CELEBRATING THE UNSEEN

A public interface to Hartebeespoort Dam water infrastructure.

A re-appropriation of the infrastructure through an architectural interface that fulfils cultural, social and economic functions to create a positive recreational space that celebrates water and its importance in our heritage. The intention is to create a productive infrastructure that facilitates exchanges between site, infrastructure and the user.

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Submitted in fulfilment of part of the requirements for the degree of Master in Architecture (Professional)

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

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

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

Ryan Taylor

Acknowledgements

I would like to thank my parents and brother for the amazing support throughout my life in order for me to reach this point. Could not have done it without you by my side.

Special thanks to Prof Arthur Barker for the time and effort that you put into each and every one of your students. An amazing mentor and friend.

Steph, thank you for always being there with me, through the good and difficult times.

PROJECT SUMMARY

Programme:	Integrated Natural Resource Facility
Site description:	The infrastructure of Hartbeespoort Dam wall
Site Location:	Hartbeespoort Dam, North West Province
Address:	Scott Street, Hartbeespoort Dam, 0216
Coordinates:	25 °43'31.95" S; 27° °50'54.20" E, elev. 1167m
Research Field:	Environmental Potential, Heritage and Cultural Landscapes
Client(s):	The Department of Water Affairs (DWA)
	The Rand Water Foundation
Keywords:	public infrastructure, regeneration, vermiculture, Hartbeepoort Dam
Theoretical Premise:	Regenerative theory with the water Infrastructure to rehabilitate the scarred landscape of Hartbeespoort Dam
Architectural Approach:	The exploration of regenerative architecture as a means of re-imagining the potential energy locked into Hartbeepoort Dam to creating a new relationship between site, infrastructure and the user.

ABSTRACT

A public interface for the infrastructure of Hartbeespoort Dam

Water sustains all living things on this earth and has a huge impact on the natural environment. Water is the most valuable natural resource on this earth. It is vital to humans' existence. It is why we have evolved to the point that we are now and if we do not appreciate it, it will be our demise. Water has the ability to adapt and change as different natural systems interact with it, it allows a constant balance to remain. Humans have broken the delicate balance of water supply and demand, detrimentally affecting the natural systems that support us.

Since the start of the industrial era our cities have grown at an exponential rate. The development of cities has impacted negatively on natural systems. This has led to a concomitant disconnection between man and nature and has divorced humans from an understanding of the role and importance of natural water systems. . We have forgotten the positive effects that we experience when directly engaging with water as we live in environments often far from nature; rarely experiencing it fully. Our physical control of natural resources has led to a physical disconnection and under appreciation of these precious resources.

This project aims to reconnect man and nature to create a new paradigm where humans value our natural resources and, in particular, water.

A re-appropriation of water infrastructure through an architectural interface that fulfils cultural, social and economic functions to create a positive recreational space that celebrates water and its importance in our heritage. The intention is to create a productive infrastructure that facilitates exchanges between site, existing infrastructure and the user.

USHWANKATHELO

Isinxulumanisi sezi bonelelo sika wonke wonke kwi dama lase Hartebeesport.

Amanzi iyona nto ibalulekileyo emhlabeni ebangela abantu baphile. Ukuba asiwongi amanzi sizokufa. Abantu bawasebenzise kakubi amanzi, lonto icaphazele indalo yethu kakubi.

Oko kwaqala ezoshishini izixeko zethu zakhula ngokukawuleza ngendlela engumangaliso.Uphuhliso bezixeko zethu bumoshe inkqubo yendalo. Lonto yenze abantu bangayikathaleli indalo; bahoye ukuphuhlisa izixeko. Lento yabantu behlala kude kune ndalo yenze abantu baphethe bengaxabisi oovimba bendalo.

Leprojekthi ijonge ukwenza uqhagamshelwano phakathi kwabantu kunye nolawulo loovimba bendalo, ingakumbi amanzi.

Leprojekthi ijonge nakhona ukwakha izinxulumanisi ezizokutshintsha indlela abantu bawasebenzinsa ngayo. Umnqweno ngowokuba abantu bazakuxabisa amanzi, bawasebenzise ngokufanelekileyo.

UITTREKSEL

'n Publieke skeidingsvlak vir die infrastruktuur van die Hartebeespoort Dam omgewing.

Water onderhou alle lewe op aarde en het 'n groot impak op die natuurlike omgewing. Water is die belangrikste natuurlike hulpbron op die aarde en is van die uiterste belang vir die mens se voortbestaan. Dit is hoekom ons die punt bereik het waar ons nou is. Dit sal ons ondergang beteken as ons dit nie bewaar en waardeer nie. Die mens het die delikate balans van aanvraag en watervoorsiening versteur tot nadeel van die natuurlike sisteme wat ons onderhou.

Sedert die begin van die industriele tydperk het ons stede eksponensieël vergroot. Die ontwikkeling van stede het 'n negatiewe impak gehad op ons natuurlike omgewing. Dit het gelei na 'n gepaardgaande diskonneksie tussen mens en natuur en het die mens se begrip van die rol en belang van natuurlike waterbronne negatief beïnvloed. Omdat ons in omgewings woon vêr verwyder van water en dikwels van die natuur kom ons nie direk met water as lewensmiddel in ons omgewing in kontak nie. Ons fisiese beheer van natuurlike bronne het gelei tot die skeiding en onderwaardeering van hierdie kosbare bronne.

Die doel van die projek is om mens en die natuur bymekaar te bring en 'n nuwe paradigma te skep waar die mens sy natuurlike bronne, en in die besonder water, waardeer.

'n Nuwe benadering tot waterinfrastruktuur deur 'n argitektonise wisselwerking wat kulturele, sosiale en ekonomiese funksies bymekaar bring om 'n positiewe onspanne ruimte te skep waar die belang van water as 'n erfenis vier, is nodig. Die doel is om 'n produktiewe infrastruktuur te skep wat uitruiling tussen die terrein, die huidige infrastruktuur en die gebruiker bymekaar bring.

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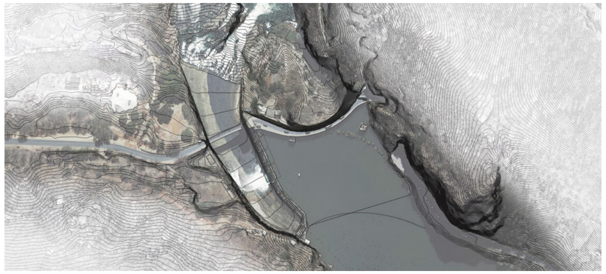
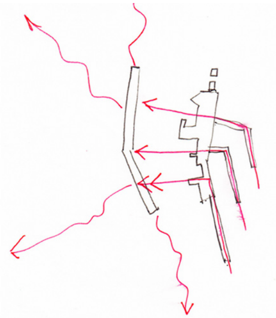
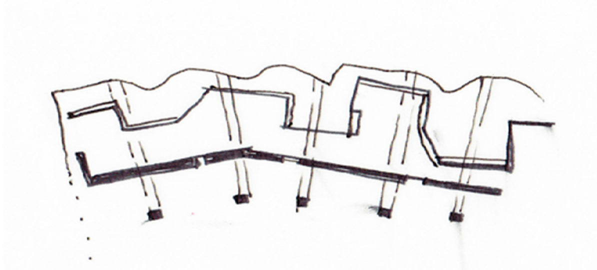
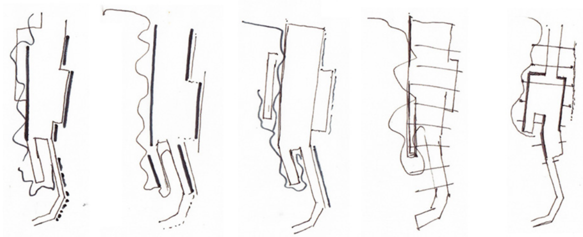
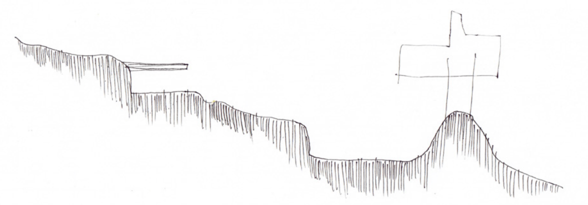
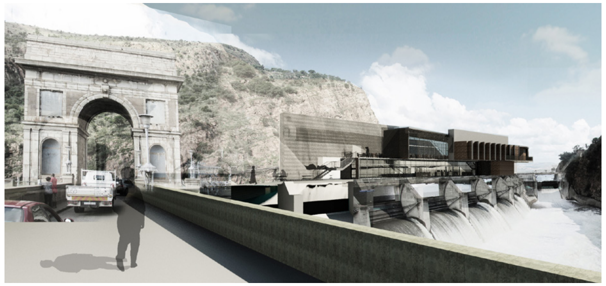












Chapter 1:
Resources and their consequences

INTRODUCTION

urtynsky (2006) remarked that "Like all animals, human beings have always taken what they want from nature. But we are the rogue species. We are unique in our ability to use resources on a scale and at a speed that our fellow species can't" (Manufactured Landscapes, 2006).

1.1 **Resources and their consequences**

1.1.1 The Cities of today

Before the modern era, human settlements such as Machu Picchu, either integrated or coexisted peacefully with nature. Here the city was sculptured into the site and man made elements such as the stonework are woven between and formed from nature.

During the industrial era infrastructure was implemented into cities to deal with the influx of people. With the use of fossil fuels, people were able to live outside of the city and commute every day. This led to the infrastructure sprawling across our natural landscape. Infrastructure was used to control our rivers and retain our water in dams. This caused a disconnection between man and nature.

Further urbanism changed cities, the modern movement a call for a home, a high rise habitat that replaced gardens.

Grant (2012: 53) states that "urban dwellers became increasingly disconnected from nature, so that nowadays many of us no longer understand the connection of a healthy ecosystem and healthy cities. Landscapes on and around our buildings and infrastructure can be more than an optional ornamental extra but a multi-functional layer of soil and vegetation that controls surface water, provides food and wildlife habitat and keeps us cool, fit and sane. To make this transformation from grey to green will require panoramic, trans disciplinary thinking and coordinated action" (The nature of cities, 2013).

Fig 1.1. Machu Picchu (Thousandwonders, 2016).

Fig 1.2 Machu Picchu (Thousandwonders, 2016).

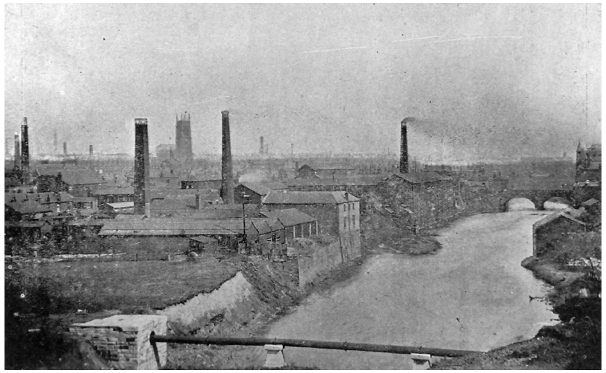


Fig 1.3 the Industrial Revolution on the River Irwell (Wikimedia, 2014).

Man and nature have always been connected. We have relied on nature to provide us with resources in order for us to grow and become the civilisation that we have. But over time we have become disconnected from nature and separated ourselves from that which sustains us. Now we tend to view nature as a form of escapism; to break away from urban life. Our cities have become so disconnected from nature and there are only remanences of it left (The nature of cities, 2013).

> Samiei's (2012) opinion is that "nature has been seen as a superficial embellishment, as a luxury encountered only in parks and gardens, rather than a meaningful essential force that permeates the city" (The nature of cities, 2013).

This is no different to Pretoria's public spaces while they were viewed as an escape from the city, a natural area contained in an urban sprawl, but over time parks and recreation spaces have become derelict and forgotten and now are places of crime. These spaces have quotidian activities in them now which create further pollution.

1.1.2 The City of Pretoria

Water is one of the main reasons why Pretoria was able to develop into the town that it is today. Fortunately there was an abundance of natural groundwater in the form of dolomite aquifers. There are two dolomite aquifers in the Groenkloof nature reserve which flow into the Apies River. Other dolomite aquifers are located to the south of Groenkloof, namely Grootfontein and Sterkfontein. This water has been retained in large dams such as Rietvlei and Hartbeespoort. They are a vital part of Pretoria's heritage and still supply drinking and irrigation water to the city. But yet there is little understanding of their significance and the role they have played in the development of Pretoria.

To gain a greater understanding of Pretoria's water systems, all water bodies have been mapped by the framework group. More detailed research has been delimited to the section of the Apies River and Hartbeespoort Dam. Through research on the urban development of Pretoria it is evident that there has been a growing disconnection between man and nature. We no longer understand natures importance and its role in our life.

In order to reconnect man and nature there is a need to install a new identity of water, an identity that looks at a symbiotic relationship between man and nature, rather than the current parasitic relationship. This identity allows a critique of our current infrastructure and a celebration of water.

Fig 1.4 Pretoria growing (Adapted from N, Clarke. 2010).


Fig 1.5 Pretoria growing (Adapted from N, Clarke. 2010).


Fig 1.6 Pretoria growing (Adapted from N, Clarke. 2010).

1.2 Problem Statement

1.2.1 Destruction of natural systems

The natural world consists of complex and integrated systems that all work in unison. Natural systems are made up of many closed loops that maintain their existence and balance. As humans we often disrupt these closed loop systems and sometimes even destroy them (Dekay and O'brien, 2001).

The impact of human activities on the world has grown significantly since the Industrial age. We see ourselves as being above nature and its systems. We have taken advantage of it. These ideas are slowly shifting to viewing ourselves as being a part of the natural balance of life. As can be seen in fig. 1.8-1.9 below that reflects these ideas.

The built environment is a major factor in the destruction of closed loop systems. With these shifting ideas of viewing ourselves as part of nature we have tried to become more sustainable and to think "Green" in the built environment. This only stops further damage to the environment but does not deal with the existing damage that has already been created. Now we need to think of regenerative architecture, where these natural systems can be integrated into our buildings to create closed loops, but also regenerate the environment and context around buildings (Grant, 2012).

1.2.2 Disconnection between man and water

Physical

In most cities there is a division between humans and water. We simply open our taps and the water comes out. There is no understanding of where it came from or where it goes after we have used it.

Visual

Often rain water is not only taken away by open storm water channels but also enclosed in pipes; as is evident in Pretoria with the Apies River as it was a natural river which has been mostly channelized.

Natural

A natural river from a natural spring is contained and dammed to hold the water. A natural element is now a man made controlled element.

The Hartbeespoort Dam contains much of Pretoria's water. It is very polluted and has disrupted closed loop natural systems. This is a problem for our water supply because as it becomes more polluted, it destroys more systems.

"Water, like many other resources, is harvested, transported and used throughout all aspects of society. Unlike other resources, water is critical to the survival of all forms of life. The underlying question that sits at the core of my exploration is to what degree we can shape water before it begins to shape us" (Manufactured Landscapes, 2006).

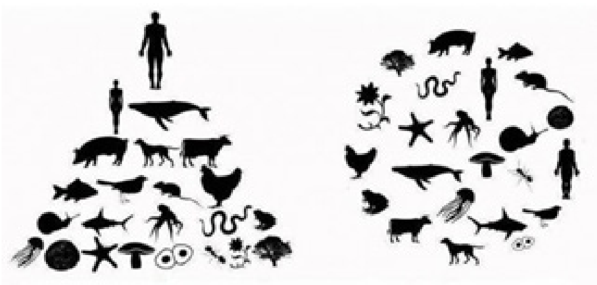


Fig 1.7 Web of life (Quotelotus. 2016).

Fig 1.8 Apies River (Author, 2016).

Fig 1.9 Floating letter in dam (Wikipedia, 2016).

Privatisation

The land around our water features has been privatised with limited public spaces or access to the water. This means that there is only a connection for a select few.

Public Space

Public spaces which used to be our one connection back to nature have now become dead zones in our city surrounded by mono-functional buildings (see fig 1.4-1.6). Pretoria's public spaces are no different. Spaces that could create a connection back to nature, such as the Apies river, have not been designed appropriately and end up being negative spaces.

Through this disconnection between humans and water we have become irresponsible with this natural resource and have forgotten its historical importance. It is hypothesised that a similar disconnection has occurred at the Hartbeespoort Dam, where space has been privatised and therefore it is thought that there is little or no connection to the water besides limited visual connection.

As can be seen in fig 1.11, Roma's water infrastructure is still displayed to this day in Italian cities, even though it may not be used. For example the aqueducts no longer have water flowing in them they but they are still highlighting their importance and heritage value. A good example is the image on the bottom right hand side, Trevi fountain that creates a public space to this day.

This is not the same in Pretoria where water infrastructure is concealed or removed from sight. For example the Fountain in Church Square (see fig 1.10) has been removed to the zoo and the furrows, where water used to run, have now been covered up. This attitude towards our water history shows the disconnection that we have created.

1.2.3 Mono-functional infrastructure

Through this disconnection we have changed our perspective of water from a natural element to a natural resource. A resource that can be used and exploited and which is used irresponsibly.

Our infrastructural buildings are the only interaction with our natural resources that remain. This infrastructure is something that we rely on every day, it provides us with power and water but yet these buildings remain inaccessible to us. They often create divisions in our city, because of their physical size and singular use.

Infrastructure is constantly used without us seeing or experiencing the processes. Our infrastructure buildings are essentially mono- functional. The engineering design is as efficient as possible with no public access or connection to the city (Davids, R, 2016: 5).

Often these areas are restricted because there are safety issues. These spaces are engineered to be as effective as possible and this does not consider safety as a priority. This being said there are ways of making these space safer in order to be publicly accessible.

Pretoria - water infrastructure covered and forgotten

Fig 1.10 Pretoria's water fountain (Wikipedia, 2016).

Rome - water infrastructure celebrated and remains a part of the city

Fig 1.11 Romes Trevi water fountain (Wikipedia, 2016).

1.3 Intention of this dissertation

This dissertation will attempt to look at infrastructure in three ways:

-To celebrate our water heritage and its importance.

-To redesign the single use spaces as multifunctional spaces.

-To re-acquaint man and nature by adapting primarily inaccessible buildings, with secondary functions to be better publicaly connected.

This calls for a re-appropriation of infrastructure through an architectural interface that fulfils cultural, social and economic functions. This will create a positive recreational space that celebrates water and its part in our heritage, reminding us of its importance - a productive infrastructure that creates a better connection between man and nature that heals scarred landscapes.

The fig, 1.13 shows a building that creates a public space as well as being a dam wall, producing a better public connection to water through contact and sight.

Summary of issues

Through the development of our cities we have controlled natural water to become a natural resource. The only place that we now have connection with water is in water infrastructure buildings and, as they are right now , these structural buildings are mono-functional and closed off to public. This has led to us being less engaged with water and a new architectural paradigm needs to be created.

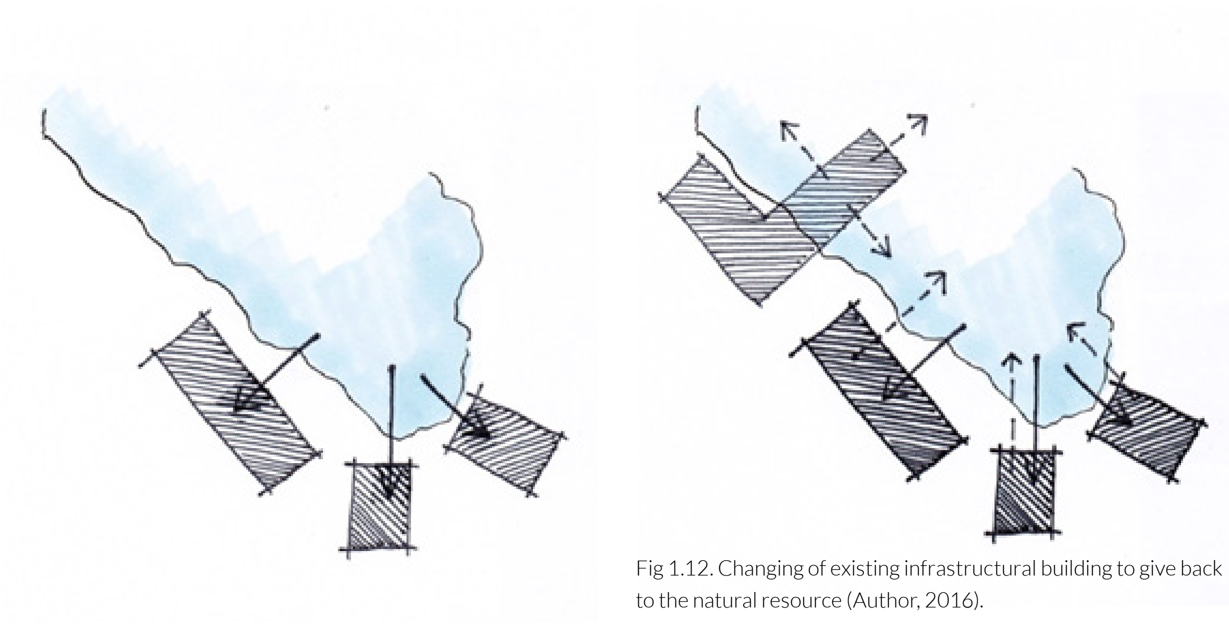


Fig 1.12. Changing of existing infrastructural building to give back to the natural resource (Author, 2016).

Fig 1.13 Landscape Architecture student (Asla. 2016).

1.4 **Regenerative and Resilient Theories**

As the existing site has been scarred by the creation of the dam and the eutrophication of the water has created an imbalance in nature that cannot be self corrected. Regenerative theories could be used to create an architecture that starts to bring equilibrium back to the site. The building does not only need to cater for the new user but also to rehabilitate the site in order for other uses to be sustained in the future.

The theories of Regenerative Architecture do not mean that the building is 'regenerated', in the way of self-healing, like a living system. Rather it means that a regenerative building is a catalyst for positive change within a unique place in which it is situated. This looks at a specific situation or site that has declined to a point where it is right for renewal (Cole, 2012: 54).

Using regenerative architecture to explore how ecosystem services available in Hartbeespoort Dam could be utilized through a public interface to the existing dam wall (Cole, 2012:54).

This dissertation will use regenerative theories as a departure point for the design. The architectural intervention will be tested against Steven Moore's eight points for regenerative regionalism. He contextualises these eight points in a non-modern regionalism refuting modernity and post-modernity. The eight points will have to be given a hierarchy of importance relative to the needs of the site in order to proceed with design(Canizaro, 2007:433-442).

The diagrams in figure 1.15 show how a system can be made stronger through regenerative theories. The top diagram shows a one-way flow of materials into a system that will eventually use up all the resources and collapse. The lower diagram shows a networks of different systems that feed into one another creating closed loop systems and insuring a continues system.

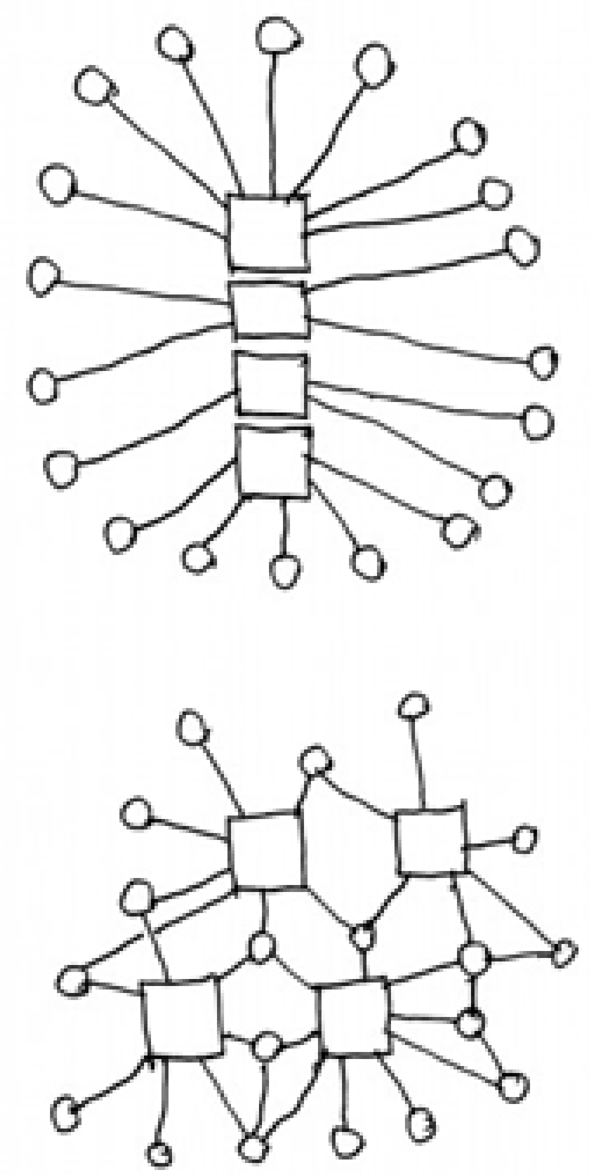


Fig 1.15 Resilient diagram (metropolismag. 2016).

1.5 Site

1.5.1 Study area

Through research of Pretoria a greater understanding of water bodies was gained and a delimitation was made to focus on the Apies river that flows through the CBD and the Hartbeespoort Dam. Through research on the urban development of Pretoria a new identity was envisioned between man and nature. This identity was applied to the Hartbeespoort Dam which became the new focus area for this dissertation.

1.5.2 Context focus

The Hartbeespoort Dam is located to the west of Pretoria and was constructed to create a constant water flow to the agricultural lands to the north. It has become a recreational space for Johannesburg and Pretoria. Many natural systems and ecological potentials have been disrupted by humans resulting in a polluted water system. This has resulted in the eutrophication of the water, through an increase of phosphates and nitrates. This abundance of nutrients leads to a boom in algae growth which, in turn, blocks out the sun and uses the oxygen in the water, killing other marine life. This increase in nutrients is due to sewer water and fertiliser polluting the water system in the Crocodile River (Harties, 2016).

Through a greater investigation of the dam it became possible to hypothesise that the dam wall was a key point to create a better connection between man and the natural resource, water.

1.6 Program

Celebration of water

The aim of this dissertation is to explore the creation of a public interface along the Hartbeespoort Dam wall infrastructure by creating a space that celebrates one of our natural resources, water. Secondary functions will be to create closed loops systems to rehabilitate the dam, mainly a vermiculture system that removes Hyacinth from the dam and creates compost.

This dissertation will reintroduce urban communities to natural processes by integrating people and natural productive systems within the context of Hartbeespoort Dam's infrastructure.

The products of this system can be used to rehabilitate the dam by creating wetlands that filter out the causes of eutrophication before entering into the dam. The systems can be heightened and displayed to create awareness and therefore create public participation in correcting the dam's state (Harties, 2016).

Products of the systems will be sold to the public in a retail and restaurant space which will draw people back to the space as well as recreation boardwalks and picnic areas.

1.7 Research Questions

The focus of this dissertation is to test whether architecture can create a public interface to Hartbeespoort Dam water infrastructure that facilitates exchanges between site, infrastructure and the user.

The dissertation aims to answer the following research questions:

- Can architecture construct integrated cultural and ecological processes to create social activity?
- How can architecture as a productive infrastructure rejuvenate and regenerate the Hartbeespoort Dam in order to create a sustainable recreational space and re connect humans with their environment?
- Can architecture facilitate closed loop systems?
- How can architecture create economic opportunities for sustainable food production to reinforce the rehabilitation of the Hartbeespoort and reconnect Pretoria and surrounding areas to the dam?

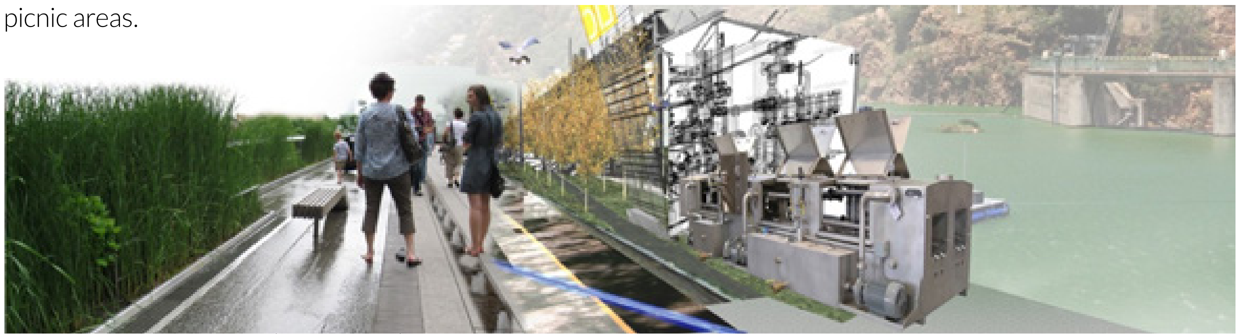


Fig 1.16 Vision perspective (Author, 2016).

1.8 Research methodology

1.8.1 Understanding of site

Context analysis and secondary data analysis of Hartbeespoort Dam will be collected to gain a greater understanding of the issues at hand. Comparative analysis and historical studies will be used in a thorough investigation of the dam wall and the Hartbeespoort context to understand its historical meaning. Photography was the primary medium used to capture qualitative data to understand the development of the wall and the context that preceded it.

Evaluative research/appraisals will give hierarchy of the existing value of the current development proposal. This will be used to understand which has potential to become integrated into the project and which are of lesser importance. The current remediation proposal for the site and its surroundings will be analysed to find whether such proposals are appropriate, and where alternatives or improvements can be considered.

Literature research of past analyses of this site and its context to gain an understanding of gaps in the research that will need to be carried out as well as gain a greater understanding of site.

1.8.2 Understanding of theory

The investigation of critical theories through literature reviews will be carried out. Relevant literature related to resilience and regenerative design was researched (desktop study) to develop an appropriate architectural design response to conditions on the site. Steven Moore's eight points for regenerative regionalism are specifically used as a departure point.

1.8.3 Understanding the condition of water

An understanding of the disconnection between man and water is to be gained through the subcategories of history, physicality and naturalness. These subcategories were interpreted to provide architectural potential for the project.

Further desktop research will be done to understand the state of the water as well as the activities that influence this and what the possibilities are of using this water 'pollutants' for alternative activities and therefore the potential energy contained in the water.

Research of what the current processes are to alleviate the eutrophication of the water and their effectiveness in doing so. If any spin off activities are required or could be utilized.

1.9 Delimitations

This dissertation looks at a specific site in its context and will not postulate a set of rules to apply to any infrastructural building/object. This dissertation will reintroduce urban communities to natural processes by integrating people and natural production systems only within the context of Hartbeespoort Dam's infrastructure.

This dissertation will look specifically at the water around the dam wall and not try and solve the entire situation of Hartbeespoort Dam. It is simply an example of catalytic intervention that could be integrated throughout the dam.

1.10 Limitations

It is important to note that the author is not an expert on the production aspect, but is simply researching the possibilities of cross programming of these production systems.

The extent of this understanding is limited by the time available for this dissertation. This may lead to further investigation of these possibilities that are being researched in this dissertation as they are not finite and can be broadened.

There is a limitation on the information about the construction of the dam wall. Due to the limitations of time, the dam wall will be drawn to the best of my knowledge and this information will be taken forward in this dissertation.

1.11 Assumptions

The assumption that the existing wall is strong and stable enough to support the proposed interventions was confirmed by the departmental engineer.

The existing water control system can be manipulated to allow for the proposed program exchanges.

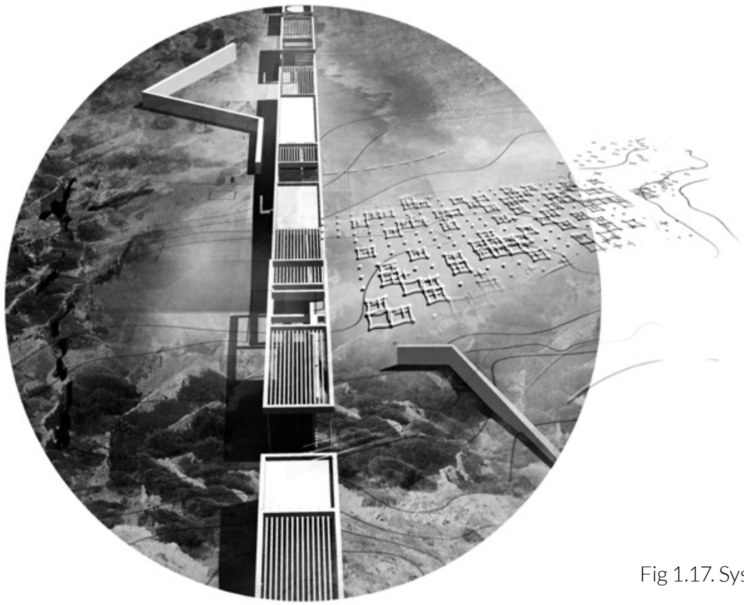
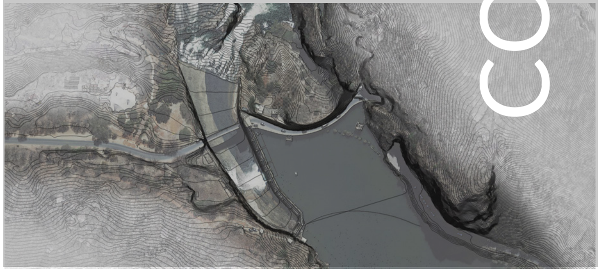


Fig 1.17. System Bridge (Alexandra Vougia, a et al., 2014).

Chapter 2:
A way of seeing



CONTEXT

"The history of water control is extremely varied in its technical complexity, its political and economic intentions, and its ecological and social impacts. Some water projects represent truly dramatic changes in history. When implemented they changed the course of development in the locality and beyond. But mostly water control is an ordinary, everyday matter – as simple as turning on a tap – practices repeated day after day and year after year, and thus re-enacting and confirming existing relationships to water " (Tvedt, 2012).

2.1 A continuum of water history

2.1.1 Giver and taker of life

Before the control over water, humans demand for water meant that we were dependent on the will of the natural water. Settlements would be developed where there were natural springs or rivers. We would have to migrate with the flow of water. Water was viewed as the giver and taker of life. This meant that many religions regarded water as a sacred entity and formed a key part of religious customs and rituals (Tvedt, 2012).

As people evolved, we started to be able to bend water to our will, we were able to create great cities around water points that we had created. The manipulation of these water sources became a celebration of our triumph and became an identity of the city that they surrounded (Tvedt, 2012).

The Greek geographer, Pausanias, who lived more than 2000 years ago, travelled what is now known as Europe. He commented that no city had the right to call itself a city unless it had at its centre, an ornamental fountain. This fountain represented an ideological and cultural notion of the triumph of civilization over nature. these elements showing triumph over water are still found in our cities to this day, maybe no longer fountains, but other water infrastructure such as dams (Tvedt, 2012,Dynesius, 1994: 753-62).

In China the largest dam in the world was created in 2010, the three Gorges dam. This dam was to control the flooding of the Yangtze River, it also created enough energy to power the entire city, more than 14 nuclear power stations can supply (Itaipu Binacional, 2015).

Fig 2.1 Religious customs and rituals (Wikipedia, 2016).

Fig 2.2 three Gorges dam in China (Wikipedia, 2016).

Fig 2.3 in Rome is the Trevi fountain (Author, 2016).

The fountain also symbolizes a more mundane and direct material fact – no city and no country has been able to exist or developed without subjugating water in one form or another to the demands of human society. This universal natural and social fact makes water a key theme in world history (Tvedt, 2012).

A famous example of a water city is Rome, with its water infrastructure still visible to this day. The symbolic fountain in Rome is the Trevi fountain, which was the final destination after the long journey along the aqueducts to its final delivery point of the fountains. Trevi fountain shows its power and the journey that the water made to get to that point. The citizens of that city understood the importance of water and the life that it brought. In modern day cities this is lost as the water infrastructure is mono-functional and hidden, often below the ground. We lose this understanding of the journey and the importance that water brings.

2.1.2 The concealing

The control of water is an endless struggle, even in today's times. Most people do not understand the historical significance of the labyrinth of piping under modern cities. They do not understand every time they turn on the tap where this water comes from and the journey it has to make to that point. They do not understand the urban planning needed from water planners and engineers over generations to make it possible. To bring water to an urban population is a continual effort that has been, and continues to be, fought in cities worldwide (Tvedt, 2012).

All societies have in one way or another been forced to manage their water resources, and have been affected by how the waters run through their landscape and how they have adapted to it and controlled it. From time immemorial, man has tried to master nature by transforming and controlling the water running through the landscape (Tvedt, 2012).

Tvedt (2012) states that man has affected all facets of water from "flood control and disease control, dams and canals for irrigation, rivers for navigation, and the different ways of using water as a source of power. Dams have stored, regulated, and raised water. Watersheds have been reworked and linked. Rivers have been forced between levees and dykes, canalized, straightened and cemented. Water has been diverted from areas of water surplus to areas of water deficit. Lakes have been lowered and wetlands drained and the natural river is now a storm water channel" (Issuu. n.d.).

Fig 2.4 Apies River (Author, 2016).

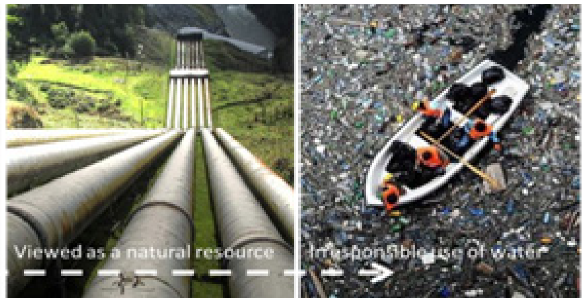


Fig 2.5 Dam wall (Wikipedia, 2016).

2.2 Riparian Networks

2.2.1 Vision

The class group urban vision focused on the theme of water in Gauteng and neighbouring areas. This was later delimited to Pretoria and the Hartbeespoort Dam. Analysis was done of its water sources, routes, tributaries and spaces along the Apies River in Pretoria, the Walkerspruit, Fountains Valley and the Hartbeespoort Dam was completed. All of these hydraulic elements embody broken ecologies and the infrastructural control of natural systems. Historically, the dam served as natural representations of our identity, where people used to spend Sunday afternoons along their banks and shores, interacting with the animals and plants that water supported (Van Der Waal Collection, 1989).

However today, public spaces around the dam that facilitated holistic engagement with the water are few and far between. The Hartbeespoort dam wall, built to retain more than 195 000 000 m^2 of water, as a purely engineered element that serves as only the physical function of water retention. Little attention was paid to connect people to the water. There was no celebration of water and the consequences thereof are experienced today. Now there are concerns regarding ecology and natural systems that need to be dealt with in urban design strategies and architectural design (Vuuren, J. 2011).

The urban analysis summarised the mapping of all variables of the river and spaces along the dam wall. These were everyday rituals along the river, ecologies that still exist along the river, spatial interfaces between water's edge and town, and movement patterns along the river. Nodes where the most opportunity for reconnection existed were identified.

The aim of the framework was to:

- Identify and build upon lost space along the water spaces and use them to reconnect the broken hydraulic ecologies.
- Redevelop lost spaces into public interfaces adjacent to the water, to foster a connection between the water and the people and show its importance in the everyday ritual of life.
- Reconnect man to the water to mitigate the limitations of infrastructural fabric and create an identity as a water city through celebration and awareness.
- Reconnect the ecological systems on the site that have been disconnected by the pollution and man and to facilitate exchanges through water and the site.

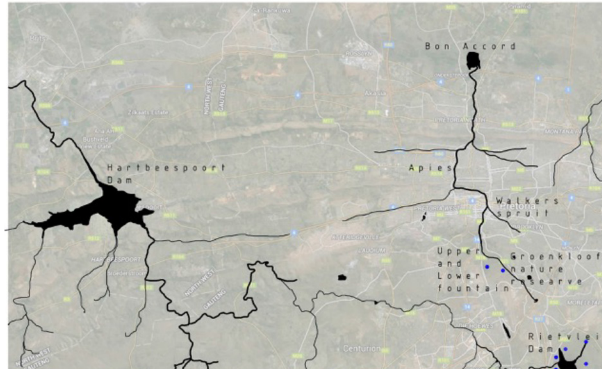


Fig 2.6 Water bodies frame work (Author, 2016).

Fig 2.7 Nodes in urban vision Apies River (Author, 2016).

2.2.2 Mapping

Mapping was done of water bodies in and around Gauteng to gain a greater understanding of current problems. Focus was then placed on the Apies river and the Hartbeespoort Dam. Parallels can be drawn between these water elements and many others in the city.

From the mapping done the following observations about both locations have been made:

-There is a lack of good multifunctional public space along the waters edge for the public to use daily.

-Gated communities and privatisation of land has created a further disconnection between man and nature.

- Water is polluted and disregarded even though it is a vital part of life. People have forgotten our heritage.

-There is a disconnection between ecological systems due to the quality of the water element.

-Through this disconnection we have forgotten our water heritage and this has caused us to lose a part of our identity.

Fig 2.8 Urban problems on Apies River (Author, 2016).

2.3 Site Location

The Hartbeespoort town is located in the North West Province of South Africa. It is situated on the slopes of the Magaliesberg mountain range and is formed around the banks of the dam. The town has become a small resort town consisting mostly of holiday homes situated around the dam as it is near to Gauteng Province. Pretoria is about 35 kilometres to the east.

Some of the main tourist attractions in or around the town are:

The Hartbeespoort Dam wall and tunnel

The Hartbeespoort Dam Snake Park

The Hartbeespoort Dam Aquarium

Hartbeespoort Aerial Cableway

Transvaal Yacht Club

The Elephant Sanctuary Hartbeespoort Dam

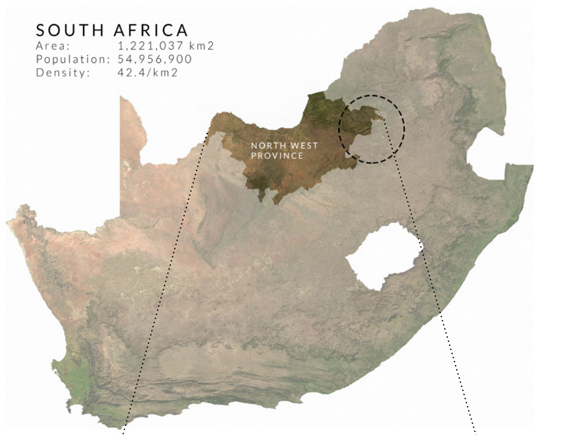
(Carruthers, 1990: 333, Wikipedia. 2016).

Hartbeespoort is part of the Municipalities of Bojanala Platinum District, North West, that also includes the nearby town of Brits. Some of the resort areas that have been developed are Kosmos, Melodie, Ifafi, Meerhof, The Coves Estate and Pecanwood Estate which can be found alongside the dam's banks. A number of new leisure developments and resorts are in progress.

Hartbeespoort means "gateway of the Hartbees" (a species of antelope) in Afrikaans. This was because it was a popular spot for hunters. The Hartbees would be chased into the "poort" in the Magaliesberg where they would be shot (de Beer, 1975: 381).

The town was previously known as Schoemansville, named after General Hendrik Schoeman. Schoeman was a Boer General in the Anglo-Boer War and sold his land so the Hartbeespoort Dam could be built (Wikipedia. 2016).

The dam was created here as there is a natural basin and gate way or "poort" through the Magaliesberg mountain range which formed a natural wall. The dam was originally constructed for irrigation purposes, which is still its primary use, but it also now fulfils the domestic and industrial need (Van Vuuren, 2008: 19-21).



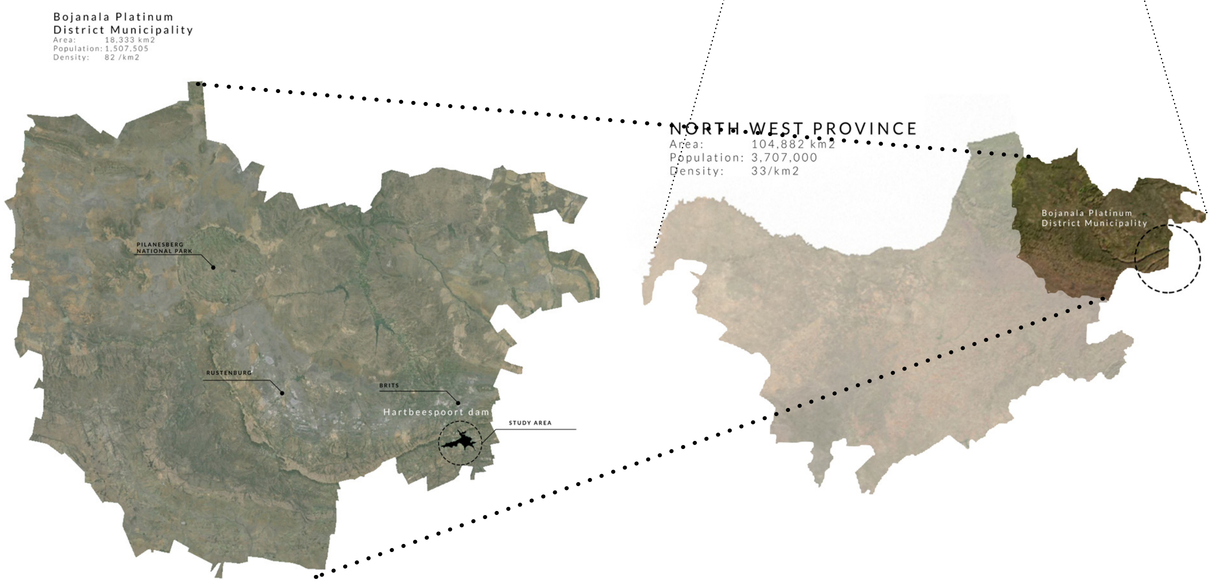


Fig 2.9 Site location. Image by Author (2016) sourced from Google Earth (2016).

Fig 2.10 Site location. Image by Author (2016) sourced from Google Earth (14 may 2016).

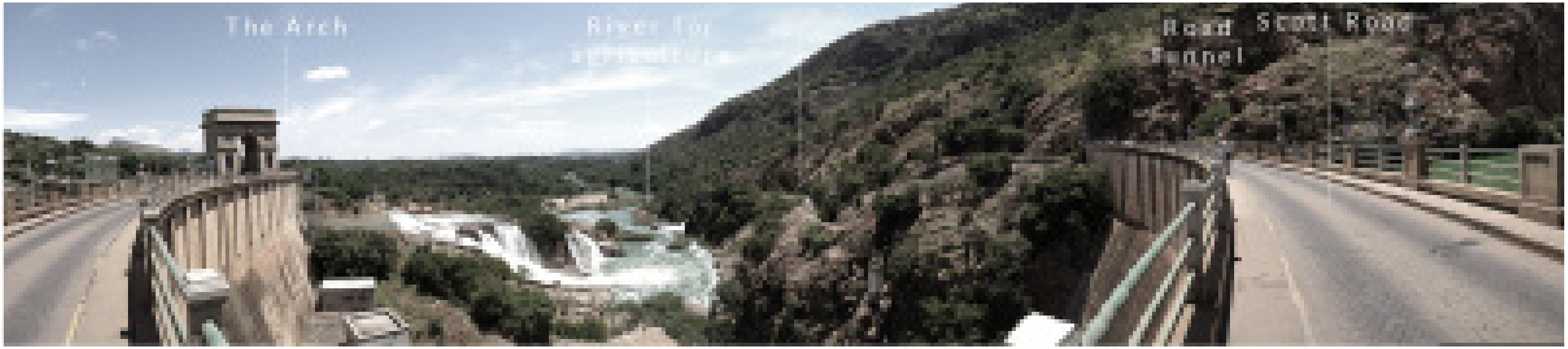


Fig 2.11 Hartbeespoort dam (Author, 2016).

Fig 2.12 Site location. Image by Author (2016) sourced from Google Earth (2000).

Fig 2.13 Hartbeespoort dam (Author, 2016).

Fig 2.14 Site location. Image by Author (2016) sourced from Google Earth (2000).

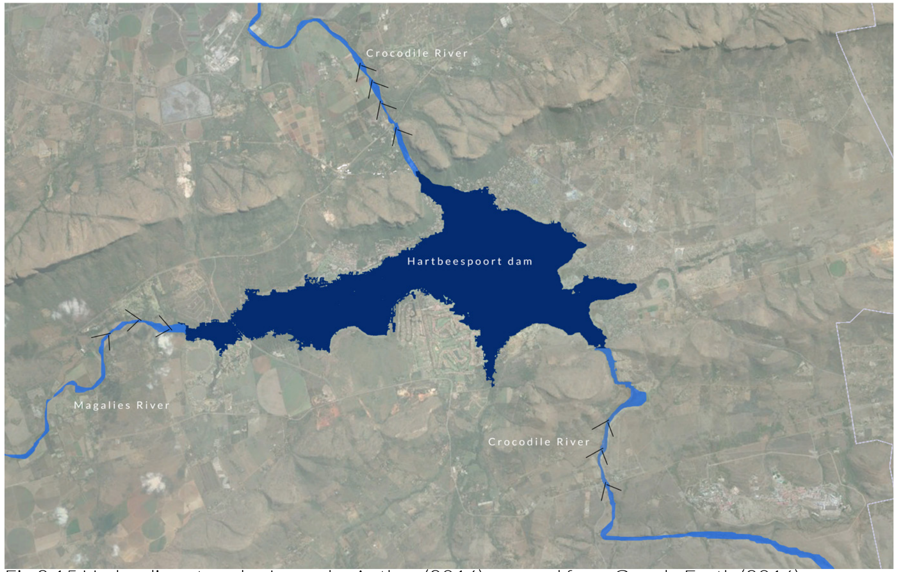


Fig 2.15 Hydraulic networks. Image by Author (2016) sourced from Google Earth (2016).

Hydraulic networks

There are two main rivers that flow into the Hartbeespoort Dam, namely, the Crocodile and the Magalies Rivers. The Crocodile is the larger supplier and flows from the Steenkampsberg mountains. The Crocodile flows through the dam, where it decreases in size as it is mostly used for irrigation purposes

Fig 2.16 Ecological networks. Image by Author (2016) sourced from Google Earth (2016).

Ecological networks

Through the creation of the dam, there has been a disconnection between the ecological networks and an increase in agricultural land. The Magaliesberg mountain range and the ridge to the south are very important ecological networks as they run all the way to Pretoria. There is a growing disconnection at the scarred gateway where the dam wall is built that breaks this network.

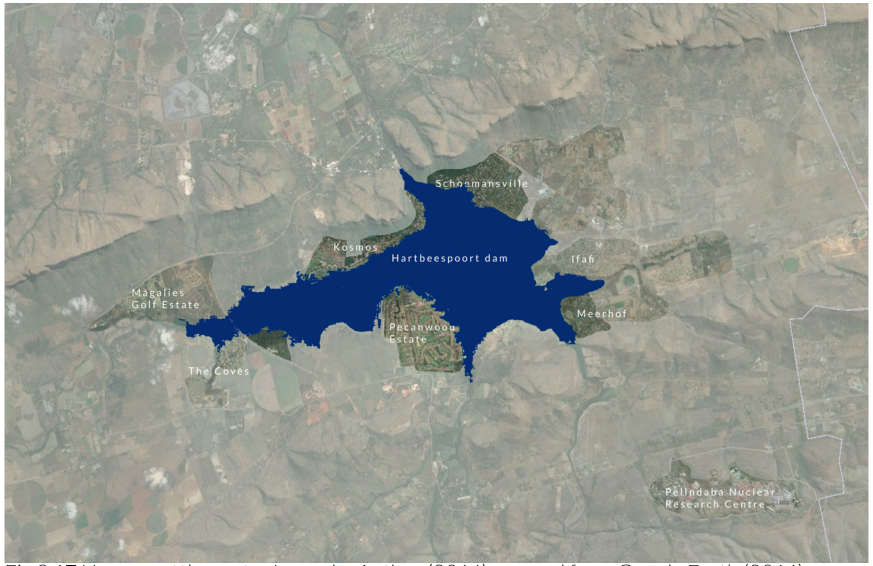


Fig 2.17 Human settlements. Image by Author (2016) sourced from Google Earth (2016).

Human settlements

These are the surrounding suburbs of Hartbeespoort dam. Schoemansville being the oldest suburb and Magalies golf estate being more recent. The town has a population of 22375 people, with large fluctuations of holiday makers. The town has grown significantly since 1980.

There has been little to no provision for public access to the water's edge as the town has developed. Most of the land around the water edge has been privatised with no street access.

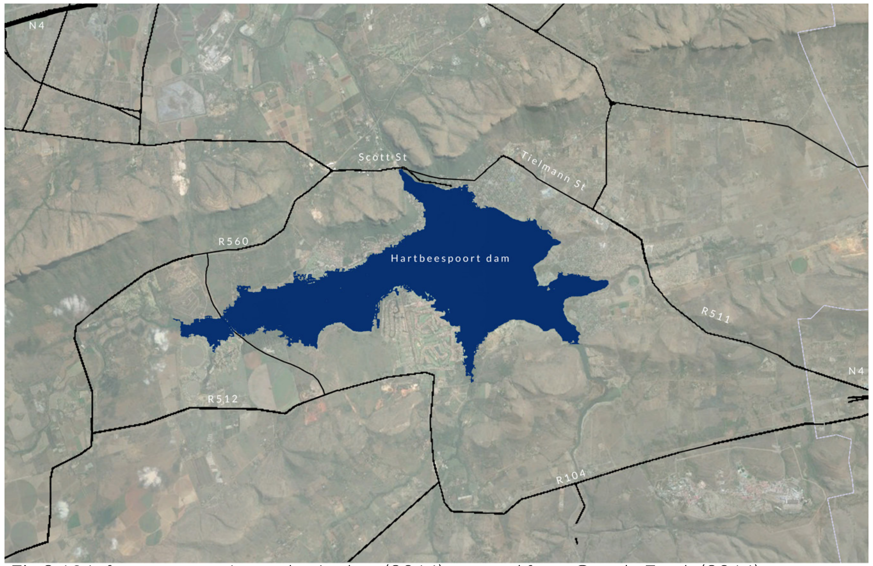


Fig 2.18 Infrastructure. Image by Author (2016) sourced from Google Earth (2016).

Infrastructure

There is fairly good road infrastructure to the edge of Gauteng province, but from there the N4 ends and two smaller roads divide and loop around the dam. Small roads branch off from this and enter into the smaller suburbs, which often lead to gated communities.

Fig 2.19 Before the dam was build (Ewisa, 2014).

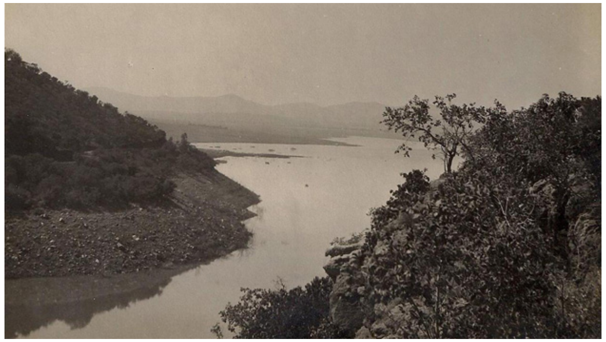


Fig 2.20 While the dam was filling up(Ewisa, 2014).

Fig 2.21 The dam today (Author, 2016).

2.4 Story of a place

2.4.1 History

For 900 years during the Iron Age people used the clay, iron ore and flora in the Hartbeespoort area. The Crocodile River was used as a constant water supply. The first white pioneers rediscovered the potential of this water and used it for agricultural purposes. Furrows were dug for households and farms to access the water. The first dam was constructed in 1896 by *General Hendrick Schoeman*, who owned the farm where the gateway was situated. The dam was named after his wife, Sophia, and was constructed to irrigate his farm as well as his neighbour's farm. It cost him a massive £10,000 to build, which was a fortune during this period. At the time it was the largest dam in the southern hemisphere. The position of this dam was not where today's dam sits, as the river ran a different course then. The dam was nearer to where the railway line runs today in Meerhof. This dam was later washed away in floods in 1891 (Wikipedia, 22 June 2016).

In 1906, the government started to investigate the possibility of building an irrigation dam at Hartbeespoort. An engineer from the Department of Water Affairs carried out a public enquiry into the feasibility of building such a dam, a favourable report was sent to the government. In 1909 a further investigation into the construction of the dam was completed, with the first test holes being drilled at the bottom of the gateway. These tests were to determine the rock formation and whether it was suitable for a dam of this scale. This report was then accepted by Parliament in 1914. Calculations were needed to measure the amount of water that would flow into this dam. Estimates were done to calculate the potential irrigable land that would be created by the building of the dam. It was finally decided to build furrows to divide up the water supply (de Beer, 1975: 387).

The Wall: Physical control


Fig 2.22.1. The dam wall in the past (ewisa, 1918).


Fig 2.22.2. The dam wall in the past (ewisa, 1925).

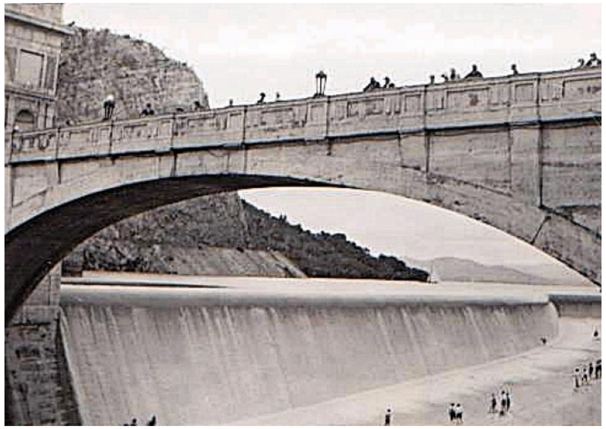


Fig 2.22.3. The dam wall in the past (ewisa, 1925).

The dam wall was constructed in 1925 and is a physical testament to man's control of water

The construction was initially delayed pending the court case between General Hendrik Schoeman and Mr. Marshevin about the expropriation of their properties in order to construct the dam. The case was finally resolved with a heavy hand by the government. The government created many laws to facilitate the creation of the dam.

"The construction of the dam finally started in August 1916 with further delays caused by flooding in 1914 and again in 1918. A large section of the construction was washed away and never recovered. In 1915, the Geldenhuysdam further up the river broke and the flooding of the site also caused a delay" (Wikipedia, 2016).

With the First World War causing further delays, "the first construction company was liquidated due to financial loss resulting from the floods and delays."

During the year of 1921 a second company took over the construction of the dam and an engineer by the name of F. W. Scott brought the project back to life. "Finally in April 1923 after many setbacks and political upheaval the project was eventually completed. Later in that same year the road over the dam wall and the tunnel was opened to traffic. The dam took just over a year to overflow for the first time in March 1925" (de Beer, 1975: 405).

The completion of the dam caused the land to gain in value, especially land close to the canal and the Corocodile river. As a result white farmers came in and replaced the Bakwena people of the Tswana ethnic group who had lived in the area for many generations (Wikipedia, 2016).

The arch was built in 1923 as a replica of the Arc de Triomphe. It was built to commemorate the builders and the men who fought in World War One. As well as the struggle against poverty as this dam made the agriculture land extremely valuable land.

The monument stands as a testament to humans ability to control the water. It speaks of a past paradigm where man sees himself as controlling nature.

The latest addition to the dam was the crest gates on top of this spillway which were added in 1970. This raised the dam by 2.44m and held back an extra 90,000,000 m^3 of water.

The Arch: Symbolic control

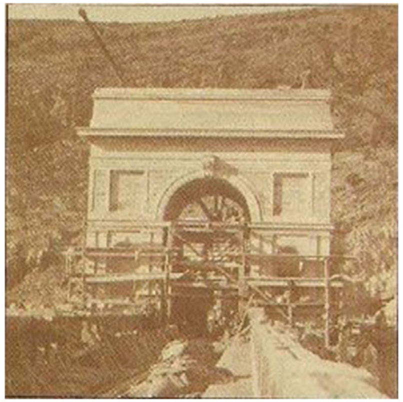
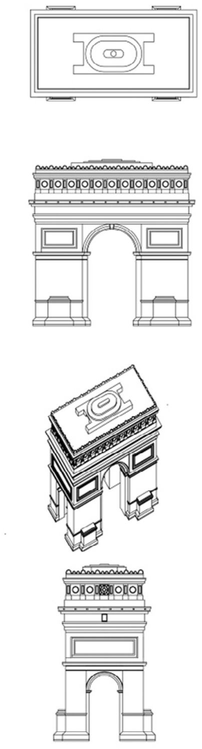


Fig 2.23.1 The Arch over time (Harties, 2016).

Fig 2.23.2 The Arch over time (Ewisa. 2016)

Fig 2.23.3 The Arch over time (Author, 2016).



2.4.2 Heritage memory

Understanding the artefact

"The so-called "Victory Arch" on the western side of the dam is something exceptional and not to be found anywhere else on a dam wall in South Africa. The motivation that it was built for structural purposes is somewhat unbelievable, if we take into account that the dam was already complete and full before the arch was started" (HEHA, 2007: 2-4).

To help construct the arch John Barrow, a specialist in decorative concrete, was called in. This indicates that the visual aspect of the arch was more important than its construction (HEHA, 2007: 2-4).

Hartbeespoort Environment and Heritage Association stated in 2007 that the arch symbolised then "that the struggle for realisation of the dam, and the struggle against poverty was rewarded with victory. The arch is a repetition of the dam's arch shape, which repeats the shape of the Union Building, which was completed just before the dam was built".

There are two quotations written on the western and eastern side of the arch. Both are written in Latin as during this time Afrikaans or English groups could not agree on which language to use

"On the eastern side of the arch an expression out of Varro's "De re Rustica" ("The Rural Case") is written. It reads: *SINE AQUA ARIDA AC MISERA AGRI CULTURA* (Without water, agriculture is withered and wretched)

The expression on the western side was derived from the Latin Bible, Isaiah 44.3. It reads: *DEDI IN DESERTO AQUAS FLUMINA IN INVIO* (For I will pour water on the thirsty land, and streams on the dry ground)" (HEHA, 2007: 2-4).

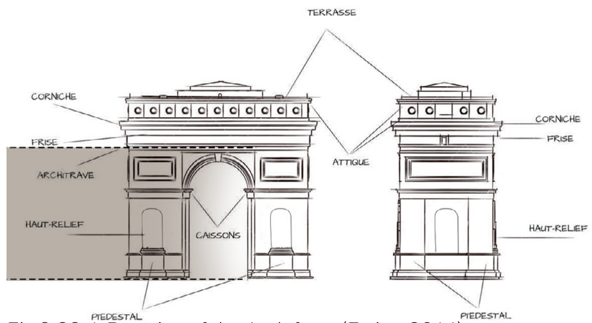


Fig 2.23.4 Drawing of the Arch form (Ewisa. 2016)

The Arch:

The arch was built in 1926 as a replica of the arc de Triomphe. It was built to commemorate the builders and the men who fought in World War One.

Overtime this monument has lost this meaning and now stands as a testament to humans ability to control water. It stands as the symbolic of control over the water as it is placed in-line with the spillway. It speaks of a past paradigm where man sees himself as being above nature.

This element on site still has significant historical value and must be retained on site. It is an important point of reference, a datum, in order for us to gauge how we have moved forward therefore it should be retained. The Burra Charter will be looked at to see how to react to this historical artefact and to develop a specific stance towards it.

The Arch and the Arc de Triomphe

The Arc de Triomphe, August 15 1806, honours those who fought and died for France in the French Revolution and Napoleonic Wars. Similarly the Arch at Hartbeespoort Dam honours those who died in the First World War. In the same way, the Arc de Triomphe became a gateway to the city of Paris and symbolises the triumphs of man.

This monument of war dates back to the ancient times of Rome, an example could be the arch of Titus which was constructed in A.D.82 which created the gateway into the city. This gives the form significance and importance in any city as a gate way (antiquitynow. 2016).

The Arc de Triomphe

Fig 2.24 Arc de triomphe (Wikimedia, 2015).

The Arch

Fig 2.25 the Arch at Hartbeespoort dam (Author, 2016).

Fig 2.26 building scale possibilities (Author, 2016).

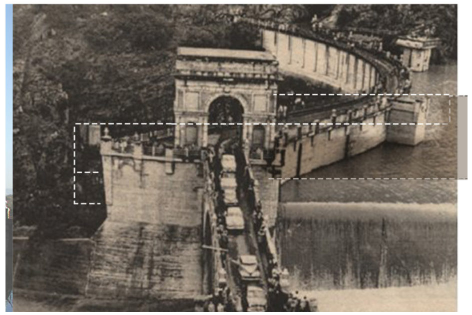


Fig 2.27 the Arch on the dam wall (Ewisa. 2016).

Fig 2.27.1 View of the dam towards the North. Author. 2016.

For nine hundred years the Iron Age people utilized the clay, iron ore and flora for man and animal

Iron Age

1836

The white pioneers “discovered” the potential of the water. Fountains, brooks and rivers were lead to household and agricultural land.

Fords and bridges were constructed and the rivers became the focal point of attention.

Fig 2.28 Painting of The Hartbeespoort (Ewisa. 2016)

General Hendrik Schoeman, owned a farm called Hartbeespoort.He started building the Sophia Dam which was the first dam on the Crocodile river and the largest dam in the Southern Hemisphere.

1896

1902

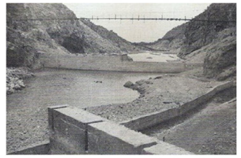
It was decided to relocate the location of the dam wall to between the two mountains. The same position it still remains today.

Fig 2.28.1 Before the dam was build (Ewisa. 2016)

A swedish man by the name of August Karlson was hired to engineer the build.

1905

Fig 2.28.2 Sophia's bridge (Ewisa. 2016)



1914

Construction of the dam was however postponed due the outbreak of the First World War (1914 - 1918).

Fig 2.28.3 Suspention construction bridge (Ewisa. 2016)

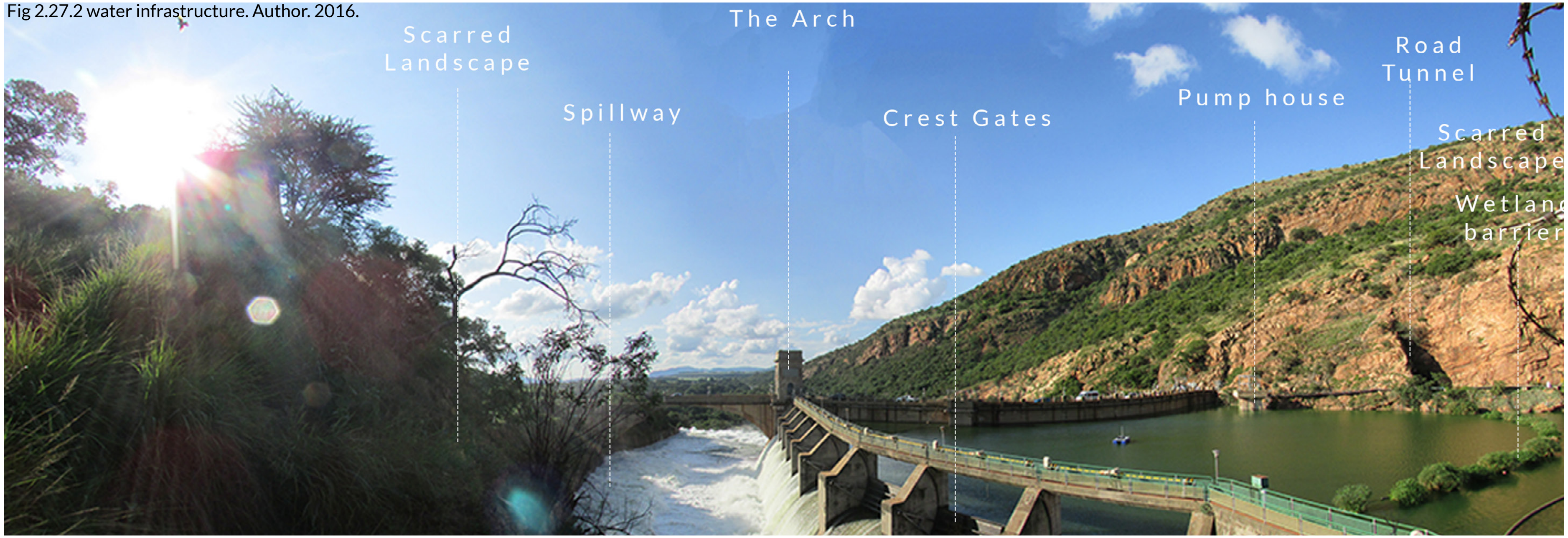
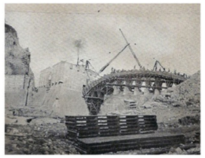


Fig 2.27.2 water infrastructure. Author. 2016.



1921

Unfortunately, torrential rain washed the temporary dam away. Again construction came to a stand still.

Fig 2.28.4 First bridge attempted (Ewisa. 2016)

The Hartbeespoort Dam first over flowed.

1923

Fig 2.29 Dam washed away (Ewisa. 2016)

1925

The Hartbeespoort Dam wall was completed after many setbacks and political upheaval

The replica of the Arc de Triomphe was built to commemorate the builders and the men who fought in the WW1.

1926

Fig 2.30 The Arch (Ewisa. 2016)

1970

The dam level was raised by 2,44 m, with the installation of ten crest gates on top of the spillway

Fig 2.31Crest gates. (Author, 2016).

The dam in a eutrophic state due to the nutrient build-up, as well as the unbalanced ecology within the HBPD system

1980

Fig 2.32 Hyacinth build up (Harties, 2015).

2007

Hartbeespoort Dam Integrated Biological Remediation Programme (HDRP), started by the Department of Water Affairs (DWA).

Phase 1 is to start the systems and build a business plans.

Fig 2.33 Hyacinth removal (Harties, 2015).

Phase 3 as started with full scale activitys. dredging, vermiculture, removal of fish and creating of wetlands.

2014

Fig 2.34 Remediation program (Harties, 2015).

2.5 Analysis of context

2.5.1 Use

The dam now supplies irrigation water along 550 km networks of canals to 160 km^2 of farmland. This allows crops such as tobacco, wheat, lusern , fruit and flowers to be produced. In the last decade Hartbeespoort dam has become a very popular holiday destination and weekend resort from the neighbouring provinces, with both Pretoria and Johannesburg being less than 50 km away. It is the primary water recreation space for Gauteng and many other neighbouring areas. The Transvaal Yacht Club has been operating at the dam since 1923 (Transvaal Yacht Club: 2008).

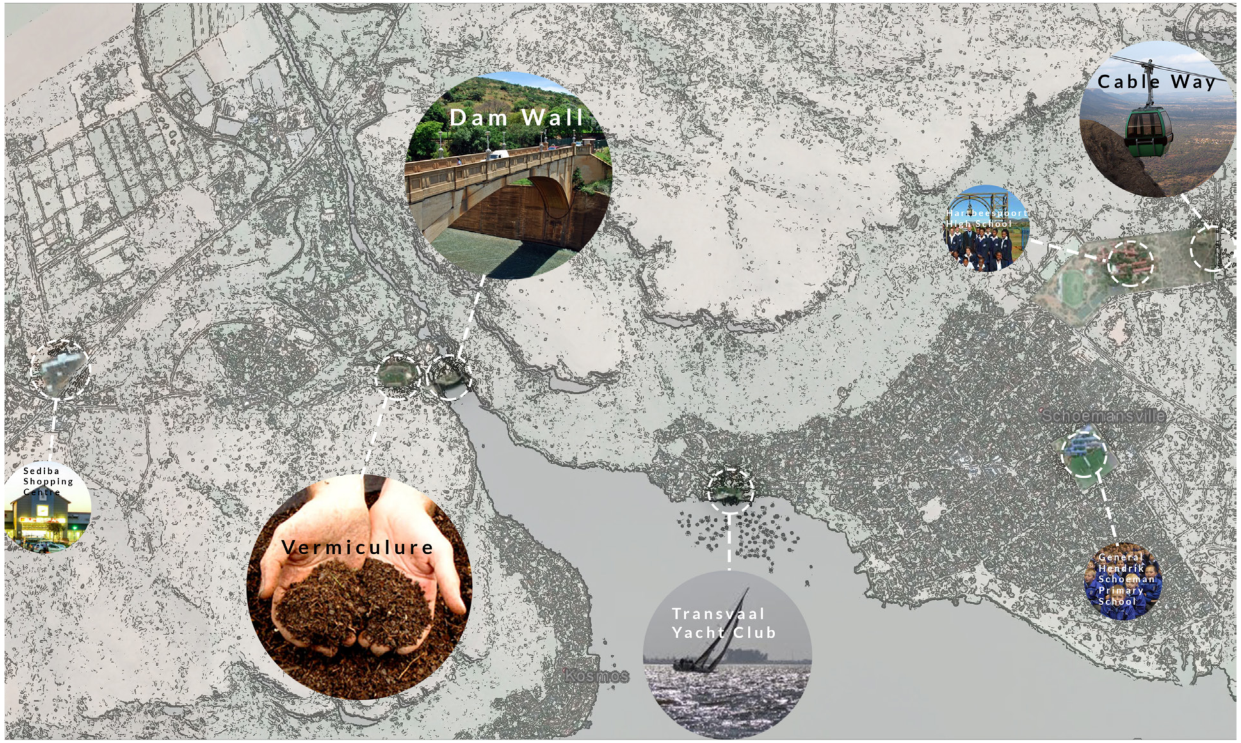


Fig 2.35 The Hartbeespoort location of attractions (Author, 2016).

2.5.2 Water quality

One of the major problems of Hartbeespoort Dam is the water quality. The dam has been in severe eutrophication since the 1970s. This causes two main issues; the nutrient build-up, as well as the unbalanced ecology within the system. This results in high concentrations of sulphates and nitrates in the water. The primary pollution source is from industrial and domestic Gauteng that flows into the Crocodile River and then eventually into the Hartbeespoort Dam (Allanson, 1961: 77–94).

This increase in nutrients causes widespread growth of algae and Hyacinth which covered the dam in 1975. The decision was made to eradicate the Hyacinth using pesticides. This caused the Hyacinth to die and sink. This decayed and released all the nutrients back into the water causing an explosion of Hyacinth (Harding, 2004 and Hart, 2015: 432-440)

Gauteng province is home to 9,6 million people which is 20.2% of the total population of South Africa. This brings a huge water demand to a very small portion of South Africa. This demand is satisfied by the Tugela and Lesotho Highlands water scheme to the Vaal dam.

The northern part of Gauteng is home to 2.5 million people and falls within the Crocodile Marico water management area. This means a huge amount of water flows into the Crocodile and Apies rivers. There are strict sanitation standards applied in this area, although most of the residents are serviced with waterborne sewers. Yet a large amount of grey water and black water still pollutes the water catchment area of Hartbeespoort Dam. " The main cause is from informal settlements, sewer blockages, pump station overflows and storm water pollution"(Harties, 2016).

The statistics from the Department of Water Affairs (DWA) states that "People using water borne sanitation results in the release of more than 700 000 000 litres (700Ml/day) of treated effluent, used and polluted water into the catchment of and directly into the Hartbeespoort Dam per day" (Harties, 2016).

"The internal load of nutrients and sediments trapped within the Hartbeespoort Dam are close to 2 000 tons. This load is constantly mobilised through the continuous movement by sediment feeding fishes, (exotic carp and barbell/catfish) as well as incoming storm water and flooding" (Harties, 2016).

In 2005 the Hartbeespoort Dam Integrated Biological Remediation Programme, Harties Metsi a Me, was put in place by the DWA to combat the eutrophication, in order to improve the water quality.

The aim of the program is to implement various techniques of improving the water quality at the dam for the short term, as well as investigating and stopping the inflow of pollution into the Crocodile River which is the main source of nutrients (Harding, 2004).

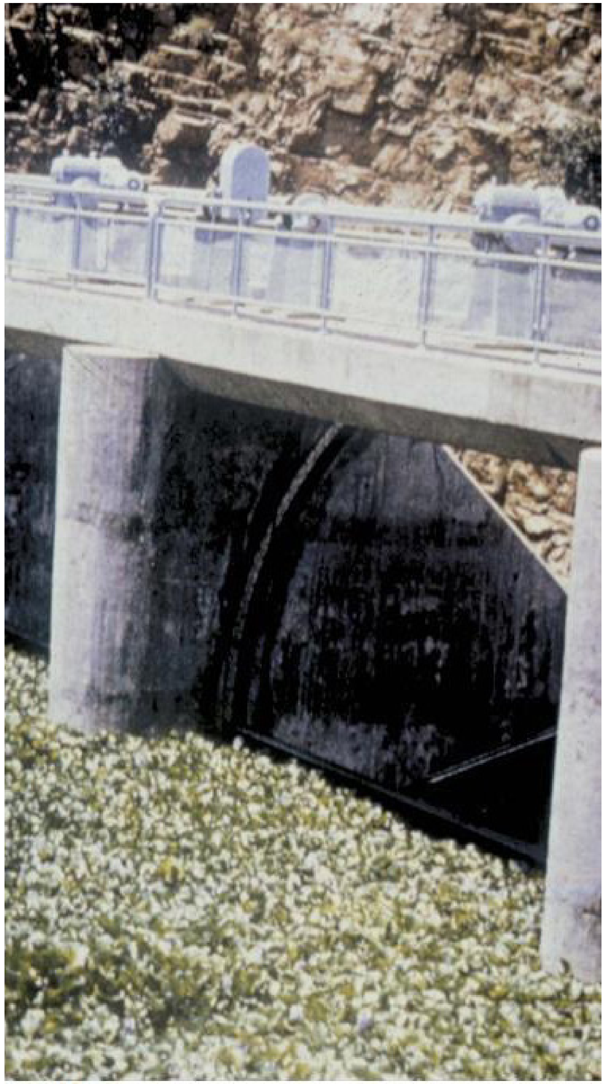


Fig 2.36 The Hartbeespoort water problems (Harties, 2015).

2.5.3 Hartbeespoort Dam Integrated Biological Remediation Programme

A 2-year study was done by the North West local municipality on the biological condition of the Hartbeespoort Dam. From these results the following steps were set as a national priority and in May 2007 the go ahead was given to implement them and fast tracking of the programme (Harties, 2016).

Solution to the problem

The remediation programme focused on projects with short term results and more long term strategies would be introduced as the project progress. A three-pronged approach was adopted to solve this problem and reach the project goal. The points, stated by the DWA (2012), are as follows;

"The application of symptomatic treatment, restorative action and the creation of a biological, self-cleaning, balanced ecosystem in the dam basin.

- This entails removing the bulk of the imbalances that are in exponential growth (excessive external and internal nutrient loads with associated sediments, algae, Hyacinths, dominating undesired fish species, litter and debris).
- Restoring and protecting the natural filters (wetlands and riverbanks) in the immediate catchment of the Hartbeespoort Dam to ensure that incoming polluted water is filtered
- Regulating water use in the greater Hartbeespoort Dam catchment, enforcing regulations regarding unlawful water use, and integrating the interdepartmental efforts across the catchment" (Harties, 2016).

Fig 2.37 The Hartbeespoort water problems (Author, 2016).

2.6 Urban Vision

2.6.1 Macro

The macro urban vision focuses on the ecological problems that were identified at the Hartbeespoort Dam. It also looks at the spatial relationships between a man and nature and tries to shift from a parasitic relationship that currently exists to a symbiotic relationship. Special interchanges were identified to target this approach. These four spatial interchanges became key points to interject with architectural interventions within the water framework.

The diagrams in figure 2.38 show the macro problems between connections to water. Figure 2.38.1 shows that natural connections have been degraded by pollution and eutrophication of the water. This has led to the detriment of natural shorelines at the dam. This is also similar along most water features in the Gauteng province such as the Apies river.

Much of the land around the Hartbeespoort Dam has been privatised and blocked off from public which can be seen in fig. 2.38.2. This means that the water has become a feature for a limited select few, leading to the rest of the public becoming disconnected to water.

Parks are few and far between and have little connection to the water's edge. This has made it an elitist condition as the only way to have a connection to nature is to own land. The town has become filled with gated communities, buying the best land with the best views to the water, leaving little to no space for public activities. This again was something found along the banks of the Apies river.

One of the positions that could create a meaningful connection and understanding of water is the infrastructure of the dam wall. The space also is one of the only public connections to the water, however limited.

2.4.1.1Spatial Interchange

natural connection

degraded river embankment
no physical connection to water

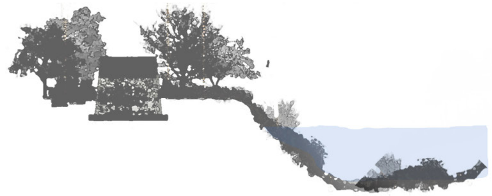


Fig 2.38.1. Existing River Embankment with Historic edge (Coetzee, 2014).

Hartbeespoort Dam Conditions (Author, 2016).

urban connection

seperation of public to waters edge by gated communities

Fig 2.38.2 Existing Urban Context (Coetzee, 2014).

Hartbeespoort Dam Conditions (www.earth.google.com. 2016).

parks connection

polluted water
no connection to river

Fig 2.38.3. Existing River Along a Park Space (Coetzee, 2014).

Hartbeespoort dam Conditions (www.earth.google.com. 2016).

bridges and roads

no physical and lack of visual connection

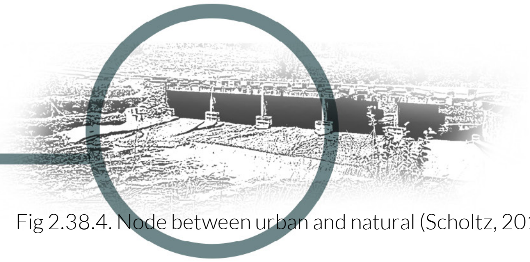


Fig 2.38.4. Node between urban and natural (Scholtz, 2016).

Fig 2.38 Spatial Interchanges (Author, 2016).

2.6.1.2 Problems

The environmental problems of the dam are extensive and mostly due to the eutrophication of the water. This has caused a downward cycle of the ecological system to a point where nature is unable to create equilibrium. The eutrophication of the water has been a result of sewage waste and pollution flowing into the feeding rivers to the dam. Fig. 2.39.1 shows where the problems are located and most severe. The hierarchical list below summarises the most severe problems (top to bottom) .

- Creation of poor water quality for domestic and agricultural use. Increase in algae and Hyacinth
- Damage of shoreline and wetlands
- Decrease in desirable fish species
- Increase in non-desirable fish species
- Increase in litter and pollution
- Increase in sediment (25% of the volume of the dam)

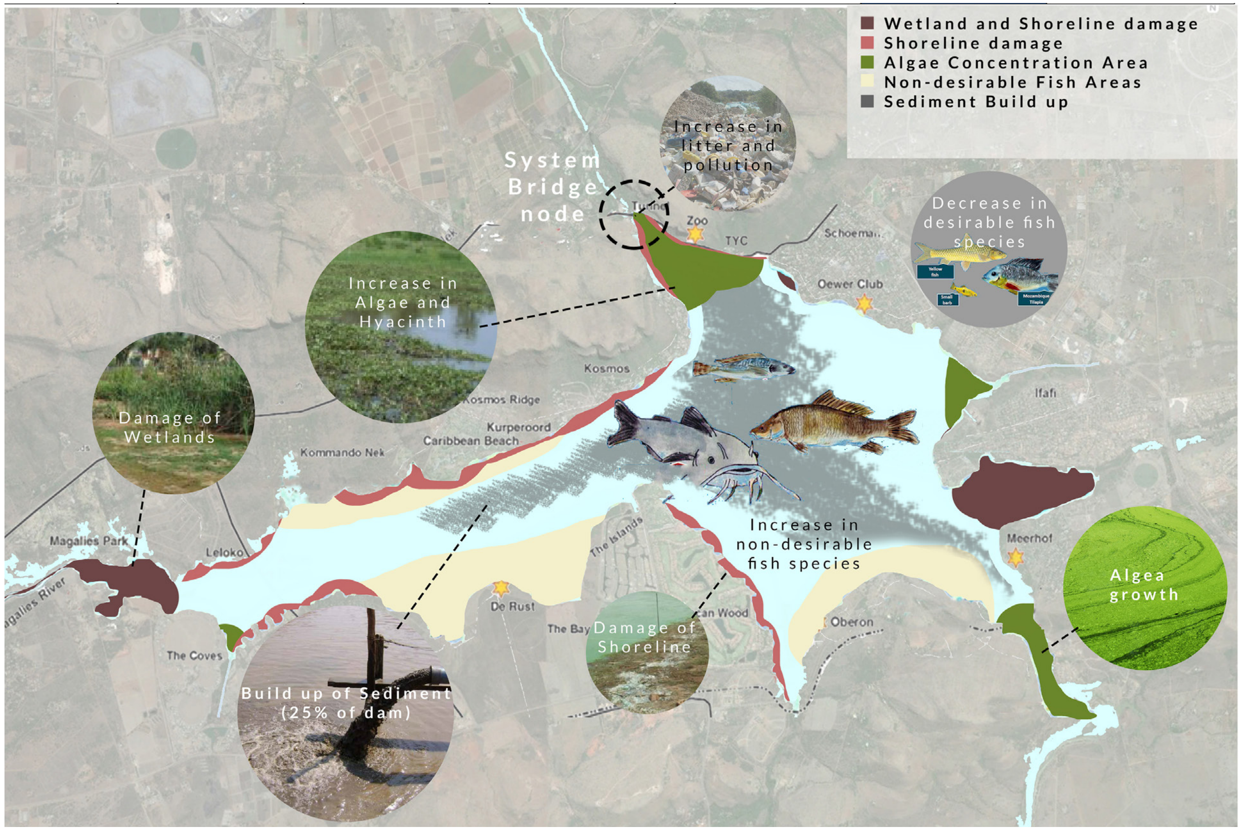


Fig 2.39.1 General location of problems. Image by Author (5 May 2016) sourced from Google Earth (2016).

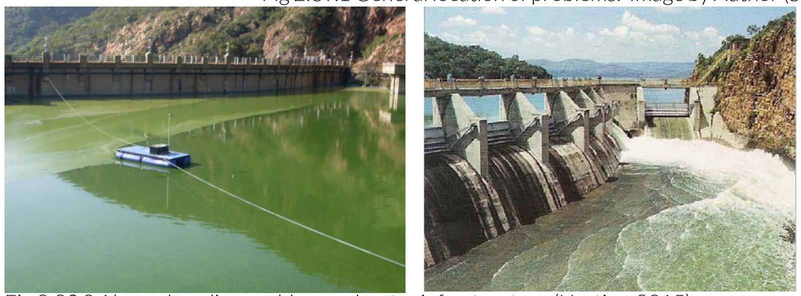


Fig 2.39.2 Algae, shoreline problem and water infrastructure (Harties, 2015).

Fig 2.39.3 General urban issues (Author, 2016).

2.6.1.3 Solutions

As a response to the severe problems that the dam was facing, a remediation program was set in place in 2007 to combat them. Fig. 2.40.1 shows the location and extent of the solutions. These solutions have created many jobs for local people around the dam and have started to have an effect but they are not solving the core problem but rather dealing with the symptoms. The list below summarises the solutions carried out to date.

- Stop inflow of sewerage and fertiliser at source
- Filtering out of algae and Hyacinth
- Rehabilitation of shoreline with compost and creation of floating wetlands
- No fishing zones to stimulate regrowth of desirable fish
- Target fishing of non-desirable fish on shoreline.
- Creation of barriers at river mouths to stop inflow of pollution and nutrients
- Dredging out of the sediment of the dam to increase volume.

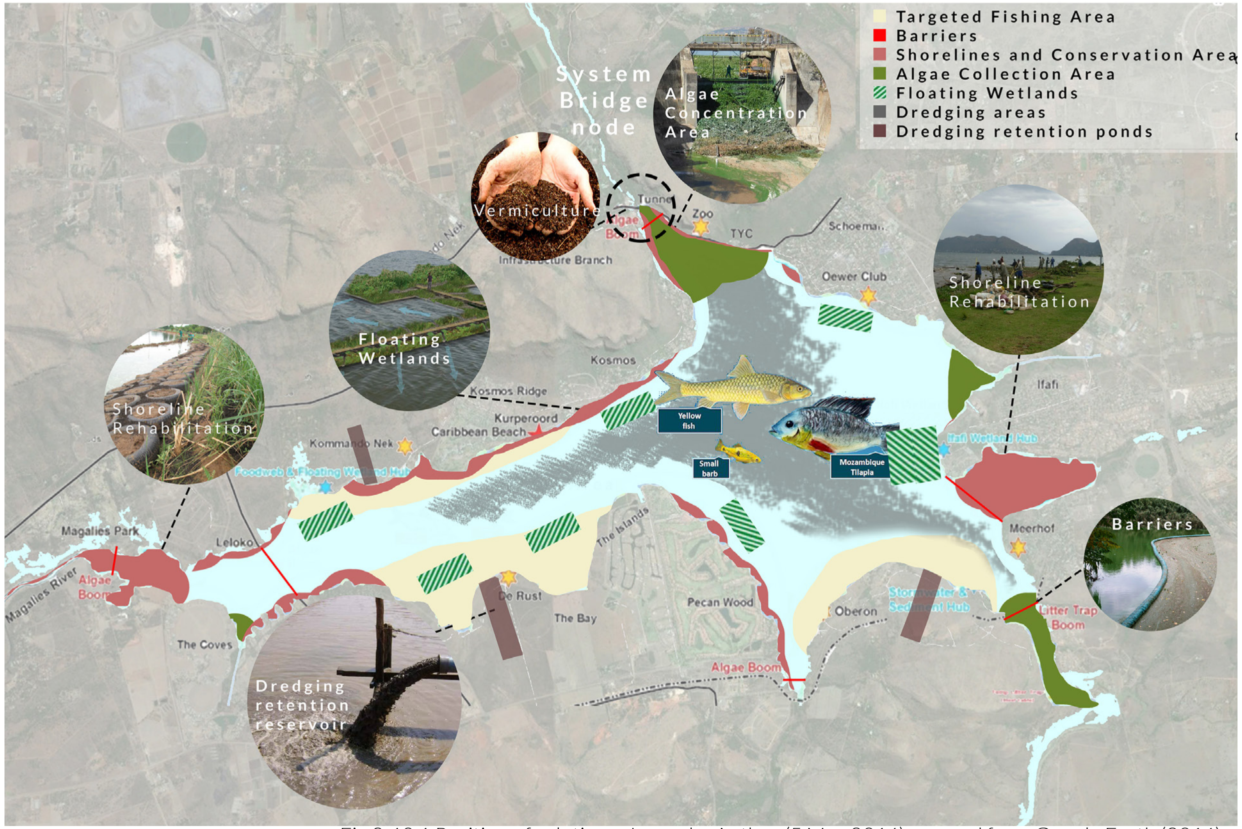


Fig 2.40.1 Position of solutions. Image by Author (5 May 2016) sourced from Google Earth (2016).

Fig 2.40.2 Corniche Nile River Walk (Methoddesign, 2015)

Fig 2.40.3 The Seven Lochs Wetland Park (GCV Green Network Partnership, 2012)

Micro site analysis

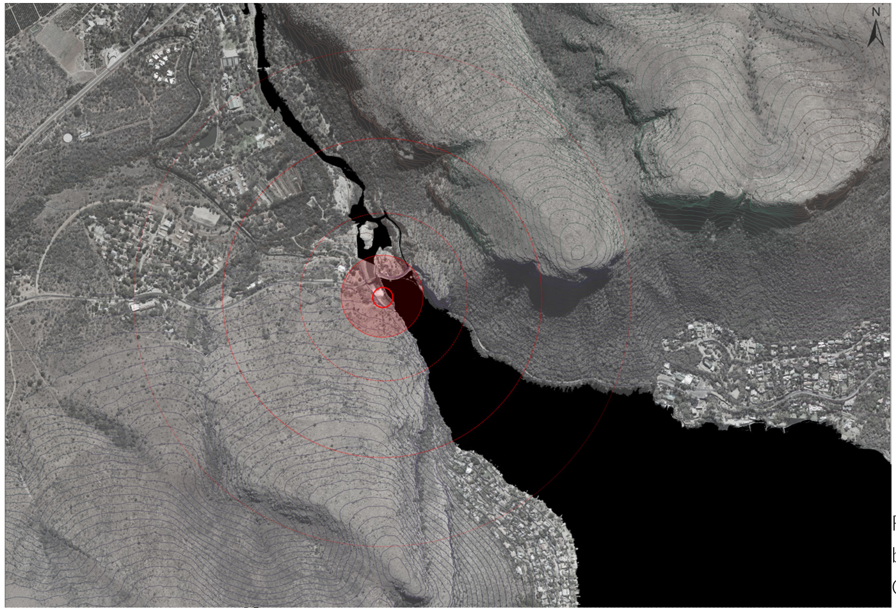


Fig 2.41.1 General location. Image by Author (May 2016) sourced from Google Earth (2016).

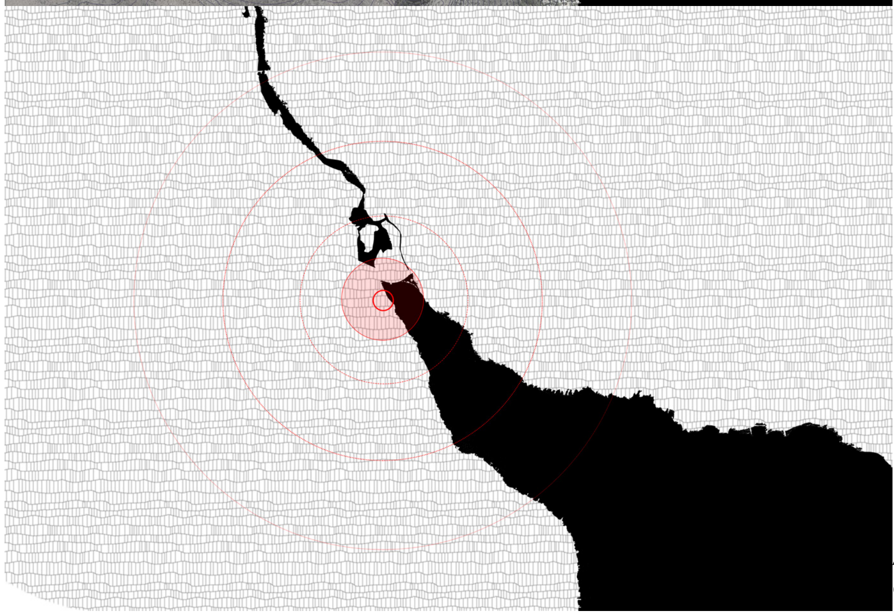


Fig 2.41.2 Water bodies. Image by Author (May 2016) sourced from Google Earth (2016).

The following diagrams analyse the space that the micro vision would deal with. They highlight the ecological systems as well as the urban spaces that happen around the intended sight of this project.

Figure 2.41.1 shows the extent of the micro vision as the area exists now, with which the building will interact. The red dot is the intended site of the project.

Figure 2.41.2 shows the water body on site of the dam as well as the Crocodile river flowing off into the distance. It is also possible to see the secondary outlet that runs on the left hand side to meet up with the river. This insures a constant flow of water in the river to irrigate the agricultural land.

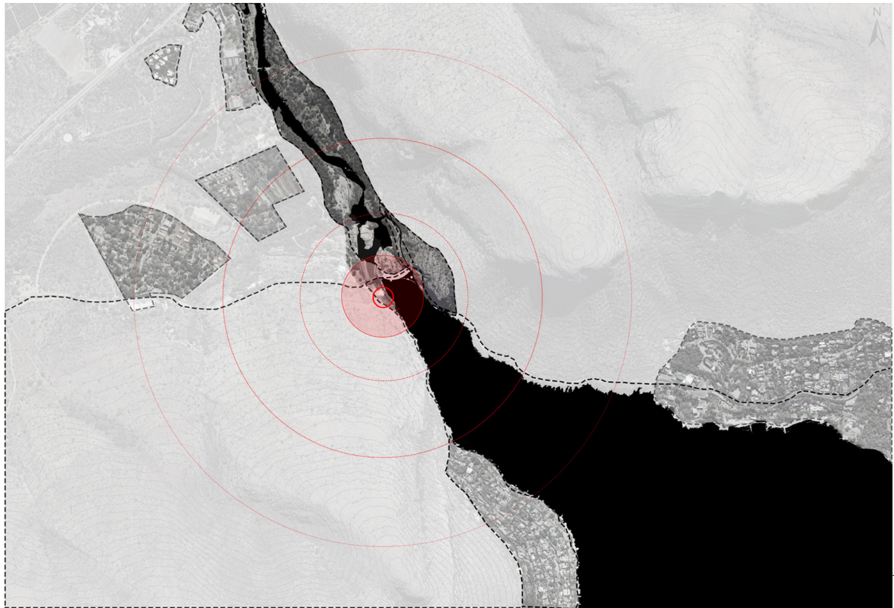


Fig 2.41.3 Human Scarred landscape. Image by Author (May 2016) sourced from Google Earth (2016).

Fig 2.41.4 Ecological scarred landscape. Image by Author (May 2016) sourced from Google Earth (2016).

Fig 2.41.3 This figure shows the disturbed sites through human interactions. The closest neighbourhoods are highlighted, the nearest being approximately 500m away. The dam and the river are included in the scarred landscape as humans are to blame for the eutrophication.

Fig 2.41.4 The area highlighted is where the intervention would most directly interact with the ecology. The water that interacts, in some way or another, with the building would then continue down the river to the agricultural land and therefore interact with a much larger ecology.

2.6.2 Micro

A micro scale analysis of the dam wall revealed three main problems:

- The build-up of Hyacinth and algae
- The lack of meaningful public space that connects to the water's edge
- The mono-functional quality of water infrastructure

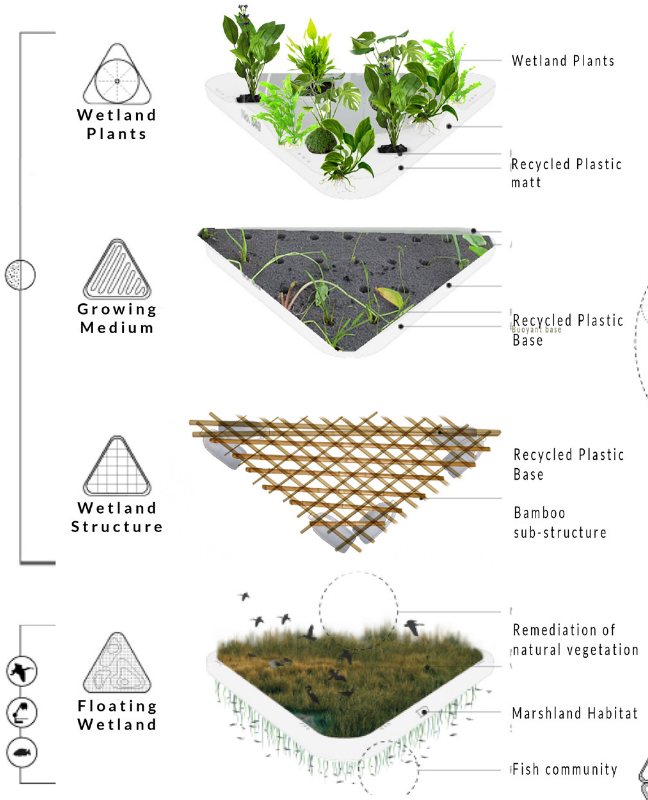
To tackle these problems certain solutions were identified that built upon the remediating program.

Fig 2.44 Micro urban solutions. Image by Author (2016) sourced from Google Earth (2016).

2.6.2.1 Floating Wetlands

Construction of new floating wetlands will allow flora to flouish. This will rehabilitate the desirable fish environments as well as filter out the nutrients that cause eutrophication. The floating wetlands act as barriers to stop and collect the algae.

Where the wetland barriers are connected to the shoreline, vermiculture activities will be located. The algae can easily be collected by walking along the wetland barrier and it can be broken down to compost through the vermiculture.



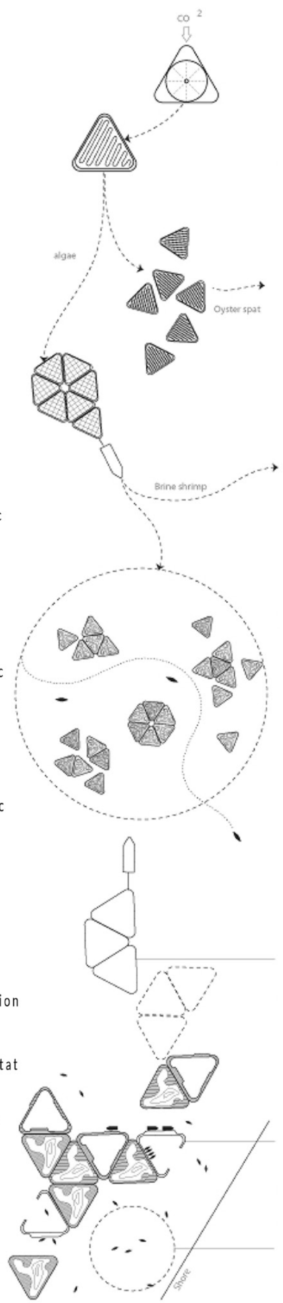
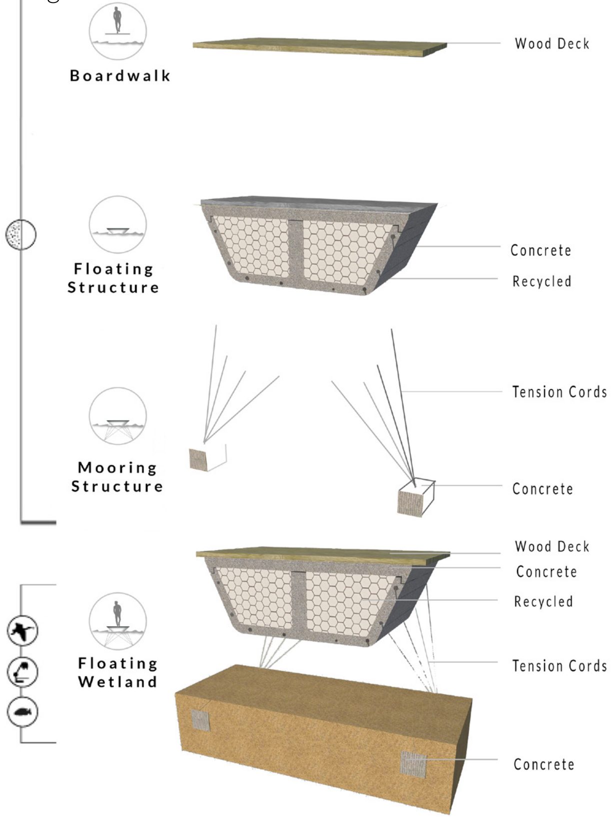


Fig 2.45 Floating wetland and plan configuration (Adapted by Author image by Ghazal Jafari & Ali Fard, 2013).

2.6.2.2 Floating Boardwalk

The integration of the floating boardwalks will allow access to the floating wetlands. This is necessary to remove algae build up and then to be placed into the vermiculture system. These boardwalks will also act as public spaces that reconnect to nature. These public routes are vital to raising awareness of the water state and creating a better appreciation of water.

This modular construction can be created near to site and allows for many different configurations. A straight route can be created or a larger public space along the boardwalk.



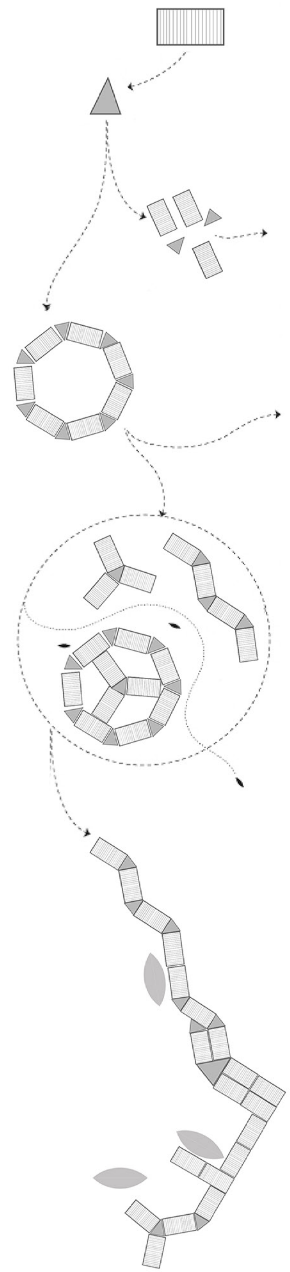


Fig 2.46 Floating boardwalk and plan configuration (Adapted by Author image by Ghazal Jafari & Ali Fard, 2013).

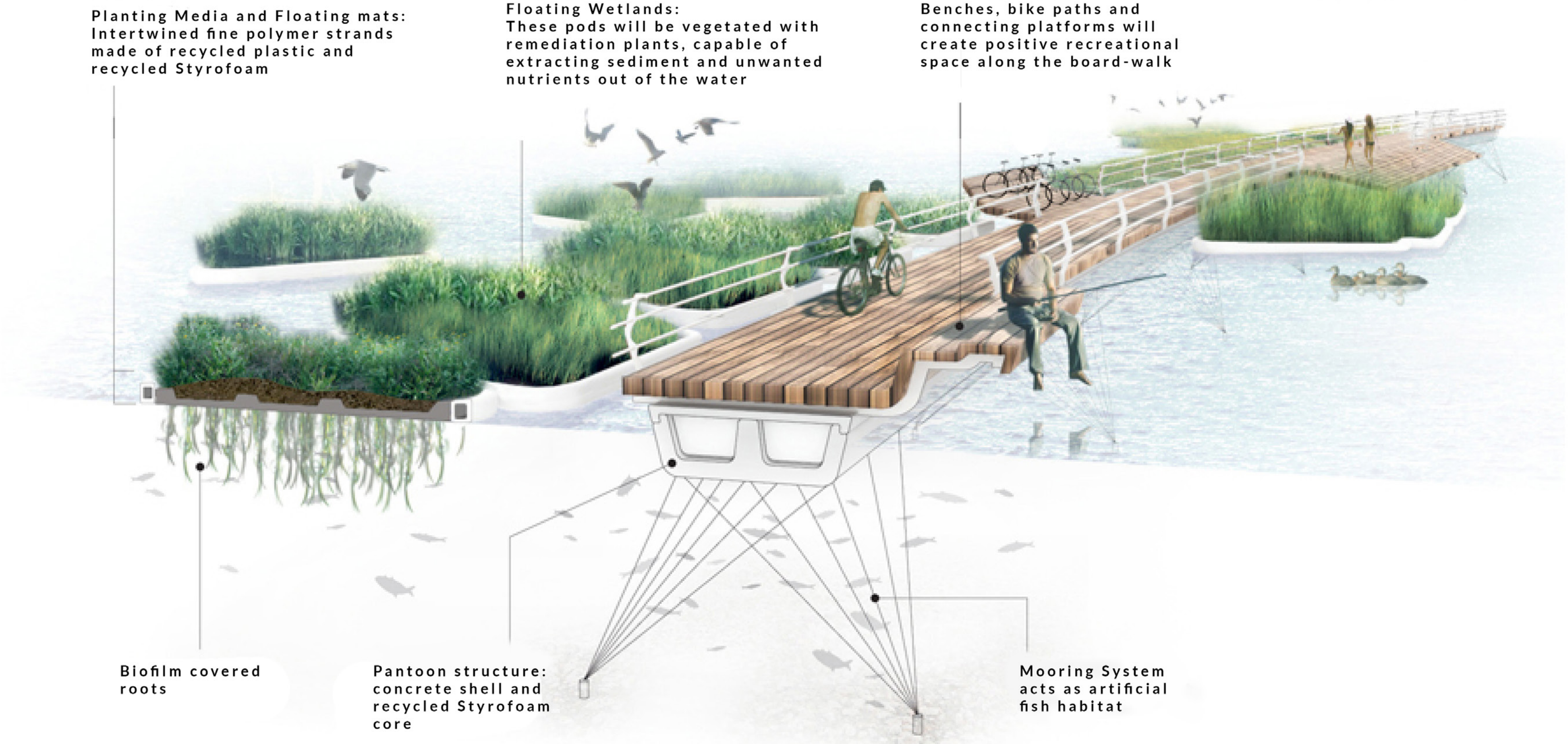



Fig 2.47 Urban vision perspective (Ghazal Jafari & Ali Fard, 2013).

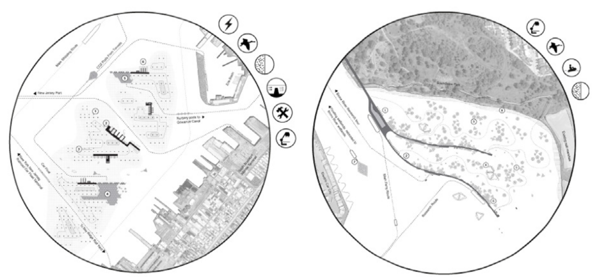


Fig 2.48 Rehabilitation of context (Ghazal Jafari & Ali Fard, 2013).


Fig 2.49 Urban vision perspective (Ghazal Jafari & Ali Fard, 2013).

Fig 2.50 Existing Infrastructure on site (Author, 2016).

2.7 Site Analysis

2.7.1 Site Critique

A site critique was carried out through a SWOT analysis by specifically looking through the following lenses; mono-functional spaces, limited access, memory and history.

The activities on site were split up into the following categories; cultural (split up into historical and social), ecological and economic.

CULTURAL

HISTORICAL

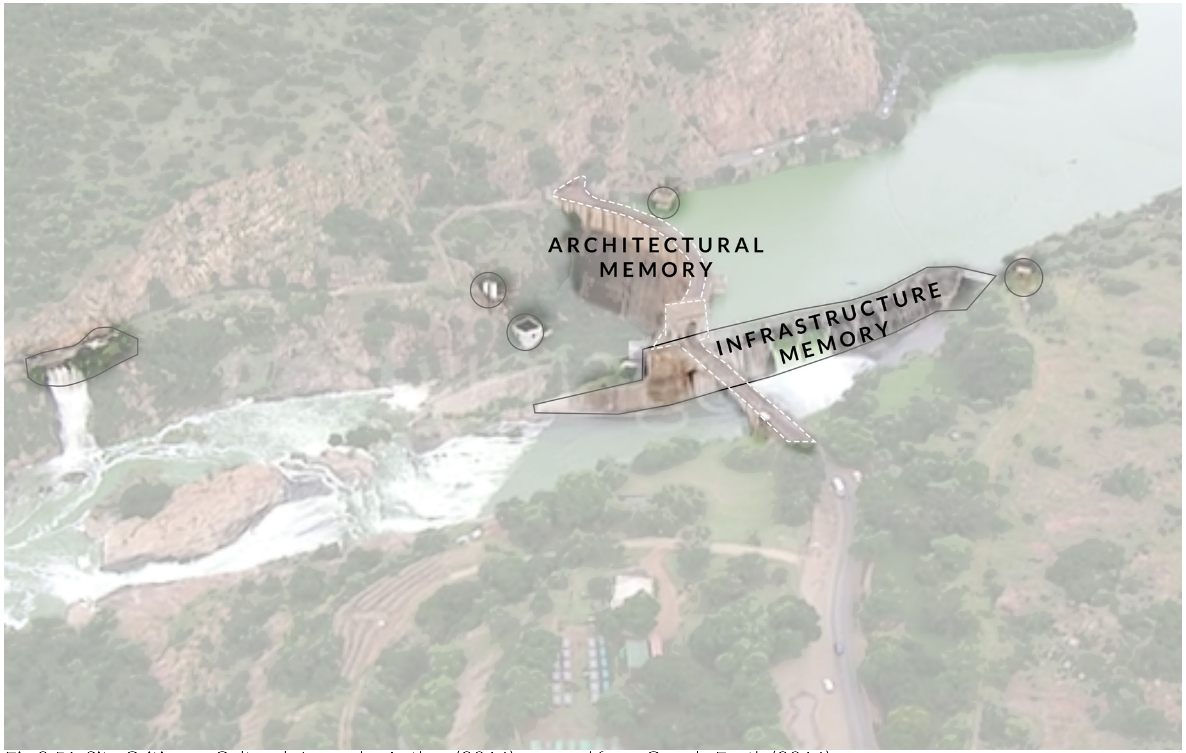


Fig 2.51 Site Critique - Cultural. Image by Author (2016) sourced from Google Earth (2016).

The dam wall was designed in a Neoclassical style and the gateway mimics the Arc de Triomphe and is in the same style. The dam wall itself is part of an architectural memory, as it has multifunctional uses; it dams up the water, it acts as a road to connect either side as well as having historical meaning to it by means of the arched gateway.

This is not the same for the crest gates and spillway which simply control the water and therefore form part of infrastructural memory. As this structure is mono functional and has no access to it, it has less historical meaning then the dam wall itself.

Two contrasting memories allow for a new celebration of site culture and water. An active space that allows for the understanding of the processes needed to rehabilitate the site.

SOCIAL

Fig 2.52 Site Critique -Social. Image by Author (2016) sourced from Google Earth (2016).

Access points are limited around the dam wall and there is little space to linger. Most people drive across the dam and only experience it visually. The idea of public access is crucial to the understanding of the problems on site and therefore a solution. As the public starts to understand the situation better they will take more care of it.

There are three major gateways that express a change in condition across the dam wall.

-From the tunnel side there is a view over a controlled water body.

-As one moves through the arched gateway you experience the power and the release of the water as it flows through the crest gates.

-And then finally the view is angled back towards the serene river that flows off into the distance.

ECOLOGICAL

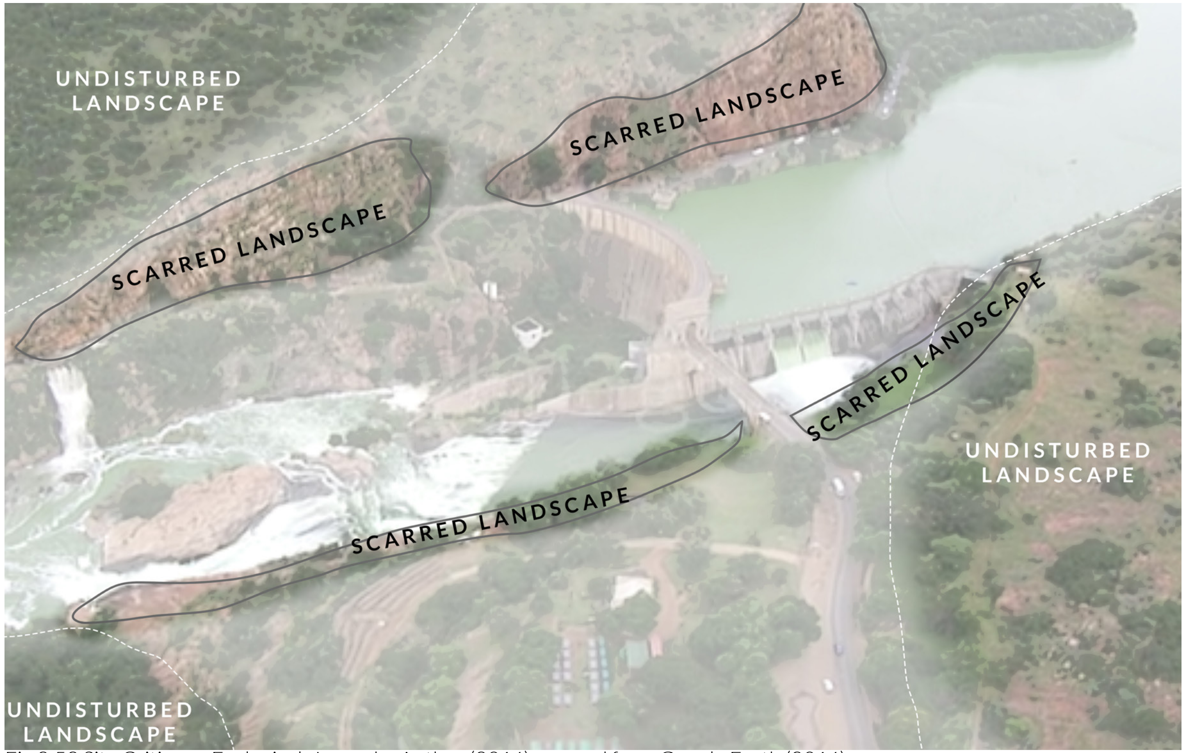


Fig 2.53 Site Critique - Ecological. Image by Author (2016) sourced from Google Earth (2016).

In order to create the dam, part of the poort had to be cut away. This is especially visible on the bank of the spillway. There is a stark contrast between the undisturbed landscape and the cut. This becomes a scar in the landscape and needs to be healed through regenerative architecture.

The ecological networks that used to exist between these two ridges have been disconnected and need to be unified. There is also little access to these ridges as they are often fenced off.

The Vermiculture system is trying to remediate this problem but is unable to do so as there is little to no capital and the system is often crippled by theft of the worms.

ECONOMICAL

Fig 2.54 Site Critique - Economical. Image by Author (2016) sourced from Google Earth (2016).

The Vermiculture system is currently ineffective but has the possibility to be extremely efficient, if security and public awareness is enhanced. There is the possibility of not only rehabilitating the site but also creating an income through selling of products such as compost and vermiliquid.

The idea of public access is crucial to the understanding of the problems on site and therefore a solution. As the public starts to understand the situation better they will take more care of it.

2.7.2 Existing site activities

The site is currently being used for a vermiculture system to deal with the growth of Hyacinth on the dam. Figure 2.49 shows the location of different parts of the vermiculture activities on site as they exist now.

A. shows the 18 vermiculture beds; some of which are partially shaded while the rest are in the sun. They also have a large tented structure that was used for presentations of the system which now is no longer used as the site is closed off to the public.

B. is the prototype testing pool for the floating wetlands, that are also created on site in a separate building. They test different structures of floating Wetlands as well as different plants and how they cope with the structure.

C. shows the litter collected from the crest gates as the litter naturally flows to this point. It was needed to create a recycling collection point to deal with the sorting of the litter. It is currently very badly organised and pick ups of the recycling, to be taken to the recycling plant, are very sporadic.

D. is the point where the Hyacinth is taken once it is removed from the dam. It sits at this point in the sun to start biodegrading, then it is put into the vermiculture beds. There is a smell from this process and it needs quite a large area as the Hyacinth builds up. This is due to the fact that the vermiculture system cannot keep up with the collection rate.

E. is the floating pump station which is tied to the crest gates; this is used to collect the Hyacinth. It is also used to pump algae buildup down to the bottom drying station before being placed in the vermiculture beds.

F. is a view from the old pump house, looking across the crest gates towards the arch and dam wall. This is quite a unique view as the public is not allowed to this point currently.

When the dam was originally constructed there was a space just below this image designed for public engagement. In 1980 it was closed for safety reasons and the fence is still there to this day.

Fig 2.55 Vermiculture activities on site (Author, 2016).

Fig 2.56 Wetland activities on site (Author, 2016).

Fig 2.57 Recycling activities on site (Author, 2016).

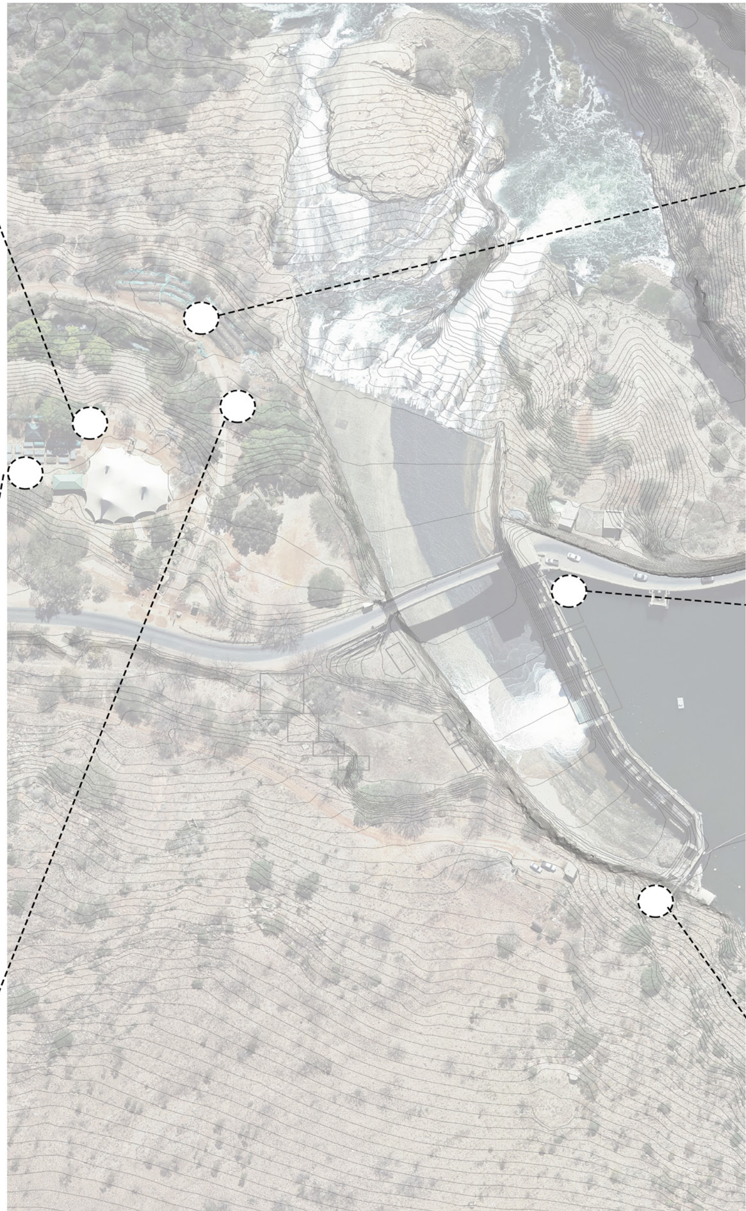


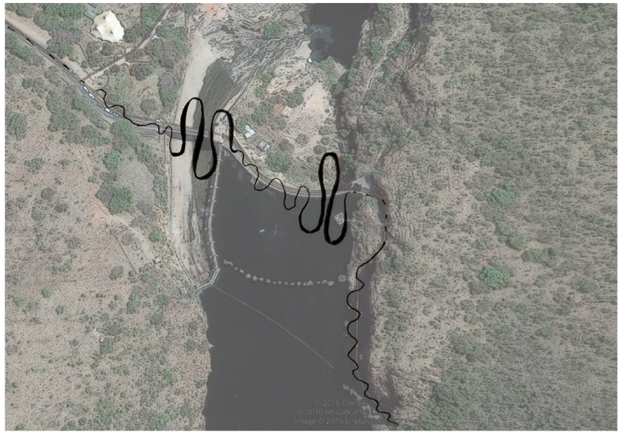
Fig 2.58 Existing site. Adapted image by Author (2016) sourced from Google Earth (2016).

Fig 2.59 Hyacinth on site (Author, 2016).

Fig 2.60 Pump raft (Author, 2016).

Fig 2.61 existing activities on site (Author, 2016).

2.7.2 Haptic Observation



When visiting the dam you experience it in different ways, depending on your movement across the bridge. Either way there is a concealment of the dam to a point where there is a sudden release, were you experience the dam in its entirety.

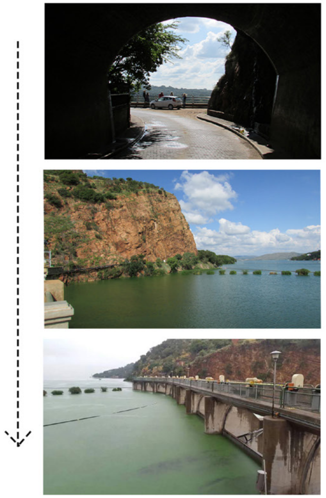


Fig 2.562 Site Understanding Fig Micro issues. Image by Author (2016) sourced from Google Earth (2016).
Fig 2.63 Hartbeespoort dam gate way (Author, 2016).

There are two conditions divided by the dam wall; on one side there is controlled water which is contained and captured and on the other side there is this serene natural river that flows off into the distance which gives life to the land.

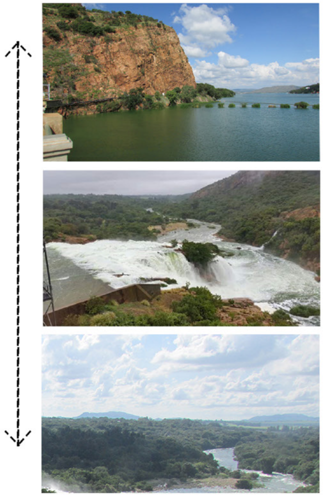
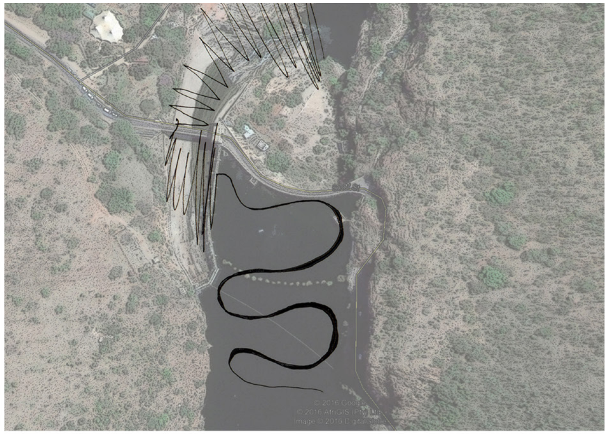


Fig 2.64 Site Understanding Fig Micro issues. Image by Author (2016) sourced from Google Earth (2016).
Fig 2.65 Hartbeespoort dam gate way (Author, 2016).



There is quite a stark contrast between the two conditions of the water; from being a large passive body of water to a raging gushing torrent that is released down the spillway.

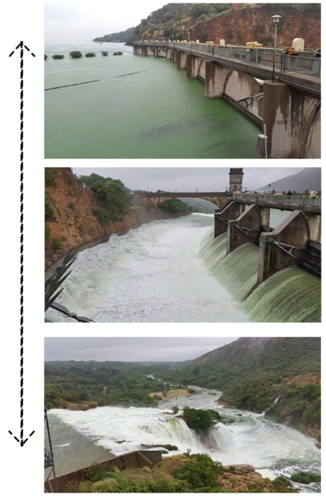


Fig 2.66 Site Understanding Fig Micro issues. Image by Author (2016) sourced from Google Earth (2016).
Fig 2.67 Hartbeespoort dam gate way (Author, 2016).

2.7.2 Water and landscape

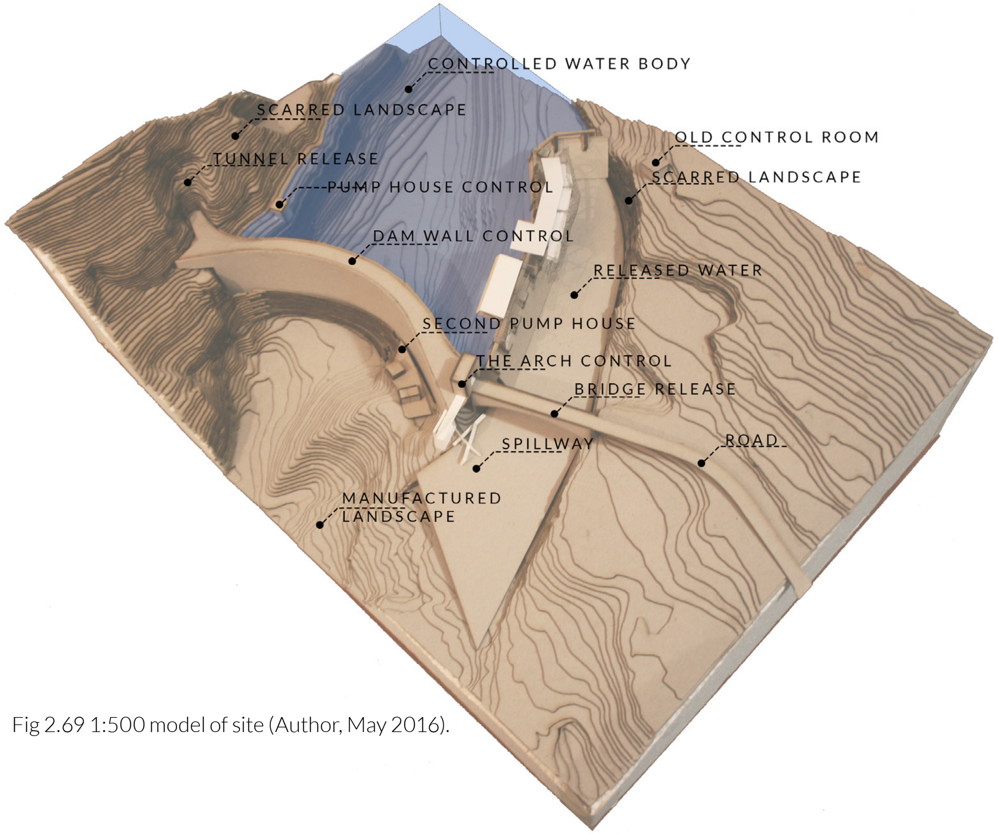
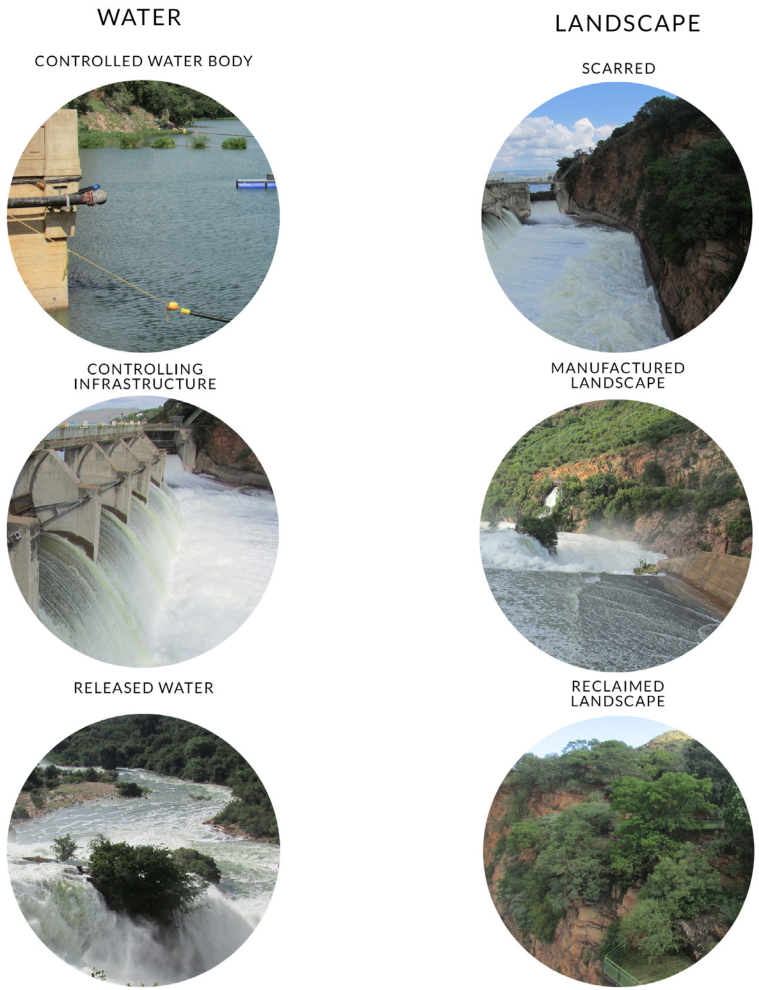


Fig 2.69 1:500 model of site (Author, May 2016).



The creation of the dam has changed certain characteristics of elements on site. This diagram shows that there are some elements that embody control and certain that embody release, such as the water infrastructure of the crest gate has both controlling and releasing elements. Even though it is controlled off site, there is still the old pump control centre, which is a palimpsest of control.

To create the dam, the landscape had to be adapted. The scar is still visible today but it is interesting to note in some places the natural vegetation is reclaiming the scar. There is also a duality between the natural bedrock and the concrete spillway which causes the water to change dramatically at this point.

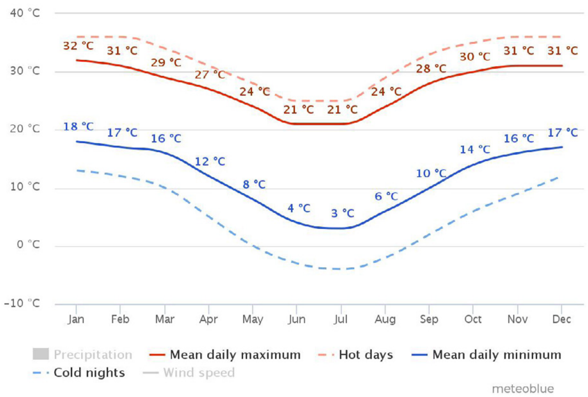
Fig 2.68 observations of water and land scape (Author, June 2016).

Climate Analysis

Hartbeespoort has almost year-round sunshine. Summer temperatures range, on average, between 18° C and 32° C, with afternoon thunderstorms from August to March. During the winter the nights are cold although the temperature may drop to below freezing. The average daytime temperature from May to July is 19° C. (show me Hartbeespoort, 2009)

The climate of the area is generally moderate, with hot summers and mild winters typical of the Highveld weather conditions. Summer rain varies between 600mm and 650rnm per year, whilst average temperatures vary between 3°C and 34°C. Frost occurs during winter in the period between 15 May and 15 August, and on average hail occurs on about 1 day a year (Seaton et al. 2003:18).

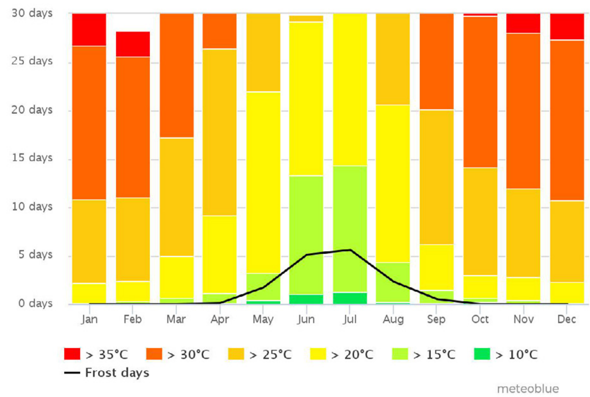
The prevailing wind direction in the months between September and March is North (NNW) to East (ENE), while in the winter months it blows much slower from an east-south-easterly direction predominantly. The average wind speed is 8 km/h with a very rear maximum of 28 km/h just +-70 hours of the year.



"The mean daily maximum (solid red line) shows the maximum temperature of an average day for every month for Hartbeespoort Dam. Likewise, mean daily minimum (solid blue line) shows the average minimum temperature. Hot days and cold nights (dashed red and blue lines) show the average of the hottest day and coldest night of each month of the last 30 years" (meteoblue, 2016).

Average temperature in summer is from 18 °C to 32 °C with minimum and maximum of 13 °C and 36 °C

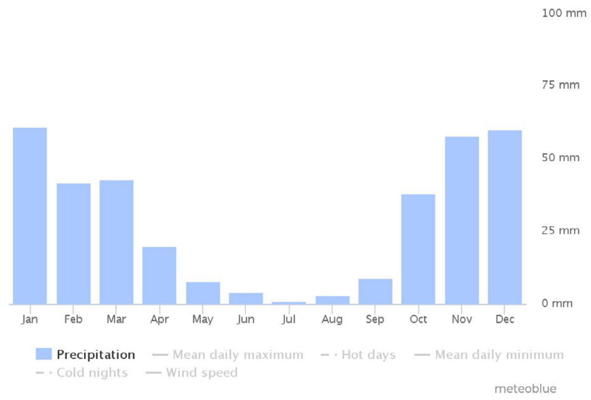
Average temperature in winter is from 3 °C to 21 °C with minimum and maximum of -4 °C and 25 °C

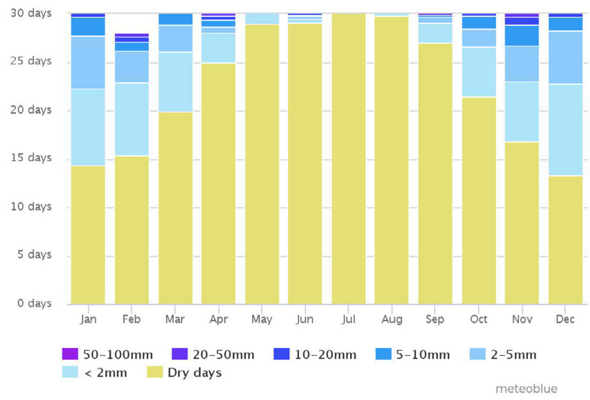


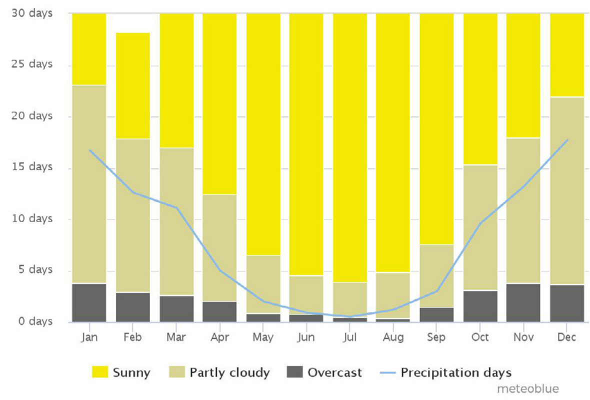
The maximum temperature diagram for Hartbeespoort dam displays how many days per month reach certain temperatures (meteoblue, 2016).

Fig 2.70 Average temp graph for Hartbeespoort dam (Meteoblue, 2016).

Fig 2.71 range of temp graph for Hartbeespoort dam (Meteoblue, 2016).







This graph shows the annual precipitation across each month. Hartbeespoort Dam has summer rainfall averaging 60mm in November, December and January. In winter months it drops to less than 10mm. (meteoblue, 2016)

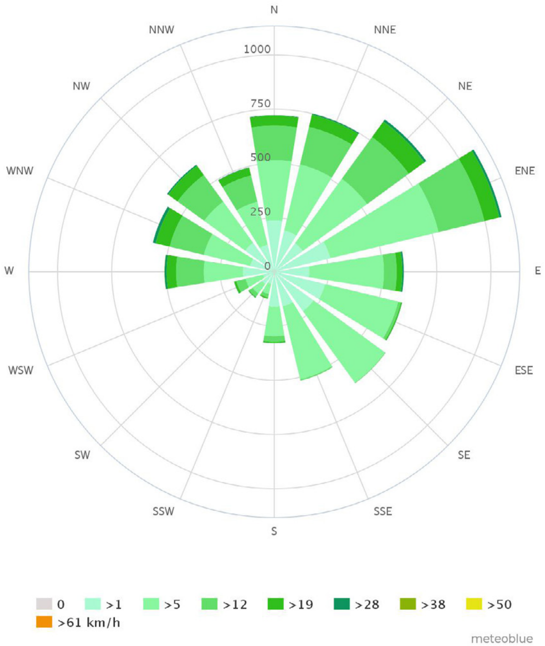
The precipitation diagram for Hartbeespoort dam shows on how many days per month it receives precipitation. Hartbeespoort Dam gets quick thunderstorms that last one or two hours and then it clears up. (meteoblue, 2016)

The graph shows the monthly number of sunny, partly cloudy, overcast and precipitation days. Days with less than 20% cloud cover are considered as sunny, with 20-80% cloud cover as partly cloudy and with more than 80% as overcast. As can be seen from the graph, there is a large amount of solar hours in the year, with short periods of overcast times in the evening. (meteoblue, 2016)

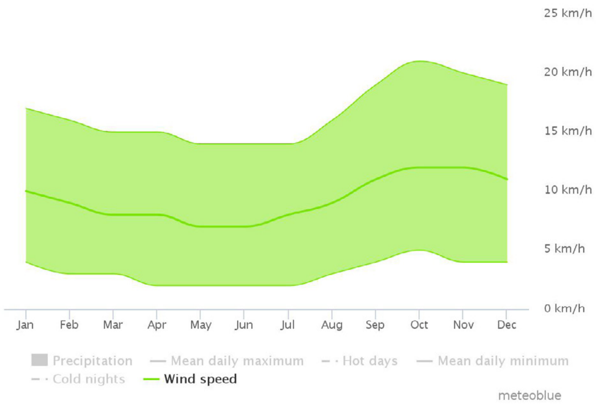
Fig 2.72 Precipition graph for Hartbeespoort dam (Meteoblue, 2016).

Fig 2.73 range of amounts of precipition graph for Hartbeespoort dam (Meteoblue, 2016).

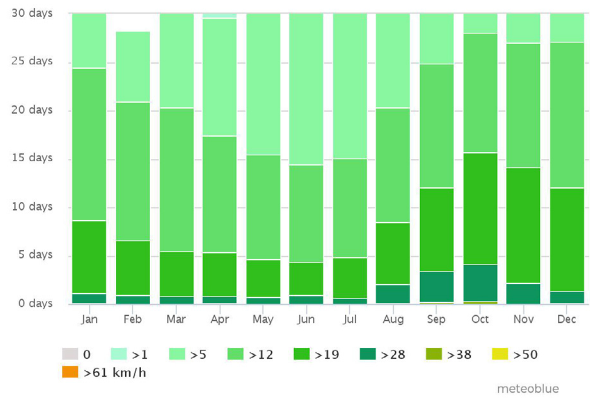
Fig 2.74 graph show cloud coverage for Hartbeespoort dam (Meteoblue, 2016).



The wind rose for Hartbeespoort dam shows how many hours per year the wind blows from the indicated direction. As seen the predominant wind is from the North (NNW) to East (ENE).



This graph show the average wind speeds as the solid green line, averaging around 8 km/h, with the light green strip as the range of wind speed.



The diagram for Hartbeespoort dam shows how many days within one month can be expected to reach certain wind speeds. Stronger winds in the summer months and weaker in the winter months with an average wind speed is 8 km/h with a very rare maximum of 28 km/h. (meteoblue, 2016)

Fig 2.75 Wind rose for Hartbeespoort dam (Meteoblue, 2016).

Fig 2.76 average wind speed for Hartbeespoort dam (Meteoblue, 2016).

Fig 2.77 graph show range of wind speeds for Hartbeespoort dam (Meteoblue, 2016).

Climate Understanding

Through this climatic analysis it is clear that the building will have to be protected during the overheated period. The winter months fall within the comfortable zone of the building and it does not need much additional heating. That being said, overhangs will need to be designed correctly to allow sunlight in the winter for the space to heat up sufficiently but stop direct sunlight in the summer to keep the space cool. To deal with the overheated period the best option is to give the building thermal mass and to have night ventilation. This may not be possible due to the difficulties of construction on the crest gate walls and so other methods may need to be investigated. Due to the linear nature of the building the façades of this building becomes extremely important in blocking out sun due to overheating. Using lighter colours on the façade and shading it with shading devices also need to be investigated.

Rain water collection would clearly be an issue in the winter months as there is very little rain. But the building is located directly on top of the dam and this water will have to be utilised during these winter months and maybe in the summer months too. this water would need to be sent through a filtration system as potable water is required. The water level in the dam only reduces by 0.8 m in winter and therefore is a reliable source (Hartie, 2016).

On dry land in Gauteng, humidity levels become very low during the winter months. This would not be a large problem as the site is directly over the water. Humidity levels staying reasonably constant all year round.

The dam experiences very little wind and therefore the outdoor space will not need to be protected.

The micro climate at Hartbeespoort Dam wall is mainly influenced by the water in the dam. This is due to the fact that water has a higher heat capacity (thermal conductivity) than land. This means that it fluctuates less and slower than land. For example at night the water body will remain warmer than the air temperature. This water body would give off heat to the air and then would heat up the space directly above it which is where the building is situated.

Likewise during the winter months the large body of water would retain the heat from the summer months and would take longer to become colder in the winter months. The sunlight is also able to penetrate deep into the water, therefore heating up more water.

There are prevailing winds from the NNW to ENE direction during the summer months. This air will be channelled through the port of the mountains and as this draws air over the water body, it will create evaporative cooling. This will greatly reduce the local temperature during the summer months. This means air needs to be drawn into the space from the North to East direction to make the most of this cool breeze during the overheated period.

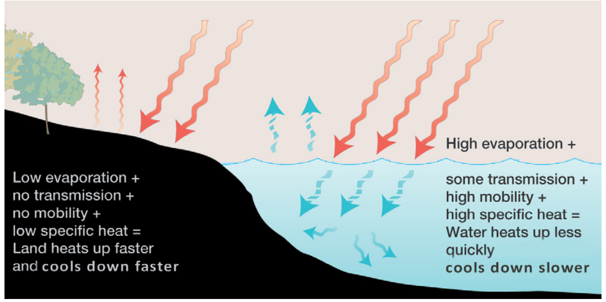
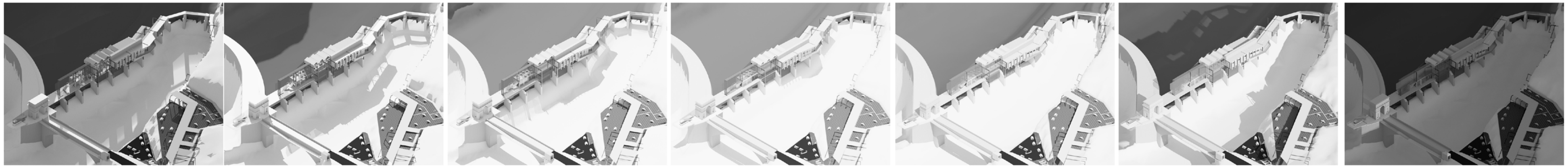


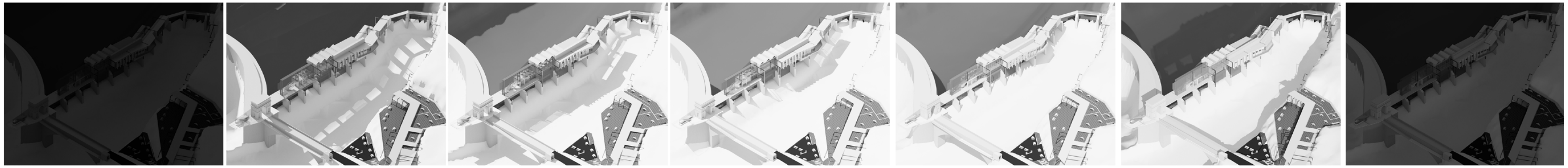
Fig 2.78 Water vs land heating (Wikipedia, 2016)

SOLAR STUDY

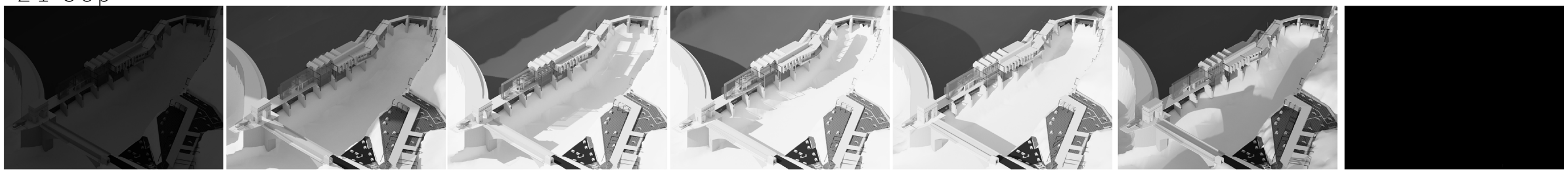
Summer Solstice
21 Dec



Winter Solstice
21 Jun



Equinox
21 Sep



The site's micro climate has some noticeable characteristics. With regards to direct sun light, the site is located directly in the middle of the "poort" of the Magaliesburg mountain range that runs in west east direction. This will change the time of sun rise and sunset, decreasing the amount of solar hours on the west and east façade. This will be mostly felt in winter due to the position of sun rise and the sun's height above the horizon. The implications of this for the project are that any habitable development will need to fully utilise and maximise exposure to available sunlight during the winter period. Public spaces will need to allow for large amounts of direct sunlight to heat habitable areas. This means solar screens need to be designed with care.

Fig 2.79 solar study for Hartbeespoort dam (Author, 2016).

2.8 Site Precedent

Project title: Borderline mediated landscape

Designer: Jurie Swart (University of the Free State)

Location: Fika Patso Dam, Eastern Free State, South Africa

Year: 2011

Swart (2016) stated in his portfolio that "this dissertation explores whether nature and architecture can amalgamate to become a hybrid solution in a vast landscape which has lost its reference to time and space. The transformation of space and time through architecture results in a progressive fusion giving meaning to a certain non-place lacking character and special qualities and resulting in an awakened space.

Architecture should become a space within which nature can grow and become part of the symbiosis called life. When the colliding systems are fused, a coherent typology emerges; juxtaposing the forgotten space and creating a tabula rasa where the non-place can be reactivated resulting in a spatial awakening".

The program of this dissertation is a water research centre for the University of the Free State. It uses biomimicry as a theoretical point and how the skin of a building can be related to the skin of plant or animal. They are able to regulate temperature, generate energy and adapt to change. He states that there are ways of applying these clues from nature to architecture that would ultimately result in the creation of a hybrid building; a building that is resilient and can adapt to its surroundings (Swart, J. 2016).

Swart's project works within a very similar kind of landscape as this dissertation and was therefore looked at as a precedent. This dissertation will look at how to align human activities with natural processes in order to continue the function and evolution of ecosystems.

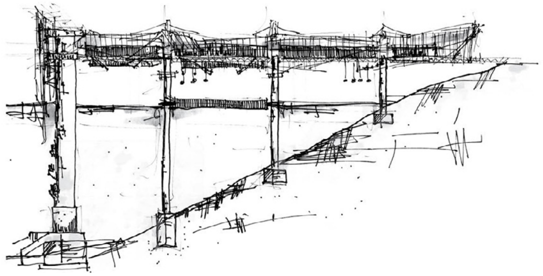


Fig 2.80 Resilient diagram (Metropolismag, 2016).

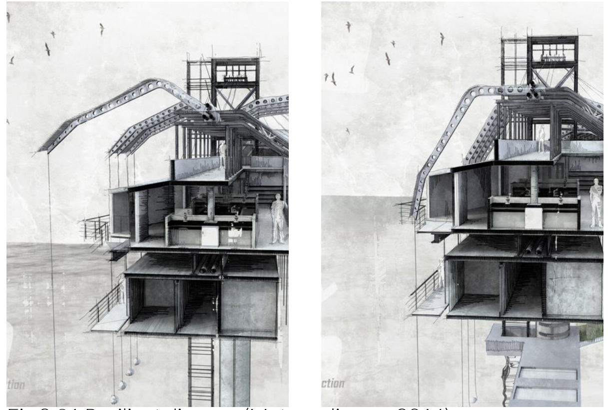


Fig 2.81 Resilient diagram (Metropolismag, 2016).

Fig 2.82 Resilient diagram (Metropolismag, 2016).

Chapter 3:
Facilitating exchanges

PROGRAM

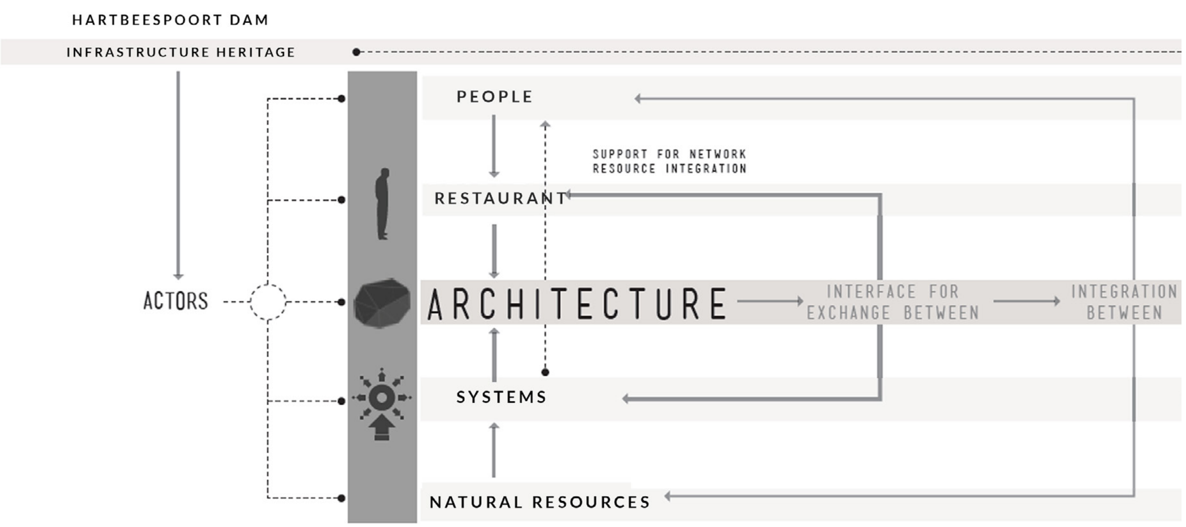


Fig 3.1 Program flow through site and program (Adapted by Author 2016 from Buchner, 2013).

3.1 Celebration of water

3.1.1 Primary program

The primary aim is to create a public interface along the Hartbeespoort dam infrastructure that celebrates one of our natural resources, water. Secondary functions will be to create closed loop systems to rehabilitate the dam.

The programs aim to reintroduce urban communities to natural processes by integrating people and natural productive systems within the context of Hartbeespoort dam's infrastructure.

The primary program is to create a space of celebration that fosters a new water identity. The space needs to remind people of their water heritage and that we are dependent on our water source to survive.

3.1.2 Secondary program

Secondary programs will create closed loops between the site, infrastructure and the user. The secondary programs will create exchanges between the "polluted water" and the needs of the user. In this way the user will be in constant contact with water and nature, this will make them aware of the state that it is in and therefore take care of it.

A restaurant and bar area was proposed in order to draw the users back to the site and continue engagement with the exchanges. The restaurant being 100 m^2 and bar being 100 m^2 in size would cater for approximately 120 users. This means that the kitchen space would be need to be quite significant in size, 100 m^2, approximately 1/3 of the restaurant. Approximately 15 staff would be needed in order to run this kitchen, to be run correctly there would also need to be officers and staff room. This staffroom would also be used for the retail workers. Integrated into this could be the management of the centre as well as safe rooms.

Boardrooms are integrated next to the restaurant space and will also be serviced by the kitchen. The space would be in total 45 m^2 but will be able to be divided into two smaller boardrooms consisting of approximately 15 m^2 and 30 m^2.

A retail space would be used to sell the products created on sites such as miniature vermiculture systems as well as plants growing on the vertical wetland. The space would also sell picnic baskets for the public space in order to engage with all classes. This space would be approximately 45 m^2 plus storage space that would be required for this space.

The vermiculture and wetland creation space would be brought into full view of the public and create a new building for both these activities. By bringing all these different systems together it will facilitate exchanges between one another. The wetland creation space would need good lighting and tables and chairs in order for the existing workers to construct the floating wetlands. There would also need to be storage for raw materials such as steel mesh and foam. They would also need to tend to the plants growing above the space or nearby. These plants will be set in to the wetland and launched along the floating boardwalks.

A public space in this building will be necessary for presentations and public interaction. Officers and staff quarters would also need to be integrated into the building as there are approximately 30 staff members working in this centre.

Vermiculture was introduced by the remediating program, to biodegrade the Hyacinth, which is removed from the dam, into compost that could be sold or used to rehabilitate the shoreline. This activity already exists on site at the dam wall, but the system is crippled and ineffective. There is simply not enough capital to make the system effective and there is often theft that causes the system to be obsolete. There is a real potential to emphasise this program and intensify it.

Vermiculture is the first step to rehabilitate the dam. The compost that is generated from the Vermiculture could then be used to grow water plants that would be placed onto the floating wetlands. In turn this floating wetland can be used to collect more Hyacinth and remove more nutrients from the water, creating a positive closed loop system. This compost will also be used to grow crops and vegetables that will be sold in a restaurant that is open to the public.

In the future, when the Hyacinth has lessened, vermiculture will shift from biodegrading material from the dam, to organic matter brought in by the public. The worms will be used as worm meal to create aquaponics. This will encourage desirable fish species in the dam. This fish could eventually be harvested and sold again, in turn, in the restaurant.

All new programs will facilitate rehabilitation of the site through exchanges. As the site and water is regenerated, programs will have to shift. The vermiculture system will no longer have as much Hyacinth, as the dam will no longer be in a state of eutrophication, and therefore will not produce as much compost. Aquaponics will be introduced as an additional program so the fish and vegetables can be produced and used in the restaurant. The vermiculture system will be scaled down to simply produce compost for the growth of vegetables for the restaurant and worms will be fed to the fish in the aquaponics. Other organic material could be brought in from local factories and residents.

Figure 3.2 shows the flow of materials moving from one program into the next and how they all become interlinked. It can be seen in the diagram how aquaponics would eventually feed into the system once the dam has become balanced. It is clear from the diagram that the water becomes the major feeder into the five programs.

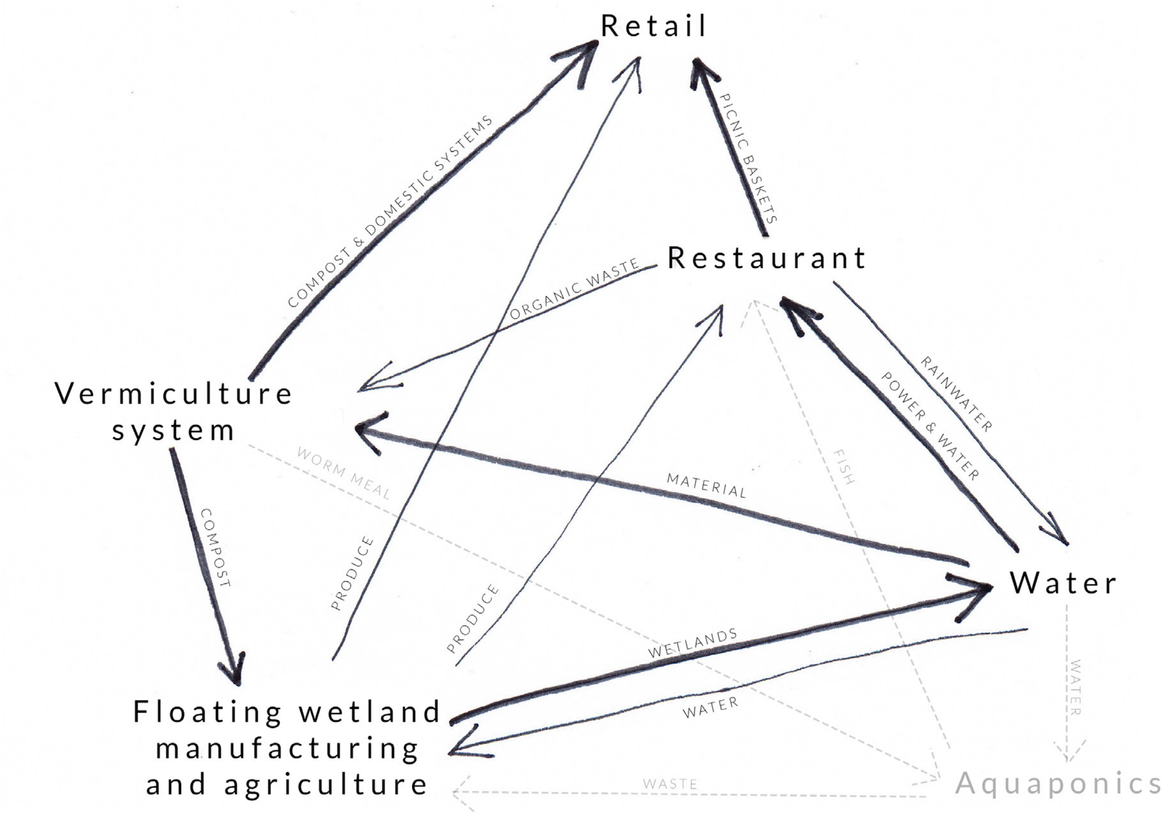


Fig 3.2 Flow of exchanges between programs (Author, 2016).

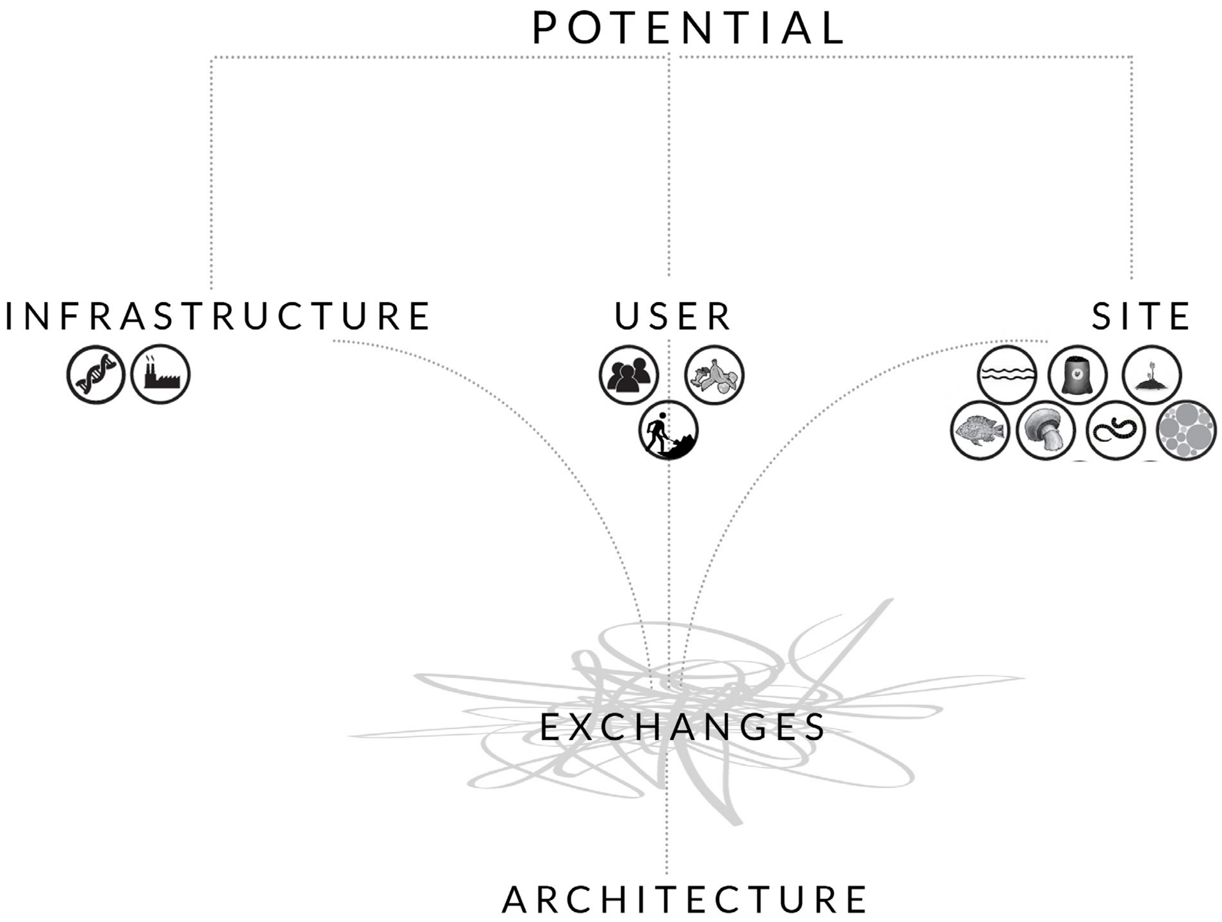


Fig 3.3 Exchanges between site, infrastrucure and user (Author, 2016).

Fig 3.4. Vermiculture turning of soil (Wormculture, 2015).

3.2 Vermiculture

The permaculture research institute (2016) states that "Vermiculture is the process of using worms to decompose organic food waste, turning the waste into a nutrient-rich material capable of supplying necessary nutrients to help sustain plant growth. This method is simple, effective, convenient, and noiseless. It saves water, energy, landfills, and helps rebuild the soil. The worms ability to convert organic waste into nutrient-rich material reduces the need for synthetic fertilizers."

Worms are a very important part of nature as they help to decompose organic matter and turn it into rich organic soil that we commonly see as topsoil. This happens naturally, but when it occurs in a controlled system, this process is called vermiculture (Permaculture research institute, 2016).

In this system decomposing organic matter is replaced with food and garden waste. The worms then consume this and creates vermicompost, that could be used to replace nutrients in the soil for plants and improve the texture of the soil. This process is extremely effective with fruit plants, vegetables and herbs as these plants quickly draw the nutrients out of the soil and need to be replaced in order for more harvests to occur. This is a more effective system then fertiliser as it is more readily available for the plants to utilize (WormFarm, 2009).

"Vermicompost improves soil structure, texture, and aeration as well as increasing its water-holding capacity. Plants will grow stronger and have deeper root systems for better drought tolerance and disease resistance.

Vermicomposting adds beneficial organisms to the soil as well. These microorganisms and soil fauna help break down organic materials and convert nutrients into a more available food form for plants" (Vermiculture Composting. 2008).

The vermiculture process is a natural way that nature recycles, creating close loops with in itself. This system can be integrated into every household to recycle garden and food waste (Vermiculture Composting. 2008).

The worms thrive in dark humid spaces that should be kept relatively warm. This means that the space needs to be well ventilated, to remove smell, but some kind of moisture needs to be released into the air. The space is to have limited windows to stop direct light and rather use indirect light. Thermal mass could be used to keep a constant temperature at night.

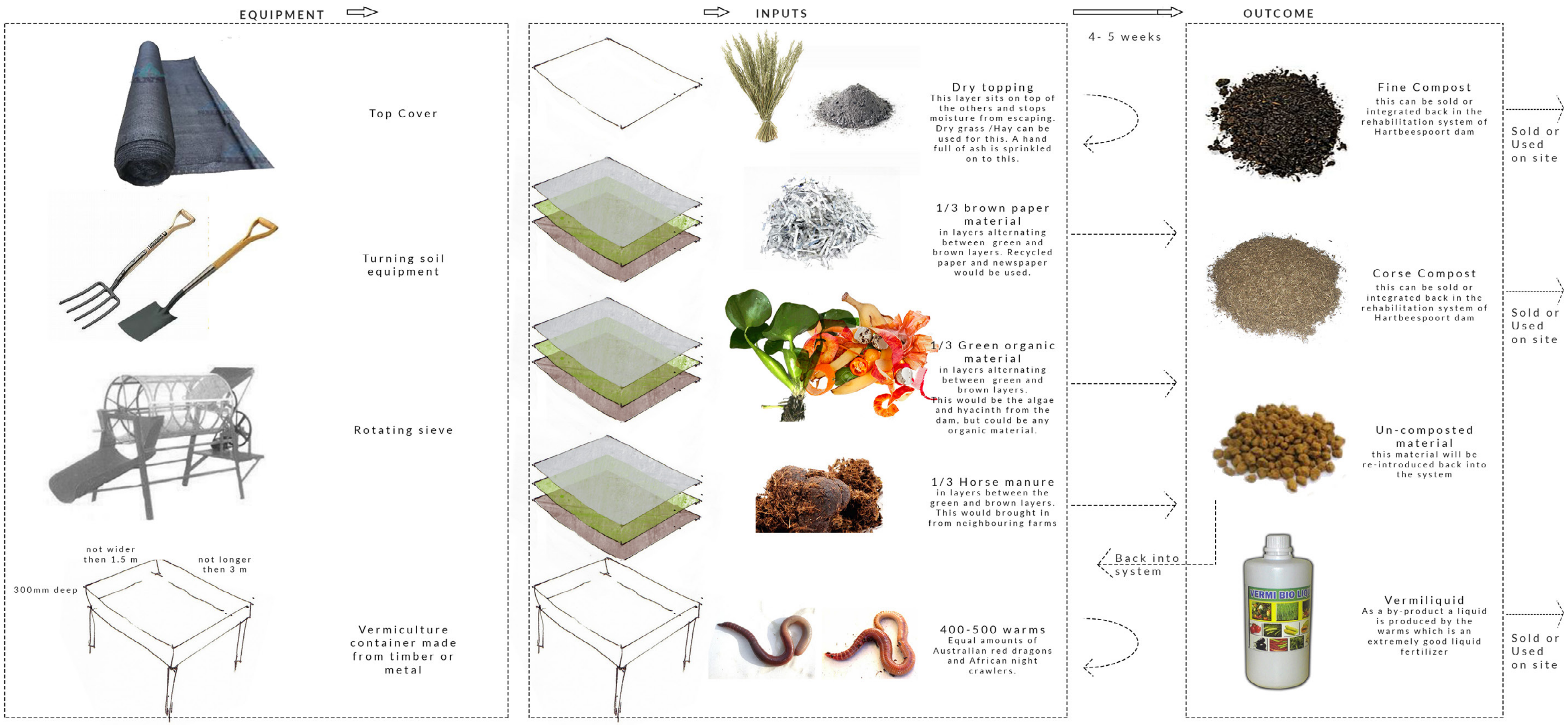


Fig 3.5 detailed flows of materials in system (Author, 2016).

Fig 3.6 Existing activities on site (Author, 2016).

The current program

Vermiculture is an existing activity on the site. It was introduced by the remediation program to deal with the eutrophication of the water. The system is inefficient as there is little capital and equipment available for the system to work. Another problem is theft of the worms that happens over the weekends. This cripples the entire system and therefore makes it unproductive.

The system has great potential though and if managed correctly and secured, a real difference can be made. There is the possibility of not only rehabilitating the site but also creating an income through selling of products such as compost and vermiliquid. Public access is crucial to the understanding of the problems on site. As the public starts to understand the situation better they will take more care of it.

The current vermiculture system has 18 composting beds, which are 2m by 1m and made from timber with a steel frame. Eight of the beds are covered with shade cloth as capital ran out and they were unable to cover the cost of the rest. As capital they have had to use other methods of creating beds such as tyres which were donated and used to construct vertical beds. These are good for reproducing the worms but ineffective for creating compost. There is an abundance of Hyacinth removed from the dam, this is stored on site but unable to be converted into compost because of the lack of beds. There have been attempts to grow vegetables and crops but only for the works and on a very small scale.

There is an existing conference centre with a small public interface where presentations of the system are made. The program employs a total of 47 permanent employees which work across the entire dam. 25 of these 47 are permanently located at the dam wall. They turn the soil in the vermiculture system and remove Hyacinth from the dam.

There is very little understanding of the vermiculture process by the public as the site is hidden from the road and there is little, to no, expression of the rehabilitation of the dam in public spaces. The public spaces that are created are unused and derelict. The spaces have also been repurposed as informal retail by the locals.

Fig 3.7 Example of potable vermiculture system (Wormculture, 2015).

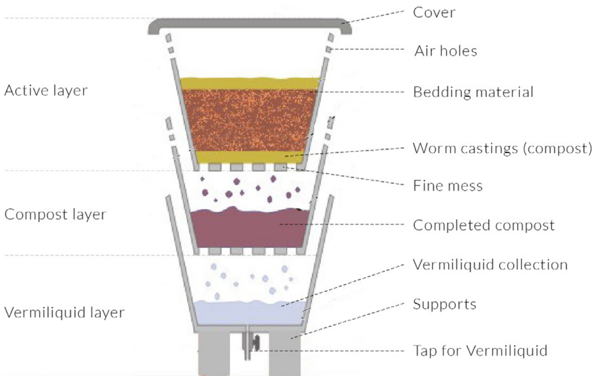


Fig 3.8 Section diagram explaining system (Author, 2016).

Fig 3.9 outputs of vermiculture system (Wormculture, 2015).

Retail Space

Retail spaces would be integrated into the design as there will be many spin-offs from the closed loop systems. The abundance of Hyacinth will mean that there will be a surplus of compost. This compost could be sold to the public or be used to grow plants that could then be sold to the public.

The storage of the compost bags can be placed in the outdoor retail space in large mesh benches that can be used for seating by the public. This will create a more open and free retail space, allowing public to engage with it weather they are indoors or outdoors.

Crops and vegetables will also be grown from the compost that will be manufactured into food at the restaurant. The restaurant could also produce picnic baskets to be sold at the retail spaces that the public could take to the picnic area.

Small vermiculture systems could be created that are spread around the dam where Hyacinth is being removed from the floating wetland barriers. This will create a catalytic approach to equalizing the eutrophication. These systems could also be manufactured for selling to the public. This will allow the public to change the way that they live their lives at home and therefore the way that they view waste. An educational tool that can be taken with them (quotidian application).

Fig 3.10 Existing activities on site (Author, 2016).

Fig 3.11 Existing activities on site (Author, 2016).

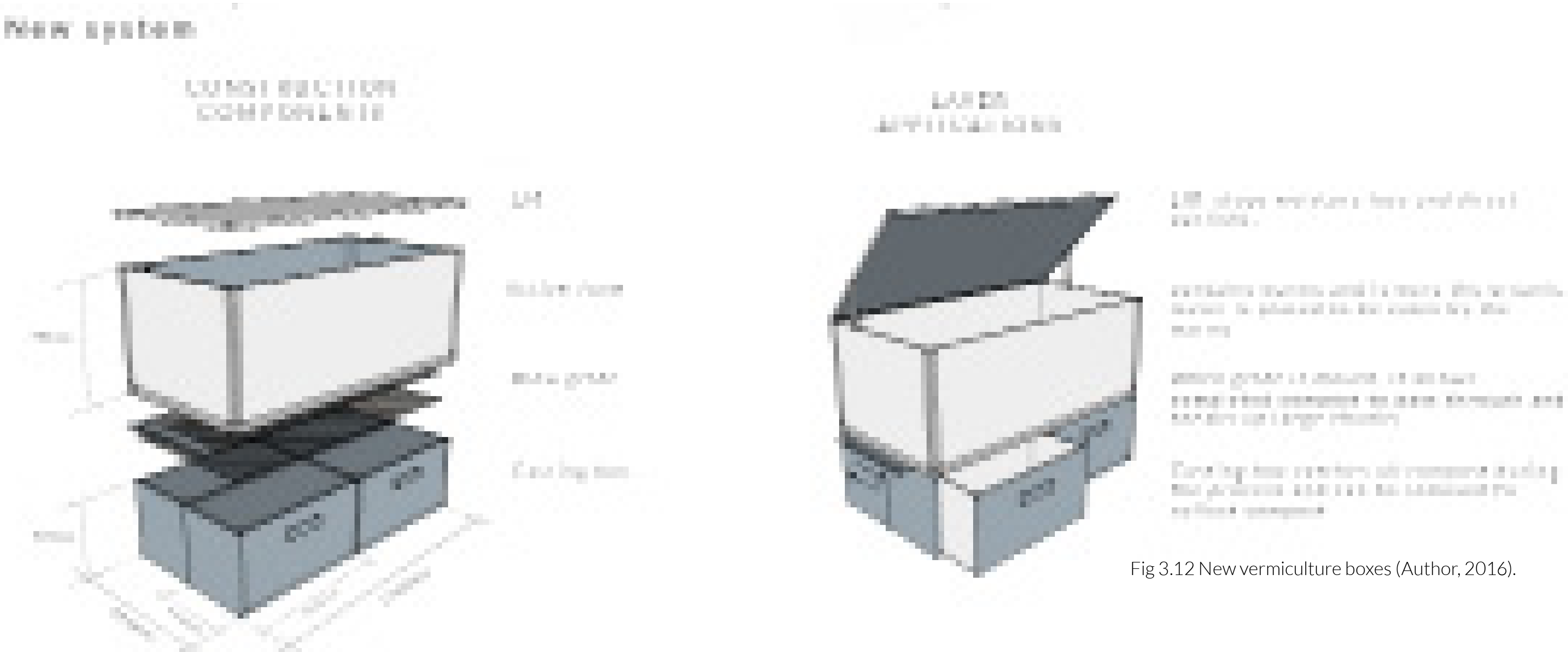


Fig 3.12 New vermiculture boxes (Author, 2016).

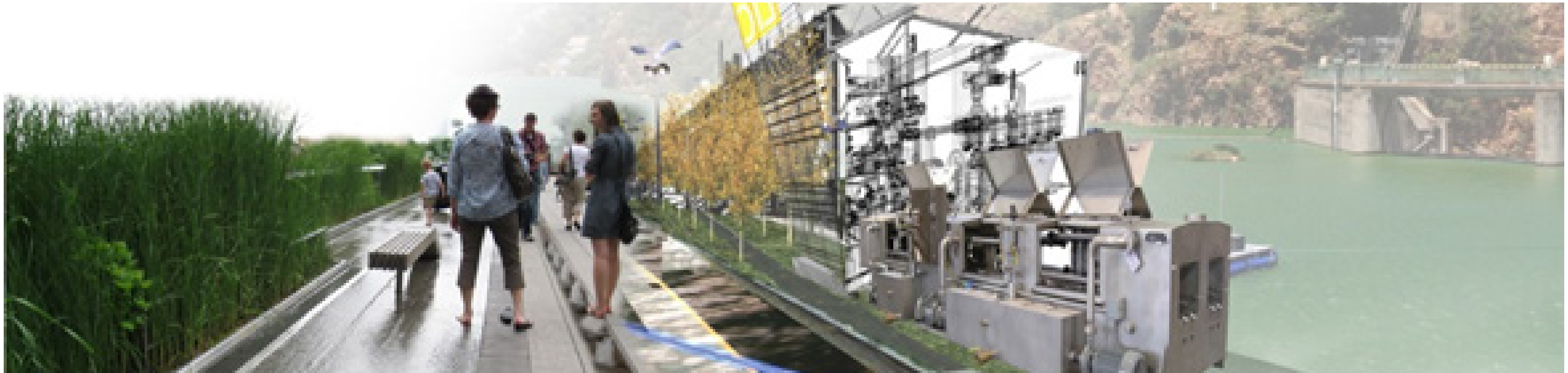


Fig 3.13 Vision Perspective (Author, 2016).

COMPOST INGREDIENT.

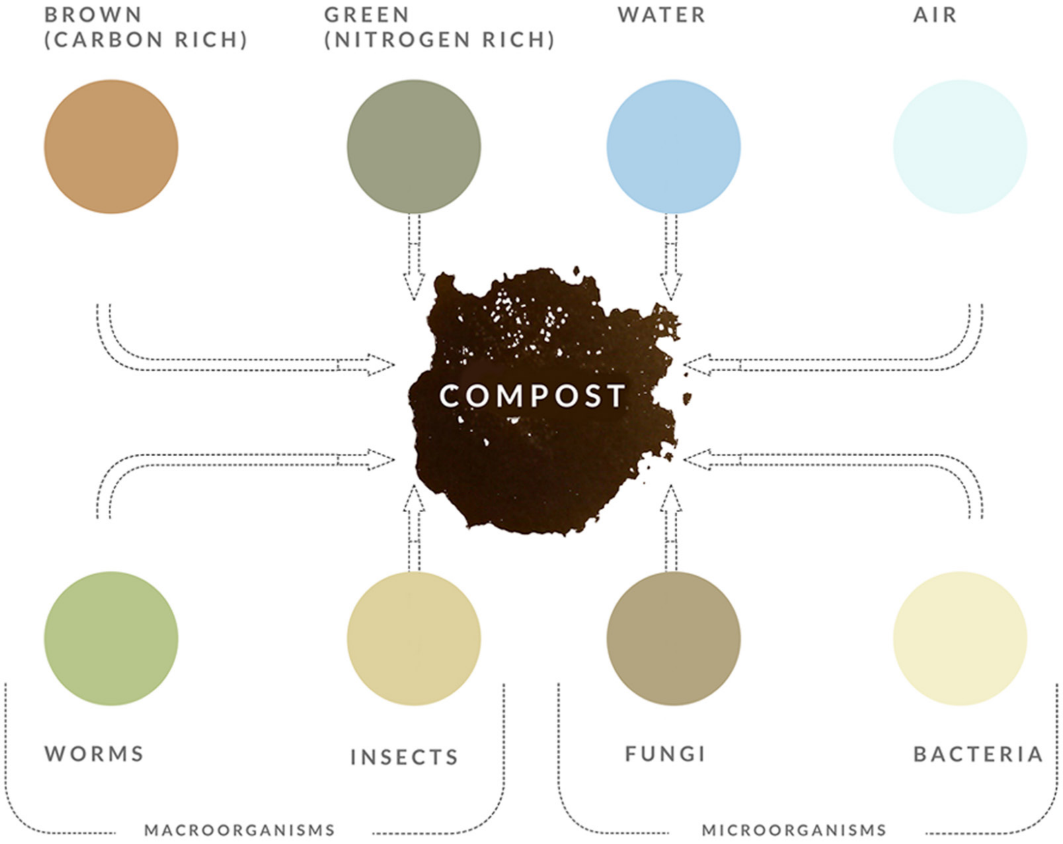
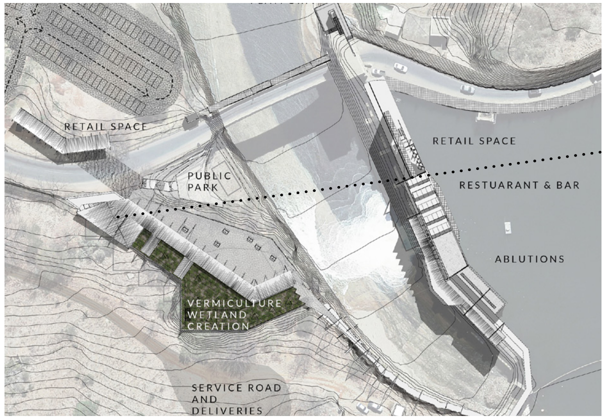


Fig 3.14 inputs and outputs of vermiculture process (Author, 2016).



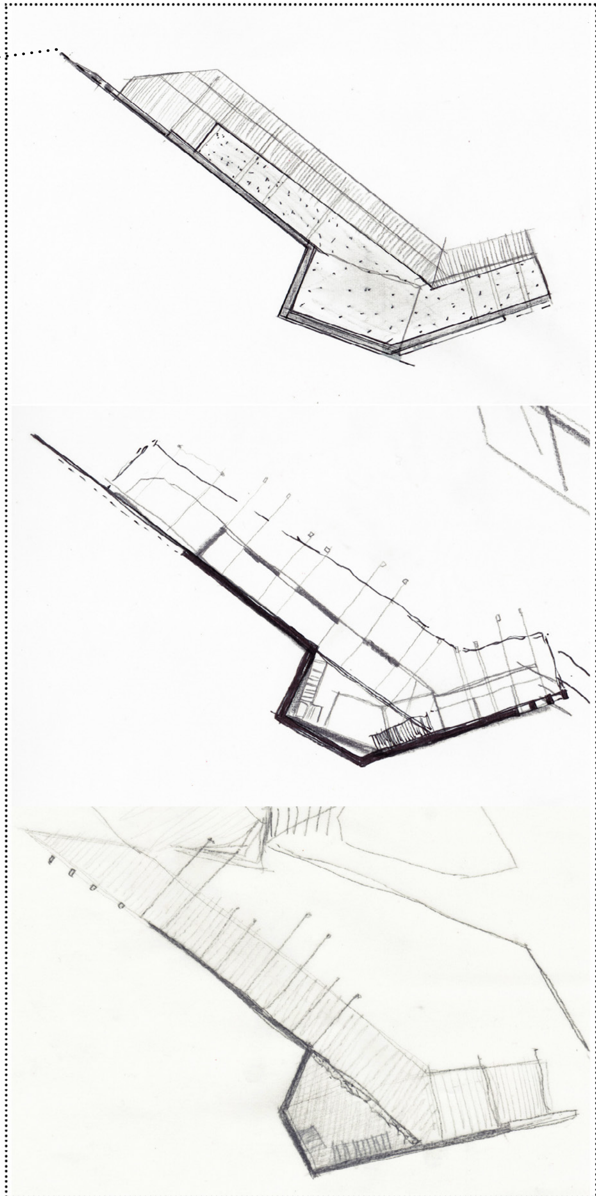


Fig 3.15 Vermiculture space development (Author, 2016).

3.3 Program space requirements

120 tons of Hyacinth is removed every year from Hartbeespoort dam. 12 000 worms can break down 1 ton of waste in one year to create 1 ton of compost. To break down 120 ton, 1 440 000 warms would be needed and each new vermiculture bed can hold 10 000. This means to turn all the Hyacinth into compost, 144 new vermiculture beds would be required.

This would require a very large space which would quickly become redundant as the problem rectifies itself over the next few years. The Hyacinth is also removed in many different locations and it would be inefficient to transport it to one location.

It is proposed to rather have five smaller vermiculture systems placed around the dam. These could be phased out slowly as the Hyacinth is reduced. Smaller systems can be monitored through the collection of organic waste in the urban areas. The buildings could become communal areas that create spaces with connections to the water.

The current vermiculture system receives 20 tons of Hyacinth every year and they are unable to convert this all to compost. The new system will require 24 vermiculture beds in order to deal with the load.

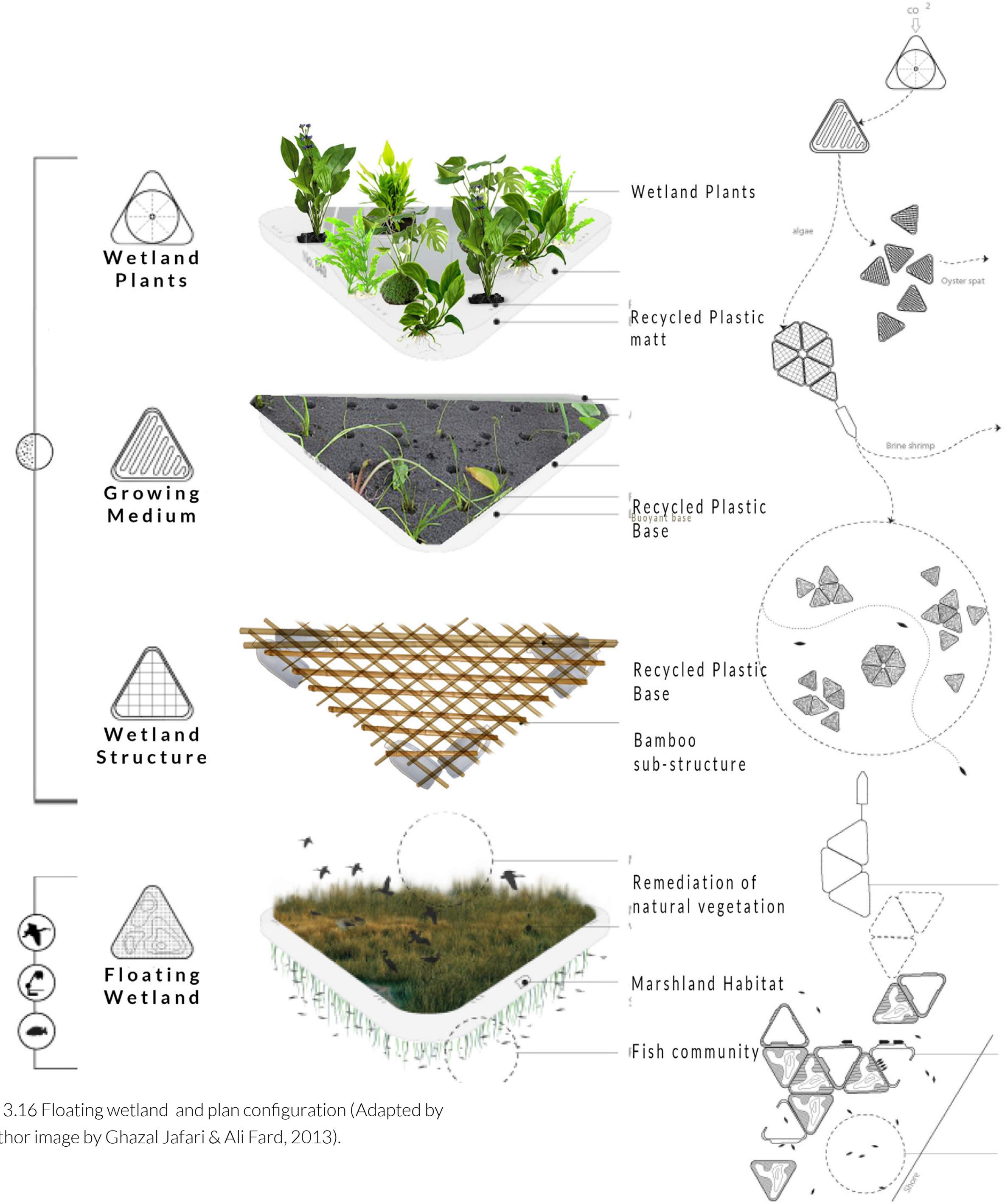


Fig 3.16 Floating wetland and plan configuration (Adapted by Author image by Ghazal Jafari & Ali Fard, 2013).

Wetland creation requirements

The creation of floating wetlands at Hartbeespoort dam were introduced through the remediation program in order to recreate the natural vegetation lost on the shorelines due to the eutrophication of the water.

Construction of new floating wetlands will allow flora to flourish as well as rehabilitate the desirable fish environments. This will as filter out the nutrients that cause eutrophication and create a balance in the water. The floating wetlands act as barriers to stop and collect the algae and hyacinth.

Where the wetland barriers are connected to the shoreline, workers can collect the organic material and used in the vermiculture process. The algae and hyacinth will be broken down to compost and in turn the compost will be used to rehabilitate the shoreline.

The materials required and construction method to create the floating wetlands are as follows;

Recycled plastic bottles and bamboo stems which are tied together with wire. This creates a buoyant base. Then a recycled plastic mat (made elsewhere) will be strapped on top of the bamboo. Young plants will be uprooted and, their soil removed,placed into the plastic mats. The wetlands are then placed and tied to the shoreline and connected together to create barriers.

This would require a staff of 15 workers. These workers would create the floating wetlands as well as grow the plants required to be placed inside them. It will also be their job to grow the fresh produce for the restaurant space which would be a constant task.

3.4 Spatial requirements

Vermiculture building

Vermiculture

- Production 50m²
- Worm boxes 200m²
- Storage 25m²
- Collection 50m²
- Bagging & sorting 30m²

Wetland Manufacturing

- Production 50m²
- Storage 25m²
- Growing of plants 300m²

Public interface

Restaurant

- Seating area 100m²
- Bar area 100m²

Kitchen

- Production 80m²
- Storage 15m²
- Cold Storage 10m²

Retail

- Outdoor 80m²
- Indoor 60m²
- Storage 20m²

3.5 SANS requirements

All programs need to be analysed with regards to the South African National Standards regulations (SANS), and where possible, the design must take these requirements further specifically looking at sustainability.

The Building and Construction Authority (BCA) Green Mark Scheme was launched in January 2005 as an initiative to shape a more environmentally friendly and sustainable built environment. It has been updated through the years as technology has advanced and was one of the first to create specific criteria for restaurants. The BCA green mark will be used in this project to add input to SANS for more sustainable design (BCA. 2012: 1).

The programs fall into three main classes of occupancy;

- The restaurant space falls under (A1) entertainment and public assembly. A place where people gather to eat, drink.
- The retail space will fall under (F2) small shop, as the floor area does not exceed 250 m².
- The office spaces that are needed in order to run the other programs fall under (G1) offices.

Each of these has their own unique requirements with regards to ablutions, lighting, population, air change rate and fire (SANS. 2012: 43).

Restaurant space A1

Population

The site would allow for approximately 100 m² to be allocated to the restaurant program, accordance to the SANS building regulations (see fig 6.23) this space could be used by 100 people. This would make for a very crowded space and would not be the norm. The restaurant space above will have tables and chairs for 60 uses as the average but could be increased to 100 users for large functions if needed.

The more informal bar area could incorporate a higher design population; the space would be approximately 100 m² and would allow for 60-80 users.

Due to the restaurant and bar area being 200 m² together, the kitchen would need to be approximately one third of this-66 m². The kitchen would also need to provide the food for the picnic baskets in the retail space as well any functions in the conference room this means that the kitchen space would need to be considerably larger (SANS. 2012: 45).

Lighting

The restaurant space is made up of two main areas, the kitchen space which needs high lux (750-1000 lux) for food preparation and the restaurant space which needs a lower lux level (300-750 lux) but it needs to be a constant light (SANS. 2012: 101).

Using large amounts of natural light will help to create an energy efficient building. In the kitchen this may not be possible throughout the day as it requires a high lux level and artificial lighting will need to be introduced. This lighting will need to be energy efficient such as LED lights throughout the spaces.

The BCA green mark assessment tool also encourages automated lighting systems such as motion sensors and light sensor switches to turn on the lights when lux levels are too low (BCA. 2012: 5).

Air change

The air change rate for the kitchen was significant at 20 air changes per hour, with approximately 15 staff members there would need to be 250 L per second of air (SANS. 2012: 101).

The seating area of the restaurant would be half of this at 10 air changes per hour, with approximately 60 users there would need to be 450 L per second of air. (SANS. 2012: 101).

Due to the longitudinal form of this building it would be possible to obtain this air change rate through natural cross ventilation if correctly designed. The kitchen space will need additional ventilation.

Ablutions

The restaurant and bar area combined population would be approximately 120 people. The ablutions required for this number of people are;

3WC's, 6urinals and 5 Whb's for males,

9 WC's and 5 Whb's for females

SANS allows for 20 L of sewage per person per day in a restaurant space. This is a significant amount of sewage. The first step to changing this is to use low water fixtures such as waterless urinals, secondary to implement a grey water harvesting system that could reuse this water for irrigation (SANS. 2012: 64).

The use of private water meters to track the water usage by the staff is encouraged by BCA. This will keep the staff conscious about their water usage and will also allow for leak monitoring. The adoption of water efficient practices by staff as well as visitors is most important especially in this project (BCA. 2012: 7).

Smoking area

A smoking area would need to be created for the restaurant space. The smoking area will need to be vented separately from the rest of the restaurant so as not to contaminate the fresh air entering into the rest of the building. The boardroom space, when not in use, could be closed off in such a way as to form a smoking room. There are also outdoor seating spaces that could be used by smoker (SANS. 2012: 117).

Cooking equipment

Energy consumption of a standard kitchen is extremely high and the BCA tool encourages the use of energy efficient kitchen equipment to save power. The key kitchen equipment to focus on are; deep fryers, grills, ovens, freezers and cold rooms. Correct lighting also helps lower energy usage. (BCA. 2012: 6).

Retail space F2

Population

The retail space is divided into approximately 60 m^2 of indoor retail space and 80 m^2 of outdoor retail space. This outdoor retail space is scattered through the public platform, creating benches for storage boxes and greenery from plant produce.

The regulations state that there can be a total population of 14 people in the space. This is an excessive amount of space for very few people. Due to limited space on site it is not possible to increase the retail size. Keeping a flow of people moving through will avoid over crowding as well as utilizing the outdoor space for storage and product browsing (SANS. 2012: 45).

Lighting

The retail area for the picnic baskets will require good lighting, as to display the food in the baskets to the best advantage. The light however will not need to be controlled in order to sell the plant and vermiculture systems, and therefore they can be in the outdoor space (SANS. 2012: 101).

Air change

The air change rate is relatively low compared to the restaurant space with 2 air changes per hour. The space is very shallow and it would be possible to achieve this through cross ventilation (SANS. 2012: 101).

Ablutions

The retail space's population would be approximately 14 people. The ablutions required for this space would be joined to the restaurant's ablutions;

1WC's, 1urinals and 1 Whb's for males,

2 WC's and 1 Whb's for females

Office G1

Population

Officers were needed in order to manage the programs on site such as the vermiculture process and the restaurant space. The office spaces would be split between the following spaces;

The restaurant building consisting of two offices (restaurant and the retail managers), a reception space and a safe room (60 m^2).

And the vermiculture building, consisting of one office, a reception space and a safe room (114 m^2) (SANS. 2012: 45).

Lighting

Like requirements for a standard office space range between 300 to 500 lx. With a relatively narrow space and deep penetration of light this can be achieved. If this is not possible then skylights could be looked at as a secondary option (SANS. 2012: 101).

Ablutions

The ablution requirements for the offices will be added to the existing ablution block of the public interface of the vermiculture building and the ablution block of the restaurant space. The requirements for offices are as follows (SANS. 2012: 65);

1WC's, 1urinals and 1 Whb's for males,

2 WC's and 1 Whb's for females

Inclusive design

Inclusive design is extremely important in this project in order for all people to engage with this new celebration of water. It was necessary to make ease of access possible, ramps would need to be introduced as there are large changes in height when moving from the proposed vermiculture space to the restaurant and public platform. Moving up into the second story of the restaurant space will also need to be thought through. Disabled toilets also need to be integrated on both sites according to the regulations.

Fire

All the types of occupancy have to have one emergency route and 2 feeder routes, but due to the fact that the route will be longer than 45 m, there will need to be an additional route added. NO emergency route shall be longer then 45m to the exit door(SANS. 2012: 158).

There will need to be a 60 min occupancy separator between the restaurant space and retail or office space. A Class 2 fire door will be required between the two occupancy (SANS. 2012: 162).

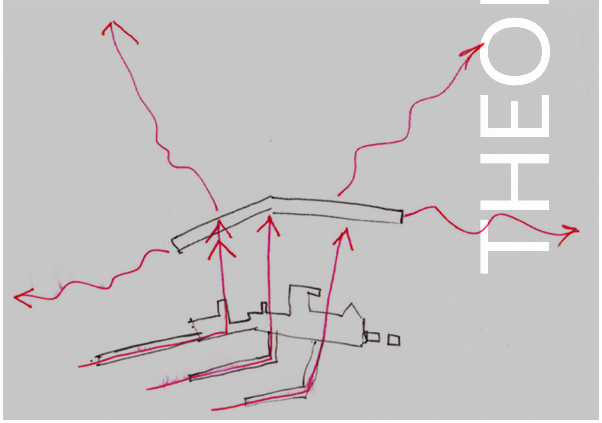
Any other structural element or component needs a 60 min fire rating in these occupancies.

All wall, floors and ceilings in the emergency route shall have a fire rating of 120 mins and be wider than 1200mm due to a possibility of there being 130 people.

Provision of hose reels, hydrants and portable fire extinguishers (every 200 m^2) will be necessary (SANS. 2012: 162).

Chapter 4:
Regenerative theory

THEORY



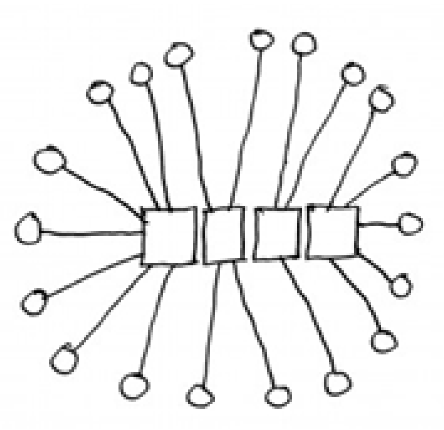
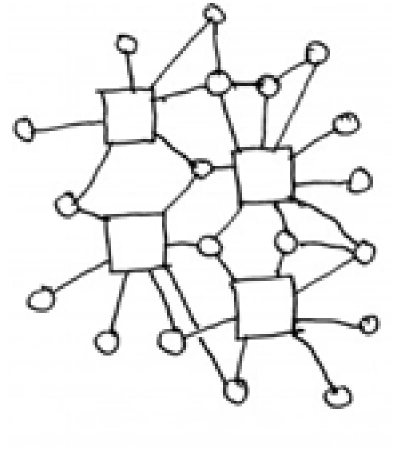


Fig 4.1 Resilient diagram (Metropolismag, 2016).



"It is an architecture that embraces the environment and uses the millions of years of engineering and evolution as the foundation for a regenerative structure" (Littman, 2009: 1).

4.1 Sustainable design limitations

Le Corbusier stated during the Modern Movement that the household is a machine for living. This negated the outside world and everything beyond the walls of the dwelling space. Sustainable design started to look at the earths "household" and how we live in the greater context. How the culture of this time had adopted a design strategy that essentially says if something is not working, you are not using enough energy (Nesbitt, 1996: 401-402).

Sustainable design was based on the respect for human life, the natural world, and its complex processes. It critiques the past movement of modern architecture and the condition of modernity. McDonough, who became the spokesperson for sustainable design, created eight ecological points. These ecological points required society to look at long-term environmental implications of their actions which then started ideas of sustainability (Nesbitt, 1996: 401-402). There was an increase in awareness that buildings had to take the environmental impact into consideration. But yet a sustainable building can be defined in the broader context as one that has a minimum impact on the natural. The building itself has a minimum impact on the immediate surroundings in either negative or positive manners. The building did not contribute anything to the site, it simply sat upon it (John, at al, 2004: 320).

As much as sustainability was an improvement on the past movements, it had its limitations. Sustainability looked at how the building could have a net zero impact on the site. Creating energy on site for the needs of the building and satisfying all the needs of the user and the building. It did not look at the needs of the site and the larger context that it is situated on. This brought about the architectural language of "green paint", covering the building in solar panels and incorporating solar stacks. It created a movement of making buildings "less bad" but not making them better for the environment.

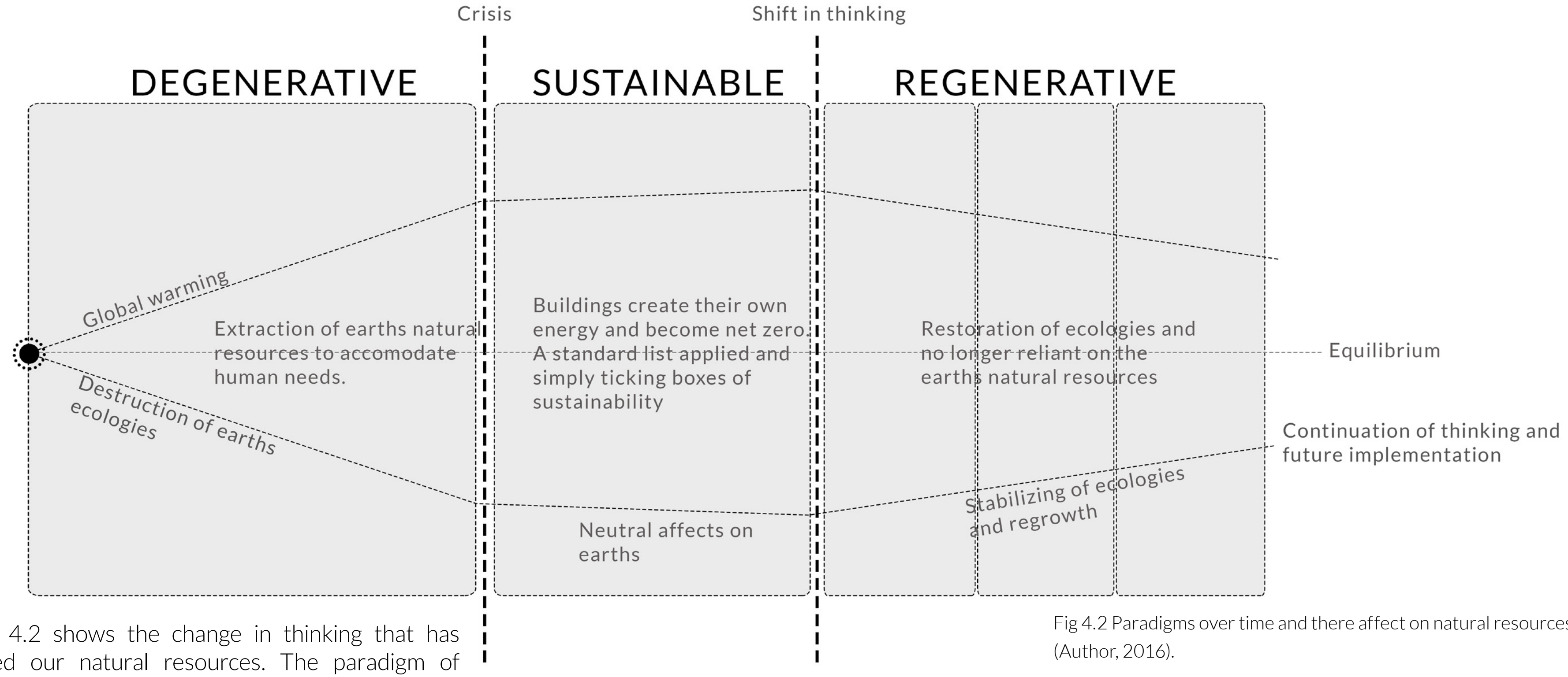


Fig 4.2 Paradigms over time and there affect on natural resources. (Author, 2016).

Figure 4.2 shows the change in thinking that has affected our natural resources. The paradigm of degeneration during the industrial era led to mankind taking advantage of natural resources. These have became depleted and have damaged our natural ecologies through global warming and extraction of natural resources. The realisation of global warming created a crisis this led to approaches like sustainability. During this time buildings were designed to achieve nett zero energy usage and the negative effect on natural resources and ecology is slowed. But these approaches did not replenish or regrow resources or deliver energy. This led to a new way of thinking which encouraged the restoration of ecology. This will hopefully will lead to the reverse of global warming and improve the future.

The Green Building Association developed four practical points that could be applied in order to overcome the previous mind-set of sustainability (Cole, 2012: 5). This led to the LEED and BREEAM rating system (DU Plessis, 2005: 3). The 4 main points are;

- The return to the use of natural building materials and the effective use of resources, like recycling.
- Buildings should aim to be self-sufficient, for example, by gathering solar energy, collecting filtered water, waste management; all to be achieved with appropriate technologies.
- The integration of the building with the site condition.
- An ultimate improvement in the air quality of a building.

4.2 Regenerative theories

This need for a greater environmental understanding brought about regenerative theories. It is distinctly different from sustainability in the way that it looks at integrating and connecting natural systems and the site to the architecture. It still focuses on conservation and performance by reducing the environmental impact of the building but it takes it one step further and views the site as an equal stakeholder in the architecture. "A full understanding of natural and living systems in the design of a structure" is utilized in regenerative design (Littman, 2009: 1).

The theories of Regenerative Architecture do not mean that the building is 'regenerated', in the way of self-healing, like a living system. Rather it means that a regenerative building is a catalyst for positive change within a unique place in which it is situated. This looks at a specific situation or site that has declined to a point where it is right for renewal (Cole, 2012: 54).

Using regenerative architecture to explore how ecosystem services available in Hartbeespoort dam could be utilized to create exchanges through a public interface to the existing dam wall (Cole, 2012:54).

Applying regenerative theories to a project means that you need to look at the engines of positive or evolutionary changes for the systems into which the building can be built. This means that you need to look at the specific site and its characteristics, you cannot simply apply a list and tick boxes which occurred with sustainable thinking(Haggard, n.d;1).

An understanding of the site and its inherent characteristics are crucial to regenerative thinking. Looking at the Hartbeespoort Dam and viewing the water as a broken system that needs to be regenerated can only happen with a full understanding.

We have to see ourselves as being part of nature, part of a life system, that occurs on this earth in order for it to function. Life is made up of many reciprocal relationships, meaning there exists continuous exchanges between two or more living organisms which are beneficial to both parties involved (Mang, et al, 2012: 9).

As already stated the site has been majorly affected by humans, this is due to our previous paradigm of degeneration. Moving to think of sustainability will not help the Hartbeespoort dam as it has become so unbalanced that it will not be able to restore itself. Regenerative theories need to be applied in order to rehabilitate the site.

Life is constantly evolving, changing and is never in a static state. Reed (2007: 2)defines restoration as a system that can progressively self-organise and evolve. In a similar way we need to change the past paradigm of infrastructure, as not just fulfilling a single function, but a regenerative infrastructure that fills many different functions and shifts and changes over time according to different needs.

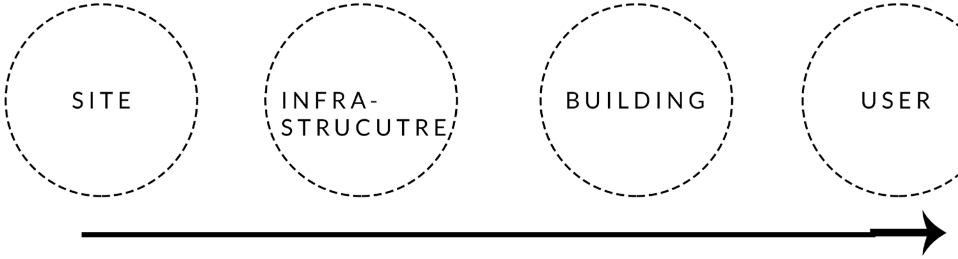


Fig 4.3 Linear diagram (Author, 2016).

This diagram shows a linear flow of materials from site to user. This is often the case for the built environment and destroys the landscape on which is depends. This diagram was called a 'one-way-linear-flow' by Lyle which he highlights as a degenerative system. This depletion of resources due to one way flow of energy will lead to the system eventually collapsing as nothing is replacing materials and energy (Mang, et al, 2012: 7).

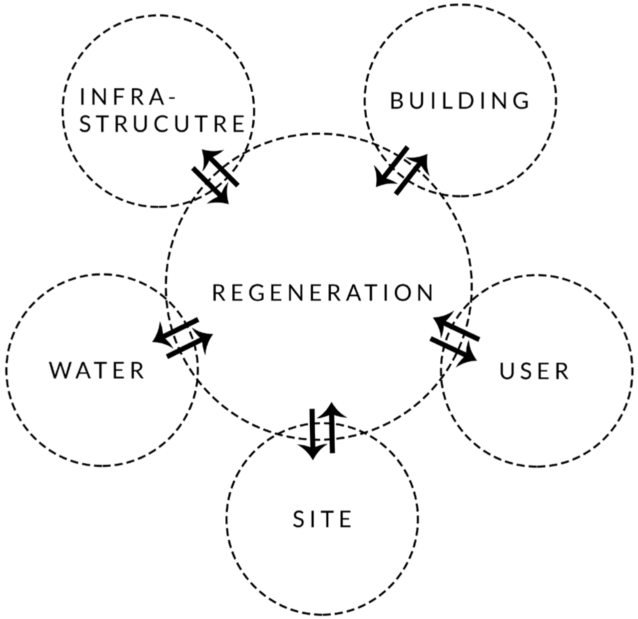


Fig 4.4 regenerative diagram (Author, 2016).

This shows the restructuring of material flows in a regenerative design. This regenerates the site and surrounding areas and adds resilience to the buildings ability to function (Mang, et al, 2012: 7).

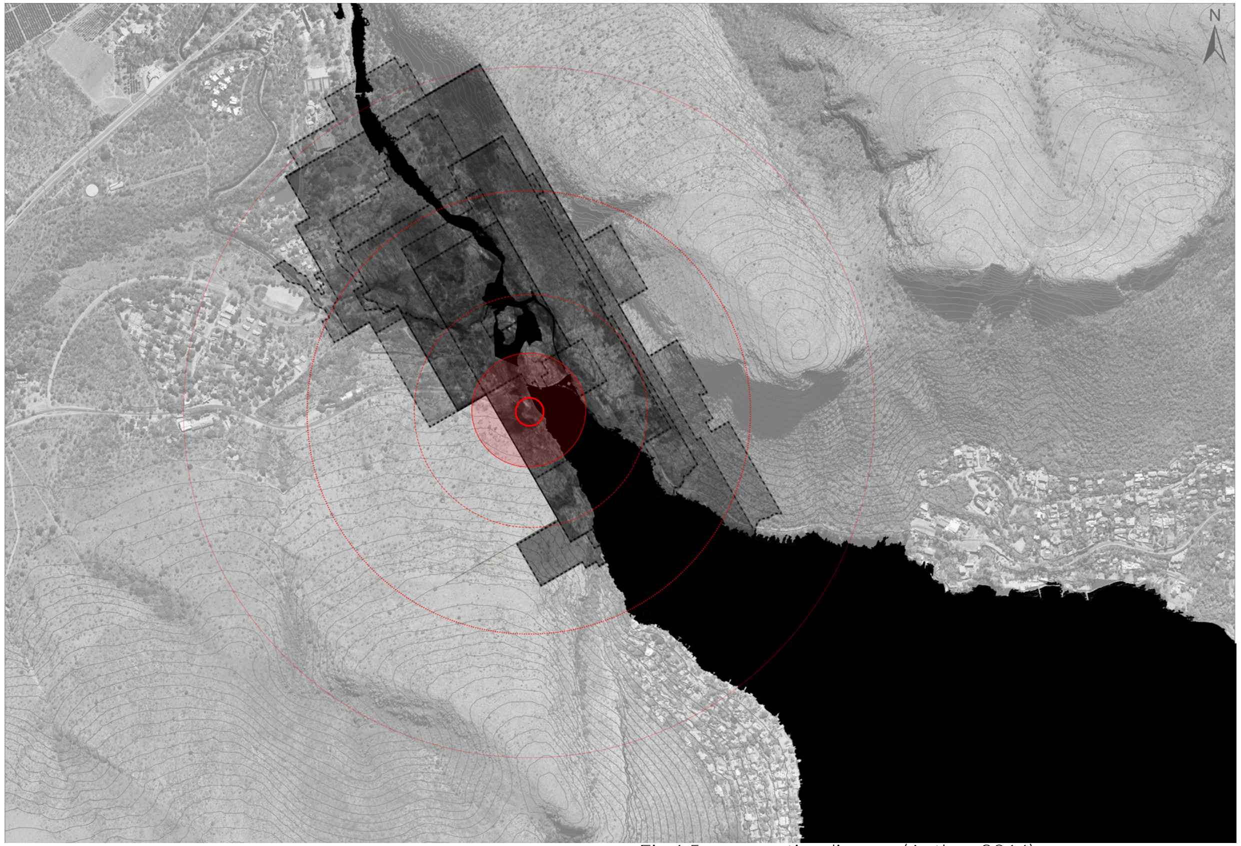


Fig 4.5 regenerative diagram (Author, 2016).

This diagram shows the positive effect on the scarred landscape that this new infrastructure can create. Over time it could regenerate more and more of the site as the system comes more effective. Changing people's perceptions, which is the intent of this building, will reach a much larger area and be able regenerate other sites.

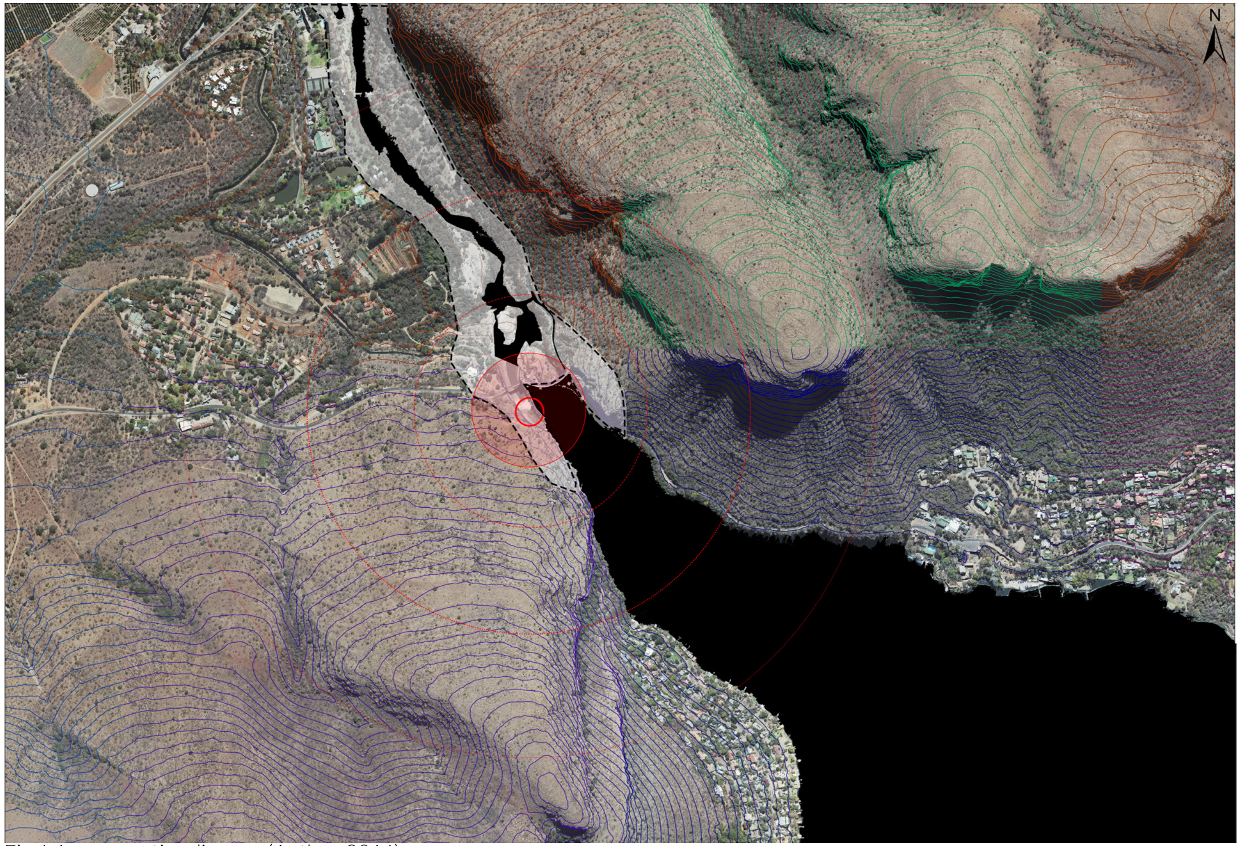


Fig 4.6 regenerative diagram (Author, 2016).

By changing the state of the water back to a balanced system and the shorelines as well as the agricultural land that the water irrigates, will also be regenerated.

This makes it a prime location to intervene as it will create the most effect possible. The public remediation program at this point will hopefully lead to many of the other solutions, that have been set up by the Department of Water Affairs, to become more public oriented. Many people are unaware of the problems that present at Hartbeespoort Dam and are therefore ignorant to the change that needs to take place.

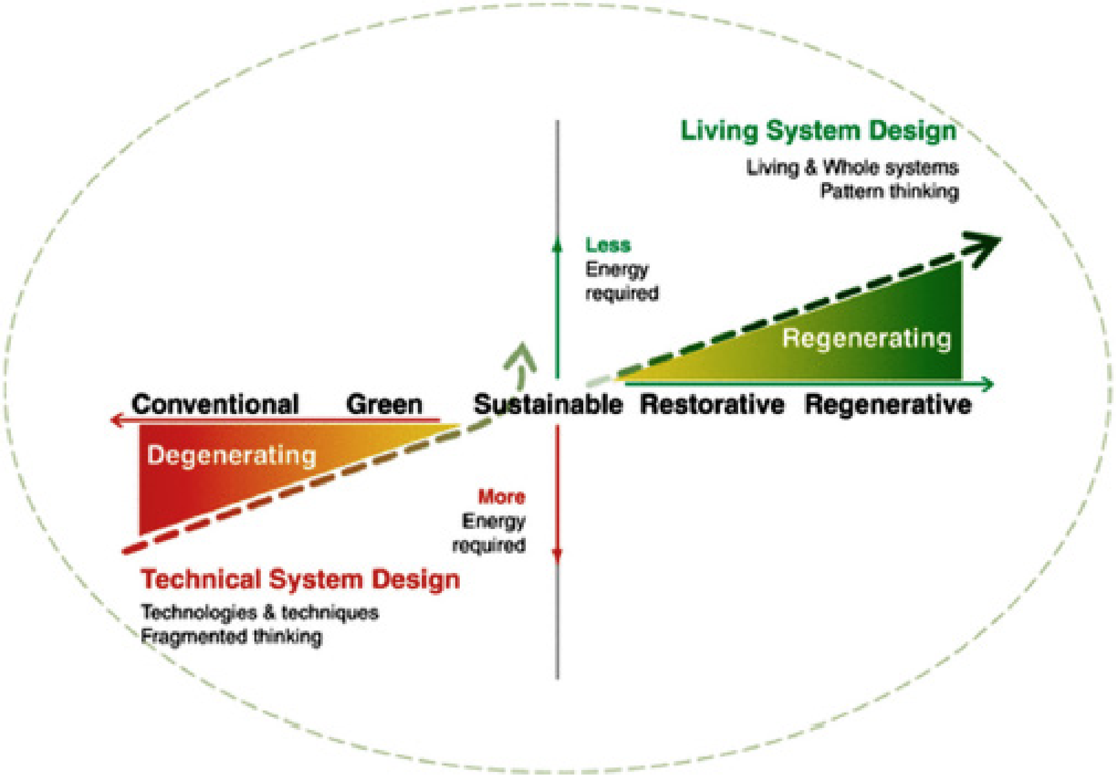


Figure 4.7 the shows the rehabilitation that a site can undergo through moving from anthropogenic idea of degeneration to biocentric thinking of regenerative theories. Framework for sustainability, contrast of technical system design and living system design (Mang et al, 2012: 10)

4.3 Design applications

This dissertation uses regenerative theories as a departure point for the design. The architectural intervention will be tested against Steven Moore's eight points for regenerative regionalism. He contextualises these eight points in a non-modern regionalism refuting modernity and post-modernity. The eight points have been ordered in importance (Canizaro, 2007:433-442).

- Rather than constructing objects, the architect must construct integrated cultural and ecological processes to create social activity (Canizaro, 2007:433-442).
- A regenerative architect must concern one's self with the production of a mutual agreement that ties humans to the ecological condition of the place (Canizaro, 2007:433-442).
- The reproduction of life-enhancing practices is preferable over aesthetic (Canizaro, 2007:433-442).
- Regenerative architects must create regenerative technology that must look at engaging humans and objects that inhabit space (Canizaro, 2007:433-442).
- A critical place can become regenerative only through the production and reproduction of democratic, life-enhancing practices (Canizaro, 2007:433-442).
- The architecture must be understood and appreciated by the local community and secondly the building must be relevant to everyday life of this community (Canizaro, 2007:433-442).
- Regenerative architects should resist following optimisation of building comfort and rather look to go beyond this. Secondly architects should use technology that reveals itself to local labour to increase knowledge (Canizaro, 2007:433-442).
- A regenerative architect will enable citizens in the decision-making about the technology that enables everyday life (Canizaro, 2007:433-442)

These points gave clues to program as well as design intentions. Specifically looking at how to integrate ecological processes into social activities, a good example being the vermiculture activity on site and how to integrate the user.

This would then tie humans to the ecological conditions of place. The program tries to do this by creating direct relationships between the systems and the typical spaces used by the visitor, such as the restaurant where visible processes will produce a direct appreciation of the "food chain". If it is functioning correctly the restaurant will have tastier and healthier food.

So rather than creating a beautiful object in the landscape it is more important to construct systems that have a direct influence on the user of the space.

These points also bring up the fact that the architecture and technology used in this building must be legible and understood by the local community. Representing these exchanges between the site, user and the infrastructure are crucial in order to do this.

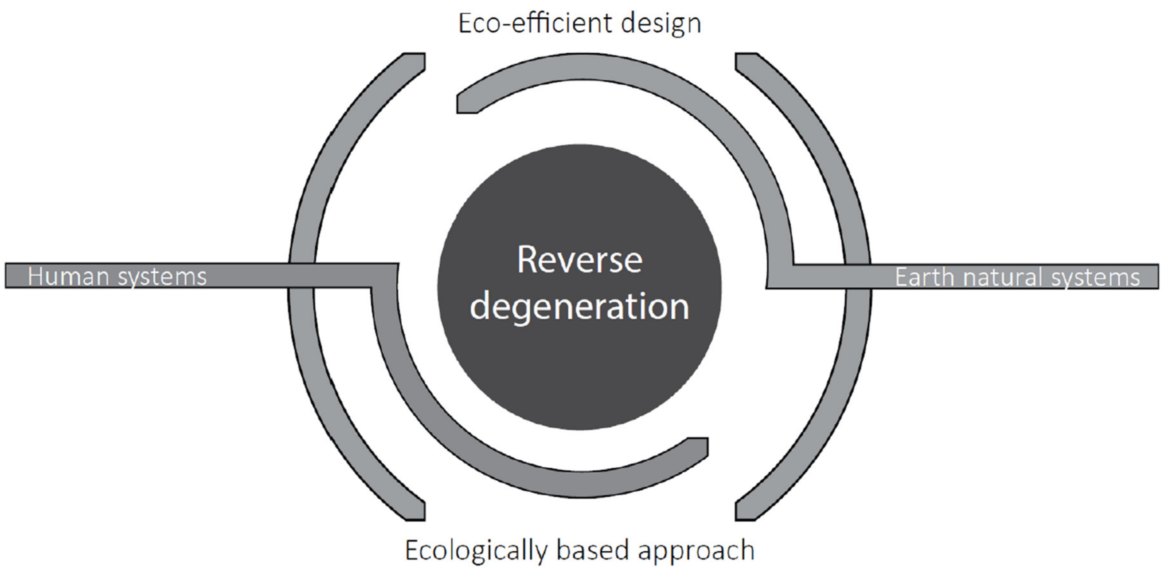


Fig 4.8 framework for reverse degeneration (Boonzaaier, 2015: 48)

4.4 Learning from nature

There are three main categories that we can learn from nature and which can be utilised in regenerative architecture.

Everything we need to design with has already been designed by nature through evolution. All materials have already been created that we can simply employ. Natural materials have no life span as they can constantly be recycled and recreated, contradictory to our belief of waste. This is especially important in the built environment; looking at how our materials can be re-utilised or purposefully decay to become food for another system. (Nesbitt, 1996: 401-402).

Secondly nature is the constant flow of energy from one system to the next. This energy is never destroyed or recreated; it simply moves from one form to the next. Nature is an extraordinary complex and effective system for creating and cycling of nutrients. The important thing is to see how we as humans fit into this flow of energy; if we are disrupting it or allowing it to continue. (Nesbitt, 1996: 401-402).

Lastly and most importantly is biodiversity. This allows living systems to continue rather than spiral out of balance. The extremely intricate and symbiotic relations between millions of organisms, no two of which are alike, allow this to happen. (Nesbitt, 1996: 401-402).

Through the design investigation these three points need to be taken into consideration as informants. From the building, to details, to the system that it contains, all need to employ the concept of waste equals food, energy flow, and protection of biodiversity in the design (Nesbitt, 1996: 401-402).

The systems that are implemented on site need to increase biodiversity and create complex and interwoven systems that become resilient over time in a similar way that nature does. Materials proposed on site need to be sourced from site and thought of what they can be used for afterwards.

4.5 Waste to energy

Regenerative theories remove the idea of waste; waste becomes a product for a second system, the input to gain another output. This gives value to waste products.

These products can be broken down into three main categories:

Firstly consumable products, this includes food, paper, tin and plastic etc. These are all materials that can be broken down and reused relatively easily, either on-site or at a recycling plant.

The second kind is service products; these are items such as cars and televisions, tables and chairs. This kind of product should be sold with a license. This license and the product could be sold on to a second user. The implication is that the end user has to return the product with a license to the manufacturer. This allows proper disposal of products and cradle to cradle systems.

The last kind of product is called an unmarketable. These are products that cannot be recycled such as nuclear waste, dioxins, paint and batteries. These are products that have to be kept until we have figured out a way to dispose of them. These products should be kept to an absolute minimum where possible (Nesbitt, 1996: 403-404).

Looking through the lens of regenerative theories architecture does not consist of a building placed upon a site but rather architecture as site, systems, energy, flora and fauna etc.

The systems that are implemented into the site by learning through nature need to focus on being consumable waste. This means that the outputs of one system need to be the input to another and therefore linking them and integrating them into the site.

4.6 Heritage memory

According to the Burra Charter (1999: 1), "places of cultural significance enrich people's lives, often providing a deep and inspirational sense of connection to community and land-scape, to the past and to lived experiences." These places become "historical records" that act as tangible expressions of identity and experience. They tell us about who we are, and how our past informed us and the landscape we inhabit. The dam wall and the Arch built to celebrate it forms an integral part of the history of Infrastructure in South Africa , and the infrastructural methods at the Hartbeespoort Dam that existed informed not only the construction of the dam wall and its heritage, but also the processes that exist today, as well as the new ones of the future. Our infrastructural heritage is therefore a part of our cultural identity, and the places where infrastructure was built give us tangible experience of that identity. The term "cultural landscape" was coined by cultural geographer Carl O. Sauer in the 1920s (Foster, 1999; 5-10). The site at Hartbeespoort Dam can be viewed as a "cultural landscape": The construction of the dam wall and the Arch that commemorated it formed and altered what had been before, and the landscape in its current form depicts that phenomenon.

Article 5.1 (Burra Charter, 1999:4) indicates that the "conservation of a place should identify and take into account all aspects of cultural and natural significance without unwarranted emphasis on any one value at the expense of others." The site has cultural value, but it carries great natural value as well, bearing in mind the valuable water source and the existing natural systems which feed off from the water.

In the conservation of The Arch, two relevant methods have been identified. Firstly, preservation, "where the existing fabric or its condition constitutes evidence of cultural significance" (Burra Charter, Article 17, 1999:7). Secondly, new work, where "new functions will be brought to the site, with the assurance that it does not distort or obscure the cultural significance of the place, or detract from its interpretation and appreciation" (Burn Charter, Article 22.1, 1999:7). The Burra Charter highlight the issue that any new additions such be identifiable as such and read differently to the existing condition (Burra Charter, Article 22.2, 1999:7). Another tool that the Charter grants in the approach to intervention is that of interpretation (Burra. Charter, Article 25, 1999:8), as the cultural significance of the Arch is not readily apparent, and should therefore be explained by interpretation. This needs to "enhance understanding and enjoyment, and be culturally appropriate."

Fig 4.9.1 Victory Arch (Author, 2016).

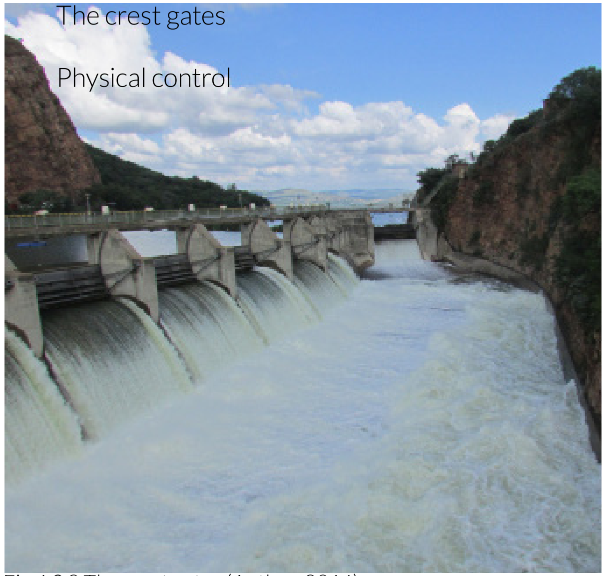


Fig 4.9.2 The crest gates (Author, 2016).

4.7 The New Celebration

Rather than removing the Arch and losing the memory of the past it will be retained as it datum point for the new monument. This will allow the user to gain an understanding of where we come from and where we need to go.

The arch also stood as a monument against white poverty. This is no longer the case as the water is now ineffective to use on agriculture. By creating a new monument the water quality would improve and this monument could stand once more against all poverty in a new South Africa. It is also a monument to those who fought in the war and this needs to be retained on site.

The arches form stood as a gateway to many cities. This feature of the form can still be utilized as it is creating a new gateway to this regenerative infrastructure which will become the new monument.

The form of the new monument could create a journey leading towards the arch in order for it to be seen in a new light. This means the new monument should not over power the Arch but rather emphasis it. The size of the building needs to be kept within the scale of the arch. There is the possibility of using its classical ordering form in the new celebration of water, in this way relating the new form to its historical context.

There is a need for a new celebration of water heritage, where man is seen as part of nature and is reliant on water. This new celebration must change the meaning of the arch and show that a paradigm shift has occurred. A palimpsest of monuments showing the changing way we view our natural resource, water.

The crest gates speak of an industrial heritage as they were designed with only one intention: to increase the dam's volume. They are a purely infrastructural element on site. This project aims to challenge the idea of industrial heritage and it's singular function by creating more roles that it can play in this new celebration of water. The building will attach itself to the infrastructure in a parasitic approach in order to regenerate the surrounding site.

The intervention will also celebrate the centenary of the heritage by overlaying a new layer depicting that new paradigm over the old, with the new layer still enabling celebration of the heritage. The idea is to celebrate the heritage by overlaying the paradigm shift and create dialogue between old and new through exchanges.

Fig 4.10 the Arch at Hartbeespoort dam with new ideas of celebration of water (Author, May 2016).

4.8 Regenerative Precedent

Project title: Borderline mediated landscape

Designer: OTH Architecten

Location: Amsterdam, The Netherlands

Year: 2007

This building sits on top of the former concrete crane-way of a ship yard, a forgotten relic of Amsterdam's shipping industry that was built in 1952. The new office block regenerates the site by adding offices to the structure that sits over the previous infrastructure (archdaily, 2008).

This lightweight steel structure supports three levels of offices and then is clad with a light glazing panel. The stereotomic concrete structure that existed as the shipyard is used as a sub structure to the building and anchors itself in the site, yet the new structure floats above it separating itself from it. Thus emphasising its historical value and making a clear distinction between new and old (archdaily, 2008).

The new building makes use of the existing structure for additional storage space and fire escapes. The existing stair way has now become the new entrance into the building with an additional lift.

The facade is made up of lightweight glazing panels with transparent double skinned glass. This allows natural light into the building but there is solar control of this by adaptive motorised louvres that shield the building in summer. In between the cavity of the glass passive ventilation is allowed and also acts as a buffer between the cold in winter and the heat in summer (archdaily, 2008).

This project is a good example of regenerative thinking as it successfully preserves an industrial heritage artefact and adds significant value by creating a new sustainable office block. The building is also a good example of a heritage response and can be utilised as a precedent for this dissertation. There are many similarities between this project and the intents of this dissertation, specifically looking at the relationship between the infrastructural historical bases and placing a new regenerative lighter structure that floats upon it.

This project also highlights the new intervention compared to the existing infrastructure extremely well. It does this through material choice as well as detailing. Figure 4.15 shows how a walkway is set slightly off the infrastructure ,the floor material is metal grating which is transparent and lets you see down to the water below. Doors are set back into the infrastructure showing their secondary nature. These are all techniques that could be used in this dissertation. The material pallet would also be appropriate in certain spaces.

Fig 4.11 Finished Kraanspoor building (Archdaily, 2008).

Fig 4.12 Historical Kraanspoor infrastructure (Archdaily, 2008).

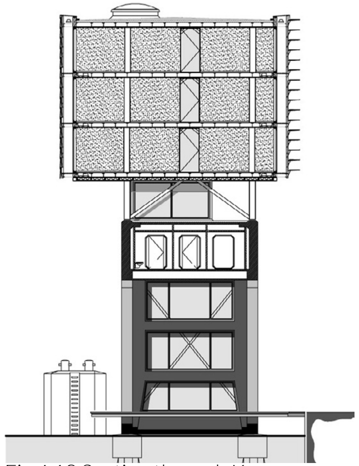


Fig 4.13 Section through Kraanspoor building (Archdaily, 2008). 2008.

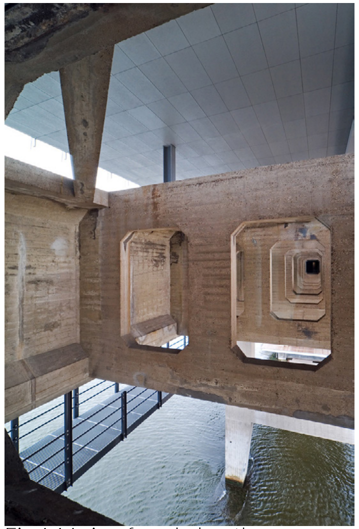


Fig 4.14 view from below the Kraanspoor building (Archdaily, 2008).

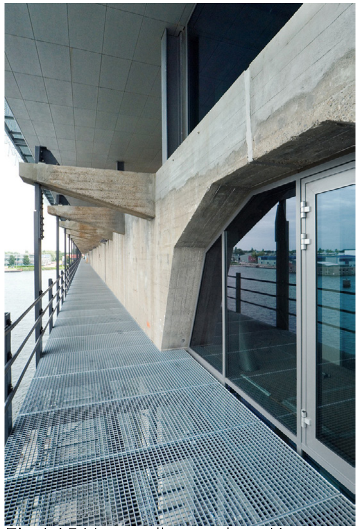


Fig 4.15 New walk way along Kraanspoor building (Archdaily, 2008).

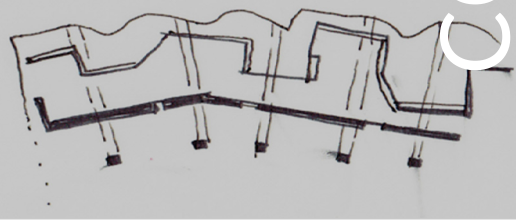
Fig 4.16 New stairway up Kraanspoor building (Archdaily, 2008).

Fig 4.17 Double glazing panels with louvres of Kraanspoor building (Archdaily, 2008).

Fig 4.18 View from water of Kraanspoor building sitting lightly above existing historical structure. archdaily. 2008.

Chapter 5:
Series of exchanges

CONCEPT



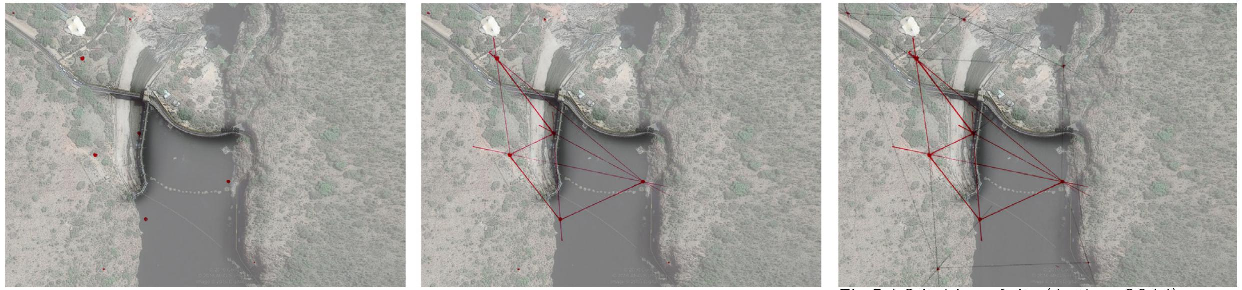


Fig 5.1 Stitching of site (Author, 2016).

Albert Einstein stated that "Energy cannot be created or destroyed; it can only be changed from one form to another" (American Institute of Physics , 2004)

Humans have upset the balance of energy on site, specifically the dam's water, to a point where nature cannot correct itself to what it used to be. There is an over-abundance of nutrients or energy in the water because of what we have put into it and polluted it. We have removed energy from the natural landscape so far that shorelines have been diminished. The whole purpose of building the dam was to utilise the water to irrigate the crops but this water now damages the plants.

5.1 Summary of informants

Design informants can be broken down into five main categories with their own subcategories.

Historical

This is the main informant that deals with the paradigm of water and how we see ourselves as being above nature and not a part of it. The problems that this has caused are evident on site and have already been discussed. The most important point to challenge this paradigm is at infrastructural buildings, the space that deals with our natural resources the most.

Cultural

The next informant is how we have been disconnected from natural resources through the way that we have designed our infrastructure as a machine. This has led to us furthering this paradigm and creating a bigger disconnection between us and the natural world.

Theoretical

Regenerative theories gives us clues of how to align ourselves with natural processes in order to seek the self-healing attributes of natural systems and therefore start to heal our broken site.

Social

We have designed infrastructural buildings to have limited access to the public and therefore we are deluded about what we are doing to our natural resources and that this has repercussions. The most important way of combating this is to gain knowledge and for it to impact our daily lives.

Economical

The existing activities on site have real economic potential if managed correctly. Security and interaction with public are key.

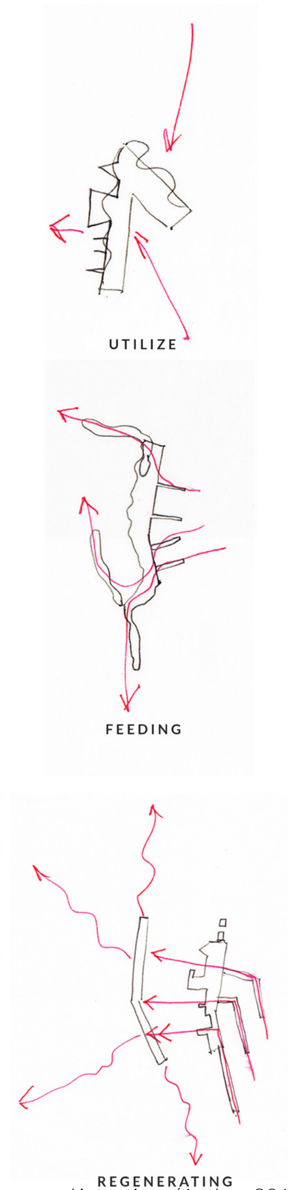
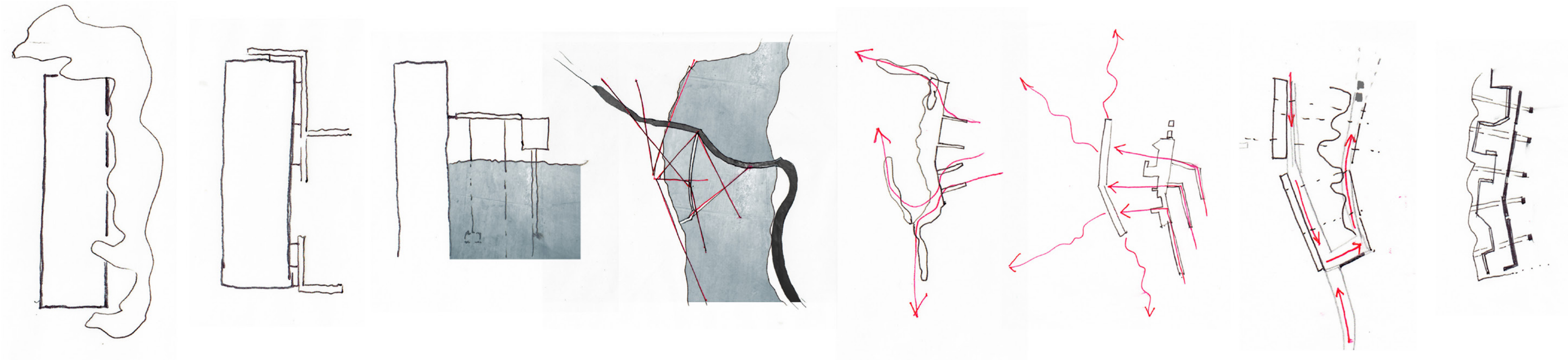


Fig 5.2 Site diagram and intentions (Author, 2016).

5.2 Infrastructure as a machine

Infrastructure is designed with a specific function to perform, it is very deliberate in what role it plays in society, it is a machine. A machine has inputs and outputs and waste that are created through this process. The system works in isolation and does not interact normally with other systems, meaning that this waste has to be removed and the system has to be maintained. If something was to disturb the system it would eventually break down, if it was not corrected, which makes it vulnerable.

If we look at natural systems this is not the case, they can withstand many disturbances and assimilate waste. This is resilience. If you look at a natural system there are no inputs and outputs; there is a simple flow of energy from one smaller system into the next into a larger one which enables the system to continue working without maintenance. This flow of energy could be seen as a series of exchanges which happen in a natural system. As the energy moves it changes form and the type of energy but it is never lost or destroyed (Nesbitt, 1996: 401-402).



PARASITIC
Viewing the site as containing potential energy that could be withdrawn by systems

ATTACHING
Attaching to the existing infrastructure as a base in order to build a new infrastructure upon it

UTILIZE
Utilising what already exists on site in order to create the new intervention

CONNECTING
Connecting multiple systems on site in order to create synergies between them

FEEDING
Using these energies to feed the building and its systems in order for it to function

REGENERATING
Using the buildings to regenerate the scarred landscape that has been created by the dam

ACCENTUATING
Accentuating the existing infrastructure and the historical arch and what it has created

STITCHING CONDITIONS
Stitching the site conditions back together such as the controlled water and released water on site

Fig 5.3 Site Intentions (Author, 2016).

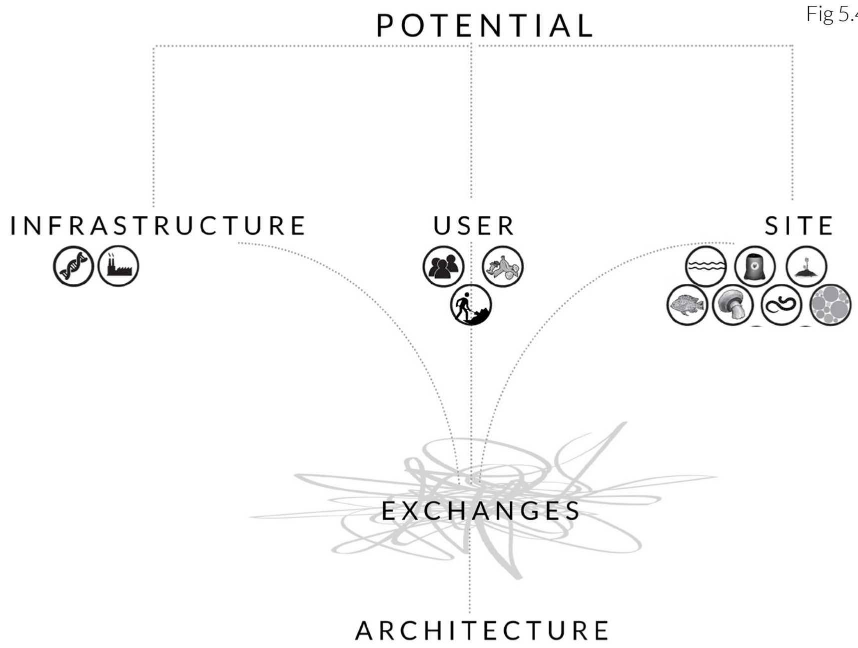


Fig 5.4 Role players diagram (Author, 2016).

5.3 Intentions

This dissertation will attempt to look at infrastructure in three ways:

-To celebrate our water heritage and its importance.

-To redesign the single use spaces as multifunctional spaces.

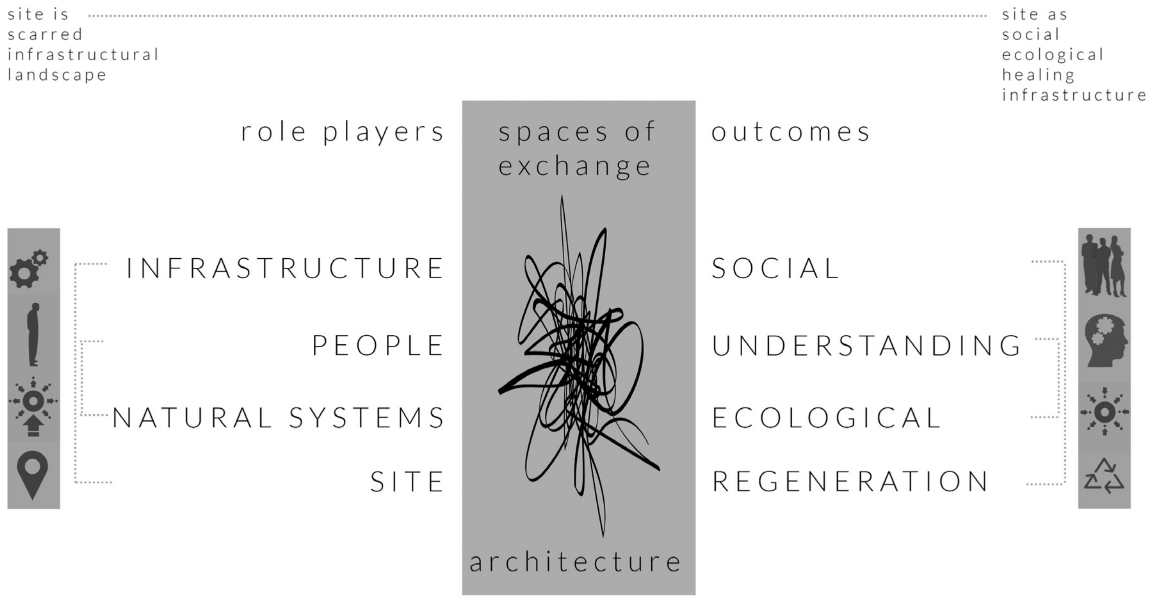
-To re-acquaint man and nature by adapting primarily inaccessible buildings, with secondary functions to be better publically connected.

This calls for a re-appropriation of infrastructure through an architectural interface that fulfils cultural, social and economic functions. This will create a positive recreational space that celebrates water and its part in our heritage, reminding us of its importance - a productive infrastructure that creates a better connection between man and nature that heals scarred landscapes.

If humans are to continue their existence on earth we need to become more resilient. This means humans need to learn to coexist with natural and living systems. To do this we need to align human activities with natural processes in order to continue it positively to the functioning and evolving of ecosystems. This will allow us to utilise the self-healing capacity of nature to rehabilitate the earth.

The best places to implement these changes are on existing infrastructure. The structures already contain embodied energy in the materials they are constructed from, as well as the energy used to construct them. This makes it a cost effective and sustainable development strategy that continues the uses of our historical infrastructural buildings.

Fig 5.5 Series of exchanges (Author, 2016).



5.4 Concept

All the informants and intents have resulted in a holistic concept through which the site is viewed as containing potential energy that needs to be released. This can only be released through understanding and utilising these energies, by means of exchanges. By understanding we can see how we affect this delicate system. These exchanges range from intangible to tangible exchanges. From the sun hitting the solar panels and creating electricity, to the hyacinth being decomposed through vermiculture into compost. The architecture needs to facilitate exchanges between the site, infrastructure and the user.

Definition of an exchange is a transaction between two entities each getting something in return.

To do this the architecture has to become the mediator between the different role players and the existing potential energy on site.

Four major role players have been identified on site; infrastructure, user, site and natural systems. Each of these role players contains a different kind of energy.

Infrastructure contains embodied energy in the structure and its form. It also has potential energy because of the function that it is performing by holding back the water and the ability to release this which would then be kinetic energy.

The site contains potential energy which is inbodied in the water and the landscape. This energy is also skewed in favour of the water on site.

The user brings energy with them, in their ability to perform labour and the ability to change the way that they interact with this water which then brings knowledge or understanding back in to play.

Natural systems have potential energy that could be utilised to create equilibrium between the other role players.

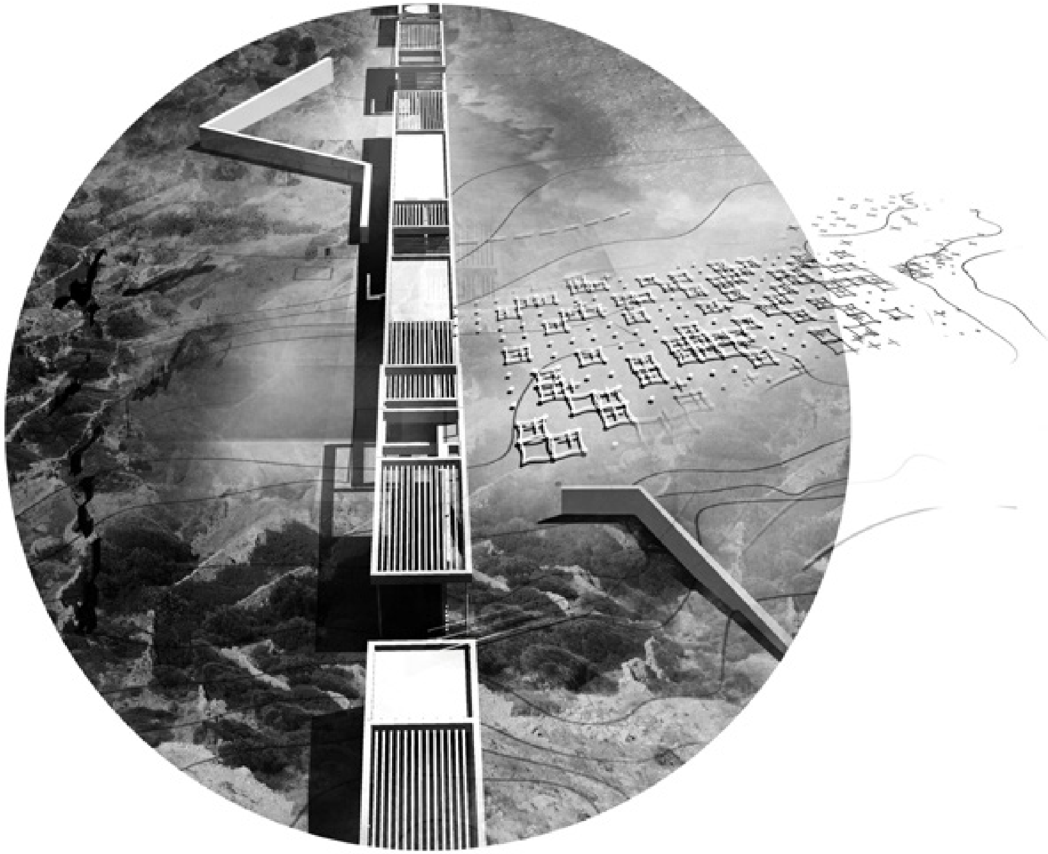


Fig 5.6 The image shows a building that creates a public space as well as being a dam wall, producing a better public connection to water through contact and sight (Alexandra Vougia, a et al., 2014).

Fig 5.6 System bridge (Alexandra Vougia, a et al., 2014).

The series of exchanges are hierarchal; the most important being that the site is regenerated and healed. The second is the distribution of knowledge or understanding to the user, of what is happening on site and how they take part in it. Lastly that infrastructure is fulfilling a multi-functional role rather than the singular use that it performed in the past.

The diagram in fig 5.6 shows the historical spine and the infrastructural memory elements and how a new productive element can be placed between them in order to regenerate the ecologies of the scarred landscape

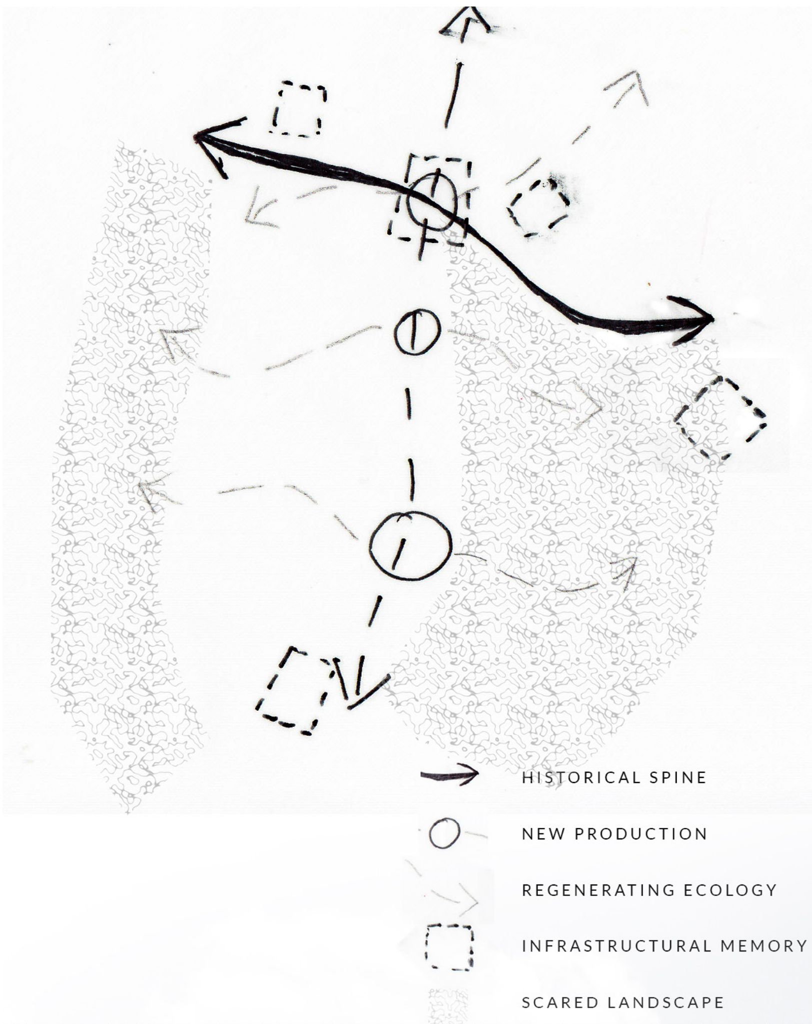


Fig 5.7 Conceptual Diagram (Author, 2016).

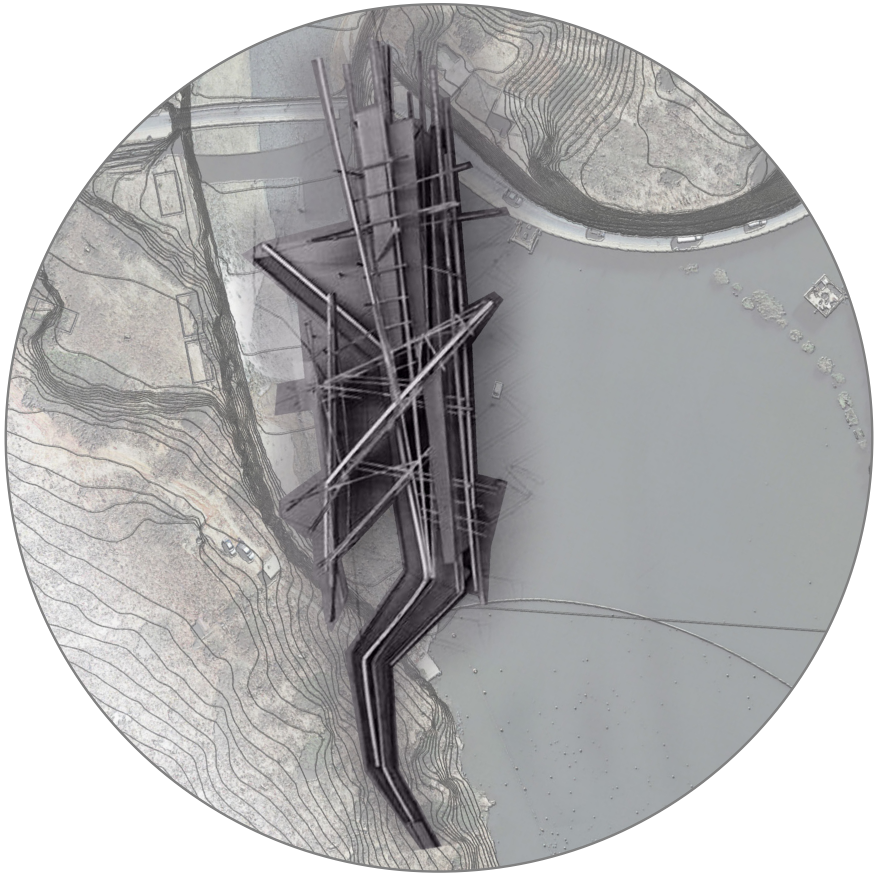


Fig 5.8 is a conceptual model that stretches across a water body, which feeds off it and gives back to the surrounding landscape.

The model aimed at creates a public space above the crest gates, producing a better public connection to water through contact and sight. (Author. April 2016).

Fig 5.8 Conceptual vision (Author, April 2016).

5.5 Exchanges Precedent

Project title: KMC corporate office

Designer: RMA architects

Location: Cyber city, Hyderabad, India

Year: 2012

This project aimed to bridge the gap between the poor working class and the well-off business men and women. In India there is a large gap between classes and very little interaction between different casts. This is a real problem as there is a segregation of the people. The way that this building does it is to create exchanges between the different classes as well as the skins of the building (archdaily, 2012).

The skin of the building is made up of plants to create a solar screen. These screens of plants have to be maintained which brings in the lower class labour force to perform this role. There is a small walkway in between the outer skin of the building and the inner layer where the labour force works and directly behind this is the cubicle and conference rooms of the office where the business men and women sit. This creates an exchange between these two people but yet it is limited to mostly visual (archdaily, 2012).

The way that the plants can grow on the skin of the building is that it has a custom cast aluminium trellis with hydroponic trays that contain the growing medium allowing various plant species. A similar system can be looked at for this project to filter out nutrients in the water to create potable water (archdaily, 2012).

This building creates exchanges between the two kinds of uses, the environment and the building. The screen is used to shade the building as well as bring the two users together. These exchanges are transparent and inform the user.

Fig 5.9 exchange of users (Archdaily, 2016).

Fig 5.10 Plant screen being maintained (Archdaily, 2016).

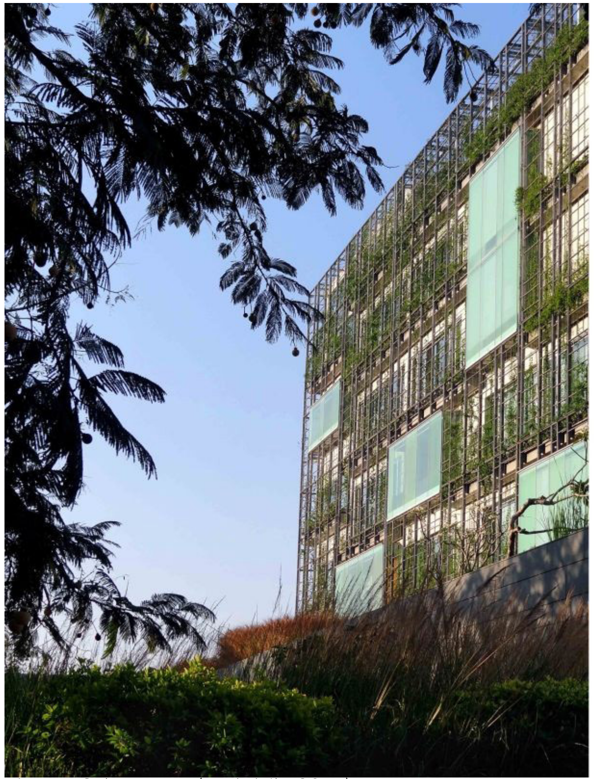


Fig 5.11 Solar screen (Archdaily, 2016).

Fig 5.12Plant screen being irrigated (Archdaily, 2016).

5.6 Form Precedent

Project title: Centre Georges Pompidou

Designer: Richard Roger and Renzo Piano

Location: Pairs, France

Year: 1977

The centre was constructed from 1969 to 1974 to fulfil a need as a cultural centre in Paris that would attract visitors to the city. The building is one of the best examples of high tech architecture. The building exposes the entire infrastructure on the outside of the building as if the skeleton of the body was reversed. It shows all the different mechanics and structural systems not only to maximise interior space but also to be understood by visitors. Each system is painted a different colour so that they can be distinguished for their different roles, such as plumbing pipes are painted green (archdaily, 2012).

One of the most well-known features about this building is the zigzagging escalator that runs up the side of the building, again staying true to that idea of internal free space and allowing circulation spaces on the outside of the building. Structure is exposed and revealed throughout the building so that visitors can understand the structure of the building (archdaily, 2012).

This dissertation does not necessarily need free interior space but the way that structure and systems are dealt with in this building is a good precedent. Similar principles could be used to express the different systems or exchanges in the building as they too are vital to be understood by the public so as gain knowledge.

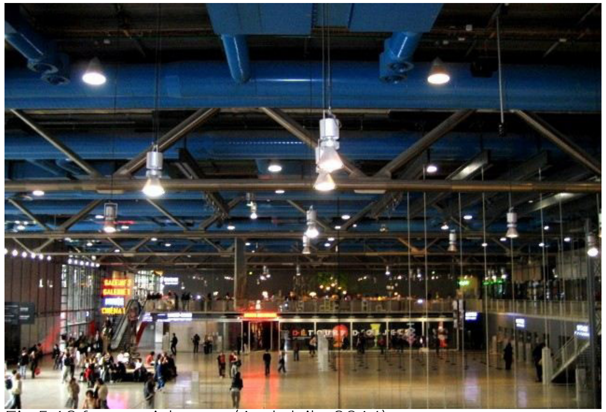


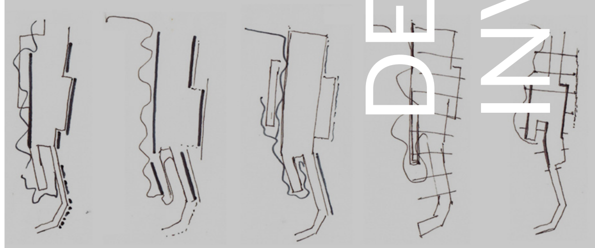
Fig 5.13 free social space (Archdaily, 2016).

Fig 5.14 expression of services (Archdaily, 2016).

Fig 5.15 Services and circulation of the facade of the building (Archdaily, 2016).

Chapter 6:
Creation of space

DESIGN INVESTIGATION



6.1 Intuitive models

The initial design strategy was to create intuitive models to explore the opportunities on site as well as look for different site choices. These models show a multitude of different site investigations such as creating a new bridge, working upon the dam wall and digging into the existing scarred landscape.

Both models, A and B, explored the site directly on the crest gates/infrastructure. They both looked at creating a journey from the proposed floating boardwalk across the infrastructure and terminating around the historical artefact of the arch. They look at different ways of connecting from the crest gates, across the spillway, to the scarred landscape. Both try to emphasise the new paradigm by wrapping the arch by the building. The models both terminate with a viewing platform looking back to nature.

Model A has structure that directly links back to the scarred landscape, with large arms that overhang the spillway. Compare to model B that the form actually twists to connect to the other side with a zigzag plan.

A

B

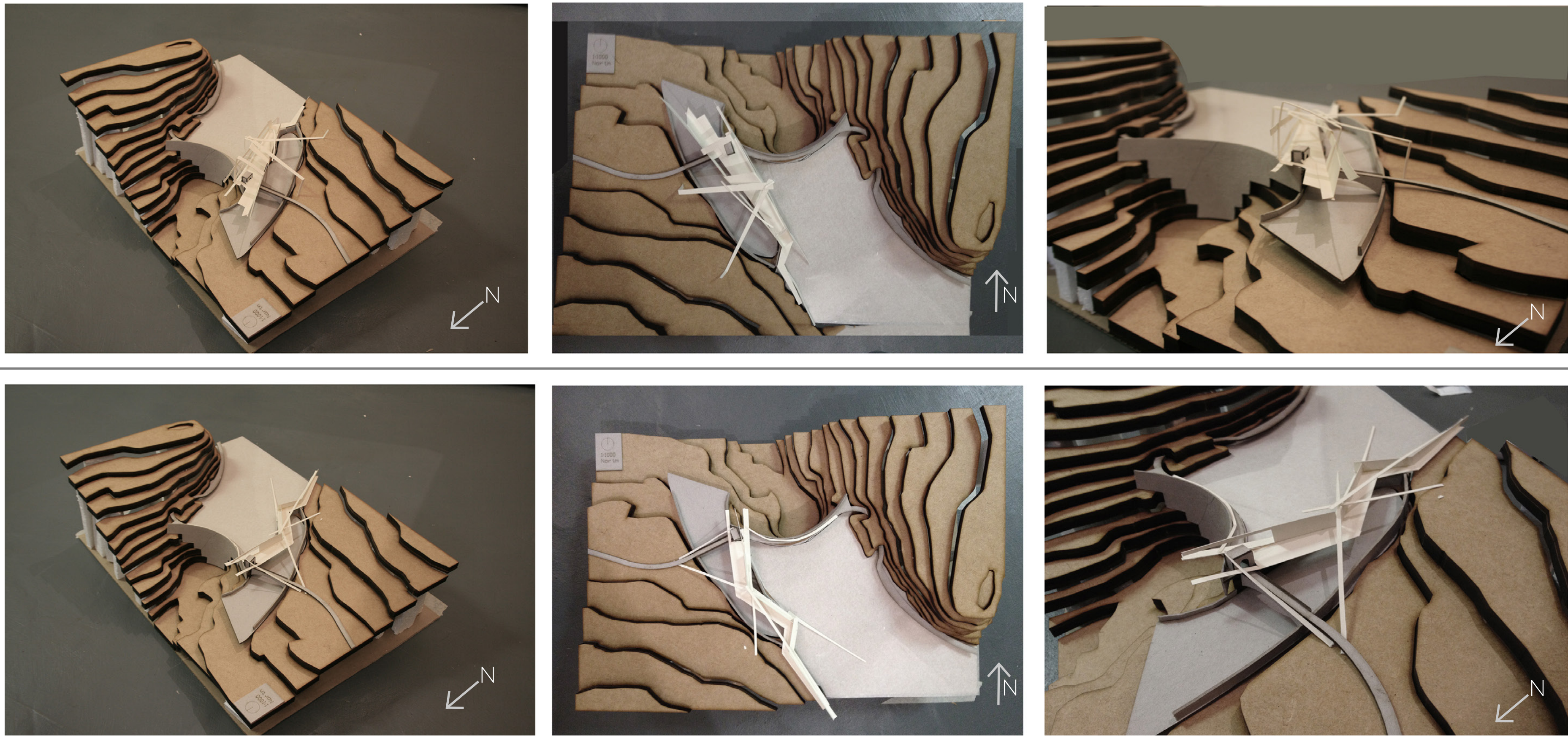


Fig 6.1 Intuitive models (Author, April 2016).

Model C made use of the existing scar and sunk the building into it in order to not disturb any more of the site. The idea of elevating the vermiculture process in order for it to be in public view was important. Creating a series of walls that lead you into the space thus revealing and concealing the dam and the site.

In model D the idea of creating an entirely new bridge was explored, that represented the new paradigm. The structure would be suspended from the two sides of the poort with ramps that connected with the infrastructure. Neither of these models dealt with the infrastructure enough which is one of the architectural problems set out for this dissertation.

C

D

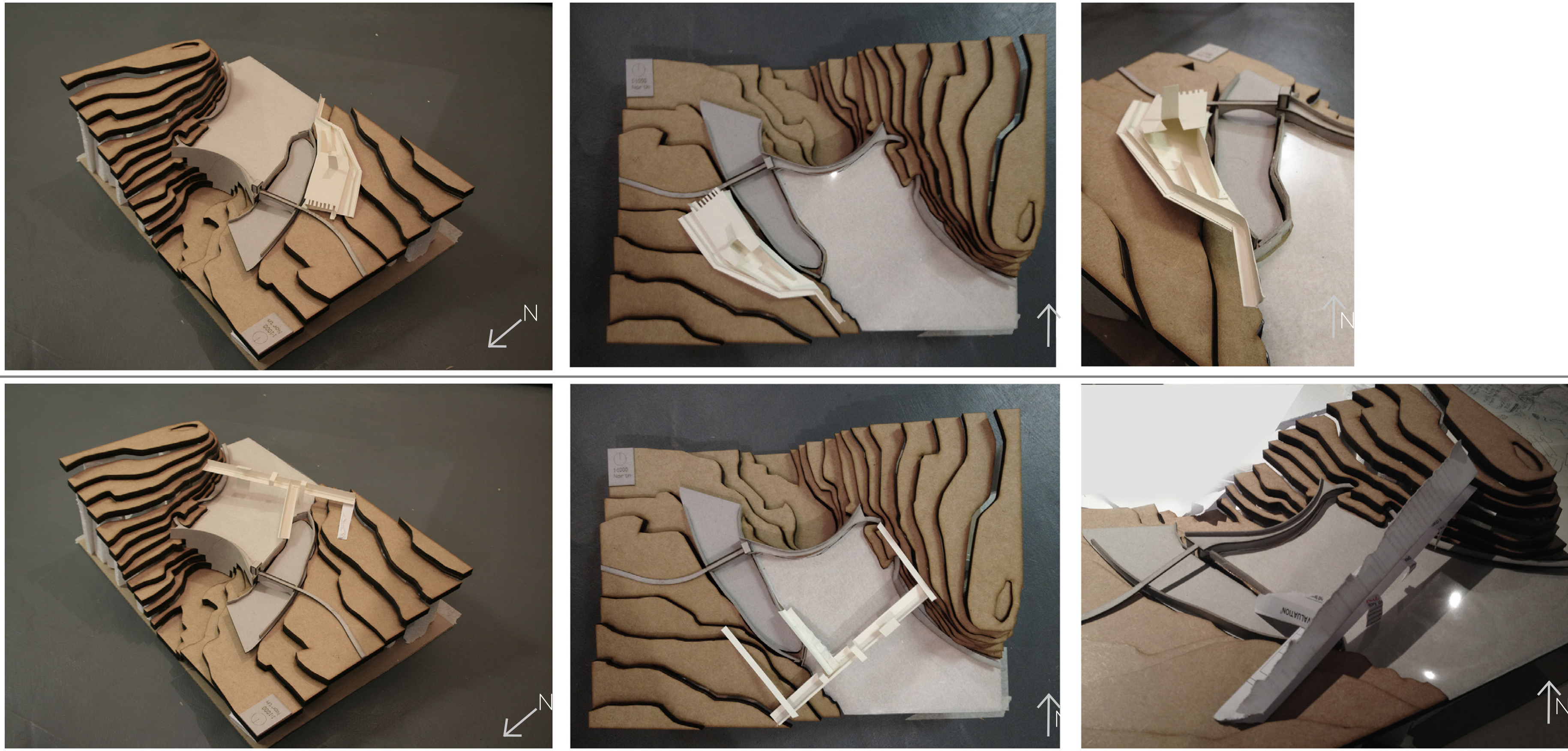


Fig 6.2 Intuitive models (Author, April 2016).

Model E was again situated on the crest gates but had arms that branched out into the dam, for the collection of the Hyacinth. It did not deal with the connection to the scarred landscape or the historical artefact of the arch.

Model F explored a variety of small interventions on site that could be linked together through a larger building on the infrastructure. This was to investigate a combination of all of the other models and explore the idea of synthesising them into one cohesive intervention.

E

F

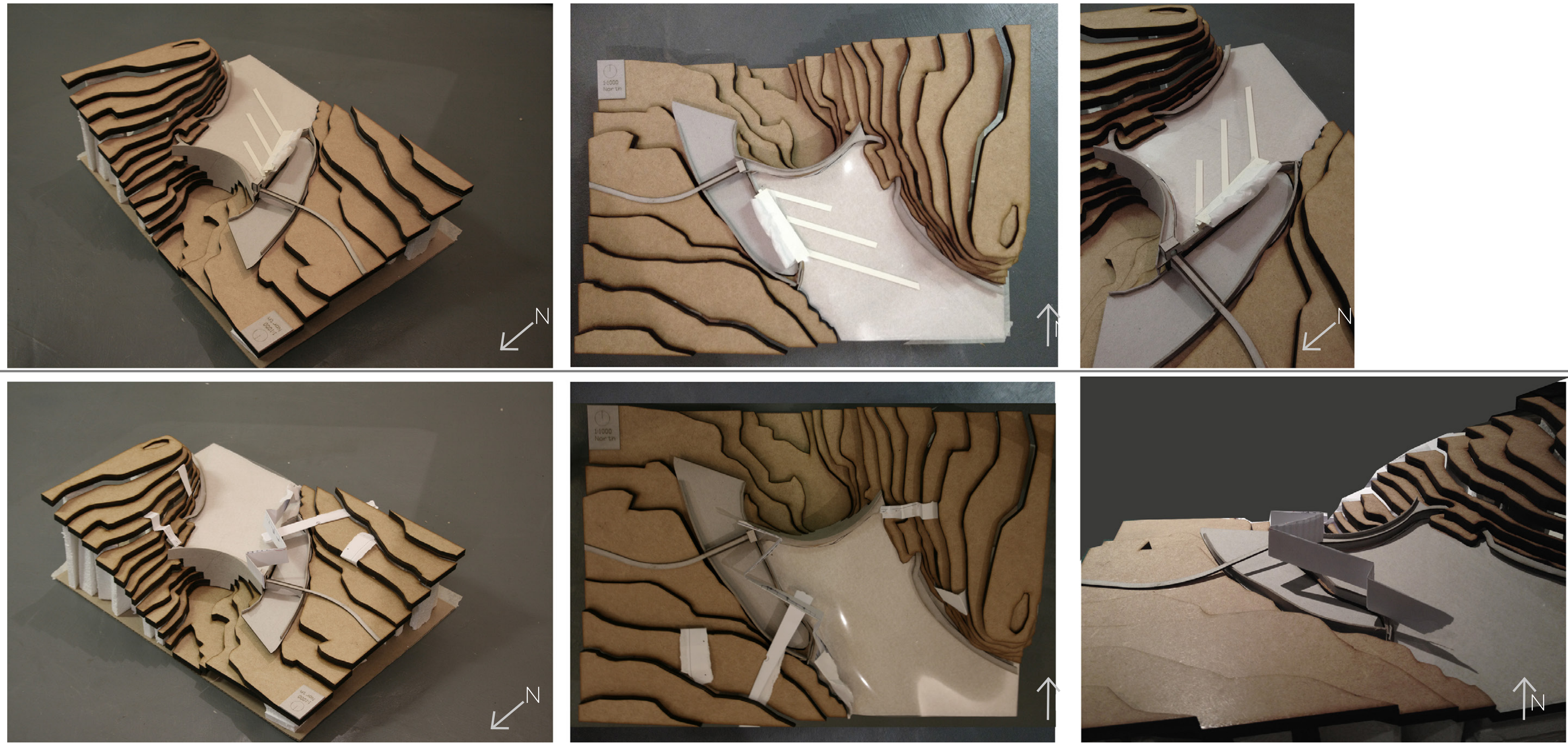
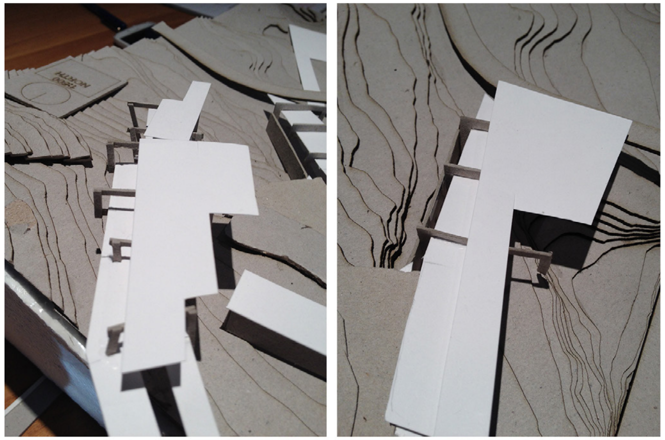


Fig 6.3 Intuitive models (Author, April 2016).

These models were used to explore the roof plan and structure, how at certain times it could be revealed and at other times be concealed underneath the roof. This then became an expression of how there was control of water on one side and the release of water on the other side of the building.

G



H

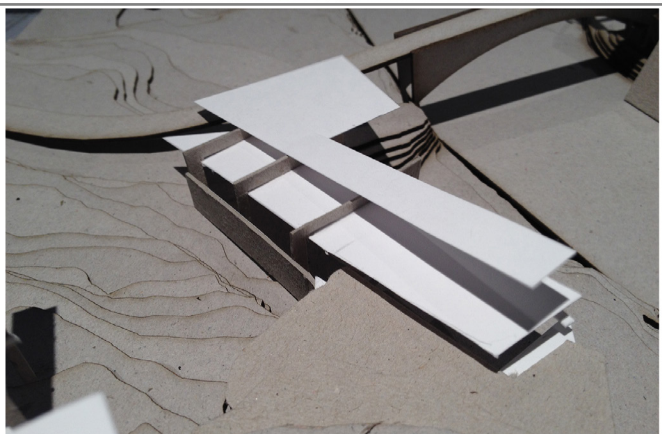
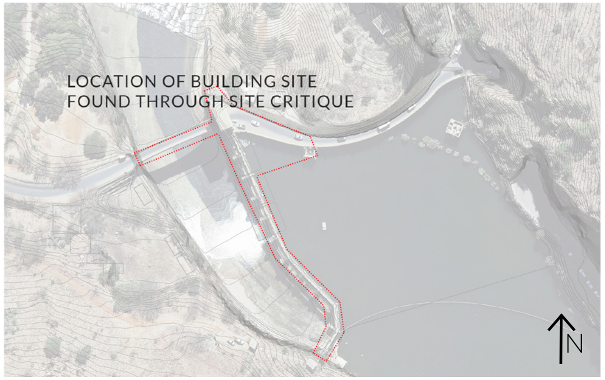


Fig 6.4 Intuitive models (Author, April 2016).

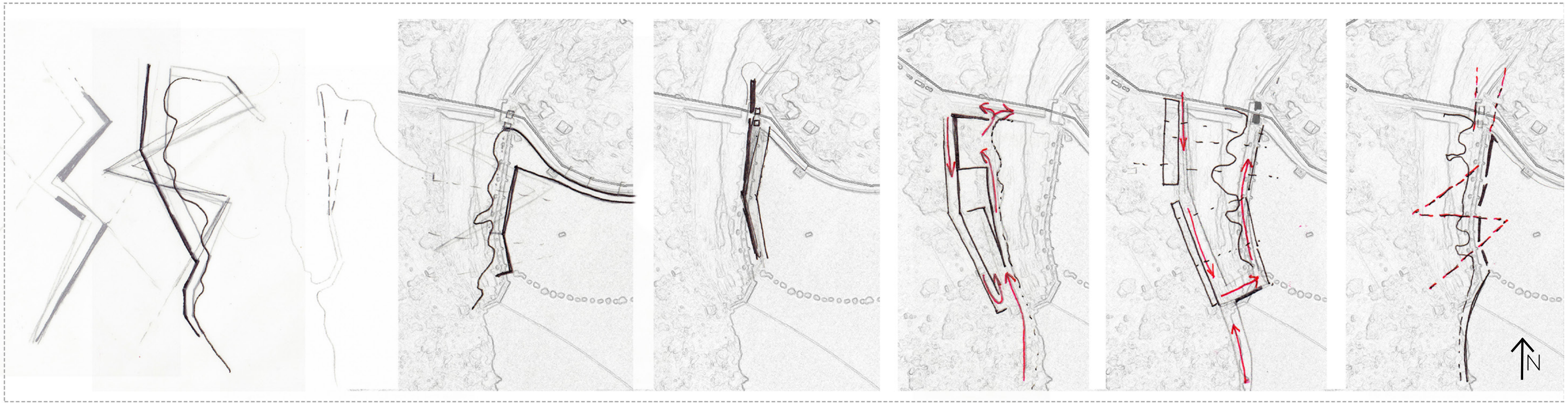
Throughout this investigation two opposing ideas were explored. One was to create a building that reads as the same language as the existing infrastructure; a building that has always been there. The second was to create a new building that contradicts the existing language of the infrastructure.

Remnants of each one of these intentions or design drivers are actually evident in the final design. The final intervention became a combination of many of these models and became a more synthesised design.



6.2 CULTURAL INFORMANTS

The Cultural informants looked at how a viewer would move through the site and experience the architectural memory versus the infrastructural memory. Creating a better celebration of our water heritage by connecting man and water through highlighting the gateways that exist on this site, this will lead to experiencing the water in different ways. The diagrams focus on a new monument to water which celebrates how we are reliant upon water rather than in control of it as the Arch does.

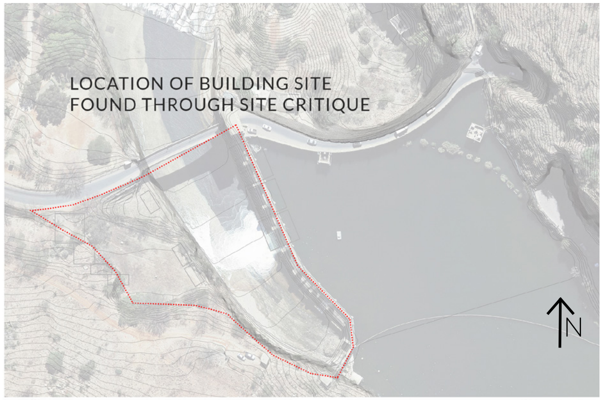


These diagrams show important views from different places on the site that could possibly be highlighted, such as the victory Arch and scarred areas in the landscape.

These diagrams look at how the new monument should interact with existing architectural memory of the victory Arch. Highlighting it through framing views, moving underneath it or over it, or even covering it and giving it a new meaning

These diagrams explore different movement routes through the site to experience it in different ways such as moving from the man-made architectural memory to infrastructural to nature.

Fig 6.5 Cultural informants for concept crit (Author, May 2016).



6.3 ECOLOGICAL INFORMANTS

From the ecological informants these diagrams focus on the exchanges that could be created between the latent potential contained within the water and the landscape. How this pollution could be extracted and utilised to rejuvenate the site. The systems look at integrating humans into natural systems that are regenerative to its surroundings. Through this connection and understanding creating a better awareness of the importance of our natural resource water.

The diagram shows the experience of the viewer understanding the context and the problems on the site and how are they are trying to be solved.

These diagrams show a building that can collect energy from the water and released it to the surrounding areas to rejuvenate the scarred landscape that the dam has created.

The building reflects the contrast in conditions that occur on either side of the crest gate; A control over the water body versus the release of its power.

Fig 6.6 Ecological informants for concept crit (Author, May 2016).

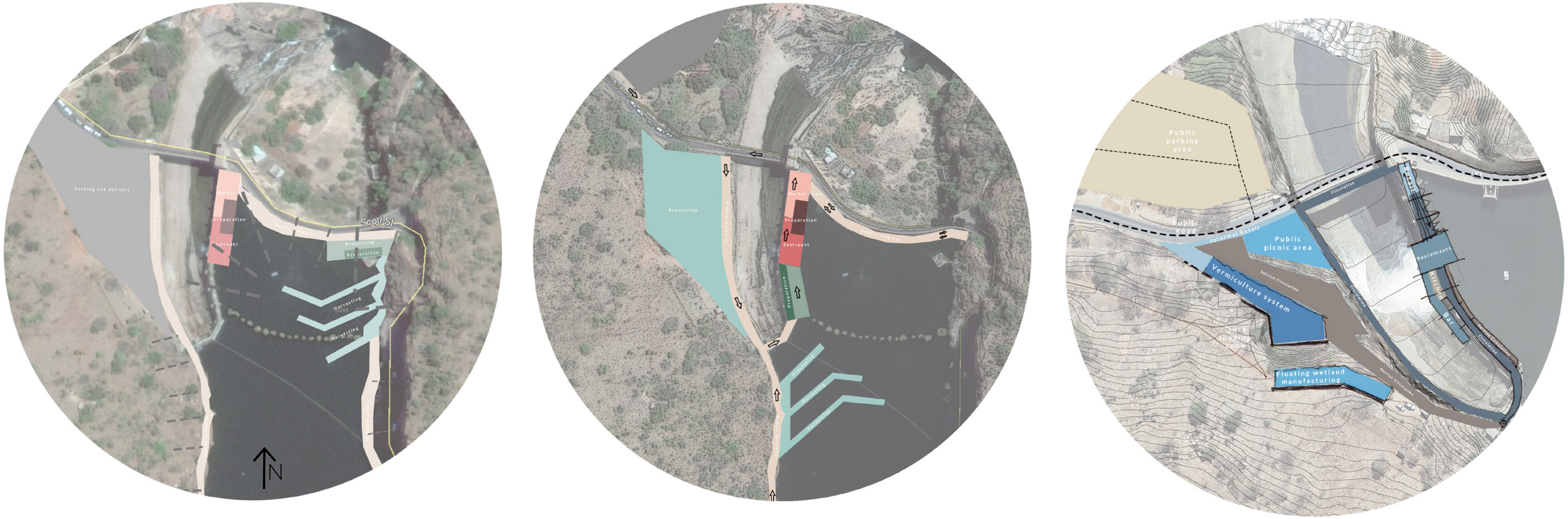


Fig 6.7 Site plan development (Author, March to April 2016).

6.4 PROGRAM LAYOUT DEVELOPMENT

There were three major site plans that changed through the initial stages of the project.

The first one looked at creating walkways in front of the dam wall that could collect the hyacinth with the main public spaces attached to the dam wall and sitting upon the crest gate infrastructure. This caused a problem as the hyacinth naturally built up on the left hand side where crest gates were situated.

The second plan looked at creating collection walkways in front of the crest gate as this was the existing area where hyacinth was collected. The public restaurant space was intertwined with the vermiculture system. This would have led to a massive structure being placed on top of the crest gates to cater for all these activities, which was inappropriate. This design did allow for a good understanding of the exchanges between the spaces.

The final site layout moved the vermiculture system on to the scarred landscape created by the dam, leaving the public spaces free on the crest gate. It was understood from the last site plan that these exchanges need to happen throughout both spaces to create a better understanding for the viewer and therefore a journey was created. The user (visitor) would have to pass the vermiculture space and then finally move onto the infrastructural and public interface. This gets the user to interact with both spaces and all exchanges.

Fig 6.8. Vision Perspective of public space next to infrastructure (Author, May 2016).

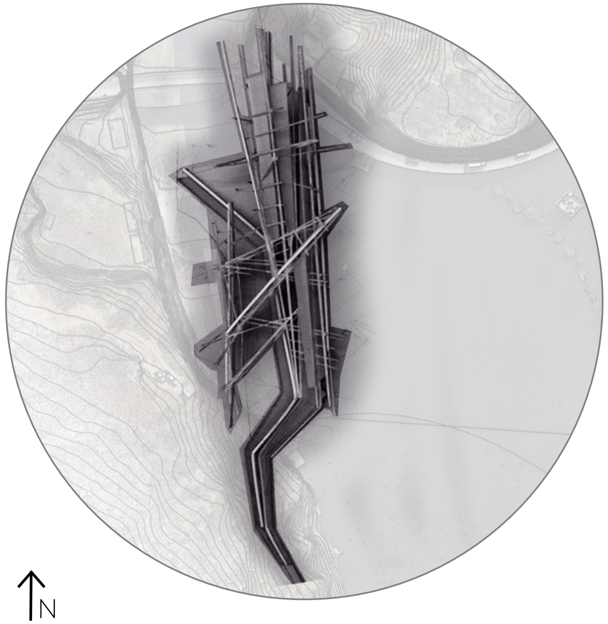


Fig 6.9. Form development (Author, April 2016).

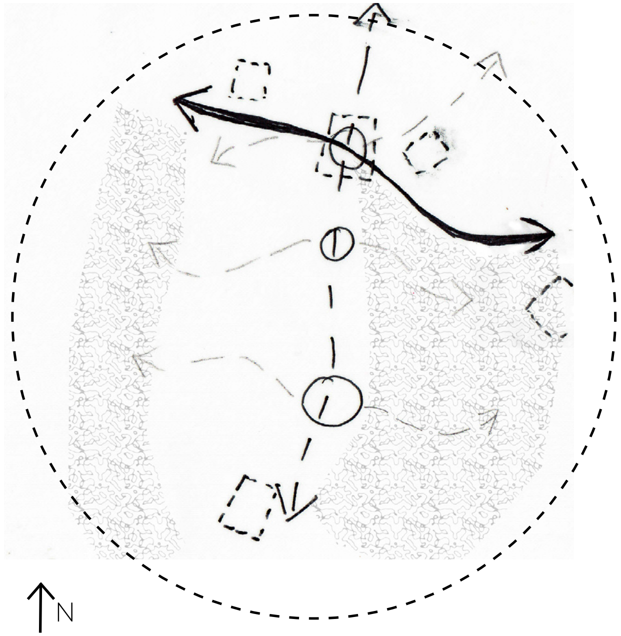


Fig 6.10. Axis of informants (Author, March 2016).

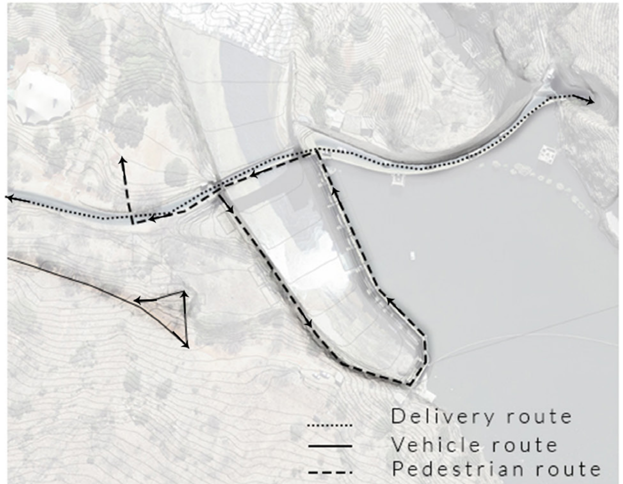
The initial driver of the form of the public interface on top of the crest gates was to reflect the stark contrast between the controlled water and the release of the water. The plan started to reflect the power of the water and the way that it was being controlled. The form looked at creating another gateway between these two experiences.

There were two primary locations to develop that were found through this investigation. The one was the infrastructure of Hartbeespoort dam which is, as already stated, the actual crest gates that exist on site. The other option was to develop the most disturbed area of the site, the scar created by the dam.

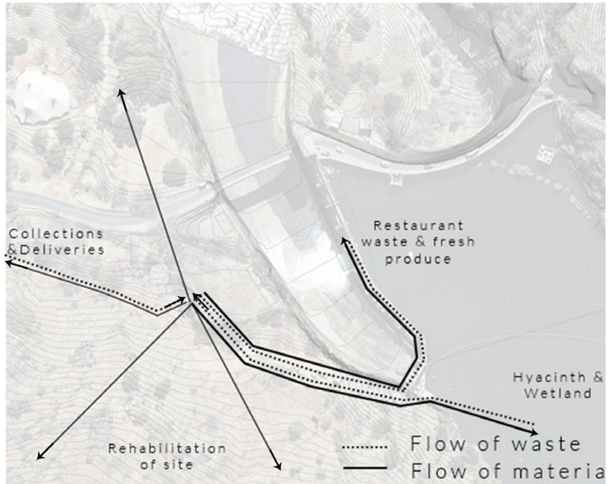
Early designs showed how the form can create an understanding of the exchanges that are being created. A journey that is guided by the form to express the problems with our previous relationship with water and a new relationship can be created.

6.5 PROGRAM LOGISTICS

The diagram above shows the level of security which would need to be created in order to secure the vermiculture building. As already stated in the program chapter the vermiculture process was unproductive due to theft of the worms. In order to prevent theft the building could be closed on weekends when staff are not working. There would still be the public interface, with some vermiculture boxes, that would be open on weekends in order for visitors to understand the full range of exchange on site.



The next diagram shows the flow of the user (the visitor) in order for them to gain a haptic understanding of the exchanges on site. There would be a specific route that the form would encourage visitors to follow. The diagram also shows vehicle routes and delivery points.



This diagram shows the flows of different materials into and out of the exchanges, the solid line being inputs and the dotted line outputs.

Fig 6.11 Spacial requirements and view of building (Author, May 2016).

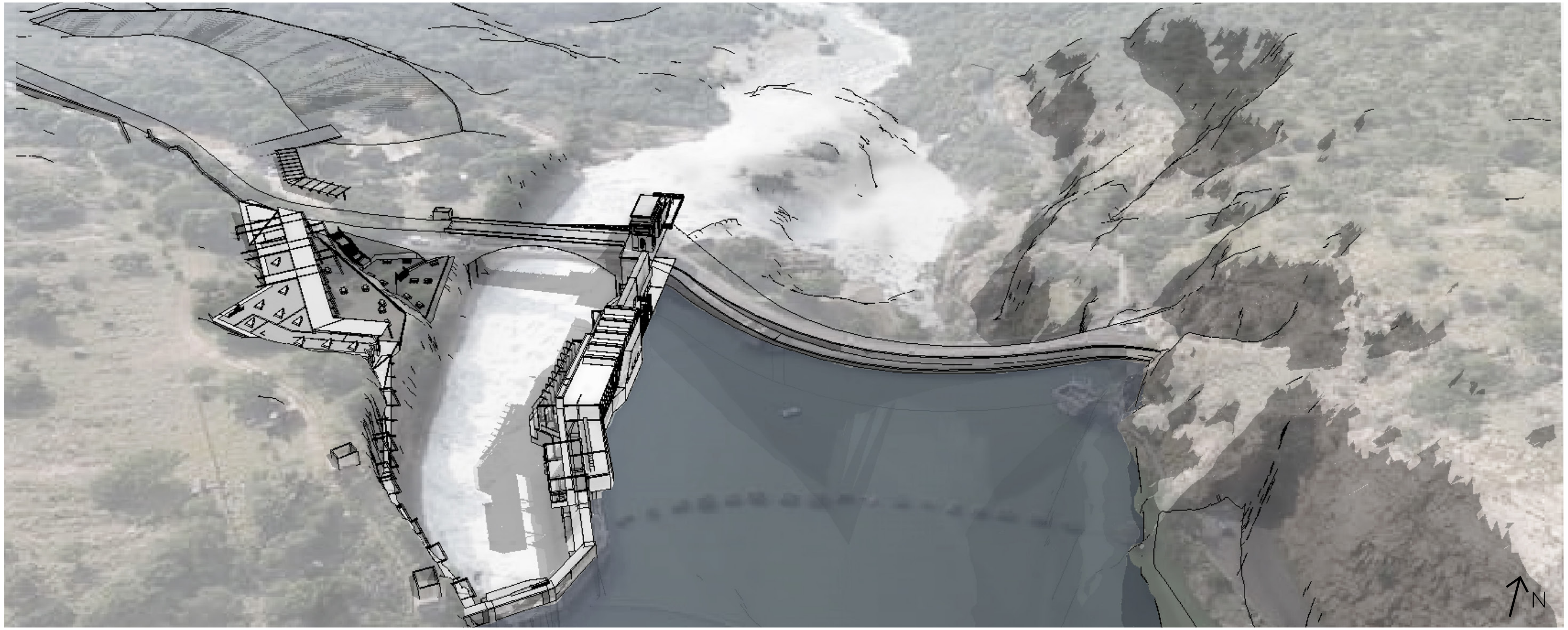


Fig 6.12 Perspective over view (Author, June 2016).

6.6 Site Layout

The layout of the site plan encourages the public to follow a specific route through the site to engage with all the different exchanges and to gain full understanding of everything that is happening on site.

Outdoor space

The existing site of the vermiculture space would be appropriated for parking as this area has already been flattened. The parking lot would be enough for 100 cars. A designated bus stop with roofed waiting area will be created alongside the road to boost public transport use. There will also be an informal retail space, where hawkers can set up their fresh produce and products. In order to allow movement across the road the texture would be changed, to direct the flow of the user along a specific route. The creation of a formal park space on the lower half of the site, next to the spillway, will encourage public to use the space.

Vermiculture space

The first building is the vermiculture which has a public interface where presentations and understanding of the system will happen. There is a covered walkway with windows that look into the vermiculture space and then finally the wetland creation space which the public can enter into the building from Monday to Friday. There are benches, tables and ablutions in front of the space for the public to use.

Public interface space

The user is then led on to the suspended walkway off the scarred cliff till they move on to the existing infrastructure next to the collection point of the Hyacinth. Next to the walk way there is a second ablution block. Once they are into the restaurant space there is a bar area on the ground floor and restaurant above and then finally the retail space as the exit. As they move around the existing arch there is a viewing platform that wraps around it. The public is inspired to view towards the natural vista. Finally moving back across to the parking lot there is an additional pedestrian bridge next to the vehicular bridge.

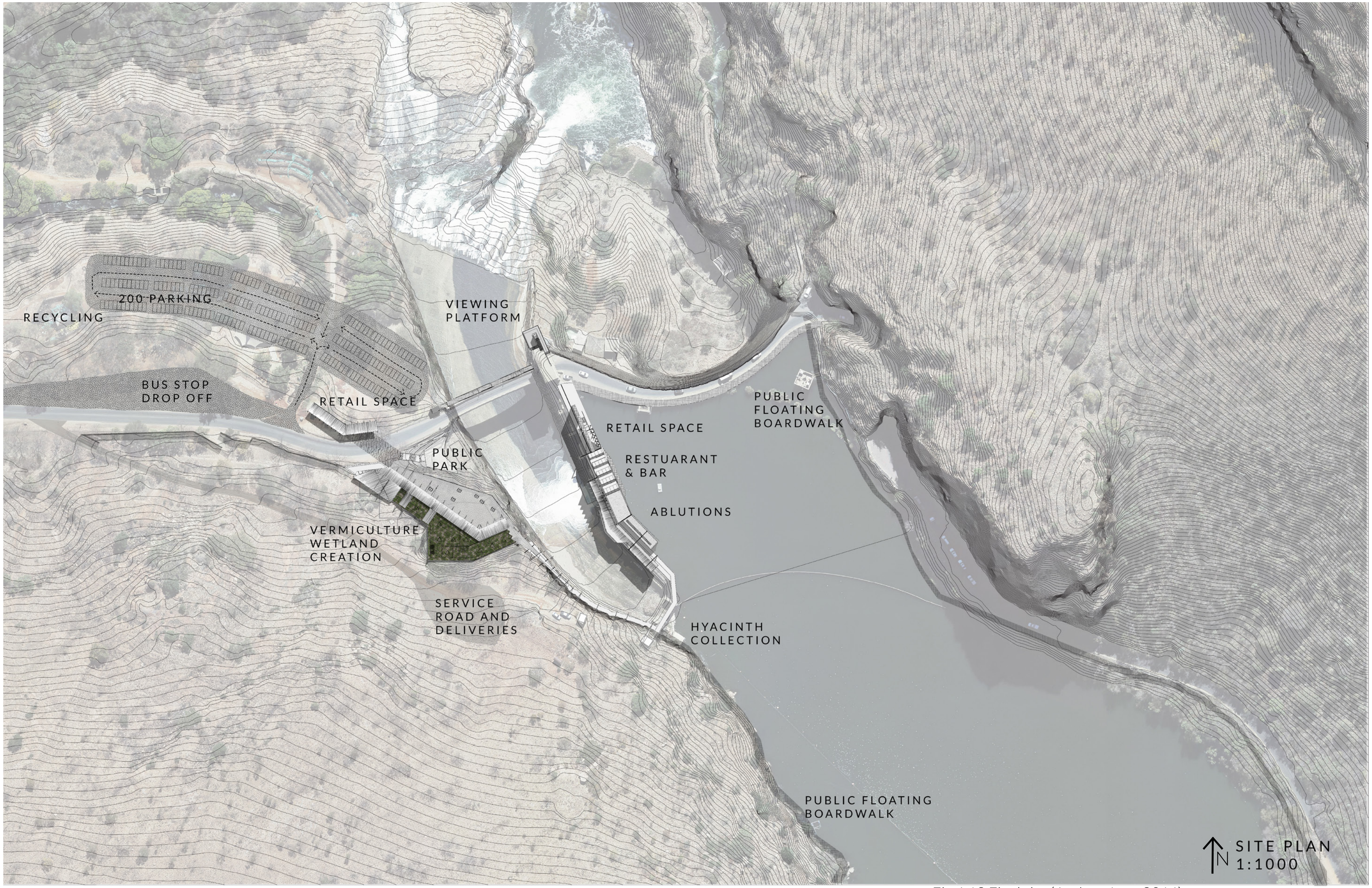
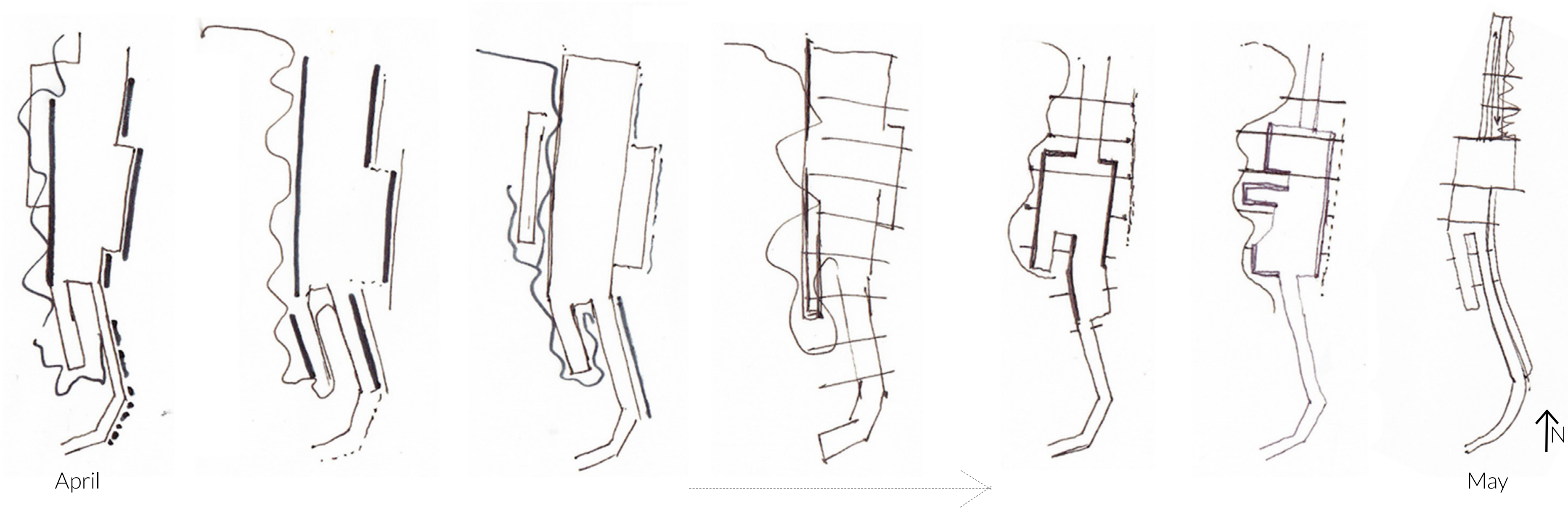


Fig 6.13 Final site (Author, June 2016).

6.7 PROCESS WORK

Plan exploration



April

May

With the conceptual designs the building simply contained exchanges rather than expressing them. High-tech architecture was used as a precedent to express these exchanges better in the facade as well as the spaces of the building. These precedents also helped with making the closed loop systems of the program more tangible to the user and thereby create a paradigm shift.

This also gave clues about choices of materials and how certain materials needed to complement the existing language of the infrastructure and other materials contradicted it, creating a series of exchanges between served spaces and service spaces.

Fig 6.14 Plan development (Author, April to May 2016).

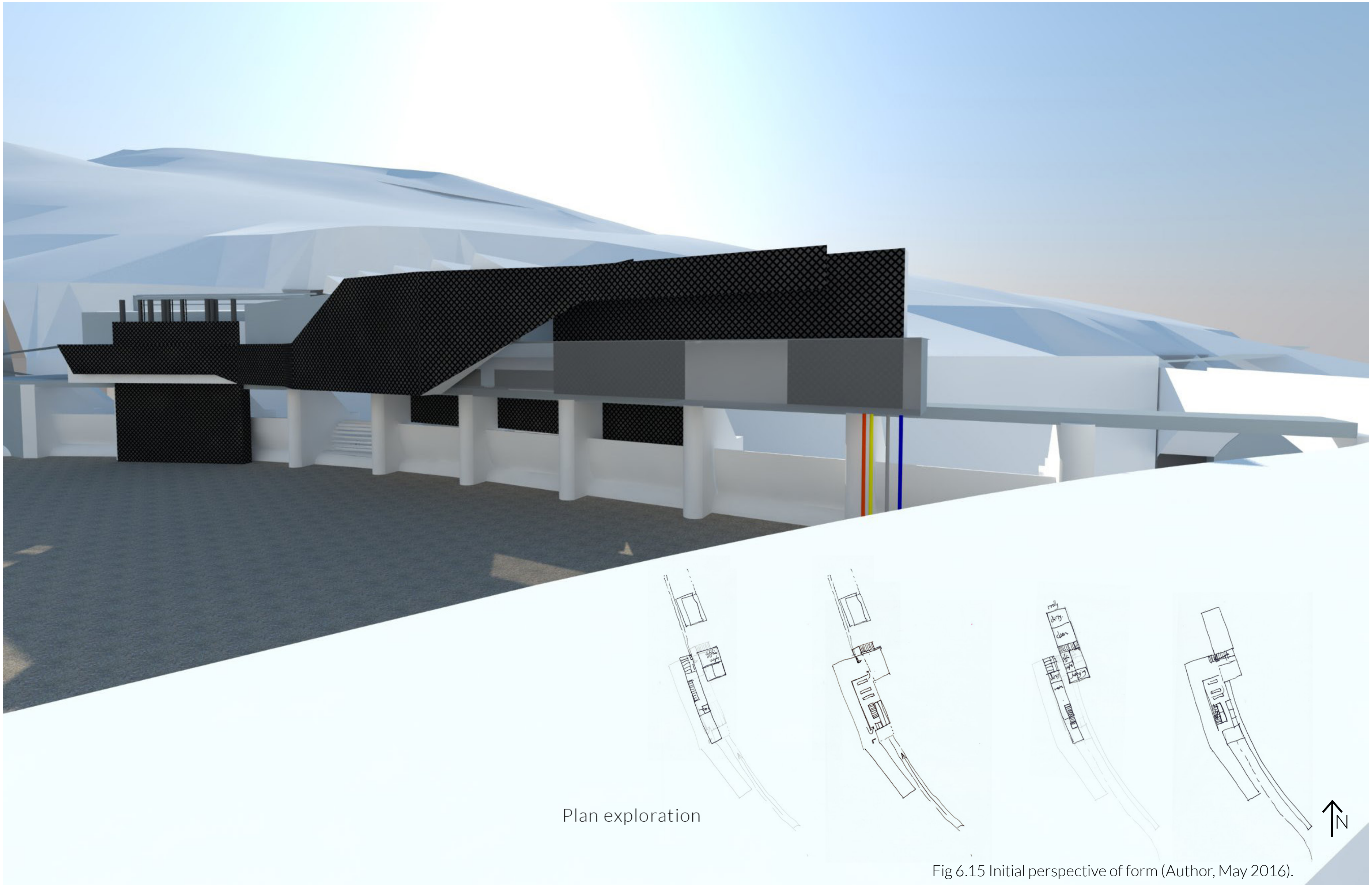


Fig 6.15 Initial perspective of form (Author, May 2016).

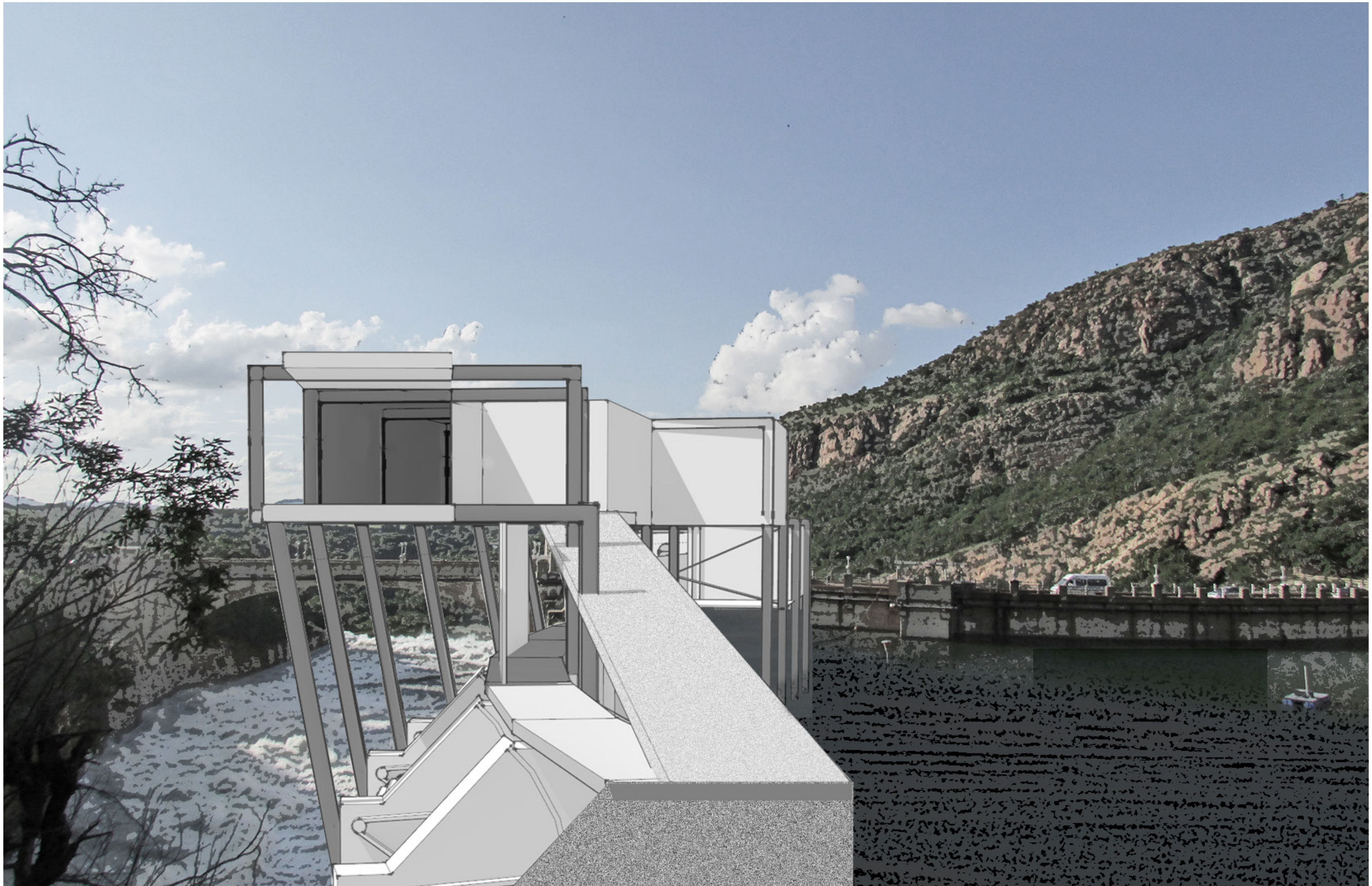


Fig 6.16 Perspective over different water conditions (Author, May 2016).

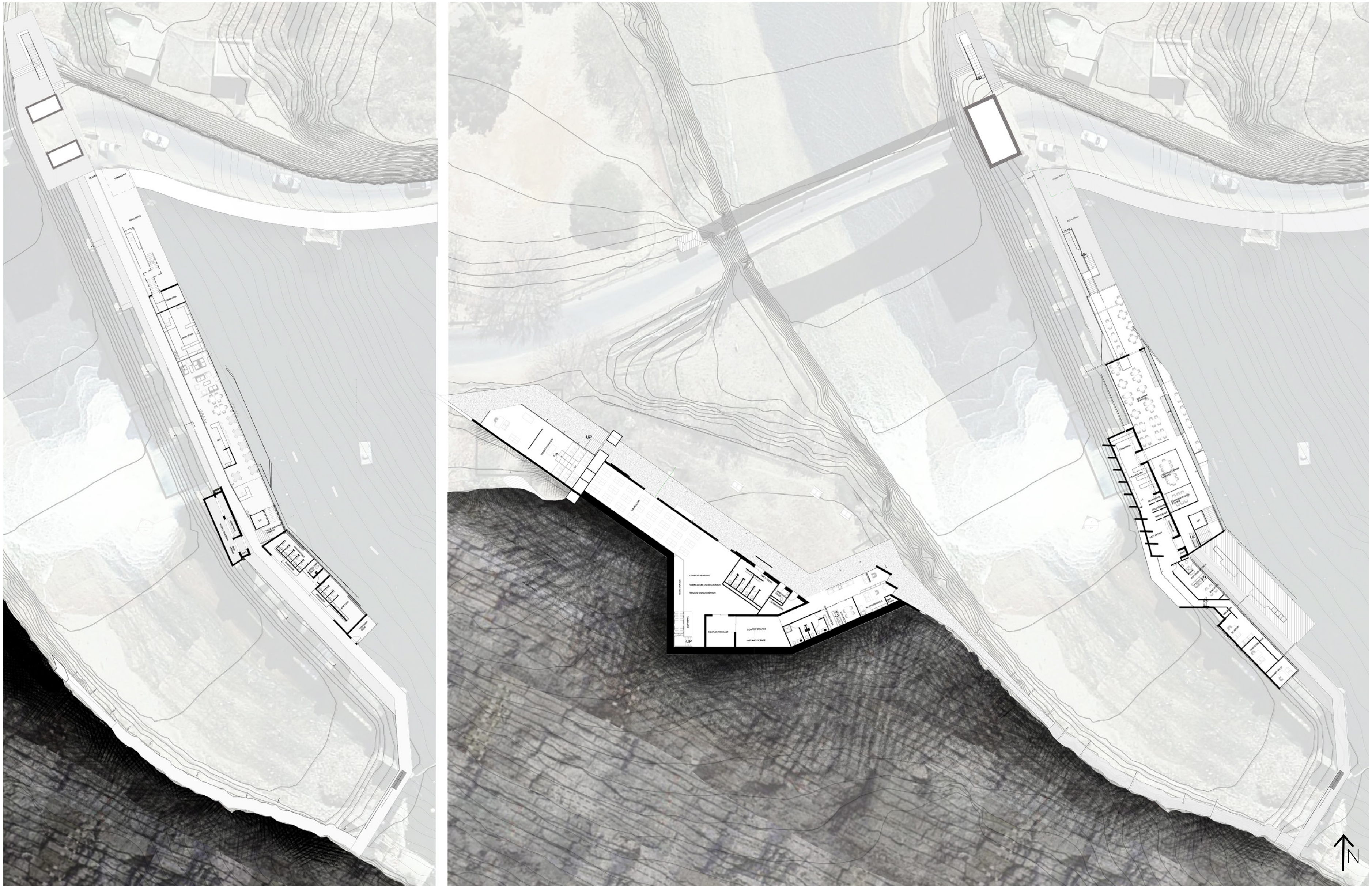


Fig 6.17 Ground floor plan and first floor plan (Author, June 2016).

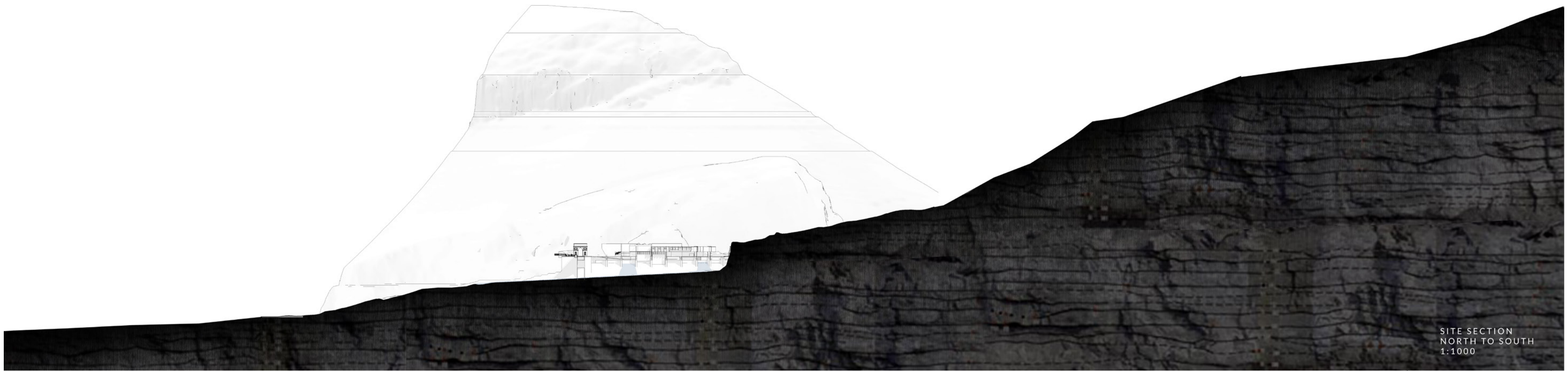


Fig 6.18 Longitudinal section North to South (Author, June 2016).

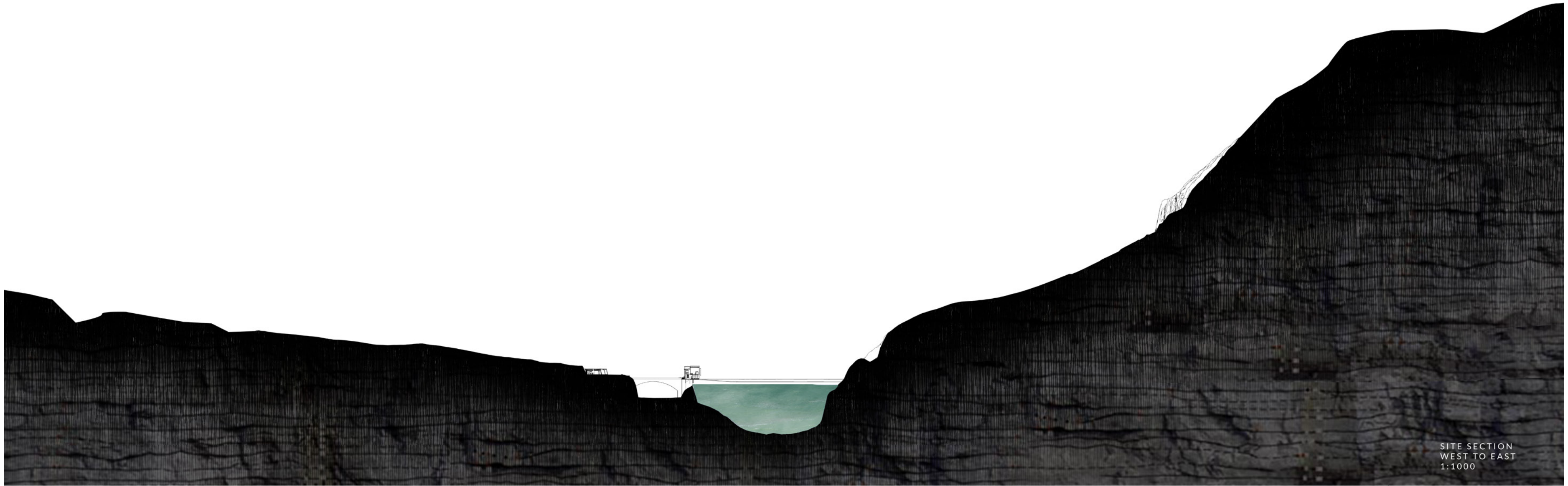


Fig 6.19 Longitudinal section West to East (Author, June 2016).

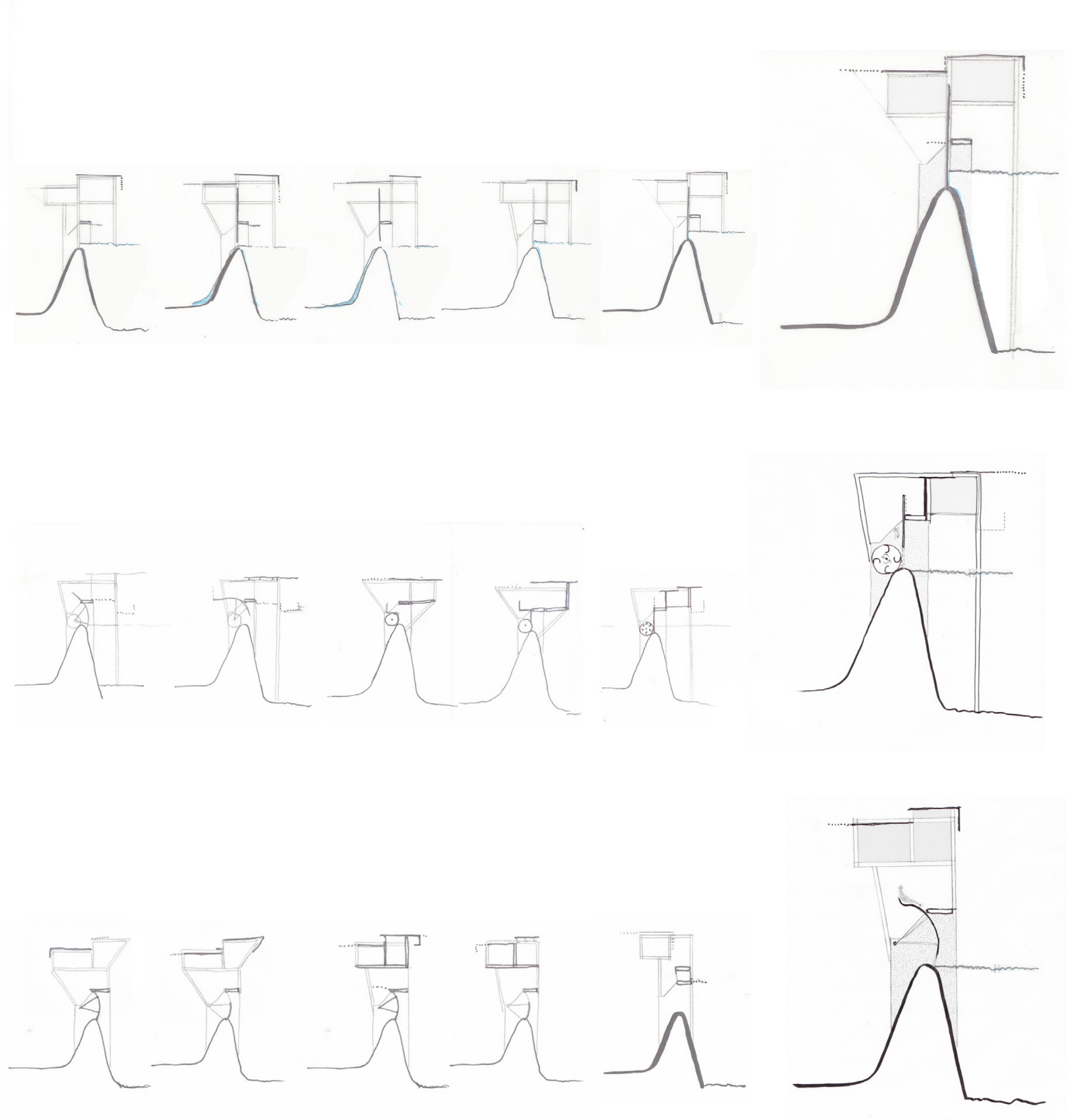


Fig 6.20 Section development (Author, April to June 2016).

6.8 Section Exploration

Restaurant spaces

The restaurant section explored the idea of release and containment of the water and expressing this in the space. Also considered was creating new crest gates that interact and change the space in the restaurant whether they are open or closed.

Retail space

The retail space needed to react to the existing monument of the arch as it is the leading space to it. The height ratios of the space relate to the order on the arch. The creation of power through watermills was also explored and how this could interact with the space.

Public walkway

The public walkway needs to be clearly defined as what is new and what is existing. This is done through the changing of materials of the walkway. Interaction between viewer and the crest gates were also explored. The gates could create seating when open and an edge to the walkway when closed.

6.9 Spatial articulation

Figure 6.20 explores the different spatial experiences of the different programs. The volume of space of these programs grows and shifts according to the journey of the user. This is in order for them to experience certain aspects and highlight certain views which allows them to gain an understanding of what is happening on site.

The ground floor bar area is an extension of the existing walkway creating a free and unconstrained space. Facilitated by sliding/folding doors that open up the space during good weather, creating an open platform over the water and infrastructure.

This would create a more informal and relaxed environment. The western side of the building will be lined with a long counter top that people could sit and have drinks at, looking out over the water and crest gates.

The restaurant space above grows in volume as you move towards the arch. The space conceals and reveals certain views as you progress through it. The intent was that the user sees the controlled water body as they move up the stairs and only as they move out onto the lighter balcony they hear and smell the water and it brings the other senses into play. Finally they move back into the space, the service core ends, and there is a view towards the vermiculture building, exposing the spillway and the release of the water. Exit is through the largest volume of the space which changes to represent the angle of the solar panels above. The user moves down the stairs, inside the screen of exchanges of the building and finally meets with the historical artefact of the arch.

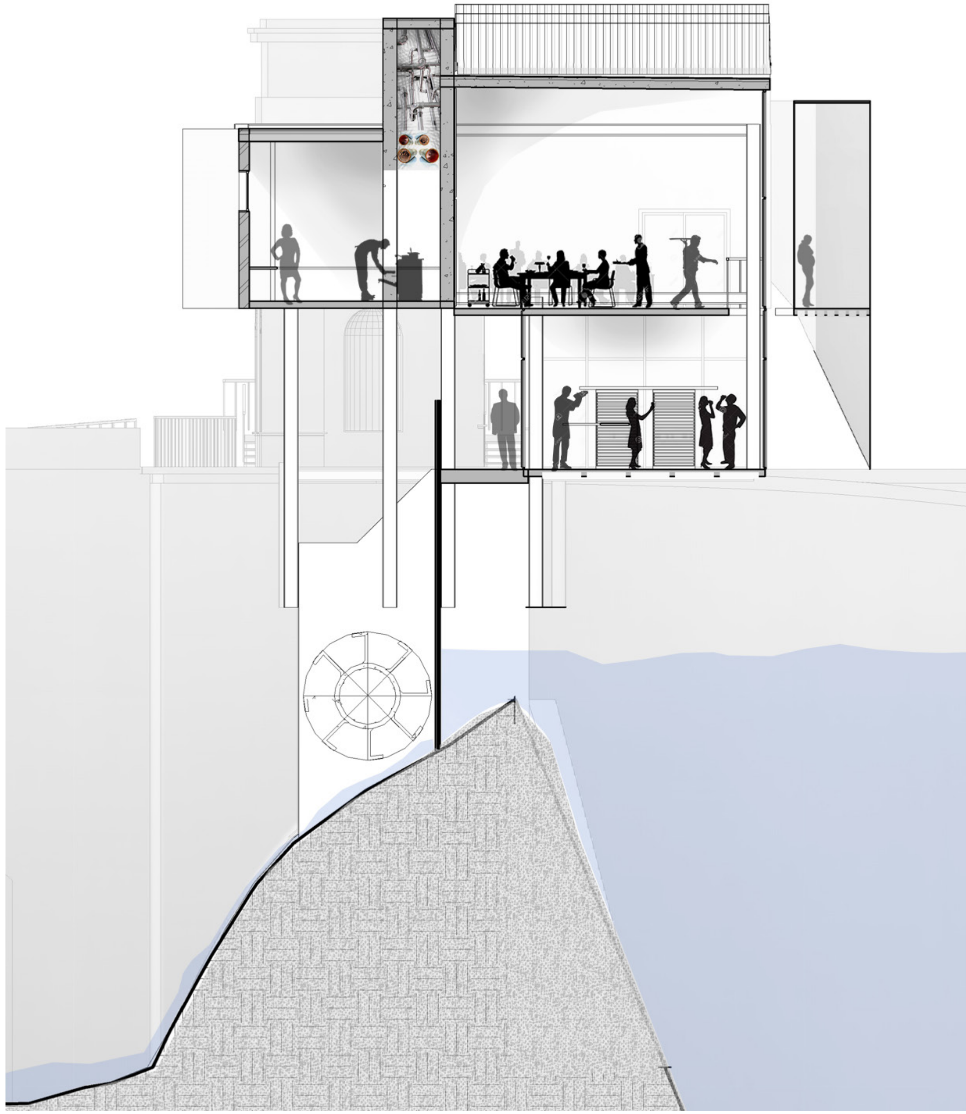
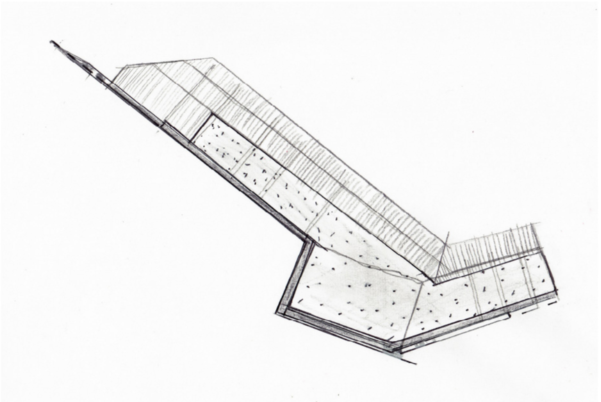
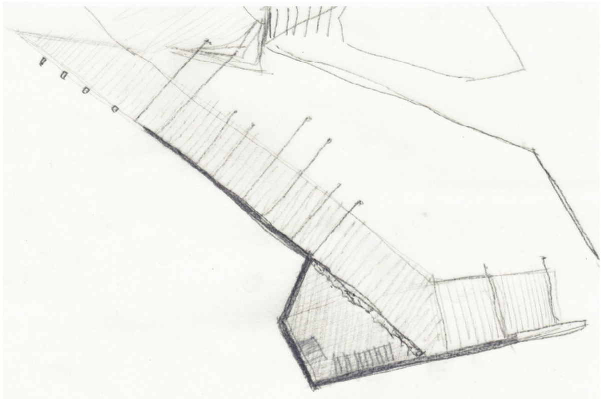
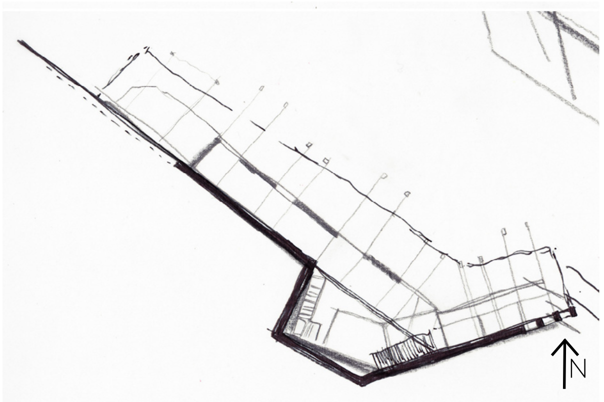


Fig 6.21 Section development (Author, April to June 2016).







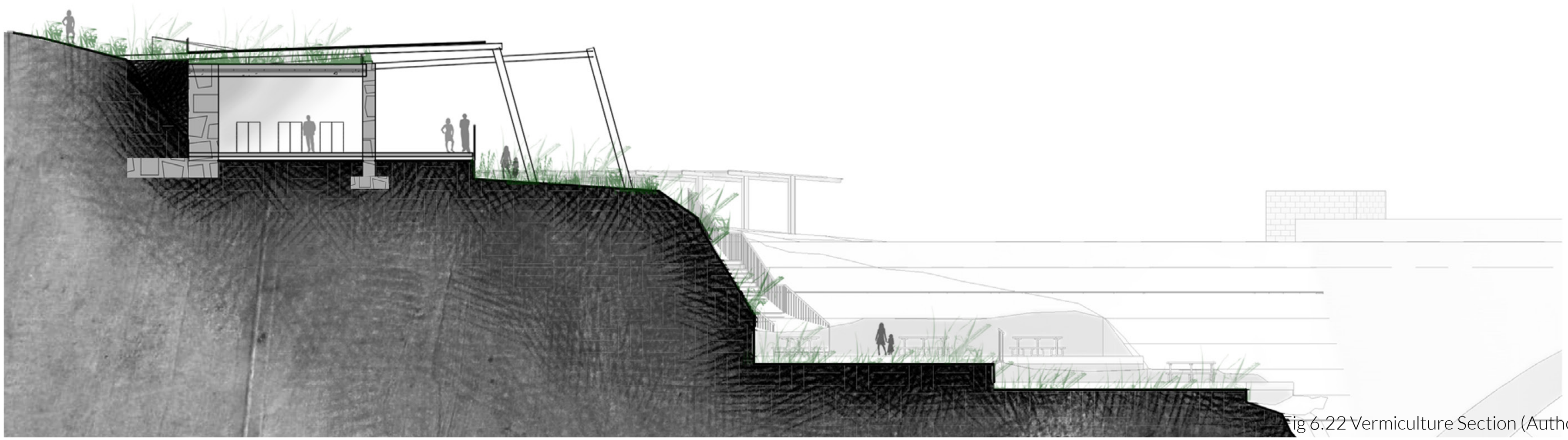


Fig 6.22 Vermiculture Section (Author, April to June 2016).

Through the separation of the vermiculture and restaurant spaces it was clear that each one needed its own design strategy. On the one hand the vermiculture building aims to develop the most scarred and disturbed area of the site, creating a new synthetic landscape that regenerates the area that it sits upon. The aim of the restaurant space is to create a public interface to the existing infrastructure that creates social and economic activities.

Through section development two very different kinds of architecture emerged. On the one hand the vermiculture building started to integrate itself into the landscape through its program and its form. A much more stereotomic building that looked like it had always been there. On the other hand the public interface and restaurant space created a much bolder, louder architecture to emphasise the new paradigm created. But these two polar strategies need to have some similar elements so that they read as they are part of the same design framework.

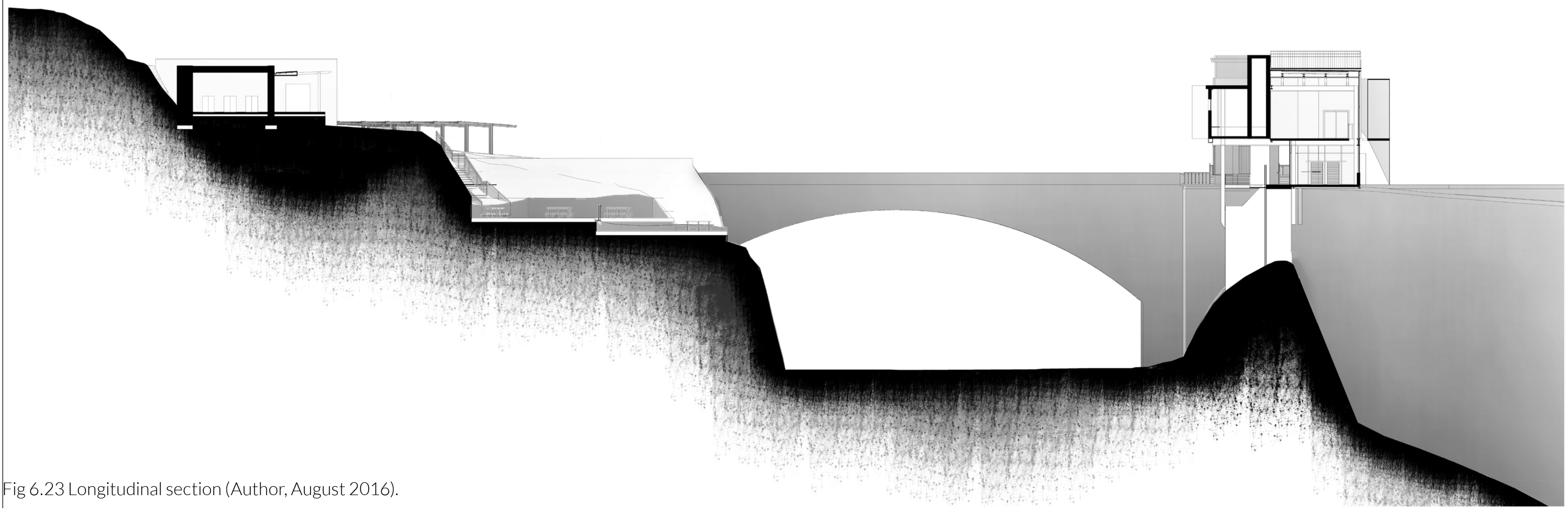


Fig 6.23 Longitudinal section (Author, August 2016).

SERIES OF EXCHANGES

HAPTIC EXPERIENCE AND UNDERSTANDING

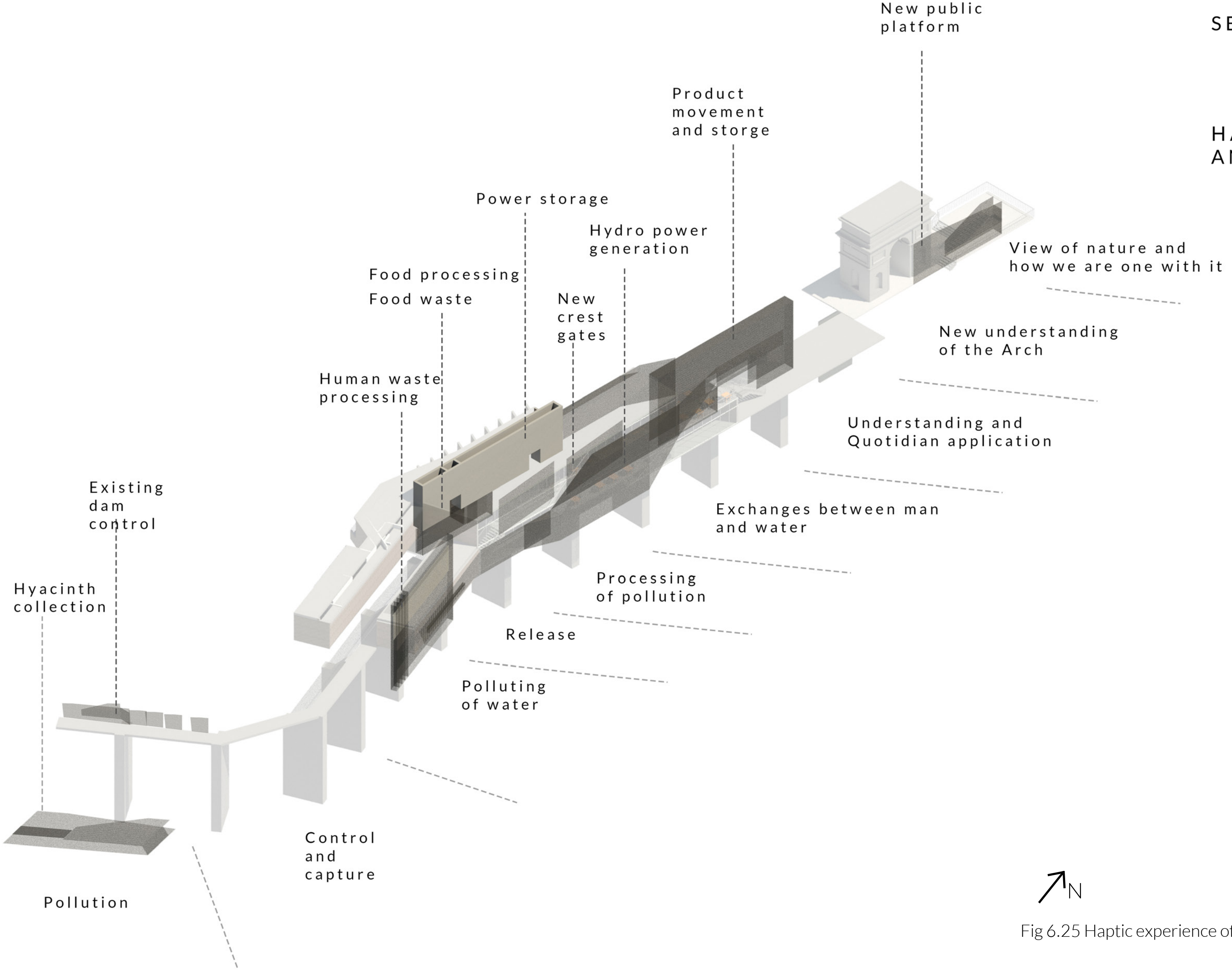


Fig 6.25 Haptic experience of exchanges (Author, June 2016).

6.10 Haptic experience and understanding

Initially most of the exchanges were contained in the vermiculture building rather than the restaurant space and the public interface. This diagram (see fig6.22) shows the haptic experience that one gains as they followed the route, as well as the different exchanges that happen within the building.

After the user crosses the road their first experience is the vermiculture public interface. At this point they are educated through presentations and hands on interaction with the vermiculture system. Then they can move through the main production space and into the wetland creation space. Here they are encouraged to view the works creating these floating wetlands and try it for themselves.

Once you move outside it is possible to see the gardeners that grow the plants that will later be used in the restaurant or be placed in the floating wetland. There is a large water tank that catches the grey water that is then used to irrigate these plants. This becomes a gateway for users moving into the public picnic space, forcing all public to interaction with water.

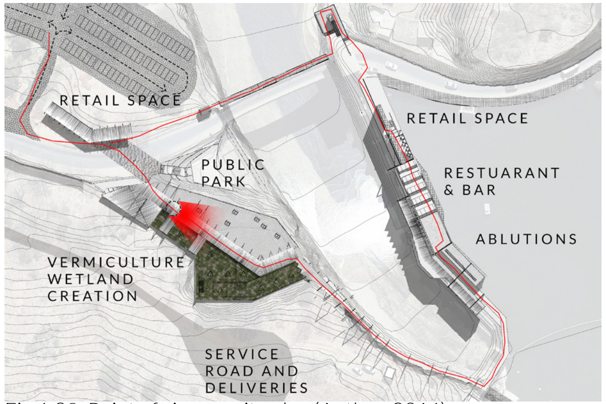


Fig 6.28. Point of view on site plan (Author, 2016).


Fig 6.26. Public walkway along vermiculture (Author, 2016).


Fig 6.27. The space for vermiculture system (Author, 2016).

If the viewer does not choose to directly interact with the systems there are still highlighted views from outside through the building to the systems. This is crucial as during the weekend, when there are large amounts of users, the space will be closed and therefore there is only a visual education at this point.

The covered walkway frames the view of the restaurant space above the crest gates and creates a sense of direction that guides the user to approach the walkway that is hung from the scarred cliff. As the user moves along this route there are planter boxes that attach themselves to the scar, allowing new vegetation to grow up and reclaim the scar over time.


Fig 6.29. Public walkway along offices (Author, 2016).

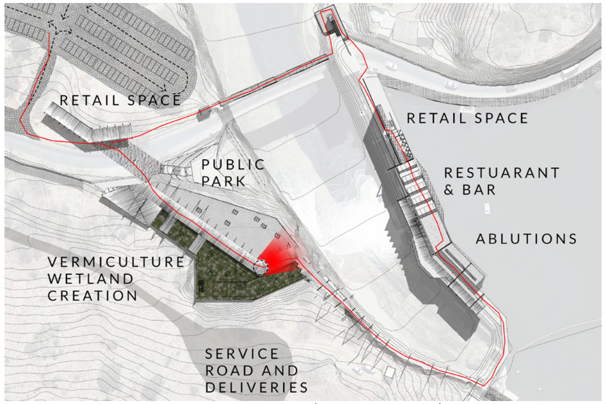


Fig 6.31. Point of view on site plan (Author, 2016).

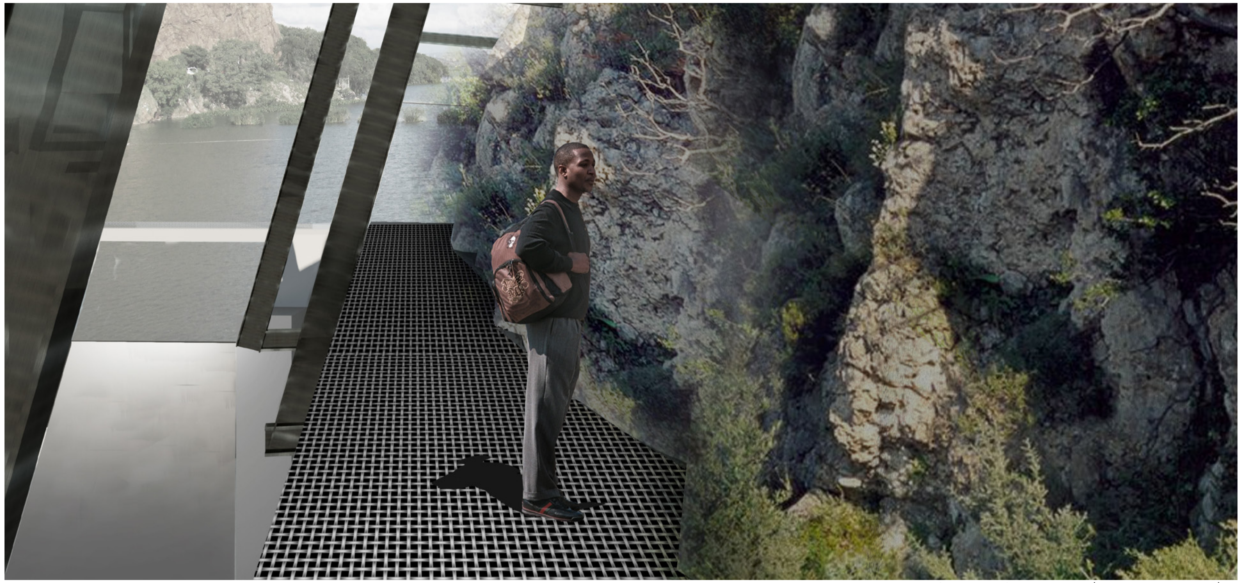


Fig 6.30. Suspended walkway along scar (Author, 2016).

Finally the user moves on to the existing infrastructure walkway, highlighted through floor material change. They are first confronted by the controlling element of the dam, which is the old pump room and the winch that controls the crest gates. This old control system has been turned into a seat where people can sit and look out over the dam, a place to contemplate and reflect.

The second sight is of the collection of the hyacinth that occurs at water level. There is an existing floating platform at the first crest gate which the workers use to remove the build-up of hyacinth. This organic plant matter is then taken back to the vermiculture space.

As they progress further they experience both types of the water bodies; the controlled on the right side and the released water on the left hand side. They gain an understanding of the forces that water can create and therefore the power needed to contain it.

Fig 6.32. Seat on old control of crest gates and view to controlled water body (Author, 2016).

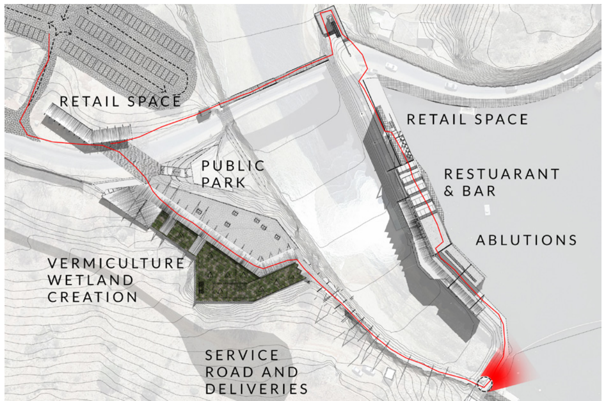


Fig 6.34. Point of view on site plan (Author, 2016).

Fig 6.33. View towards ablutions with both controlled and released water bodies (Author, 2016).

Approaching the ablutions block there is a large inlet pipe that comes out of the dam and becomes the balustrade of the walkway. This pipe sucks water into the water filtration system. It flows into a tanking system that creates the back wall of the ablutions. As they progress into the space, the user will be made aware of the biodigester that sits below the floor with a large gas bladder suspended in steel mesh.

The toilets are designed in such a way that the most private spaces are integrated into this system wall of the biodigester and water tanks. Lined with a long window looking out towards the dam, the basin is one long trough that looks as if the water flows directly into the dam, even though it is taken through the water filtration system. This is to represent what is happening every time the person uses water at home as a dam such as this is where eventually the water ends up.

All along this existing walkway there is a constant flow of material for example; the hyacinth being taken to the vermiculture space, fresh produce being brought form the planted roof of the vermiculture building to the restaurant space, the removal of organic matter from the kitchen and placing it in the biodigester, the flow of water in the pipes into the ablution block and the gas leaving the biodigester bladder and flowing into the kitchen through pipes.

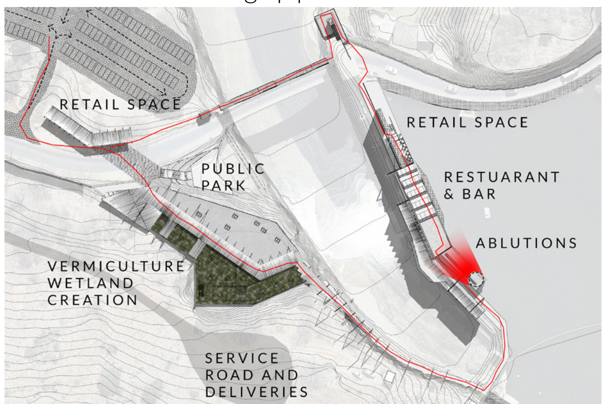


Fig 6.36. Point of view on site plan (Author, 2016).


Fig 6.35. Men's ablutions with system wall and water tank above (Author, 2016).

Whether the user moves up into the restaurant space, stays on the ground floor and simply uses the bar space or even just walks along the existing infrastructure, there are exchanges that educate them. There are seating spaces that look over the controlled water body and others that hang off the crest gates over the released water. This view highlights the hydroelectricity being generated below.

From below on the existing walkway there are views highlighted up through the service core where movement happens between the kitchen and the restaurant space as well as water tanks and batteries for storage of water and energy.

As the user moves up into the restaurant space, there is still a connection to the processing of the pollutants in the water through visual links back towards the vermiculture building. The crest gates also move up, when opened, into the space, changing its dynamics to smaller separated spaces. This release of water generates power through the water wheel. When the gates open the view is shifted down towards the release of the water, but when the crest gates are closed, there is a view to the vermiculture space.

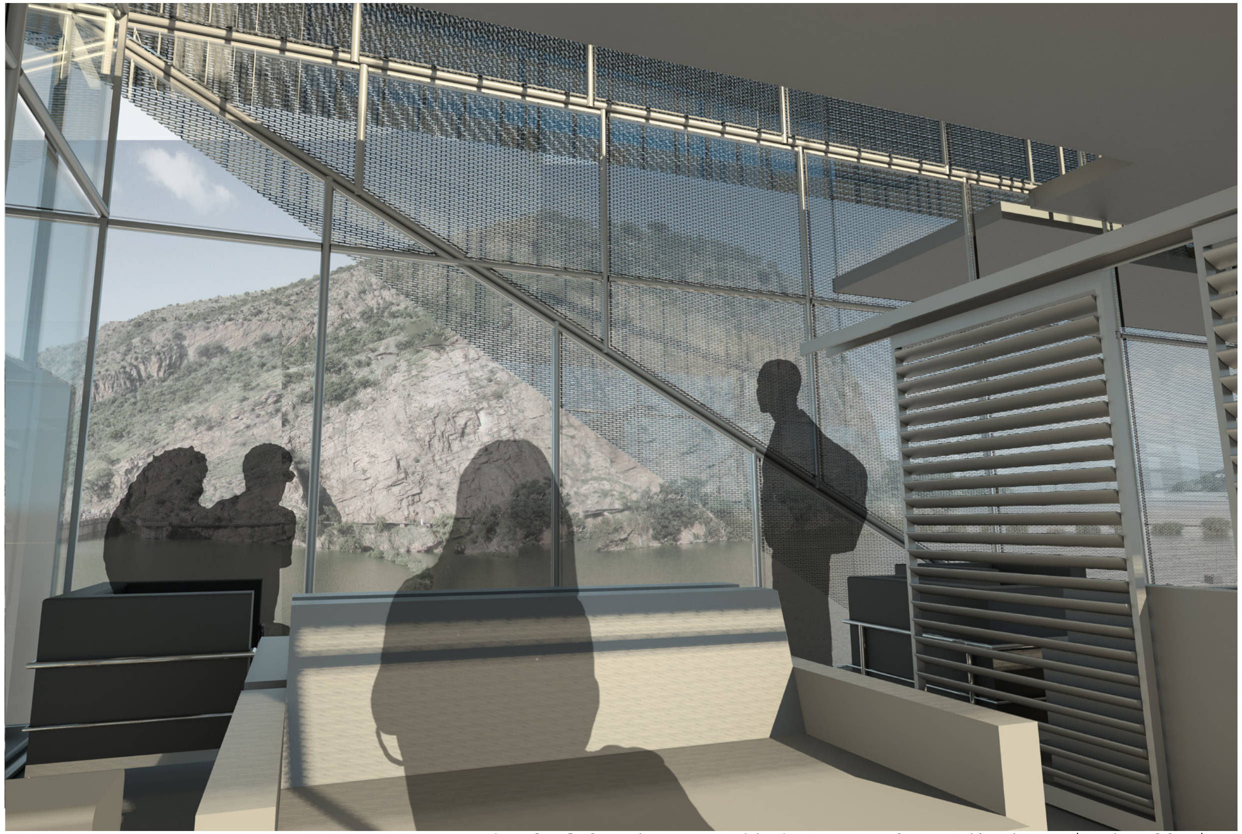


Fig 6.37. Cafe and Bar area with view to east of scarred landscape (Author, 2016).

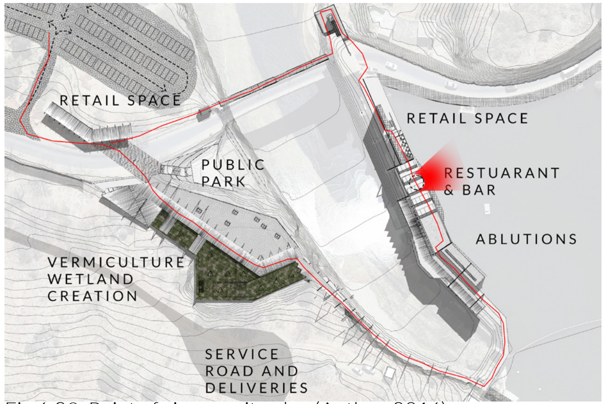


Fig 6.38. Point of view on site plan (Author, 2016).

In the restaurant space there are evaporative cooling towers that have water misters inside them which force the flow of air down, losing energy to evaporate the water and then flow into the space, as a cool breeze during summer months. These evaporative water towers create education of how water could be used for alternative methods.

Throughout the rest of space there are visual connections back to where the food was grown that the users are now consuming and how it was produced through the series of exchanges.

In the retail space there are goods that are sold to the consumers that they can take home and use to change the way that they live their lives with this new found understanding. The spaces of retail do not only consist of indoor space, but flow into the outdoor space, with metal cages that contain compost and the vermiculture systems. These cages become seating areas for passing users. The separation of these retail spaces will create more interaction with passing viewers and therefore exposure of the systems and more economic gain.

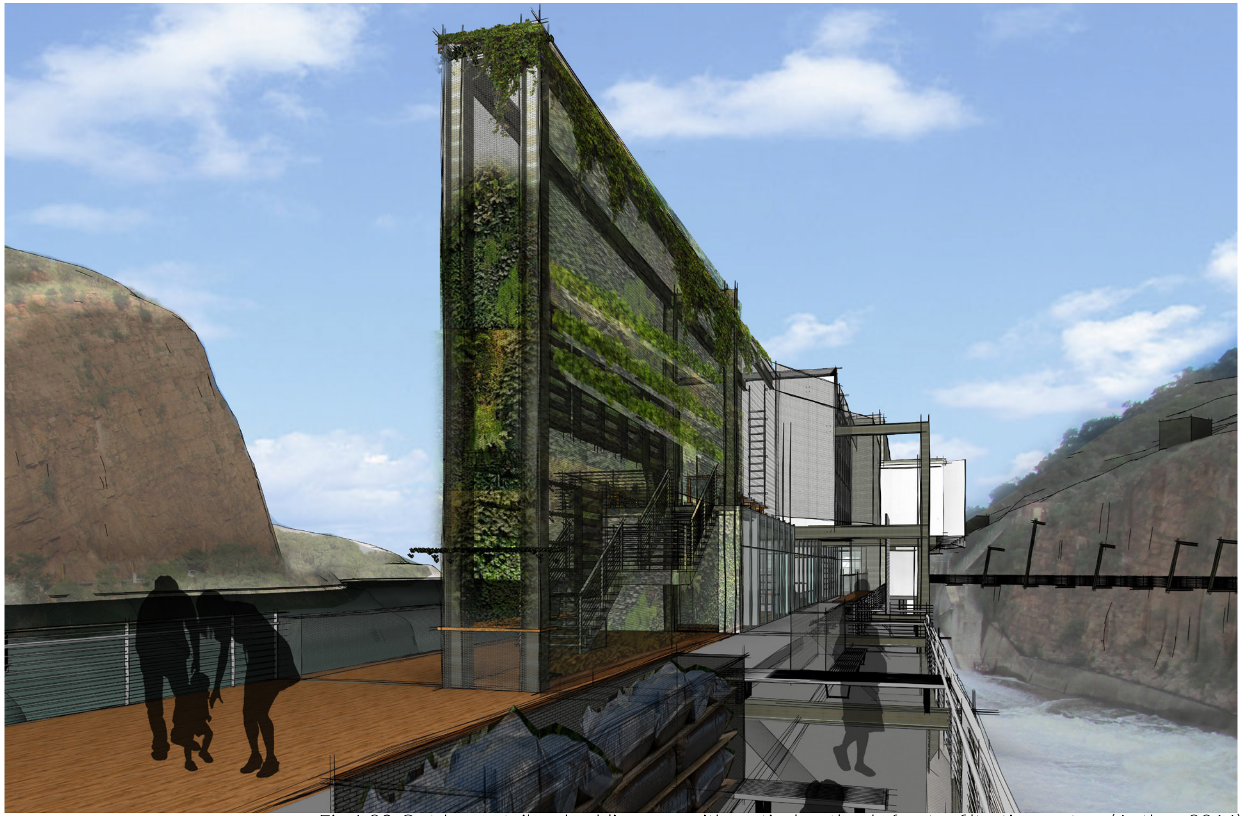


Fig 6.39. Outdoor retail and public space with vertical wetland of water filtration system (Author, 2016).

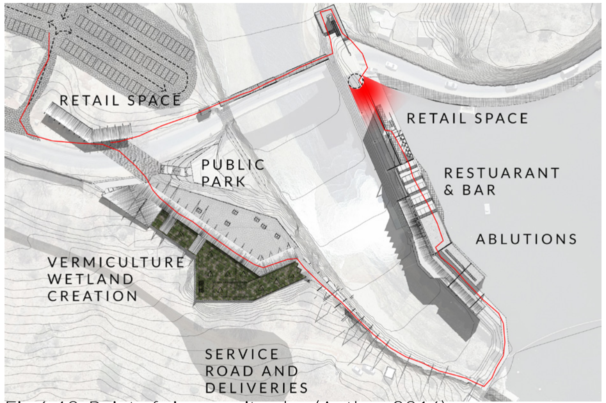


Fig 6.40. Point of view on site plan (Author, 2016).

When leaving the space they are confronted with the existing arch which represents the old paradigm. As they progress across the road there is a new public platform with a metal mesh that wraps around the structure and visually links them back to nature through a picturesque view. In this space the user is confronted with the old paradigm and how this has affected nature and hopefully with a new understanding of what needs to be done to create a better relationship with our natural resource, water.

Fig 6.41. New viewing platform wrapping around existing arch (Author, 2016).

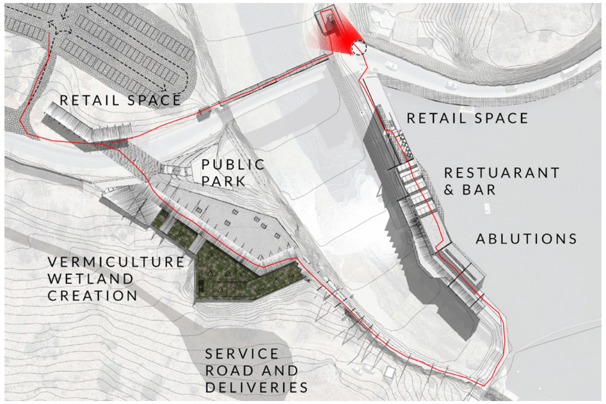


Fig 6.42. Point of view on site plan (Author, 2016).

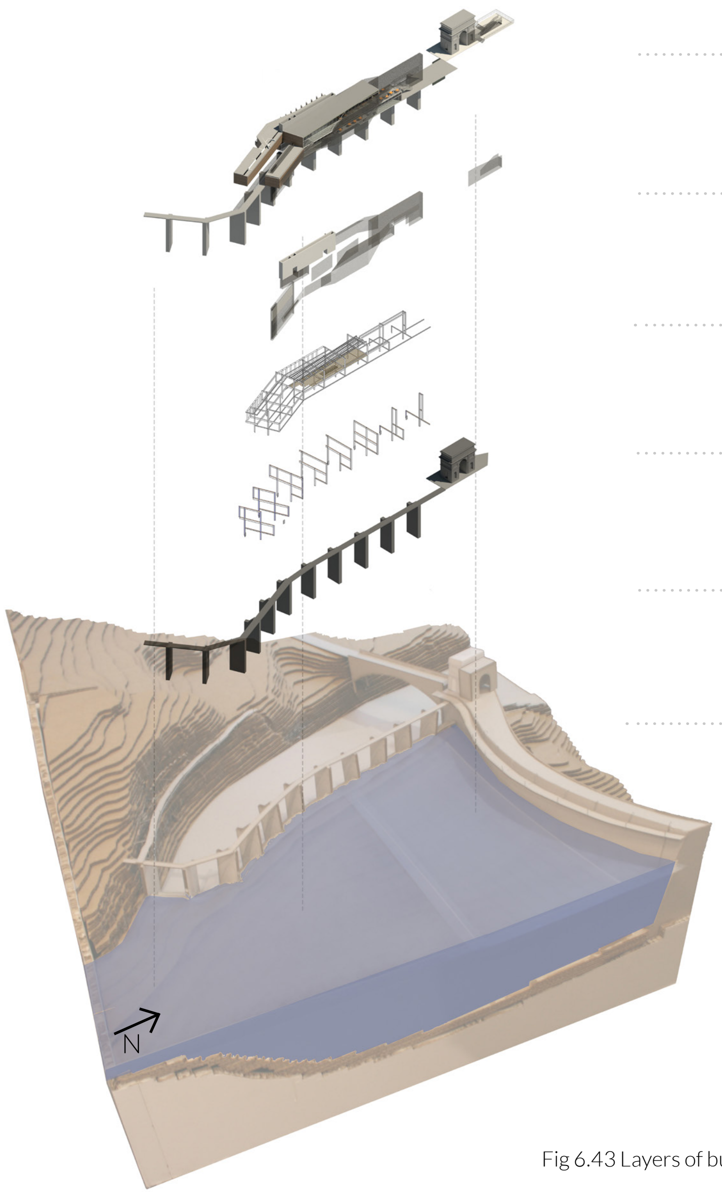


Fig 6.43 Layers of building and structure (Author, June 2016).

Image to the left expresses the five layers of the building. The spaces of exchange that twist through the building create service spaces for the public interface which become served spaces. The series of exchanges range from being an entire space within the building to a singular wall that plays a specific role in the exchanges.

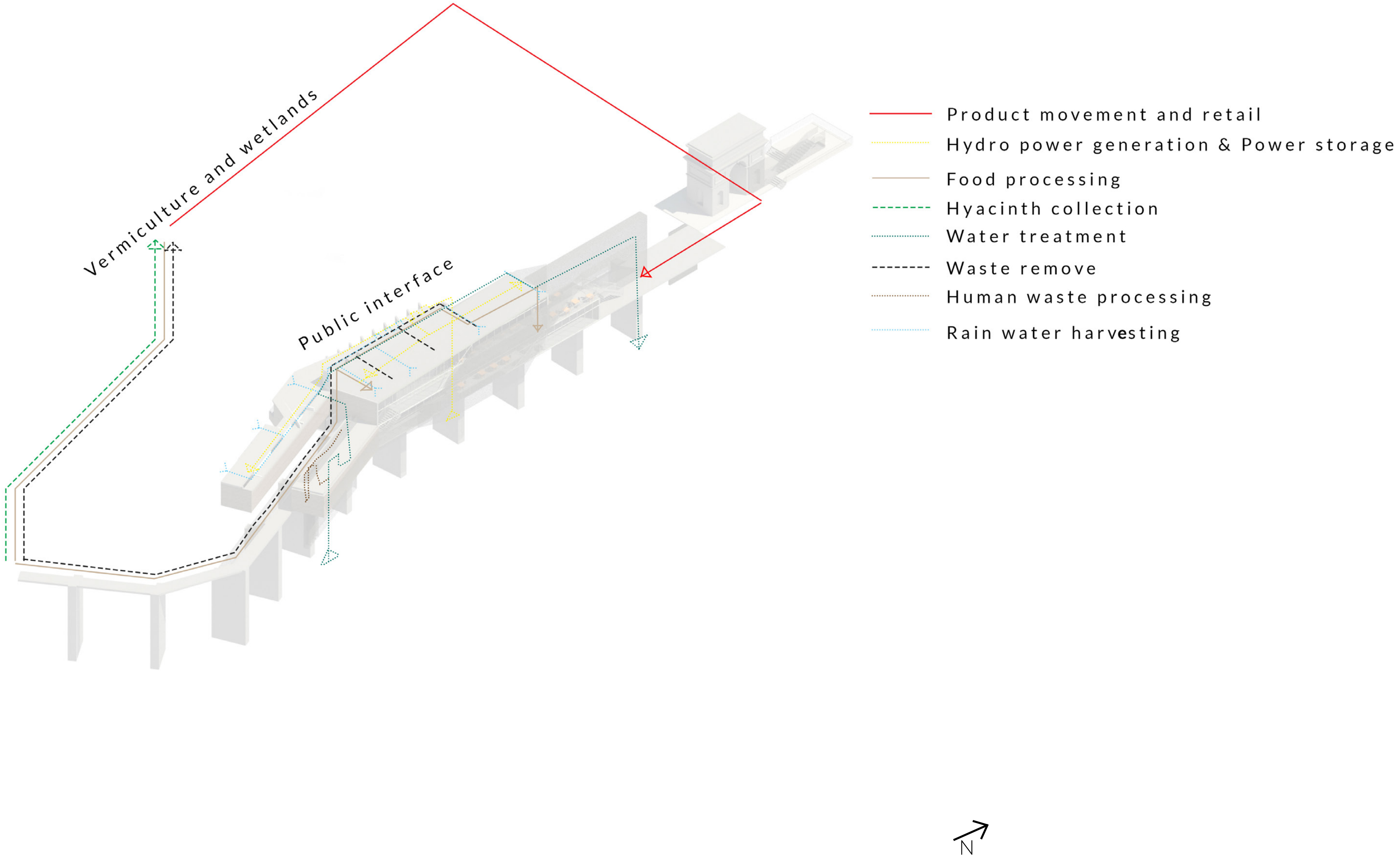


Fig 6.44. Flows of different exchanges on site (Author, June 2016).

6.11 Elevation exploration

East elevation

These sketches were done to explore the idea of the new form relating to the existing arch. It became clear that the scale could not exceed what existed on site. The new intervention had to line up and mimic the existing orders of the classical arch. Certain roof plains of the new building could slope in line with the mountain landscape behind and marry the two different scales of the site, the crest gates and the arch. They building would grow in scale as the user progressed through the space and finally ending at the arch.

The sketches also show the exploration of the shading device and the articulation of the angle of it. It grew from the ablution block up and across the restaurant space and terminating at the same height as the arch. This represented the flow of exchanges as well as movement inside the building. It directly relates to the flow of the water in the filtration system as it moves across the building and ends at the vertical wetland space.

The final sketch shows how the shading device was punctured at certain key points to highlight views either to the scarred landscape or the controlled water body.

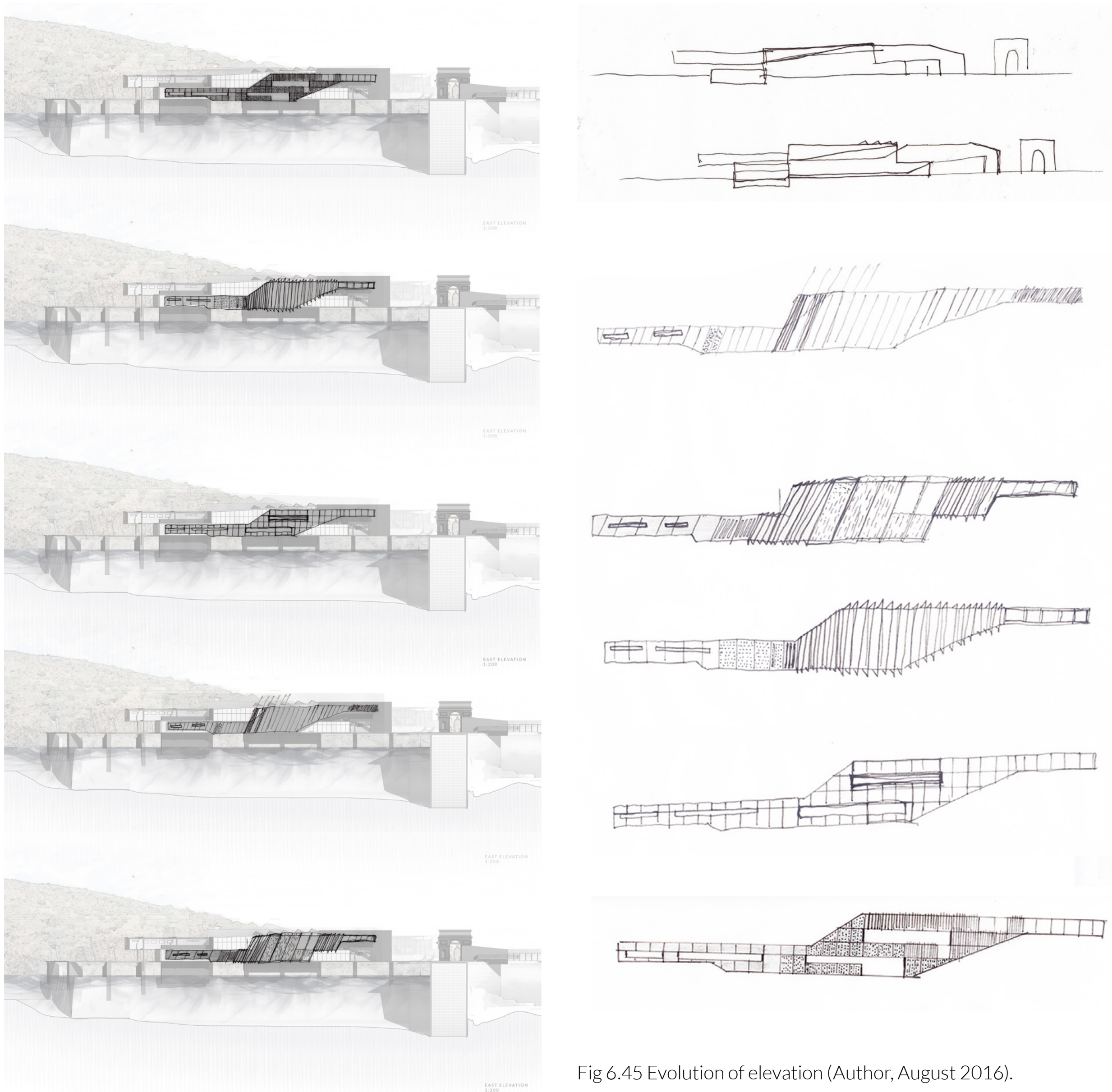


Fig 6.45 Evolution of elevation (Author, August 2016).

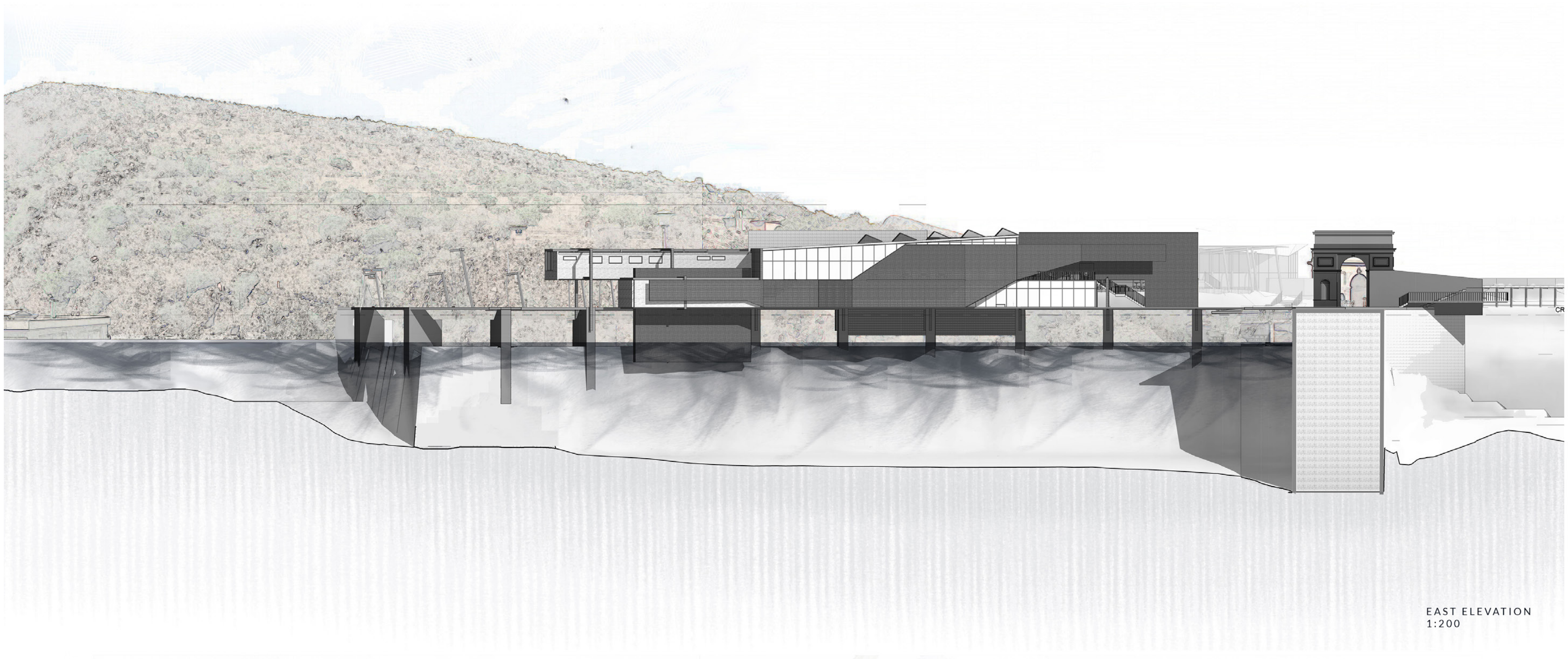
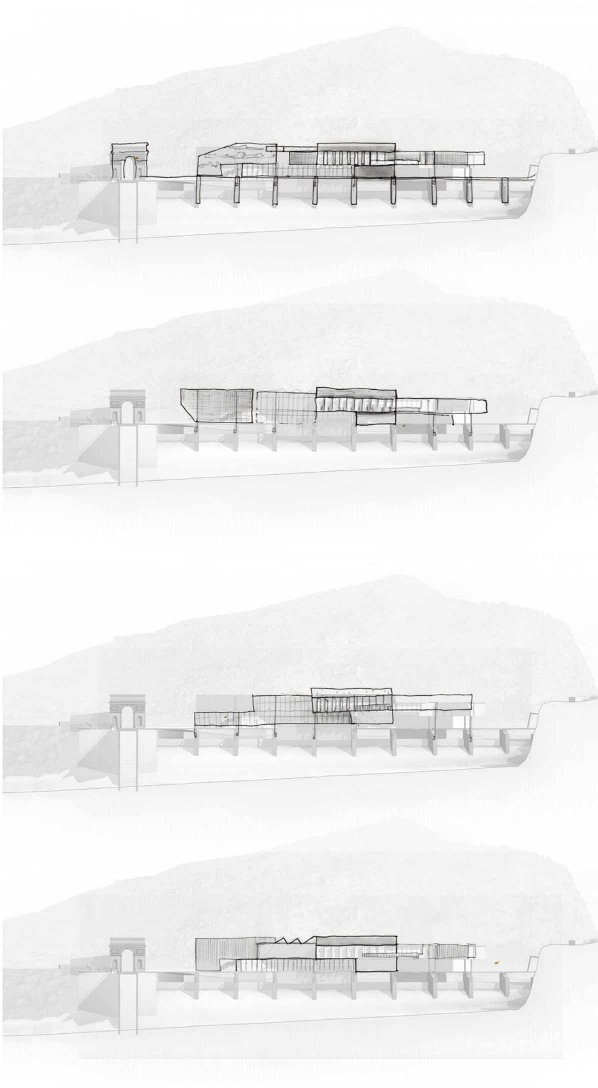


Fig 6.46. East elevation (Author, June 2016).

West elevation

The West elevation looked at connections down to the crest gates. The idea explored ways of creating new crest gates that move up and interact with the space above. The building grounding itself and blocking off some of the spillway was investigated. The articulation of the service and serviced spaces with stereotomic and tectonic languages began to emerge. The kitchen space became more fragmented as the facade started to pull away and separate from the space resembling the release of the water.

The sketches show different intentions of how the building would end with a steel mesh meets the existing arch: Should it lightly touch the Arch or leave a public space between it; should it dominate the Arch, or scale down towards the Arch. The final solution was to allow the building to form an edge to a public space between itself and the arch.



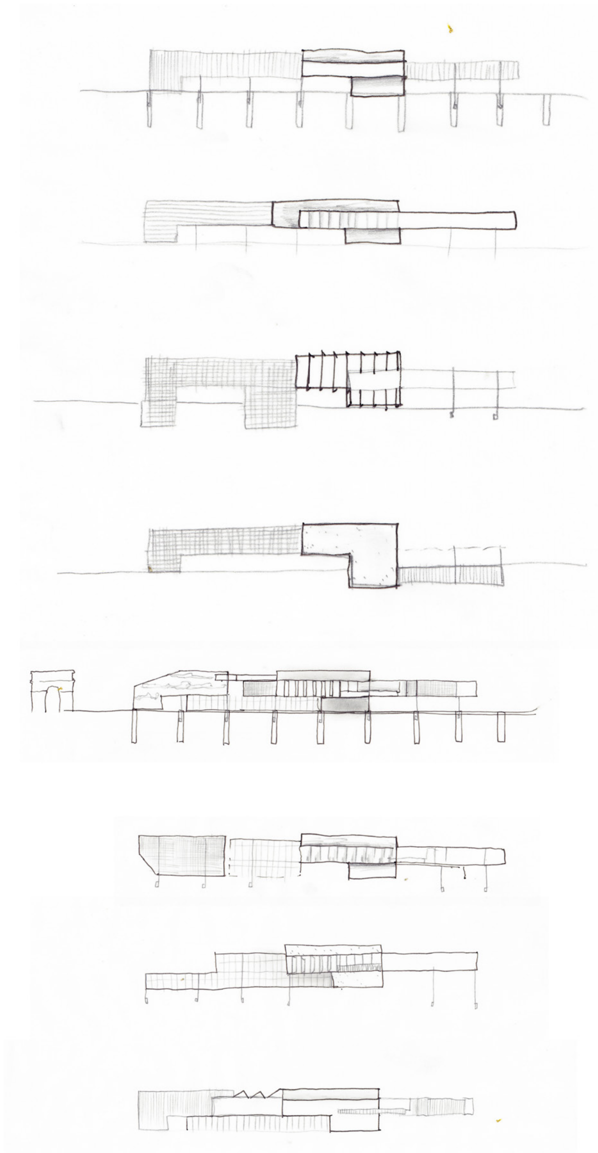


Fig 6.47. Evolution of eastern elevation (Author, June 2016).

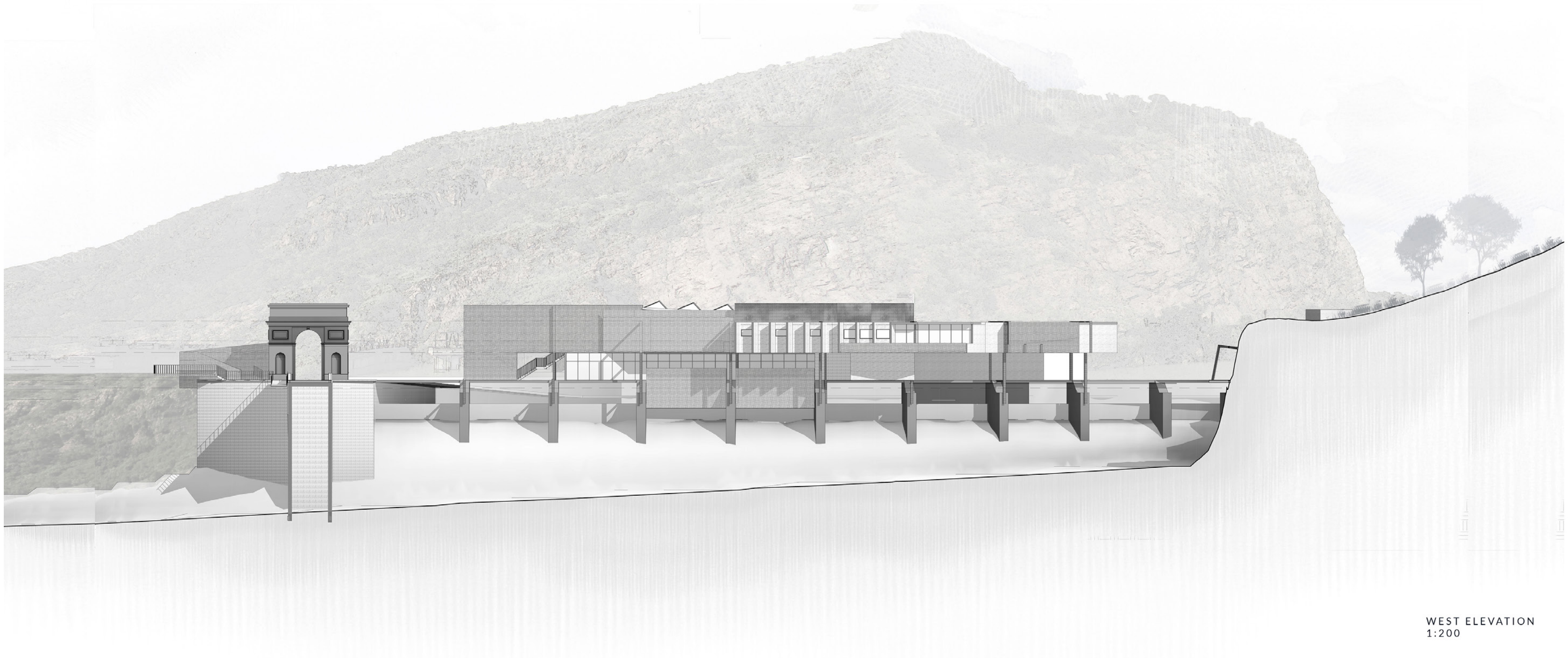


Fig 6.48. West elevation (Author, June 2016).

Fig 6.49. 1:200 model of site and intervention (Author, June 2016).

Fig 6.50 1:200 Model for June crit (Author, June 2016).

Fig 6.51 1:200 Model for June crit (Author, June 2016).

6.12 Landscape

The site was broken down into six different types of landscapes. From this approach the two different strategies could then be stitched together to form one cohesive design. Each different type of landscape makes exchanges with one another as well as exchanges with themselves. Understanding/knowledge is left out of this as it is an overall principle that is experienced throughout the site at different levels, ranging from passive education to formal training.

Fig 6.52 Analysis of landscapes (Author, June 2016).

Infrastructure

The mono-functional elements on site that control the water are defined as infrastructure. Included in this landscape is the pump house and control room. This does not include the dam wall as this is a multifunctional element as it also serves as a road and forms part of the historical landscape.

The infrastructure becomes the platform for the social spaces which were previously closed off to the public. The infrastructure was identified as being a key location that was a direct connection to water and has the strongest possibility to change people's perception of it.

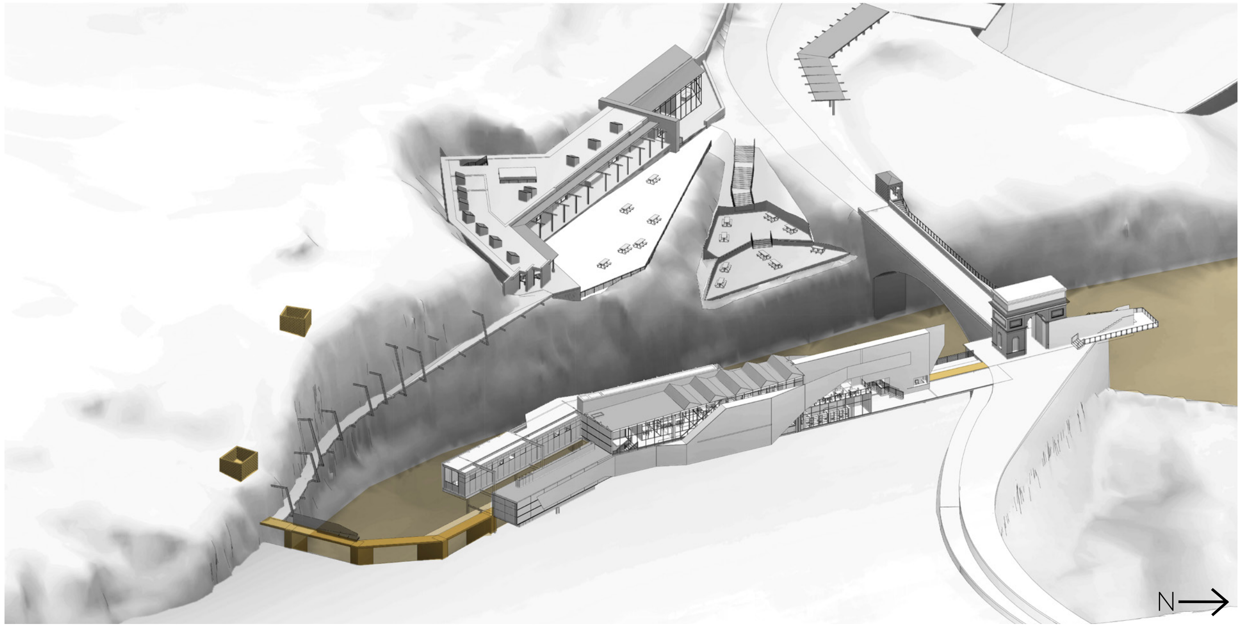


Fig 6.53 Infrastructure landscape (Author, June 2016).

Historical landscape

The historical landscape is defined as all the remnants and memories of the past infrastructure, as well as the consequences, ranging from the remaining structures to the scarred landscape. Creating social awareness of the past historical landscape and the paradigm that it represents, utilising these buildings to emphasize the change in thought. By reusing these buildings they gain a new life and continued existence as a resource- rich infrastructural artefact. How the new structure meets the arch is a key point to represent this.

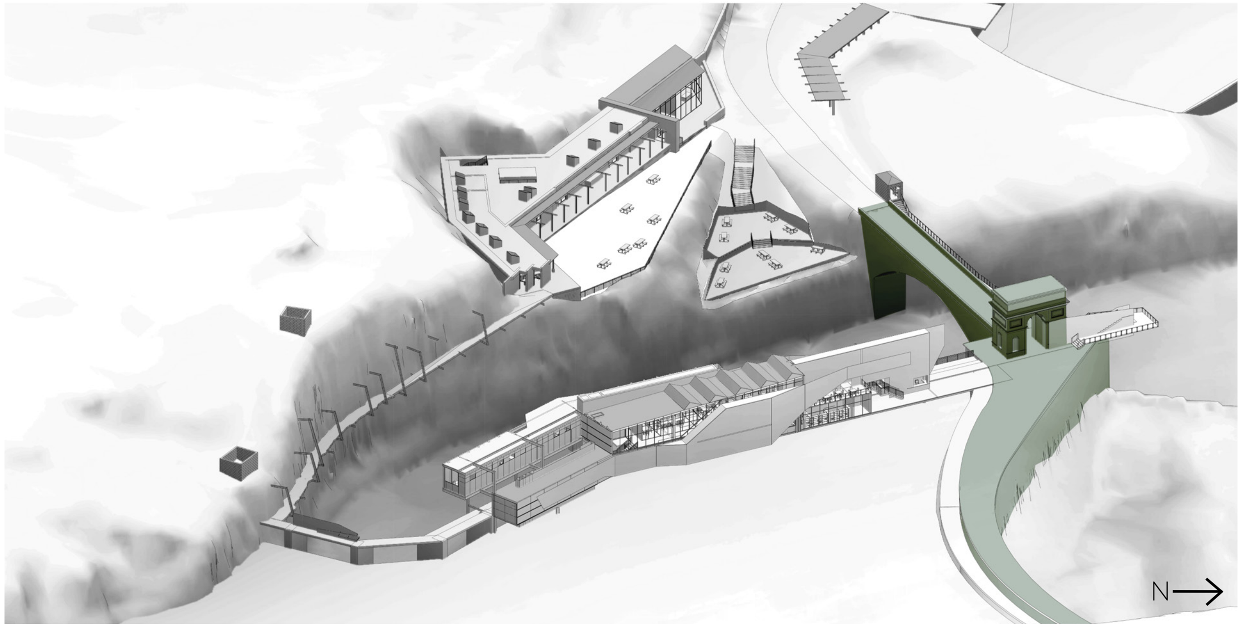


Fig 6.54 Historical landscape (Author, June 2016).

Social landscape

The social landscape was identified as all the spaces that contain human activities, ranging from the ones of visitor to the everyday labour.

The social landscape allows for social interaction between all other landscapes. People are immersed in nature and its processes experiencing life as part of nature rather than separate from it. These interactions are key to maintaining the site as well as changing the way they interact with their own landscapes.

The social landscape is specifically arranged as a journey to gain a greater haptic understanding of the site. This will be complimented through the qualities of the spaces expressed through materiality and tectonics and the expression of these exchanges.

Rather than relying on the remediation program of the dam there will be more of an effect by linking social spaces to problems that exist in and around the dam. By changing the way people perceive water, using this paradigm shift to rehabilitate the dam.

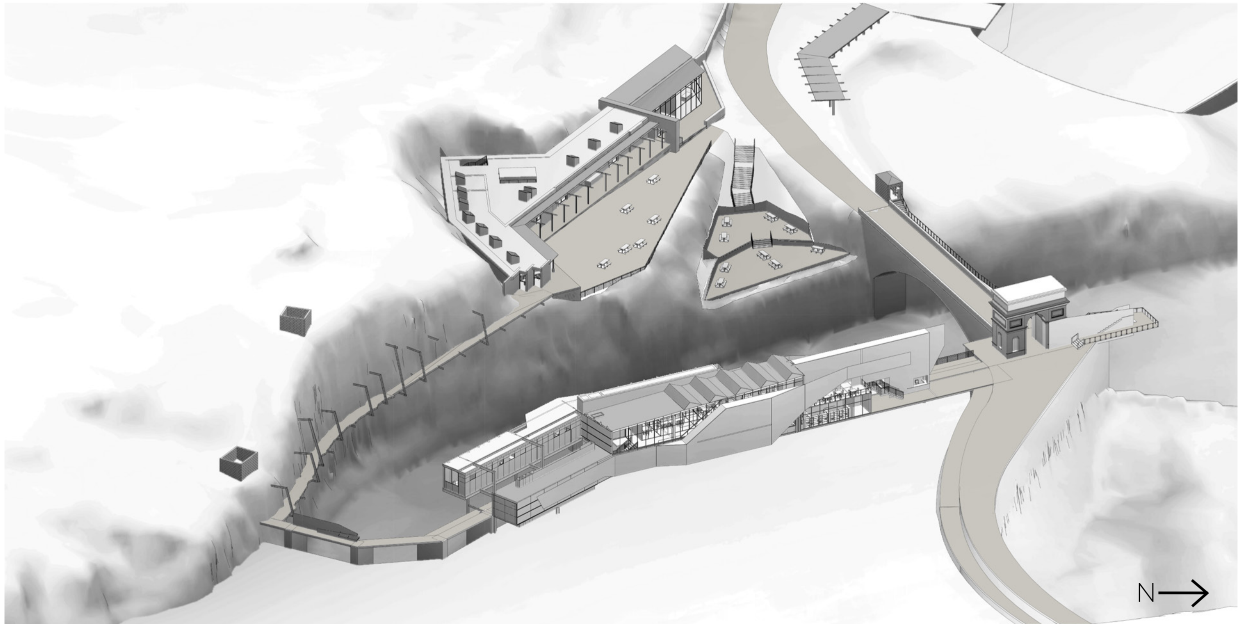


Fig 6.55 Social landscape (Author, June 2016).

Scarred landscape

The scarred landscape was created by the construction of the dam as well as the further exploitation of the water it contains. This is part of the remnant that has been created by the past paradigm. This landscape becomes the new site to build upon. All the exchanges try to rehabilitate this scar through direct influence or indirectly through changes to people's perceptions.

The vermiculture building has a planted roof, this gives back the green space that the building footprint takes up on site. Bioswales will also be introduced on the hillside above the roof to prevent run off that has been worsened due to the scar. The compost created in the vermiculture building will then be used to rehabilitate natural vegetation on the hillside above in order to recreate the condition that was there before. The platform walkway that links the vermiculture building to the crest gates walkway will be supported on steel I beams that are bolted to base plates that are anchored into the bedrock. These I beams support planter boxes to start vegetation reclaiming the scarred surface.

The water body itself is also regarded as part of the scarred landscape and through the removal of algae and Hyacinth, as well as the floating wetlands, the nutrients will be extracted slowly but surely out of the water allowing it to reach equilibrium again.

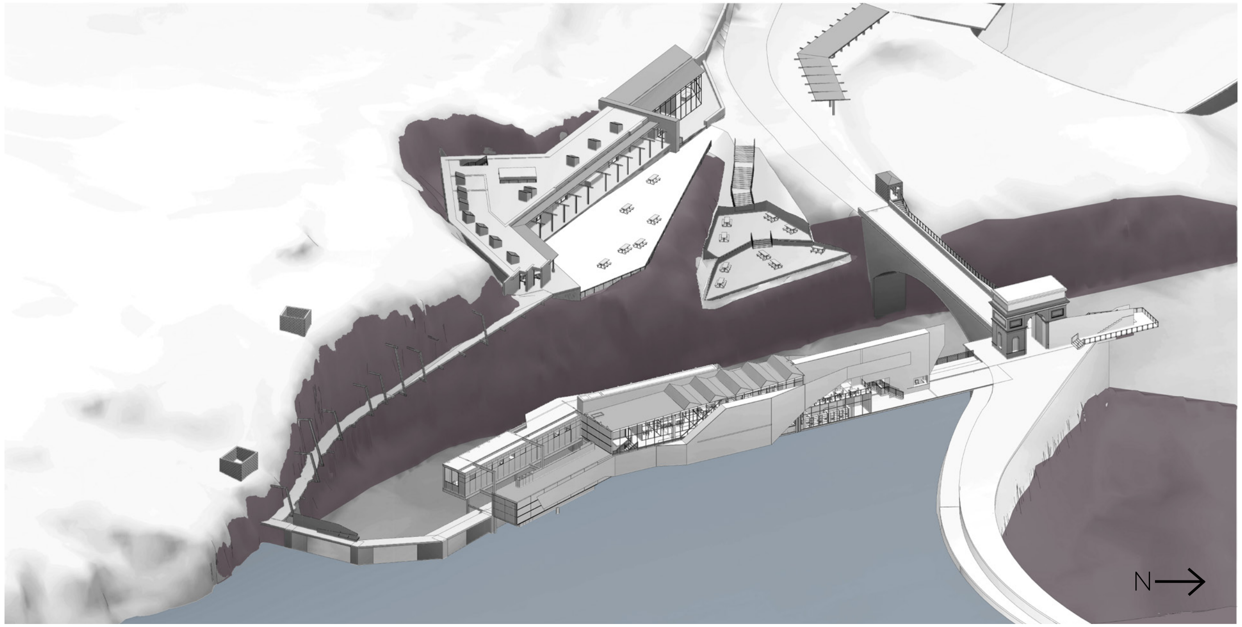


Fig 6.56 Scarred landscape (Author, June 2016).

Productive landscape

The productive landscape is all the spaces that cater for the user. These spaces aim at creating equilibrium in the scarred landscape and the dam water. In a similar way to nature utilizing the abundance of nutrients in the water and so it feeds other systems. The productive landscape contains man facilitated natural systems that aim to create equilibrium and self-healing properties of nature. The majority of exchanges happen between this landscape and another. Social and productive spaces are shared and intersect with one another and use infrastructure as a platform to do this. The productive landscape ranges from creation of energy to biodegrading of the hyacinth that is contained in the dam.

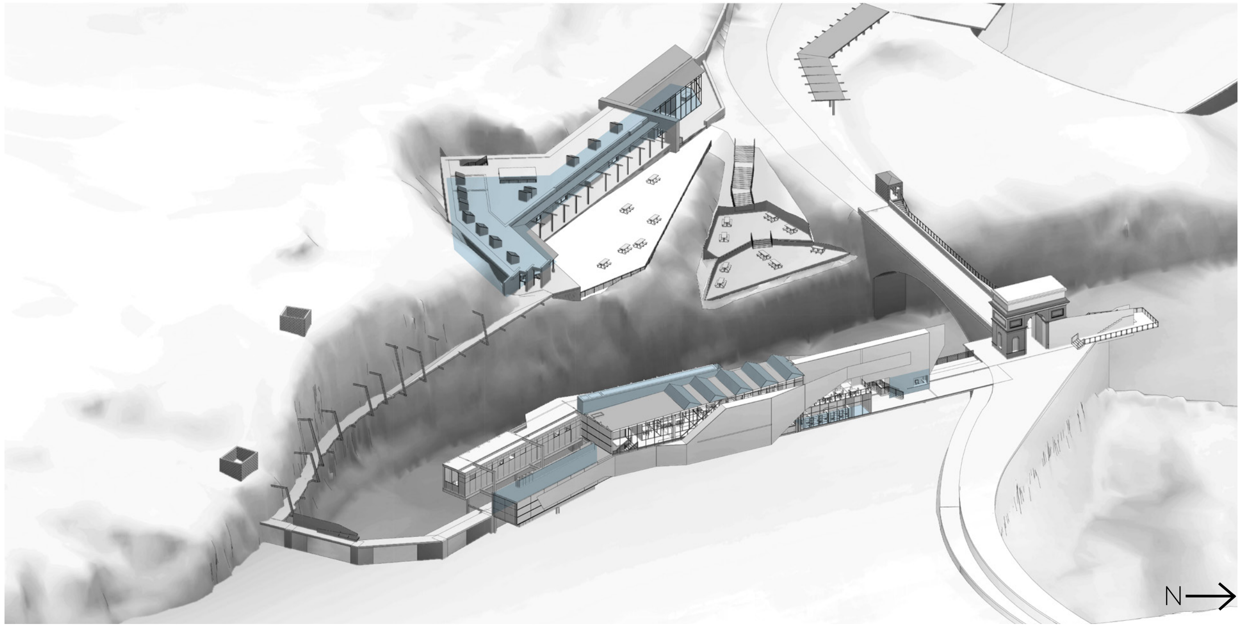


Fig 6.57 Productive landscape (Author, June 2016).

Synthetic landscape

This synthetic landscape is defined as the landscape that would not naturally occur in this environment but it has been created by man. This landscape does not try to recreate the landscape that once occurred naturally on this site but aims to create a new landscape that feeds into the exchanges on site. It is located on top of the building that is situated on the scar, that has already been created, so not to harm more of the site. Vertical crops have been placed on the solar screen to clean the dam water to potable water level.

The vertical wetland purifies the water by absorbing the minerals in the roots of the plants. Smaller plants such as the herbs and vegetables, for example coriander, basil, lettuce, tomatoes and strawberries, will be growing in the hanging water channels.

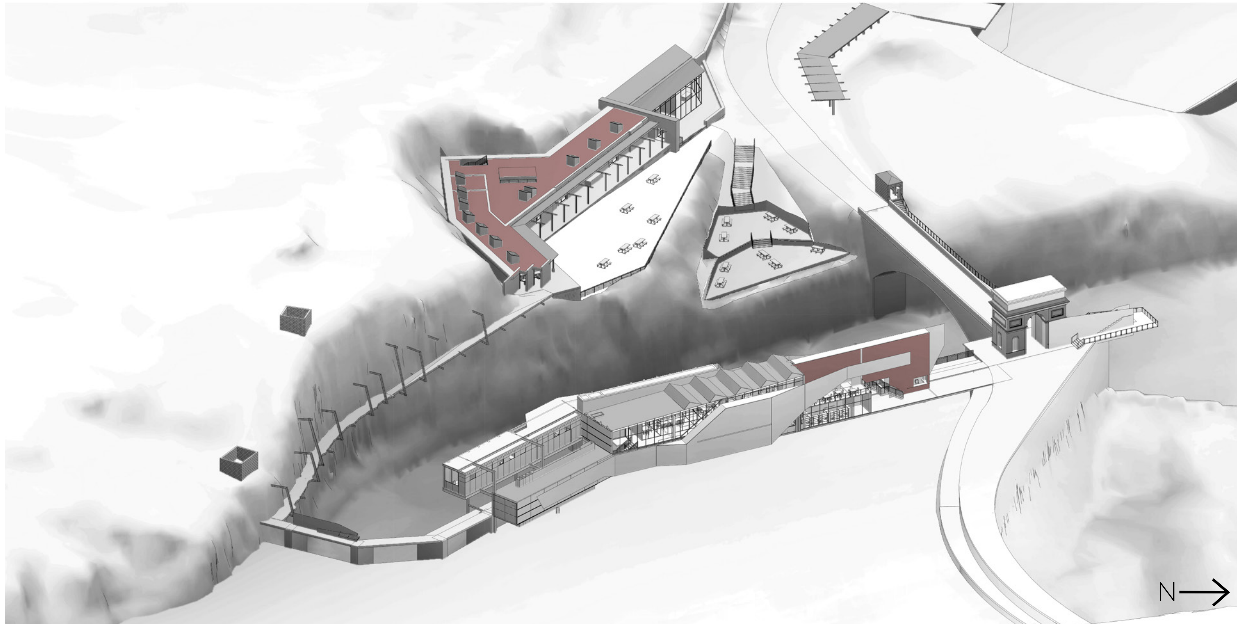
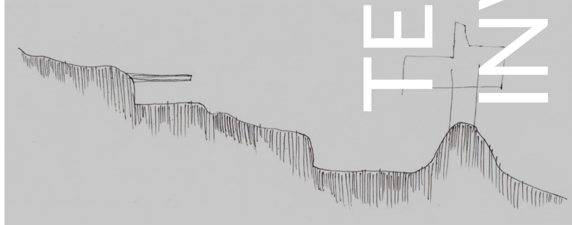


Fig 6.58 Synthetic landscape (Author, June 2016).

Chapter 7:
Developing of space

TECHNICAL INVESTIGATION



7.1 Concept

The design concept was to create exchanges between the site, infrastructure and the user. In a similar way the tectonic concept was to highlight how these exchanges happen, to look at how services can create space and change their language, in a similar way as the High-Tech architects approached the design services in their buildings. To do this a focus was placed on to the services spaces and how they provide for the served spaces. Articulation of these service spaces would give an understanding to the user of these exchanges. Articulation of the services themselves to reveal them to the user, such as services pipes and ducts.

The exchanges in the two spaces serve different entities on site. In the vermiculture building most of the exchanges serve the landscape or site, but in the case of the public interface exchanges cater for the user, in the majority.

Highlighting these two exchanges groups gave different forms to the sections. The vermiculture building looked at integrating itself into the landscape and growing out of it, whereas the public interface building attached itself to the existing infrastructure.

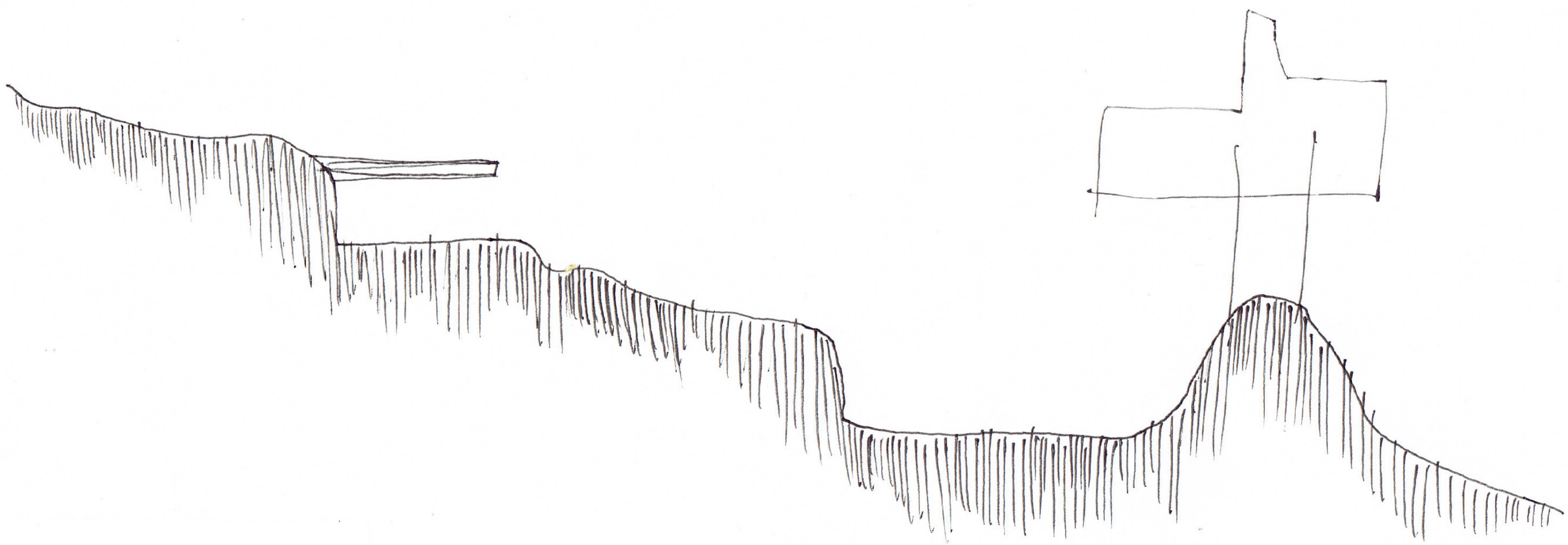


Fig 7.1 Tectonics sections of whole site (Author, September 2016).

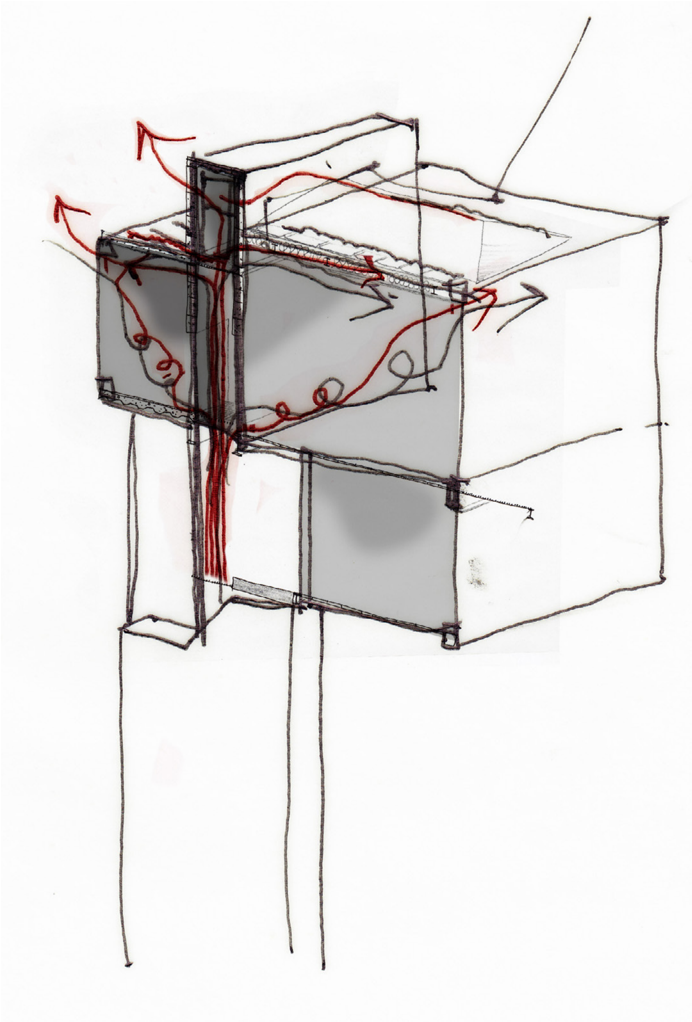
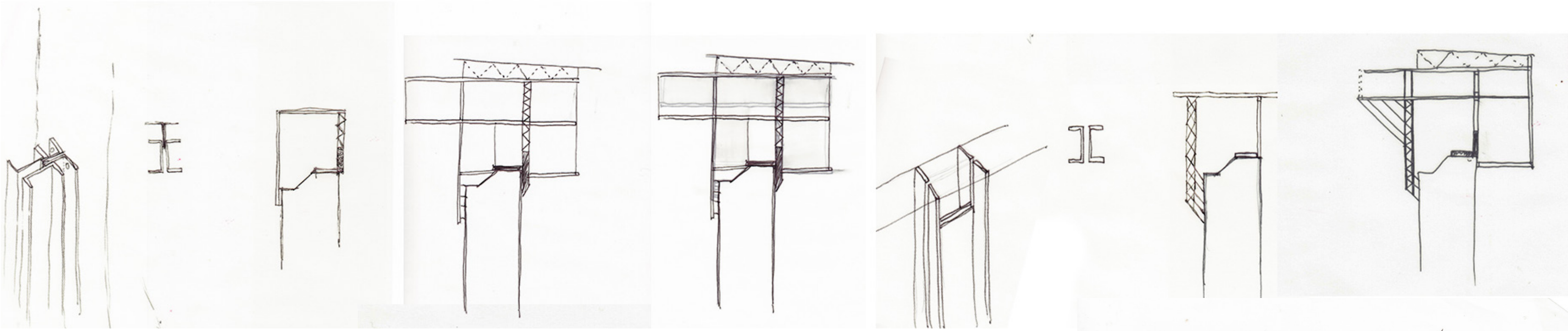


Figure 7.2 shows the flow of exchanges through the service core and into the public interface. These exchanges range from electricity to air flow.

Fig 7.2 Tectonics sections (Author, September 2016).

Fig 7.3 longitudinal section (Author, September 2016).



Section development shown here was to investigate the relationship to the existing infrastructure and how the new building attaches itself to this. Through this it was identified that floor materials were a key element in identifying which kind of space the user is in.

Portal frames were identified as being the primary structure. They could be pre-assembled offsite and then simply brought to site and erected in place by means of an extendable crane. This eliminates the difficulty of building scaffolding on site as there is little to no space to do this. This portal frame would then be used to build the rest of the structural form.

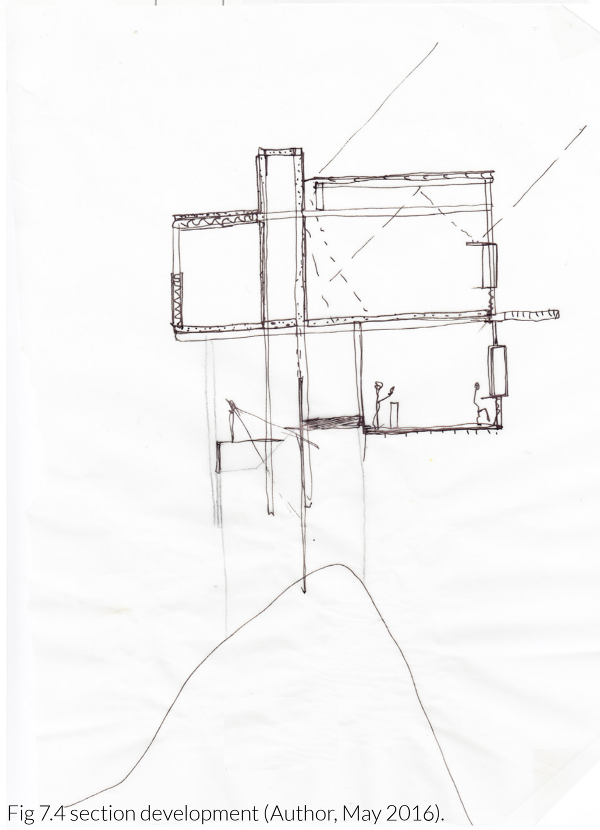


Fig 7.4 section development (Author, May 2016).

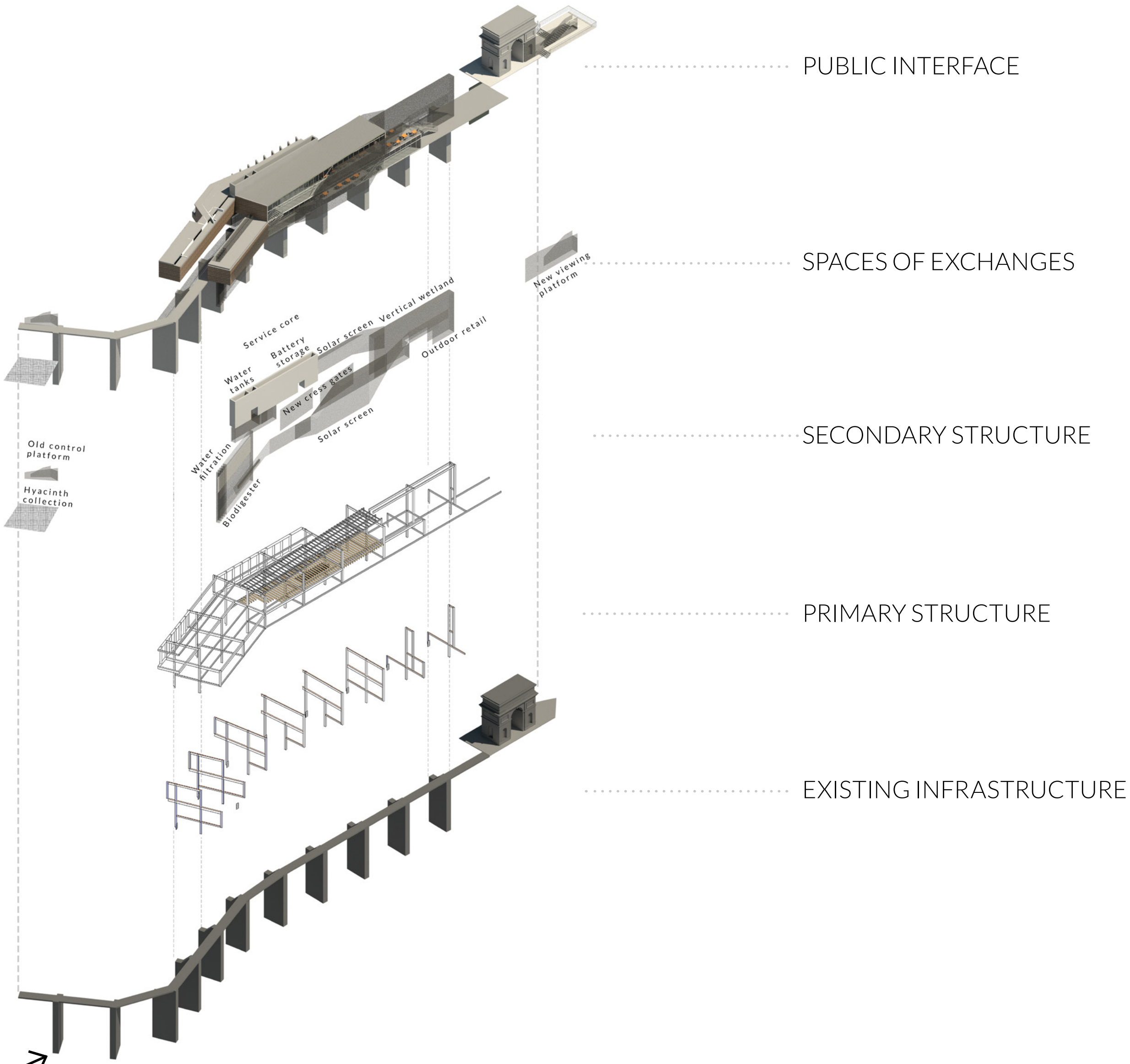


Fig 7.5 Layers of building and structure (Author, September 2016).

7.2 Structure

Figure 7.5 expresses the five layers of the building.

The existing infrastructure was used as a support for the new building giving it a new function and changing its role in society.

The primary structure is made up of steel portal frames that change throughout the length adapting to the form of the building. These portal frames are made from H columns and I beams that then support the secondary structure.

The secondary structure is made up of many different members and materials. For the substructure of the walls there are steel square hollow sections and Lipped c channels that make up frames that are bolted to the steel portal frames. For the floor there are timber beams that are hung between I beams that span between the portal frames.

The roof is made up of I beams as rafters that span between the portal frames and on top of this there are lipped c channels as purlins.

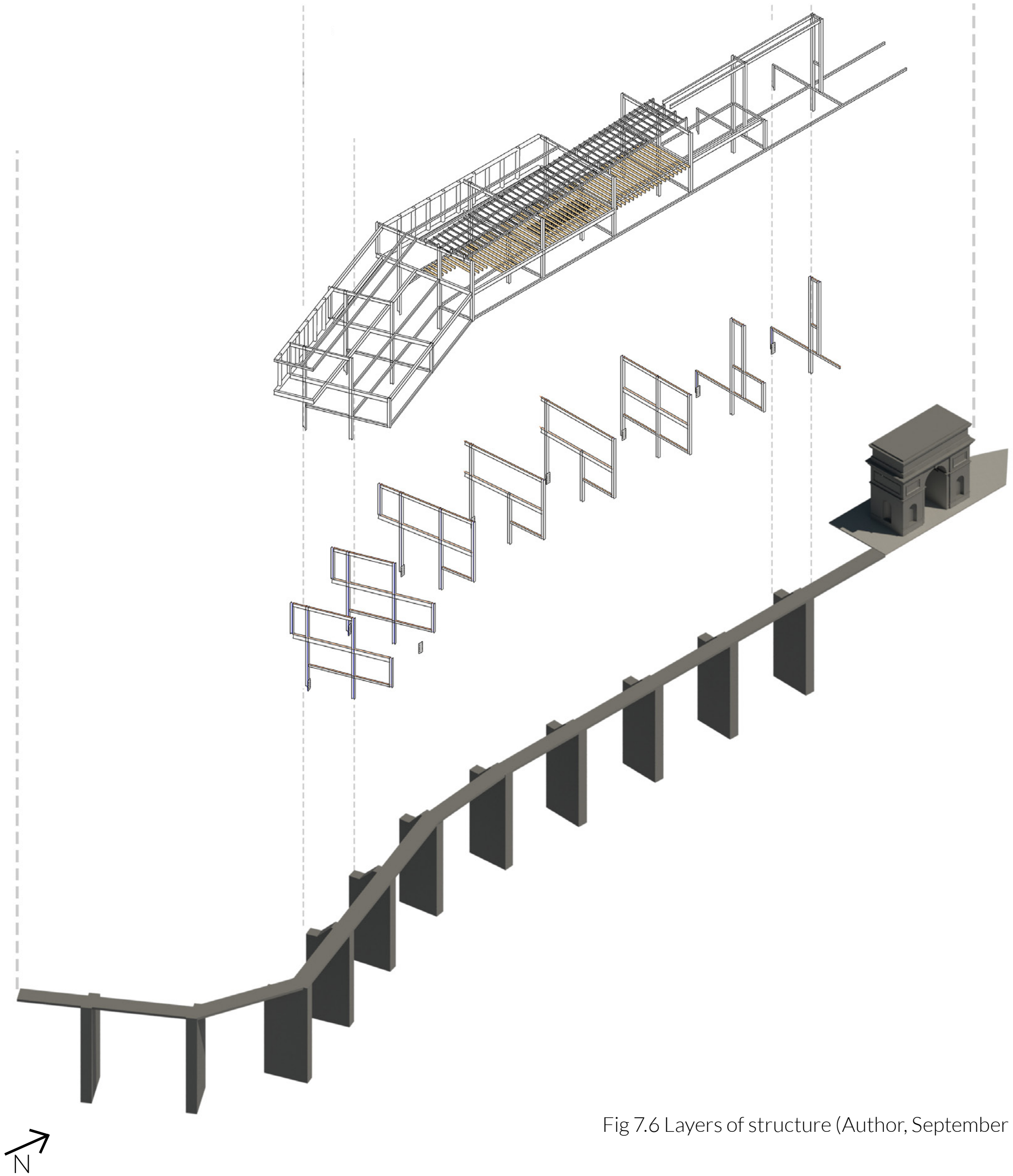


Fig 7.6 Layers of structure (Author, September 2016).

The spaces of exchanges that twist through the building create service spaces for the public interface which become served spaces. The series of exchanges range from being an entire space within the building to a singular wall that plays a specific role in the exchanges. The primary service core that runs between the kitchen and the restaurant space deals with many different exchanges. Contained within the wall there would be water tanks for water collection, batteries for power storage and ducts to facilitate air movement into the spaces.

The public interface is made up of the restaurant space and retail space below. The kitchen being primarily a services space is seen as part of the spaces of exchange but partly in the public interface such as the offices spaces.

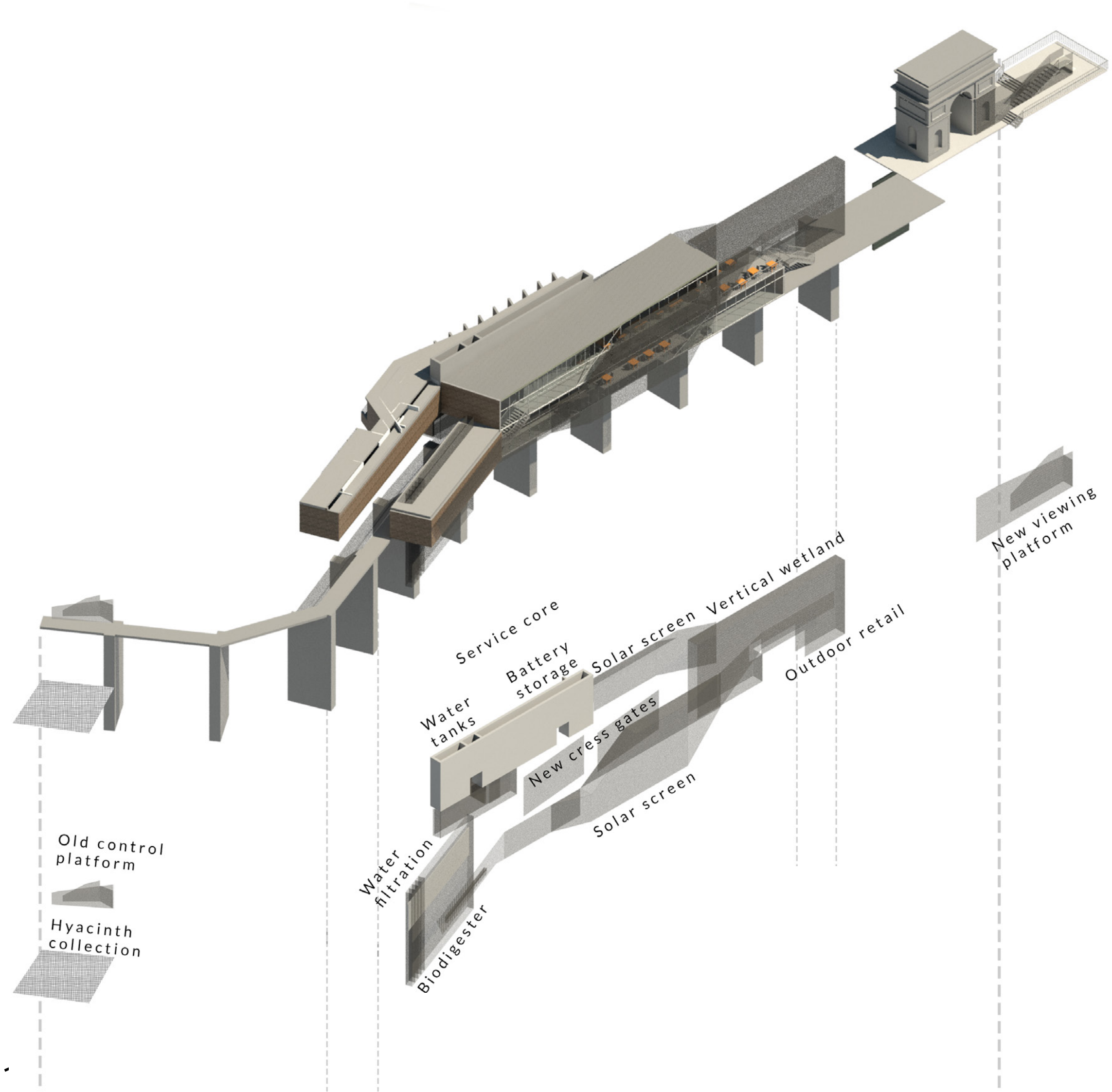


Fig 7.7 Layers of building (Author, September 2016)..

7.3 Material

Existing materials

The materials on site that exists now had to be analysed in order to make decisions on materials for the new design.

The infrastructural materials consist of concrete and steel of the crest gates. The dam wall itself is also made from concrete and steel but only the concrete is visible.

The most important material on site, water, has turned to a green pea soup colour due to the eutrophication. This element clearly shows that the site is unbalanced and needs to be rectified. This material has the most potential but yet is actually causing the most issues.

The bedrock has been exposed through the construction of the dam as they had to cut into the "poort" in order to dam the water. This has become quite an important material that surrounds the site.

Fig 7.8 Crest Gate (Author, September 2016).

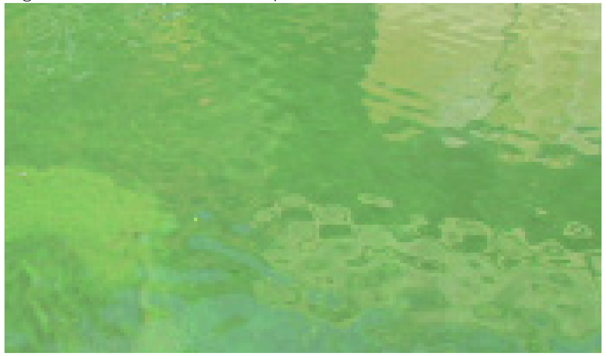


Fig 7.9 Water (Author, September 2016).

Fig 7.10 Bedrock (Author, September 2016).

The Public Interface, restaurant and retail spaces

The public interface has a defined services core, where exchanges run vertically as well as horizontally into the restaurant space and retail space. These exchanges range from creating ventilation for climatic reasons, to housing of batteries for storage of power that then feed into the spaces.

Due to the difficulty of construction on site, wet construction was kept to a minimum. Prefabricated elements were rather used as they could be brought onto the site and erected quickly. This became a challenge when choosing wall materials. As the substructure was already to be steel, some kind of cladding could be placed upon this. Alucabond was identified as a good material for wall application

Structural members

Steel sections are the main structural members throughout the project; this is because of their large span capability. The joints between these members would mainly be bolted together on site. This would allow the smaller elements to be transported to site and then assembled in place.

All of these members would be pre-painted and galvanised in order to minimise finishes on site because of the difficulty of placing of scaffolding.

Large steel I beams and H sections make up the main portal frame. The secondary structure is primarily made from square hollow sections and C sections. This forms the sub structure for the wall cladding.

Fig 7.11 Square hollow section (bracket sand bolts, 2016).

Fig 7.12 C section (bracket sand bolts, 2016)

Fig 7.13 I section (bracket sand bolts, 2016)

As the building continues to perform its role in changing the way that society interacts with water then the water should start to change back to a more natural colour. This means that water is the key element to engage the effectiveness of understanding. This means that water needs to be expressed in the building in the same state it is in the dam, forcing a direct interaction with the problem.

Water will be used to change the hue of the light that enters into the space, by passing light through it or reflecting it off the water. This hue will change with the quality of the water over time. This will give a very direct and tangible relationship to the water and its quality.

Lights will be installed below the water so at night when they are turned on, the building will be washed with the colour of the water and constantly change as the water moves.

Fig 7.14 Torafu Architects (Water Projection Art Installation, 2016).

Wall materials

It was necessary for the services core to have a different material language then the served spaces. For this the existing site was looked at for inspiration, the previous series element was the crest gates which are made from concrete and steel, therefore these became the materials of choice for the new service core. Foam concrete panels were used as a substitute, due to the weight of in situ concrete. These panels will be pre-manufactured and then brought onto site and erected onto a light square gauge hollow section frame.

The public spaces such as the restaurant and the retail space would be made from lighter elements such as the suspended timber floors, Alucabond and glazing to highlight views. Alucabond was identified as a good material as it is durable and relatively maintenance free which was a key aspect because of the harsh environment, constant water condensation and direct sunlight. The aluminium composite panel consists of a non-combustible high-filled mineral core. The system has it own unique substructure which can be added onto the steel frame. A tray panel fixing system will be used for this project, as the panels will be able to be fixed from the inside.

Alucobond spectra sakura finish was chosen to be the primary finish. As can be seen in fig. 7.16.1, this finish allows the surrounding colours to be reflected in the facade without creating glare or mirroring the surroundings. In this way the building will pick up the colours of the water and the landscape around it, slowly changing as the systems take effect. The building will also change from the east to the west side. On the east side it would reflect the colours of the natural ground and bedrock but on the west side it would reflect the colour of the water and hyacinth.

Fig 7.15 Foam concrete (Buildbase, 2016).

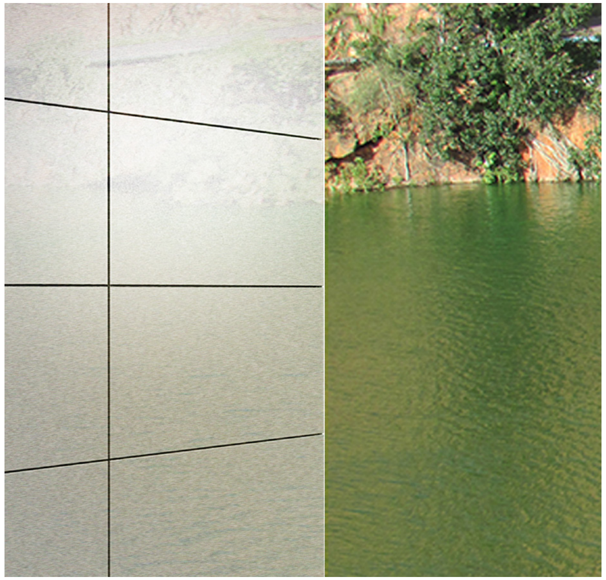


Fig 7.16.1. Alucobond panels reflecting colours of site(Adapted by author. June 2016).

Fig 7.16.2. Alucobond panels (Alucobond, 2016).

Flooring materials

As already stated throughout the design process, floor material was identified as being a good way to indicate which kind of space the user was in. Three main materials were identified; precast concrete slabs, suspended timber floors and steel gratings.

Originally concrete precast slabs were looked at as a flooring method as they would be simply brought to site and placed in the correct location. Due to weight and large spans on a suspended area of the building this would not be possible. Alternatively wood suspended floors have been investigated. This material would also create a better contrast between the existing infrastructure concrete walkway and the new interface.

Precast concrete slabs would be used in the kitchen and offices space. These spaces made up part of the service spaces and therefore needed to reflect somewhat the previous materials of the service element on site.

Steel grating would be used as the floor for the service core as this would make it transparent from below so that the public could see into the space from the existing walkway on site. This will also allow air movement that would ventilate the spaces on either side.

Suspended timber floors were decided on for the restaurant, bar and retail space. This would create a visual, tactile and audible contrast between the existing concrete walkway and the lighter timber floor. Due to the constructability it was necessary to choose a lighter flooring solution.

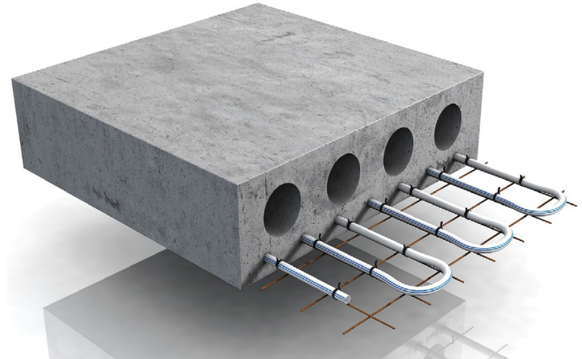


Fig 7.17 Pre cast concrete slab (Hollowcore, 2016).

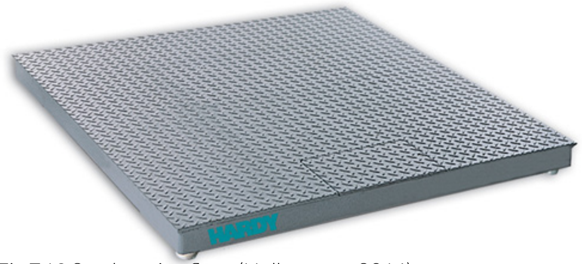


Fig 7.18 Steel grating floor (Hollowcore, 2016).

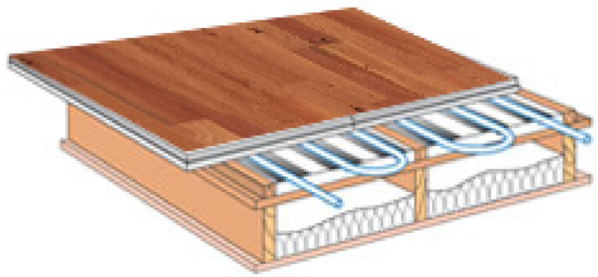


Fig 7.19 suspended timber floor (Hollowcore, 2016).

Roof materials

The roof structure will be supported on steel I beams that span between the main portal frames. Between these beams will be cold formed steel lipped c channels as purlins. Expanded polystyrene will be in between the purlins as insulation. The roofing material will be klip-lok 700 at a 3° pitch. The roof sheets would be pre-painted with colour tech G4 grey to reflect as much light as possible. This roof surface is very large and therefore is a key point to stop heat gain and loss.

In the kitchen and office spaces, pre-cast concrete slabs would be used as a roof structure which would need a screed with a fall to it. On top of this would be a dual reinforced membrane specified for exposed waterproofing. Derbigum Special Polyester 4 mm Roofing is a UV stable, polymer modified bitumen waterproofing membrane that would could be used in this environment. (Derbigum, 2016)

Fig 7.20 steel lipped channel (bracket sand bolts, 2016).

Fig 7.21 Expanded Polystyrene (Globalroofs, 2016).

Fig 7.22 Klip-lok 700 (Globalroofs, 2016).

The Vermiculture and wetland creation space

The vermiculture building had very different material requirements compared to the public interface. This building aimed to rehabilitate the scarred landscape and was sunken into it via a cut and fill method. This meant that there would be a large amount of broken bedrock that could be utilised. Wet construction would be possible to construct on this part of the site and therefore was used. The roof structure became the most important element to continue the landscape and rehabilitation of it.

In situ concrete could be used for the floor and roof of the structure. Due to the one edge being completely sunken into the landscape water proofing problems needed to be dealt with. Two layers of walls would be used; in situ concrete as a exterior retention wall and as the internal surface a gabion wall would make use of the crushed bedrock that has been created on site.

This would make the internal space reflect the site condition, reminding the user of their location.

The planted roof aims to continuing the broken landscape over the building. This planted roof would be used to grow crops and herbs for the restaurant space. It would also, similarly as the double skinned wall, serve as a very good insulation.

Fig 7.23 Insitu concrete floor (Hollowcore, 2016).

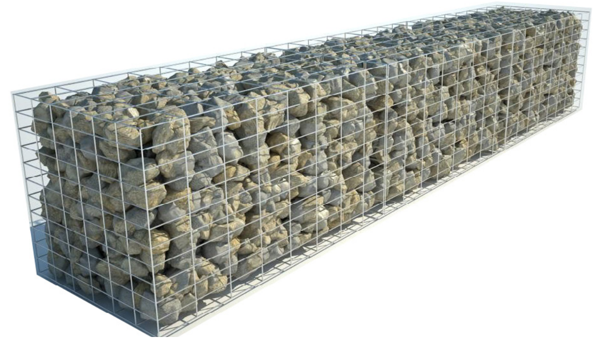


Fig 7.24 Gabion wall (Turbosquid, 2016).

Fig 7.25 Planted concrete roof (Author, June 2016).

Services

The use of services themselves can become a material if they express the flow of energy from the systems. This will make the architecture understandable to any user and how the systems allow for the building to operate. Figure 7.6 show good examples of exposed and articulated services, such as water pipes and electrical conduits. Each of these services can be expressed in a different material in order for the user to differentiate between the different energy systems.

The exposing of the services will also indicate where the energy is coming from. This is necessary as not all the systems are visible from the internal spaces, such as the solar panels that create energy for lighting. By the use of exposed services these systems can be expressed in the interior spaces.

Fig 7.26. Exposed water and electrical conduits (Masquespacio 2016).

Fig 7.27. Expression of services (Archdaily. 2016).

Fig 7.28. Articulation of electrical wiring (josephine-road, 2013).

Fig 7.29. Lighting expression of power and energy (101pallets, 2013).

7.4 Section- Vermiculture and wetland creation space

To continue iterating each architectural language, sections were done through the vermicultural space as well as the restaurant space.

The vermiculture section looks at the space created in this building and how it portrays the intent of the architecture. Figure 7.27 shows the plan and where the section is cut through the building.

This building makes use of wet construction as it is much easier to construct on this site. The one side of the building, being completely sunk, is made of gabion walls to give a grounded feeling within the building. The gabion wall makes use of the excavated bed rock that would be created on site to sink the building into the scar. This space is lined with a much lighter walkway that facilitates movement along the space and then changes in structure to lead your eye directly across to the public interface on the crest gates to the east.

The section shows the lightwells that were introduced to bring diffuse light into the space due to the requirements of the vermiculture process. This also facilitates removal of heat through vents in the light shaft.

This building has a significant amount of thermal mass, as well as being sunk in underground, therefore temperature would remain constant all year round.

Due to the fact that there would be a constant flow of compost in and out of this area, the space needed to be easily cleaned. Rougher materials that would appear more natural in its context and showing less dirt were chosen.

The earthy smell of the vermiculture meant that ventilation needed to be thought of and therefore the vents in the light wells became quite important for air circulation.

Water is a crucial element in both the activities shown in the section, vermiculture and the growing of crops and herbs. It is therefore necessary to have a large storage tank. This tank was designed in such a way that it showed the change in activities from the upside. The tank was integrated into the wall between the public space of the vermiculture building and the actual vermiculture systems, which can be seen in elevation in the section of figure 7.29.

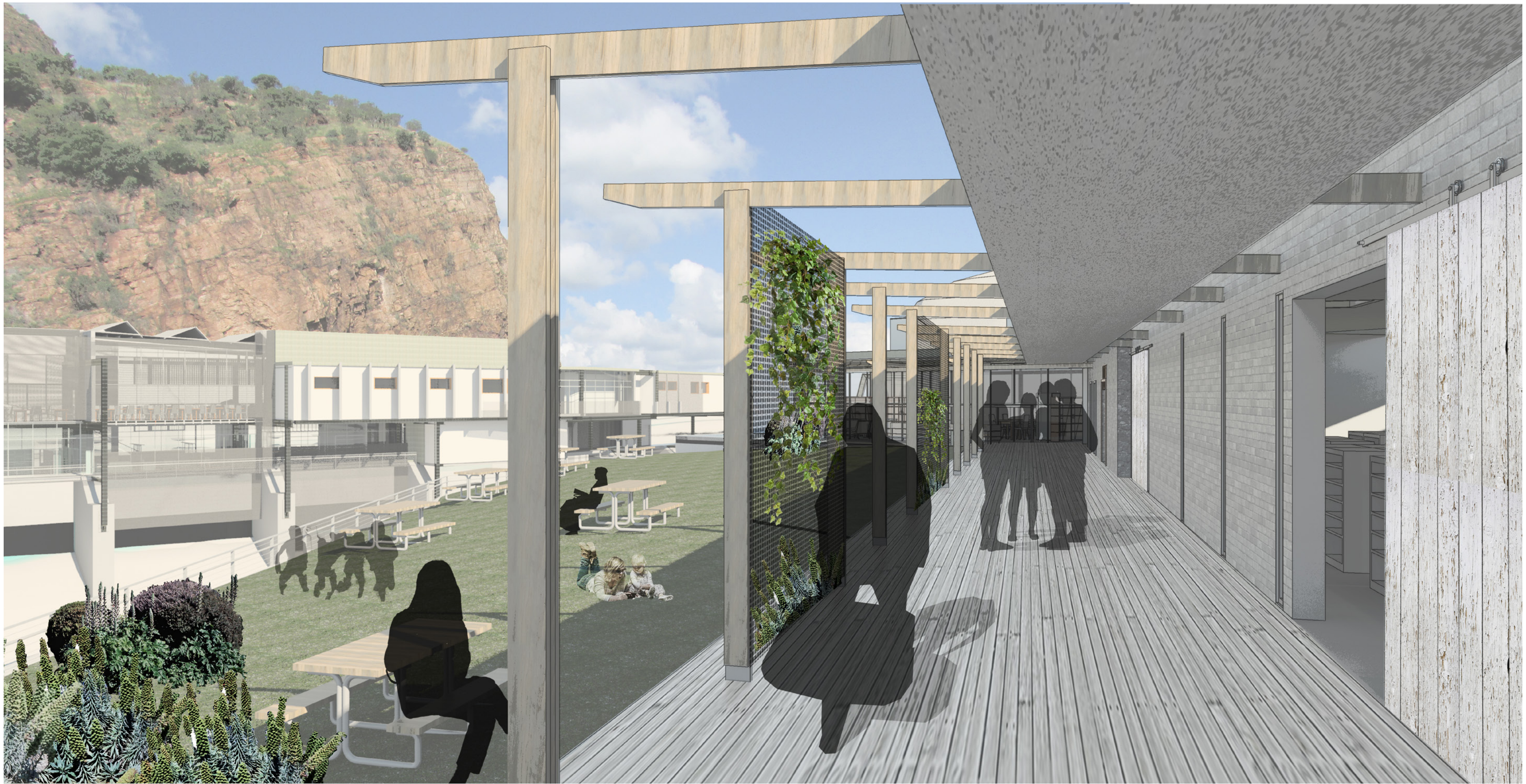


Fig 7.30 Vermiculture Public walkway (Author, September 2016).

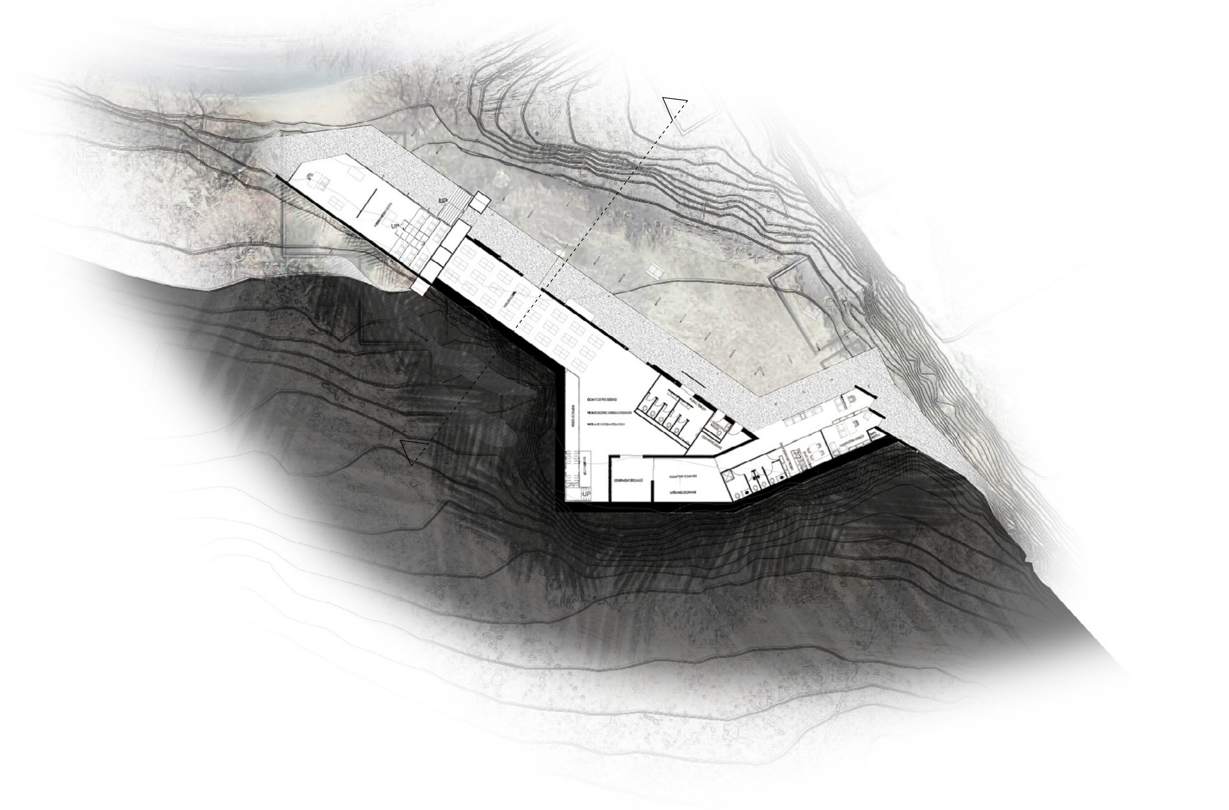
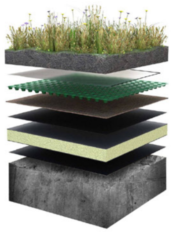
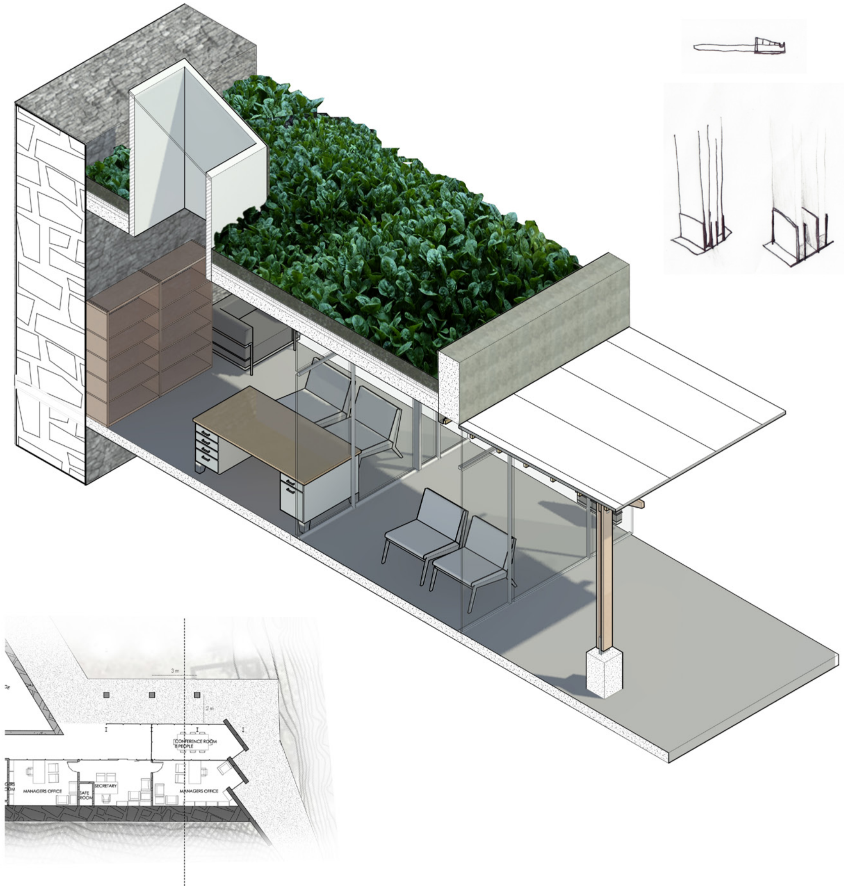


Fig 7.31. Vermiculture Building Plan (Author, June 2016).





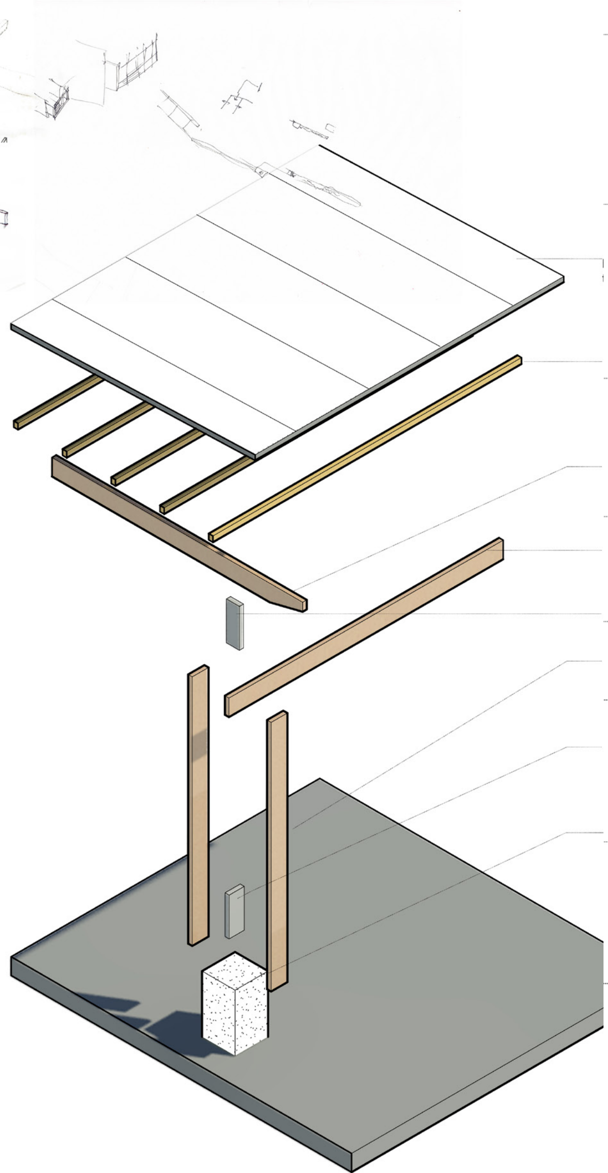
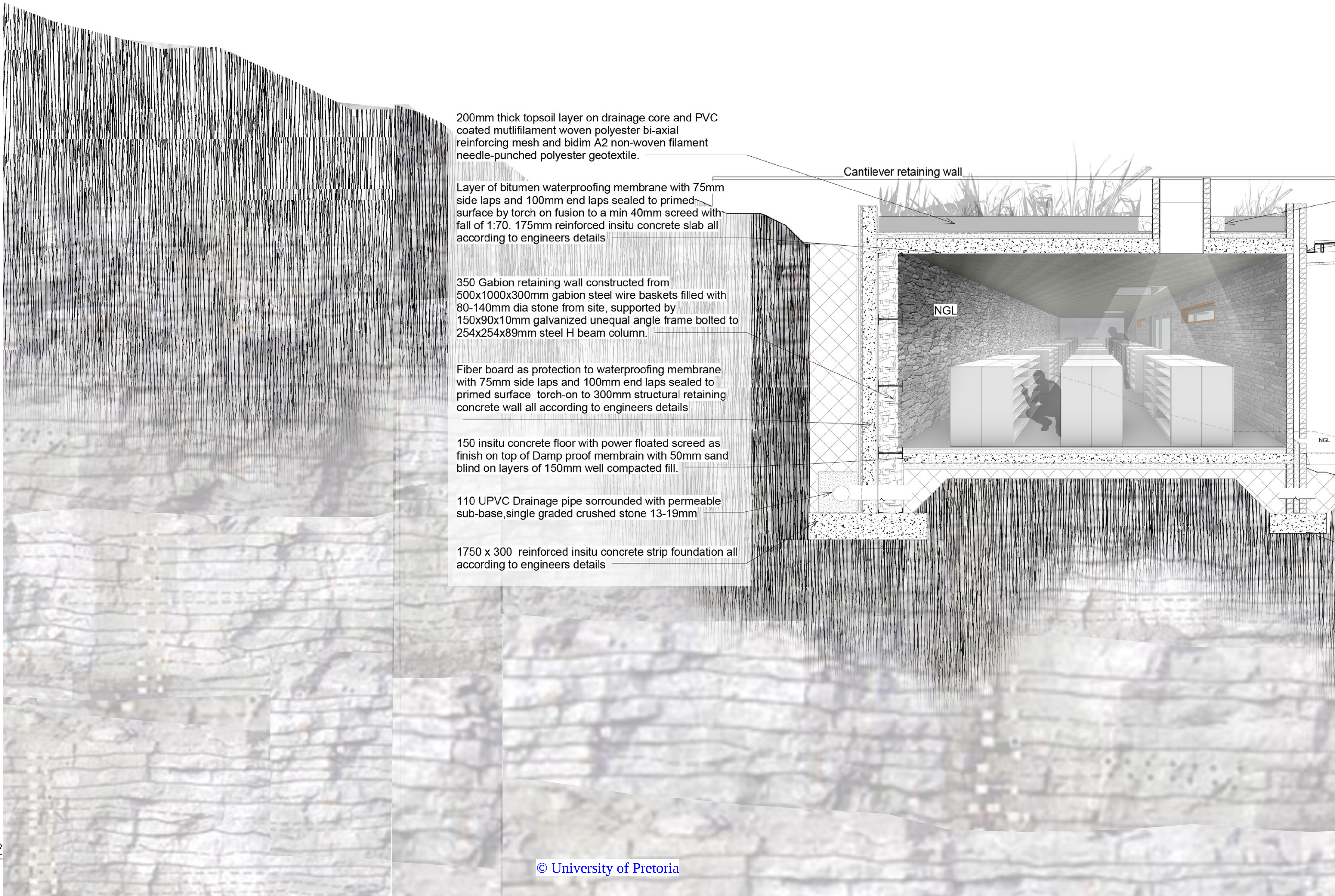


Fig 7.32. Layers of structure in section through vermiculture (Author, August 2016).


200mm thick topsoil layer on drainage core and PVC coated mutlifilament woven polyester bi-axial reinforcing mesh and bidim A2 non-woven filament needle-punched polyester geotextile.
Cantilever retaining wall
Layer of bitumen waterproofing membrane with 75mm side laps and 100mm end laps sealed to primed surface by torch on fusion to a min 40mm screed with fall of 1:70. 175mm reinforced insitu concrete slab all according to engineers details
350 Gabion retaining wall constructed from 500x1000x300mm gabion steel wire baskets filled with 80-140mm dia stone from site, supported by 150x90x10mm galvanized unequal angle frame bolted to 254x254x89mm steel H beam column.
NGL
Fiber board as protection to waterproofing membrane with 75mm side laps and 100mm end laps sealed to primed surface torch-on to 300mm structural retaining concrete wall all according to engineers details
NGL
150 insitu concrete floor with power floated screed as finish on top of Damp proof membrain with 50mm sand blind on layers of 150mm well compacted fill.
110 UPVC Drainage pipe sorrounded with permeable sub-base,single graded crushed stone 13-19mm
1750 x 300 reinforced insitu concrete strip foundation all according to engineers details

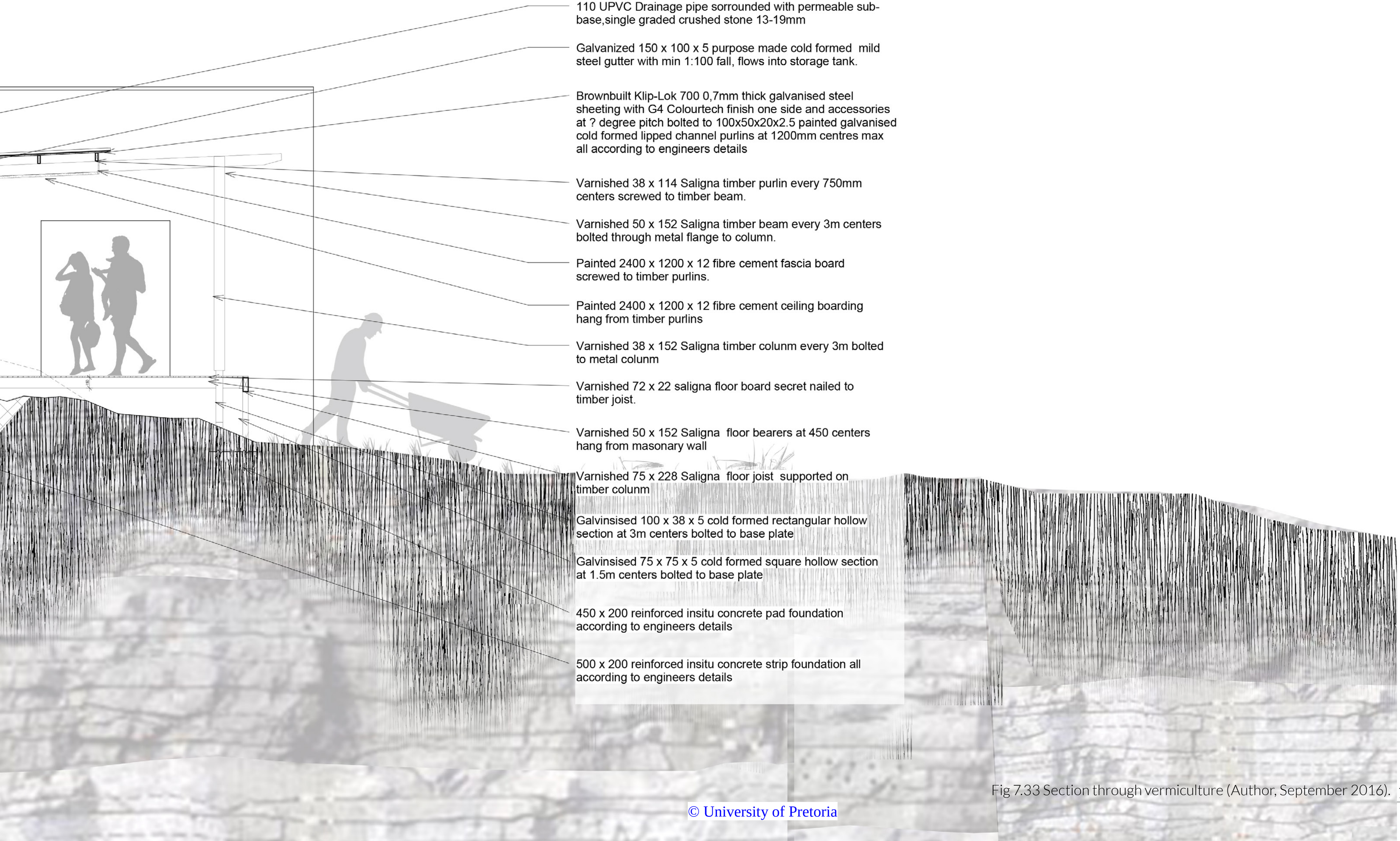


Fig 7.33 Section through vermiculture (Author, September 2016).

7.5 Section- Restaurant and kitchen space.

Figure 7.31 shows the plan and where the section is cut through the building. This section shows the restaurant space, bar area and kitchen space. As well as the service core which houses water tanks, ducts and power batteries.

Through the iterations of the section it was clear that the roof plane and shading device became an environmental skin to the building and had to protect it from the sun, wind and rain. This made the living box within it a more comfortable space for the user.

The service core becomes the most important feeder to the other spaces. It needed to express the flow of exchanges. For example, the electric fittings would branch out from the service core. Similarly water pipes would run on the surface and then branch out into the kitchen. Even air ventilation would come through the metal grating in the service core and then into the spaces.

This section shows the different floor materials and how each space is characterised by its materials. It also shows where the structural members are and how they are revealed in certain places. A good example is the Vierendeel truss where, the wall reveals the square hollow section and at other times conceals it.

The materials clearly define what space the user is in, the kitchen and service core are made from stereotomic materials such as concrete, whereas the served spaces are much lighter and hang off the existing infrastructure. These spaces make use of light material such as timber and Alucobond.

The articulation of the roof plan was explored and the roof structure lifted off the primary portal frame as the volume increases lengthways to the building.

The crest gate moves up into the space blocking the view from the existing walkway down to the spillway when opened. When closed it becomes a balustrade for people to lean on.

The downstairs bar area opens up onto the existing walkway as well as on the dam side to allow an open and contained space.

It is visible in this section how the different power systems, such as the solar panel on the roof and the Pelton wheel are connected to the crest gate.

Fig 7.34 Restaurant space (Author, September 2016).

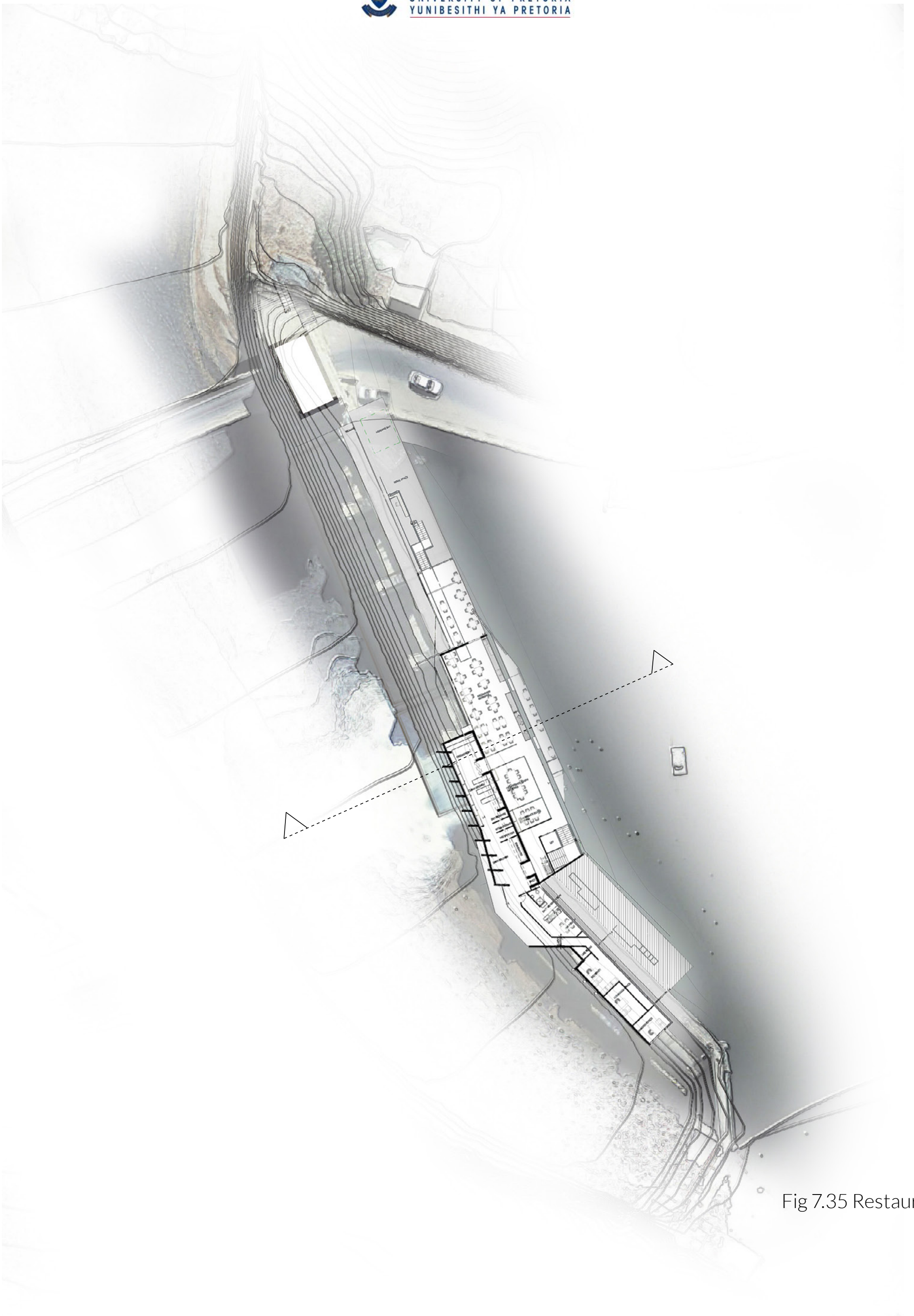


Fig 7.35 Restaurant Building Plan (Author, June 2016).

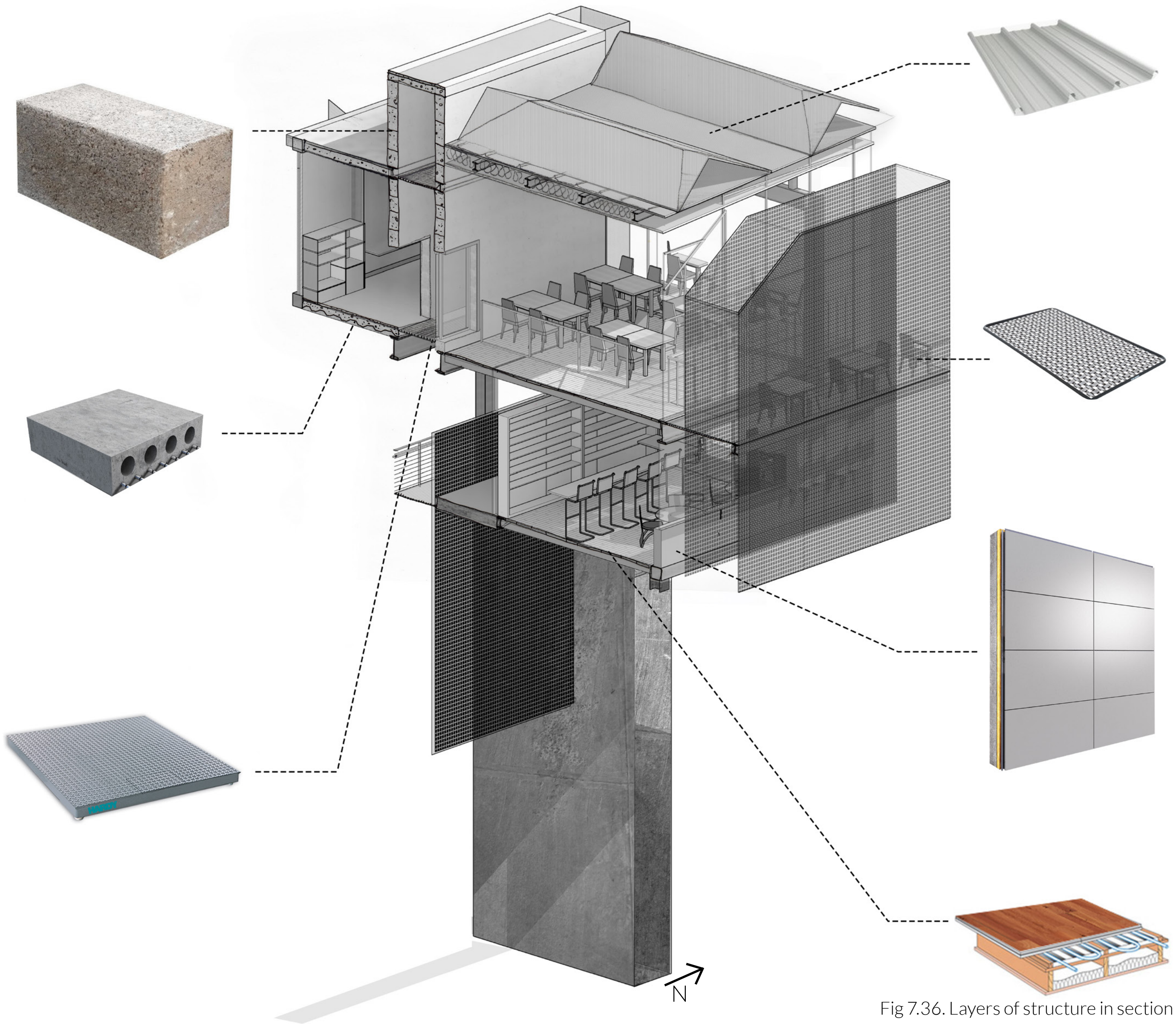


Fig 7.36. Layers of structure in section through restaurant (Author, August 2016).

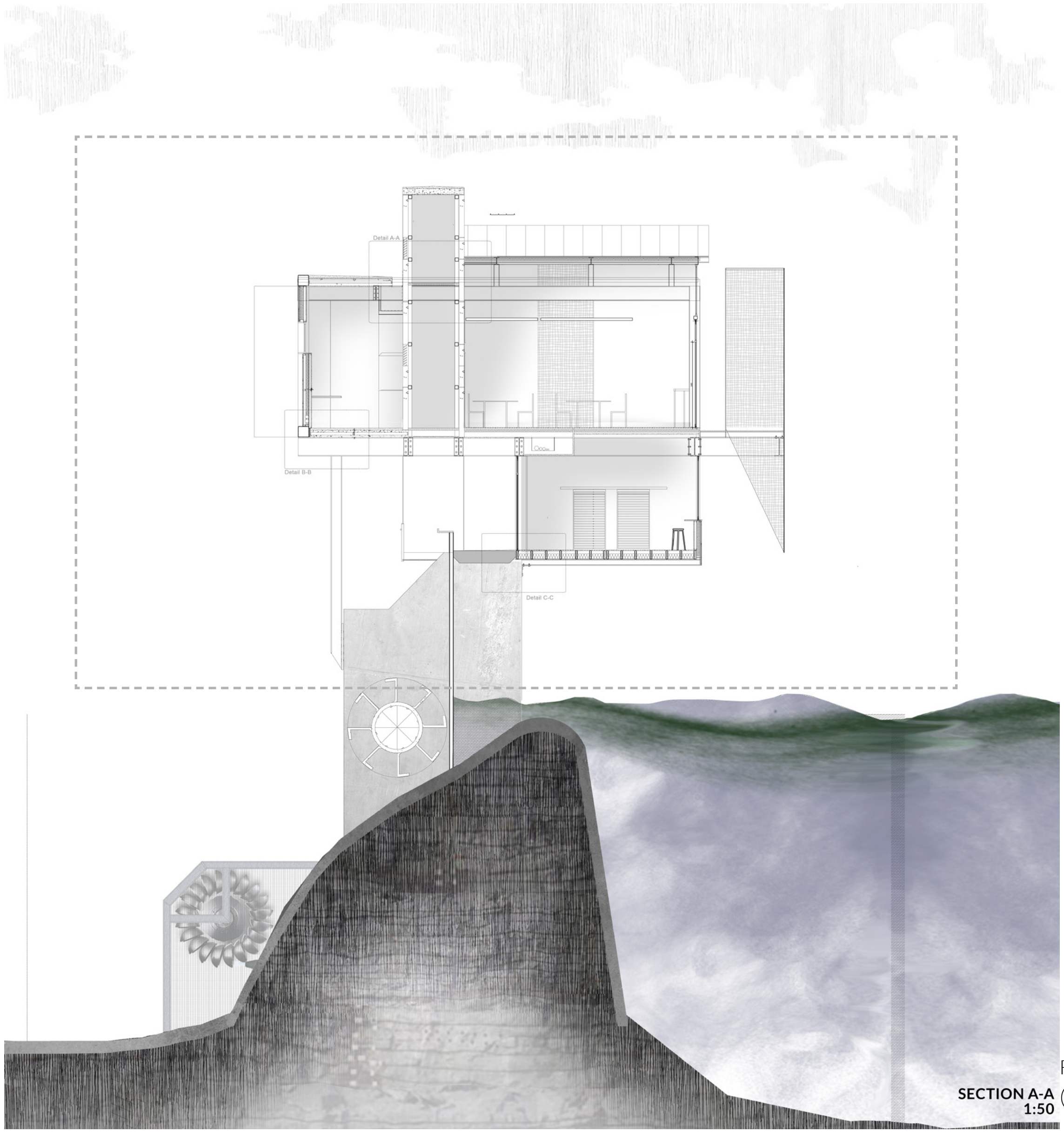
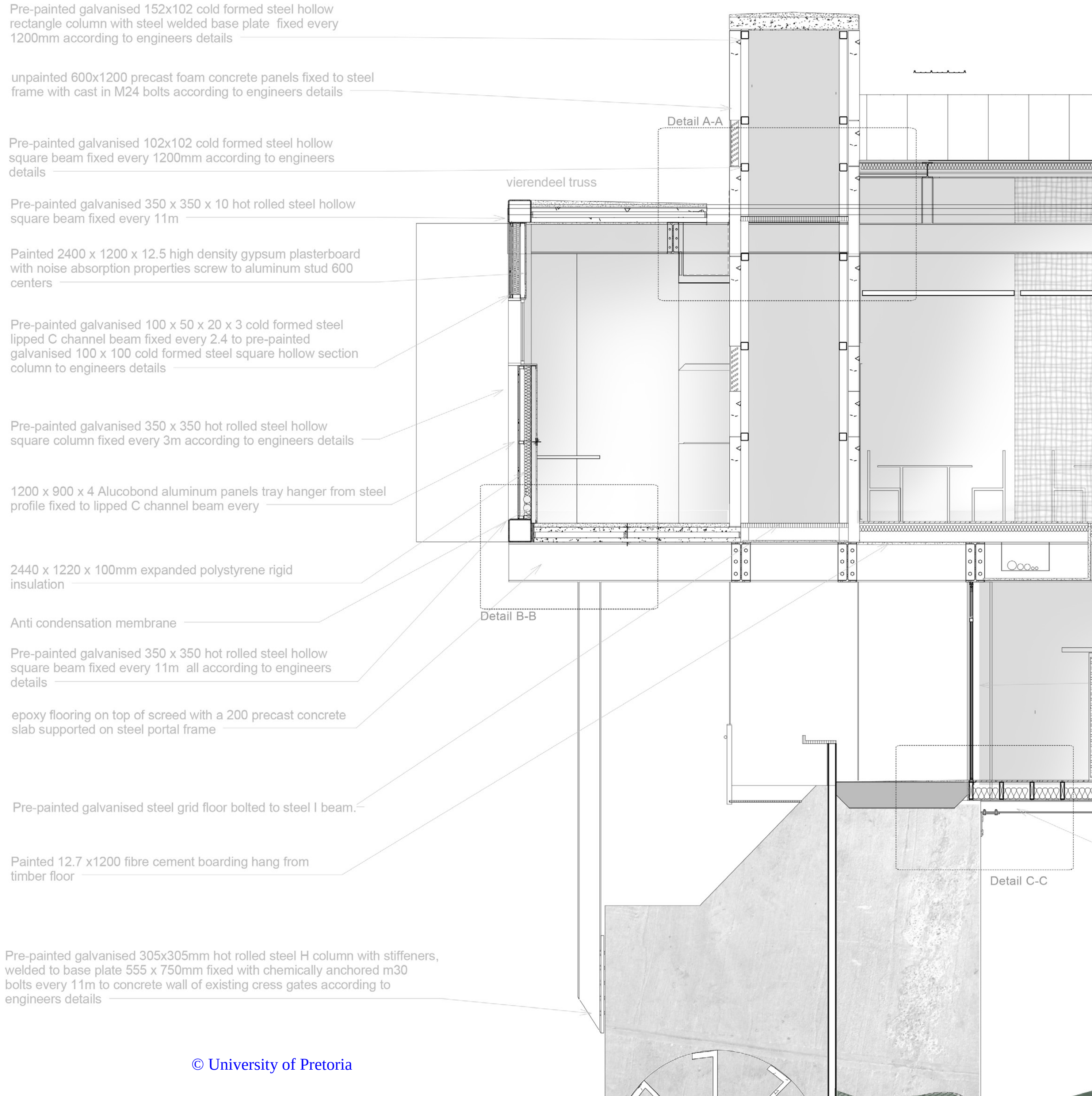


Fig 7.37 Section through restaurant (Author, September 2016).


Pre-painted galvanised 152x102 cold formed steel hollow rectangle column with steel welded base plate fixed every 1200mm according to engineers details
unpainted 600x1200 precast foam concrete panels fixed to steel frame with cast in M24 bolts according to engineers details
Pre-painted galvanised 102x102 cold formed steel hollow square beam fixed every 1200mm according to engineers details
Pre-painted galvanised 350 x 350 x 10 hot rolled steel hollow square beam fixed every 11m
Painted 2400 x 1200 x 12.5 high density gypsum plasterboard with noise absorption properties screw to aluminum stud 600 centers
Pre-painted galvanised 100 x 50 x 20 x 3 cold formed steel lipped C channel beam fixed every 2.4 to pre-painted galvanised 100 x 100 cold formed steel square hollow section column to engineers details
Pre-painted galvanised 350 x 350 hot rolled steel hollow square column fixed every 3m according to engineers details
1200 x 900 x 4 Alucobond aluminum panels tray hanger from steel profile fixed to lipped C channel beam every
2440 x 1220 x 100mm expanded polystyrene rigid insulation
Anti condensation membrane
Pre-painted galvanised 350 x 350 hot rolled steel hollow square beam fixed every 11m all according to engineers details
epoxy flooring on top of screed with a 200 precast concrete slab supported on steel portal frame
Pre-painted galvanised steel grid floor bolted to steel I beam.
Painted 12.7 x1200 fibre cement boarding hang from timber floor
Pre-painted galvanised 305x305mm hot rolled steel H column with stiffeners, welded to base plate 555 x 750mm fixed with chemically anchored m30 bolts every 11m to concrete wall of existing cress gates according to engineers details
vierendeel truss
Detail A-A
Detail B-B
Detail C-C

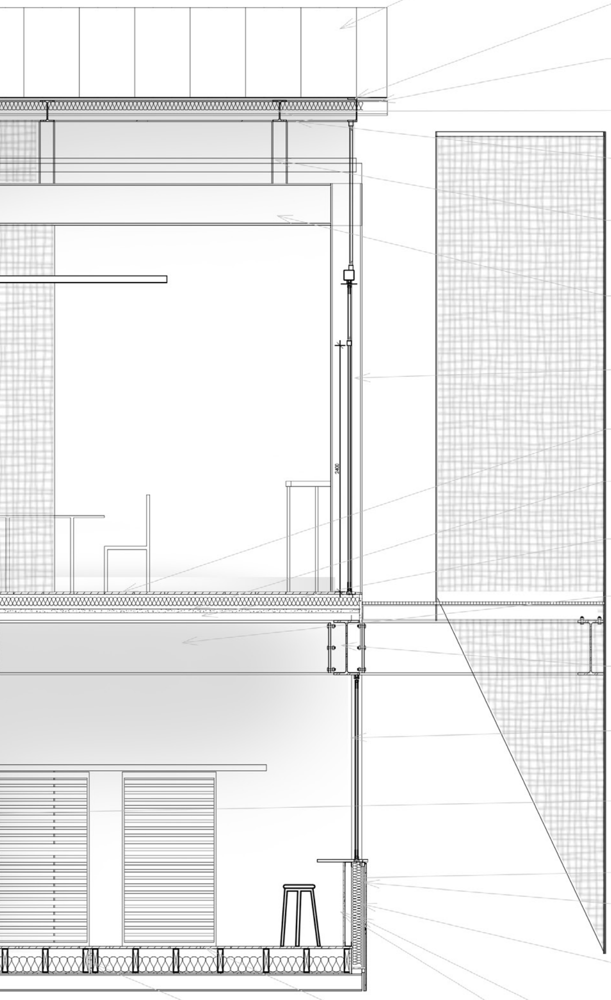


Fig 7.38. Section through restaurant (Author, September 2016).

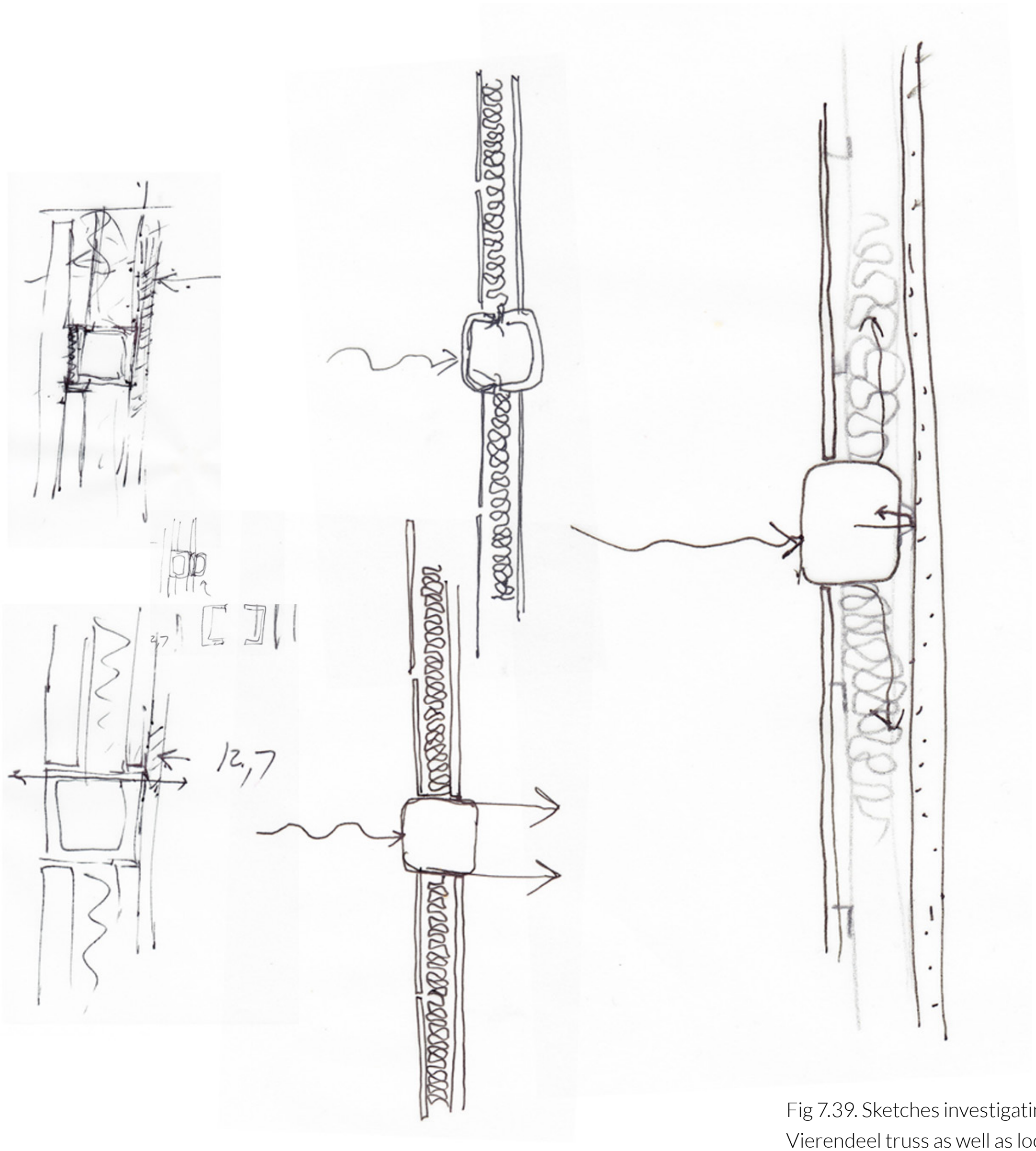


Fig 7.39. Sketches investigating revealing and concealing the Vierendeel truss as well as looking at thermal breaks (Author, September 2016).

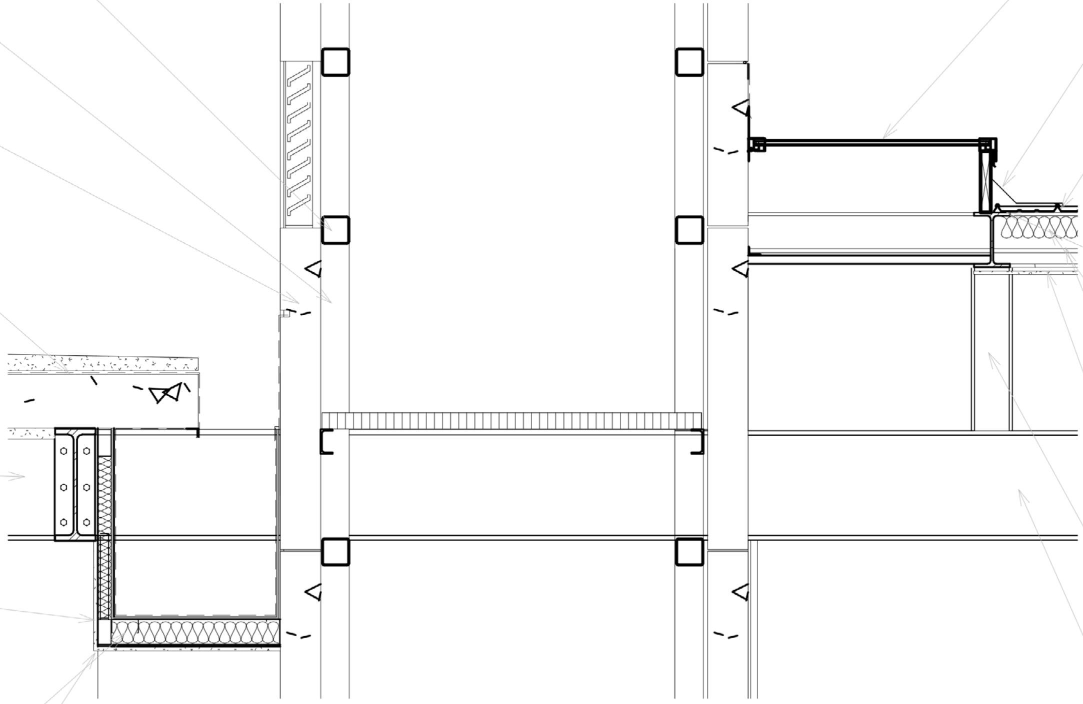


Fig 7.40 Detail A (Author, September 2016).

Detail A-A

1:10

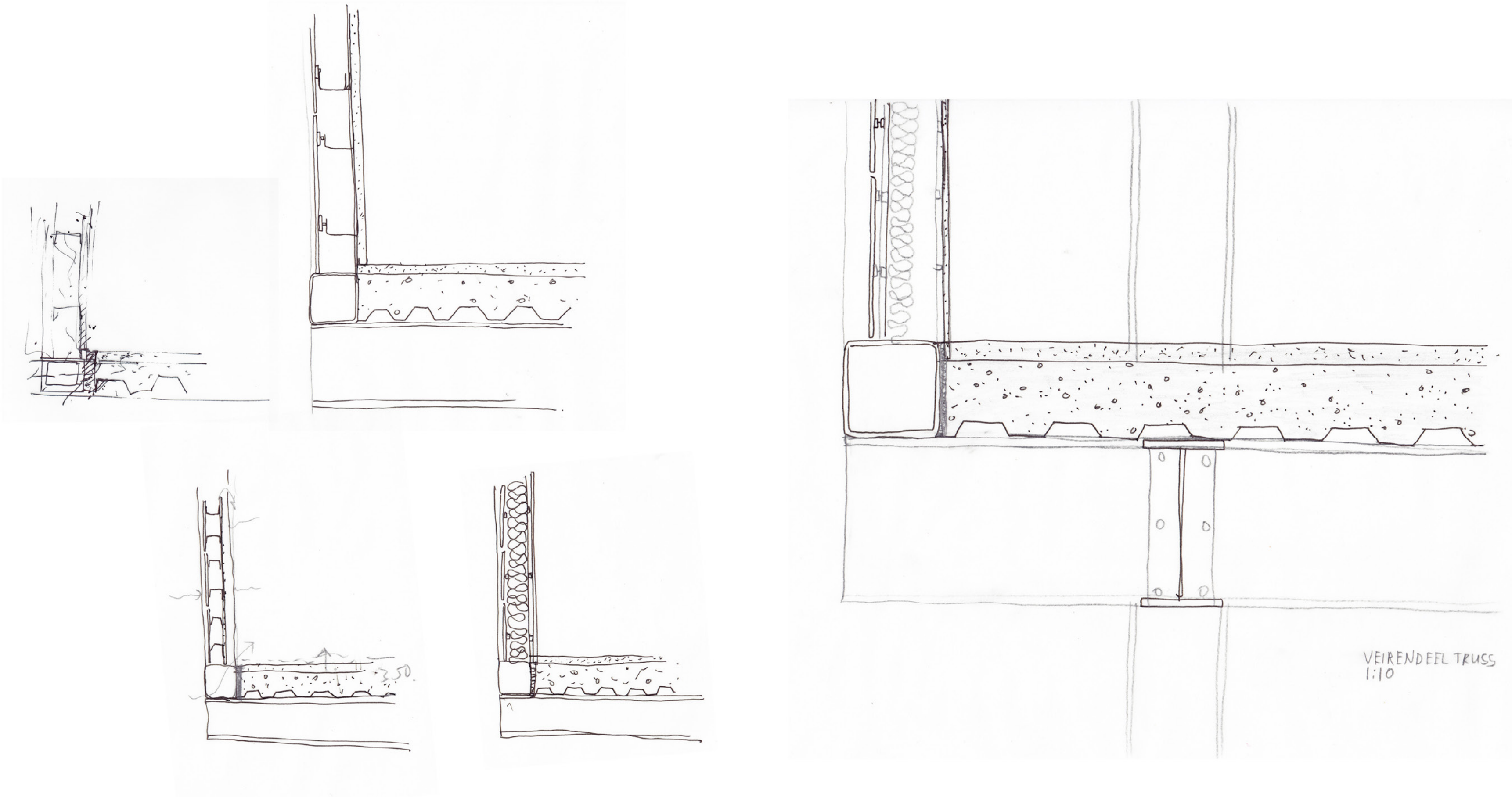
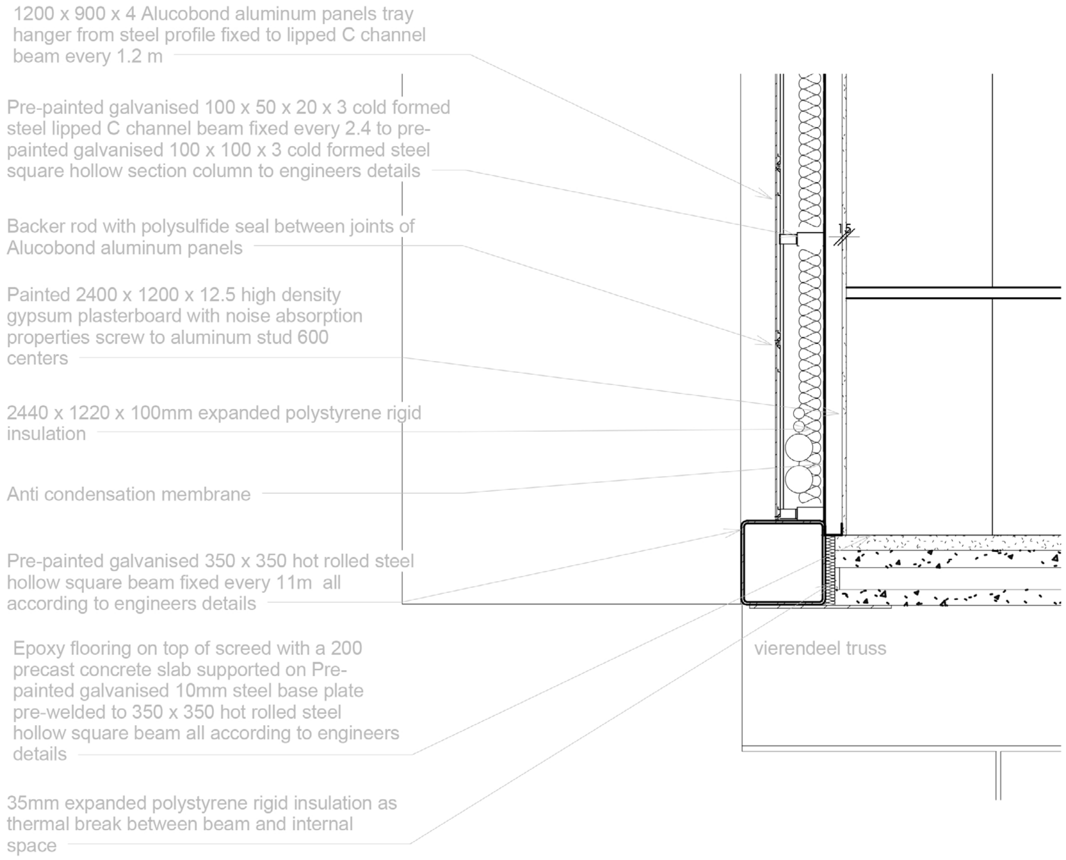


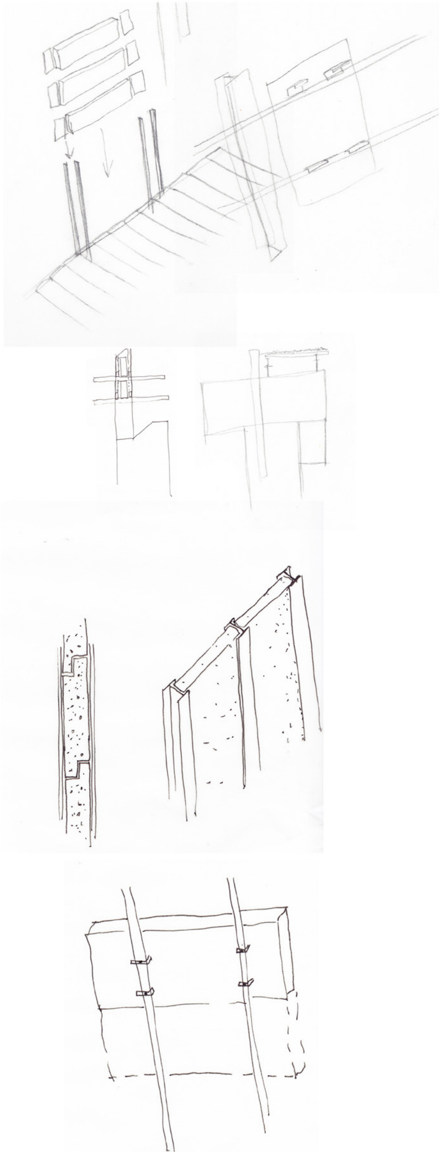
Fig 7.41 Sketches investigating junction of the Vierendeel truss, Alucobond and the pre-cast concrete floor slab, as well as looking at thermal breaks (Author, September 2016).



Detail B-B

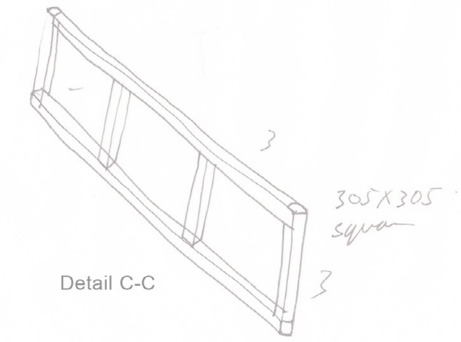
1:10

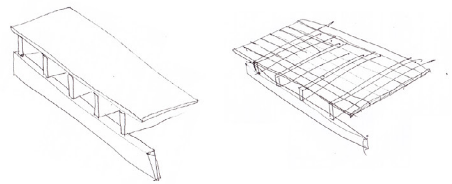
Fig 7.42 Detail B (Author, September 2016).



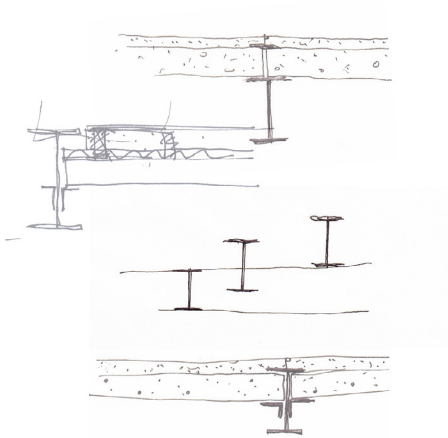
Pre-cast concrete panels for service core wall.

Understanding the Vierendeel truss and its' components



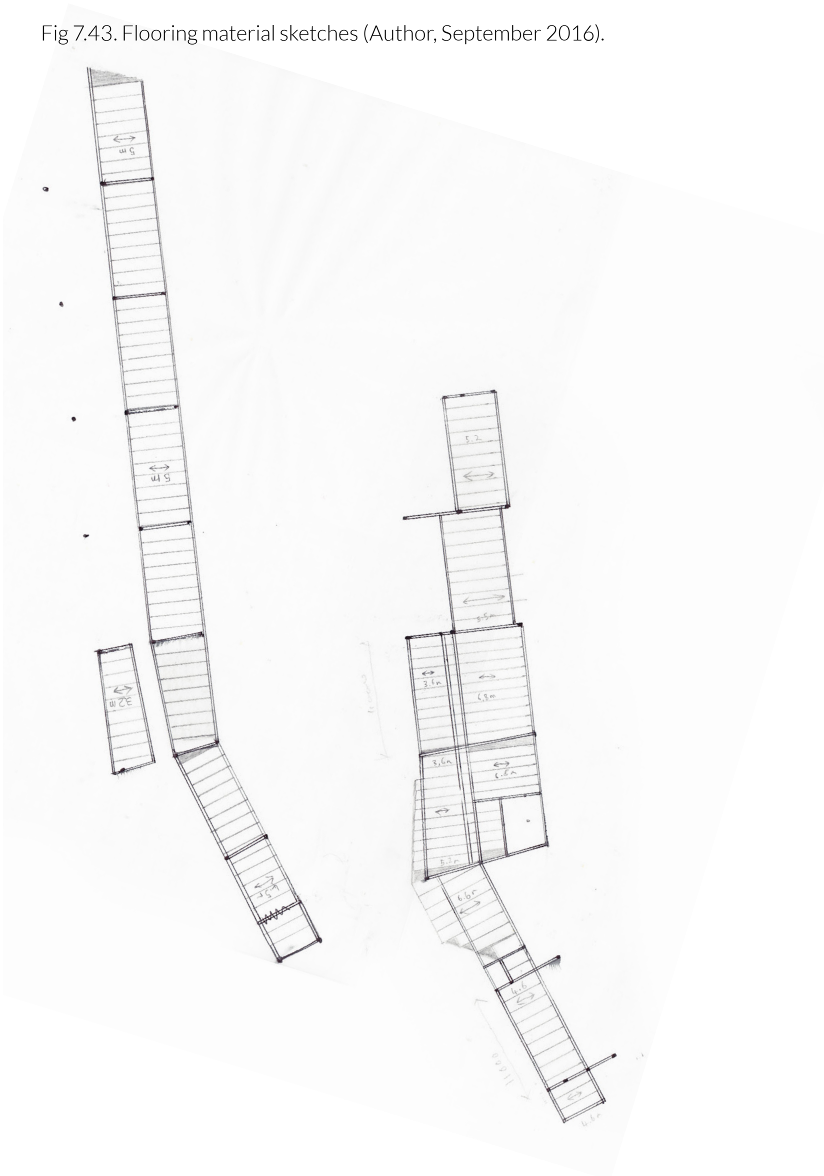


Understanding the Timber floor joists and tongue and groove timber floor boards



Sketches investigating revealing and concealing the steel portal frame

Fig 7.43. Flooring material sketches (Author, September 2016).



Layout of the pre-cast concrete floor slabs to work out possibility of using this material and span directions. This was later changed to a light timber floor due to weight of concrete.

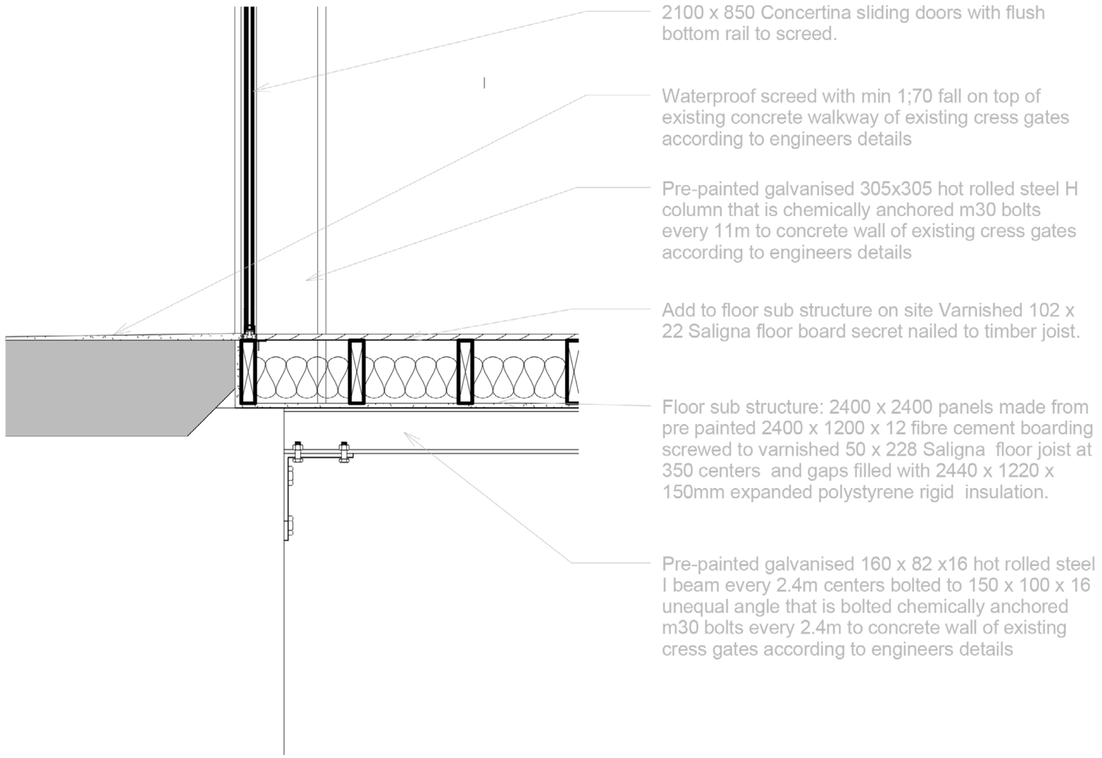
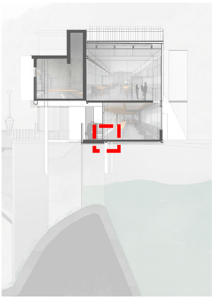


Fig 7.44 Detail C (Author, September 2016).



Detail C-C

1:10

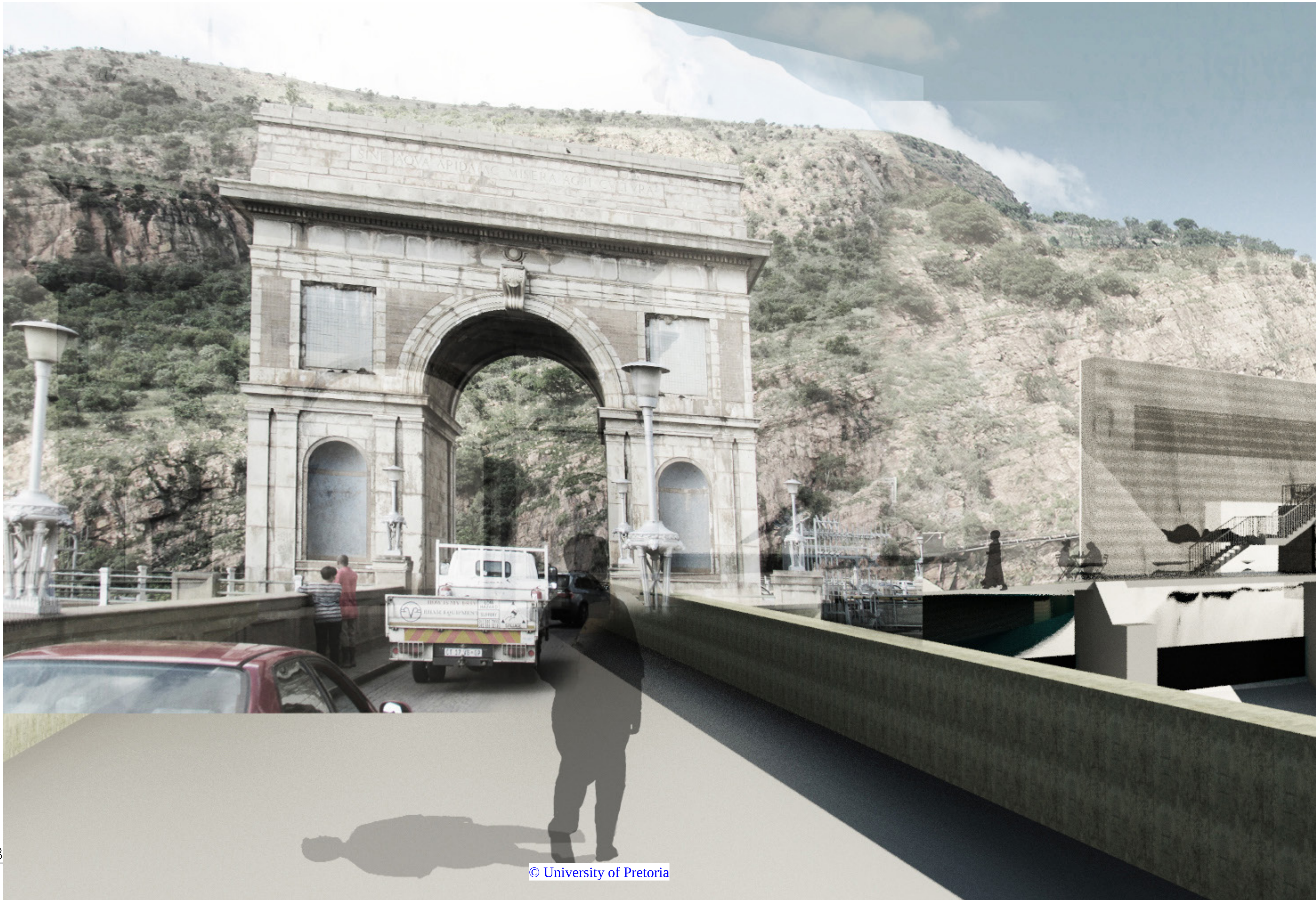

SINE AQVA ARIDA AC MISERA AGRI CVLTVRA

Fig 7.45 View of new infrastructure (Author, September 2016).

7.6 Systems

Figure 7.10 shows the different exchanges that happen on site. The didactic exchange happens with the user throughout the route as explained in the haptic understanding of site. These exchanges can be broken down into subcategories of food, water, waste and power.

Each one of these subcategories of exchanges will be explained in depth in the next few pages. It is important to note that these exchanges do not happen in isolation within each subcategory, but are intertwined. The inputs of one exchange can be the outputs of another and this allows the systems to flow as a series of closed loop systems.

The project aims to create new understanding for the user. An understanding of what is happening on site and why. This means that these exchanges needs to be expressed throughout the building. The articulation of these exchanges need to be clear and legible to the user. For example water pipes should not be hidden in the wall but exposed on the surface of it. The service core should be transparent and open to be viewed by the public. There needed to be an understanding so as to create an appreciation of the systems at work and what role water played in them.

Flows of materials in systems

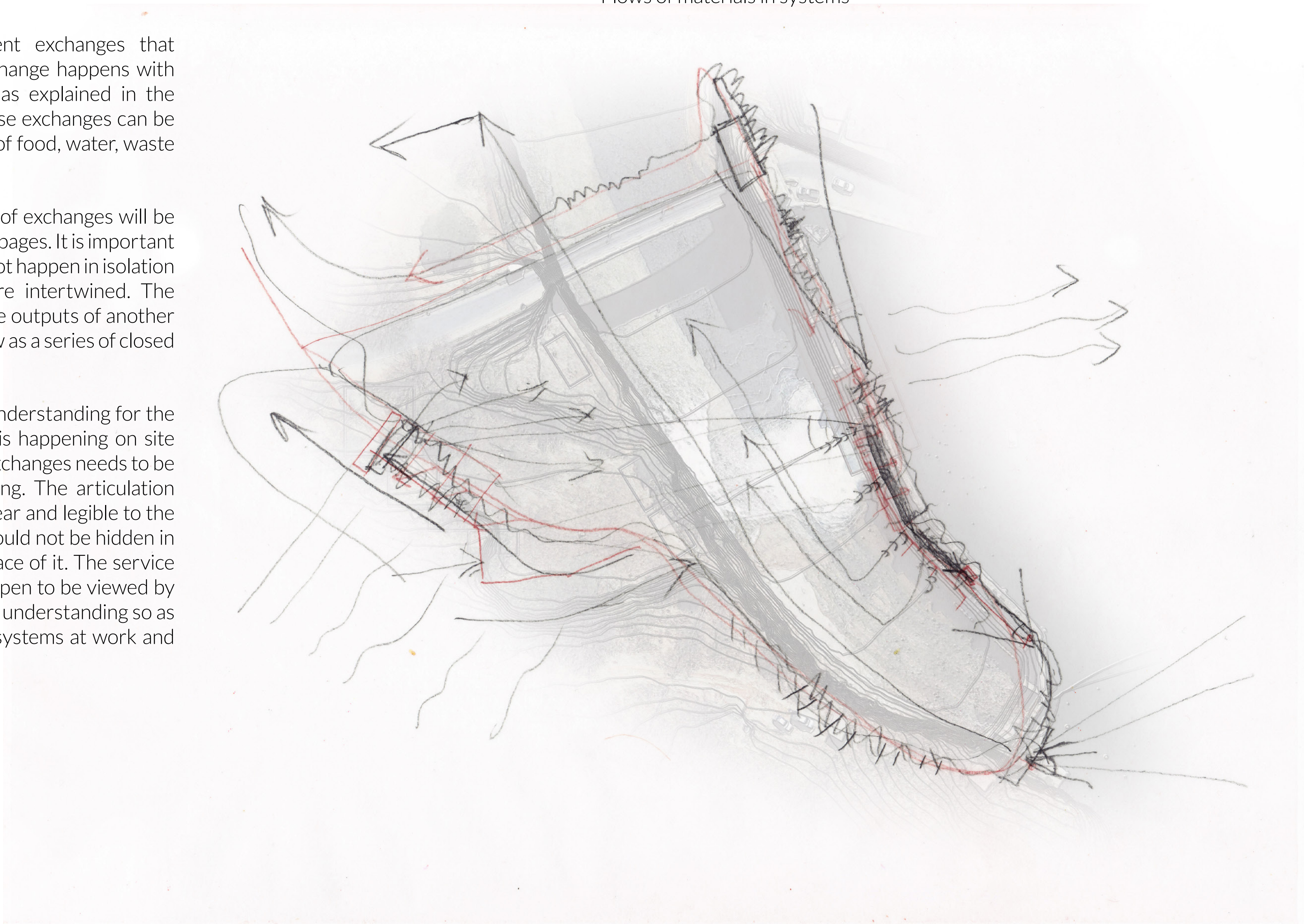


Fig 7.46. Diagram of exchanges (Author. June 2016).

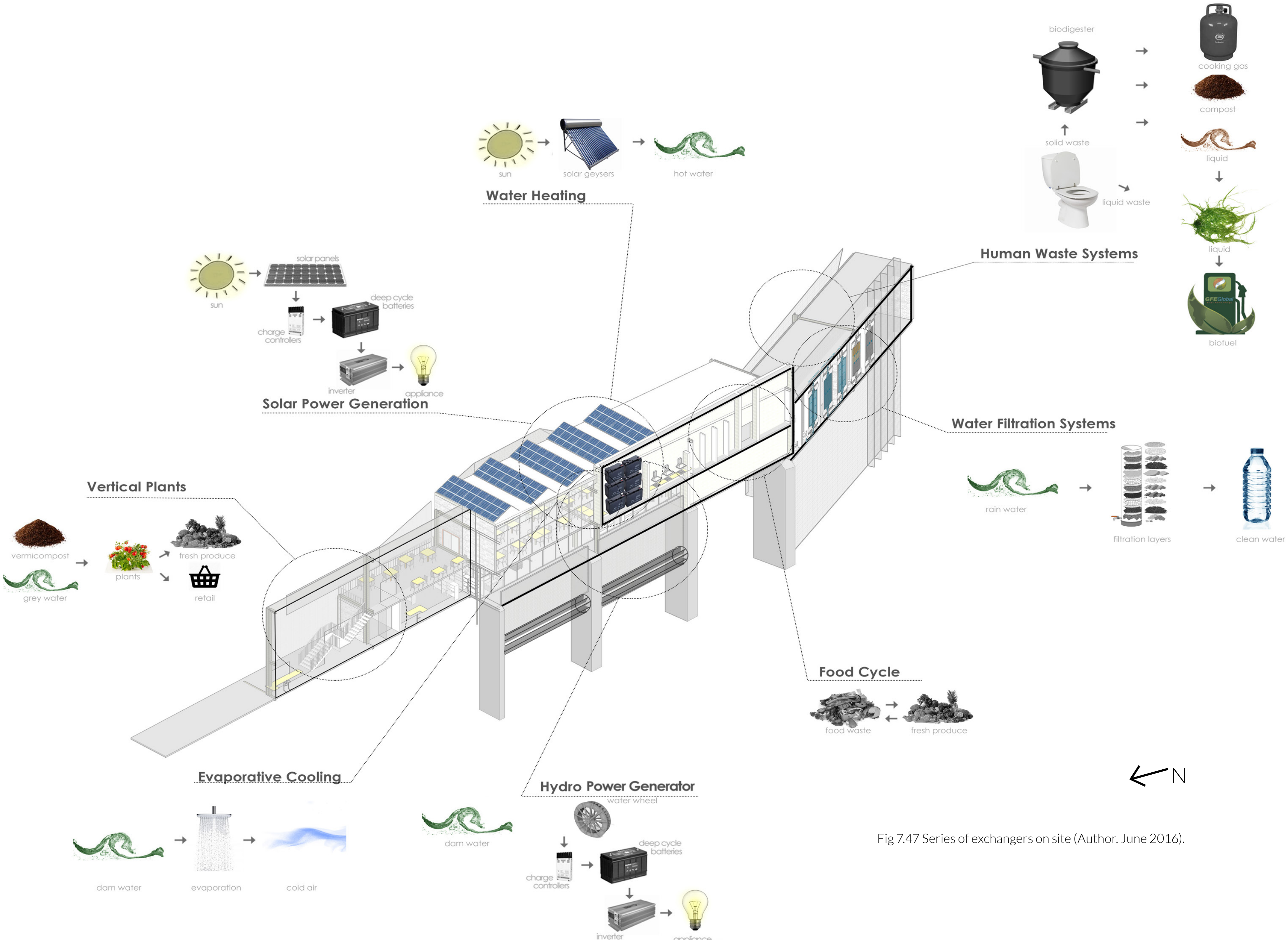


Fig 7.47 Series of exchangers on site (Author. June 2016).

Water exchanges

There are a range of different water exchanges on site. To deal with potable water demand rainwater would need to be collected from the roofs as well as the dam, as the roof area is quite small. This water would then need to be sent through a purification system in order to become potable water.

Grey water harvesting would also be carried out in order to reduce the amount of potable water used on site.

There are also water demands for irrigation of the scarred landscape as well as the crops and herbs growing for the restaurant space. Water would also be needed in the vermiculture space as moisture is needed in the system in order for it to function correctly.

Appliances that use as little water as possible will be implemented even though the site has abundance of water, it is still a precious resource and needs to be preserved. Due to the kitchen having the largest demand for potable water the tank should be located as near as possible to this. The second largest demand would be irrigation; this would mean that there would also need to be a secondary tank near the vermiculture building.

As already stated water would also be used to change the hue of light. Thus creating further exchanges between heat as well as light, integrating them into the spaces would be key to creating better understanding.

This will be done through fountains in public spaces to cool them down. Pools of water which lead to irrigation canals through public spaces in order to foster a direct engagement with water.

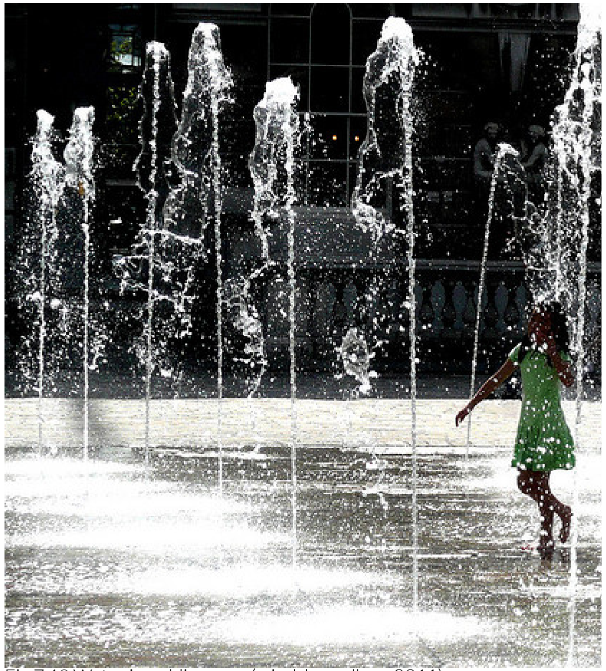


Fig 7.48 Water in public space (mindshapedbox, 2011).

Fig 7.49 Water in public space (90La, 2014).

Fig 7.50 Water in public space (Project for public spaces, 2016).

Water Yields Graph

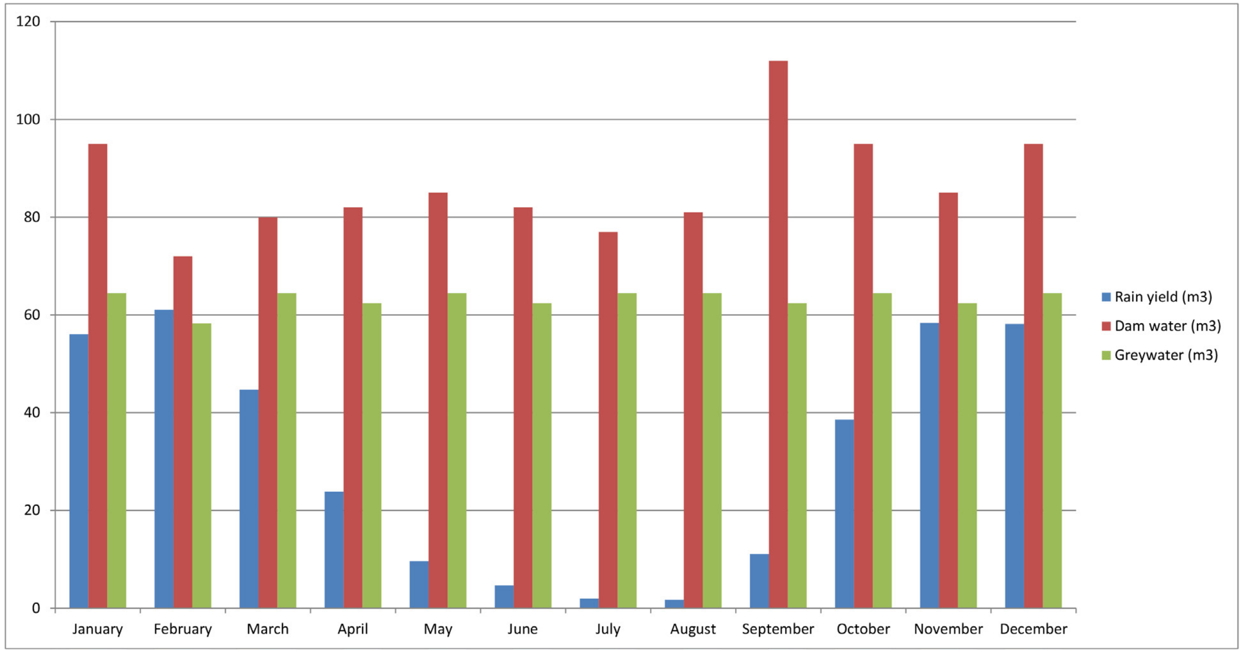


Fig 7.51 Water calculations yield (Author, September 2016).

Water yields

Due to the small footprint of the building, only 600 m^2, it was not possible to collect enough rain water for the functions of the building. The vermiculture building is also planted which means that there is little collection of water. This meant that dam water would also need to be used. This water would need to be extracted from the dam and put through a filtering system in order for it to become potable water, similarly with the rain water.

The amount of water taken out from the dam can fluctuate to the needs of the building, less during summer as there is more rain water and more in the winter when it is drier.

Grey water collection would also be needed for irrigation of the planted area and rehabilitation of the site. Biodegradable soaps could be used in the kitchen and ablutions spaces so that this water could be used for irrigation purposes.

Primary Water Demand Graph

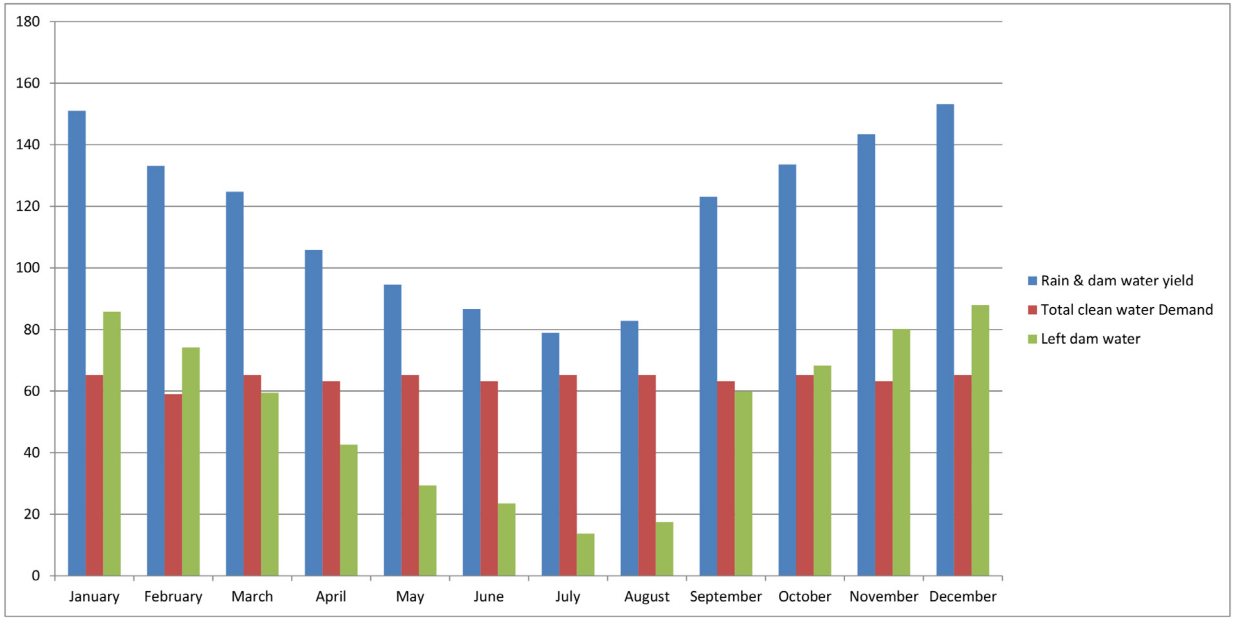


Fig 7.52 Primary water demand (Author, September 2016).

Water demand

Primary

Water demand was split into two groups. Primary water demand would be satisfied with potable water. Under this category are activities such as shower, food preparation and washing of hands. The secondary water demand would be made up of grey water and dam water cleaned to a certain point. This water would then be used for irrigation of plants and ablutions. This water would also be needed for the vermiculture.

The primary water demand graph shows the total yield from rainwater and dam water, the total primary water demand and how much water would be left. This demand is very consistent all year and would be at about 60 m^3.

Secondary Water Demand Graph

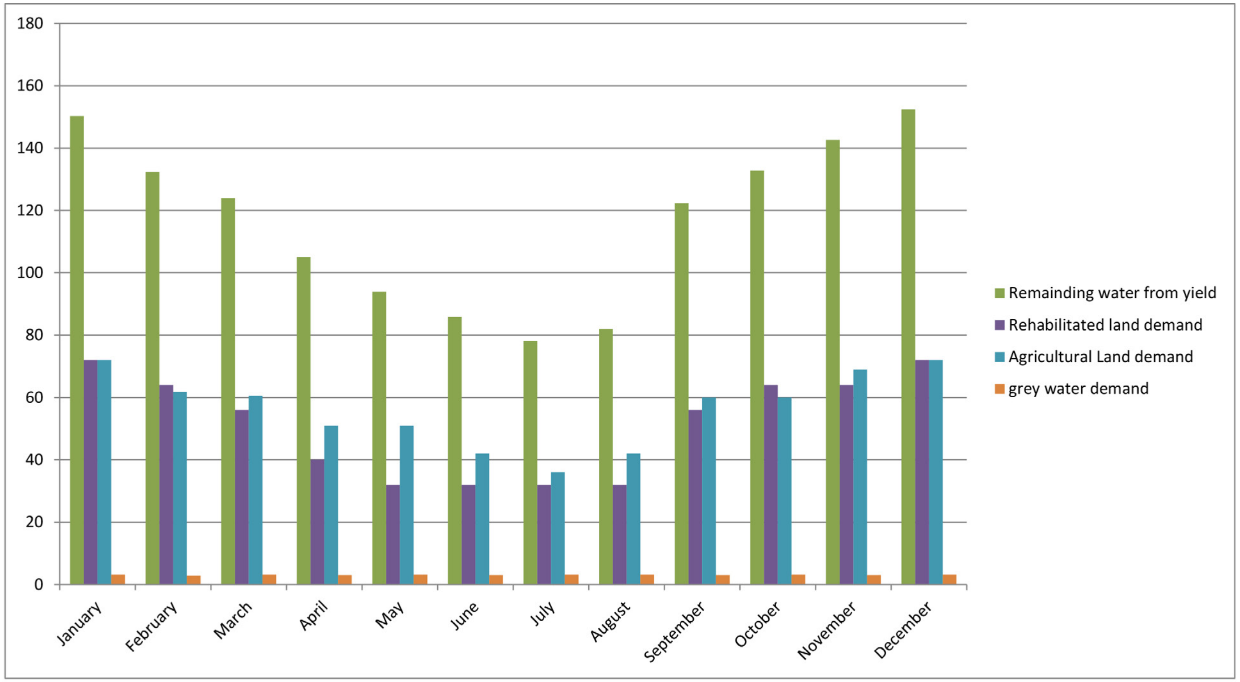


Fig 7.53 Secondary water demand (Author, September 2016).

Water demand

Secondary

This second graph shows the secondary water demands, the largest being irrigation demands ranging from 70m^3 in summer to 30m^3 in winter.

Water Budget Graph

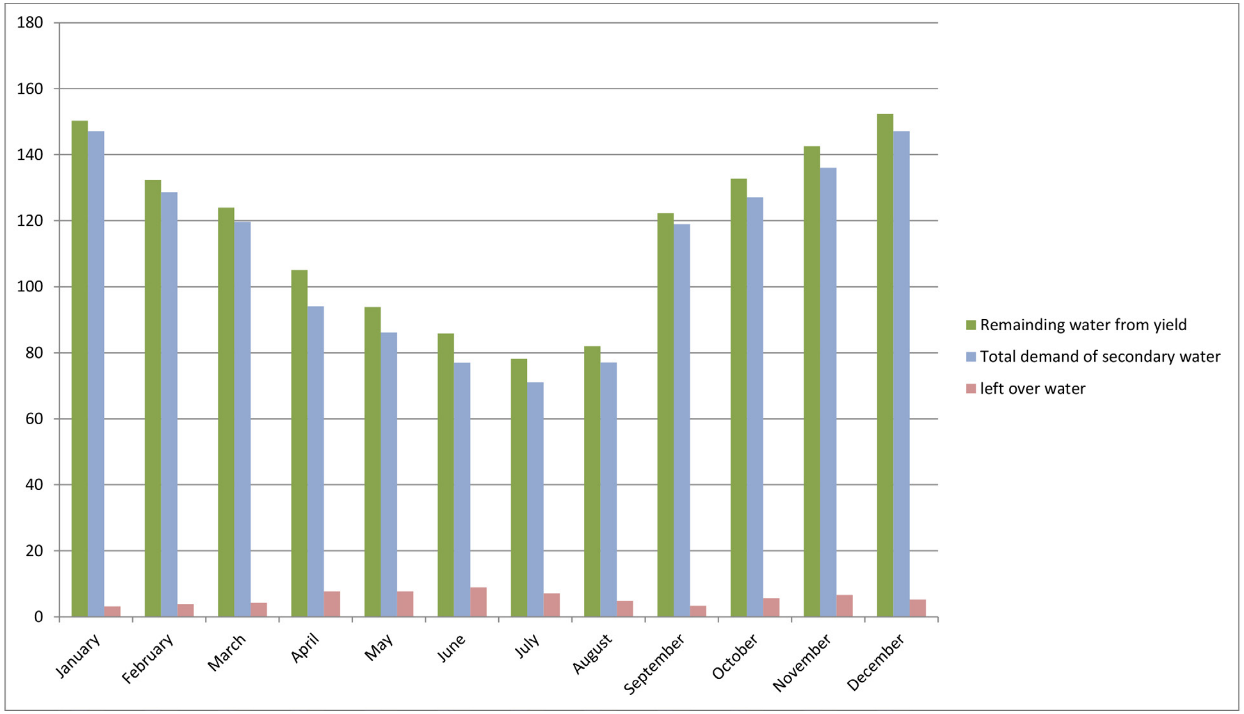


Fig 7.54 Secondary water demand (Author, September 2016).

Water budget

To satisfy all the demands a filtration system and tank size would need to be designed correctly. In order to satisfy the primary demands a tank size for rainwater and dam water would need to be approximately 175 m^3. But the fact that the water is always readily available at the dam means that the tank can be significantly smaller and the filtration system can constantly replenish it when needed. This tank could be approximately 75 m^3 in size to hold at least one summer months' worth of rain that would then be used up before the next month's rain.

The grey water tank could be half the size of the total grey water of one month as this water would consistently be used for irrigation. The total grey water of one month 65 m^3 and therefore the tank can be 35 m^3

There are a range of different water systems-

Starting with collection of rainwater, this will be collected from the roofs and flow into a surge tank where, at a later time, it will be pumped into the purification system.

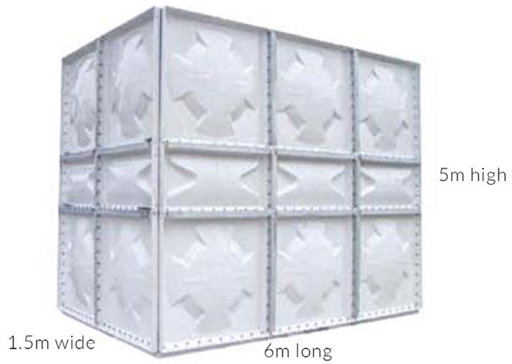
The water purification system is made up of five different steps. The first is to remove floating debris, such as litter and hyacinth. This will be done by simply submerging the inlet valve in the dam. The second is an oil trap to remove pollutants lighter than water such as oils.

The third is a 10 m^3 settlement tank where the heavier pollutants will settle and then the clean water can be drained off the top. At this point some of the water will be removed that will be used for irrigation purposes as well as the vermiculture activities. This water will be stored in the 40 m^3 grey water tank as well as the 25 m^3 grey water tank.

The rest of the water will be pumped into the fourth stage which is a vertical wetland where the plants roots will extract the minerals from the water. These plants will grow produce for the restaurant as well as be sold as products from the retail space.

And lastly to remove pathogens the water will need to go through a UV filter and a sand filter. At this point the potable water will be pumped into the storage tank where it will stay until it is utilised. There are two storage tanks, one on the vermiculture side (70 m^3) and one in the service core of the restaurant (25 m^3).

Purpose made hot press steel tank construction to 25m^3 and 40m^3. Inlet and outlet with built in pump, equipped with man hole for inspection and maintenance



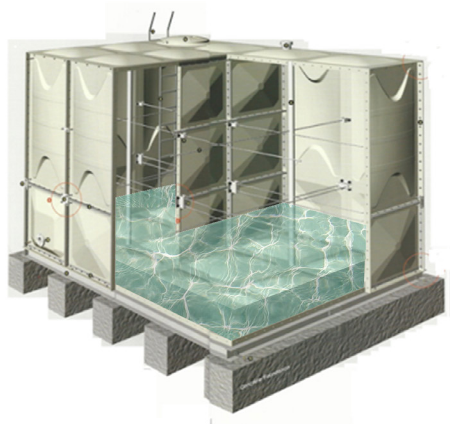
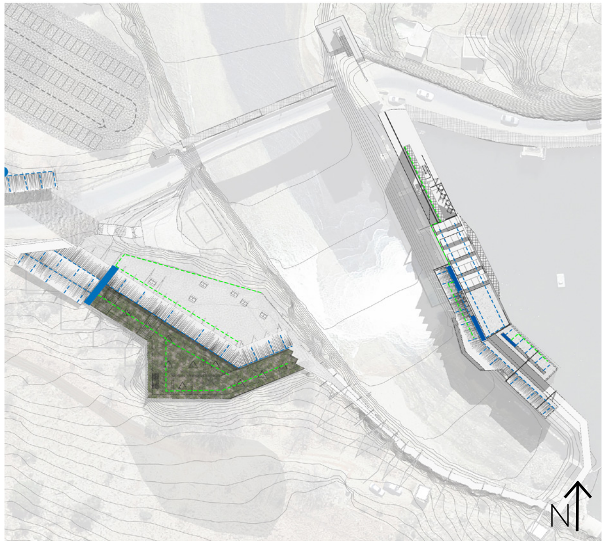
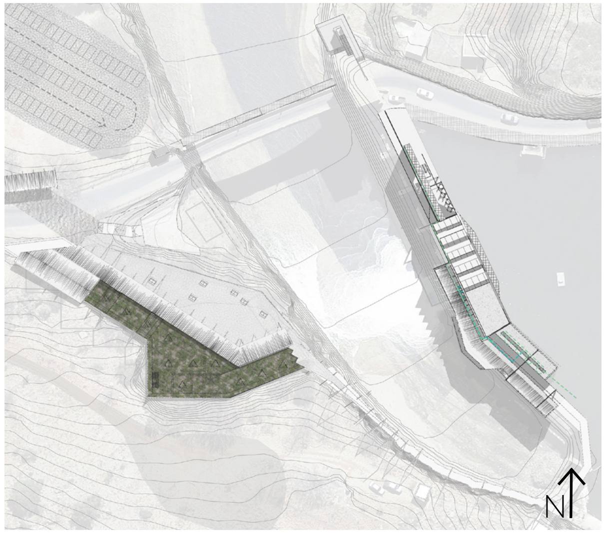


Fig 7.56 Water calculations result (Author, September 2016).



WATER CATCHMENT AND USE

Fig 7.55 Water Catchment and use (Author, September 2016).



WATER FILTRATION SYSTEM

Fig 7.57 Water Filtration system (Author, September 2016).

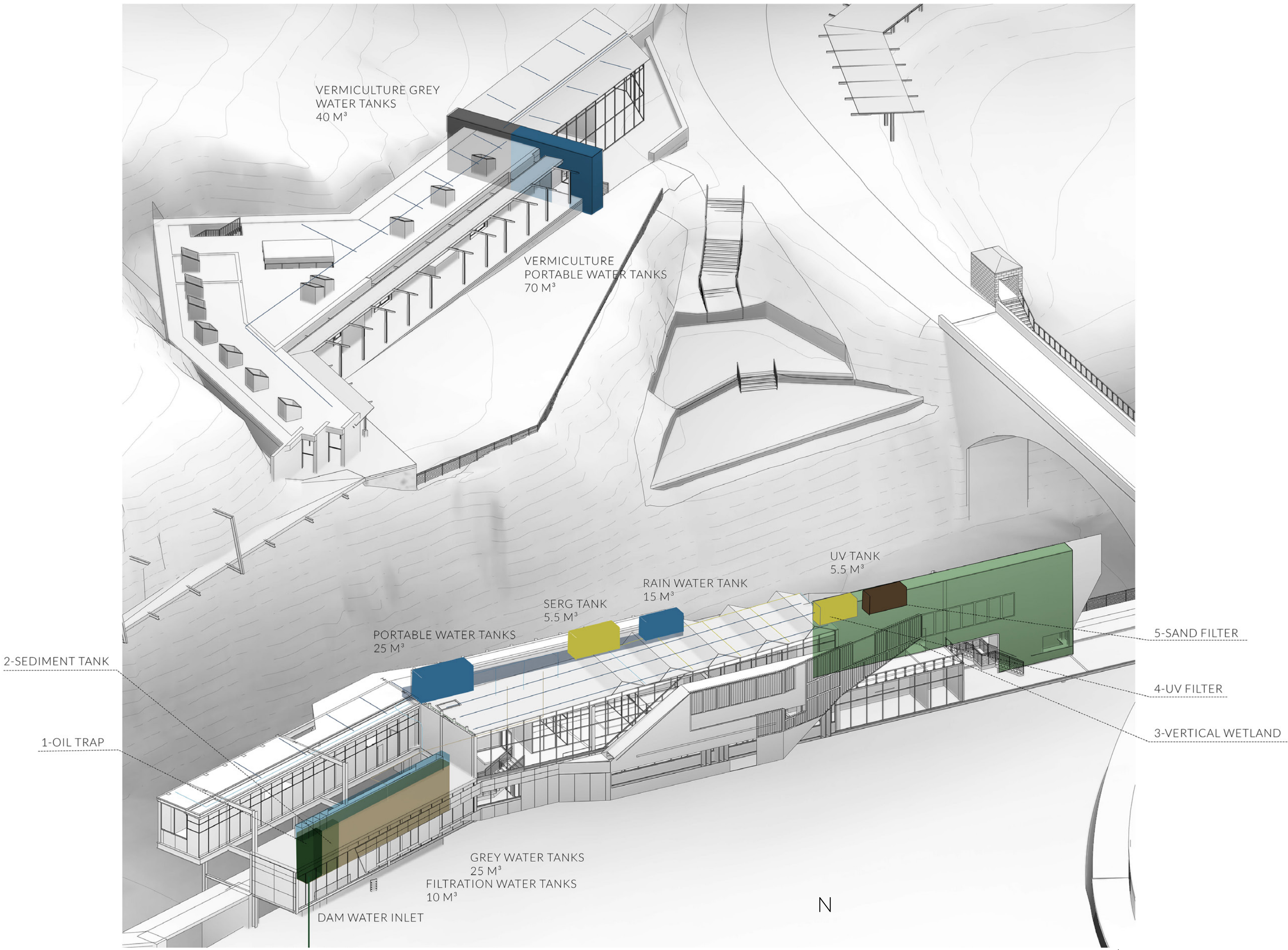


Fig 7.58 Water System on site (Author, September 2016).

Water yields calculations

Catchment surface			
Roof			
	Area (m2)	Runoff coefficient weighted	Area of catchment weighted
	600	0.9	540
			540

Rainwater yield calculation	Ave. monthly percepitation	Area of catchment weighted	Rain yield (m3)	Dam water (m3)	Yield (m3)
January	0.1038	540	56.052	95	151.052
February	0.1131	540	61.074	72	133.074
March	0.0828	540	44.712	80	124.712
April	0.0441	540	23.814	82	105.814
May	0.0178	540	9.612	85	94.612
June	0.0086	540	4.644	82	86.644
July	0.0036	540	1.944	77	78.944
August	0.0032	540	1.728	81	82.728
September	0.0205	540	11.07	112	123.07
October	0.0714	540	38.556	95	133.556
November	0.1081	540	58.374	85	143.374
December	0.1077	540	58.158	95	153.158
Total	0.6847	6480	369.738	1041	1410.738

Grey Water Harvisting

visitors			
150	Handwashing:spray taps	2	300
0	Clothes washing machine	4	0
75	Dishwashing machine	3	225
0	Shower	25	0
75	Drinking, food preparation and cooking	15	1125
			1650
Permanent workers			
30	Handwashing:spray taps	2	60
0	Clothes washing machine	25	0
15	Dishwashing machine	3	45
2	Shower	50	100
15	Drinking, food preparation and cooking	15	225
			430
	Total grey water back as yeild		2080

Grey Water Harvisting

Month	Days/month		Working days/month		Water capita/Day	Water capita/month	Greywater Domestic Harvisting/month (m3)
January	31	430	31	1650	2080	64480	64.48
February	28	430	28	1650	2080	58240	58.24
March	31	430	31	1650	2080	64480	64.48
April	30	430	30	1650	2080	62400	62.4
May	31	430	31	1650	2080	64480	64.48
June	30	430	30	1650	2080	62400	62.4
July	31	430	31	1650	2080	64480	64.48
August	31	430	31	1650	2080	64480	64.48
September	30	430	30	1650	2080	62400	62.4
October	31	430	31	1650	2080	64480	64.48
November	30	430	30	1650	2080	62400	62.4
December	31	430	31	1650	2080	64480	64.48
						759200	759.2

Water yields graph

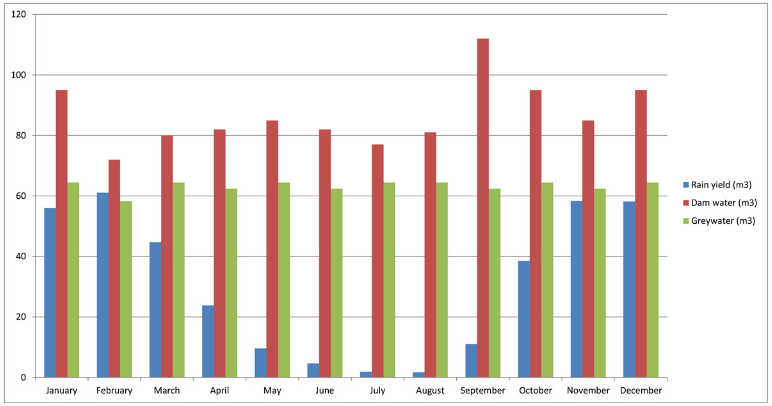


Fig 7.59 Water yield calculation (Author, September 2016).

Water demand calculations

Permanent workers

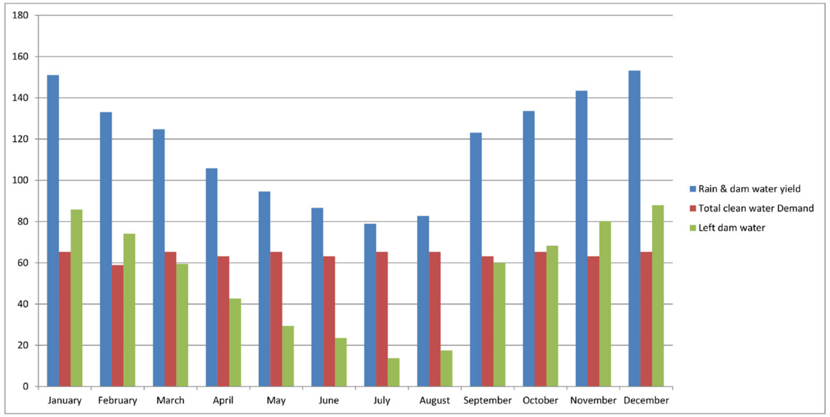
Permanent people	Appliances	Litres/day/person served	total demand per day
30	Handwashing:spray taps	2	60
30	Urinial flushing 8h day	1	30
15	Dishwashing machine	3	45
5	Shower	25	125
15	WC flushing-urinals provided	0	0
15	Drinking, food preparation and cooking	15	225
			485

WATER CAPITA/DAY (L)

Visitors

Public People	Appliances	Litres/day/person served	total demand per day
150	Handwashing:spray taps	2	300
70	Urinial flushing 8h day	1	70
75	Dishwashing machine	3	225
35	WC flushing-urinals provided	0	0
75	Drinking, food preparation and cooking	15	1125
			1720

Primary water demand graph



RAIN WATER & DAM WATER DEMAND

Month	Days/month		Working days/month		Water capita/Day	Water capita/month	Domestic demand/month (m3)
January	31	410	31	1425	1835	56885	56.885
February	28	410	28	1425	1835	51380	51.38
March	31	410	31	1425	1835	56885	56.885
April	30	410	30	1425	1835	55050	55.05
May	31	410	31	1425	1835	56885	56.885
June	30	410	30	1425	1835	55050	55.05
July	31	410	31	1425	1835	56885	56.885
August	31	410	31	1425	1835	56885	56.885
September	30	410	30	1425	1835	55050	55.05
October	31	410	31	1425	1835	56885	56.885
November	30	410	30	1425	1835	55050	55.05
December	31	410	31	1425	1835	56885	56.885
						669775	669.775

DAM WATER DEMAND

Month	Days/month		Working days/month		Water capita/Day	Water capita/month	Domestic demand/month (m3)
January	31	45	31	225	270	8370	8.37
February	28	45	28	225	270	7560	7.56
March	31	45	31	225	270	8370	8.37
April	30	45	30	225	270	8100	8.1
May	31	45	31	225	270	8370	8.37
June	30	45	30	225	270	8100	8.1
July	31	45	31	225	270	8370	8.37
August	31	45	31	225	270	8370	8.37
September	30	45	30	225	270	8100	8.1
October	31	45	31	225	270	8370	8.37
November	30	45	30	225	270	8100	8.1
December	31	45	31	225	270	8370	8.37
						98550	98.55

Fig 7.60. Primary water demand calculation (Author, September 2016).

Water demand calculations

GREY DEMAND

Month	Days/month		Working days/month		Water capita/Day	Water capita/month	Domestic demand/month (m3)
January	31	30	31	70	100	3100	3.1
February	28	30	28	70	100	2800	2.8
March	31	30	31	70	100	3100	3.1
April	30	30	30	70	100	3000	3
May	31	30	31	70	100	3100	3.1
June	30	30	30	70	100	3000	3
July	31	30	31	70	100	3100	3.1
August	31	30	31	70	100	3100	3.1
September	30	30	30	70	100	3000	3
October	31	30	31	70	100	3100	3.1
November	30	30	30	70	100	3000	3
December	31	30	31	70	100	3100	3.1
						36500	36.5

Fig 7.61 Secondary water demand calculation (Author, September 2016).

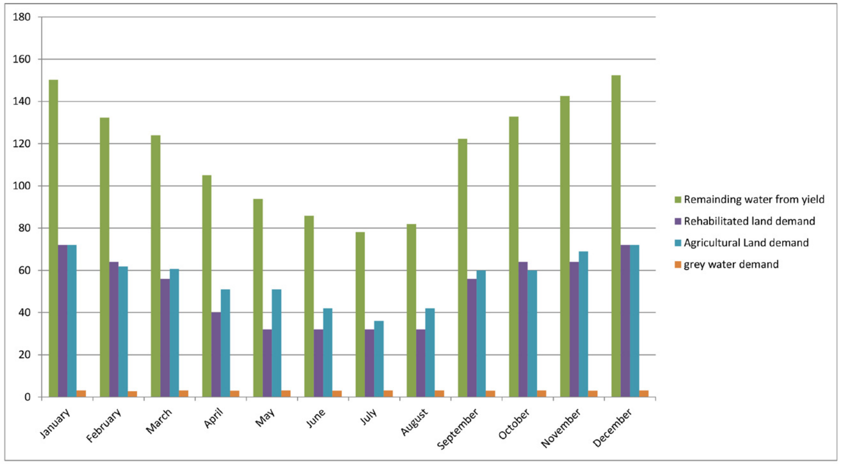
Irrigation Demand
Agricultural Land

	Planting Area (m2)	Irr. Depth/ month	Agricultural Land Irrigation demand (m3
January	600	0.12	72
February	600	0.103	61.8
March	600	0.101	60.6
April	600	0.085	51
May	600	0.085	51
June	600	0.07	42
July	600	0.06	36
August	600	0.07	42
September	600	0.1	60
October	600	0.1	60
November	600	0.115	69
December	600	0.12	72
		Total	677.4

Irrigation Demand
Rehabilitated landscape

	Planting Area (m2)	Irr. Depth/ month	Rehabilitated landscape demand (m3
January	800	0.09	72
February	800	0.08	64
March	800	0.07	56
April	800	0.05	40
May	800	0.04	32
June	800	0.04	32
July	800	0.04	32
August	800	0.04	32
September	800	0.07	56
October	800	0.08	64
November	800	0.08	64
December	800	0.09	72
		Total	616

Secondary water demand graph



Water budget calculations

Clean Water Demand Cal	Dam water	RAIN WATER & DAM WATER DEMAI	DAM WATER DEMAND				
	Rain & dam water yield	Domestic demand/month (m3)	Domestic demand/month (m3)	Total clean water Demand	Left dam water		Tank size 500 m3
January	151.052	56.885	8.37	65.255	85.797	399.618	500
February	133.074	51.38	7.56	58.94	74.134	473.752	500
March	124.712	56.885	8.37	65.255	59.457	533.209	500
April	105.814	55.05	8.1	63.15	42.664	575.873	500
May	94.612	56.885	8.37	65.255	29.357	605.23	500
June	86.644	55.05	8.1	63.15	23.494	628.724	500
July	78.944	56.885	8.37	65.255	13.689	0	433
August	82.728	56.885	8.37	65.255	17.473	17.473	455.63
September	123.07	55.05	8.1	63.15	59.92	77.393	500
October	133.556	56.885	8.37	65.255	68.301	145.694	500
November	143.374	55.05	8.1	63.15	80.224	225.918	500
December	153.158	56.885	8.37	65.255	87.903	313.821	500
Total	1410.738	669.775	98.55	768.325	642.413		

Grey water demand							
	Greywater Domestic Harvisting/month (m	Left dam water	Remainding water from yield	Rehabilitated land demand	Agricultural Land demand	grey water demand	Total demand of secondary water le
January	64.48	85.797	150.277	72	72	3.1	147.1
February	58.24	74.134	132.374	64	61.8	2.8	128.6
March	64.48	59.457	123.937	56	60.6	3.1	119.7
April	62.4	42.664	105.064	40	51	3	94
May	64.48	29.357	93.837	32	51	3.1	86.1
June	62.4	23.494	85.894	32	42	3	77
July	64.48	13.689	78.169	32	36	3.1	71.1
August	64.48	17.473	81.953	32	42	3.1	77.1
September	62.4	59.92	122.32	56	60	3	119
October	64.48	68.301	132.781	64	60	3.1	127.1
November	62.4	80.224	142.624	64	69	3	136
December	64.48	87.903	152.383	72	72	3.1	147.1
Total	759.2	642.413	1401.613	616	677.4	36.5	1329.9

Water Budget Graph

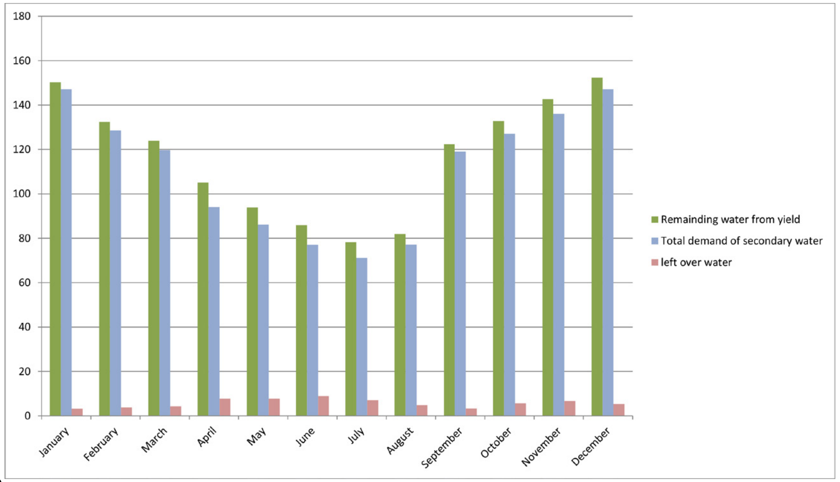


Fig 7.62 Water Budget calculation (Author, September 2016).

Food exchanges

Exchanges of food start at the vermiculture building, with the changing of the hyacinth into compost in the productive landscape, which is then used to grow plants and herbs in the synthetic landscape.

There are two points where the crops and herbs are grown; the planted roof above the vermiculture space will be utilised for this, as well as in the vertical wet land that will purify the water by absorbing the minerals in the roots of the plants. Smaller plants such as the herbs and vegetables for example coriander, basil, lettuce, tomatoes and strawberries will be growing in the hanging water channels and the larger plants such as cauliflower, broccoli, carrots, rosemary and thyme would be grown on the planted roof space.

These plants and herbs are then utilised in the kitchen space to make meals to be sold in the restaurant space. Picnic baskets are also made up to be sold in the retail space to engage a range of different people. Any food scraps left over from the kitchen would then enter into the biodigester and help that system to be more effective.

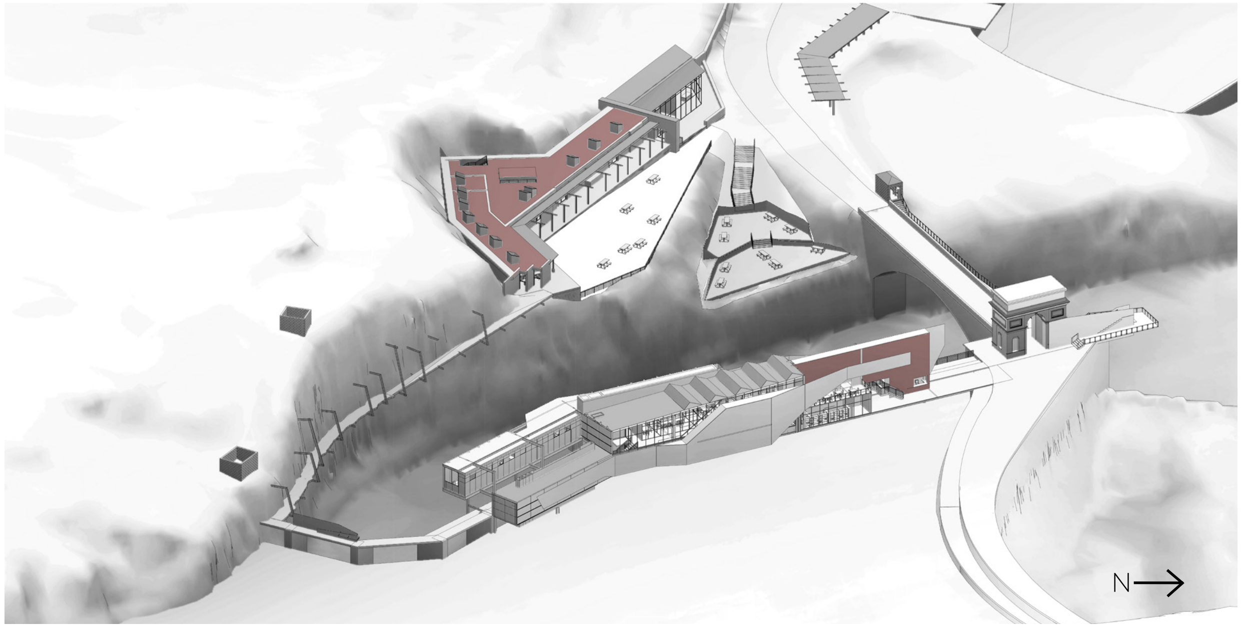


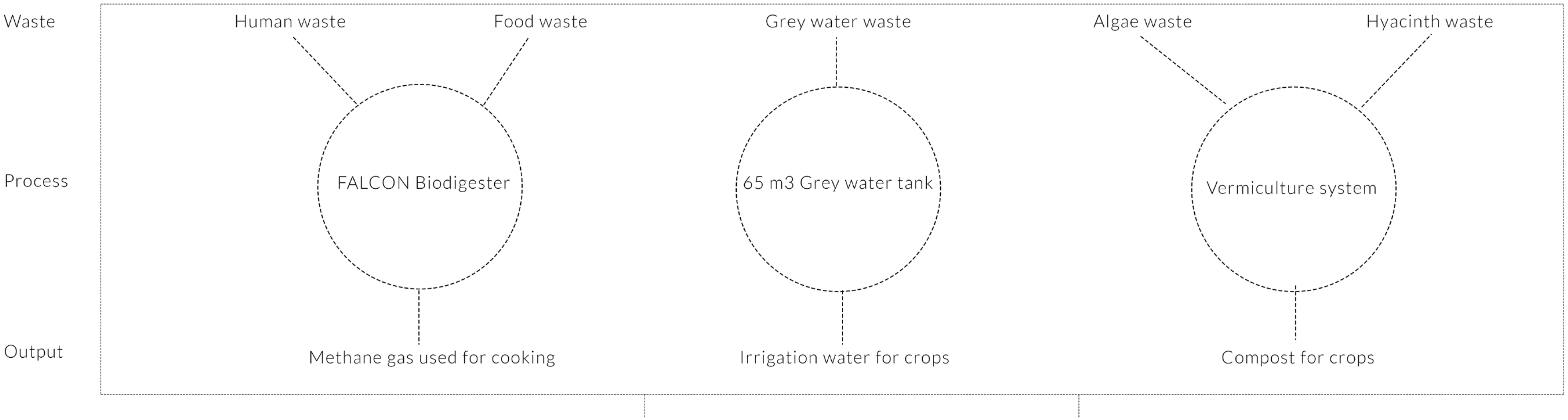
Fig 7.63 Food exchanges (Author, September 2016).

Waste exchanges

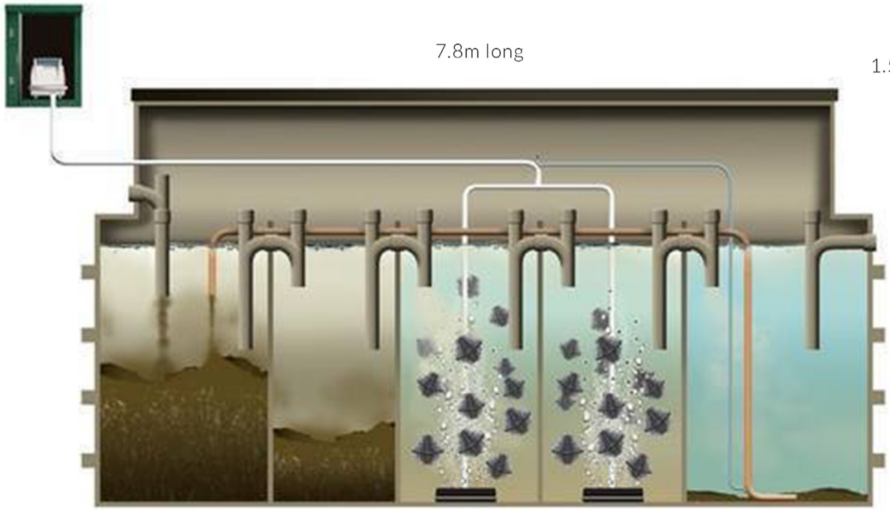
Human waste will enter into a biodigester that will create methane gas that can be used as cooking gas. A secondary by product of the system is also a compost sludge that can be placed on the plants and herbs. To further this process, any scraps or waste from the kitchen will also be placed into the system in order to increase productivity.

A secondary system is the vermiculture process that will deal with algae and hyacinth from the dam water and creating compost. The compost will then be used to grow new crops

WASTE SYSTEMS



FALCON Biodigester Sewage Treatment System
The plant illustrated is a Falcon 100 person system.



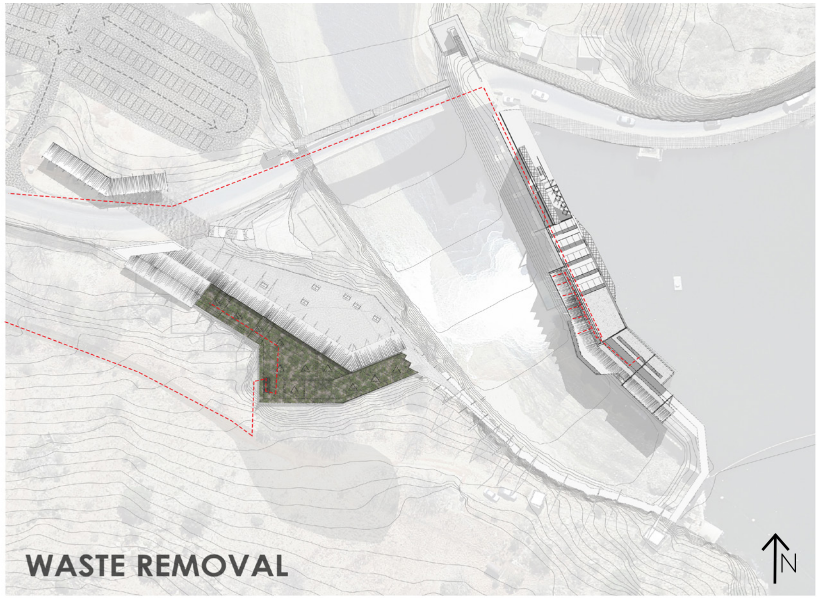
Electricity required	YES (Very Low)
Emptying Interval	6 to 12 months, depending
Primary tank	YES
Internal moving parts	NO
Concrete backfill	YES
Performs during intermittent use (holiday lets, etc.)	YES
Visually intrusive (large lids, kiosk, etc.)	NO
Expensive servicing	NO
Tank Warranty period	25 Years
Easy Installation	YES

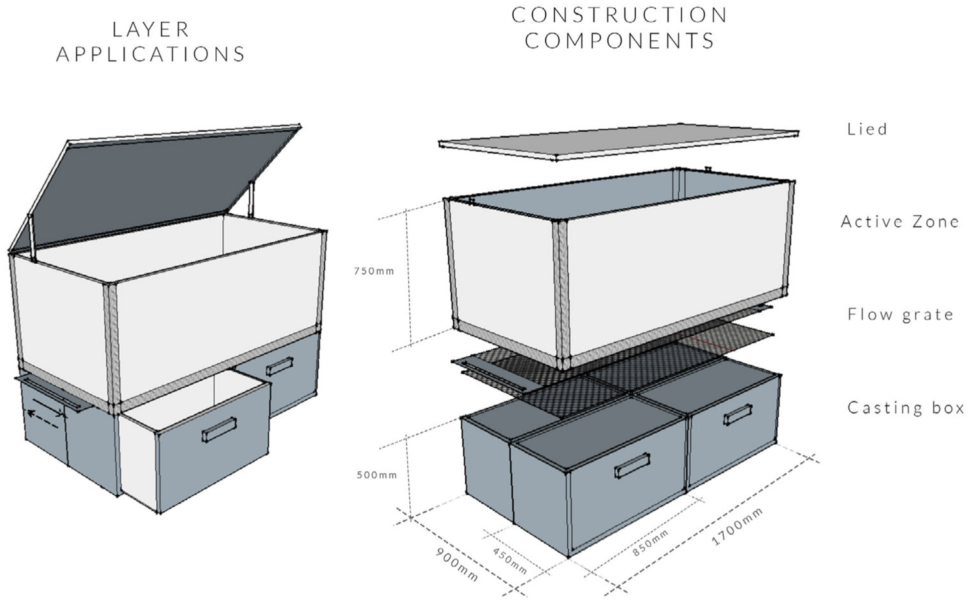
The biodigester would have to be of a significant size due to the number of users. The Falcon which is a domestic sewage treatment biodigester was looked at to fulfil this need. Falcon creates biodigesters to cater for 20 to 300 people, but the system size for this site would only need to cater for 100 people (Water Technology Engineering, 2016).

The system is an extremely effective and unobtrusive means of dealing with sewage disposal. It has a very low electrical consumption, very high effluent quality and minimal services required. This system deals with periodic use which most biodigester are unable to handle. This may occur at this site during the winter months when there are not as many users (Water Technology Engineering, 2016).

Due to its significant size it would have to be hung from the primary portal frames below the ablutions block, to free up space above. This way the toilets can feed directly into the system. The gas bladder would sit above this in front of the ablutions wall and from this point the gas would flow in pipes to the kitchen.

Fig 7.64. Biodigester (Crystaltank, 2016).





Electricity required	YES (Very Low)
Emptying Interval	1 months, depending on use
Labour intervals	1 week
Internal moving parts	NO
Smell	NO
Performs during intermittent use (holiday lets, etc.)	YES
Expensive od capital	Small
Expensive servicing	NO
Tank life period	10 Years
Easy Installation	YES

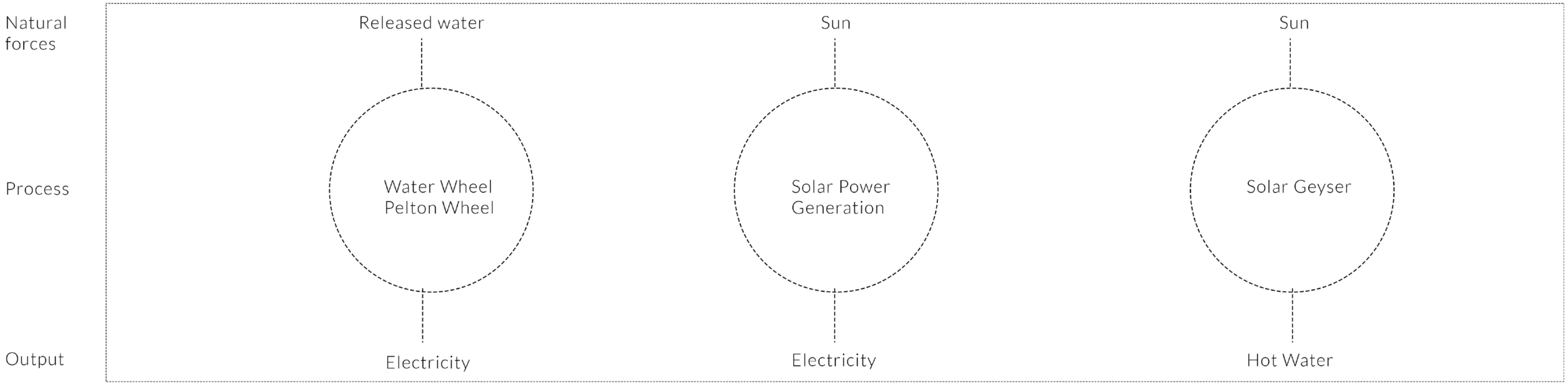
Fig 7.65 Vermiculture system (Author, September 2016).

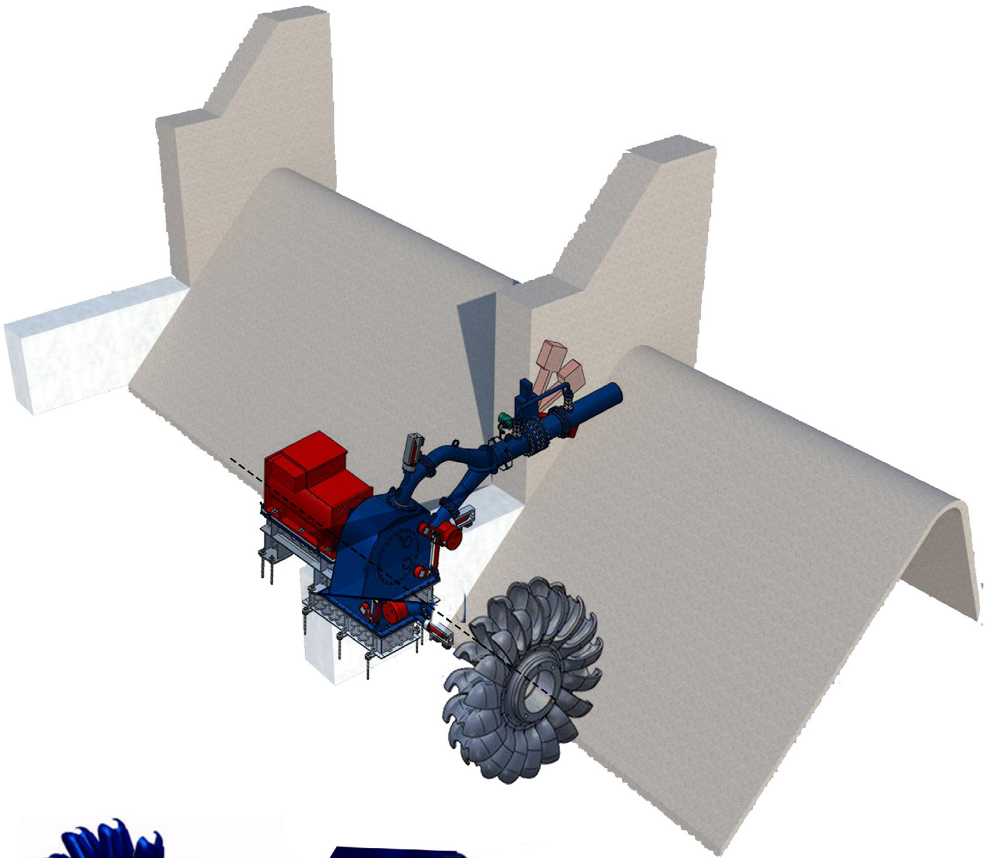
Power exchanges

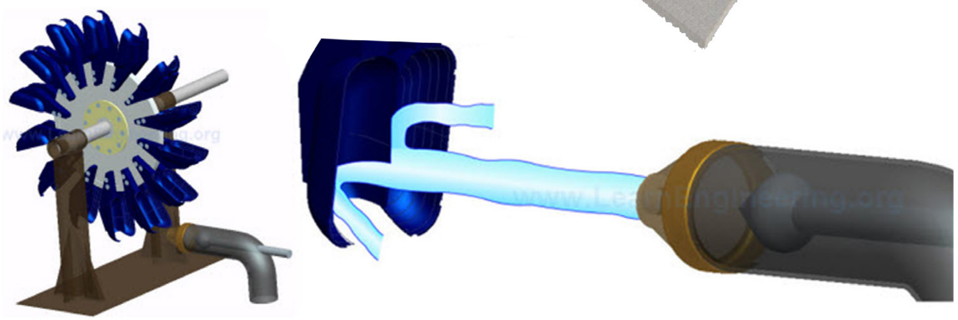
Currently there is no power generation from the dam water but this is the place where power could be generated easily. The integration of a water wheel could be placed at certain crest gates and at the other gates a very effective Pelton wheel could be placed which is small and would not disrupt the current system.

A secondary system of solar panels can be integrated into the roof so that in times of drought water would not have to be wasted in order to gain power. Similarly, to generate hot water a solar hot water geyser system can be integrated into the roof. Hartbeespoort Dam receives a large amount of solar hours, making both of these effective systems.

POWER GENERATION







The Pelton wheel was designed by Lester Allan Pelton in the 1870s (Wikipedia, 2014). It is an impulse type water turbine, this means that it extracts energy from impulse of moving water through a jet. This allows you to use a very little amount of water to generate a lot of power. The most important part of the Pelton wheel is the paddle which is uniquely designed to extract as much dynamic energy as possible, making this a very effective system.

The dam has a constant outflow of water on the eastern side of the dam through a pipe. This is in order to keep the river with a base flow, this water then feeds the agricultural land. This means when power is needed the water could rather be diverted through the jets on to the Pelton wheel in order to generate electricity without wasting any additional water.

The system could be integrated into the existing concrete crest gate walls. The downfall to the system is that there is not much visual link to it as it is contained with in a structural frame. This will not lead to much understanding by the viewer and this is why it is proposed that one crest gate has a regular water wheel.

This water wheel will run periodically and only when the crest gate is open. The system is not as effective as the Pelton wheel as it wastes a large amount of water.

Fig 7.66. Pelton wheel (learn engineering, September 2016).

The electrical requirements are relatively large due to the kitchen space (260 kW per day). There needs to be a minimum of 300m² solar panels (900x1800). Rather then doing this, it would be more appropriate to have a hybrid system. 125m² of solar power and hydroelectrically through the Pelton wheel.

The hydro-electrical system can also be turned on during peak hours when needed. This is also a more reliable energy source as it can run at night with out having to store energy from the day. Peak hours of the restaurant will be at night so this system will function better. The Pelton wheel uses less water than a conventional hydroelectrically system, even in water shortages the system can function.

Figure 7.64 shows the roof plan with the extent of the solar panels. Integrated into this would also be solar geysers to create hot water needed for the ablution block as well as the kitchen.

For maintenance and repairs, access to the roof will be needed. There will be two points of access to the roof; one from between the screens as a simple ladder and the other would be above the stairwell that would be a drop-down ladder.

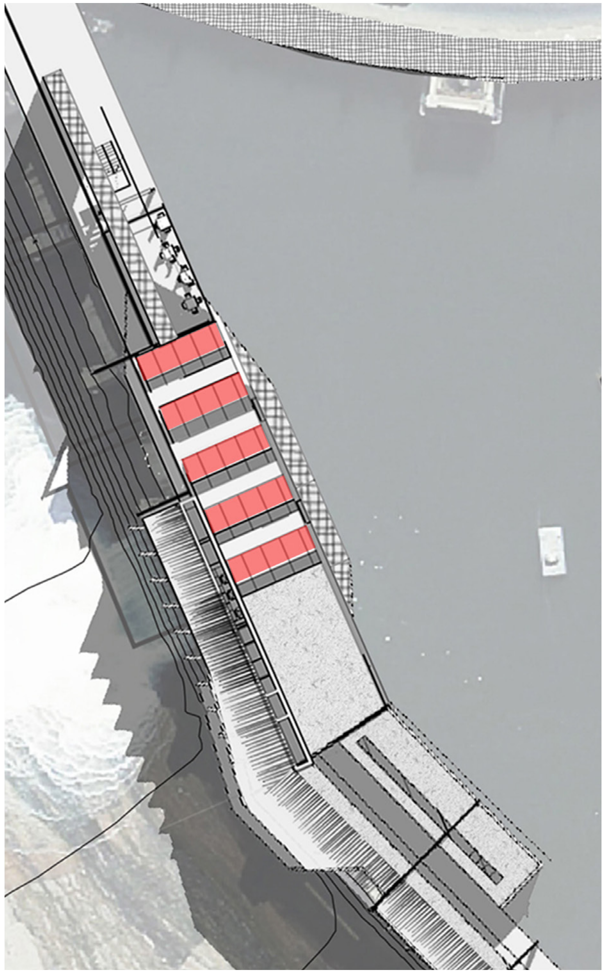


Fig 7.67 Solar panels (Author, September 2016).

7.7 Climatic responses to over heating

Climatic responses mainly had to deal with the overheated period due to local climate. The following diagrams show different responses that the building will use to become climatically comfortable.

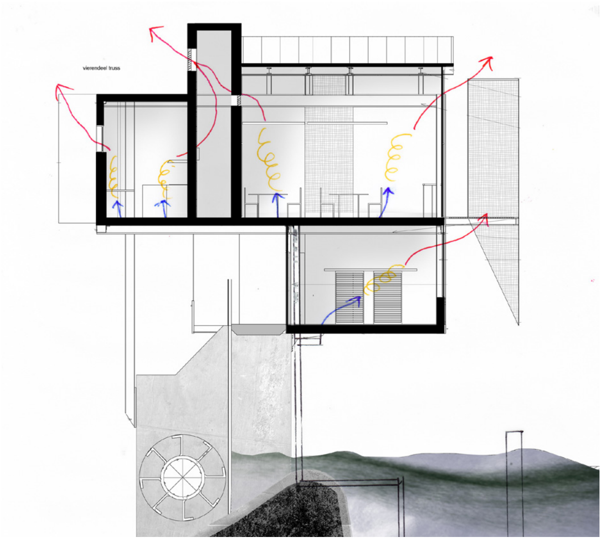
As previously stated the outdoor air will be channelled through the poort of the mountains and, as this draws air over the water body, it will create evaporative cooling. This will greatly reduce the local temperature. This means air needs to be drawn into the space from the north and east to make the most of this cool breeze.

Cross ventilation

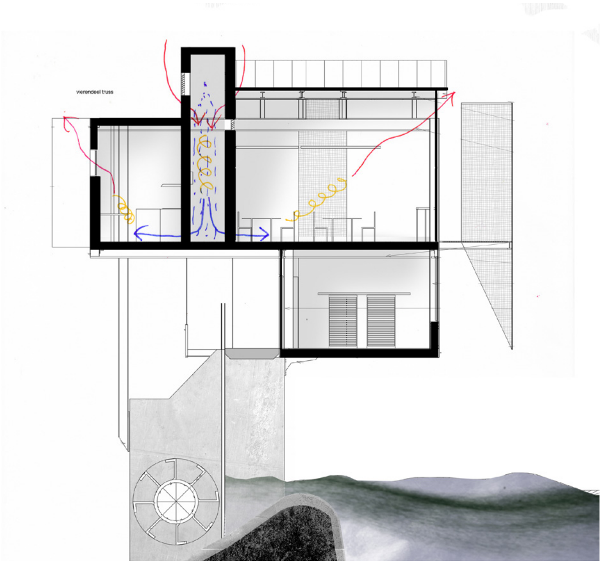
As the spaces range between 6m and 8m wide, it was possible to have cross ventilation. This natural cool air could be drawn in from the services core and then through controllable vents in the spaces. Openable windows under the ceiling level will be places on the east and west façade for the extraction of hot air.

Evaporative cooling

Evaporative cooling towers are to be used. Pretoria has dry summers and the hot dry air uses heat to evaporate the water therefore cooling it and integrated water elements to continue the education of the user in the potential of water.



Cross ventilation



Evaporative cooling towers

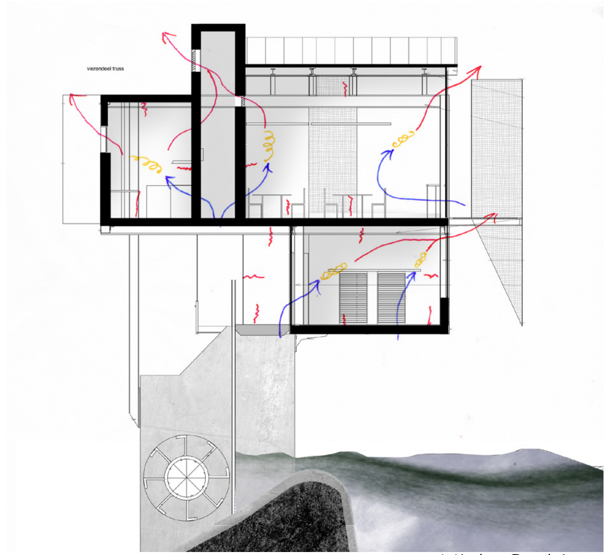
Fig 7.68. Overheating (Author. September 2016).

Night flushing

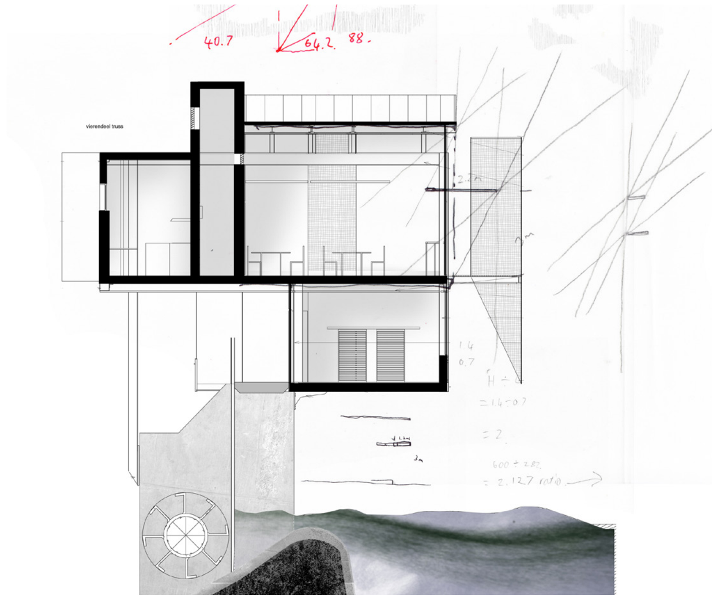
The night flushing system is very effective in this climate to lose the heat build-up in the thermal mass of the building in order for it to absorb heat the next day again. The system is also easy to be implemented as it uses the same elements as cross ventilation. It does need good management of opening and closing of the windows at night, for the system to function.

Solar screen

With regards to the over heated periods and the fact that there are large amounts of glazing on the facade for views meant that the solar screen needed to be articulated very carefully in order to let as little direct sun light into the space in summer but the maximum in winter while always allowing the view to be seen.



Night flushing



Solar angles. North vs. east & west

Fig 7.69. Cooling (Author. September 2016).

7.8 Climatic responses to under heating

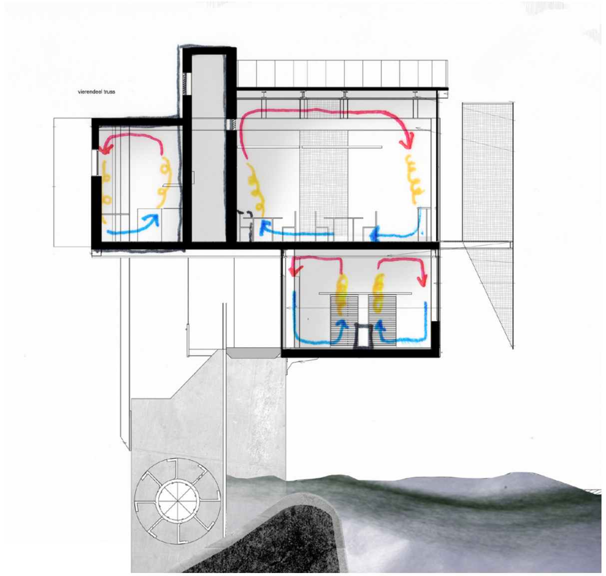
Climatic responses mainly had to deal with the overheated period, but due to the fact that there is little thermal mass in the building and large amounts of glazing on the facade for views, heating in winter would also become a factor. The following diagrams show different responses that the building will use to become climatically comfortable.

Fireplaces

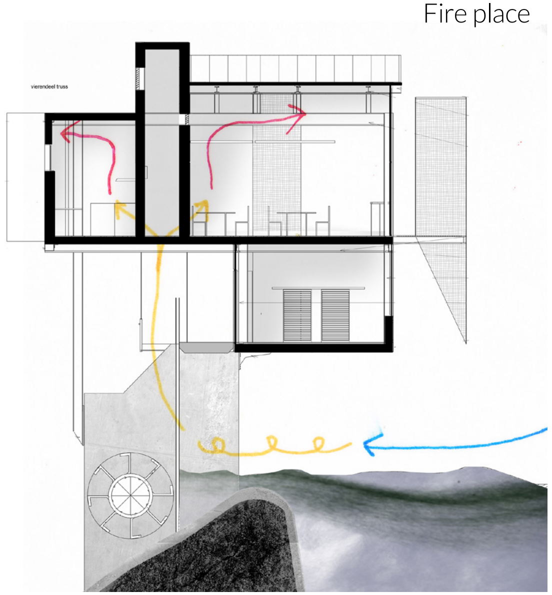
Fireplaces will be set into the thermal mass elements of the building such as the concrete services core. Any heat created in the kitchen will also be utilised and circulated through the public space. The solar screen that covers the large glazing has also been articulated at the right angle to allow winter light to penetrate deep into the spaces.

Large water body

In winter the large body of water will keep a more constant temperature and therefore air that is drawn across this will heat up and can be brought into the space for air change.



Fire place



Large water body

Fig 7.70. Under heated (Author. September 2016).

Solar screen

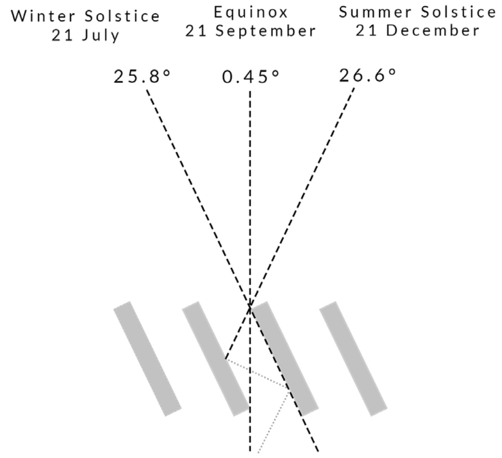
As already stated the articulation of the solar screen to allow maximum light into the space in the winter months was crucial. The design of the screen looked at the optimum solar angles. Through the investigation it was found that vertical louvres rotated at an angle of 25° would allow in winter solstice light and the spacing between the louvres could be played with to allow in the equinox light. These louvres would block the direct summer solstice light but reflect indirect light into the space.

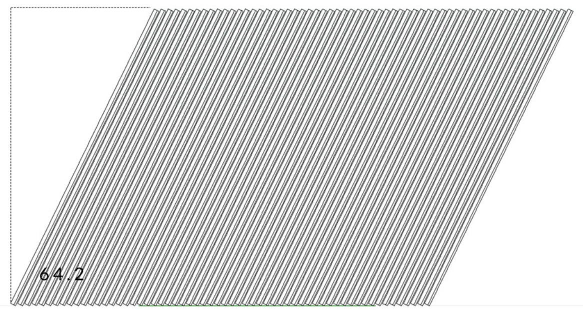
To allow no direct sunlight during the summer solstice the louvres would actually need to be at 64° from the horizon and not directly vertical at 90° (rotated to an angle of 25°). This would allow very little view out and was rather kept to vertical louvres

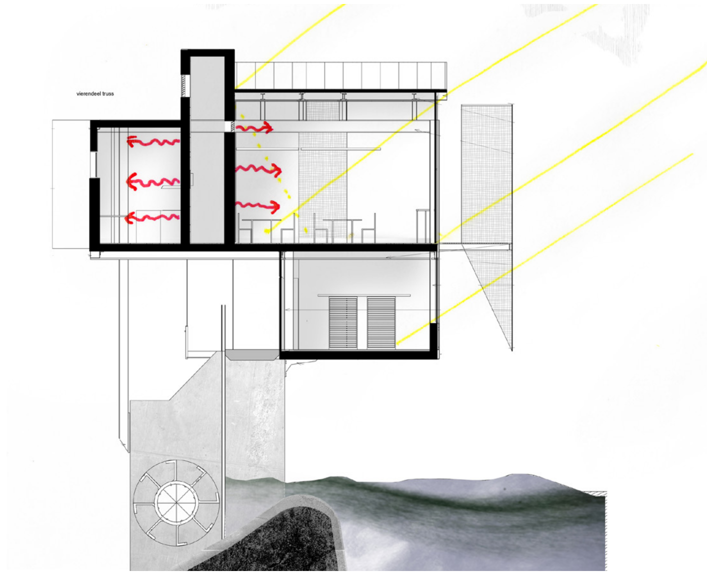
Thus creating the best screen possible mediating these two informants (design and environmental needs). A glazed gap was placed between the service core and the roof plane to wash the concrete service core with natural light. This will warm up and then radiate heat back into the space to keep a more constant temperature.

Gas heaters

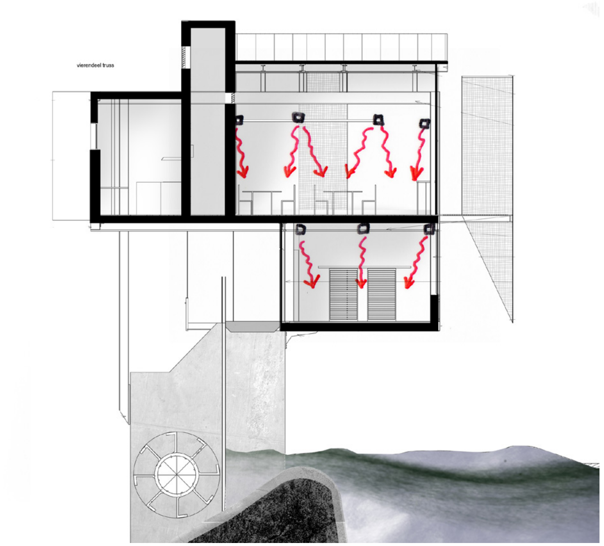
Simple gas heaters could be introduced into the space as gas has already been created on site through the biodigester.







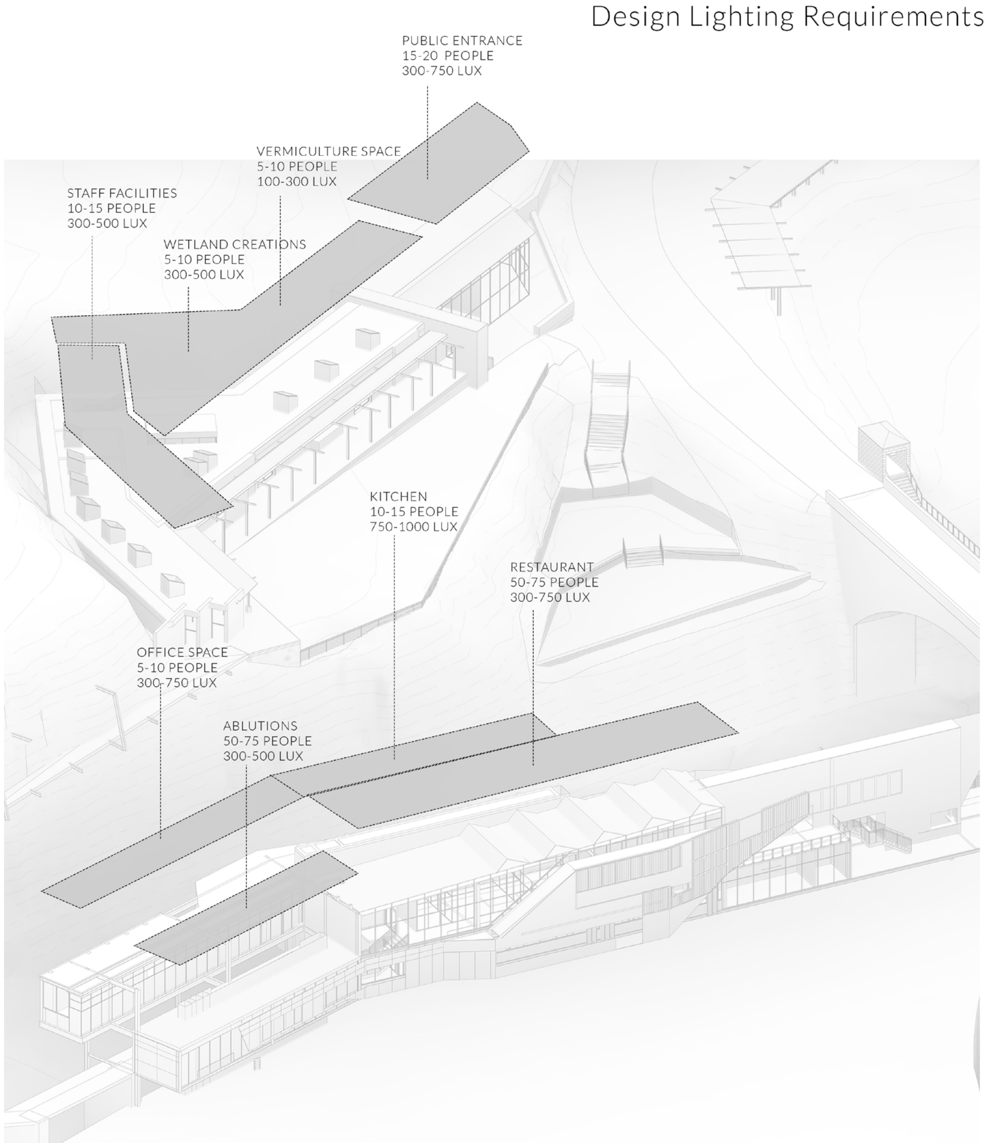
Deep penetration of light



Gas heaters

Fig 7.71. Heating systems (Author. September 2016).

7.9 Lighting exchanges



Analysis program

In order to test the lighting quality of the iterations, a computer program called Sefaira was used. In this program it is possible to set the required lux levels of the space and the program would generate three main analysis tools; Daylight factor, annual illuminance, underlit and overlit spaces.

The underlit and overlit analysis tool gave a good indication of specific spaces that needed more or less light. "Spatial Daylight Autonomy (sDA) is used to evaluate whether a space receives enough usable daylight throughout the year. Annual Sunlight Exposure (ASE) helps to identify whether a space is subject to overlighting" (Sefaira, 2016).

Daylight analysis tool also produced an average daylight factor which then could be used to gauge the overall lighting condition throughout the spaces (Sefaira, 2016).

"Minimum Daylight Factor shows the lowest value of Daylight Factor in the area, excluding a perimeter zone around the walls. This is the "worst case" value within the area" (Sefaira, 2016).

Fig 7.72. Lighting requirements (Author, September 2016).

Lighting requirements

The two main activities need very different kinds of lighting. The vermiculture building needs a constant low lux light level (100-300 lux) with very little to no direct sunlight. This is due to the fact the worms enjoy dark spaces. Skylights were introduced to bring in natural light but the light was bounced down a light tube to avoid any direct sunlight. The public interface to the vermiculture space needs to have control over the light as presentations could be done in the space. The wetlands creation space needed a higher lux level (300-500 lux) and therefore a large skylight was used to allow natural light into the space. The vermiculture building is only active during the day so making the most of natural light to avoid lots of electrical lights was critical.

The restaurant space is made up of two main areas, the kitchen space which needs high lux (750-1000 lux) for food preparation and the restaurant space which needs a lower lux level (300-750 lux) but it needs to be a constant light. This was a challenge as there are amazing views from this point and therefore a lot of glazing was introduced into the facade this meant that the solar screen needed to be designed correctly in order to allow light in during winter and block light out in summer but have all year round views through to the landscape.

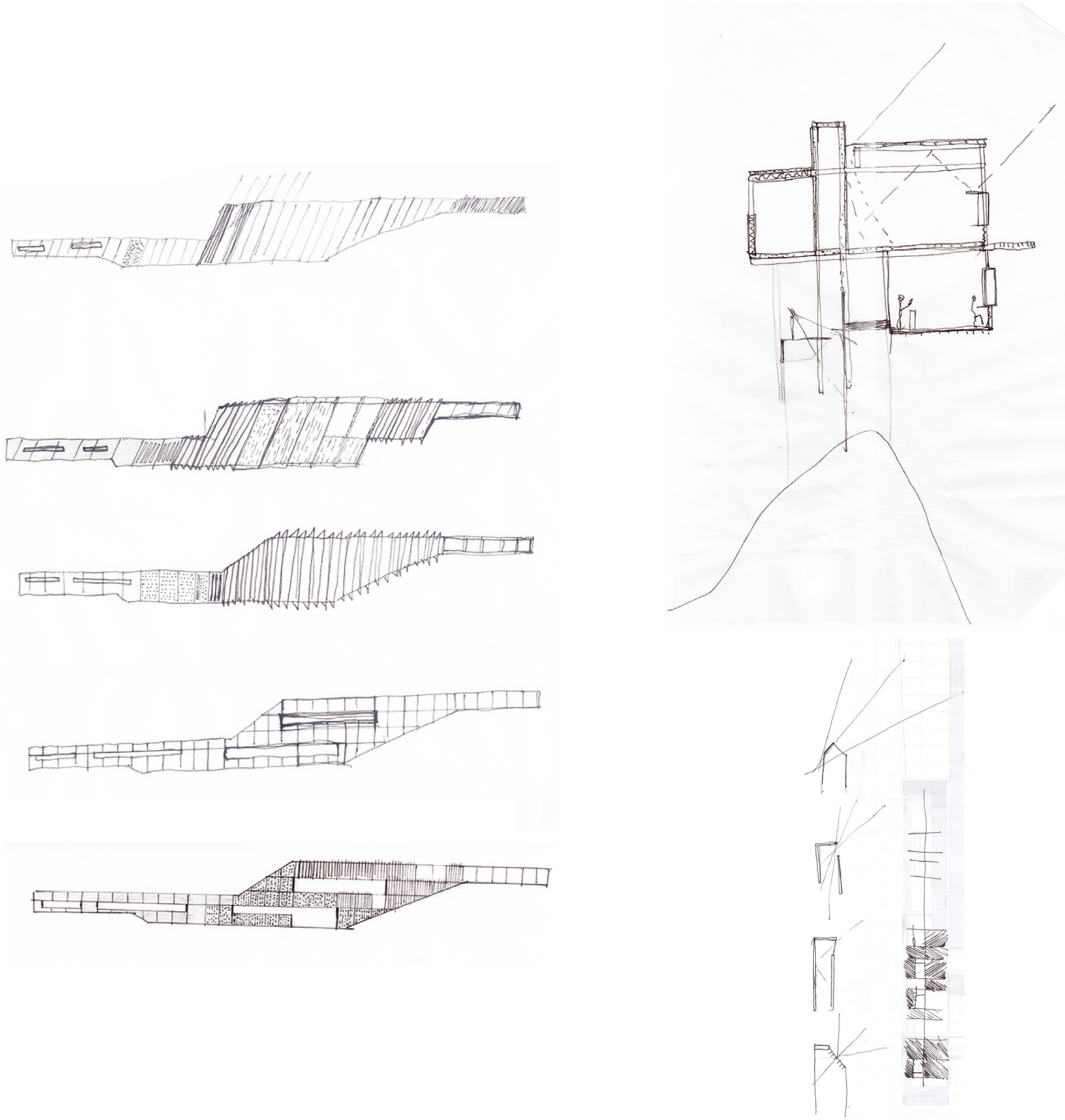


Fig 7.73. Lighting sketches (Author, September 2016).

Iteration 1

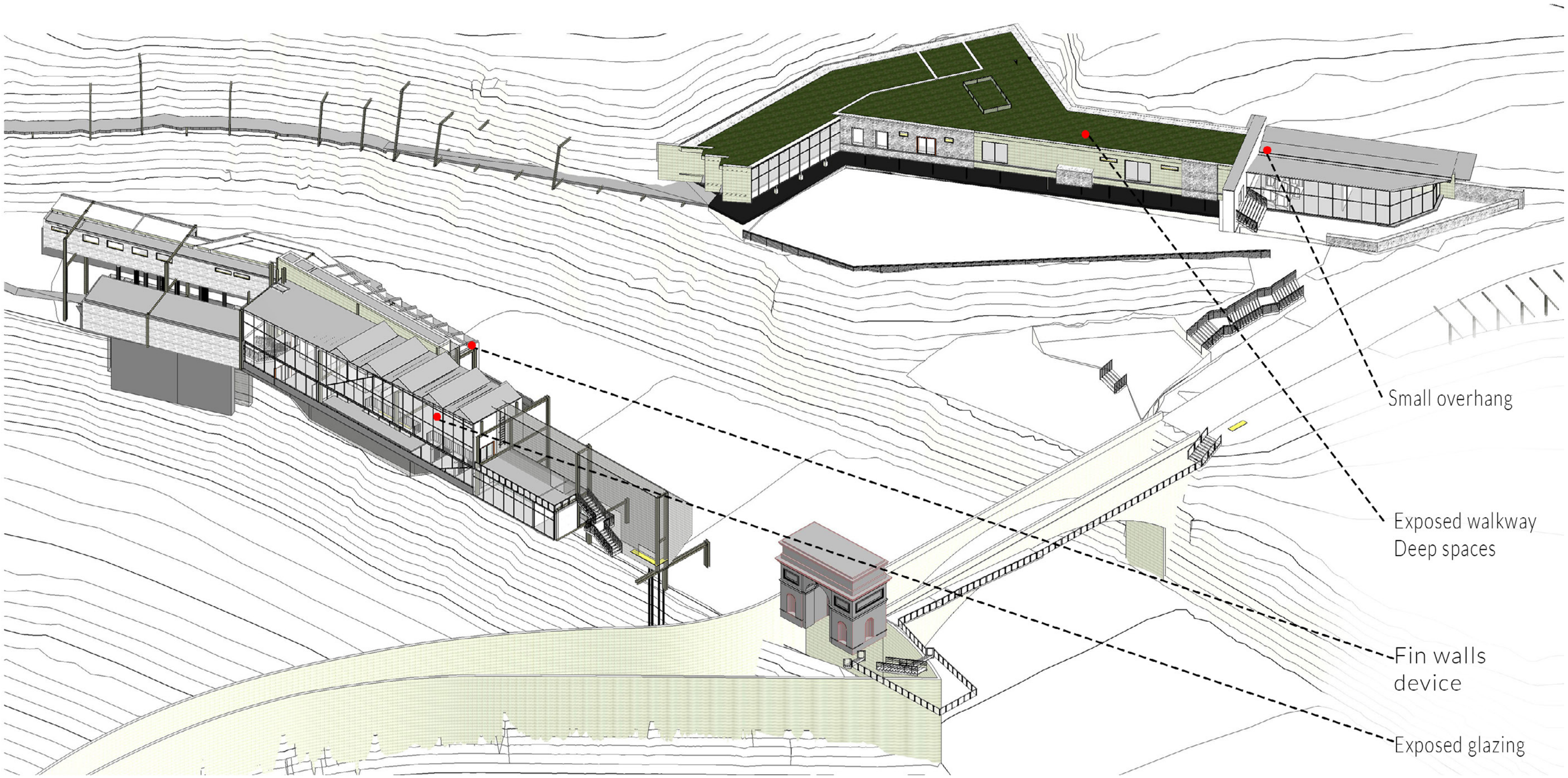
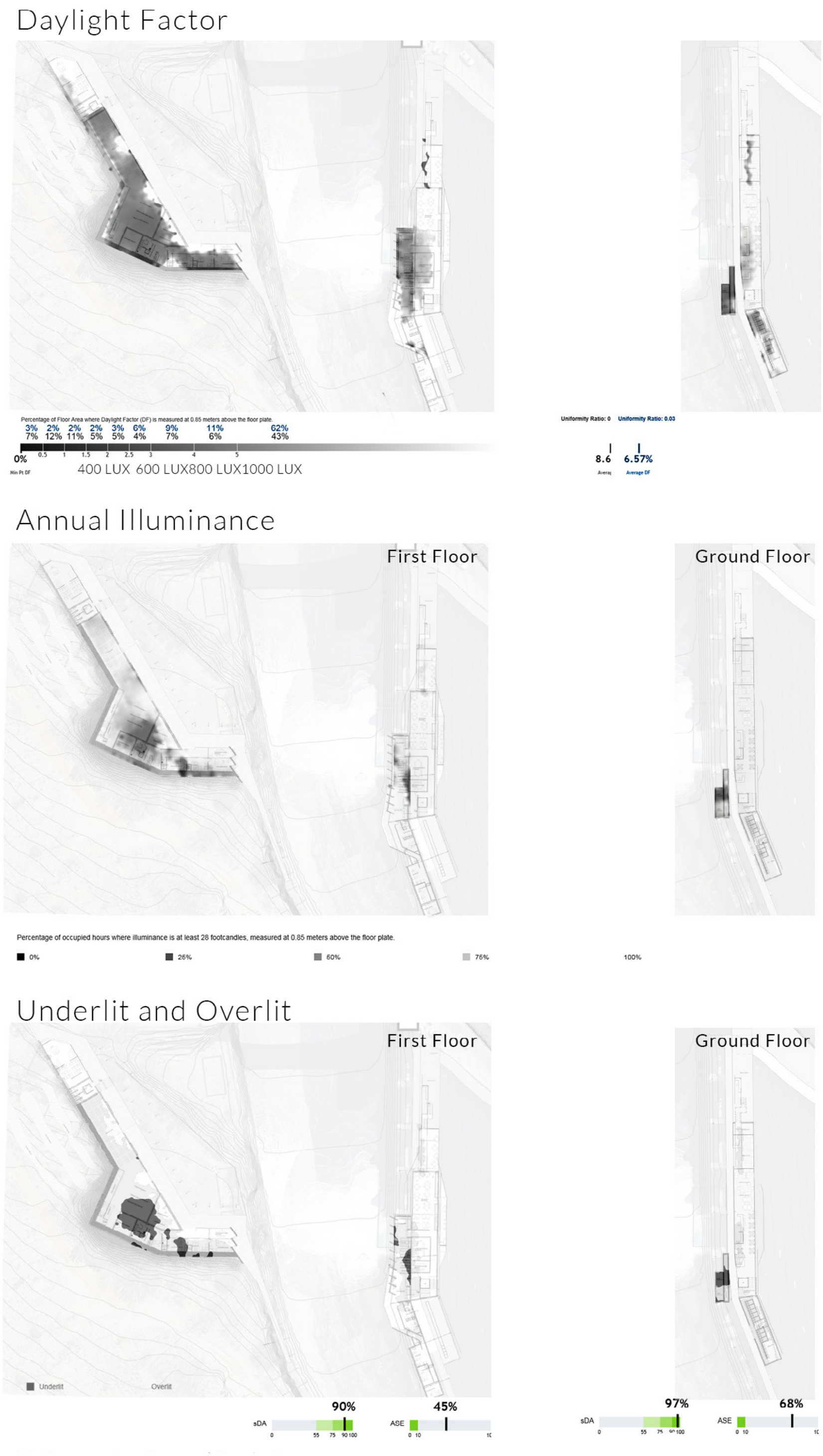


Fig 7.74 iteration 1 (Author, September 2016).



Iteration 1

The initial design had quite severe light problems. This was due to the small overhangs of the roofs as well as the exposed glazing in order to gain views of the site. The vermiculture building also had a large exposed walkway that would have made an uncomfortable space for people to walk along. There was too much light in the vermiculture space and a significant amount of light in the restaurant space, glare was a major issue.

Due to deep spaces the front would be overlit and the back would be dark and underlit. This is clearly visible in the wetland creations space.

Fig 7.75 iteration 1 results (Author, September 2016).

Iteration 2

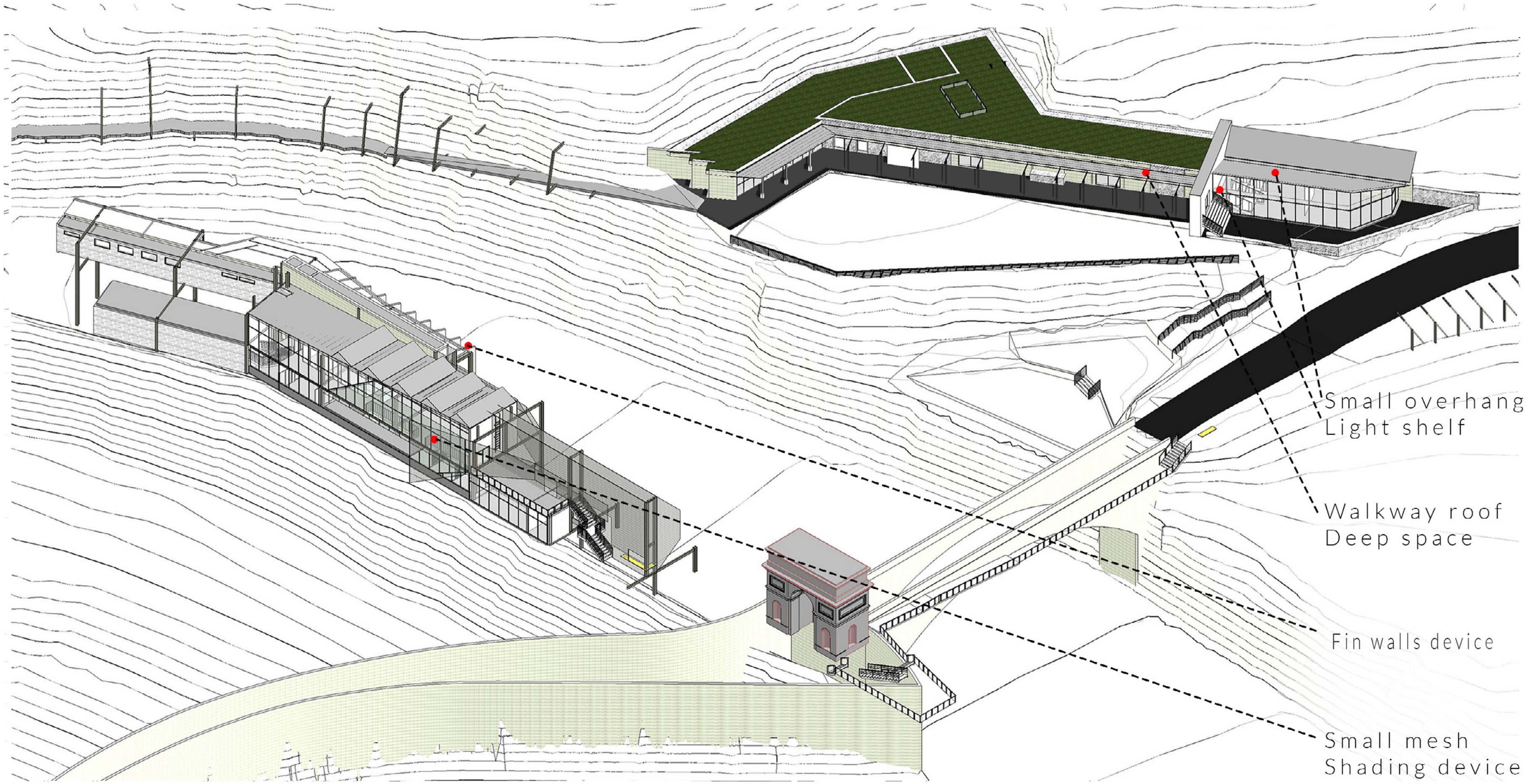
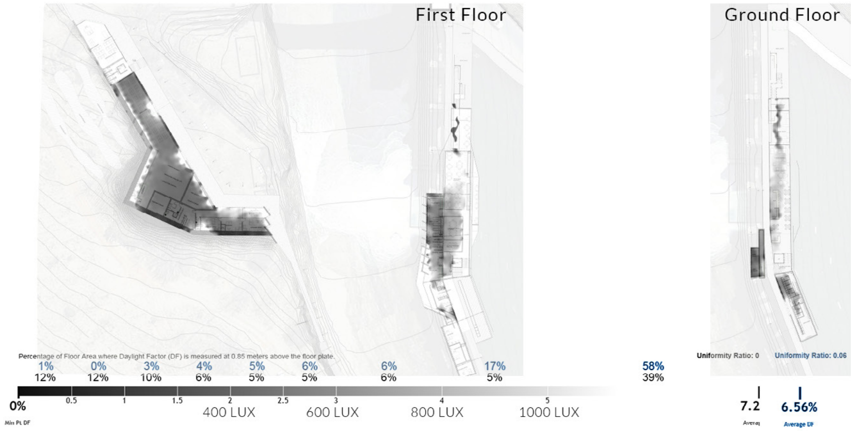
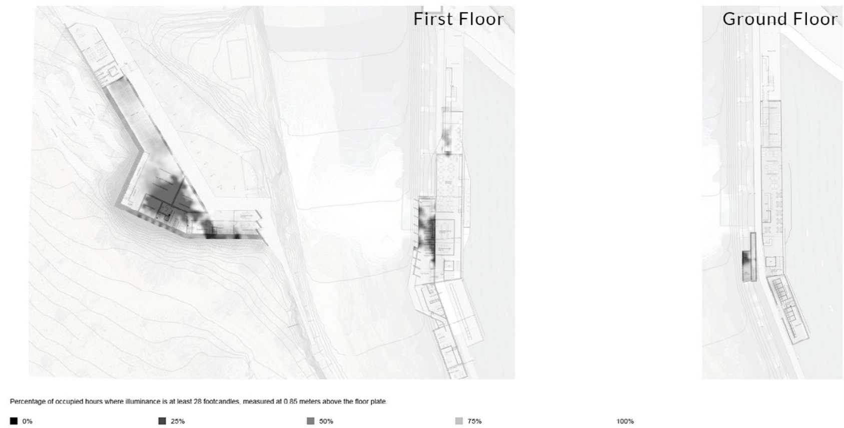


Fig 7.76. Iteration 2 (Author, September 2016).

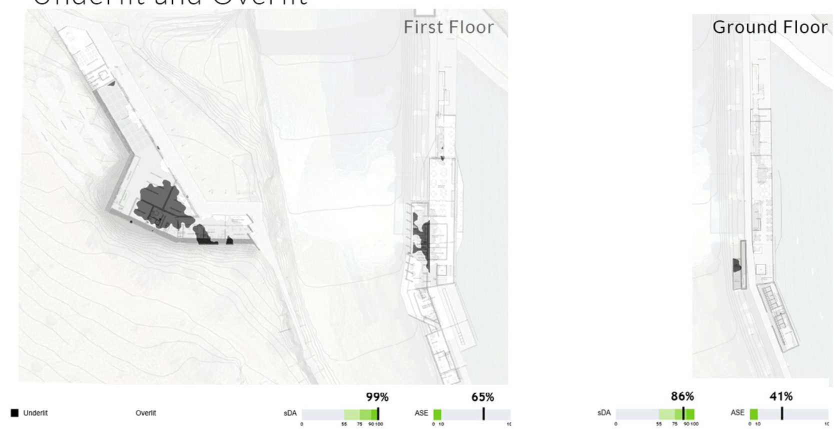
Daylight Factor



Annual Illuminance



Underlit and Overlit



Iteration 2

A small mesh shading device was added to cover the large amount of glazing in the restaurant, This helped to an extent but the space was still overlit. A roof was placed over the walkway of the vermiculture space, this would make the space more comfortable but little light then entered into the offices and wetland creation space.

In the public space of the vermiculture building light shelves were installed to bounce light into the back corners of the room. Deep rooms in the vermiculture space were still a problem.

Fig 7.77. Iteration 2 results (Author, September 2016).

Iteration 3

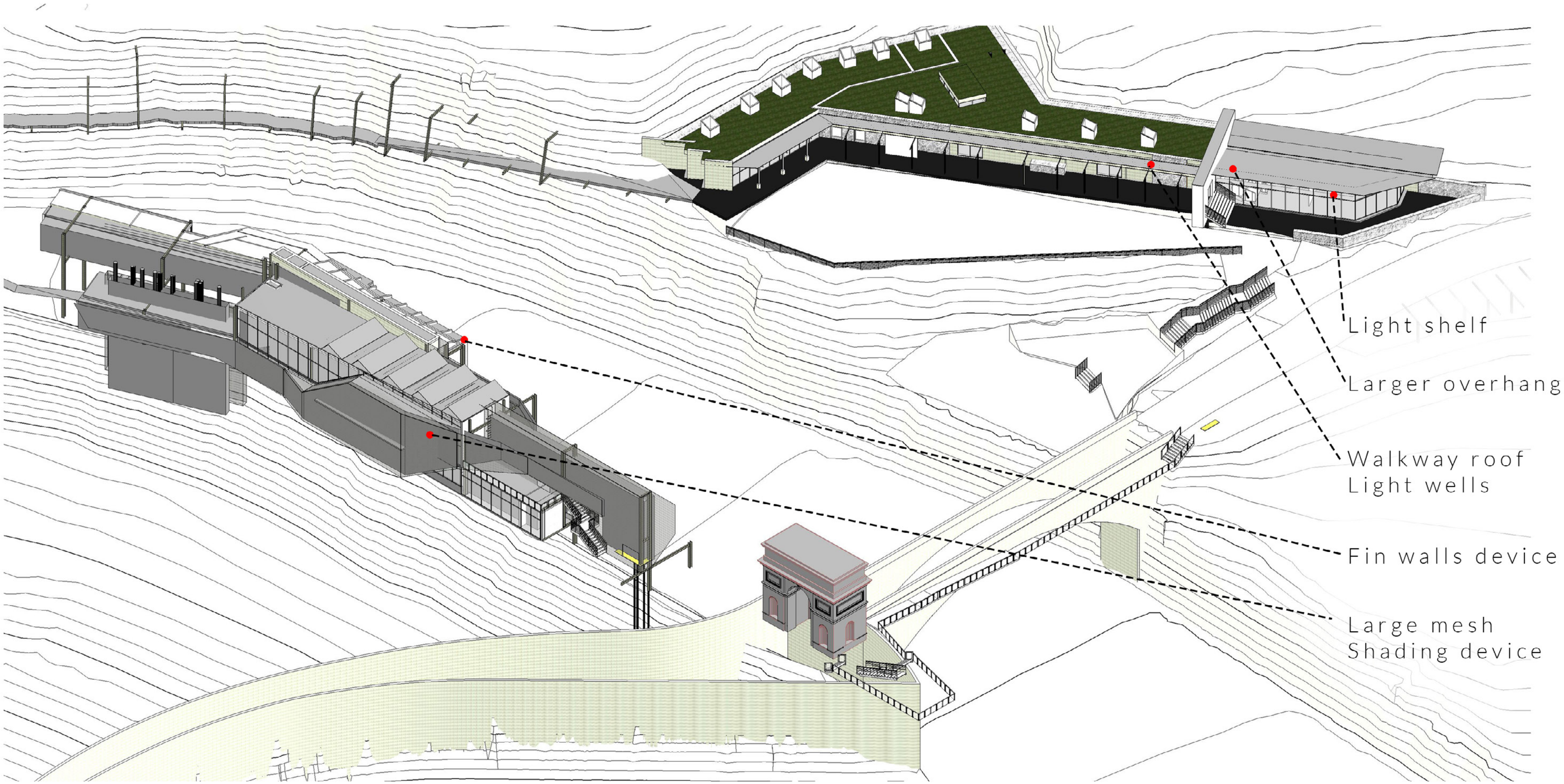
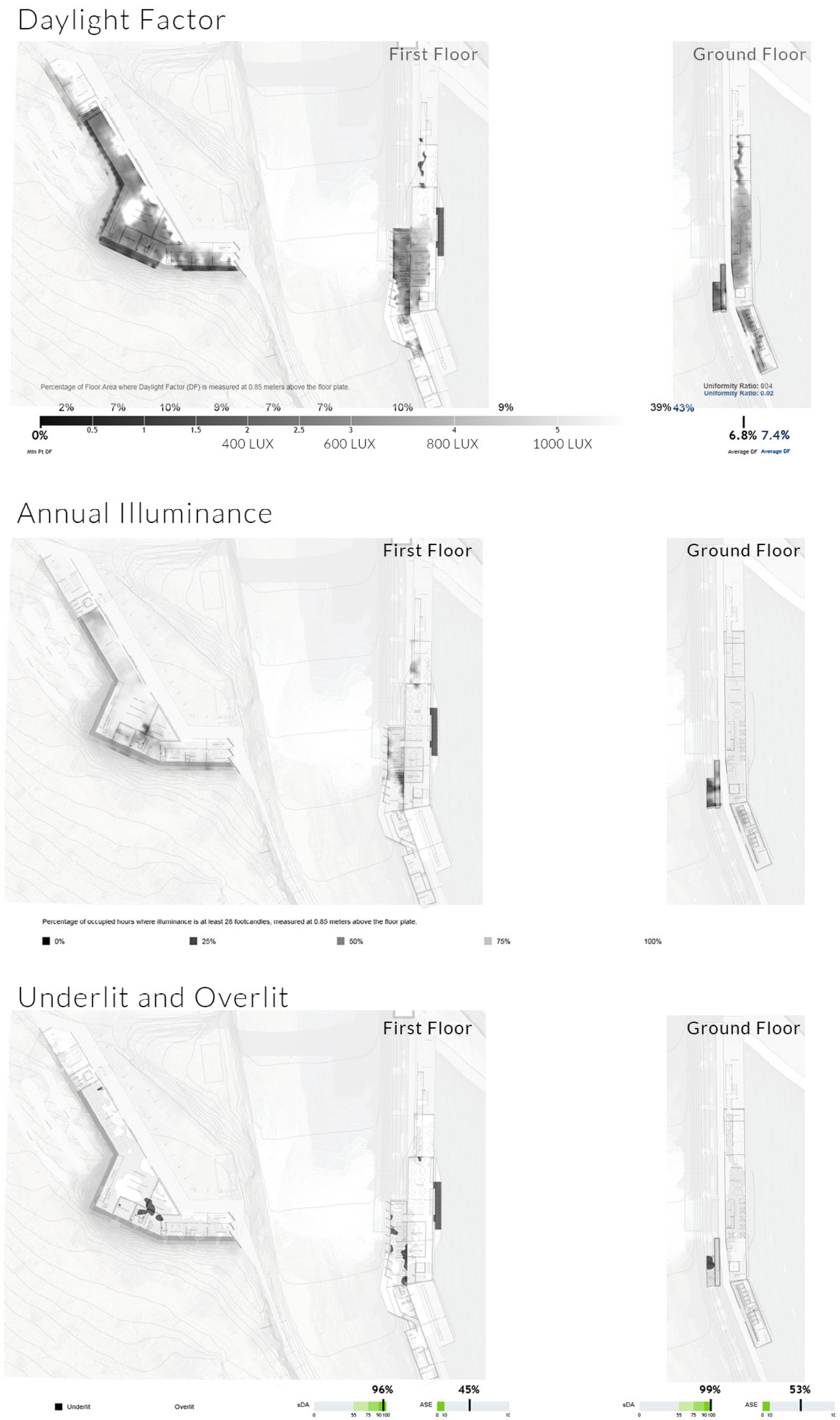


Fig 7.78. Iteration 3 (Author, September 2016).



Iteration 3

A much larger, less perforated, shading device was added to the restaurant space which helped with glare and overlit spaces.

Along the vermiculture walkway, the roof was kept and light wells were introduced into the back corners of deep spaces. The light wells significantly helped with creating a better light quality. This also meant that they could be articulated in such a way as to bring in diffuse light into the vermiculture space which required this.

The light shelves in the public space of the vermiculture building were increased in size as well as a larger overhang was introduced which created a better light.

Fig 7.79. Iteration 3 results (Author, September 2016).

Iteration 4

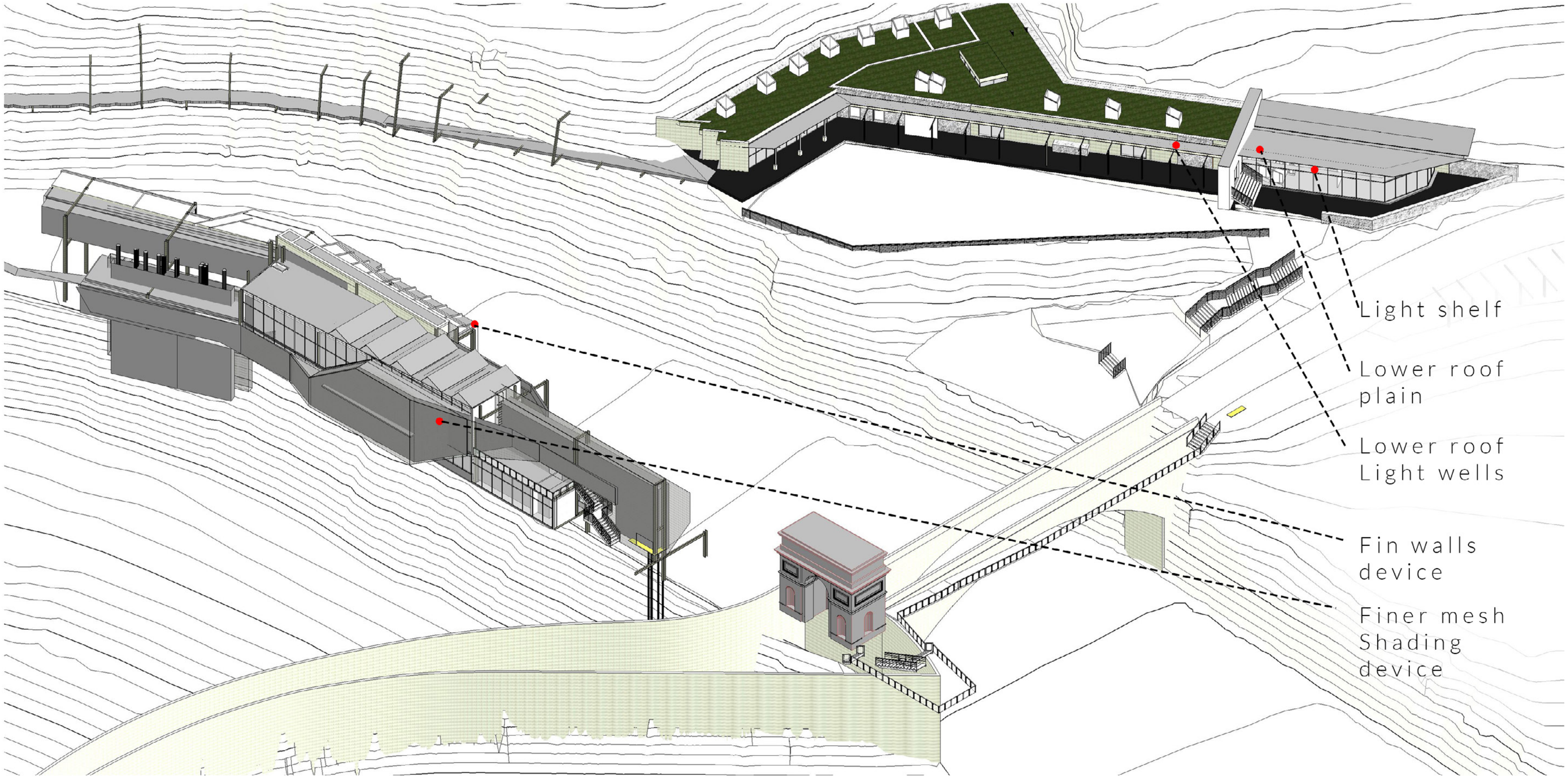


Fig 7.80 Iteration 4 (Author, September 2016).

Iteration 4

The volume of the public space of the vermiculture was lowered so that less light would penetrate into the space, the large light shelves were kept. This created a much more consistent light. There were also louvres introduced to the one side that could be controlled for different functions in the space such as presentations.

A larger light well was introduced directly over the wetland creation space in order to bring more light into this space for more detailed work. Windows in the vermiculture space were changed from high vertical windows to thin slits that light up the space. The space now has a good consistent light. The vermiculture space was a much lower lux which is what was required.

A finer mesh was introduced for the shading device of the restaurant which made the space have a very consistent light throughout and minimized glare. The lux levels in the space were now becoming more appropriate for the function of the space but are still too high 800 lux.

Fig 7.81. Iteration 4 results (Author, September 2016).

Final Design

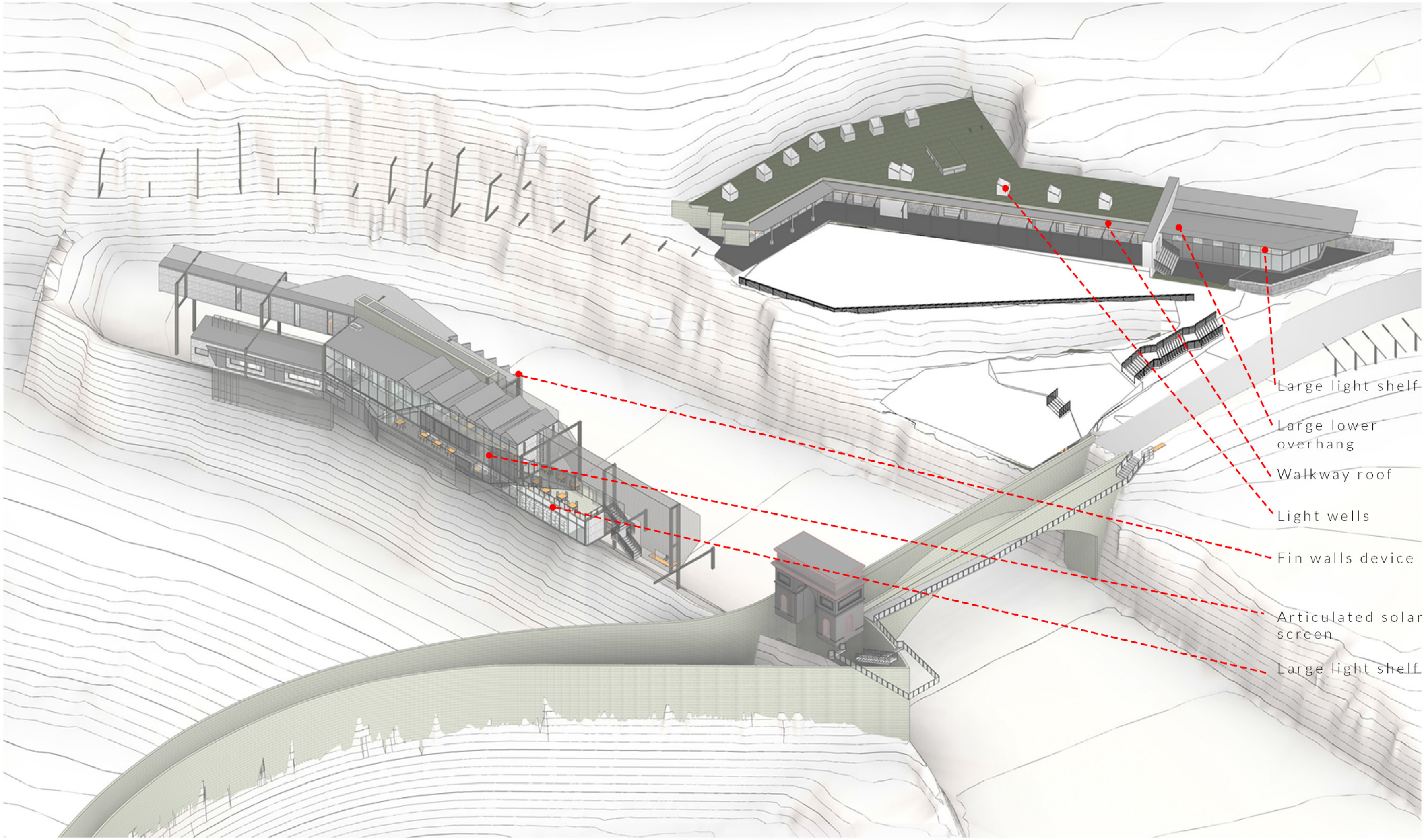


Fig 7.82. Final iteration (Author, September 2016).

Final Design

Daylight Factor

Annual Illuminance

Final Iteration

Daylight factor

The daylight factor analysis showed a more consistent light throughout the space except for the wetland creation space, directly below the large skylight. The skylight may still need additional articulation of a shading device.

As for the restaurant space it has a consistent light due to the articulation of the shading screen, with an average daylight factor of 3.45%.

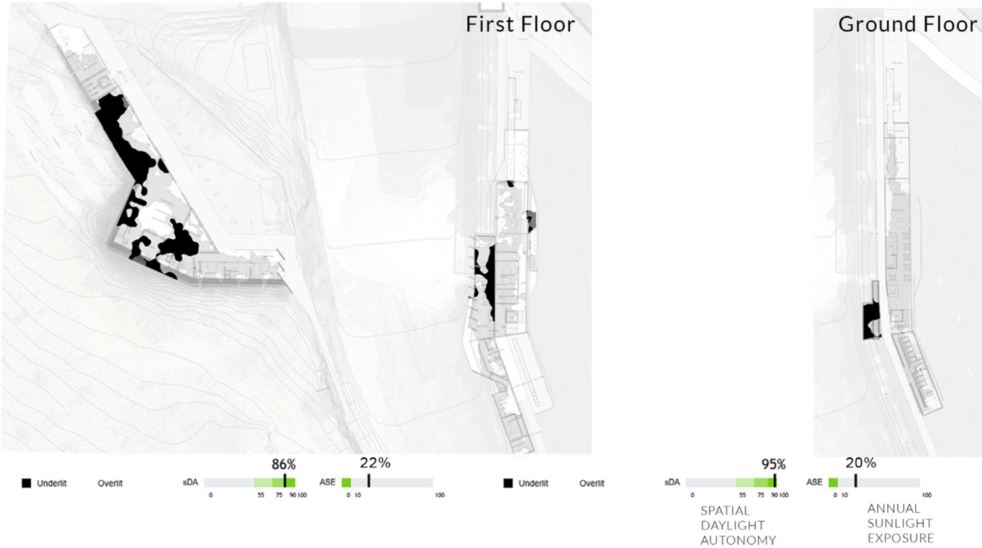
Annual illuminance

This iteration shows the louvres closed in the public space of the vermiculture building and how the space can be made dark for presentations.

The vermiculture space has a good consistent light with a low lux level. The wetland creation space has more light and there maybe a problem with contrast between these two spaces. The restaurant space lux has also been lowered to a more appropriate light level of 500 lux, glare is also now much better.

Fig 7.83. Final iteration results (Author, September 2016).

Underlit and Overlit



Direct Sunlight

Winter Solstice
Jun 21

Underlit and overlit

The wetland creation and vermiculture space, even though they require very different amounts of light, were set to have the same lux levels in the program. As can be seen from the underlit and overlit analysis the vermiculture space is significantly darker than the wetland creation space as required.

In the kitchen space, the service core was underlit, this was not able to be naturally lit as there are services running overhead such as water tanks, ducts and batteries. This space would need artificial light to a high lux level as it is where food is prepared. Similarly the dirty kitchen on the ground floor was underlit and would need to be artificially lit.

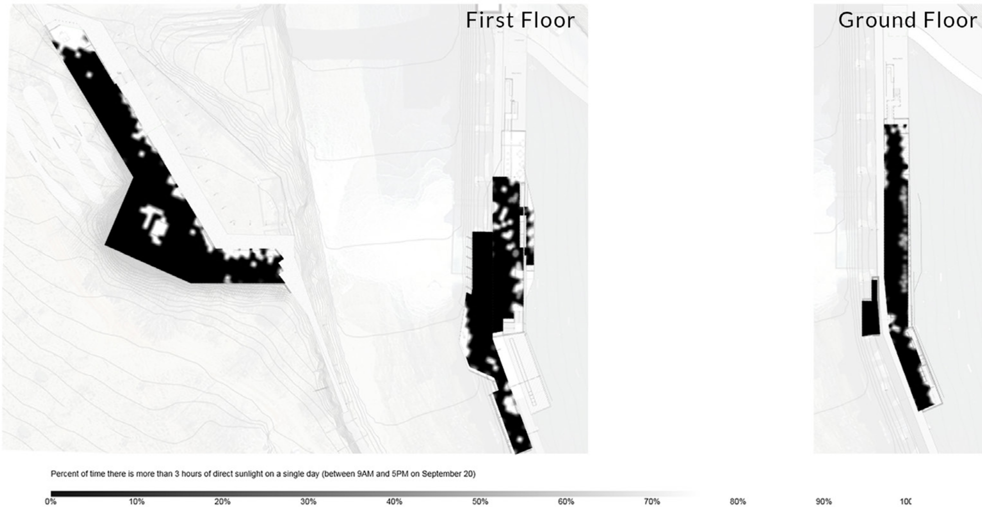
Direct sunlight

This analysis shows the percent of time that there is more than three hours of direct sunlight in a single day (represented as white). This tool was used to gauge how well the screen and the skylights were working.

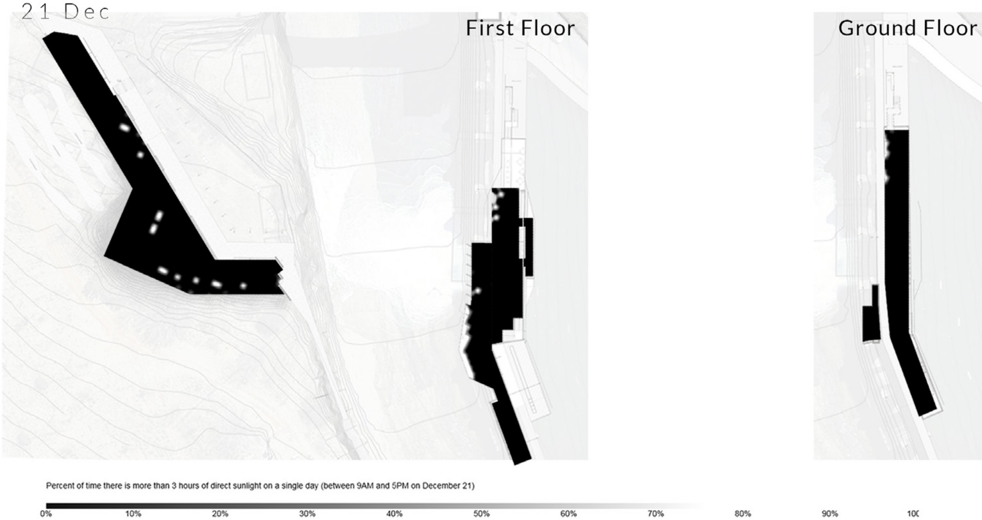
As can be seen from the winter solstice analysis there are larger and more frequent white areas. In the ground floor of the restaurant space it is visible that the light is penetrating deep into the space through the screen as designed. The wetland creation space is also being well lit from the skylight. The smaller skylights are also letting in a good amount of light and can be seen as dotted white areas along the back wall as well is in the vermiculture space.

Fig 7.84. Final iteration results (Author, September 2016).

Equinox
21-Sep



Summer Solstice
21 Dec



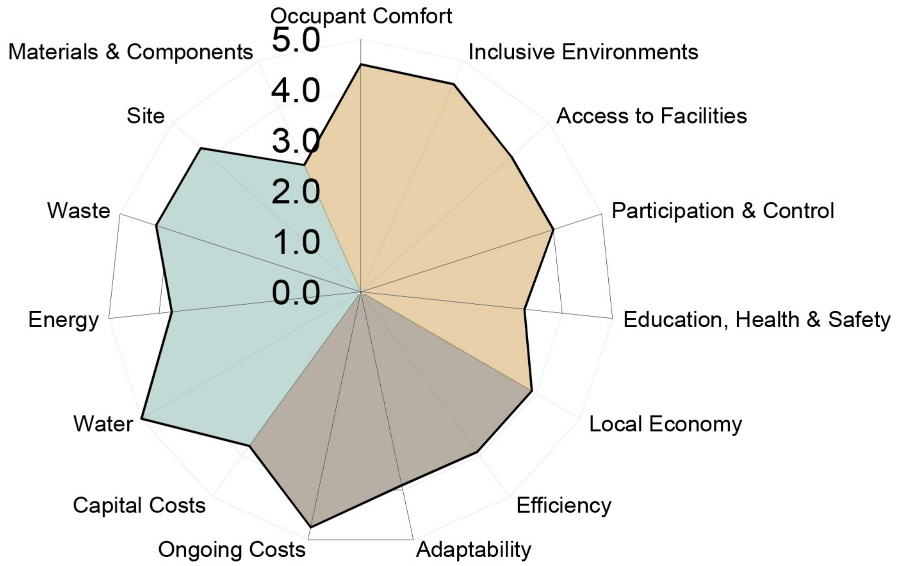
During Equinox these white spaces become smaller and less frequent, with the exception of the wetland creation skylight, as already stated might need a further articulation. Moving into summer there are only a few white dots mainly under the skylight in the office space and as for the restaurant space it is completely black meaning that the screen articulation is working correctly.

This proves that the skylights have been articulated correctly to allow the low angle of the winter sun to penetrate into the spaces and block out as much of the direct sunlight in the summer months to avoid overheating. This does not mean that the spaces will be underlit in summer as this analysis only gauges direct sunlight.

Fig 7.85. Final iteration results (Author, September 2016).

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT	
Project title:	Celebrating the unseen
Location:	Hartbeespoort dam wall
Building type:	Vermiculture andRestaurant
Internal area (m2):	1711 m2
Number of users:	120



Social	4.1	Economic	4.0	Environmental	4.0
Overall	4.0	Classification	Good		

Fig 7.86 SBAT analysis (Author, September 2016).

7.10 Sustainable building assessment tool

SBAT tool was completed for the entire building in order to gain an indication of the performance of the building in terms of sustainability. This too could be used for schools, housing, restaurants and offices. SBAT is normally used directly after the building has been completed. But in this case the building would score a higher score during the life cycle of the building as the systems become more effective.

As can be seen from the SBAT tool the capital cost would be quite significant for this building, but as the systems start to become more and more effective the ongoing cost would be relatively low and the building will start to repay the capital put in to this project.

Inclusive design was very important to this project and a difficult task as there are so many levels that need to be negotiated by a disabled person. This was able to be fulfilled by mostly ramps but in the restaurant space a lift was required.

Participation and control as well as education were very important to this project but the way that SBAT rates these, the project scored relatively low. SBAT rate takes education as amount of seminar rooms and libraries which is not the way that this building educates people. It educates people through the understanding of exchanges, which can only be understood through sight, touch, hearing.

Moving on to environmental aspects, energy was quite low even though renewable energy was being created on site. The requirements under the energy category is how people commute to this building but due to the location there is little public transport. Specifically at night when the restaurant space would be used frequently. This meant that people would have to arrive in cars and a parking lot would have to be constructed.

Materials and components scored lowest on the list, this is due to the embodied energy in the materials. As already discussed this was necessary due to the harsh environment as well as the difficulty of construction on the site. As well as little to no materials were able to be recycled in the new building. Only the gabion wall in the vermiculture building would make use of material on site.

Overall the three categories, social economical and environmental, scored an average of four points which classifies the building as good.

Chapter 8:
Space outcomes

CLOSING

8.1 Conclusion

This project aimed to reacquaint humans and the natural world, specifically water. Water is our most important natural resource and is essential to human survival. But currently it is being abused and exploited all over the globe. The intent in this dissertation was to question current human interaction with water by understanding what our relationship to water was and locating an important point to intervene.

It was hypothesised that water infrastructure was the point where humans could have a direct relationship with this natural resource. This led to the investigation of historical water infrastructure and location of important elements that represented the past paradigm on site.

Regenerative theories were used as a starting point for this project, rather than the limited theories of sustainability which only correct the damage done by the past rather than extending possibilities for the future. The role that architectural design can play in enhancing our understanding of water was investigated by viewing the site as containing potential energy to create mutually beneficial exchanges between site, infrastructure and the user.

The site of Hartbeespoort Dam displayed the characteristics of a broken ecology that had been disconnected from humans. The existing crest gates formed an important infrastructural element on site and the arch representing a degenerative paradigm, as it stood for man's control over water. Through regenerative design emphasis was placed on the existing vermiculture activities on site. This fostered the creation of other closed loop systems that related to the vermiculture practices.

By introducing secondary programs such as a restaurant space, retail space and ablution space that all fed off the initial system of vermiculture it was possible to create a new public interface to Hartbeespoort Dam's water infrastructure as a regenerative monument.

The new regenerative architecture has created a change in condition in the way that people perceive infrastructure and therefore their relationship to water. By shifting the users' perceptions of the existing Arch, a new paradigm where humans value their natural resources and take care of them was

Fig 8.1. New celebration of water (Author, September 2016).

established. By doing this it has reacquainted man and the natural world through new public spaces related in different ways to water.

This new architectural regenerative infrastructure allows for the restoration of the destroyed and scarred landscape. It encourages economic and cultural growth in the area by creating jobs and sustainability, as well as improving the quality of the water. This has a direct influence on the agricultural land that this dam was originally built to serve. It creates a foothold for ecological networks to reclaim the space as it did before. The building is a facilitator for natural closed loop systems to occur between the site, infrastructure and the user.

Considering the principles of regenerative design, the building created exchanges that restore the natural landscape by equalising or balancing the potential energies on site. This led to a new paradigmatic relationship between humans and the natural world.

Edward Burtynsky (2006) stated"There is an importance to have a certain reverence [for] what nature is, because we are connected to it and we are part of it, and if we destroy nature, we destroy ourselves. Maybe the new landscape of our time... is the landscape that we change" (Arch-assoc, 2006).

Chapter 8:
Space outcomes

ADDENDUM

9.1 FINAL WORK

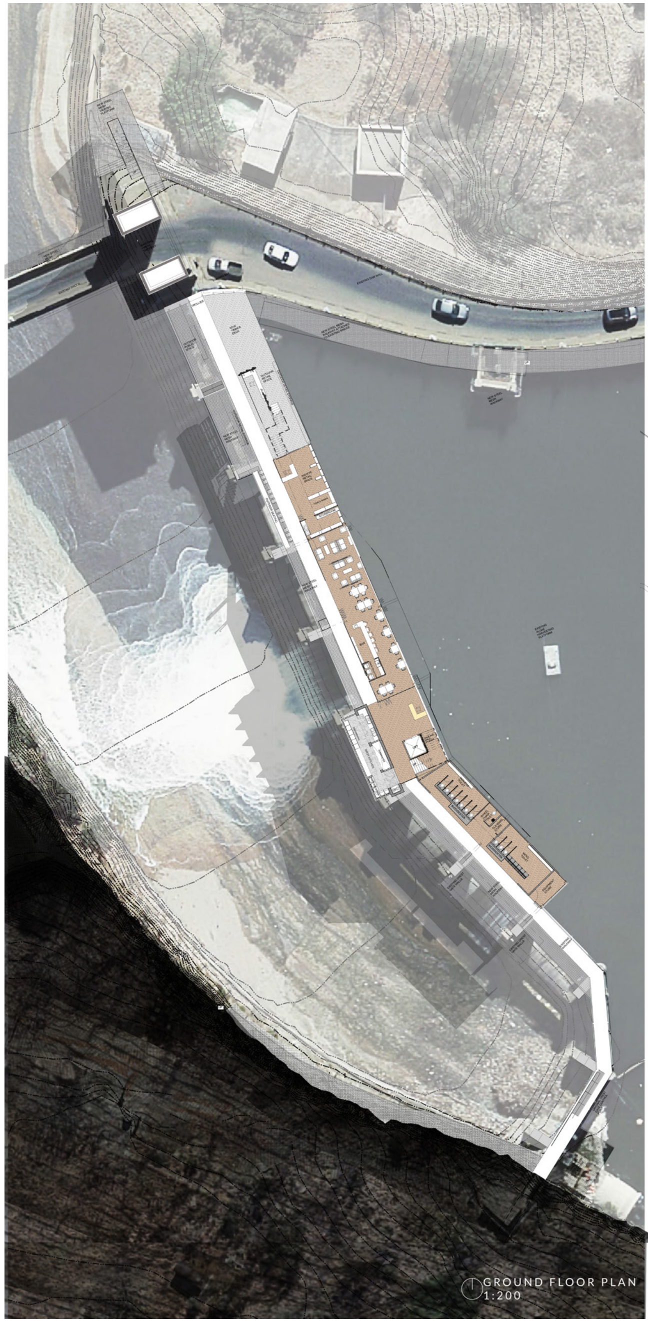
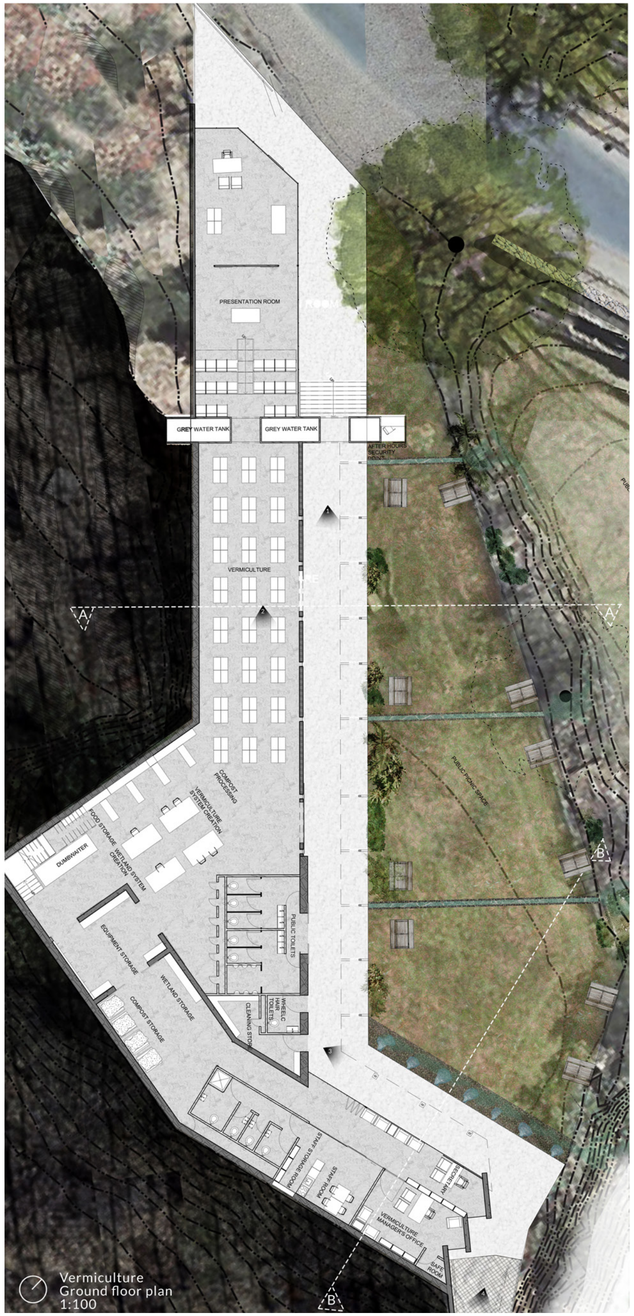
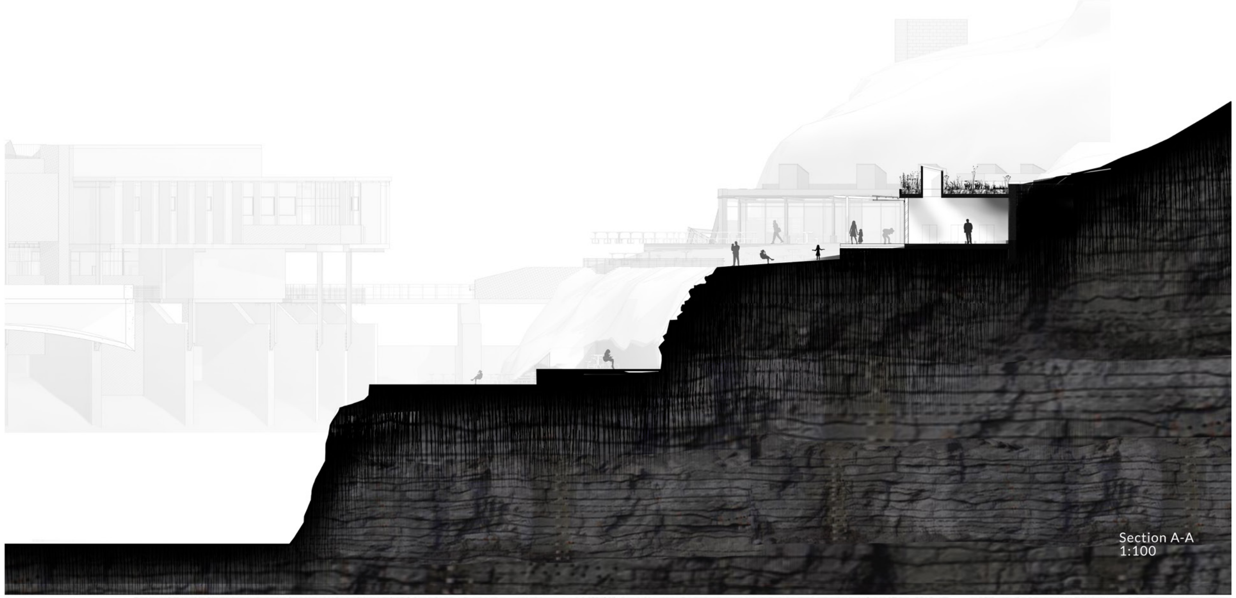


Fig 9.1. Final work (Author, November 2016).





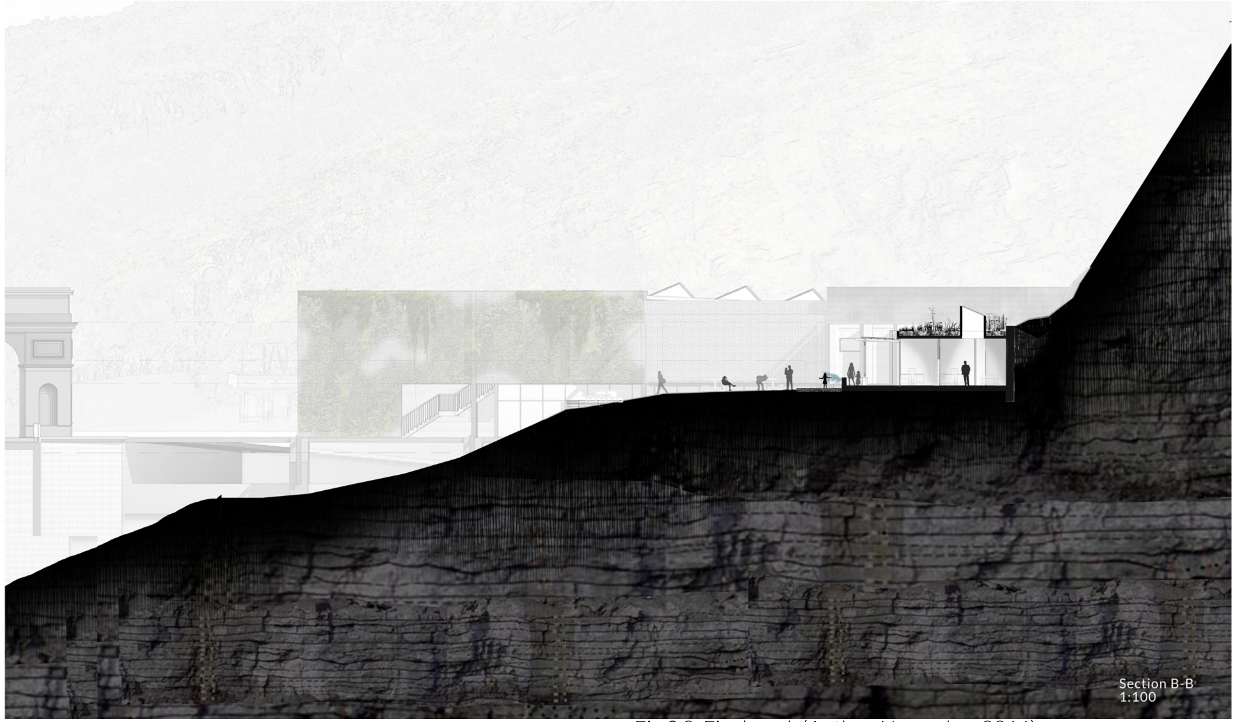
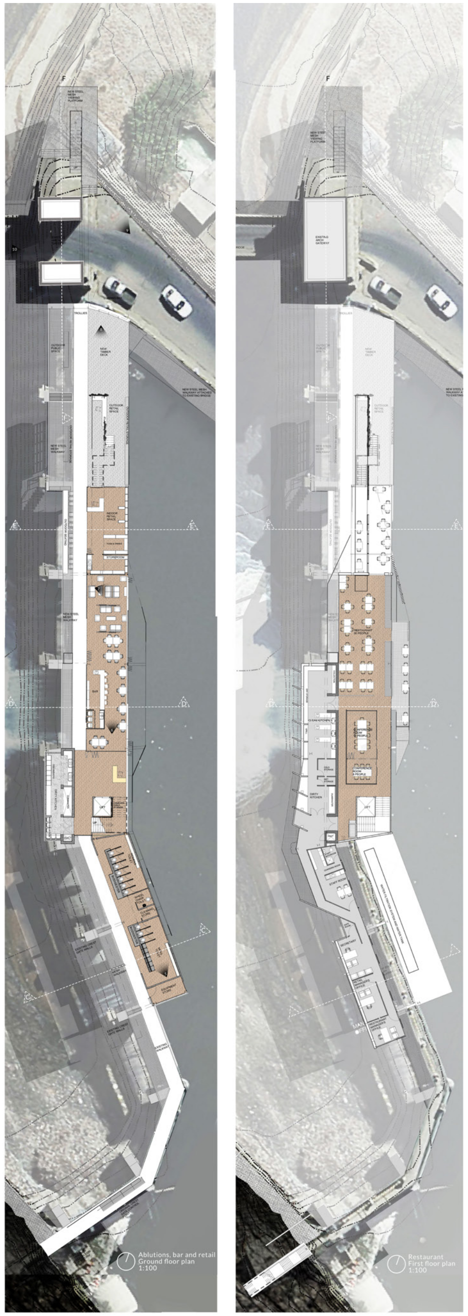
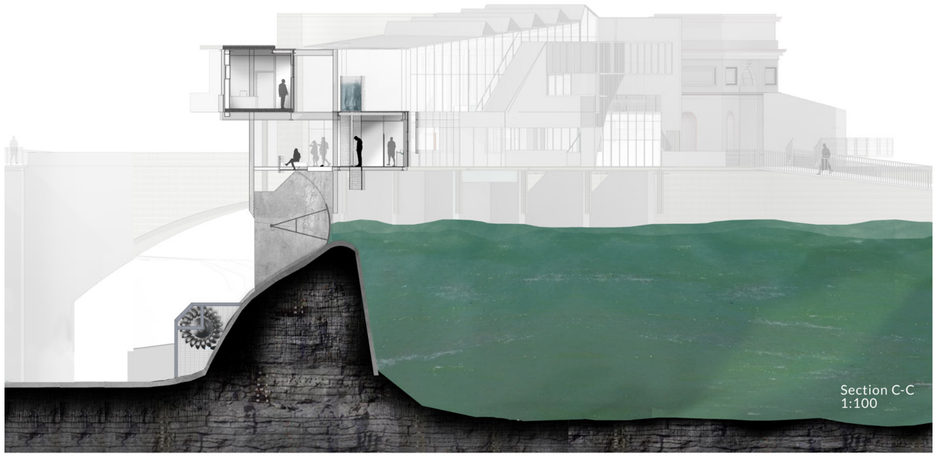


Fig 9.2. Final work (Author, November 2016).





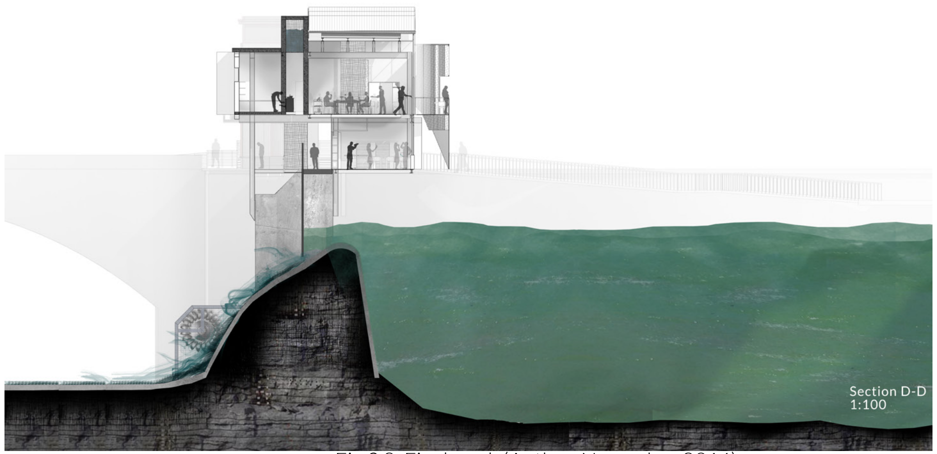


Fig 9.3. Final work (Author, November 2016).

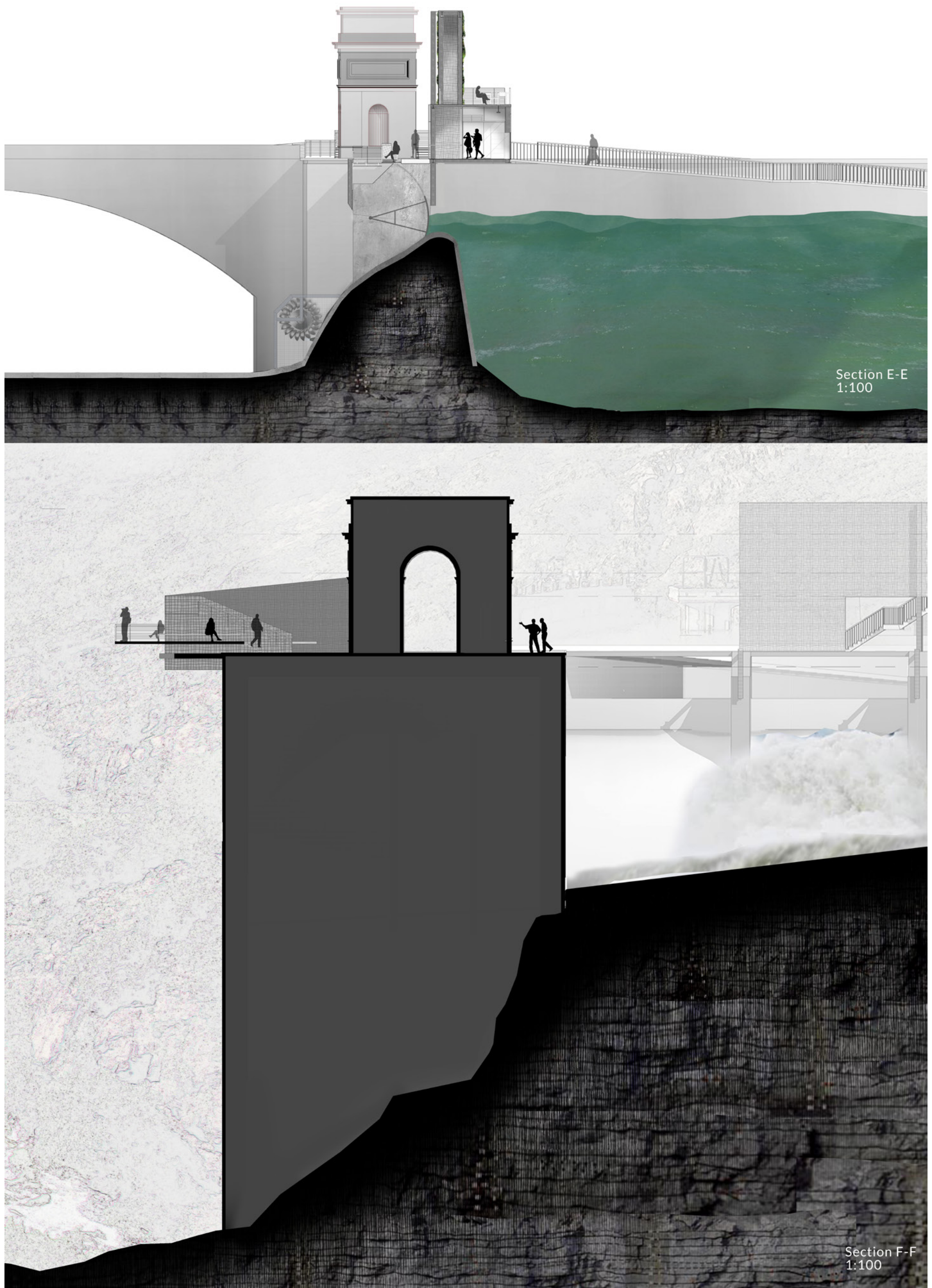


Fig 9.4. Final work (Author, November 2016).

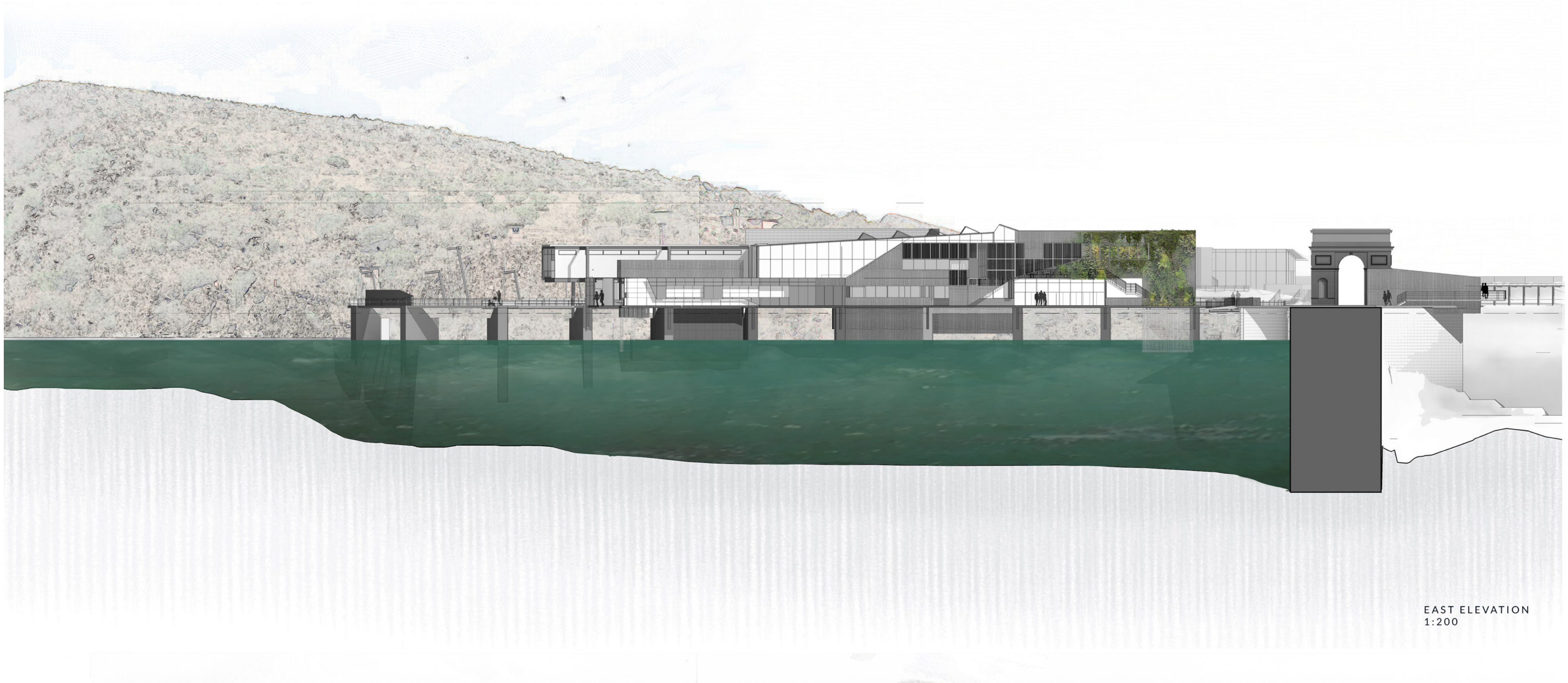


Fig 9.5. Final work (Author, November 2016).

Fig 9.6. Final work (Author, November 2016).

WEST ELEVATION
1:200

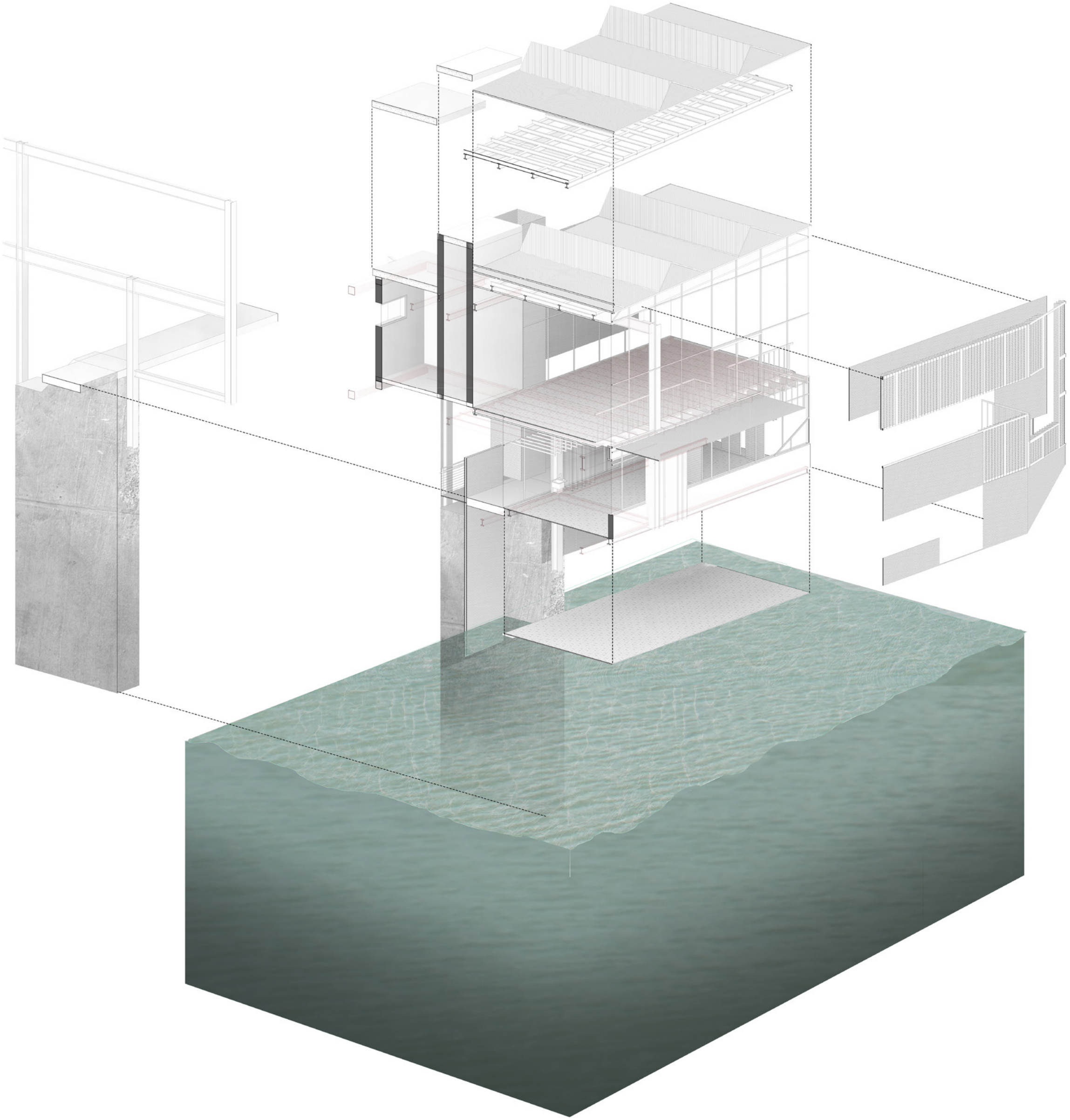


Fig 9.7. Final work (Author, November 2016).

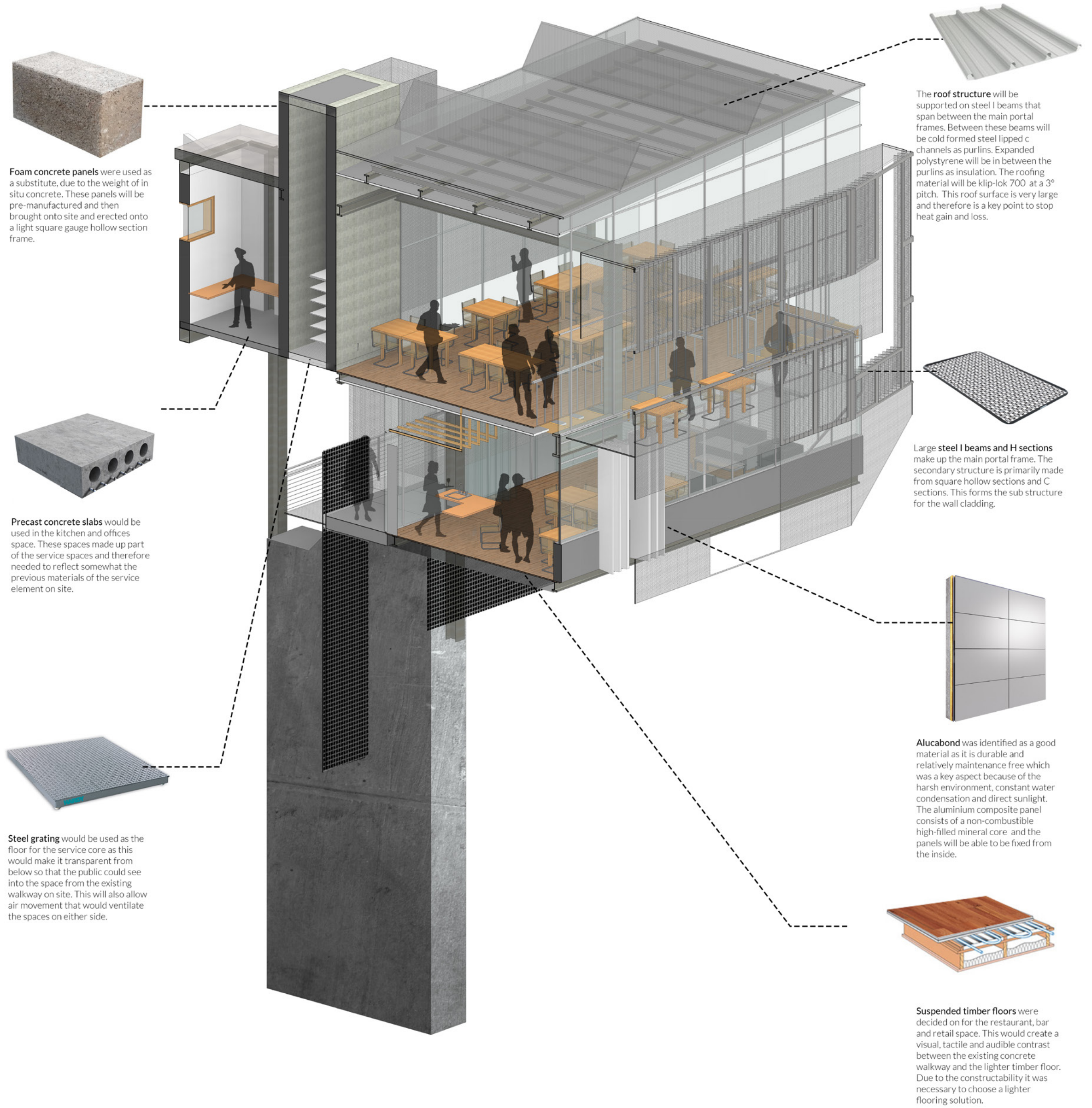


Fig 9.8. Final work (Author, November 2016).

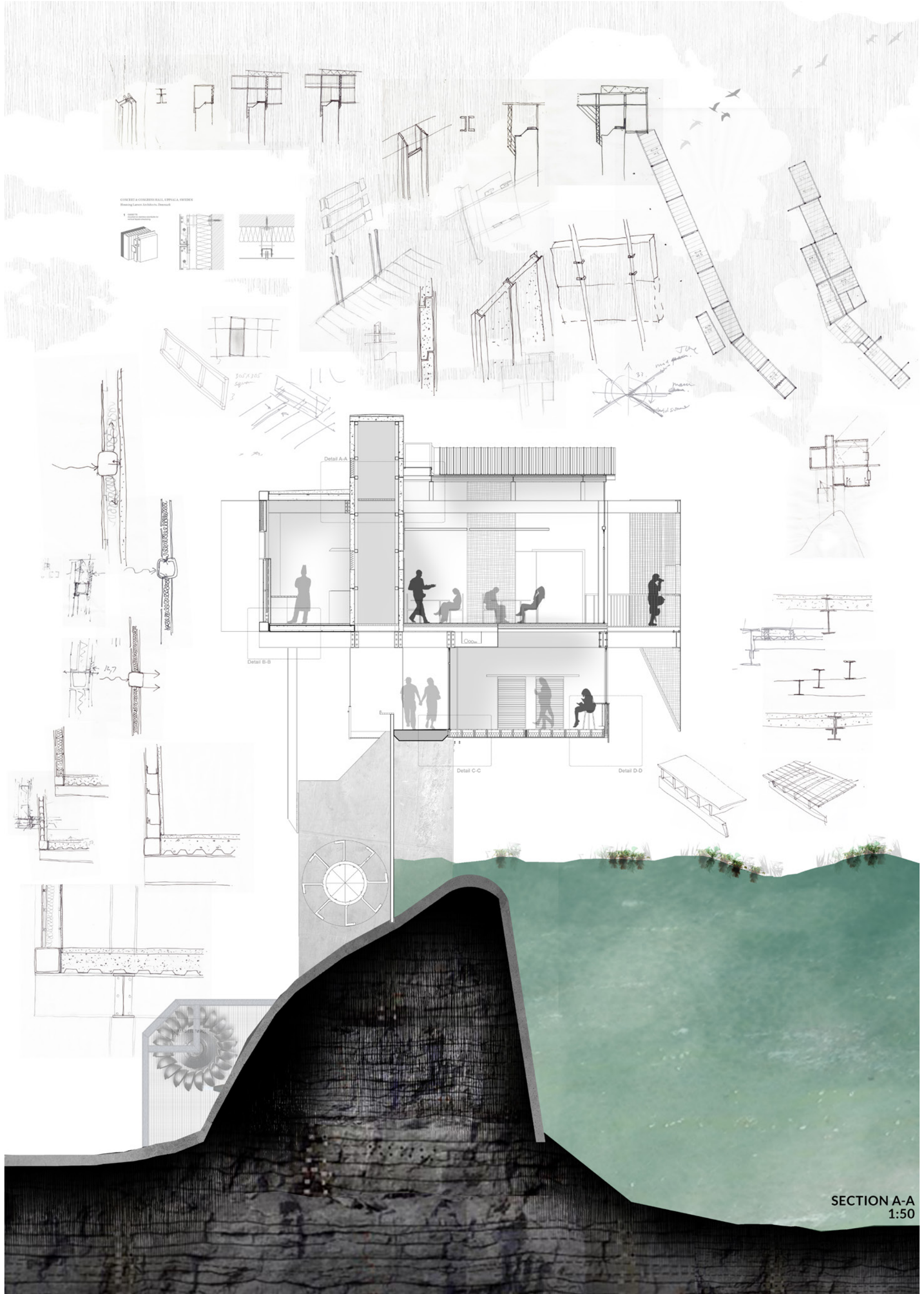


Fig 9.9. Final work (Author, November 2016).

HAPTIC EXPERIENCE AND UNDERSTANDING

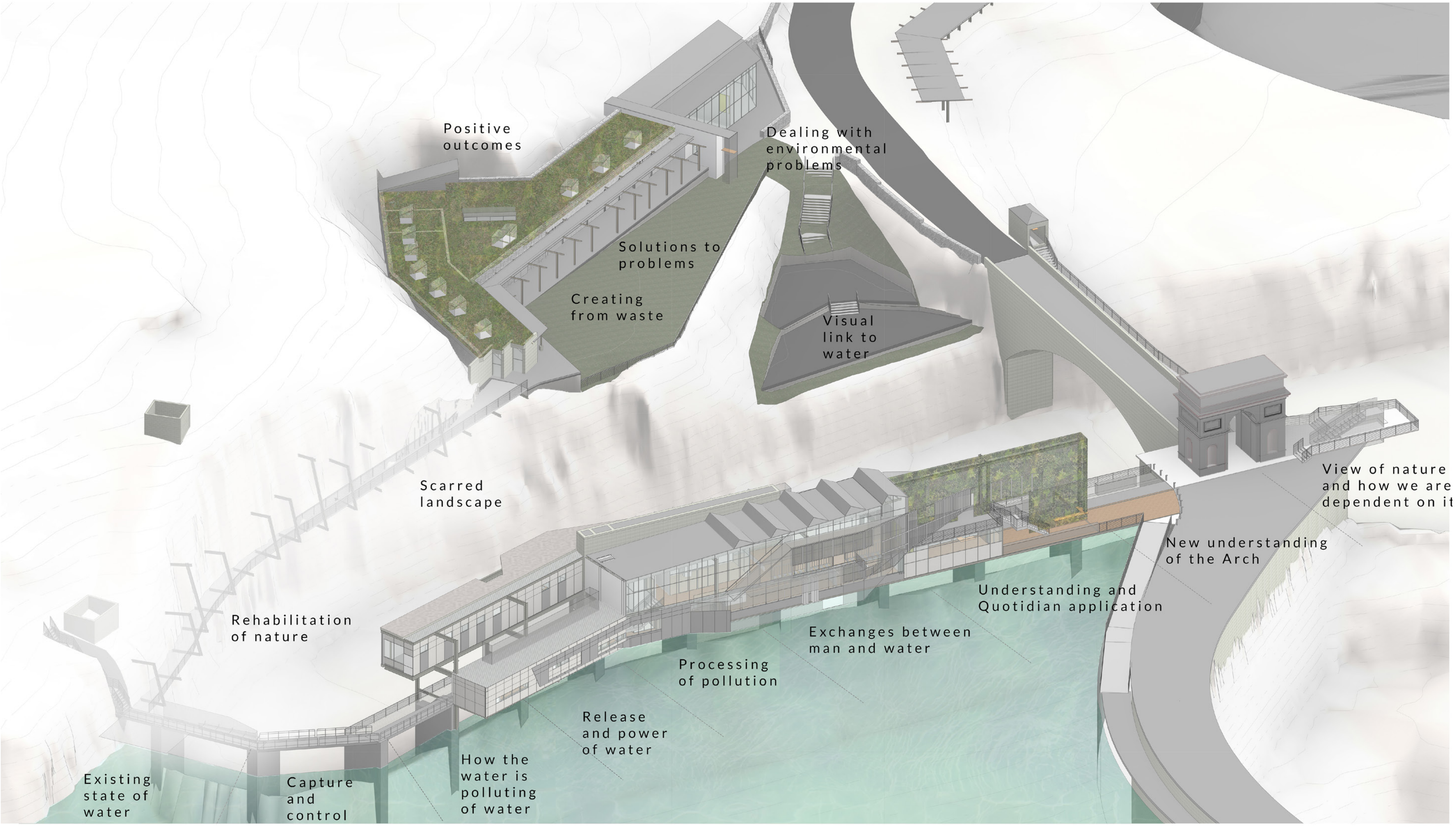


Fig 9.10. Final work (Author, November 2016).

SERIES OF EXCHANGES

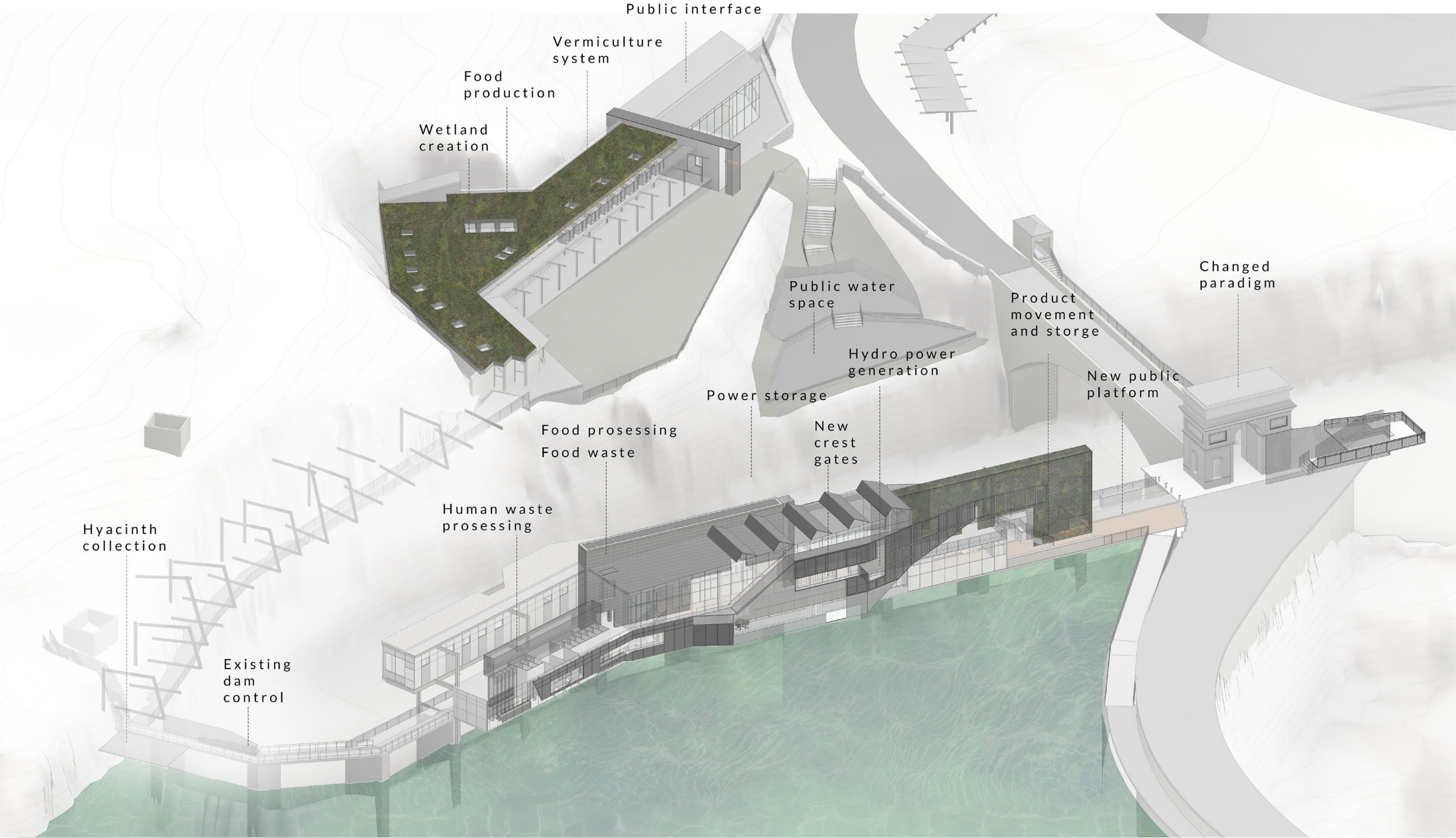


Fig 9.11. Final work (Author, November 2016).

SYSTEMS

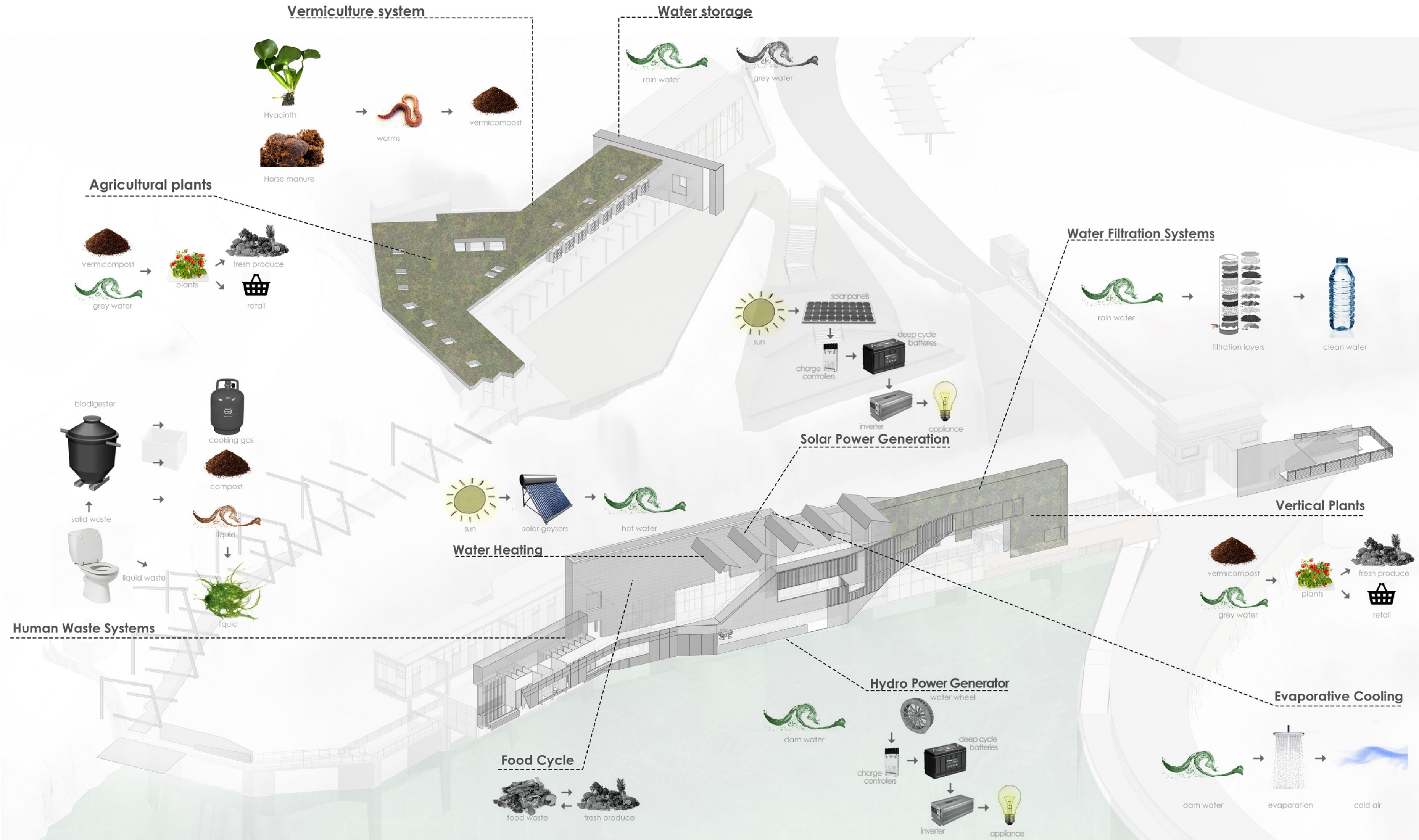
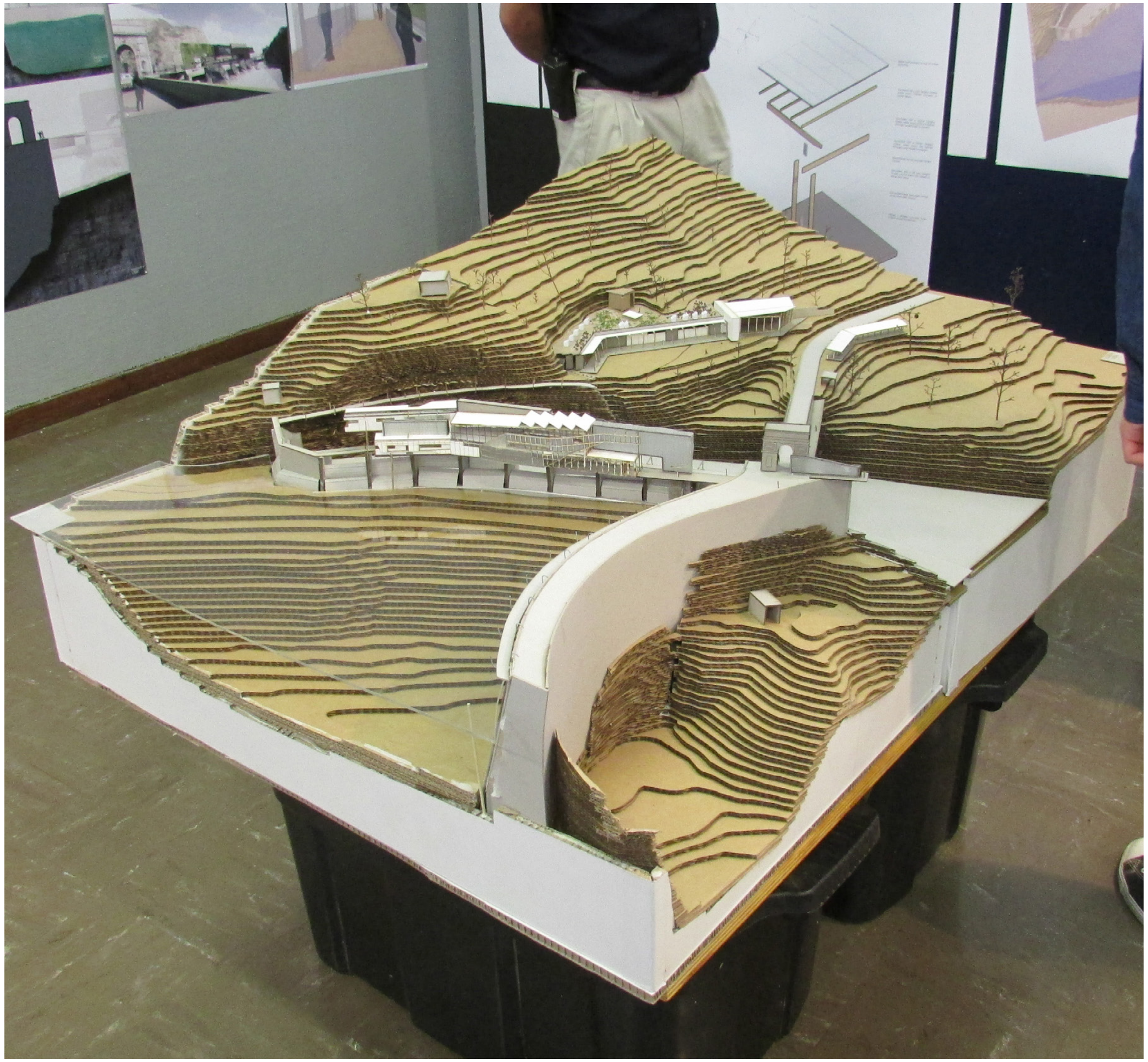


Fig 9.12. Final work (Author, November 2016).

9.2 FINAL MODEL



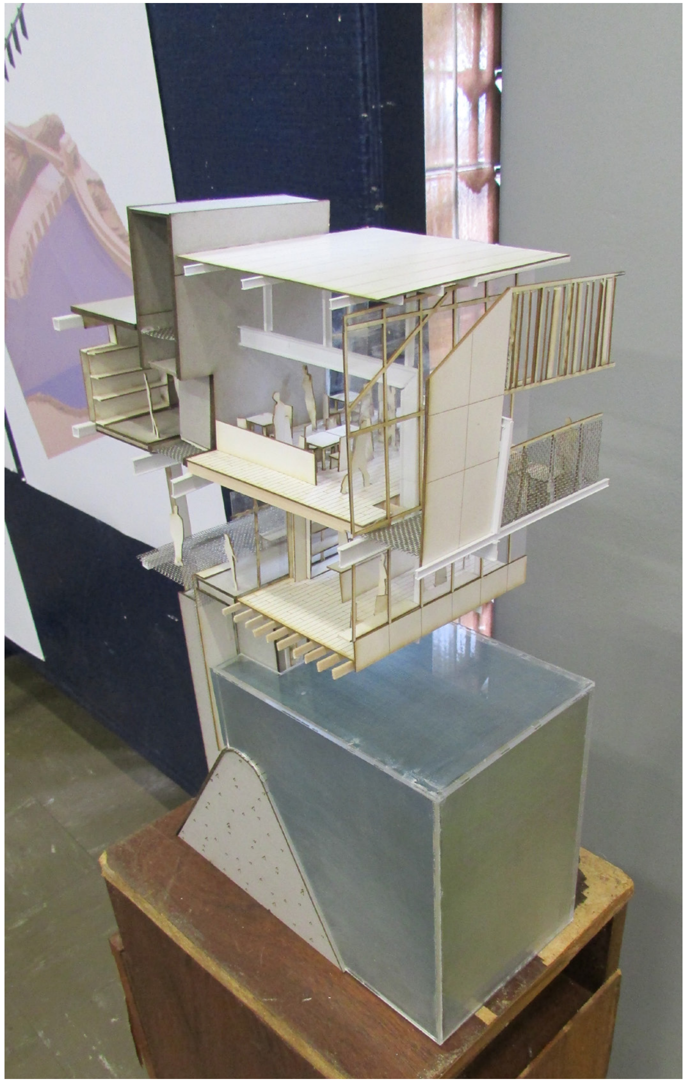


Fig 9.13. Final work (Author, November 2016).

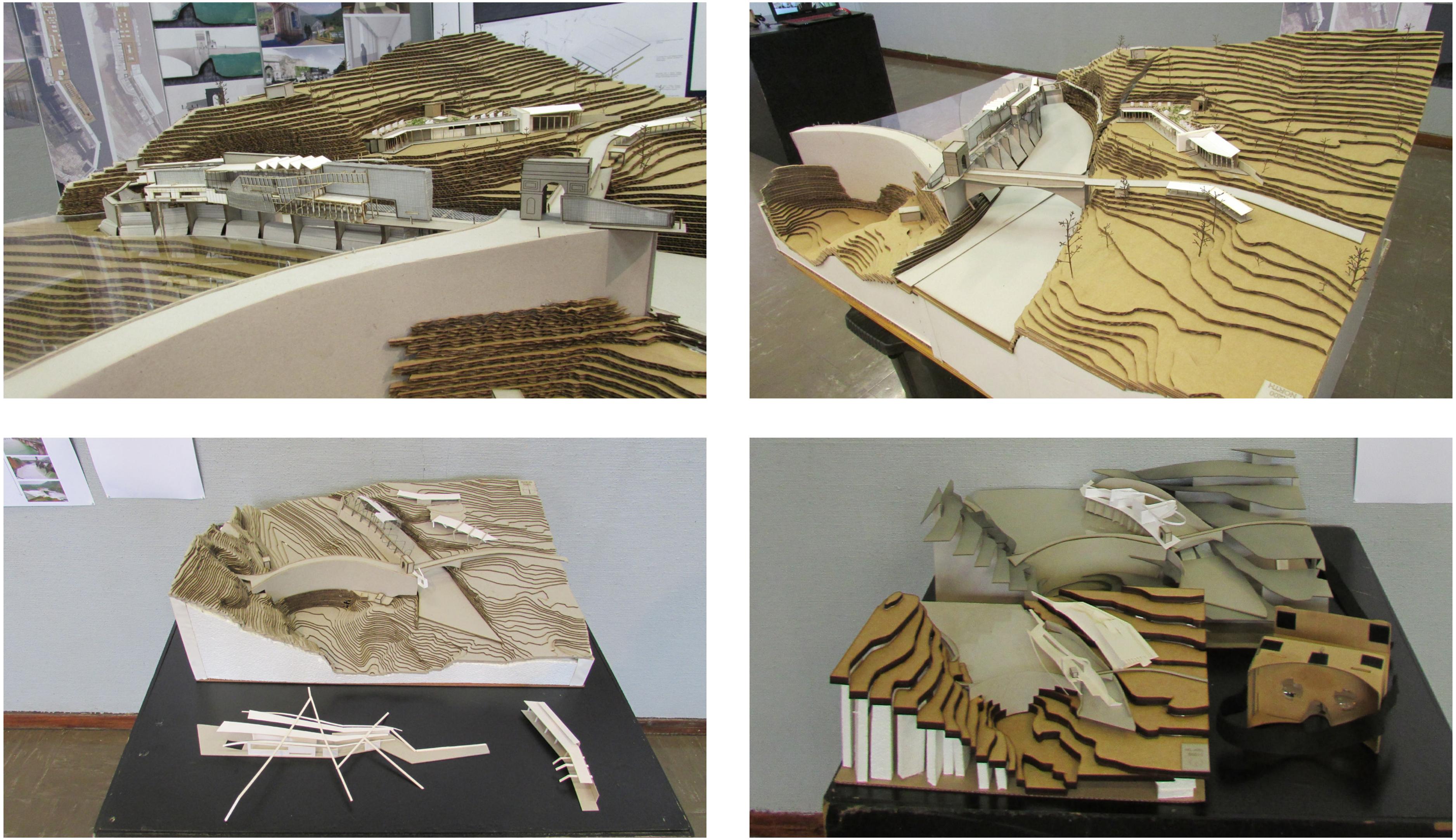


Fig 9.14. Final work (Author, November 2016).

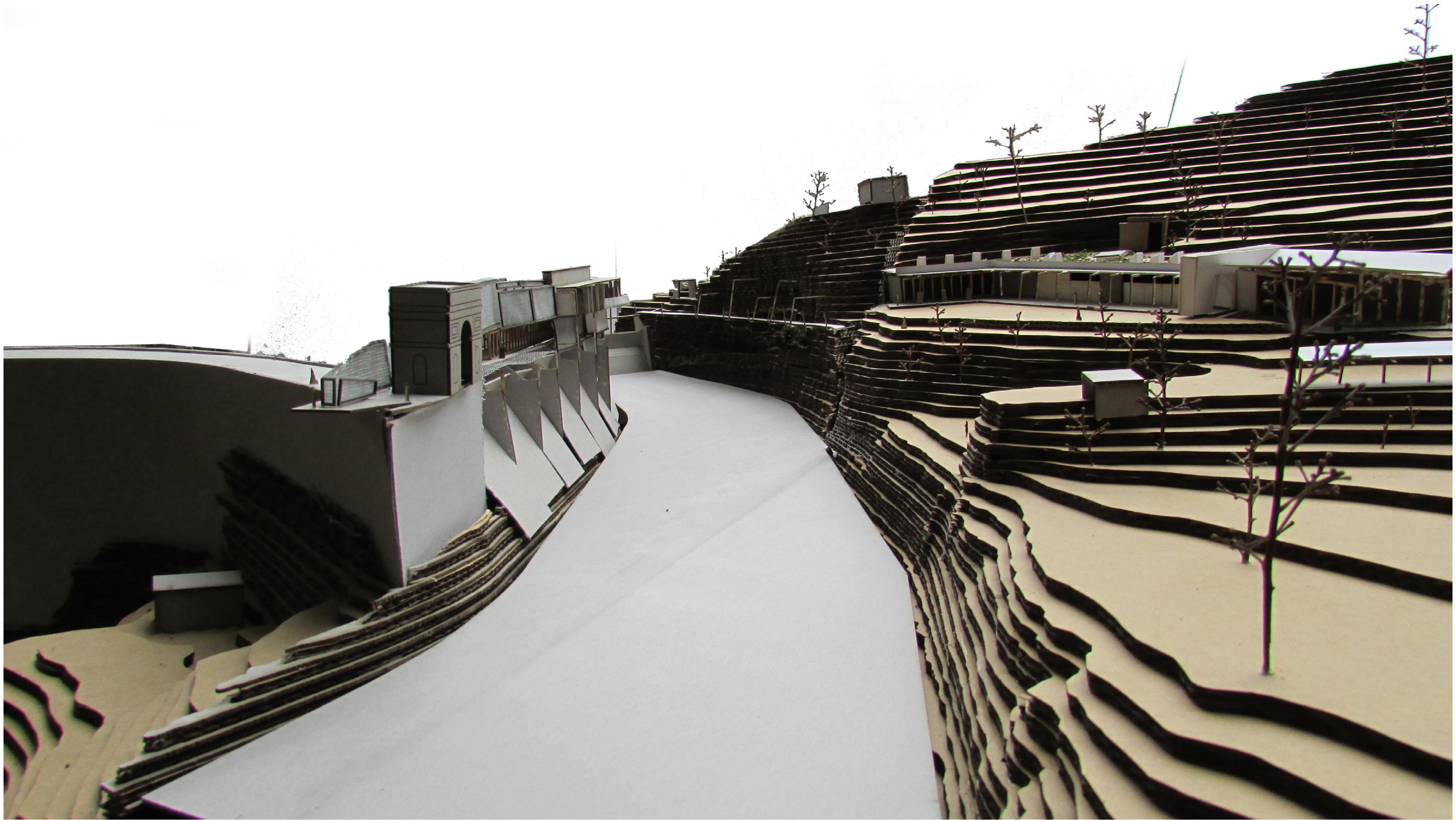


Fig 9.15. Final work (Author, November 2016).

Fig 9.16. Final work (Author, November 2016).

9.3 FINAL CRIT

Fig 9.17. Final crit (Author, November 2016).

Fig 9.18. Final crit (Author, November 2016).

Chapter 10:

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10.1 List of figures

10.2 References

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