filled with kitchen waste on a daily basis, collected and transported to the Karwydeerskraal landfill.

Recycling is also collected on a daily basis from homes and dropped into containers next to the ramp. 6 containers fill up on a daily basis and is transported to the Hermanus Material Recovery Facility.

Garden waste is dropped by gardening companies and individuals. A plant chipper is called as soon as enough plant waste is collected on site in its location next to the shed and ramp. The chipper cuts the plant matter into smaller pieces for three days at a time, where it is then collected and transported to Karwyderskraal.

Building Rubble is collected from site as soon as the space fills-up. The waste is dropped on the ground, and moved into low containers which is collected and transported to Karwyderskraal or buyed back by companies to use it as road aggregate.

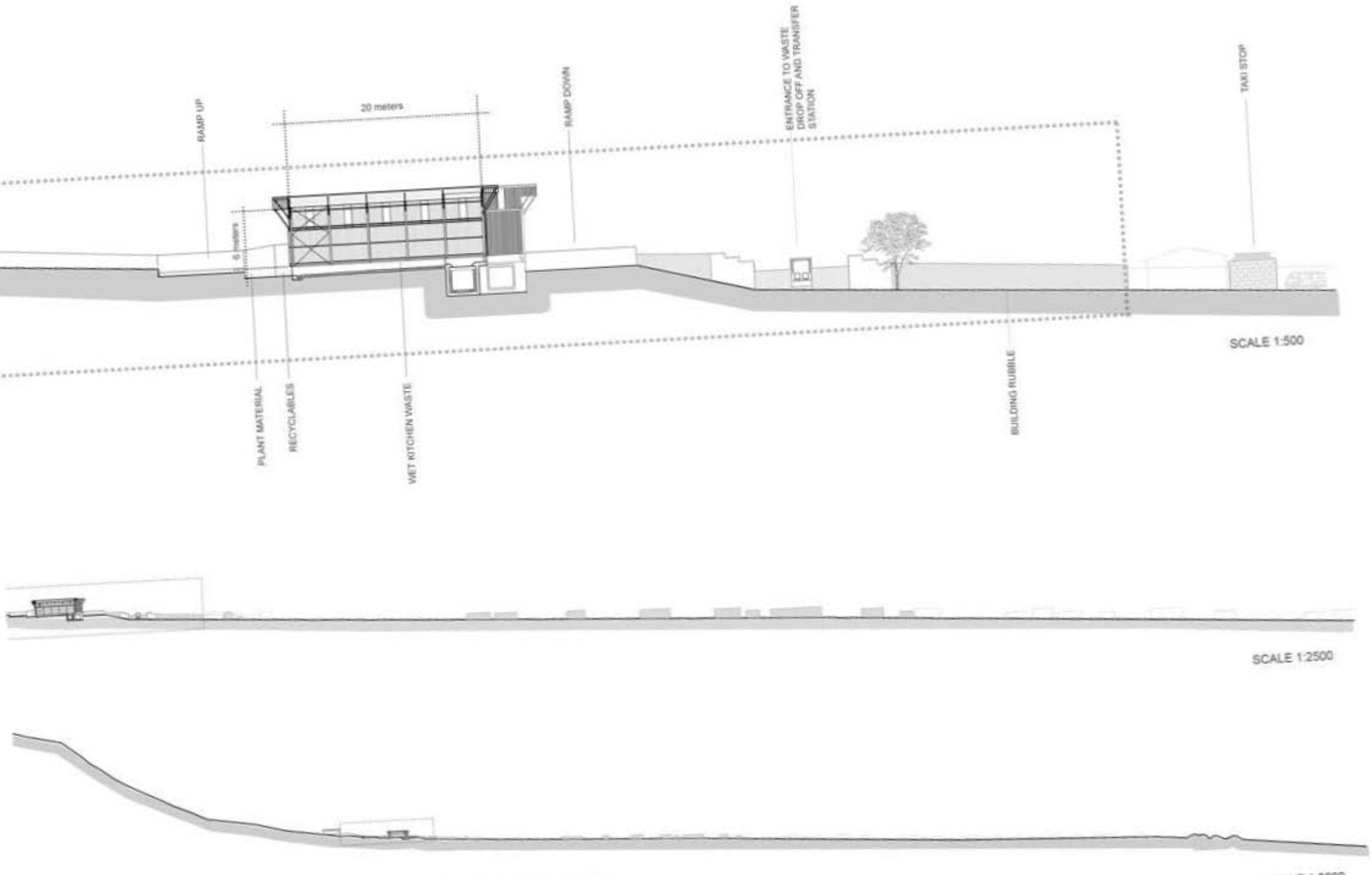


Fig 28 Sections through existing Kleinmond Waste Drop-off and Transfer Station.
(Source: Author, 2017)

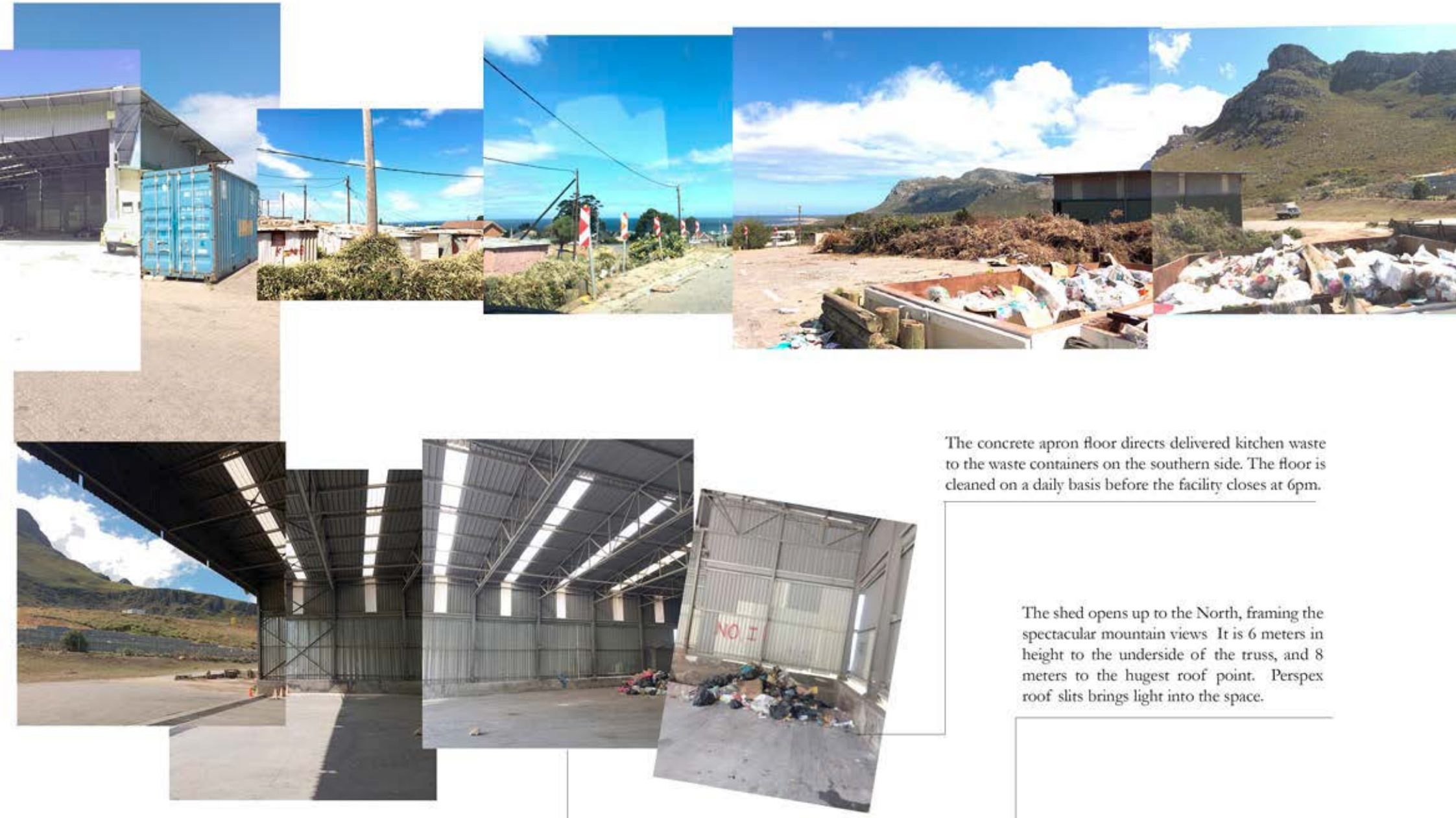
4.4.2 PHOTOS MONTAGE

THE SHED

The shed is made up of a steel frame, with trusses spanning 20 meters across. The trusses are spaced 4 meters apart, creating 4 bays on the western facade, 5 bays in the middle, and 6 bays on the eastern facade.

Kleinmond Waste Drop-Off and Transfer station
Open Monday to Friday 8am to 6pm, and Saturdays from 7:30 am to 4:30pm.

The building takes advantage of the slope by having waste drop-off at an higher level within the steel shed. The concrete base holds three containers which are picked up and replaced daily. The building steps back to allow for ease of disposal and pick-up of waste.



The concrete apron floor directs delivered kitchen waste to the waste containers on the southern side. The floor is cleaned on a daily basis before the facility closes at 6pm.

The shed opens up to the North, framing the spectacular mountain views It is 6 meters in height to the underside of the truss, and 8 meters to the hugest roof point. Perspex roof slits brings light into the space.

Fig 28 Photos montage. (Source: Author, 2017)

SECTION 5

INTERVENTION

5.1 DESIGN OBJECTIVES AND DESIGN APPROACH

The design objectives refers back to the topic of seeing everyday residual space and materials as a valuable public resource. The aim is to reveal their value by using the process of transformation, referring back to the inherent approach of the alchemist. In the context of this paper, transformation is achieved by integrating the flows of waste, the flows of the people, and the flows of nature. These rhythms will create a cross-programmed landscape, where movement and openness sits at its core.

Integrating the new flows, allows the isolated facility to stretch beyond its intended, industrial function and spatial nature. It will become a Re[Source] centre that can benefit the surrounding social, urban, and natural landscapes. This approach requires a shift in thinking, and means that we have to change our traditional perceptions about waste infrastructure and materials. This is one of the main objectives of the Re[Source] centre, and does this through a variety of spatial strategies.

5.2 DESIGN DEVELOPMENT

5.2.1 NEW PROGRAMS

WASTE PROGRAMS	
KITCHEN WASTE	1. Delivery 2. Sorting & Harvesting 3. Cleaning 4. Distributing: - Recycling / Buy Back - Landfill Storing - Shop - Workshop - Building Material
RECYCLING	1. Delivery 2. Sorting 3. Distributing - Baling - Chipping - Landfill Storing - Shops - workshops - Building Material Pickup From Recycling Companies
BUILDING RUBBLE	1. Delivery 2. Sorting 3. Distributing - Landfill Storing - Shops - Workshops - Building Materials
ORGANIC WASTE	1. Delivery 2. Sorting 3. Biogas 4. Composting 5. Shop 6. Tools storage & management 7. Nursery

Table 3: Waste Programs (Source: Author, 2017)

SOCIAL PROGRAMS	
TOURISM	1. Visitor's Centre 2. Public Knowledge Centre/ Gallery 3. Public Gathering Space 4. Commercial - trade/shops 5. Refreshment Facility 6. Public WC 7. Tourist Parking
TRADE	1. Trading Stalls 2. Trader Storage Space 3. Bric and Brac Shop 4. Building Material Shop 5. Sunday Markets 6. WC
CULTURAL	1. Artisan Workshops 2. Event space 3. Performance space / Amphitheatre 4. Gallery 5. WC & kitchen
RECREATIONAL	1. Public Event Space 2. Soccer Fields and Play areas 3. Picnic Spaces 4. Cafe (kitchen & wc) 5. Mountain Walks
ECOLOGICAL	
WATER MANAGEMENT	1. Estuary flood mitigation 2. Rain Water Harvesting
ENERGY	1. Biogas from organic waste 2. Solar Power
NATURAL HABITAT	1. Estuary 2. Green Roofs & Walls
PROCESSING	
WORKSHOPS	1. Work Station 2. Machine & product Storage 3. Water Point 4. Communal Thinking Space
MANAGEMENT	1. Production/ shops 2. security & check-in (people and cars) 3. parking
EMPLOYEE SPACES	1. Cafeteria & Kitchen Facilities 2. WC, locker rooms & wash rooms 3. Recreational Break Areas 4. Employee parking

Table 4: Social and natural programs. (source: Author, 2017)

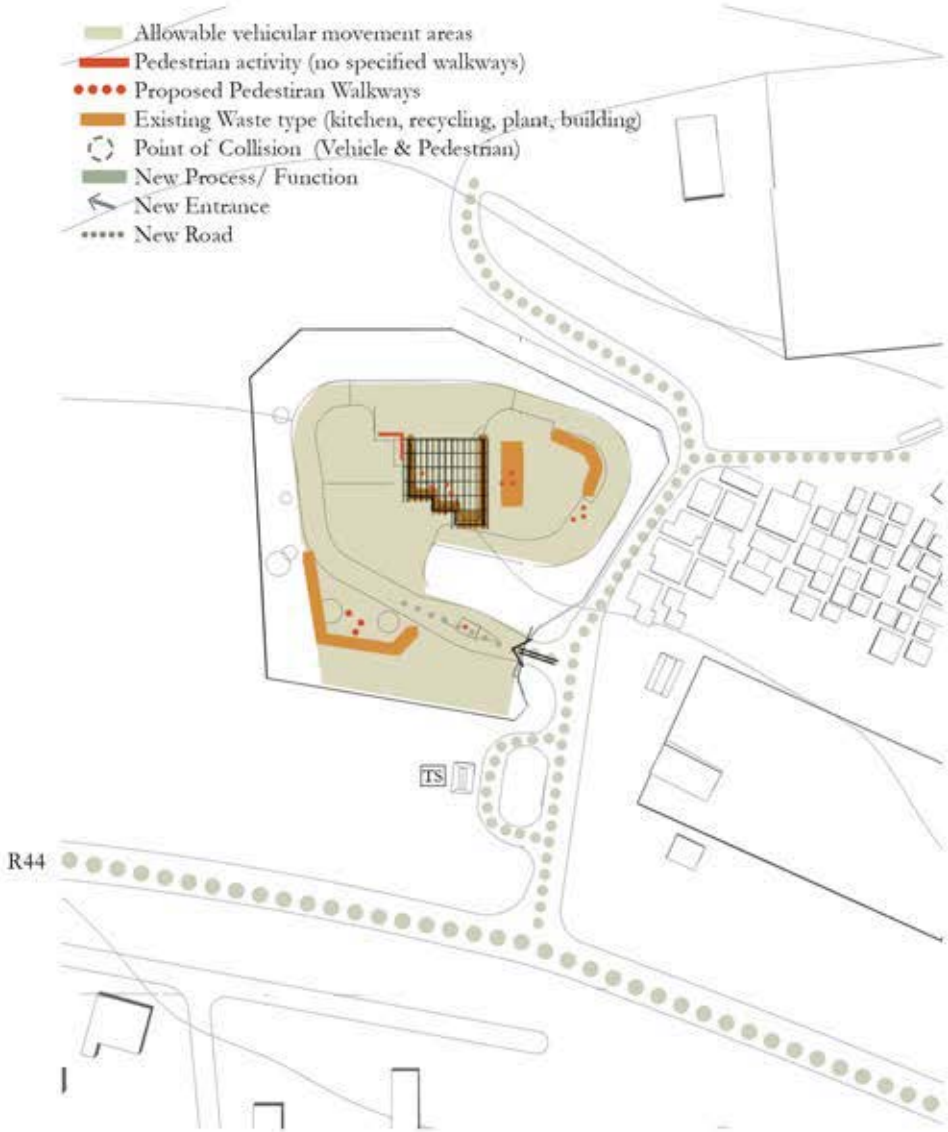
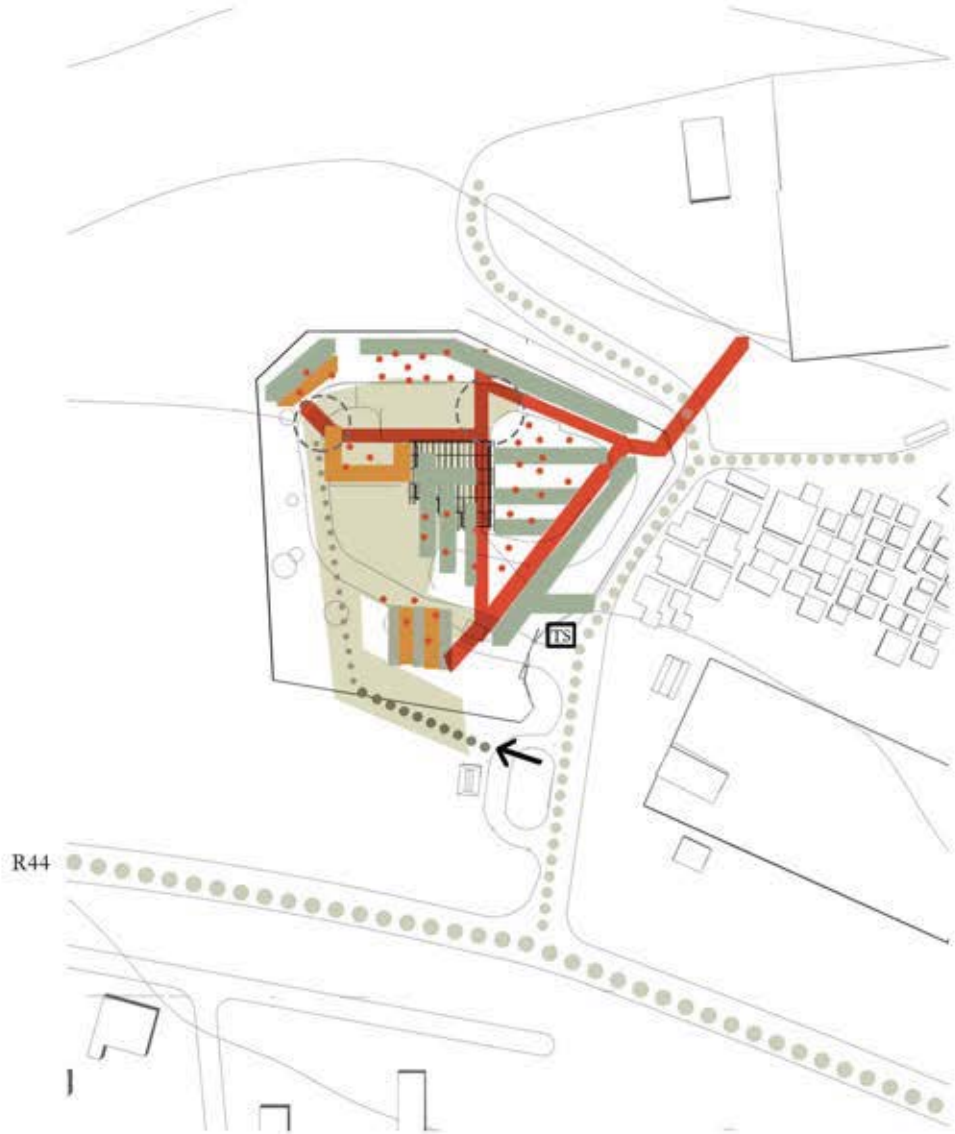
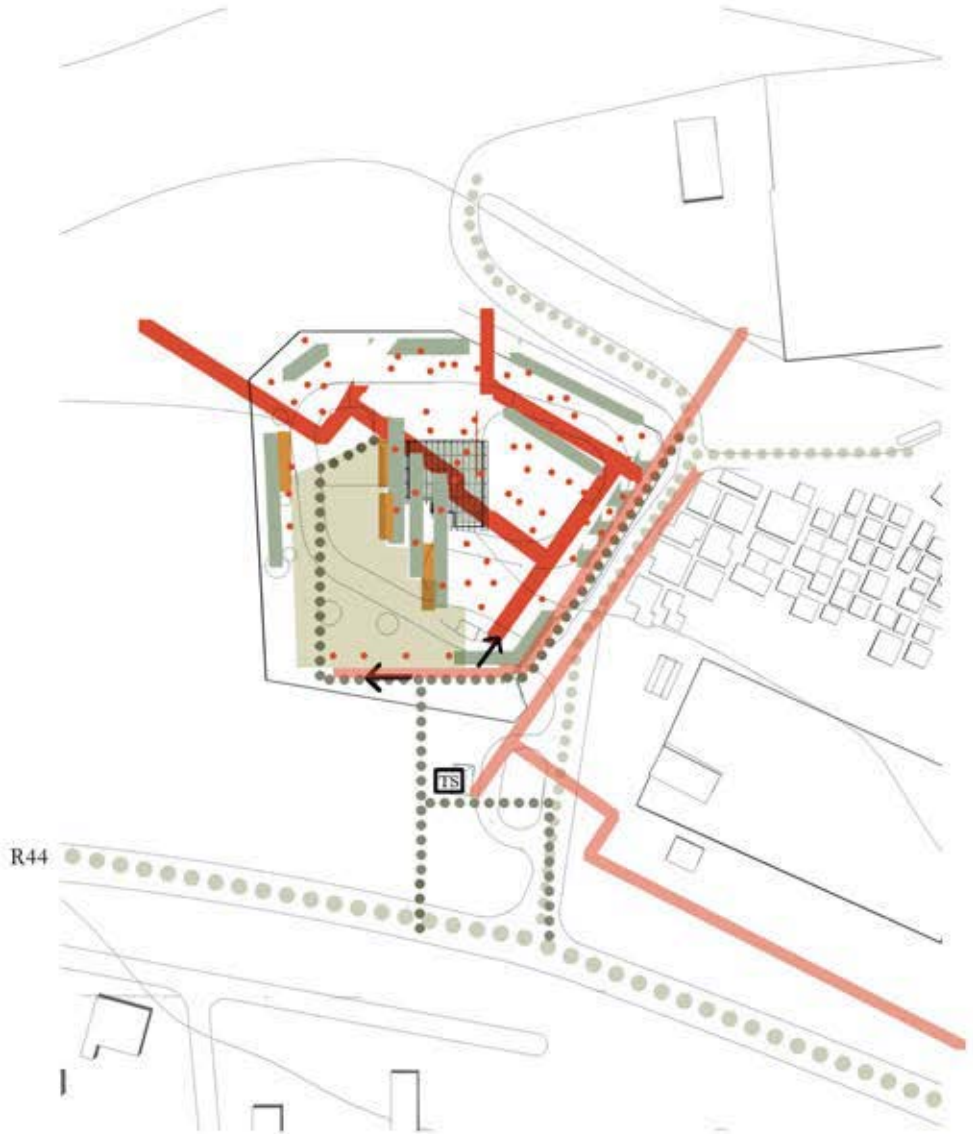


Fig.30 Testing th flows of waste and people in and around the site (Source: Author, 2017).


R44
TS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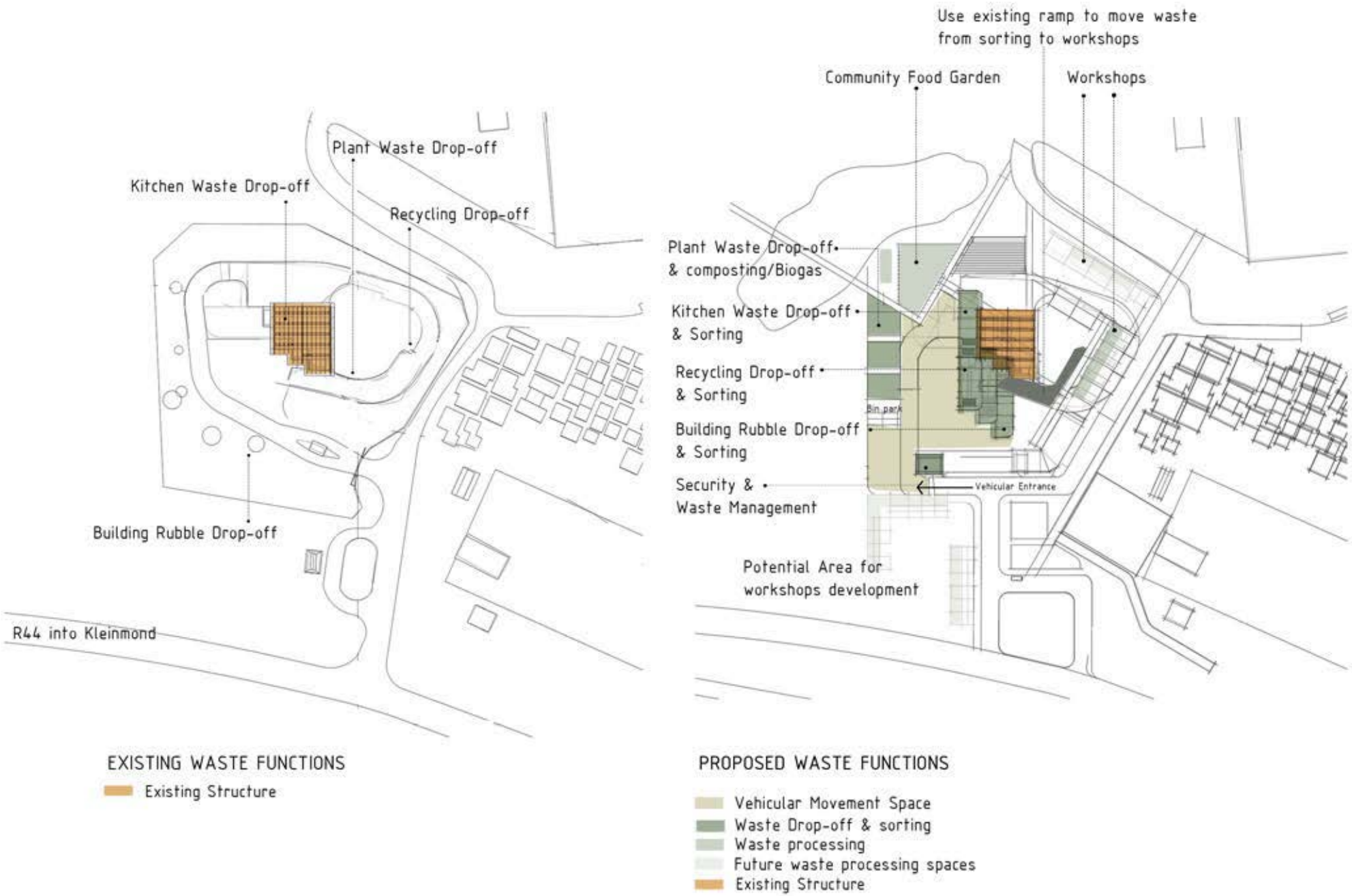

Plant Waste Drop-off
Kitchen Waste Drop-off
Recycling Drop-off
Building Rubble Drop-off
R44 into Kleinmond
EXISTING WASTE FUNCTIONS
Existing Structure
Use existing ramp to move waste from sorting to workshops
Community Food Garden
Workshops
Plant Waste Drop-off & composting/Biogas
Kitchen Waste Drop-off & Sorting
Recycling Drop-off & Sorting
Bin park
Building Rubble Drop-off & Sorting
Security & Waste Management
Vehicular Entrance
Potential Area for workshops development
PROPOSED WASTE FUNCTIONS
Vehicular Movement Space
Waste Drop-off & sorting
Waste processing
Future waste processing spaces
Existing Structure

Fig.31

5.2.2 WASTE LAYER

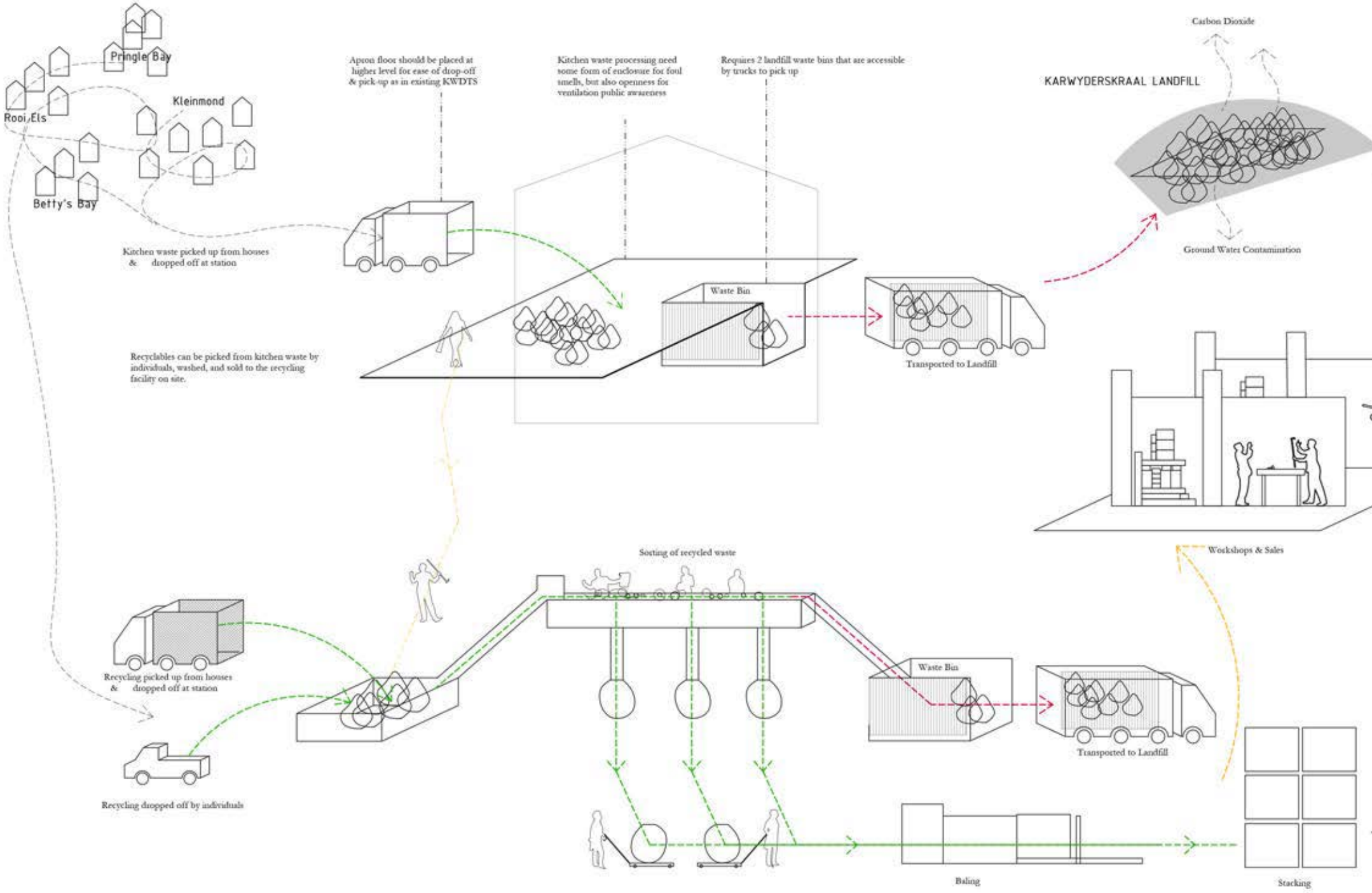
The waste process is one of the layers of the cross-programmed landscape. The waste layer includes the existing function of the Drop-off and Transfer Station, as well as new waste systems, such as recycling, sorting, and processing kitchen waste, building rubble, and plant waste (refer to figure 32).

A separate vehicular entrance and vehicular movement area is created to allow vehicles, workers and visitors to move freely and safely in, out and through the facilities. Figure 19 reveals how the flows were tested, and the mitigation of these flows was one of the most demanding challenges of the project. The design intervention keeps vehicular movement to the western side of the site along with all the waste processes.

Generally, waste is dropped off, sorted, and processed for collection or use on site. A buy back centre is provided where people can pick recyclables from kitchen waste and sell it to the recycling facility. Similar process is evident at the Hermanus Material Recovery Facility and can sustain the livelihood of residents from the surrounding communities.

Usable waste will move from the sorting and processing facilities to the workshops and shops, using the existing ramp on-site for movement. Affordable waste materials will be sold on site to the general public or reinvented into new crafts. Value will be added to the waste materials by using them as building materials in and around the facility. The precinct will become a construction laboratory in itself, with the intention to teach people how to use waste as a building material. It is intended to become a sustainable building method, responding to its location in the Biospher .Alternatively, materials can also be creatively processed in workshops and sold in small shops located on-site, contributing to the economic livelihood of Kleinmond residents.

Although the waste processes are placed on the western edge of the site, it still has the ability to connect to its surroundings, preventing it from becoming an isolated environment. The openness of the architecture allows waste functions to physically and visually connect to pedestrian movement routes. Three of the waste management functions (kitchen waste, recycling, building rubble) are placed in three bands, connected to the new knowledge centre. As people move through the permeable knowledge centre, they are able to view the waste processes on site. The semi-enclosed framed structures bands are made +from industrial recycled materials, becoming an exhibition in itself. Rather than hiding the 'filthy' such as kitchen waste, it is placed 'in your face' reminding one to minimise waste and see it as a valuable everyday resource.


Pringle Bay
Kleinmond
Rooi Els
Betty's Bay
Apron floor should be placed at higher level for ease of drop-off & pick-up as in existing KWDTS
Kitchen waste processing need some form of enclosure for foul smells, but also openness for ventilation public awareness
Requires 2 landfill waste bins that are accessible by trucks to pick up
Carbon Dioxide
KARWYDERSKRAAL LANDFILL
Ground Water Contamination
Kitchen waste picked up from houses & dropped off at station
Waste Bin
Transported to Landfill
Recyclables can be picked from kitchen waste by individuals, washed, and sold to the recycling facility on site.
Workshops & Sales
Sorting of recycled waste
Recycling picked up from houses & dropped off at station
Waste Bin
Transported to Landfill
Recycling dropped off by individuals
Baling
Stacking

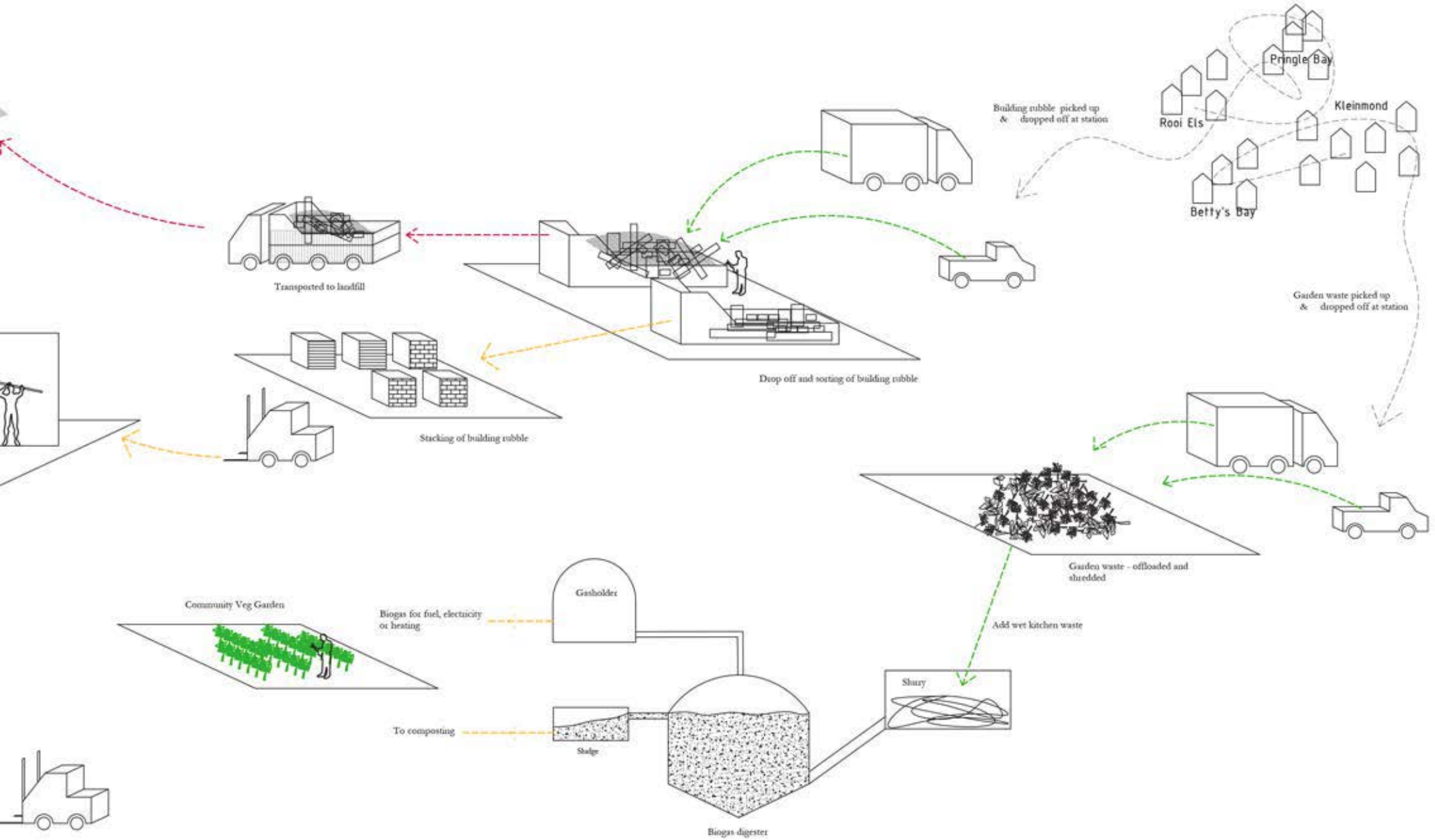


Fig.32 The new flow of waste in the facility (Source: Author, 2017).

5.2.3 SOCIAL LAYER

The social layer of the cross-programmed landscape includes a variety of everyday and event functions and spaces. The existing shed structure on site is adapted from transferring waste, to transferring knowledge. The approach to the existing structure is to completely strip its skin, a "shock" treatment, revealing its steel skeleton and its new organs.

The corrugated panels are harvested and used as the roof sheets for the new workshops and shops. As time passes, the skin will grow back, but this time from recycled materials gathered on-site. The panels will be movable and able to breathe, opening up and closing as functions, events, and seasons change. On an everyday basis, it will act as a knowledge centre, providing information on exhibition panels.

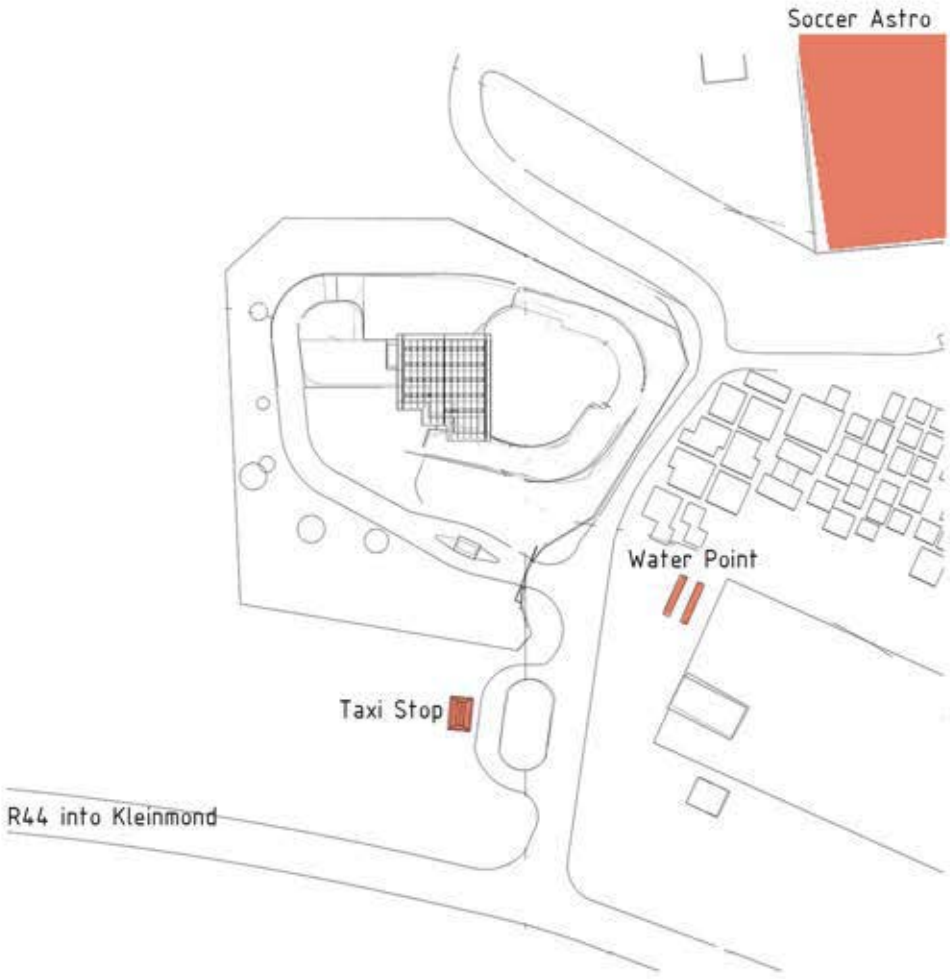
The movable panels will be an exhibition itself, and so will the rest of the architecture, made from recycled materials. Standing within the skeletal structure, one will now be able to obtain a 360 degree view of all the waste processe s happening on site; drop-off, sorting, processing, pick-up, and appropriation in the workshops. You will also have a view of the surrounding urban and natural landscape, and people from outside will be able to see in, enforcing the concept of integration. In a later phase, the knowledge centre will provide adaptable spaces to facilitate a business incubator, supporting entrepreneurs to develop their business that were started in the workshops or elsewhere in the town. Afterhours and on Sundays, the space can be used for events, and as an extension of the external public spaces.

The outside public spaces can be used on a daily basis by employees, entrepreneurs, and visitors, allowing social interaction. On an event day, the public spaces can be used as a stage, overlooked by the new amphitheatre. It can also accommodate markets events related to the soccer matches played at the astro north of the site.

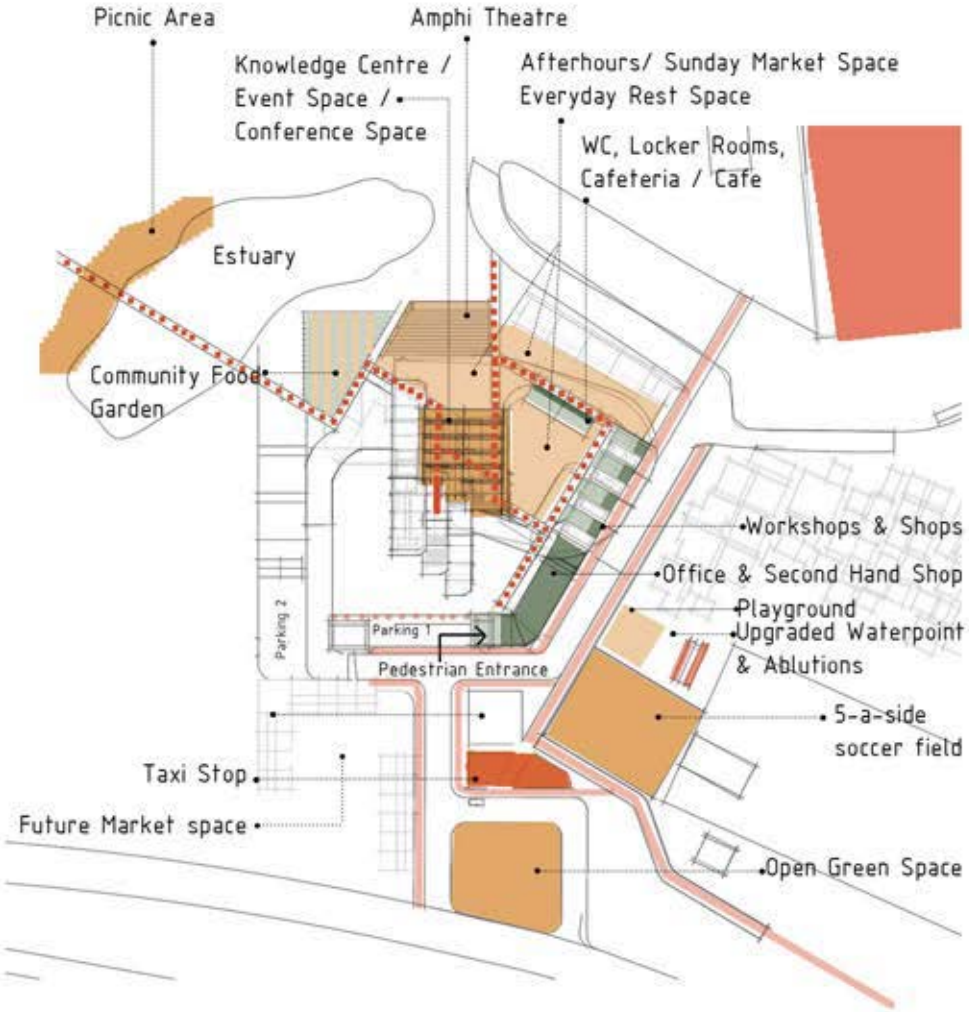
Ramps and walkways connect different functions in and around the facility, moving people and waste. The public is directed through the site, creating a visitor experience. This refers back to Tschumi's concept of movement becoming an event in itself. In the Re[Source] centre, much emphasis is placed on public movement, as it takes one through the different waste processes. Through this, awareness and education is gained, and negative perceptions about waste sites and waste materials can be changed. Trade, commerce, and tourists are encouraged in and around the site, as it can provide much needed economic support to many unemployed Kleinmond residents. Small shops are connected to workshops, and a larger second hand shop is located at the entrance of the site. This will create a new urban edge and is achieved through gradually demolishing sections of the existing imposing vehicular ramp.

The dead and unfriendly edge will be transformed in stages, and workshops and shops will now take over its place. A new urban scenario is imagined where sidewalks allow pedestrians to interact with these new spaces. A swop shop is located in the second-hand shop where children can trade waste for school supplies. The existing road is shifted to give space back to the residents staying next to the dirt road leading to Protea Dorp and the soccer field.

The polluted trenches will be cleaned and formalised using recycled building rubble and gabions. Walkways and sidewalks are also provided to create safe pedestrianised areas. A new taxi rank made from recycled materials will be placed close to a variety of new recreational spaces such as a playground and a 5-a-side soccer field. This responds to the existing need for recreational and public space for the fast developing informal community. The existing water point and ablution facilities are upgraded to become a dignified communal resource. The site can act as a gateway to surrounding recreational facilities such as picnic areas, mountain walks, and the soccer field. More people means that more awareness can be raised, and divided social communities can share one space.



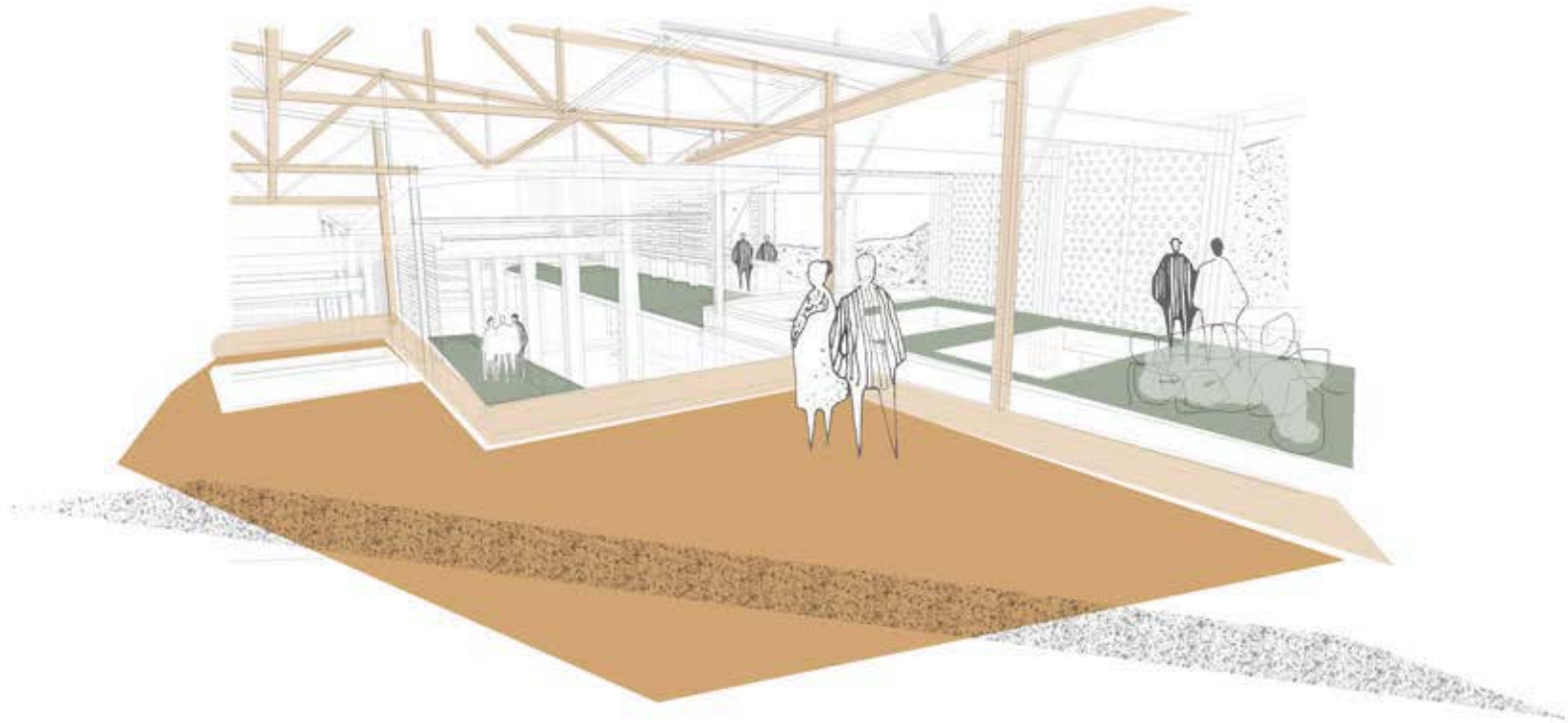
EXISTING SOCIAL FUNCTIONS



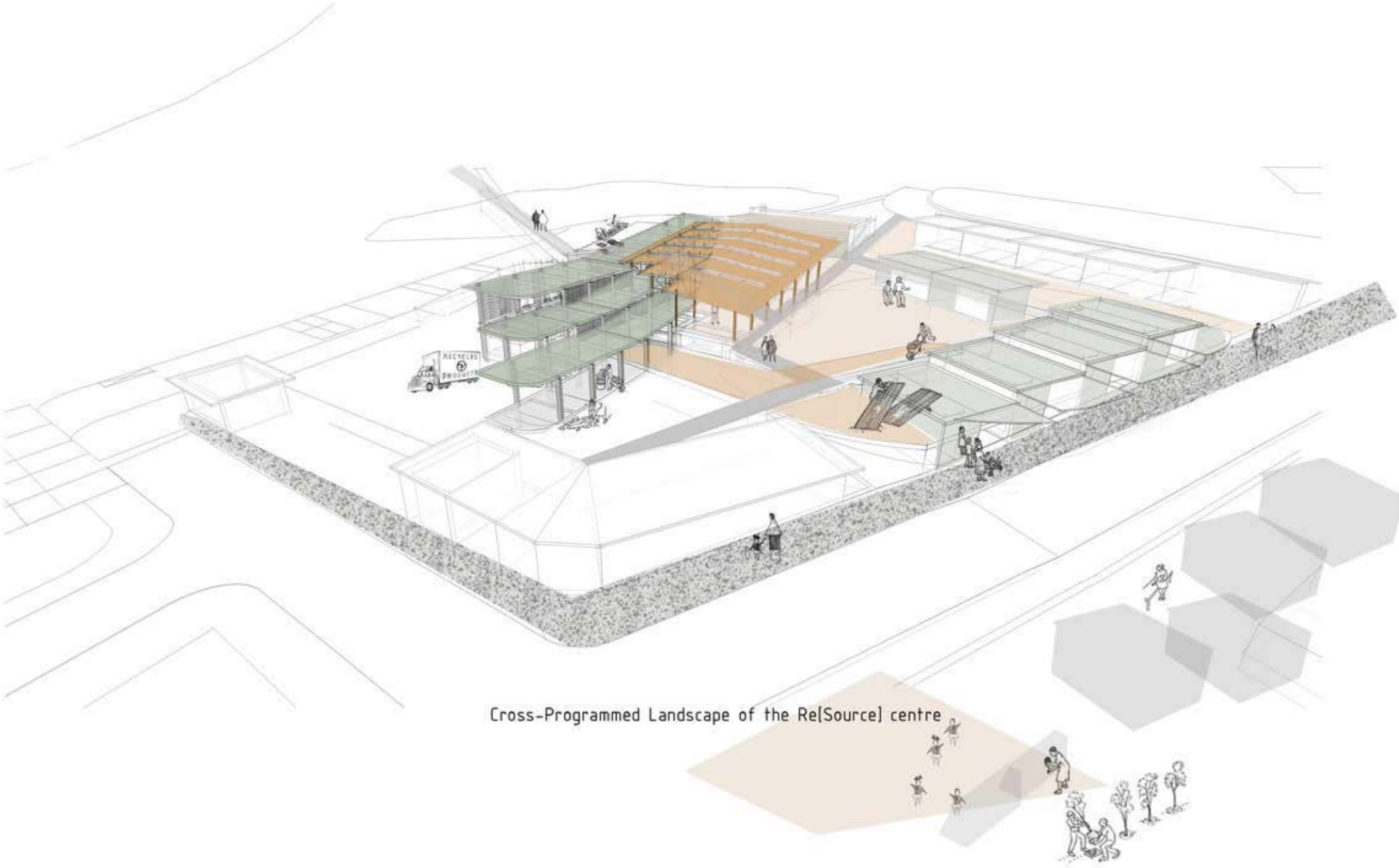
PROPOSED SOCIAL FUNCTIONS

- Pavement
- Ramps & Walkways
- Trade / Shops / commerce
- Public / Event Space
- Recreational Space

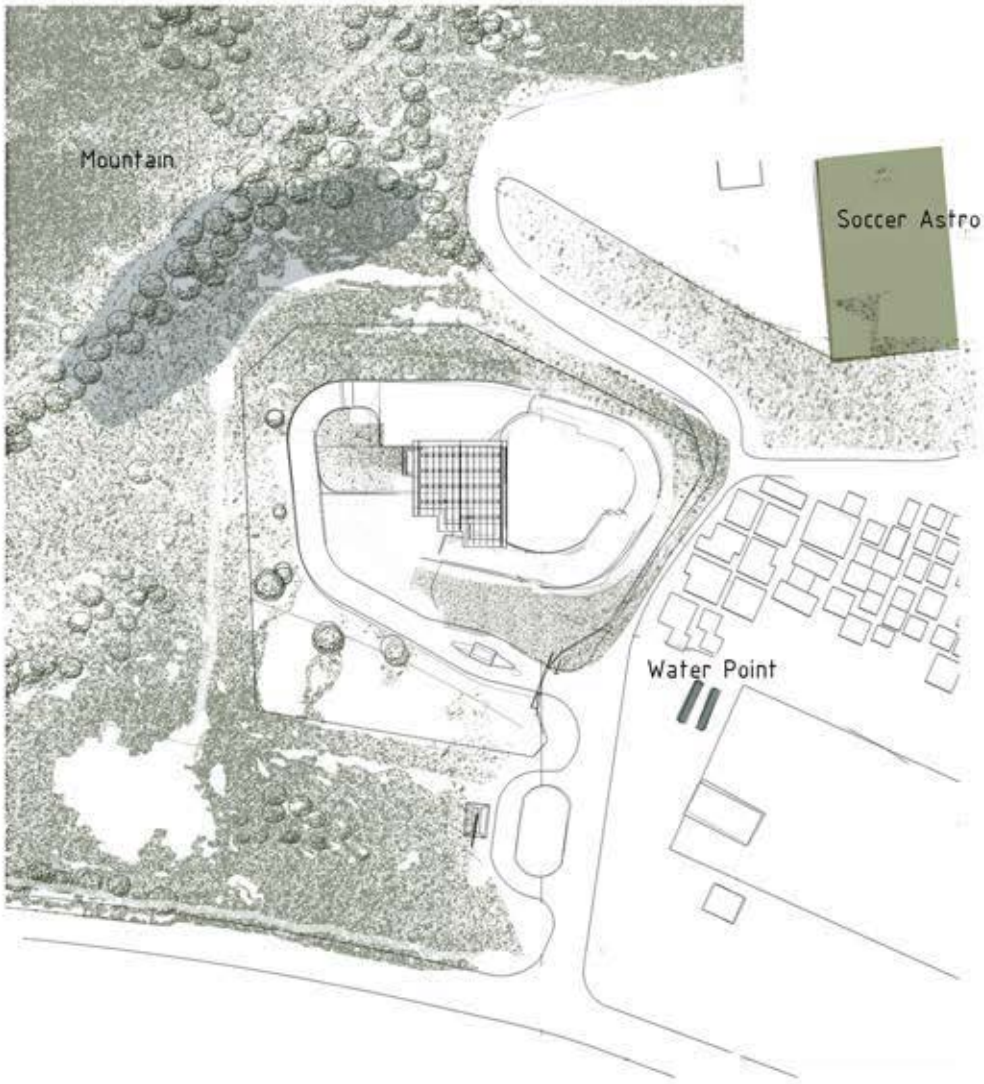
Fig.33



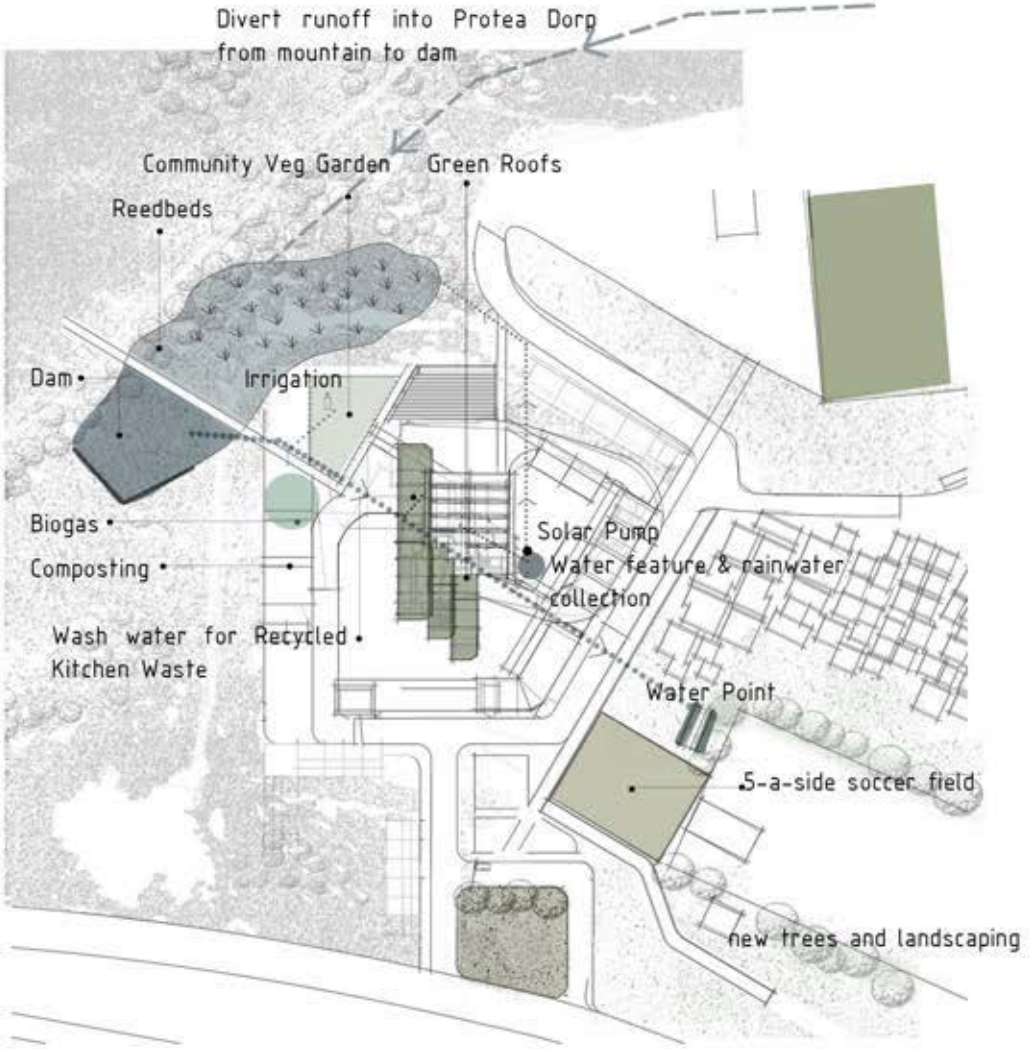
Knowledge centre overlooking waste processess



Cross-Programmed Landscape of the Re[Source] centre



EXISTING NATURAL FEATURES



PROPOSED NATURAL RESPONCES & ADDITIONS

Water

Greenery

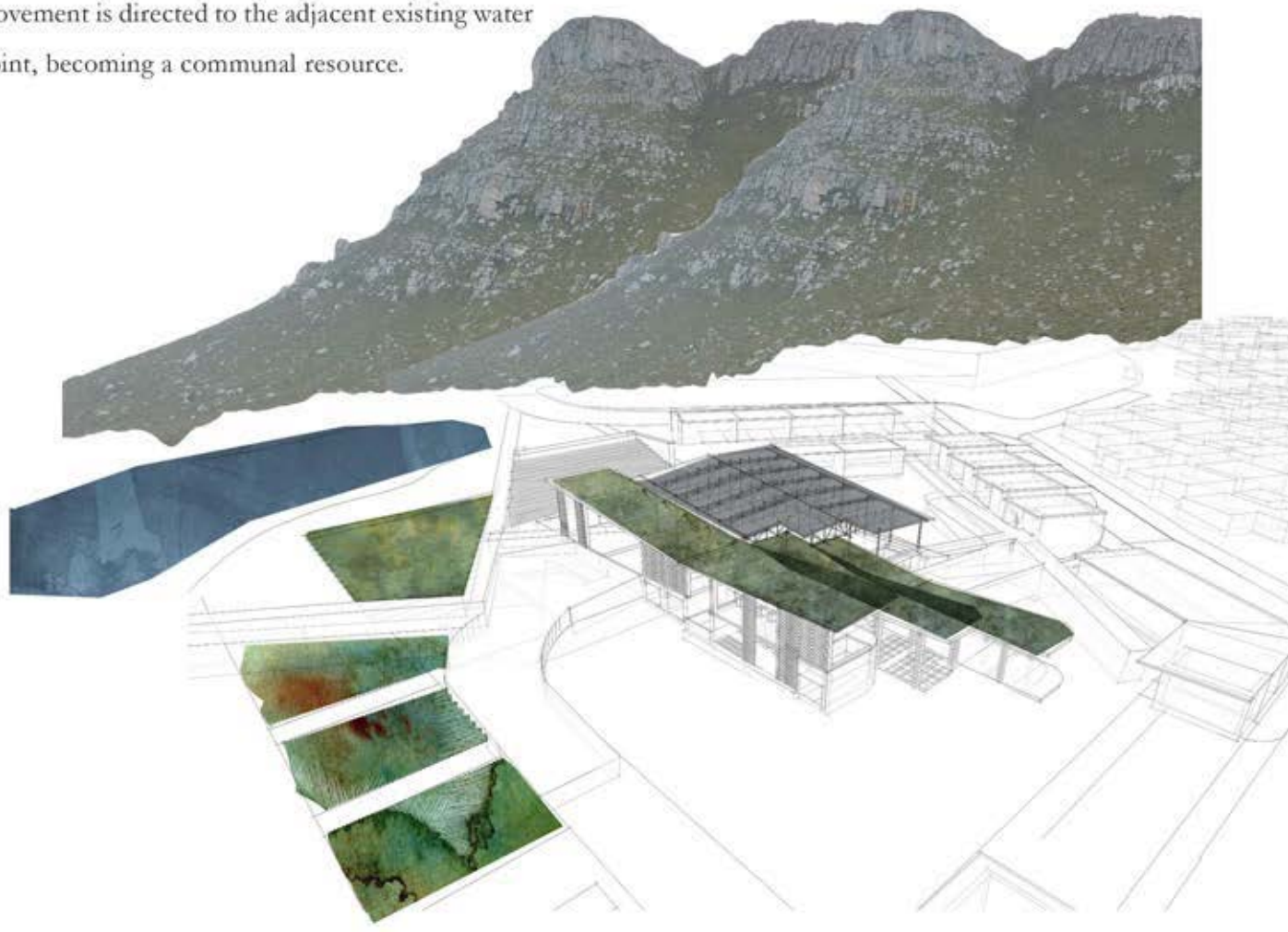
5.2.4 NATURAL LAYER

The natural layer of the cross-programmed landscape includes water management, and new greening solutions. It also refers to how the buildings respond to the environmental conditions, opening up to the views, sun, and wind as discussed previously. The openness of the architecture responding to the environment, allowing for dignified and comfortable working spaces. The sun is allowed to penetrate the spaces through permeable panels made from recycled waste from the site, and cross ventilation is able to occur. In terms of the kitchen waste, smell is considered and the semi-enclosed nature of the spaces allow it to be visible, accessible and able to ventilate, whilst keeping smells away from the public and residential areas.

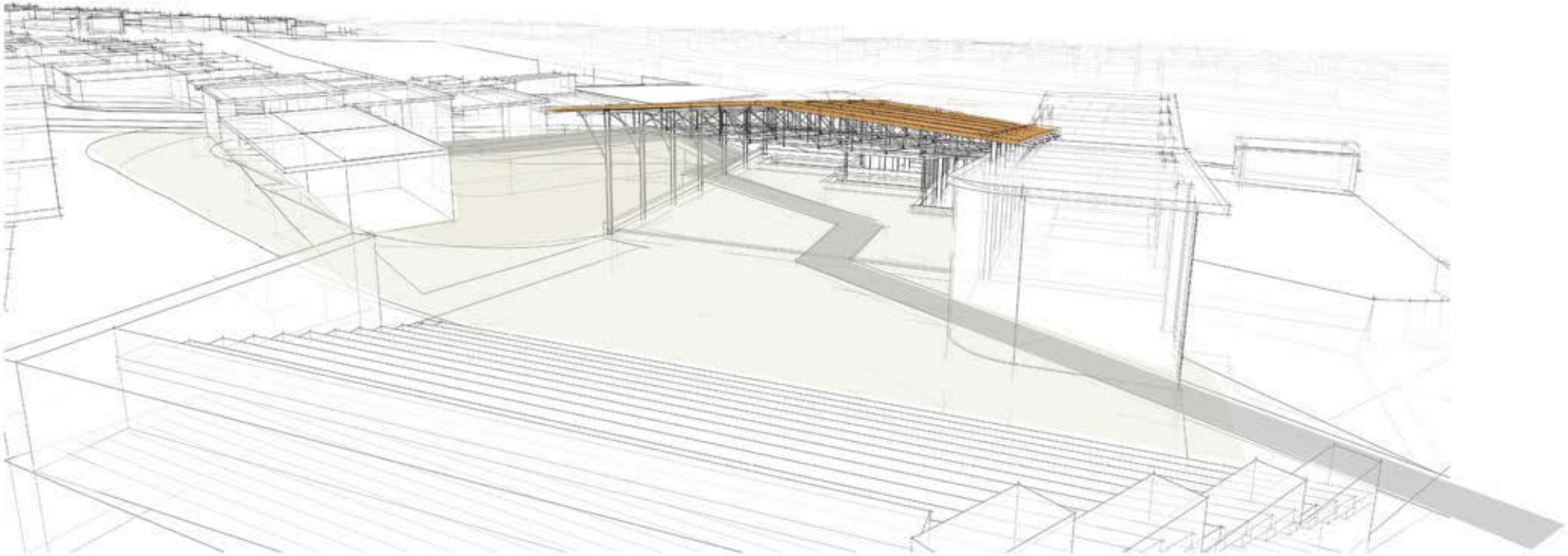
Green roofs are an important part of the system as they have the ability to bring fauna and flora back into the site. It also has isolative properties, creating habitable working environments.

The roof of the existing shed is adapted and tilted to respond to the natural landscape and mountain. Rather than a 'pimple in the landscape' it now follows the spatial rhythms of its environment. The bands of the new waste facilities scale down towards to informal community, and it can now be better incorporated into the urban environment It creates a visual rhythm and well as a processional rhythm that allows waste to move freely from one stage to another.

Water is redirected from the mountain to an existing estuary, responding to the issue of many houses flooding in Protea Dorp. Water is brought into the site to clean recovered materials and the movement is directed to the adjacent existing water point, becoming a communal resource.



Longitudinal section through knowledge centre and waste processing



Re[Source] Centre from north

SECTION 6

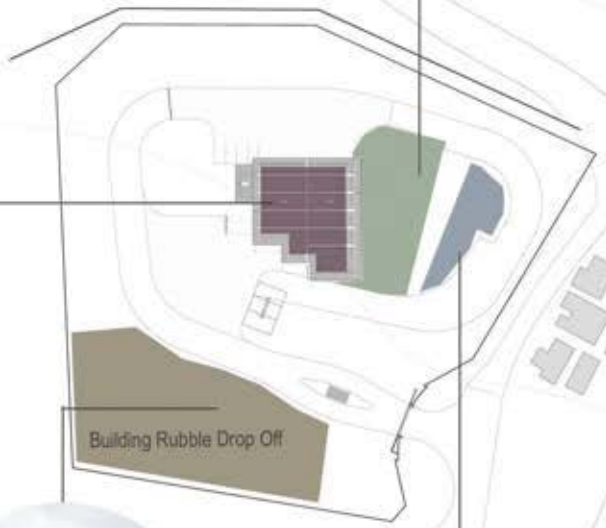
DEVELOPING A BUILDING METHOD

6.1 AVAILABLE MATERIALS ON SITE

Plant Material Drop Off & Chipping
all as organic composting resource

Found Resources:
Food scraps
Recyclable items
Building waste (timber)

Wet Kitchen Waste Drop Off



Building Rubble Drop Off

Found Construction Resources:
Concrete
Bricks
Timber
Steel
Roof Tiles
Ceramic Tiles

Found Construction Resources:

Plastic
- PET: Carbonated drinks bottle
  - Mineral water bottles
  - Clear boles
- PE-LD/LLD: bags
  - foam sheeting
  - bubble wrap

Cardboard & Paper
- White office paper
- Magazines and books (as long as nothing is laminated)
- Newspaper
- Cardboard (boxes and cereal boxes).

Metal
- Cold-drink and beer cans
- Food tins

Glass
- Beverage bottles
- Food jars

Household Recyclables Drop off

6.2 BUILDING MATERIALS AND METHODS

The structure of the design project is based on everyday resources generally taken for granted, namely waste. Building with waste remains a controversial topic, but changing our perceptions of waste can contribute to environmental, social, and economic sustainability. With the construction industry being one of the biggest exhausters of our natural resources, we should rethink the way we build. It becomes the responsibility of architects to push the idea of adapting the resources that are found in our urban environments. Our cities can become the mining grounds of valuable materials. Extensive research was done into recycled waste as building materials in my Theory & Technology Studies paper with regards to Location, Program, and Structure.

In this section, the types and implementation of particular building materials and building methods are presented to inform the design, which will be follow the written dissertation.

Aapart from using the recycled and alternative materials for cost saving, job creation and environmental purposes, it is also the intended to use them for purposes of education, research and development. It is foreseen that the local community as well as visitors, through observation or actual participation, will be able to gain knowledge and appreciation of the importance as well as advantages of recycled materials. This will be especially relevant for the workshops and shops that will be constructed in phases, as described below.

6.2.1 DIRECTLY RECYCLED BUILDING MATERIALS AND METHODS

In principle, the smaller new buildings and structures will be constructed with waste materials that are directly harvested and recycled at the Re[Source] centre as far as practically possible. These buildings will include the workshops, shops, garden centre and amphitheatre. The materials will be sourced from household waste, building rubble and garden waste as well as waste materials that will be acquired for building purposes, for example used timber pallets and poles from the fruit and wine farms in the region and pickets from ongoing alien vegetation clearing programmes.

It is foreseen that the following recycled building materials can be directly used:

- Foundation walls and column bases: Gabion baskets filled with building rubble, harvested bricks.
- Walls: Bottle bricks, gabion baskets filled with building rubble, harvested bricks, timber from pallets.
- Roof beams and columns: Timber from pallets, planks and poles.
- Roof sheets and tiles: Galvanised cladding sheets recovered from existing waste handling building.
- Doors and windows: Harvested items and items manufactured from timber and steel from building rubble.

In addition to this, various other standard as well as innovative items can be manufactured from waste using small equipment and power tools, for example: Cement-polystyrene bricks and panels, cement and clay bricks, windows and doors frames, doors, furniture, etc. Specific types of recycled materials and building methods are presented in Addendum B.

6.2.2 COMMERCIAL RECYCLED BUILDING MATERIALS AND ALTERNATIVE METHODS

It is foreseen that the larger process buildings, i.e. the kitchen waste, waste recycle and rubble sorting buildings, will primarily be constructed with commercial recycled materials and even some conventional building materials. The reason for this is that process buildings and more official buildings will require stringent building approvals and complex structural designs, which

remains a big challenge for recycled materials. Typical commercial recycled building materials and their sources are shown in Addendum B. Note that mostly conventional building methods are used for these materials.

WORKSHOPS AND SHOPS

It is planned that the workshops and shops on the eastern perimeter of the site will be constructed in two phases. The first phase will be to build a single room structure that will serve as a workshop and a space where re-cycled building materials can be stored and manufactured until enough materials become available to proceed with the second phase. For the second phase the workshop will be extended by a room that will provide more working space and space for display and selling of building materials and crafted articles like furniture and ornaments. A conceptual sketch of the combined workshop and shop, showing how the materials will typically be used, is given in Addendum B.

KNOWLEDGE CENTRE

The existing Waste-handling shed will be adapted into a Knowledge centre as discussed in Section 5. Existing galvanised sheeting that is used for cladding will be replaced with panels made from translucent recycled materials. It will be possible to open some panels to provide openness and unhindered views of the beautiful environment, as discussed in Section 5.

7. CONCLUSION

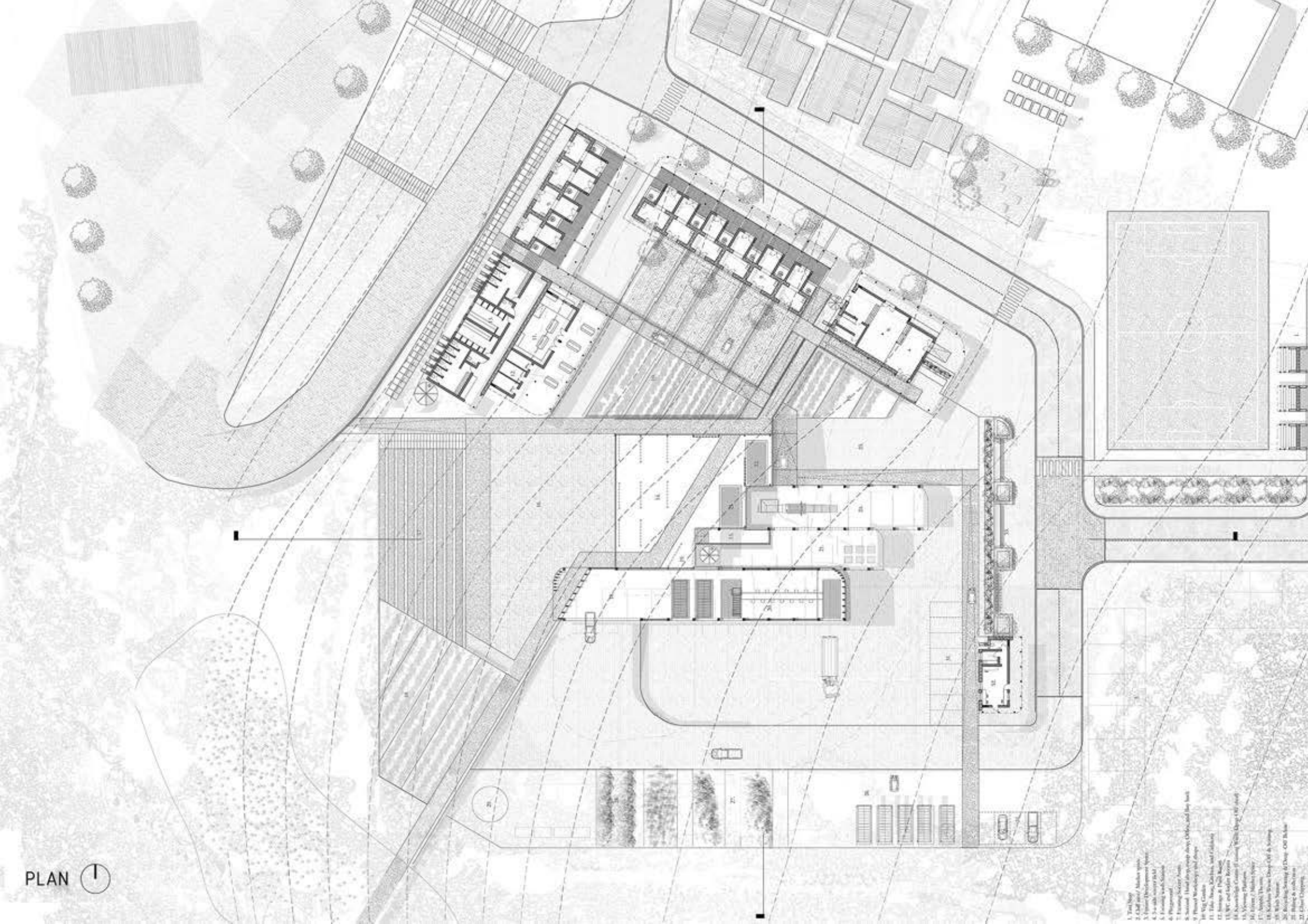
Reimaging our relationship with waste, its infrastructure, and its management, allows for new spatial, social, and environmental connections to be created. This promotes healthier environments and social communities.

It can therefore be said with confidence that the relationship between waste materials, waste infrastructure, society, and the urban and natural landscape needs critical evaluation. We should strive for a closed loop system where resources can remain within the economic cycle, rather than seeing the outcome of our consumption as a worthless product that should be excluded from our economic systems.

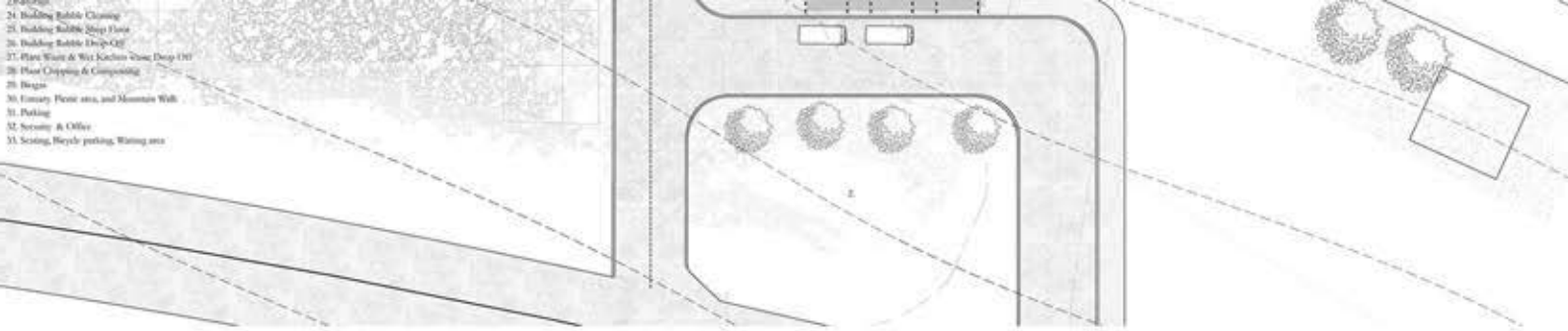
Openness, movement, and integration are spatial strategies that facilitate transformation. The architecture inspired by these processes allow the building to influence growth on a physical and mental level as time passes. The ordinary has now been revealed through transformation to become a valuable and spiritually golden public resource, in true spirit of the alchemist.

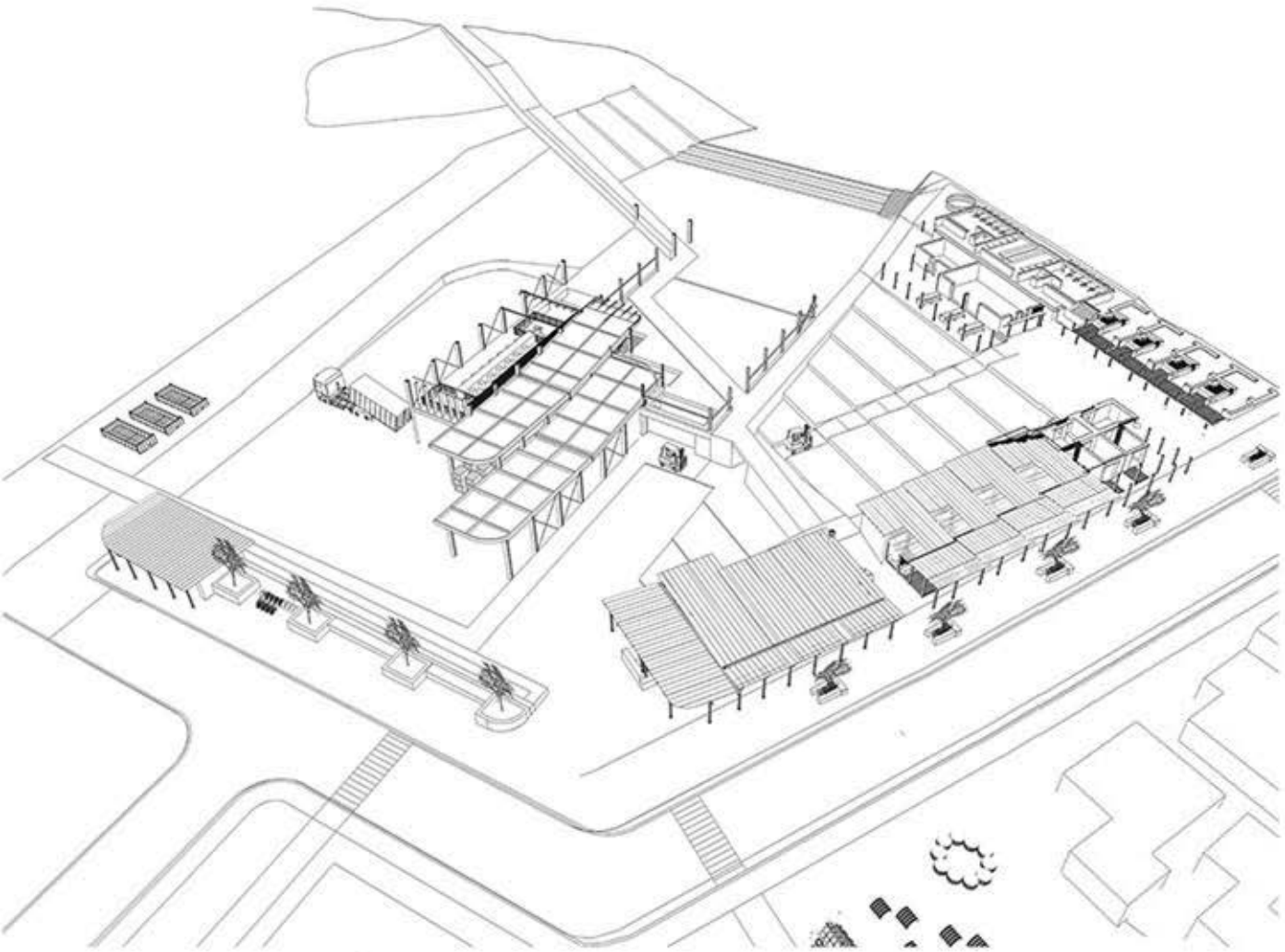
8. FINAL DRAWINGS

SITE PLAN 1
1:500

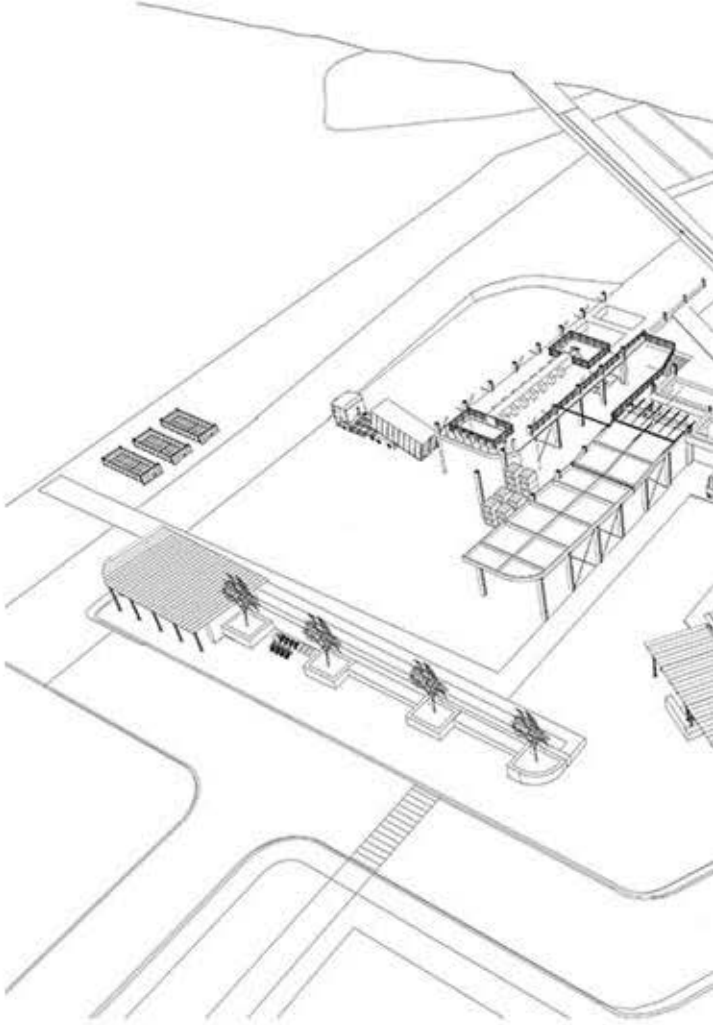


PLAN 1

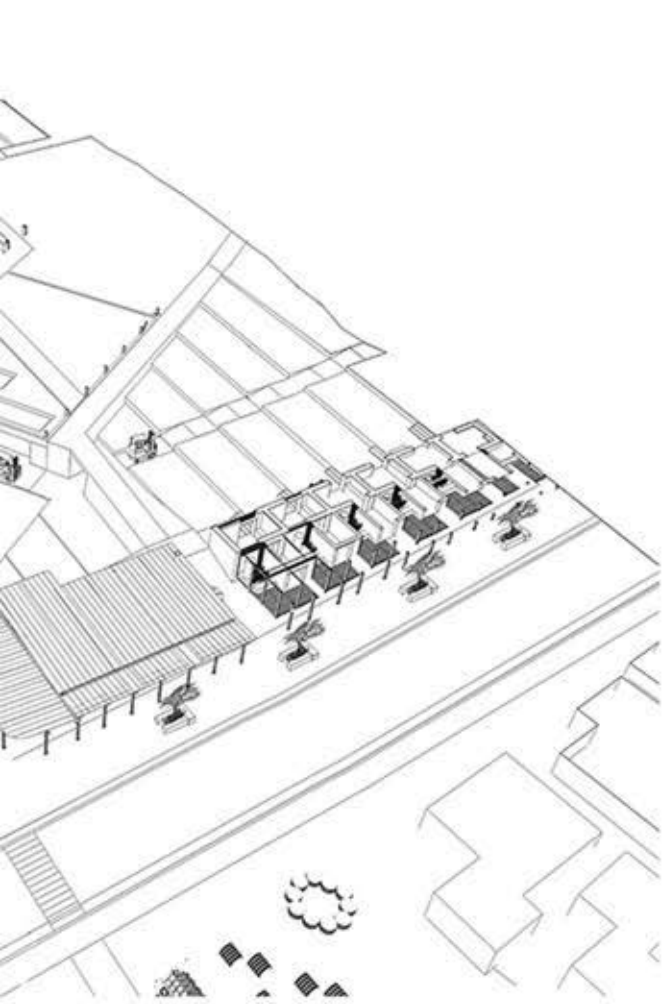

24. Building Rubble Cleaning
25. Building Rubble Shop Floor
26. Building Rubble Drop-Off
27. Plant Waste & Wet Kitchen Waste Drop Off
28. Plant Chipping & Composting
29. Biogas
30. Estuary, Picnic area, and Mountain Walk
31. Parking
32. Security & Office
33. Seating, Bicycle parking, Waiting area

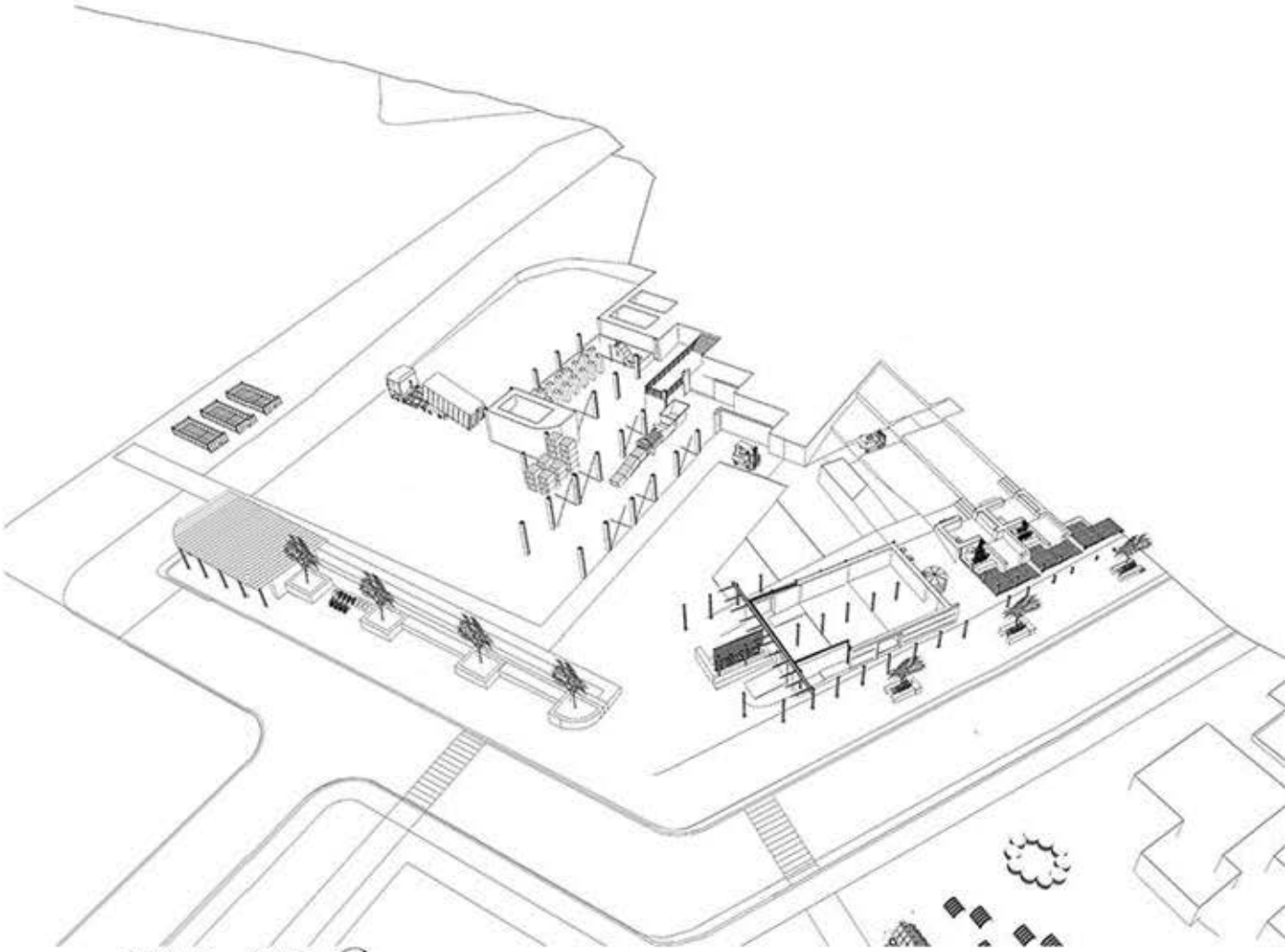


LEVEL THREE



LEVEL TWO





LEVEL ONE

PROPOSED WASTE FUNCTIONS

- Vehicular Movement Space
- Waste Drop-off & sorting
- Waste processing
- Future waste processing spaces
- Existing Structure

WASTE FLOWS

Community Food Garden

Workshops

Plant Waste drop-Off & composting/ Biogas

Kitchen Waste Drop-Off & Sortng

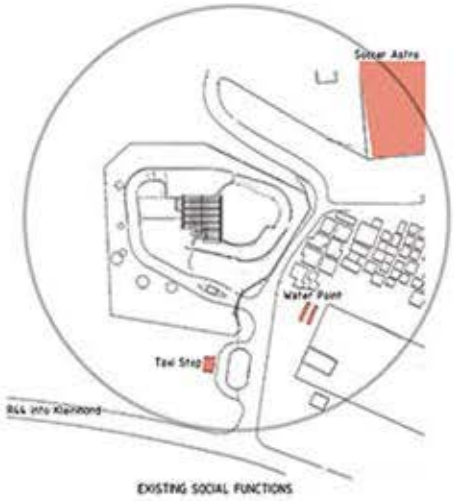
Recycling Drop-Off & Sortng

Building Rubble Drop-off & sorting

Security & waste Management

Vehicular Entrance

Potential Area for workshop development



PRO

Knowledge Centre / Event Space

Amphi Theatre

Everyday rest space, Sunday

Picnic Area

Caffeteri Away, Ki

WC Caf

Estuary

Pedestrian Entrance

Future Development

POSED SOCIAL FUNCTIONS

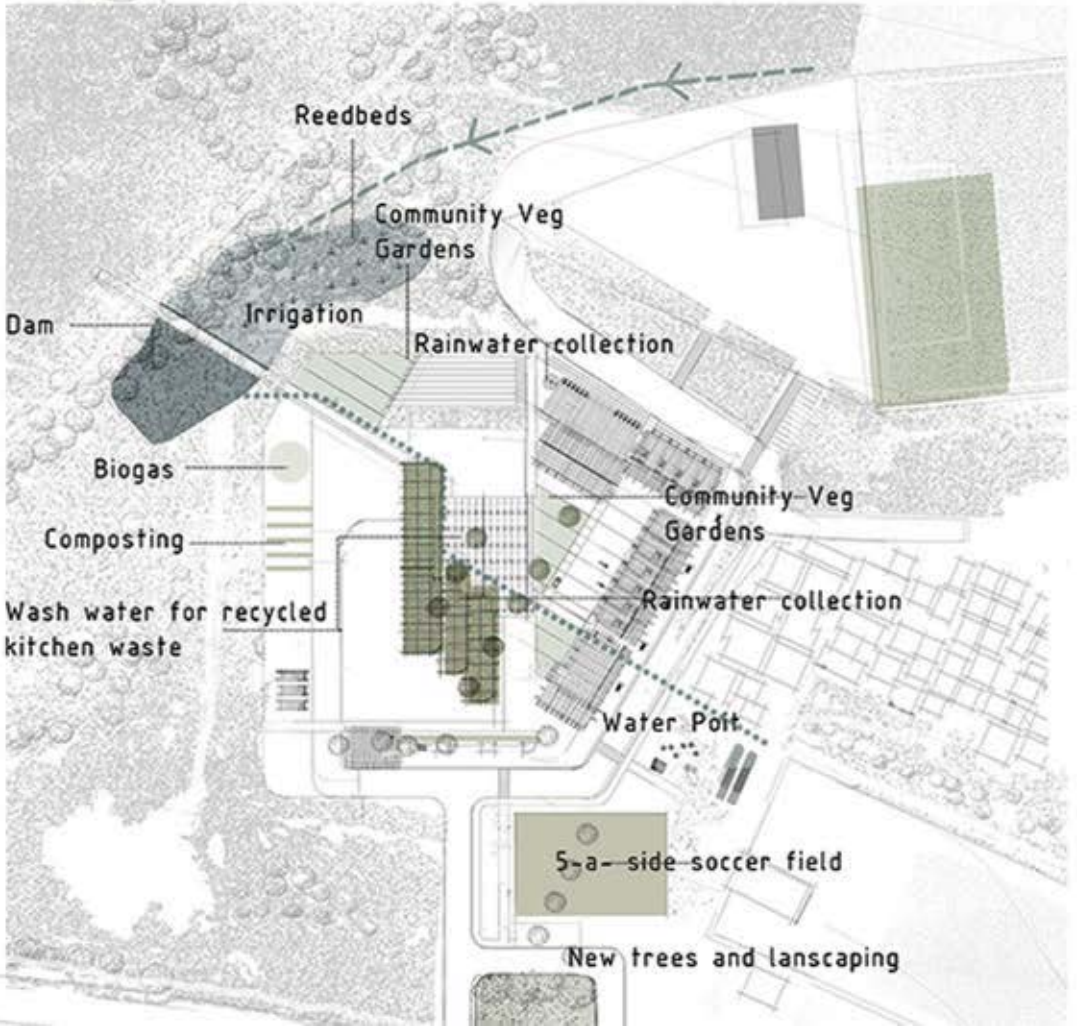
- Pavement
- Ramps & Walkways
- Trade / Shops / commerce
- Public / Event Space
- Recreational Space

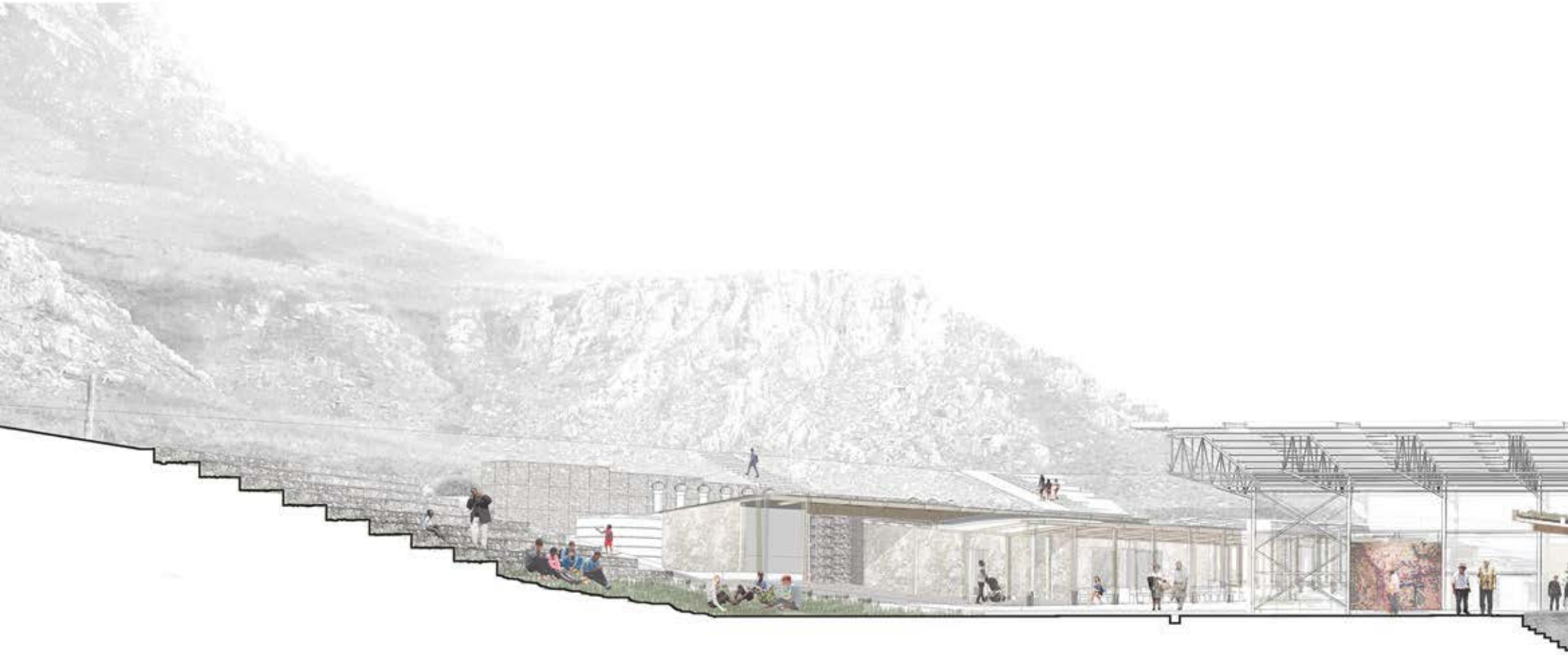
SOCIAL FLOWS

PROPOSED NATURAL RESPONCES & ADDITIONS

- Water
- Greenery

NATURAL FLOWS

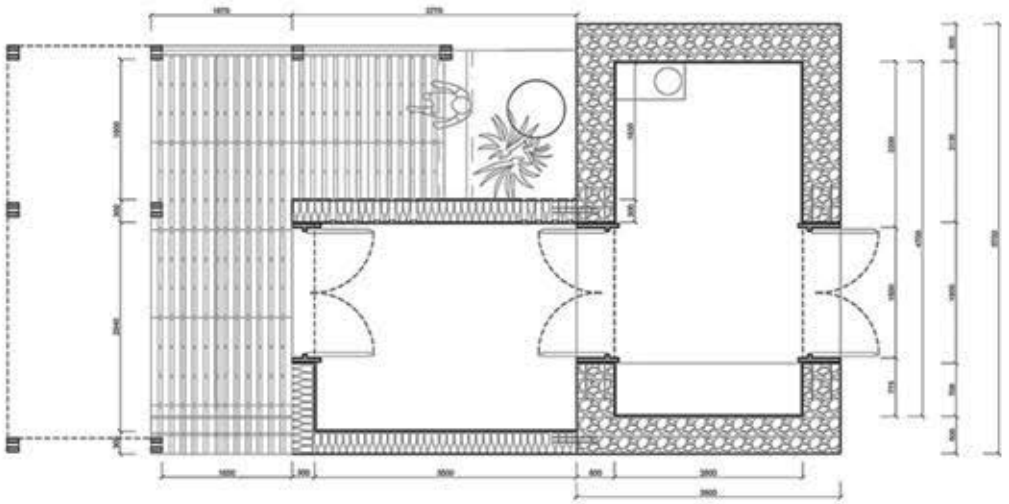


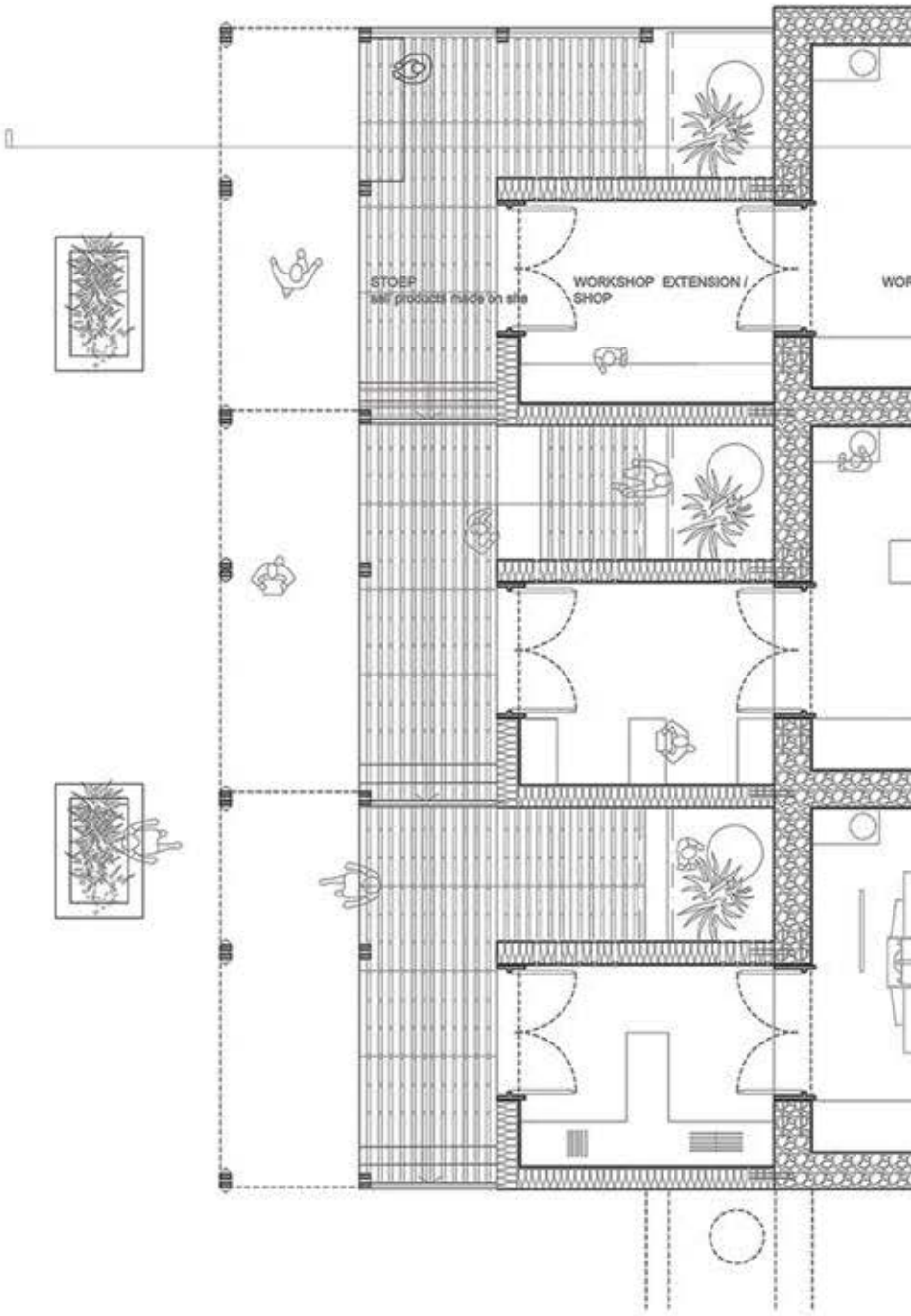


LONGITUDINAL SECTION

TRANSVERSE SECTION

1:50

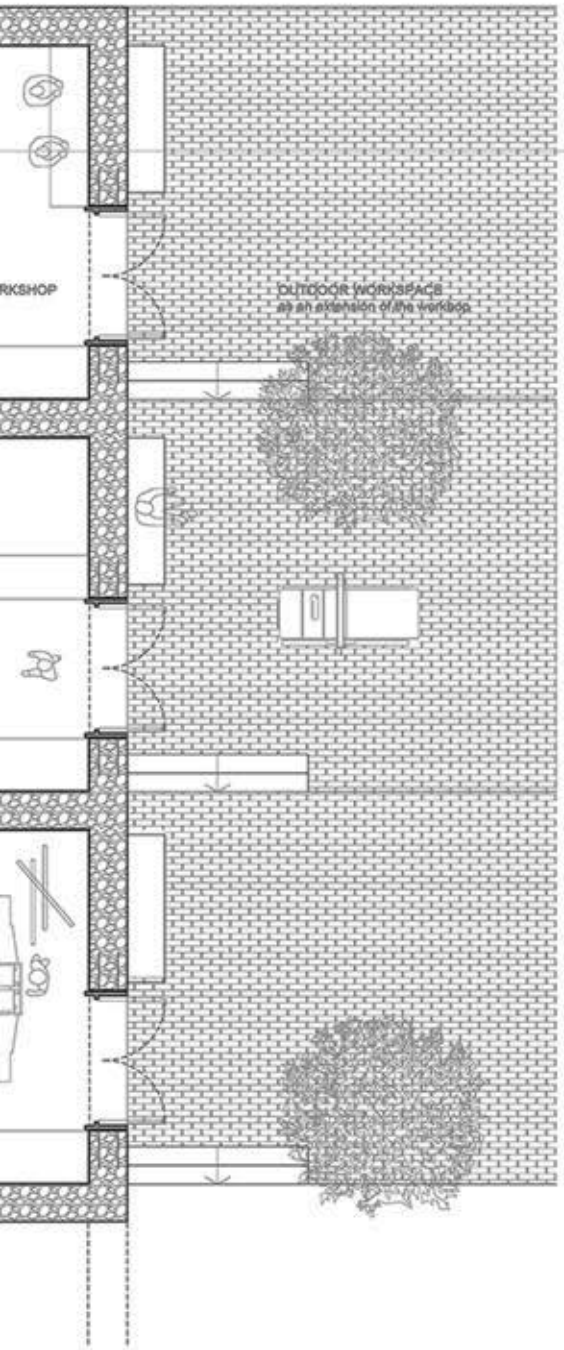




WORKSHOP TECHNICAL EXPLORATION

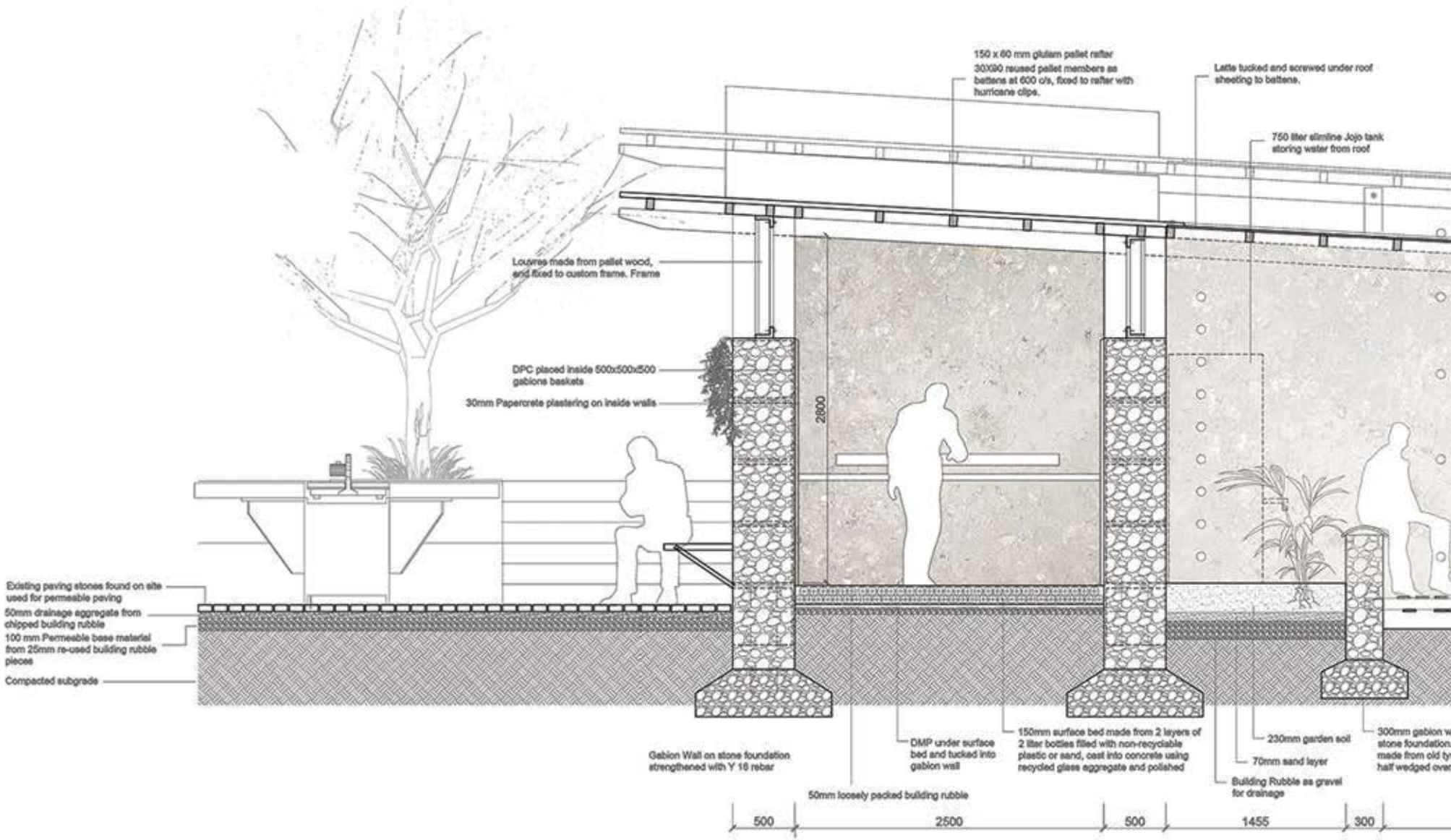
plans at 1:50

used to store recycled
example bottles.
rial is collected, the
th building rubble as

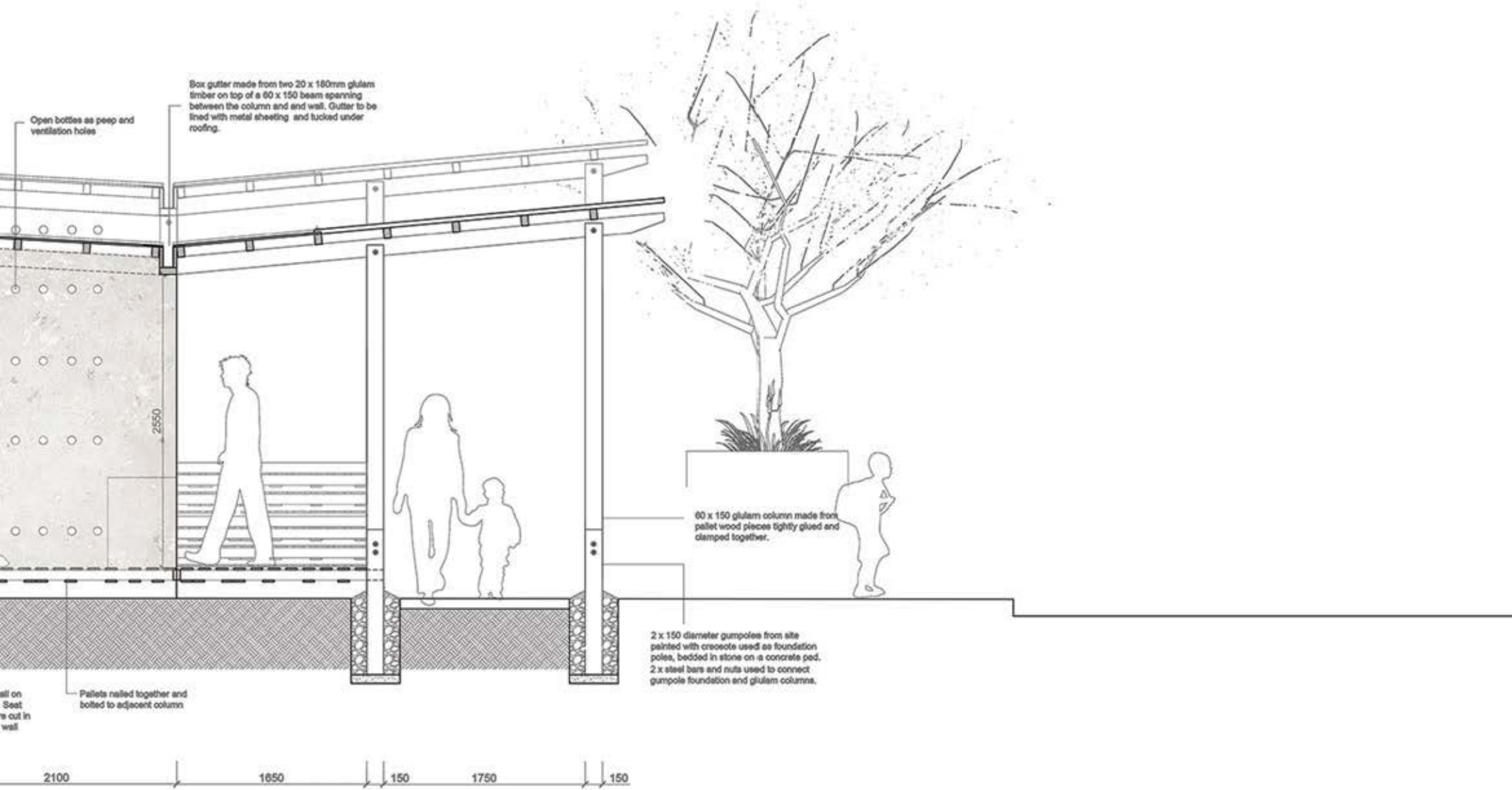


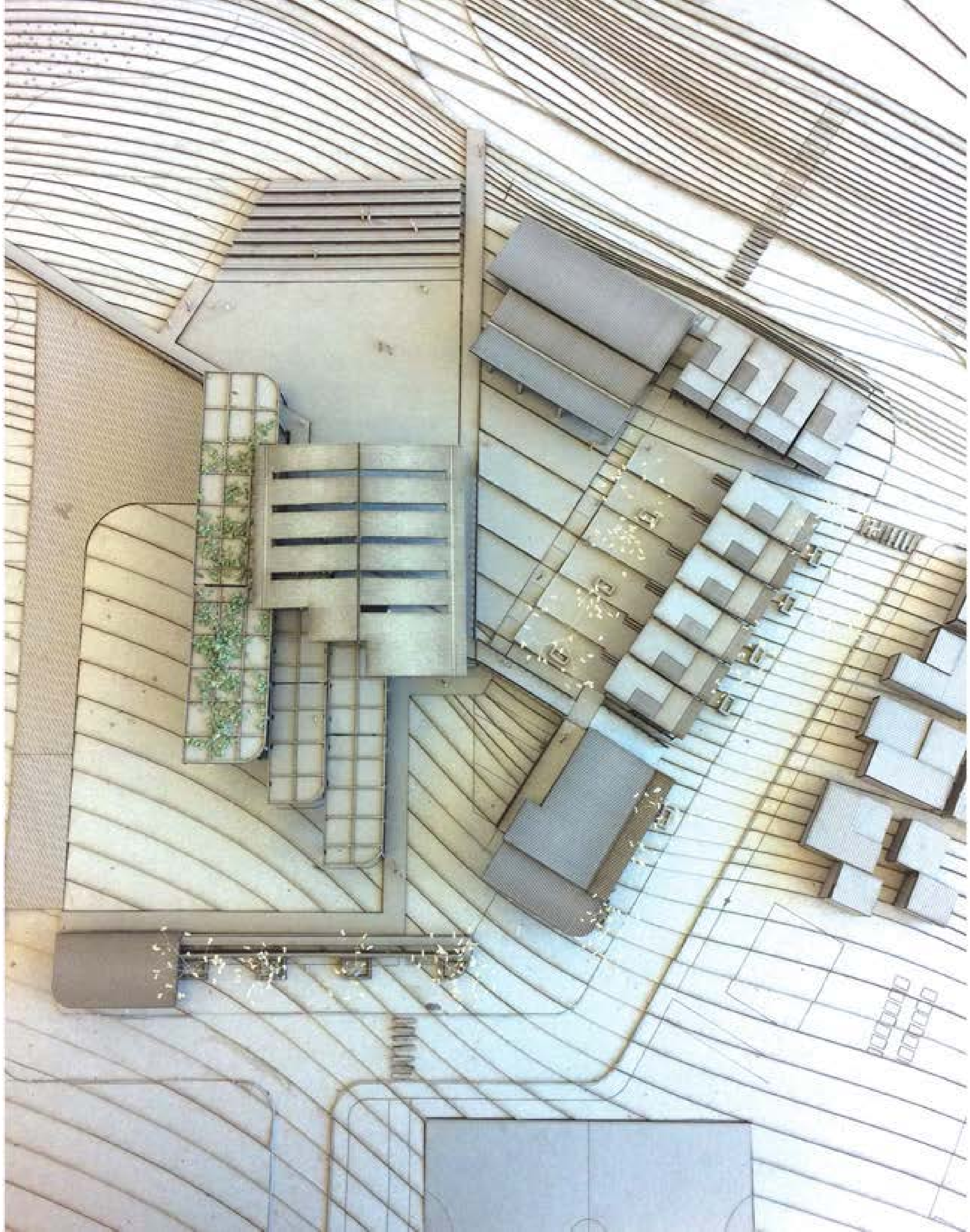
View facing inwards

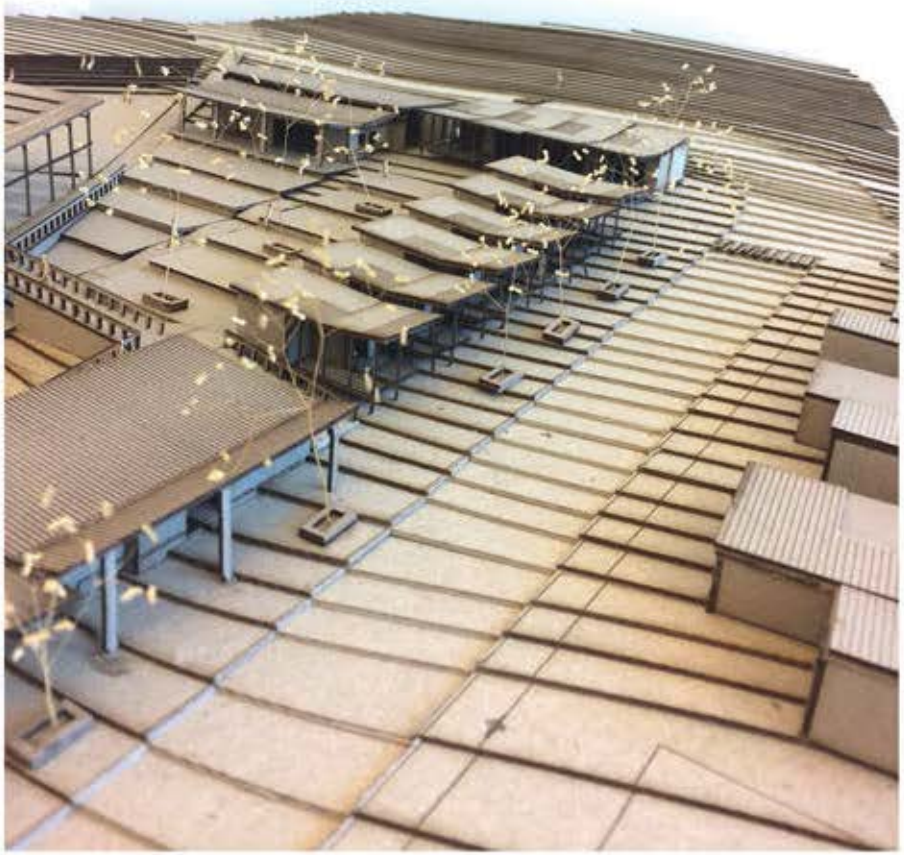
Street View



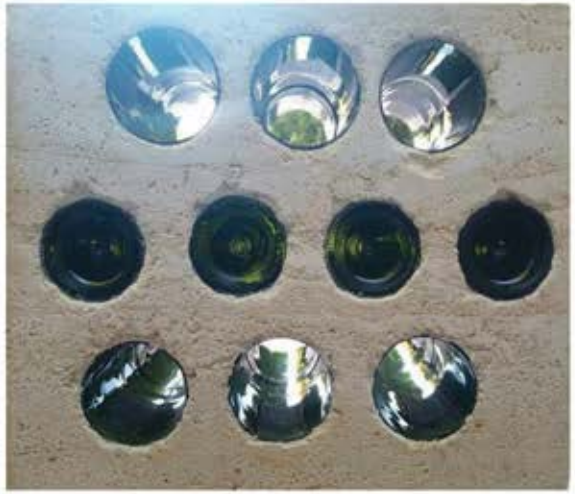
WORKSHOP SECTION


Box gutter made from two 20 x 180mm glulam timber on top of a 60 x 150 beam spanning between the column and and wall. Gutter to be lined with metal sheeting and tucked under roofing.
Open bottles as peep and ventilation holes
2550
60 x 150 glulam column made from pallet wood pieces tightly glued and clamped together.
2 x 150 diameter gumpoles from site painted with creosote used as foundation poles, bedded in stone on a concrete pad.
2 x steel bars and nuts used to connect gumpole foundation and glulam columns.
Pallets nailed together and bolted to adjacent column
all on
Seat
e cut in
wall
2100
1650
150
1750
150





Glass Bottle Brick Wall



Cut clean glass bottles and split by thermal shock along the score line.

Prepare glass tubes and bottle bricks as required.

Smooth edges via sanding.

Prepare concrete mix and build using prepared bottles (brick substitute).

Glulam Columns & Beams from Reclaimed Pallets

Strip pallet and plane the planks

Glue planks into sheets and bond by clamping

Prepare final glulam by gluing and clamping sheets

Plastic Bottle Brick

&

Papercrete Wall

Stuff plastic bottles firmly with non-recyclable plastics.

Prepare paper pulp from discarded paper material.

Prepare papercrete using paper pulp, concrete and sand.

Build using above materials and chicken mesh reinforcement.

8. LIST OF FIGURES

9. LIST OF TABLES

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10. ADDENDUMS

ADDENDUM A

ETHICS CLEARANCE

APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data.The objective of submitting this application *prior* to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook**(available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Louise Malan
Department		Architecture, Planning and Geomatics
Preferred email address of applicant:		Louisemalan5@gmail.com
If a Student	Your Degree: e.g., MSc, PhD, etc.,	M(Arch)
	Name of Supervisor (if supervised):	Stella Papanicolaou
If this is a researchcontract, indicate the source of funding/sponsorship		Click here to enter text.
Project Title		Understanding everyday life to enable Urban Acupuncture in Kleinmond, Western Cape

I hereby undertake to carry out my research in such a way that:

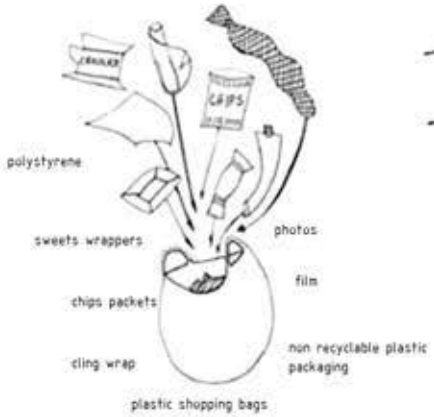
- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Louise Malan	Signed	28 Jul 2017

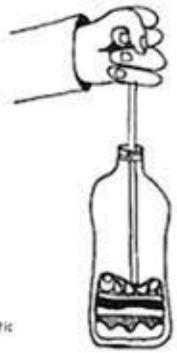
APPLICATION APPROVED BY	Full name		Date
Supervisor (where applicable)	Stella Papanicolaou		28 Jul 2017
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1; and for all Undergraduateresearch (Including Honours).	Toma Berlanda		28 Jul 2017
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.	**Roger Behrens** Click here to enter text.		**06Sep17** Click here to enter a date.

ADDENDUM B

BUILDING WITH WASTE CASE STUDIES

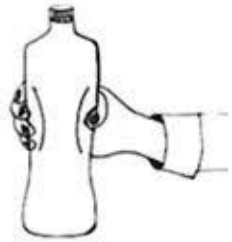


STEP 1:
Collect, clean, and dry non biodegradable plastic waste at home/ drop off station.



STEP 2:
Compress waste in plastic bottle with stick or rod.

STEP 3:
Pack waste tightly throughout the process to ensure that the bottle is 'unsquishable.'



STEP 4:
Squish bottle with one hand to measure if its full enough. (squish < 10% = complete)

STEP 5:
Celebrate! The Eco-brick is ready to be built with.

Figure X: How to make an Eco-brick
source: https://www.facebook.com/EcoBrickExchange/ accessed 27/09/2017

PLASTIC

Plastic is not separated from kitchen waste or recyclables at Kleinmond Waste Drop-off and Transfer Station. With the intention to introduce a sorting station on site, plastic can be identified for construction and recycling which can be stored on site or transported to the Hermanus Walker Bay Recovery facility.

One of the most popular consumer plastic in the world is Polyethylene terephthalate (PET). It is commonly used for containing food and beverages, with PET bottles forming a massive part of consumer's yearly waste production. PET is easily recyclable, but sadly, a majority of it ends up in landfills, especially PET bottles. PET products are extremely robust in the sense that it can last for decades. Because PET is hardly degradable, it has the ability to end up in our food systems by, for example, fine pieces of plastic floating in our ocean that is eaten by fish, and ultimately by us. (Hebel, et al., 2014) On the other hand, the robustness of PET bottles can be seen as a resource that can be used for construction

In Kleinmond two bottle 'fills' are avialable: Sand as it is located close to the beach where an abundance of wet and dry sand can be found; and waste plastic at Kleinmond Waste Drop-off and Transfer station.

Figure X & X: Children, woman, and elderly are able to fill bottles with waste or sand to create the Eco-brick.
source:https://www.seed.uno/awards/all/2015/ecobuick-construction-facilitation-service.html accessed 28/09/2017

ECO - BRICK CONSTRUCTION

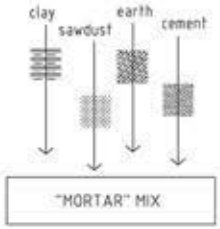
PET bottles can be used to create Eco-bricks and ultimately bottle walls. This building method has become more popular in the past decade, especially in developing countries such as Uganda, Colombia, Mexico and even South Africa. It uses a system where PET bottles are tightly filled with non-recyclable materials to form an eco-brick.

The benefits of using the Eco-brick as a building materials is first and foremost its environmental sustainability by minimising landfill space through reusing PET bottles and non-biodegradable plastic. It also minimises the production of new materials which protects out natural resources, and reduces the production of CO2. Secondly, the making of the Eco-brick is low-tech, and has the ability to empower marginalised and vulnerable communities. At the Idutywa Crèche in the Eastern Cape, bottle filling has become an economic opportunity, where ladies filling the bottles earn from R1 to R3 per bottle. The low-tech nature of this construction system allows people to be trained in to building and maintaining community projects and even their own homes.

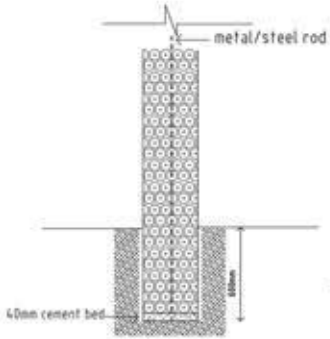
A study done in 2014 at the Curtin University Sarawak, Malaysia and University College Cork, concluded that the Eco-brick is a viable resource for a number of applications within the construction industry. The nature of the Eco-brick is lightweight, non-brittle and strong, and its compressive strengths values matched the strength of the basic concrete block. The lightweight characteristic can reduce transportation costs and minimise the chances of obtaining an injury on site by lifting heavy materials. The sound index was tested and indicated that the Eco-brick has a high sound reduction index due to its greater density compared to the concrete block. The density also allows for good thermal properties, keeping a building cool in the summer and warmer in the winter.

The disadvantage of the Eco-brick is that it is not fire resistant, and plastic can easily catch fire. Having said that, the bricks are usually covered by a cob or cement mix, which will offer some fire resistance. (Taaffe, et al., August 2014)

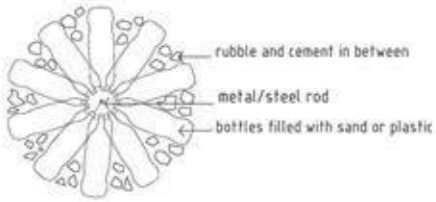
1. Fill bottles with sand/waste. Compress with stick/rod and close bottle top



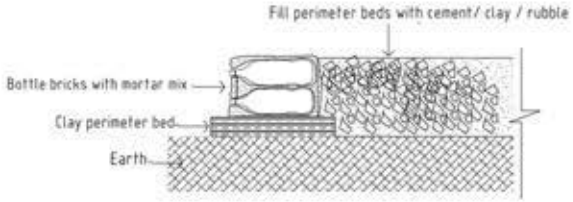
2. Mix earth, clay, sawdust, and a little cement. This will act like mortar between bottle bricks



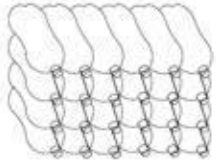
3. Foundations & columns. Dig a cylindrical pit about 600mm in depth. Make a cement bed of 40mm in the pit. Insert a long iron/steel rod at the centre. Tie a long and strong sting around the rod.



4. Lay 10 bottles around the rod radially orientated towards the centre. Take the tread and make a knot around each bottle neck. Fill the gaps between the bottles with rubble and cement.



5. Foundations & surface bed: Make a clay bed about 50mm high and 50mm wider that the bottles around the perimeter of the platform/surface bed. Lay the bottles (neck facing outwards) one by one on this bed and tie them to each other to strengthen the structure. After laying the course, fill the inside area with cement, clay, or rubble.



6. Walls: Continue with the same method as the perimeter bed, laying course by course and tying them together as you go up.

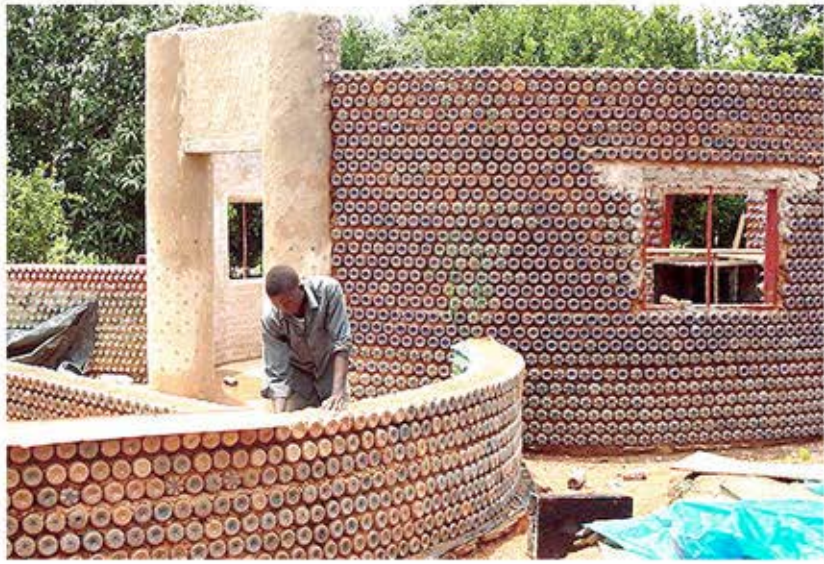


Figure X: Bottle Brick & Column System
source: Image: https://za.pinterest.com/pin/429741989418302580/accessed 27/09/2017 Drawing: Author (2017)

ECO-BRICK/BOTTLE BRICK STRUCTURAL SYSTEMS

(see addendum X for detailed photographs)

There are various ways of using the Eco-brick or the Bottle brick for construction. There are four types of structural systems: The bottle brick and column system, the frame and infill system, Eco-block system, and the PET bottle and fishnet system.

1 BOTTLE BRICK & COLUMN SYSTEM

see figure X

This system uses a similar approach to conventional masonry construction. Bottle bricks are horizontally layered on top of one another with a mortar or cob mix placed in between each layer. Bottle caps are tied together for extra stability. Circular structural columns made from bottle bricks are be placed at intervals to support the walls. Steel rods are placed in the centre of these columns and the radiating bottles are tied to the rod.

A consideration of the Bottle Brick & Column system is the big circular columns that should be placed in structural intervals. Precedent studies also indicate walls predominately built in a circular fashion for more structural stability.

2 FRAME & INFILL SYSTEM

The frame and infill system can use bottles in two ways: bottles can either be kept empty and strung together and fixed to the frame. Alternatively, bottles can be filled with sand or waste and kept together in the frame by means of steel rods, cages, or cob/cement mortar mix. The structural frame can be made from concrete, timber, brick, or steel. The walls can be plastered afterwards or left as it, which may have aesthetic benefits. The disadvantage of this system is that more steel/wire mesh and structural elements are necessary which may be less sustainable than the bottle brick & column , and PET bottle and fishnet system. Bottles that are exposed also poses a fire risk, and has the ability to degrade in the sun.

3 ECO-BLOCK SYSTEM

This system was developed in South Africa and uses two pieces of plywood on either side of the bottle brick. Holes are cut in the wood for the alternating bottle caps and are tied together with reinforcing string. This forms a block which can be stached on top of one another. This structural system avoids cement as a binder, which means that the bottles can be re-used after building demolition. and allows for buildings to be easily extended. This is a relatively new concept, and cladding and fire safety of this system should be considered.

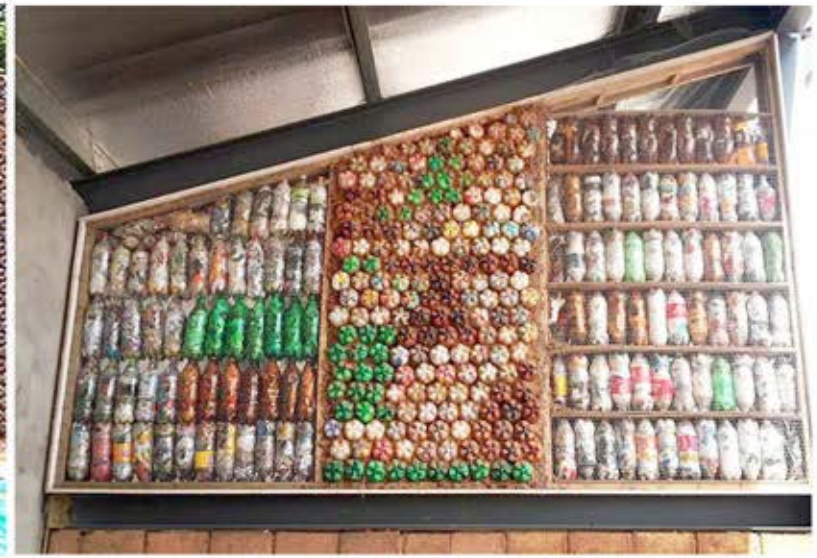


Figure X Delft Early Childhood Development Centre in Cape Town used 3 kinds of Eco-brick technology in one wall using the Frame and Infill system. On the left two skins of vertically stacked Eco-bricks are caged in between chicken mesh wire; in the middle Eco-bricks are stacked horizontally with cob in between the gaps; and on the right Eco-blocks are stacked vertically. with chicken mesh over to allow for plastering afterwards.
Source: https://www.facebook.com/EcoBuck Exchange/photos/ a.361738917268910.1073741831.
356852801090855/1278094772299982/?type=3&theater accessed 29/09/2017

Opposite page Figure X:
PET Bottle & Fishnet Construction method.
source: SamarpanFoundation, 2015

Bottom Right Figure X :
Filled recycled PET Bottle construction configuration.
Source: SamarpanFoundation, 2015

Figure X Redhills Forest Nursery, Chennai, India. The double story structure and 8m tall water towers are built with bottle bricks and uses fisnet & fishnet ropes for reinforcement.
Source: https://samarpanfoundation.org/news/redhills-forest-nursery-relocates accessed 27/09/2017

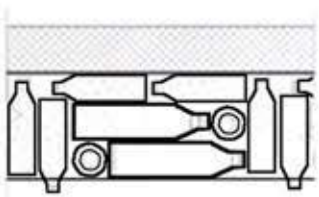
4 PET BOTTLE & FISHNET CONSTRUCTION

Samarpan Foundation - South Africa, India, Nepal, Australia, Malawi (see addendum X for detailed photographs)

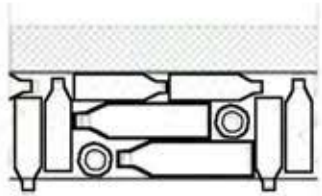
The PET bottle and fishnet system uses 500ml, 1 litre, and 2 litre reused PET bottles bricks either filled with sand, mud, or fly ash. The main benefit of this system is that it uses fishnet and fishnet ropes as reinforcement rather than steel. The means that the impact on the environment is reduced as well as the building costs. Samarpan Foundation, that have used this system all over the world, claims that fishnet costs 5% of steel, and reduces the total building cost by 60%.

The building method has undergone numerous structural tests in India and in South Africa and has passed with flying colours, able to withstand earthquakes up to 9.8 on the Richter scale. Double story units and 8m tall water towers holding 6000 litres of water has been constructed without using steel.

Architecturally, circular or rectilinear structures can be built with flat roofs and without columns,. Lintels and beams are also not required as tensioned fishnet ropes provide sufficient support. Floors and raised floor levels can also be constructed using this system. (SamarpanFoundation, 2015) The disadvantages of this system is that it uses cement mortar between bottles, rather than more environmentally friendly solutions such as cob. This can be justified by arguing that no steel, concrete, or timber frames are necessary for structural stability and therefore less requires less new materials.



PET Bottle course 1



PET Bottle course 2

1) Foundations trench dug as per load bearing capacity of soil.

2) 15cm of PPC cement laid at base of foundation trench.

3) Bottles placed in trench at twice the width of the wall.

4) A mixture of 1 part cement and 6 parts sand is poured between bottles. Nylon 6 fishnet (210 denier, 3 ply, 3cm x 3cm) and fishnet ropes (Nylon 6 fishnet cut 20 squares wide & twisted to make ropes) are placed over foundation.

5) Bottles are arranged on foundation according to figure X configuration. Fishnet ropes are placed every half meter.

6) Windows and doors are created by pulling the fishnet rope in high tension, 60 cm beyond the opening.

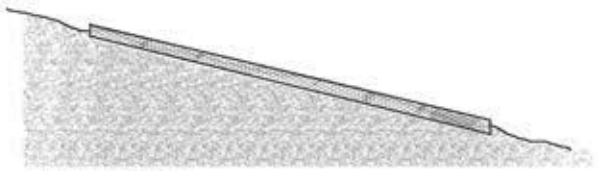
7) Once the height is achieved, fishnet is connected to the bottle caps on the outside surface, making the bottles one continuous surface.

8) The roof is cast by using conventional wood shuttering with fishnet ropes over it. A concrete slab (1 part cement, 3 part sand, 3 part gravel 16mm) is cast over the fishnet ropes and a layer of fishnet is placed on top.

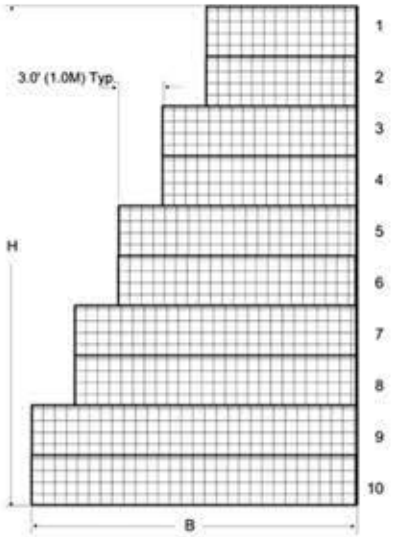
9) The walls are plastered and the fishnet is trimmed and melted with frame at the rod and window openings.

Figure X: Top right: Three Gabion systems.
source: Main, K, 2016 reworked by author 2017

Figure X: Below: General design Principles for Gabion walls.
source: http://www.gabions.net/downloads/Documents/MGS_Design_Guide.pdf accessed 29/09/2017



GABION MATTRESS



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	H	B
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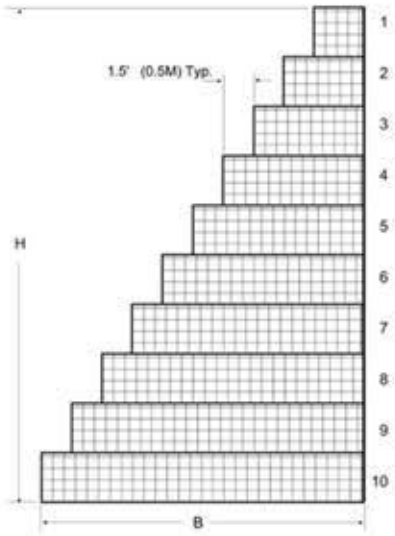
2	2.0	2.0
3	3.0	3.0
4	4.0	3.0
5	5.0	4.0
6	6.0	4.0
7	7.0	5.0
8	8.0	5.0
9	9.0	6.0
10	10.0	6.0



NO. OF COURSES	METRIC METERS	
	H	B
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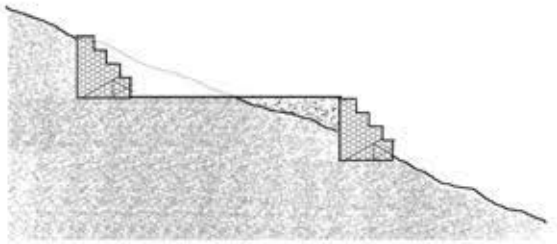
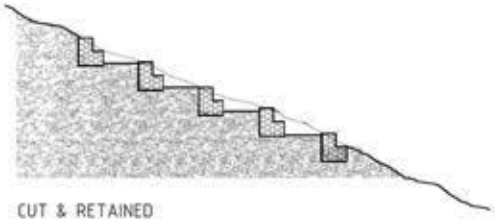
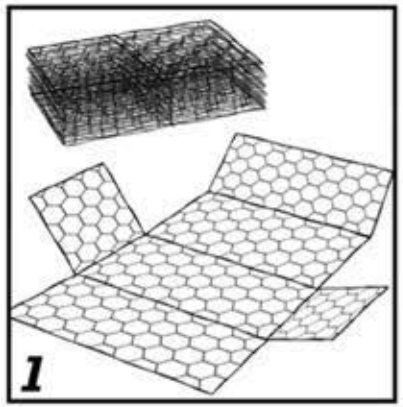
3	3.0	2.0
4	4.0	2.5
5	5.0	3.0
6	6.0	3.5
7	7.0	4.0
8	8.0	4.5
9	9.0	5.0
10	10.0	5.5

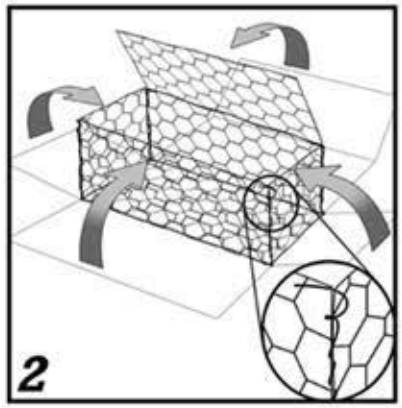


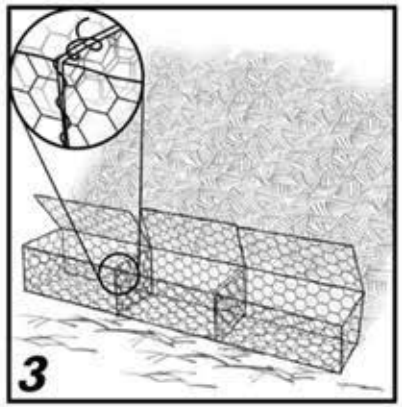
CUT & FILLED

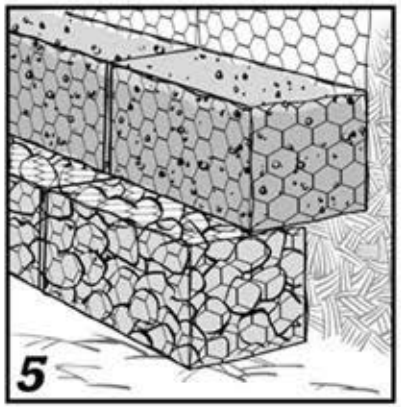


CUT & RETAINED









BUILDING RUBBLE

The construction industry is one of the biggest exhausters of our natural resources and produces massive amounts of CO2 that enters our atmosphere daily. Although the reuse of building rubble is evident in the construction industry, vast amounts still end up in our landfills every year.
At the Kleinmond WDTS, building rubble is dropped off at the station and transported to Karwyderskraal Landfill. Concrete, cement, masonry, stone, and tiles are chipped and used for landfill capping, or alternatively sold to civil companies for road aggregate (Louis, 2017). In other instances, building rubble is used as fill for surface beds, bricks are reused by chipping off old mortar, and timber used for cladding and furniture. An opportunity exists to reuse more amounts of construction rubble in the built environment, minimising the impact of the environment.

GABION STRUCTURES

The introduction of gabion systems relates to the sloping nature of the site, as well as the availability of great amounts of building rubble as fill. Gabion structures have been used for decades, mostly in the civil work industry as foundations, retaining walls, stabilising soil banks against erosion, and directing water.

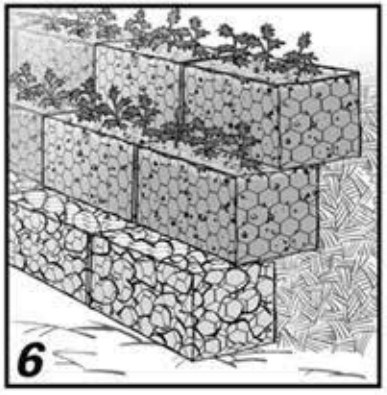
Gabion systems at the RE(SOURCE) centre can influence members of the Overhill community to apply it to their own scenarios. After interviews and time spent in Kleinmond, it is evident that storm-water in the rainy season was a massive issue. Overhill residents dig trenches before each rain but is only a temporary solution. Gabion structures filled with builders rubble can be a more permanent solution to this problem.

GABION SYSTEMS

There are two types of gabion approaches to treating the landscape namely matrasses and boxes.
Matrasses are usually used over large slopping sites or river beds to prevent ground erosion. They are similar to gabion boxes, made from welded wire mesh and spiral binders to contain the stone filling, but relatively low in height in comparison to their horizontal dimension.

Gabion boxes are used to retain earth, and the landscape can either be 'cut and retained', or 'retained and filled' as indicated in figure X. This ultimately creates flat surfaces that slow down the flow of water, as well as create more walkable landscapes. This system can also act as a means to collect surface water runoff.
Both these systems should be placed on a layer of geotextile to prevent finer sand and soil to pass through the gabion. The geotextile in the case of the gabion boxes should be laid at the interface of the wall and the backfill.

Gabion structures are made by neatly filling different sized galvanised mild steel woven baskets with various sizes of stone, gravel, or soil. This filling process takes place on site to form monolithic, permeable, and flexible structures. Gabion baskets can be purchased as units, unassembled panels, or can be made on site from rollstock. When baskets are assembled, they are fixed to one another and the foundation by means of spiral binders in each corner. They are filled, closed, and ready to receive the next course on top. This is repeated until the desired height is achieved. The higher it goes, the more buttressed it would require (Figure X). An engineer should determine the structural qualities (height, size, amount of buttresses) of the gabion after a geotechnical engineer has completed a soil inspection. Gabions.net have supplied a basic gabion design system, which can be used for spatial and architectural planning.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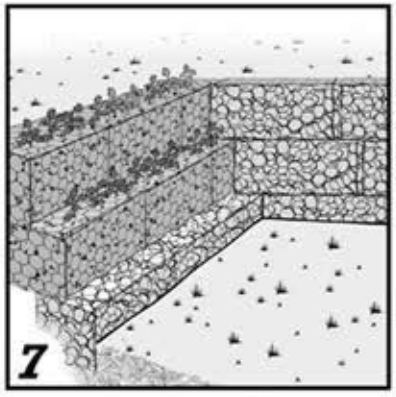
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Figure X: Opposite Page:
Gabion construction details by Nina Maritz Architects
Figure X: Bottom: Gabion Walls by Nina Maritz Architects
source: Ninamaritzarchitects.com

Gabion systems have been used in various architectural applications, as structural and non-structural elements. It can become great landscaping elements, water and soil retainers, pathways, furniture, and semi-permeable wall structures. Nina Maritz, a Namibian Architect uses large gabion walls in various projects. Wire baskets are made on site and usually filled with rubble from demolition sites. These are up to 5 meters in places, and Maritz states that the rectilinear rubble blocks create regular patterns in a contemporary style (Maritz, n.d.). In all of Maritz's projects, focus is put on environmental and social sustainability

The benefits of Gabions are that their strength and stability increases with age, due to silt and vegetation forming in-between the rocks. The natural habitats contribute to the aesthetic qualities and emphasise its relationship with the environment. Reusing building rubble also contributes to the idea of minimising the impact on the environment. Rather than hand-laying great amounts of stone that uses vast amounts of cement and water, gabions are a great alternative. These structures are therefore lighter, timesaving, and cost saving. Gabion walls can take great loads immediately after construction and as opposed to concrete construction, does not crack, or deform under pressure.

Socially, low-skilled labour can construct the modular gabion systems, filling baskets and closing them property, with no need for mechanical equipment. If carefully constructed, gabions are virtually maintenance free (Gabions.net) and can be dissembled after their lifetime and used elsewhere, remaining within a closed loop cycle.

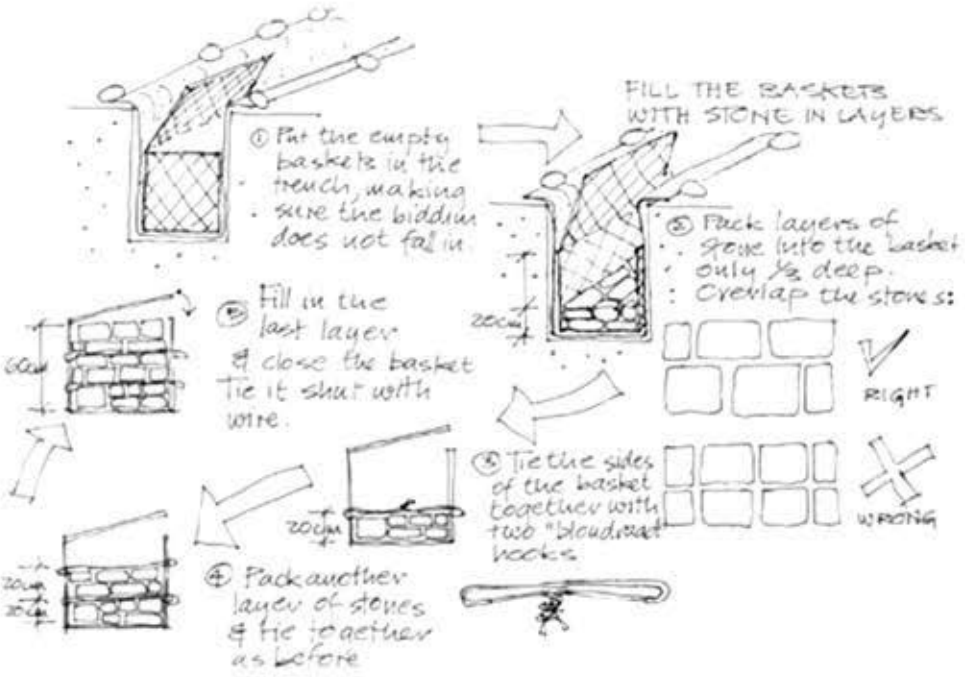
The gabion wall system in architectural applications is thermally efficient, as it can be heated by the sun during the day, stored, and slowly released during the night. Its permeability also allows for wind and light to gently pass through the voids, creating natural ventilation and light.

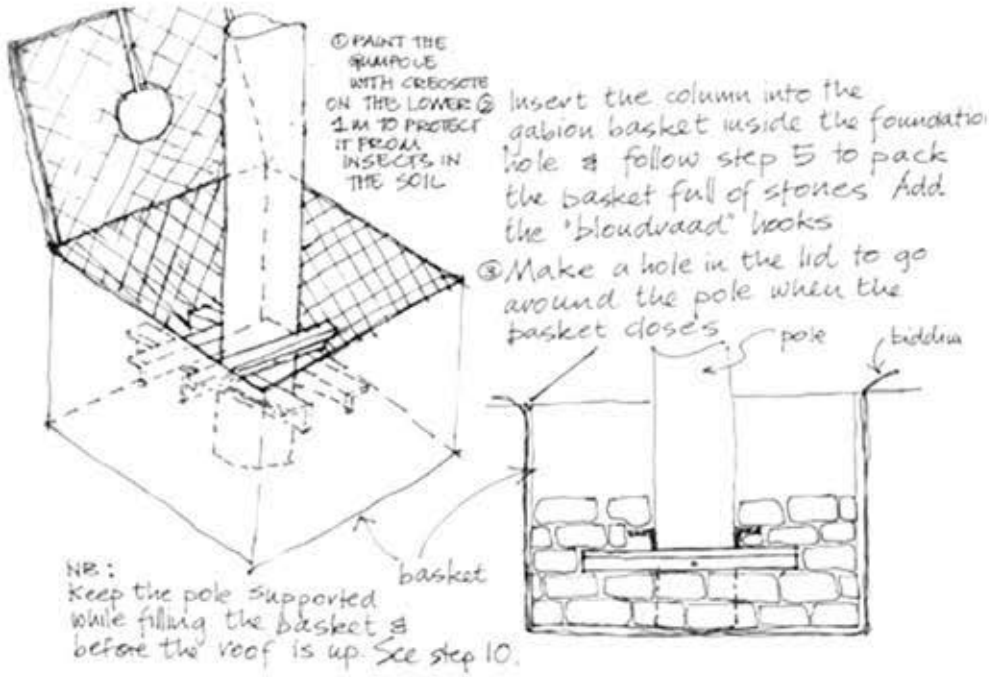
Figure X: Collectif Saga Architects' Silindokuhle Preschool in Port Elizabeth using eucalyptus trees and reclaimed wood as roof support.
source: http://collectifsaga.com/fr/home-fr/ accessed 29/09/2017

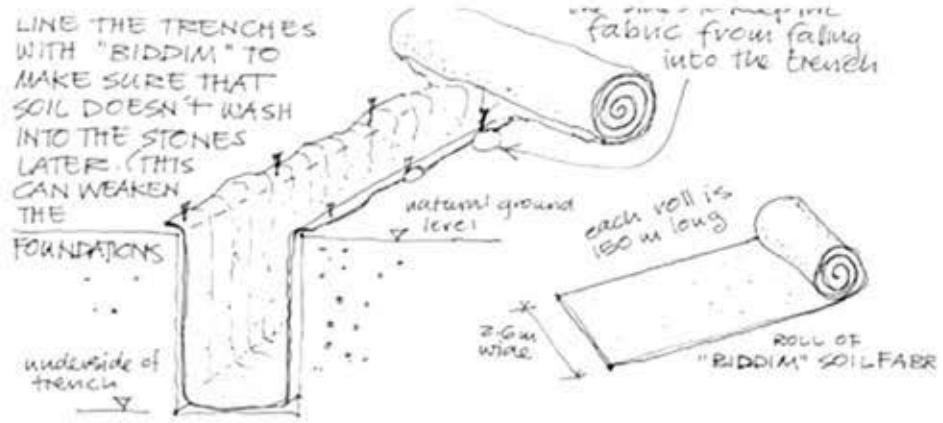
Figure X: Africa Centre by Eastcoastarchitects constructing a roof from reclaimed Eucalyptus poles, and thatching laths are used for shading and balustrades.
source: https://www.eastcoastarchitects.co.za/eca-africa-centre.html accessed 29/09/2017

Figure X:Nina Maritz' Habitat Resource and Development Centre using reclaimed wood in between steel members as a shading device.
source: http://www.afritecture.org/profiles/nina-maritz-understanding-responding-context accessed 30/09/2017

Figure X:Uiba-Oas Crystal Market by Nina Maritz architects using relained invader trees as roof structure and support.
source: http://www.ninamaritzarchitects.com/uiba-oas-crystal-market/ accessed 30/09/2017







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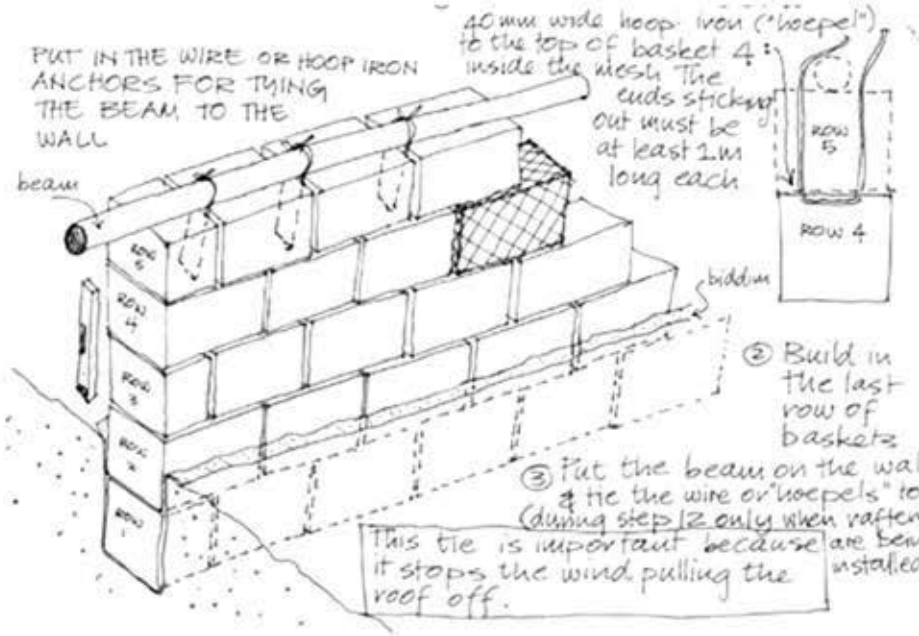


Top Figure X : BARNagain by In.Site-Architecture, using reclaimed timber as cladding.
source: https://www.6sqft.com/
accessed 29/09/2017

Middle Figure X : Timber found at the KWDTS in landfill waste.
source: Author (2017)

Bottom Figure X: Reclaimed timber cladding texture.
source: https://www.houzz.com/
product accessed 29/09/2017

TIMBER

At the Kleinmond WDTS, timber is not separated from the waste stream and remains within the landfill pile. This is a wasted opportunity, as timber is easily reusable. Reclaimed timber is a popular material for furniture manufacturing, and a few artisans in Kleinmond make use of this resource. They do however collect their wood from other sources, as KWDTS does not separate it from building rubble and kitchen waste. Reclaimed timber can be used as structural elements by configuring the timber into frame-like units. It can also be used as non-structural members for shade screens and overhangs.

INVASIVE ALIEN TREES

Kleinmond and surrounds have been fighting invasive alien trees for years. Australian myrtle, long leaf wattle, black wattle, Australian albizia and spider gums are clearly evident along the R44 and in large part of the Kogelberg Biosphere. The Kleinmond Nature Conservation Society (KNCS) and the Kleinmond Hack Group invests a lot of their time in clearing areas with invasive trees. Every third Thursday of the month, 20 members of the Hack Group joins a session where alien trees are 'hacked', which includes less accessible areas such as the mountain slopes and kloofs. (KBRC, 2015)

This presents the opportunity to use 'hacked' invader trees as a structural building resource. Nina Maritz Architects (from Namibia) use a similar approach and applies a system in her architecture where invader trees are debarked and slowly charred over a bed of coals, which releases toxins within the wood and prevents insect attacks (Maritz, n.d.).

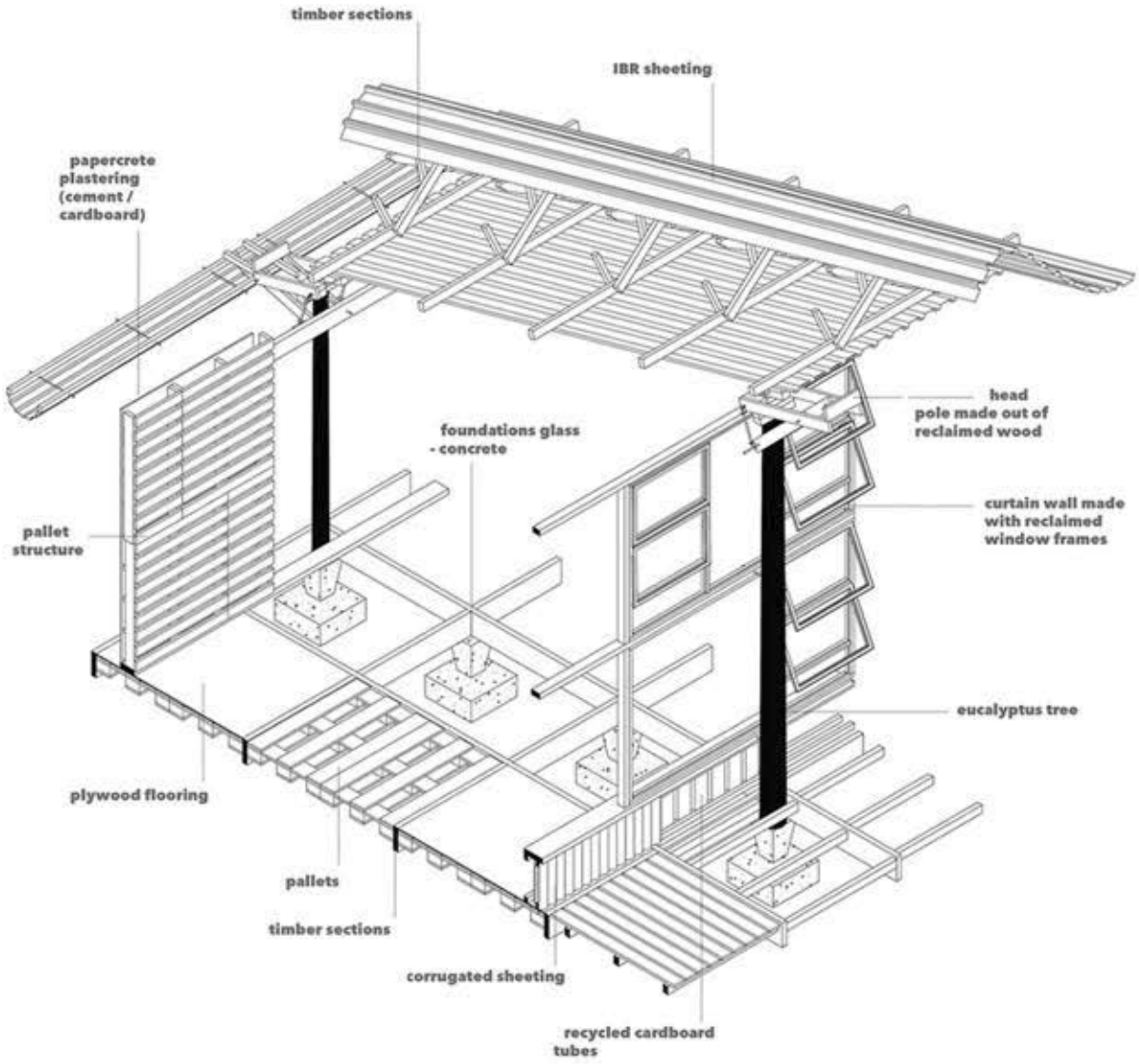


Figure X: Silindokuhle Preschool construction components. It is clearly evident that a big part of the structure consists of reclaimed materials.
source: http://collectifsaga.com/fr/home-fr/ accessed 29/09/2017

Silindokuhle Preschool
source: http://collectifsaga.com/fr/home-fr/ accessed 29/09/2017

Left Figure X: Interior view of pallet structure showing the spatial qualities of using reclaimed pallets.

Middle Figure X: Exterior view of Preschool showing the structural and non-structural applications using reclaimed pallets.

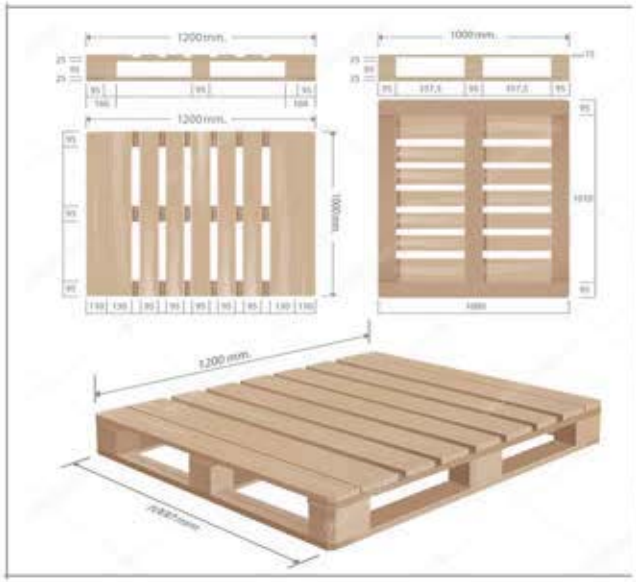
Bottom Figure X: Constructing the school using reclaimed Eucalyptus trees and wood as the roof structure and support. The pallet floor structure is visible before plywood floor surface was installed.

PALLETS

Neighbouring apple farm presents additional opportunities to use second-hand pallets. Although not many pallets are delivered to the Kleinmond WDTS, they can be sourced, sold and used at the RE(SOURCE) facility.

Collectif Saga Architects is a French firm focused on facilitating the growth and development of communities by working with locally sourced and upcycled materials. They are developing new ways of building that allow for collaborative work with the community that will oversee and maintain the structure in the future. For Collectif Saga Architects, the building materials should be easy to obtain, as resources are limited within the community. At the Silindokuhle preschool in Port Elizabeth second-hand wooden pallets were sourced and used reassembled for walls, cladding, roofs, floors, doors & window frames (Fig X). This technical details of this precedent study can act as a construction manual for the RE(SOURCE) centre.

The reclaimed timber methods discussed above has great architectural opportunities. Its structural stability and lightweight qualities encourage many applications that can create a variety spatial experiences. The methods are low-tech, and skills developed can be used beyond the RE(SOURCE) centre.

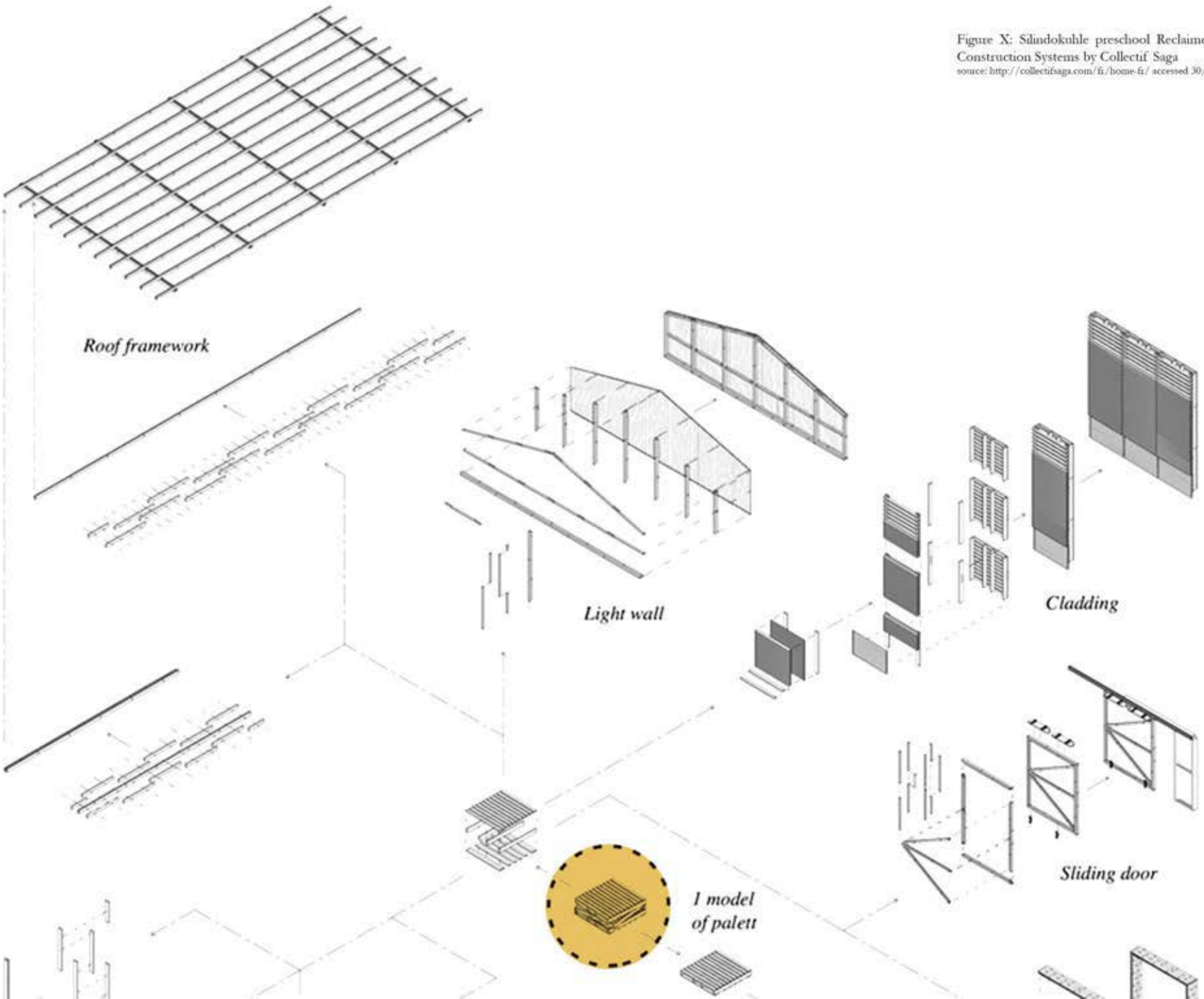


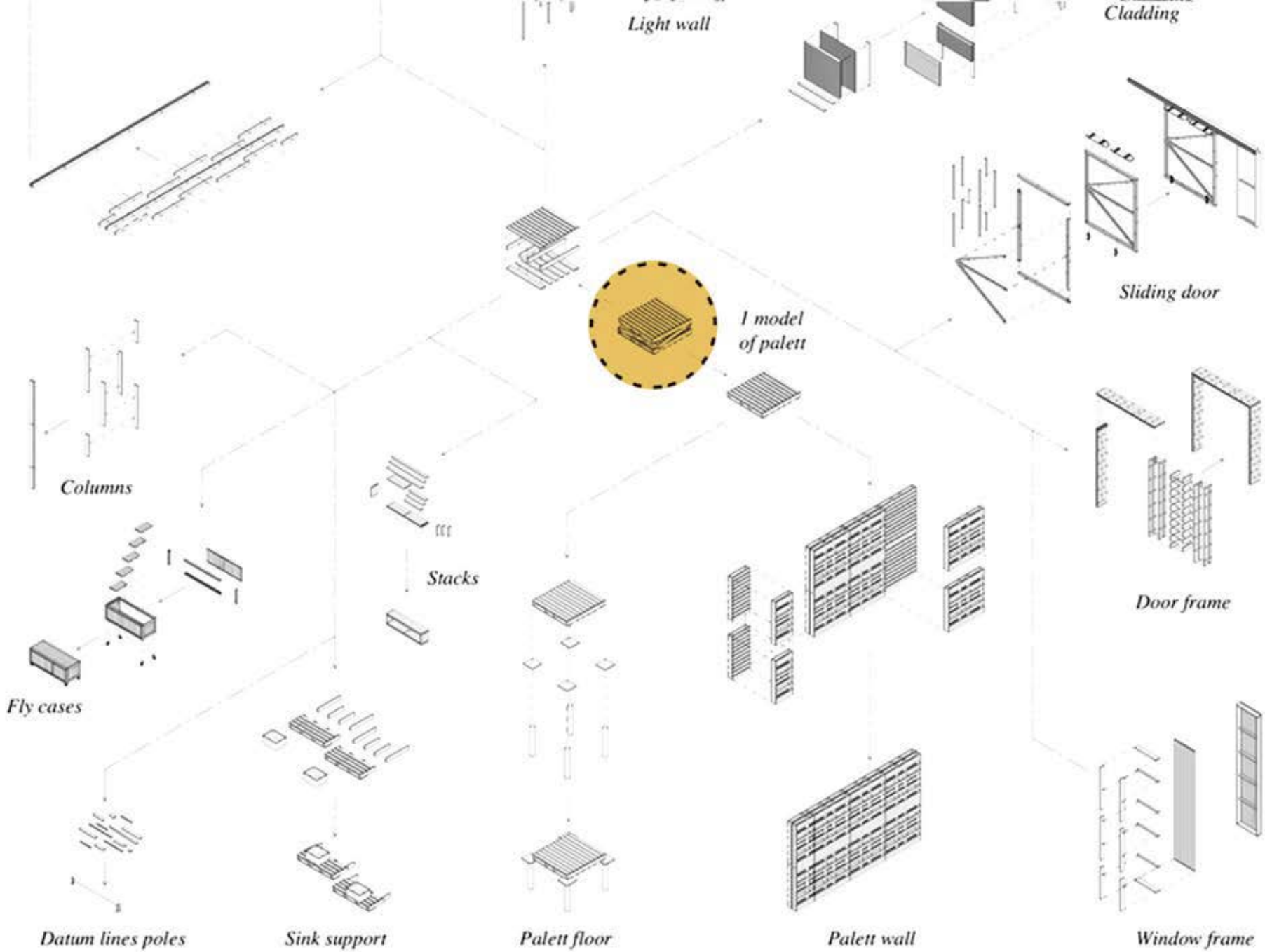
Left Figure X: Detailed dimensions of standard Pallet in South Africa.
source: https://depositphotos.com/71254667/stock-illustration-american-standard-pallet-views.html accessed 29/09/2017

Middle Figure X: Movable bay window at Silindokuhle preschool made from reclaimed pallet wood.
source: http://collectifsaga.com/fr/home-fr/ accessed 29/09/2017

Right Figure X: Facade cladding texture made from reclaimed pallet wood at Silindokuhle preschool.
source: http://collectifsaga.com/fr/home-fr/ accessed 29/09/2017

Figure X: Silindokuhle preschool Reclaimed Pallet Construction Systems by Collectif Saga
source: http://collectifsaga.com/fr/home-fr/ accessed 30/09/2017




Light wall
Cladding
Sliding door
1 model
of palett
Columns
Stacks
Door frame
Fly cases
Datum lines poles
Sink support
Palett floor
Palett wall
Window frame