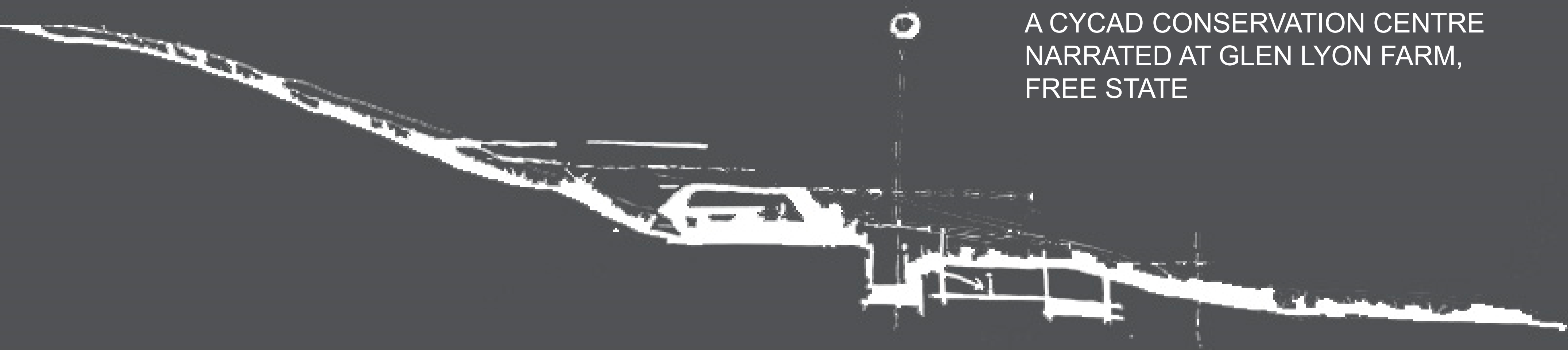
SCULPTING THE LANDSCAPE



A CYCAD CONSERVATION CENTRE
NARRATED AT GLEN LYON FARM,
FREE STATE

MINETTE COERTZEN

“The land belongs to the voices of those who live in it. My own bleak voice among them. The Free State landscape lies at the feet at last of the stories of saffron and amber, angel hair and barbs, dew and hay and hurt”

Antjie Krog (1998)

DECLARATION

I hereby declare that this dissertation submitted for the degree M. Arch. (Prof), at the University of the Free State, is my own work and has not been submitted to any other institution. All figures not referenced were generated by the author. All quoted text are indicated and acknowledged by a comprehensive list of references. (Annexure E)

SCULPTING THE LANDSCAPE

A Cycad Conservation Centre narrated at Glen Lyon Farm, Free State

Submitted by

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Submitted in partial fulfilment of the requirements for the degree

MASTER IN ARCHITECTURE

MArch(Prof.)

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SKY
IN BETWEEN
EARTH

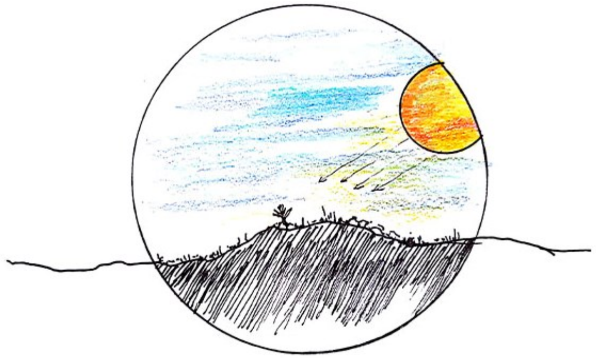
ABSTRACT

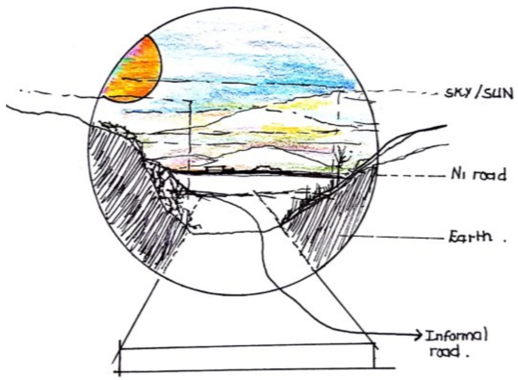
The focus of this dissertation recognises a concern in the constituted endangerment of the South African Cycad species, where the condition of these plants has been governed by external circumstances, shaped by human and natural interventions.

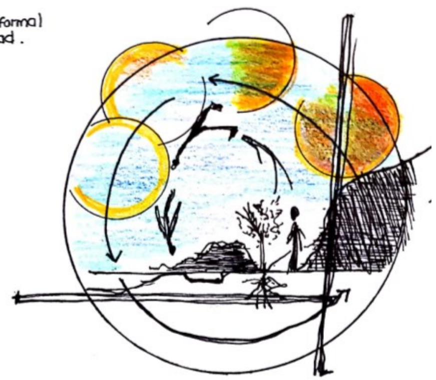
The research highlights a shift in the reciprocal relationship between humans and nature, where nature has become secondary to the cultural impact of developed environments. Therefore, this thesis aims to investigate the design of a Cycad conservation centre, at Glen Lyon farm, as a narrative structure functioning to form a cognitive relationship between humans and nature.

The thesis further explores a meaningful architectural narrative that celebrates a character relationship between the familiar Free State landscape and unfamiliar Cycad species. The project specifically focuses on providing a facility for conservational research and implementing strategies at a national level, which, accordingly, provide a platform for public awareness and education. The investigation of the design project firstly identifies challenges, along with corresponding aims, as possible guiding solutions to the investigated project. Secondly, research methods suitable within the parameters of the topic, were conducted in the form of published literature, precedent studies, analytical sketches and conceptual models.

These explorations are then further developed and applied to the proposed project, to formulate an appropriate design resolution and a reflective study, thereby communicating an analytical perception of the design process and project.







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INTRODUCTION

INTRODUCTION

The ontological understanding of place and place–making concerns the human act of dwelling in relation to natural and cultured place phenomena (Coates & Seamon, 1984:6). Human beings, as the sculptors of the built and natural environment, often regard the earth as a commodity with which to uncompromisingly shape wilderness into cultured, human-made environments (Allen & Smout, [n.d.]:1). In fact, the SANBI report (2013:6) on South Africa's biodiversity, warns that various parts of the country, specifically Gauteng, KwaZulu Natal and the North Western Province, sacrifice enormous expanses of wilderness to cultivation, mining and urban development. At this rate, protected areas excluded, these provinces will have almost no wild surroundings left by 2050 (Figure 1).

Aside from the general loss of natural habitat, the focus of this dissertation stems from a concern in the constituted endangerment of South African cycads. Botanists reported on several occasions, that cycads have increasingly been disappearing from their natural habitats over recent years, designating many of the species as nearly extinct in the wild (Donaldson, 2003:10). Therefore, this dissertation offers research as the building blocks for a conservation strategy in the design of a Cycad Conservation Centre at Glen Lyon Farm, Free State.

Located within the Classical Landscape of the Free State, the objective of the Cycad Conservation Centre is to provide a suitable facility that will enable Cycad conservation actions in the form of research, cultivation and public awareness. The following aspects are investigated to assist with the formulation of an appropriate design resolution:

- The cognitive relationship between man and nature
- The phenomenological, compositional and representational relationships between architecture and the natural realm
- A spatial exploration of a narrative composition within the unique setting and specific functions.
- Passive and active environmental design solutions appropriate to a facility located in a cold temperate plateau.

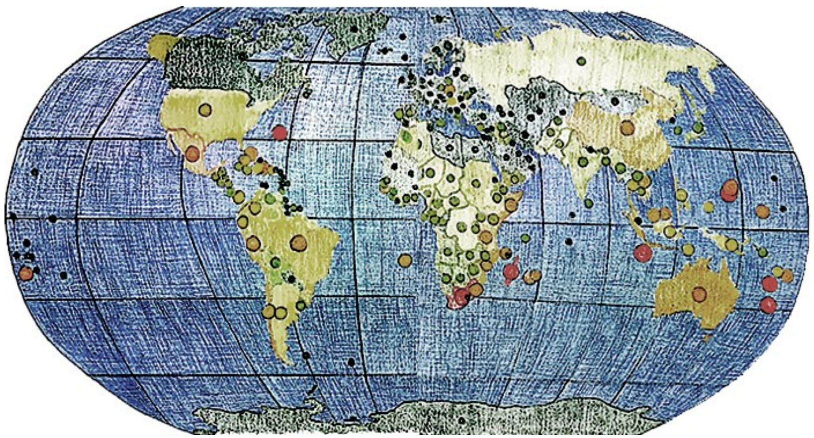


Figure 1: World map of endangered plant species zones, sketched from (KEW, 2019: online)

The design research employs the notion of narrativity to guide the design process and structure the design composition of the foreseen facility, that may be described as a contemporary interpretation of various South African folktales, concerning man's experience within the character of nature (Figure 2). The proposed building attempts to convey a narrative thread between two main protagonists: the familiar classical landscape of the Free State and the unfamiliar South African cycad species.

The design composition aims to guide the reader or the visitor through a portrayed narrative, embodying a series of sculpted experiences that memorialises already-extinct Cycad species and further celebrates both landscape characters accommodated within and around the architectural language. By building on the elements of a narrative structure, the design of the conservation centre aims to emplace humans in an experiential relationship with the narratives of the Free State landscape and the South African Cycad species. Consequently, providing a curated experience where the potential for intellectual growth in both public awareness and scientific research is accessible to surrounding communities.

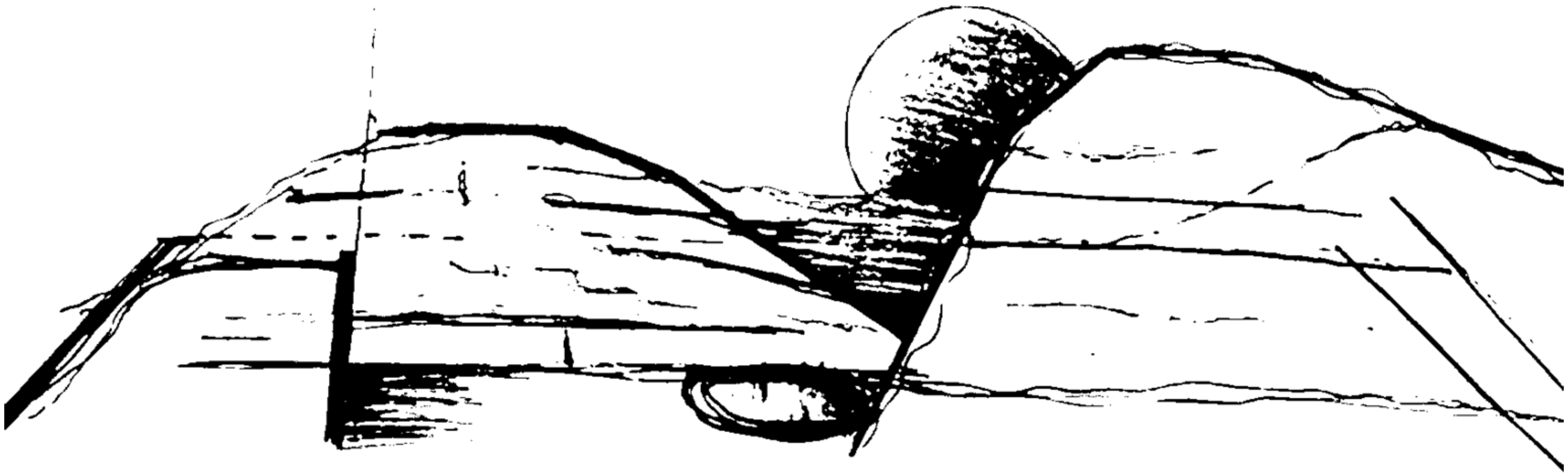


Figure 2: An interpretation of the Free State landscape

A CYCAD CONSERVATION NODE

“Cycads for Africa” was established by owner Steve Trollip in a small town called Brits in 1995. The aim was to identify key factors which would lead to a more successful conservation programme in South Africa (Trollip, 2018: online). Journalist, Beth Coetzee (2018: online), described Trollip's passion for nurturing Cycads by saying: “We bounced from plant to plant, a full background story being given on each.... To the untrained eye, many of the species look almost identical but Steve can spot their subtle differences from far away.” (Figure 3) The overriding theme for the established programme is conservation through cultivation. Hence, Trollip is motivated to develop a facility where cultivation, research and commercialization of many critically-endangered Cycad species are possible (Trollip, 2018: online).

CHALLENGES, AIMS AND RESEARCH QUESTION

The design of a Cycad Conservation Centre will act as one of Steve Trollip’s Cycad conservation nodes, which aims to address the current need for a “conservation through cultivation” strategy. Furthermore, the design will address the need for accommodating a research and seed export facility, which includes Cycad conservatories, as cultivation hubs and public destinations to increase awareness of the endangerment of Cycads in South Africa.

Figure 3: Client, Steve Trollip (Coertzee, 2018: online)

With the natural habitats of Glen Lyon farm as the setting, this project is based on an evaluation of the land's instinctive character, in terms of its historically-rooted indigenous values and the existence of a connected landscape narrative. Therefore, the research provided aims to scrutinize and recognize a design resolution that evaluates how an interpretation of architectural narrativity can augment the relationship between the familiar and unfamiliar flora of the Free State landscape. In so doing, a sympathetic relationship between the public visitors and the natural realm accommodated within and around the architecture may be constructed.

The proposed design explores the typology of paths in order to constitute a journey through a series of conservatories, alongside research and cultivation facilities and the landscape. The design focuses on both the public and private realm to cater for both visitors and professional users. The design facilitates interaction where these users meet. As part of the design process, the following challenges were investigated:

- The journey as a narrative thread through the narrations of the familiar and unfamiliar landscape characters
- The architecture as a mediator between man and nature
- The site-specific climatic conditions

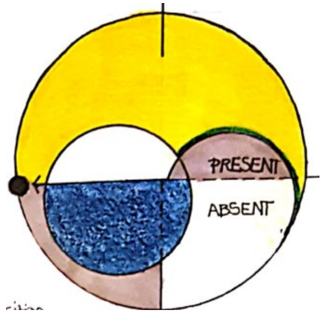
DESIGN RESEARCH

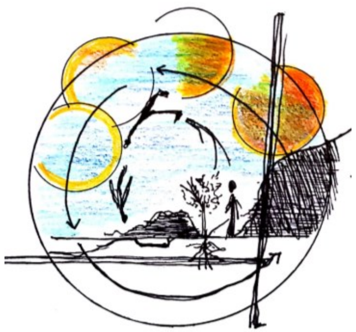
The following methods were employed during the study:

- Studying the spatial significance of accommodating various plant species, in terms of passive and active design strategies.
- Analysing and interpreting existing site conditions, in terms of climatic conditions and the status of existing vegetation on site.
- Investigating, interpreting and applying knowledge gained by studying and analysing relevant precedents.
- Conducting historical desk research on the typology of conservatories and the Cycads accommodated.
- Establishing the brief, accommodation and programme, by means of literature research on the physical properties and cultivation needs of cycad species, as well as relevant precedent studies.
- Formulating relevant concepts as possible design tools, by means of conceptual interpretation of site analysis and Cycad analysis, as well as theoretical desk research.
- Developing and finalising the design
- Structural and material research precedents

RESEARCH QUESTION

How can an interpretation of narrativity be employed in the design of a Cycad Conservation Centre to augment and architecturally sculpt the relationship between the familiar Free State landscape and the unfamiliar flora?





DOCUMENT STRUCTURE

CHAPTER_01 THE NATURE OF NARRATIVES

This chapter conveys an understanding of narrative functions and its structural composition, to understand how humans relate to their surroundings and others. Specific to Ricoeur's theory highlighted in Architecture and Narrativity (2016), the chapter consists of three main sub-sections: Cognitive Connection, Temporal and Spatial Structuring and Framing Place, discussing the three stages of a narrative as delineated in Ricoeur's argument, parallel to precedents and case studies.

CHAPTER_02 THE CHARACTER OF CYCADS

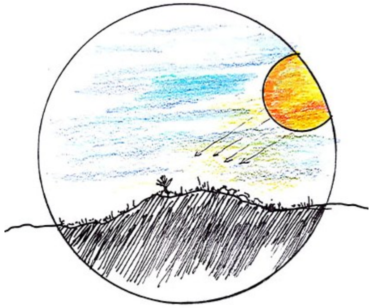
This chapter presents a concise understanding of South African Cycads, in terms of their historical background and physical properties, specific to understanding their requirements for optimal growth and reproduction. Furthermore, the chapter offers an investigation on conservatories as the project typology, to formulated an understanding of how nature can be accommodated in an unfamiliar setting. It portrays a 'pre-narrative' stage of the design process, while simultaneously composing a narrative composition of the Cycad character itself.

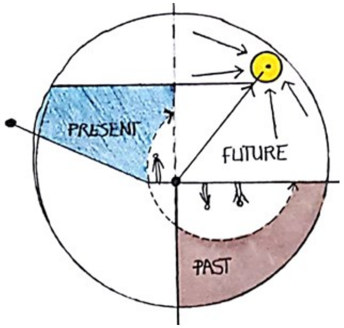
CHAPTER_03 THE CHARACTER OF THE FREE STATE LANDSCAPE

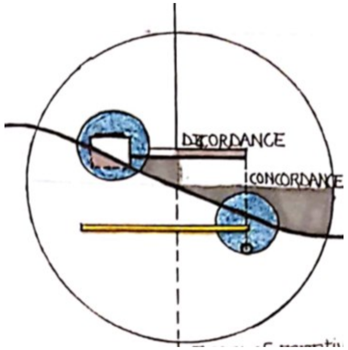
In response to the research discussed in chapter 2, this chapter briefly investigates three possible settings for successfully accommodating South African Cycads. It then continues to discuss and exemplify the conceptual and physical peripheries of the selected site: Glen Lyon farm, situated in the Free State, to convey an understanding of the familiar landscape's character. Here, a cognitive connection is presented together with a narrative structure of the Free State landscape's character.

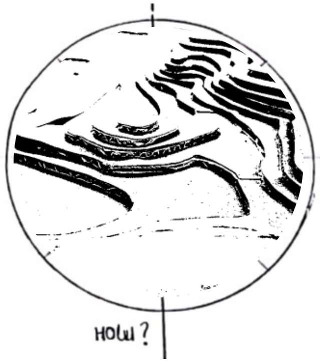
CHAPTER_04 EMPLOTMENT

An analysis, in terms of precedent studies is conducted on the typology of a 'path', with the intention of constructing a narrative experience for humans between the unfamiliar Cycad species and the familiar Free State landscape. This chapter presents the second stage of narratives, known as the 'configuration stage'. The design development conveys the process of constructing a narrative in terms of architectural design, by means of collecting and assembling a sequence of spatial events.









CHAPTER_05 THE NARRATIVE

Here the final stage of a narrative is presented, in the form of a final design resolution, together with a reflective study. The purpose of this chapter is to formulate a shared understanding of the architectural narrative, between the author/ designer and the reader/ examiner. It allows for a platform where the author of this dissertation reinterprets the architecture, by concluding with a reflection, and where the reader is provided with the opportunity to interpret and reinterpret the architectural narrative, by reflecting on past experiences and imagining a view of the future.

CHAPTER_06 THE TECHNICAL SYNTHESIS

This chapter presents the technical investigation of the site and the structural and material selection in the design of a Cycad conservatory. The chapter selectively refers to the design research, conveyed in chapter 2 and 3, to present a full understanding of the technical decisions presented in the design of the project's conservatory.

CHAPTER 01 _THE NATURE OF NARRATIVES

1.1 FROM NARRATIVE TO NARRATING

Narratives have always been an essential part of our everyday life. It has always fully embedded a way of communication and a way of making sense of our past, present and imagined experiences. The act of narrating dates back to the beginning of human existence, where stories were told in the form of myths, legends and folktales in order to carry knowledge and wisdom forward from one generation to another (Tobin, 2006:3-1) (Figure 4). The word 'narrate' originates from the Latin word gnoscere, meaning 'to know' and was first used in 1656 in the context of telling a story (Merriam-Webster's Online Dictionary, 2019). According to Brian Schiff (2012:34) "Narrative is a powerful metaphor for understanding life… Narrating discloses experience. Importantly, we move from understanding narrative as a static entity and begin to view it, more accurately, as a process. Narrative is a doing, a happening, an eruption. Or, as I like to think about narrating, it is an expressive action, unfolding in space and time." (Figure 5)

The purpose of this chapter is to convey a concise understanding on the notion of narrativity, with specific reference to the structural nature of a narrative. The theoretical framework investigates the central concepts highlighted in Paul Ricoeur's philosophical essay titled, *Architecture and Narrativity* (2016) to understand how the dynamic process of a narrative functions to create meaningful places.

The chapter starts with an outline of Ricoeur's narrative theory, followed by a discussion on narrative composition. It then continues to discuss and exemplify the three notions central to Ricoeur's argument on the structural nature of a narrative. The chapter concludes with a concise discussion on the use of narratives in architectural design, with specific reference to this dissertation topic, and design project.

Figure 4: Stories told in the Kalahari desert.
(The gods must be crazy, 1980: movie)

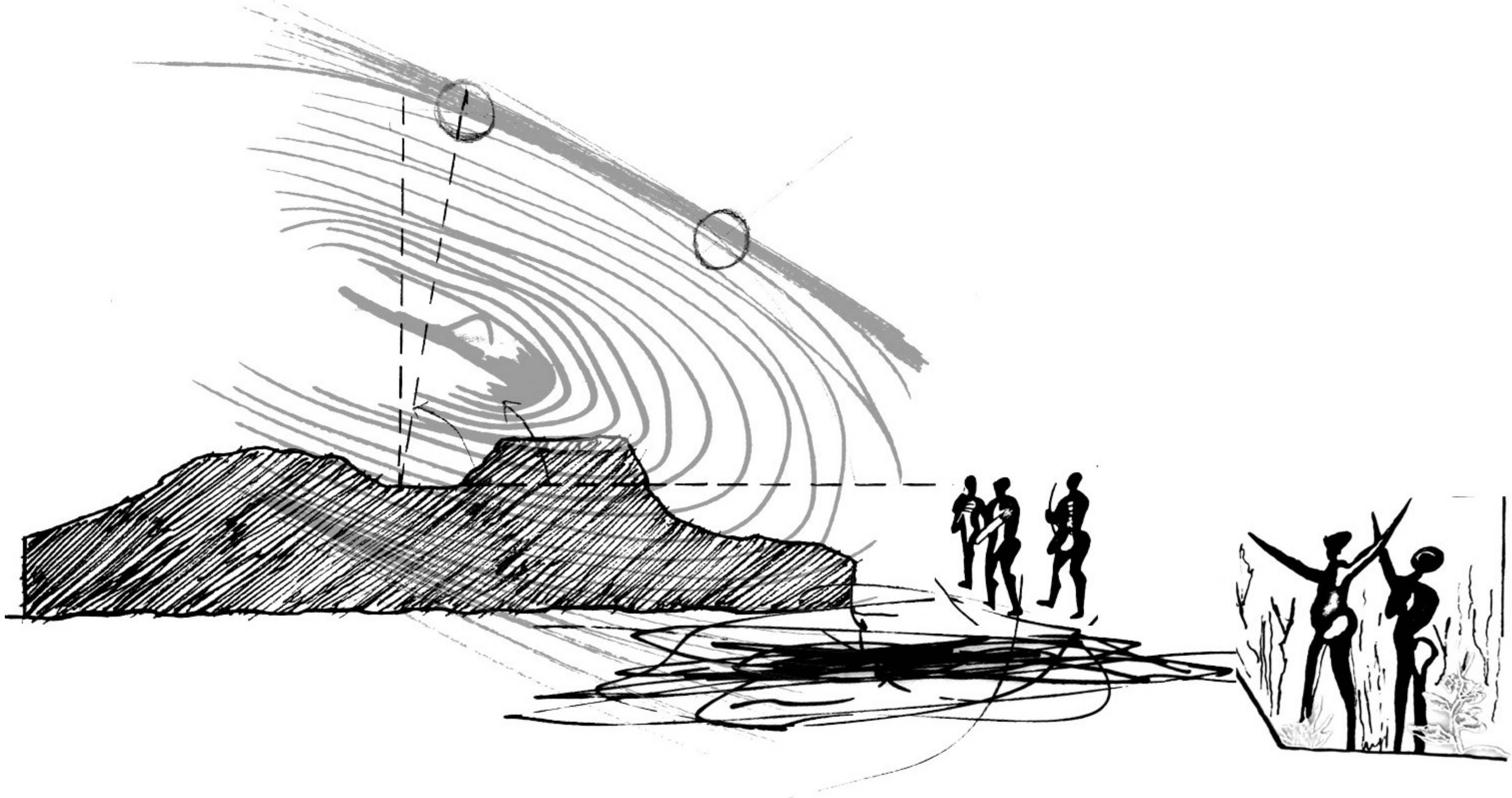


Figure 5: Concept sketch of narratives in our surroundings.

1.2 NARRATIVES AS MAKING PRESENT

Writing a narrative is like constructing a place, both configures temporal events, acts, chance and change in an intelligible and communicative way, in reference to the surrounding environment, other memories, or a way of life that precedes the story or the building. The configuration a narrative between the built and natural environment is to create a node in the present where chronological and psychological time, past and future actions within which humans' dwell, intersect (Ricoeur, 2016:34-38). The mere understanding of a narrative charts the notion of collecting and recollecting in what we refer to as memory or imagination. French philosopher, Paul Ricoeur (2016: 31) describes this phenomenon as, "'making the absent thing present'… the absent as simply the unreal, which would then be the imaginary, and the absent-which-once-was, the previous, the before."

The progression from memory to narrative adopts a methodology where humans build relationships with their surroundings by means of constantly evaluating what once was, collecting what is, and allowing for what can be (Ricouer, 2016:32). The discourse between time and narrative portrays the ontological layers of actions and experiences (Dowling, 2011:19). Time within a narrative approach, translates to the lived experiences of human beings - the essence of narration only attains its core meaning when mediated within a time-based existence in real spaces (Kaufmann, 2010: 82).

Accordingly, no narrative can be understood without experiences in time and space, and no experience can exist without narrative. It is within this framework that Ricoeur forms a conception of what it means to construct a narrative as a whole and how the act of narrating functions to make sense of life.

Ricoeur begins with a simple analogy between narrativity and architecture, in which he explains the configuration of a narrative in time parallel to the construction of a building in space. He explains that "…it is really a matter of crossing space and time through building and recounting.:. to entangle the spatiality of the narrative and temporality of the architectural act." (Ricoeur, 2016: 32). Concurrently, the temporality of the architecture brings forth the dialogue between memory and building, which accordingly portrays the narrative function with the relationship between man and the built environment. It is in this understanding of the narrative function that three central notions were identified to comprehend the structure of narration within a built environment as a whole.

The first notion, cognitive connection, relates to the act of giving presence to past or imagined experiences. The second notion, identified as temporal and spatial structuring, gives meaning to past, present and imagined events; and the third notion, framing place, provides presence to shared understandings of narratives.

1.2.1 COGNITIVE CONNECTION

Cognitive connection refers to the innate awareness between ourselves and the spaces we dwell in. It is a relationship that is established well before a new narrative or building is put into any form of composition (Ricoeur, 2016:33). Ricoeur highlights this notion in "Architecture and Narrativity" (2016:33) by describing it as the 'prefigured' stage of a narrative. He explains that narratives are composed from a preunderstanding of previously lived-actions. Without any such understanding it would not be possible to narrate our experiences within the world, or allow others to understand what we have experienced or what stories we tell (Ricoeur, 2016:33). It is in this stage of narrativity where two assertions originate: first, the nature of human knowledge and second, the nature of being. Both likened to narrative as knowing through reflecting on the narratives that surround us, and existing by recognising our stories-in-action and the stories-in-action of others (Kaufmann, 2010:84, Ricoeur, 1992:). In order to act meaningfully within the wold, a practical knowledge is needed by the being that dwells on the Earth (Figure 6). According to Tissink (2016:21), it is through "narratives, stories, events and memories, [that] we feel connected to our environment and we form our identity. Narratives contain information about where we come from, so we can understand who we are and have an idea about how we see our future."

In architectural terms, prefiguration means that the architect must reflect, interpret and attempt its best to understand the world of which it is a part, that precedes it, which is shared by others and which it wants to relate into a new narrative. In order for the architect as writer to configure an intelligible narrative, it needs to understand the world of its protagonist: in my case that means the narrative of the cycads and the narrative of the Free State landscape. . However, preceding these worlds, it also means an investigation into the nature of humans, and the nature of human interaction with the environment. It is on the latter that I employ a case study of an experienced understanding of the urban dweller in Bloemfontein and its relationship with the urban and natural environment of Charlotte Makeke Street.

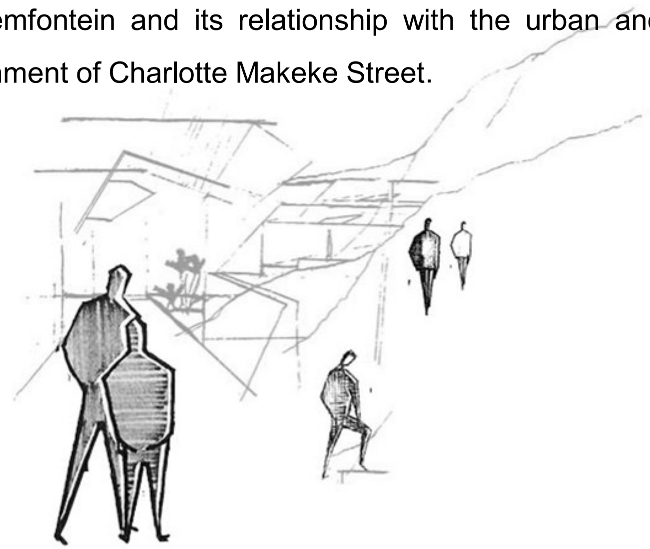


Figure 6: Concept sketch of beings that dwells within the built and natural environment.

COGNITIVE CONNECTION | A CASE STUDY

Reflecting on the cognitive relationship between the environment and identity is an active part of designers' understanding of the narratives embedded within an environment (Tissink, 2016:21). It is by understanding the prefigured cognitive relationship that the writer itself builds a cognitive relationship with the reader. In the case of architecture, by reflecting on the existing relationship between humans and the environment, a cognitive relationship is simultaneously formed between the architect as writer, the architecture as narrator, and the client, the users and the dwellers of a place, as the reader of the architectural text. It is through the act of communicating absent past or imagined experiences into the social dynamics of the real world, that a designer has the ability to act meaningfully within a community's historical or cultural context. However, it is also important to understand the limitations around making absent experiences present. For Schiff (2012: 38), "There is always a gap between what we know and experience and what we tell. The gap consists of the inability of words to truly capture and represent events."

In the following case study of Charlotte Makeke street, a cognitive relationship of my past experiences as an architectural student reflecting on the built environment of Bloemfontein is presented to convey my present understanding of humans in relation to the built and natural environment (Figure 7).

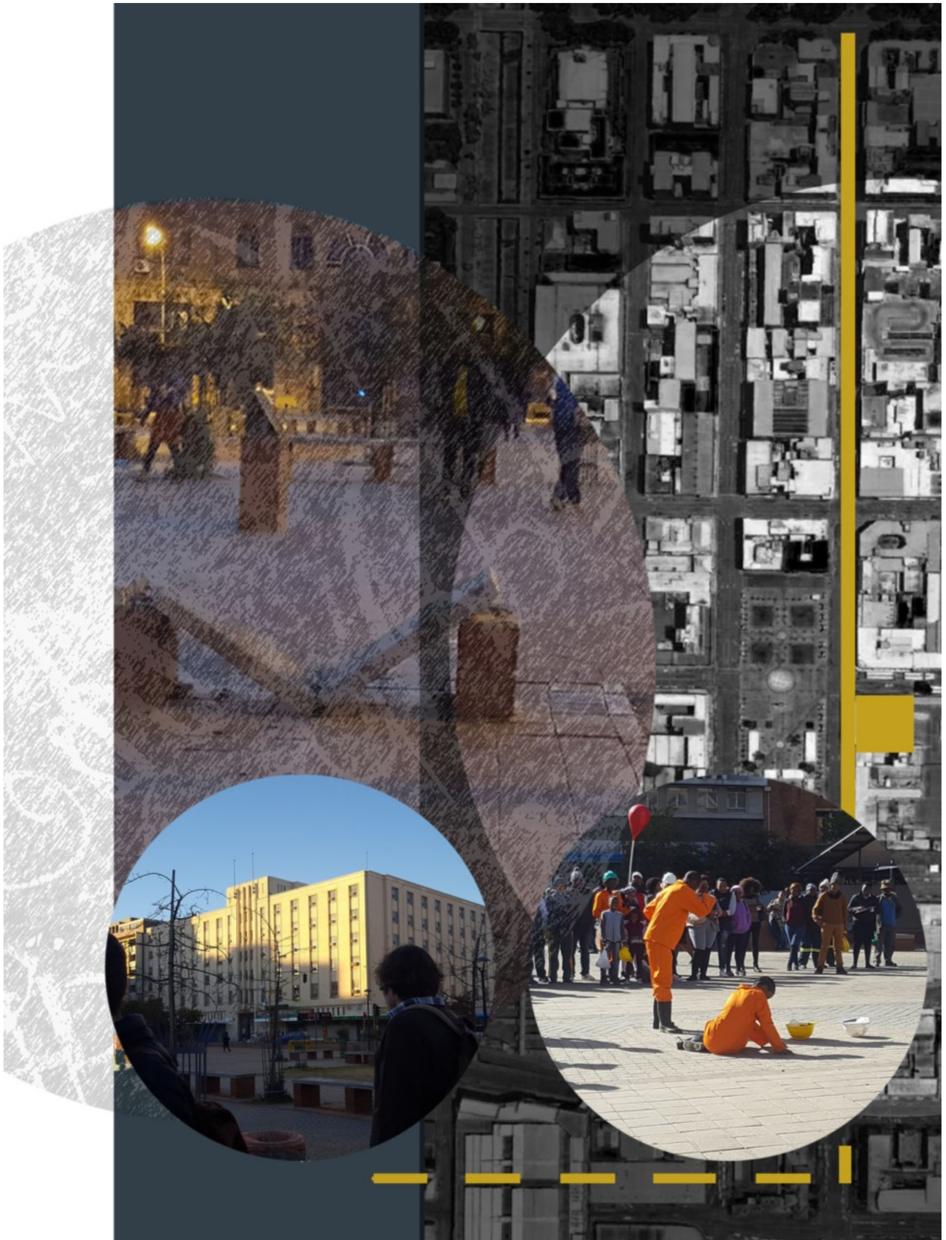


Figure 7: Narratives told by humans and nature.

The memory of the stories told by both the everyday dweller and the everyday natural realm within the build environment of Charlotte Makeke street, presents a clear understanding of the notion, ‘making present’ in terms of communication, written text, or performance (Figure 8). It was within this particular context that I observed and understood how narratives became active through the subjective experiences inscribed onto the setting by the bodily actions of the dwellers going about their everyday activities (Figure 9). Aside from the dweller’s experiences portrayed within Charlotte Makeke street, I also remember observing a second narration taking place when the intangible touch of nature imposed a texture of life onto the tangible setting. It was through the ritual of the sun’s movement across the cityscape, that I perceived nature’s way of communicating its own identity to the dweller, by simply using the face of a building as a blank canvas onto which it portrays its presence. It was in this moment that a cognitive relationship between myself and others was established with the natural environment, as well as understanding the role of architecture as the medium through which the identity of the sun is communicated within time and space (Figure 10).

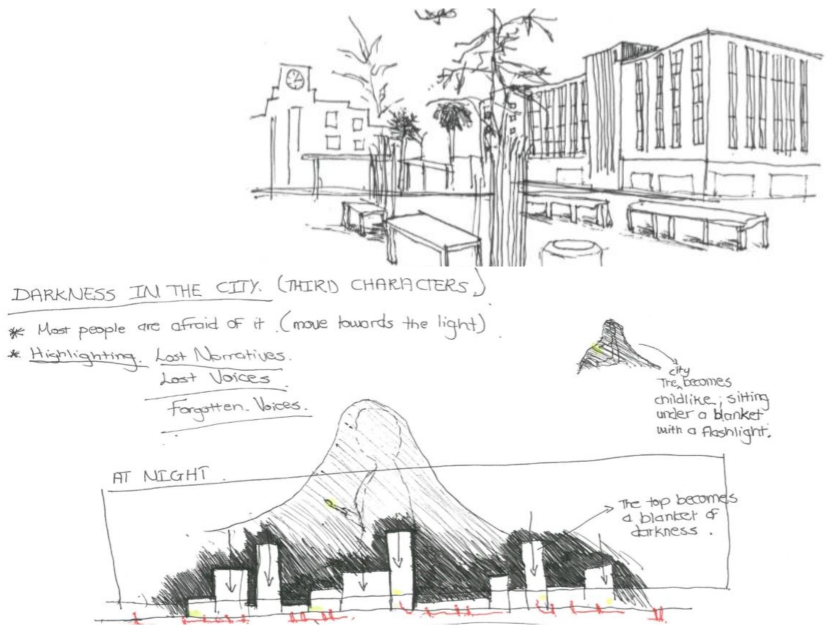


Figure 8: My memory of the city’s childlike character

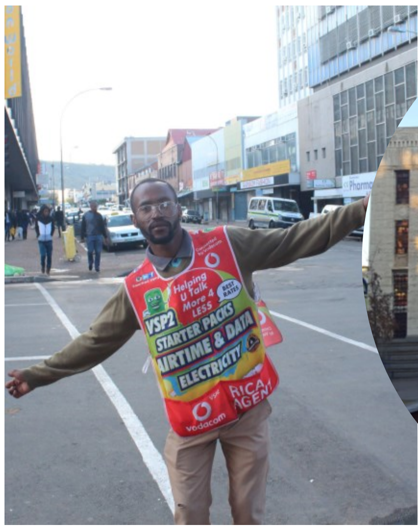


Figure 9: Advertiser in the street

Figure 10: The sun portrayed in Hoffman Square

1.2.2 TEMPORAL + SPATIAL STRUCTURING

In the very real sense of composing a narrative, a line of thought is established making something present which occurs within a sphere of space and time (Schiff, 2012:38). It offers a comprehensive account whereby Ricoeur (2016:34) defines this stage of narrativity as 'configuration' - where the act of recollection liberates itself from the framework of lived experiences and constitutes a progression into a literary sense of understanding. It is a notion that retains a structuring function, where the dweller begins to arrange memories of the past, experiences of the present and the imaginative discourse of the future, as a way of constructing meaning within a collection of events (Kearney, R. 1991:55,64).

With a brief understanding of narrative configuration, Ricoeur (2016:35) then continues to explain this notion by identifying three key factors central to 'configuration'. First, the synthesis of events, diverse in character or content, in what he refers to as 'emplotment'. According to Kaufmann (2010:89) "The notion of emplotment is borrowed by Ricoeur from Aristotle's concept of 'composition', mythos in Greek, 'which means both 'fable' (in the sense of imaginary story) and 'plot' (in the sense of 'well-constructed history')" Hence, a comprehension of the world through narratives, is merely an augmented reality of the world's actions, encompassing its own ontological layering (Kaufmann, 2010: 90).

The second factor, defined by Ricoeur (2016:35), is 'intelligibility', which highlights the function of narrative modes as a mere attempt to understand the complexity within narratives of life. This factor is conveyed in terms of a golden thread constructed by means of emplotment, that unifies the various narrative patterns as a whole and thus develops a recurring theme throughout the narrative. Thirdly, the factor referring to the juxtaposition of confronting narratives, in what Ricoeur (2016:35). defines as 'intertextuality'. The content of a narrative, in most cases, consists of several other narratives that form contradicting patterns amongst one another. This sense of discontinuity within a narrative brings about the possibility of constructing and deconstructing the unfolding thread between events (Ricoeur, 2016:35). Hence, adopting the notion of concordance and discordance, where the latter is a discontinuity that interrupts or twists the storyline, while concordance embodies the continuity that follows through the instances of discontinuity (Ricoeur, 2016:35) (Figure 11 & 12).

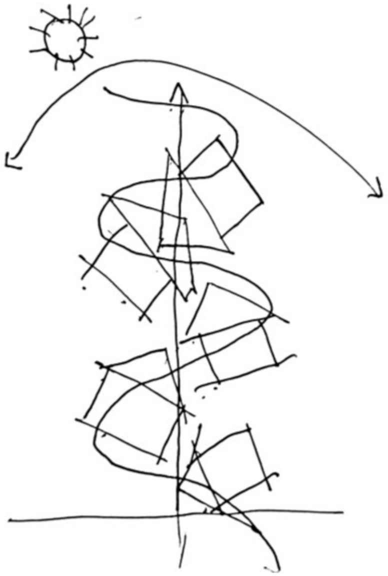


Figure 11: Concept sketch of spatial configuration.

Figure 12: Concept sketch of con/ discordance in space.

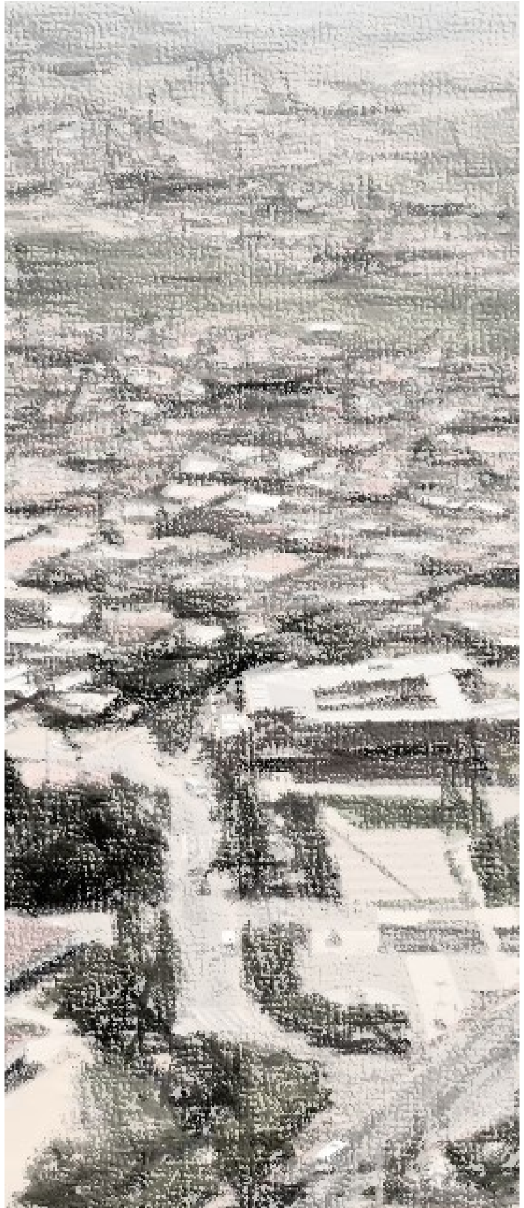


Figure 13: Spatial sketch of Soweto

TEMPORAL+SPATIAL STRUCTURING | PRECEDENT

To convey a parallel understanding between the act of configuring a narrative and the act of spatial synthesis, the following precedent is investigated to understand how narrative structuring can play a role in architectural design. Narrative rationality in spatial emplotment is a major factor in the composition of various independent elements, such as units of space, immense forms and boundary surfaces (Figure 11). In the case of the "Hector Pieterson Museum", the design successfully conveys a sense of complexity within the spatial configuration which narrates the memory of the 1976 Soweto uprising of black children in poor educational upbringings (Joubert, 2009: 130) (Figure 13). The structure of the narrative, is experienced according to the circulation route of the design, in which the idea of a spiralling circulation pattern formulates an adequate concordance within the discordance of accordingly choreographed spatial events (Figure 14).

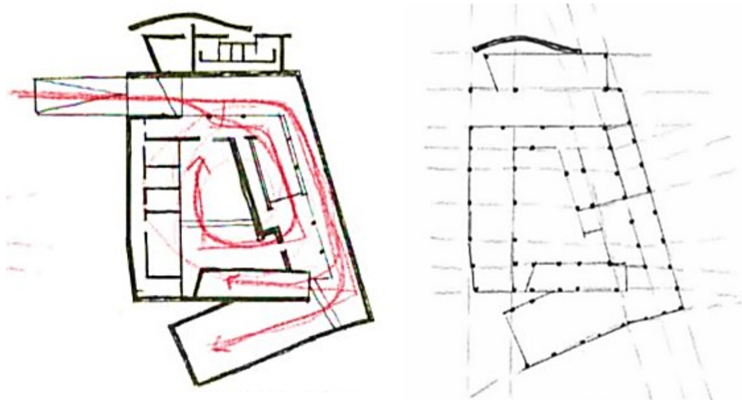


Figure 14: A circulation and structural parti sketch of the museum's narrative.

PRECEDENT | Hector Pieterson Memorial Museum

Location: Orlando West, Soweto

Architect: Mashebane Rose Associates

Year: 2002

The accommodation list of the design offers a manifold of continuous readings that guide visitors throughout the narrative as a whole (Figure 15). The journey begins with a commemorative square in front of the entrance and then further guides visitors to a ramp leading around the periphery. The narrative embodiment within the exhibition spaces consists of articulated views by means of engraved narratives on the windows, juxtaposed with the contextual views of the surrounding Soweto township (Figure 16 & 19). The central courtyard is gravel - filled with memory plaques of the students who died, offering nothing more but views of the heavenly sky (Joubert, 2009:130) (Figure 17 & 18).

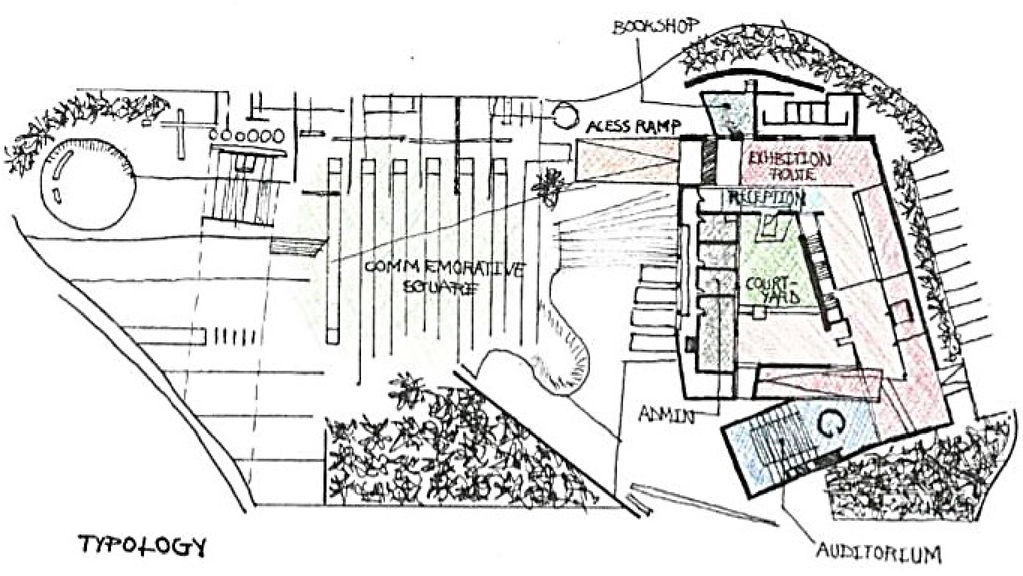


Figure 15: Floor plan sketch, highlighting the sequence of events.

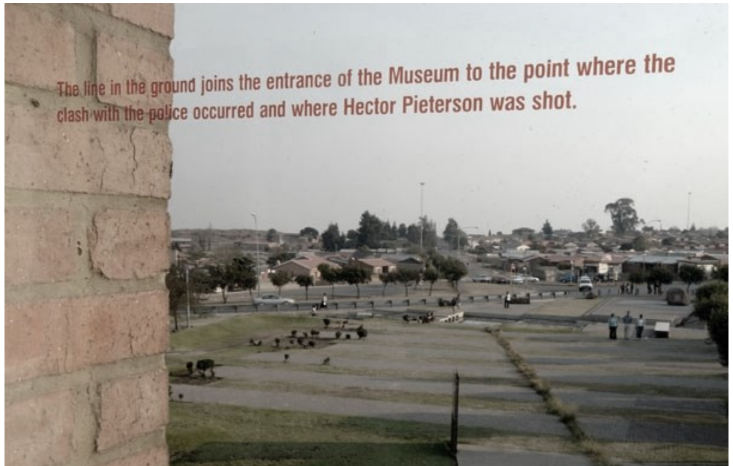


Figure 16: Narrative window (Mashabane Rose: online)

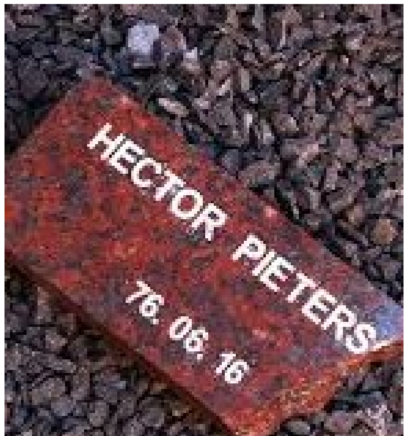


Figure 17: Memory plaque (Jonker,2012: online)

Figure 18: The central courtyard. (Mashabane Rose: online)

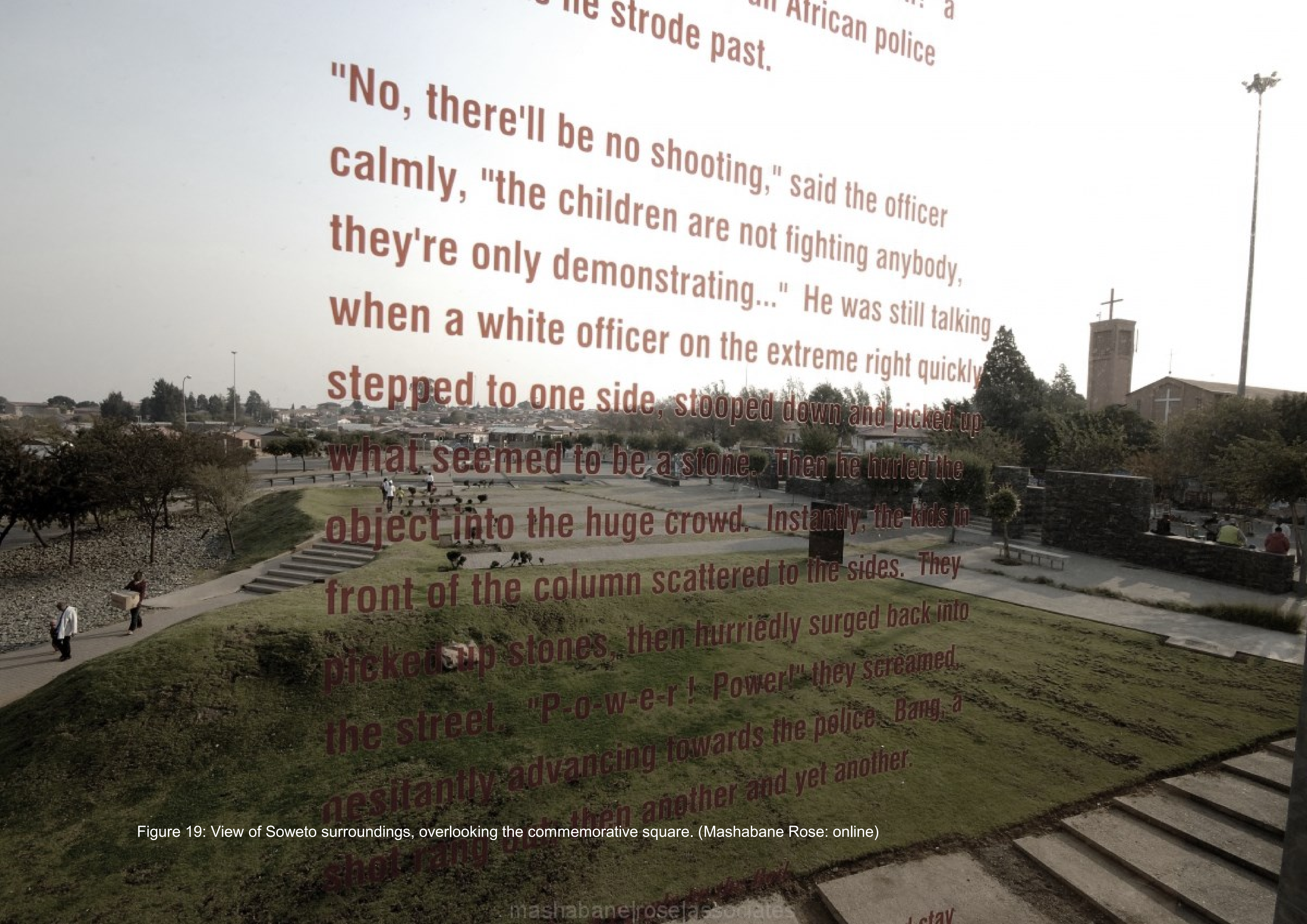


Figure 19: View of Soweto surroundings, overlooking the commemorative square. (Mashabane Rose: online)

1.2.3 PLACE FRAMING

The final notion identified, embodies the totality of knowing how the dynamic process of a structured narrative continues to function within a shared environment. In "Architecture and Narrativity" (2016:39), Ricoeur concludes the final narrative stage, 'refiguration', by establishing a theoretical stance in the context of a reader's re-interpretation. He begins by stating that a narrative is not fully developed after it has been configured by its author or architect. It really only achieves its full potential once it has been 'refigured' by its reader (Ricoeur, 2016: 39).

The progression from narrative composition to the reading of text provides a theoretical framework where the configuration of a narrative only results in intelligibility, when the narrative is perceived and reinterpreted by a reader (Kaufmann, 2010:93). However, in addition to the latter understanding of this notion, Ricoeur continues his theoretical argument by portraying a comprehensive account on how the reading of a narrative spirals back to the intersection between the second notion, temporal and spatial structuring, and the first notion, cognitive connection. He states that the act of reading a narrative, can merely be described as a response from the reader's preunderstanding of past or imagined experiences (Ricoeur, 2016:39). According to Kaufmann (2010: 93) "The reader 'fulfils' the meaning of the text by "dwelling" in the world of the text. At the same time the reader is enriched by the text by finding in it a world of possibilities." Hence, it can be interpreted that the dialogue between a narrator and a reader at this stage of narrativity, serves to make present a shared understanding of past and imagined experiences.

The interplay between a narrator's composed narrative and a reader's interpretations, by means of memory and imagination, highlights an analogy in the relationship between a designer and an observer. The following case study is presented to portray how a detailed grasp of this notion can assist designers to selectively attract the awareness of observers within a staged narrative (Figure 20). According to Tissink (2016:27), the process of constructing a narrative, provides the designer with the ability to share a narrated experience, by inviting an observer's attention through the notion of framing place. It allows the observer to dwell within the selectively narrated experiences of the designer - in which to "dwell" refers to taking ownership of the text and to identify and orientate in the text through the use of imagination. Hence, it is within this notion that the reader shares an understanding of the narrated experiences but also frees itself from the meaning of the author.

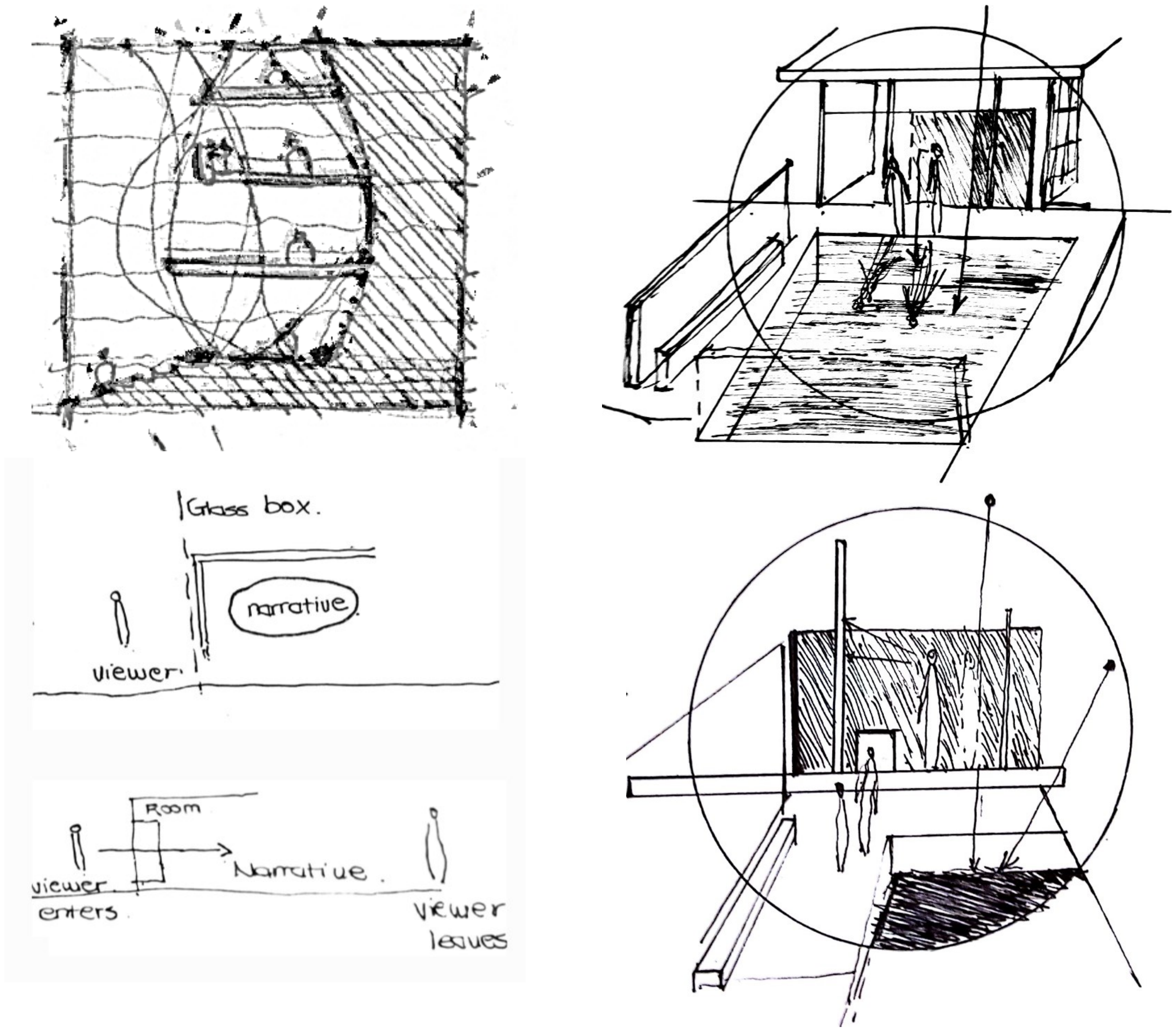


Figure 20: Concept sketches of framing views in architecture.

FRAMING PLACE| PRECEDENT

In the case of artist Gordon Froud's narrated art exhibition titled: *Harmonia* (Sacred Geometry, the Pattern of Existence), the latter notion is distinctly present in the form of a curated representation. The framed views selectively positioned, encompasses a series of photographic works, depicting the shapes of Platonic Solids that act as disruptions in the landscape by way of displaced reflections. It was through the use of geometry, imposed onto the landscape, that Froud was able to successfully engage the viewer in a narrative dialect perceived through the lens of the camera and the eye of the artist (Figures 21 & 22).

The nature of Froud's exhibition not only successfully frames narrations of the landscape but also captures the viewer's ability to reflect on the portrayed events. He achieves this through the use of a reflective photographic medium, subsequently allowing the viewer's image to reflect onto the framed image itself (Froud, 2019: Oliewenhuis Exhibition) (Figure 23). It is at this moment where the viewer really engages in a shared understanding of Froud's narrative, described as, "if one looks at the statement 'God created man in His image', perhaps it is in Geometry that a micro/ macro-man/ God pattern becomes evident" (Froud, 2019: Oliewenhuis Exhibition).

Figure 21: Artwork 1

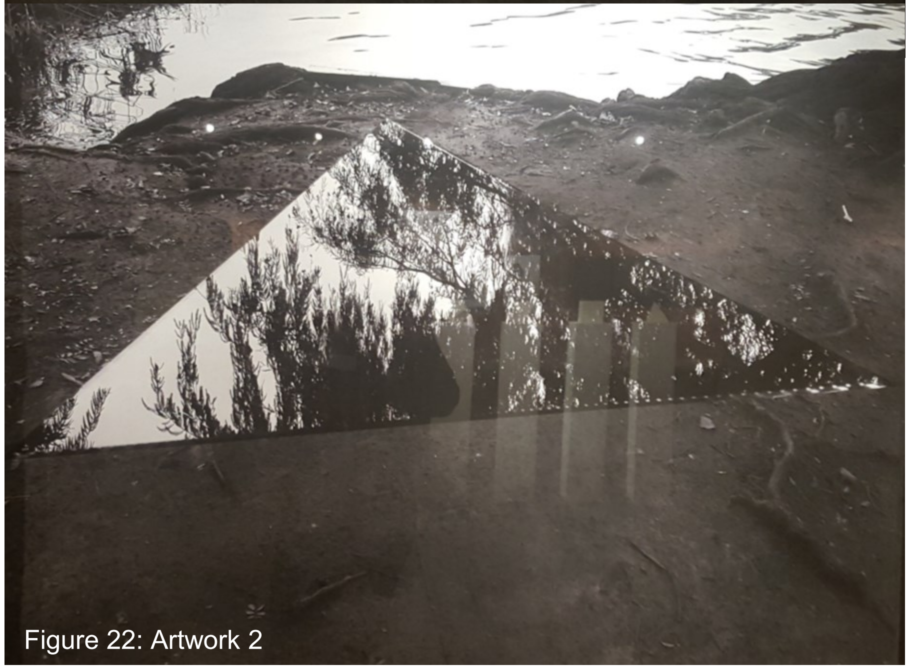


Figure 22: Artwork 2

Figure 23: Artwork 3

1.3 TOWARD A NARRATIVE PSYCHOLOGY OF MEANINGFUL PLACEMAKING

The theoretical framework presented in this chapter first and foremost communicates the meaning of a narrative and the act of narrating as a way of expressing human knowledge to form identities within the world. The chapter, then continues to discuss the structural function of narrating, as making the absent thing present, from which three central notions are discussed, in reference to Paul Ricoeur's philosophy on architecture and narrativity.

To summarize these three notions, a concise interpretation on each notion is presented parallel to the process of designing architecture. The purpose of this summary is to understand how the theoretical framework is applied in the design process specific to this dissertation, thus formulating a comprehensive account on both the document structure as a whole and the structure of the chapters to follow.

COGNITIVE CONNECTION | Dwelling in the world before building

The first notion highlights the preunderstanding before a narrative takes shape. This entails the act of collecting and recollecting past and imagined experiences, to understand a personal reflection from which the second notion originates. In reference to architecture, this notion relates to the idea of inhabiting, or what I would refer to as "reason for building" (Ricoeur, 2016:32). In other words, before the designing of this project was initiated, the first stage entailed explorations to establish the client and users' needs as well as the cognitive understanding of the site, to formulate a design concept.

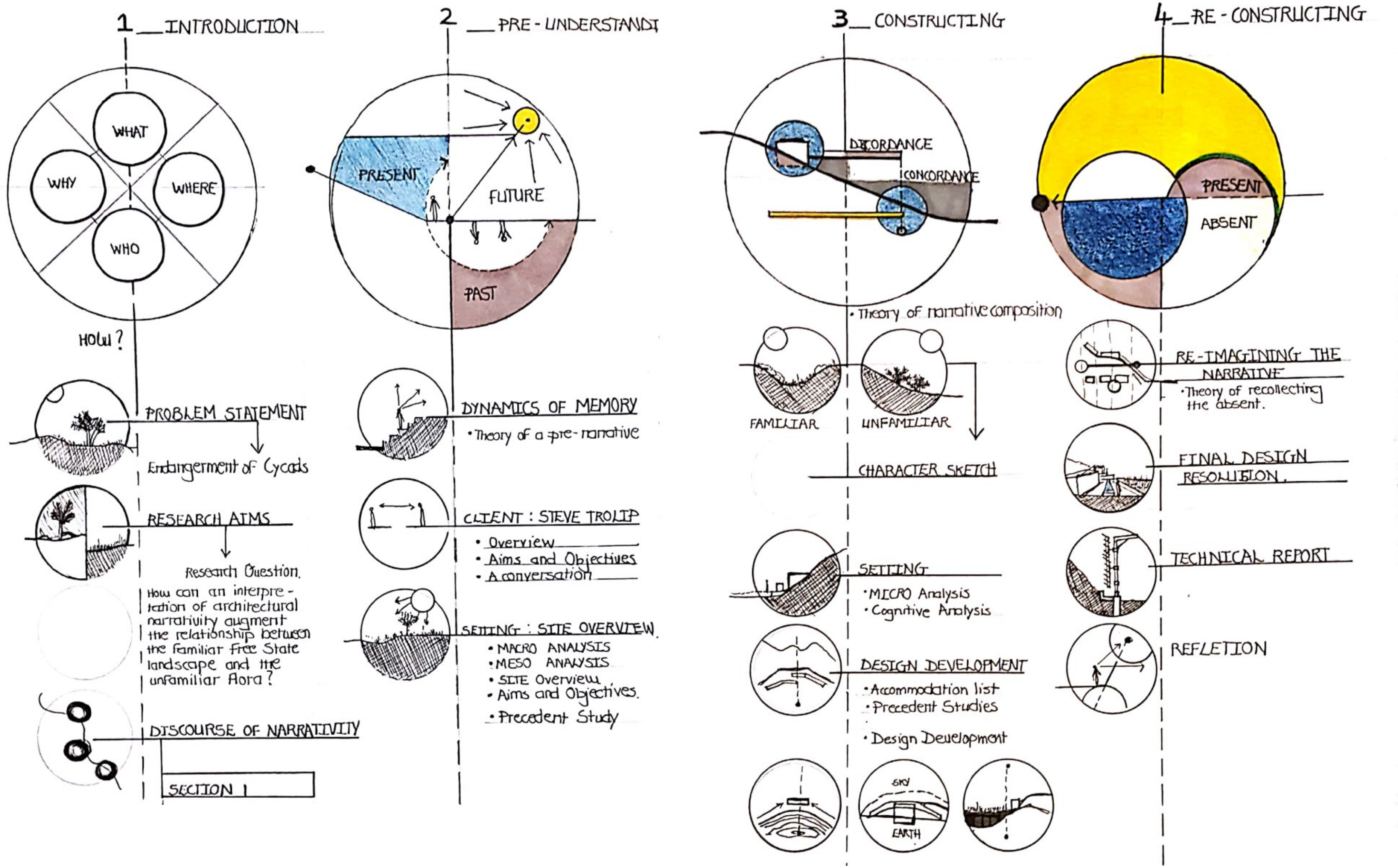
TEMPORAL STRUCTURING | Configuring dwelling

The second notion focuses on the formation of a narrative, by means of emplotment. This entails the ordering of events, character narratives and settings, to achieve a unified portrayal of past and imagined stories. It is within this notion where the act of building or designing presents an analogy to the act of composing a narrative (Ricoeur, 2016:32). Specific to this dissertation, the second stage initiates the design process of the project, in the form of precedent studies, parti diagrams and a quantitative site analysis, as a means to forming a character sketch of the users and the site, as well as the ordering of events structured in the accommodation list.

SPATIAL FRAMING | Identifying and orientating with the building

The third notion focuses on the act of reading and interpreting the narrative. It is the stage where the narrative is understood, in order for the reader to reflect and further imagine possibilities. According to Ricoeur (2016: 32) it is the stage in architecture that progresses back to a thoughtful inhabiting. Hence, the third stage concludes the design process with a final design and technical resolution that is reflected on by the writer and re - interpreted by the reader.

THE NARRATIVE STRUCTURE OF THE DISSERTATION



CHAPTER 02 _ CHARACTER OF CYCADS

2.1 ECHOES OF A CYCAD PAST

Beyond the modern perceptions of Cycads, lies a deeply rooted history that can be traced back to a time - when dinosaurs still roamed the earth (Goode, 1989 :13). Constituting an existence of roughly 200 million years, the plant life of Cycads established one of the dormant behaviours throughout Earth's history. They are often referred to as the 'living fossils' of the botanical domain (Goode, 1989:13).

The historical documentation of South African Cycad species, dates back to the first cycad collected by botanist, Carl Peter Thunberg in 1772 (Giddy, 1974:12). It was during this three-year exploration throughout South Africa that Thunberg, accompanied by Francis Masson (KEW's first plant hunter), gathered the first cycad known today as Encephalartos longifolius, along with 3000 other cycad specimens (Giddy, 1974:12). More than 200 years later, South Africa's first collected cycad still thrives today in the Palm House of KEW gardens in London (Avis-Riordan, 2019: online)(Figure 24).

Many Cycad species have since then survived the natural dangers of the world, such as fire and drought, but today they struggle for survival against the threats inflicted by human greed (Jones, 1993:21).

Figure 24: Oldest pot plant in the world, 240 year-old Eastern Cape Cycad (Avis-Riordan, 2019: online).

The practice of conservation in South Africa originated with the first hunter – gatherers, through the management of using natural resources. (Grundy & Wynberg, 2001: 18) Over time, these management strategies have changed radically, as the network of the South African plant diversity continues to be threatened due to human impact, where there is a rapid growth in agricultural and urban development. (Raimondo, Grieve, Helme, Koopman & Ebrahim, 2013: 1) (Figure 25).

Aside from the destruction of natural habitats resulting in a population decline of Cycad species. The ongoing decrease in numbers also stems from the fact that Cycads are slow growers that generally produces one cone with up to 500 fertile seeds each year. Subsequently a few survive in the natural habitat, due to drought, fire or natural predators (Giddy, 1974:13) Hence, to continue the interest in these 'living fossils', while maintaining the population rate, conservation strategies in the form of cultivation and propagation from seed, as well as increasing the availability of seedlings to the public and commercial nurseries, will assist in relieving the strain from natural suppliers (Giddy, 1974:13).

The focus of this chapter is to review the physical and conceptual character traits of South Africa's cycad species . It serves as an exploration in the cultivation requirements for cycads, in order to successfully design a conservation centre, specific to the typology of a conservatory.

Figure 25: Historical photographs identifying the disappearance of Cycad species from their habitat in South Africa. (Donaldson. 2003:11)

2.2 THE CHARACTER TRAITS OF CYCADS

As living remnants from a long history, the general morphology of Cycads has presented an extent of evolutionary stagnation when compared to their ancestors, in the examination of fossils. Traces of primitive features in the plant structure is still evident in the modern Cycad today (Figure 26). According to Goode (1989:13) "like all gymnosperms, [they] still carry their ovules naked on cone-scales and not enclosed in an ovary as in the more advanced angiosperms. Indeed, the seed-bearing structure or 'inflorescence' of the genus Cycas are even more primitive than those of other cycad genera: instead of a cone, Cycas produces a much-branched arrangement or sporophylls. These leaf-like structures resemble those of the extinct Palaeozoic pteridosperms which had not developed cones and produced ovules directly on their leaves." However, cycads are still evolving, due to their capability of responding to a wide range of environmental conditions (Jones, 1993:21)

2.2.1 CULTIVATION

The following sections of this chapter presents a summary (Table 1) of the cultivation conditions required for each accommodated Cycad species. There are 38 South African Cycads in total, that naturally occur in three different climatic zones, namely: sub-tropical coastal, hot interior coastal and temperate coastal regions (Refer to Annexure A for more information).

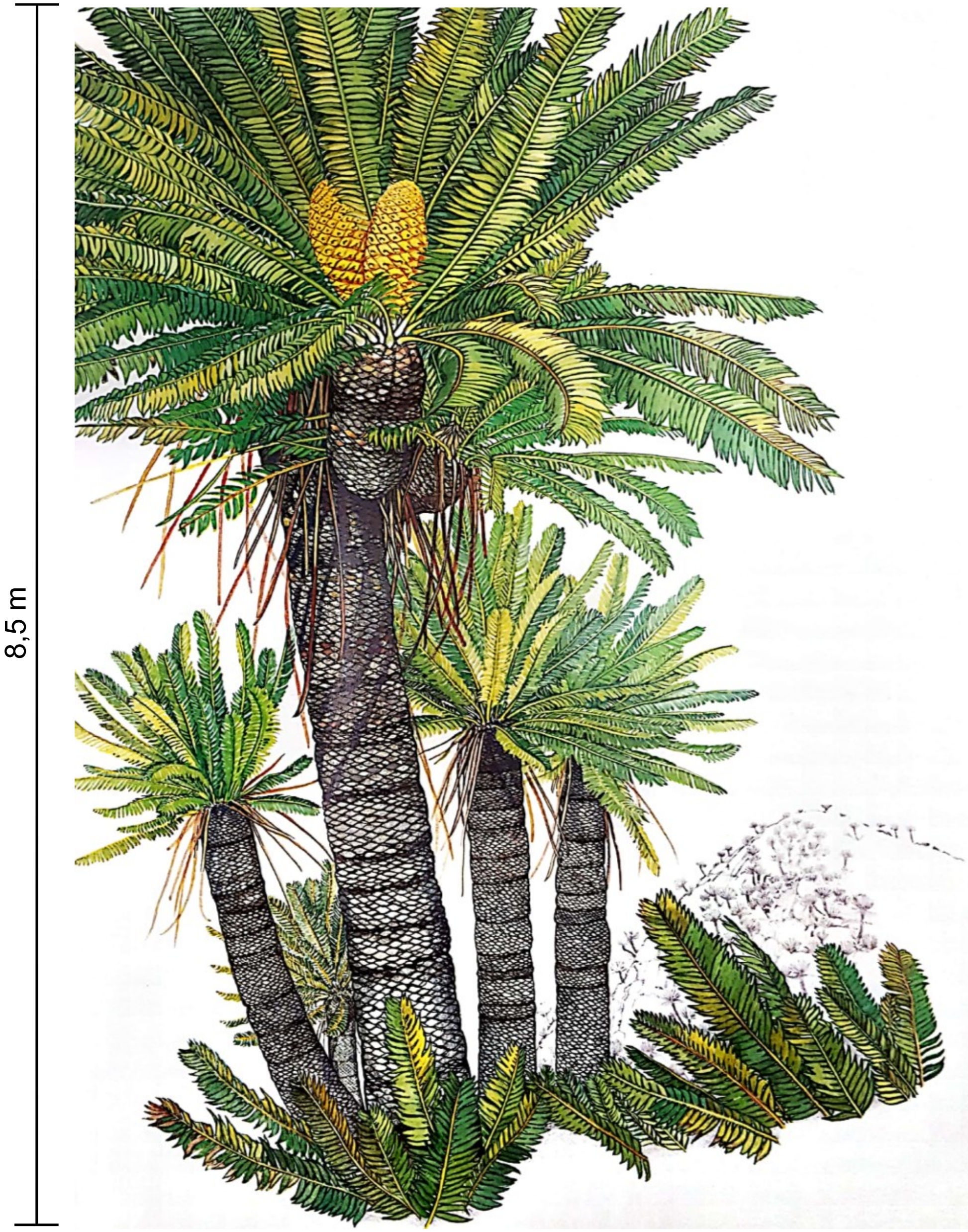


Figure 26: The Madjadji Cycad (Goode, 1989:133)

Table 1: The natural distribution, maximum height and cultivation conditions required for South African Cycads.

SCIENTIFIC NAME	DISTRIBUTION	HEIGHT	DRAINAGE	FROST-HARDINESS	SUN	GREENHOUSE CONDITIONS YES/NO
1. Stangeria eriopus	Eastern Cape	2m	Good	Sensitive	Semi	Yes
2. Encephalartos ghellinckii	Natal	4m	Good	Hardy	Shade	No
3. Encephalartos cycadifolius	Eastern Cape	2,4m	Good	Hardy	Full	No
4. Encephalartos lanatus	Transvaal	4m	Good	Hardy	Semi	Yes
5. Encephalartos humilis	Eastern Transvaal	0,7m	Good	Hardy	Full	No
6. Encephalartos laevifolius	Eastern Transvaal	2,5m	Good	Hardy	Full	No
7. Encephalartos friderici – guilielmi	Eastern Cape	4m	Good	Hardy	Full	No
8. Encephalartos eugene – maraisii	Transvaal	5,5m	Good	Hardy	Full	No
9. Encephalartos middelburgensis	Transvaal	6m	Good	Hardy	Full	No
10. Encephalartos dolomiticus	Transvaal	2m	Good	Hardy	Full	No
11. Encephalartos dyerianus	Transvaal	5m	Good	Sensitive	Full	Yes
12. Encephalartos cupidus	Transvaal	1,5m	Good	Hardy	Full	No
13. Encephalartos princeps	Eastern Cape	5m	Good	Hardy	Full	No
14. Encephalartos lehmannii	Eastern Cape	3m	Good	Hardy	Full	No

Table 1: Compiled from Jones (1993), Goode (1989) and Giddy (1974)

Table 1: …Continued. The natural distribution, maximum height and cultivation conditions required for South African Cycads.

SCIENTIFIC NAME	DISTRIBUTION	HEIGHT	DRAINAGE	FROST-HARDINESS	SUN	GREENHOUSE CONDITIONS YES/NO
15. Encephalartos horridus	Eastern Cape	2m	Good	Sensitive	Semi	Yes
16. Encephalartos trispinosus	Natal	4m	Good	Hardy	Shade	Yes
17. Encephalartos arenarius	Eastern Cape	2,4m	Good	Hardy	Full	Yes
18. Encephalartos latifrons	Transvaal	4m	Good	Hardy	Semi	Yes
19. Encephalartos longifolius	Eastern Transvaal	0,7m	Good	Hardy	Full	Yes
20. Encephalartos altensteinii	Eastern Transvaal	2,5m	Good	Hardy	Full	No
21. Encephalartos natalensis	Eastern Cape	4m	Good	Hardy	Full	No
22. Encephalartos lebomboensis	Transvaal	5,5m	Good	Hardy	Full	No
23. Encephalartos heenanii	Transvaal	6m	Good	Hardy	Full	No
24. Encephalartos transvenosus	Transvaal	2m	Good	Hardy	Full	Yes
25. Encephalartos paucidentatus	Transvaal	5m	Good	Sensitive	Full	Yes
26. Encephalartos ferox	Transvaal	1,5m	Good	Hardy	Full	No
27. Encephalartos villosus	Eastern Cape	5m	Good	Hardy	Full	Yes
28. Encephalartos cerinus	Eastern Cape	3m	Good	Hardy	Full	Yes

Table 1: Compiled from Jones (1993), Goode (1989) and Giddy (1974)

Table 1: …Continued. The natural distribution, maximum height and cultivation conditions required for South African Cycads.						
SCIENTIFIC NAME	DISTRIBUTION	HEIGHT	DRAINAGE	FROST-HARDINESS	SUN	GREENHOUSE CONDITIONS YES/NO
29. Encephalartos ngovanus	Eastern Cape	2m		Sensitive	Semi	Yes
30. Encephalartos caffer	Natal	4m		Hardy	Shade	No
31. Encephalartos inopinus	Eastern Cape	2,4m		Hardy	Full	No
32. Encephalartos aemulans	Transvaal	4m		Hardy	Semi	Yes
33. Encephalartos hirsutus	Eastern Transvaal	0,7m		Hardy	Full	No
34. Encephalartos msinganus	Eastern Transvaal	2,5m		Hardy	Full	No
35. Encephalartos senticosus	Eastern Cape	4m		Hardy	Full	No
36. Encephalartos brevifoliolatus	Transvaal	5,5m		Hardy	Full	No
37. Encephalartos nubimontanus	Transvaal	6m		Hardy	Full	No
38. Encephalartos woodii	Transvaal	2m		Hardy	Full	No

Table 1: Compiled from Jones (1993), Goode (1989) and Giddy (1974)

2.2.2 SEED PROPAGATION

Cycads are usually easy to grow, considering that their primary requirements, such as unconstrained soil drainage, a reasonable amount of water and warmth is ensured. Most mature cycads grow optimally in full sun conditions, excluding some exceptions that may need protection from sun, this is the case with most Cycad seedlings. Intense cold may be a limiting factor for the growth of most species, except for when provisions are made, like the construction of a conservatory (Jones, 1993:66).

To successfully cultivate Cycads from seed, the following seed propagation methods may be employed to increase chances of successful reproduction and germination of seeds. This section of the chapter briefly discusses the various propagation methods commonly implemented in Cycad cultivation. The purpose of this chapter is to formulate an understanding of various functions that will be accommodated in the design project.

SEED PROPAGATION I HAND POLLINATION

One of the most recent advances for Cycad grows is the method employed to augment seed stock (Giddy, 1974:13). The procedure is employed in the case of when a male and female cone reaches maturity at different time intervals, or when there are no pollinators within the area. According to Jones (1993:82), this method entails a grower to cut off a ripe male cone and carefully dust the pollen over the mature female cone (Figure 27).

In accordance to hand-pollination, the following methods need to be accommodated as described below.

i. Pollen Collection: When pollen shedding is initiated in the male cone, the cone should be cut off and placed on a smooth piece of paper. It can then be stored indoors in a warm, dry environment, to speed up the process of shedding. Thereafter, the pollen is either dusted onto a mature female cone, or stored (Jones, 1993:82).

ii. Pollen Storage Pollen needs to be store under the correct conditions, to prevent it from deteriorating. The conditions entail the use of small paper envelopes that are sealed in an airtight jar containing silica gel. The jars are then stored in liquid Nitrogen to allow the pollen to remain viable indefinitely (Jones, 1993:83).

Figure 27: The hand pollination process of cycads (Giddy, 1974:48)

SEED PROPAGATION I SEED COLLECTION

Upon attaining maturity the female cone of a Cycad begins to break down, allowing the seeds to fall to the ground. These seeds are then collected for planting (Jones, 1993:83). The following methods discussed are employed to speed up the process of germination and will be accommodated in the phytosanitary lad, as illustrated in chapter 4 under design development.

i. SARCOTESTA INHIBITORS: The fleshy layer of Cycad seeds contains chemical inhibitors that defers seed germination. The removal of this layer will consequently increase the rate of germination (Jones, 1993:84).

ii. SEED SCARIFICATION: This method entails the cutting or scratching of the hard outer coat to enhance seed germination (Jones, 1993:85).

iii. SEED STRATIFICATION: This method entails the exposure of seeds to extended periods of low temperatures of roughly five degrees Celsius (Jones, 1993:85).

iv. PRE-SOAKING SEEDS: Some Cycad growers soak the seeds for a couple of days before sowing. Hence, improving the rate of germination (Jones, 1993:85).

2.2.3 FOLKTALE I Mojadji Rain Queen

The Modjadji's Royal Kraal, situated in the ancient and mystical Modjadji Cycad Forest, is where part of the big rain-making ceremony takes place during the first weekend of October every year (Njanja, A. 2017: online). The ritual encompasses a celebration of respect towards the queen and the ancestors with singing, dancing and drinking of home-brewed beer (Njanja, A. 2017: online) (Figure 29). The tradition of rain-making filtered down into South Africa from its origins in Zimbabwe, bearing a culture that is deeply connected to understanding and respecting nature. The picturesque landscapes of Limpopo entail more than pleasant sightseeing trips - the lands of Limpopo bear stories that embody a deeper, more spiritual experience (Njanja, A. 2017: online) (Figure 28).

Figure 28: Queen Modjadji's palace is situated on the mountains of the Cycad Forest in Limpopo. (Miss Zeee, 2015: online)

Figure 29: The royal dancers entertaining visitors at the Balobedu royal ground where visitors are only allowed to enter barefoot. (Njanja, A. 2017: online)

2.3 THE HISTORY OF A CONSERVATORY

Constituting the notion of accommodating nature, that would otherwise not survive in the hostile conditions of the surrounding context (Manohar & Igathinathane, 2007:43). The origin of a conservatory dates back to Roman times, when Roman Emperor Tiberius required the availability of cucumbers all year round, for medical purposes (Shamshiri, 2006-2007:8).

This notion further developed 1500 years later, that by the 16th century the design of a conservatory was intended for many purposes. In Italy, a conservatory was known as "botanical gardens' intended to house and exhibit exotic plants that were shipped in be explorers (Shamshiri, 2006-2007:8). Here the typology of a conservatory already resembles that of a gallery or a museum. Other areas used bell jars or glass lanterns to protect their crop against harsh climate conditions (Manohar & Igathinathane, 2007:2). French botanist, Jules Charles, is well known for constructing the first practical modern conservatory to cultivate medicinal plants (Manohar & Igathinathane, 2007:2).

By the 17th century, Japan constructed the notion of a conservatory, by means of straw mats combined with translucent oil paper for the purpose of heating the plant environment. Conservatories in France and England were heated with compost and glass panes. It was only later in the century, that glass was more commonly used as a covering material for cultivating fruit and vegetables (Manohar & Igathinathane, 2007:2).

During the 18th century, conservatories were built on an enormous scale, intended to accommodate both botanical and non-botanical exhibitions, that would be used to entertain the aristocratic section of the population. A prime example is the design of the Victorian conservatory, located at KEW Gardens, in London (Shamshiri, 2006-2007:8). After World War II, the protection of food crop environments was only fully established with the establishment of polyethylene as a cheaper alternative to the use of glass in conservatories (Manohar & Igathinathane, 2007:2).

Today, conservatories are readily available, in the form of home construction kits. The design of conservatories constitutes endless possibilities, ranging from geodesic domes to traditional glass structures. For the purpose of the dissertation, the design of a Cycad conservatory is primarily determined by the physical properties and climatic requirements of the Cycad species, previously discussed in this chapter. This section of the chapter, presents an exploration of conservatory precedents to understand how the design of a conservatory relates to its surroundings. Refer to Chapter 6, for the full investigation on Conservatories, in terms of structure and material selection.

2.3.1 PRECEDENT EXPLORATION

PRECEDENT | Princess of Wales Conservatory

Location: KEW, London

Architect: Gordon Wilson

Year: 1987

Set within the historical context of KEW gardens, the design of the Princess of Wales conservatory, further develops and challenges the construction methods of the surrounding historical conservatories, that were built during the 18th century. The design's structural composition employs advance climate control systems to accommodate 10 individual climatic zones (Avis-Riordan, 2019: online) (Figure 32).

The Conservatory was constructed on the site of the T-Range and 25 other dilapidated glasshouses (Avis-Riordan, 2019: online). Designed not only for the intention of referencing the historical landscape, but also to convey an architectural statement of power and significance (Figure 30 & 31). Consequently, following in the footsteps of its surrounding predecessors (Avis-Riordan, 2019: online). The differentiating factor that sets the Princess of Wales Conservatory aside from the other large greenhouses at Kew is the internal approach in which the plants, and not the architecture, governs the space, thus signifying the conservation values of Kew constituted in the later half of the 20th century (Avis-Riordan, 2019: online).

Figure 30: The Eden Biomes in context (Avis-Riordan, 2019: online)

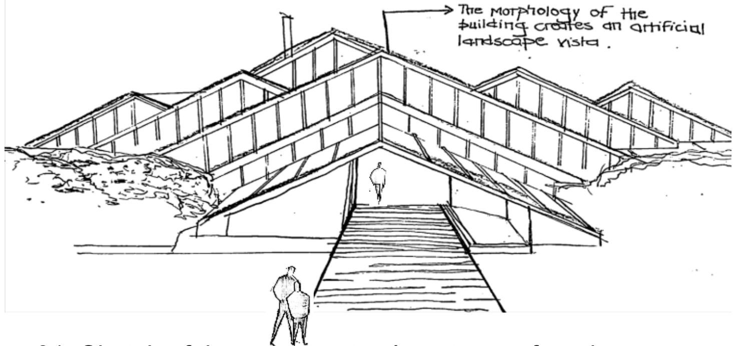


Figure 31: Sketch of the conservatory's entrance façade.

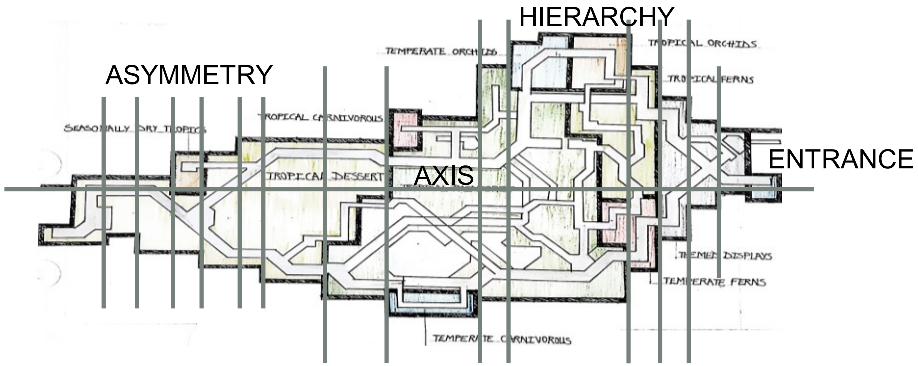


Figure 32: Sketch of design principles on plan

PRECEDENT | Siu Siu Laboratory of Primitive Senses

Location: Taipei, Taiwan

Architect: Divooe Zein

Year: 2014

Originating from a belief that humans have detached themselves from nature. The design of the Siu Siu Laboratory of Primative Senses, intends to provide a spatial experience where humans can systematically transition from an urban environment to a primitive surrounding, that encourages a healing process (ArchDaily, 2014: online) (Figure 33).

Set within a natural liminal space (Figure 35), the design of the conservatory is completely open-ended on both sided and employs the covering of a permeable membrane to allow for a transitional space, where humans can unconditionally expose themselves to nature, and nature can effortlessly inhabit the human-made structure (Mairs,2015: online). Furthermore, it establishes the functions of a meditation space, a gallery and workshops (Figure 34), intended to provide the feelings, “here and now”. According to the architect, Divooe Zein, the design aims to embody an experience that imposes the feeling of - “Unpractical, ephemeral, completely incapable of coping with everyday needs, these instinctive feelings are in fact a power of healing developed by contemporary man towards certain natural relationship. It will go on, in a manner proper to primates, to the unknown” (ArchDaily, 2014: online) (Refer to Chapter 6, for full analysis).

Figure 33: Permeability in design (ArchDaily, 2014: online).

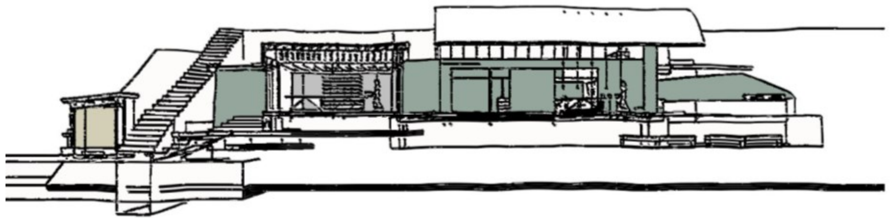


Figure 34: Sketch of accommodation in section

Figure 35: The conservatory in context.

PRECEDENT | The Eden Project

Location: Cornwall, UK

Architect: Nicholas Grimshaw

Year: 2011

The Eden Project, stems from an exploration in notion of sustainability in both design and construction. It intends to promote an ethical understanding in the relationship between humans, nature and resources. The design focus was to develop something new, that would function as a tourist attraction, research and education platform for future generations (Bissegger, 2006: online). Therefore, the design consists of eight enormous, yet lightweight geodesic biomes, that intends to serve as the world's largest plant enclosure, for humid tropics and warm temperate regions (Stevens, 2016: online) (Figure 37).

According to Bisseger (2006: online) "Grimshaw's solution to this challenge was to look at nature. He got his inspiration from looking at the honeycomb of bees and even the multifaceted eyes of a fly. These creatures used their surroundings most effectively to create a very strong, yet light-weight solution." The shape of the design allows for minimal impact on the setting of the abandoned quarry (Figure 36). The morphology of the design also allows for a better strategy in heat conservation, providing the ideal climatic conditions for the humid – tropics biome (Grimshaw, [n.d]: online).

Figure 36: The Eden Biomes in context (Grimshaw: online)

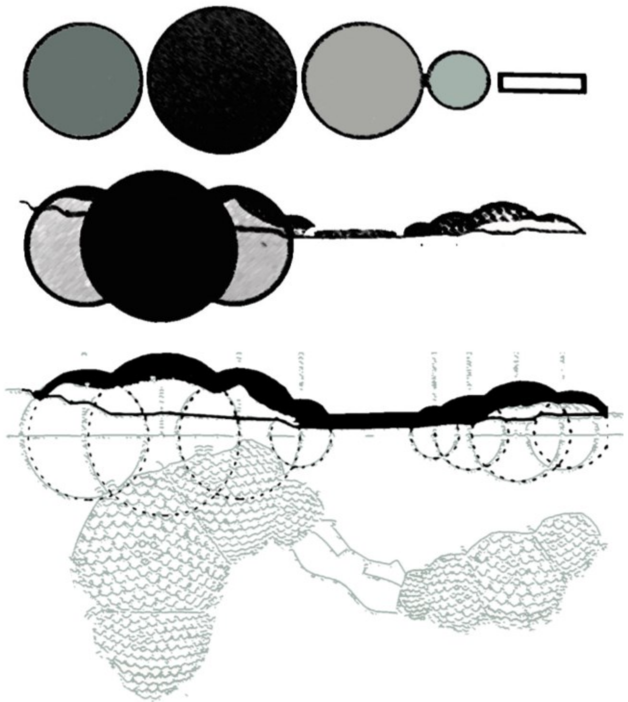


Figure 37: Sketch of section to plan development generated from (Grimshaw: online)

2.4 TOUCHSTONE I Towards a View of the Future

The touchstone for this project acts as a physical exploration of the relationship between humans and nature, by means of exploring the notion of narrativity, as a possible conservation strategy (Figure 38).

The essence of the project stems from an understanding of endangered plants species, in which man, and nature play a vital roles in the endangerment of plants. The essence of the project is explored with the idea of a pendulum's movement as a symbolical portrayal of the instability in plant status. This notion is employed, because the initial movement of a pendulum is either introduced through man's reactions or a natural intervention, such as wind. Furthermore, the touchstone expresses the notion of narrativity, where the narrative composition of meaningful placemaking acts as a physical manifestation, that aids in the development of a sympathetic relationship between humans and nature. Thus providing a conservation strategy in the form of understanding and being consciously aware of our natural surroundings.

This notion is conveyed, by tying each weight with several strings, in order to depict how relationship between architecture and nature can act as a conservation tool in stabilizing the status of endangered plant species or stabilizing the movement of each pendulum (Figure 39).

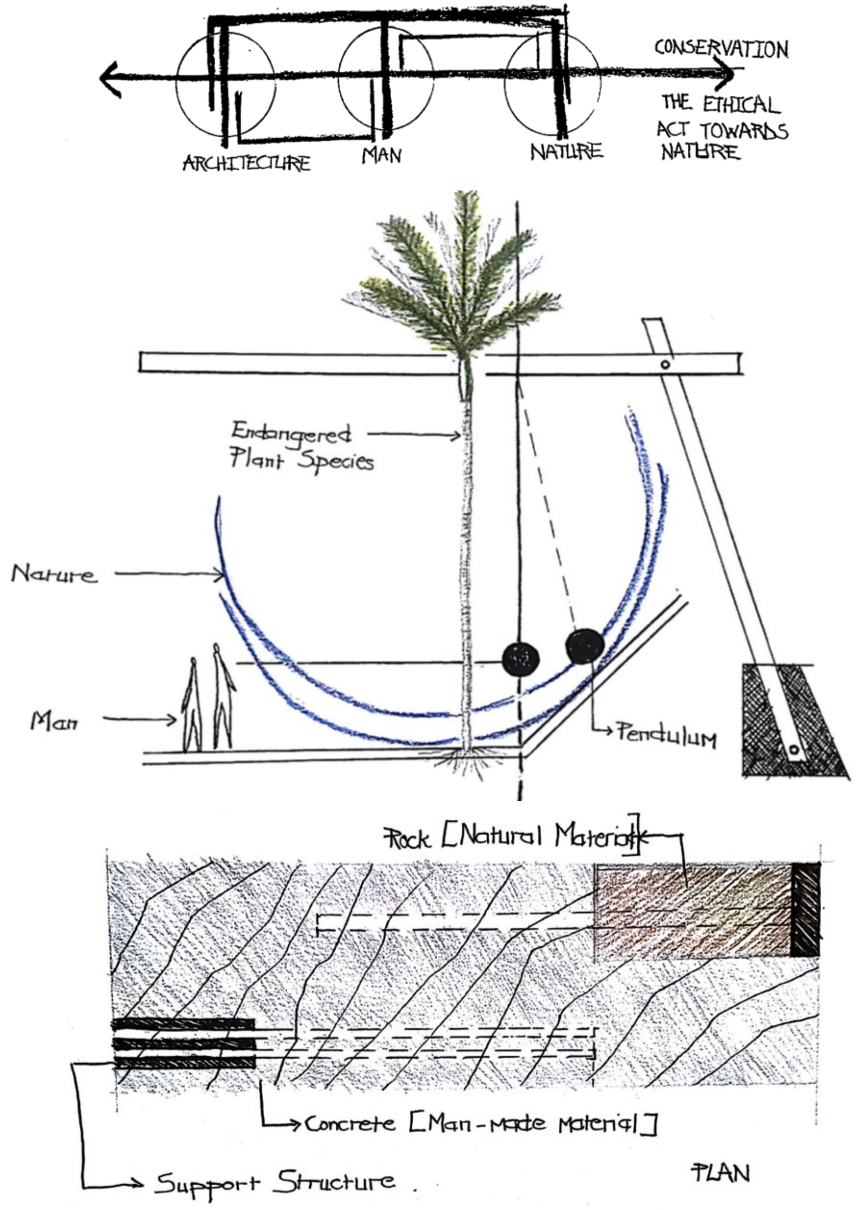


Figure 38: Concept sketches portraying the relationship between man and nature.

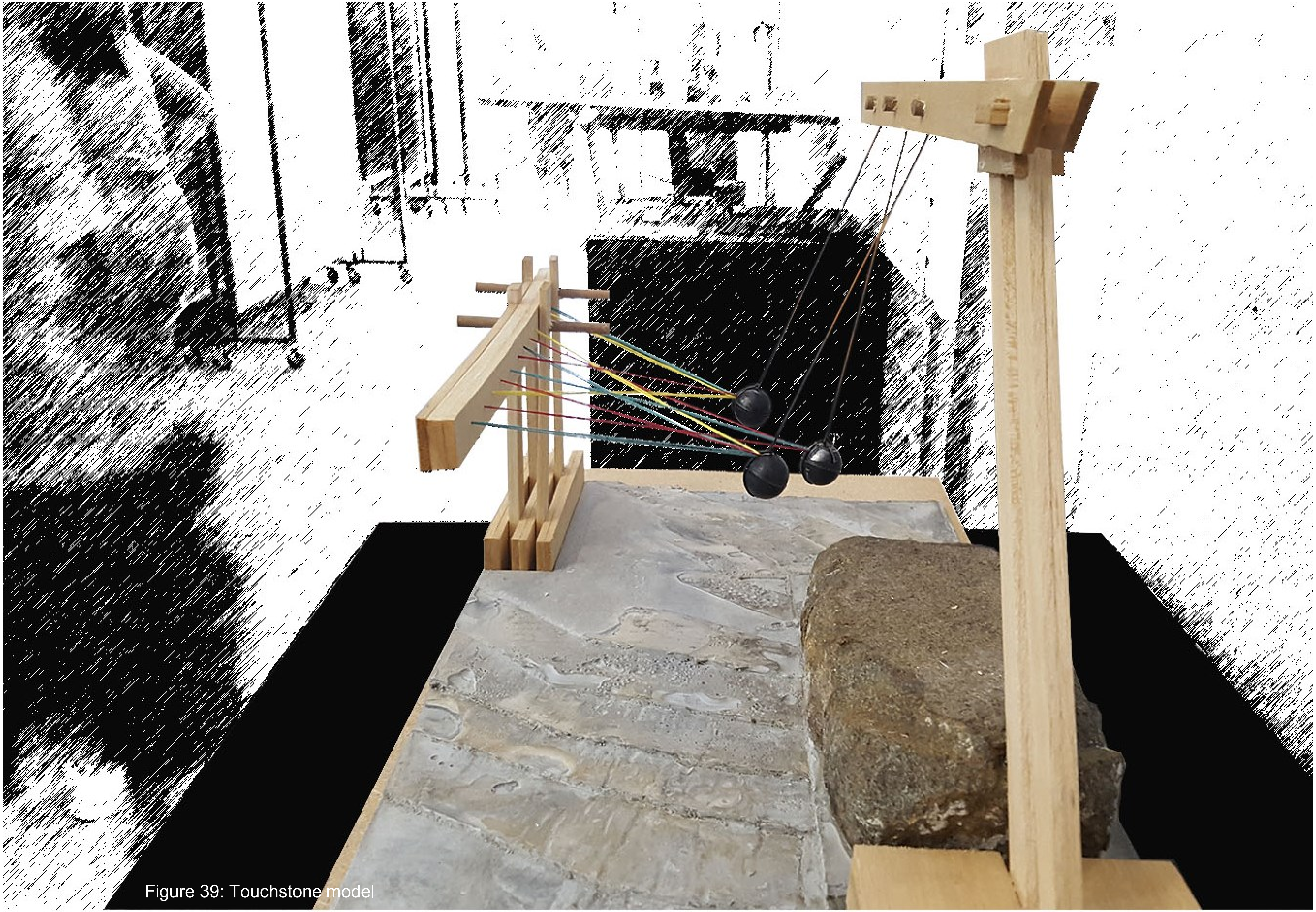


Figure 39: Touchstone model

CHAPTER 03 _ CHARACTER OF THE FREE STATE LANDSCAPE

3.1 IN RELATION TO THE LANDSCAPE

The process of understanding a site starts by acknowledging that there is an acquisitive connection between an object and its surroundings (Figure 40). An object formulates meaning from its context and as the context changes, so does the meaning of the object. (Mahdavinejad, Shahrigharahkoshan & Ghasempourabadi, 2012: 1001) Mario Botta explains this relationship by stating that: “the relationship between architecture and site is mutual influences and remain constantly.” (Mahdavinejad, Shahrigharahkoshan & Ghasempourabadi, 2012: 1001)

The focus of this chapter serves as an exploration of the physical and conceptual site peripheries, that can be considered as potential design influencers. The research aims to convey an understanding of the site’s character within its macro context, its immediate surroundings as well as factors concerning the site itself.

In response to the previous chapter - discussing the character narrative of South African Cycads, this chapter starts with an outline of the key site conditions required to successfully accommodate the selected Cycad species. Followed by a section that identifies and investigates three possible site locations, in terms of a SWOT analysis, to determine a suitable site for the design of a Cycad conservatory. The chapter then continues with a series of explorations on the selected site - Glen Lyon farm, situated north of Bloemfontein. For the purpose of formulating a concise comprehension of the site’s character, the chapter further discusses relevant precedents, to assist in concluding with three concepts, as possible design generators.

Figure 40: Concept sketch of a being in relation to the landscape

3.2 SITE SELECTION CRITERIA

LOCATION

- The facility must be situated in a central location (Figure 41).
- It must be situated within a natural setting that is protected from the winter climate.
- It should be located in an area that is able to provide security from illegal cycad collectors.
- The facility should be located in an area where existing vegetation that is not endangered.
- It requires a northern orientation and good drainage (Figure 42)

SERVICES

- The facility should be in close proximity to existing infrastructure, such as main road/ airport.
- Requires access to loading areas and deliveries for maintenance and service.

PUBLIC

- The public should be able to access the facility
- The architecture should be semi - visible to encourage citizens to visit the facility.

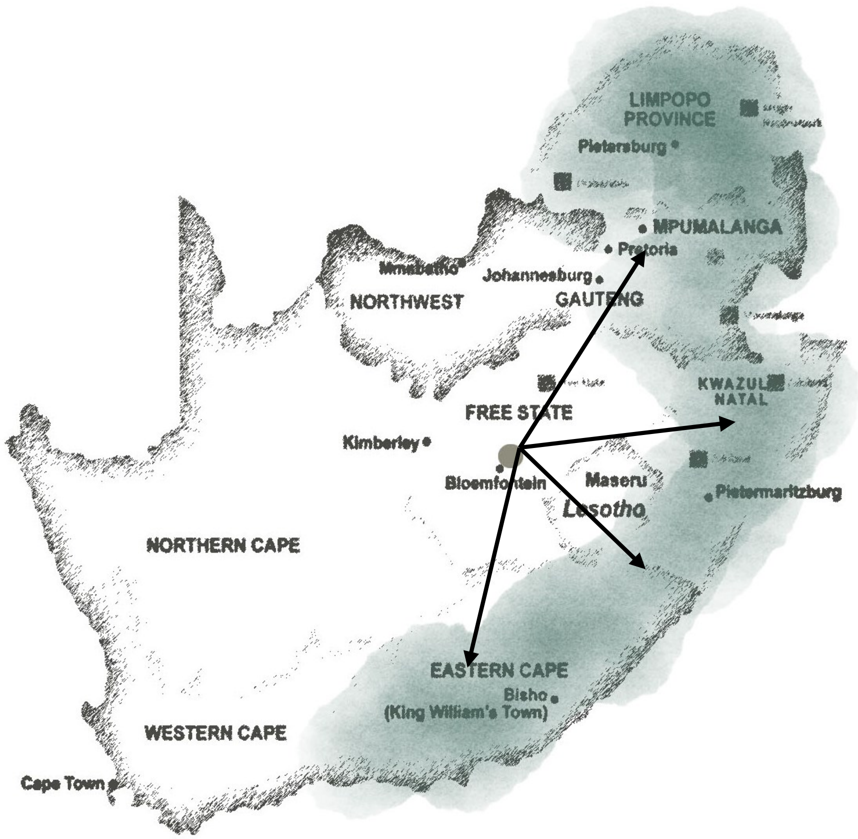


Figure 41: Map indicating Cycad distribution in South Africa and proposed location area for the project generated from (Donaldson, 2003:9)

Figure 42: Sketch of site slope, providing frost protection, and natural water drainage.

3.2.1 SITE SELECTION INVESTIGATION

The existing natural surroundings formed the basis of a possible location for the proposed designed facilities. It is argued that the existing surroundings should be respected and taken into consideration. The following three possible sites were identified for the intervention and a SWOT analysis was compiled for each site.

Figure 43: View towards South direction. View through Botanical Garden with Rayton water reservoir and Naval Hill visible on the horizon.

Figure 44: View towards East direction. View of Botanical ravine with ridge in the distance.

01 BOTANICAL GARDENS (Figures 43 – 47)

- Located in a protected natural environment
- South Western Orientation
- Site option A is only protected from the cold on one side (North), whereas site option B is protected from three side (North, east and west)
- Situated near water
- Both site option provide poor solar radiation

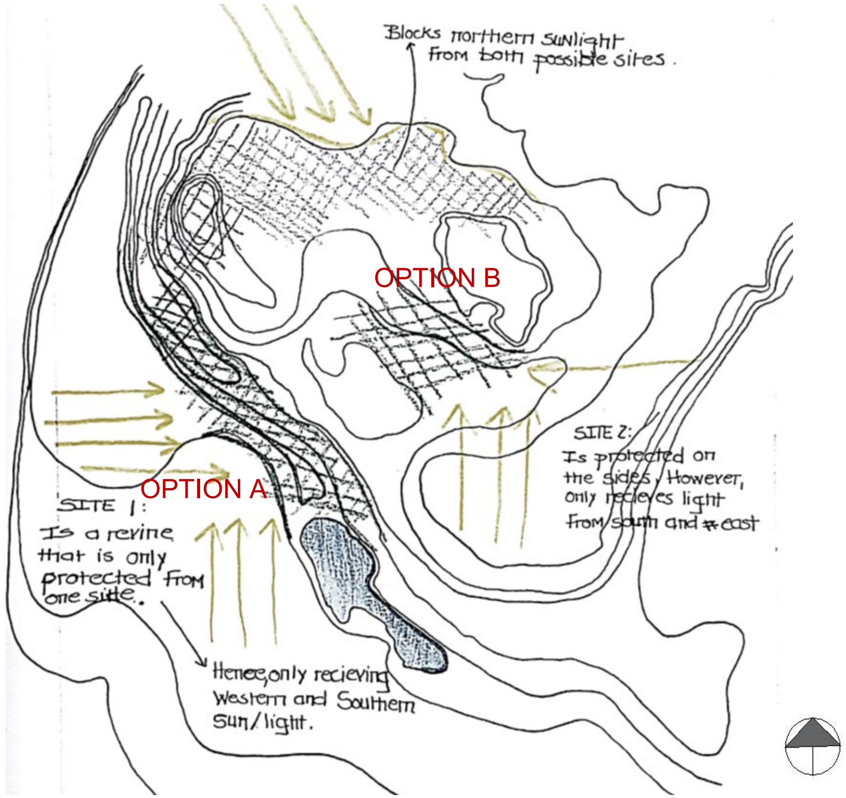


Figure 45: Analysis of possible site at the Botanical Gardens, Bloemfontein

Figure 46: View of site option A

Figure 47: View of site option B

02 HANGMANSKLOOF, NAVAL HILL (Figure 48 – 51)

- Located in a protected natural environment
- Northern - Western Orientation
- Protected from the cold from two sides
- Located within the city
- Situated near water
- Good solar Radiation

Figure 48: View towards North-West direction, from the bottom of Hangmanskloof.

Figure 49: View towards North – West direction overlooking Rayton/ Hewelsig water reservoir in the distance.

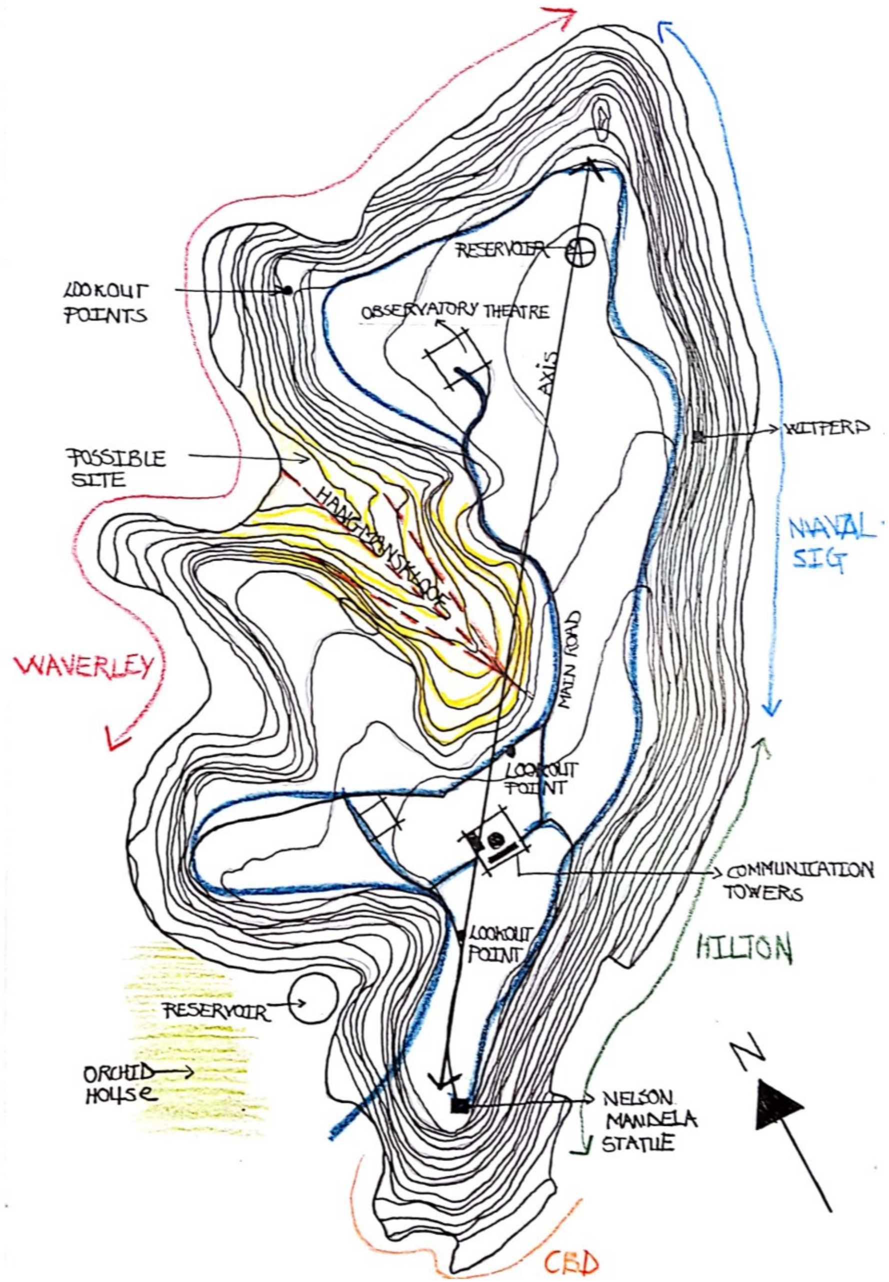


Figure 50: Analysis of Hangmankloof within its surrounding context.

Figure 51: View from site, with urban context in the distance.

03 GLEN LYON FARM (Figures 52 – 55)

- Northern Orientation
- Protected from the cold with surrounding hills
- Located between cities
- Situated near water and main road
- Good solar Radiation

Figure 52: View towards the South-East direction, overlooking the N1 road in the distance.

Figure 53: View of proposed site, sketched from the dam wall.

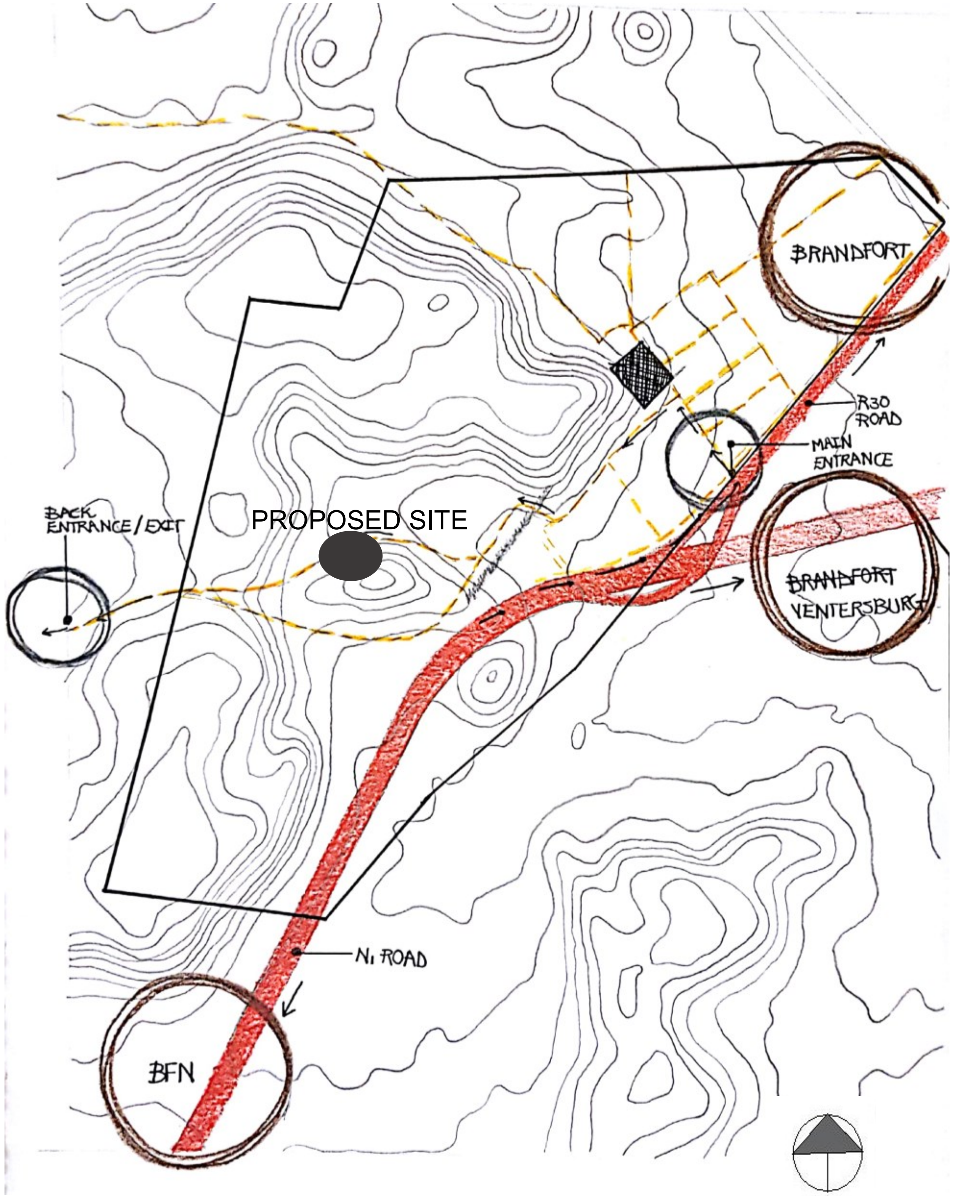


Figure 54: Analysis of possible site at the Botanical Gardens, Bloemfontein

Figure 55: View of north facing hill

3.3 MAPPING A LANDSCAPE CHARACTER

In light of attempting to understand the site within its surrounding context, mapping forms part of a component that enables a design tool where layered information highlights the hidden potential of the site. According to James Corner, in his essay on the *Agency of Mapping* (Kaprielian, [n.d.]: 2) “Mapping is perhaps the most formative and creative act of any design process, first disclosing and then staging the conditions for the emergence of new realities.” Therefore, this section of the chapter serves as part of the design process, that aims to comprehend the conceptual and physical characteristics of the site in order to imagine the Free State landscape in new and unexpected ways.

The process of mapping and exploring the site within its surrounding context, this section of the chapter start with an overview of South Africa’s diversity in landscape regions. It then continues to discuss and exemplify a personal understanding of the site’s character, in the form of conceptual sketches. Thereafter, this section presents an exploration of the physical characteristics of the site. (Refer to chapter 6, for full site investigation)

SITE LOCALITY

The site is located about 11 km North - West of Bloemfontein and 35 km South – East of Brandfort in Mangaung Metropolitan Municipality, Free State Province. The site is situated next to the N1 highway in a low-lying area at an elevation of 1360 m above sea level surrounded by numerous hills. (Figure 56 & 57)

Figure 56: Analysis of possible site at the Botanical Gardens, Bloemfontein

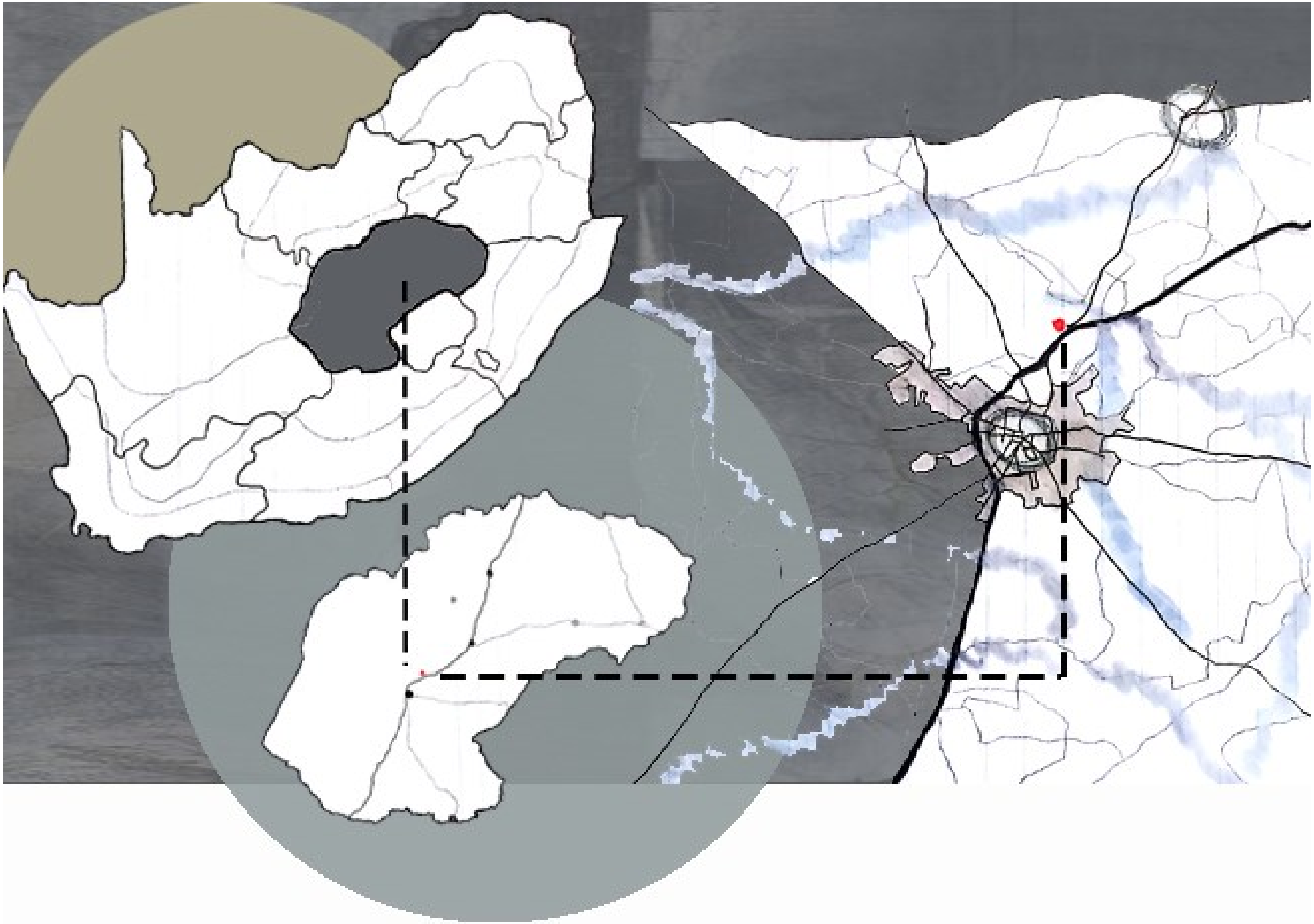


Figure 57: Locality of proposed site, indicated by red dot.

3.3.1 SOUTH AFRICAN'S LANDSCAPE DIVERSITY

In the broad context of the site, South Africa has been recognised as a country with an underlying richness in both culture and vegetation of vast diversity. (Rutherford, Mucina & Powrie, 2012: 1) The general environmental perception of this country can be described as a relatively dry landscape, with vegetation that flourishes in a low mean annual rainfall. (Grundy & Wynberg, 2001: 1) According to Rutherford and Westfall (1986: 14) South Africa harbours seven biomes, namely: Grassland; Savannah; Succulent Karoo; Nama – Karoo; Forest; Fynbos and Thicket. The majority of the area consists of a dry savanna woodland, with patches of forest communities reaching more than 5m in height (Grundy & Wynberg, 2001: 1) (Figure 58 & 59).

Poet and writer, Antjie Krog, describes the South African landscape as, "a landscape of paradise…where the Free State lies amongst the sweepings of grass and stone and windswept sky." (Viljoen, [n.d.]: 7) It is important to understand the broad contextual landscape in terms of plant diversity, as this dissertation proposes to accommodate cycads as well as other forms of plant species from various biomes within South African.

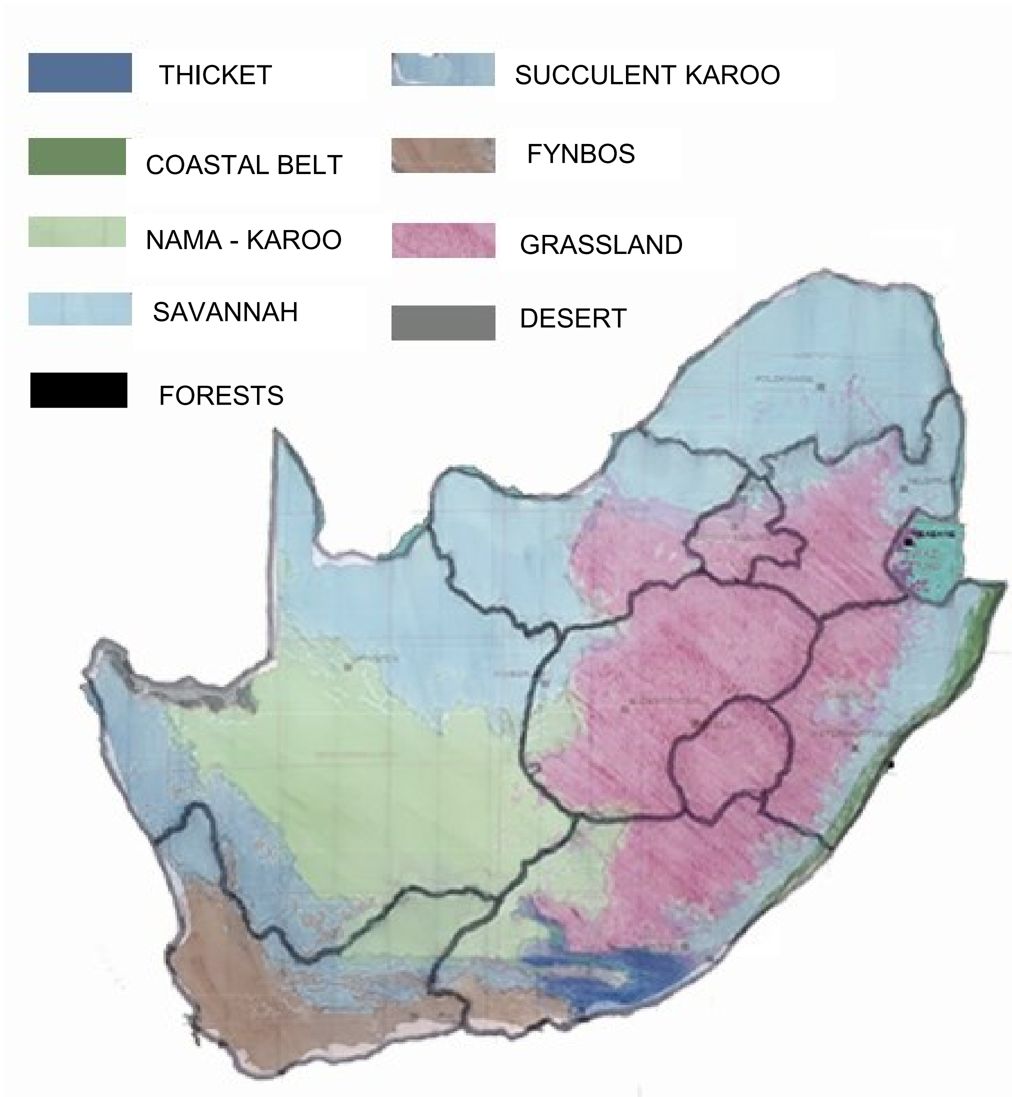


Figure 58: South African Biomes (Mucina & Rutherford, 2006: 33)

Figure 59: South African Biomes (Quintin, 2019: online)

3.3.2 A COGNITIVE CONNECTION TO THE SITE

Consequent, to the first site visit, a series of sketches were produced to explore a personal understanding of the site's character. It presents a reflection of my initial memories of the site and the experiences of dwelling within its natural setting. The setting of Glen Lyon farm, was conceived as a haven isolated from the surrounding cultural interventions, such as the N1 route, agricultural practices and urban developments (Figure 60) The site resonates an untamed identity, rich in various dimensions of plant life (Figure 62). .

Figure 61: The sun's interaction with the landscape

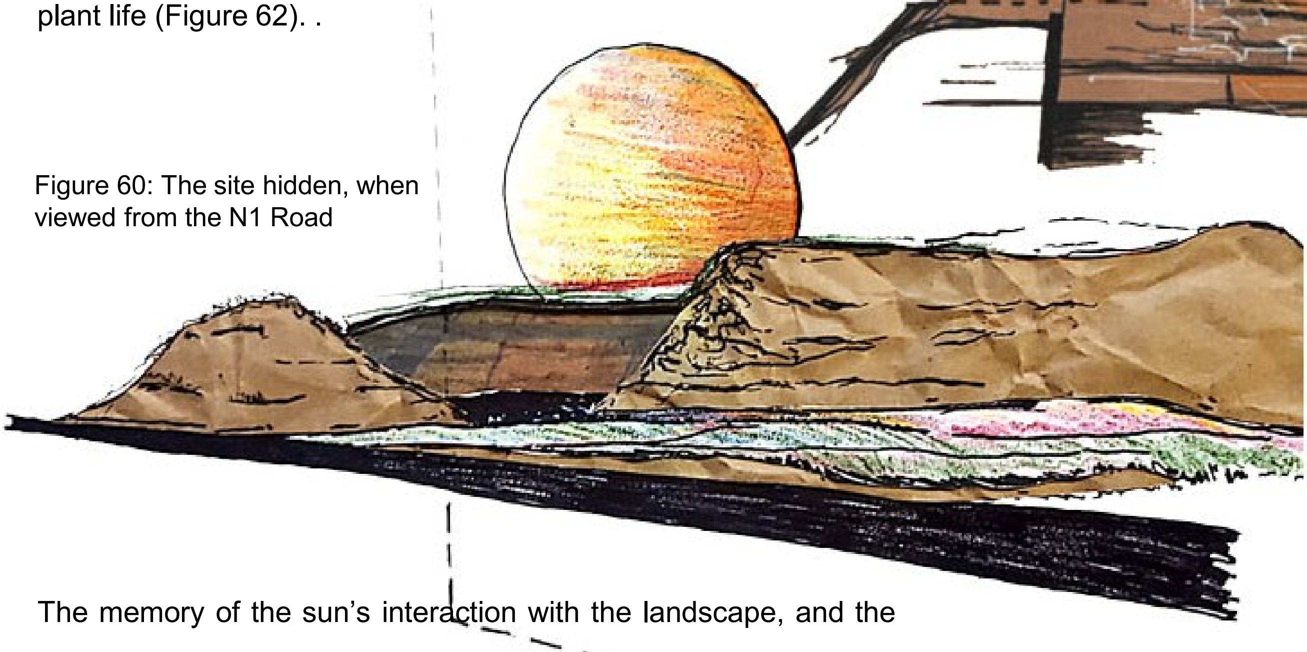
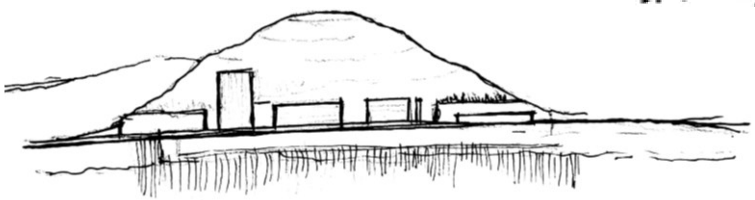


Figure 60: The site hidden, when viewed from the N1 Road

The memory of the sun's interaction with the landscape, and the traces of human interaction inscribed in the form of informal roads, formulated an understood of the site as a collective domain of individual bodies that is essentially open to history, transformation and an imagined future (Figure 61).



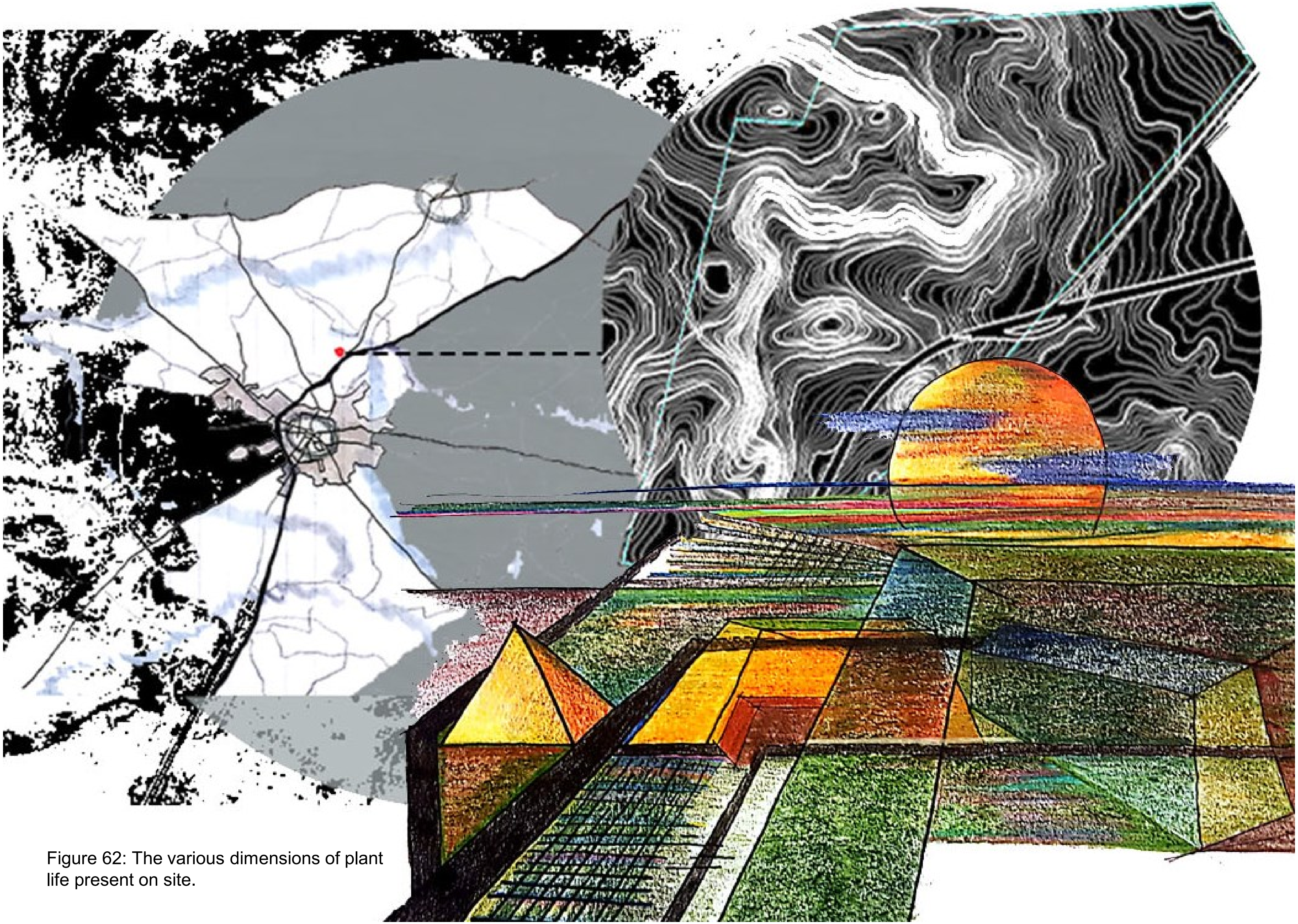


Figure 62: The various dimensions of plant life present on site.

3.3.3 THE PHYSICAL CHARACTERISTICS OF THE SITE

Situated on the northern embankment of the hill, highlighting the surrounding views and natural embodiment of the site (Figure 63)

Figure 63: Site Photo

REGIONAL CONTEXT

While the Free State of South Africa is one of the centrally located provinces in South Africa, it is also relatively sparsely populated.

As mentioned earlier, the focus area is situated on the northern mountain slope at Glen Lyon farm 12 km north-west of Bloemfontein. Of relevance to this intervention is the Ni road overlooking the site, as one drives by. Therefore, the positioning of the site acts both as a public awareness node, and a protected nature ravine (Figure 64).

Figure 64: Google maps aerial view of site (Google Earth: 28* 58' 35.94" S 26*16'46.99" E)

NORTH FACING SLOPE

The proposed design is placed on a north facing slope 1370m above sea level, to obtain maximum sunlight and drainage for the accommodated cycads (Figure 65 & 66). The design acts as a node between the main entrance and the service entrance to the site, activating the typical Free State landscape, by cautiously locating the public areas on top of the slope and the private areas as the foot of the hill.

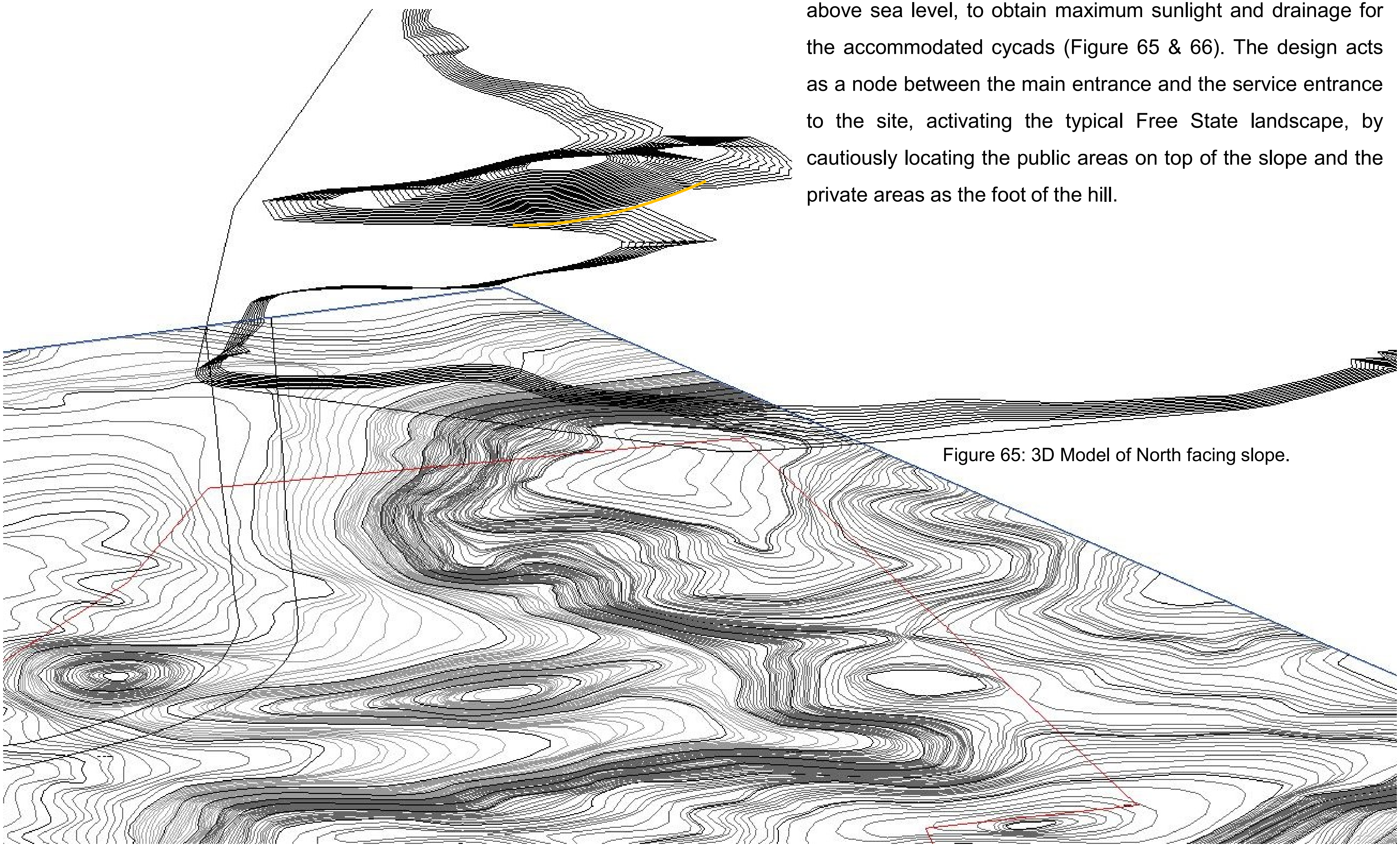
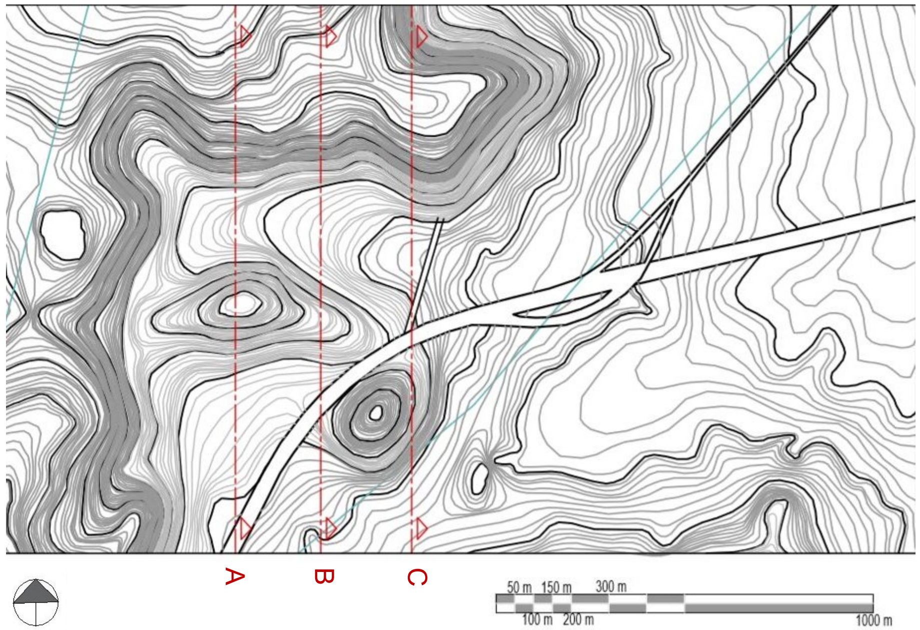


Figure 65: 3D Model of North facing slope.

Figure 66: View of the slope

TOPOGRAPHY ANALYSIS

The identified site, with an approximate developed area of 19 000 sqm, rises almost 20m over a distance of 34m, this incline (0,2: 0,34) is used in the design proposal and parts of the building are sunken into the existing slope (Figure 67).



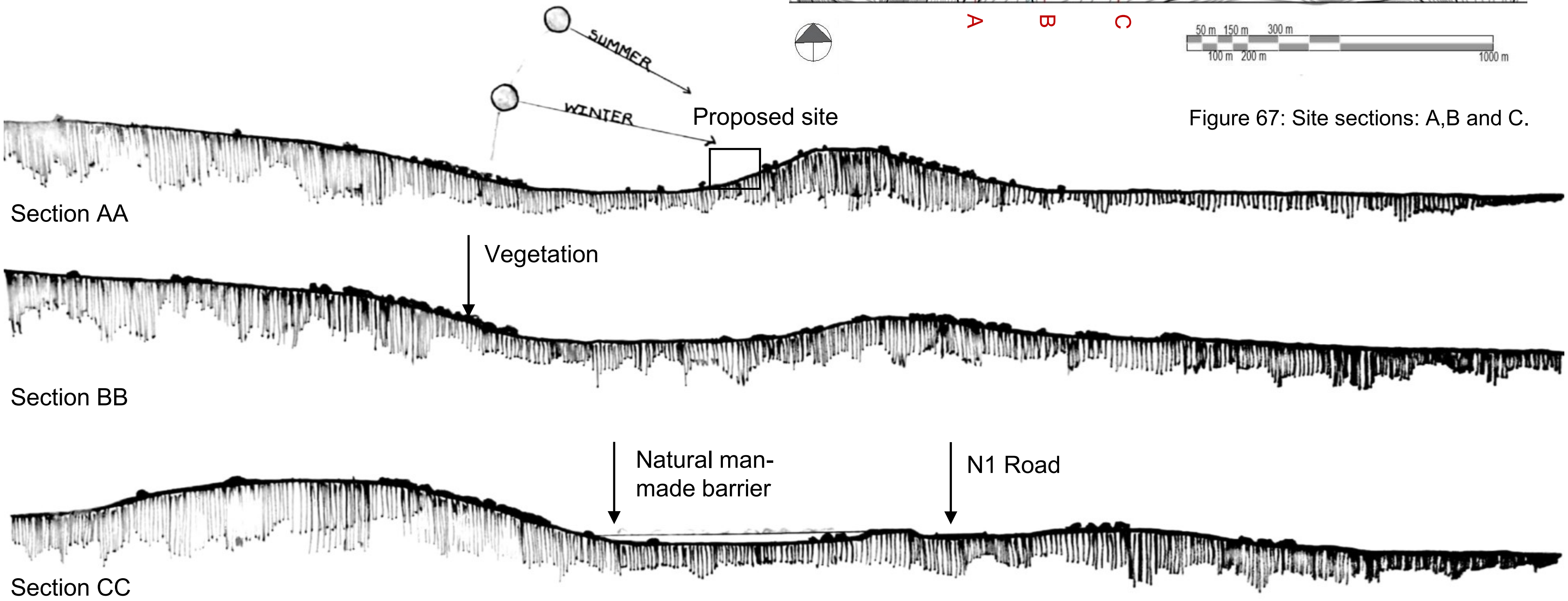


Figure 67: Site sections: A,B and C.

ELEMENTS ON SITE

01 PHYSICAL	02 PATHWAYS	03 EDGES	04 CHARACTER

Shrubs and Grass

Rocks form natural edges

Presence of water

N1 Road passing site

Existing informal road

Dolomite Hill

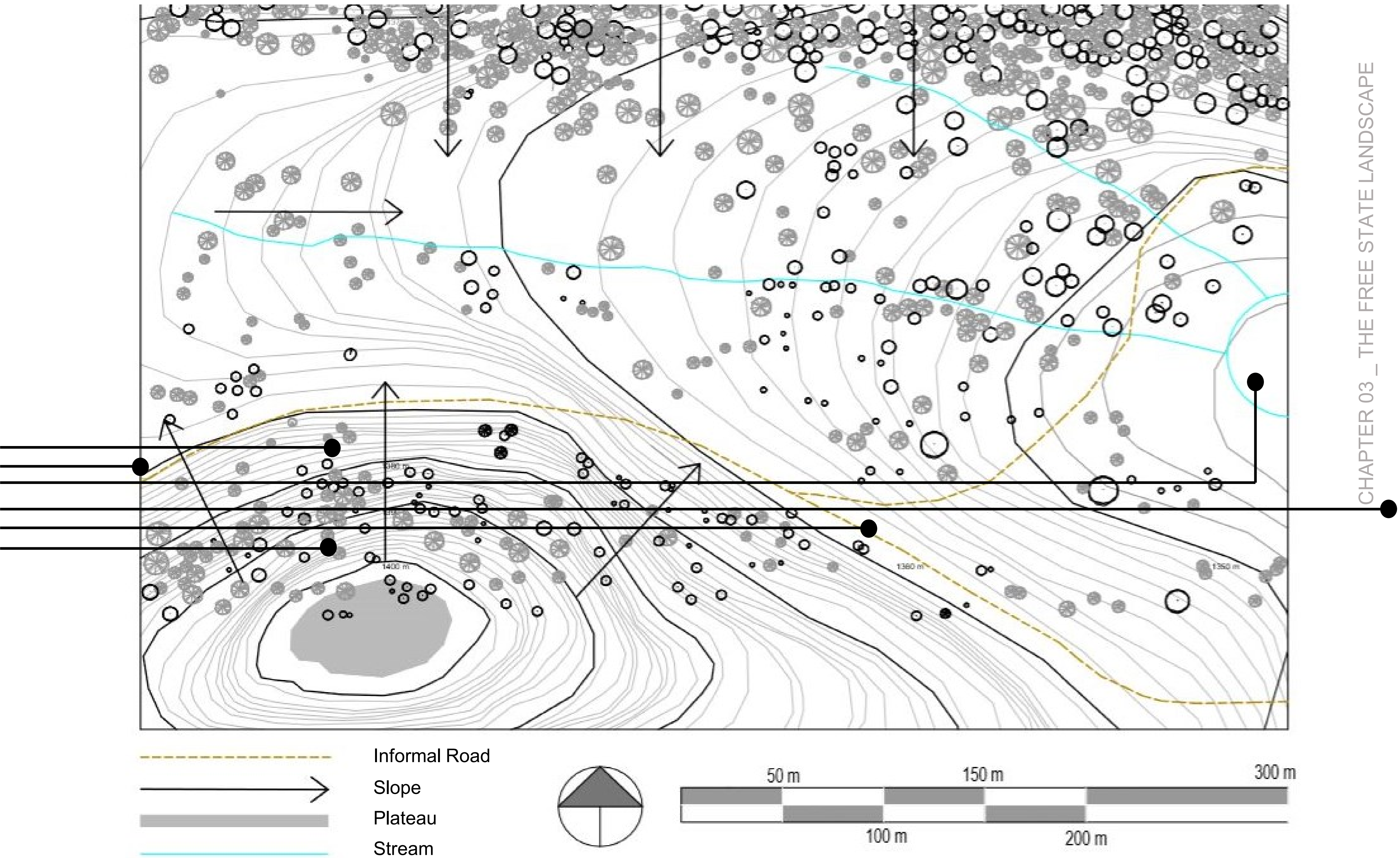

Informal Road
Slope
Plateau
Stream
50 m
150 m
300 m
100 m
200 m

Figure 68: View of site from the N1 road

OPPORTUNITIES AND CONSTRAINTS

Constraints

- Site is isolated from any major city
- Site is located on a northern slope of the hill (Figure 69).
- Cold interior climatic region
- Site is surrounded by hills, causing little visual connection from the N1 road (Figure 68).

Opportunities

- Site is situated in a central location, between cities
- Site is located in a natural landscape
- Exploration in creating an environmentally awareness facility for public visitors.
- Explore design solutions for climatic response

CHALLENGES TO BE ADDRESSED IN DESIGN PROPOSAL:

- Investigate indigenous building materials to incorporate in building construction.
- Address the north facing slope of the hill with appropriate design methods to integrate the architecture into the landform of the slope.
- Design the building to contextually fit into its surroundings
- Design a built environment suited for cold interior climatic conditions.

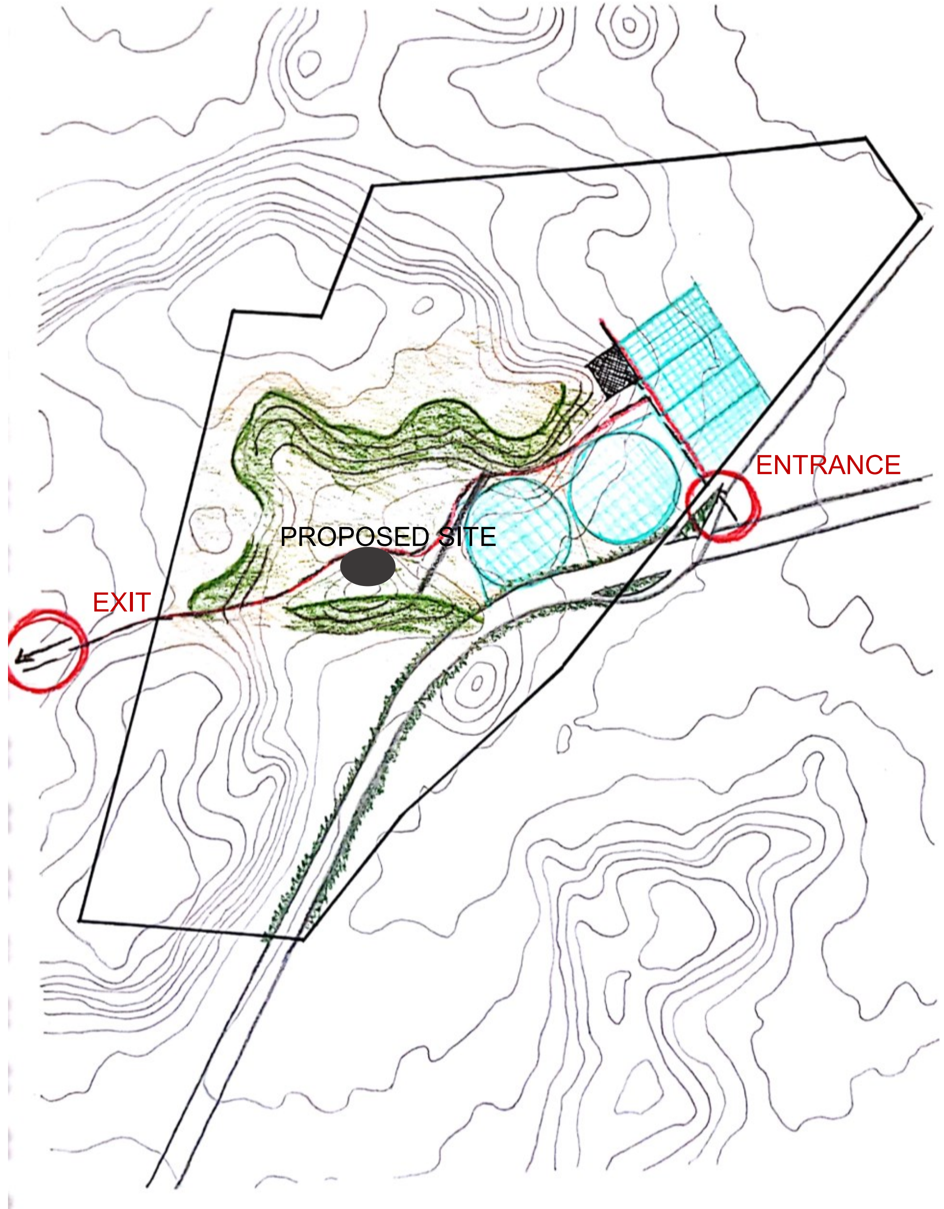


Figure 69: Map indicating nodes of entrance and exit

3.4 PRECEDENT EXPLORATION

The following precedents are explored to further develop an understanding of the relationship between humans and nature.

PRECEDENT | The Gods must be Crazy

In the movie, ‘The Gods must be Crazy’, an narrative outline is presented to narrate the relationship between the Koi San Culture and the natural settings of the Kalahari dessert. Here four interpretations were derived, firstly, the landscape, providing for the humans that dwell within it. Secondly, the introduction of the unfamiliar, establishing a heightened sense of awareness. Thirdly, human’s connection with the earth, learning and surviving from it’s natural provisions, and lastly, traces of human intervention, inscribing a narrative onto the landscape (Figure 70).

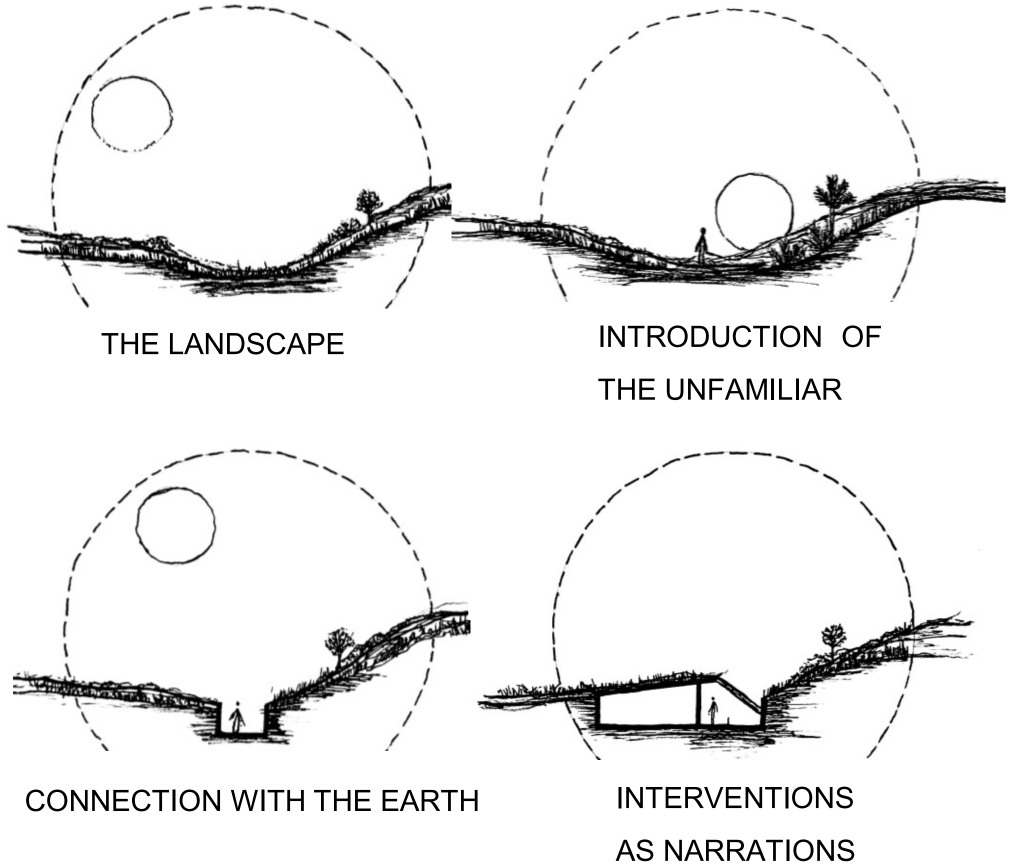


Figure 70: The four interpretations established from the movie.

PRECEDENT | Antjie Krog Poem

Antjie Krog describes the Free State landscape as a sacred ground that embodies all the stories of the people that have once embarked on it. She starts off by reflecting on herself within the landscape, by stating, "This is my landscape. The marrow of my bones." and then continues to add character to the landscape itself, by giving it a spiritual quality, as if our ancestors speak through the medium of the land that was once lived (Figure 71).

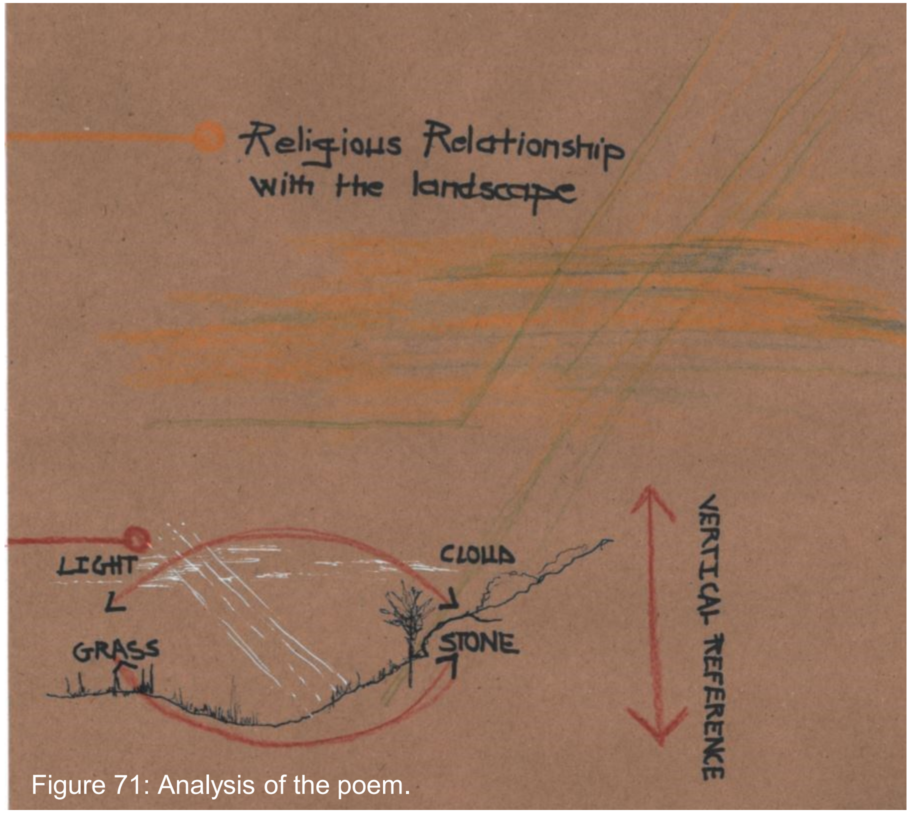


Figure 71: Analysis of the poem.

ANTJIE KROG_ COUNTRY OF MY SKULL (1998)

The next morning on my way to town, I take a detour through the countryside.
As far as the eye can reach there is rooigras,
I stop. I once wrote: "I adore, Themedra Triandra the way other people adore God."
I want to lie down.
I want to embrace.
I want to sing the shiny silk stems upwards.
I want to ride the rust – brown seeds, the rustling forest – white growth around ankles. Grass, red grass bareback against the flanks.

This is my landscape.
The marrow of my bones.
The plains.
The sweeping veld.
The honey – blond sandstone stone.
This I love.
This is what I'm made of.

And so I remain in the unexpectable wondrous ambuscade of grass and light, cloud and warm stone.

As I stand half – immersed in the grass cracking with grasshoppers and sand, the voices from the town hall come drifting on the first winds blowing from the Malutis – the voices, all the voices of the land.

The land belongs to the voices of those who live in it. My own bleek voice among them.

The Free State landscape lies at the feet at last of the stories of saffron and amber, angel hair and barbs, dew and hay and hurt.

3.5 CONCEPT EXPLORATION

01_ AUGMENTING THE LANDSCAPE

Augmenting the landscape explores the idea of nature adapting to architecture, in which an investigation was conducted on the ideas of the first, second and third landscapes. The chosen site, Glen Lyon farm situated north of Bloemfontein, is a typical first landscape, as the proposed facility is located in an area that is mostly untouched and conveys a wild natural vegetation growth. Therefore, the concept investigates the idea of the third landscape as a consequence to the architectural intervention within the sites landscape. Hence, the third landscape in this case refers to the idea of interrupting or distorting the existing landscape, and then allowing the landscape to re – establish itself within the interrupting factor (Figures 72 – 75).

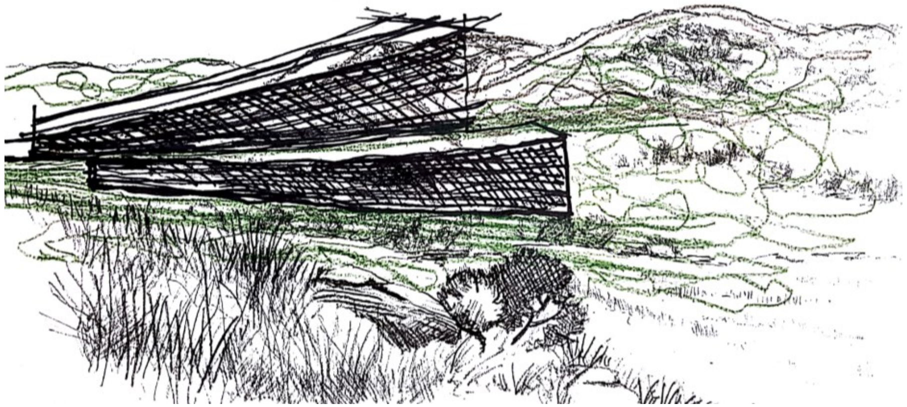


Figure 72: Interpretation of concept in a landscape context.

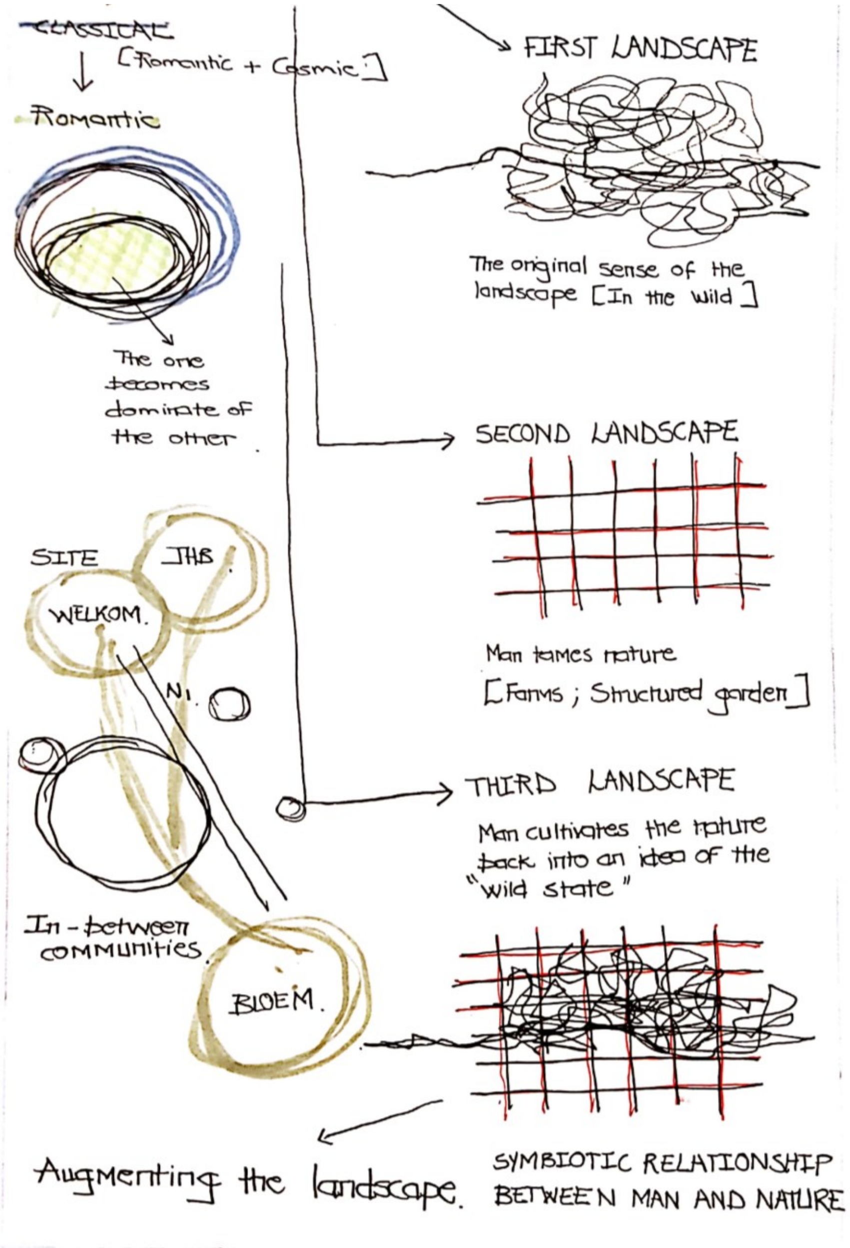


Figure 73: Explorative sketches of the concept.

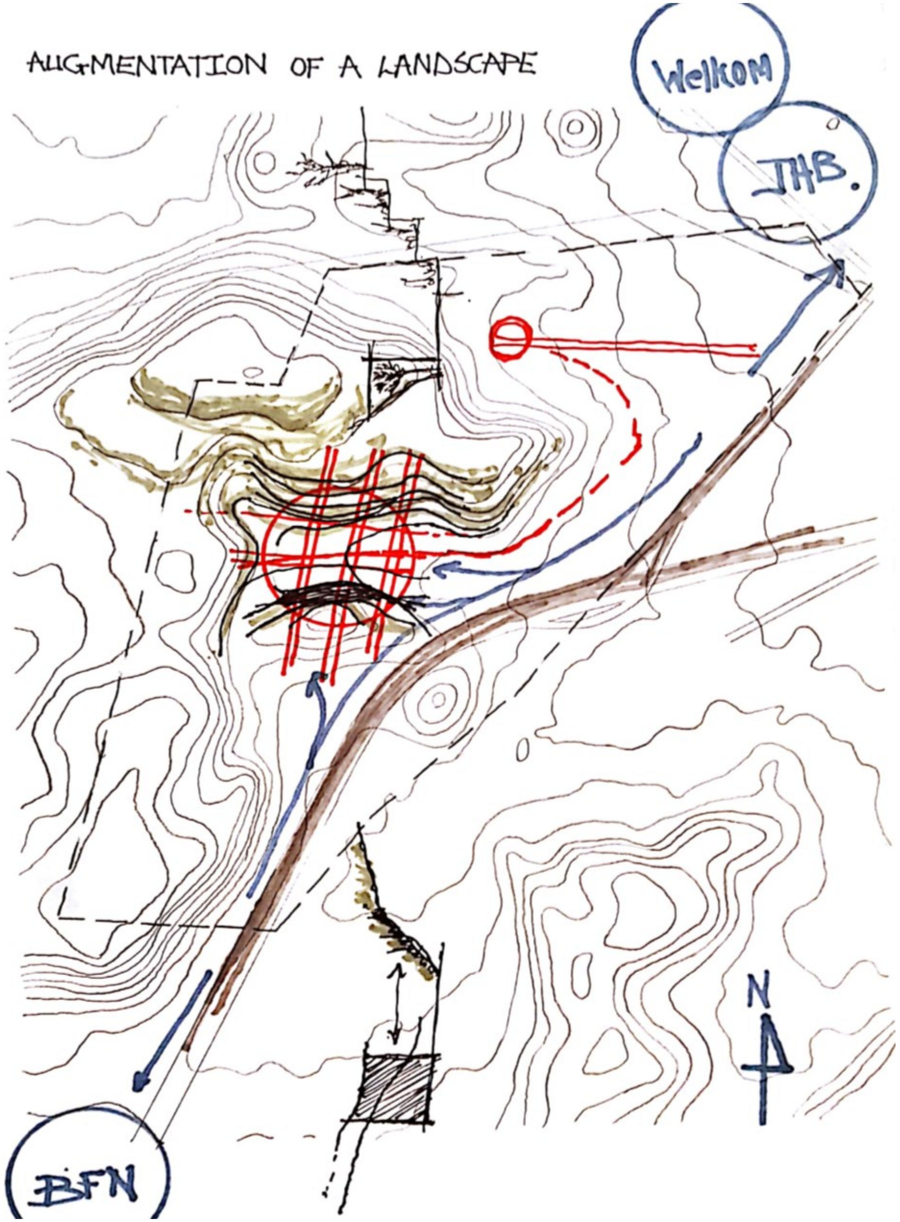


Figure 74: Mapping the first and second landscape.

Figure 75: Concept model

02 _ FROM A HETEROTOPIA TO THRESHOLDS IN SPACE

The idea of a heterotopia refers to the project intervention that is proposed between cities and next to the N1 in the realm of Bloemfontein's classical landscape, with these juxtaposing elements in mind, this concept explores the idea of thresholds within the existing landscape, together with the experience of various spaces throughout the project, by way of highlighting the different heterotopias but at the same time reminding the user of the journey from one place to another.

The proposed site already highlights various thresholds in both vegetation and man – made structures as one travel's through the site, therefore this concept explores the architecture as becoming a continuation of the existing thresholds (Figures 76 – 79).

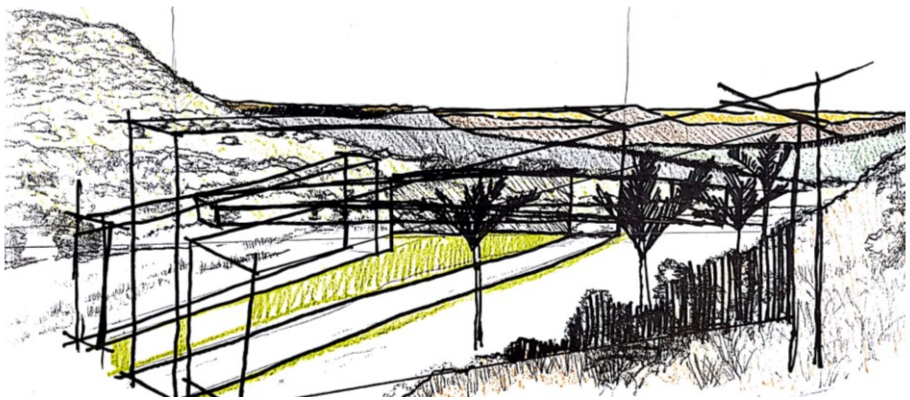


Figure 76: Concept interpretation in context.

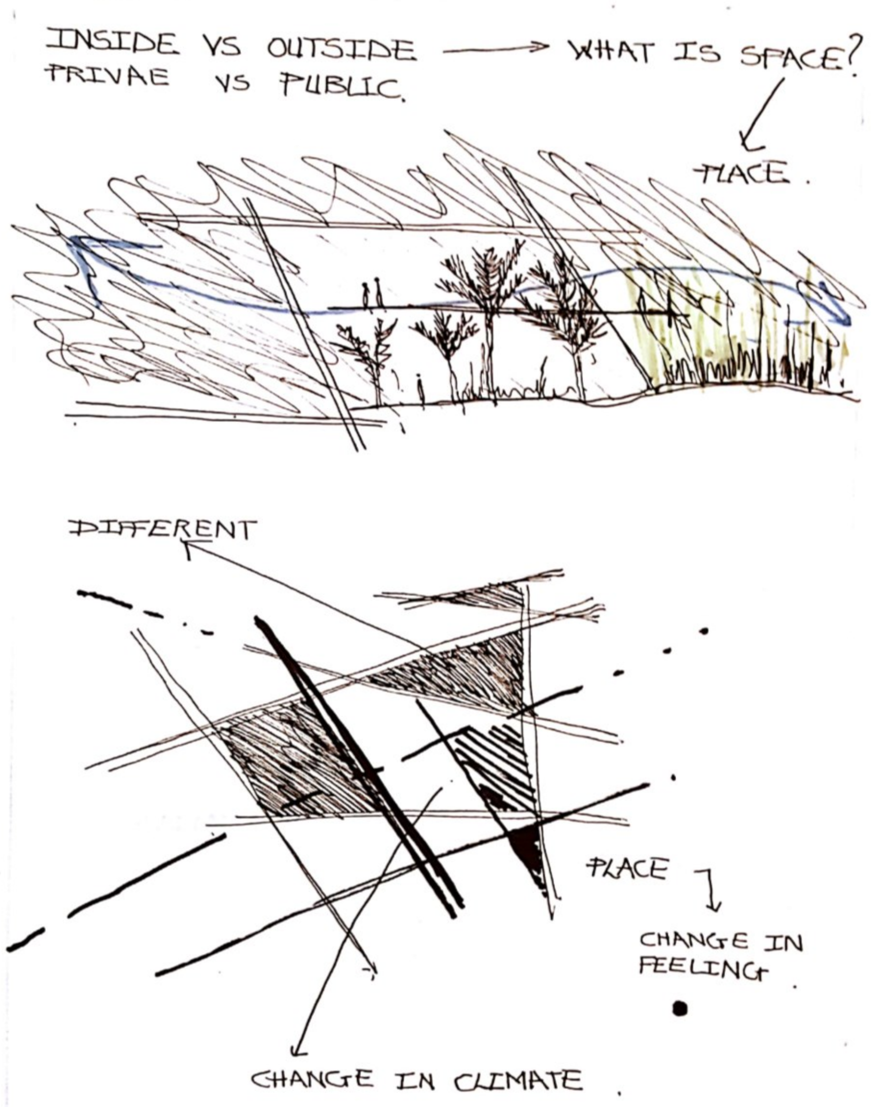


Figure 77: Concept exploration.

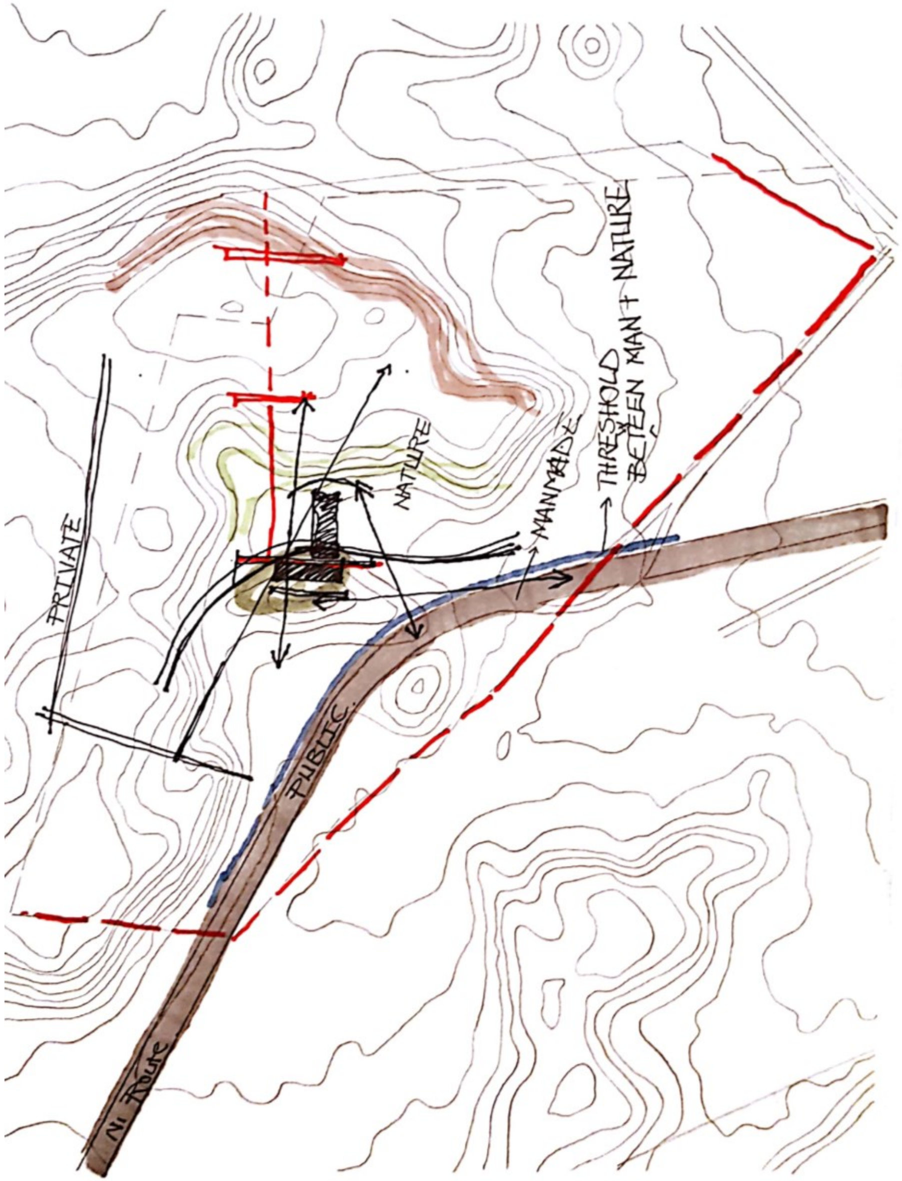


Figure 78: Mapping the existing thresholds.

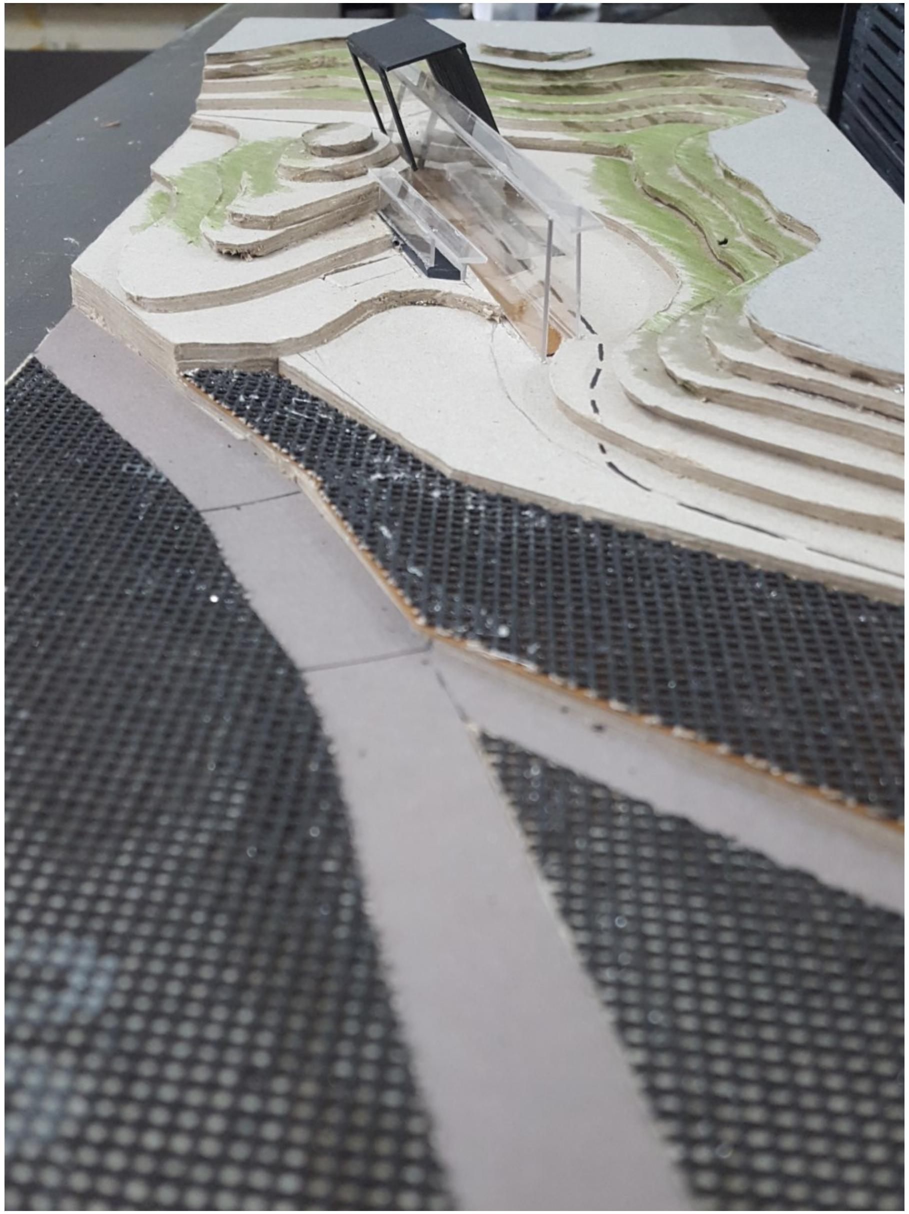


Figure 79: Concept Model.

03 _THE MECHANICS OF EVOLUTION

Mechanics of evolution refers to the continuing change in the landscape's vegetation and climate over time. There is a dynamic essence in natures growth, the transfer of vegetation through seed migration as well as the change in a plant's needs as the climate changes.

Therefore, this concept explores the idea of architecture forming a dynamic relationship with the natural realm, by means of adaptation to nature's change (Figures 80 – 83).

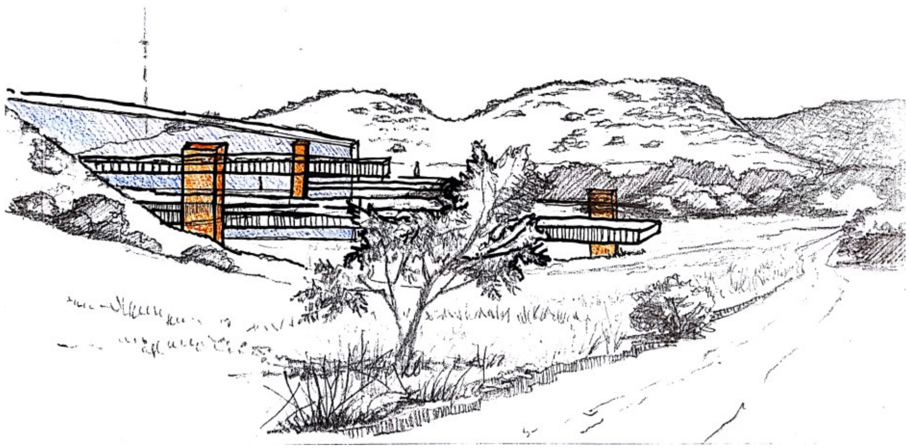


Figure 80: Interpretation of the concept in context.

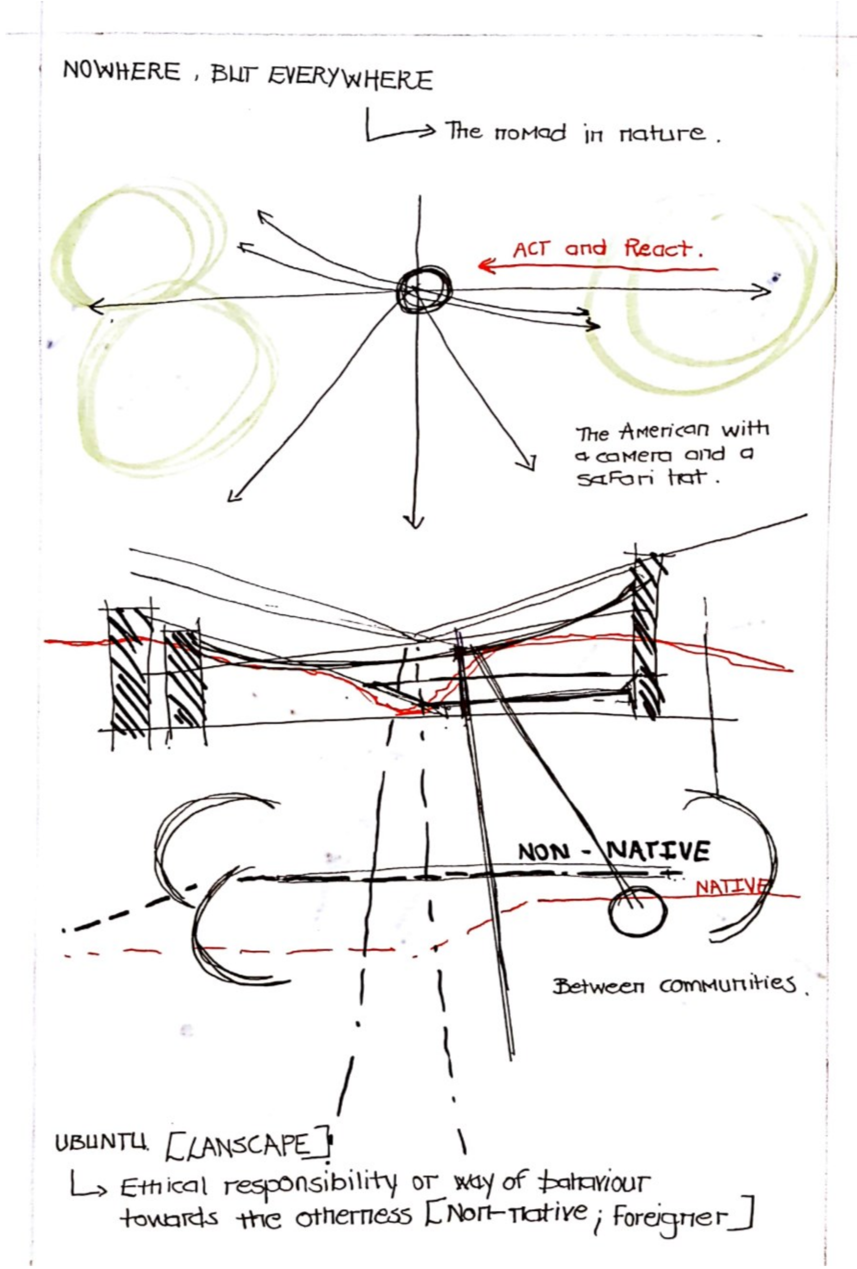


Figure 81: Exploration sketches of the concept.

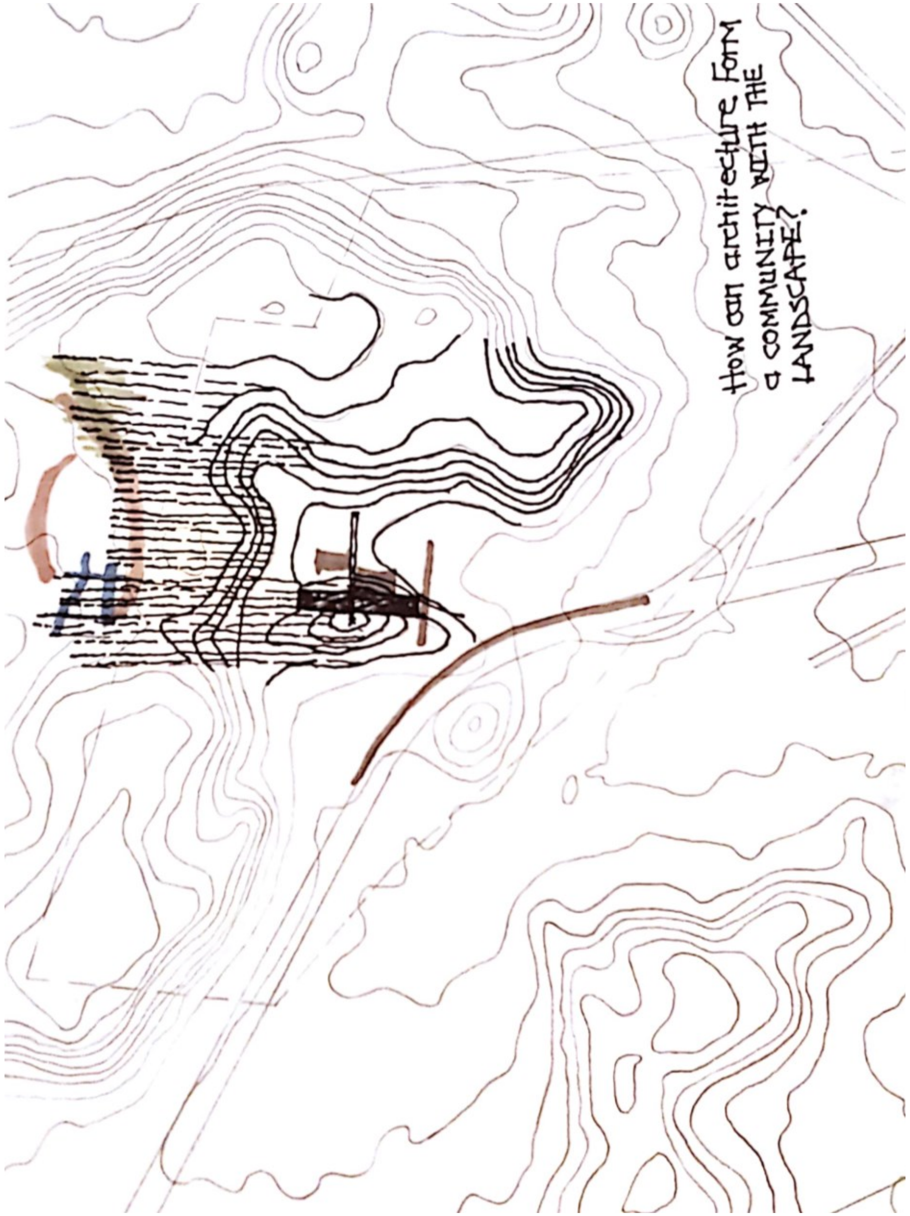


Figure 82: Mapping the dynamic character of the site.

Figure 83: Concept Model

CHAPTER 04_EMPLOTMENT

4.1 ARCHITECTURE AS MEDIATOR

This chapter looks at the physical and ontological dynamics of a modern – day pilgrimage. The word “pilgrim” dates back to the Late Latin *peregrinus* – referring to “one who journeys in foreign land” (Merriam Webster, 2019: online). In the traditional sense the term pilgrimage, highlights the destination as the focal point in the definition: “journey to a holy place”. However, many modern – day pilgrims regard the journey as the holy destination in itself (Donato, J. P. 2015: 74). According to Janice Donato, in her essay: *The pilgrimage and the stranger* (2015: 80) : “The potential power and meaningfulness of pilgrimage emerge from a willingness to endure foreignness in both self and other; to set aside one’s constructed and comfortable identities and normative experiences of the world and to open oneself to an unsettling world of new possibilities and new identities.” This notion exemplifies a deeper understanding of the relationship between humans and their surrounding context.

The proposed facility seeks to narrate an interpretation of folktales between the foreign landscape (cycads) and the familiar landscape (Free State) as a way of developing a relationship of understanding and sympathy between the users of the facility and the natural realm. The architecture engages with the earth and the sky in various ways, bringing elements of nature to the foreground. The relationship between these two characters creates a unique environment for the proposed buildings, where the vertical plane interacts with the horizontal one.

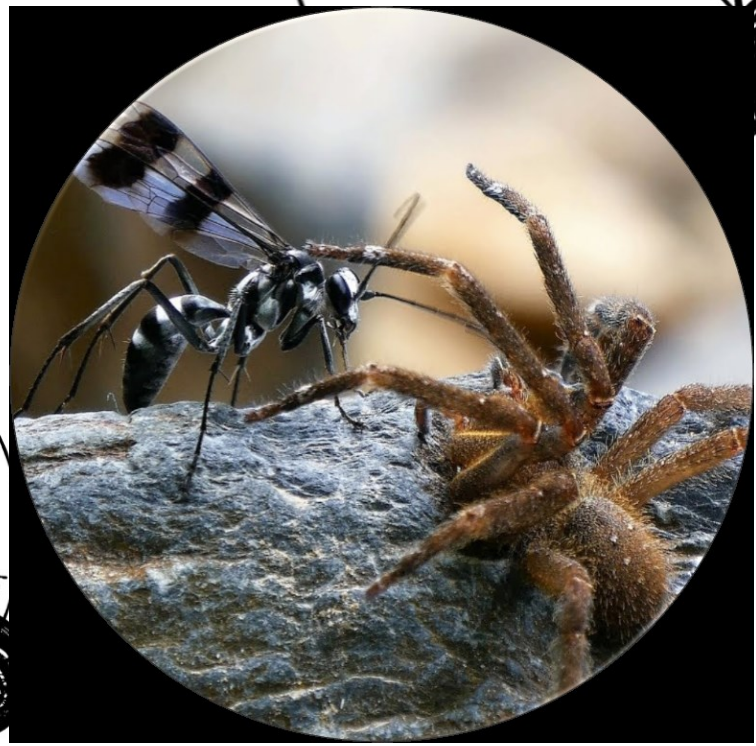
4.2 PRECEDENT EXPLORATIONS

PRECEDENT | Movement of a spider-wasp

The day – to – day behaviour of a spider wasp is a fascinating wonder within the large realms of nature. The understanding of it, inspired the possibility for the public to circulate in a similar way through the conservation centre.

The spider wasp is an insect that is known for paralyzing its prey and then storing it in its nest, for the larvae to feed on. But what's fascinating is the way in which this kind of wasp circulates in the natural realm, in order to achieve this goal. In search of spiders, the wasp moves away from the nest in an organic manner, but when it returns to the nest, the wasp will move its prey in a perfectly straight line, no matter what obstacle may be in its way (Figure 84 – 86).

Figure 86: Sketch of path towards nest.



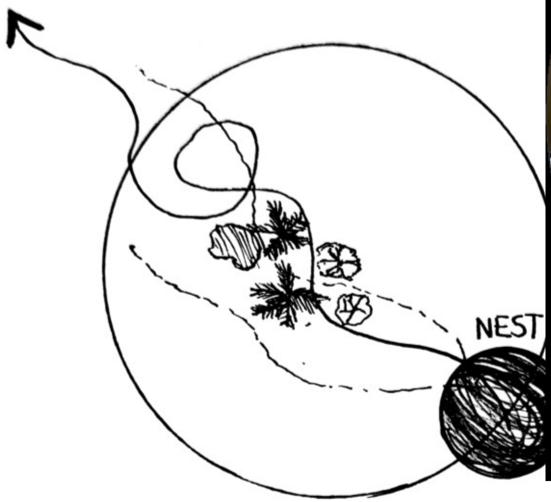


Figure 84: Sketch of path away from nest.

Figure 85: The spider-wasp catching its prey (Encyclopaedia Britannica, 2018: online)

PRECEDENT | Botanical garden in Nerja

Location: Spain

Architect: ISMO Arquitectura

Year: 2015

The Botanical Garden is based on the principle of making the place natural. So, it stands according to simple schemes of distribution and vegetation cultivation. Although it's just a part of Nature, it also becomes a representation of the native plant species of the province (ArchDaily, 2016: online). The garden must dialogue with the environment and develop the continuity with the landscape. A guide, a gardener and a biologist will be the staff (ArchDaily, 2016: online) (Figures 87 & 88).

The paths, according to the level lines of the land to be used by handicapped people, will display different layer with different kinds of plants, so that the Garden will be green covered. These unpaved paths will be also in lower or higher levels, according to the needs of the program (ArchDaily, 2016: online). The elevation is useful for a stage area, a shady place for people to join and observe. The buildings rise over the landscape, being folded to create covered viewpoints (ArchDaily, 2016: online) (Figures 89 – 92).

Figure 87: The path along the typology of the land (ArchDaily, 2016: online)

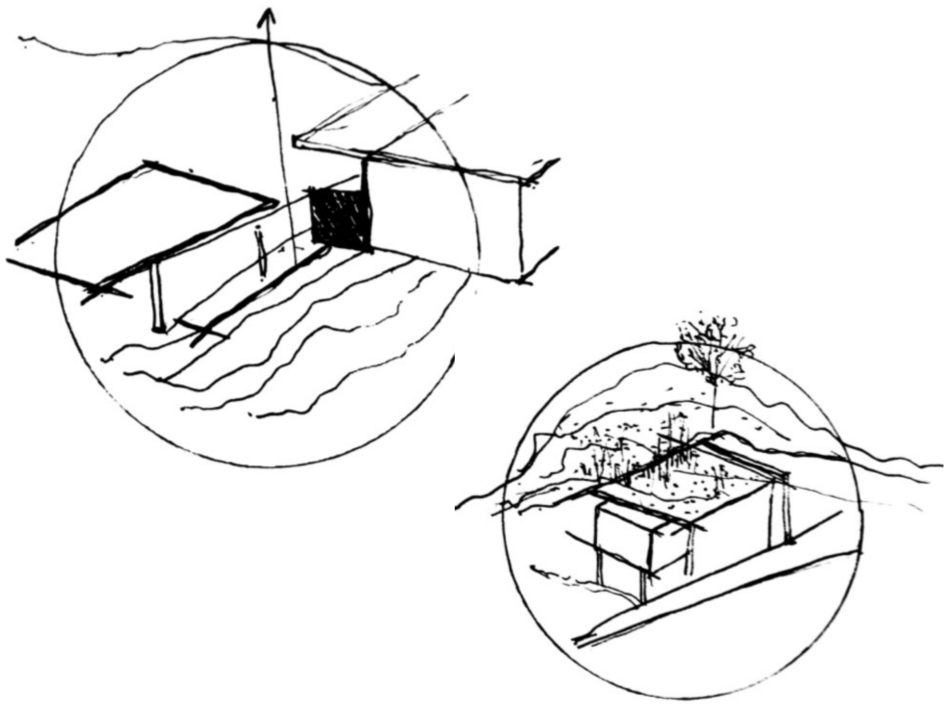


Figure 88: Concept sketches of framing place

Figure 89: External façade of the building (ArchDaily, 2016: online)

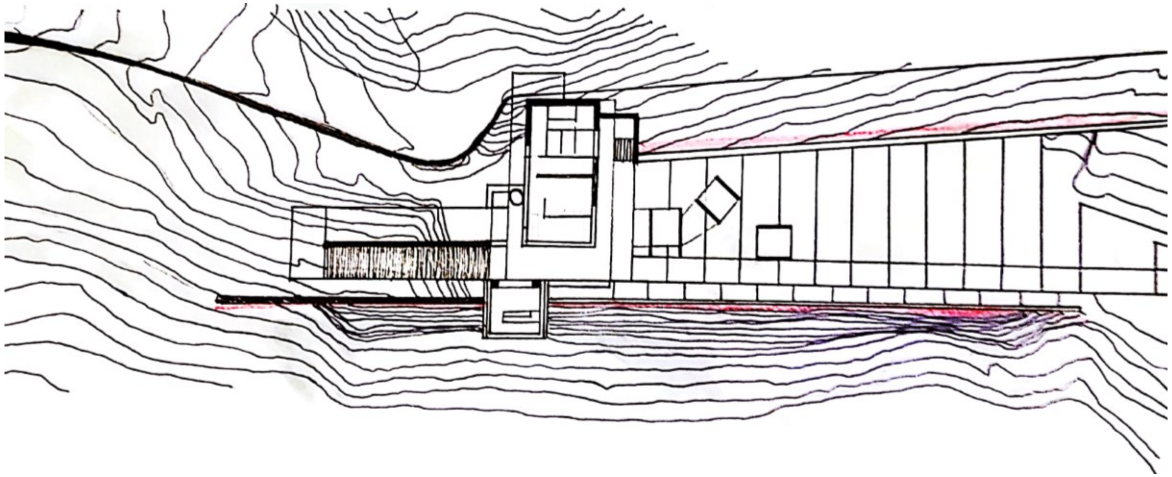


Figure 90: Sketch of ground floor plan

Figure 91: View of ramps (ArchDaily, 2016: online)

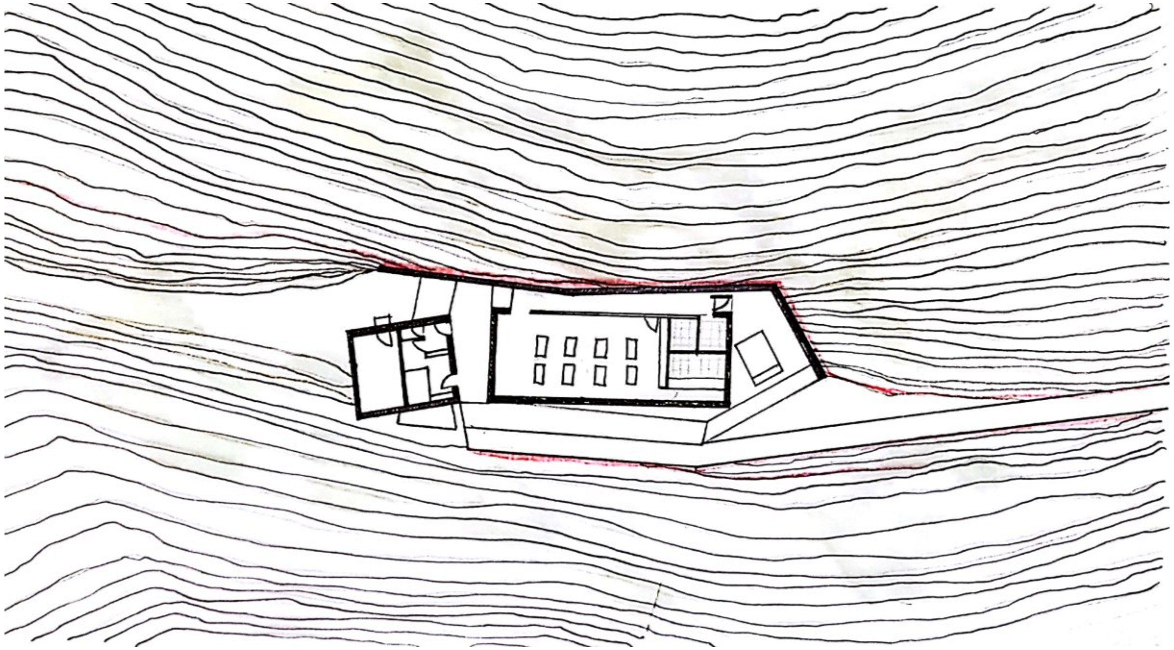


Figure 92: Sketch of First floor plan

PRECEDENT | Freedom Park, Phase 1

Location: Pretoria, South Africa

Architect: GAPP + Mashabane Rose Architects + MMA

Year: 2008

Set on a prominent hill, overlooking Tshwane, the architectural and landscape interventions of Freedom Park, serves to highlight indigenous knowledge as a means to celebrate the leading narratives of humanity and freedom (ArchDaily, 2012: online). According to ArchDaily (2012, online), “Its mission is ‘to provide a pioneering and empowering heritage destination that challenges visitors to reflect upon our past, improve our present and build on our future as a united nation.’”

Curated by a spiral pathway, visitors follow a narrative journey that connects events such as the ‘Place of Remembrance’ featuring the ‘wall of names’, to the sanctuary and the main gathering space (ArchDaily, 2012: online). A string of events designed to commemorate African spirituality in an ongoing journey that celebrates the ancestral freedom fighters (ArchDaily, 2012: online) (Figure 93-95).

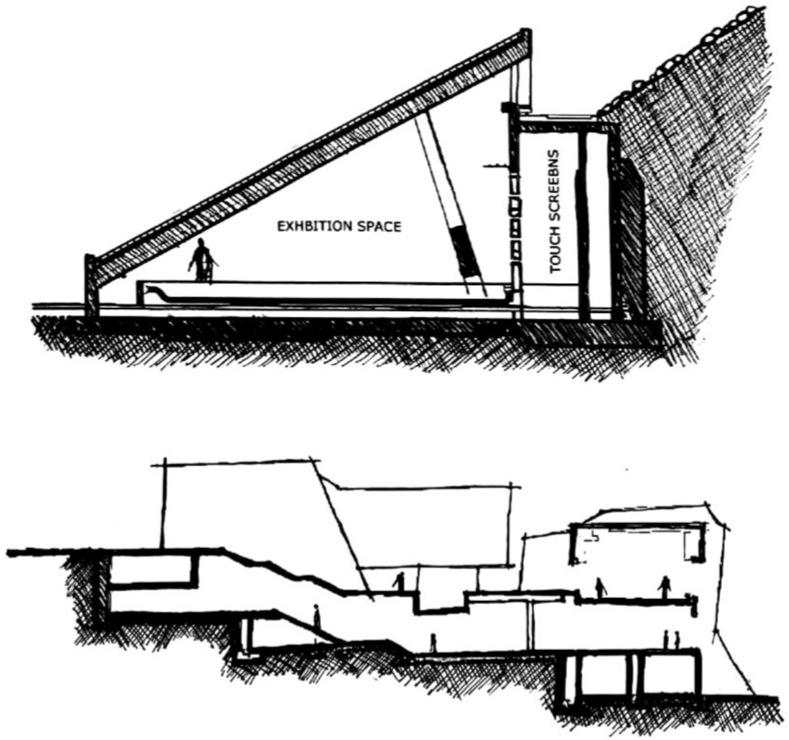


Figure 93: Sections sketched from (ArchDaily, 2012: online)

Figure 94: Memorial labyrinth (ArchDaily, 2012: online)

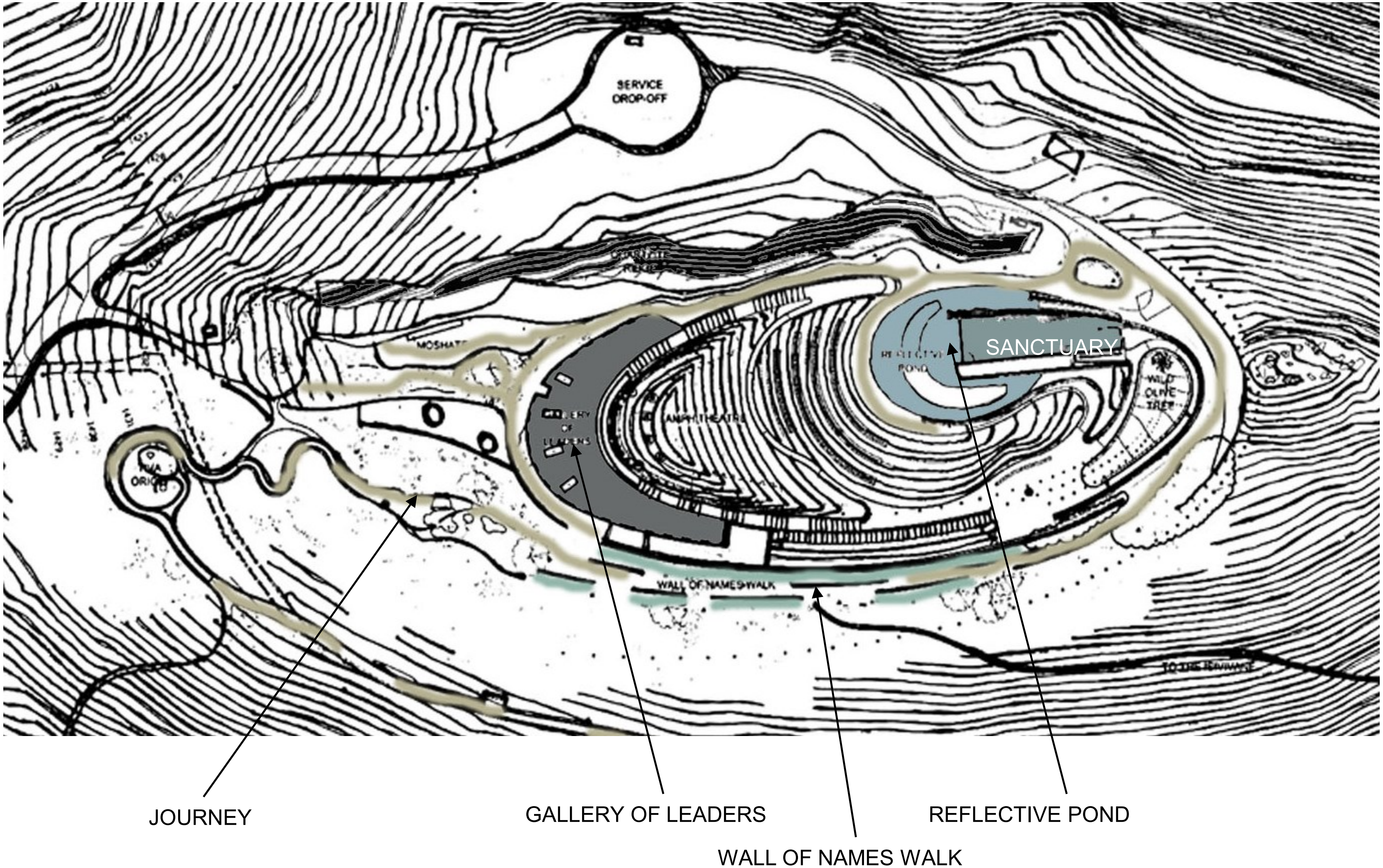


Figure 95: Analysis of Plan

PRECEDENT | Saya Park

Location: South Korea

Architect: Alvaro Siza & Carlos Castenheira

Year: 2018

The art pavilion, embedded in the slope of a woodland forest south of Korea, embodies the notion of adaptation to both the site and the beauty of the project (ArchDaily, 2018: online) (Figure 96). The site's existing characteristics, such as the forest pathway makes its way through the building's elegant sculptural form, allowing visitors to embark on a journey of internal and external reflection (Mac, 2019: online) (Figure 98).

This dissertation project was particularly inspired by the projects interplay of light and shade to highlight the elements of time in what was before and what is beyond the high concrete walls (ArchDaily, 2018: online) (Figure 99). Accommodating a series of gallery exhibition spaces, visitors experience a cave-like concrete sculpture, that entails two narrow sections, connected by a double volume tunnel that allows for selective glimpses to the surrounding natural infinity (Mac, 2019: online) (Figure 97).

Figure 96: The project in context (Vada, 2018: online)

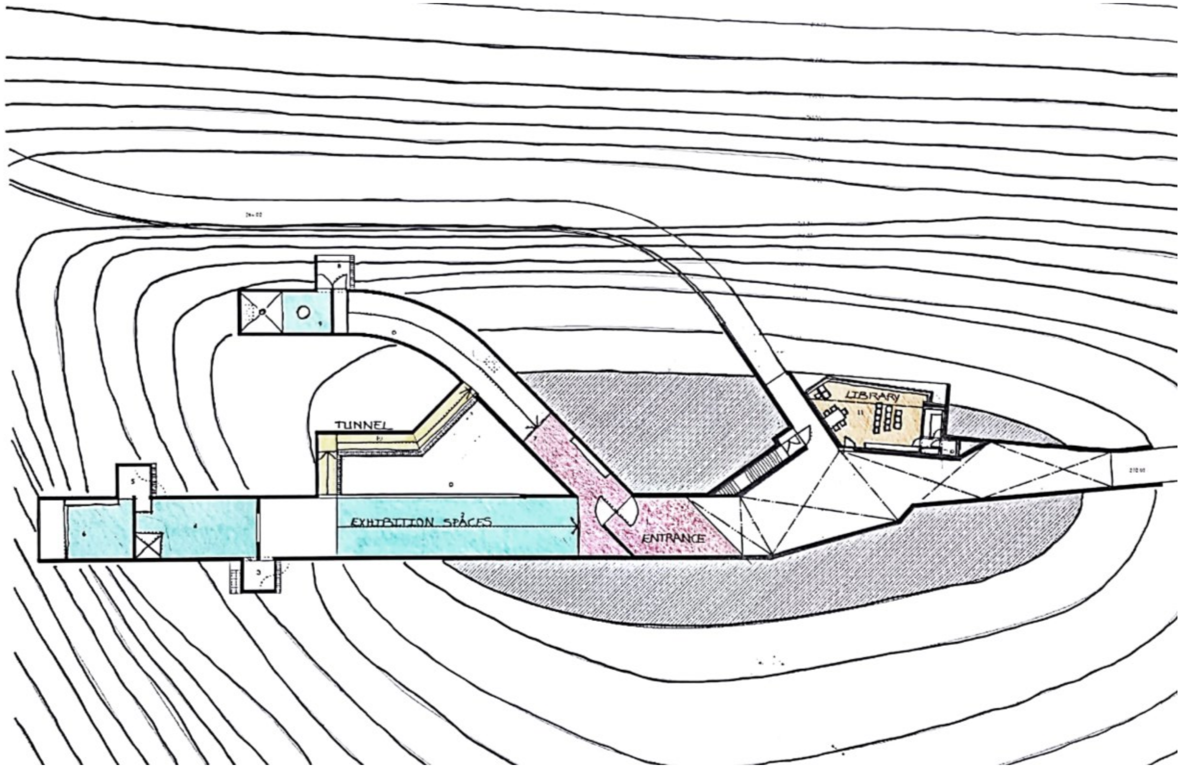


Figure 97: Analysis of plan

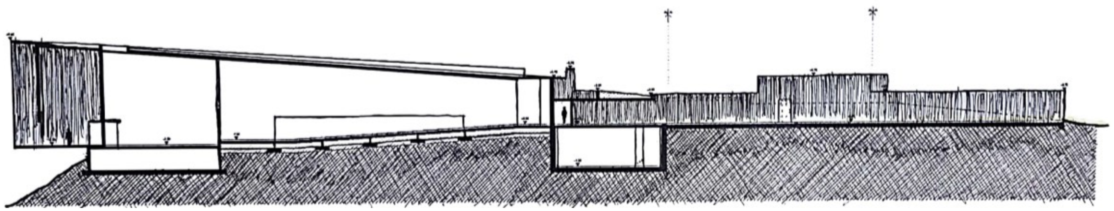


Figure 98: Sketch of section

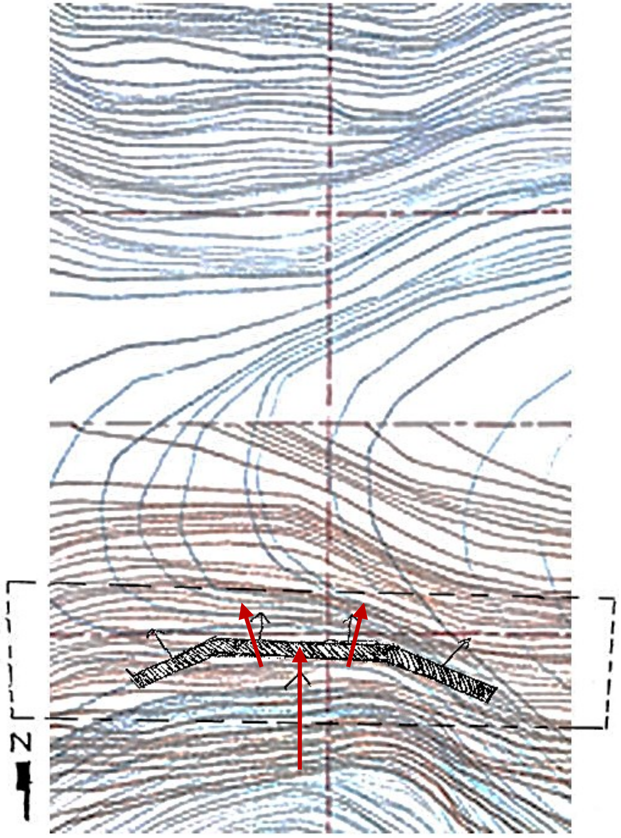
Figure 99: Interior of circulation route (Vada, 2018: online)

4.3 DESIGN DEVELOPMENT

In the process of developing the building composition, various forms and the composition thereof was investigated to formulate an appropriate narrative experience between visitors and the two landscape characters, that is both informative and functional.

Both the public and private functions required separate routes, with occasional nodes of visual and physical intersection.

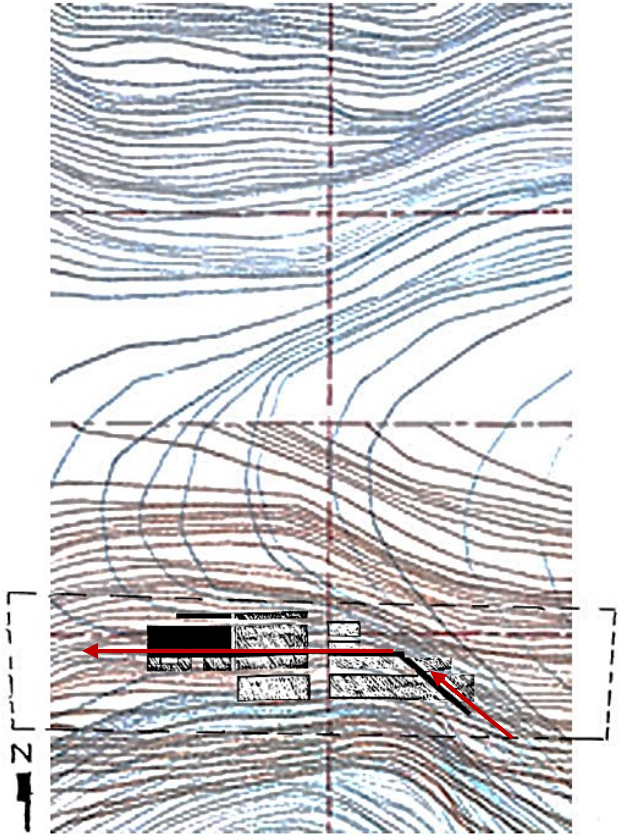
ITERATION 1



ORIENTATION

The accommodation list needs to meet the requirements and behavioural processes of the Cycad species.

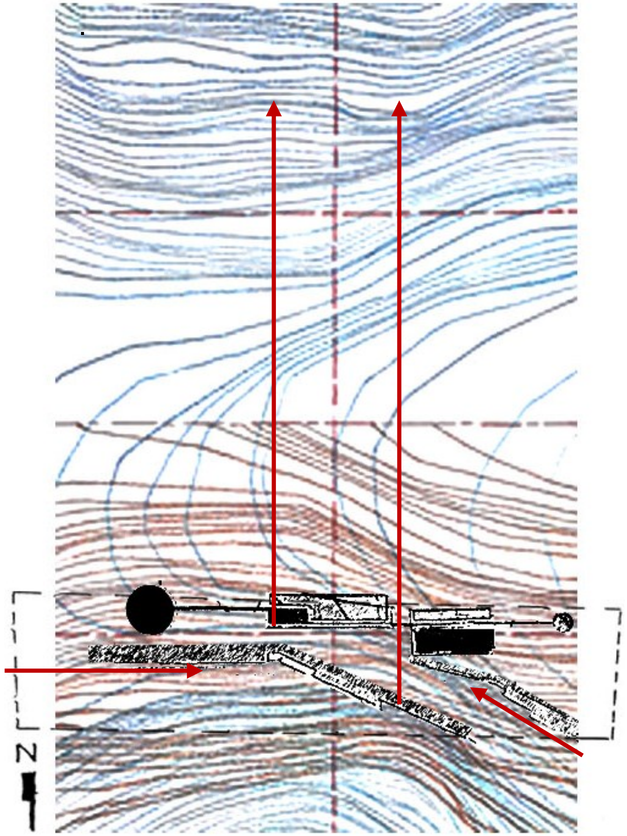
ITERATION 2



INITIAL MASSING

Integrating the existing circulation routes as the datum, the initial massing is split into separate components, each with it's own function

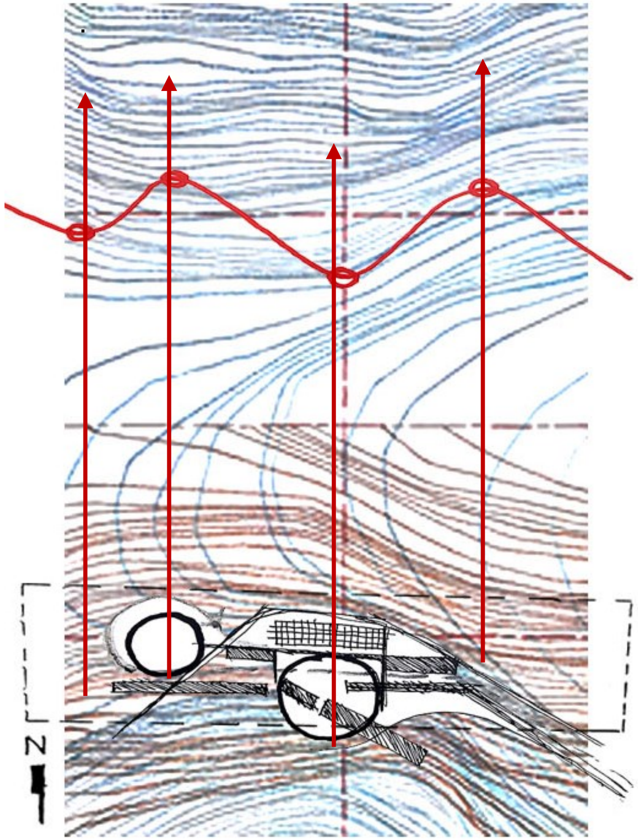
ITERATION 3



BUILDING INTEGRATION

The project is integrated within the distribution of movement, the surrounding landscape in terms of material use and geographical elements such as water and the vegetation.

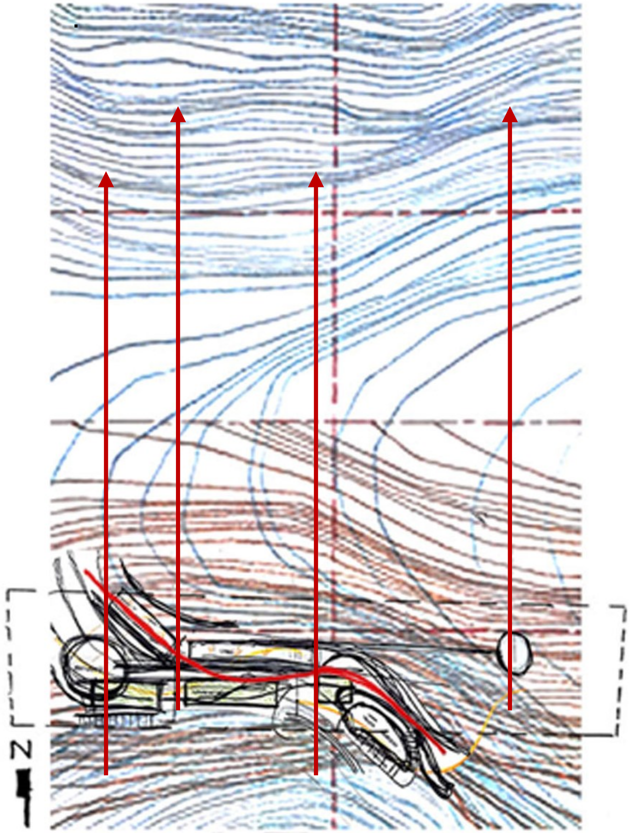
ITERATION 4



FRAMING VIEWS

The spatial composition of the project is purposefully placed to frame the surrounding vistas of the opposite hill.

ITERATION 5



THE JOURNEY

The circulation throughout the centre highlights the site’s contours, that would otherwise not be visible to the dweller on site.

ITERATION 1 | ORIENTATION

The first phase of the design process stems from the understanding of Cycads, in terms of their cultivation needs and physical properties, as discussed in Chapter 2 of this dissertation. This understanding assisted in formulating an accommodation list, which was then placed in the context of the site, in order to determine the physical area of the site the will be utilised.

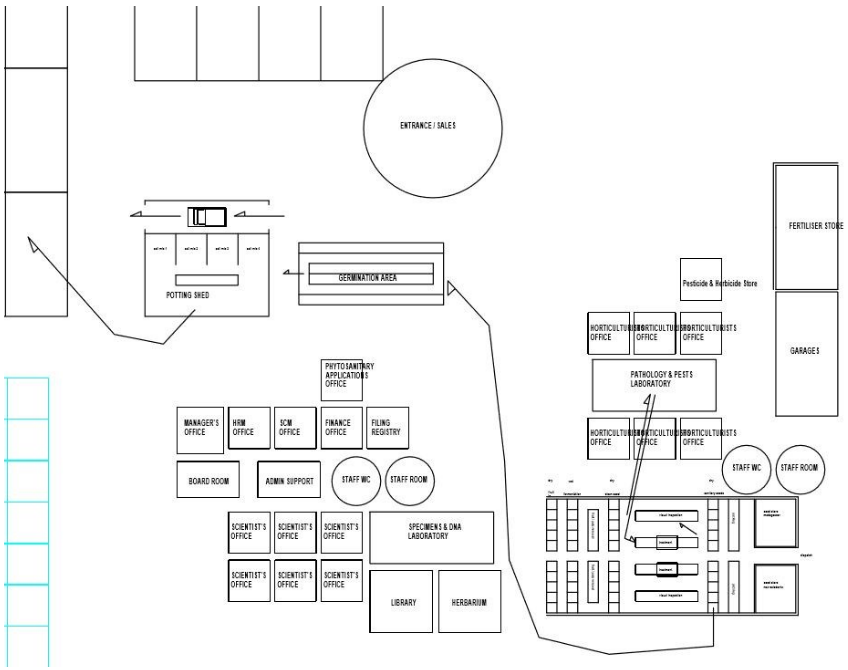


Figure 100: Initial composition of accommodation list.

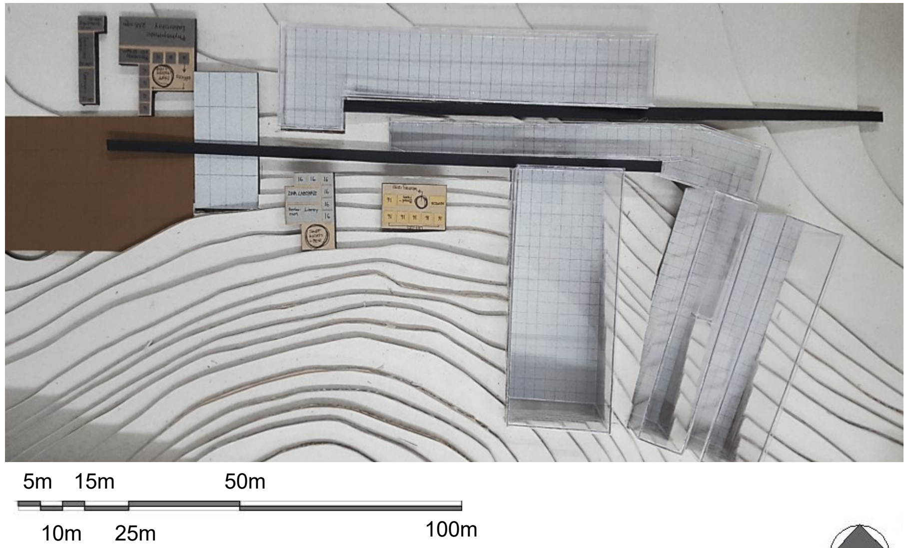


Figure 101: Concept model of accommodation list in context.

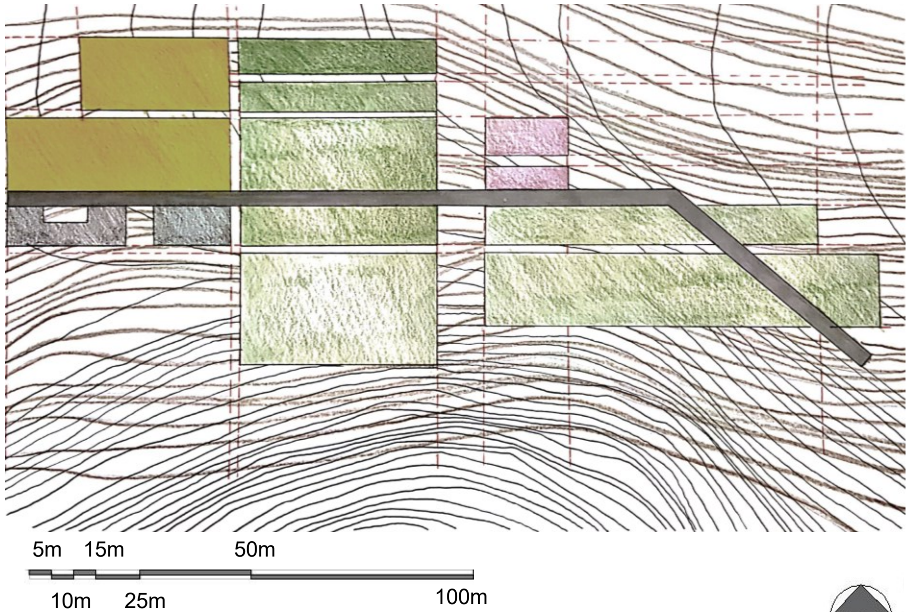


Figure 102: Initial plan integrated with existing route on site.

ITERATION 2 | INITIAL MASSING

The proposed conservation centre activates the natural surroundings of Glen Lyon Farm, and benefits from the ongoing vehicle traffic on the N1, to bring about awareness to South Africa's biodiversity. Located against the northern slope of a typical Free State hill, the site provides sufficient conditions for the growth of cycad species within conservatories. The foreseen facility acts as a node, connecting both the main entrance and the service entrance.

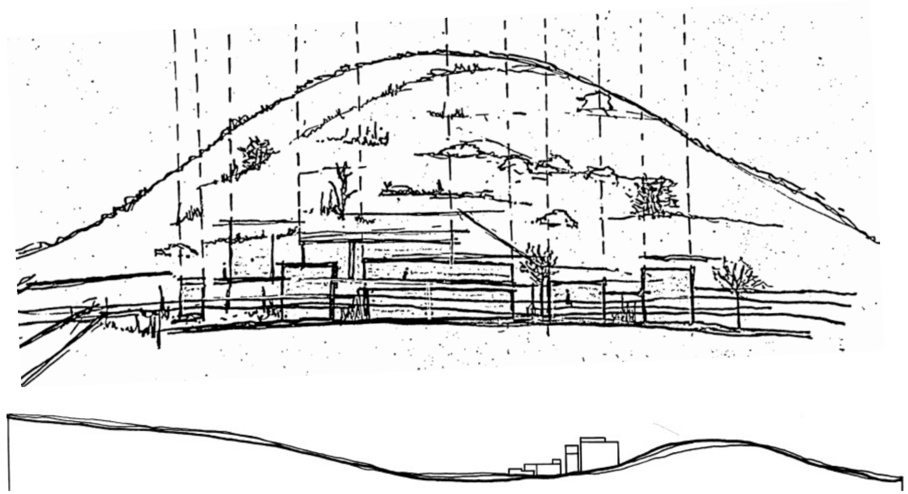


Figure 103: Conceptual section and elevation in context.

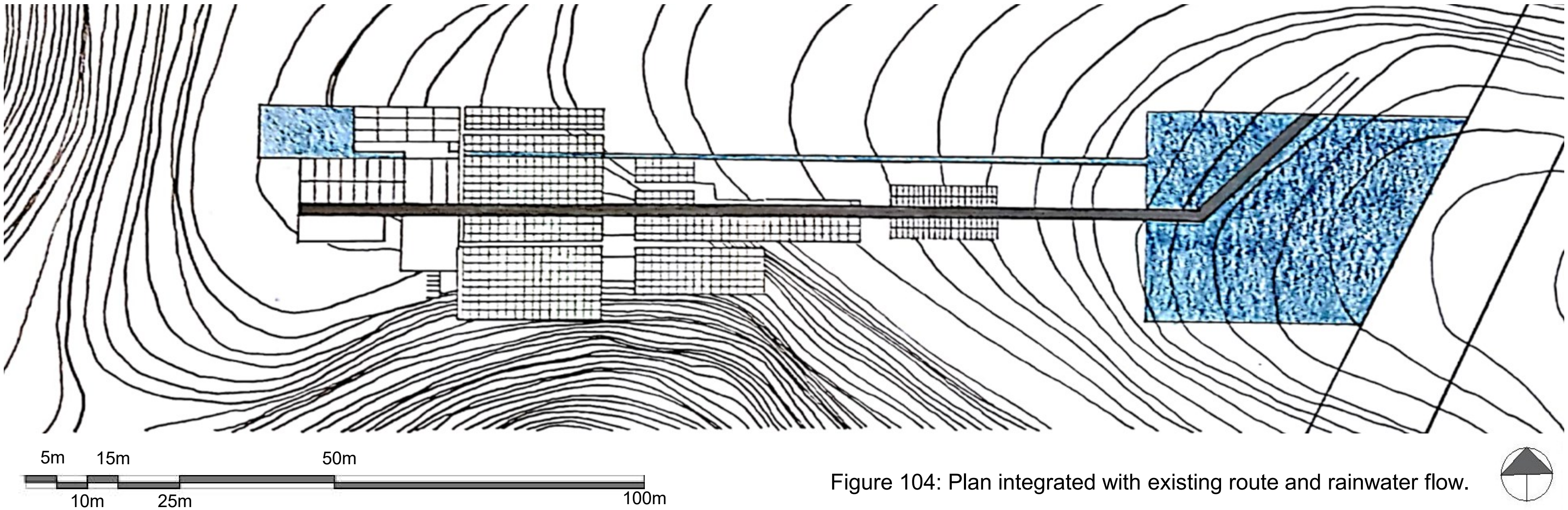


Figure 104: Plan integrated with existing route and rainwater flow.

ITERATION 3 | BUILDING INTEGRATION

Here a layout and morphology started to develop from the understanding of the folktales investigated in chapter 2 and 3. Site elements, such as the existing water stream and dam wall, initiated the ordering of functions within the design.

WATER COLLECTION

The proposed building harvests rain and stormwater, running down from the site's slope, to re – use for the watering of the cycads. Excess water will be distributed back into the existing water stream on site.

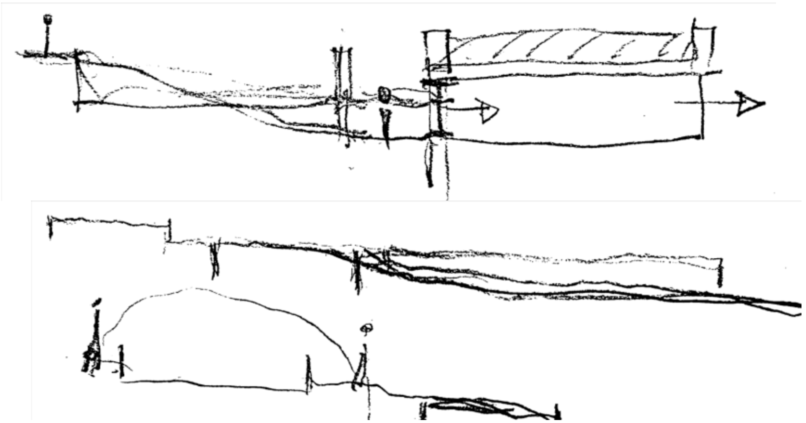


Figure 105: Conceptual sections of building in relation to the slope.

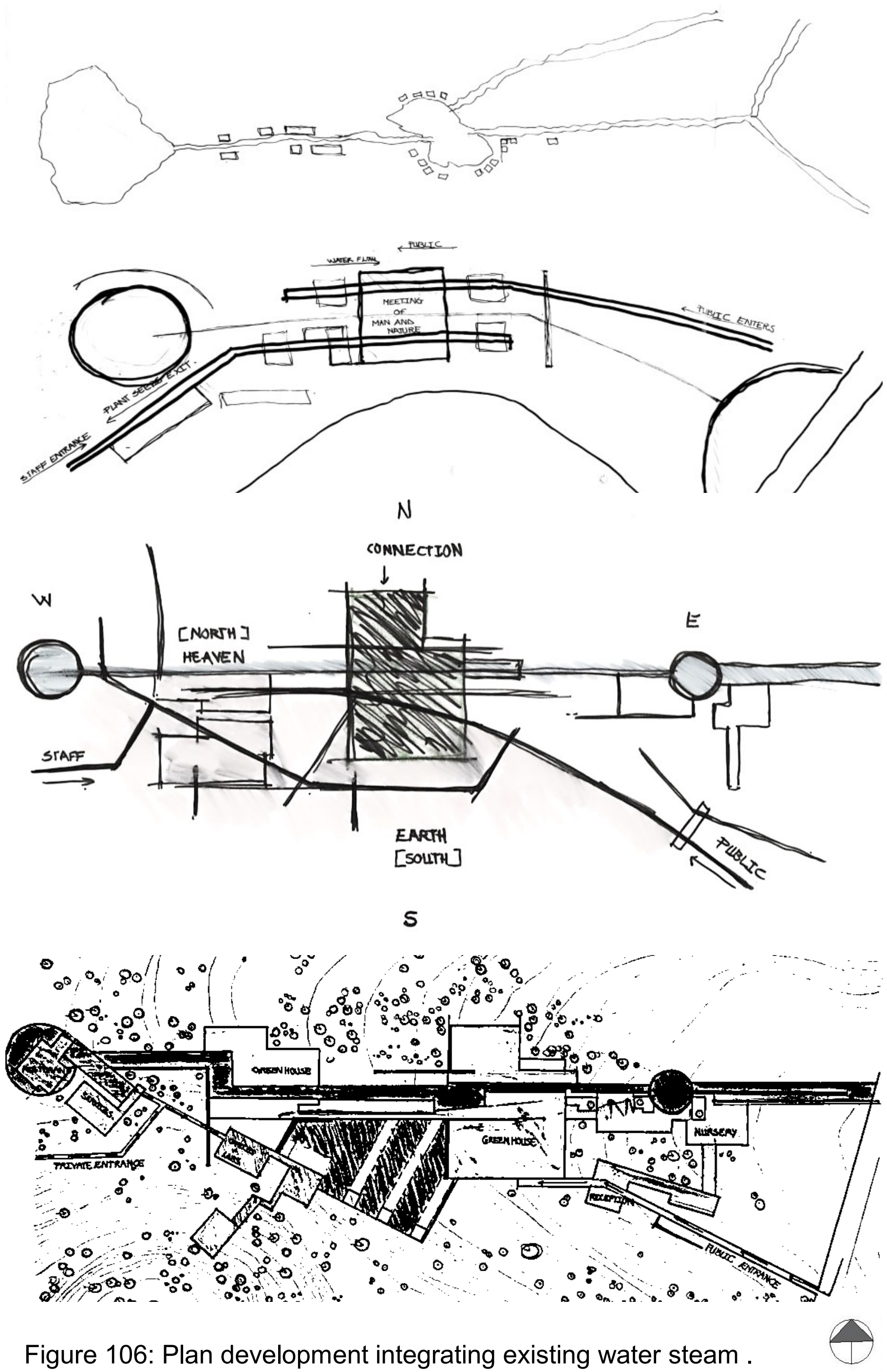


Figure 106: Plan development integrating existing water steam .

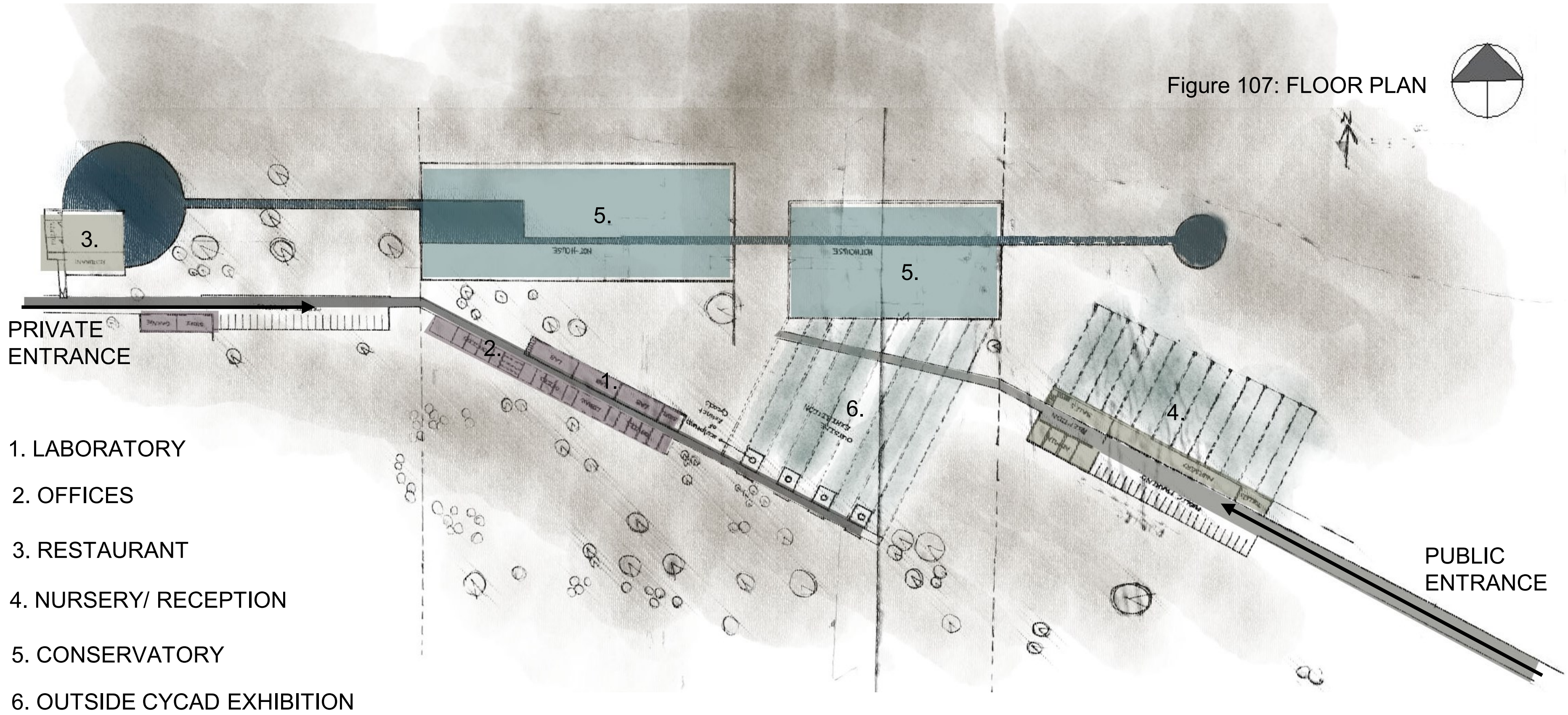


Figure 107: FLOOR PLAN

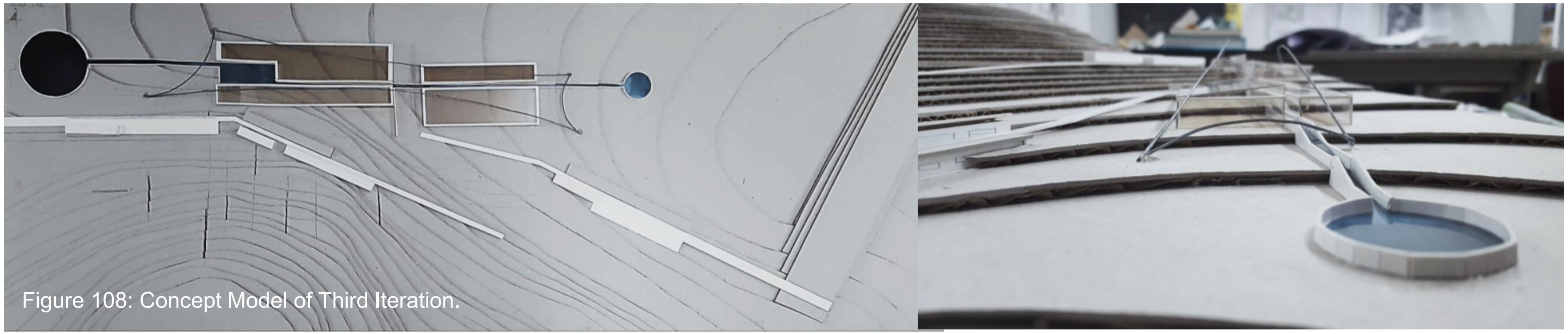


Figure 108: Concept Model of Third Iteration.

MATERIAL PALETTE & EXPLORATION

In order to understand how materials or layers affect a space. This exploration summaries the natural and raw quality of materials within a natural setting. The investigation aims at an understanding of the relationship between nature and the material.

1. Art Pavilion in South Korea (Puluuso, S. 2018: online)
2. Fortress and Banks of Goian (Picard, P. G. 2014: online)
3. Gabion retaining walls in Landscape Architecture (Souza, E. 2018: online)
4. Sancaklar Mosque in Istanbul (Emden, C. 2015: online)
5. Third wave kiosk in Torquay (Hayward-Melbourne, A. 2016: online)
6. Ferreteria O' Higgins in Chile (Hayward-Melbourne, A. 2016: online)
7. Bihar Museum in India (Maki, F. 2017: online)
8. Low lying home at Nova Scotia coastline (Mckniight, J. 2017: online)
9. Kiasma Museum of Contemporary Art. (Santos, S. 2016: online)
10. Campo Baeza's House in Cadlz (Zajonc, A. 2006: online)

CONCRETE

STONE

WEATHERING STEEL

SOFT SURFACES


1
2
3
4
5
6
7
8
9
10

ITERATION 4 | FRAMING VIEWS

At this stage of design, the building was integrated to frame the vistas of the surrounding context. Furthermore, consideration for circulation routes as a narrative guider was initiated.

It is argued that humans build a sympathetic relationship with their experiences and surroundings through the use of narratives. (Jeffway, N. 2017: 4) By differentiating between the familiar Free State landscape and the unfamiliar cycad species, the spatial quality and ordering allows the architecture to articulate and sculpt the earth to bring about a narrative quality. The form of the building takes inspiration from the surrounding natural environment, such as the natural contour lines, together with the surrounding views.

Figure 109: Sectional exploration.

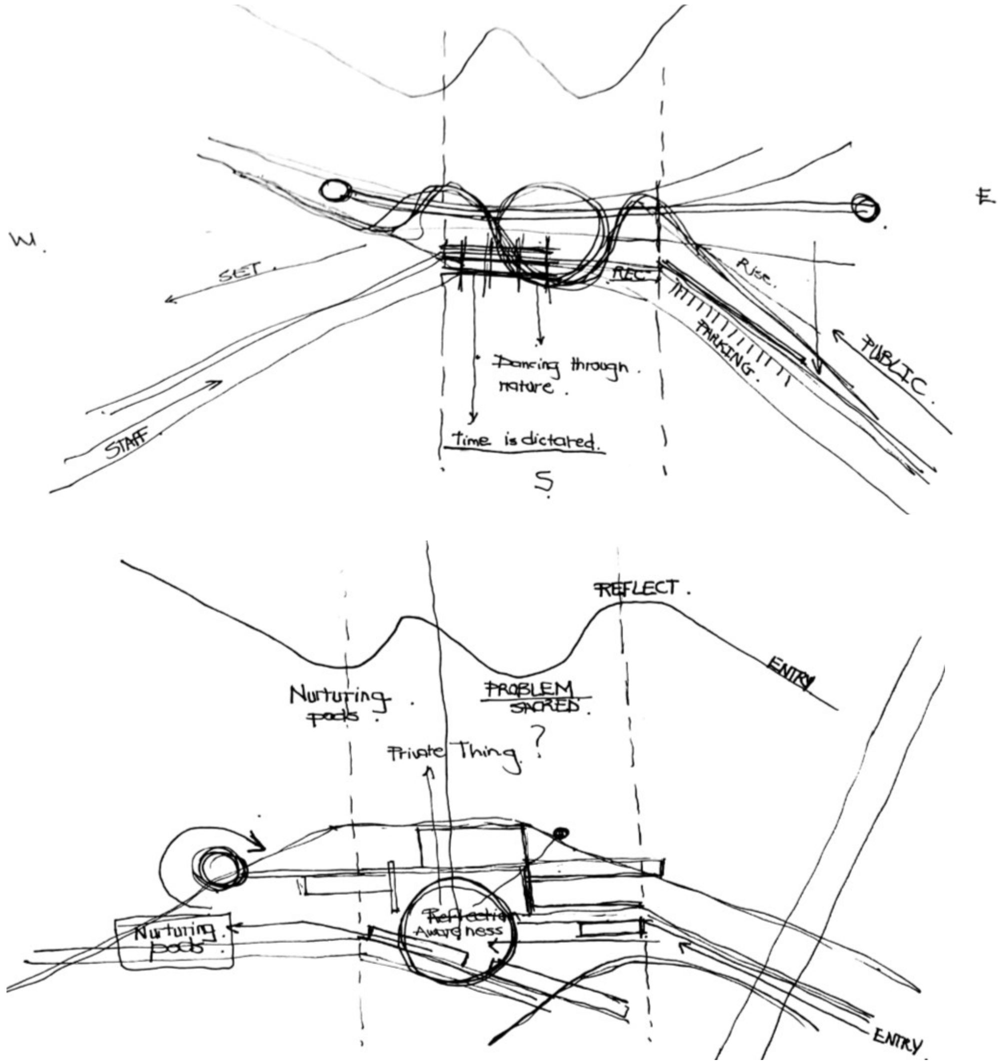


Figure 110: Conceptual plans considering narrative experience in circulation.

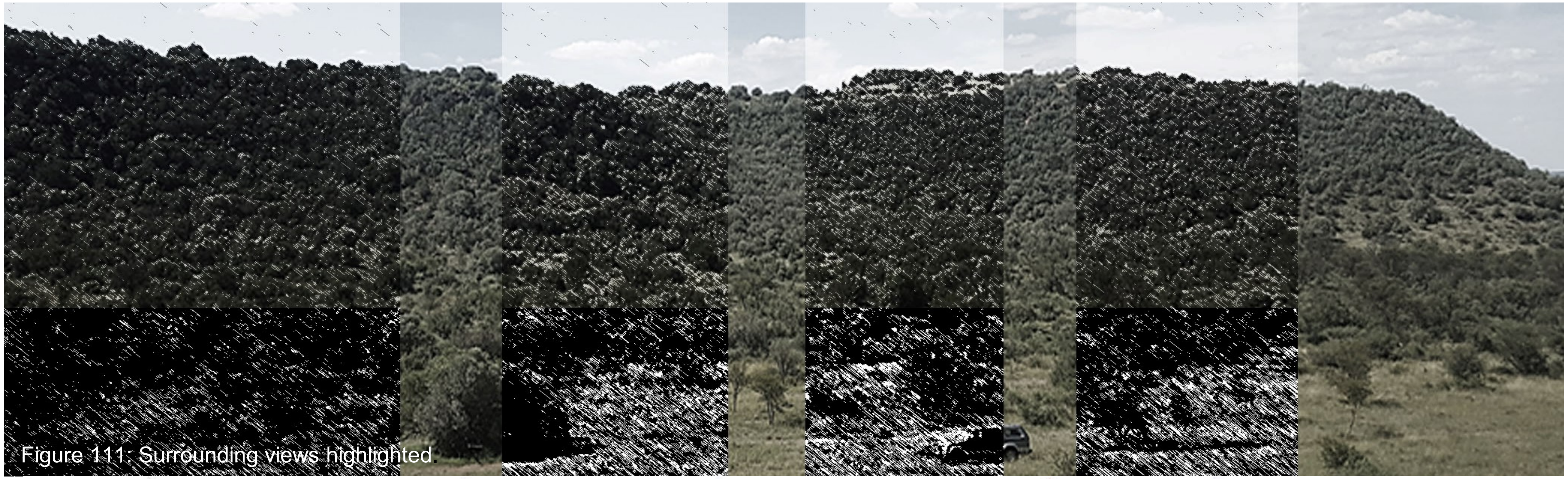


Figure 111: Surrounding views highlighted.

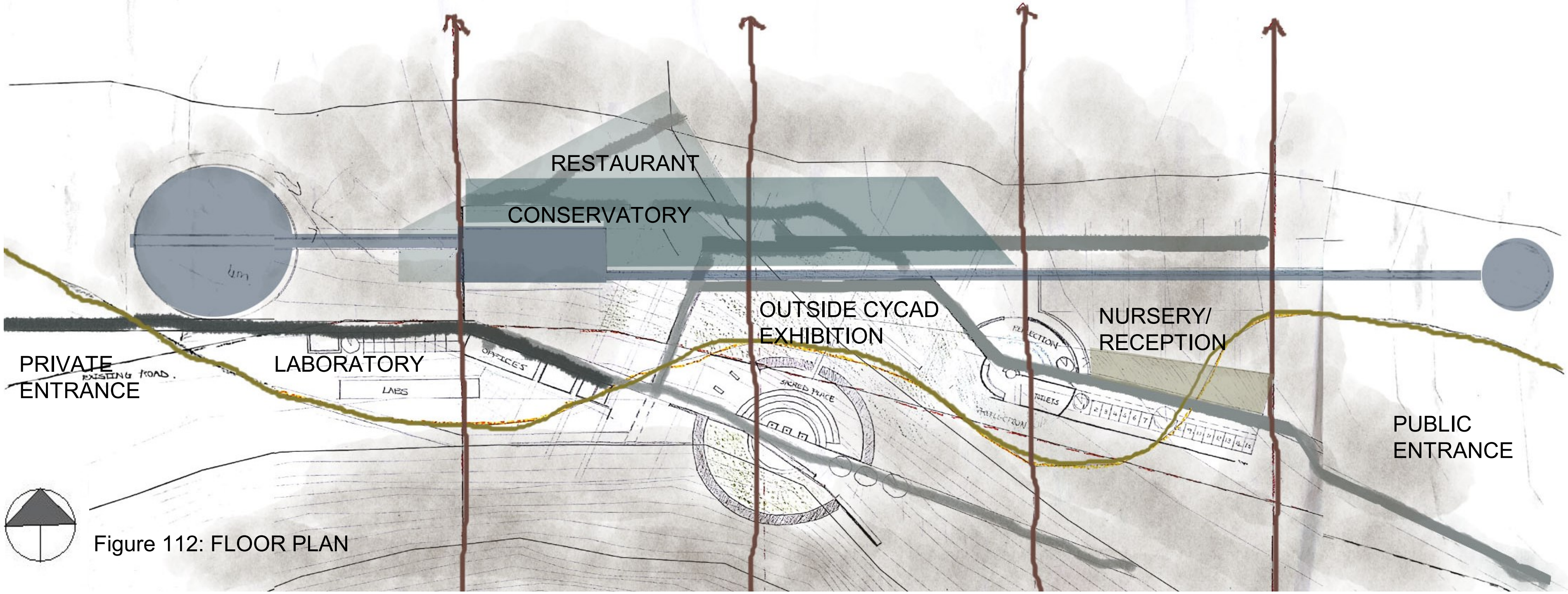


Figure 112: FLOOR PLAN

ITERATION 5 I THE JOURNEY

Using substantial walkways that are up to 3m wide, the design is able to accommodate public pause spaces, that is strategically located along the public route, to ensure for visual curation of both the familiar and unfamiliar landscape, as well as the private functioning systems and the workings thereof.

- The public route acts as a journey that stimulates curiosity, and narrates the landscape as characters in themselves.
- The private route runs parallel to the public route, allowing for visual connection between the public and private. This also allows the research facilities and labourers to function without any unnecessary distractions.

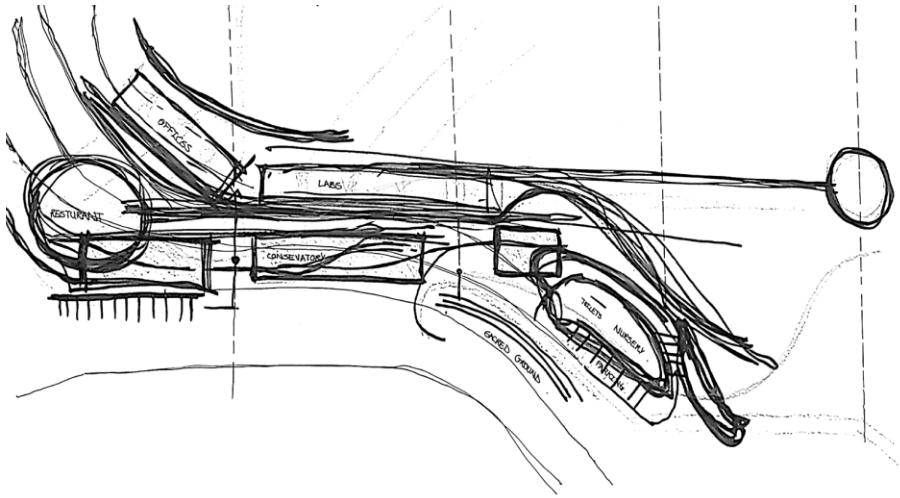


Figure 113: Concept plan of building following the site's typology.

Figure 114: Sections exploring circulation through context

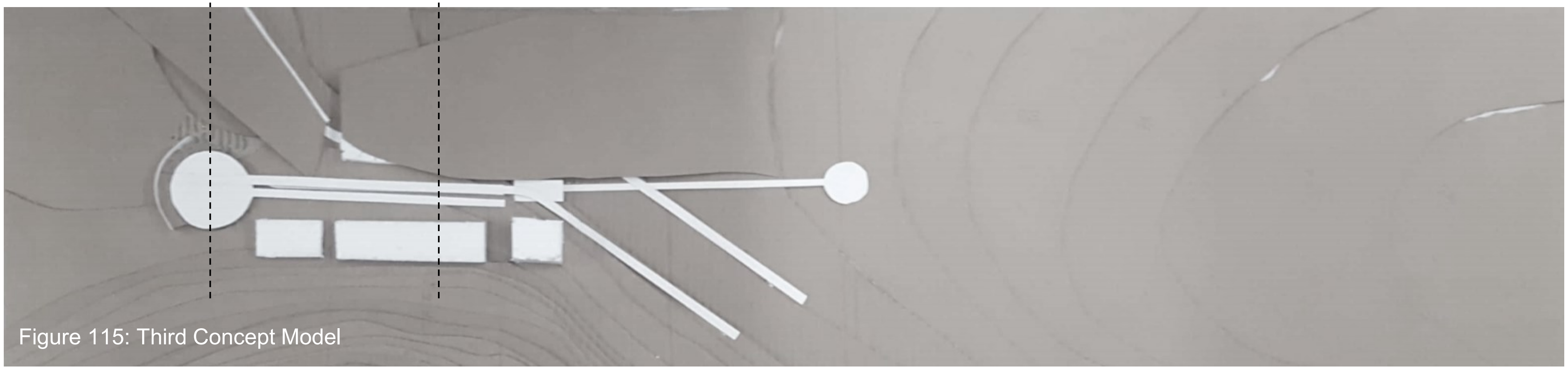
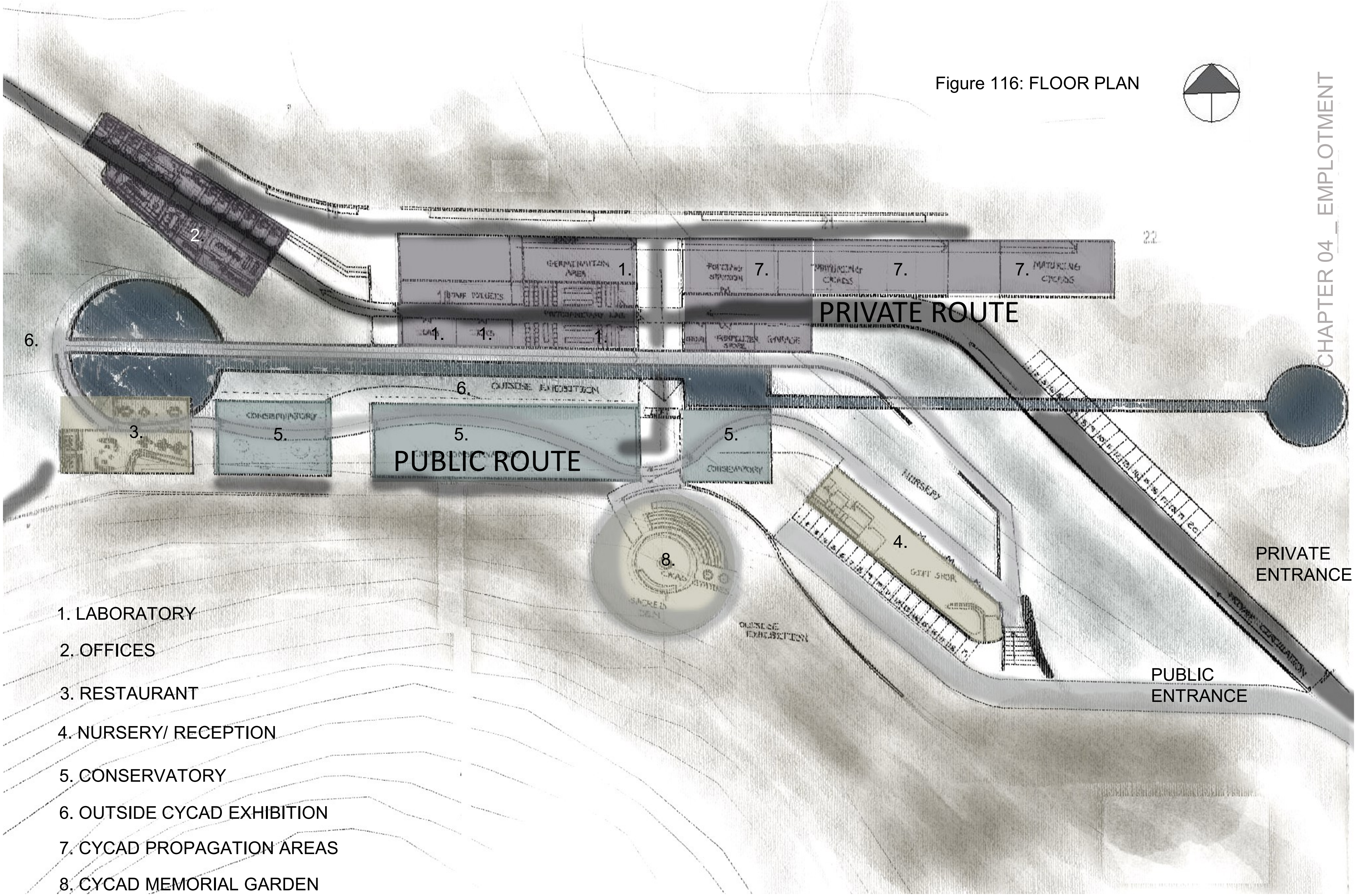


Figure 115: Third Concept Model

Figure 116: FLOOR PLAN



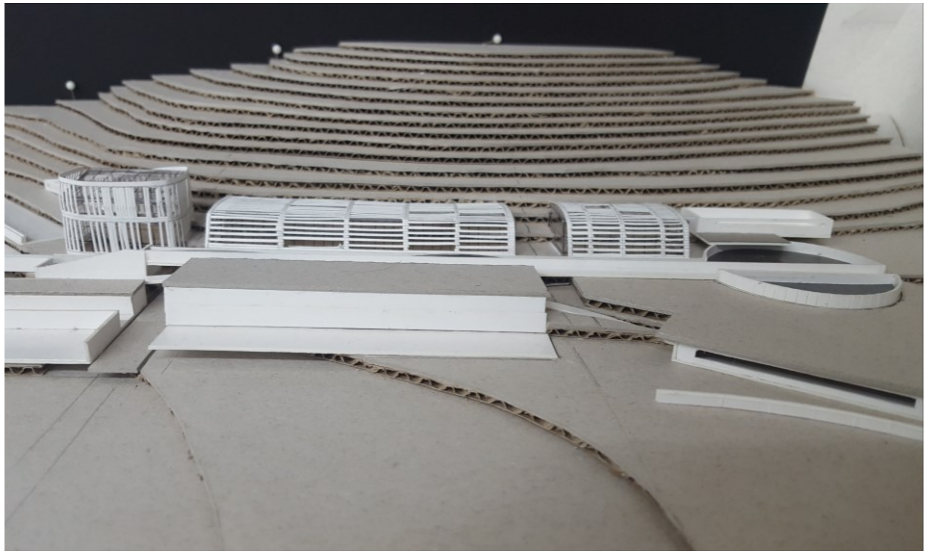


Figure 117: Façade of conservatories

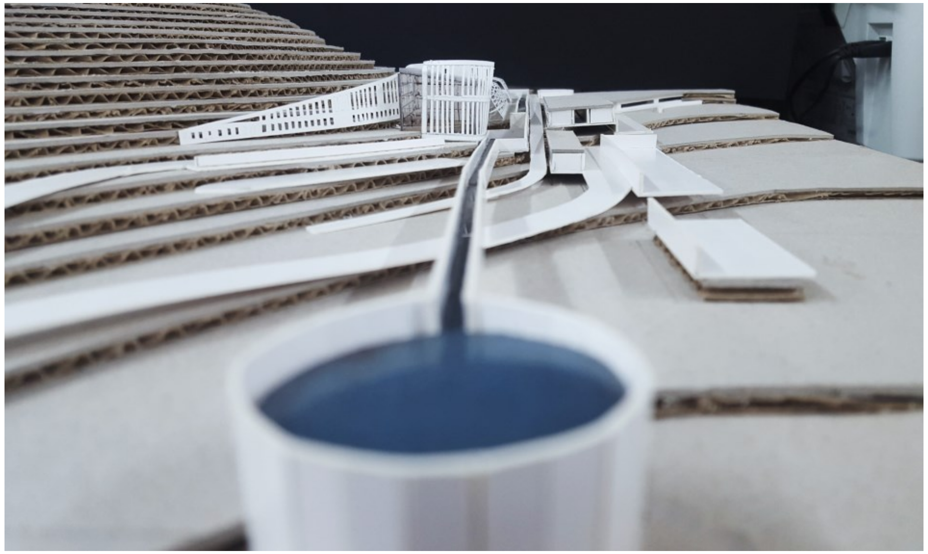


Figure 118: Perspective of project from entrance dam

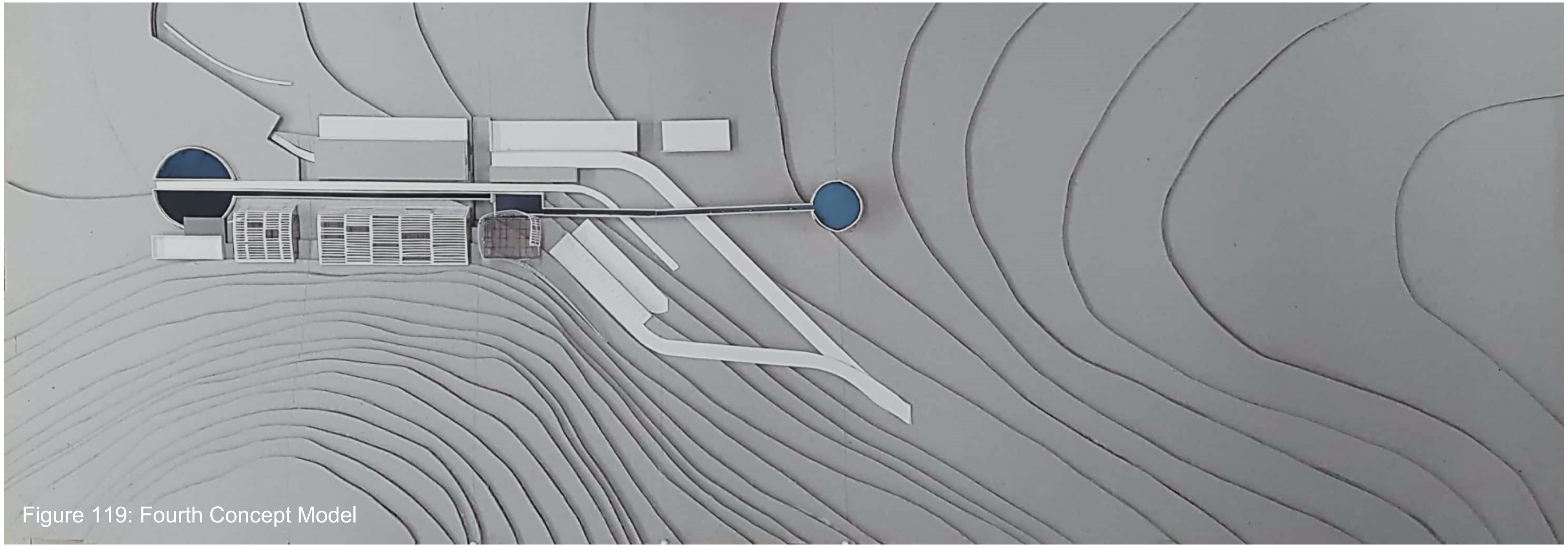


Figure 119: Fourth Concept Model

NEW VEGETATION

Introducing new vegetation within the conservatories, as well as around the architecture, acting as natural exhibition spaces. The northern façade is designed as an extended or deep skin to mediate solar radiation. The design, should take into account the amount of natural sunlight needed for cycads during summer and winter periods, for optimum growth.

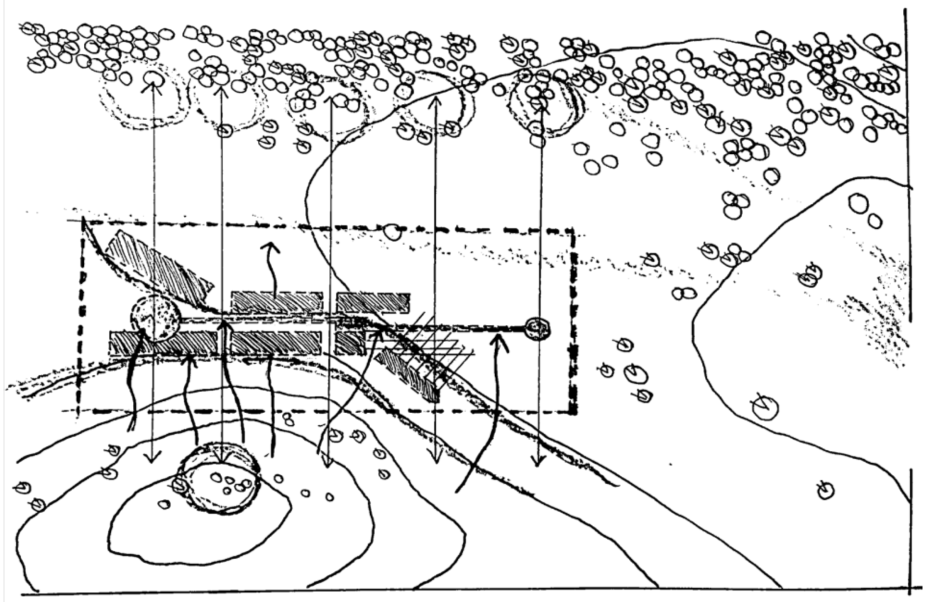


Figure 120: Massing of foreseen facility

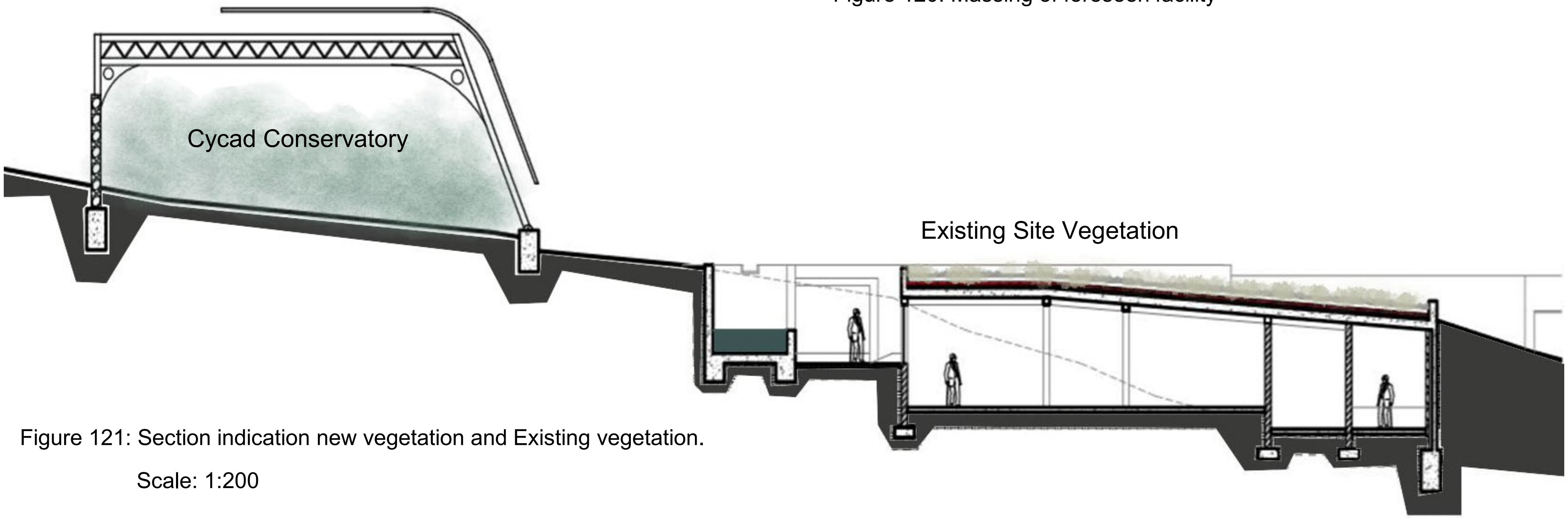


Figure 121: Section indication new vegetation and Existing vegetation.

Scale: 1:200

CHAPTER 05_THE NARRATIVE

5.1 THE NARRATIVE I Between the Earth and the Sky.

Here in the lingering presence amongst the sweeping velds of the Free state, where the hills cast shadows long after the searing sun has melted into the horizon. Here, the stories of many breeze the Themedra Triandra and oxidize red on the rocks over the grasses onto the ironstone of the landscape and within the Grassland regions of Glen Lyon farm. Slightly hidden from civilization, a moment in time plays no factor. Upon entrance, the rooigras leads the way towards a deliberate act of ritual, burning memories of self – reflection for times to come. No matter your background, your cultural or religious beliefs, there is something intensely unforgettable about the humble approach winding its way up to the ancient living artefacts of South Africa.

I cannot help, but to follow a narrow paved footpath, carefully curated by the permanence of retaining concrete and stone walls first leading up to a pond of refection, that stretches into the vast horizon of the cycad forest, and then pivoting into a different direction, leading up to a pit of sacred ground, where everyone is casually asked to remove their shoes, in respect of the cycads that South Africa has already lost. Here, the awareness of the critically endangered status of most South African cycads, is almost over whelming. As I sit in silence with nothing but the earth beneath my feet and the open sky shining onto the memorials of cycads that are extinct in the wild.

I then carefully put my shoes back on and continue to follow the journey into the cycad conservatories. The winding path through the forest, unconsciously allows for an experience of dance within these landscapes, and every now and then, the forest breaks into a view of humans shaping the narrative of each Cycad's character. Each view highlighting an event that adapts and re – adapts to the cultivating and nurturing of Cycad seeds that are ready to be exported back into their natural habitat. As these ancient living fossils adapt with time, the captivating retaining walls remain still with memories and voices etched into them, while the skins of the cycad conservatories slowly weather away, leaving future generations with an augmented landscape that time cannot erase.

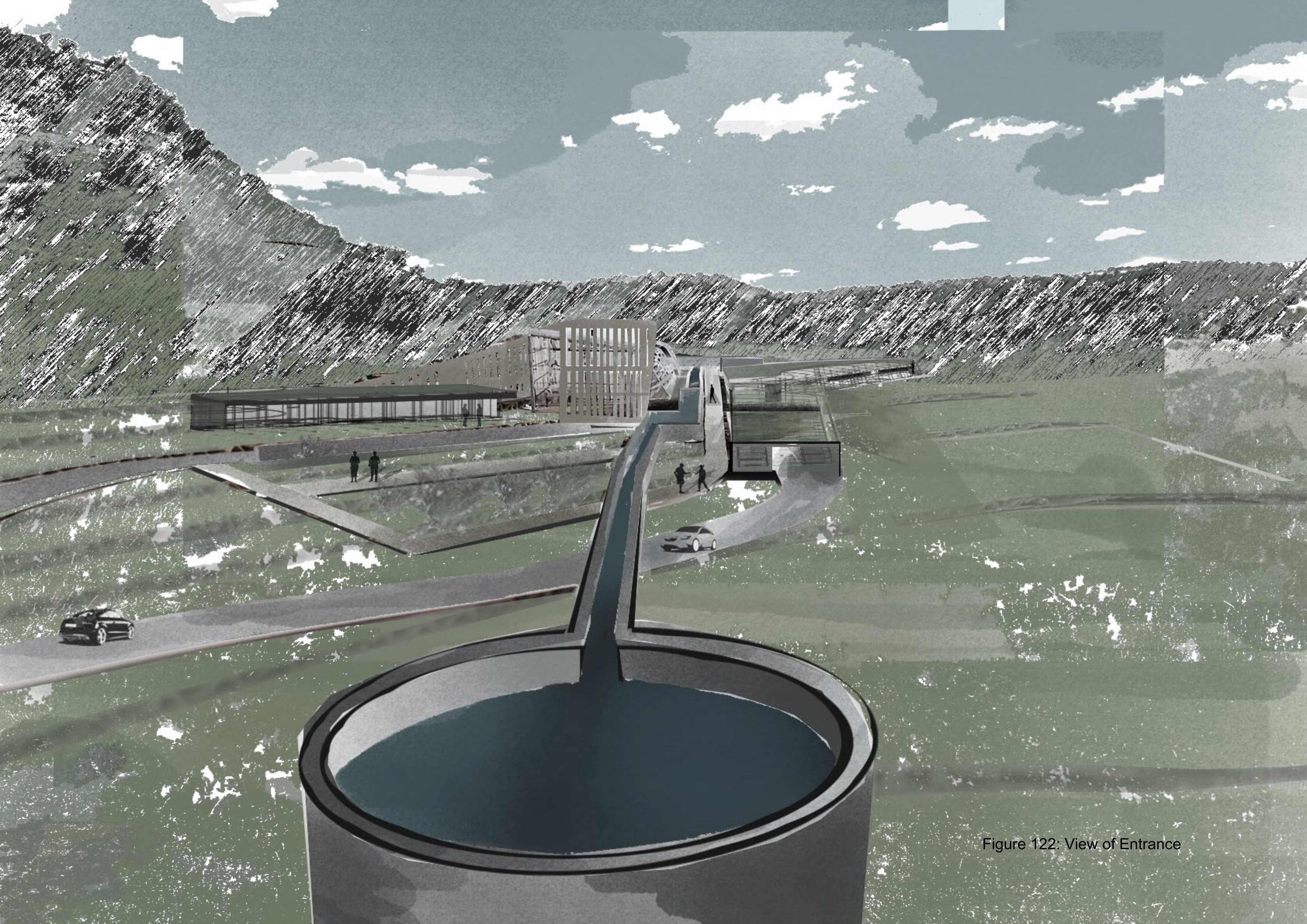


Figure 122: View of Entrance

5.2 DESIGN SYNTHESIS

5.2.1 ACCOMMODATION LIST

1. Research Facilities

Administration

- Reception
- Administrative offices (Management, HRM, Finance, SCM)
- Phytosanitary applications office
- Filing Registry
- Boardroom
- Library
- Herbarium
- Staff toilets
- Staff room

Laboratories

- Pathology & pests laboratory
- Phytosanitary laboratory
- Specimens & DNA laboratory
- Quarantine laboratory

Storage

- Pesticide and herbicide store
- Fertilizer store
- Seed store
- Equipment store

2. Recreational Facilities

Nursery

- Reception
- Permits offices
- Retail area
- Public toilets
- Germination area
- Potting shed
- Maturing area

Restaurant

- Seating (Indoor & Outdoor)
- Kitchen
- Stores
- Scullery
- Manager’s office
- Staff and Public toilets
- Waste area

3. Cycad conservatory

Exhibition spaces

- Indoor display area
- Outdoor display area

Operations

- Equipment Store
- Compost and soil area

5.2.2 SITE PLAN

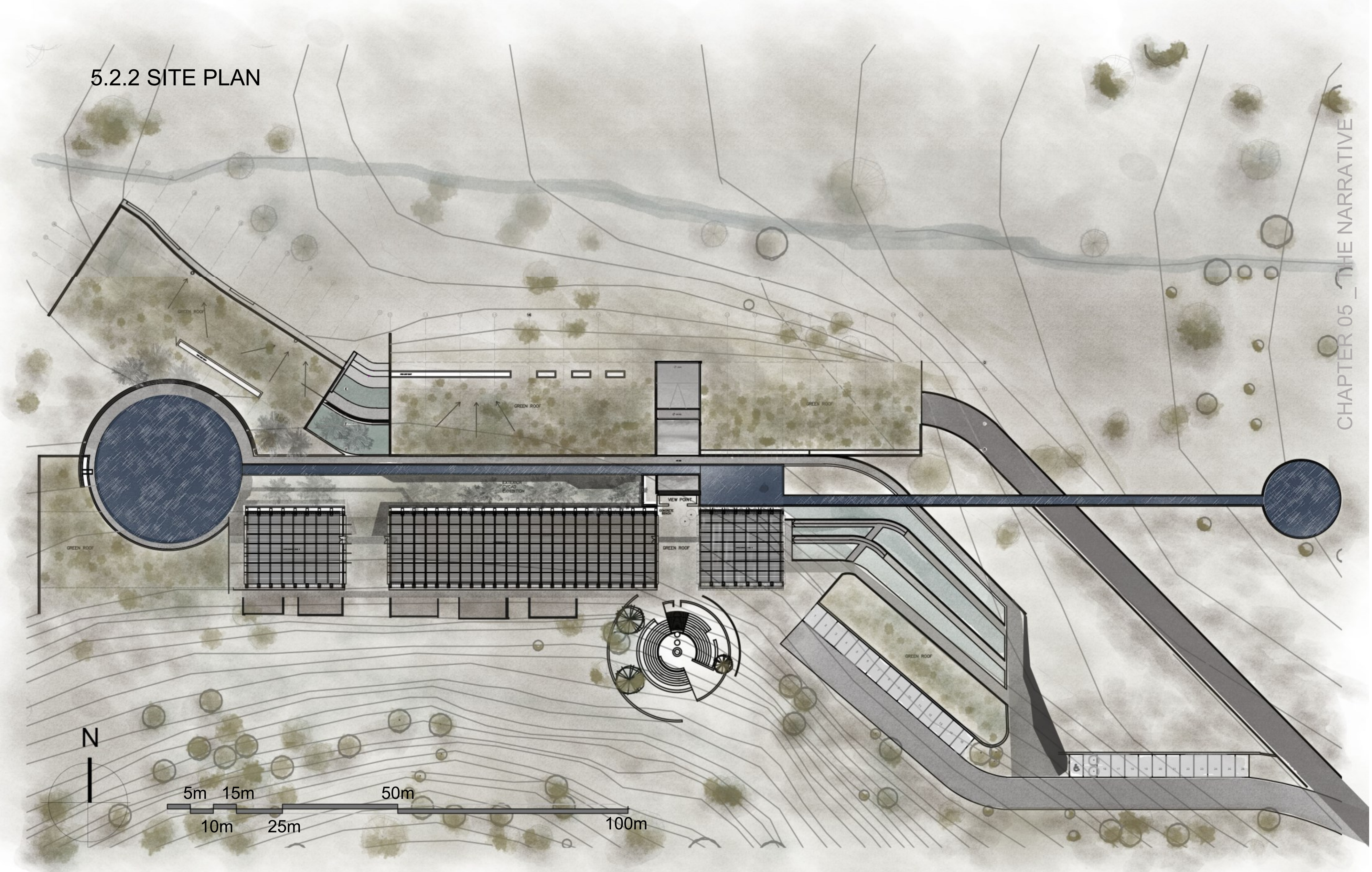


Figure 123: Roof layout of Cycad conservation centre

5.2.3 FIRST LEVEL PLAN

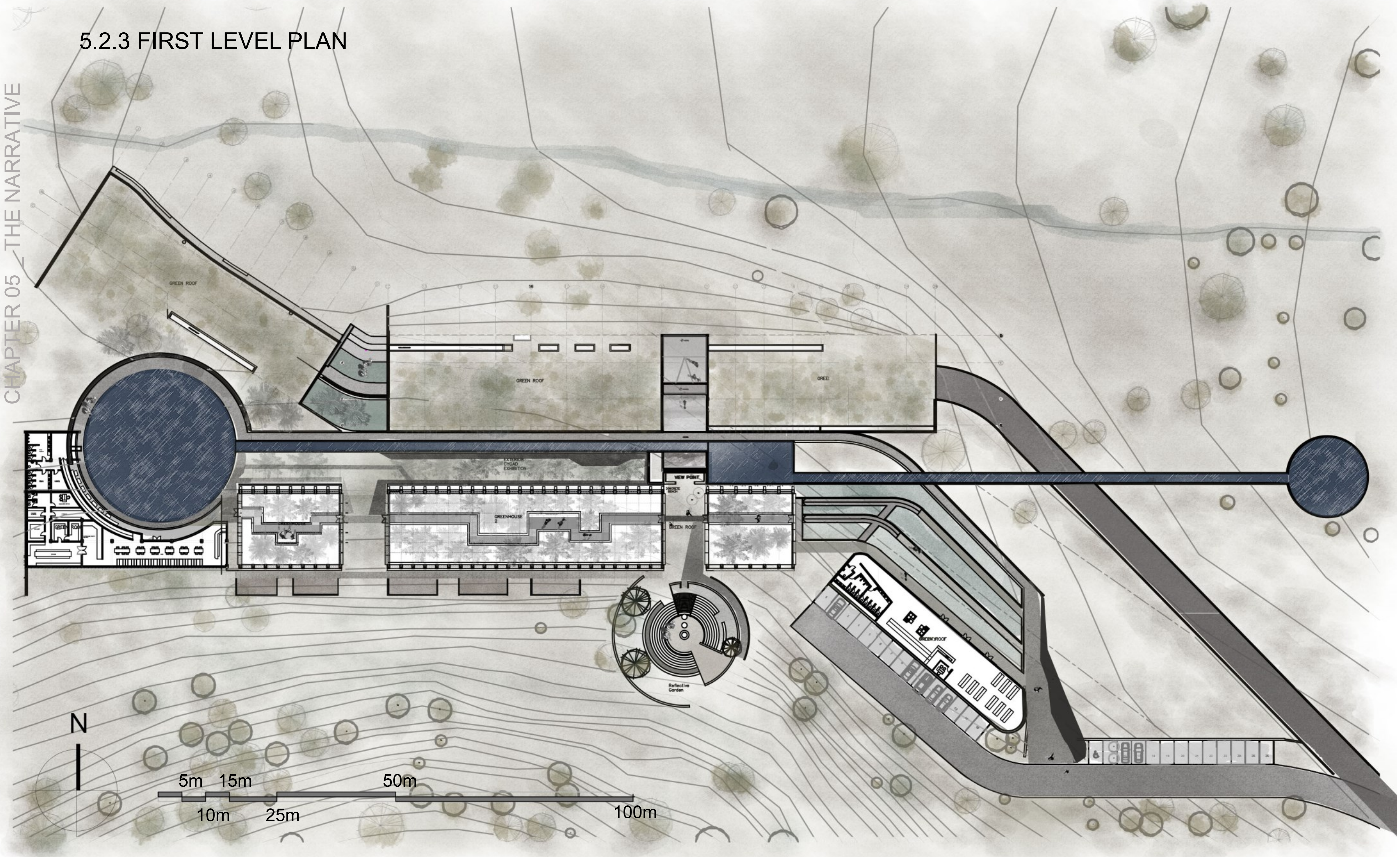


Figure 124: Nursery, Cycad Conservatories and Coffee Shop

5.2.4 SECOND LEVEL PLAN

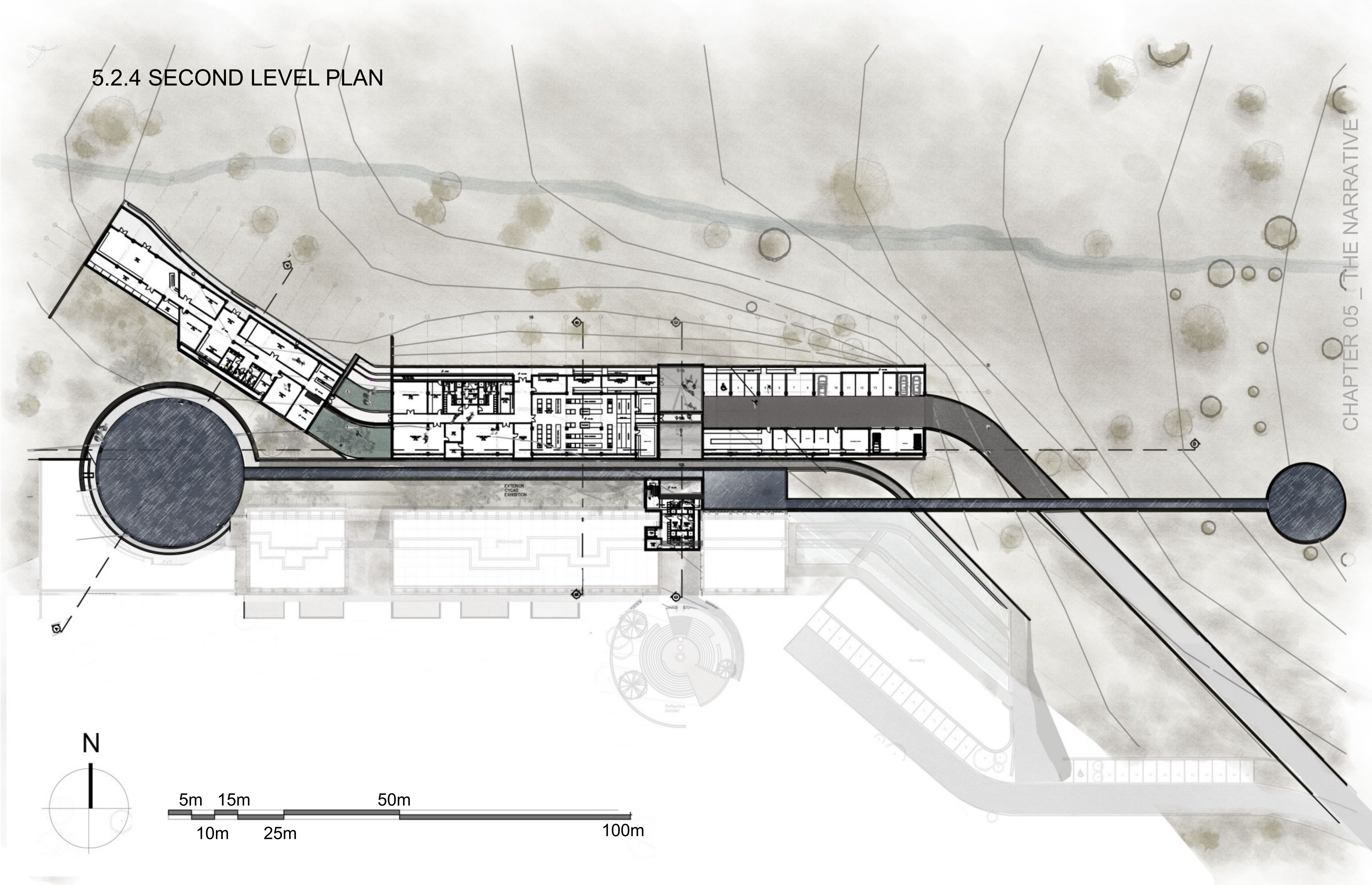


Figure 125: Admin offices, Labs and Staff Parking

5.2.5 THIRD LEVEL PLAN

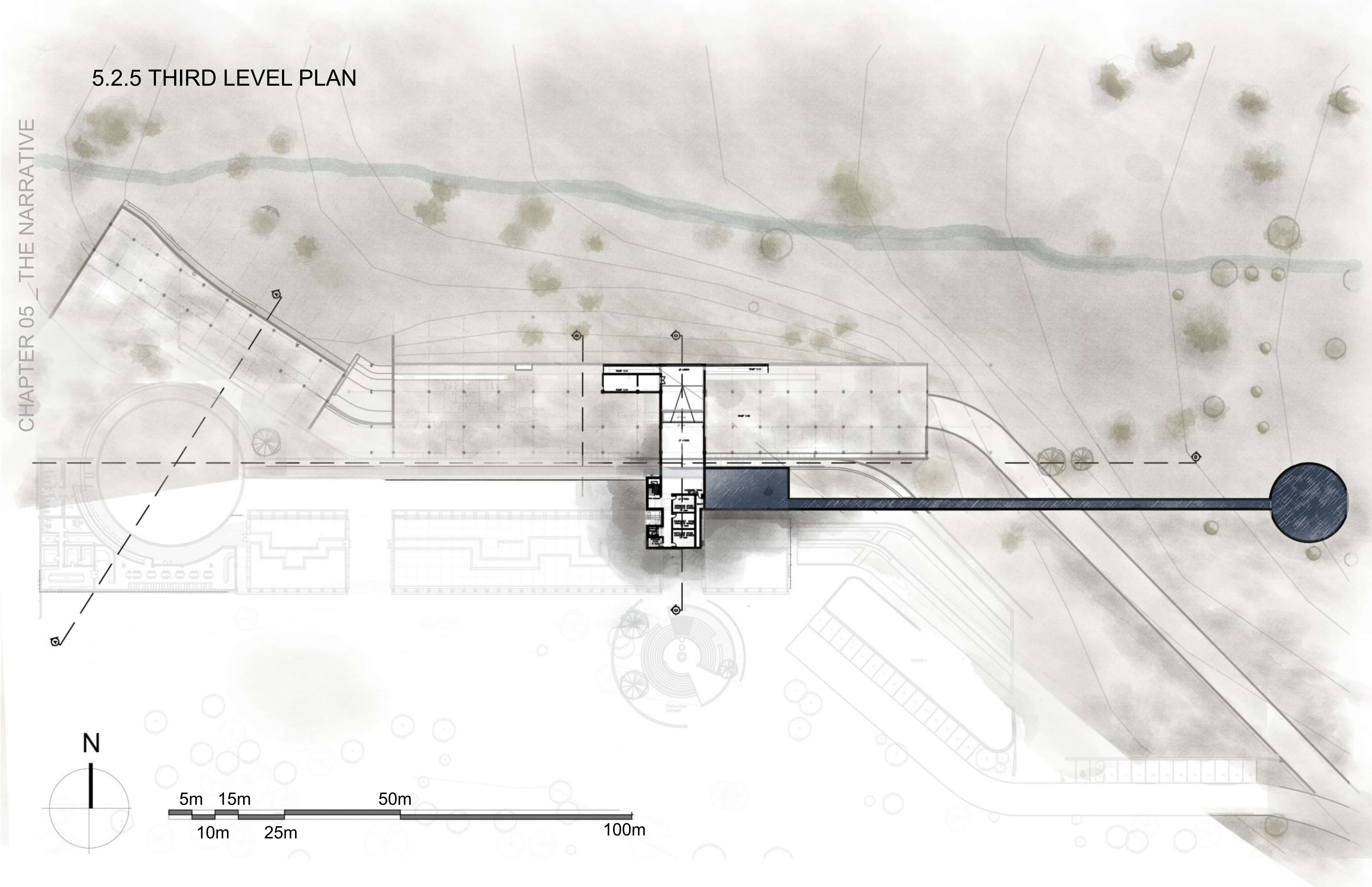


Figure 126: Staff toilets and Storage

5.2.6 PUBLIC VS. PRIVATE

The proposed design distinctly distinguishes between public, semi – public and private areas. This is achieved between physical barriers, such as windows, gabion walls and visual elements that convey different degrees of privacy (Figure 122).
The design consists of 3 components:

Recreational spaces – (PUBLIC): This includes spaces where sales and distribution take's place. Spaces such as the Cycad nursery and the restaurant.

Cycad conservatories - (SEMI – PUBLIC): These spaces consist of permanent Cycad exhibitions, that produces seeds for research and re – distributions to their natural habitats.

Research facilities – (PRIVATE): This component is only fully visible along the public route, to serve an educational purpose to the public visitors. It is however, not accessible to public users.

1. The Cycad Conservatories

The conservatories have a higher frequency of occupation, including both visitors and plant species. However, the conservatories are specifically designed to accommodate the needs of the cycad species. Therefore, a steel structure with glass covering is used to allow for maximum sunlight, Shading screens, to control heat gain, as well as gabion retaining walls, allowing for natural ventilation and heat storage.

2. The Recreational and Research Facilities

The recreational and research facilities articulate and sculpts the landscape, by replacing the excavated soil strategically, and replacing the existing vegetation on the building's green roof. This component is also sunken into the landscape, as a way for the architecture to highlight and become a part of its surroundings.

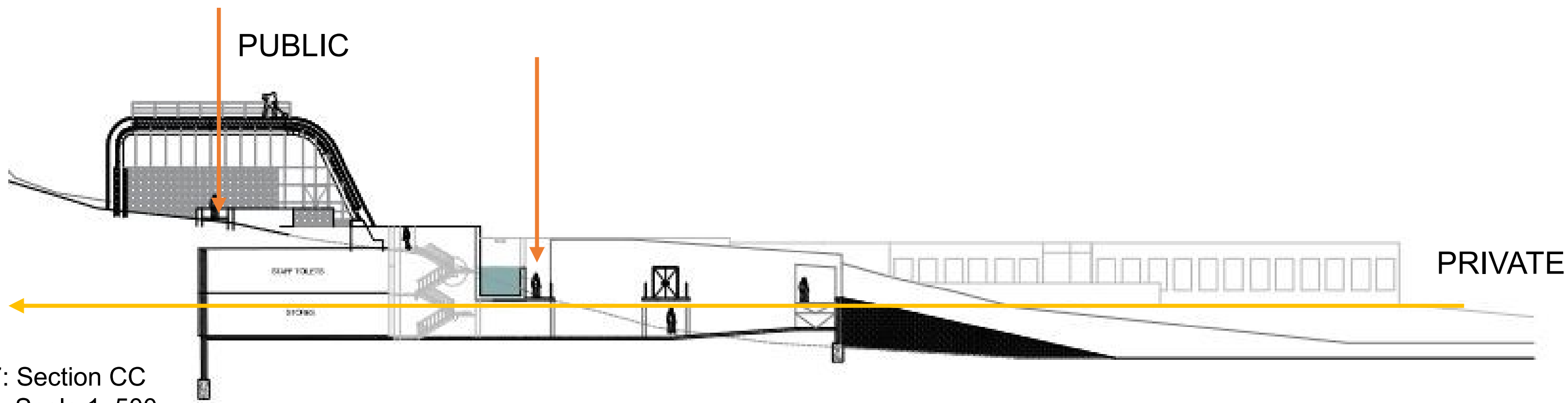


Figure 127: Section CC
Scale 1: 500

5.2.7 STRUCTURAL RESPONSE

The buildings structure responds differently in regard to the different functions. The structural components, wall thickness and roof covering is determined between the centre's private and public zones. All the materials and structural integrity share a common theme throughout the building, in which various components in the building adapts accordingly to the surrounding landscape (Figure 123). These changes include:

- Wall thickness
- Floor to ceiling height
- Glazing to wall ratio
- Exposed structures vs sunken structures
- Influence of natural lighting

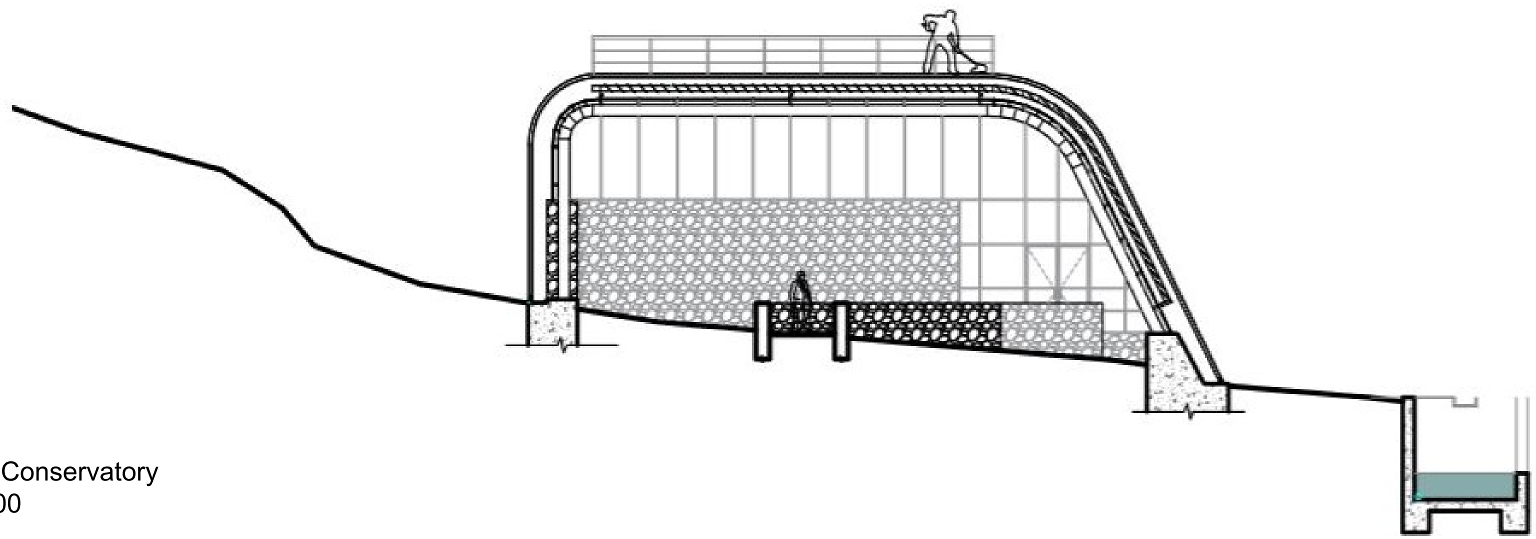


Figure 128: Section of Conservatory
Scale 1: 200

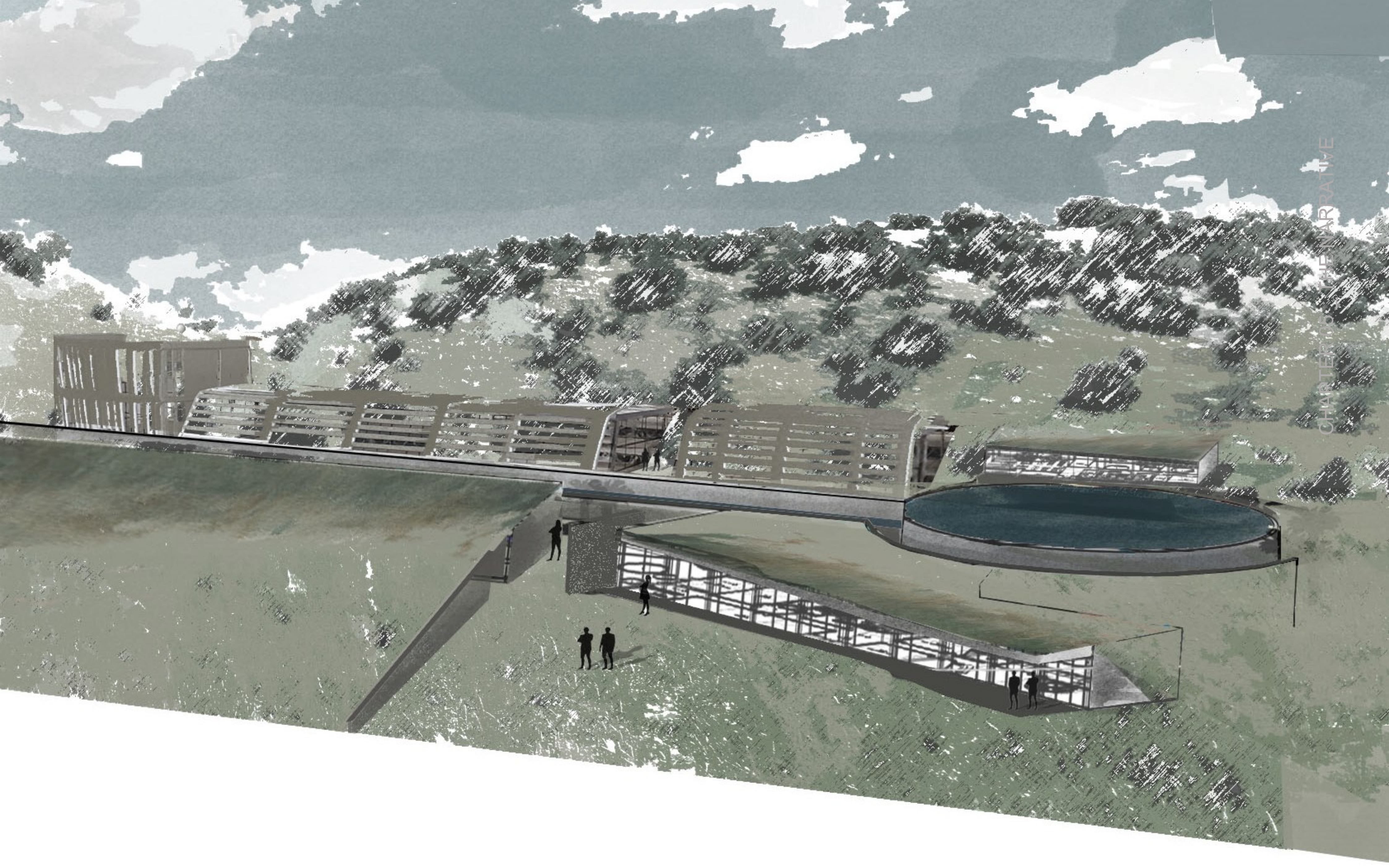


Figure 129: Perspective overlooking conservatories

5.3 REFLECTION

Upon Reflection and opening this architectural narrative to new possibilities. This section of the final design chapter serves as a personal journal entry, that narrates past and present experiences of a final year as an architectural student and re- imagines the possibilities of an architectural future.

It is evident that young architectural professionals will rarely ever embark on a journey, where the role of a client, architect and engineer is merged into one. Consequently, this year can easily be described as a schizophrenic one. A rollercoaster of emotions and identities constantly shifting from one to another.

However, reflecting back on the year, even though difficult, the challenge of gathering information, whilst simultaneously making design decisions was definitely a huge learning curve, that has forced me to become a more flexible designer. I have a huge passion for research and reading every possible narrative within a specific setting, that I can easily get caught up in it.

This year's project was particularly challenging, as one needs to listen even more attentively within a landscape setting. A setting that is constantly at change, yet seems to stand still in character. It was a project that was quite different in the sense of designing for plants, rather than humans.

Thus, moving towards the idea where anyone and anything can be a client, needing a place in the world.

CHAPTER 06_TECHNICAL SYTHESIS

6. 1 INTRODUCTION

6.1.1 PROJECT BACKGROUND

The proposed Cycad Conservation centre, situated on Glen Lyon Farm, north of Bloemfontein aims to promote sustainable measures in meaningful architecture, that acts as an active conservation strategy for South African cycad species.

The centre is divided into three building types, namely: Cycad conservatories, Laboratories, and Recreational facilities such as a nursery and café, joined by outside gathering spaces. The facility operates with two main processes that divides the public from the private, but still maintains a visual connection between the two parties. The functioning of the processes are as follows:

i) EDUCATIONAL AND AWARENESS PROCESS:

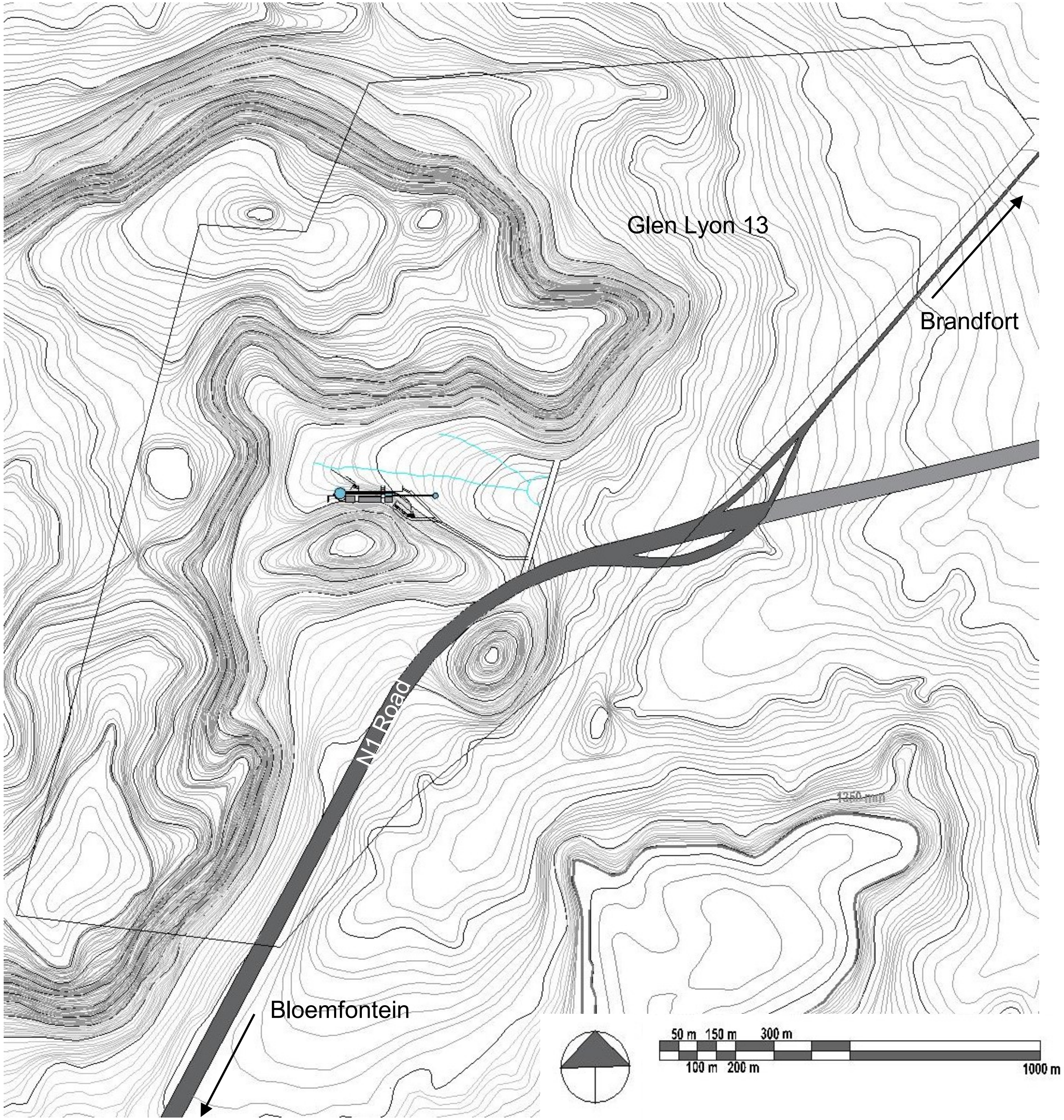
The public route throughout the centre, allows for an experience that brings about awareness and education on the endangerment of cycads, and measures taken to ensure the wellbeing of cycads in an unfamiliar environment. The architecture also sets an example of how man – made interventions can be respectfully implemented within the natural environment.

ii) RESEARCH AND CULTIVATION PROCESS:

The research facilities acts as the backbone for ensuring that the operation of the conservation centre runs properly. The process of research and cultivation enables the centre to implement an active conservation strategy, whereby the Cycad seeds are harvested from the Cycad conservatories, processed in the phytosanitary lab and transported back into their natural habitat.

6.1.2 OBJECTIVES AND SCOPE OF WORK

This chapter includes a series of explorations that aims to develop the best possible technical design resolution for the surrounding environment, community and the client, Steve Trollip. Therefore, the technical report on the proposed project, includes numerous factors, that investigates the technical aspects of the existing site conditions, on a macro, micro and meso scale. Furthermore, the chapter also includes studies on possible sustainable measures within the project, possible structural compositions, material use and services needed for adequate functioning within the buildings.



6. 2 TECHNICAL SITE ANALYSIS

6.2.1 SITE DESCRIPTION

The site is located about 12 km North - West of Bloemfontein and 35 km South – East of Brandfort in the Mangaung Metropolitan Municipality, Free State Province. The site is situated next to the N1 highway in a low-lying area at an elevation of 1360 m above sea level surrounded by numerous typical Free State hills (Opentopotmap, 2019: Online) (Figure 130 & 131).

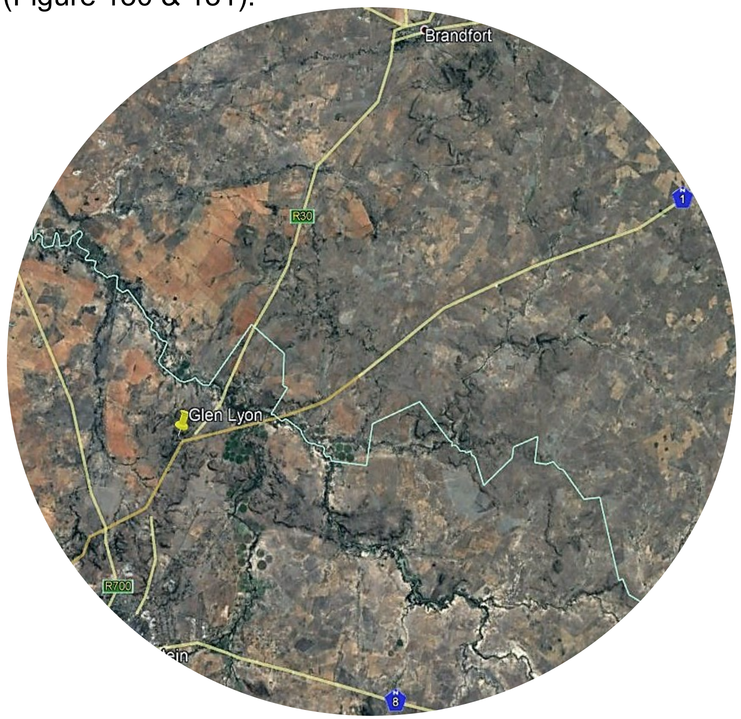


Figure 130 & 131: Location map of site
(Google Earth: 28* 58' 35.94" S 26*16'46.99" E)

CADASTRAL INFORMATION

NAME	Glen Lyon Farm
ERF NUMBER	13
ZONE	Farm, Rural Area
COORDINATES	28*58’35.94” S 26*16’46.99” E

For more detailed cadastral information, refer to Annexure A. (CSG, 2019: online)

6.2.2 TOPOGRAPHY

The topographical analysis identifies as the ideal site for the endangered cycad species, as the site is situated in a ravine surrounded by Bloemfontein hills allowing the cycads to grow against a north facing slope, as they do so in their natural habitat (Figures 132 - 136).

Figure 132:Topographical Model

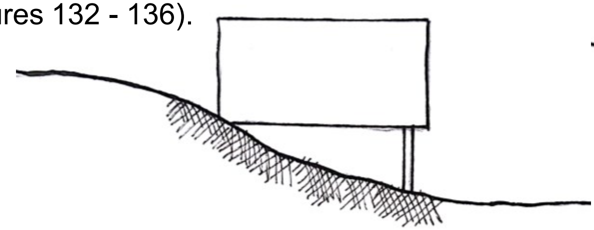


Figure 133: Elevated on slope with piers

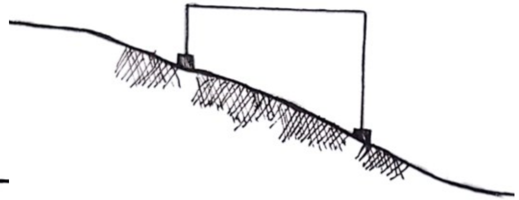


Figure 134: On slope with concrete footings

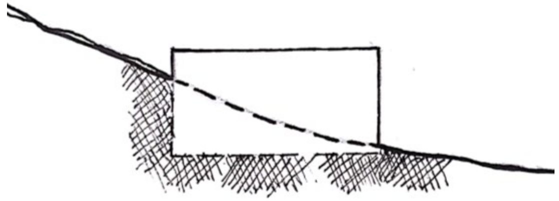


Figure 135: Excavated into the Slope

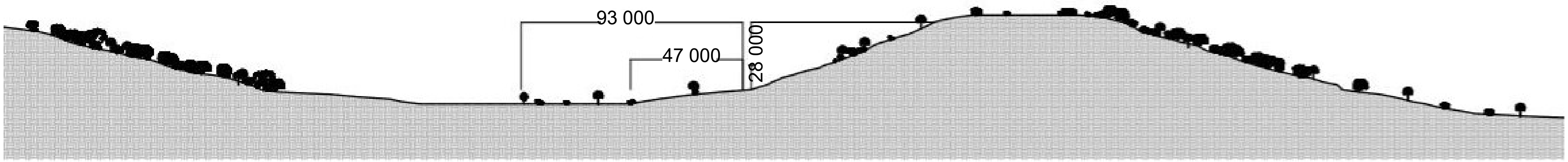
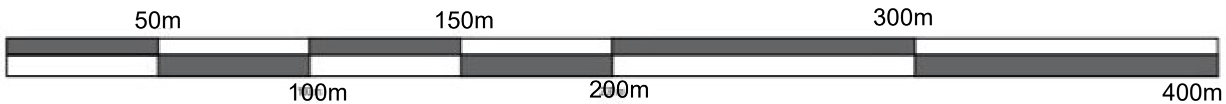


Figure 136: Site Section



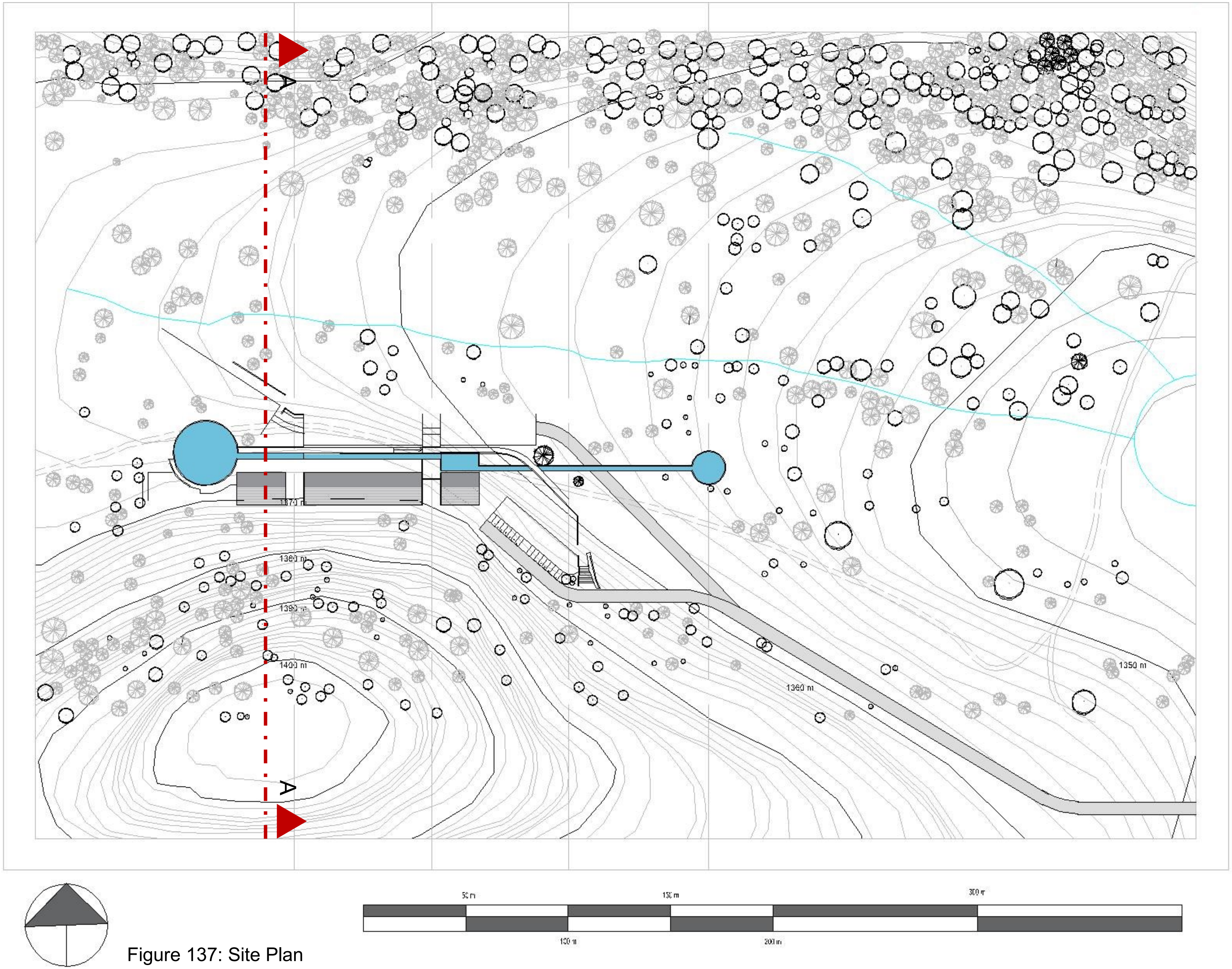


Figure 137: Site Plan

VEGETATION

The vegetation of Glen Lyon farm was clearly influenced by the Karoo. The investigation was carried out to determine the endangered status of the existing vegetation species on site. This investigation concludes, according to the Red List Index, that no plant species in the surrounding area of Glen Lyon are threatened with endangerment, all species indicated fall under the category of least concern (IUCN, 2019: Online) (Figure 138).

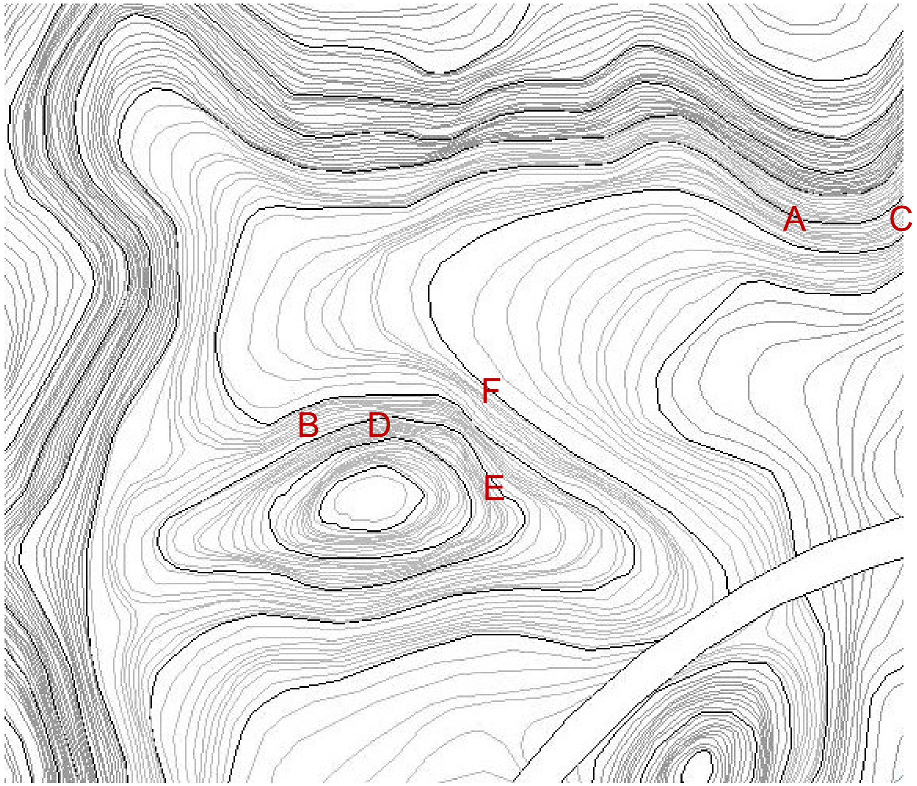
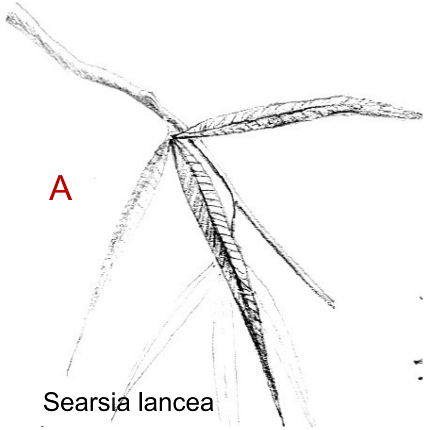


Figure 138: Vegetation on site indicating the status of plant species

A

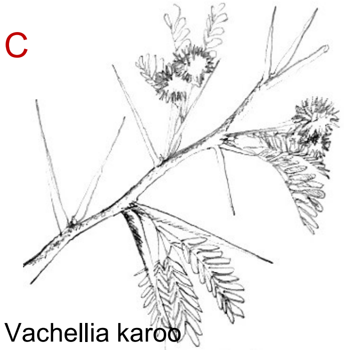


Searsia lancea
(Karee Boom)
Status: Least Concern

B

Boophone disticha
(Gifbol)
Status: Least Concern

C

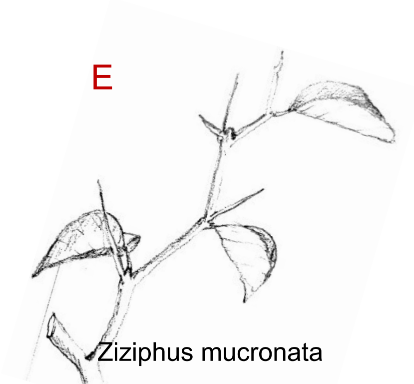


Vachellia karoo
(Soetdoring)
Status: Least Concern

D

Pleopeltis polypodioides
(Resurrection Fern)
Status: Least Concern

E



Ziziphus mucronata
(Blinkblaar Wag-n'-bietjie)
Status: Least Concern

F

Tatchonanthus camphoratus
Status: Least Concern

6.2.3 CLIMATE

Governed by marine and continental interactions, Africa is known to have a trend in fluctuating climate change (Jury, 2013: 1). The seven vegetation biomes of South Africa are administered by the country's climatic conditions, soil types and incidental veld fires, to name a few (Conradie, 2012: 3). According to SANS 204 – 2 [1] standard, South Africa identifies with six climatic regions, ranging from sub – tropical to arid climate conditions (Conradie, 2012: 4) (Figure 139).

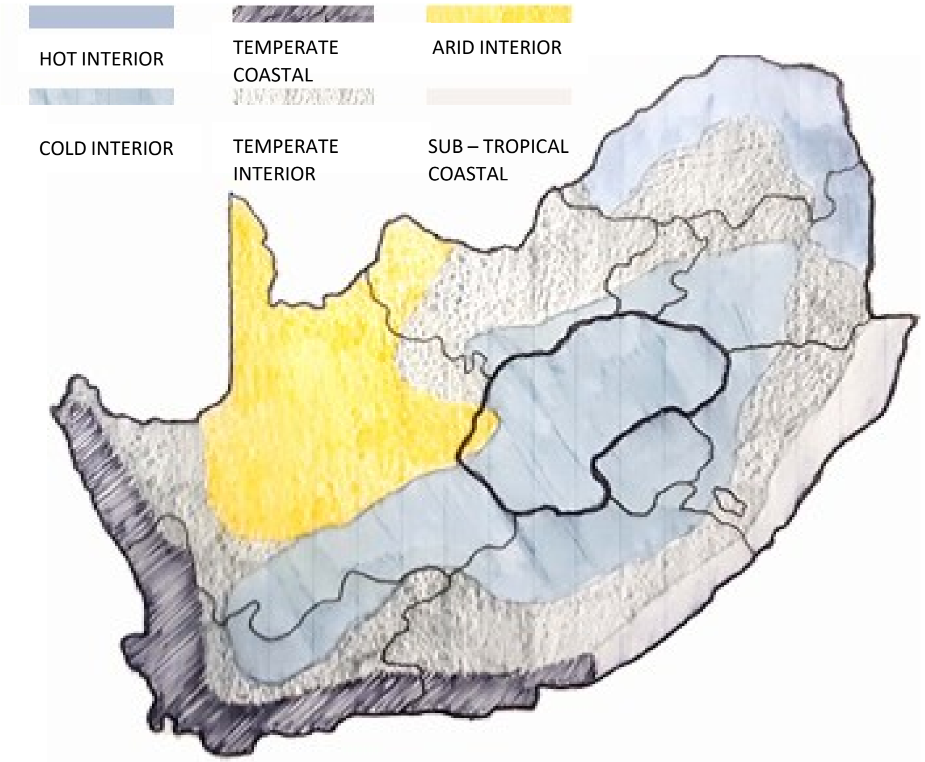


Figure 139: South African Climatic Zones sketched from (Conradie, 2012:4)

PASSIVE DESIGN STRATEGIES

The cycad conservatories accommodates cycad species from three different climatic regions in South Africa, namely: The sub-tropical coastal, Hot interior coastal and the Temperate coastal regions. Therefore, it is essential to take both passive and active design principles into consideration, in order to obtain the optimum environmental control inside the conservatories, located in a cold interior region. The following passive design strategies were investigated as possible solutions (Figure 140).

- Passive Solar heating, with the use of correct orientation, High window to wall ratio on the north and eastern façades, as well as operable external shading.
- Passive cooling systems, with ponds situated in the interior, allowing for evaporative cooling of air and increasing humidity levels.
- Passive ventilation with small openings on either side of the conservatory, allowing for cross ventilation.

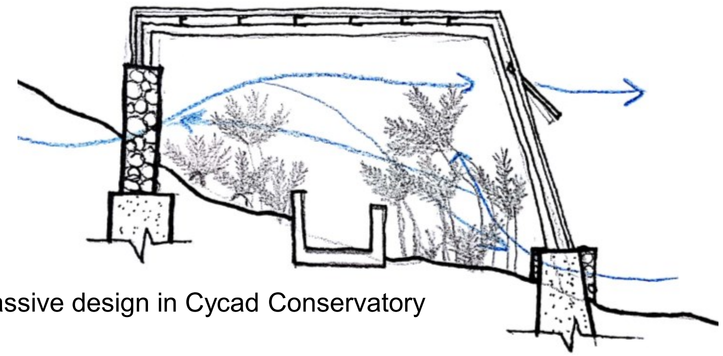


Figure 140: Passive design in Cycad Conservatory

6.2.4 GEOTECHNICAL SETTING

According to the geotechnical map (Figure 141), the region north of Bloemfontein is under laid by dolerite mud rock and sandstone of the upper stage.

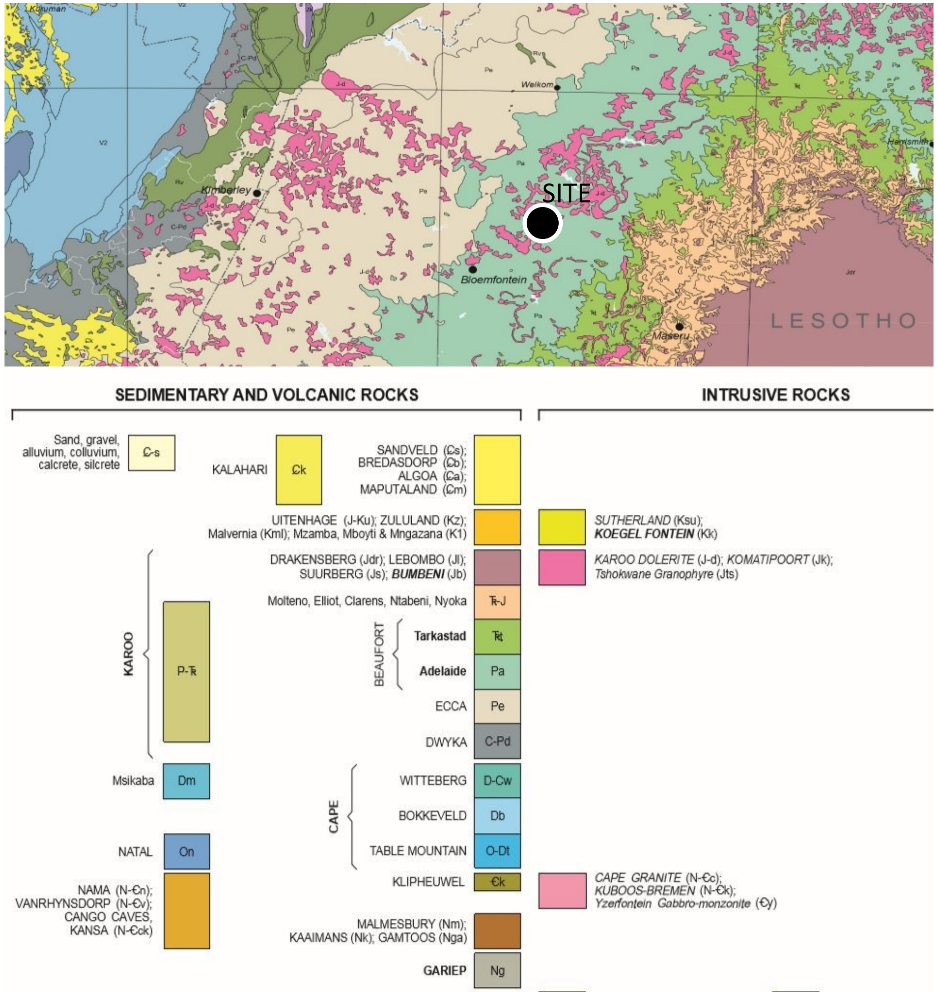


Figure 141: South African Geological Map, indicating site position. (Johnson & Wolmarans, 2008:1)

BOTTLE TEST INVESTIGATION

In order to form an idea of the site-specific soil conditions, a bottle test investigation was conveyed in the following manner (GSP, 2017: 15):

Experiment: Separating soils and estimating soil particles

Materials needed for the experiment: (Figure 142)

- Soil samples from two locations on the site.
- 2 x Jars of same size with lids
- Water softener
- Water

Steps to be followed to complete the investigation:

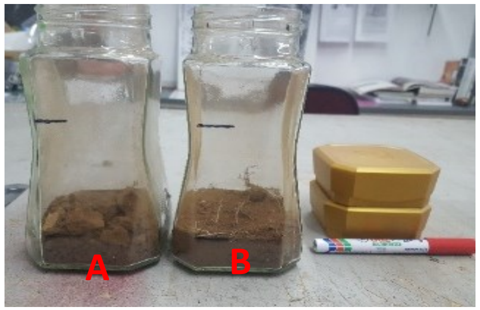
Step 1: Fill each jar half full with soil samples

Step 2: Mark the level of soil on each jar and then add the water softener

Step 3: Add sufficient water to fill the jar and shake well

Step 4:Let the soil settle and document at different time intervals.

Figure 142: Equipment used in experiment.



RESULTS | Soil Profile

Soils are composed of different sizes. The top layer indicates the smallest particles (clay), the second layer, the medium size particles (silt) and the largest size particles (sand and rocks) is indicated by the bottom layer.

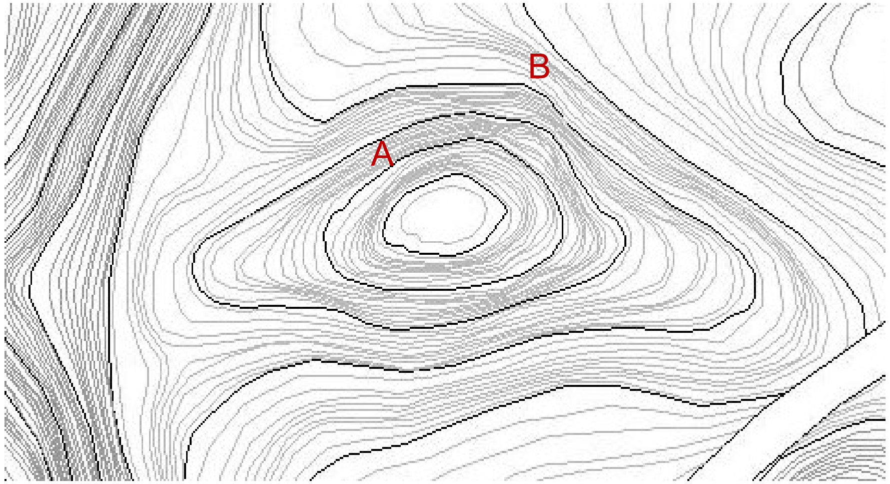


Figure 143: Plan indicating position of soil samples

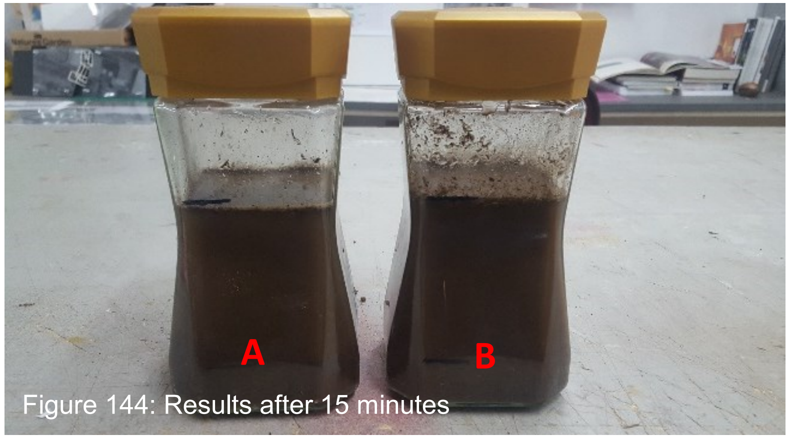


Figure 144: Results after 15 minutes

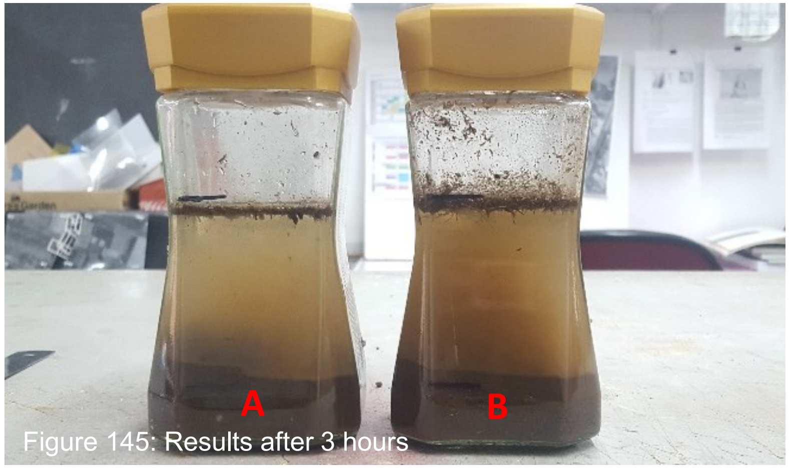


Figure 145: Results after 3 hours

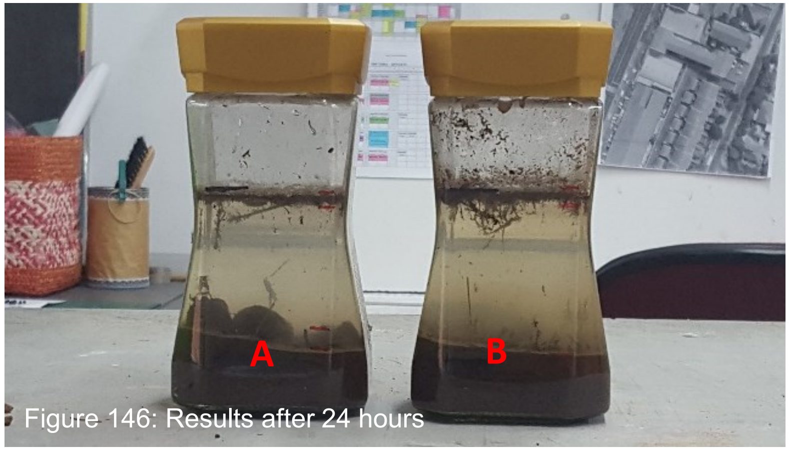


Figure 146: Results after 24 hours

CONCLUSION

The results from the experiment conveyed that sample A consists of more heavy materials as oppose to sample B, as (Figure 146) shows how sample A is a lighter colour than sample B. Also, when the experiment was conducted Sample B drained the water slower than sample A. Hence, I would say that sample A consists mostly of clay and dolerite soil types, where sample B consists mostly of clay and silt soils.

6. 3 SUSTAINABILITY AGENDA

6.3.1 SUSTAINABILITY OVERVIEW

This section of the chapter aims to give a concise understanding of sustainability within the built environment. Arguments have been made by numerous intellectuals and practitioners from various professions, debating the meaning of sustainability, and what it entails to be sustainable. (Morelli, 2011: 2) According to Torsten Schroeder (2018: 5) “Sustainability encompasses an interrelated concern of the diverse issues associated with protecting the environment: ‘promoting human welfare; satisfying basic needs [...] considering the fate of future generations; achieving equity between rich and poor; and participating on a broad basis in decision-making’” In general the word “sustainability” comes a long way and has evolved over time, where three discourses seemed to have emerged. (Giovannoni & Fabietti, 2014: 23;24) Therefore, the following section discusses the discourse of environmental, social and economic sustainability, and how it can be applied in place making.

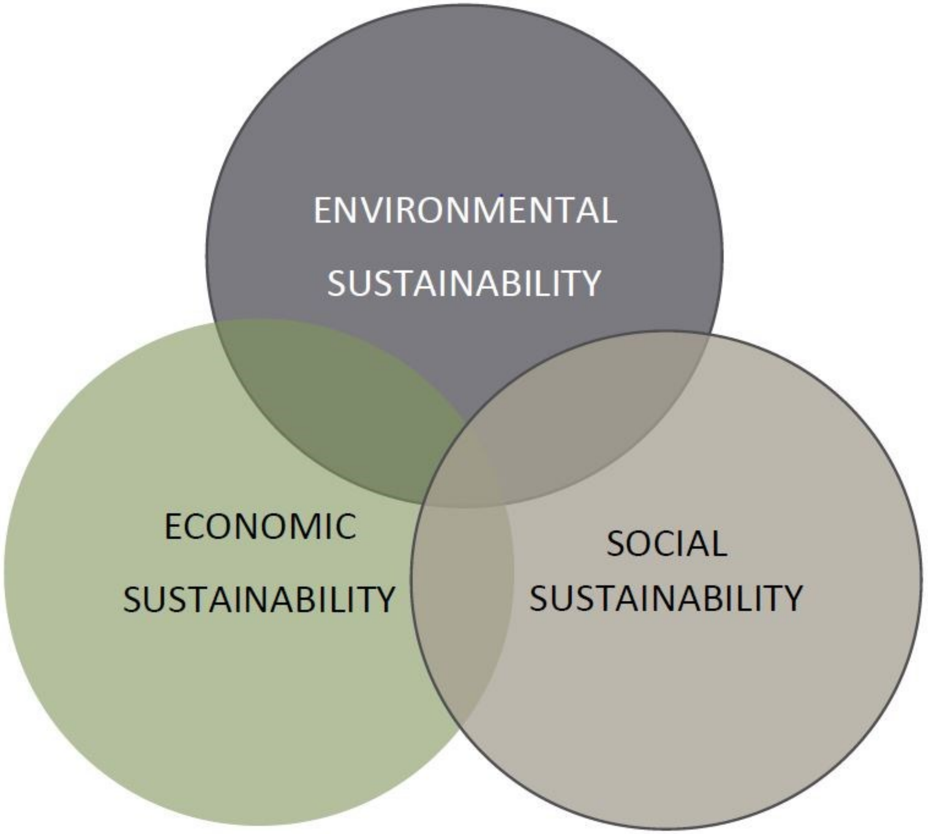


Figure 144: The three discourses of sustainability.

6.3.2 DISCOURSE OF ENVIRONMENT SUSTAINABILITY

The defining word being "environmental", often tends to be associated with the existence of a dynamic relationship between man and nature, and the impact that the other have on one another. Callicott and Mumford describes this component of sustainability from a conservational point of view as: "meeting human needs without compromising the health of ecosystems." (Morelli, 2011: 2) In the design process of the conservation centre for endangered plant species, the above-mentioned concept becomes crucial in carefully considering how architecture can mediate such a relationship between man and nature. Therefore, the following passages explores possible design strategies, by investigating a precedent study dealing with environmental sustainability.

PRECEDENT | Solar City

ARCHITECT: Atelier Dreiseitl

LOCATION: Linz – Pichling, Austria

YEAR: 2004 - 2006

Building a relationship with nature has proven to be extremely beneficial to the welfare of human beings. (Sassi, 2006: 36) The following precedent study discusses the design of a solar city by Atelier Dreiseitl and the innovative ways in which the project integrates a housing scheme with accessibility to its natural environment.

Figure 145: Arial photograph of Solar city (Land 8: 2015:online)

ACCOMMODATING MAN AND NATURE

The Solar City design responds to the needs of neighbouring residents as well as incoming residents. However, being in the immediacy of a sensitive natural environment, the project also needed to be carefully planned in terms of limiting and controlling the human impact onto the environment’s sensitive sedimentary forest (Figure 146). Therefore, the design accommodates the need for conserving the attractive open spaces (Land8, 2015: Online).

ACCESSIBILITY TO THE NATURAL ENVIRONMENT

For physical and mental health encouragement, the design further inspires residents to enjoy the natural surroundings by making certain areas accessible to the public (Figure 147). However, from a natural conservational perspective, the design protects the environment from excessive human presence, but highlighting views of its surrounding, allowing residents visual access, as appose to physical access (Sassi, 2006: 36).

Figure 146: Open public seating within nature(Land 8: 2015:1)

Figure 147: View from living units (Land 8: 2015:1)

SUSTAINABLE METHODS FOR DEALING WITH WATER

The “wastewater – free” housing scheme project, implements the sustainable method of separating urine, and recovering it, to be reused as fertilizer for the surrounding natural realm. The innovative system also purifies grey water and discharges it into the nearest stream. The project also deals with rainwater in innovative ways, through drainage, collection and disposal (Figure 149). This is achieved by means of gutters, retention hollows and vegetated swales (Figure 148). The rainwater management is further integrated into the open public spaces, so that residents can be educated and become aware of the natural rainwater cycle (Land8, 2015: Online).

Figure 148: Resident experiencing the rainwater cycle (Land 8: 2015:1)

Figure 149: Public dam (Land 8: 2015:1)

Figure 150: Courtyard with pond (Land 8: 2015:1)

DESIGN APPLICATION

The design responds to the needs of both the existing ecosystem of the site and the Cycads was handled with optimum care, in order to achieve the best possible design resolution.

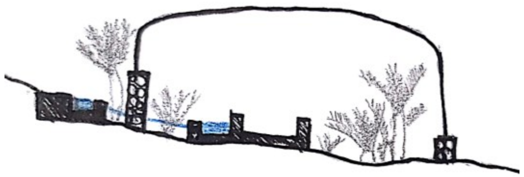


Figure 151: Section of conservatory, indicating stormwater drainage

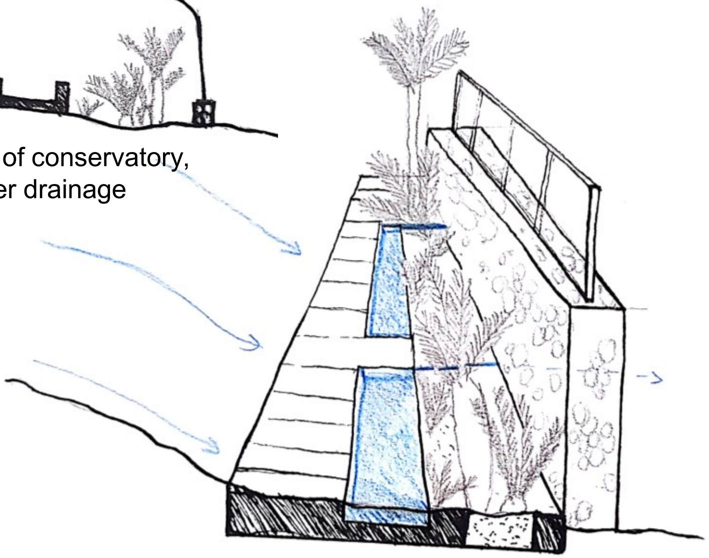


Figure 152:Detail of stormwater drainage

DESIGN STRATEGIES

In designing for nature conservation within the proposed Cycad conservation centre, the following sustainable strategies were implemented in the design of the project:

- The design aims to avoid any destruction of existing natural habitats, by re-allocating vegetation and soil from the site, where excavation takes place (Figure 153).
- A thorough analysis was conducted of the existing conditions on site, to establish the ecological value of the site, before any design decisions commenced.
- New plant species (Cycads) that are not native to the Free State area was introduced in order to increase the plant diversity of the site. These species are not invasive in any way, and further develops the existing ecosystem by providing new nesting places for birds and insects (Figure 154).
- Educational and recreational public spaces were designed to contribute to the environment’s awareness factor (Figure 154).

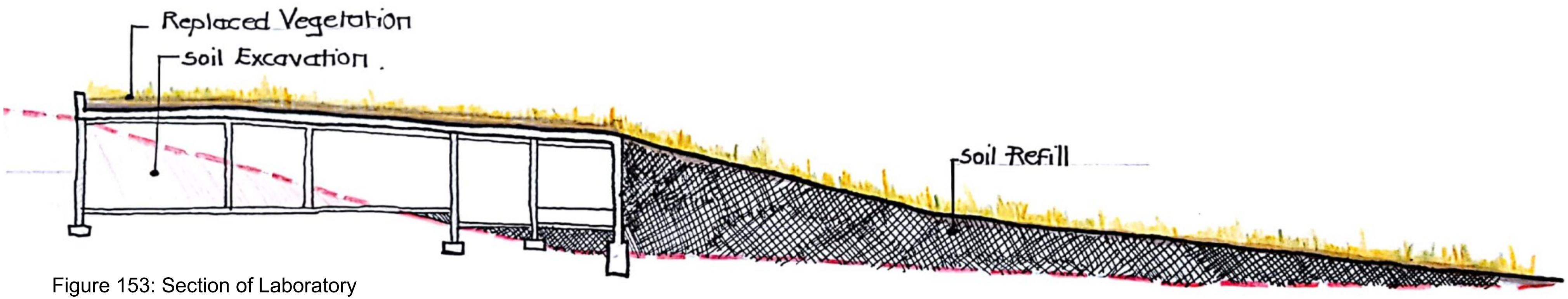


Figure 153: Section of Laboratory

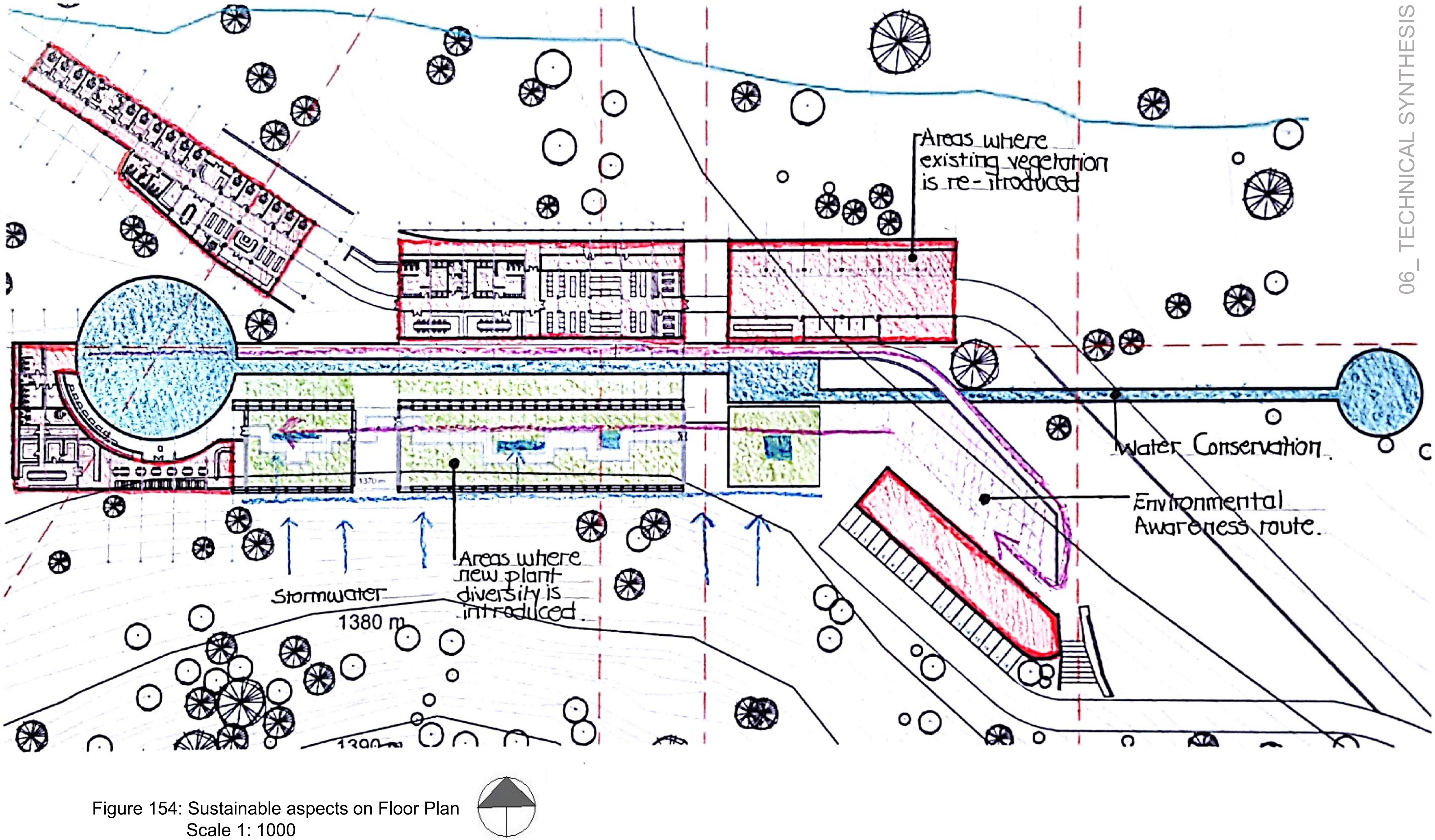


Figure 154: Sustainable aspects on Floor Plan
Scale 1: 1000

6.3.3 DISCOURSE OF SOCIAL SUSTAINABILITY

Social sustainability within the formation of the built environment, often forms a fundamental part of human activities (Othman, 2007: 10). In defining the word 'social' within a sustainable context, can be described as creating an environment that celebrates, enhances and supports human activities. In order to build networks and systems of support amongst people in an urban environment (Othman, 2007: 10).

PRECEDENT | Torre David

ARCHITECT: David Brillembourg

LOCATION: Caracas, Venezuela

YEAR (Unfinished): 1993

The lecture by photographer, Iwan Baan (2013: Online Lecture), titled: Ingenious homes in unexpected places, is a well photographed journey exploring intuitive place making decisions done by everyday communities, consisting of people living in vastly different sets of circumstances. Baan starts the lecture by explaining that it is fascinating to witness how inhabitants within a place take over in many different ways, once the architect or developer leaves the site. The Tower of David (Figure 155) conveys a concise understanding of such places where social aspects play a crucial role (Baan, 2013: Online Lecture).

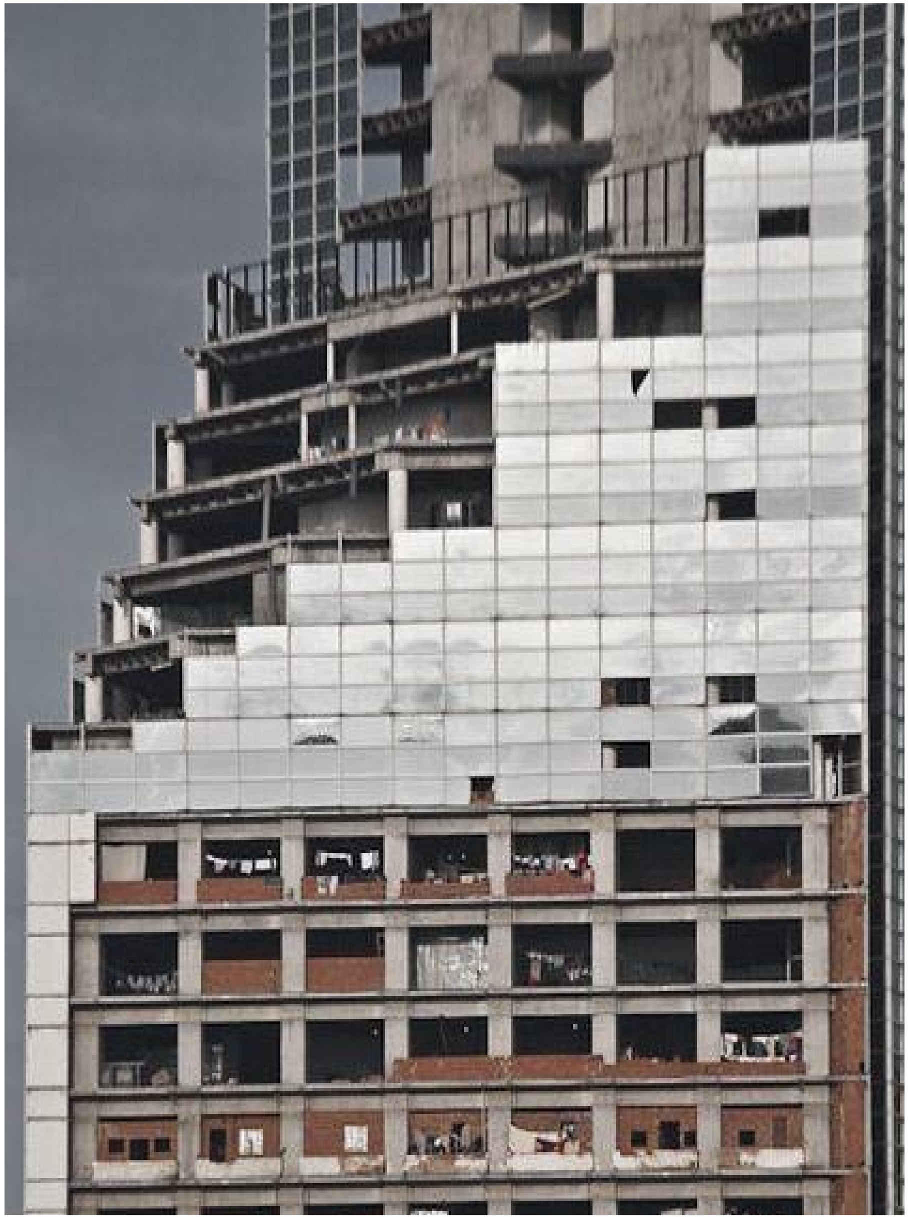


Figure 155: Tower of David facade (Baan, 2013)

After the death of the developer, David Brillembourg and the financial crisis in Venezuela, the Tower of David was left unfinished as a 45-storey concrete skeleton wrapped with glass in the city centre of Caracas (Baan, 2013: Online Lecture). Eight years later, people moved into the unfinished building, and started to create a place they can call home. The place – making decisions were fascinating, for example people placed brick printed wallpaper onto a face brick wall (Figure 156), or residents created a home from found objects, such as old newspapers and furniture (Baan, 2013: Online Lecture). More convenient entrances (Figure 157) and ways of circulating was created and service spaces such as small businesses started settling (Figure 159), as a way of sustaining this community (Baan, 2013: Online Lecture).

The building had no lifts installed or any form of easy transportation from the ground floor to the 45th floor. Therefore, a taxi rank was created on the ground floor as a way of giving lifts to the residents to their upper floor apartments, via the ramps (Figure 158) (Baan, 2013: Online Lecture). The building in itself became a micro city within a larger city. It was interesting to see how the design of architecture in this case continues to grow with networks and social needs of its inhabitants.

Figure 156: Apartment decorated by residents (Baan, 2013)

Figure 157: Entrances created (Baan, 2013)

Figure 158: Service space created by residents (Baan, 2013)

Figure 159: Taxi Rank on ground floor (Baan, 2013)

DESIGN APPLICATION

To meet the need for a healthy social environment, where both the staff and public community benefit from an informative and educational network. A study on alternative social interventions was done in order to achieve a social sustainable environment within the project (Figure 160 – 162).

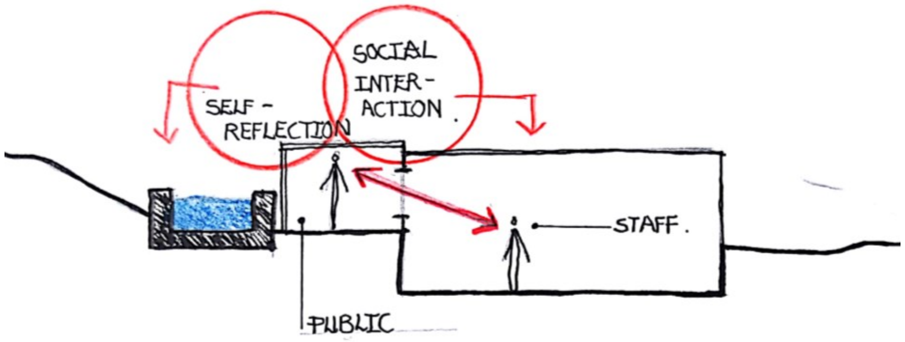


Figure 160: Section indicating connection between public and private

DESIGN STRATEGIES

In "Social Sustainability, the defining concept refers to an environment with a positive outlook within communities. The concept was achieved with the following principles, within the design of the project:

1. Ensuring equal access to key services for all users
2. Allowing for a system of relations valuing cultural difference
4. Allowing for a sense of community ownership
5. Transmitting awareness of environmental, economic and social sustainability from one party to the other.
6. Social tools for a community to fulfil its individual needs where possible (Figure 161).

Figure 161: Social convention around a tree

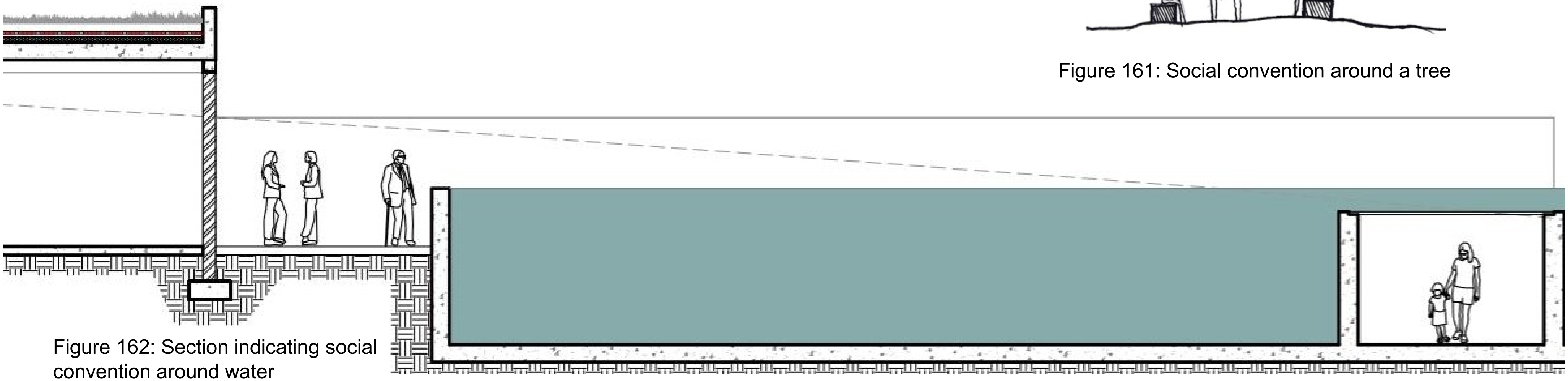
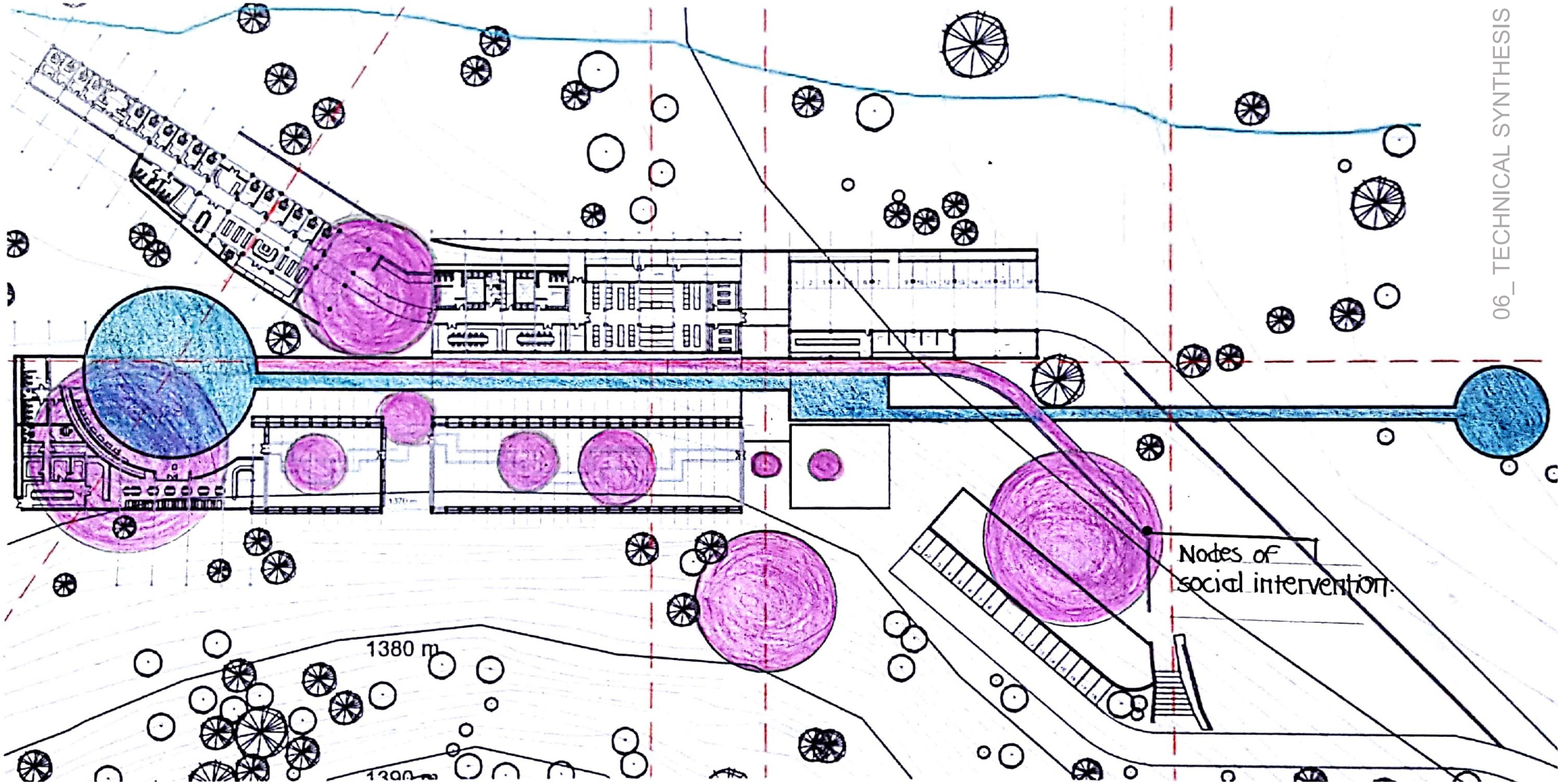


Figure 162: Section indicating social convention around water



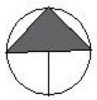


Figure 163: Nodes of social intervention on Floor Plan
Scale 1: 1000

6.3.4 DISCOURSE OF ECONOMIC SUSTAINABILITY

The defining dimension of economic sustainability can be seen as twofold. Firstly, an implemented process of stimulating growth within a community's economic environment, through job creation. Secondly, providing a system that increases investment return and project (Othman, 2007:11). Therefore, in general economic sustainability entails an approach were an analysis is conducted to minimize social costs of meeting the requirements of a community, by protecting environmental assets (Morelli, 2011:2).

PRECEDENT | Genzyme Centre

ARCHITECT: Behnisch & Partner

LOCATION: Cambridge, USA

YEAR: 2000 - 2003

The Genzyme Centre (Figure 164) located within the surroundings of other active research institutions on a former brownfield site near Charles River, Cambridge (Arch20, 2012-2019: online). The building successfully conveys a point of identification for the client, in which architect, Behnisch, organized the building in the form of a 'vertical city' with the application of sustainable strategies, aiming to effectively lower the functioning costs within the workplace environment (Arch20, 2012-2019: online).

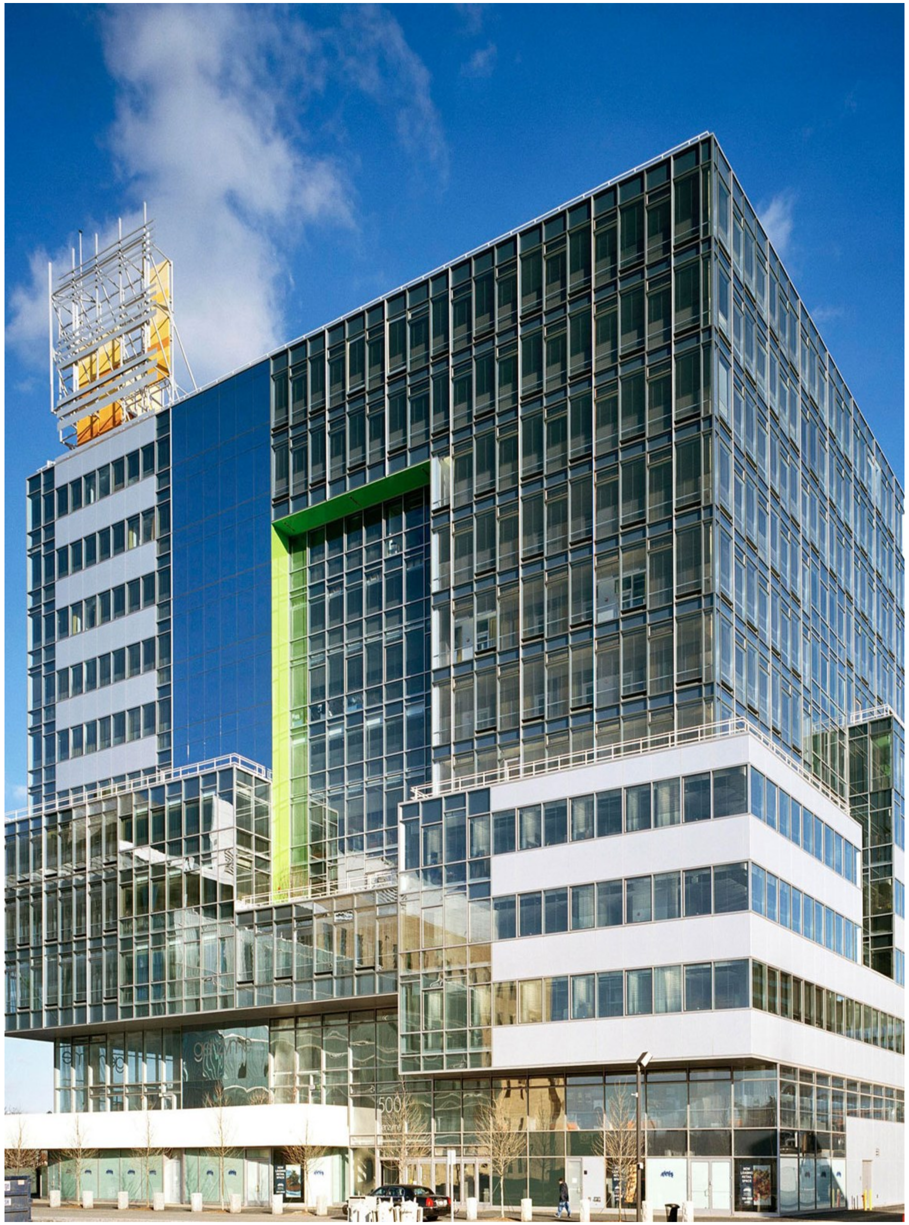


Figure 164: The Genzyme Centre (Pfammatter, 2014.)

STRATEGIES FOR NATURAL LIGHT IN DESIGN

Designed from an individual workspace to the overall complexity of the building. The Genzyme centre aims to generate an economical sustainable environment, by acting as a catalyst for community regeneration (Genzyme Corporation, 2007:4). This environment was achieved in numerous aspects, such as passive design strategies, that aid in natural light enhancement. The 12-storey building features an open atrium (Figure 168) with an operable skylight, allowing light to fill the centre of the building (Genzyme Corporation, 2007:6). Furthermore, the use of reflective ceilings, metal light distributors and prismatic chandeliers fills 90% of the workspaces, reducing the cost of artificial lighting in the functioning of the building (Figure 165) (Phun, 2012:2).

BENEFITS OF NATURE IN AN ECONOMIC ENVIRONMENT

Plants in an urban setting serve various functions both environmentally and economically (Sheweka & Magdy, 2011:596). In this case the use of greenery inside and outside of the Genzyme centre serves the purpose of establishing social connections, an escape from a stressful work environment which aids in directly benefiting the health of staff members (Sheweka & Magdy, 2011:596). The eighteen courtyard garden spaces within the building contributes to the sustainable building concept, in which an excellent air quality and social dynamic is created (Sheweka & Magdy, 2011:596).

Figure 165: View of the atrium. (Pfammatter, U. 2014.)

Figure 166: Use of solar panels (Phun, X. Y. 2012: 2)

Figure 167: Use of green roofs. (Phun, X. Y. 2012: 2)

Figure 168: Section indicating voids that allows for visual connection

DESIGN APPLICATION

The design aims to encourage an economically sustainable environment, with the use of design tools, that will allow the facilities to function semi – off – the – grid. The following strategies were investigated as possible solutions to the final design resolution.

DESIGN STRATEGIES

Economic Sustainability focuses on the following strategies:

1. Creating new markets and opportunities for sales growth (Figure 169 & 171).
2. Reducing functioning costs by reducing and improving energy and raw material inputs (Figure 171).
3. Creating a healthy environment for surrounding communities, by increasing job opportunities and education (Figure 170).

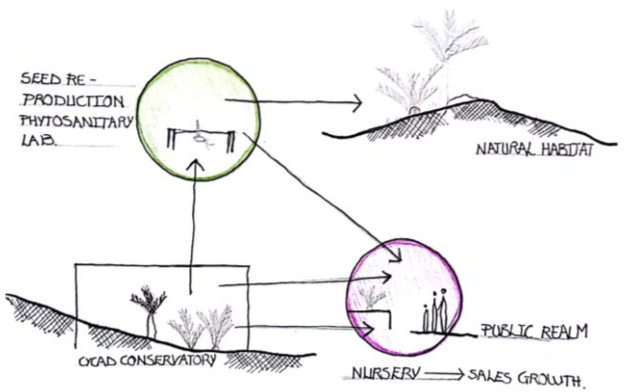


Figure 169: Diagram of Cycad distribution process

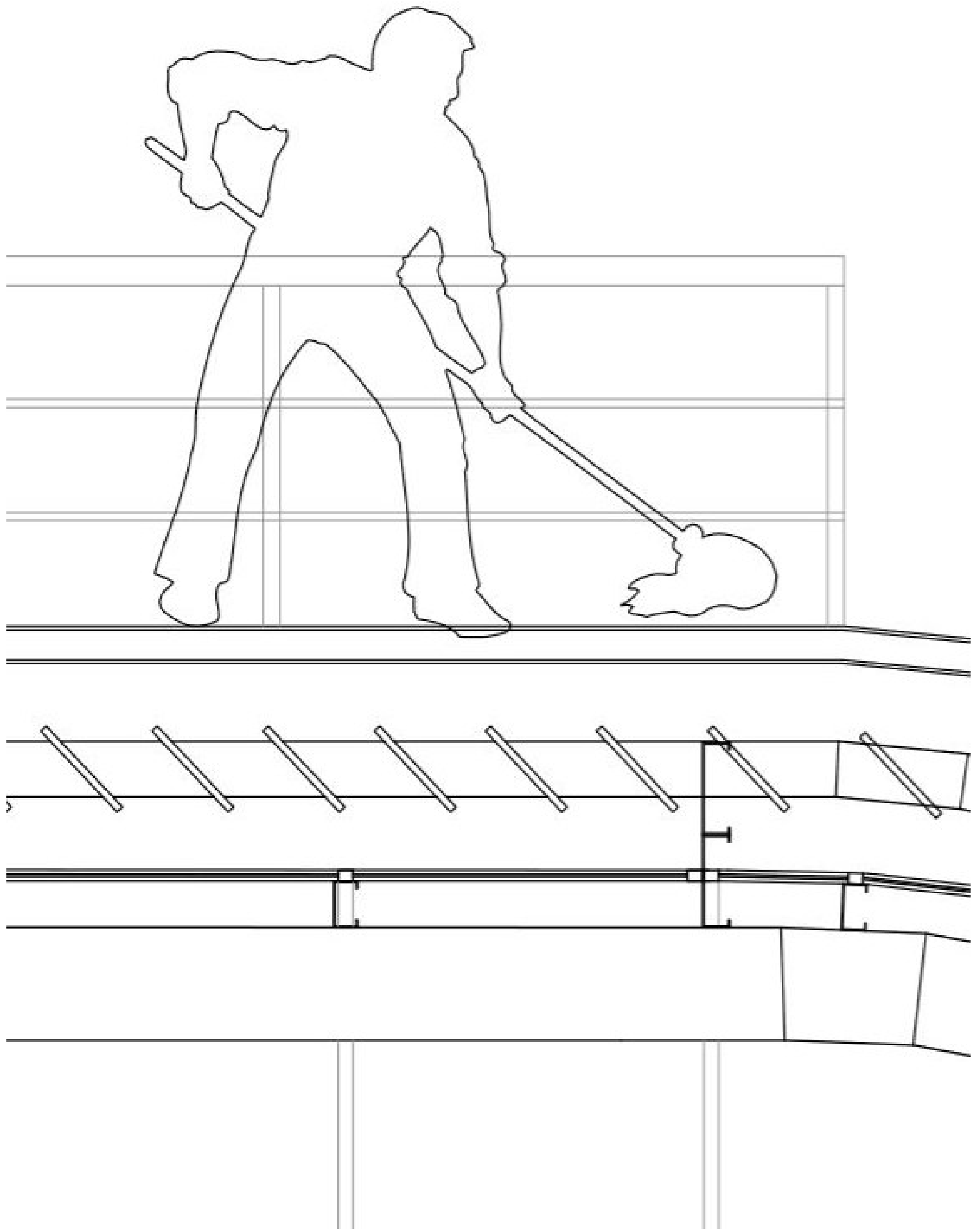


Figure 170: Detail of Cycad conservatory

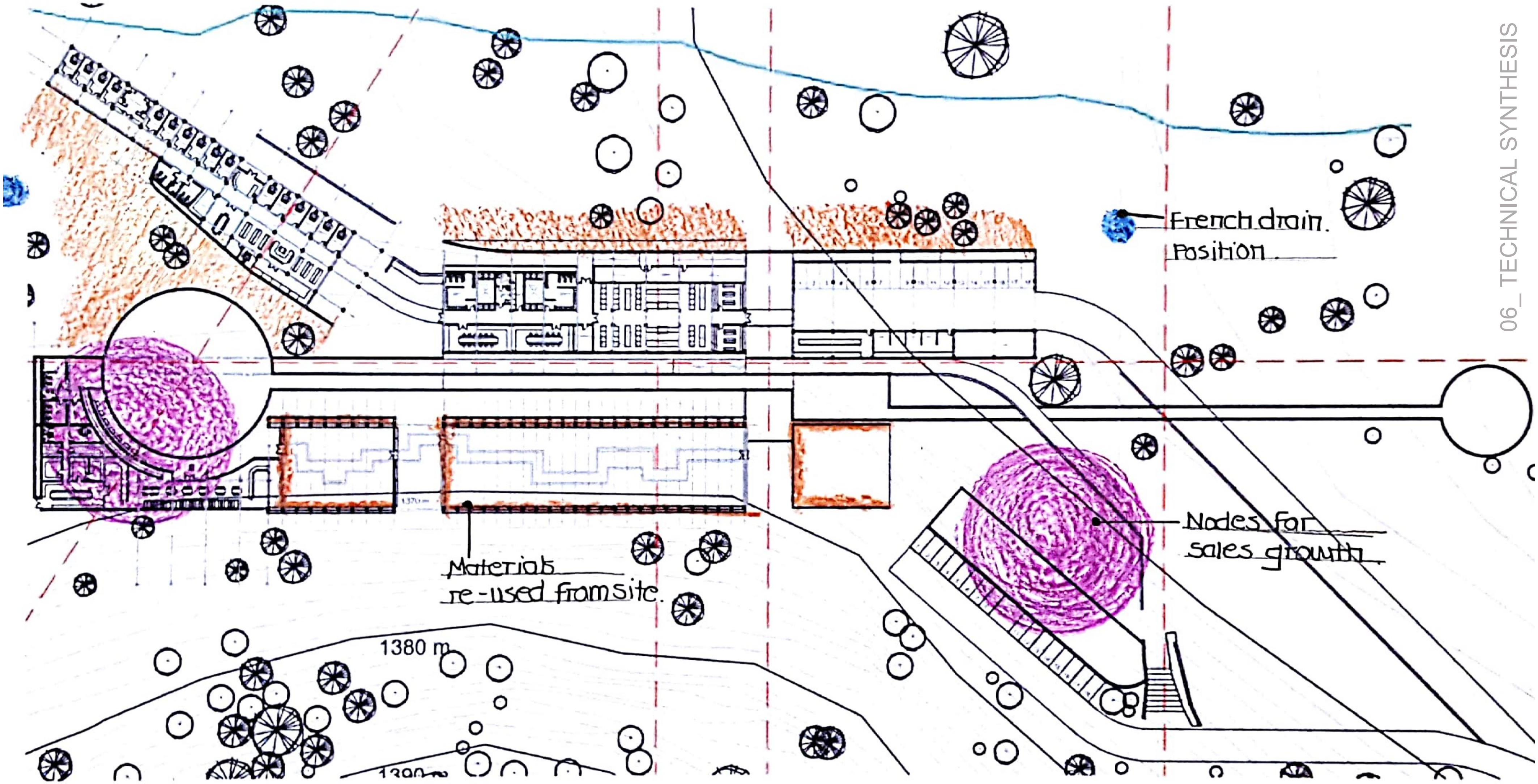


Figure 171: Economical Sustainable aspects on Floor Plan
Scale 1: 1000

6. 4 TECHNICAL ANALYSIS: CYCAD CONSERVATORIES

6.4.1 CONSERVATORY OVERVIEW

The mere definition of a conservatory, also known as a greenhouse or a glasshouse, constitutes the concept of housing nature, that would otherwise not survive in hostile climatic conditions. (Manohar & Igathinathane, 2007:43) In this case, the choice of structural and material compositions is based on decisions specific to the selected South African Cycad species. In general, the functioning purpose of a conservatory, is to allow for the sun's ultraviolet radiation to heat up the interior of the building, during cold winter periods and cool down the building during summer, through the use of passive and active ventilation systems. (Shamshiri, 2006- 2007:8) In view of structural and material use, the design criteria requires' thorough consideration towards energy conservation, in which sufficient transparency in contrast to solar energy is maintained. (Manohar & Igathinathane, 2007:43) This section of the chapter, investigates possible structural elements and materials needed for the conservatory to function optimally in the cultivation of the accommodated cycad species.

6.4.2 STRUCTURAL INVESTIGATION

The structural composition of a conservatory is based on the covering material used, as well as the established objectives and challenges of the type of plant species accommodated, within the unique conditions of the surrounding environment, in terms of climatic and geotechnical conditions (Shamshiri, 2006- 2007:12). In the case of this design project, the overall objective of the conservatory design, is to develop an effective controlled environment within which the growth and reproduction of South African cycads can optimally be cultivated in the climatic conditions of the Free State landscape.

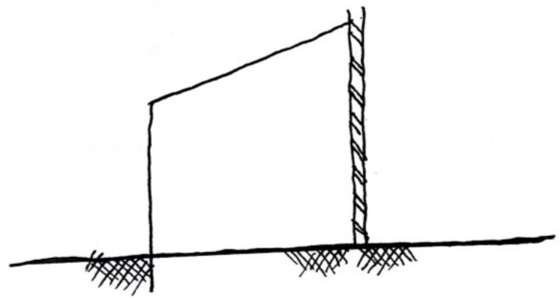
Various types of structural frames are commonly employed to achieve a protected environment for agriculture, each with its own advantages and disadvantages. The following discussions serves as explorations in determining the most appropriate structural frame for the cycad conservatory design. According to Shamshiri (2006-2007:12), there are two types of conservatory styles generally constructed: Firstly, the attached style and secondly, the freestanding style.

i) AN ATTACHED CONSERVATORY

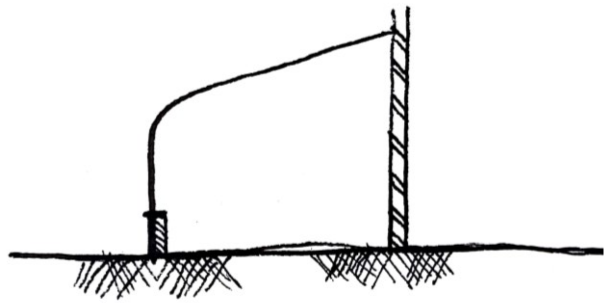
A conservatory designed to structurally co – exist with an adjacent building. This style is particularly useful in situations where space is restricted. The main disadvantage of this style is the restrictions constituted by the existing architecture. It is designed to blend with the surrounding buildings and landscape, and therefore presents restrictions in terms of structural form, height and types of cultivations. (Shamshiri, 2006- 2007:12) Structural forms included in this style are as follows:

a) Straight-side lean-to
b) Curved-side lean-to
c) Slant-side lean-to

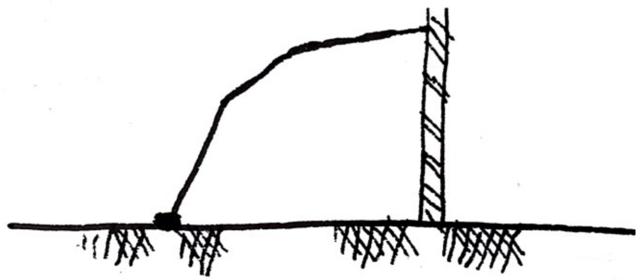
The lean-to structural design of a conservatory entails a structural frame that is placed against an existing structure. The design reduces the requirement of roof supports, as the roof of the existing building is extended with appropriate greenhouse covering material. (Manohar & Igathinathane, 2007:8) This style of construction was not further investigated as the design of this project leans more towards a freestanding conservatory style, which is further investigated in the following discussion, due to the spatial site conditions of the project as well as the height required for accommodating the various cycad species



a) Straight-side lean-to



b) Curved-side lean-to



c) Slant-side lean-to

ii) A FREESTANDING CONSERVATORY

Defined as a conservatory that structurally functions in isolation from its surrounding architectural context. The main advantage of this style is the flexibility offered in terms of structural shape and sizes, site selection and accommodating a large variety of growing situations. The only disadvantage established in this style of construction is the height restriction presented near the side walls of the conservatory. (Shamshiri, 2006- 2007:12) The various structural forms included in this style are as follows:

d) Quonset

The Quonset frame, in general, entails a pipe frame construction with a flexible covering material, such as polyethylene. It is typically less expensive to construct and useful for covering small isolated areas (Manohar & Igathinathane, 2007:10).

e) Even span

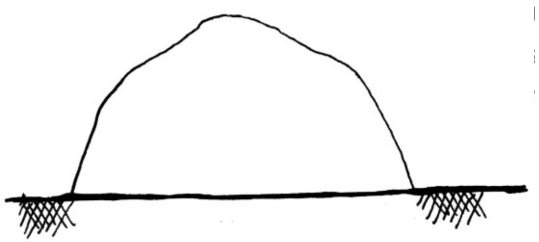
This type of structure, generally entails truss frames consisting of flat steel, tubular steel or angle irons welded together to form a truss, supported by columns, only in the case of wide truss frame greenhouses (Manohar & Igathinathane, 2007:10). It is more efficient to heat or cool and functions better with a rigid covering material, such as plastic or glass, thus increasing the life span of the greenhouse (Shamshiri, 2006- 2007:12).

f) Dome

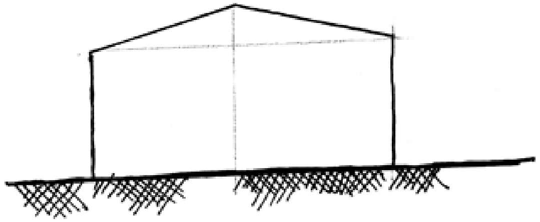
The dome form constitutes an organic – like structure, that has the ability to be completely self-supporting, with no internal supports. Thus, increasing the internal space of a conservatory. It entails a composition of tubular space frames supporting individual transparent panels, glass or plastic, in the form of hexagons, pentagons or triangles. (Jordaan, 2007:39) Although the structural look may present itself as unusual, yet attractive, this structural form is challenging to construct and expensive to sufficiently heat or cool (Shamshiri, 2006- 2007:12).

g) A-frame

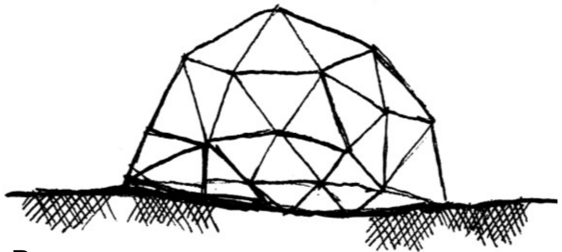
An A-frame structure entails a basic structural composition of two parallel beams angled at 45 degrees, attached at the top by means of a central beam. This structure is easy to construct and inexpensive. It allows for a small usable growing area, but also tends to establish awkward internal spaces (Shamshiri, 2006- 2007:12).



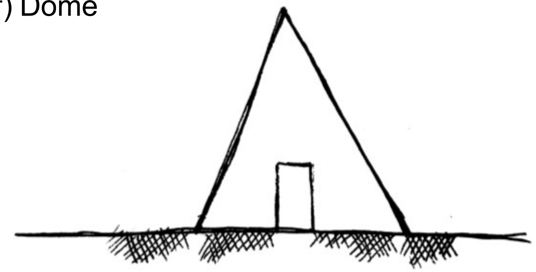
d) Quonset



e) Even Span



f) Dome



d) A-frame

Figure 172: Woodland Greenhouse (Arch Daily, 2014: online)

Figure 173: Gage Park (Mc Callum Sather, 2019: online).

Figure 174: Eden Project (Grimshaw: online).

Figure 175: Notre Dame (Wang, 2019: online).

6.4.3 CONSERVATORY PRECEDENTS

The following precedent studies, serve as an investigation in the previously discussed structural forms of a freestanding conservatory style. The structural philosophy and composition, as well as the materials used in both the structural framework and the conservatory skin will be discussed. Hence, the precedents investigated are as following:

1. Siu Siu Laboratory of Primitive senses, set in Taiwan and designed by Divooe Zein Architects (Figure 172).
2. Gage Park Greenhouse, designed by Mc Callum Sather Architects in Hamilton, Ontario (Figure 173).
3. Sir Nicholas Grimshaw explores the notion of efficiency in the design of a series of conservatories, called the Eden project, in Cornwall, UK (Figure 174).
4. After the devastating fire at Notre Dame Cathedral in Paris, based architects, Studio NAB, proposed the design of a giant greenhouse, replacing the damaged roof of Notre Dame Cathedral (Figure 175).

PRECEDENT | Siu Siu Laboratory of Primitive Senses

Location: Taipei, Taiwan

Architect: Divooe Zein

Year: 2014

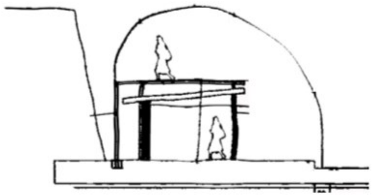


Figure 176: Exterior Façade
(ArchDaily, 2014: online).

Set within a woodland liminal space near Taipei, architectural studio, Divooe Zein explores the environmental transition between the built and natural realm (Arch Daily, 2014: online).

The structural philosophy presented in the curved greenhouse structure is an open habitable space, not for human comfort but for nature and stray animals to settle. Hence, the structural composition entails a steel and timber framework, covered with a permeable screen, that allows for sunlight and ventilation to filter throughout the space (Mairs,2015: online). The structure itself, does not embody a state of permanence, but instead impermanence, as it allows nature to invade and settle within and around the architecture (Refer to chapter 2 for full analysis).

PRECEDENT | Gage Park Greenhouse

Location: Hamilton, Ontario

Architect: Mc Callum Sather

Year: 2019

Figure 177: Internal structure
(Mc Callum Sather, 2019: online).

The recently constructed Gage Park Greenhouse acts as a cultural focal point in Hamilton, supporting the need for knowledge on natures hidden wonders (Mc Callum Sather, 2019: online).

The design's structural philosophy is to pay tribute to the park's historical landmarks, such as the previously demolished teak greenhouse, from the 19th century (Mc Callum Sather, 2019: online). Therefore, the design embraces a structural combination between pre – engineered steel components and curved glulam ribs (Wager, 2019: online). Furthermore, the structure is encompassed by two envelopes, consisting of transparent Lexan polycarbonate sheeting, covered with shade cloth for the purpose of reducing the internal temperature during summer periods (Wager, 2019: online).

PRECEDENT | The Eden Project

Location: Cornwall, UK

Architect: N. Grimshaw

Year: 2011

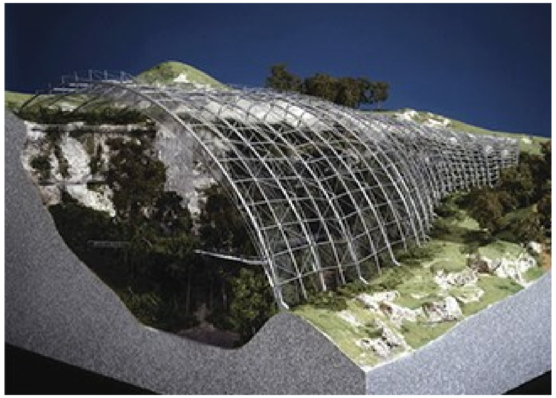


Figure 178: Structural Model (Grimshaw: online)

Engulfed in an 80m deep abandoned quarry, architect, Nicholas Grimshaw designed a series of bubble–like biomes, structured to easily adapt to the site's crumbling clay conditions (Grimshaw, [n.d]: online).

Presenting a structural philosophy of efficiency in both space and material. Each dome consists of a 'hex-tri-hex' space frame comprised by geometric steel components that are light and easily transportable to the site (Stevens, 2016: online). The dome's geodesic shape provides an even distribution of loads to the ground, thus eliminating the need for large concrete footings (Bissegger, 2006: online). Furthermore, the design's efficiency is further intended with an external cladding of high performance ETFE transparent foil cushions, providing maximum surface area and minimum perimeter detailing (Stevens, 2016: online) (Refer to chapter 2 for full analysis).

PRECEDENT | Proposed Greenhouse in Notre Dame Cathedral

Location: Paris, France

Architect: Studio NAB

Figure 179: Project in context (Wang, 2019: online)

Subsequent to the flaming destruction of Notre Dame's roof structure in Paris, design team, Studio NAB proposed to shelter the 856-year-old cathedral with a greenhouse (Wang, 2019: online).

The design intends to act as an inspirational node for education on environmental diversity and harmony within its urban setting. The structural approach aims to re – active the damaged roof of the 13th-century Gothic landmark, by restoring and modernizing its original structural form (Wang, 2019: online). Hence, the structural composition of the greenhouse shadows the original silhouette of the distorted roofline, featuring gold-coloured steel A-frames, enclosed with clear glass panels, to allow for a panorama view of the cityscape (Wang, 2019: online).

6.4.4 MATERIALS

The earliest resemblance of a greenhouse system dates back to the era of Roman emperor Tiberius, where artificial methods were employed to cultivate cucumbers all year-round. Agricultural writers of the era, documented the first known covering materials of the cucumber house, as an oil cloth, identified as 'specularia' or sheets of transparent stone, defined as 'mica' (Shamshiri, 2006-2007:8). By the 19th century, the manufacturing of glass as a construction material became more popular in covering the traditional greenhouse steel structures (EAT, 2007: online). Today, the possibilities of covering materials provides a wide spectrum from flexible polyethylene mesh to high performance ETFE transparent panels.

Central to the following exploration is the key factors influencing material selection in a conservatory's surface design. According to Shamshiri (2006-2007:16), the external envelope of a conservatory serves as a key component in the internal functioning of the cultivated area. It directly impacts plant growth, in terms of the level and type of solar radiation transmitted to the plant canopy, thus conveying an indirect impact on the microclimate of the enclosed space.

For the purpose of this research, the four covering materials (Polyethylene membrane, Polycarbonate sheeting, ETFE foil and glass) identified in the previously discussed conservatory precedents, will be further investigated in terms of their physical properties, such as light transmission, material weight, resistance to impact, durability to outdoor weather and thermal stability. In addition, the advantages and disadvantages of its application in terms of cost and usage life span will conclude the research to selecting an appropriate covering material for the cycad conservatory. With the intention of accommodating South African cycad species from three climatic regions in the Free State's cold interior climate conditions, the following material properties is required to obtain an optimal conservatory habitat for the selected cycads.

- It should have a high light transmittance, to allow for optimal photosynthesis to occur.
- It should reflect or absorb IR radiation, to prevent the conservatory from overheating.
- It should be locally manufactured and maintained, for the purpose of an economically sustainable design.
- It should have a usable life span of 10 to 20 years, to allow for a long enough period where young cycad seedlings can establish themselves without any climatic interruptions.

MATERIAL | Polyethylene Membrane

The notion of a membrane originates from the Latin word 'membrana' and literally means skin or parchment (Moritz, 2004:59) The characteristics central to this type of material, is that it is thin and permeable, allowing for natural ventilation and a light weight (Moritz, 2004:59).

Figure 180: Membrane (ArchDaily, 2014: online).

Polyethylene (PE) is classified as a synthetic thermoplastic, widely manufactured through the process of polymerization to derive chain-like molecule structure, allowing for its flexibility in size and shape (Kattenbach, 2004:41). Polyethylene mesh is typically a knitted fabric exhibiting a thread like structure, consisting of numerous synthetic fibres (Moritz, 2004:59) Commonly used in greenhouse structures, for its ability to disperse loads (Moritz, 2004:59). The polyethylene membrane also cools the internal temperature of a conservatory, when in contact with warm air. Polyethylene, manufactured with Infrared absorbing properties, reduces internal heat gain and loss, whilst maintaining the level of light transmittance (Manohar & Igathinathane, 2007:10).

Offering advantages in low labour and construction costs, due to less structure required, the main disadvantage of this material is its short life span of 2 year (Manohar & Igathinathane, 2007:10).

MATERIAL | Polycarbonate Sheeting

The rigid but also flexible properties of polycarbonate sheeting revolutionized the field of greenhouse structures during the 60's of the 20th century (EAT, 2007: online).

Figure 181: PC Panels (Wager, 2019: online).

Polycarbonate (PC) is classified as a synthetic thermoplastic widely manufactured by means of polycondensation. Plastics derived from this process offers physical properties such as high impact strength and high heat refraction temperature (Kattenbach, 2004:41). When employed in greenhouse structures, a uniform light intensity is provided along with a more cost-effective solution due to its light weight.

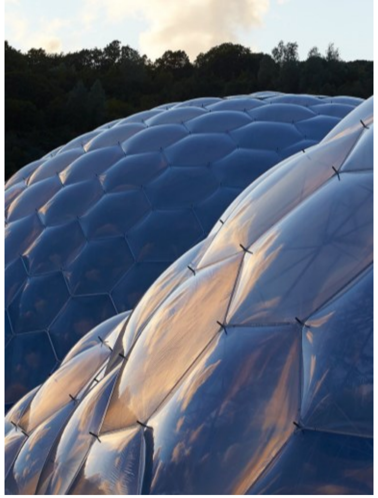
In comparison to glass, the advantage of polycarbonate sheeting is its resistance to breakage, reducing maintenance costs. It also has a usable life span of 10 to 15 years and it often used for its insulation properties, reducing heat transmittance (Manohar & Igathinathane, 2007:14). The major disadvantage is its tendency to harbour algae, when used in greenhouse conditions, resulting in the darkening of panels and thus reducing light transmission (Manohar & Igathinathane, 2007:15).

MATERIAL | ETFE [ethylene tetrafluoroethylene] Foils

Initially designed in the 1930's as an insulation product for the field of aeronautics, Ethylene tetrafluoroethylene (ETFE) recently took to light in the application of building textiles (Kayayci, Avinc & Yavas, 2016: 717).

Ethylene tetrafluoroethylene (ETFE) exhibits the chemical structure of a fluoroplastic, classified as a synthetic plastic, that is engineered during the process of polymerization to derive a chain-like macro-molecule structure (ETFE) with high performance properties, such as resistance to flame or high temperatures (Kattenbach, 2004:41). The manufacturing of EFTE pillows consists of a single or multi membrane layers, that is supported by an aluminium net system, in which each pillow is recurrently pressurized by a small inflation unit (Architen Landrell, 2013:2) (Figure 54 & 55).

The use for application in a conservatory design, such as The Eden Project, is its ability to roughly transmit 85 – 95% light, together with the function of acting as an excellent insulator for solar control performance (Kayayci, Avinc & Yavas, 2016:719). ETFE, is environmentally sustainable in many ways, as it is provided with a 100% recycling ability, it is light in weight, reducing the need for excessive structural support and large foundation footings and has a life span of approximately 50 years (Architen Landrell, 2013:3).



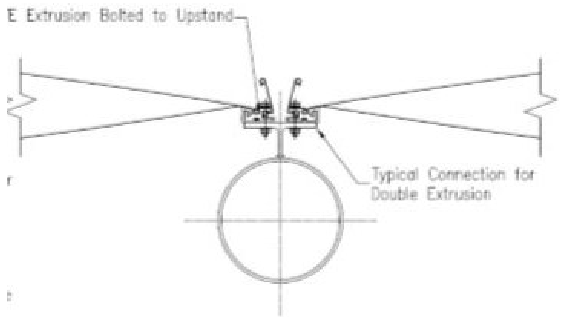


Figure 182 & 183: Detail of EFTE Pillows (Architen Landrell, 2013:2).

Although this material provides promising qualities in the application of architectural designs, for the purpose of this design project, the major disadvantage of EFTE used in South Africa, is that the material is not manufactured locally, thus increasing the cost of application, as it has to be imported. Consequent to the latter, is the requirement for frequent maintenance by a specialized team, from the manufacturer (Texlon: website). In situations, such as power failure, a rapid response is needed from the maintenance team, as the EFTE cushion will only maintain pressure for three to six hours before deflating, in which the possibility for roof damage is increased (Architen Landrell, 2013:3). For these reasons, it is important that the product provider, along with their maintenance team is based in a close proximity to the projects.

MATERIAL | Glass

From a scientific perspective, the word ‘glass’ relates to the concept frozen, it delineates a process whereby supercooled liquid solidifies without crystalizing (Bernhard, Kristina, Tasche & Unnewehr, 2009:11). It is an inorganic fusion product, that exhibits a no crystalline structure, allowing for properties such as transparency and light transmittance without diffusion. (Compagno, 2004:10). In the field of greenhouse construction, glass is commonly known as a traditional glazing material, that has been used prior to the 1950’s.

Glass though fragile, is a strong material when it is used properly and loaded in the correct way. (Manohar & Igathinathane, 2007:45). It provides the advantage of greater light transmittance, as well as a higher air infiltration providing conditions for disease prevention (Manohar & Igathinathane, 2007:45). In the case of the cycad conservatory design, the use of glass is affordable, and has a life span of about 20 years. It is locally manufactured and commonly known in terms of maintenance, thus providing job opportunities to surrounding communities. Furthermore, the high light transmittance and lack of insulation properties provides the opportunity for greater internal variety in climatic conditions, that may be provided with the application of glass together with a shading system. Hence, providing the ability for accommodating all South African cycad species, from various geographic locations.

CASE STUDY | Botanical Conservatory

Location: Kirstenbosch Botanical Gardens, South Africa

Architect: Jullian Elliot

Year: 1996

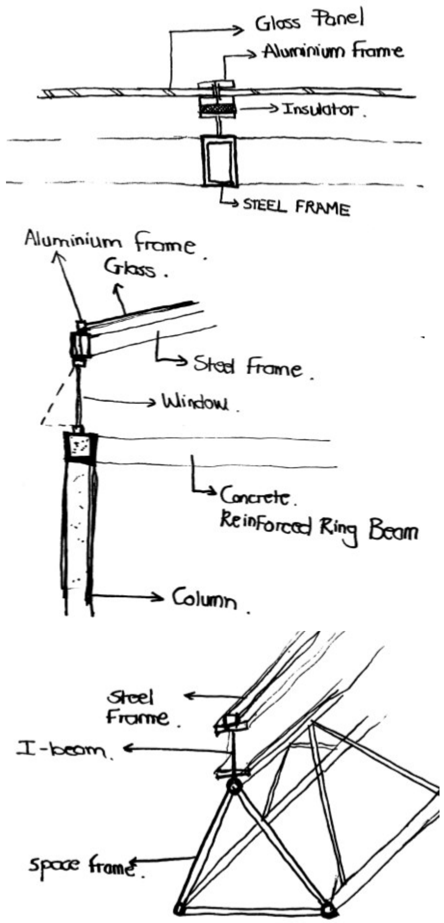


Figure 184: Sketches of glass connections.

Figure 185: Glass conservatory (Photo by Author)

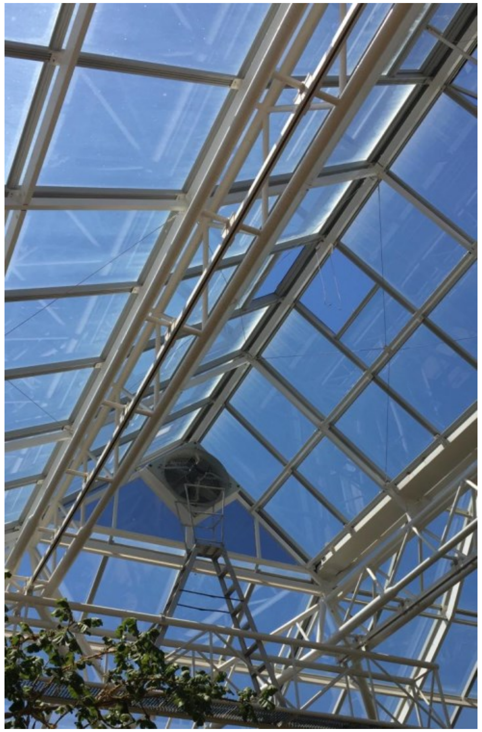


Figure 186: Internal structure (Photo by Author)

6.4.5 CONSERVATORY SERVICES

GREENHOUSE COOLING SYSTEM

The fan-and-pad cooling system has been available since 1954 and is still the most common summer cooling system in greenhouses. Along one wall of the greenhouse, water is passed through a pad that is usually placed vertically in the wall (Shamshiri, 2006-2007:8).

Exhaust fans are placed on the opposite wall. Warm outside air is drawn in through the pad. The supplied water in the pad, through the process of evaporation, absorbs heat from the greenhouse air passing through the pad as well as from the surroundings of the pad and frame, thus causing the cooling effect (Manohar & Igathinathane, 2007: 21) (Figure 187).

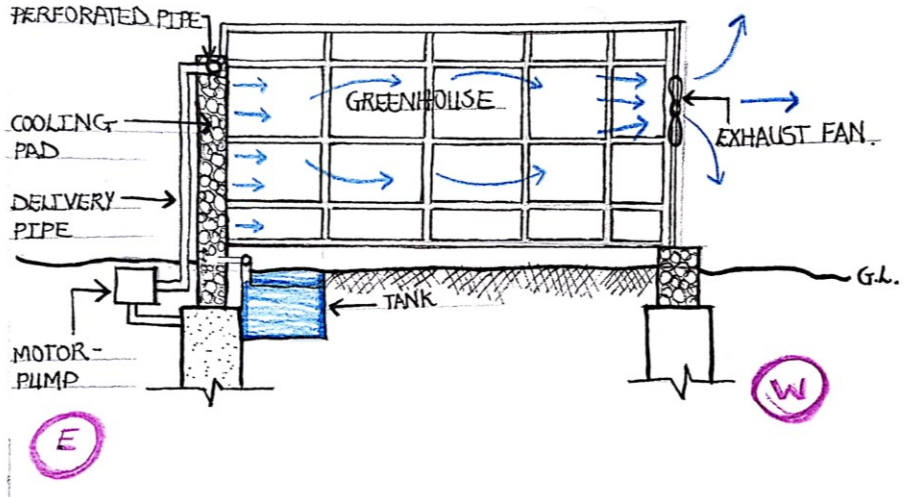
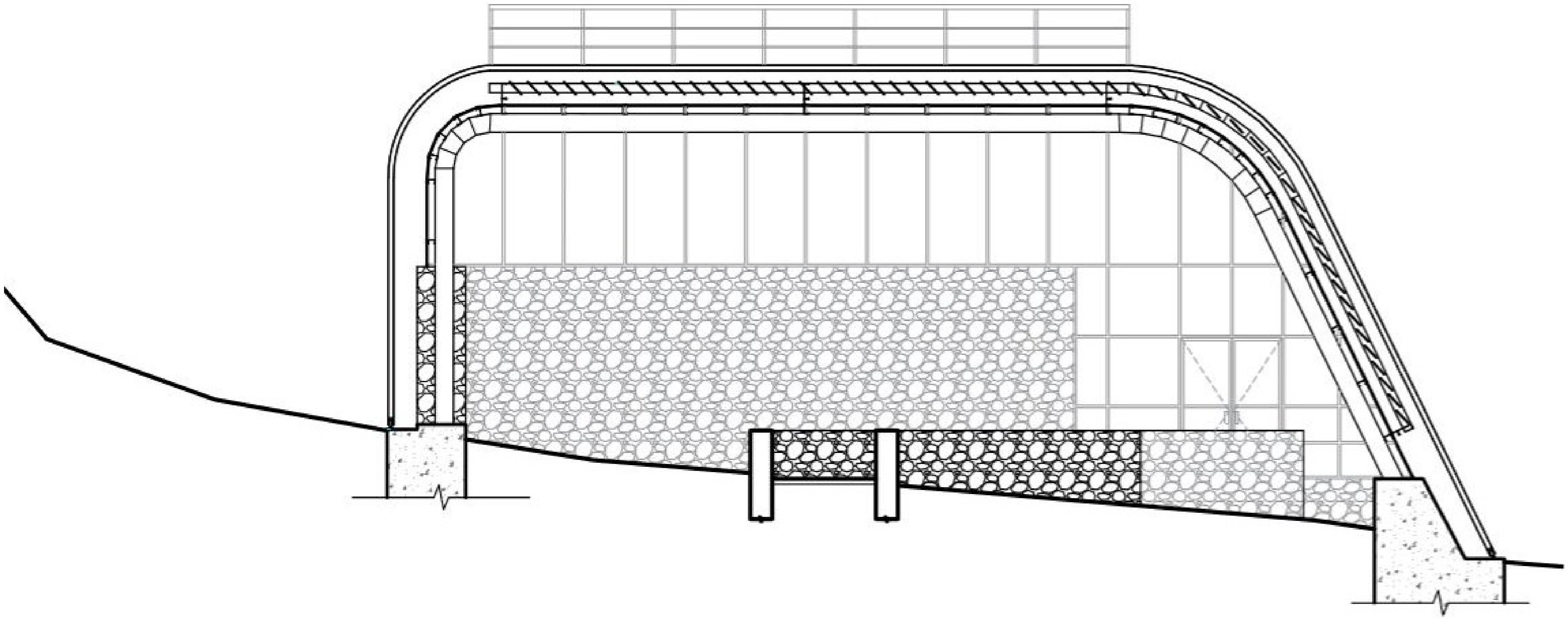


Figure 187: Sketch of Fan and Pad system



Cycad Conservatory Section
Scale 1: 100

6. 5 TECHNICAL ANALYSIS: RESEARCH FACILITIES

6.5.1 WATER HARVESTING

The proposed project is designed to collect rain, that will be reused in the watering of the Cycads. These collection methods includes sub – drainage systems collected from the run-off of the surrounding hard landscaping (Figure 188). Furthermore, rainwater is collected in the catchment of the plenum, which is circulated/ discharged into the surrounding landscape and Cycad conservatories, thus creating a loop system where the water remains in constant motion (Figure 189). This system eliminates the threat of bacteria and fungi growing in motionless water, that may be transferred to the Cycad species. Water discharged from the plenum will assist where possible to supplement the use of borehole water on site (Figure 190).

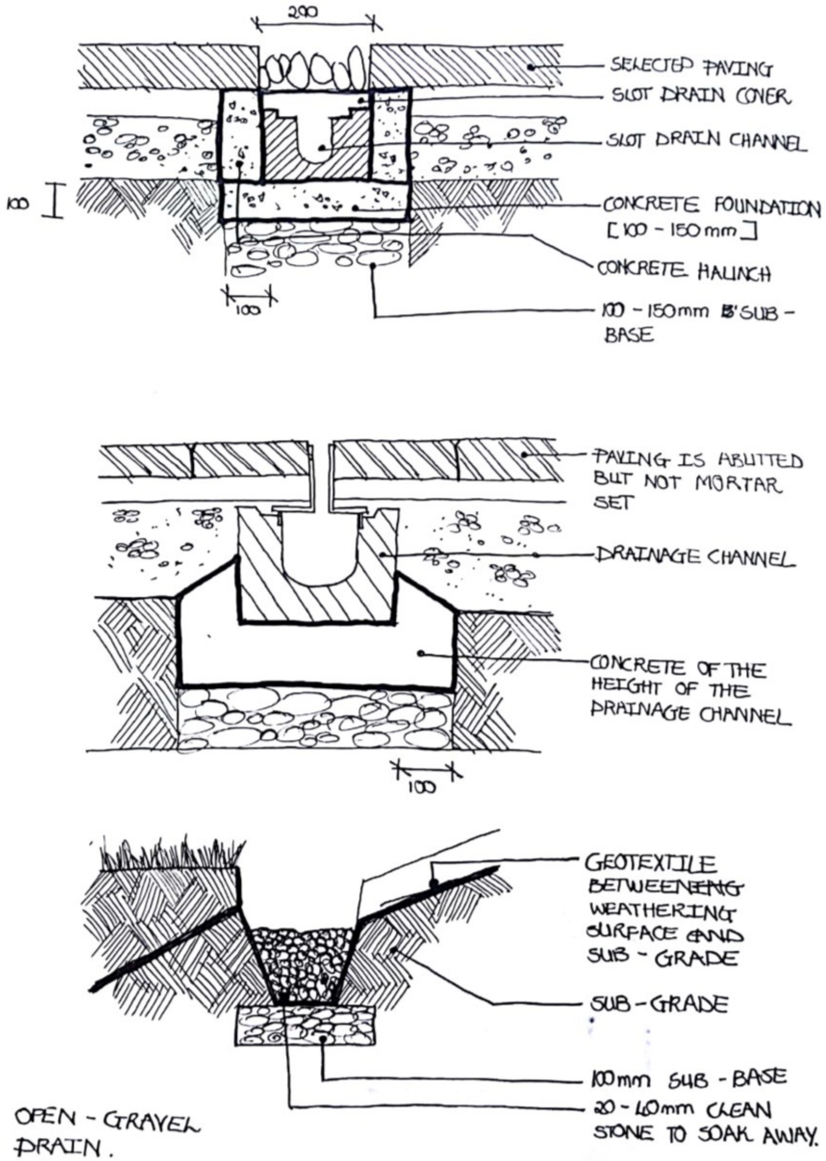


Figure 188: Details of slot drain set below paved level or decorative cobble cover.

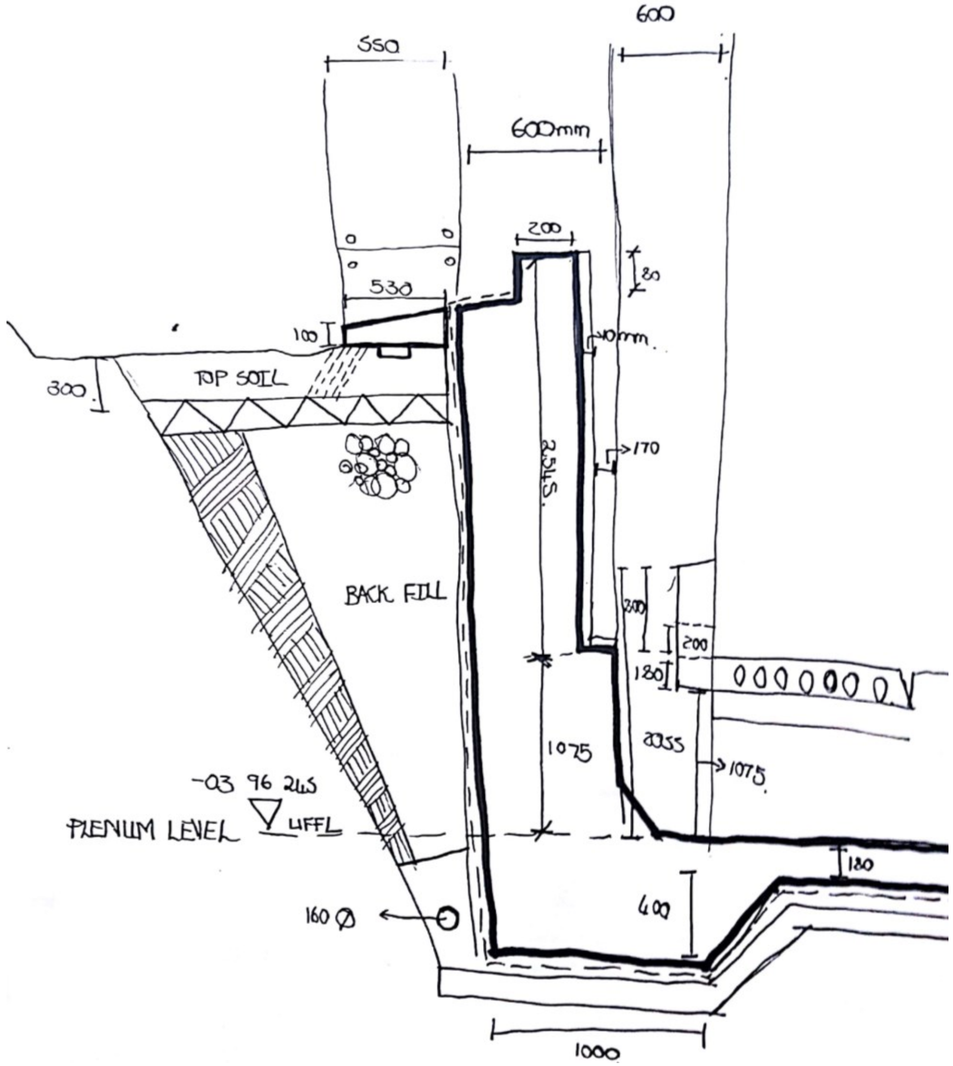


Figure 189: Detail of sub-drainage

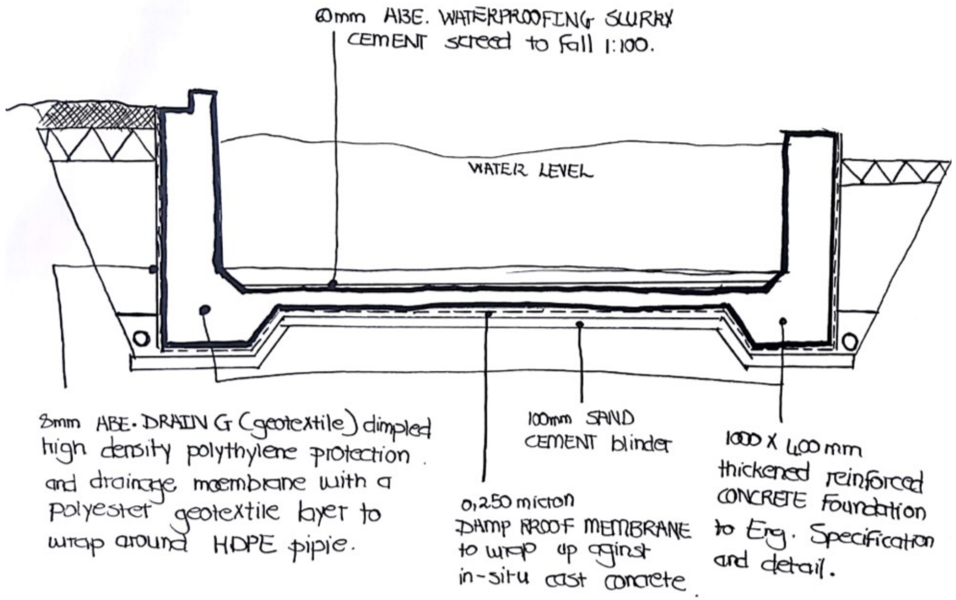


Figure 190: Detail section of plenum

6.5.2 GREEN ROOF

The research and recreational functions of the facility is lowered into the ground, consequently allowing for the landscape to be extended onto the building's roof structure. The proposed project utilises green roofs, to act respectfully towards the existing site's vegetation, by replanting the vegetation on the green roof structure. This sustainable strategy in incorporated to minimize the destructive impact of developing infrastructure in a natural setting. The roof structure also aids in insulating the building and thus, acts as thermal mass during the Free State's hot summers and cold winters. The green roofs consist of a sloped screed, two layers of bitumen waterproof membranes and an anti-root protective geotextile drainage layer (Figure 191).

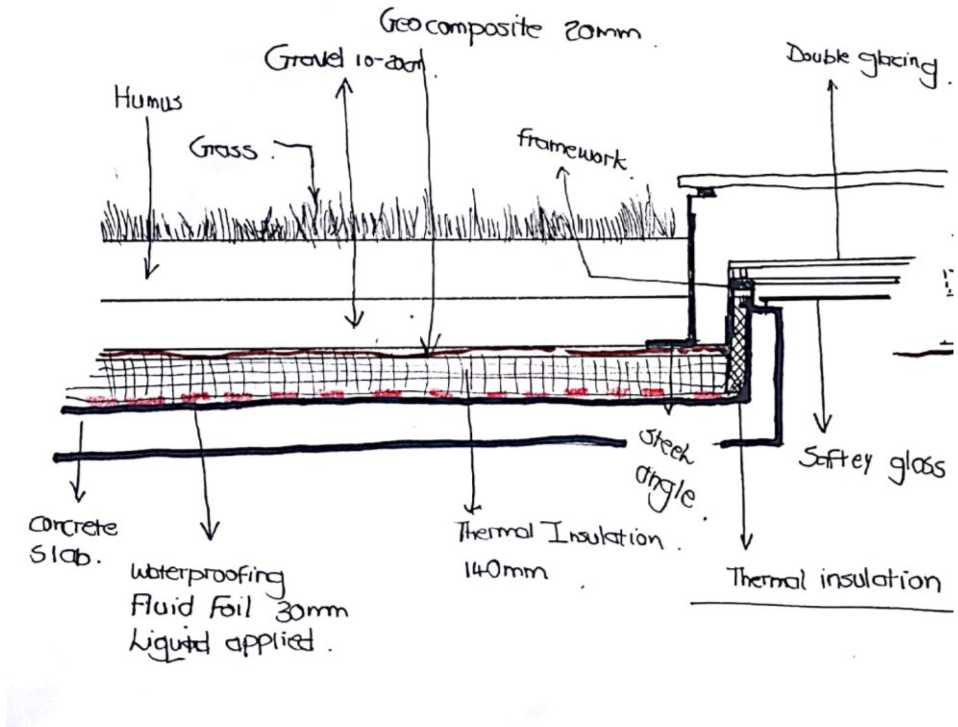


Figure 191: Detail of green roof.

6.5.3 NATURAL LIGHTING

Structural glass in skylights is used to allow natural light to penetrate deeply recessed areas within the building (Figure 191-193). These light shafts protrude above the natural ground level and are assembled using structural glass fins and stainless steel spider brackets. The structural glass consists of 12mm thick PVB laminated glass panels with an OPEL finish, allowing for a softer illumination.

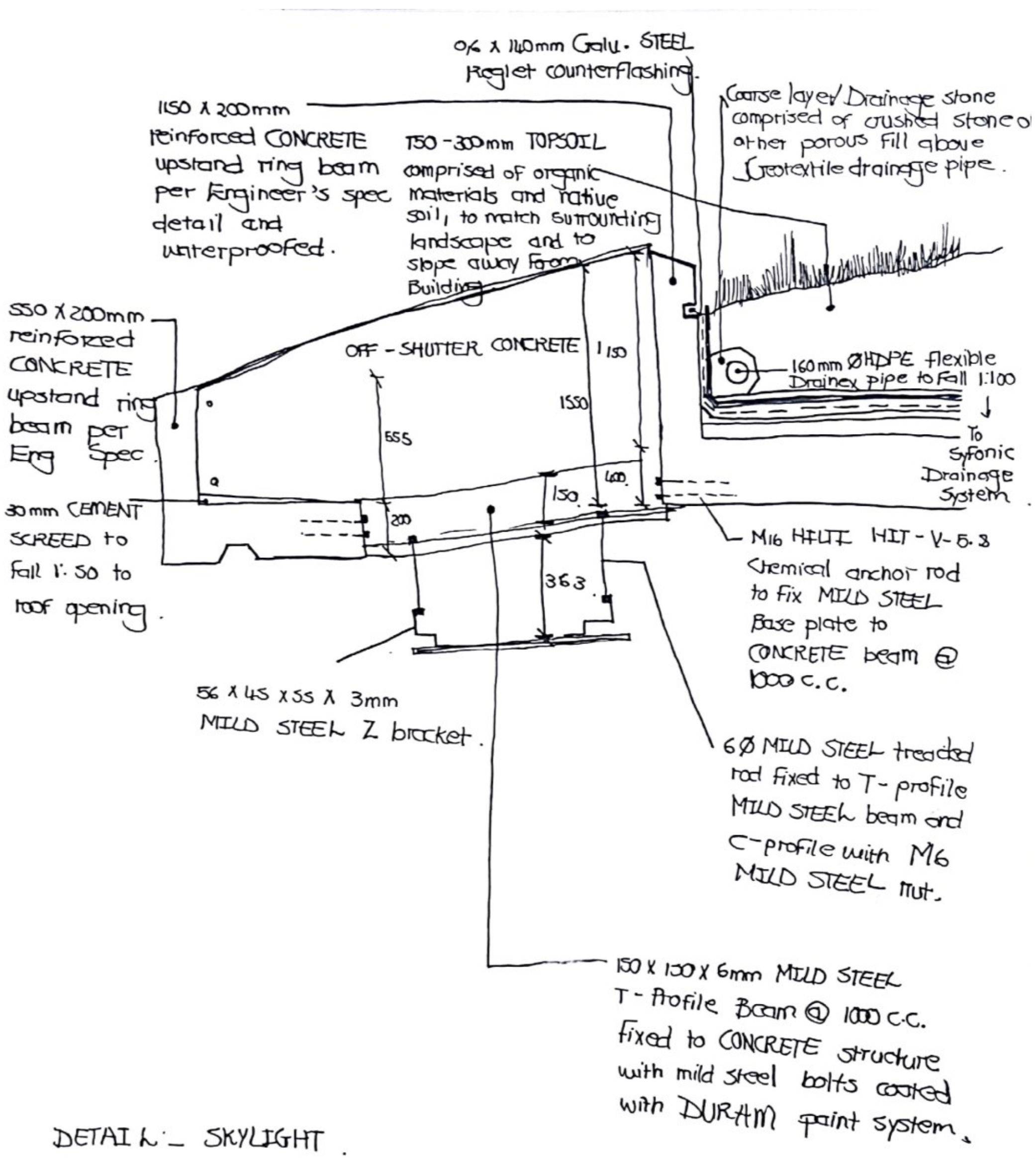


Figure 192: Detail of Skylight in green roof.

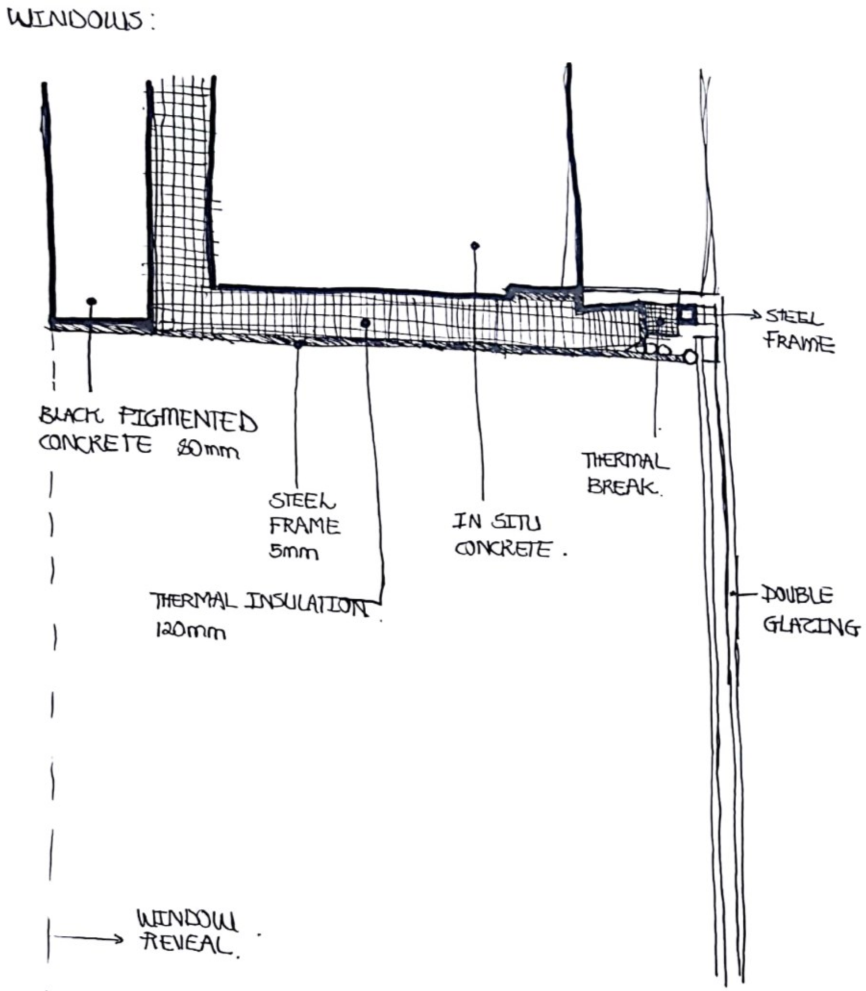
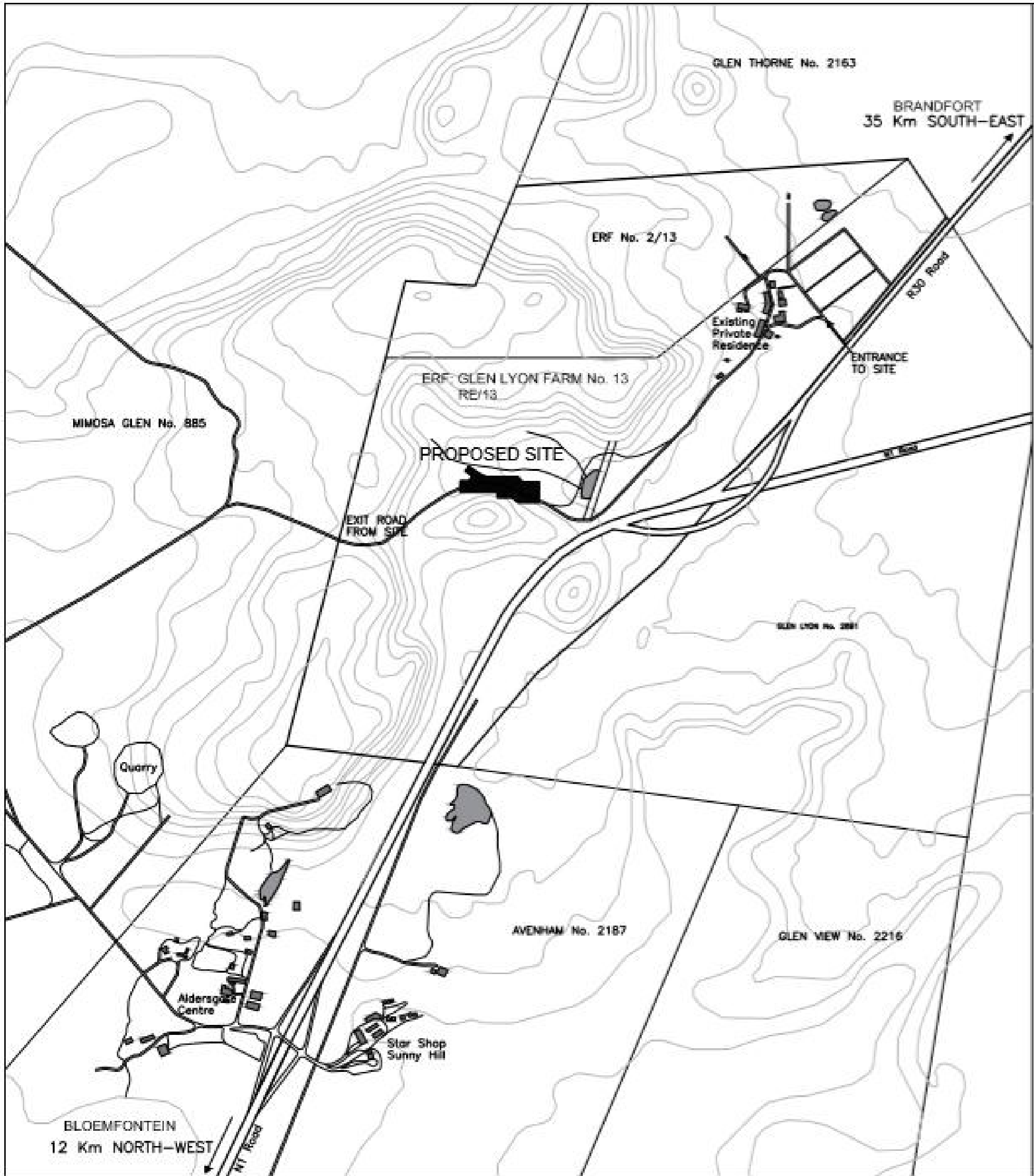


Figure 193: Detail of window.

TECHNICAL DRAWINGS

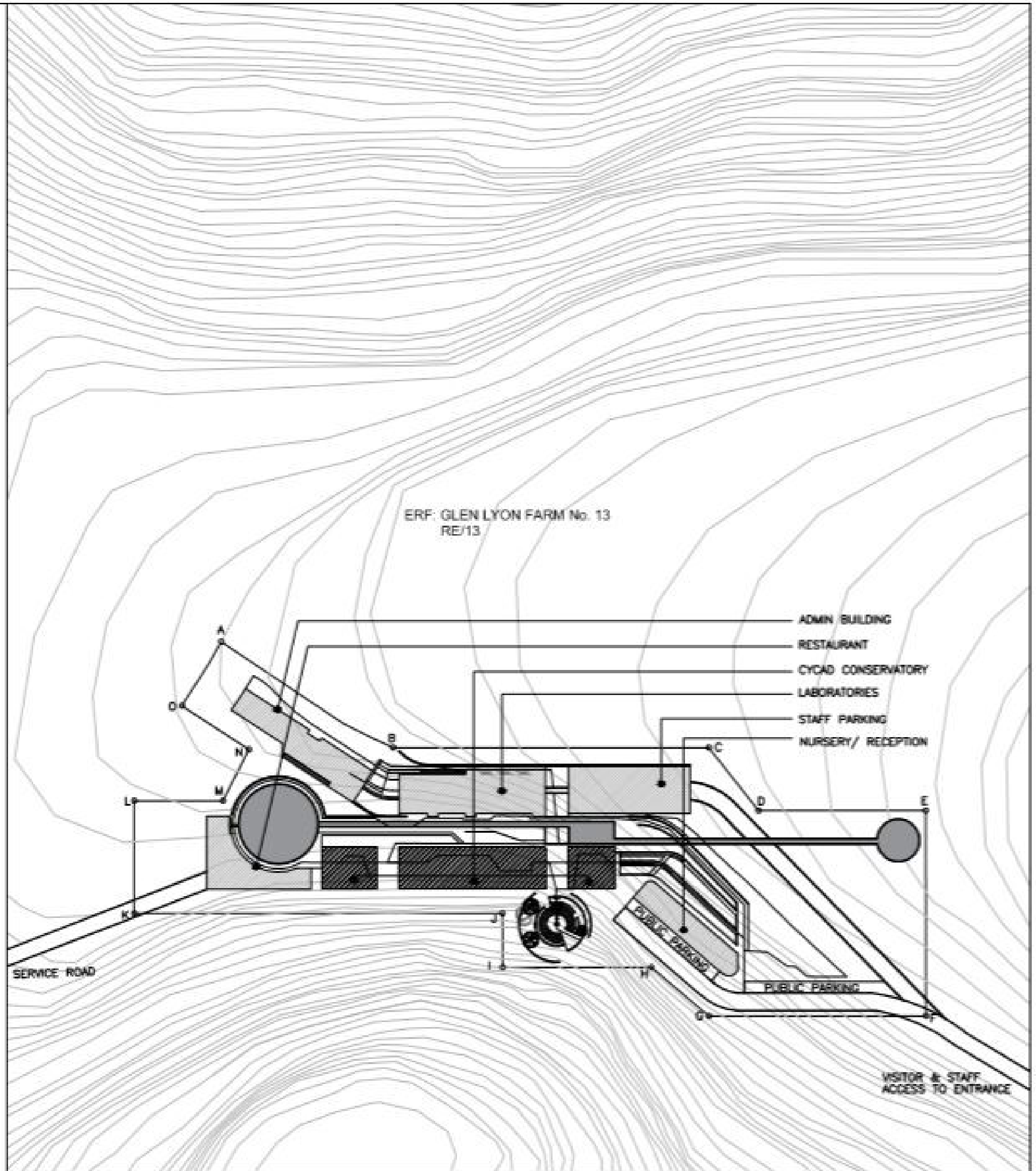


LOCALITY PLAN
SCALE: 1:10 000

N

LEGEND

Project Boundary Line		Main Tar Road		Existing Infrastructure	
Other Boundary Line		Informal Dirt Road		Water Body	



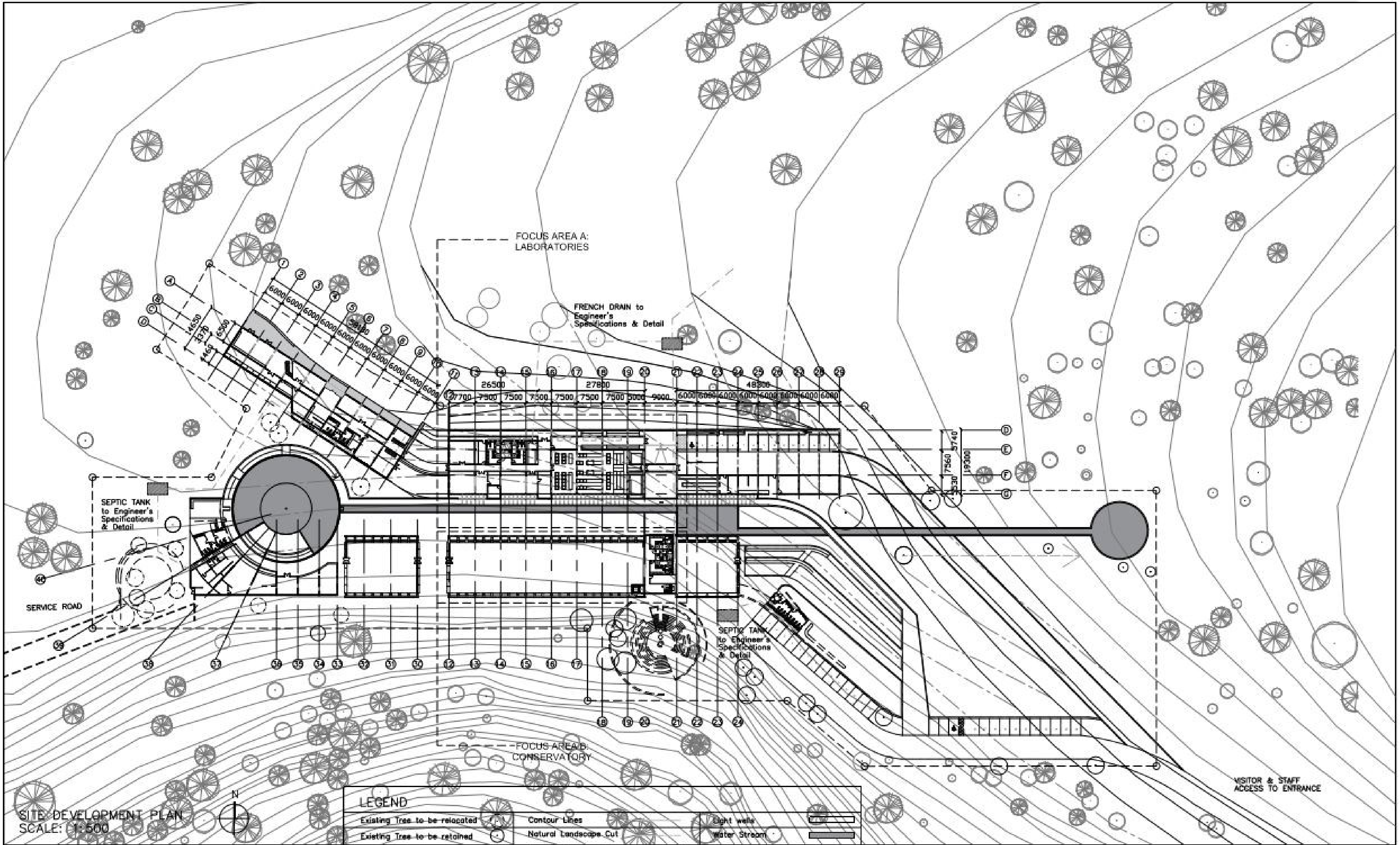
SITE PLAN
SCALE: 1:1000

N

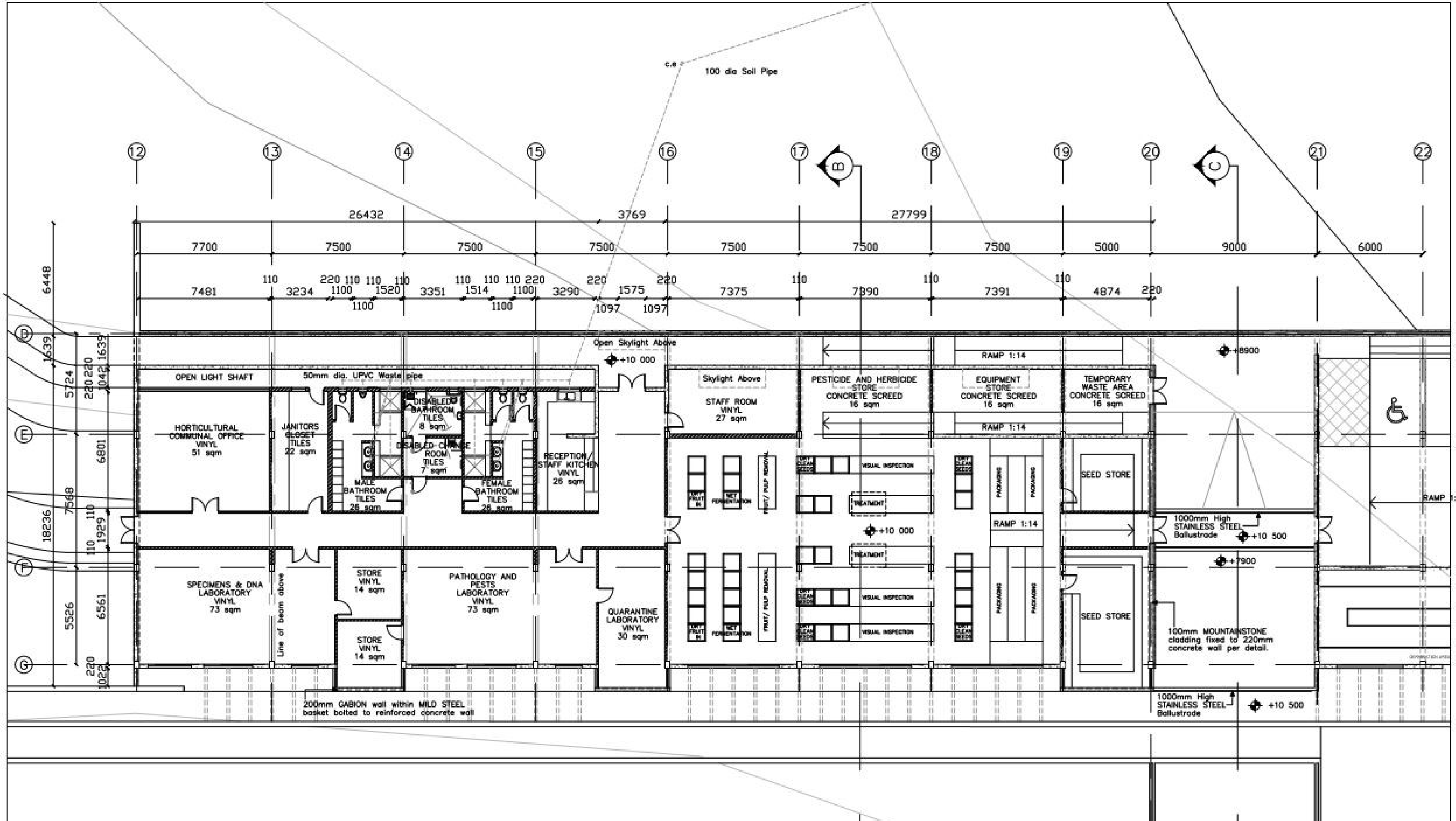
LEGEND

Building semi-below ground		Vehicle Access Route		Light wells	
Exposed Building above ground		Pedestrian Pathway		Water Stream	

PROJECT: Proposed Cycad Conservation Center	DRAWING TITLE: Locality & Site Plan	DRAWN: Minette Coertzen	STUDENT NUMBER: 2012031692
LOCATION: Glen Lyon Farm, Free State	SCALE: 1:10 000 & 1:1000	DRAWING NO: 01	PLOTTED ON: 28 October 2019
Rev / Date / Description	AREAS:	DATE: 29 October 2019	Rev: A
	Erf –		
	Lower Floor –		
	Upper Floor –		



PROJECT: Proposed Cycad Conservation Center			DRAWING TITLE: Site Development Plan	DRAWN: Minette Coertzen	STUDENT NUMBER: 2012031692
LOCATION: Glen Lyon Farm, Free State			SCALE: 1:500	DRAWING NO: 02	PLOTTED ON: 28 October 2019
Rev	Date	Description	AREAS:	DATE: 29 October 2019	Rev: A
			Erf –		
			Lower Floor –		
			Upper Floor –		



FOCUS AREA A_LABORATORY LOWER GROUND FLOOR
SCALE: 1:100

PROJECT: Proposed Cycad Conservation Center		DRAWING TITLE: LOWER GROUND FLOOR PLAN	DRAWN: Minette Coertzen	STUDENT NUMBER: 2012031692
LOCATION: Glen Lyon Farm, Free State		SCALE: 1:100	DRAWING NO: 03	PLOTTED ON: 28 October 2019
Rev	Date	Description	AREAS:	DATE: 29 October 2019	Rev: A
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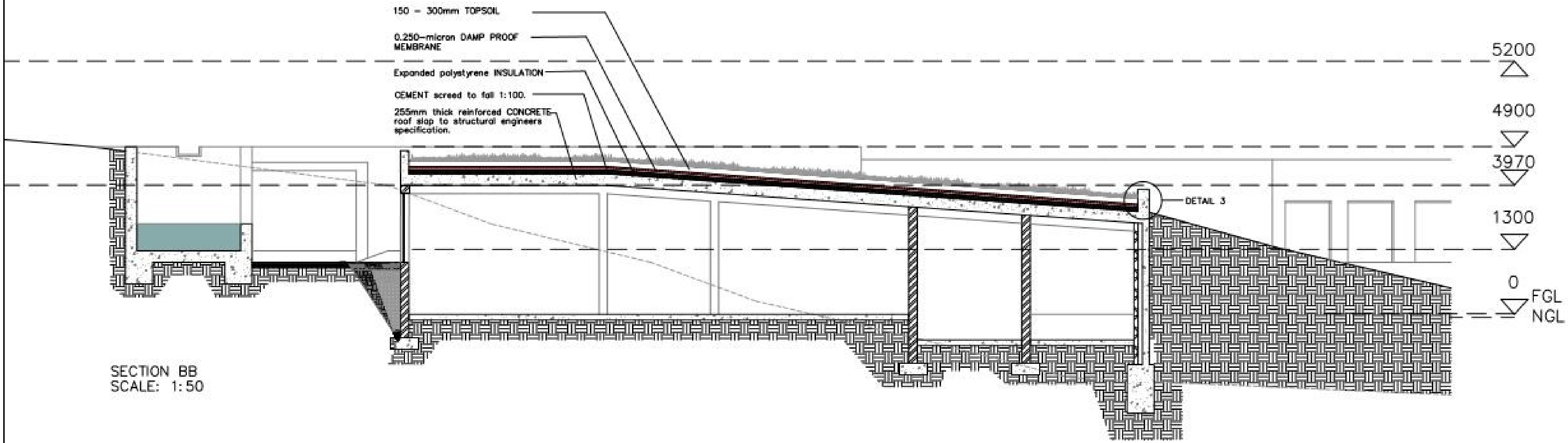
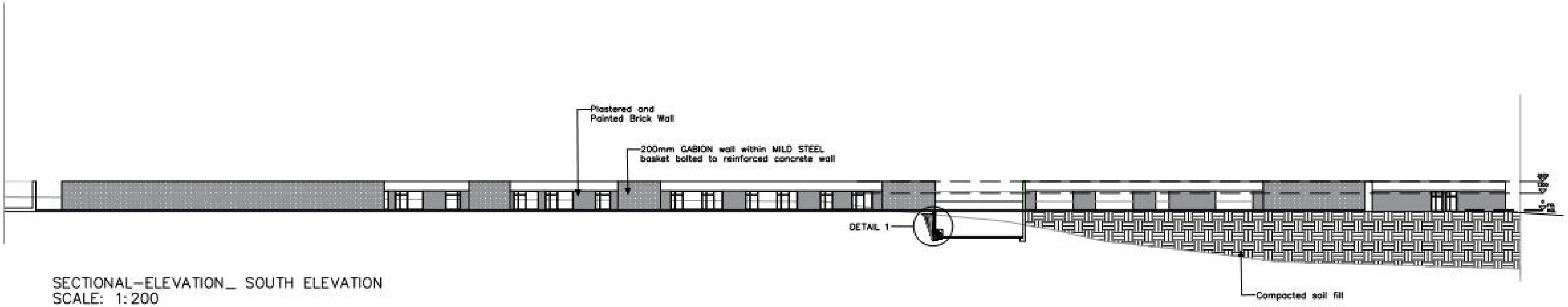
			Lower Floor –		
			Upper Floor –		

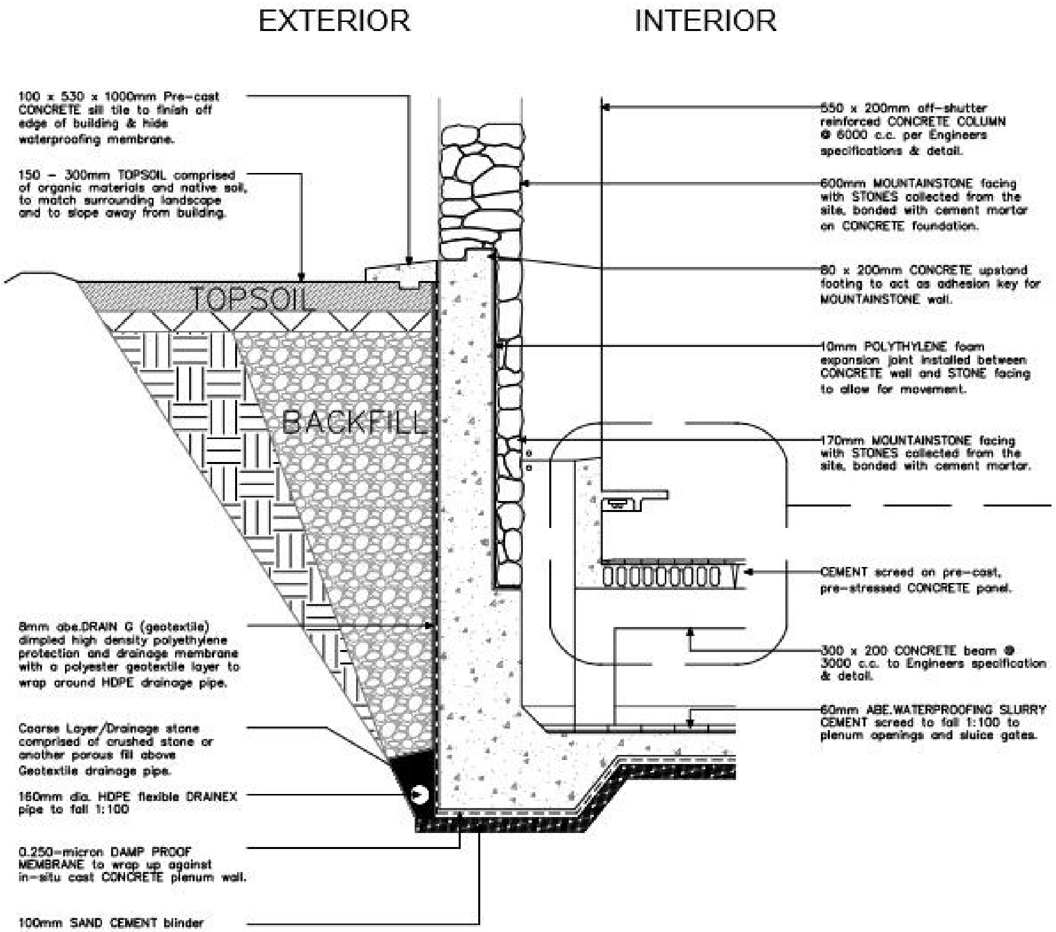


SECTION BB
SCALE: 1:50

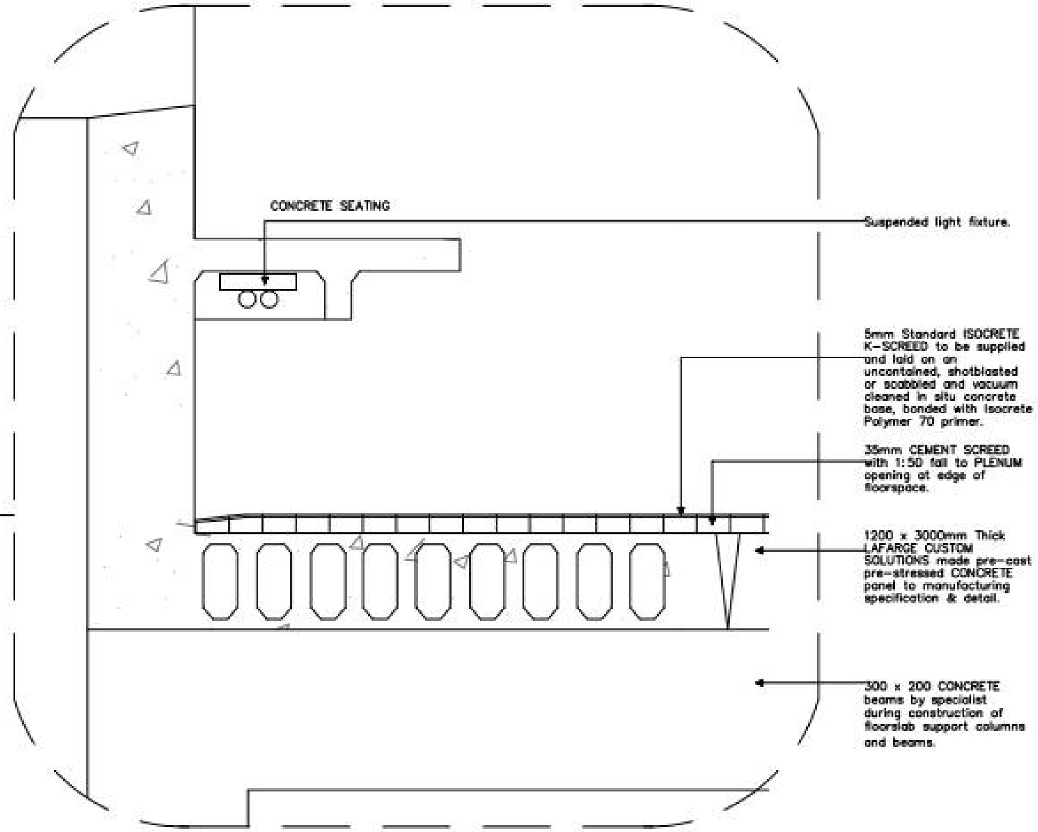


SECTIONAL–ELEVATION_ SOUTH ELEVATION
SCALE: 1:200

PROJECT: Proposed Cycad Conservation Center			DRAWING TITLE: Section & Elevation	DRAWN: Minette Coertzen	STUDENT NUMBER: 2012031692
LOCATION: Glen Lyon Farm, Free State			SCALE: 1:50 & 1:200	DRAWING NO: 04	PLOTTED ON: 28 October 2019
Rev	Date	Description	AREAS:	DATE: 29 October 2019	Rev: A
			Erf –		
			Lower Floor –		
			Upper Floor –		

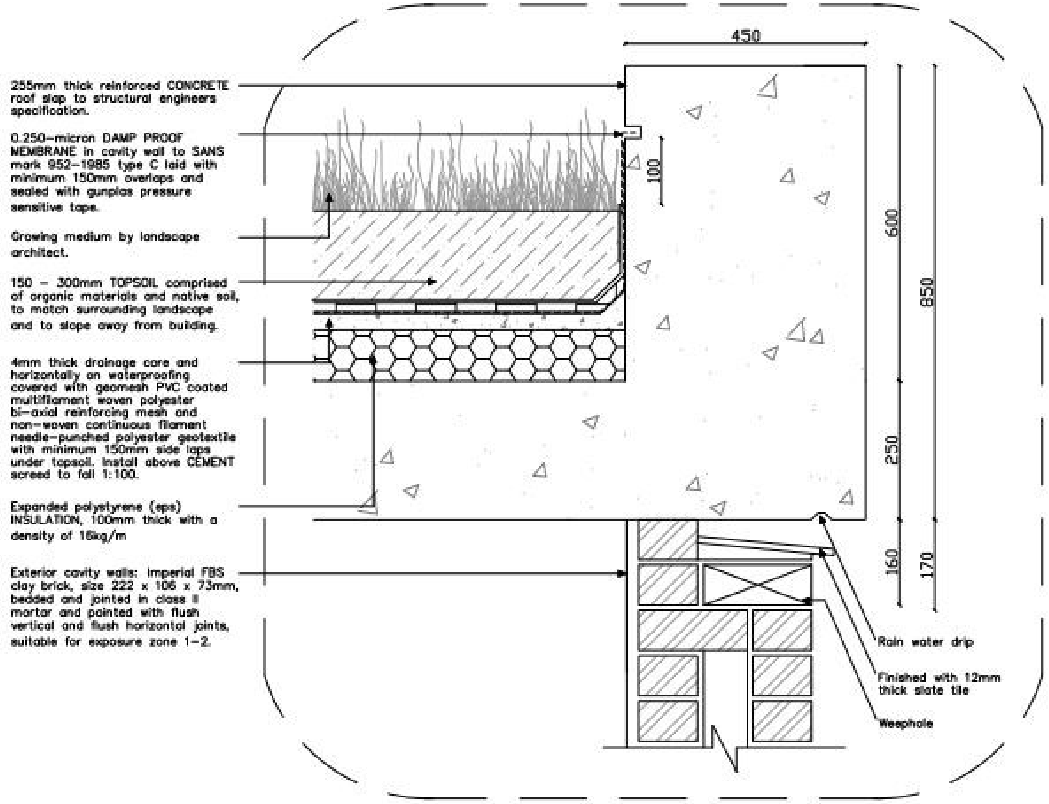


DETAIL 1_DRAINAGE
SCALE: 1:20

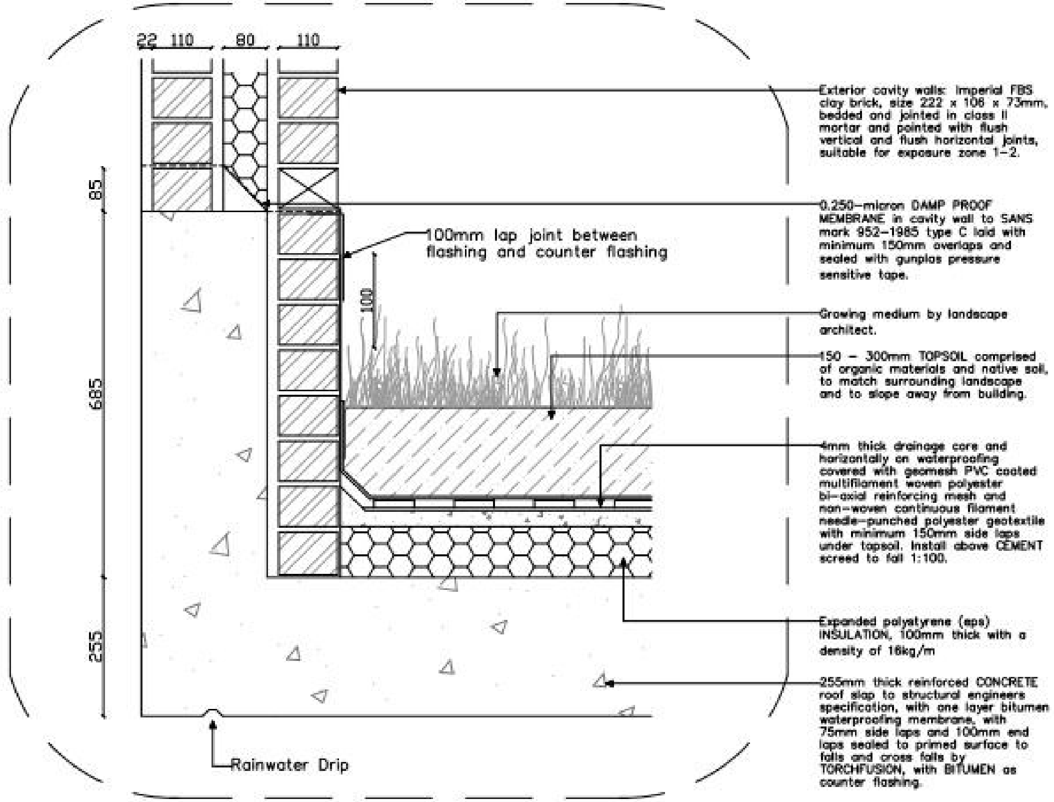


DETAIL 2_SEATING
SCALE: 1:5

PROJECT: Proposed Cycad Conservation Center			DRAWING TITLE: Details	DRAWN: Minette Coertzen	STUDENT NUMBER: 2012031692
LOCATION: Glen Lyon Farm, Free State			SCALE: 1:20 & 1:5	DRAWING NO: 05	PLOTTED ON: 28 October 2019
Rev	Date	Description	AREAS:	DATE: 29 October 2019	Rev: A
			Erf –		
			Lower Floor –		
			Upper Floor –		



DETAIL 3_GREEN ROOF
SCALE: 1:5



DETAIL 4_GREEN ROOF
SCALE: 1:5

PROJECT: Proposed Cycad Conservation Center			DRAWING TITLE: Details	DRAWN: Minette Coertzen	STUDENT NUMBER: 2012031692
LOCATION: Glen Lyon Farm, Free State			SCALE: 1:5	DRAWING NO: 06	PLOTTED ON: 28 October 2019
Rev	Date	Description	AREAS:	DATE: 29 October 2019	Rev: A
			Erf -		
			Lower Floor -		
			Upper Floor -		

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ANNEXTURE A

1. Stangeria eriopus

Common Name: Stranger's Cycad

Distribution: Eastern Cape and Natal

Status: Vulnerable

Cultivation: Stangeria eriopus is frost tender and responds well to ample moisture and light shade. Cultivation in the Free State's climate occurs under greenhouse conditions.

Height: 2m

Threats:

The Natal grass cycad has been seriously depleted in parts of its natural range by the extension of agriculture and forestry.

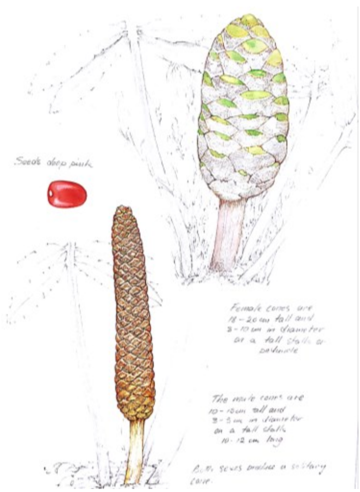


Figure: Stangeria eriopus (Goode, 1984:24)

Giddy, C. 1984. Cycads of South Africa. Cape Town: Struik Winchester.

Goode, D. 1984. Cycads of Africa. Cape Town: Struik Winchester

2. Encephalartos ghellinckii

Common Name: Drakensberg Cycad

Distribution: Natal

Status: Vulnerable

Cultivation: Encephalartos ghellinckii is a frost-hardy species that should be grown in a shady position with a cool, moist root run, in a slightly acidic soil mixture.

Height: 4m

Threats:

Many of these specimens have stems blackened by veld fires, and it seems that fire may simulate the production both of new leaves and of cones. Veld fires in the habitat of the Transkei form are so frequent and so intense that the leaf – base scar pattern of the stems of the majority of the specimens is burned away completely and is no longer disenable.

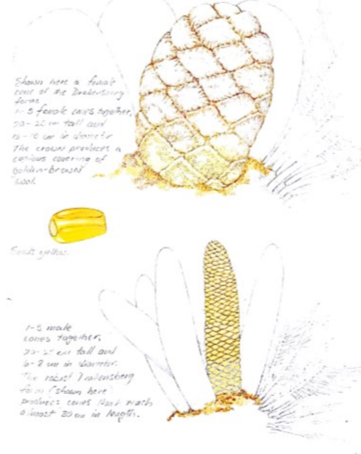


Figure: Encephalartos ghellinckii (Goode, 1984:28)

3. Encephalartos cycadifolius

Common Name: Winterberg Cycad

Distribution: Eastern Cape

Status: Least concern

Cultivation: Encephalartos cycadifolius is a frost-hardy species that requires full sun, along with well-drained and alkaline soil mixtures.

Height: 2,4m

Threats:

During a prolonged draught, these cycads are reproductively dormant. Soon after the rain starts, however, both male and female plants will start to cone. Porcupines are known to enjoy eating the scales of cones that are easy to reach, and they inflict some damage on the stems by gnawing the fleshy 'bark'. It has been suggested that seeding populations are usually to be found only in areas where porcupines are being controlled by the local farmers. When the plants are coning, considerable damage may also be caused by baboons, which break the leaves and snap off young immature cones.

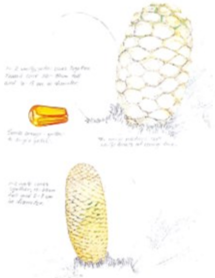


Figure: Encephalartos cycadifolius (Goode, 1984:32)

4. Encephalartos lanatus

Common Name: Olifants River Cycad

Distribution: Transvaal

Status: Near Threatened

Cultivation: Encephalartos lanatus is more challenging to re-establish plant specimens, preferably not larger than 25cm. The wolly stem of the cycad requires frequent moisture, under greenhouse conditions. Furthermore, this species is frost-hardy, but sensitive to dry heat.

Height: 4m

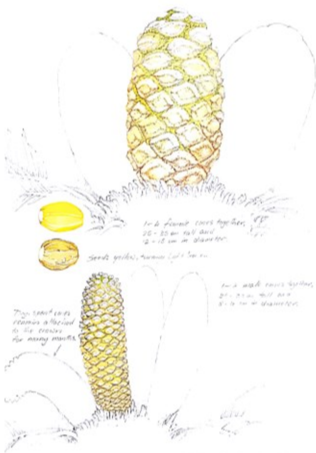


Figure: Encephalartos lanatus (Goode, 1984:36)

5. Encephalartos humilis

Common Name: Dwarf Cycad

Distribution: Eastern Transvaal

Status: Vulnerable

Cultivation: Encephalartos humilis easily grows in cultivation and rarely requires special treatment. It is a grassland species that prefers full sun and adequate moisture.

Height: 0,7m

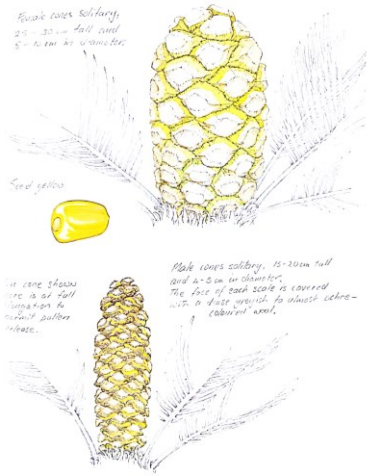


Figure: Encephalartos humilis (Goode, 1984:40)

6. Encephalartos laevifolius

Common Name: Kaapsehoop Cycad

Distribution: Eastern Transvaal

Status: Critically Endangered

Cultivation: Encephalartos laevifolius naturally occurs in the rocky outcrops alongside the Kaapsehoop mountains. This species grows well against a slope in full sun, and is able to survive extreme climatic conditions.

Height: 2,5m

Threats:

A small surviving colony of 30 to 40 plants grows on the very steep slopes. The procumbent, ebony-black stems are clearly subject to scorching fires at regular intervals. Veld fires are fatal to seedling cycads. Also no seedling populations in the habitats of this cycad is found, due to a fungal infection of female cones which prevents them from maturing.

The plants were also damaged by locals, who were using portions of its stem for herbal medicines.

Very recently a fifth locality was discovered , however only three to six strictly protected plants remain here, others have already been removed – apparently illegally – by collectors.

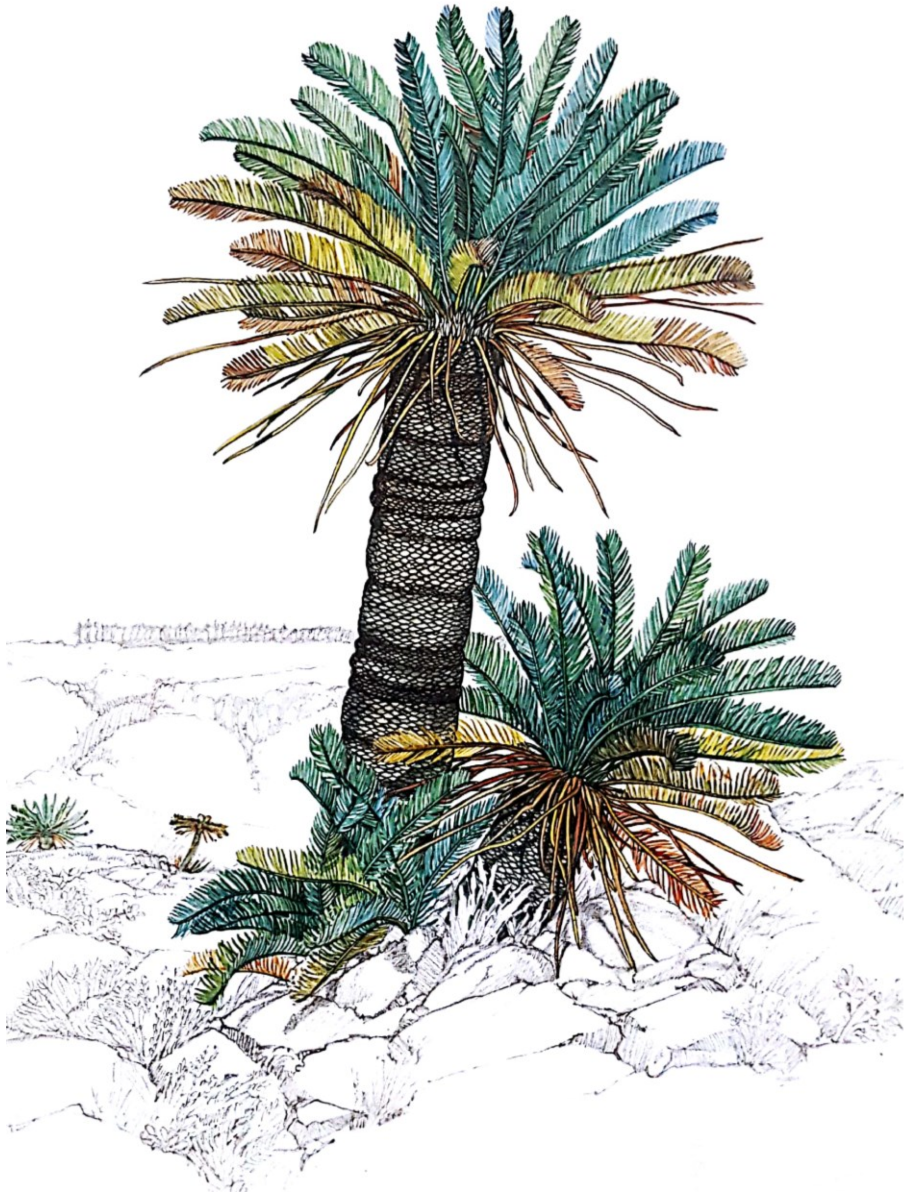


Figure: Encephalartos laevifolius (Goode, 1984:44)

7. Encephalartos friderici - guilielmi

Common Name: White – haired Cycad

Distribution: Eastern Cape

Status: Near threatened

Cultivation: Encephalartos friderici – guilielmi is a frost-hardy species that readily adapts in various climatic conditions. It grows optimally in full sun with good drainage.

Height: 4m

Threats:

The immediate future of this species seems assured if one goes by the large numbers of seedlings present throughout its range. Although it occurs in grassland habitats presumably subject to regular fires there is little evidence of significant damage, perhaps because its stems are hard and compact enough to resist even sever scorching.

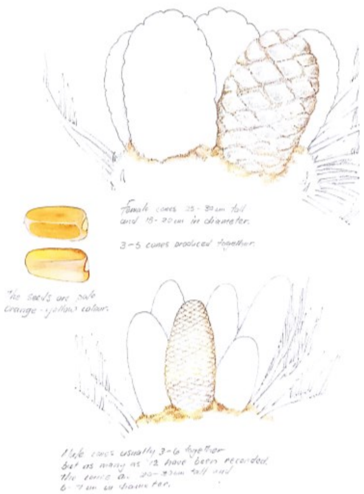


Figure: Encephalartos friderici-guilielmi (Goode, 1984:50)

8. Encephalartos eugene-maraisii

Common Name: Waterberg Cycad

Distribution: Transvaal

Status: Endangered

Cultivation: Encephalartos eugene-maraisii is a frost hardy species that grows optimally in full sun. Therefore, this species will do well in the Free State's climate conditions.

Height: 5,5m

Threats:

Baboons are common in the areas where this species occurs and large troops can often be seen foraging among erect and procumbent specimens. Fortunately, they take little or no interest in the surrounding cycads except for the occasional breaking of a cone out of curiosity. In recent years, however, there has been little evidence of successful natural regeneration, and a restocking programme is now in progress.

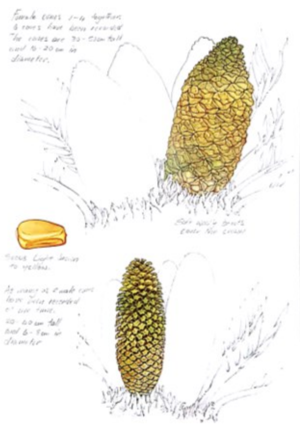


Figure: Encephalartos eugene-maraisii (Goode, 1984:58)

9. Encephalartos middelburgensis

Common Name: Middelburg Cycad

Distribution: Transvaal

Status: Critically Endangered

Cultivation: Encephalartos middelburgensis naturally occurs in the valleys of the Olifants River in the Middelburg and Witbank districts. The natural habitat occurs in hot summers and cold winters, with frequent frost occurring.

Height: 6m

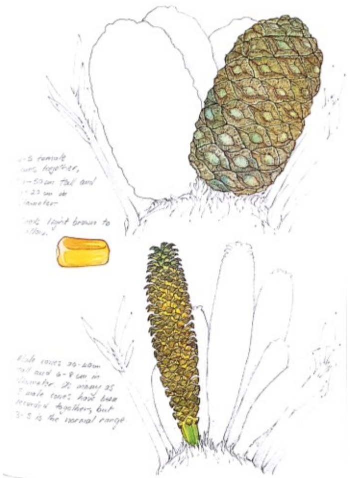


Figure: Encephalartos middelburgensis (Goode, 1984:62)

10. Encephalartos dolomiticus

Common Name: Wolkberg Cycad

Distribution: Transvaal

Status: Critically Endangered

Cultivation: Encephalartos dolomiticus naturally occurs within a grassland habitat and is securely situated next to large outcrops of dolomite rock. This species requires full sun and good drainage.

Height: 2m

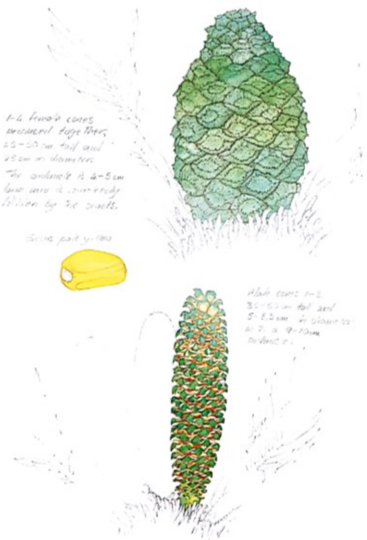


Figure: Encephalartos dolomiticus (Goode, 1984:66)

11. Encephalartos dyerianus

Common Name: Lillie Cycad

Distribution: Transvaal

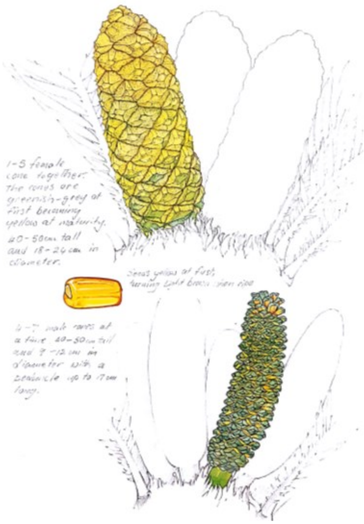
Status: Critically endangered

Cultivation: Encephalartos dyerianus grows naturally in subtropical conditions with hot summers and mild winters. Needs to be cultivated under hothouse conditions, to protect the cycad from frost damage in the Free State's climate conditions.

Height: 5m

Threats:

Although plants cone regularly, considerable damage is inflicted on the female cones by tree squirrels and most cones abort before maturity.



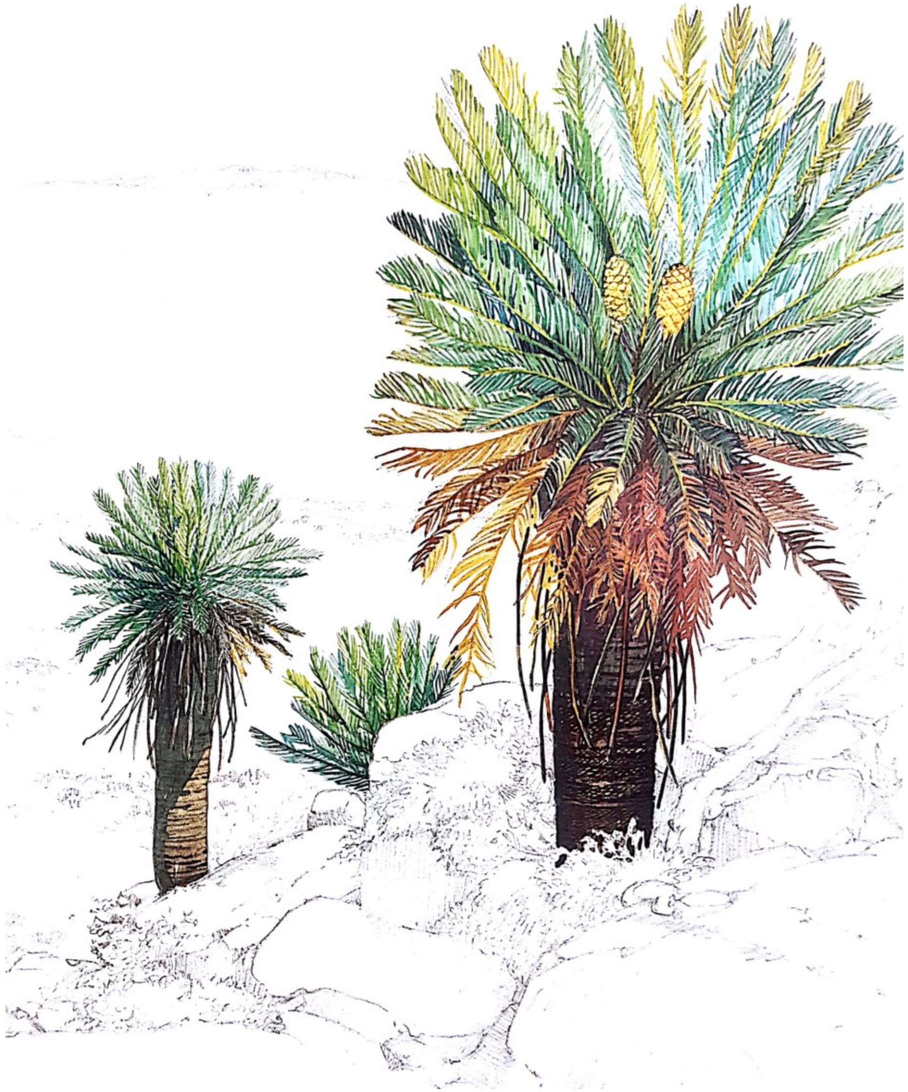


Figure: Encephalartos dyerianus (Goode, 1984:70)

12. Encephalartos cupidus

Common Name: Blyde River Cycad

Distribution: Transvaal

Status: Critically endangered

Cultivation: Encephalartos cupidus is a frost hardy species, that grows well in in full sun, where good drainage is an essential factor.

Height: 1,5m

Threats:

The leaves of E. cupidus are frequently attacked by the larvae of the leopard magpie moth, but although the damage inflicted is probably temporary rather than permanent.

The recurrent grass fires are a far greater threat to the cycads, destroying both cones and the vulnerable seedlings.

Baboons also take their toll of cones and seeds and are present in large numbers in E. cupidus habitat.

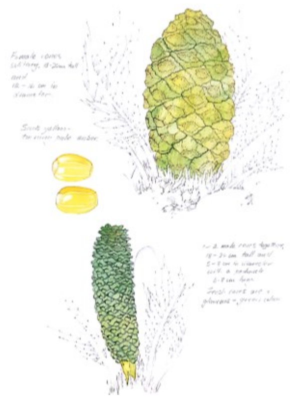


Figure: Encephalartos cupidus (Goode, 1984:74)

13. Encephalartos princeps

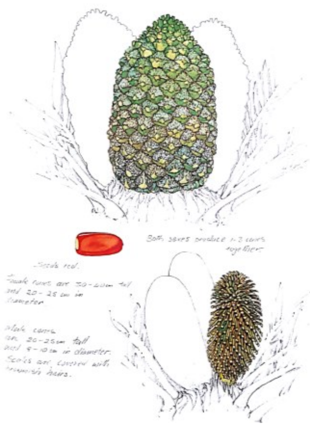
Common Name: Kei Cycad

Distribution: Eastern Cape

Status: Vulnerable

Cultivation: Encephalartos princeps is an extremely hardy cycad species, that requires full sun and good drainage. Therefore, this species will grow well in the Free State's climatic conditions.

Height: 5m



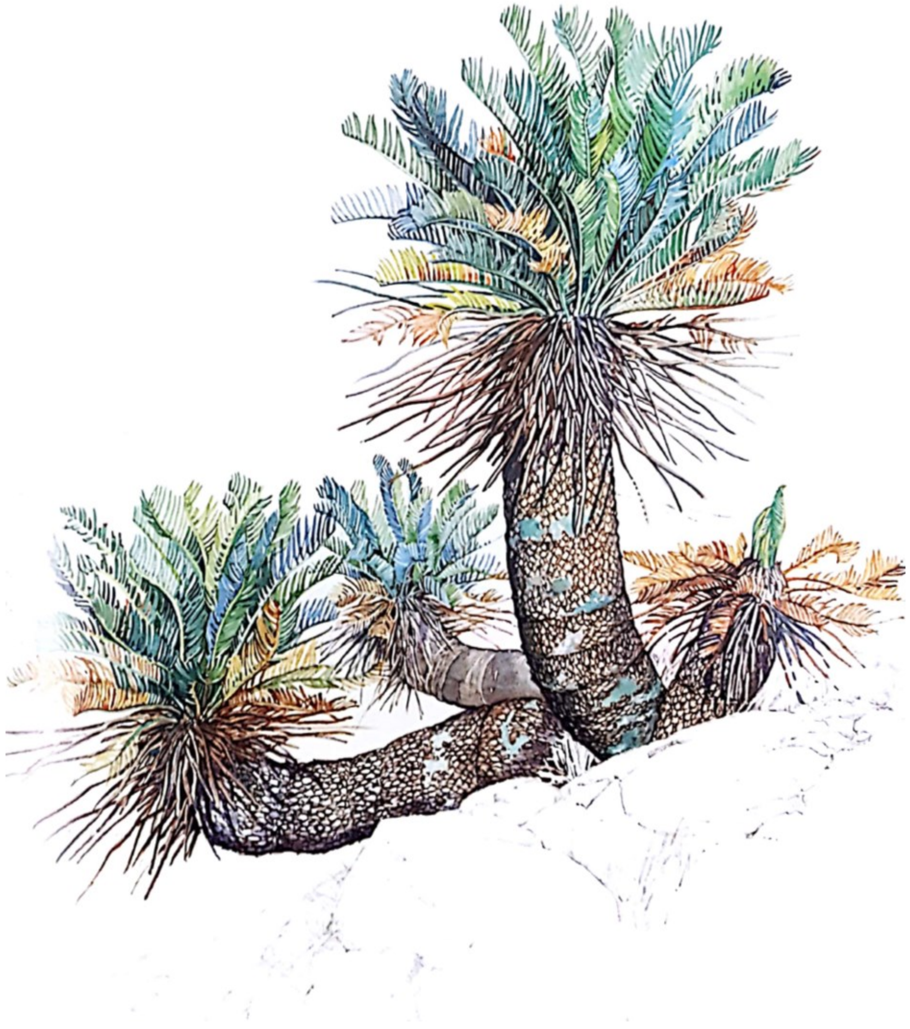


Figure: Encephalartos princeps (Goode, 1984:78)

14. Encephalartos lehmannii

Common Name: Karoo Cycad

Distribution: Eastern Cape

Status: Near Threatened

Cultivation: Encephalartos lehmannii is an extremely hardy plant, and requires full sun and good drainage. This species will grow well in the Free State's climate conditions.

Height: 3m

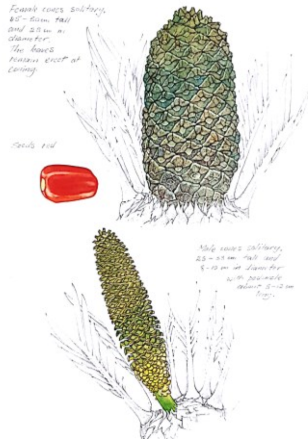


Figure: Encephalartos lehmannii (Goode, 1984:82)

15. Encephalartos horridus

Common Name: Eastern Cape Blue Cycad

Distribution: Eastern Cape

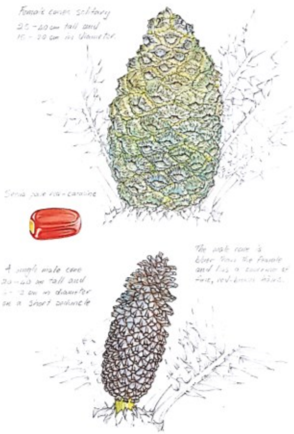
Status: Endangered

Cultivation: Encephalartos horridus is a frost-hardy species that should be positioned in a well drained area, in full sun.

Height: 1,6m

Threats:

There is little doubt that Encephalartos horridus is one of the most unusual and interesting of all the Encephalartos species. The intense blue of its foliage is unique, and is not equalled by any of the other ‘blue’-leaved cycads. The plant itself is considered to be extremely attractive both in it’s coloration and in the unusual rigid curling of its leaves, making this species, incredibly attractive to illegal cycad collectors.



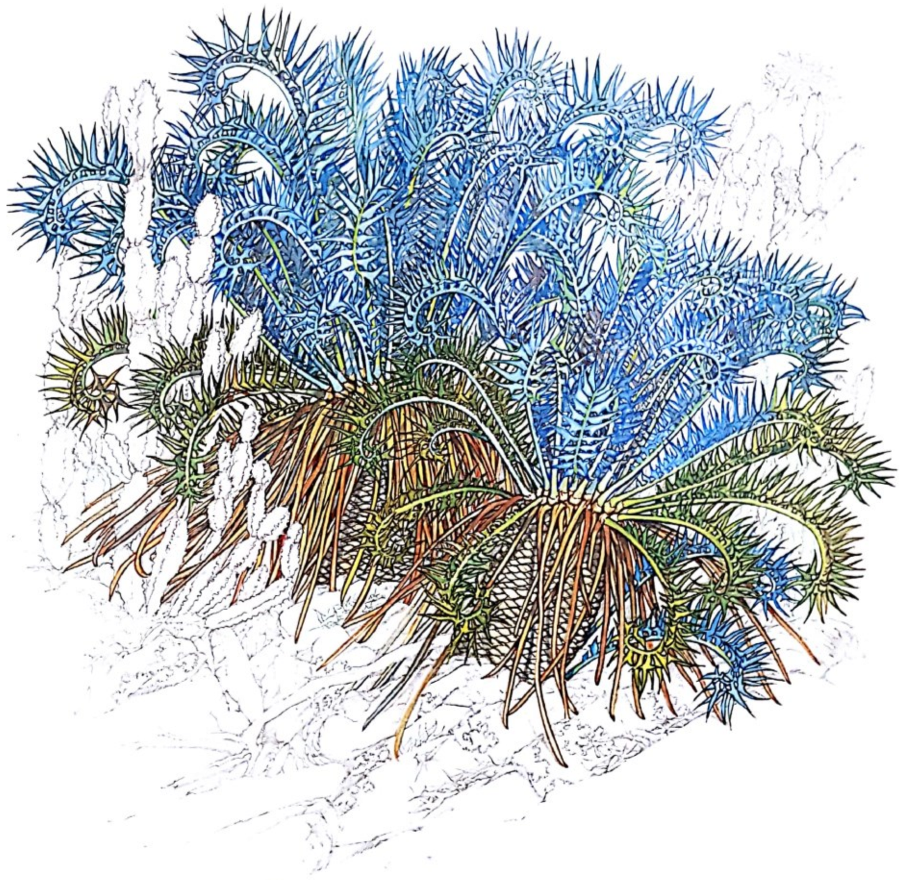


Figure: Encephalartos horridus (Goode, 1984:86)

16. Encephalartos trispinosus

Common Name: Bushman's River Cycad

Distribution: Eastern Cape

Status: Vulnerable

Cultivation: Encephalartos trispinosus is a hardy species that requires full sun and good drainage.

Height: 2m

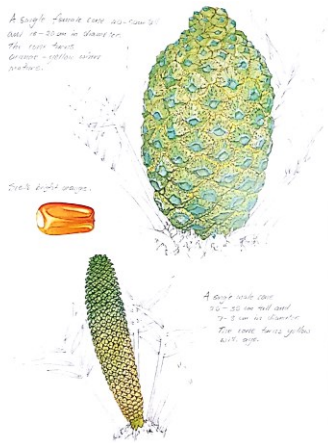


Figure: Encephalartos trispinosus (Goode, 1984:90)

17. Encephalartos arenarius

Common Name: Alexandria Cycad

Distribution: Eastern Cape

Status: Endangered

Cultivation: Encephalartos arenarius is a frost sensitive species and should be cultivated in half shade area with low humidity during summer.

Height: 2,5m

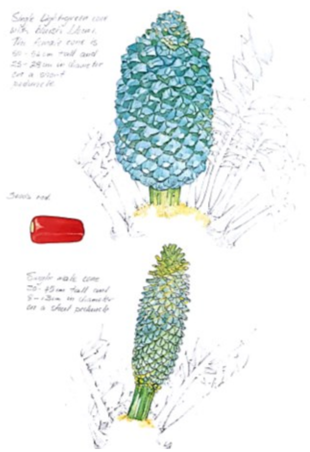


Figure: Encephalartos arenarius (Goode, 1984:94)

18. Encephalartos latifrons

Common Name: Albany Cycad

Distribution: Eastern Cape

Status: Critically Endangered

Cultivation: Encephalartos latifrons is a slow growing species, and occurs in close proximaty to E. arenarius. Reproduction in it's natural habitat is close to impossible, due to the fact that the male and female plants are situated to far apart from each other, in order for reproduction to take place. Therefore, hand pollination needs to take place in order to conserve this particular species.

Height: 4,5m

Threats:

Seed production in nature is believed now to be non-existent. Coning in this cycad is irregular at the best of times and the problem is compounded by the fact that the few plants surviving in the wild are widely separated.

With male and female plants no longer occurring in close proximity to one another to allow pollination to take place.

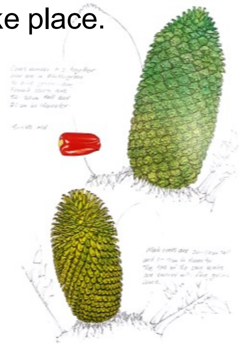


Figure: Encephalartos latifrons (Goode, 1984:98)

19. Encephalartos longifolius

Common Name: Suurberg Cycad

Distribution: Eastern Cape

Status: Near threatened

Cultivation: Encephalartos longifolius is semi-hardy to frost, and prefers a slightly acid soil mixture with ample moisture. This cycad will be able to survive in the Free State's climatic conditions.

Height: 6m

Threats:

In the Perdepoort and Kirkwood areas considerable damage is caused to E. Longifolius by porcupines which chew beaver-like at the bases of the stems.

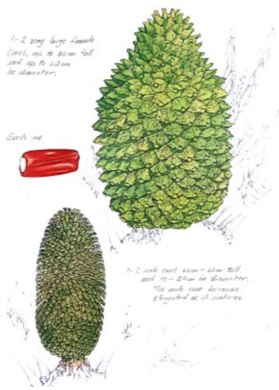


Figure: Encephalartos longifolius (Goode, 1984:102)

20. Encephalartos altensteinii

Common Name: Eastern Cape Giant Cycad

Distribution: Eastern Cape

Status: Vulnerable

Cultivation: Encephalartos altensteinii is semi-hardy to frost, and grows well in either full sun or shade. Therefore this cycad can be cultivated in the Free State climatic conditions.

Height: 5,5m

Threats:

Encephalartos altensteinii is not often subjected to fire in its protected forest habitat and is still a relatively common species despite the depredations of collectors. The Knysna lourie has been known to eat the seeds of this cycad species, digesting the fleshy covering and regurgitating the poisonous kernel. The larvae of the geometrid moth have recently been reported as feeding on the leaves of E. altensteinii.

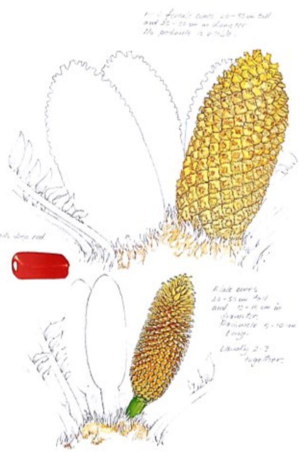


Figure: Encephalartos altensteinii (Goode, 1984:106)

21. Encephalartos natalensis

Common Name: Natal Giant Cycad

Distribution: Natal

Status: Near threatened

Cultivation: Encephalartos natalensis naturally grows in a rocky area in steep sided valleys, where good drainage occurs. With correct site orientation and frost protection provided by surrounding hills, this cycad will be able to grow in the natural conditions of the Free State climate.

Height: 7m

Threats:

Fire is not normally a threat to E. natalensis, whose rocky environment and evergreen vegetation associates provide it with the necessary protection. The larvae of the leopard magpie moth, however, causes considerable damage to the species foliage in certain areas.

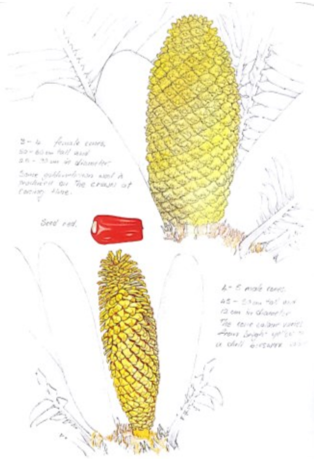


Figure: Encephalartos natalensis (Goode, 1984:114)

22. Encephalartos lebomboensis

Common Name: Lebombo Cycad

Distribution: Natal and Transvaal

Status: Endangered

Cultivation: Encephalartos lebomboensis is semi-frost hardy and requires full sun to grow optimally.

Height: 5,5m

Threats:

Known as one of the most common

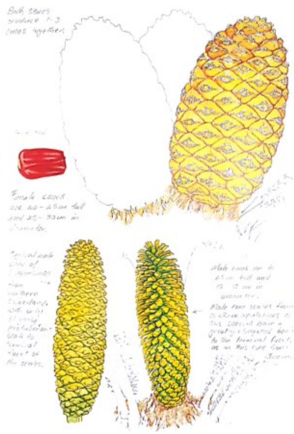


Figure: Encephalartos lebomboensis (Goode, 1984:120)

23. Encephalartos heenanii

Common Name: Woolly Cycad

Distribution: Transvaal

Status: Critically Endangered

Cultivation: Encephalartos heenanii grows naturally in steep rocky areas with a clear preference for open situations.

Height: 4m

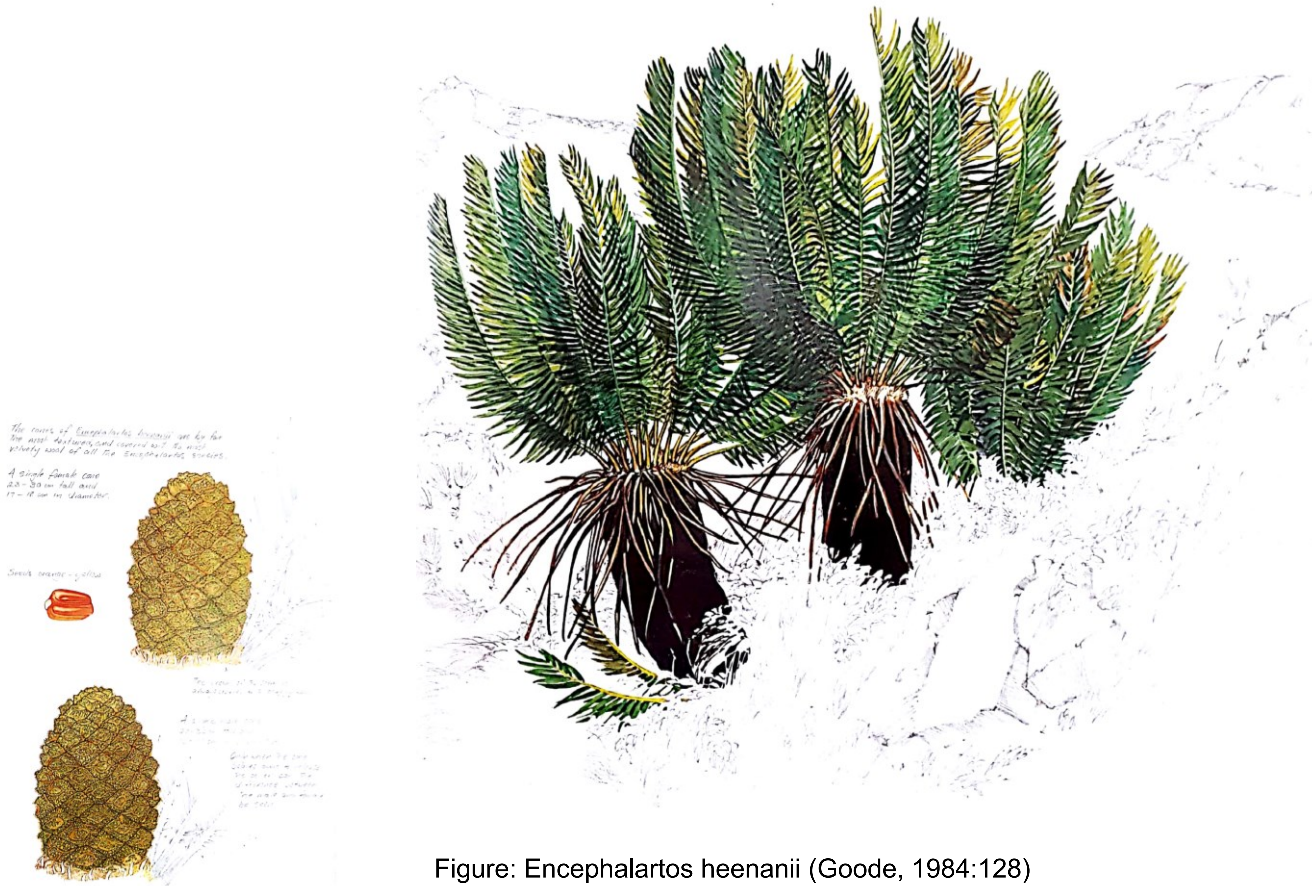


Figure: Encephalartos heenanii (Goode, 1984:128)

24. Encephalartos transvenosus

Common Name: Modjadji Cycad

Distribution: Transvaal

Status: Least Concern

Cultivation: Encephalartos transvenosus grows naturally in cool and humid summers and when grown in drier areas with full sun, the leaves may become scorched. Frost protection is necessary for optimal growth. Therefore, hothouse conditions is required in the Free State.

Height: 8m

Threats:

The Modjadji cycad takes its name from the tribal lands of the Balobedu Baga Modjadji people in the self – governing state of Lebowa. It has enjoyed the protection of a succession of hereditary rulers known as the "Rain Queen" over a period of some 300 years and has flourished to the extent that it has formed a quite splendid cycad forest.

Figure: Encephalartos transvenosus (Goode, 1984:132)

25. Encephalartos paucidentatus

Common Name: Barberton Cycad

Distribution: Eastern Transvaal

Status: Vulnerable

Cultivation: Encephalartos paucidentatus is a forest cycad, therefore shade and sufficient moisture is essential. Sunburn and frost damage may occur if conditions are too far from those of its habitat. Hence, hothouse conditions is necessary for cultivation in the Free State.

Height: 8m

Threats:

This species natural habitat has been considerably reduced in recent years by the expansion of timber expansion of timber plantations.

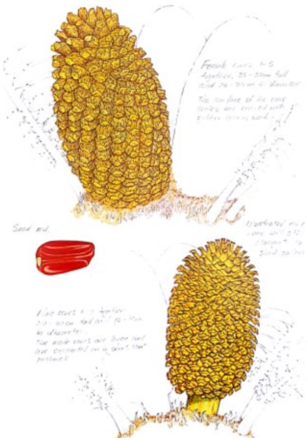


Figure: Encephalartos paucidentatus (Goode, 1984:136)

26. Encephalartos ferox

Common Name: Maputaland Cycad

Distribution: Natal

Status: Near threatened

Cultivation: Encephalartos ferox grows optimally in semi-shaded areas, in a sandy mixture with a good proportion of leaf mould. E. ferox needs to be grown within greenhouse conditions, when cultivated in the Free State. If grown in full sun, the leaves will burn and extreme cold temperatures could damage the plant.

Height: 3m

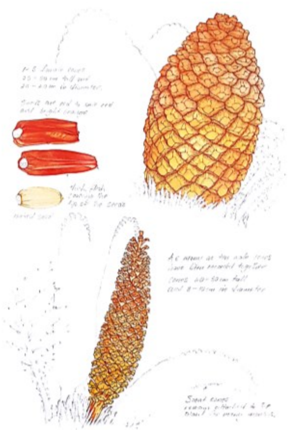


Figure: Encephalartos ferox (Goode, 1984:140)

27. Encephalartos villosus

Common Name: Forest Cycad

Distribution: Eastern Cape, Natal & Transvaal

Status: Least Concern

Cultivation: Encephalartos villosus is a frost sensitive species, that needs to be grown shady – moist greenhouse conditions.

Height: 3m

Figure: Encephalartos villosus (Goode, 1984:144)

28. Encephalartos cerinus

Common Name: Waxen Cycad

Distribution: Natal

Status: Critically Endangered

Cultivation: Encephalartos cerinus naturally occurs alongside a sheer sandstone cliff in full sun, however some prefer light shading.

Height: 1,5m

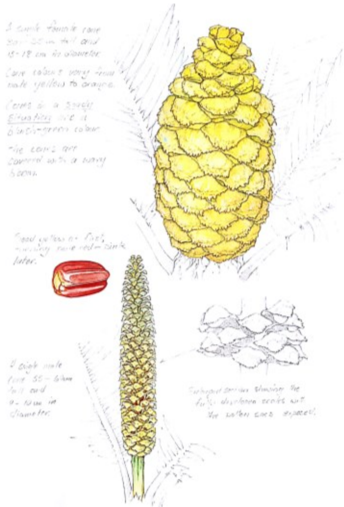


Figure: Encephalartos woodii (Goode, 1984:110)

29. Encephalartos ngoyanus

Common Name: Ngoye Dwarf Cycad

Distribution: Natal and Transvaal

Status: Vulnerable

Cultivation: Encephalartos ngoyanus is a semi-frost hardy species that prefers slightly dry climatic conditions and should be grown in full sun.

Height: 1,3m

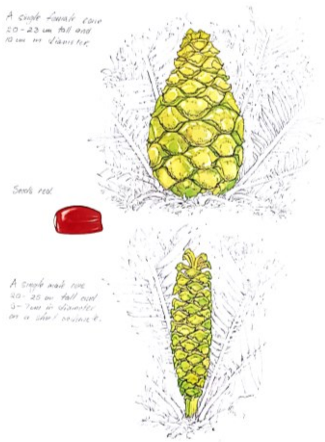


Figure: Encephalartos ngoyanus (Goode, 1984:158)

30. Encephalartos caffer

Common Name: Eastern Cape Dwarf Cycad

Distribution: Eastern Cape

Status: Near threatened

Cultivation: Encephalartos caffer requires slightly acid soil mixture, rich in organic matter with sufficient moisture. It grows in full sun and is semi-hardy to frost. Therefore, this cycad is able to grow in the Free State climate.

Height: 1m

Threats:

The largest surviving population of E. caffer is protected by the Cycad Nature Reserve of the Cape Provincial Administration. Proclaimed in 1973, this recently expended reserve accommodates as least 300 mature plants together with a small number of E. trispinosus and E. altensteinii. The reserve is fenced and access is strictly controlled.

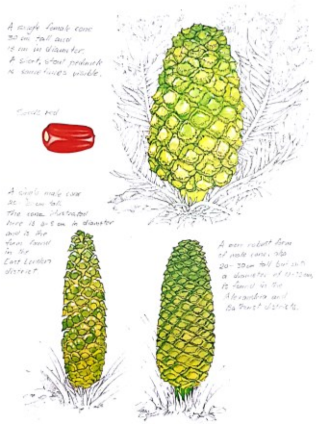


Figure: Encephalartos caffer (Goode, 1984:162)

31. Encephalartos inopinus

Common Name: Lydenburg Cycad

Distribution: Transvaal

Status: Critically Endangered

Cultivation: Encephalartos inopinus occurs naturally against steep rocky slopes in the valleys of the Olifants and Steelport rivers. Cultivation in the Free State needs to occur under hothouse conditions for frost protection, as well as for a protective barrier from illegal – cycad – collectors.

Height: 5m

Threats:

Large troops of baboons in the area regularly inspect each cycad; as soon as a cone appears it is quickly damaged or removed.

Although the grass and bush in these valleys are burned almost annually, most specimens of E. inopinus are out of reach of the flames, protected by bare rock.

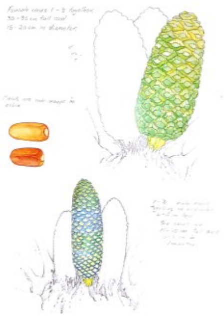


Figure: Encephalartos inopinus (Goode, 1984:54)

32. Encephalartos aemulans

Common Name: Ngotshe Cycad

Distribution: Natal

Status: Critically Endangered

Cultivation: This cycad grows best in semi-shade or full sun. This species will tolerate light frost and is a fast grower when planted in sandy soil. Encephalartos aemulans is propagated by seed and suckers. Sow seed in river sand and place on a heated bench at 24–28ºC. Germination should start 3 weeks after sowing. However, some seeds will take longer, especially where there is no heat. At the one-leaf stage of development, the seedlings are susceptible to infection by the fungus that causes damping off.

Height: 0,26 m

Uses:

In Zulu culture, most of the cycads are referred to as isqgiki–somkhovu. This name refers to witchcraft practices, where a person is converted into becoming a zombie and is used for witchcraft. The cycad is planted in front of the gate of the homestead to protect it from the evil spirit. If someone practices any witchcraft using umkhovu, this zombie will sit on top of the cycad, which is referred as isqgiki, which means 'chair', and that is where the common name is derived from.

Figure: Encphalartos aemulans (sketched from Zondi, 2019:online)

33. Encephalartos hirsutus

Common Name: Venda Cycad

Distribution: Limpopo

Status: Critically Endangered

Cultivation: Encephalartos hirsutus can be treated much the same as E. eugene-maraisii, E. dolomiticus, E. dyerianus and E. middelburgensis, given that the species are related and have a similar habitat. Like all cycads they prefer well drained soils, as well as a modest amount of watering. Plants grow well in full sun, and is frost resistant. Propagation occurs by seed.

Height: 3,5m

Figure: Encphalartos hirsutus (Zondi, 2019:online)

34. Encephalartos msinganus

Common Name: Msinga Cycad

Distribution: KwaZulu-Natal

Status: Critically Endangered

Cultivation: A medium-sized, glossy green cycad, that occurs in short grassland areas on steep north-facing slopes, often suckering from the base to form clumps. This plant grows best in light shade or full sun. This species is frost tolerant and is a fast grower, if it is provided with deep, well-drained soil and is watered frequently. For the sucker to develop new roots quickly its must be placed in warm glasshouse, this important because the rooting occurs faster at warmer temperatures. At the one-leaf stage of development, the seedlings are susceptible to infection by the fungus that causes damping off.

Height: 3m

Threats and Uses:

In Zulu culture, most of the cycads are used for witchcraft practices.This species has also become common in private collections, but the ocurrence of the wild species has declined so much, that this species can be considered to be on brink of extinction and its continued existence is uncertain. The decline of this species is partly because it was never abundant, and small cycad populations often experience reproductive failure because of human activities.

Figure: Encphalartos msinganus (sketched from Zondi, 2019:online)

35. Encephalartos senticosus

Common Name: Jozini Cycad

Distribution: Natal

Status: Vulnerable

Cultivation: This frost-hardy cycad prefers subtropical to warm climates and, as in many cycad species, it appreciates being planted in well-drained soil in sunny and partial shade areas. In suitable conditions E. senticosus grows very rapidly, reaching an appreciable size within 5-10 years. Therefore, in terms of the project this species needs to be accommodated under conservatory conditions. Seeds germinate about one year after having been released. E. senticosus also makes a good container decoration plant.

Height: 4m

Uses: The name of the genus Encephalartos was derived from a Greek word for "bread in head" and refers to the floury, starchy material in the trunk of some species used traditionally as food.

Figure: Encphalartos senticosus (sketched from Mothogane, 2011:online)

36. Encephalartos brevifoliolatus

Common Name: Escarpment Cycad

Distribution: Limpopo

Status: Extinct in the wild

Cultivation: Due to the fact that no mature species are existing in natural habitats, very little is known about the cultivation of E.brevifoliolatus. None the less it is represented in at least one, possibly two, collections. It should be grown in full sun and the normal requirements for cycads should be adhered to. Since female cones are not known, this species can only be propagated by removing suckers from the base.

Height: 2,5m

Threats: Removal of plants from the wild by collectors was the main threat.

Figure: Encephalartos brevifoliolatus (sketched from Donaldson, 2019:online)

37. Encephalartos nubimontanus

Common Name: Blue Cycad

Distribution: Limpopo Province

Status: Extinct in the Wild

Cultivation: Encephalartos nubimontanus is the fastest growing blue leaved African cycad, more vigorous than other members of the 'Eugene-maraisii complex', it forms clusters of offsets, handles wetter conditions and prefers full sun. It is hardy, adaptable and striking in appearance. As a garden subject, it is one of the most spectacular of all cycad species and is quite adaptable in cultivation. It thrives and grows best in filtered sun or shade. When grown in full sun, the leaves are a little shorter and less likely to be damaged by wind. The leaves of those plants grown in the shade can become stretched out and damage the caudex if they break off close to their base. It is suited to subtropical and warm temperate regions. Frost may burn the leaves but will not easily kill established plants.

Height: 2,5m

Threat: It was originally known from 66 plants, only 8 were counted in a 2001 survey and none could be found in a 2004 survey despite very careful searching. The species is popular with collectors and there has been much poaching activity in the Limpopo Province of South Africa.

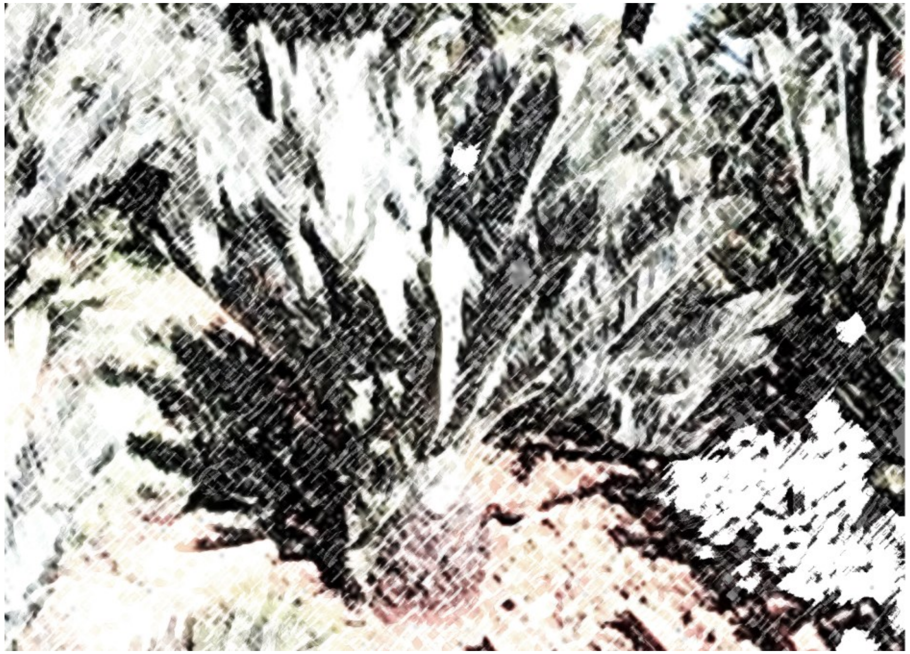


Figure: Encephalartos nubimontanus (sketched from Donaldson, 2019:online)

38. Encephalartos woodii

Common Name: Wood's Cycad

Distribution: Natal

Status: Extinct in the wild

Cultivation: Encephalartos woodii in cultivation one of the more rapid growing cycads. Sufficient moisture and rich soil conditions is required for optimal growth. In hot and dry inland areas, light shade is required to prevent sunburn.

Height: 6m

Threats:

Encephalartos woodii is extinct in the wild, due to the fact that it is unable to produce any seed, because no female plant exists. It is possible of course that a female plant will someday be found in a secluded gorge, although numerous unsuccessful searches have been made over years, or perhaps one of the many cultivated specimens will undergo sex reversal and produce female cones.

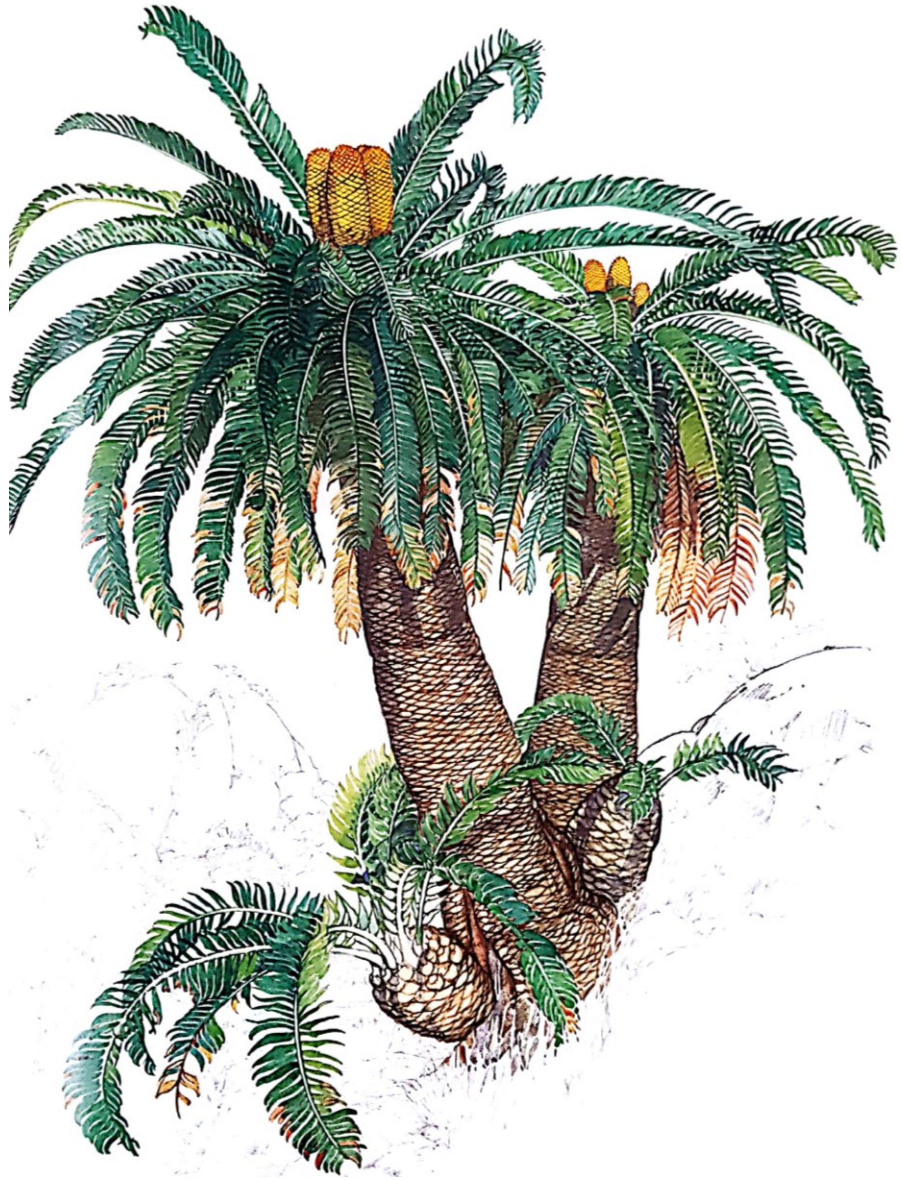


Figure: Encephalartos woodii (Goode, 1984:110)

Giddy, C. 1984. Cycads of South Africa. Cape Town: Struik Winchester.

Goode, D. 1984. Cycads of Africa. Cape Town: Struik Winchester

ANNEXTURE B

A STORY OF THE SUN

"In the times when it was still dark everywhere on earth, there were mongooses, bat-eared foxes and jackals who all lived together in their villages of holes. Their children played with the light. The Great Being, Bohopii-bohopi, saw them playing with the light. They played the stick-game with the light into the air with their sticks, but because they were only small children, they couldn't throw the ball up very high. Every time the ball would fall back close by.

Bohopii-bohopi thought to himself, 'No, these children are playing with Life. They are going to cause trouble and set the world alight'.

Bohopii-bohopi went to his two wives and said to them, 'The children of the Mongooses, Bat-eared foxes and Jackals are playing with the most beautiful thing'. He said this because he knew that this thing was actually the sun. He sat down with his wives to consider what they should do. Then they went to the village of the Mongooses, Bat-eared foxes and Jackals. On their way they cut themselves long raisinbush sticks. They saw that the children were still playing with the most beautiful thing; plating with life. Then the woman started dancing, clapping their hands and singing.

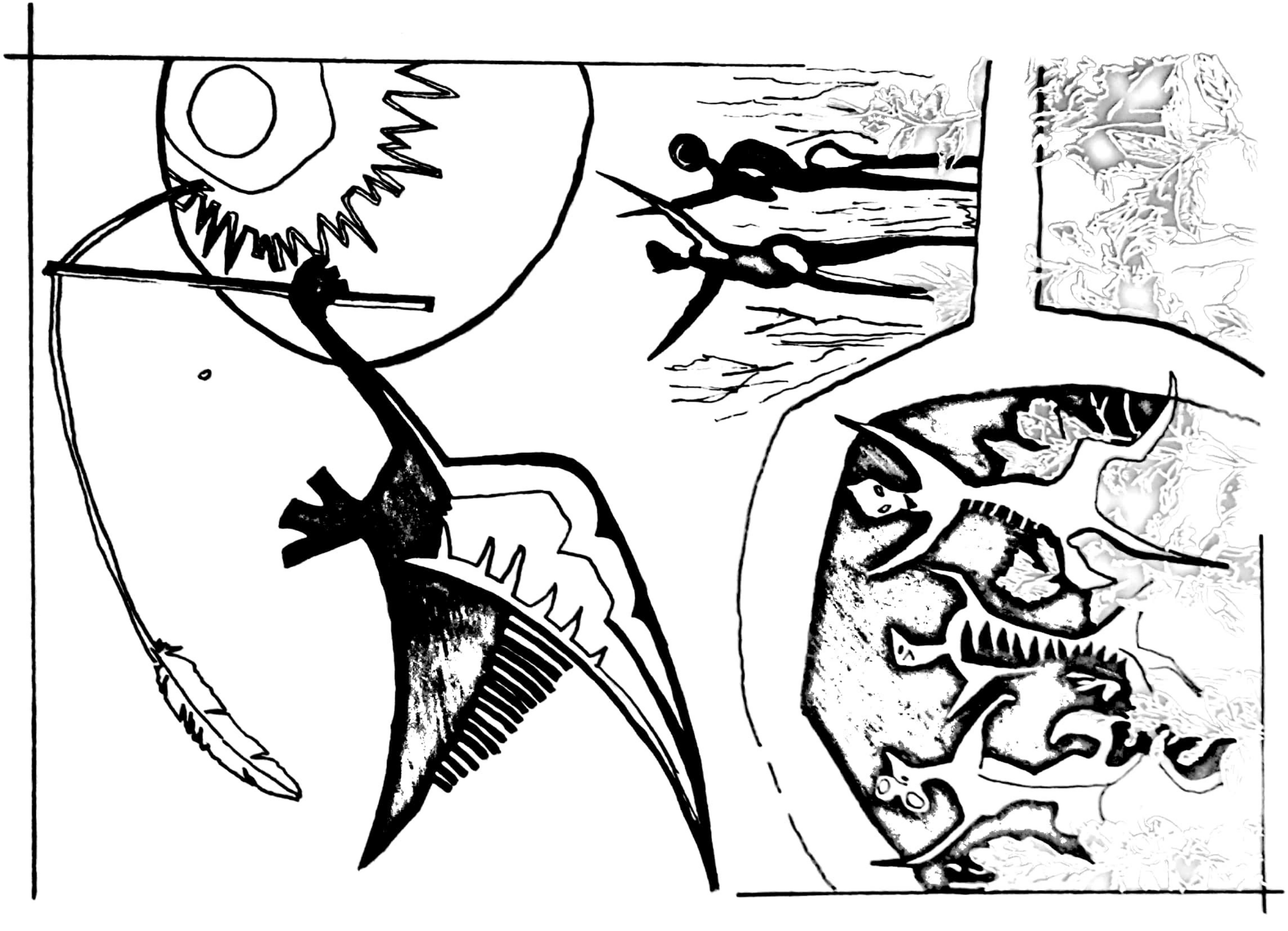
Song: Pambe, pambe Bohopii-o-ho-pii! And they took their long raisinbush sticks and played with the ball of Light, throwing it up high into the air while dancing and singing. But every time the ball would fall back. Time and again, time and again the ball fell back.

The Great Being, Bohopii-bohopi, became very impatient. 'Higher, throw it up higher!' but the women struggled to get the light higher and every time the ball would fall back to the ground.

Bohopii-bohopi then spoke to the Light, 'Why do you, who are actually Life itself, allow it that these children and women play with you thus?' And to the children he said, 'If only you could realise what you are doing! Run! Hide in your holes or else I'm going to catch everyone of you and eat you. Why are you playing with Life?'

Bohopii-bohopi then took the very long stick which he had, flew up to the sky and threw the ball of light up even higher to where the sun is still shining from the sky today, and until this day the Jackal, Mongooses and Bat-eared foxes still live in their holes all day and only come out at night when it is dark."

Told by woman from Central Kalahari (Fourie, C. 1994: 12)



THE ORIGIN OF PANS AND RIVERS

“Two sisters lived together in a village. One was good and had many children, the other was bad. The good woman went off to collect food and left her children with the bad sister to look after them. While she was away she had a bad feeling that her sister was not going to look well after her children, so she returned home. While she was away, her children saw that their aunt was unkind to them; she didn’t feed them and they told their mother, ‘Our aunt never gave us food. She said we were ugly, ‘You are ugly and you are too many’ our aunt said.’

Then their mother decided to see for herself how her sister was treating her children. She said to herself, ‘I have to find out why my sister is such a bad women. I’ll bury myself in the sand just like a puffadder does and nobody will see me.’

Thus did she hide herself. Then she told her children to sing and dance a very good song. Their aunt came closer and closer to listen, to watch and to dance too. She started dancing together with the children. She danced closer and closer to the place where her sister had buried herself in the sand. While coming closer to her sister in the sand, the buried one would hiss like a snake and the aunt who dancing would leap into the air and jump away from the spot. But once more the children would sing out very loudly and she would dance and come closer again.

When she was close enough to where her sister was buried, her sister grabbed her foot and bit it hard; she bit her on the foot.

The bad aunt was startled because she thought a snake had bitten her. So she started running. As she ran, she would stop and run her foot on the ground and in the sand to try and rid herself of the poison of the snake which she thought had bitten her, and then she would run on again, and stop and rub. Every time she rubbed her foot on the ground, a pan occurred. But she kept on running until she was so tired that she dropped to the ground. In her exhausted state she still panicked so much that she kept on dragging herself across the sand and the dragging marks made deep furrows in the sand which eventually became riverbeds. She crawled on and on until she dropped dead, and that is how pans and riverbeds occurred.”

Told by woman from Central Kalahari (Fourie, C. 1994: 50)

=UM =UM BOROSE

"=um / =um Borose was a gigantic old woman who filled the whole world. She is the one who created everything. After she had created it all, she swallowed it again; all the people, the Matabele, the Tswana, the white people, the animals, the trees, all of it. That is how it happened.

There were also two men. Ka / eledi who had big dogs and Kgabu / ane who was small but clever. He had small dogs.

These two men talked and argued. 'Where have all the people gone? Why is this big world so empty?'

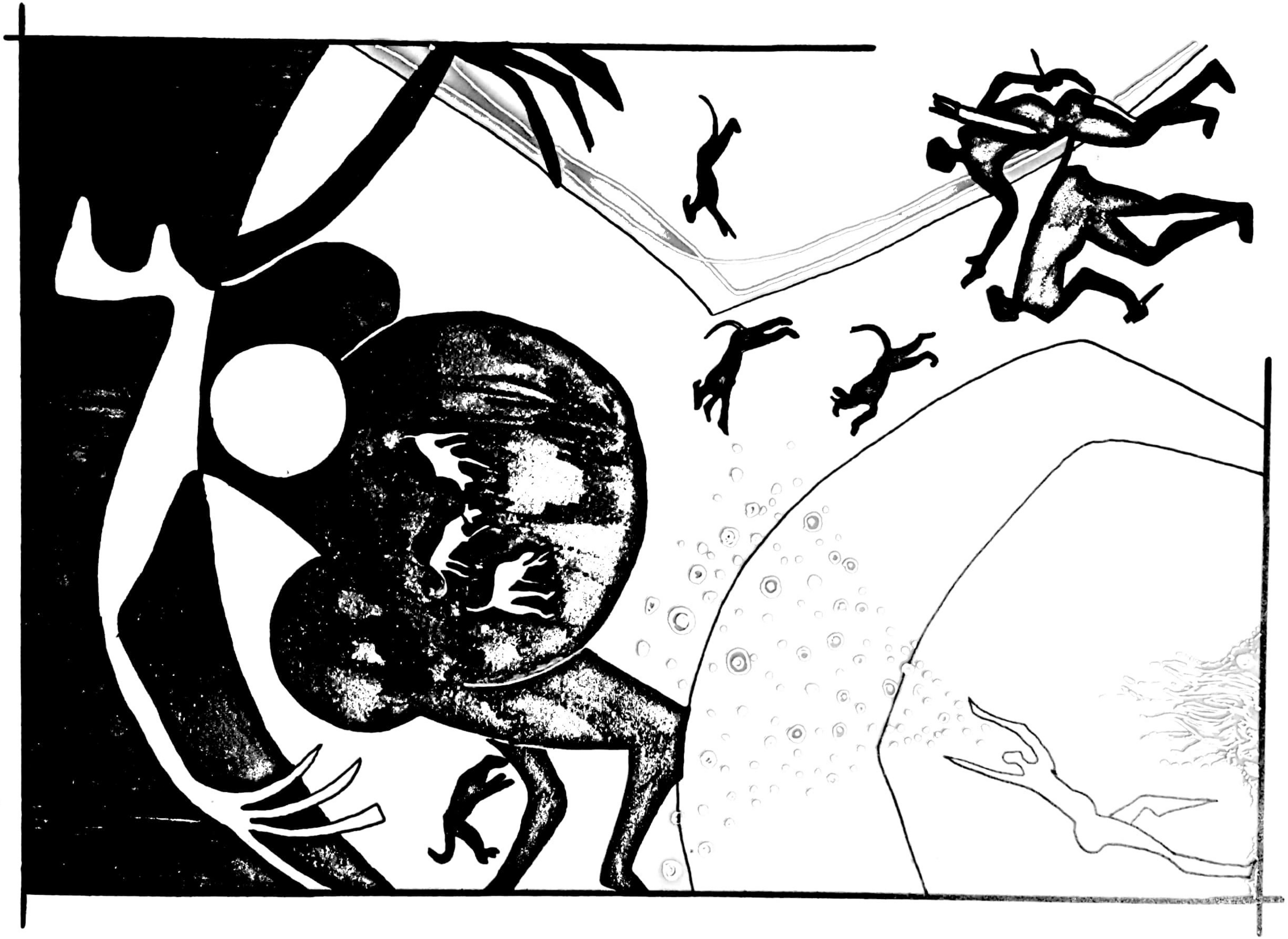
Kgabu / ane then said to Ka / eledi, 'You know, I'm sure =um =um Borose was swallowed it all. That is why she is so gigantic. That is why she can fill all the earth. She must have an enormous stomach. How shall we open this big person to get out all the things that should be on earth? The animals, the stars, Kgabu / ane said that they should kill her and tear open her belly. But how?

'Ka / eledi, you have big digs, but they approached =um =um Borose, she grabbed and swallowed them one-by-one. Then she lay down again.

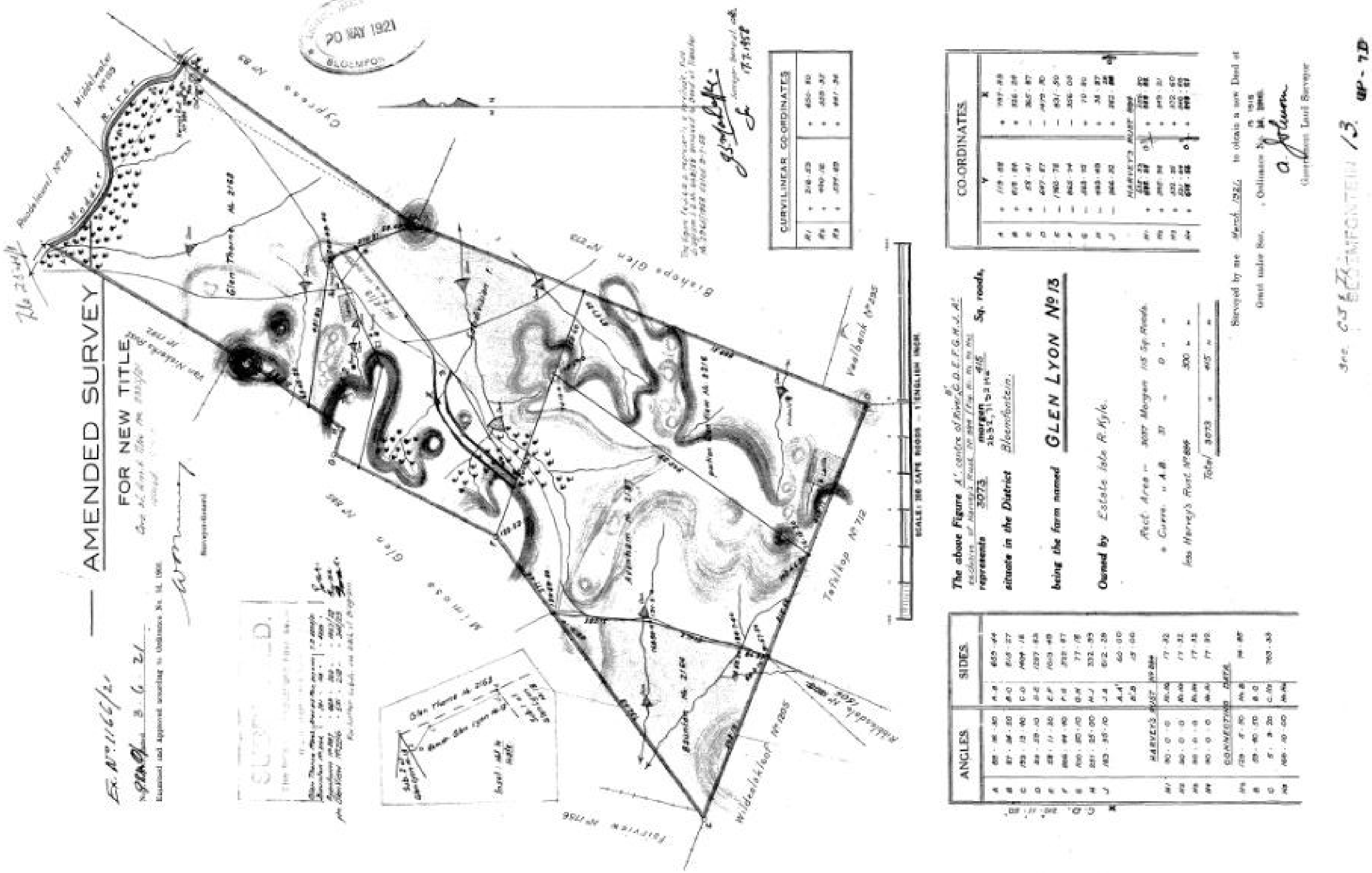
After that Ka / eledi said, 'Kgabu / ane, fetch your small dogs, so much easier for her to swallow my small dogs. But we shall see. I'll go and fetch them.'

Kgabu / ane fetched his small dogs and they started nibbling her. They were too small for =um =um Borose's big hands to grab. They nibbled her all over her big body; her eyes, her nose, her breasts and nipples, under her arms, her bottocks, between her legs, all over; so much so that she didn't know what to do. They nibbled her and nibbled her until she was dead. Kgabu / ane said, 'There she is. She is dead." Then Ka / eledi started cutting, but he was too big and strong. He also cut the people inside her. 'No! You are killing the people. You are finishing them. Don't think because you are big and strong that you are cleverer than I am. Give me that knife and I'll do the cutting.' Then Kgabu / ane worked very carefully cutting away small pieces at a time, and with each cut something else came out. Everything, even the trees and animals appeared from her inside. 'Ka / eledi, how are we going to get the things of the sky? Let's take these truffles and roast them to eat.' They made a fire and started roasting the truffles, but suddenly Kgabu / ane grabbed the truffles from the fire and threw them high up into the sky, and they became stars. The truffles that fell back all started growing and became veldkos. Thus, it happened that people had enough to eat from the veld and that the stars are shining from the sky."

Told by man from Eastern Kalahari (Fourie, C. 1994: 58)



ANNEXTURE C


AMENDED SURVEY
FOR NEW TITLE
20 MAY 1921
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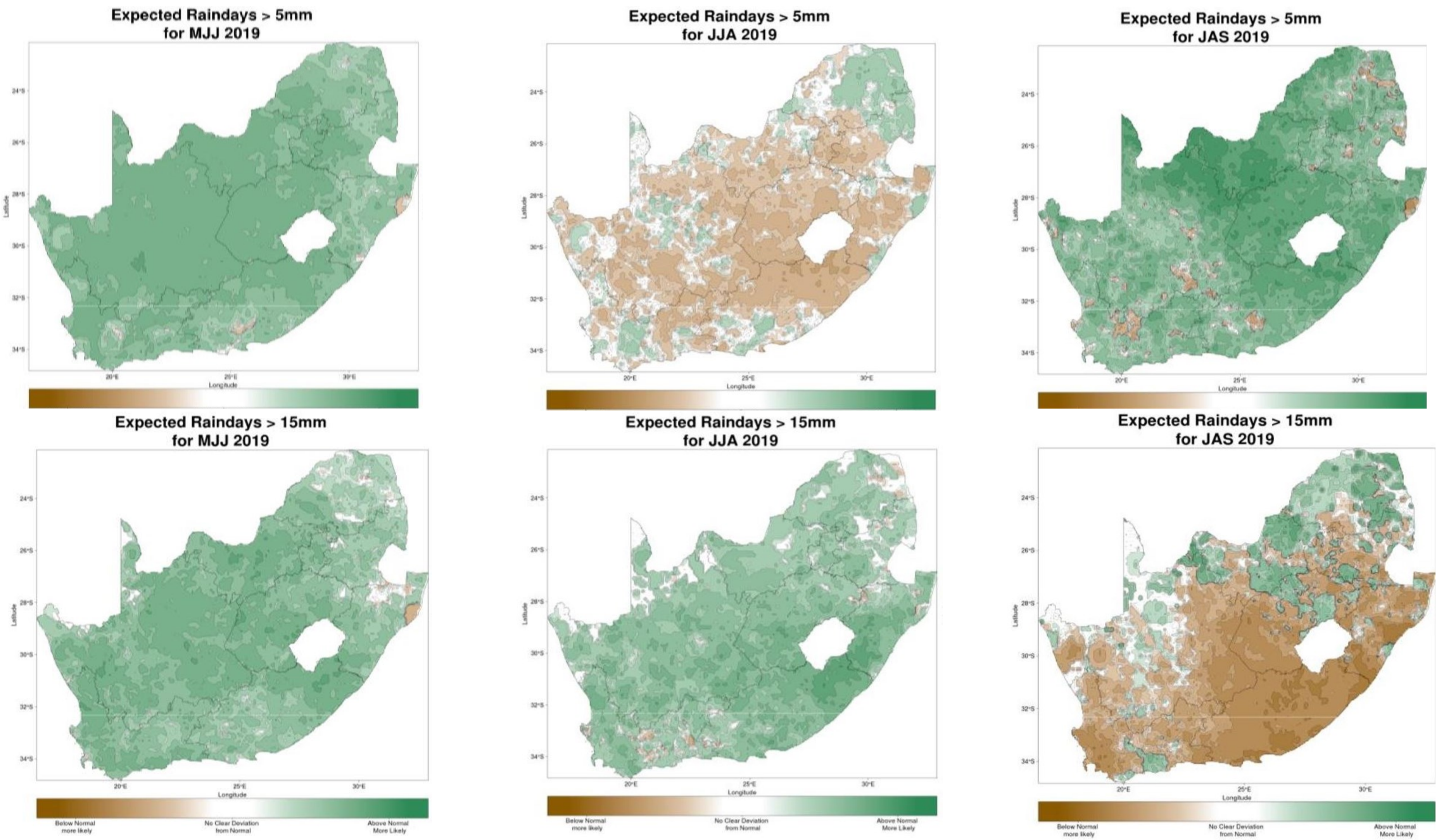
CO-ORDINATES
CURVILINEAR CO-ORDINATES
ANGLES
SIDES
Bishops Glen
Cypress
Mimosa
Tafelkop No 712
Fairview
Vaalbank No 295

ANNEXTURE D

RAINFALL FORECAST:

Figure 10: May – September 2019 rainfall – days forecast for high and low number of rainfall days exceeding 5 and 15mm without skill taken into account. (South African Weather Service, 2019: 15 – 17)

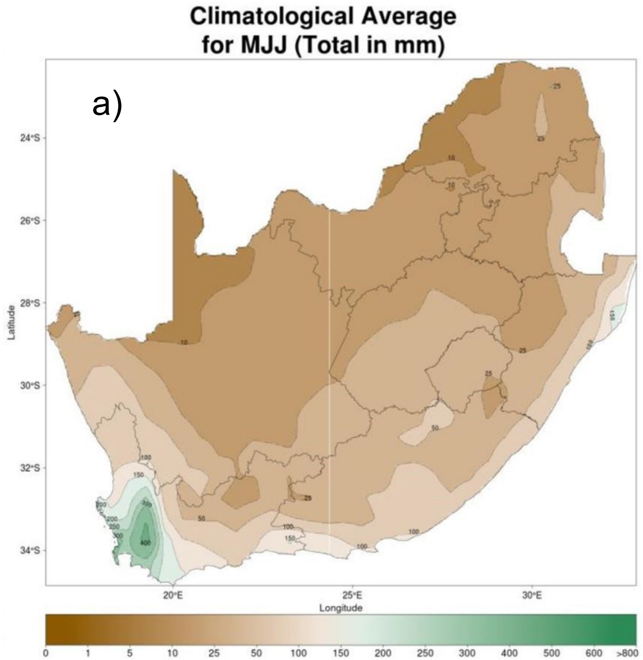


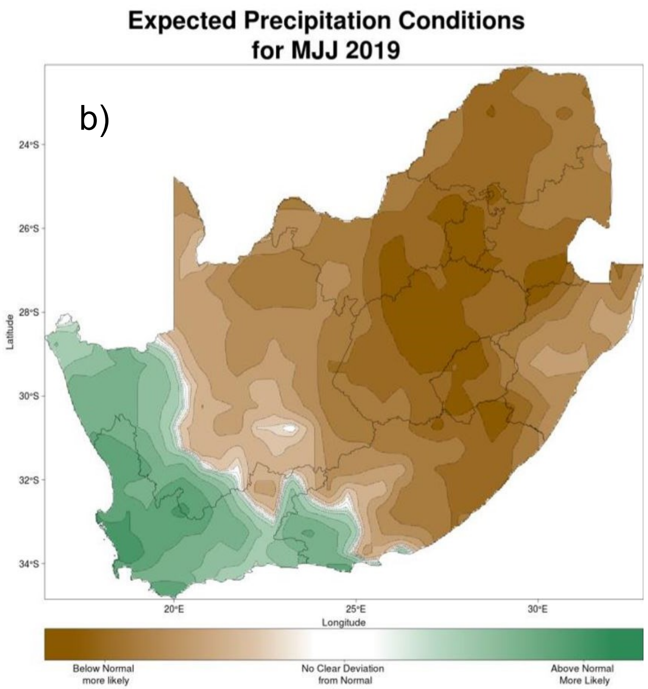
PRECIPITATION

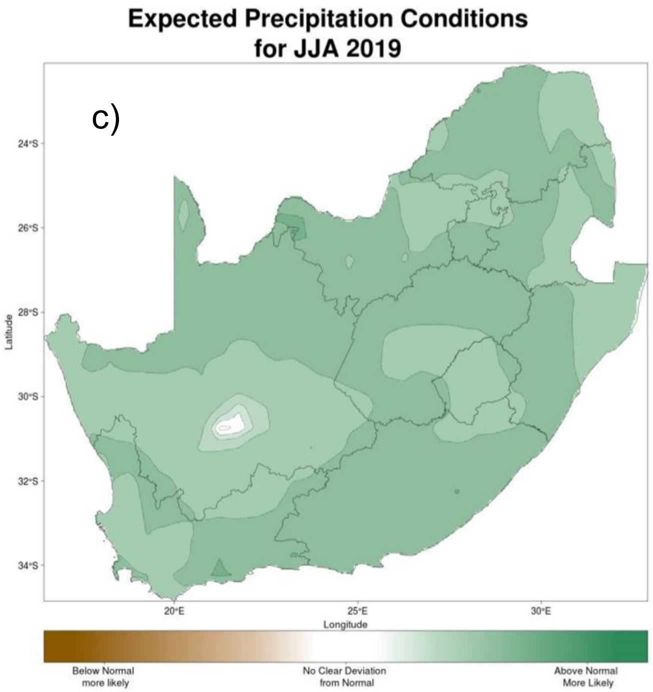
Figure 7:

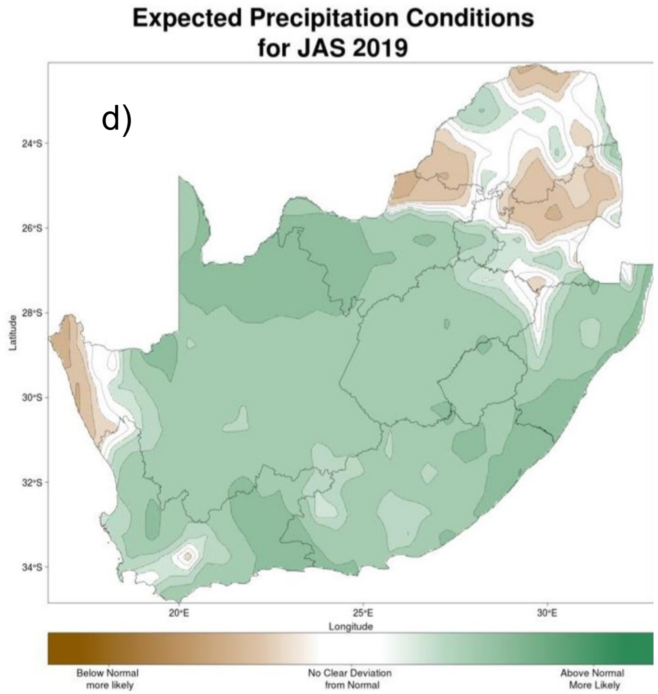
a) Climatological average (in mm) calculated over a period of 1979 - 2009
b) May – June – July (MJJ) 2019 Seasonal precipitation prediction without skill taken into account.
c) June – July – August (JJA) 2019 Seasonal precipitation prediction without skill taken into account.
d) July – August – September (JAS) 2019 Seasonal precipitation prediction without skill taken into account.

(South African Weather Service, 2019: 5 – 7)







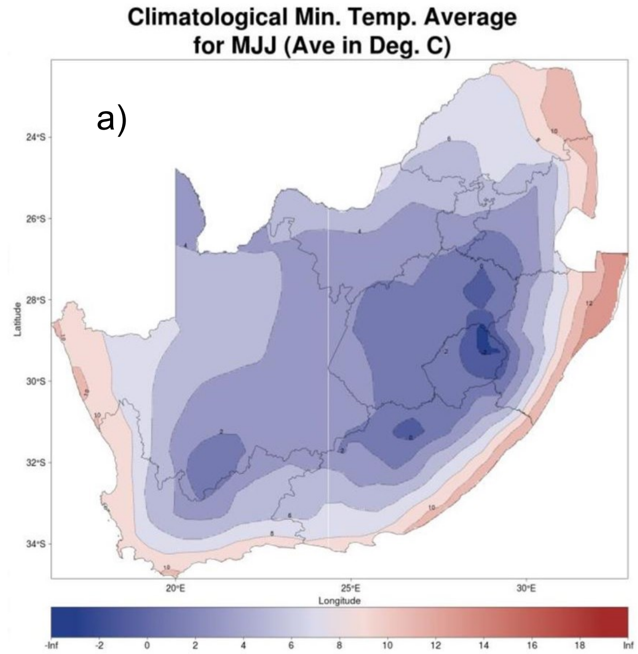


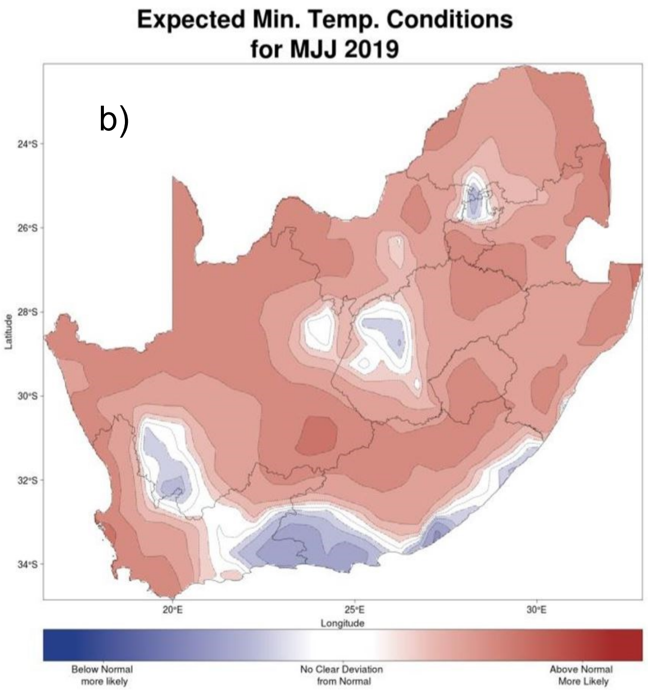
MINIMUM TEMPRETURE

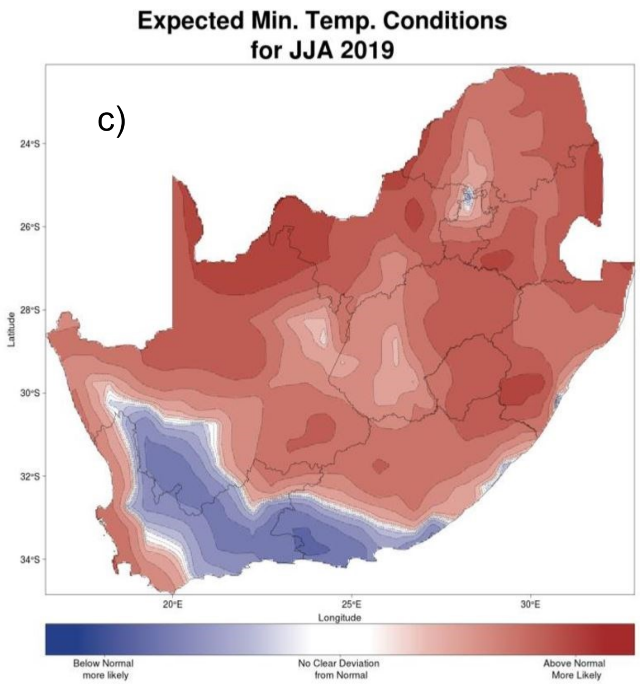
Figure 8:

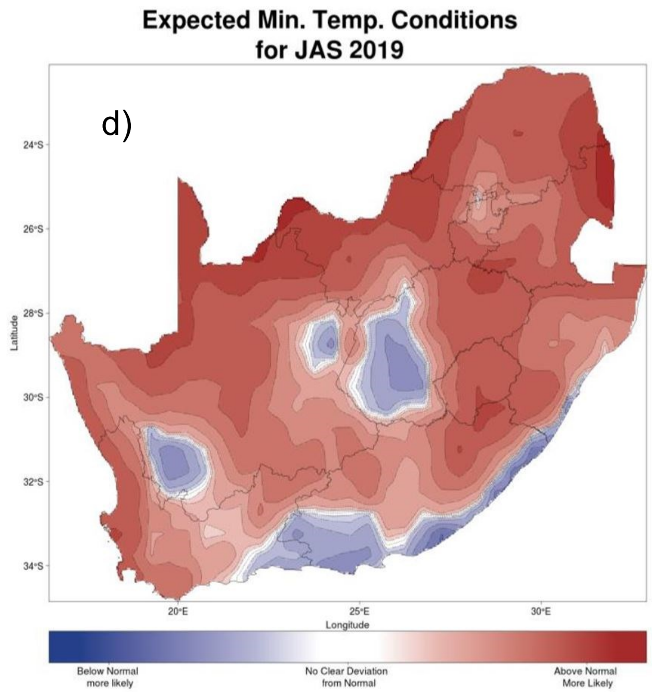
a) Climatological average calculated over a period of 1979 – 2009
b) May – June – July (MJJ) 2019 Seasonal minimum – temperature prediction without skill taken into account.
c) June – July – August (JJA) 2019 Seasonal minimum – temperature prediction without skill taken into account.
d) July – August – September (JAS) 2019 Seasonal minimum – temperature prediction without skill taken into account.

(South African Weather Service, 2019: 8 – 10)







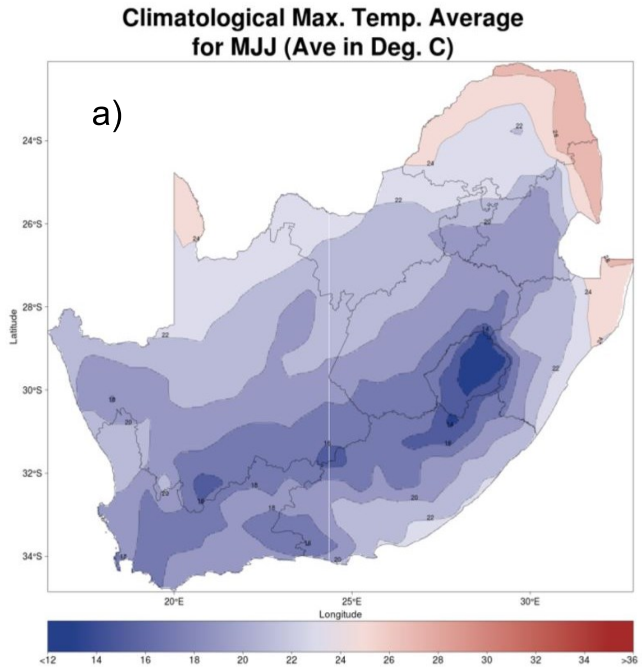


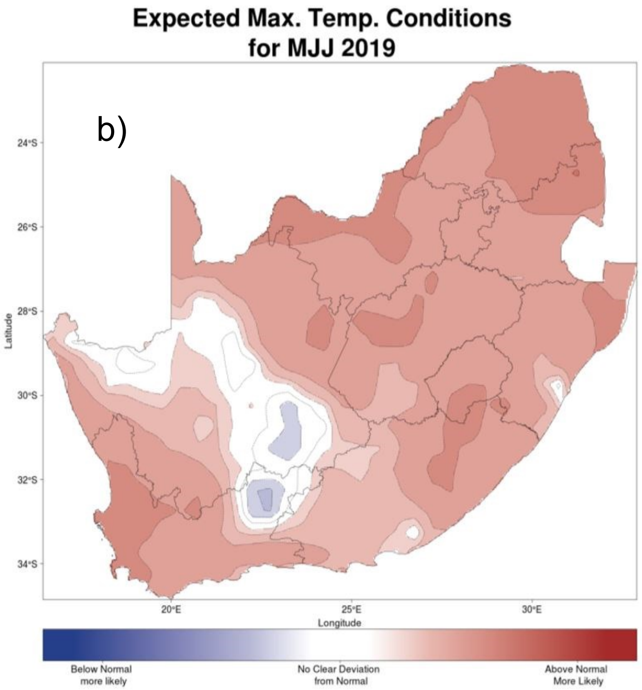
MAXIMUM TEMPRETURE

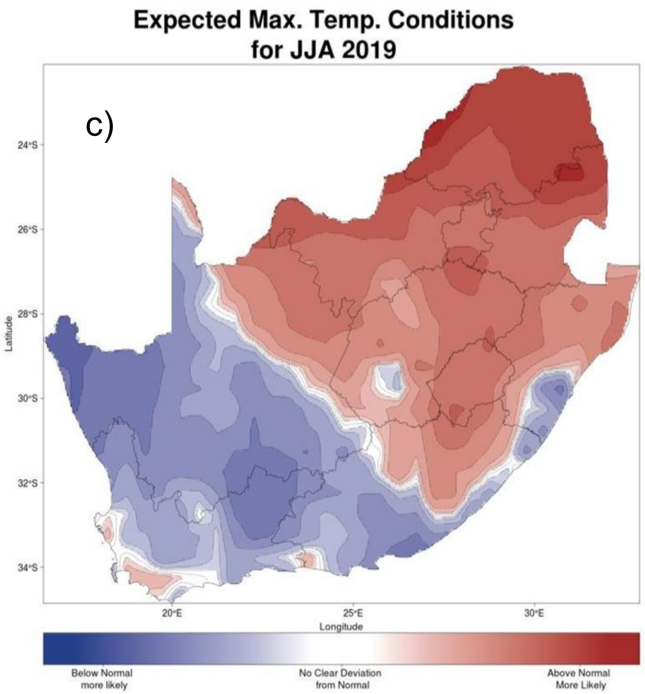
Figure 9:

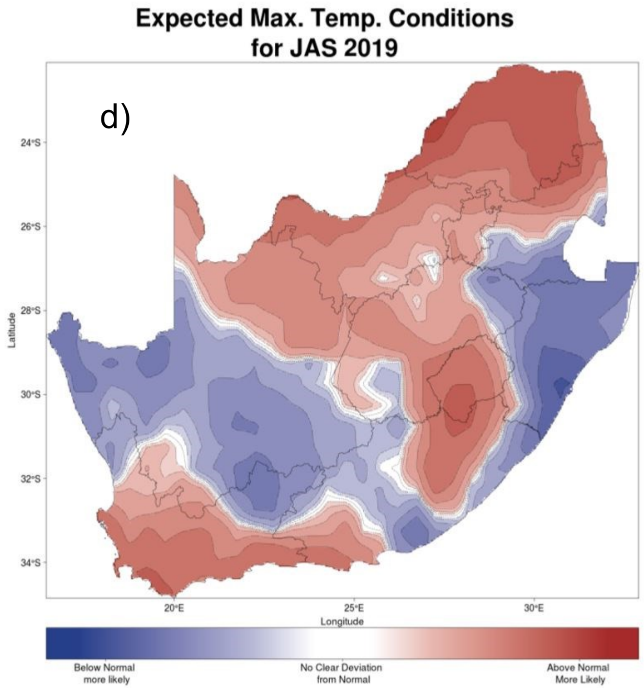
a) Climatological average calculated over a period of 1979 – 2009
b) May – June – July (MJJ) 2019 Seasonal maximum – temperature prediction without skill taken into account.
c) June – July – August (JJA) 2019 Seasonal maximum – temperature prediction without skill taken into account.
d) July – August – September (JAS) 2019 Seasonal maximum – temperature prediction without skill taken into account.

(South African Weather Service, 2019: 11 – 13)









ANNEXTURE E

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