6

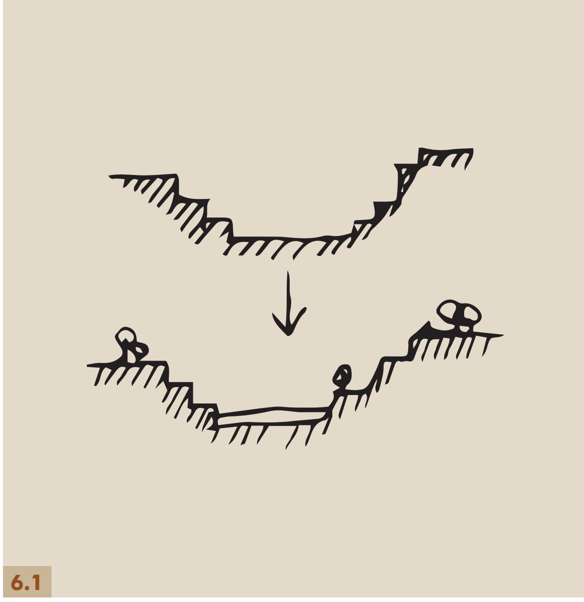
DESIGN DEVELOPMENT: MASTER PLAN

6.1 APPROACH TO MASTER PLAN

As mentioned in the Theory chapter, there are three approaches to adaptive reuse: typological, strategic and technical. Typological and strategic will be explained in this chapter while technical will be explained in the Technification chapter.

6.1.1 Typological

Typological is fairly straightforward – the quarry landscape type will be converted into a mixed-use park landscape type. Natural stone quarries are well suited for this transition because of their unique characteristics such as their physically stable quarry faces and benches, waterbody (Lintukangasa et al. 2011:123) and stockpile of overburden. If well-considered, these features can be utilised in the adaptive reuse of Quarry X.



6.1

6.1.2 Strategic

Within landscape design, one can discern two general strategies to how wasted sites (which includes urban quarries) are perceived and therefore approached in terms of their reuse (Höfer & Vicenzotti 2013). Table 6.1 outlines these two design strategies as well as the combination approach the dissertation will apply to Quarry X.
The "Clean Slate" strategy is generally characteristic of American adaptive reuse projects, while the "Idealisation" strategy is characteristic of European projects (especially in Germany) (Höfer & Vicenzotti 2013:406).
Quarry X is a landscape-dominant site that is not characterised by many buildings and/or structures such as steel factories for example. Therefore, much of the site manipulation is with regards to the landscape.

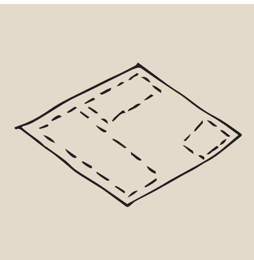
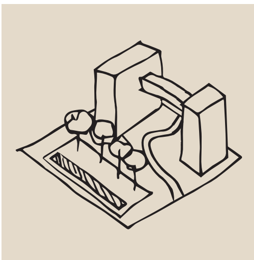
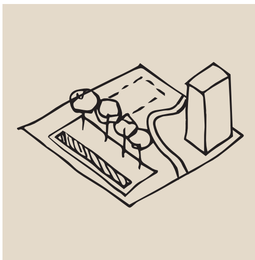
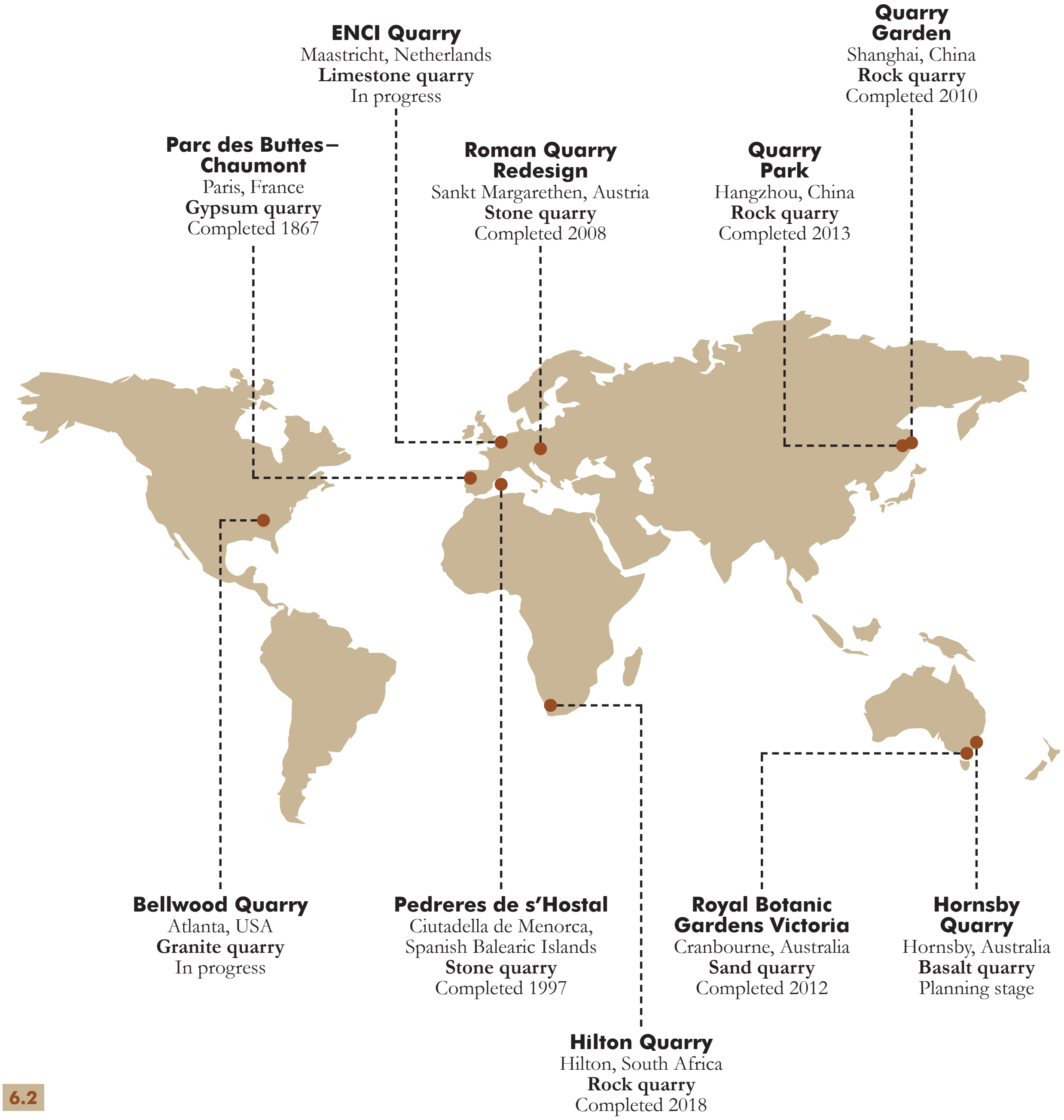
CLEAN SLATE	IDEALISATION	COMBINATION
		
• Site considered as an opportunity for economic development in metropolitan areas • Site remediated of any environmental hazards as far as possible to improve public health and protect investors from any future liability • Heritage aspects (such as buildings and machinery) and spatial qualities of site often erased • Romanticised view of historic industrial relics which are often used as merely decorative elements	• Site appreciated for its indifference and seen as a unique space with a specific character • Sites seen as part of nature or wilderness (an idea related to the nature conservation movement) • Entire site signifies an important component of an area's cultural history worth maintaining and/or celebrating • Existing structures understood as complex systems and considered as one layer of information in the design process	• Quarry is viewed for its potential for economic development in the Midrand area as well as for its uniqueness • Site also intended to address urban issues (in relation to waste management)

Table 6.1

Table 6.1 "Clean Slate" vs. "Idealisation" strategies (Author 2019) [Adapted from Höfer & Vicenzotti 2013]
Fig. 6.1 Quarry converted into landscape park (Author 2019)

6.2 PRECEDENTS

Globally, there are relatively few projects in which quarries have been intentionally reused to serve as public open space. Figure 7.0 indicates some of the more notable examples, where three will be described and analysed. These three were chosen as they each represent a different strategy to the adaptive reuse of urban quarries.



6.2

Fig. 6.2 Global map indicating projects which have (or are planning to) reuse quarries as public, open space (Author 2019)

6.2.1 Parc des Buttes–Chaumont

Program: Public park
Engineer: Adolphe Alphand

One of the first notable transformations of a quarry site into a public, green open space is Parc des Buttes-Chaumont. Part of the site was exploited for gypsum and by the end of the 1850s, the quarries were exhausted (Paris Digest n.d.). Thereafter, Napoleon III decided to turn the abandoned site into a public park (ibid.). Extensive earthworks were carried out to create a cave within the quarry, a lake (Figure 6.3) and a waterfall (ibid) – completely transforming the initial appearance of the site into a picturesque oasis.
Furthermore, new elements inspired by classical architecture were added.

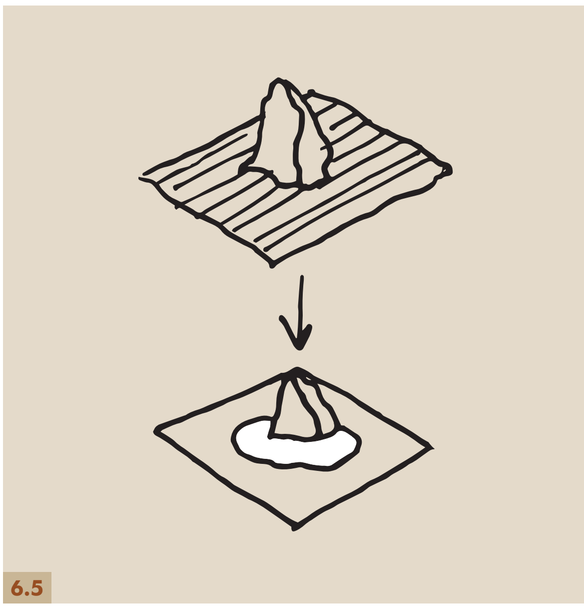
6.2.1a Conclusions Drawn

Existing landforms on site can be manipulated in ways to create a unique experience for visitors. There is an idealisation of the old site through the incorporation of the gypsum cliff, however, it appears from present-day images, that other remnants of the old site were destroyed. Including those which may have added an additional attraction to the park.


6.3

Fig. 6.3 An artificial lake surrounds the steep cliffs of the former gypsum quarry at Parc des Buttes-Chaumont. Temple de la Sibylle sits at the top of the cliff. Photo take between 1890 and 1900 (Gallica n.d.)
Fig. 6.4 Parc des Buttes-Chaumont (Vandevivère 2007)
Fig. 6.5 Park manipulated and transformed to a typical picturesque scene (Author 2019)


6.4


6.5

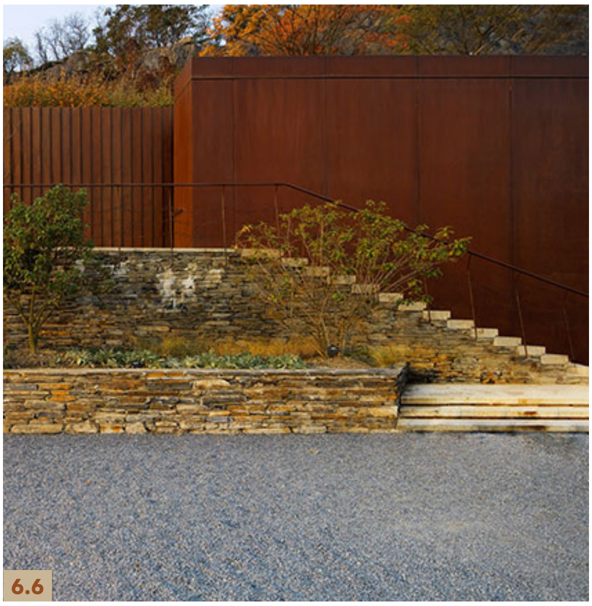
6.2.2 Quarry Garden

Program: Public park
Landscape Architect: THUPDI & Tsinghua University, Beijing

Through ecological restoration and culture reconstruction strategies, this abandoned quarry was transformed from a hazardous, inaccessible space, to an attractive landmark. Visitors can experience the magnitude of the quarry in all its honesty, as well as the natural landscape.
Based on the site analysis, the site was split into three areas, each with different design strategies to respond with the different area conditions. The Lake Area reconstructed the landform and enriched the ecological community through an understanding of oriental natural landscape culture. The Platform Area improved spatial sequence and the ability for sightseeing around the landscape. Finally, the Deep Pool Area created a dramatic route for visitors to explore the quarry from other angles (ASLA 2012).

6.2.2a Conclusions Drawn

The design unapologetically celebrates the local mining industry by allowing users to get up-close-and-personal with the "rough" areas of the quarry, such as the cliff face by the Deep Pool. This gives visitors a more enriching experience of the entire landscape in addition to the ecological and social benefits.
Furthermore, by splitting the site into different areas and strategies rather than implementing a generic strategy over the entire site, the final design was comprehensive and site specific.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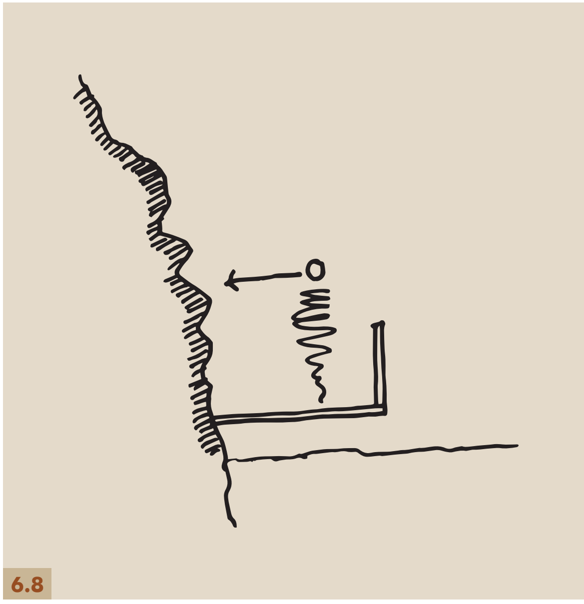
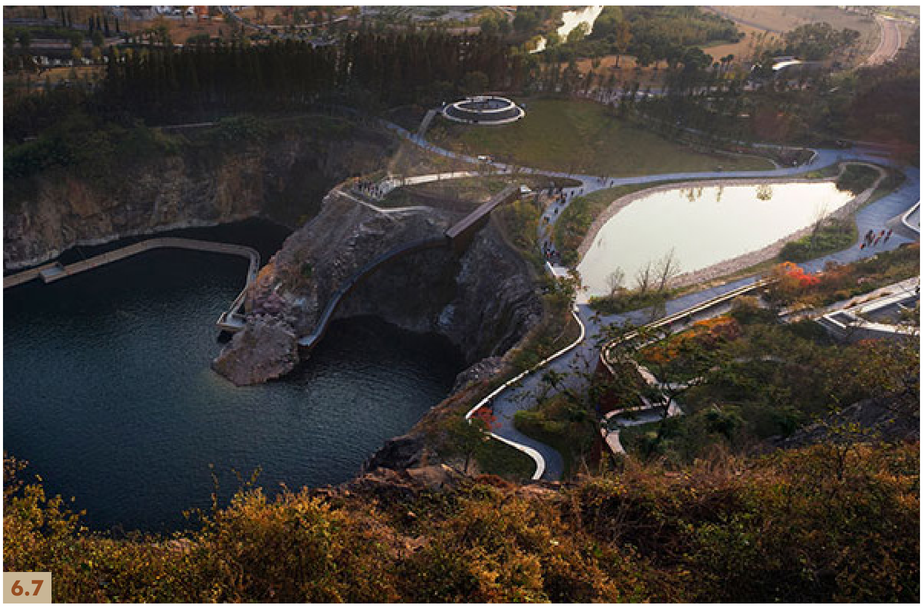

6.8

Fig. 6.6 Natural stone used at Quarry Garden (Chen 2012)
Fig. 6.7 Aerial view of Quarry Garden showing the different areas (Chen 2012)
Fig. 6.8 "Rough" areas of the site celebrated (Author 2019)
Fig. 6.9 Viewing platform at ENCI Quarry overlooking the large extent of the site (Afasia Arch Zine 2018)
Fig. 6.10 Extent of viewing platform and stairs (Afasia Arch Zine 2018)
Fig. 6.11 Steel stairs leading down ENCI Quarry (Afasia Arch Zine 2018)
Fig. 6.12 Movement and pause to take in unique elements of the site (Author 2019)


6.7

6.2.3 Recovery of The ENCI Quarry — Luikerweg Viewpoint and Stairs

Program: Viewpoint and trails
Architect: Rademacher de Vries

This scenic route is part of a larger scheme to transform the first and only cement quarry in the Netherlands into a natural reserve. First, visitors are led to panoramic views of the quarry before descending 50 metres down a staircase and into the quarry where they have intimate access to an uncommon landscape within the context. Rest areas are strategically positioned with stratigraphic transitions that mark major geological events in the history of the earth. Furthermore, the platform is symbolically aligned with the Luikerweg – the old road that used to connect The Netherlands to Belgium. When the large-scale transformation is completed, the connection between the neighbouring countries will also be restored (Afasia Arch Zine 2018).

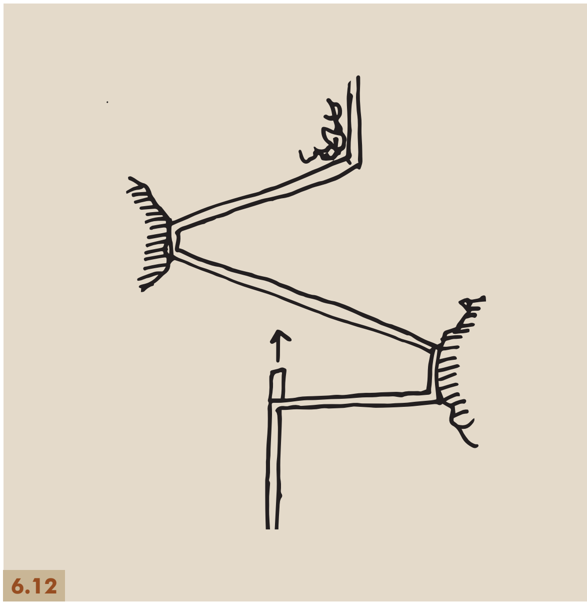
6.2.3a Conclusions Drawn

This intervention is more subdued compared to the previous two precedents. The focus here is on movement and pause – this allows visitors to appreciate aspects of the site which are probably less known to the public (such as the geological strata). Beyond the spectacular views, each quarry has unique aspects and/or qualities which can be utilised to enhance the visitors experience of the site.


6.9


6.10

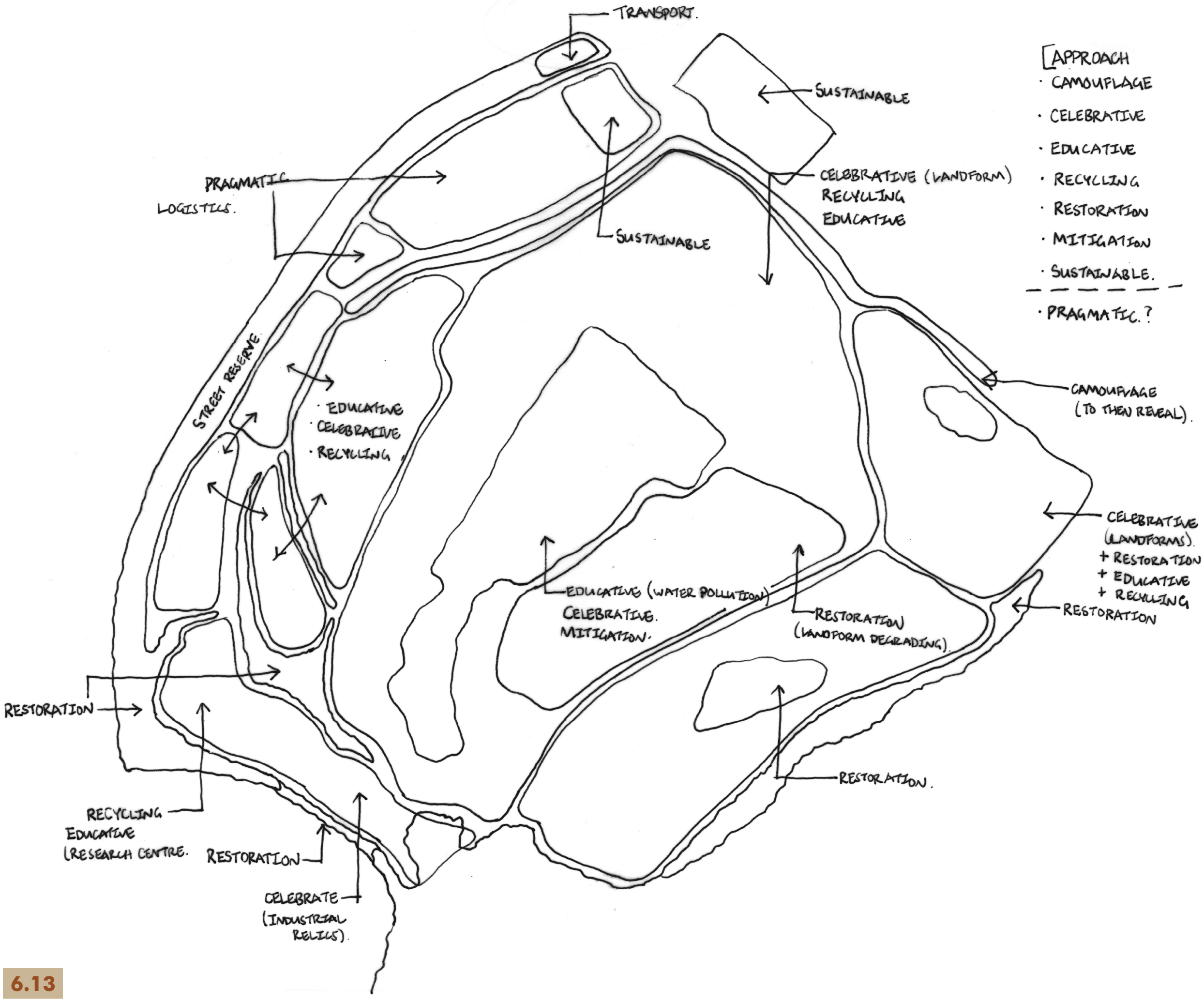

6.11


6.12

6.3 MASTER PLAN DEVELOPMENT

6.3.1 Initial Zoning

Initial zoning of the site was characterised under seven general sub-approaches set out by Mira Engler (1995). These sub-approaches are: camouflage, restoration, recycling, mitigation, sustainable, educative and celebrative. Engler applied these sub-approaches to "waste landscapes" – literally disposal and treatment facilities; however these sub-approaches are equally relevant to wasted sites in general (such as Quarry X). As the master plan was iterated, the sub-approaches were shifted and/or added/subtracted from each area.



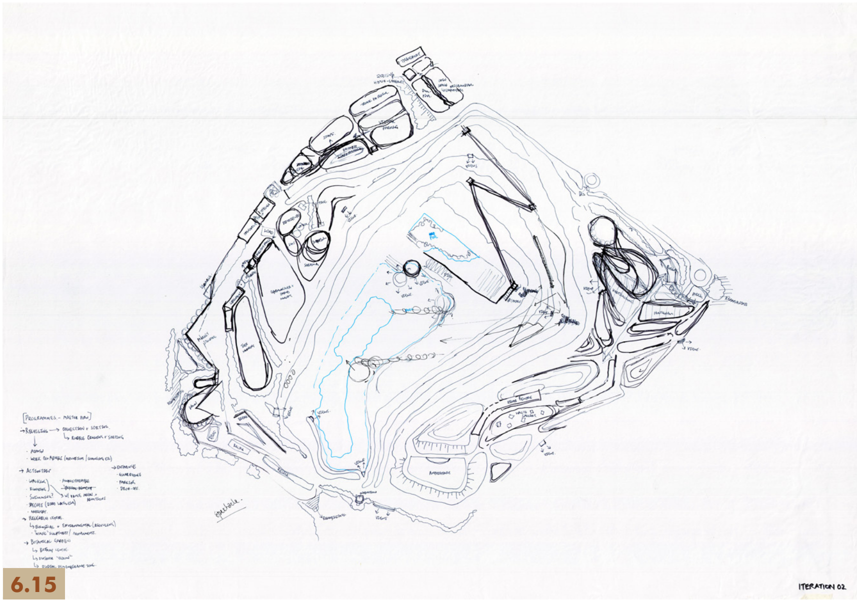
6.13

Fig. 6.13 Initial Master Plan zoning (Author 2019)

6.3.2 Development of Master Plan

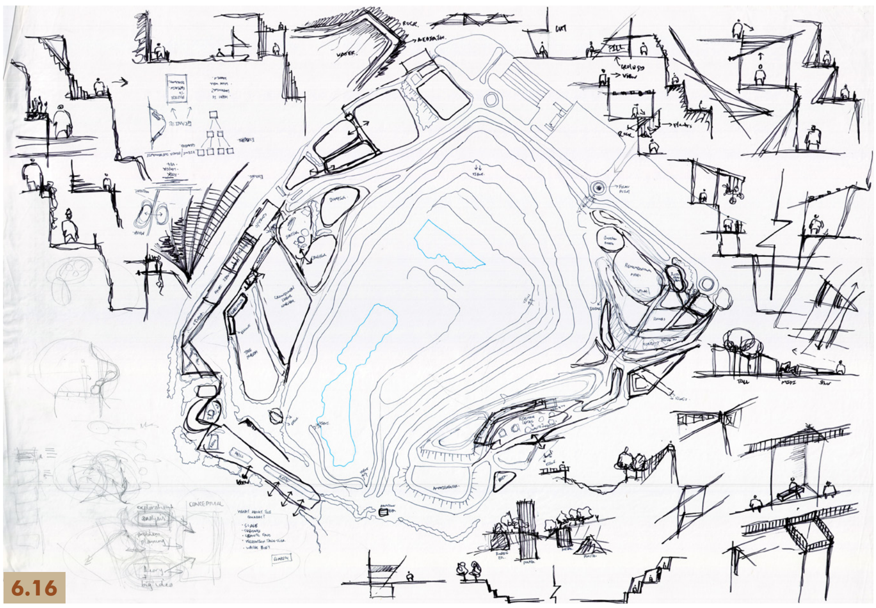
6.14

Fig. 6.14 Early master plan drawing. All areas have a programme. Major experiential walkway in/out of quarry. (Author 2019)



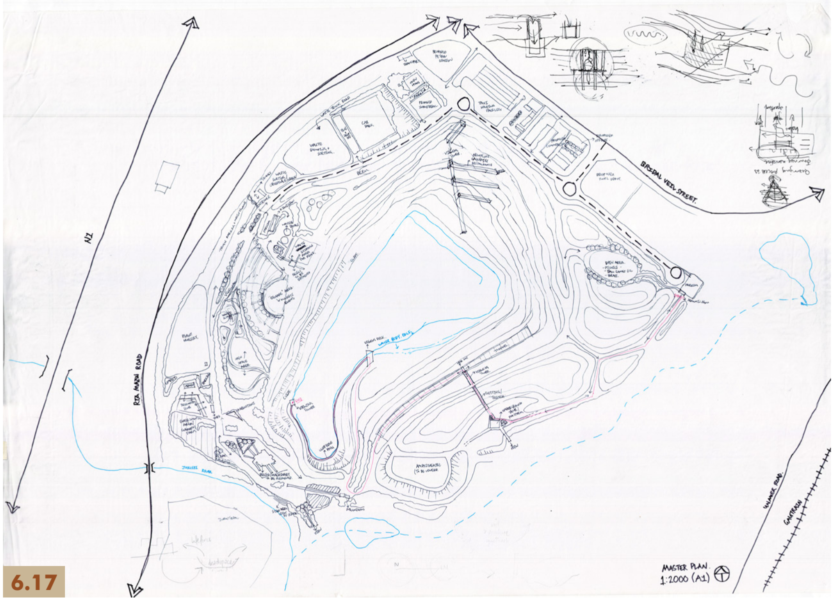
6.15

Fig. 6.15 Changes made to "biodiversity hub" in the east corner (Author 2019)



6.16

Fig. 6.16 Exploring slope treatment to create break areas along terraces (Author 2019)

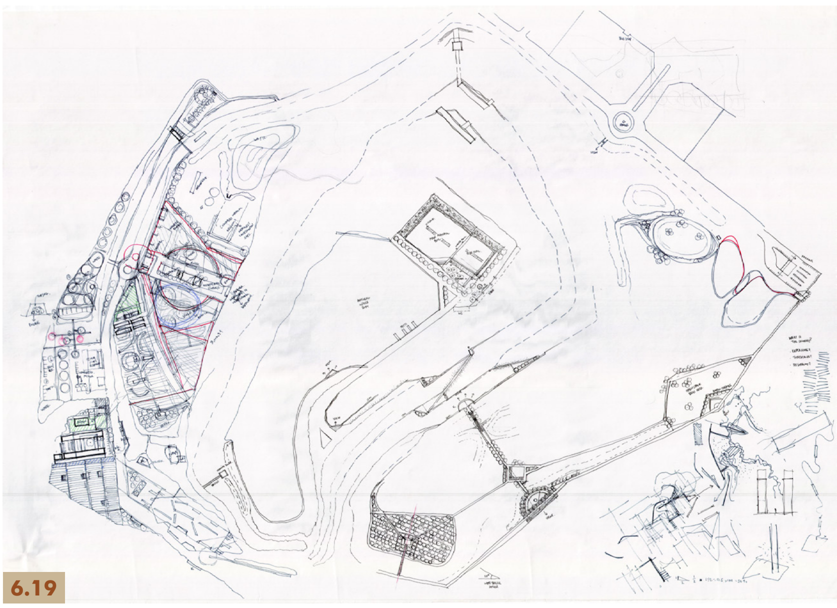


6.17

Fig. 6.17 Active programmes moved to the west area of site. Addition of buildings within quarry (Author 2019)

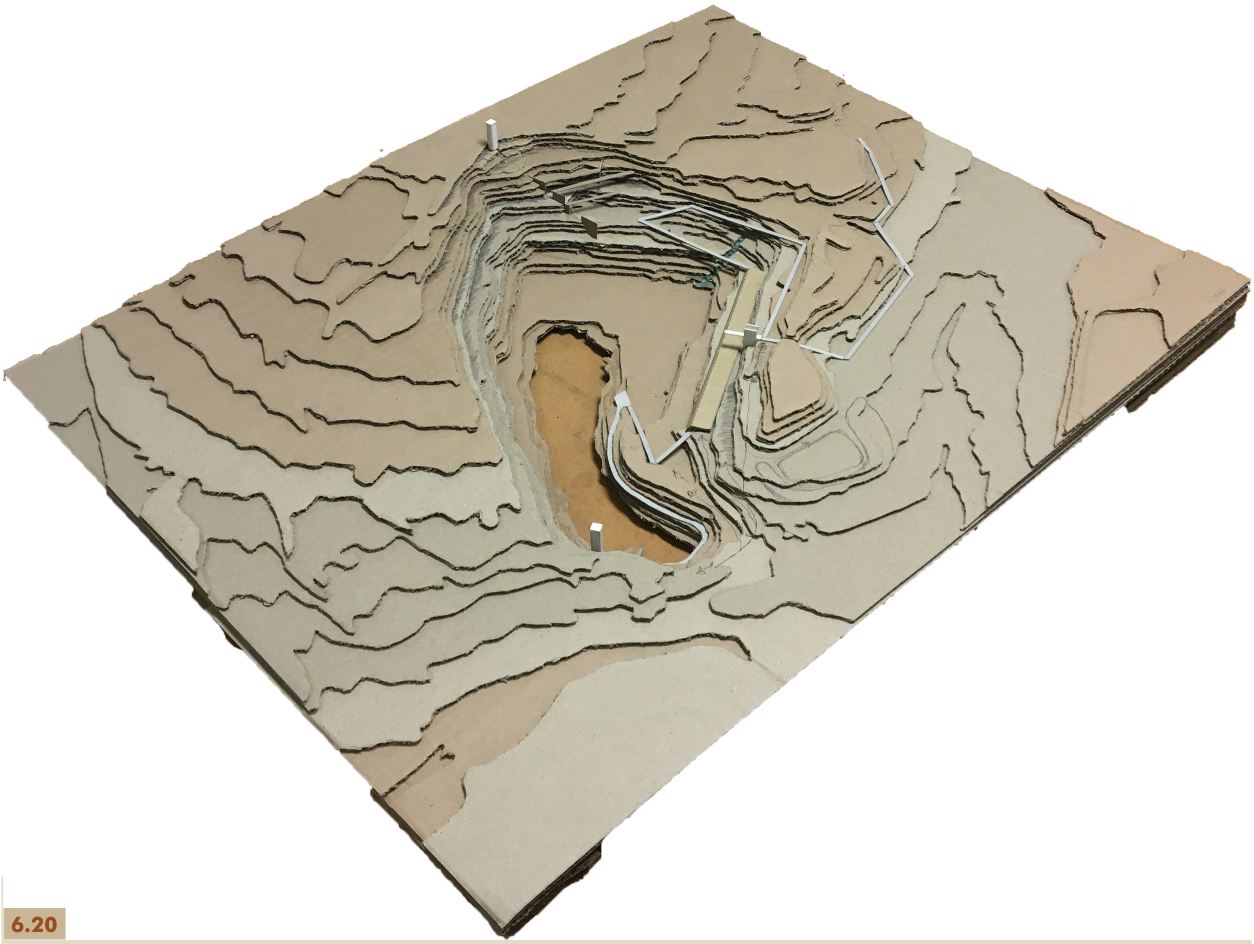
6.18

Fig. 6.18 Exploration of experiential walkway to the east of site. Addition of natural pool at the bottom of quarry (Author 2019)



6.19

Fig. 6.19 Formalisation of areas (Author 2019)



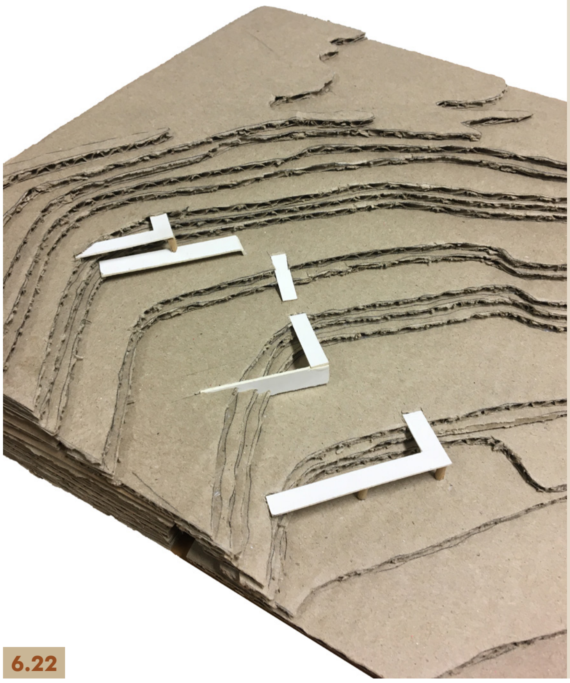
6.20

Fig. 6.20 Model exploring experiential walkway in/ out of quarry, with viewing platforms and viewing towers at key intervals (Author 2019)

6.3.3 Moments within Master Plan

6.21

Fig. 6.21 Model exploration of main lookout point (Author 2019)



6.22

Fig. 6.22 Model exploration of restaurant, event space, gallery and viewing platform (Author 2019)

6.4 FINAL MASTER PLAN

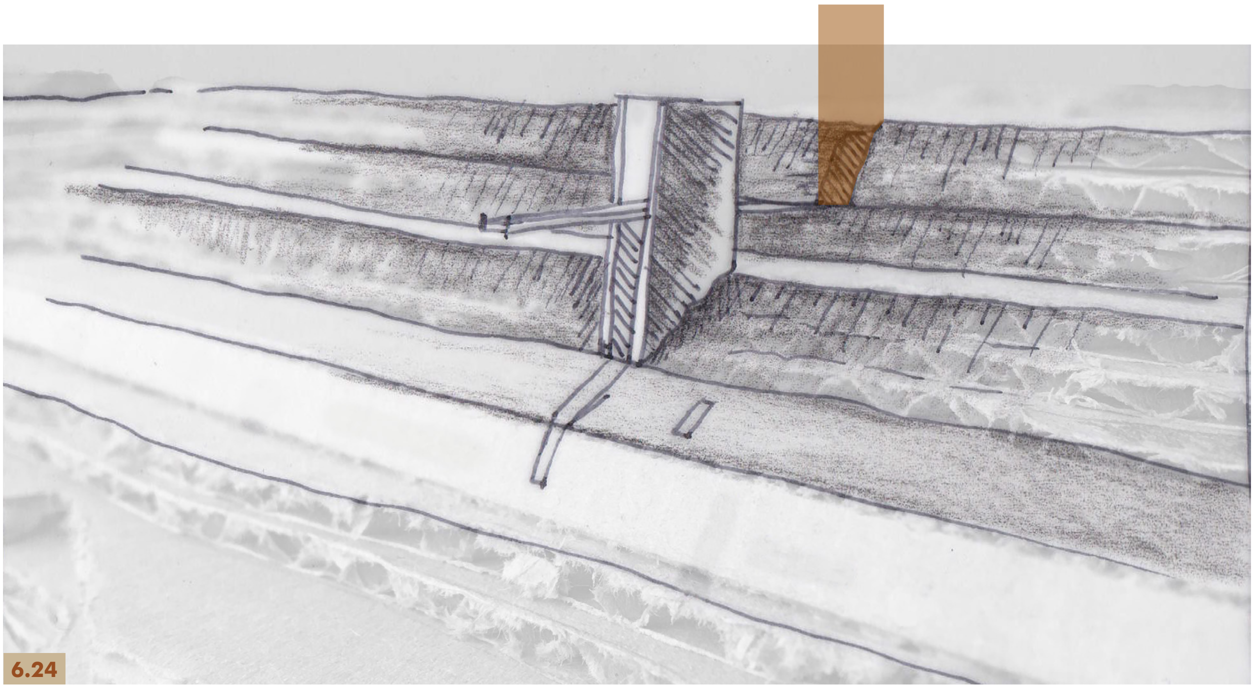
6.23

LEGEND

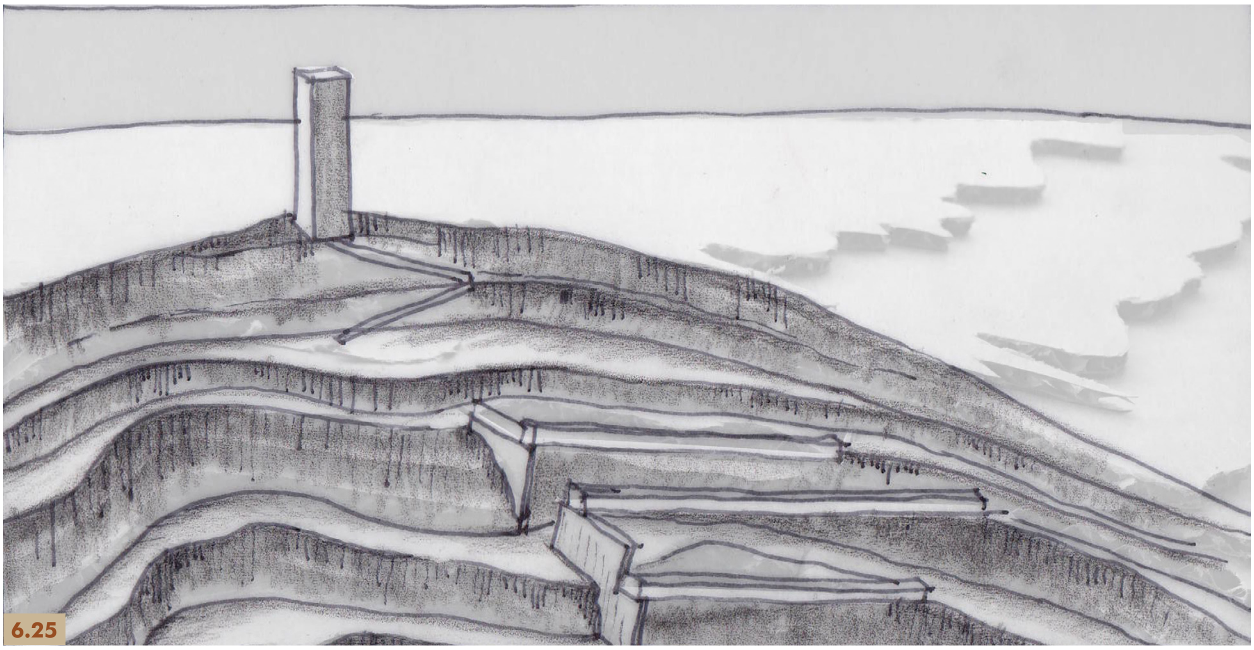
1. Parking
2. Stockpile Square
3. Café
4. Plant nursery
5. Reservoir
6. Builders' rubble sorting, processing and distribution
7. Paper, plastic, glass (from visitors) sorting and distribution
8. Biodiversity research hub
9. Experimental farm
10. Relic Square
11. Viewing tower
12. Jetties
13. Constructed wetland
14. Viewing platform
15. Restaurant, event space and gallery
16. Great lawn
17. The Settlement
18. Ramped terraces
19. The Cut
20. The Sublime and The Descent
21. Pool

Fig. 6.23 Final Master Plan. Not to scale (Author 2019)

6.4.1 Master Plan Perspective Images



6.24



6.25

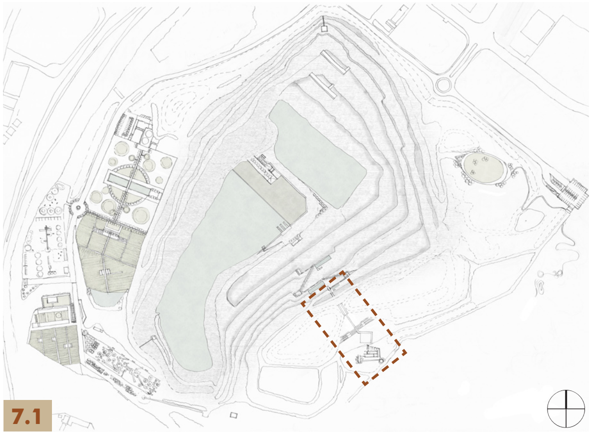
Fig. 6.24 Perspective of The Sublime, indicating entrance/exit through mound (Author 2019)
Fig. 6.25 Perspective of viewing tower and horizontal spanning restaurant, event space and gallery on quarry terraces (Author 2019)

7

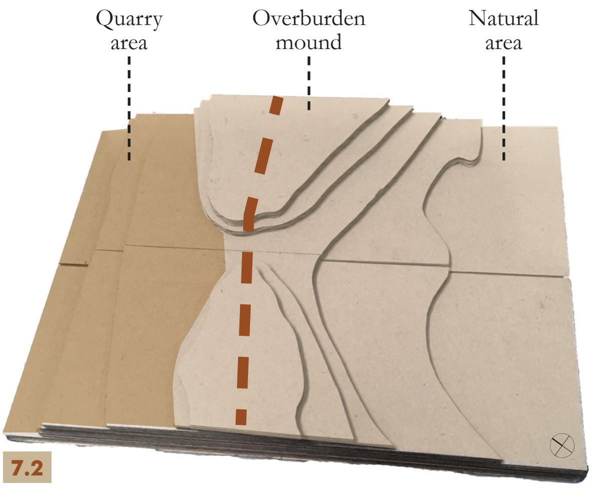
DESIGN DEVELOPMENT: SKETCH PLAN

7.1 INTRODUCTION

The sketch plan area focuses on part of the experiential route into and down the quarry (Figure 7.1) which is inspired by Midrand's cultural resources. The area was chosen as there is a distinct transition between the "outside," natural area of the site, and the "inside," artificial quarry (Figure 7.2). This transition is made even more apparent as an overburden mound separates the two sides. A powerful and meaningful route can be designed (using a minimal design approach) which capitalises on this visual and spatial contrast.



7.1



7.2

Fig. 7.1 Master Plan indicating Sketch Plan area (Author 2019)
Fig. 7.2 Two distinct areas separated by an overburden mound (Author 2019)

7.2 PRECEDENT

7.2.1 Cultural Landscape Path in the Regional Park of The Minci

Location: Virgilio, Mantova, Italy
Program: Rest areas
Architect: Archiplan Studio
Completion: 2013

This project consists of five lightweight structures or "landmarks" along a pedestrian path that runs along the bank of a river. The path is located within a historically and culturally significant landscape where the cultural attraction is the figure of the Roman poet Virgil. His poetry is integrated with the river landscape through the series of structures.
The rest areas and accompanying structure are: the "door courier" (Figure 7.3) which is placed to correspond with an ancient post road, and emphasizes its geographical position. The "gate of the fort" (Figure 7.4) is configured as formal reference marks and the presence of the nearby fort of Pietole from which he draws the figures of bastions. The "gateway to the Eclogues" points metaphorically to the landscape fragment described by Virgil in his poems. The "door of the Georgics," placed at the same Virgilian ancient court, represents the balance between nature and man's work sung by Virgil in his opera. Finally, the "door of Travata" located in a pumping station of the 20th century celebrates man's attempt to govern the natural element of water (Landezine 2013).

Conclusions drawn
Physical site conditions and Virgil's poetry is not interpreted too literally by the designers – this results in a thoughtful design response which does not distract from the surrounding cultural landscape, but draws attention to aspects within it. Moreover, the restricted material palette and use of weathered steel for all the structures creates unity between the "family" of installations.

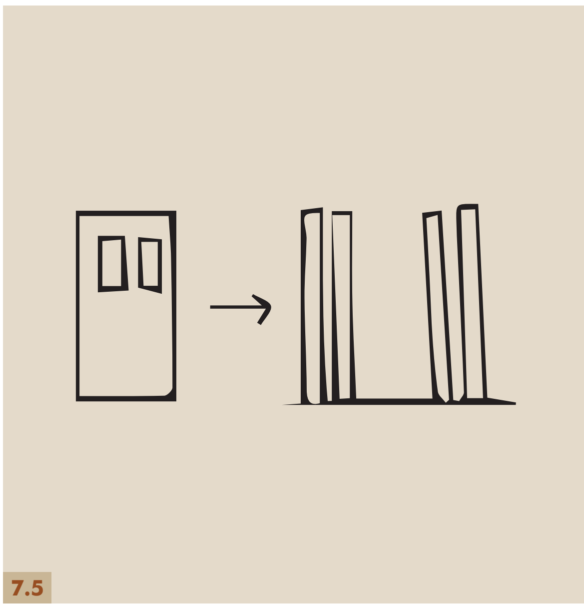


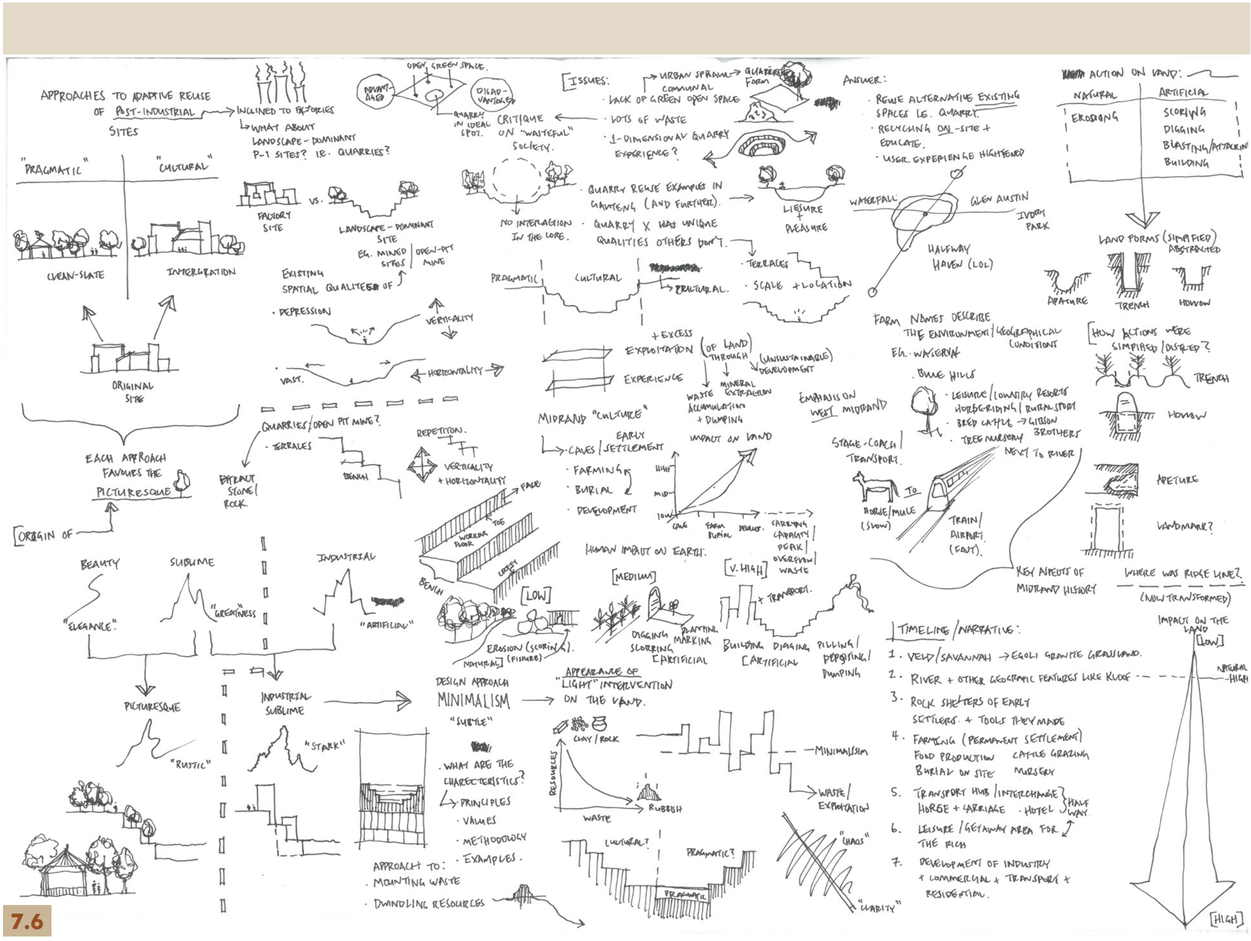
Fig. 7.3 The "door courier" (Mambrin 2013)
Fig. 7.4 The "gate of the fort" (Mambrin 2013)
Fig. 7.5 Inspirational for design not interpreted too literally (Author 2019)

7.3 CONCEPT

The concept began to take form after an all-encompassing exploration of the themes and research presented thus far (Figure 7.6): unsustainable waste management practices, lack of public green open space, urban sprawl, the industrial sublime, narrative in landscape and minimalism. Key elements were extracted and summarised in a conceptual mind-map (Figure 7.7). Quarry X, and the context Quarry X is situated in, has been subject to different forms of exploitation and excavation. The land is exploited (made use of) for beneficial purposes – whether it is to conceal waste or grow crop. The forms of exploitation stated in the mind-map undoubtedly impact the land to varying extents. This exploitation is performed through excavation methods – of which five spatial forms were identified.

The new, experiential, layer derives cues from these spatial forms – this will be further explored in this chapter. The experiential layer also acts as a sobering reaction against the "excess" that the exploitation and excavation layers represent. The notion of contrast was first brought up in the conclusion of the industrial sublime section of the Theory chapter, where a minimal landscape design approach was seen as appropriate.

Fig. 7.6 Exploration of concept (Author 2019)
Fig. 7.7 Mind-map of concept (Author 2019)



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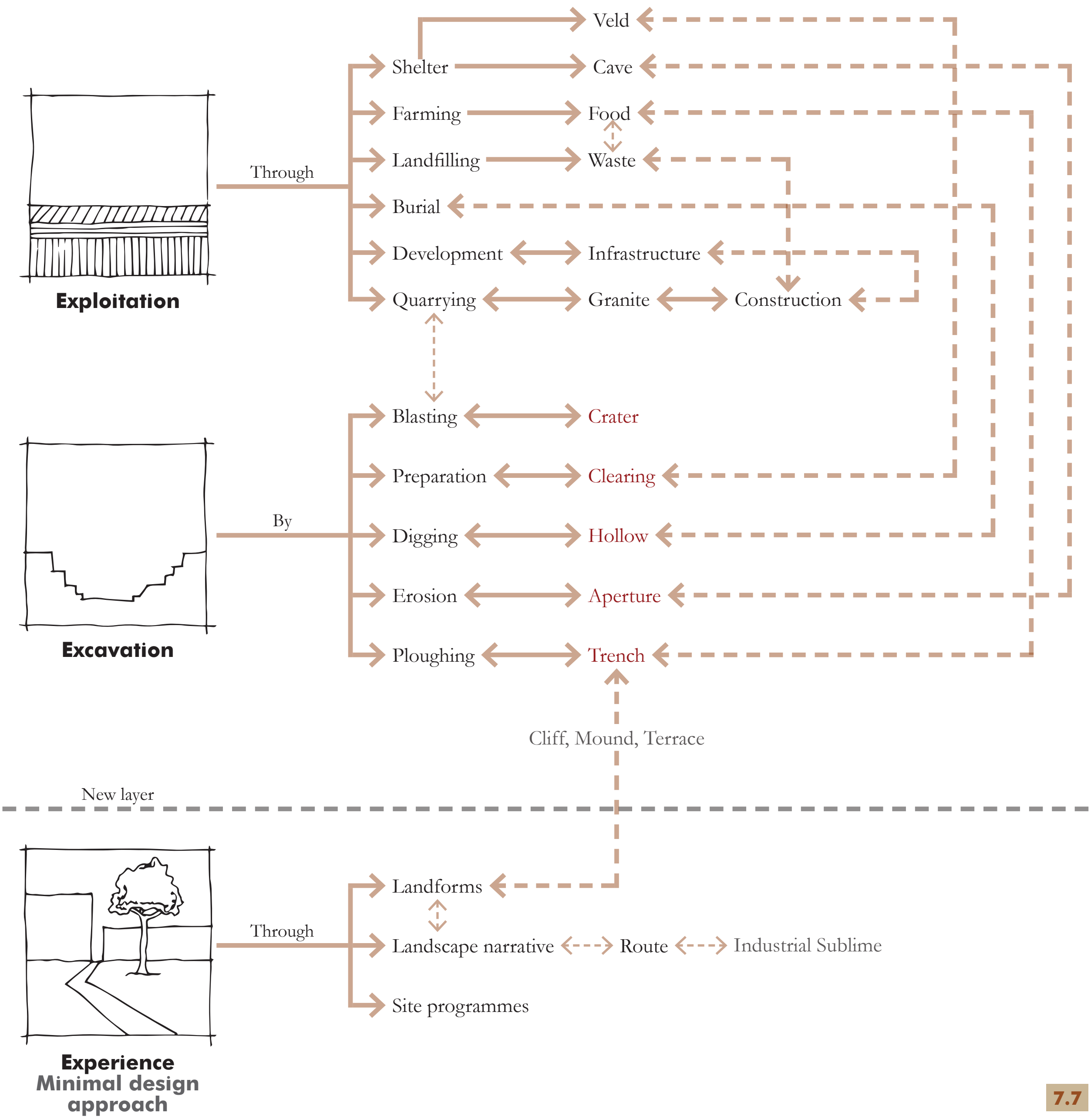
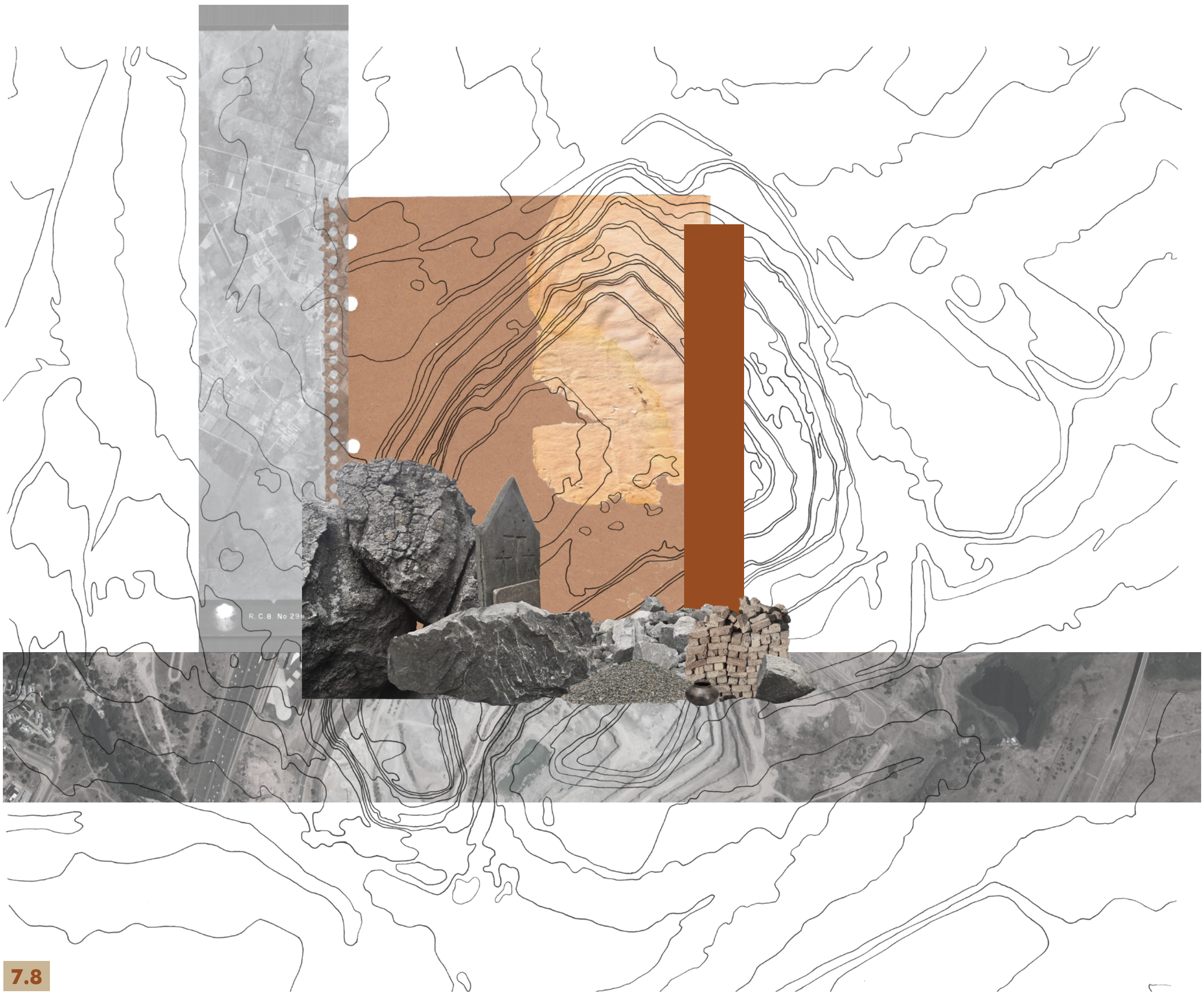

Veld
Shelter
Cave
Farming
Food
Landfilling
Waste
Burial
Development
Infrastructure
Quarrying
Granite
Construction
Through
Exploitation
Blasting
Crater
Preparation
Clearing
By
Digging
Hollow
Erosion
Aperture
Ploughing
Trench
Excavation
Cliff, Mound, Terrace
New layer
Landforms
Through
Landscape narrative
Route
Industrial Sublime
Site programmes
Experience
Minimal design approach

7.7

7.4 THE NARRATIVE

7.4.1 Summary

As mentioned in the "Narrative in Landscape" section in the Theory chapter, a narrative embedded in the landscape can inform the spatial landscape design and communicate a local sense of place.
In line with keeping an open narrative, as Potteiger and Purinton (1998) recommend, inspiration for the narrative was derived from Midrand's cultural resources and what was interpreted by the author as the "accumulation of excavation and exploitation in Midrand" (Figure 7.8). These cultural resources exhibit stories of multiple "authors." The narrative is summarised in Table 7.1 according to two of the realms outlined by Potteiger and Purinton's (1998b:137) [see Page 68 for full description of realms]. In addition, spatial forms extracted from each phase of the story is also included.



7.8

Fig. 7.8 Conceptual image of the accumulation of excavation and exploitation in Midrand (Author 2019)

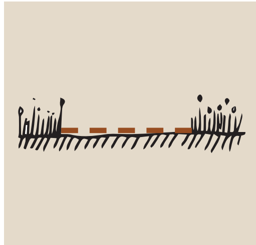
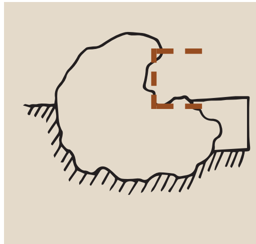
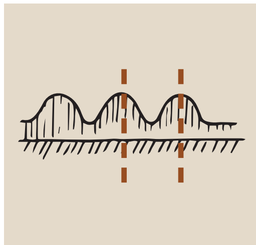
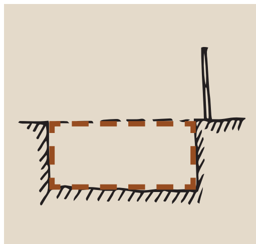
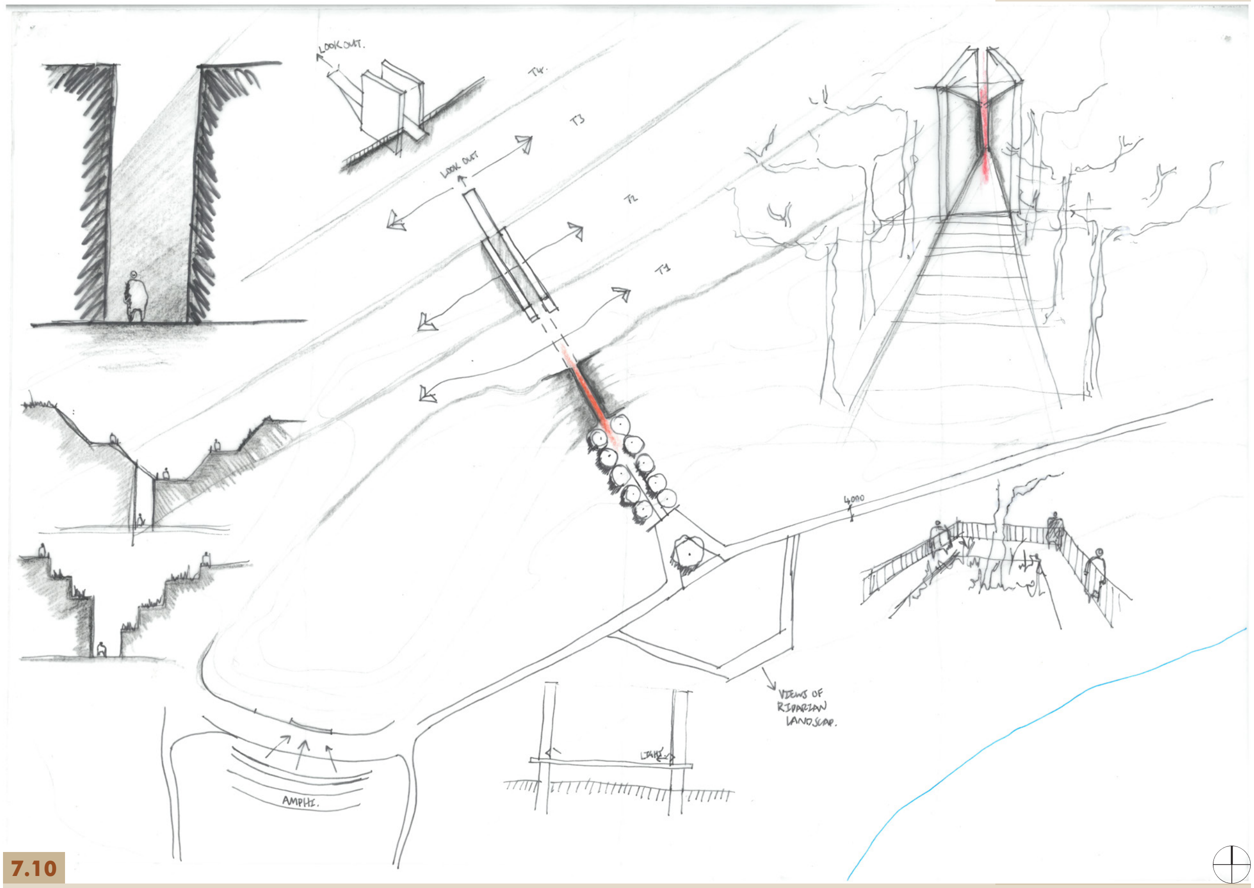
STORY REALM	CONTEXTUAL REALM	SPATIAL FORM
Hunter-gathering	 Mia archaeological site	 Clearing
Hunter-gathering	 Glenferness Cave Rocky granite outcrop	 Aperture
Cultivating	 Brick ruins; Farmhouse; Pine tree lane; Water furrow	 Trench
Burying	 Cemeteries Burial sites	 Hollow
Extracting	 Quarry X	 Crater

Table 7.1

Table 7.1 The narrative summarised according to two of the realms outlined by Potteiger and Purinton's (1998b:137), with spatial forms extracted from each phase of the story (Author 2019)

7.9



7.10

Fig. 7.9 Exploration of spatial forms using foam (Author 2019)
Fig. 7.10 Initial sketches imagining the Sketch Plan area. Not to scale (Author 2019)

7.4.2 The Arrangement and Naming of Zones within the Narrative

The arrangement of the narrative naturally called for the naming of the key zones within it. Naming not only bestows identity to each zone, but Potteiger and Purinton (1998) believe that naming assist in situating a place within its larger context. The names of each zone (in order) are: The Settlement, The Cut, The Sublime and The Descent (Figure 7.11).

The Settlement is situated on the natural side of the mound and represents the earliest cultural resources pertaining to Midrand's history of hunter-gathering, agriculture and associated burial.

Once visitors exit The Settlement, they ascend towards **The Cut**. The Cut represents the stark and dramatic transition from the relatively "idyllic" landscape the visitor has left behind, and are now faced with the vast, extractive landscape.
As the visitor starts to lower into the quarry, they can begin to take in its enormity and alternative beauty.

But it is not until they reach the look-out area do they see the full extent of Quarry X. Hence naming this zone **The Sublime**, as the scene they witness would be truly breathtakingly – the full extent of the sheer scale, the repetitive terraces, the cliffs and the large waterbody. This zone also demands a moment of contemplation and realisation – of the (negative) impact we as human have on our own environment.

After such an overwhelming experience, **The Descent** offers some respite while still allowing larger views of the quarry during the descent. While The Sublime views the quarry on a macro, public scale, The Decent allows the visitor to observe the Quarry on a micro, intimate scale – such as the texture of the granite rock face.

Although the zones are arranged in this manner, it will obviously not be experienced by every visitor in the order outlined above.

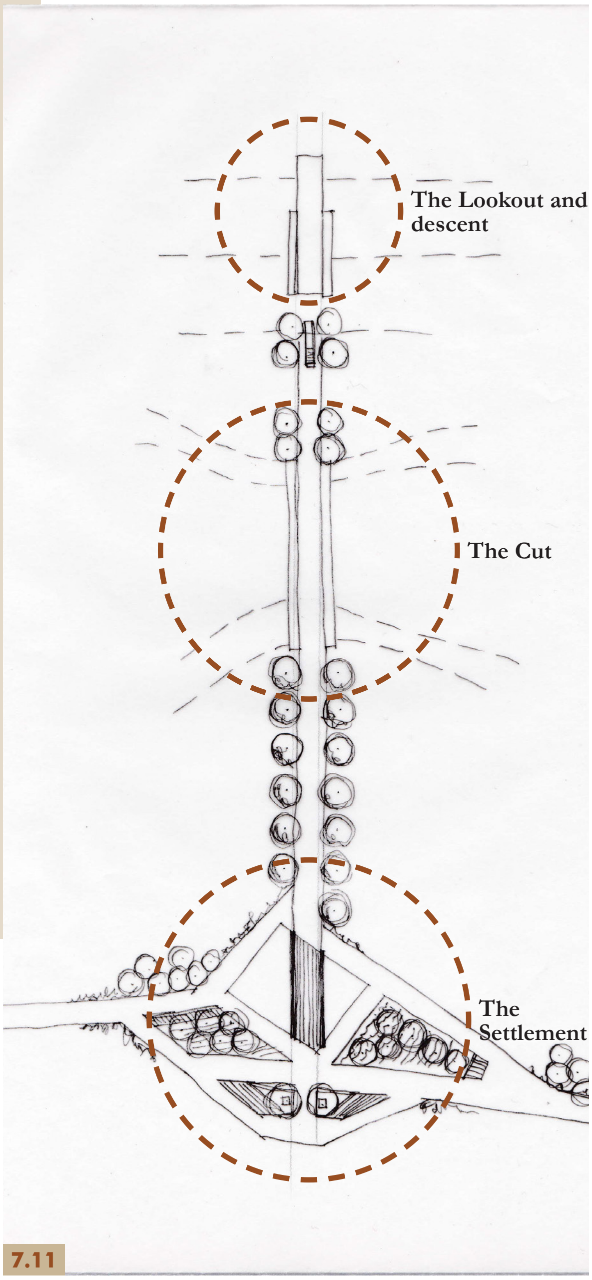
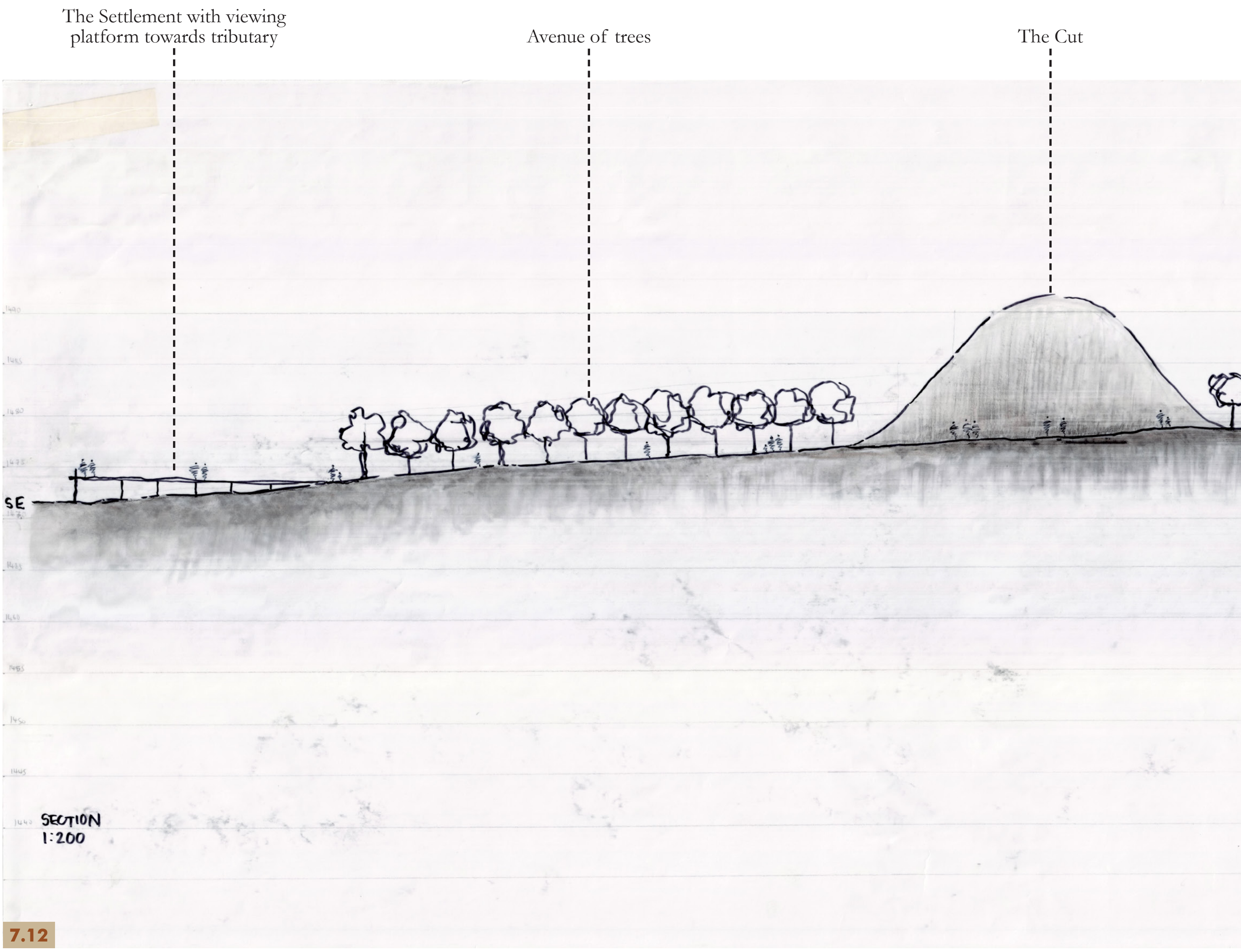
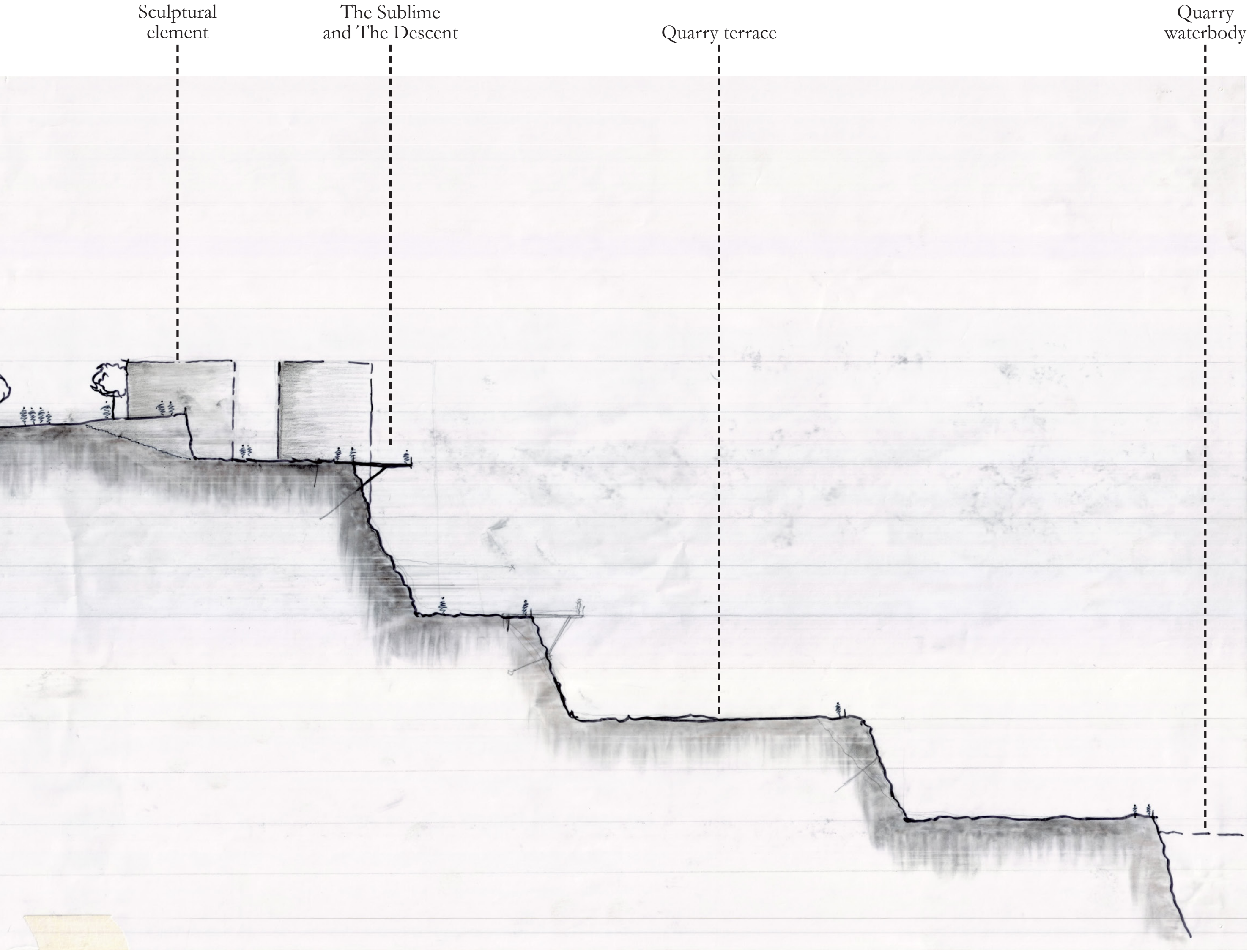


Fig. 7.11 Exploration of sketch plan area highlighting the different zones. Not to scale (Author 2019)

Fig. 7.12 Section through exploration of sketch plan area. Not to scale (Author 2019)

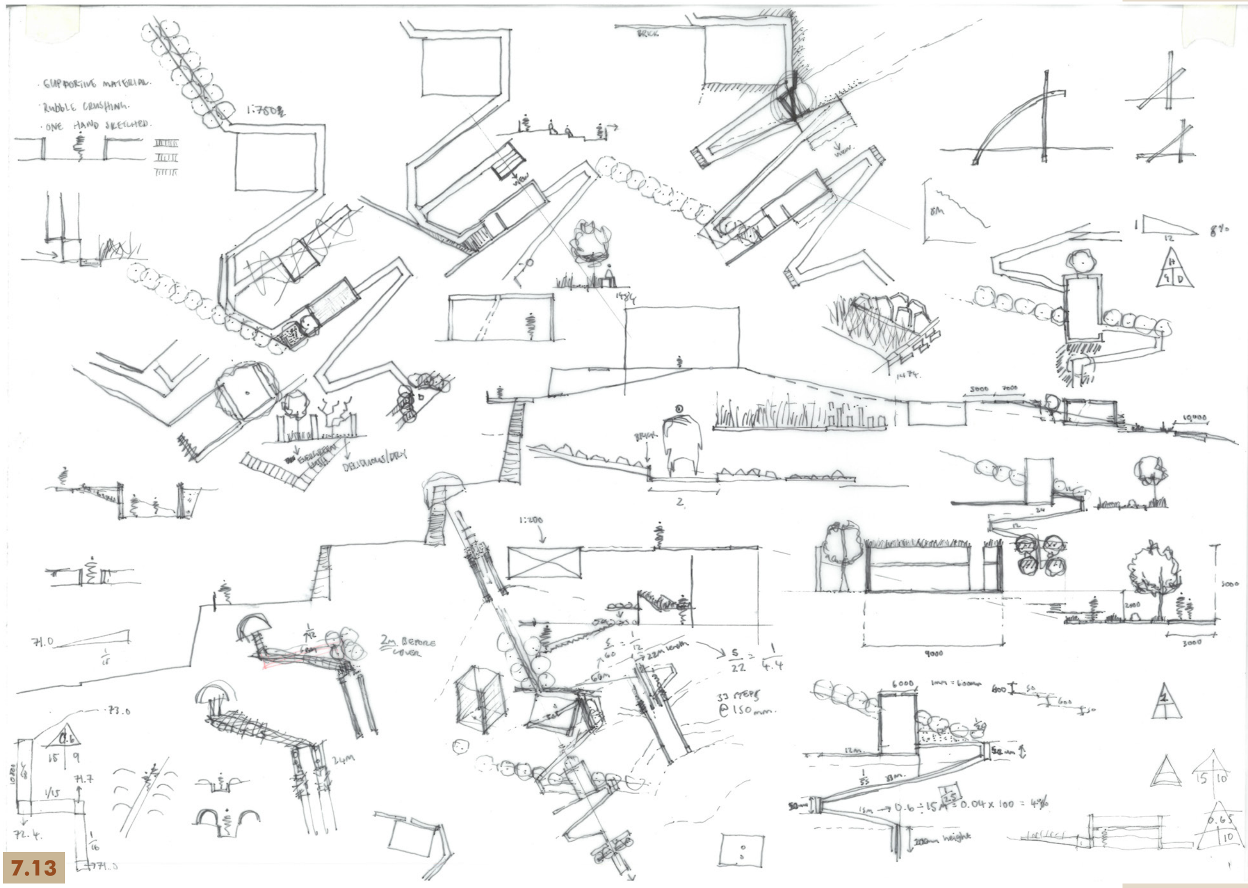



Sculptural element
The Sublime and The Descent
Quarry terrace
Quarry waterbody

7.5 THE DESIGN

7.5.1 Exploration of The Settlement

The development of The Settlement was focused around the spatial form of the clearing, trench, hollow and aperture (Figure 7.14) – which were informed by the cultural resources in Midrand (Refer to Table 7.1).



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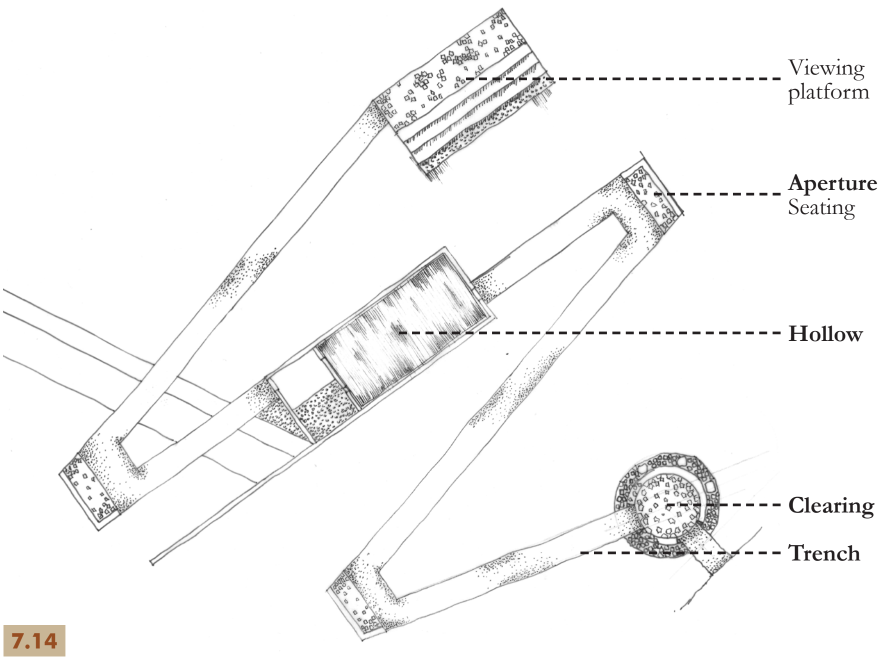

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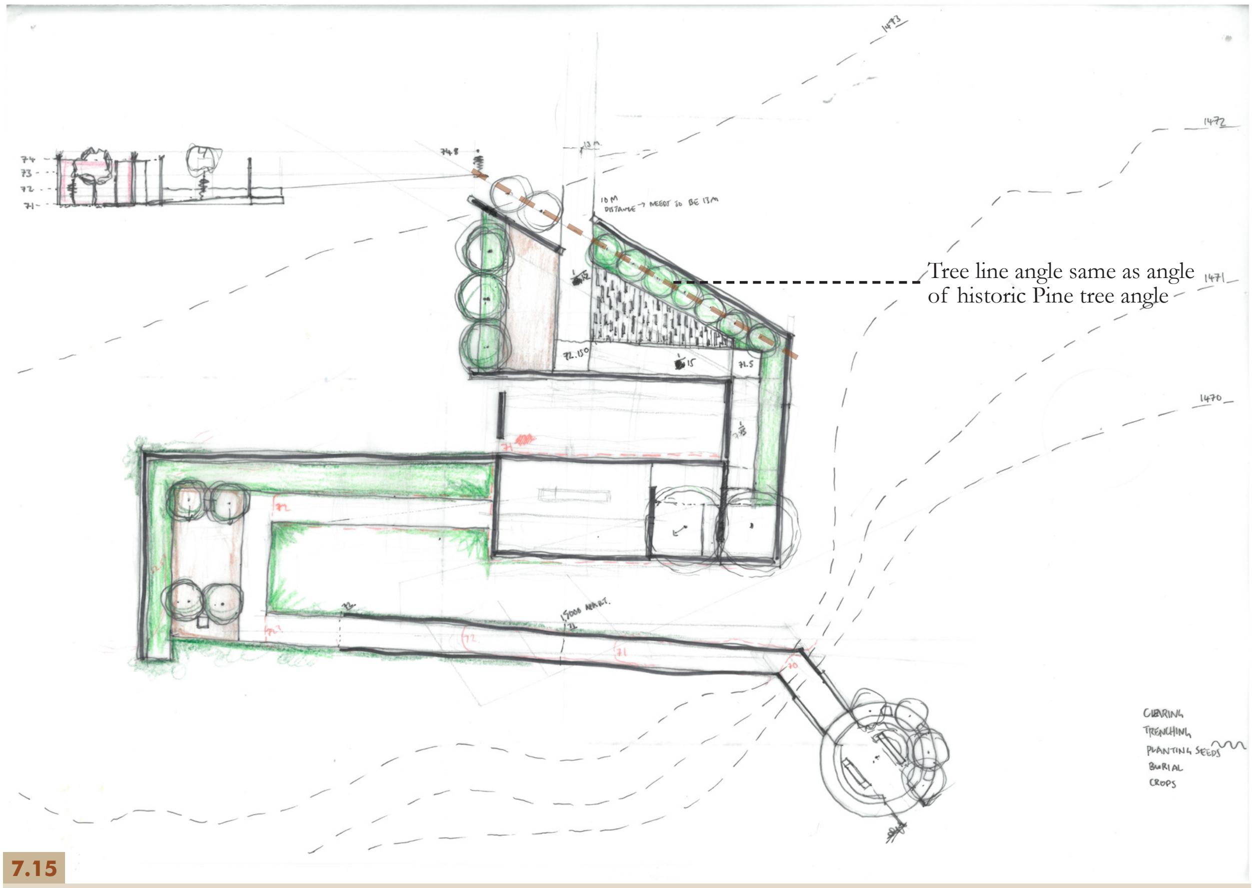
Fig. 7.13 Initial explorations of The Settlement (Author 2019)
Fig. 7.14 Early iteration of The Settlement highlighting the spatial forms. Not to scale (Author 2019)



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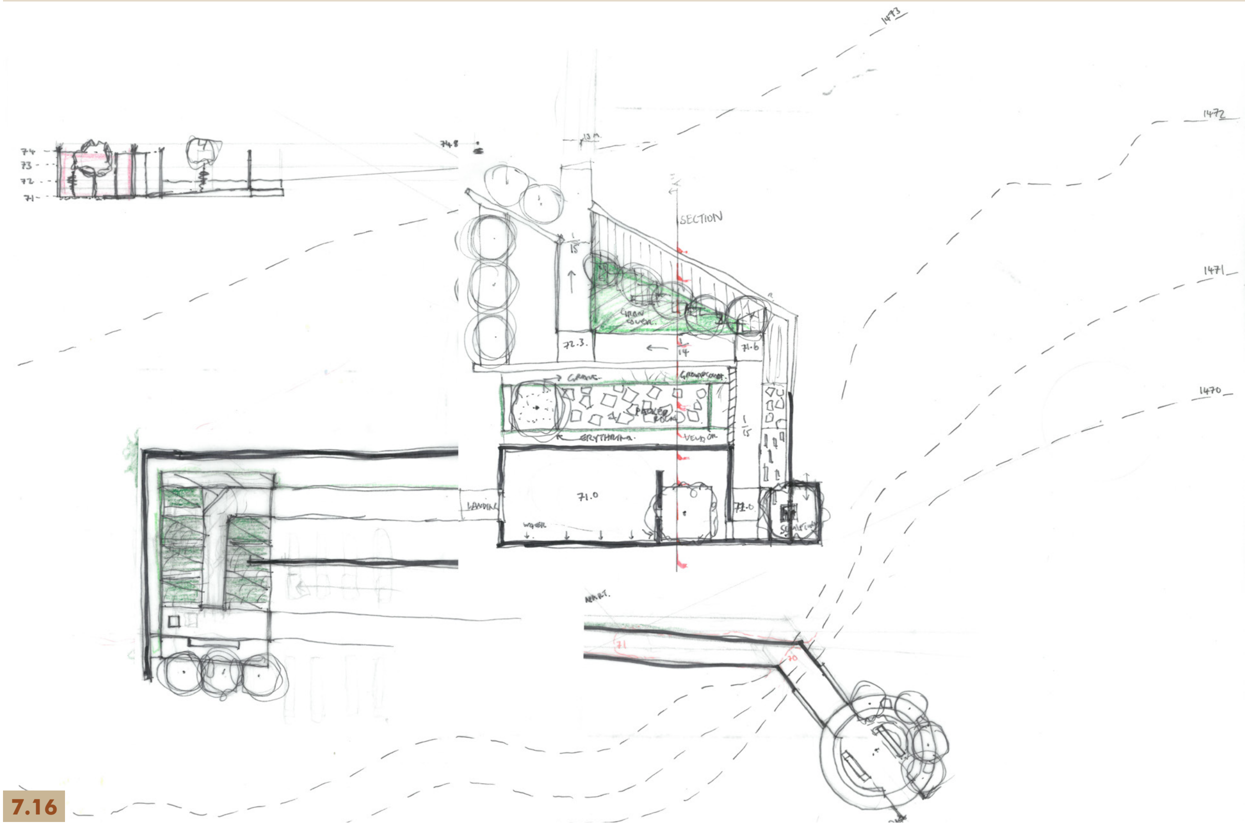

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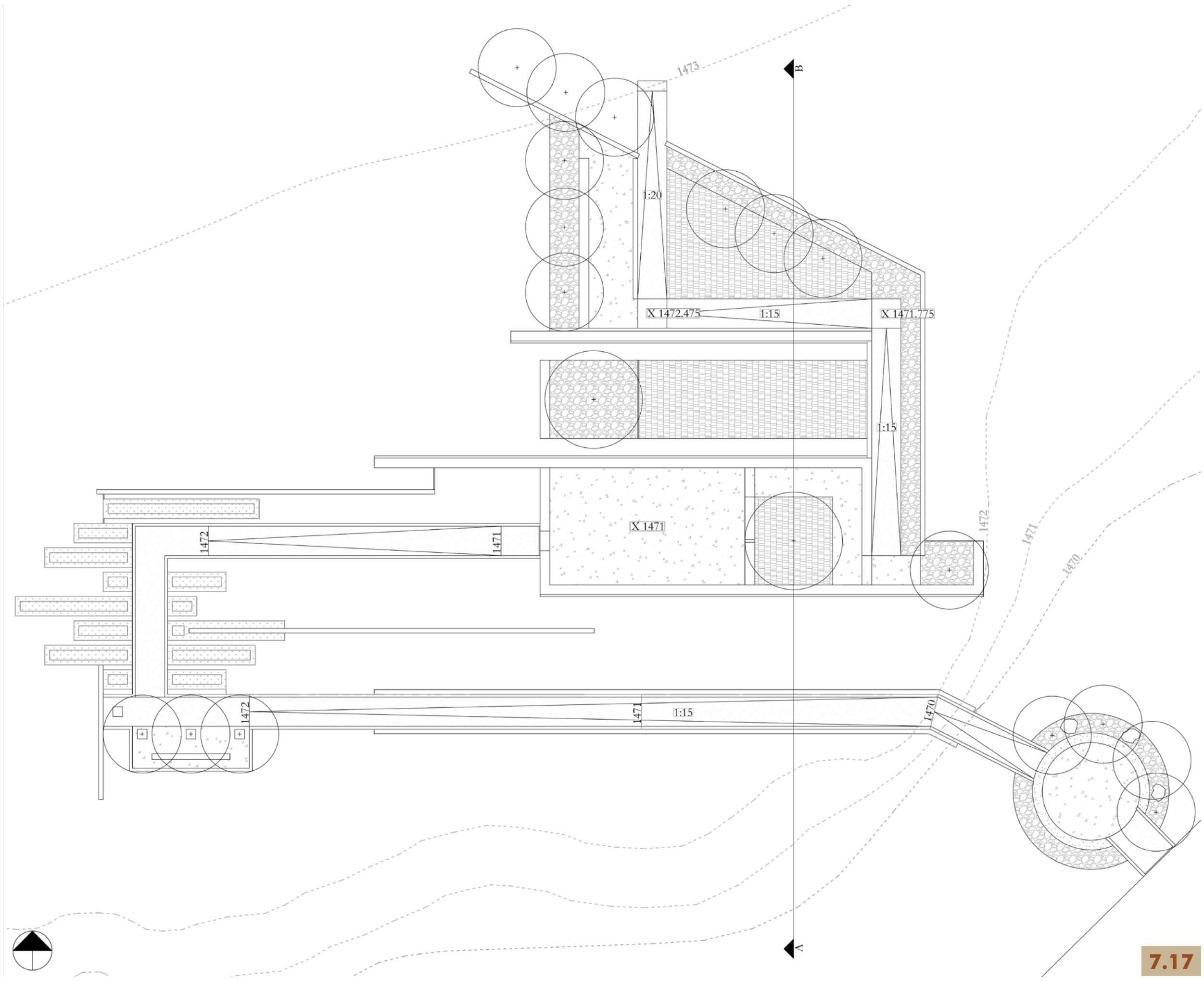
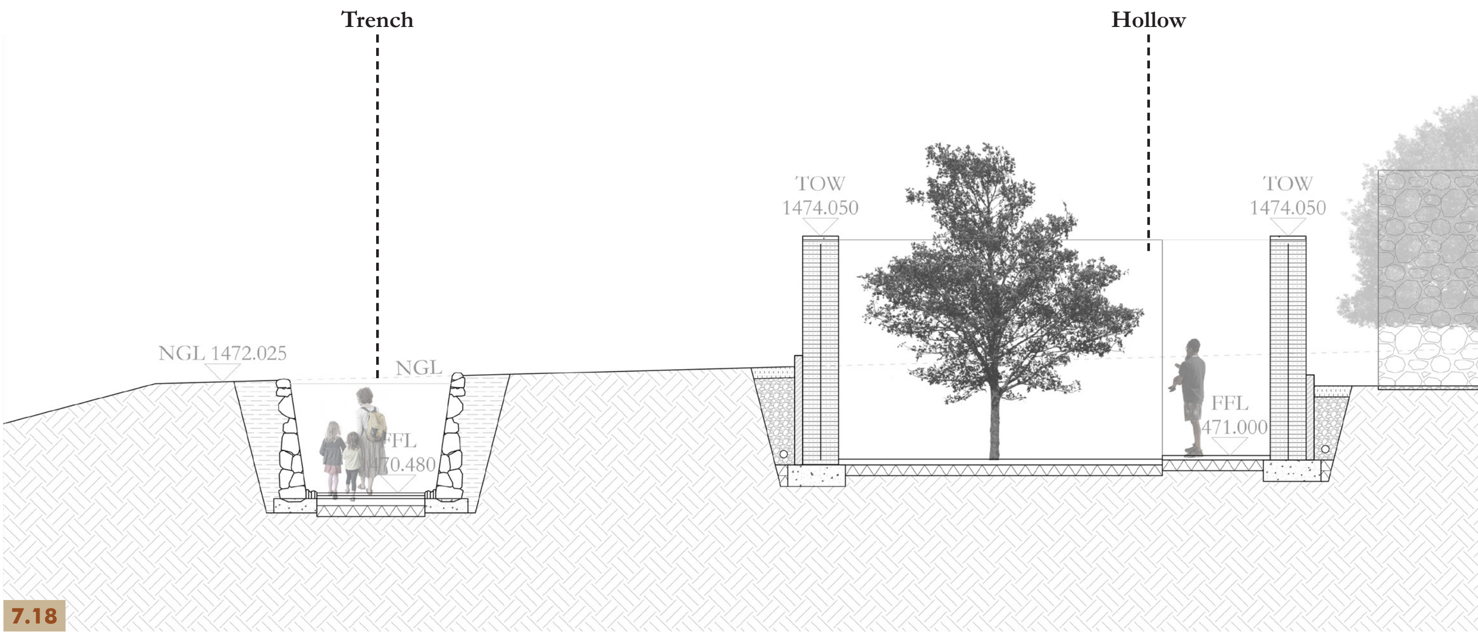
Fig. 7.15 Developed iteration of The Settlement. Not to scale (Author 2019)
Fig. 7.16 Further development of The Settlement. Not to scale (Author 2019)


1473
B
1:20
X 1472.475
1:15
X 1471.775
1:15
X 1471
1472
1471
1472
1471
1470
1472
1471
1:15
1470
A

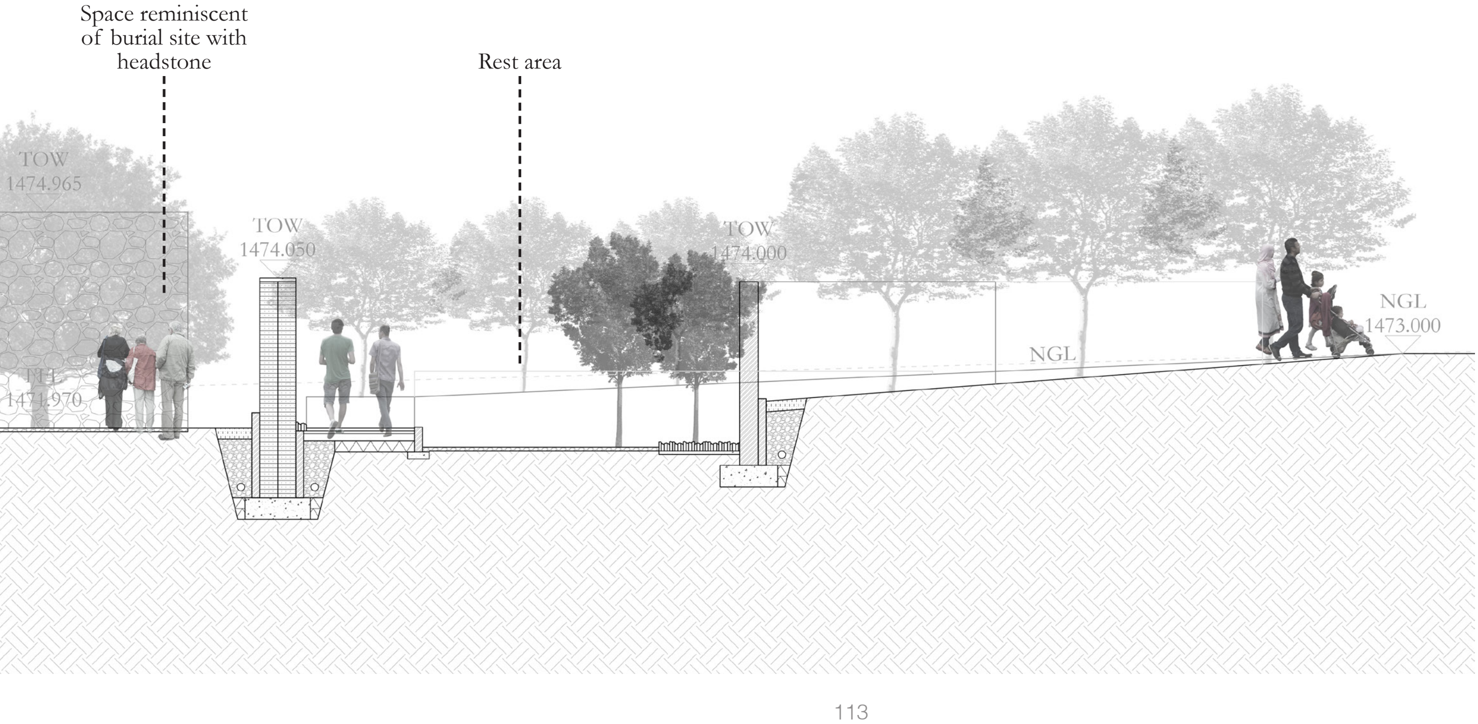
7.17


Trench
Hollow
TOW
1474.050
TOW
1474.050
NGL 1472.025
NGL
FFL
1470.480
FFL
1471.000

7.18

To strengthen the open narrative, the narrative is not represented too literally. Elements of the design have been simplified and/or abstracted – leaving the interpretation of the design to the visitor. This is in line with the minimal design approach of symbolism.

Fig. 7.17 The Settlement iteration. Not so scale (Author 2019)
Fig. 7.18 Section through The Settlement iteration. Not to scale (Author 2019)

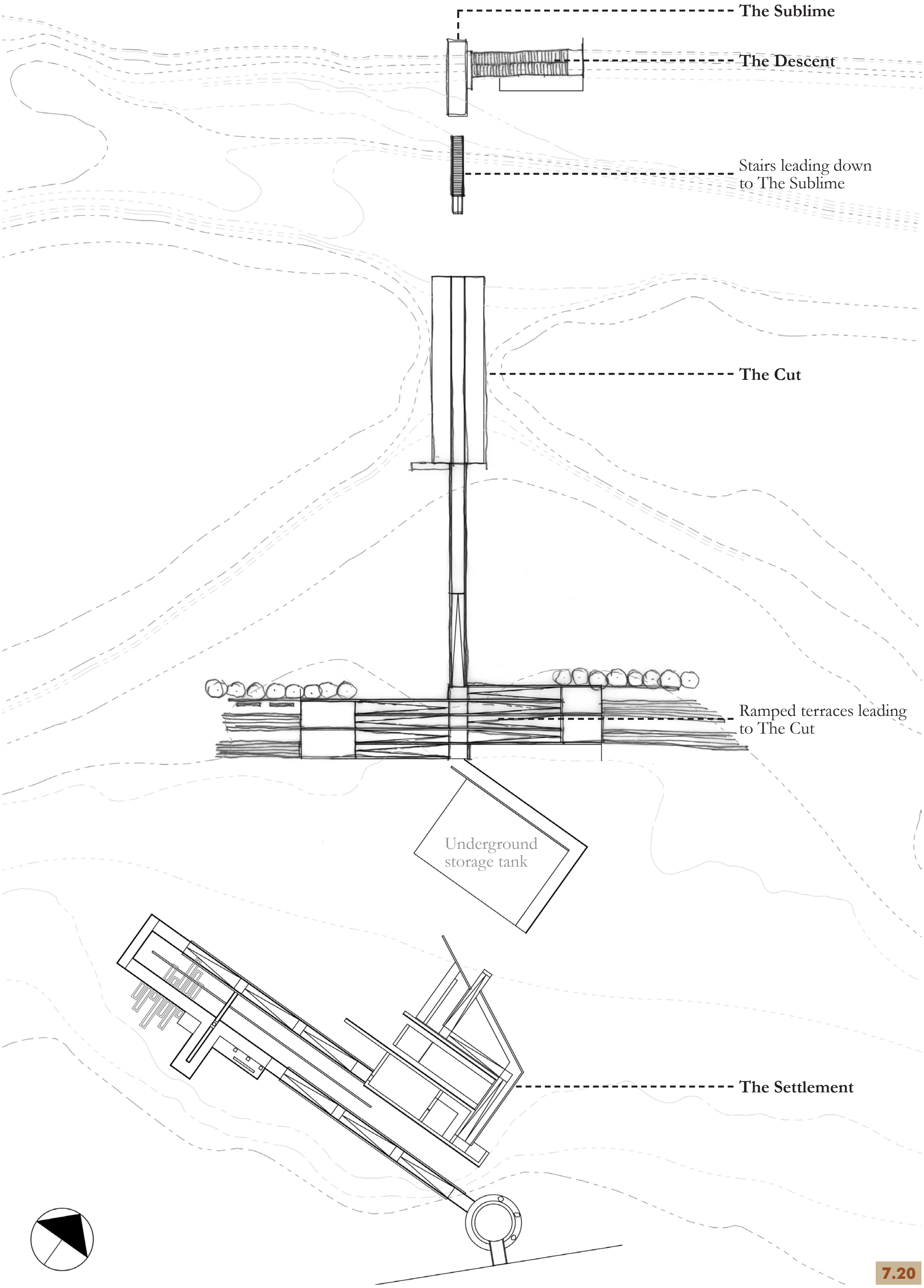


7.5.2 Exploration of The Sublime and The Descent

7.19

Fig. 7.19 Model exploration of The Sublime and The Descent (Author 2019)
Fig. 7.20 Sketch Plan iteration. Not to scale (Author 2019)

7.5.3 SKETCH PLAN ITERATION



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7.6 FINAL SKETCH PLAN

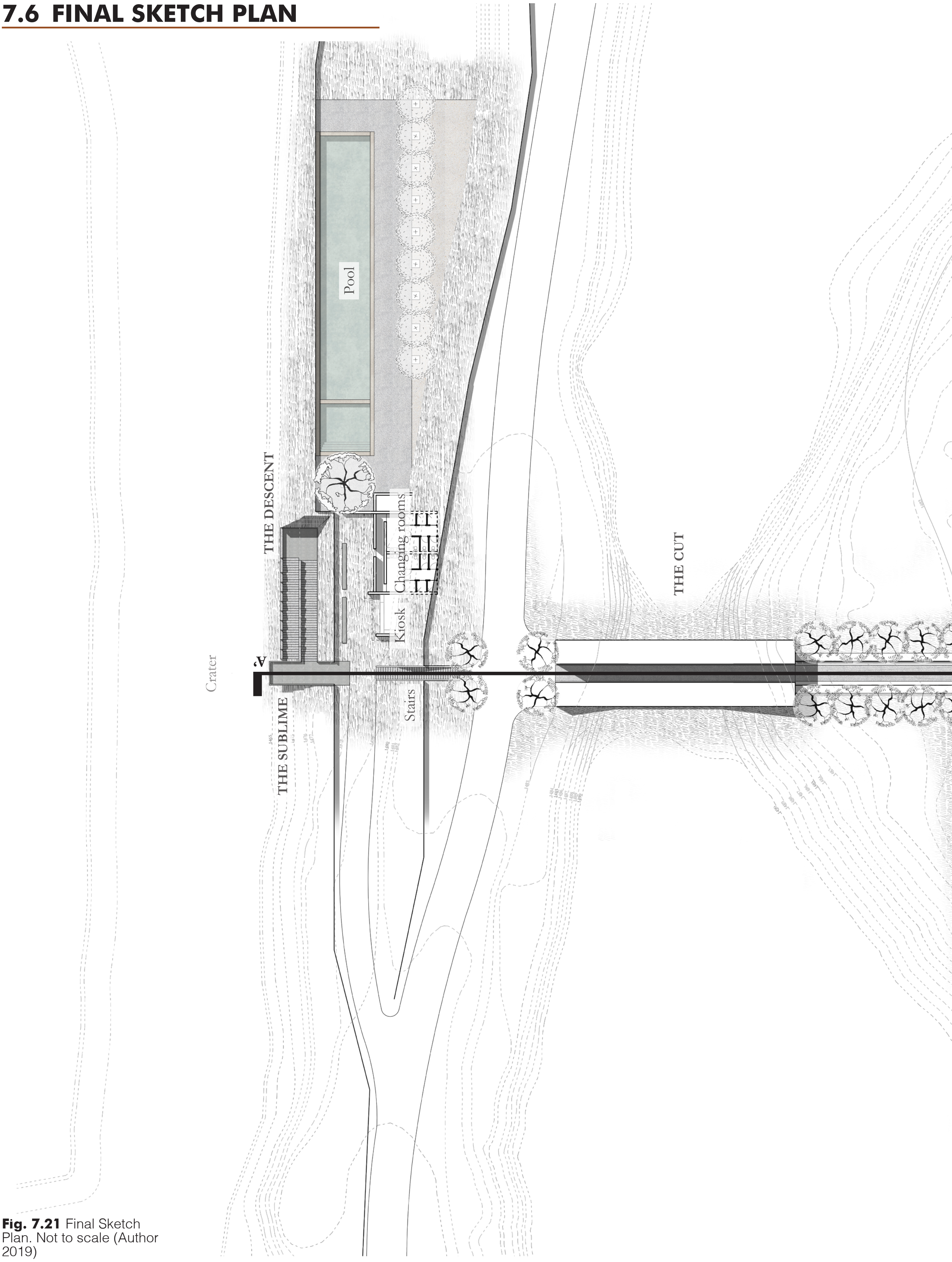
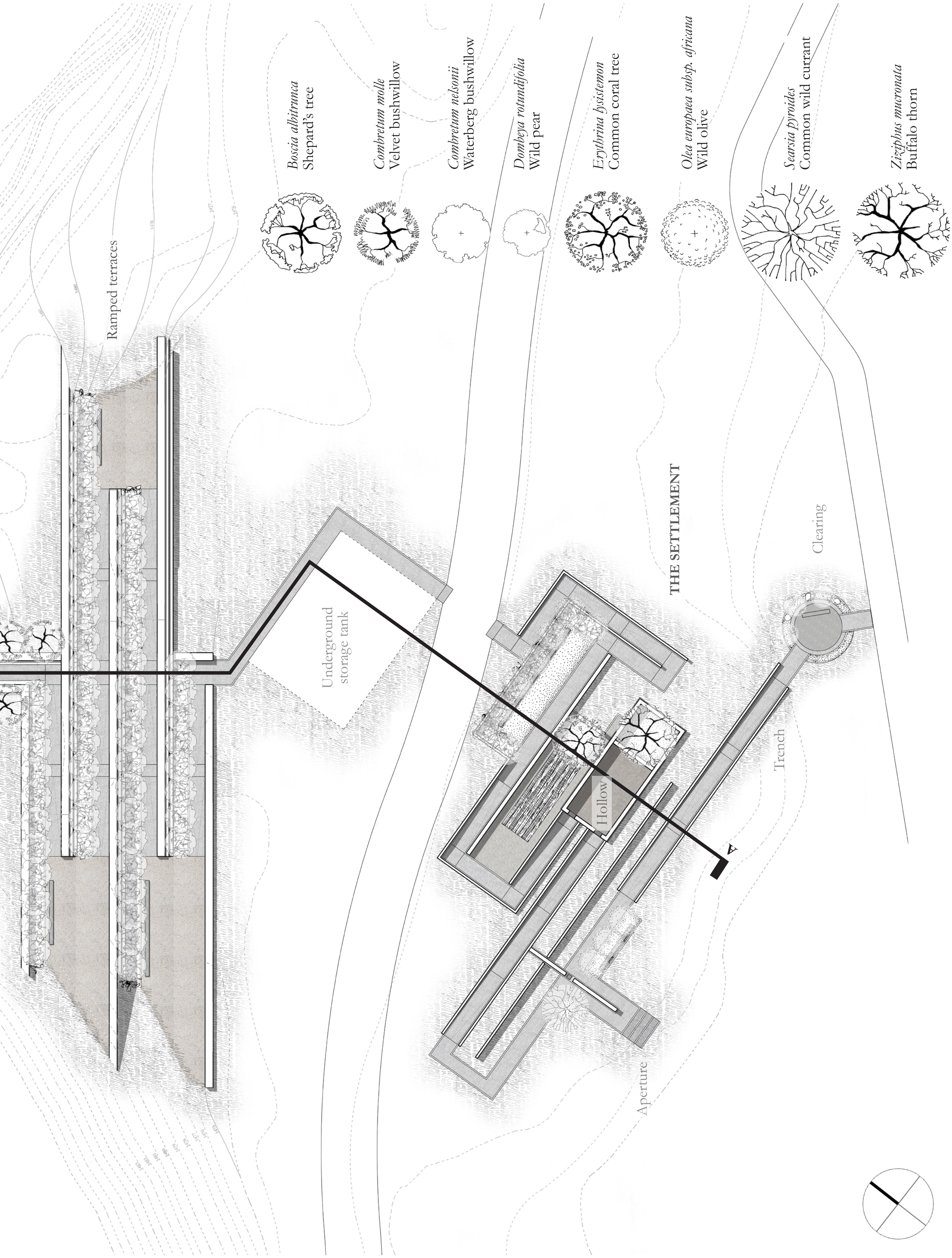


Fig. 7.21 Final Sketch Plan. Not to scale (Author 2019)



Boscia albitrunca
Shepard's tree
Combretum molle
Velvet bushwillow
Combretum nelsonii
Waterberg bushwillow
Dombeya rotundifolia
Wild pear
Erythrina lysistemon
Common coral tree
Olea europaea subsp. africana
Wild olive
Searsia pyroides
Common wild currant
Ziziphus mucronata
Buffalo thorn
Ramped terraces
Underground storage tank
THE SETTLEMENT
Clearing
Trench
Hollow
Aperture
A

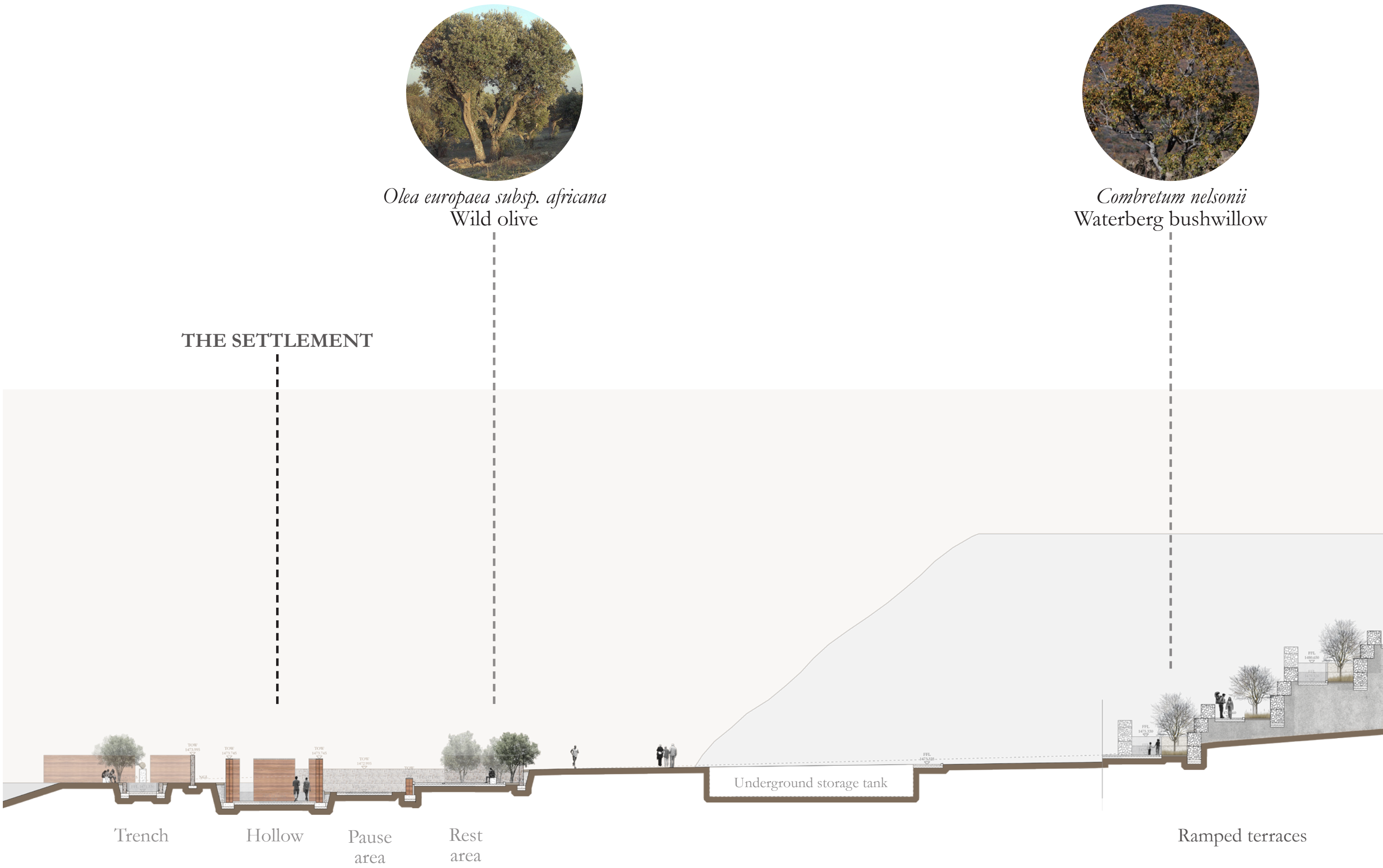


Fig. 7.22 Section A - A'.
Not to scale (Author 2019)

Combretum molle
Velvet bushwillow

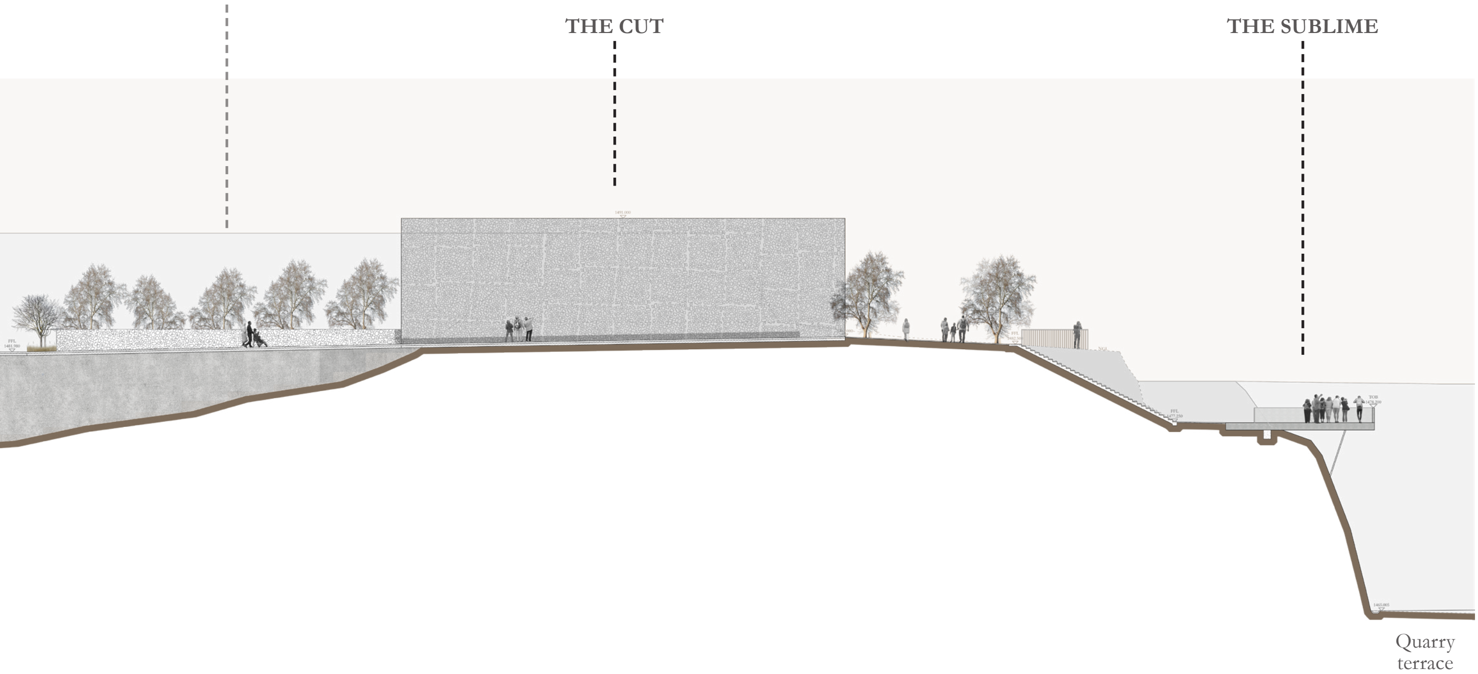


Fig. 7.23 View from the “clearing” towards the “trench” within The Settlement (Author 2019)

Fig. 7.24 Rest area within The Settlement (Author 2019)

Fig. 7.25 View of pause area within The Settlement representative of Midrand's agricultural history (Author 2019)

Fig. 7.26 Ramped terrace area with The Cut in the background (Author 2019)

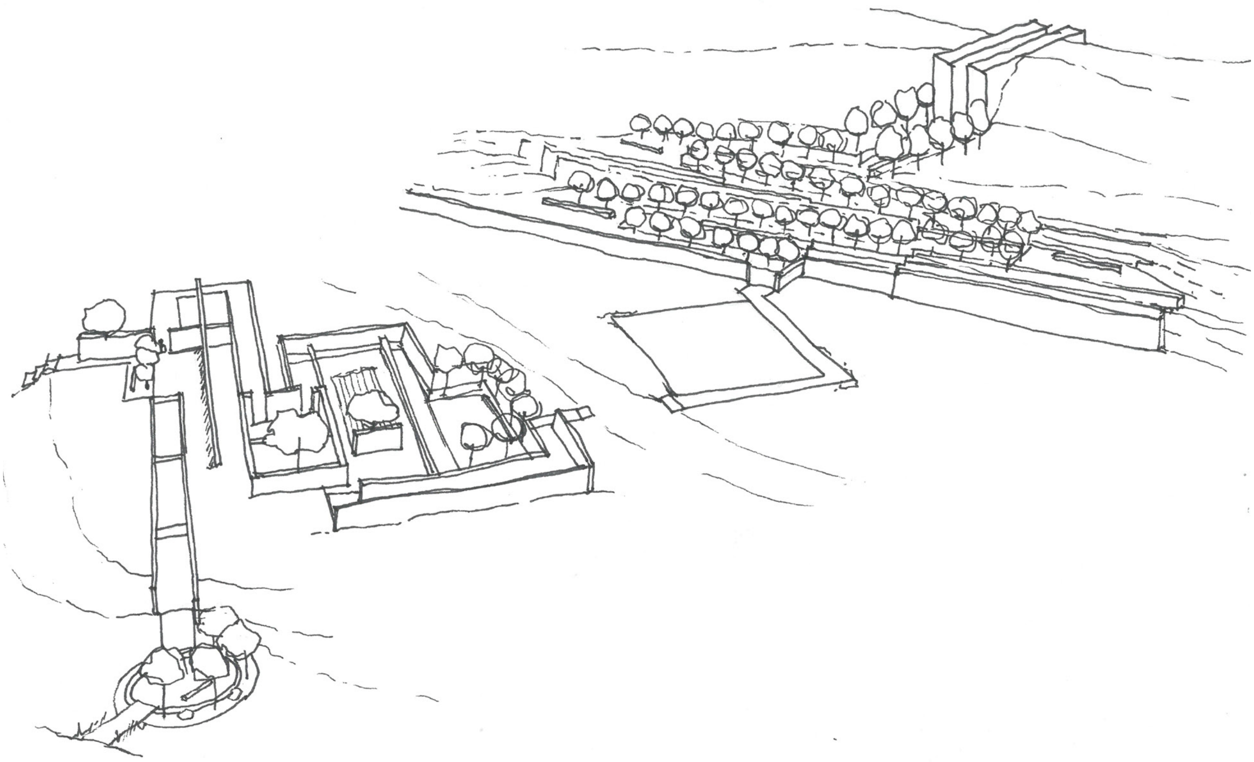


Fig. 7.27 Sketch of aerial view of final sketch plan area (Author 2019)

8

TECHNIFICATION

8.1 INTRODUCTION TO TECHNIFICATION

The following chapter splits technification into Master Plan and Sketch Plan. The Master Plan will address waste management; the water strategy; the planting strategy; and slope stabilisation and erosion control.
The technification of the Sketch Plan area will include the relevant construction detailing – with specific emphasis on the reuse of builders' rubble.

8.2 MASTER PLAN

8.2.1 Waste Management

Quarry X will not only function as a regional mixed-use park, but as a location where waste produced within the site is collected, sorted and distributed (to the relevant recycling companies and waste reclaimers). Builders' rubble is a special exception as it is used in the construction of the site. Once construction of the site is complete the designated builders' rubble processing area will cater to the general public.

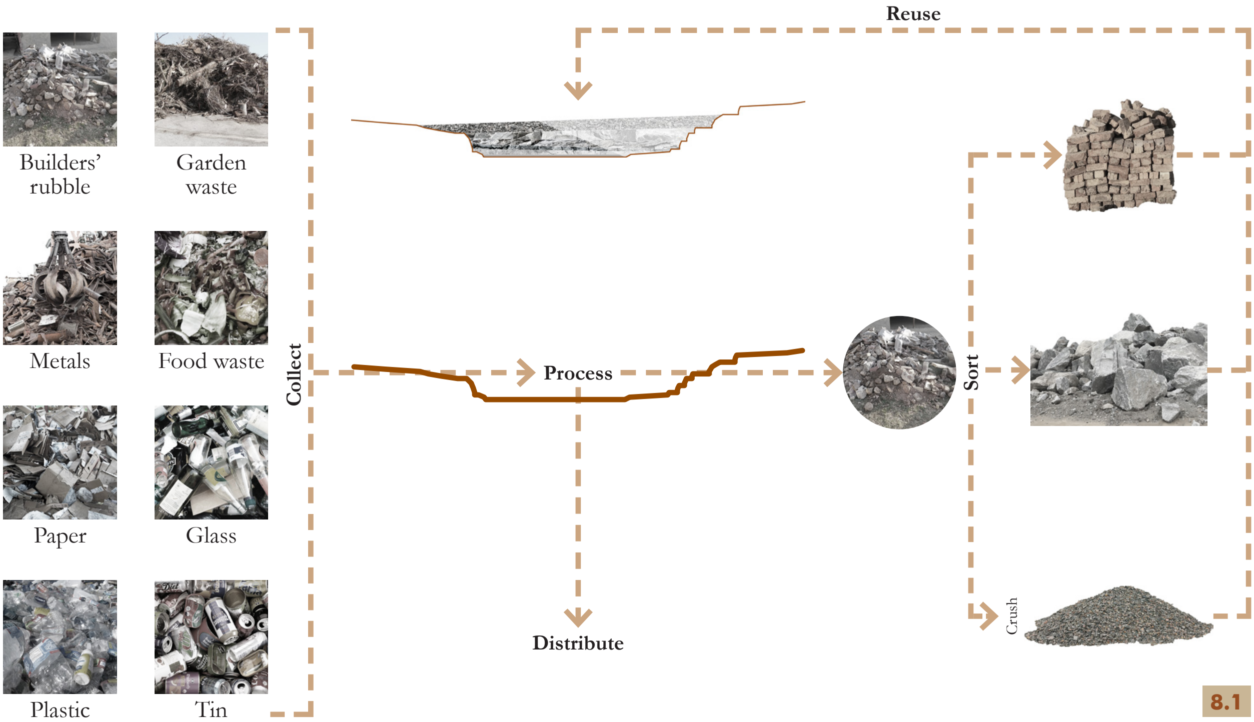


Fig. 8.1 Waste management strategy (Author 2019)
Table 8.1 Water pollutants and method of removal (Author 2019) [adapted from Vosloo 2017]
Fig. 8.2 Summary of water strategy (Author 2019)

8.2.2 Water Strategy

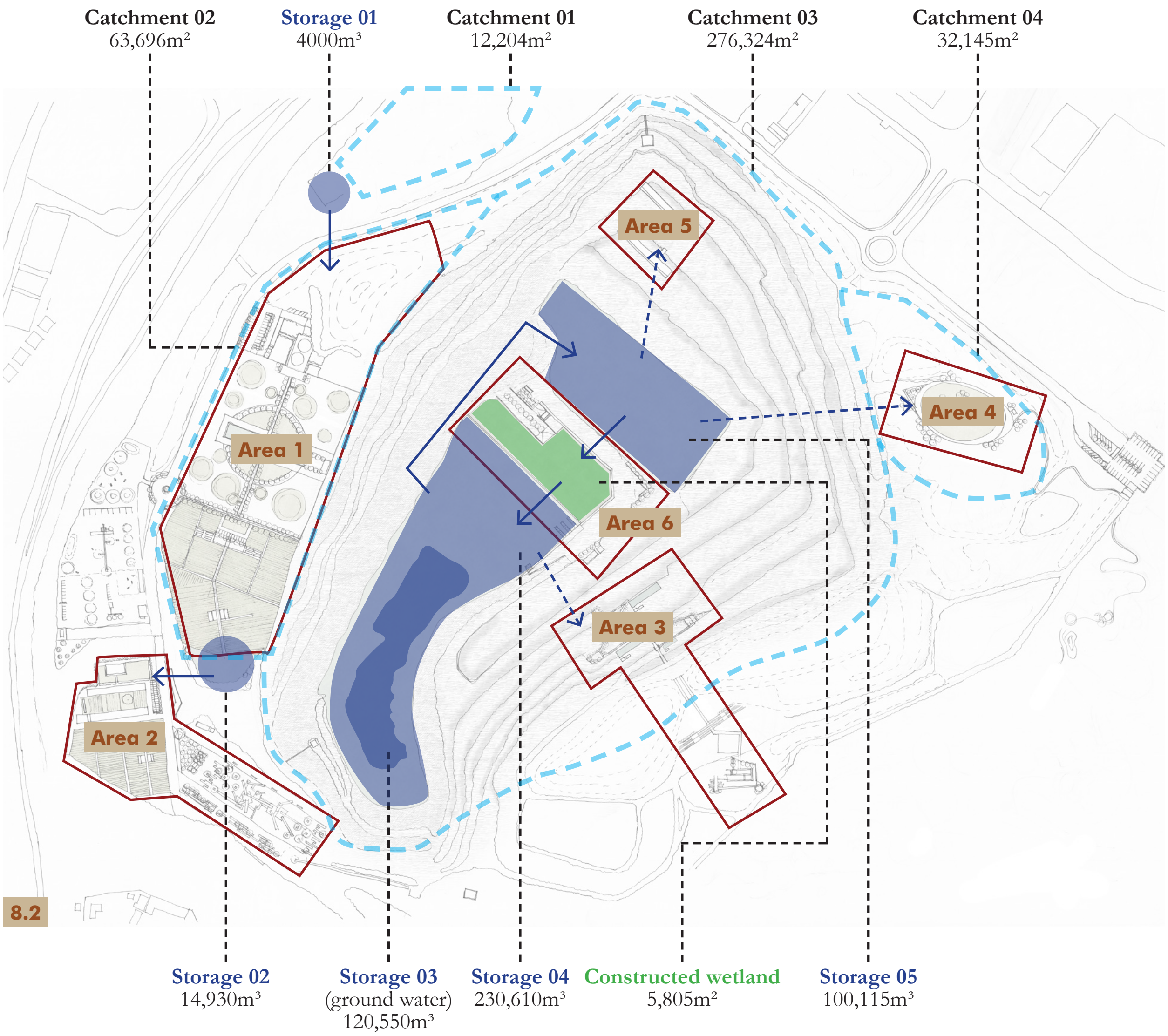
In line with the sustainable outlook of the adaptive reuse of Quarry X, the overall approach to water is to capture, clean, store and distribute as much surface water as possible for reuse within the site – namely: irrigation and the pools.

Table 8.1 outlines the five types of water pollution and the method each can be removed from the water.

Quarry X contains mainly floating debris, contaminants lighter than water and contaminants heavier than water. Figure 8.2 summaries the water strategy. For full water calculations please refer to Appendix A.

WATER POLLUTION	METHOD OF REMOVAL
Floating debris i.e. plastic bags, bottles and cans	Trash trap/gridded inlets
Contaminants lighter than water i.e. hydrocarbons such as petrol, diesel, oil	Removed/separated in an oil trap
Contaminants heavier than water i.e. dirt and other sediments	Settle in a structure where water is allowed to be stilled through sedimentation, detention and retention ponds, septic tanks or oil traps
Dissolved minerals i.e. nitrates, sulphates, phosphates and other minerals which are essentially plant nutrients	Nutrient uptake through by wetland plant species
Microbes i.e. pathogens/ bacteria that cause sickness	Chemical application such as chlorine or with ultra-violet spectrum lights

Table 8.1



8.2

8.2.3 Planting Strategy

The site has been separated into 5 zones (Figure 8.3) depending on the planting and/or soil conditions: transformed grassland, compacted soil with no vegetation, granite rock with no vegetation, cliffs and aquatic.

Transformed grassland
The transformed grassland area is well established with the odd area of disturbance and invasive species. There is no need for drastic manipulation of this zone, however, all alien and invasive species would need to be removed and disturbed areas seeded with an indigenous grass seed mix. Thereafter, the area would need to be carefully monitored to prevent re-emergence of any invasive species.

Compacted soil with no vegetation
Because this area is frequented by heavy vehicles and/or used to stockpile aggregate, the soil is highly compacted with almost no vegetation. In this case, the soil structure must be "opened" if successful plant growth is to take place. Ripping of the of the soil to a depth of about 50mm is required. Ideally, the ripping should incorporate organic material. Topsoil is spread and plants can be introduced – when they become established, they will be able to maintain the structure of the soil themselves by their root growth and contribution of organic matter (Bradshaw & Chadwick 1980:88).

Granite rock with no vegetation
The proposal for this zone is to allow it to naturally colonise with planting overtime. Instead of visitors seeing an "instant" effect of lush green terraces, they will see a gradual development of vegetation in this area – encouraging them to revisit the site to view this progression. This relates to the minimal design principle of expressing the passage of time – here it is done through plant material. Furthermore, this natural colonisation of endemic species is better than introduced plant material because they will be adapted to the local ecotype (ibid. p. 209).
Granite is a hard, acidic rock which is nutrient poor (ibid. p. 203). Major nutrient supply is supplied through rain and is very limited (ibid. p. 205). These may seem like inhospitable conditions for plants, but plant growth is possible. Fine material accumulation is very important to encourage plant colonisation (ibid.) – seeds fall into small cervices of fine material where they find moisture and protection (ibid. p. 207). The passage of heavy machinery on quarry surfaces creates fines, so the horizontal benches at Quarry X have an accumulation of fine on these surfaces. Another source of fines can be through the recovered concrete crushing process – this is expanded on later in the chapter. The fines are spread over the relevant areas with fertiliser and some lime (which is reapplied in subsequent years to maintain growth) (ibid. p. 207). As long as there is fine material, seeds will be able to fall into small

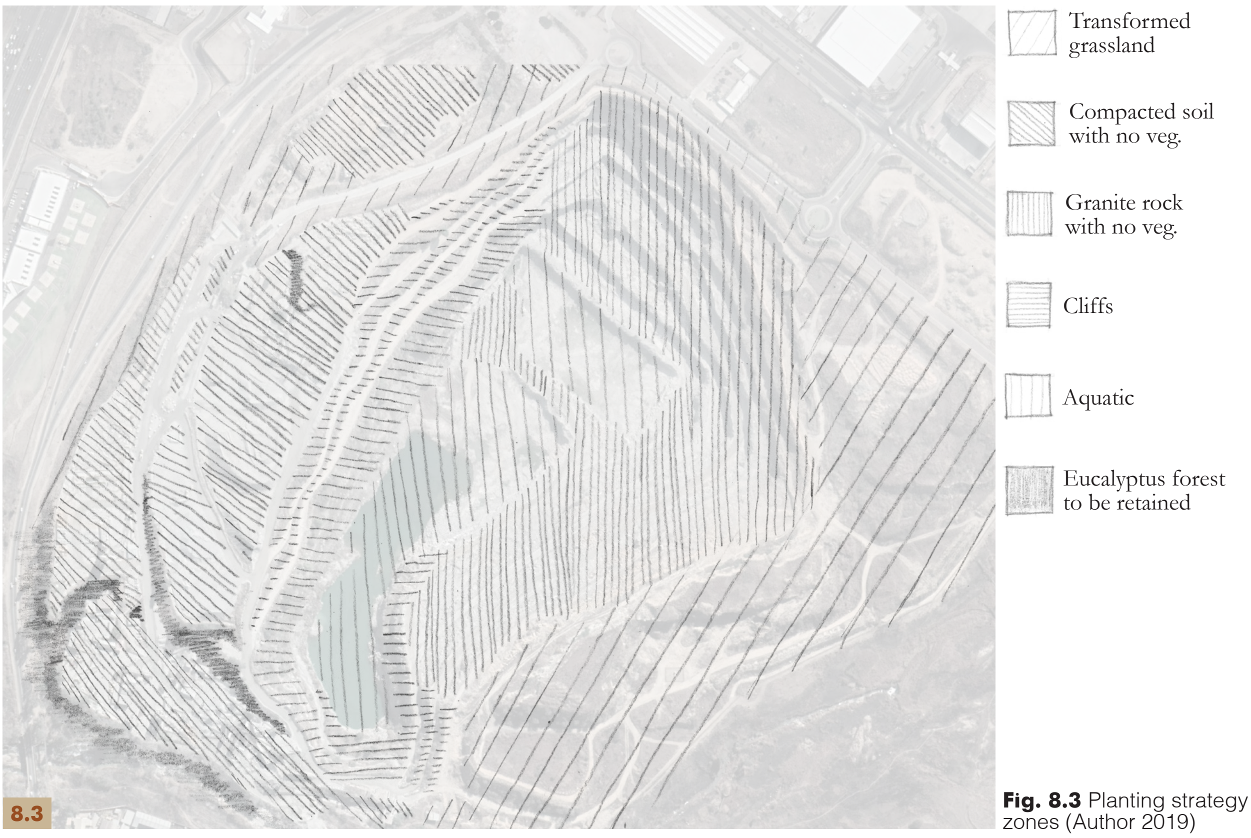
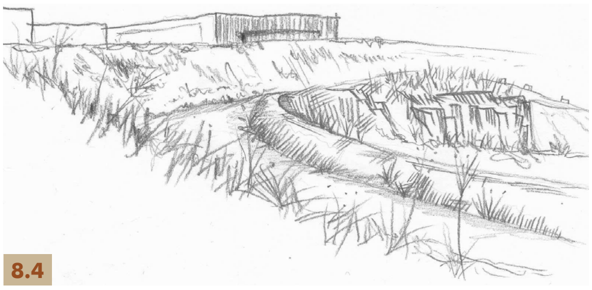


Fig. 8.3 Planting strategy zones (Author 2019)

crevices of moisture and protection.
The establishment of trees in this zone does not require fine material because trees can root downwards into moisture layers. However, trees do require a pocket of water-absorbent material of about 5 litres. This is to provide enough moisture in the dry season (ibid. p. 205).

Cliffs
Similar to the transformed grassland zone, the cliff vegetation is well established. It appears to be a rehabilitation effort by the owners of Quarry X and contains indigenous vegetation. This zone should be monitored to prevent re-emergence of any invasive species. There is an opportunity to make strategic openings in the rock face, to allow plant growth.

Aquatic
Unlike the granite rock terraces, quarry floors accumulate fine material (ibid.) and are therefore more hospitable for plants to naturally colonise. The boundary between the reservoir and the quarry floor is made more formalised.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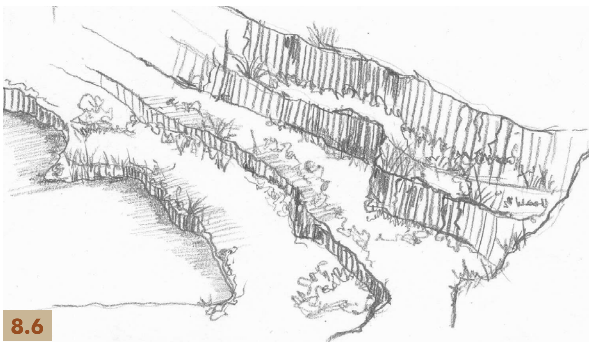
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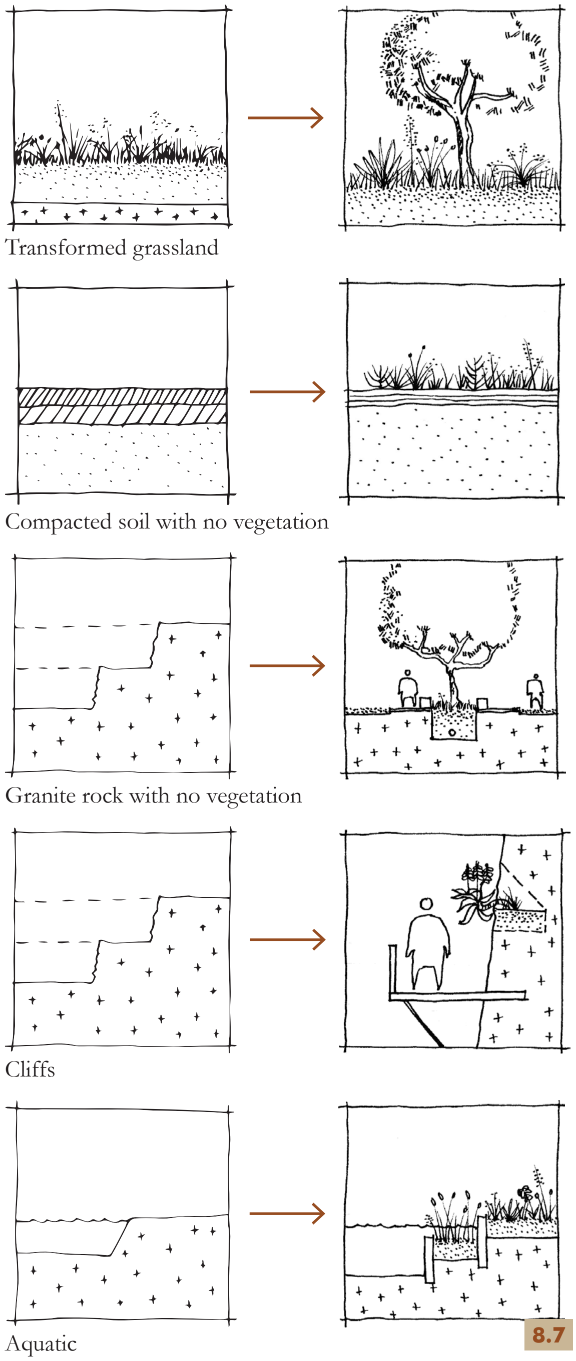
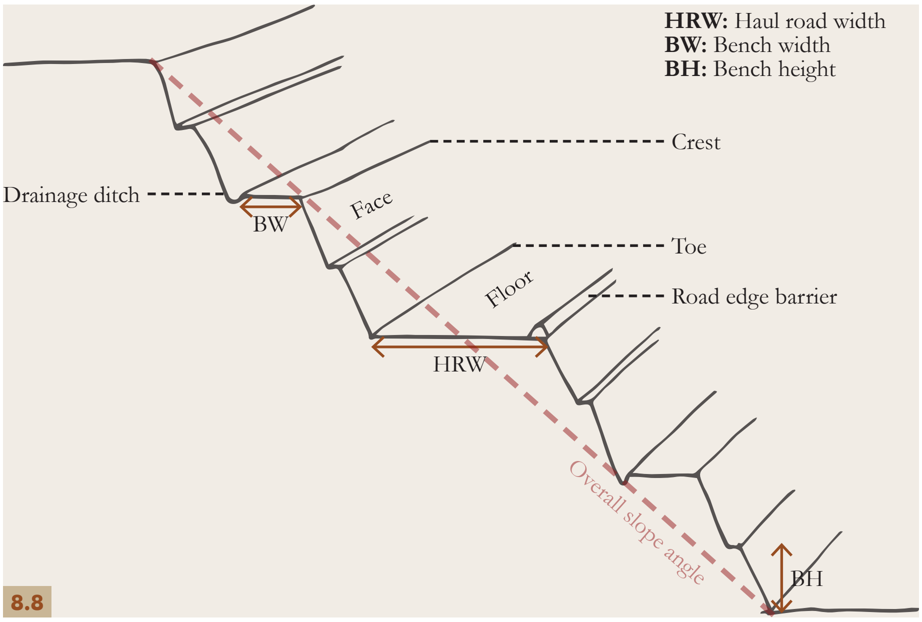


8.7

Fig. 8.4 Sketch of transformed grassland (Author 2019)
Fig. 8.5 Sketch of dumped rubble which contributes to compacted soils (Author 2019)
Fig. 8.6 Sketch of cliff and aquatic area (Author 2019)
Fig. 8.7 Plant strategy zones and approach (Author 2019)

8.2.4 Slope Stabilisation and Erosion Control

Quarry X is a privately-owned quarry registered under the Department of Mineral Resources South Africa; therefore, it must adhere to strict health and safe regulations. Quarrying methods must maintain slope stability to ensure the safety of those who access or work at the quarry. This is beneficial as when extraction has ceased, a relatively stable quarry remains from a geo-technical perspective. Figure 8.8 illustrates the common features of a quarry. Multiple bench quarries require careful planning and closer supervision than single bench quarries, however, each level can operate independently (Integrated Publishing n.d.).
The bench heights are determined by equipment limitations and geologic conditions (Integrated Publishing n.d.), and therefore would never exceed what is deemed a safe height.
At Quarry X, the vertical benches (generally 12 metres), and horizontal benches (generally 8 metres) appear physically stable, although a thorough geo-technical examination is required before the public could access the site.
Quarry X does not a have defined drainage ditch on any of the horizontal benches, this contributes to erosion and loss of fines over the crest. Figure 8.9 shows how the slope can be manipulated to incorporate a drainage ditch. Water from the drainage ditch can be diverted into the quarry reservoir. Furthermore, the drainage ditch can also act as a catch ditch – which literally catches eroded rock fragments that may fall from the vertical rock face.



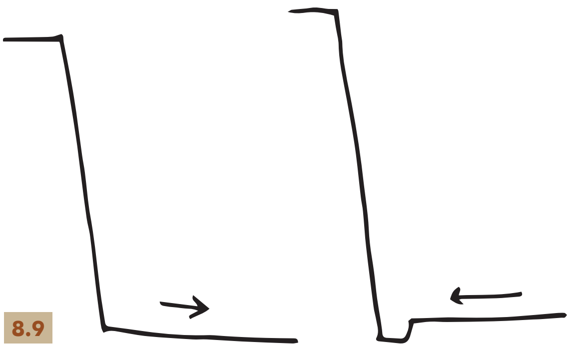


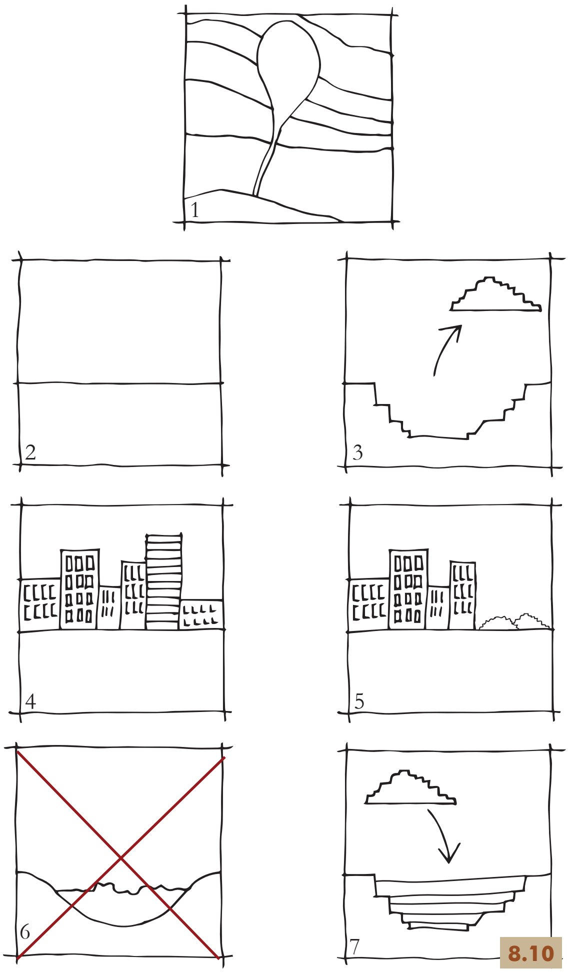
Fig. 8.8 Common features of a quarry (Author 2019) [Adapted from Gambrenk 2010]
Fig. 8.9 Horizontal bench manipulation to incorporate a drainage ditch (Author 2019)

8.3 SKETCH PLAN

8.3.1 Builders' Rubble

Builders' rubble is used for the construction of the site as far as possible. The reuse of this material at a quarry evokes the cradle-to-cradle concept. Instead of the material being dumped at the nearest landfill, it is given new life as construction material (Figure 8.10).
The relevant quantities required would have to be sorted and stockpiled before construction of the site officially begins. After construction is complete, the designated builders' rubble recycling area will cater to the general public.

Builders' rubble consists mostly of concrete (Figure 8.11). In this rapidly developing world, approximately 6 billion tons of concrete is produced globally per year (Marinković 2013:45). This industry is detrimental to the environment as the main component of concrete is aggregate – which comes from natural rock. Therefore, it is important to not only reduce the use of concrete, but to reuse it as far as possible to preserve natural resources.



8.10

Fig. 8.10 Instead of builders' rubble ending up in a landfill, it can be reused at Quarry X as construction material. Natural material returned to "origin" (Author 2019)
Fig. 8.11 The composition of builders' rubble mainly consists of concrete (Author 2019)


8.11

The idea of recycling demolished concrete originated at the end of World War II after extensive destruction was caused to entire cites through strategic bombings (Figure 8.12). A dilemma occurred as these cities had to be rebuild, and large amounts of rubble had to be cleared (Frick 1987:1). The logical solution was to reuse the demolished concrete to construct new buildings. Enormous, landscaped mounds, known in Germany as Trümmerberg (rubble mountain) (Figure 8.13), were also created using the demolished concrete as fill material.

Because builders' builder is non-combustible and inert (without the power to move) – it has high potential for recycling. However, in South Africa, there is very little awareness of the recycling opportunities for builder's rubble (CoJ 2017:41). This is exemplified by the fact that 85% of builders' rubble is landfilled in South Africa (Barnes & Basson 2016:151), and only 6% is recycled (DEA 2018:18).
Data regarding builders' rubble quantities in the Johannesburg region is sparse. Builders' rubble generation in the Johannesburg Municipality is projected to increase to 370,00 tonnes per annum by 2022 (CoJ 2011:24). However, this figure is based on amounts recorded at landfills, it does not take into consideration illegal dumping or private landfill companies; therefore, the quantity could be much higher.
However, according to GreenCape, the "market for builders' rubble is growing across South Africa, especially in the Western Cape and Gauteng. There are growing opportunities for businesses and investors seeking to capitalise on this material, particularly in the Western Cape" (GreenCape 2018:54).

Builders' rubble is predominantly crushed and reused as aggregate. This aggregate is used within the following applications (from highest to lowest material value) (GreenCape 2018:54):

- Re-concreting – finely ground recovered concrete incorporated into a ready-mix or precast concrete process;
- Foundations;
- Sub-base or base layers of parking lots and roads;
- Platforms for housing developments, pipe bedding and fence line foundations; and
- Fill.

All the applications mentioned above are within the civil engineering sphere. This dissertation will explore alternative ways to reuse builders' rubble within a landscape architectural application. Figure 8.14 outlines the composition of builders' rubble and how it can be processed. While Table 8.2 outlines how builders' rubble can be used within the ground, wall/vertical and sky planes of a space.

Fig. 8.12 German women clear rubble from bomb damaged buildings in Berlin, 1945 (Imperial War Museum 1945)
Fig. 8.13 Grüner Heiner rubble mountain in Baden-Württemberg, Germany is 395 metres high (Creative Commons 2005)

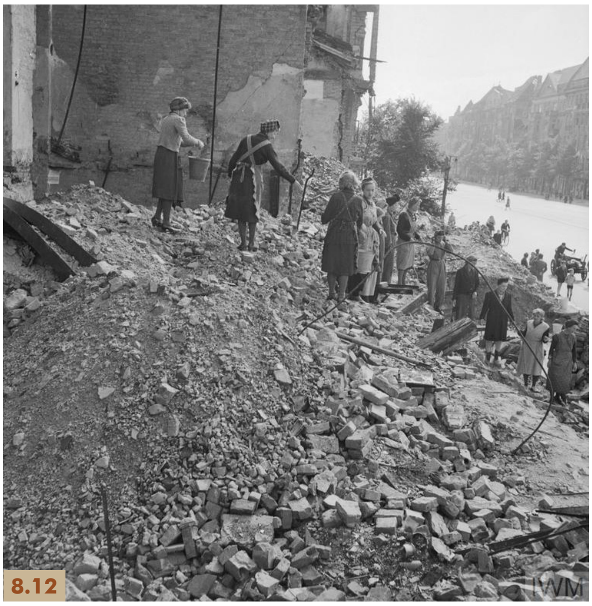
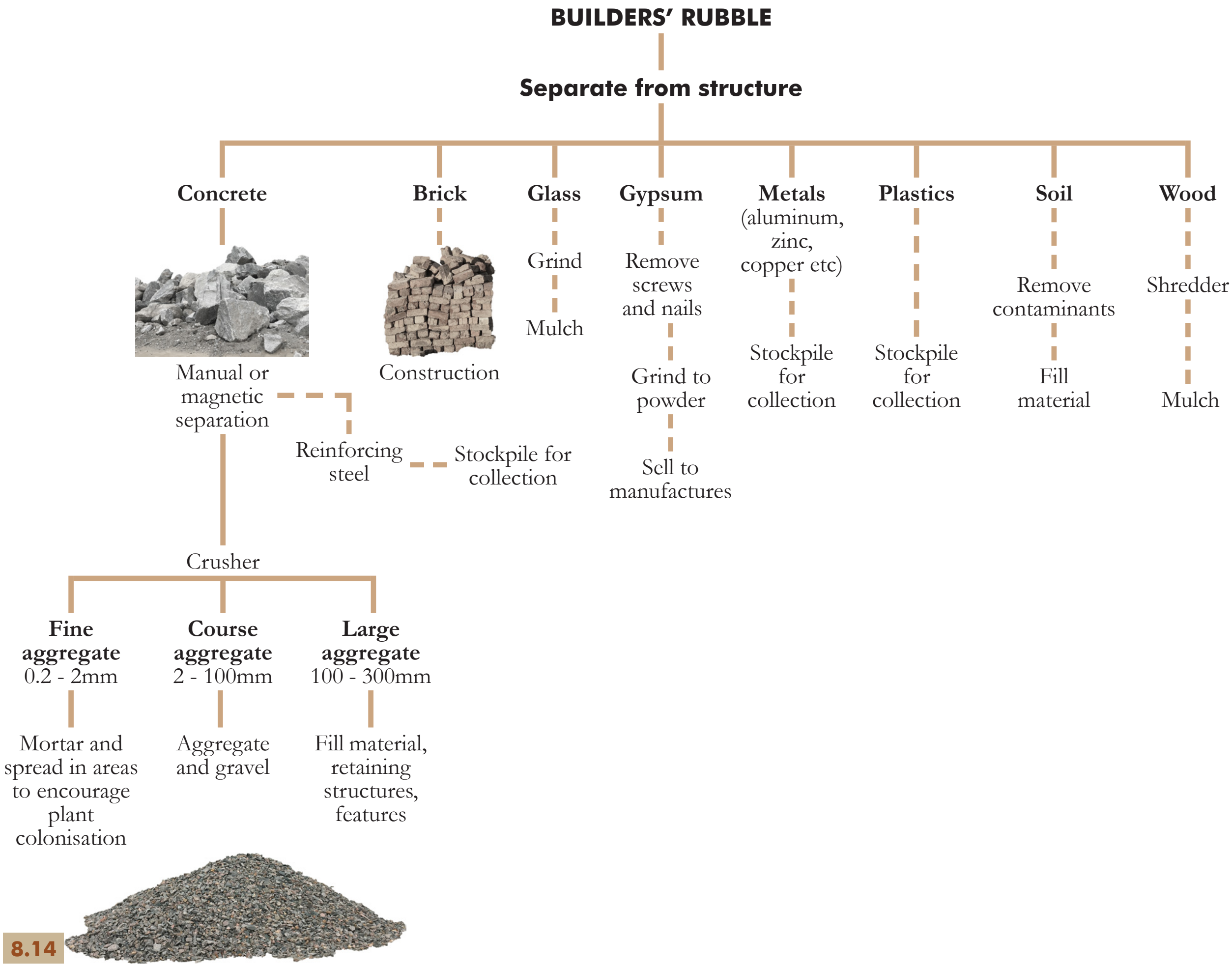


Fig. 8.14 A breakdown of the composition of builders' rubble (which consists mainly of concrete) and possibility of each material (Author 2019)
Table 8.2 How builders rubble can be used in ground, wall/vertical and sky planes (Author 2019)



8.14

GROUND	WALL/VERTICAL	SKY	OTHER
• Paving • Packed material, • Paving edge, • Gravel • Breakwater structure • Fill for earth mounds	• Cladding • Retaining wall (dry or wet packed) • Fill for gabion wall	• Hanging elements	• Outdoor furniture elements e.g. seating, lighting • Artistic/sculptural elements

Table 8.1

8.4 TECHNIFICATION OF SKETCH PLAN AREA

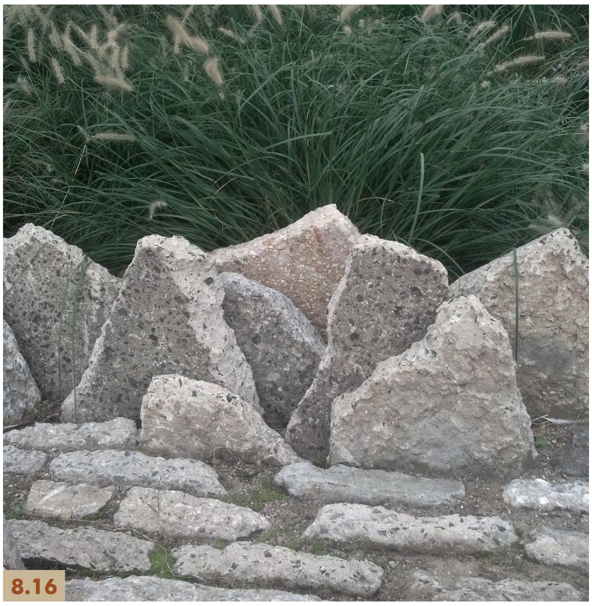
8.4.1 Material

As mentioned previously, where possible, builders' rubble will be used as construction material. The previous section indicated the potential reuse of builders rubble in landscape design. This section will show it applied in instances within the Sketch Plan area.

Builders' rubble may appear disorderly, but once it is sorted, the different materials can be used in unique ways. Either in a raw state (individual bricks), or as a mixture to form another material (aggregate within concrete).

Fig. 8.15 Recycled runway concrete used to stabilise slopes at Orange County Great Park, USA (Lamb 2009)
Fig. 8.16 Reused concrete paving edge at Queens Plaza, USA (Horton 2012)
Fig. 8.17 Recovered material used on the façade of Ningbo Museum, China (Middle East Architect n.d.)
Fig. 8.18 Rubble used in parking area at Artémisia cultural space in La Gacilly, France (La Plage Architecture et Paysage 2018)


8.15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8.4.2 Technifiation of The Settlement

The Settlement is the only zone in the sketch plan area which makes use of material of a "natural" appearance – rammed earth. This material was chosen as it relates to the themes of Midrand's early history of hunter-gathering, agriculture and associated burial which this zone represents – notions of the earth.

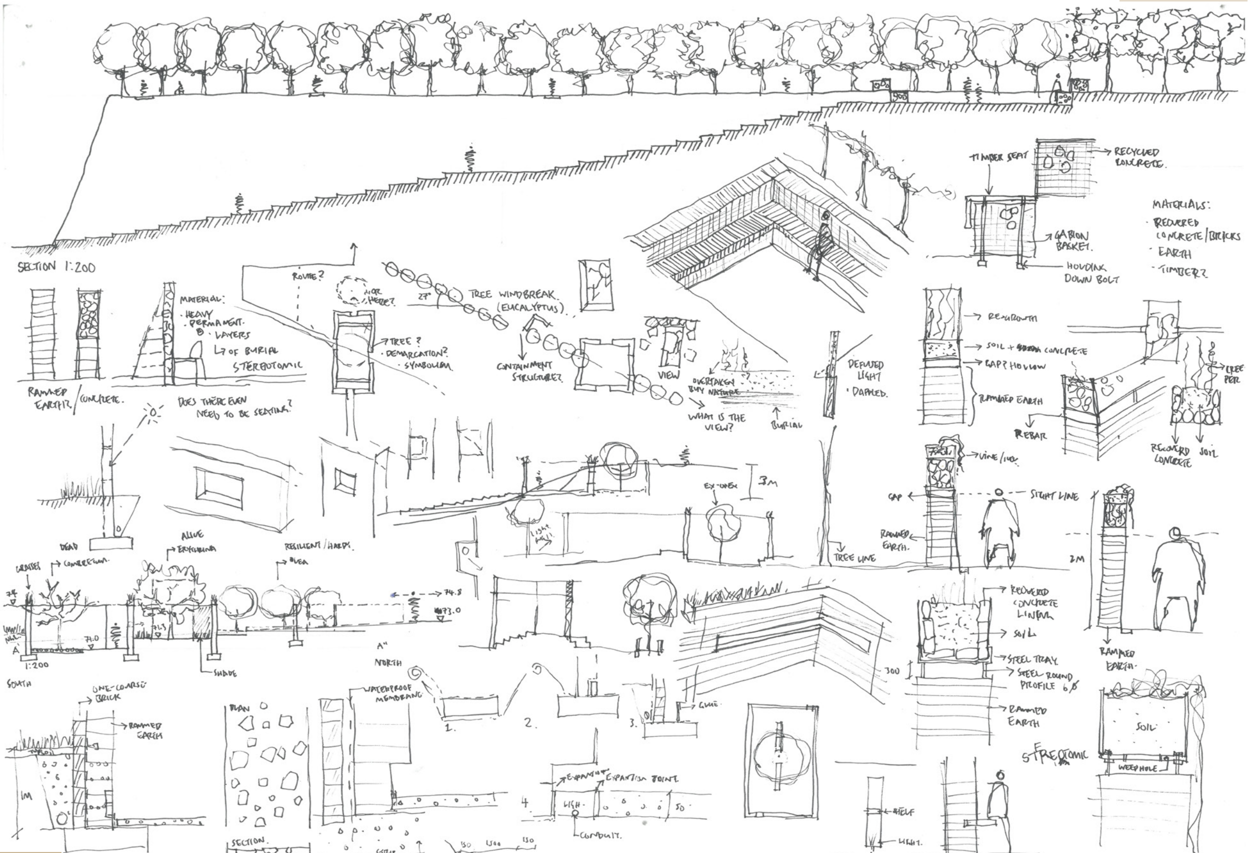

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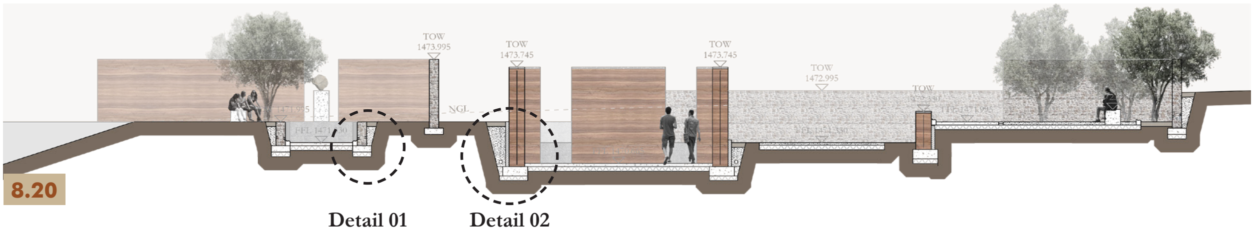
Fig. 8.19 Early exploration of rammed earth wall at The Settlement (Author 2019)



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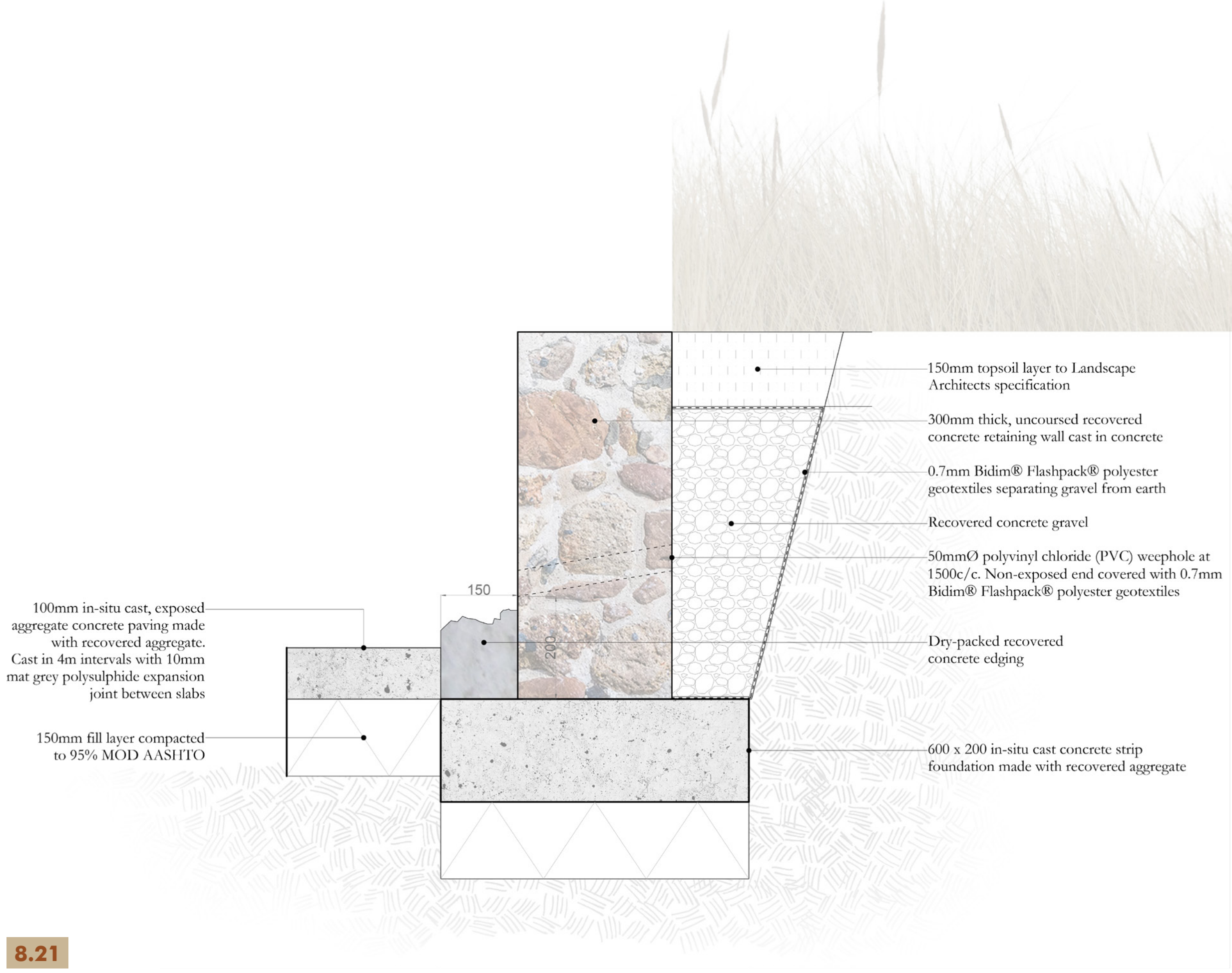

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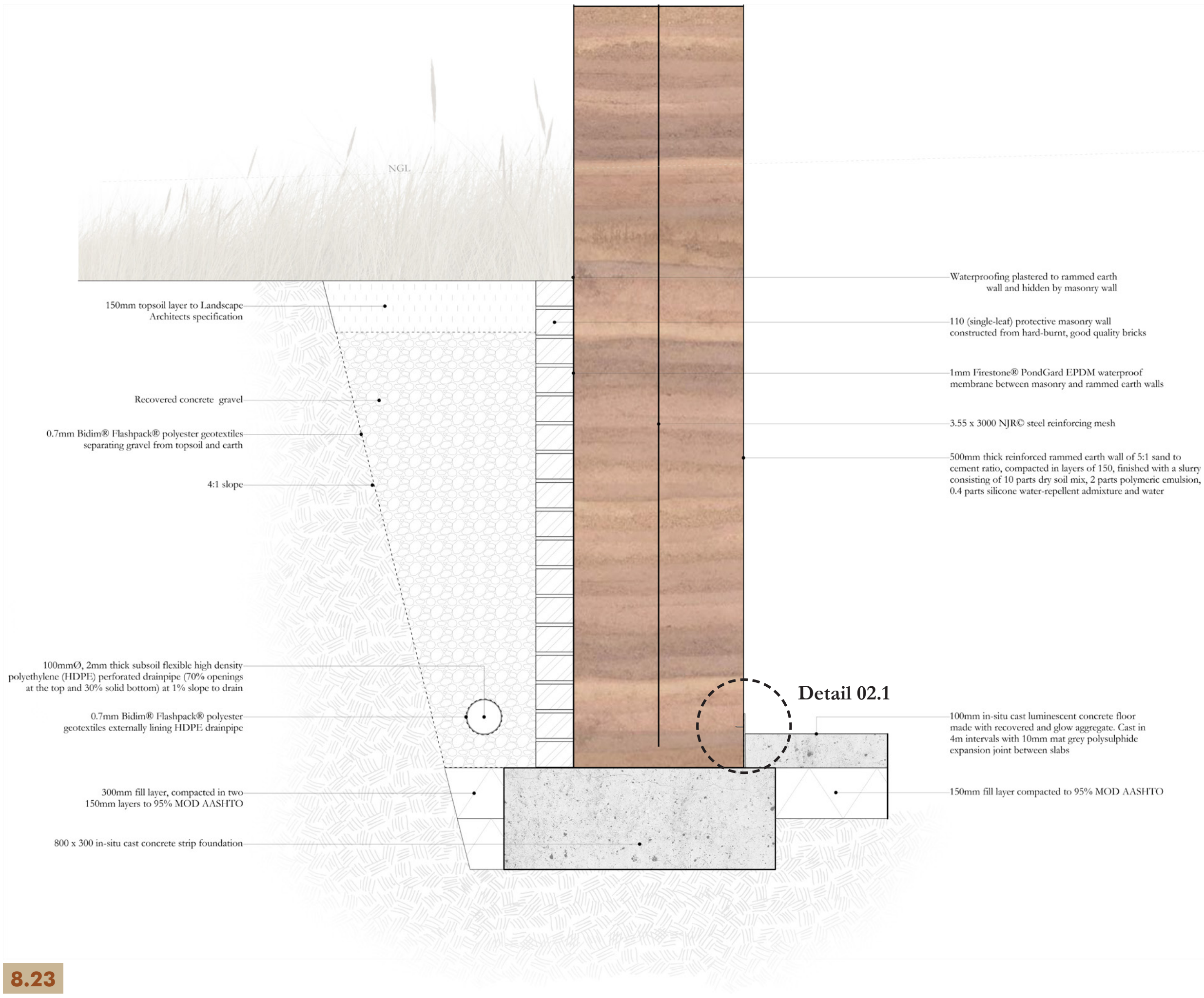
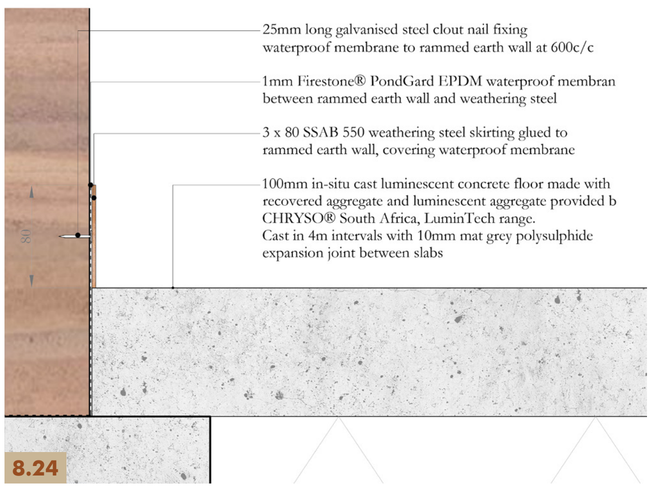
Fig. 8.20 Section through The Settlement indicating detail areas (Author 2019)
Fig. 8.21 Detail 01 through recovered rubble retaining wall (Author 2019)
Fig. 8.22 Typical process of rammed earth construction (Author 2019)
Fig. 8.23 Detail 02 through rammed earth wall (Author 2019)
Fig. 8.24 Detail 02.1 indicating skirting around rammed earth wall (Author 2019)


Concrete strip foundation
Form-work and first layer of rammed earth with reinforcing
Second layer of rammed earth
Concrete coping on top of wall

8.22

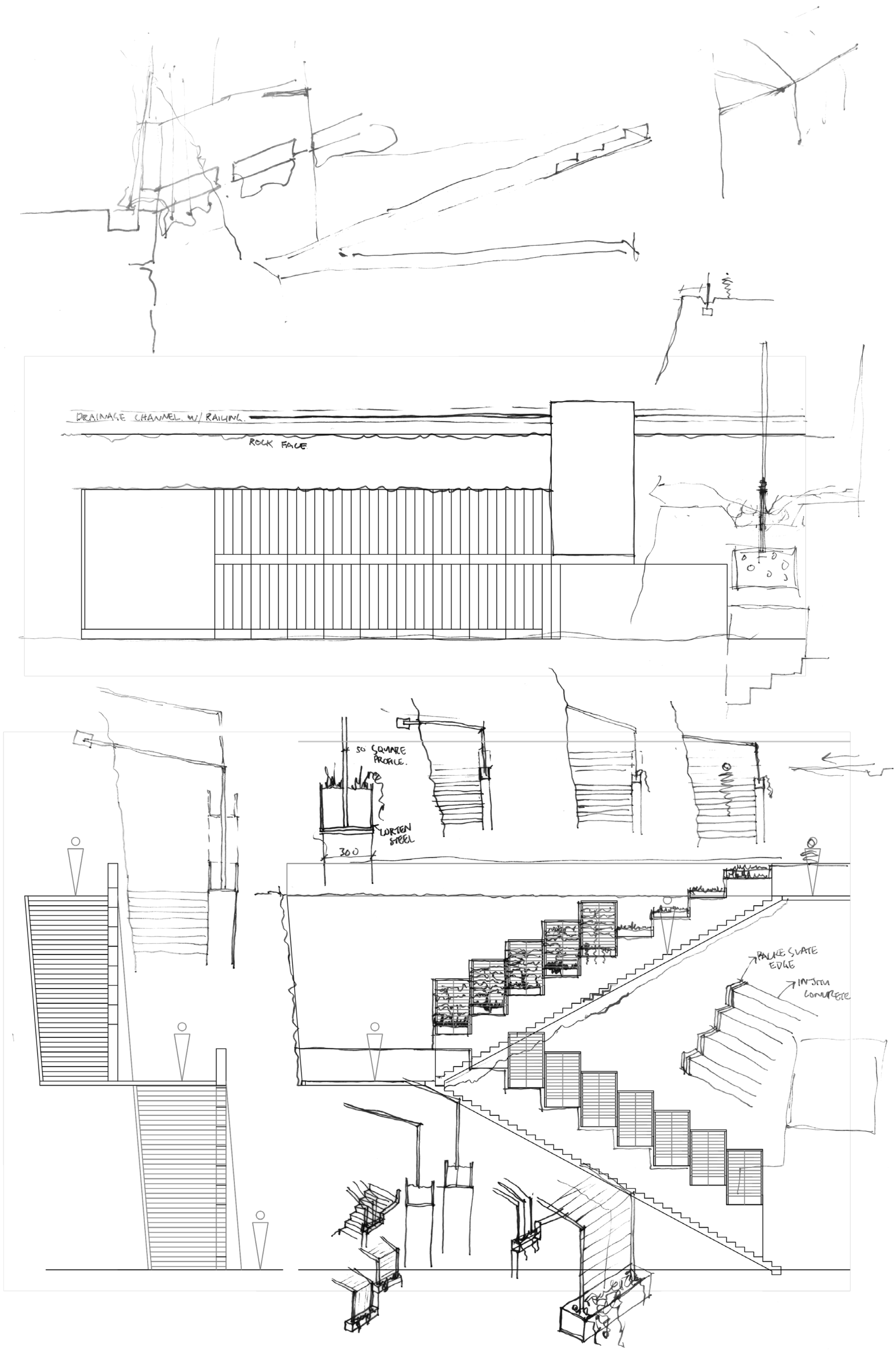

NGL
150mm topsoil layer to Landscape Architects specification
Recovered concrete gravel
0.7mm Bidim® Flashpack® polyester geotextiles separating gravel from topsoil and earth
4:1 slope
100mmØ, 2mm thick subsoil flexible high density polyethylene (HDPE) perforated drainpipe (70% openings at the top and 30% solid bottom) at 1% slope to drain
0.7mm Bidim® Flashpack® polyester geotextiles externally lining HDPE drainpipe
300mm fill layer, compacted in two 150mm layers to 95% MOD AASHTO
800 x 300 in-situ cast concrete strip foundation
Waterproofing plastered to rammed earth wall and hidden by masonry wall
110 (single-leaf) protective masonry wall constructed from hard-burnt, good quality bricks
1mm Firestone® PondGard EPDM waterproof membrane between masonry and rammed earth walls
3.55 x 3000 NJR© steel reinforcing mesh
500mm thick reinforced rammed earth wall of 5:1 sand to cement ratio, compacted in layers of 150, finished with a slurry consisting of 10 parts dry soil mix, 2 parts polymeric emulsion, 0.4 parts silicone water-repellent admixture and water
Detail 02.1
100mm in-situ cast luminescent concrete floor made with recovered and glow aggregate. Cast in 4m intervals with 10mm mat grey polysulphide expansion joint between slabs
150mm fill layer compacted to 95% MOD AASHTO

8.23


25mm long galvanised steel clout nail fixing waterproof membrane to rammed earth wall at 600c/c
1mm Firestone® PondGard EPDM waterproof membran between rammed earth wall and weathering steel
3 x 80 SSAB 550 weathering steel skirting glued to rammed earth wall, covering waterproof membrane
100mm in-situ cast luminescent concrete floor made with recovered aggregate and luminescent aggregate provided b CHRYSO® South Africa, LuminTech range.
Cast in 4m intervals with 10mm mat grey polysulphide expansion joint between slabs

8.24

8.4.3 Exploration of The Descent



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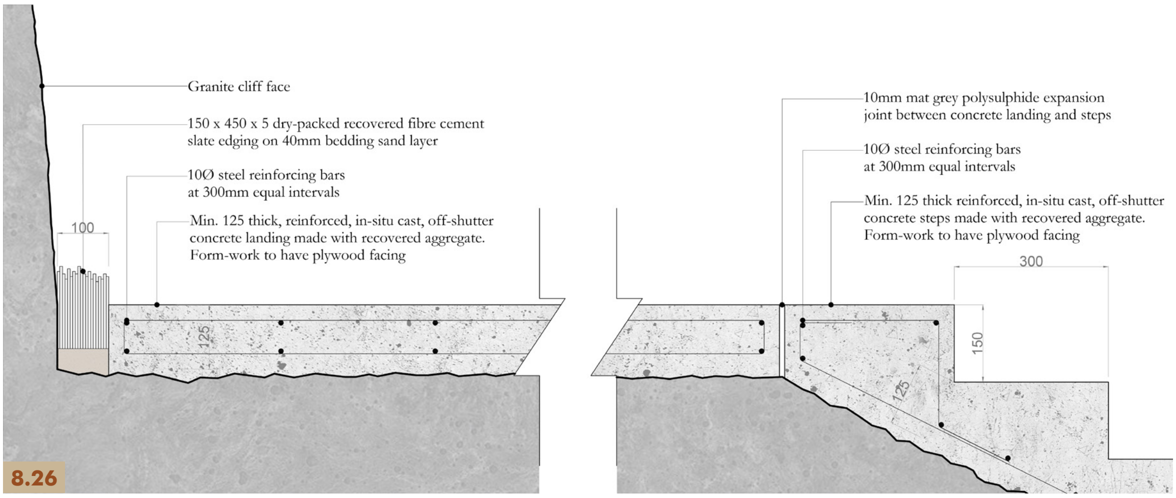
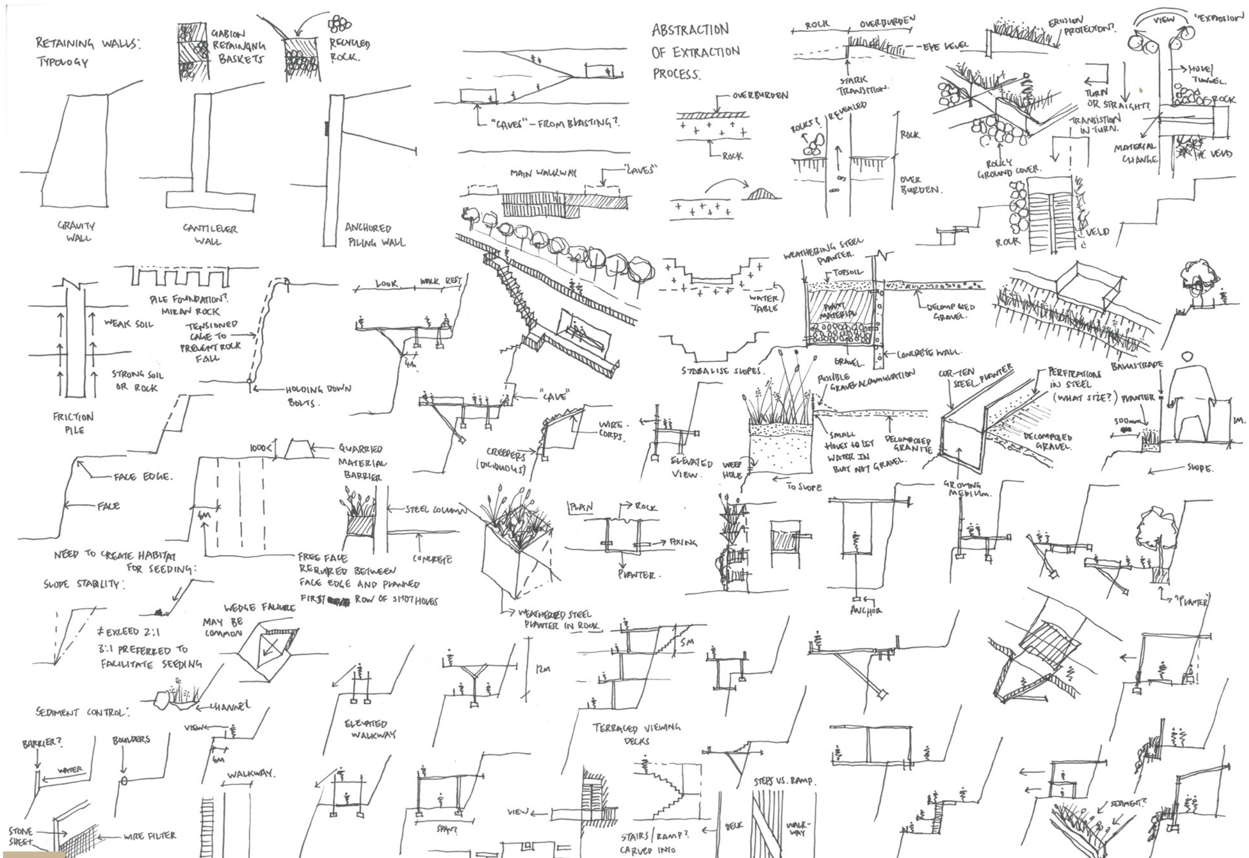


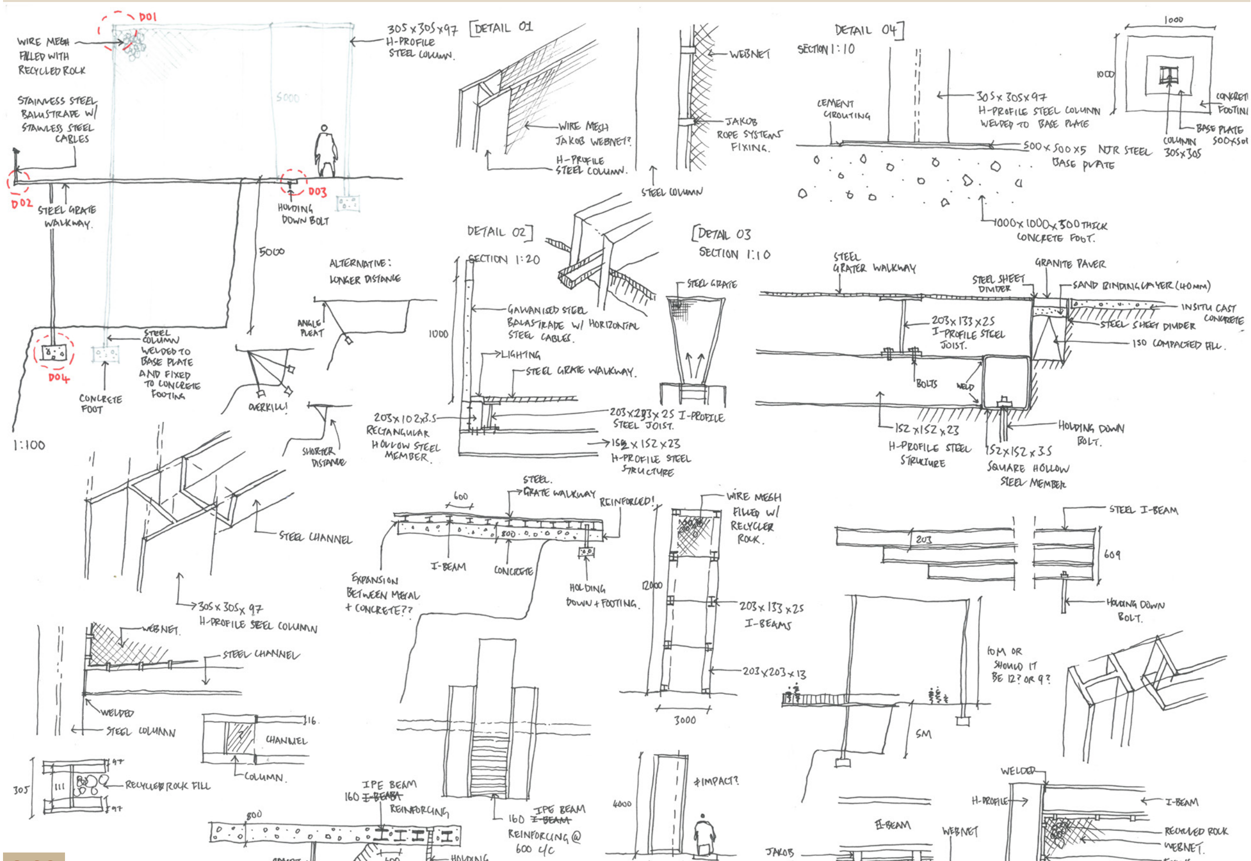
Fig. 8.25 Technical exploration of concrete steps and planting screens at The Descent (Author 2019)
Fig. 8.26 Details of concrete steps (Author 2019)
Fig. 8.27 Detail of concrete planter boxes and wire trellis (Author 2019)

8.4.4 Technical explorations of Quarry terraces and The Sublime

Fig. 8.28 Technical exploration of quarry terraces and incorporation of rest areas in that area (Author 2019)
Fig. 8.29 Initial exploration of The Sublime was a more tectonic structure (Author 2019)



8.28



8.29

9

CONCLUSION

CONCLUSION

The intention of this dissertation was to propose an alternative approach to the adaptive reuse of quarries. This was done through a minimal landscape design approach, which utilised waste material (in this case builders' rubble) sustainably in the construction of the site, while also recognising the unique visual and spatial qualities of many quarries.

Through the design proposal, it is hoped that quarries (as well as other wasted sites) are considered in built environment planning. Not only will this utilise space, but it will de-stigmatise and make the public more aware of pressing environmental issues such as poor waste management and natural mineral depletion.

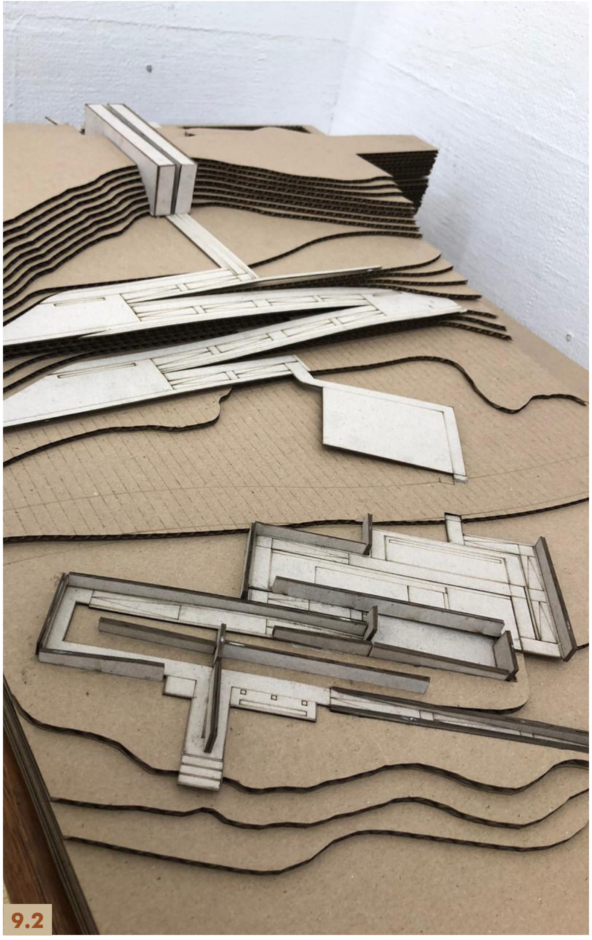
Although locally there is a lack of proposals (let alone implemented projects) which consider the reuse of quarries, there is great value for such proposals in future; there is even greater value if that quarry can responsibly address multiple local issues concurrently.

FINAL PRESENTATION

22 November 2019

Fig. 9.1 Final model of sketch plan area (Author 2019)
Fig. 9.2 Final model of sketch plan area (Nelissen 2019)
Fig. 9.3 Final model of sketch plan area (Nelissen 2019)


9.1


9.2

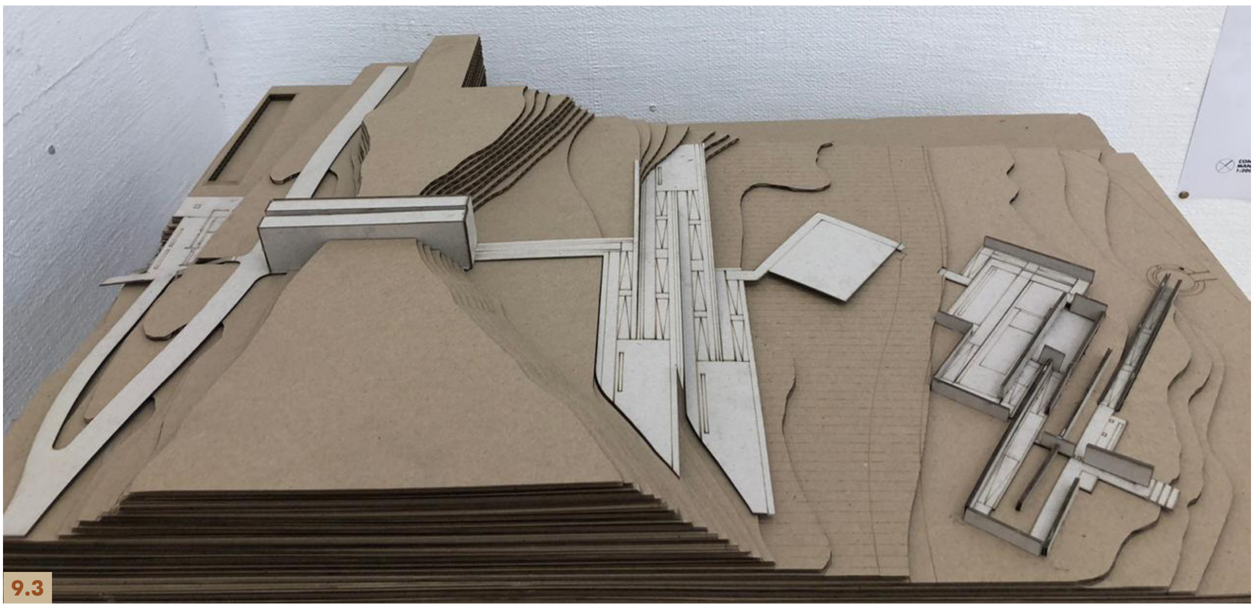
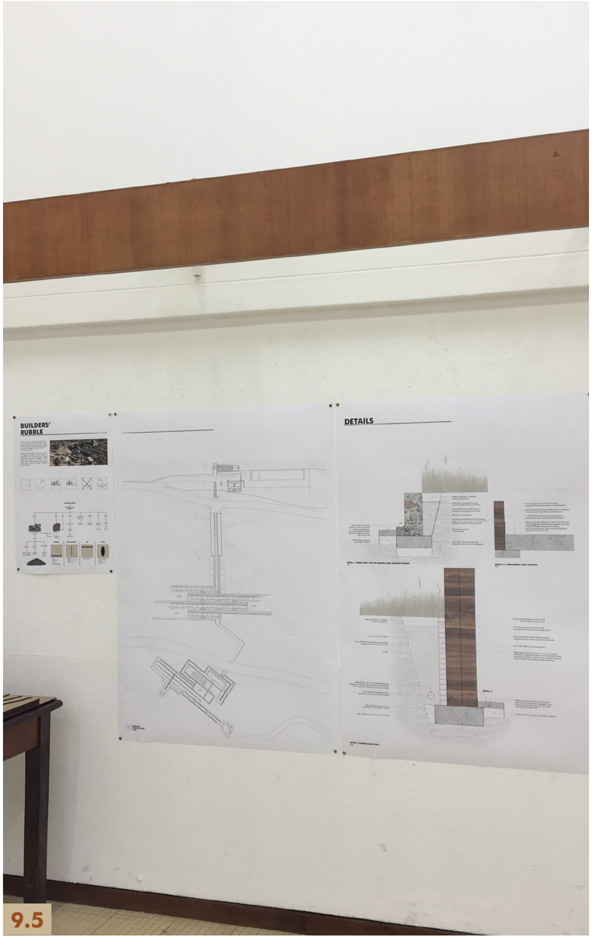

9.3

Fig. 9.4 Process models (Author 2019)
Fig. 9.5 Technification posters (Author 2019)
Fig. 9.6 Final presentation (Author 2019)

9.4



9.5

9.6

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APPENDIX A: WATER CALCULATIONS

WATER MANAGEMENT MODEL

A **WATER RESOURCE INFORMATION (YIELD, m³)**

A1 RAIN WATER HARVESTING DATA

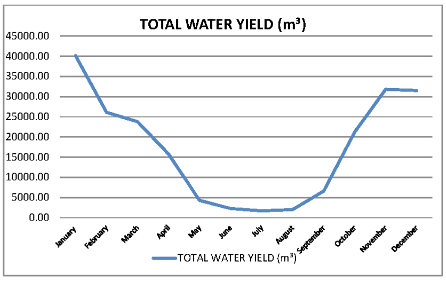
DESCRIPTION	AREA (m²)	RUNOFF COEFF. (C)
Catchment A (Gravel)	12204	0.75
Catchment B (Urban/Agri)	63696	0.65
Catchment C (Granite)	276324	0.75
Catchment D (Park)	32145	0.15
Storage C	24110	1
TOTAL AREA (A)	408479.00	
WEIGHTED C		0.70

A2 RECYCLED / ALTERNATIVE WATER SOURCE

MONTH	SOURCE 1		SOURCE 2		
	WEEKLY YIELD (m³)	MONTHLY YIELD (m³)	WEEKLY YIELD (m³)	MONTHLY YIELD (m³)	TOTAL / MONTH (m³)
January	0	0.00	0	0.00	0.00
February	0	0.00	0	0.00	0.00
March	0	0.00	0	0.00	0.00
April	0	0.00	0	0.00	0.00
May	0	0.00	0	0.00	0.00
June	0	0.00	0	0.00	0.00
July	0	0.00	0	0.00	0.00
August	0	0.00	0	0.00	0.00
September	0	0.00	0	0.00	0.00
October	0	0.00	0	0.00	0.00
November	0	0.00	0	0.00	0.00
December	0	0.00	0	0.00	0.00
ANNUAL AVE.		0.00		0.00	0.00

A3 TOTAL WATER YIELD

MONTH	AVE RAINFALL , P (m)	CATCHMENT YIELD (m³) (Yield = PxAxC)	ALTERNATIVE WATER SOURCE (m³)	TOTAL WATER YIELD (m³)
January	0.140	40142.22	0.00	40142.22
February	0.091	26092.44	0.00	26092.44
March	0.083	23798.60	0.00	23798.60
April	0.055	15770.16	0.00	15770.16
May	0.015	4300.95	0.00	4300.95
June	0.008	2293.84	0.00	2293.84
July	0.006	1720.38	0.00	1720.38
August	0.007	2007.11	0.00	2007.11
September	0.023	6594.79	0.00	6594.79
October	0.074	21218.03	0.00	21218.03
November	0.111	31827.05	0.00	31827.05
December	0.110	31540.32	0.00	31540.32
ANNUAL AVE.	0.723	207305.90	0.00	207305.90



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B **WATER DEMAND**

B1 LANDSCAPE IRRIGATION DEMAND (m³) (Including constructued wetland)

DESCRIPTION:	LAWN (m²): 14024		AGRI (m²): 22771		PLANTING (m²): 26013		
MONTH	WEEKLY IRR. (m)	MONTHLY DEMAND (m³)	WEEKLY IRR. (m)	MONTHLY DEMAND (m³)	WEEKLY IRR. (m)	MONTHLY DEMAND (m³)	TOTAL MONTHLY IRR. DEMAND (m³)
January	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
February	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
March	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
April	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
May	0.01	560.96	0.025	2277.1	0.005	520.26	3358.32
June	0.01	560.96	0.025	2277.1	0	0	2838.06
July	0.01	560.96	0.025	2277.1	0	0	2838.06
August	0.02	1121.92	0.025	2277.1	0	0	3399.02
September	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
October	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
November	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
December	0.02	1121.92	0.025	2277.1	0.005	520.26	3919.28
ANNUAL TOTAL		11780.16		27325.2		4682.34	43787.7

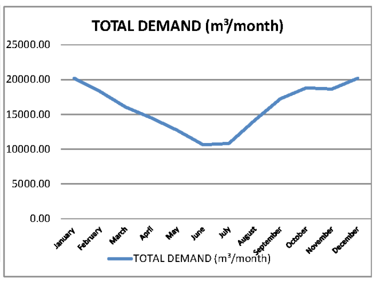
B2 ALT DEMAND

MONTH	PERSONS	WATER/ CAPITA/ DAY (l)	DOMESTIC DEMAND (m³/month)
January	41975	4	5204.9
February	41975	4	4701.2
March	41975	4	5204.9
April	41975	4	5037
May	41975	4	5204.9
June	41975	4	5037
July	41975	4	5204.9
August	41975	4	5204.9
September	41975	4	5037
October	41975	4	5204.9
November	41975	4	5037
December	41975	4	5204.9
ANNUAL TOTAL	503700		61283.5

B3 EVAPORATION LOSS (For 'open' reservoirs) (Excluding C) 35mm - 45mm/week in summer

AREA OF RESERVOIR (m²): 69131

MONTH	EVAPORATION RATE (m/week)	EVAPORATION RATE (m/month)	TOTAL LOSS (m³/month)
January	0.04	0.16	11060.96
February	0.035	0.14	9678.34
March	0.025	0.1	6913.1
April	0.02	0.08	5530.48
May	0.015	0.06	4147.86
June	0.01	0.04	2765.24
July	0.01	0.04	2765.24
August	0.02	0.08	5530.48
September	0.03	0.12	8295.72
October	0.035	0.14	9678.34
November	0.035	0.14	9678.34
December	0.04	0.16	11060.96
ANNUAL TOTAL	0.32	1.26	87105.06



B4 TOTAL WATER LOSS & DEMAND

MONTH	TOTAL DEMAND (m³/month)
January	20185.14
February	18298.82
March	16037.28
April	14486.76
May	12711.08
June	10640.30
July	10808.20
August	14134.40
September	17252.00
October	18802.52
November	18634.62
December	20185.14
ANNUAL TOTAL	192176.26

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C **WATER BUDGET**

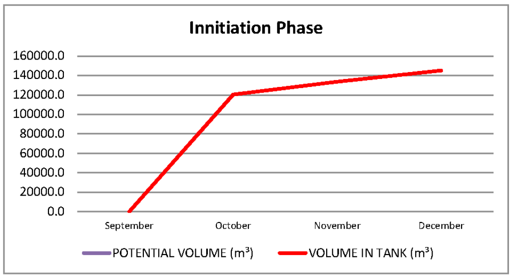
RESERVOIR CAPACITY (m^3): 470205
MIN VOLUME (m^3): 120550

C1 WATER BUDGET INNITIATION PHASE

MONTH	YIELD (m^3/month)	DEMAND (m^3/month)	MONTHLY BALANCE	POTENTIAL VOLUME (m^3)	VOLUME IN TANK (m^3)
September	6594.8	17252.0	-10657.2	**0.0**	**0.0**
October	21218.0	18802.5	2415.5	**120550.0**	**120550.0**
November	31827.0	18634.6	13192.4	**133742.4**	**133742.4**
December	31540.3	20185.1	11355.2	**145097.6**	**145097.6**
	91180.2	74874.3	16305.9		

C2 WATER BUDGET YEAR 1

MONTH	YIELD (m^3/month)	DEMAND (m^3/month)	MONTHLY BALANCE	POTENTIAL VOLUME (m^3)	VOLUME IN TANK (m^3)
January	40142.2	20185.1	19957.1	**165054.7**	**165054.7**
February	26092.4	18298.8	7793.6	**172848.3**	**172848.3**
March	23798.6	16037.3	7761.3	**180609.6**	**180609.6**
April	15770.2	14486.8	1283.4	**181893.0**	**181893.0**
May	4301.0	12711.1	-8410.1	**173482.9**	**173482.9**
June	2293.8	10640.3	-8346.5	**165136.4**	**165136.4**
July	1720.4	10808.2	-9087.8	**156048.6**	**156048.6**
August	2007.1	14134.4	-12127.3	**143921.3**	**143921.3**
September	6594.8	17252.0	-10657.2	**133264.1**	**133264.1**
October	21218.0	18802.5	2415.5	**135679.6**	**135679.6**
November	31827.0	18634.6	13192.4	**148872.1**	**148872.1**
December	31540.3	20185.1	11355.2	**160227.2**	**160227.2**
ANNUAL AVE.	207305.9	192176.3	15129.6		



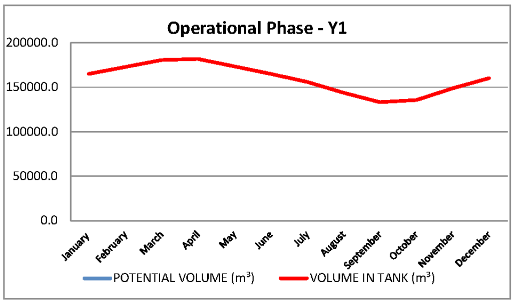


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Fig. 9.7 Water calculations, page 01 (Author 2019)
Fig. 9.8 Water calculations, page 02 (Author 2019)
Fig. 9.9 Water calculations, page 03 (Author 2019)