06

CHAPTER SIX

DESIGN DEVELOPMENT

6.1
INTRODUCTION

The design development is a response to the theory of regenerative thinking which attempts to integrate the understanding of the site as well as the programmatic requirements and the natural systems explored.

6.2
CONTEXTUAL INFORMANTS

The main design informants are the flow of the contaminated water through the site and the existing wetland. Figure 6.1 illustrates a model constructed during one of the first workshops expressing an intuitive design response to the site's natural landform and architectural concept of intercepting the landscape to heal the polluted condition. The first response was to have the contaminated water flow under the building, but as the research developed into processes and spatial requirements this concept evolved into the contaminated water running through the length of the building, becoming the spine. The three primary conceptual intentions developed as follows:

1. The landscaped dam as an urban filter
2. The phytoremediation wetland spine
3. A resilient algae and wetland spine

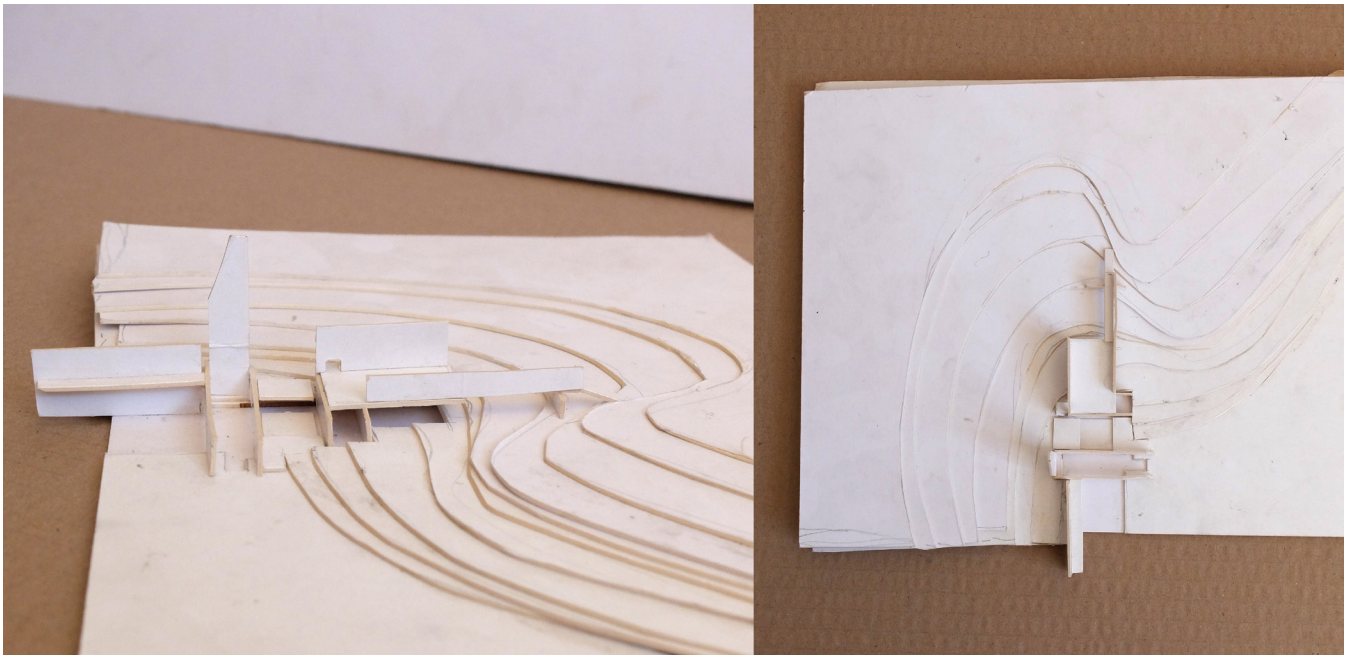


Figure 6.1: Model constructed during February workshop. (Author, 2016)

6.3
DESIGN PRECEDENT SOCIETY & INFRASTRUCTURE

The Living Dam proposal is a response to the United Kingdom's water crisis where the government proposes a series of reservoirs that will maintain hydrological self-sufficiency. The Living Dam is a new typology constructing a dam, moving away from the image of hydrological infrastructure as a solitary object. It becomes a model which is integrated with society assisting to alter the public's perception of dams and dam management. The dam's hydrological network becomes a vital system that supports social and ecological aspects of the design. The dam is integrated into its environment to accommodate people, plants and the opportunity for new ecosystems to emerge.

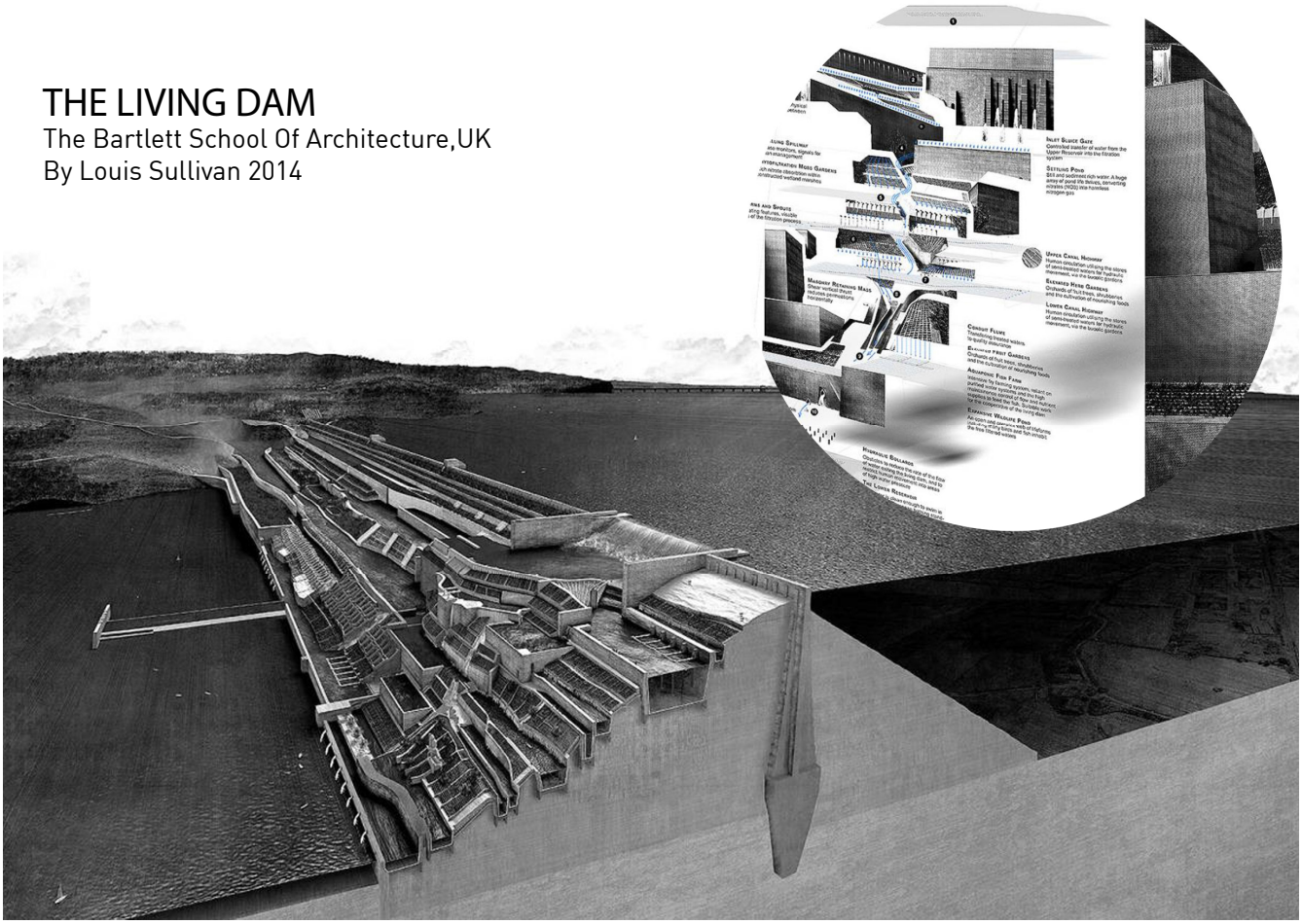


Figure 6.2: The Living Dam (The RIBA President's Medals Student Awards, 2014)

1 DESIGN ITERATION

THE LANDSCAPED DAM AS AN URBAN FILTER

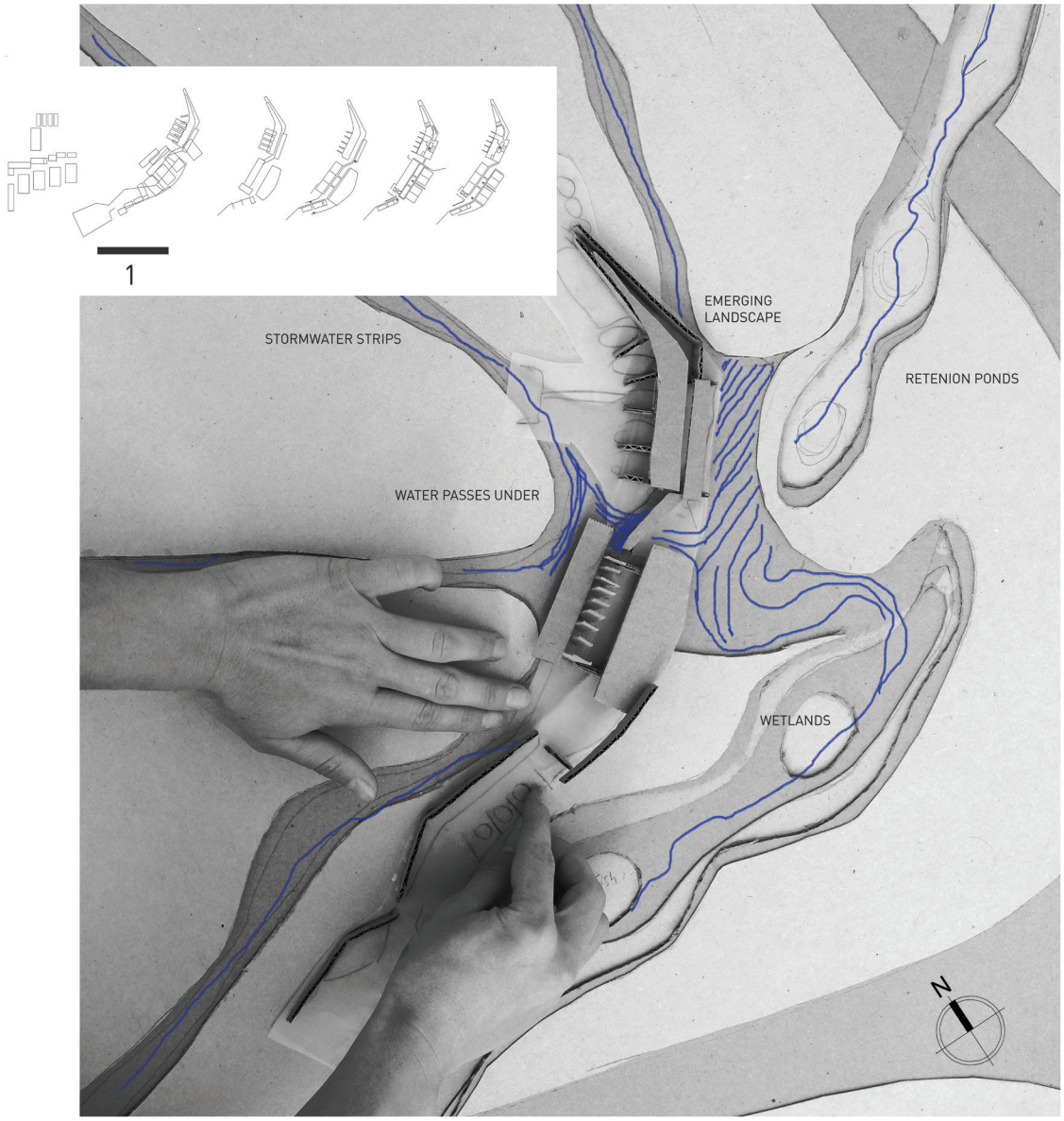


Figure 6.4: Model constructed for iteration 1. (Author, 2016)

6.3
ITERATION 1
THE URBAN FILTER

The design's intention is for the new infrastructure to be integrated into the landscape as a dam collecting the industrial effluent. A conventional planted wetland catchment is proposed to accumulate, purify and direct the water under the facility through an urban filter. The author researched the properties of silk as a removable, biodegradable filter for the removal of heavy metals from the water. The contaminated water passes through the wetland and silk filter under the building with the supportive functions of the facility above the contaminated water.

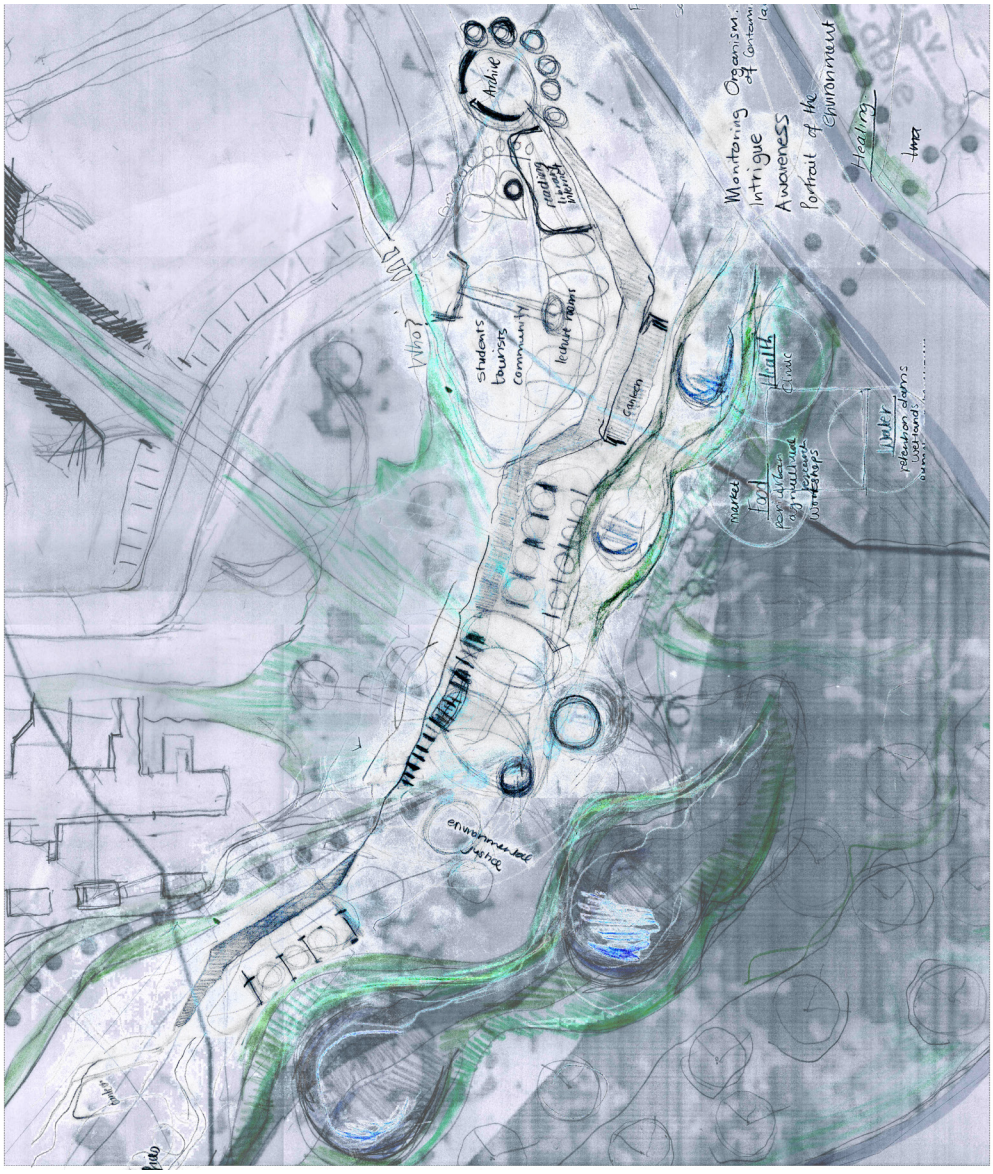


Figure 6.3: Site plan sketch responding to existing wetland. (Author, 2016)

Understanding that led to the next iteration:

Iteration 1 requires an understanding of the community's involvement. The precedent set by The Living Dam integrates infrastructure and social activities as a holistic system.

The process of heavy metal removal requires more than a planted wetland catchment and silk filter. At this point the author researched the bioremediation process called phytoremediation to understand how heavy metals can be mechanically removed from contaminated water.

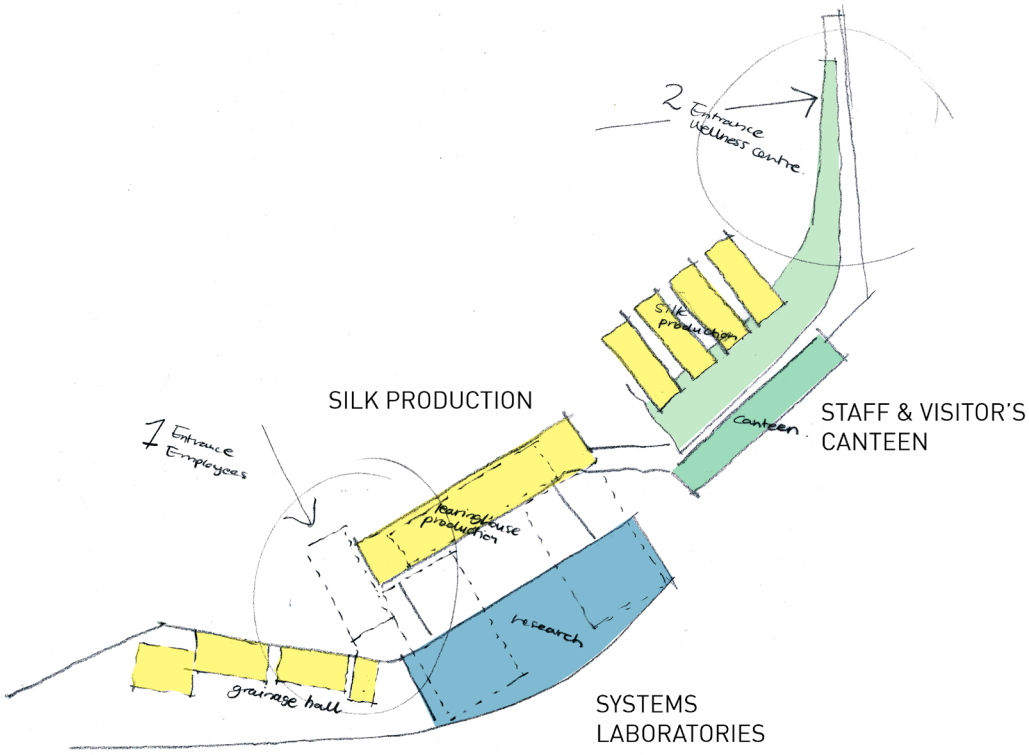


Figure 6.7: Iteration 1 area zoning of the water treatment facility - water flowing under the building. (Author, 2016)

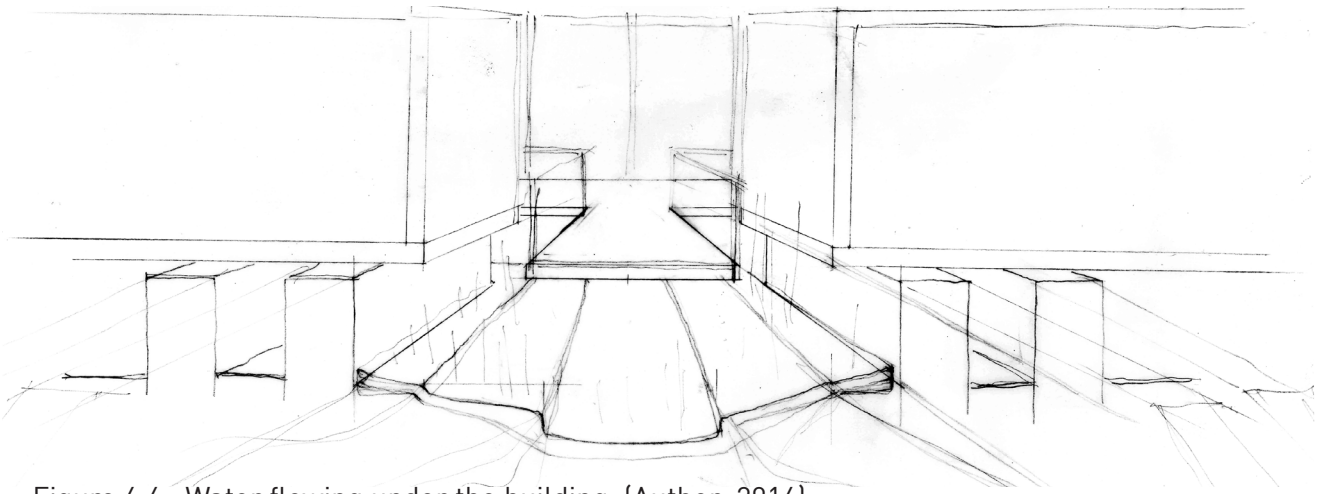


Figure 6.6: Water flowing under the building. (Author, 2016)

6.4
DESIGN PRECEDENT
A HABITAT INFRASTRUCTURE

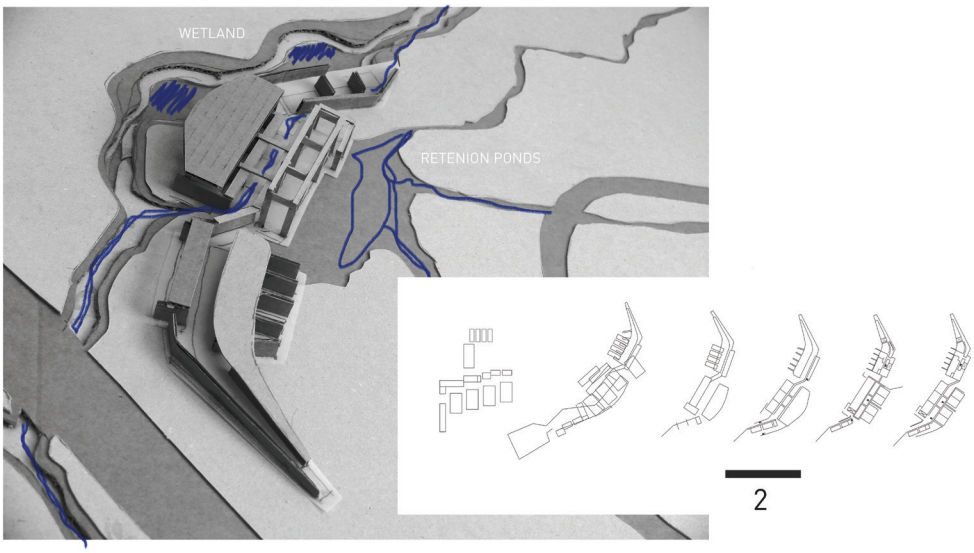
The Institute for Forestry and Nature research merges nature and man in a new constructed habitat. A design strategy was developed which used the few remaining ecological qualities of the landscape to create a diverse new habitat which could accommodate both insect and animal species as well as the organizations staff. The building was designed to embrace its rural setting by including trees, alleys, hedges, berms, ponds, swamps and water channels to create intricate microclimates which support the ecosystem. Indoor water gardens provide a tranquil setting for meeting areas and serve as the lungs of the building, improving the performance of the external envelope. The designers chose to use standard mass produced roofs traditionally used for horticultural greenhouses, that costs 75% less than custom-made roofs. The building is highly flexible - capable of adapting to the changing requirements of the Institute.

INSTITUTE FOR FORESTRY &
NATURE RESEARCH
NETHERLANDS
By BEHNISCH ARCHITEKTEN, 1998

Figure 6.7: Institute for Forestry and Nature Research (Divisare, 2016)

2 DESIGN ITERATION

THE PHYTOREMEDIATION WETLAND SPINE



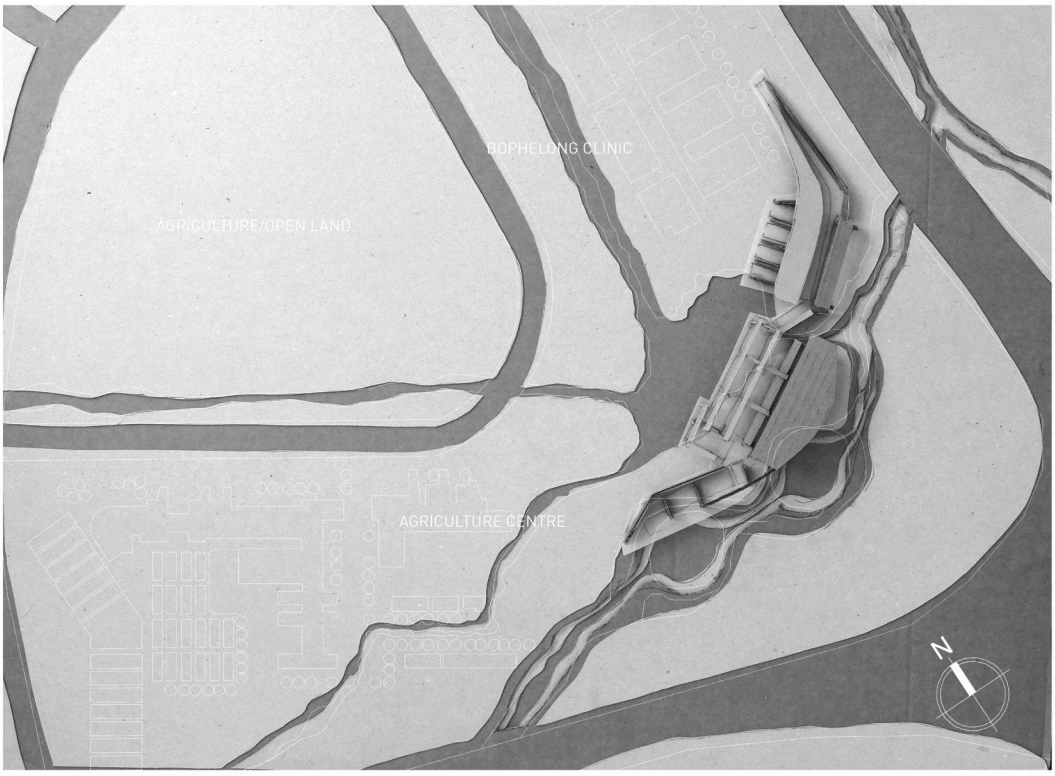
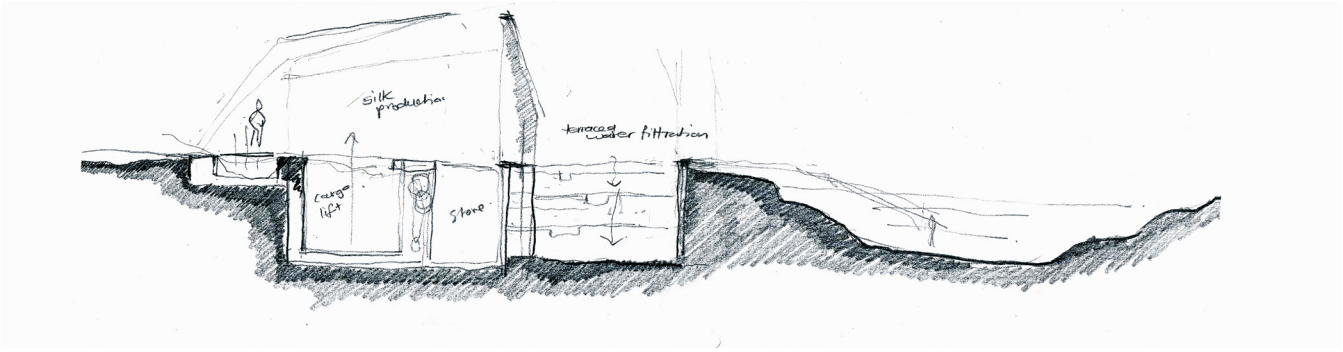


Figure 6.10: Model constructed for iteration 2. (Author, 2016)

6.5
ITERATION 2
PHYTOREMEDIATION WETLAND SPINE

The design development evolves with the knowledge of the potential of plants to remove the heavy metals, as well as the precedent study on The Institute for Forestry and Nature Research which integrates a constructed wetland within the envelope of the research facility. Iteration 2 focuses on revealing the treatment of the water, making it visible to the users of the facility. The spine of the facility is developed into a series of wetlands hosting phytoremediation plants that serve the purpose of accumulating heavy metals from the water. The community members have access to the facility and can move freely along the walkways connecting the supportive programmes of the facility.



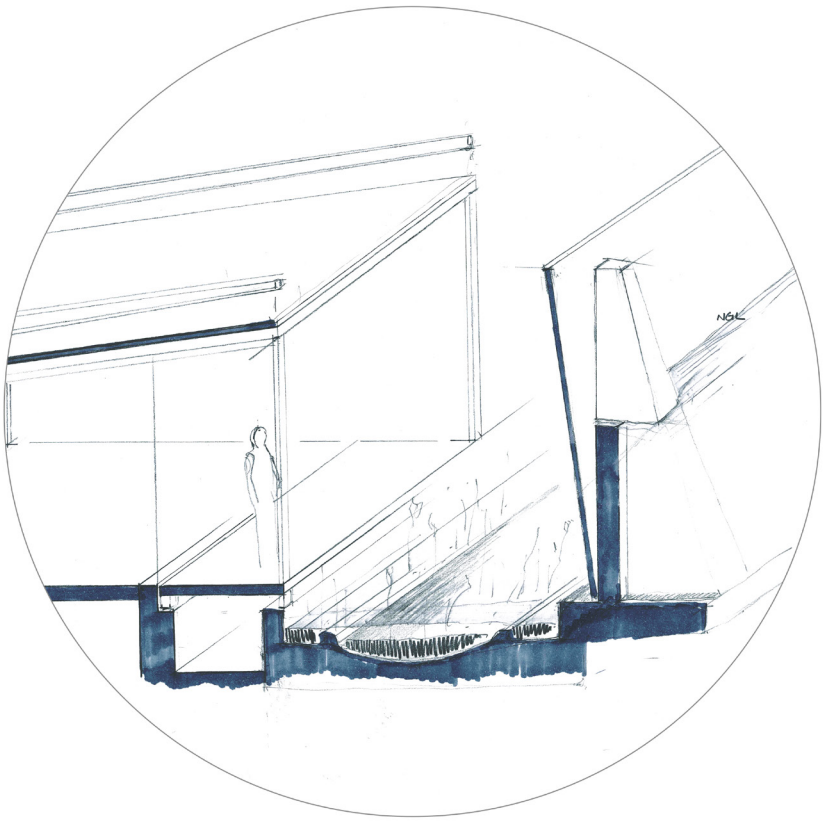


Figure 6.8: Integrated water treatment wetland. (Author, 2016)

Understanding that led to the next iteration:

Large quantities of water from the summer high rainfall period will flow too fast for the plants to perform their function. The facility will need an integrated detention dam that will regulate the water's speed, slowing it down for the removal of heavy metals by the plants.

The process of phytoremediation as an alternative infrastructure results in the accumulation of heavy metals on the plants roots which requires the entire plant to be harvested to ensure the contaminants don't enter the river network. High volumes of water will undermine the process of heavy metal removal as the contaminants would become dislodged from the phytoremediation plant's root structures. A natural treatment method that immobilizes and contains the heavy metals is required.

Figure 6.9: Ground floor planning for Iteration 2. (Author, 2016)

3 DESIGN ITERATION

A SELF-REPLENISHING ALGAE AND WETLAND SYSTEM

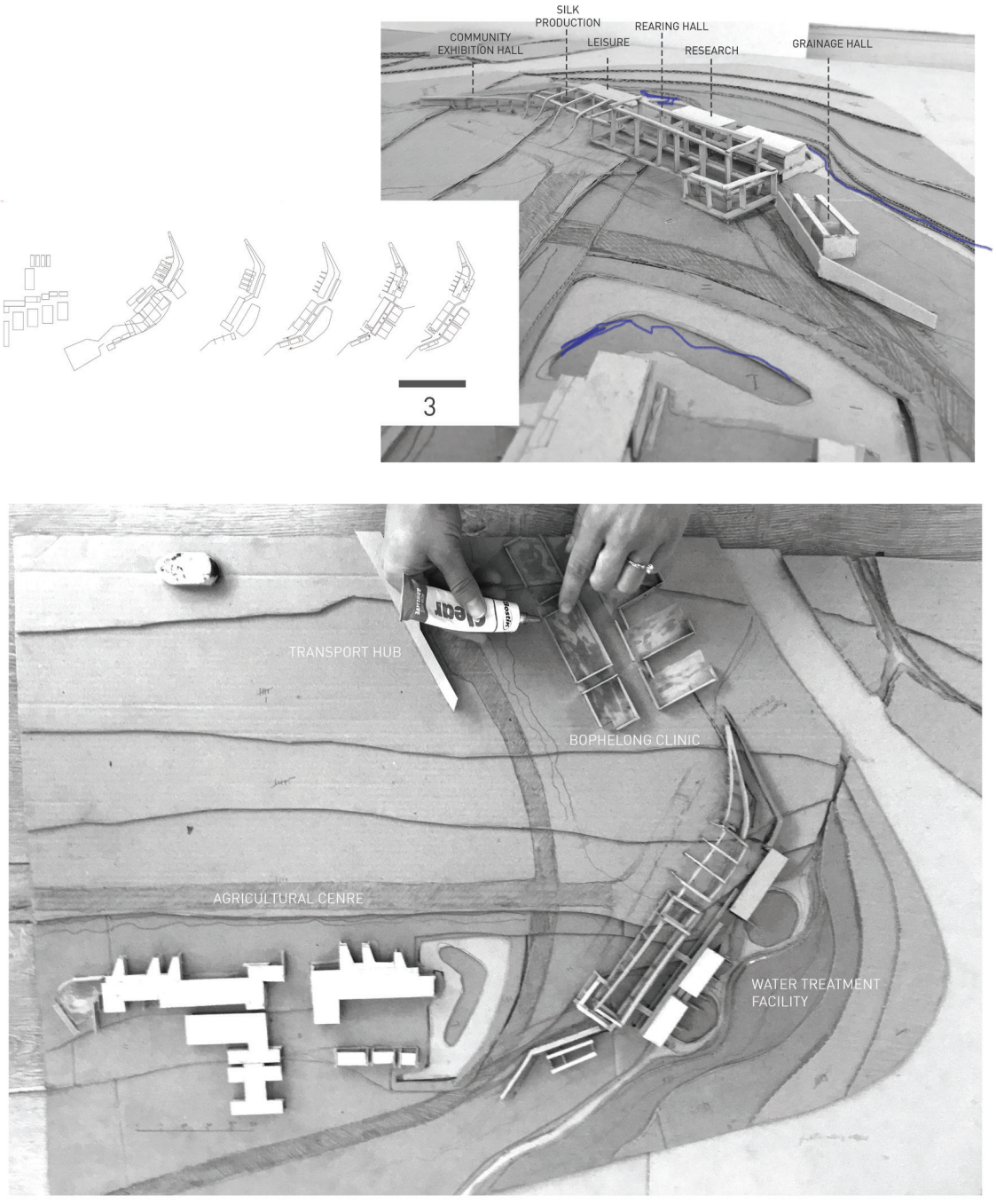


Figure 6.13: Model constructed for iteration 3. (Author,2016)

6.6
ITERATION 3
A RESILIENT SYSTEM

An understanding of the challenges linked to phytoremediation led to a more efficient method of heavy metal removal. A metal resistant algae water treatment method replaces phytoremediation as the primary method to remove heavy metals. Phytoremediation plants are incorporated into the wetland design s a supportive, backup heavy metal removal method.

The infrastructure is expressed as a constructed landscape form with the water treatment occurring in sub-system throughout the facility. The detention dam and network of water regulation direct the flow of water into the algae treatment troughs which flow into wetlands and into the river. All the supporting functions required for the new infrastructure, sit on either side of the spine and create rhythm throughout the building. The design evolves to accommodate the gradient of the site, and the landscape terraces down to create concealed basement parking.

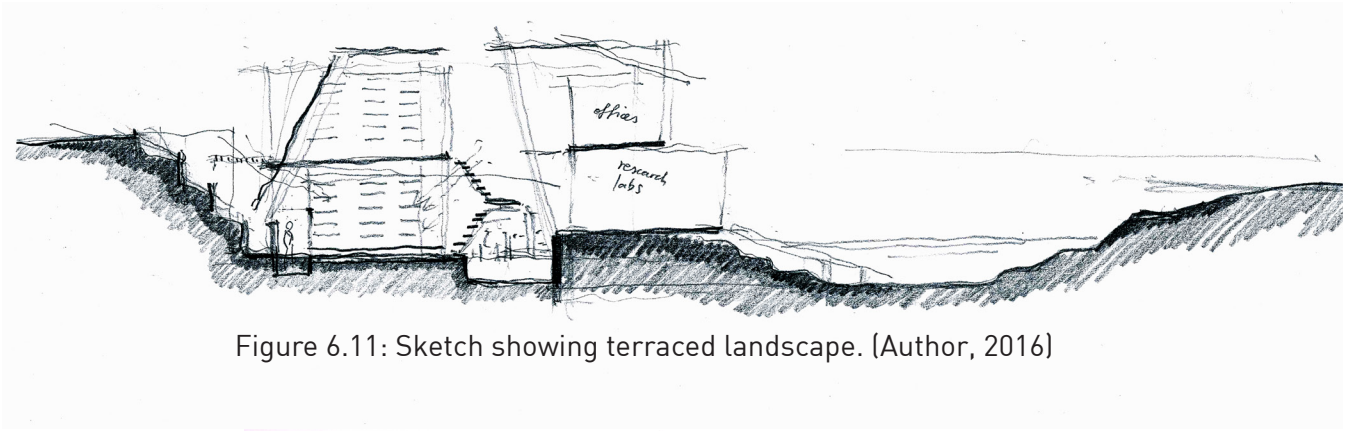


Figure 6.11: Sketch showing terraced landscape. (Author, 2016)

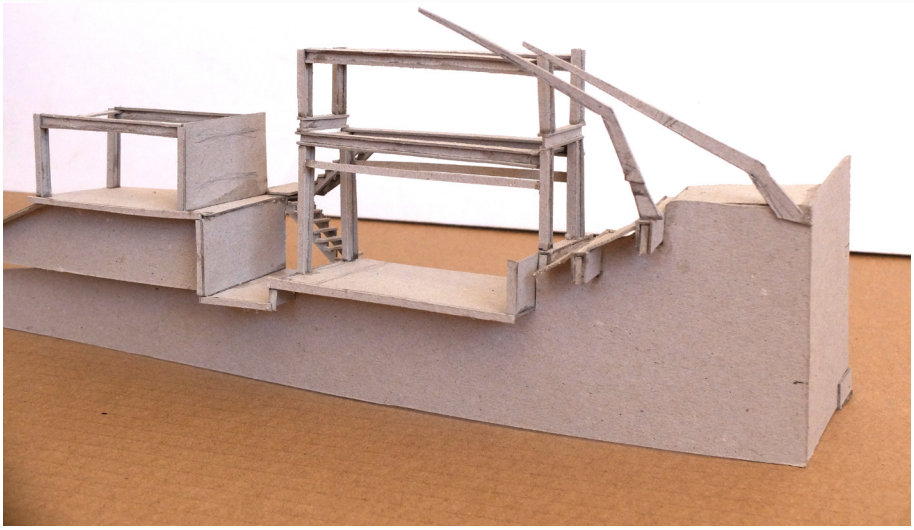
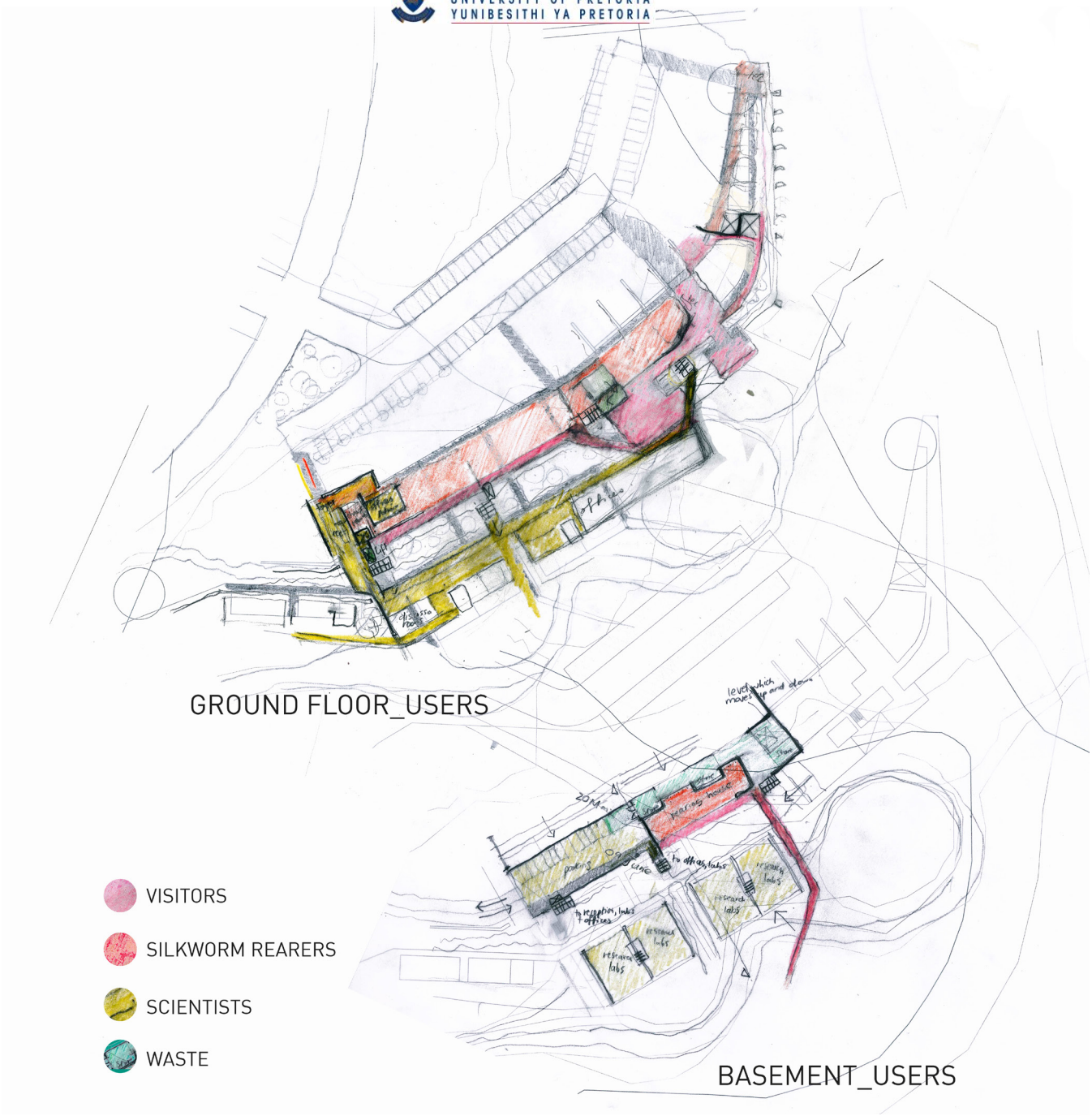


Figure 6.12: Model constructed for iteration 3. (Author,2016)



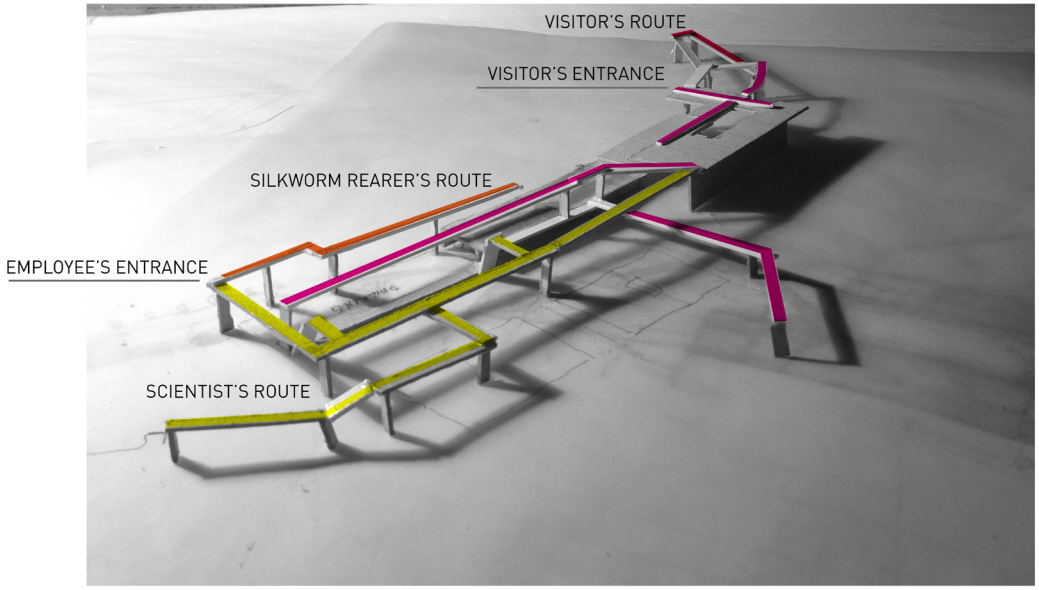


Figure: 6.19: User's movement diagrams. (Author, 2016)

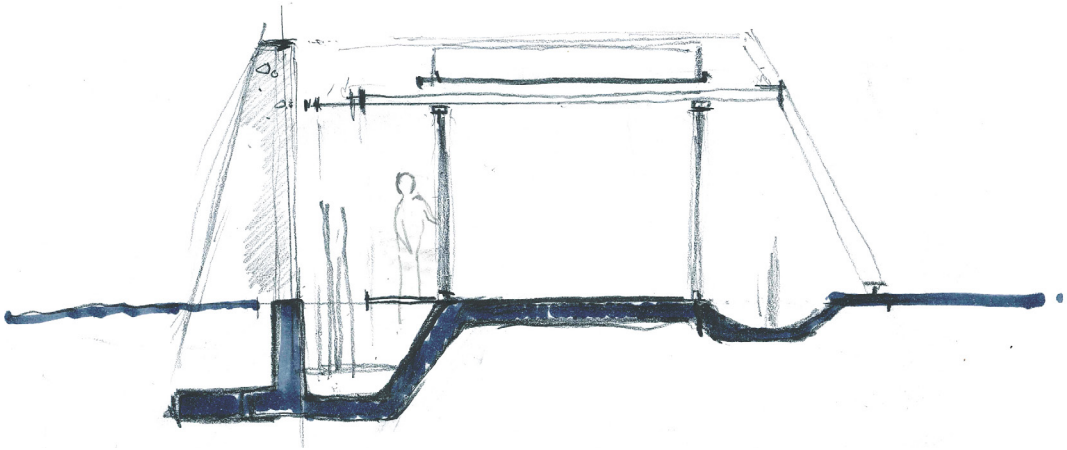


Figure 6.14: Section exploration of exhibition hall. (Author,2016)

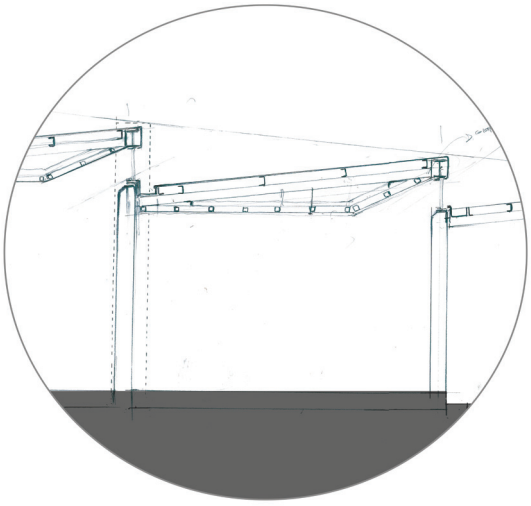


Figure 6.14: Section exploration of exhibition hall roof. (Author,2016)

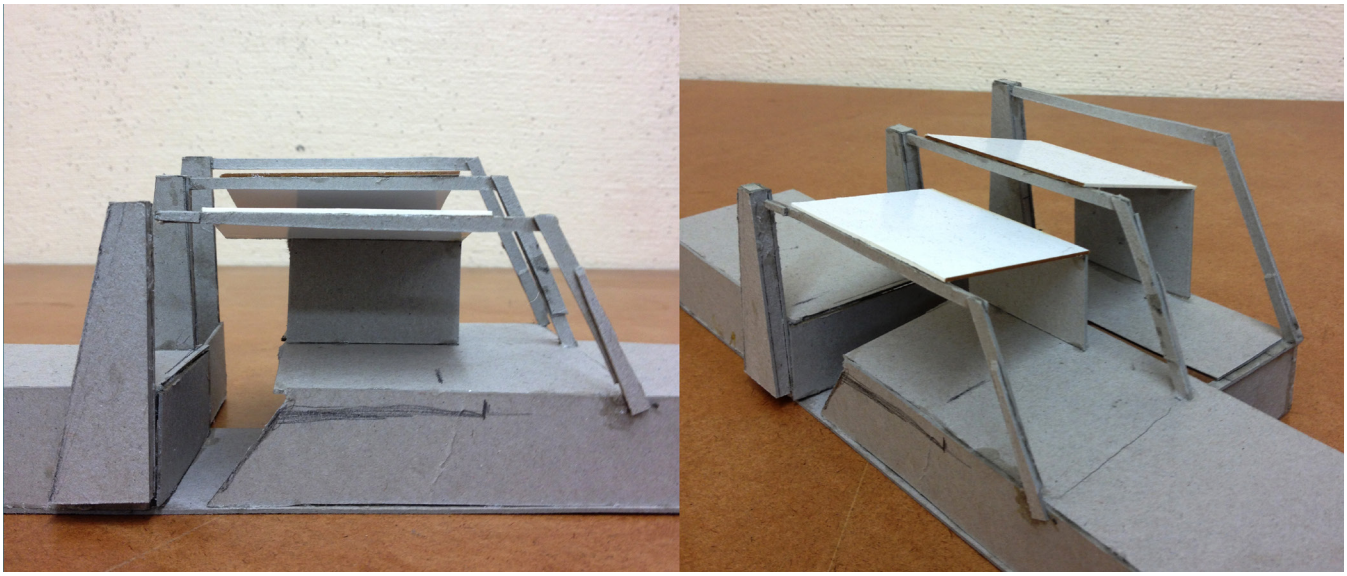


Figure 6.15: Model roof exploration for exhibition hall. (Author,2016)

4 DESIGN INTENTION

A HOLISTIC SOCIAL-ECOLOGICAL RESILIENT APPROACH

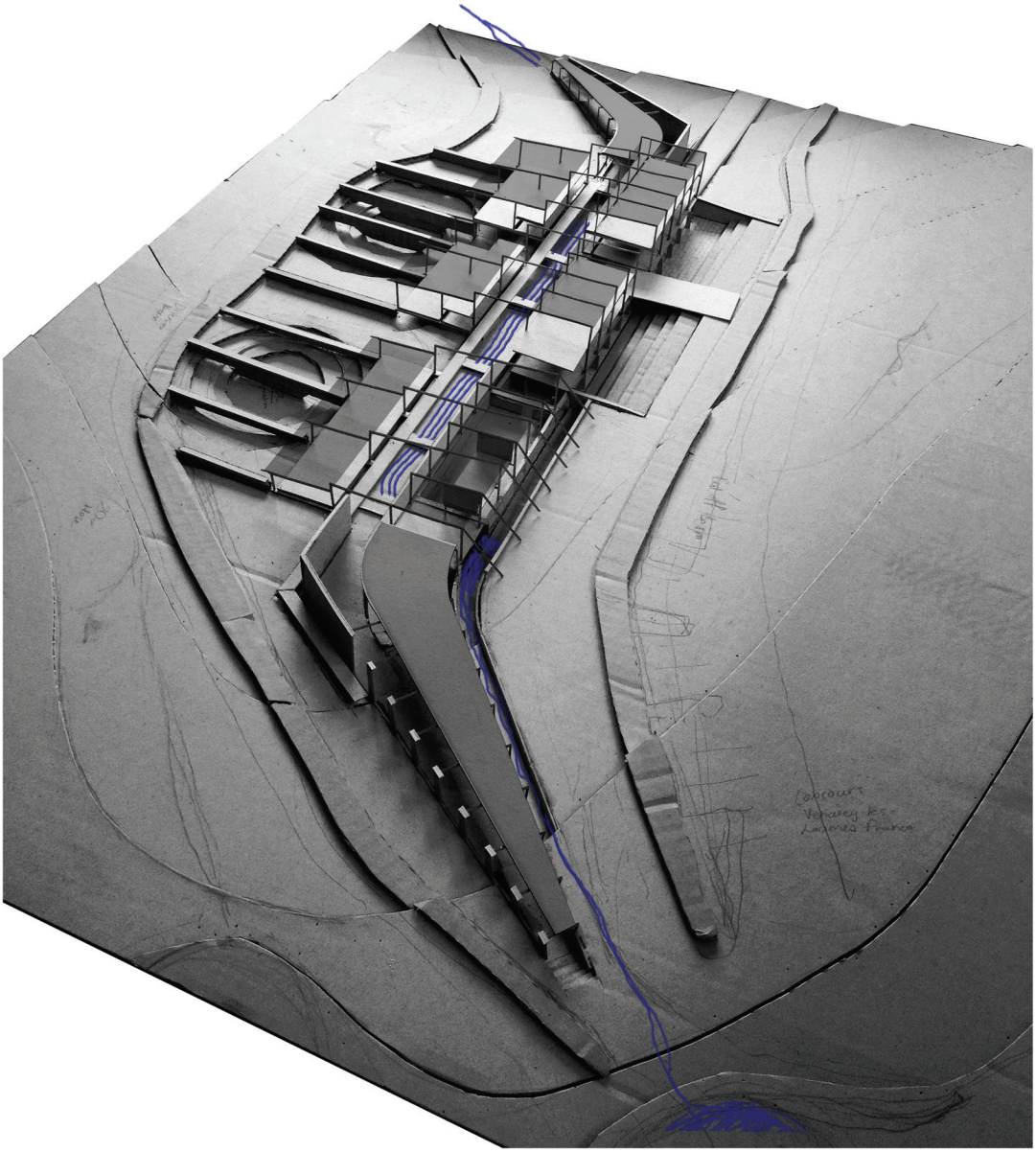


Figure 6.17: Model constructed for design summary. (Author,2016)

6.7
DESIGN SUMMARY
A SOCIO-ECOLOGICAL APPROACH

The final design's intention is to express the interconnected relationship between nature, the community and the remediation building. The walls gently rise from the ground creating a space for community involvement. The entrance has been placed on the existing foot route used by the Bophelong community. This is an informal entrance which allows community members easy access into the building to view exhibitions or sit in on talks. Ramps and walkways facilitate the visitor's freedom of movement through the facility, allowing them to seamlessly discover aspects of the entire treatment process, explore open spaces and utilise facilities such as the canteen and ablutions.

The exhibition hall is a space dedicated to the community, a tangible place for community to feel a sense of stewardship. The community art, photography, crafts and proposals can be presented in the exhibition hall.
The auditorium is intended as a meeting place where community members can discuss environmental issues and becomes a soapbox for the VEJA to share information with the community.

Figure 6.16: Model constructed community entrance for exhibition hall. (Author, 2016)

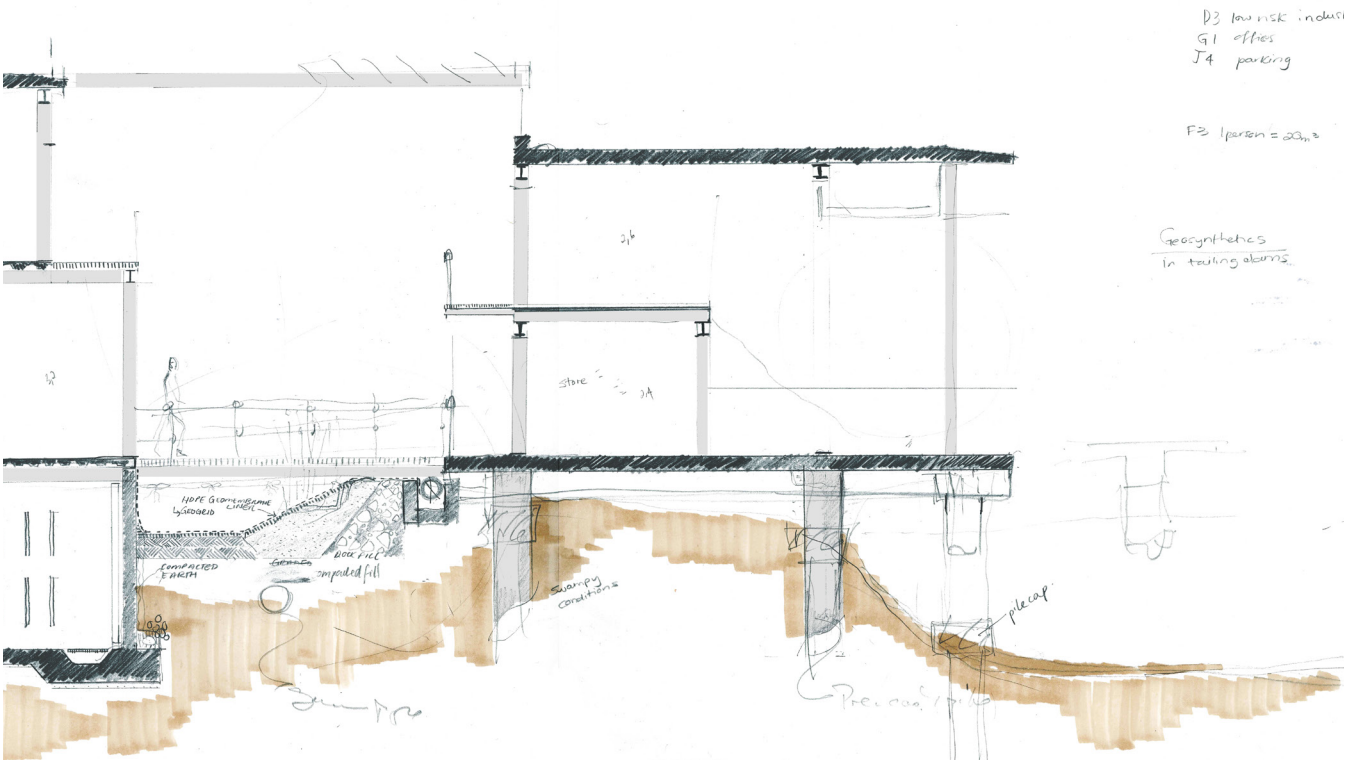


Figure 6.17: Section through wetland spine and laboratory .(Author, 2016)

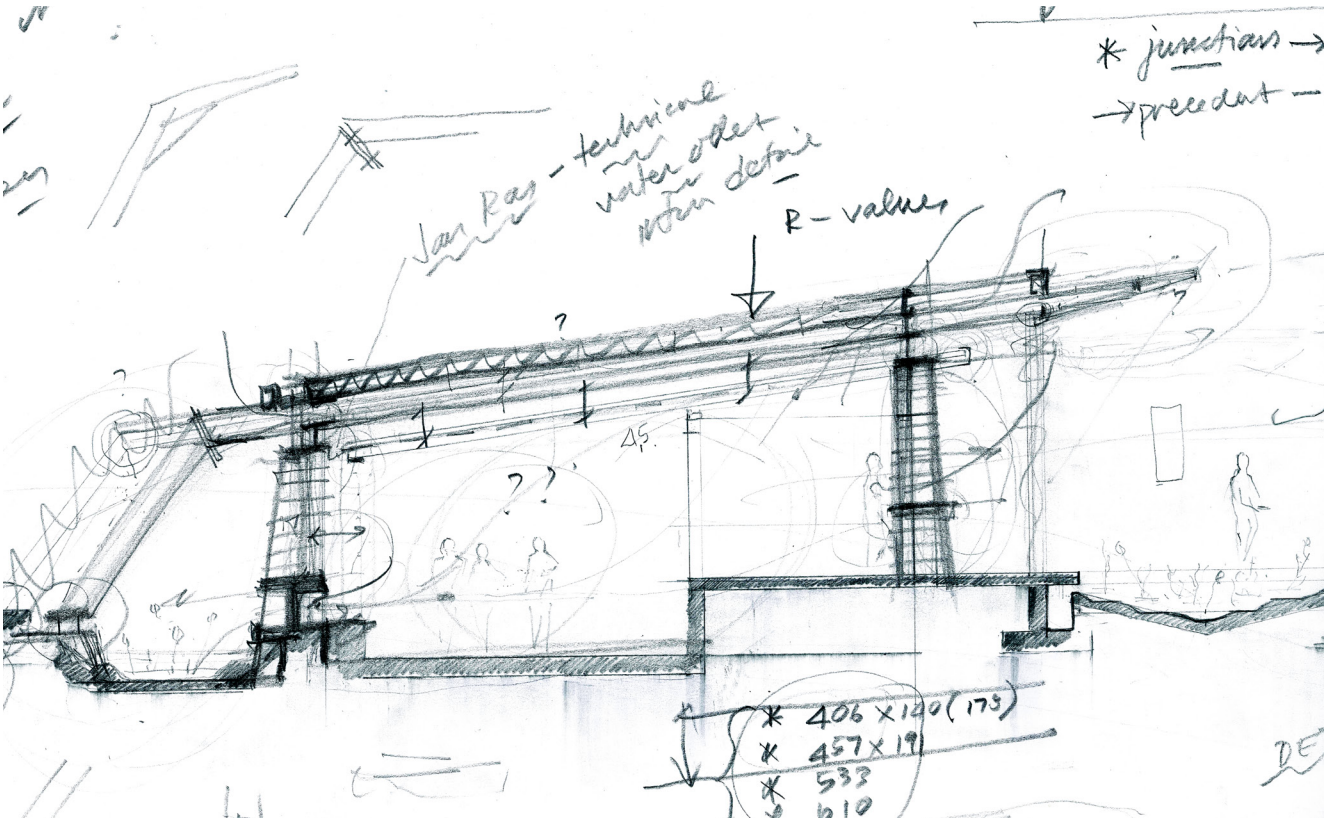


Figure 6.18: Silk fabrication and wetland section . (De Bruyn & Author, 2016)

MOVEMENT THROUGH THE FACILITY

The movement through the facility embraces both the flow of the contaminated water through the various remediation circulation channels, as well as community, visitor and staff pedestrian circulation through the facility.

Community member and visitor's entrance
The public's entrance is walking distance via pedestrian footpaths from the transport hub. Visitors enter with immediate access to the lounge and canteen with a view into the silk fabrication zone. The reception, auditorium, exhibition space and ablutions are all within immediate proximity.

Employees Entrance
The employees are divided into four groups:
1. The researchers/scientists
2. The algae workers and managers
3. The silkworm rearers and managers
4. The silk fabrication workers and managers

1.The researchers/scientists
Arrival in basement parking, stairs to reception on ground floor. Immediate access to laboratories, rearing hall, ablutions and canteen.

2.The algae workers and managers
Arrival at entrance on ground floor walking distance from transport hub. Immediate access to algae and wetland spine, ablutions and canteen. Open air meeting space. Manager's offices on upper level.

3. The silkworm rearers and managers
Arrival at entrance on ground floor walking distance from transport hub. Immediate access to change rooms, ablutions, rearing hall and canteen. Ramps connect all rearing hall spaces. Open air meeting space. Manager's offices on upper level.

4. The silk fabrication workers and managers
Arrival at entrance on ground floor walking distance from transport hub. Short walk to circulation core which provides access to silk workshop, ablutions and canteen. Manager's office's on mezzanine level.
Waste removal access

Services
Services are grouped and placed rhythmically along the spine. Separate services for visitors and employees. The canteen's service core includes the kitchen which produces waste which is removed and placed in a refuse bin yard to be collected by waste removal service. Organic waste is separated and added to the anaerobic bio digester. A ring road along the edge of the facility allows for the necessary waste removal and the anaerobic bio digesters sludge removal.

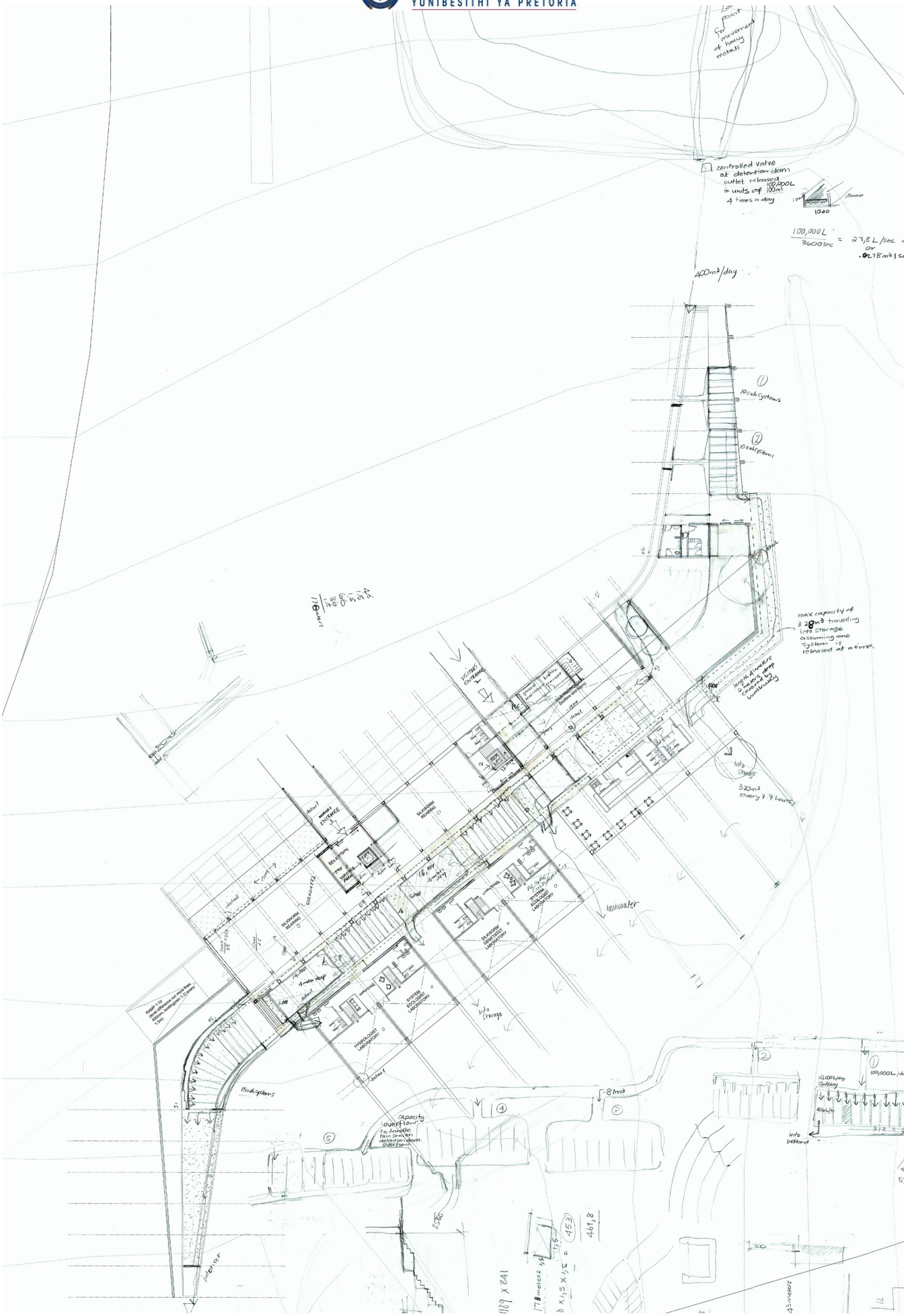


Figure 6.19: Ground floor plan showing the movement of the water through the processes. (Author, 2016)