Establishing an Ecosystemic Narrative

Walter Coetsee

Preface

Figure 1. Site Photo showing degraded natural condition. (Author, 2018)

Project Summary

Establishing an Ecosystemic Narrative

Walter Coetsee

Study Leader
Prof Arthur Barker

Course Co-ordinator
Prof Arthur Barker

University of Pretoria 2018

Research Fields
Heritage and Cultural landscapes,
Environment Potential

Site
ArcelorMittal Coke and Chemicals
Frikkie Meyer Road, Pretoria Townlands 351-Jr, Pretoria, 0183

25° 77' 25,02" S
28° 13' 76,92" E

The Client
ArcelorMittal

Program
Ceramic manufacturer
Aquaponics facility
Sports and recreational park

In accordance with Regulation 4(c) of the General Regulations (G.57) for dissertations and theses, I declare that this thesis, which I hereby submit 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 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.

Walter Coetsee

Ekserp

Die besorgdheid oor die rehabilitasie van post-industriële tereine is besig om toe te neem, weens die groeiende bewustheid oor die brose toestand van die omgewing. Hierdie bewustheid word onderskryf deur deur wetgewing wat die rehabilitasie van post-industriële tereine as 'n vereiste afdwing. Die motief wat hierdie wetgewing dryf, word ondervang in die meganistiese wêreldbeskouing en is besorg oor die bestuur van natuurlike hulpbronne, met die doel om die onginning van hierdie hulpbronne te verleng en die ontwikkelings status quo te behou (du Plessis, 2012: 8).
Die gevolg is dat die rehabilitasie slegs die simptome van die disfunktionele interaksie aanspreek, in plaas daarvan om 'n nuwe simbiotiese interaksie te bewerkstellig, wat die oorsaak van die natuurlike agteruitgang aanspreek. In die geval van die Pretoria Staal Werke, het symptomatiese rehabilitasie slegs 'n beperkte omvang en kan nie die natuurlike kompleksiteit herstel, wat voor die industriele aktiwiteite bestaan het nie. Die huidige rehabilitasie benadering wat geïmplementeer word, is daarop gemik om alle bewyse van nywerheidsaktiwiteite op die terein uit te wis en dus die industriële erfenis van Pretoria bedreig. Hierdie aanslag ondermyn ook die latente potensiaal om die huidige nywerheidsaktiwiteite in 'n aangpaste vorm te herbruik met inherente ekonomiese voordele.
Hierdie proefskrif sal die implementering van ekosistemiese denke ondersoek as 'n alternatiewe benadering tot post-industriële rehabilitasie. Hierdie benadering beoog om beide die oorsaak en simptome van natuurlike agteruitgang aan te spreek, deur 'n nuwe simbiotiese verhouding tussen mense en die natuur te vestig en deur die implementering van teorieë rakende biofilie, hergenerasie en bewaring van erfenis. Argitektoniese toepassings van hierdie teorieë, in die fasilitering van ekologiese remediëring en kompleksiteit sal ondersoek word.
Die Pretoria Staalwerke sal die basis van die ondersoek in hierdie verhandeling vorm. Dit sal verder poog om 'n presedent te stel vir die herontwikkeling van soortgelyke post-industriële terreine wat 'n alternatief bied vir die tradisionele rehabilitasiebenadering.

Abstract

Rehabilitation of post-industrial sites has become a major concern due to the growing awareness of the fragile state of the natural environment. This awareness has been met with the enactment of legislation that enforces rehabilitation as a post-industrial activity. The motive underpinning such legislation is rooted within a mechanistic worldview and is concerned with the management of natural resources to prolong its exploitation for the purposes of maintaining developmental status quo (du Plessis, 2012: 8). As a result, rehabilitation addresses the symptoms of dysfunctional interactions with nature rather than establishing new symbiotic interactions which would address the causes of natural degradation. In the case of the Pretoria Steel Works, symptomatic rehabilitation has a limited scope of intervention, failing to re-establish the natural complexity that existed before industry. A rehabilitation approach is implemented that seeks to erase all evidence of industrial activity on site thus threatening the industrial heritage of Pretoria. This approach also negates the latent potential of adaptive reuse and its inherent economic benefits.
This dissertation will investigate the implementation of ecosystemic thinking as an alternative approach to post-industrial rehabilitation. This approach seeks to address both the cause and symptoms of natural degradation by establishing a new symbiotic relationship between humans and nature through the implementation of theories related to biophilia, regeneration and heritage conservation. Architectural applications of these theories in facilitating ecological remediation and complexity will be explored.
The Pretoria Steel Works will form the platform for investigation in this dissertation and will seek to set a precedent for the redevelopment of similar post-industrial sites providing an alternative to the traditional rehabilitation approach.

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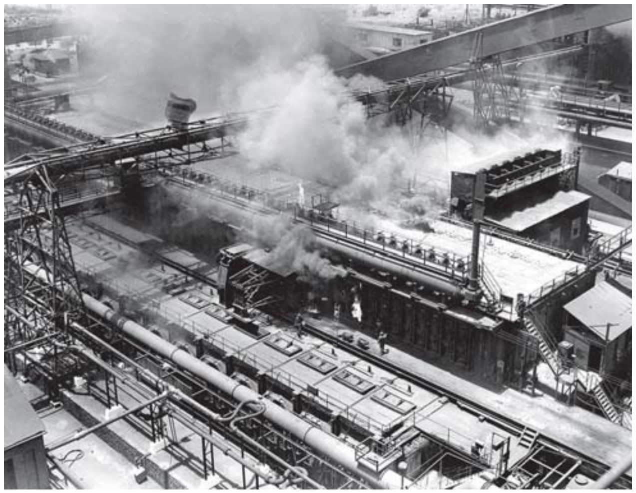


Figure 4. Photo of the coke plant on site. (https://c1.staticflickr.com/8/7323/13898434575_d8c31f9ae6_b.jpg, accessed 2018)

Figure 3. Photo of newly constructed steel mill. (https://arcelormittalsa.com/portals/0/Untitled-1.jpg, accessed 2018)

Background And History

History of Pretoria metal works

The making of steel and iron in south Africa can be traced back to the fifth century with the small-scale production of steel. The 1800's saw a drastic increase in demand for steel with the establishment of gold and coal mines; at this point steel was imported from Europe (Dondofema, et al., 2017:3). The Pretoria Metal Works, founded by Cor Delfos in 1916, was established shortly after the formation of the Union of South Africa. The Pretoria Metal Works plant processed scrap steel and conducted experiments to determine the feasibility of local steel production to secure independence from European producers (Dondofema, et al., 2017, p. 5). In 1924 a German manufacturer was sourced to investigate means of establishing a fully integrated mass production steel Mill. After several failed attempts at launching steel production in Pretoria, the Iron and Steel Industry Act (No.11 of 1928) was implemented by the state as a means to supplement industry and provide employment, specifically for the poor white demographic (Langley, 1997: 11). In 1928 Iscor was established as a state entity and in 1930 construction of the nation's first fully integrated steel mill commenced at the Pretoria Metal works.

The first batch of steel was produced in 1934 and marked a turning point in the steel industry (Dondofema, et al., 2017: 5). The supply of local steel catalysed the rapid expansion of industry and resulted in expansion of the Pretoria steel mill and establishment of other steel mills in the country. The Iscor mill in Pretoria grew to a steel producing capacity of 300 000 tonnes of iron per annum after it became the first steel mill in the world to convert to the Corex process of iron reduction in 1988 (Dondofema, et al., 2017: 7). In 1994 the Pretoria mill underwent another conversion to modernise its processes resulting in a production capacity of 600 000 tonnes of steel per annum (Referenceforbussiness, n.d.). Soon after its conversion, international steel supply surged owing to the emergence of Asian steel production markets. Iscor's exports plummeted and resulted in the decommissioning of the steel mill in 1997 (Referenceforbussiness, n.d.). Since then the site was acquired by ArcelorMittal who maintained the operation of the coke plant that supplied the steel mill with fuel.

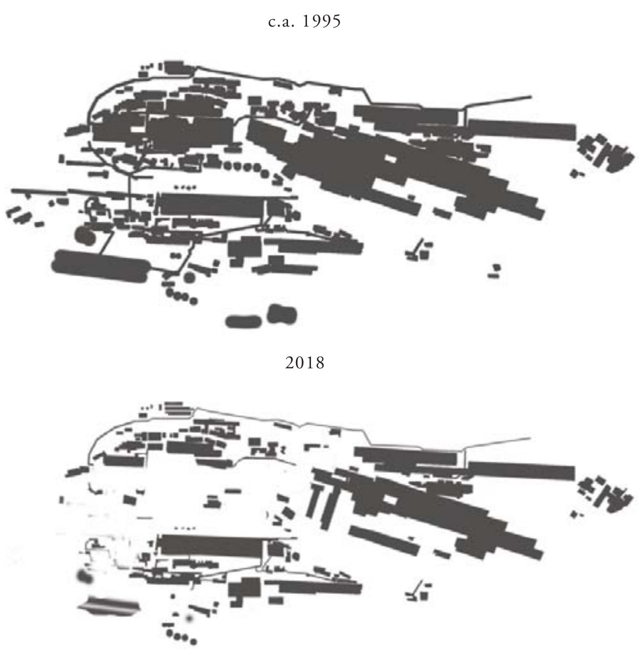


Figure 6. Figure ground diagram showing extent of demolition on site. (Author, 2018)

Current state of the Pretoria Metal Works

The Pretoria Works is still operational today but only as a manufacturer of coking coal used as fuel for other industries. The site also hosts tenants that manufacture steel related products. Since the decommissioning of the steel mill a rehabilitation program has been implemented to remediate the contaminated state of the site. The area of the site most affected by contamination is the massive slag heap towards the east of the site that has developed over the decades of the plant's operation. The slag heap, if left in its current state, threatens to contaminate ground water with metallic oxides that make water supplies unsuitable for consumption. The rehabilitation program implemented on site entails the excavation of the slag heap for use as aggregate for the construction industry. Another part of the rehabilitation program is the demolition of decommissioned buildings and infrastructure. Since the decommissioning of the steel mill much of the built fabric on site has been demolished. The slag heap, owing to its enormity, has only partially been excavated and it is estimated that excavation will continue for another decade. From an urban perspective the site is considerably static when compared to the dense urban fabric and economic energy that surrounds it.

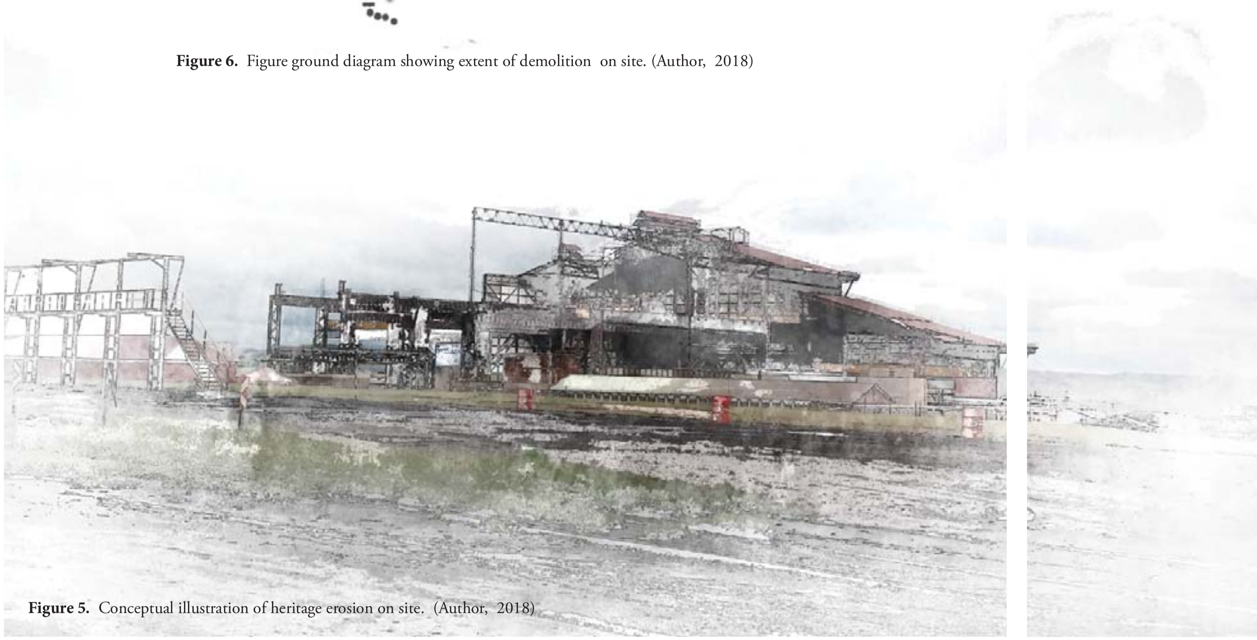


Figure 5. Conceptual illustration of heritage erosion on site. (Author, 2018)

PROBLEM STATEMENT

General issue

The Pretoria Metal Works has been responsible for significant degradation of the natural landscape over the past century. It has, however, made an important contribution to the development of Pretoria and the production sector of South Africa. Its presence contributes extensively to the industrial heritage of Pretoria and is a manifestation of the worldviews and paradigms that shaped both the physical and social environment of the city over the past century. The rehabilitation programme that is currently implemented on site aims to remove all evidence of past industry and restore the natural condition that existed before industry. This approach, though ecologically intended, is still situated in a mechanistic worldview that assumes the mutual exclusivity of humans and nature and disregards the deep ecological impact of industry on the natural environment. It regards human artefacts as separate from the ecology and negates opportunities for co-evolution as a viable way forward.
The outcome of this rehabilitation programme is the demolition of decommissioned buildings and the excavation of the slag heap that has formed over the years of production. Furthermore, it is aimed only at superficial restoration of nature and decontamination.
In general, the rehabilitation programme has resulted in a loss of valuable heritage fabric and a decline in the site's economic contribution to the production sector. It also fails to re-establish the natural complexity that existed prior to industry.

Urban issues

The Pretoria Metal Works exists as an urban parcel in the greater urban context, with its own road network and infrastructure. Its urban fabric is relatively coarse in comparison to the finer surrounding urban fabric. The site is contained within a region between the southern hill and northern railway. The arrangement of buildings on site is evidently informed by the production process that extends from west to east. Primary production functions such as the coke plant and steel mill are situated on the western side with secondary production functions in the middle and the slag waste heap on the eastern side.
The evolution of the site around this production axis between the hill and railway line has resulted in a large mono-functional urban parcel that is removed from its context. The decline of the industry and the demolition of decommissioned buildings are creating static voids that are not accessible to the surrounding urban fabric. This inhibits the emergence of new functions in these voids that could contribute productively to society. This arrangement also removes public access to the southern nature reserve on the hill, creating a divide between nature and the urban condition. The eventual closure of the Pretoria Metal Works will leave behind a large disconnected urban parcel that, though rehabilitated, contains low biodiversity and ecological complexity. It will also result in an economic void that once contributed significantly to Pretoria's production sector.

Figure 7. Collage depicting mechanistic thinking. (Author, 2018)

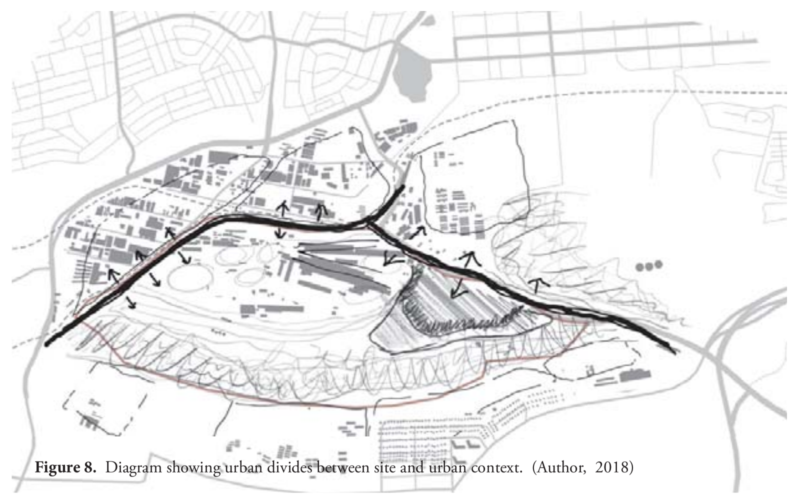


Figure 8. Diagram showing urban divides between site and urban context. (Author, 2018)

Figure 9. Site photo of static voids that are the result of demolition. (Author, 2018)

Architectural issue

The demolition of decommissioned buildings at the Pretoria Metal Works for the sake of rehabilitation is eroding the industrial heritage of Pretoria. Embedded in the buildings and landforms, are narratives of the industrial development of Pretoria. These narratives expose the effects of a mechanistic approach to the environment and act as a reminder of the impact of human development. The heritage value and narratives embedded on site are, however, implicit and inaccessible to the public. The buildings and landforms, should they be preserved, would become objects in the landscape that do not elicit interpretation of their past function and contribution to Pretoria's industrial heritage. Furthermore, rehabilitation will still need to take place to remediate past degradation and may place into question the functional use of retaining decommissioned, built fabric. Existing built fabric may also be considered active deterrents to rehabilitation which would make their conservation problematic. Thus, it is important for the sake of heritage conservation that existing buildings assume new productive functions to validate their presence on site and create an interface for the interpretation of heritage value and embedded narratives. The built fabric also needs to be recalibrated to establish interactive relationships with the natural environment and become agents of rehabilitation.

INTENTIONS

Research intention

This dissertation will investigate the implementation of architecture as an agent of ecosystemic post-industrial rehabilitation that engages with the heritage of place. This alternative approach seeks to conserve heritage and expose site narratives by transforming buildings from agents of destruction to agents of remediation and economic upliftment. Such a transformation would validate the conservation of buildings as opposed to their demolition.

This investigation will be underpinned by an ecosystemic worldview that recognises the deep complexity of natural systems and the impact of human interaction with these systems. The design process will be guided by an understanding of humans and human artefacts as part of the ecology and will seek to establish mutualistic relationships between humans and nature that restore the ecology of place whilst contributing to society. Regeneration, biophilia and heritage conservation theories will be visited to guide this process.

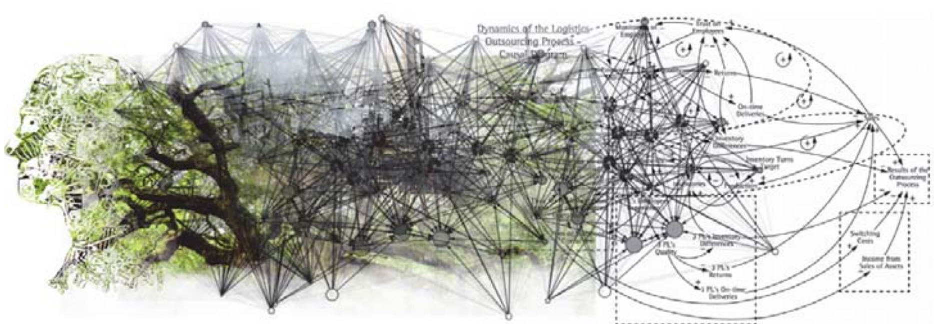


Figure 10. Collage demonstrating ecoytemic thinking (Author, 2018)

Urban Intention

An urban framework is proposed that aims to diversify the mono-functional Pretoria steel works to include a variety of urban functions. The urban development will be approached as an ecosystem, the health of which is determined by its biodiversity and its ability to assimilate waste into productive resources that facilitate rehabilitation. The urban development will be informed by an approach that considers existing buildings as artefacts that form part of the ecology. Conservation of heritage fabric will be actioned through adaptive re-use of buildings and integration into surrounding urban fabric. Adaptive re-use and urban integration will be implemented to facilitate occupant engagement with heritage and expose narratives embedded in place.

Architectural intention

To address the issue of heritage erosion and natural degradation, an architectural approach will be implemented that transforms agents of natural degradation into agents of remediation and productivity. This will validate the conservation of altered landscapes and built fabric in which heritage and site narratives are embedded. This architectural approach will also aim to establish a pertinent sense of place by exposing the embedded heritage value and narratives. To achieve the restoration of ecology and societal contribution, the architecture will be positioned as an interface between humans and the natural environment that facilitates mutualistic interactions. The architecture will be designed to be embedded operationally in the living systems of its environment. Its interaction with these systems will extract productive value whilst channelling resources for the benefit of the ecology. As an extension of its operational functionality, architecture will be implemented as a poetic device, employing spatial metaphors that express the narratives embedded in place and the processes that action rehabilitation.

RESEARCH QUESTIONS

Main Questions

-How can an ecosystemic approach to architecture be implemented to ensure that the objectives of both rehabilitation and heritage conservation are met?

-How can architecture facilitate a shift towards sustainable and regenerative urban development?

-What role can architecture play in facilitating proximate and symbiotic relationships between humans and nature?

Sub questions.

-What changes can be made to the existing built fabric of the site to incorporate it into the urban fabric of its surroundings?

-How can architecture be applied to reinvigorate the site's economic and social contribution to society?

- What role can architecture play in redefining economic patterns and facilitate endorsement of local procurement and consumption?

-How can architecture facilitate an understanding of the industrial heritage of the site and elicit the value of the site in its contribution to the development of the city?

-How can architecture assist in facilitating sensory proximity between humans and the natural environment?

-How can architecture become embedded in its natural environment and participate in the ecology?

- How can building systems be designed to extract productive potential from the environment whilst facilitating the rehabilitation and augmentation of the natural environment?

RESEARCH METHODOLOGY

Historical study

A historical study of the Pretoria Metal Works is undertaken to gain an understanding of the development of the steel manufacturer in its larger context. This study is important to understand the political economic, technological, and environmental conditions in which the site evolved. A deeper understanding of these conditions will facilitate the identification of pertinent issues that are the result of broader environmental interactions. This deeper understanding of issues will elicit an objective approach to formulation of intentions. Historical studies are also valuable as they sketch a story of place and facilitate the identification of heritage value and appropriate strategies to conserve heritage. The history of the site will be investigated by visiting literature that pertains to the evolution of the steel manufacturer within its environment. Heritage conservation charters will also be consulted to guide the process of intervention.

Theoretical studies

A theoretical study will be performed to gain an understanding of the cause of identified issues and strategies to alleviate these issues. The works of theoreticians, who critique contemporary societies' approach to environment and heritage fabric, will be visited to understand the causes of issues. Theories related to ecosystemic thinking, such as regeneration and biophilia, will be investigated as approaches that can alleviate issues. Secondary literature sources will be consulted to formulate the theoretical study.

Case studies and precedents

Case studies and precedents will be consulted to understand how specific theories have been applied in architecture and will facilitate the design process. Case studies related to production processes will also be consulted to understand the programmatic requirements that need to be satisfied.

Assumptions and delimitations

For the sake of this dissertation, the assumption is made that the Pretoria Metal Works has been decommissioned and that the site will be undergoing rehabilitation. It is also assumed that the owners of the site, ArcelorMittal, will opt for the redevelopment of the property. In this dissertation, the Pretoria Metal Works will be approached from a holistic perspective, taking into consideration the heritage and natural condition of the site as a single entity. The design intervention will, however, be limited to the slag heap that forms only a part of the site.


Figure 11. Site photo showing slag crushers. (Author, 2018)

CHAPTER 2 Context

Introduction

The Pretoria Metal Works, known today as ArcelorMittal Coke and Chemicals, has a strong presence in the city's industrial landscape. over the past century the development and demise of the industry has significantly altered the landscape. The processes that effected this alteration will be illustrated and will be followed by a narrative study that describes the evolution of the site. The site will then be analysed on varying scales to attain a deep understanding of place.

Figure 12. Conceptual illustration of site buildings in their transitory state. (Author, 2018)

Industrial Processes

Past and present industrial processes and their impact on the landscape

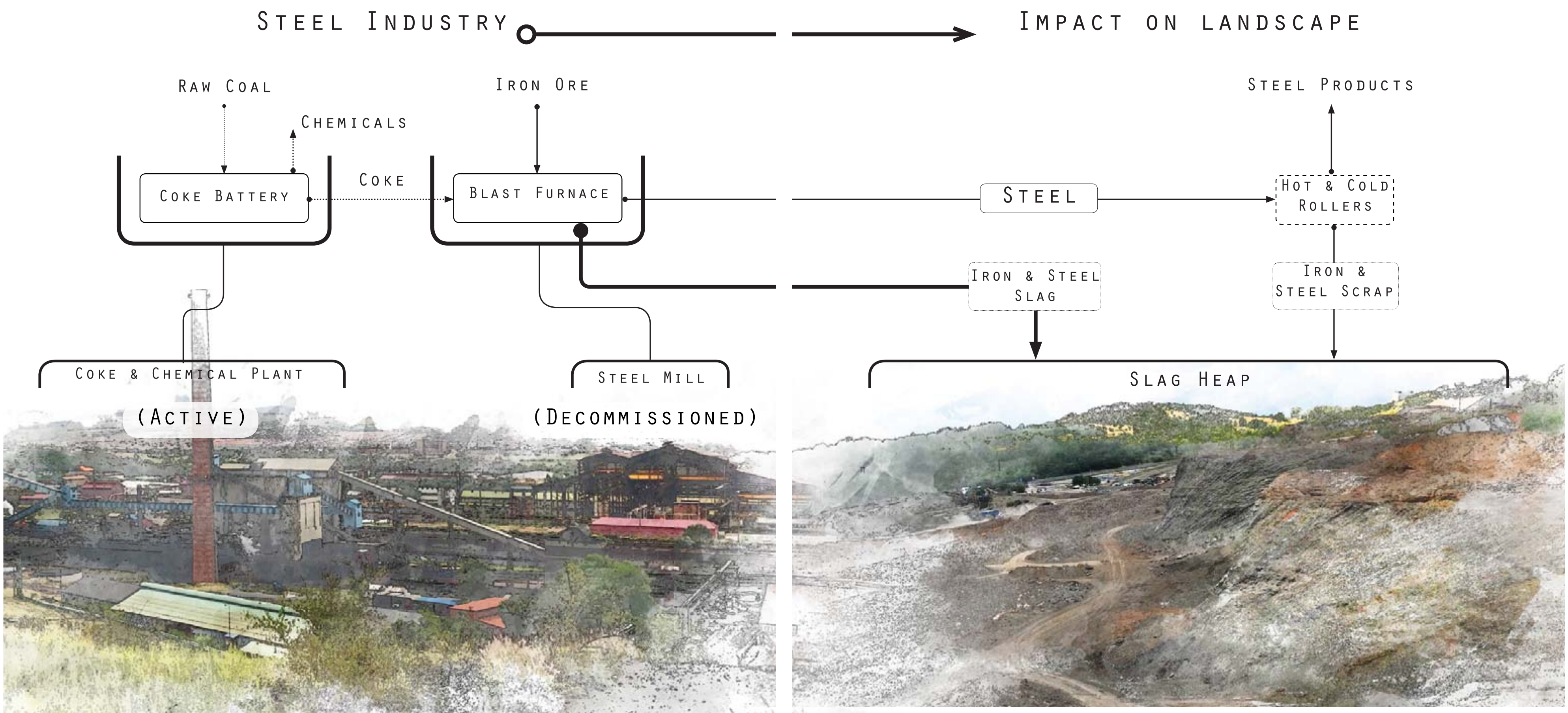


Figure 13. Diagram showing the impact of steel manufacturing on the environment. (Author, 2018)v

Excavation and processing of slag

The past industrial processes resulted in an environmental condition that needs to be rehabilitated. The slag by product of steel making has been dumped on site forming a large heap that can contaminate ground water with metallic oxides. Part of the rehabilitation program entails the excavation and processing of the slag heap. The process includes the excavation of slag that is crushed and sold as aggregate for the construction industry

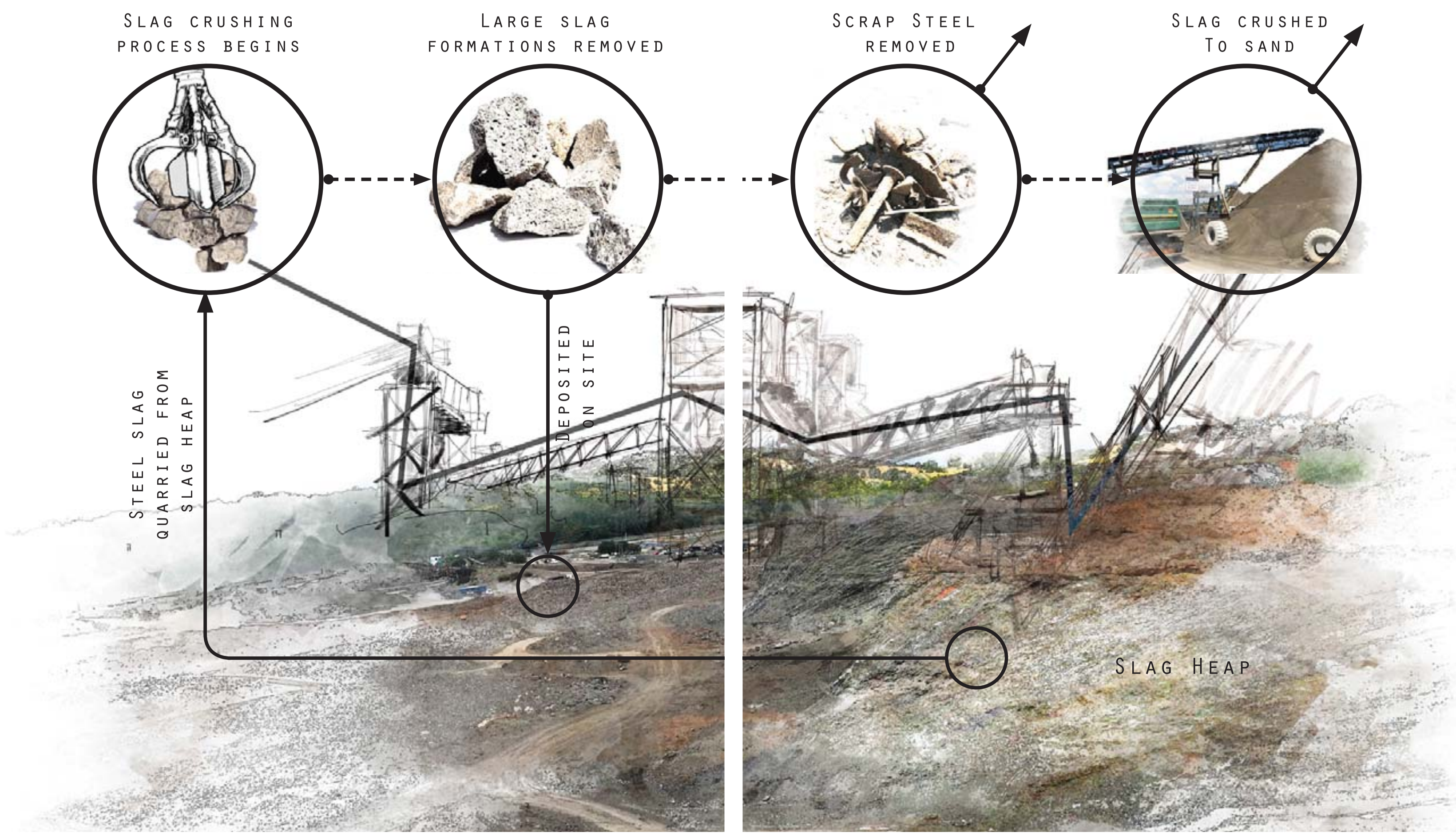


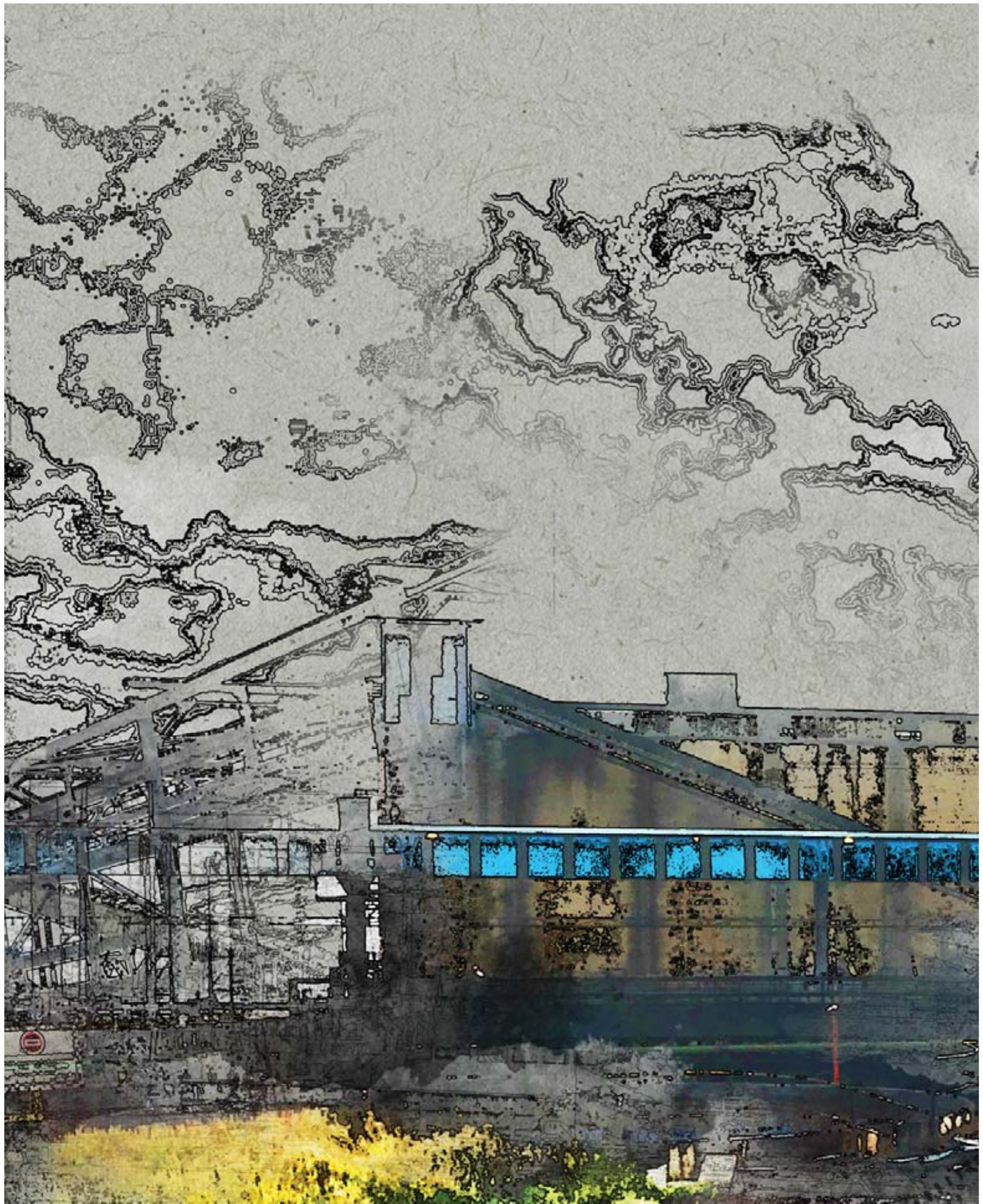
Figure 14. Diagram of the slag excavation process. (Author, 2018)

Site Narrative

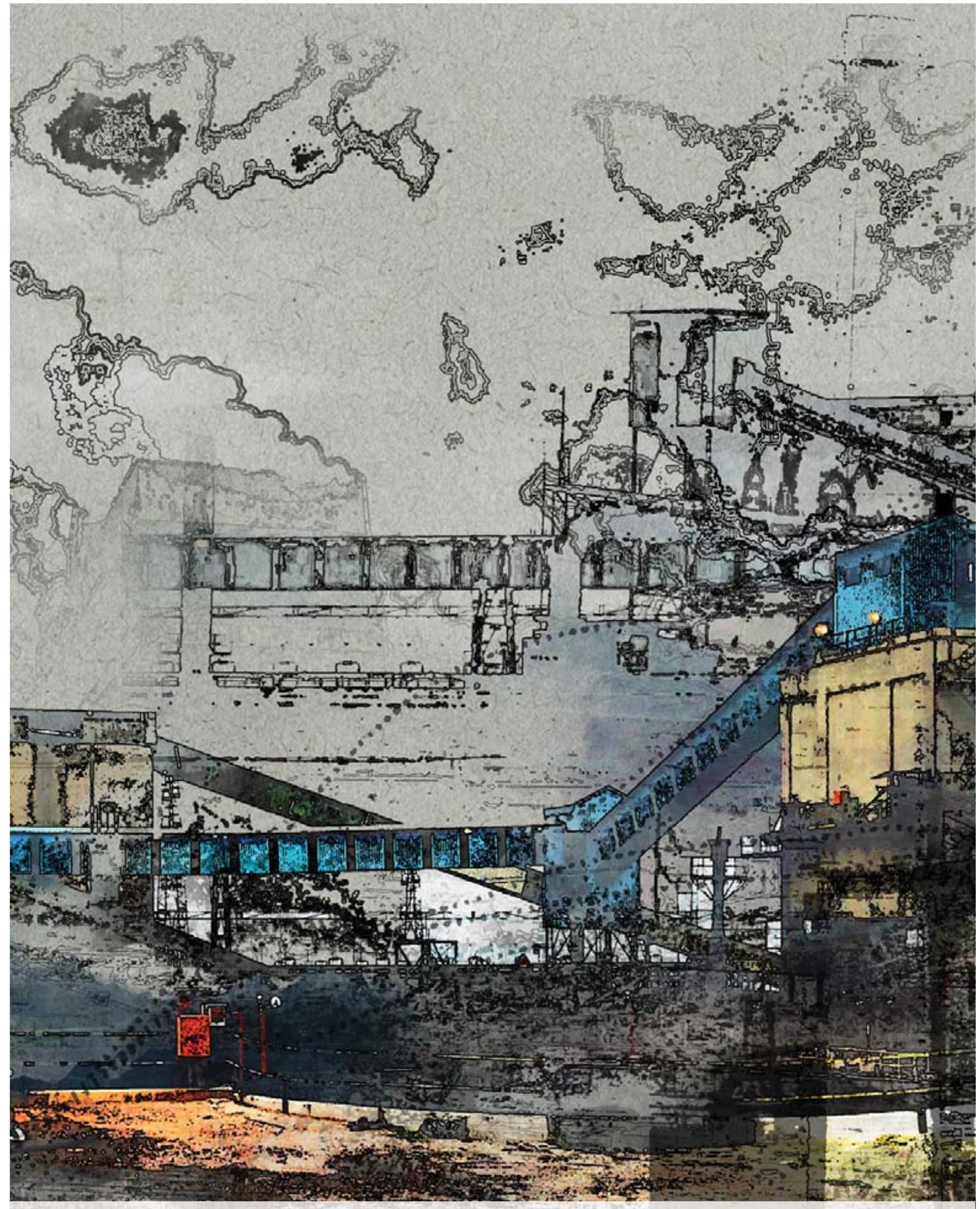
Figure 15. ConceptualThcollageThillustratingThsiteThnarrative(author,ThTh2018)

The natural environment, classified as the Gauteng Shale Mountain Bushveld, existed as complex ecology.

eThbirthThofThtheThsteelThindustryThcatalysedThtheThdemiseThofThtheThnaturalThcondition.Th AThmechanisticThevolutionThofThtheThlandscapeThwasThsetThintoThmotionThwhichThsawThtheTh landscapeThalteredThtoThsuitTheThendeavoursThofThhumankind.

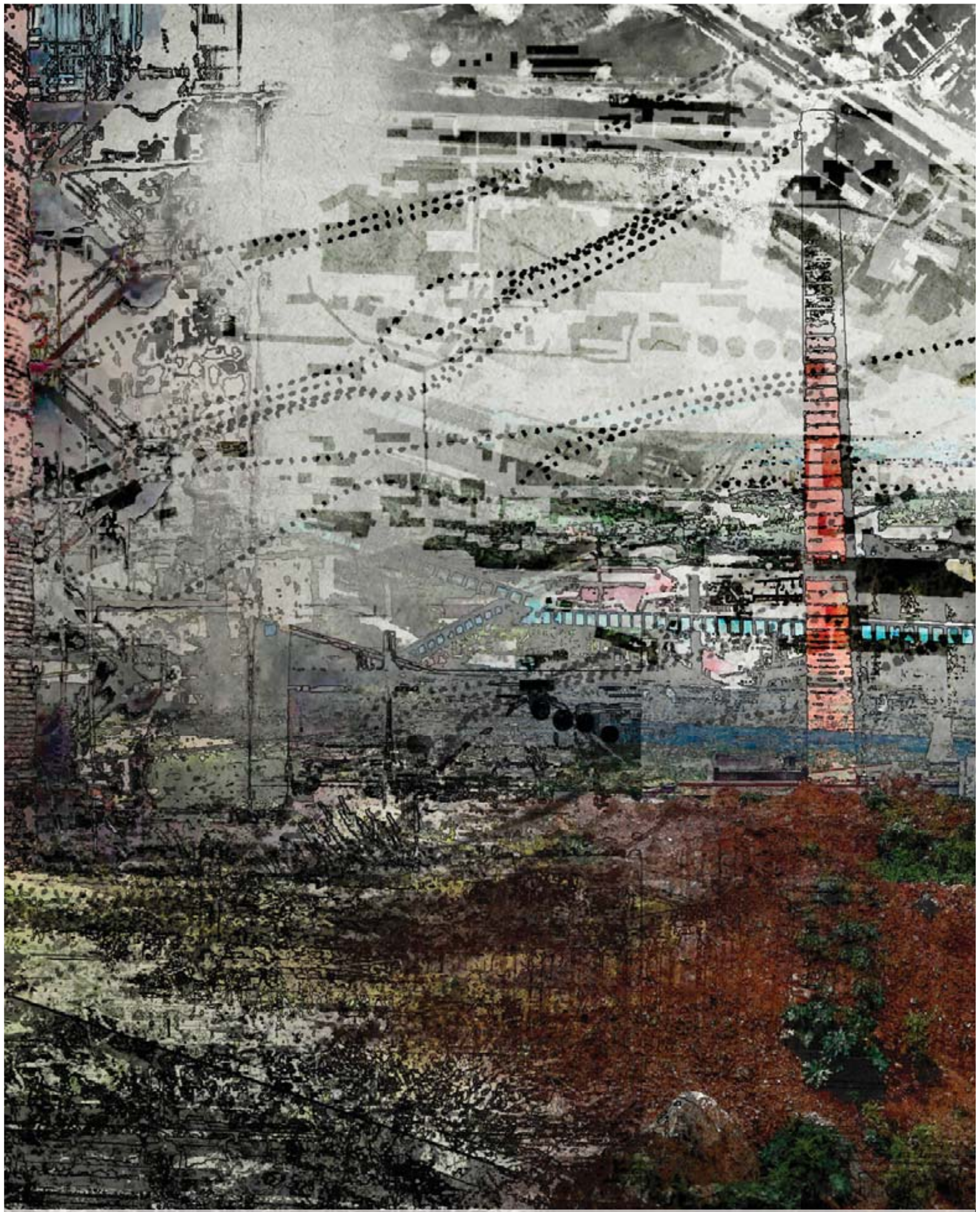


The industry continued its prolific evolution. Several additions were made to the industrial built fabric, strengthening the mechanistic presence in the landscape.

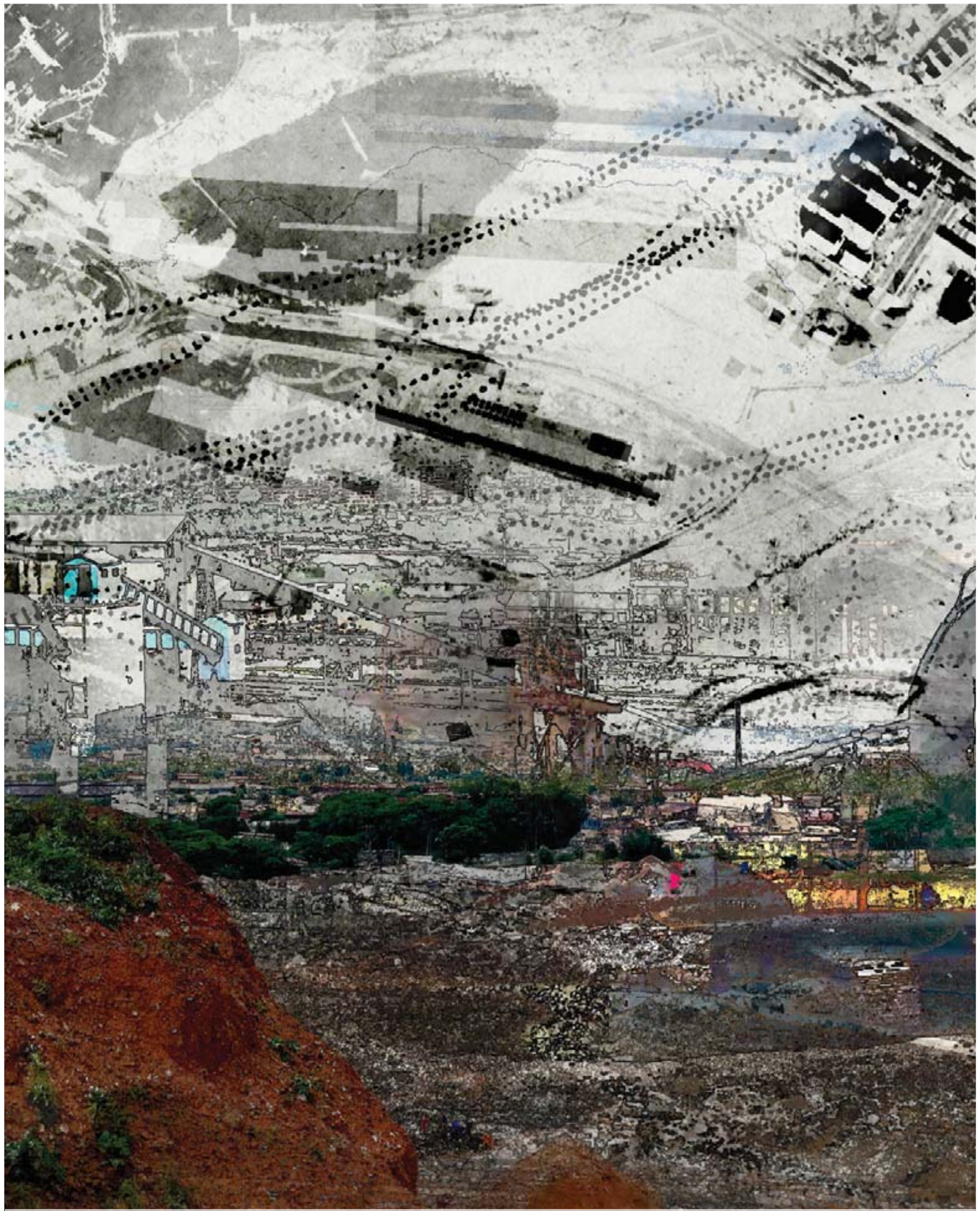


Industrial processes were streamlined to attain maximum efficiency. This preoccupation with efficiency, though yielding vast steel output, also resulted in vast waste outputs.

The industry continued to grow but came to an abrupt stop at the sudden drop in the international demand for steel.

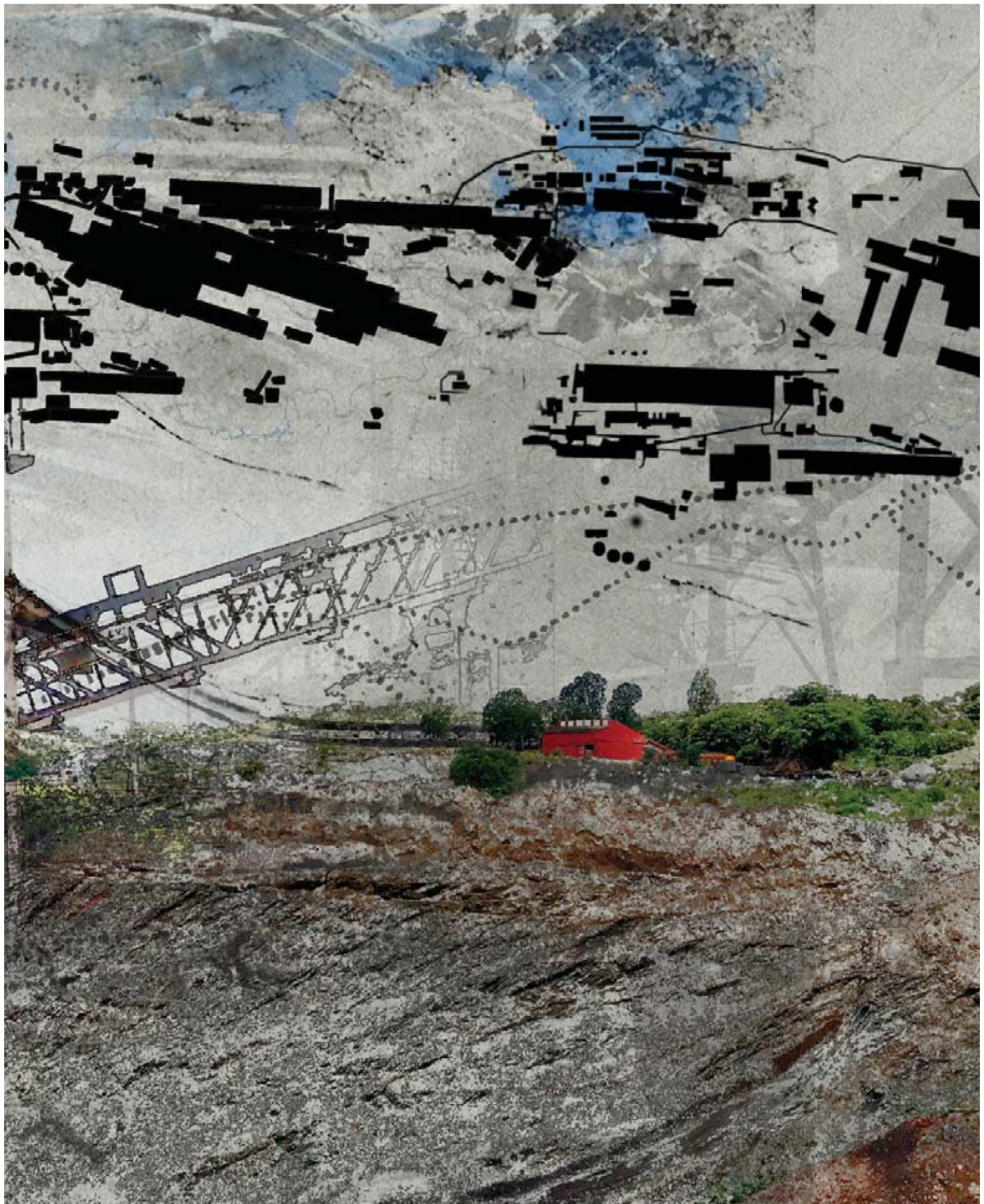


The once prolific industry that effected deep environmental degradation was now scheduled for demolition. Parts of the industry such as the coking plant and steel processors did survive and would continue to operate.

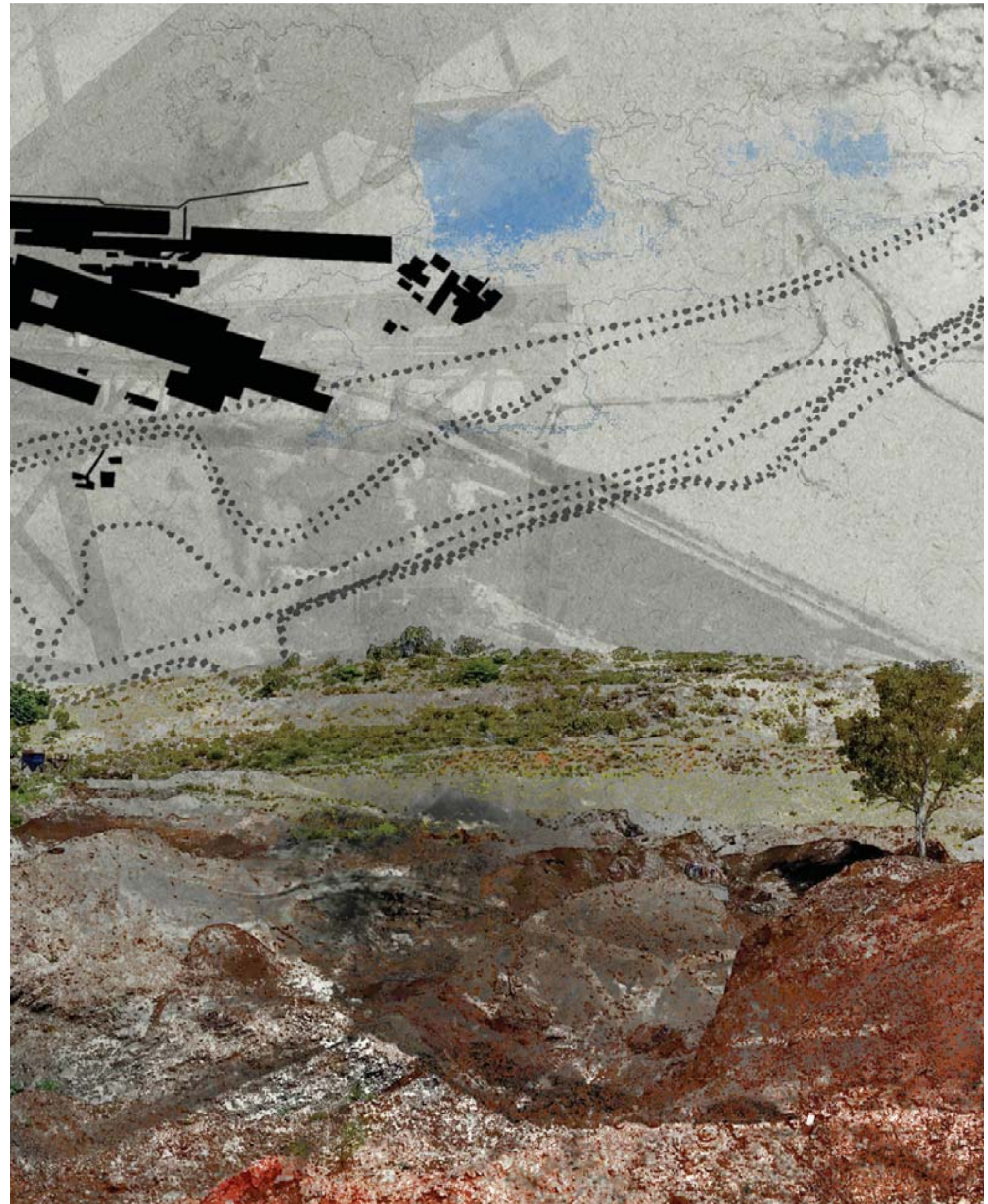


The environmental degradation caused by the wasteful industry needed to be addressed not only to restore the natural condition but to prevent further ontamination of the environment.

A rehabilitation program was initiated that entailed the demolition of decommissioned buildings and industrial structures. It also entailed the excavation of the giant slag heap that had grown over the decades.



As the rehabilitation process continued, buildings became voids. Today these voids exist in stasis and are far removed from the natural condition that once existed. The slag heap, now undergoing excavation is equally barren and uninhabitable.



The landscape, scarred by industry, expresses the impact of parasitic interactions with nature and elicits the importance of establishing a new relationship with nature.

Pretoria Industrial in Context

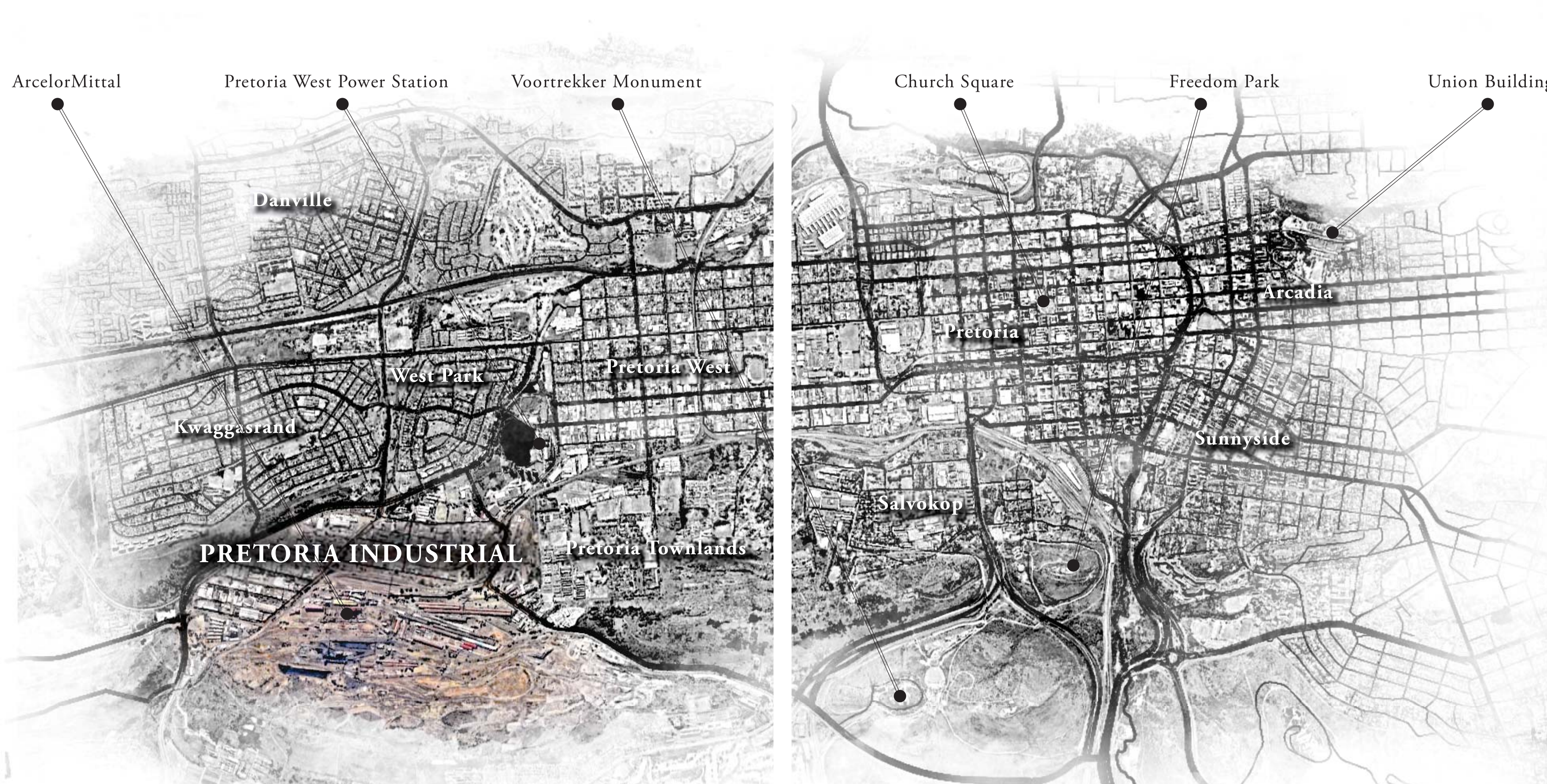


Figure 16. Map of Pretoria Industrial in its urban context. (Author, 2018)

Pretoria Industrial

This region of Pretoria is situated toward the west of the city centre and is characterised by the presence of industrial activity. ArcelorMittal forms the nucleus of this region, occupying a large part of the land. It is framed by a region of light industrial building toward the north and west of the site. The north eastern border is framed by Roger Dyson road and a nature reserve on the other side of the road. The southern part of the site is framed by a hill and a nature reserve belt. The military headquarters precinct is situated towards the south of the hill. The ArcelorMittal Pretoria Works site largely defines the character of the area and has significantly changed the landscape of the region over more than a century of its operation and currently exists as an island within the urban fabric.

Figure 17. Diagram indicating site boundary. (Author, 2018)

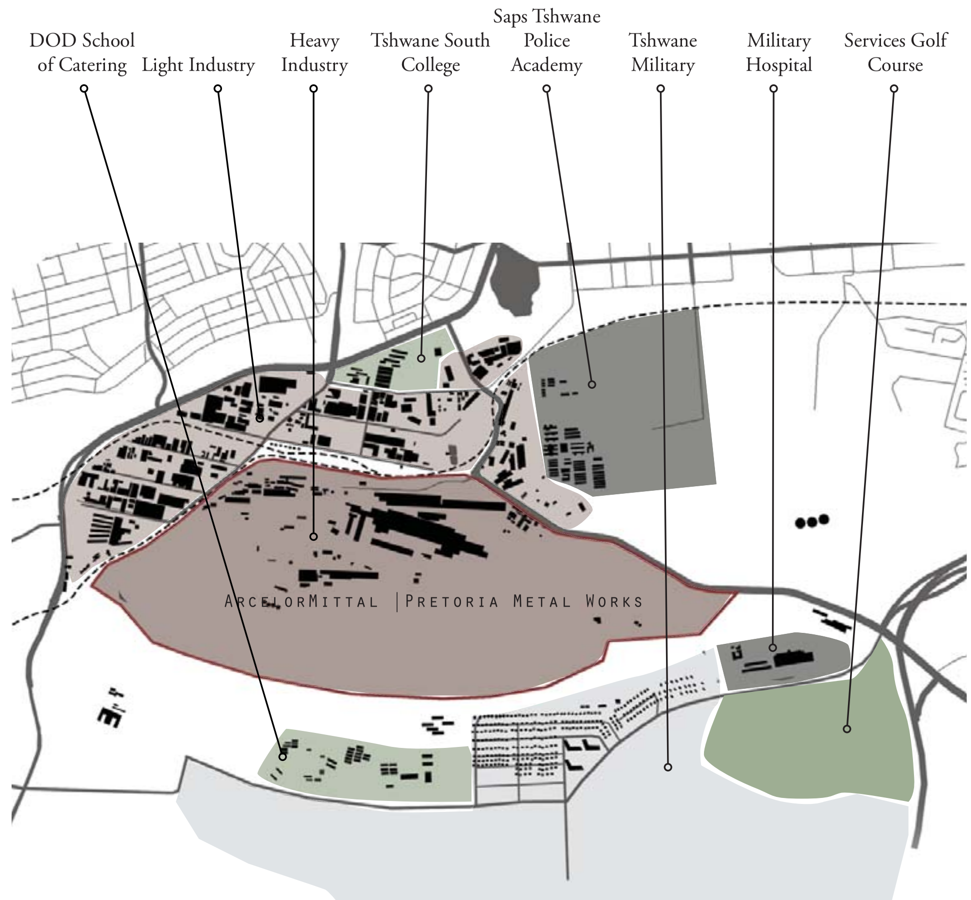


Figure 18. Diagram of the urban condition surrounding ArcelorMittal. (Author)

Site Map

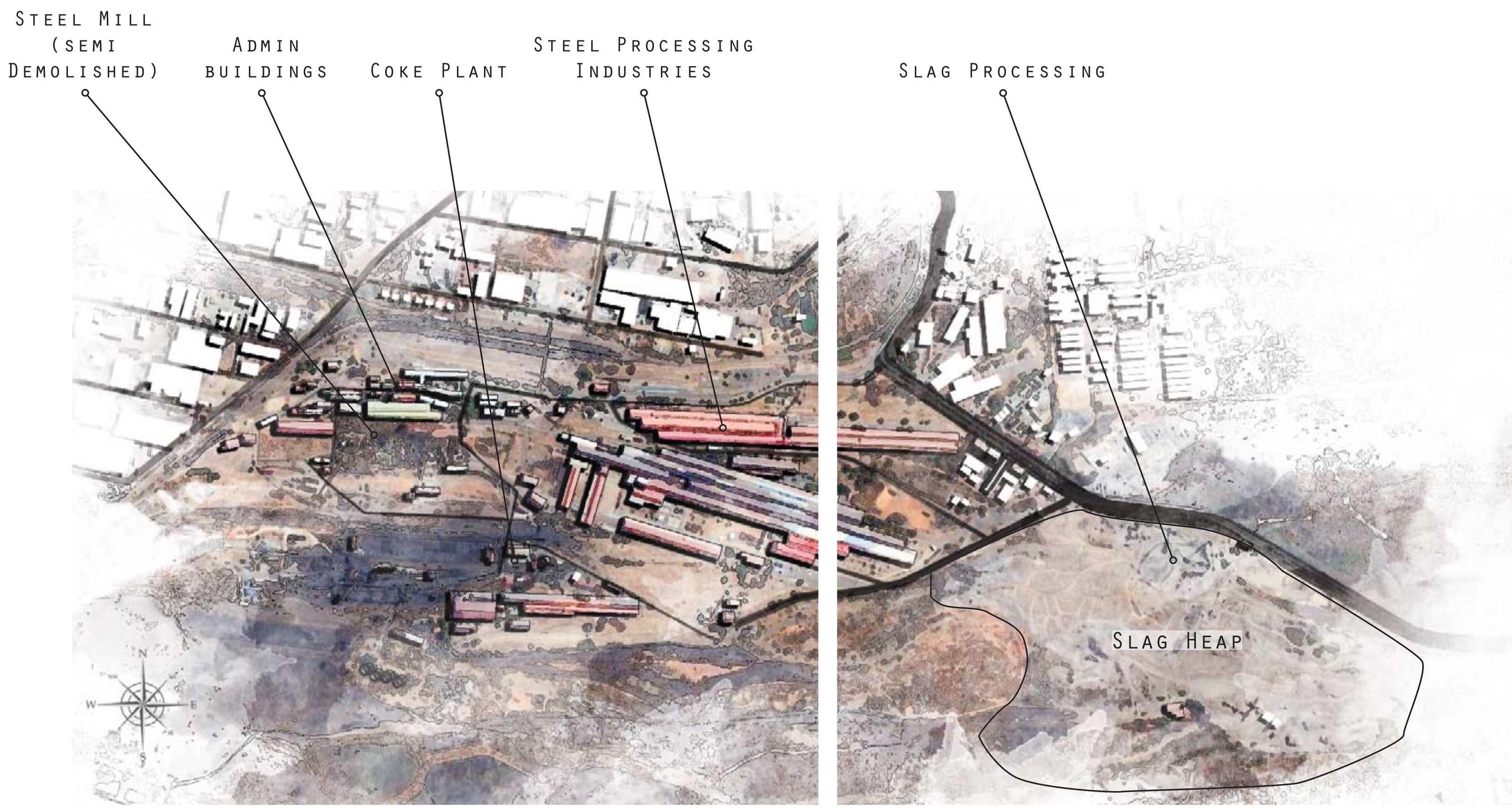


Figure 19. Site map diagram indicating buildings. (Author, 2018)

Demolition of decommissioned buildings

-| ca. 1995 |-

-| 2018 |-

Figure 20. Site map diagram showing the extent of demolition on site. (Author, 2018)

Heritage Value

Slag Heap

VALUE
Social.
CONDITION
Under going excavation.
HERITAGE APPROACH
Needs to be excavated but parts of the heap can be retained and stabalised to maintain its heritage value.
POTENTIAL
The heap can be adaptively reused as a sports and recreational park.

Steel Processing Industry

VALUE
Social and Functional.
CONDITION
Still operational and in good condition.
HERITAGE APPROACH
Can be modified to make site more accessible but overall building character and functional use needs to be maintained.
POTENTIAL
The buildings can be used for a variety of industries without much intervention.

Chemical Processor

VALUE
Functional and Technological.
CONDITION
Still operational and in good condition.
HERITAGE APPROACH
Once decommissioned the structure can be adaptively reused. New interventions must reference the structures past use and ideally maintain the function of machines and structures.
POTENTIAL
The distilation equipment can be reused for distilation of bio-fuels.

Admin Building

VALUE
Social and Architectural.
CONDITION
Semi vacant and in good condition.
HERITAGE APPROACH
The exterior character of the building must be preserved. It's function as an office building can be maintained.
POTENTIAL
The large office building can be rented by the private or public sector.

Coke Plant

VALUE
Social, Functional and Technological.
CONDITION
Still operational and in good condition.
HERITAGE APPROACH
Once decommissioned the structure can be adaptively reused. New interventions must reference the structures past use and ideally maintain the function of machines and structures.
POTENTIAL
Coke ovens can be reused as furnaces and kilns for variety of products.

Steel Mill

VALUE
Social, Functional and Technological.
CONDITION
Decomissioned and extensively demolished.
HERITAGE APPROACH
Needs to be adaptively reused. Building additions will be necessary but should make reference to the memory of lost heritage fabric.
POTENTIAL
The latice structure can be reused as a green house. Glass additions will clearly reference old and new structures.

Figure 21. Diagram of the heritage value of buildings on site. (Author, 2018)

Land Form

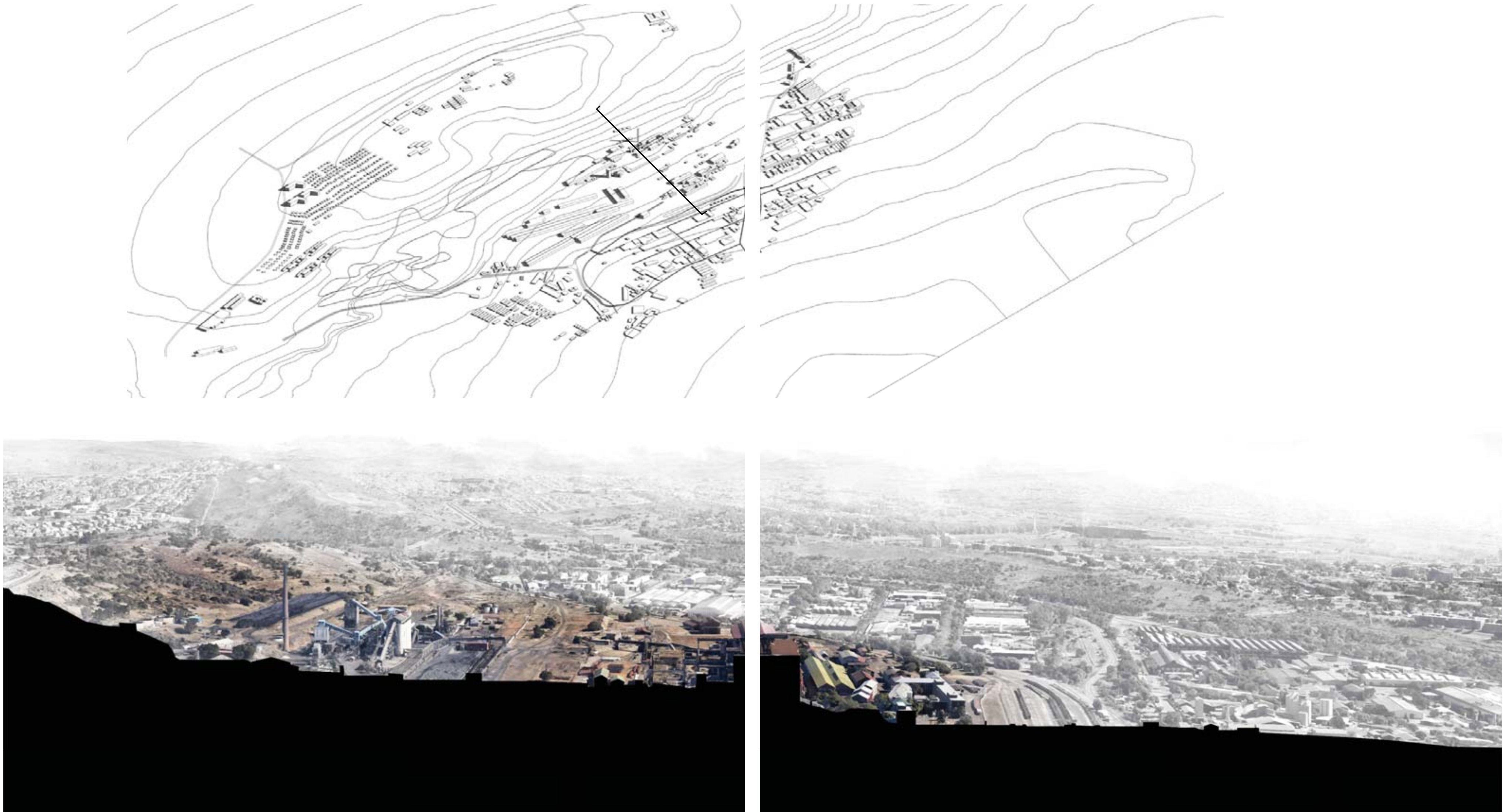


Figure 22. Section diagram showing the landform of the site. (Author, 2018)

Environmental Condition

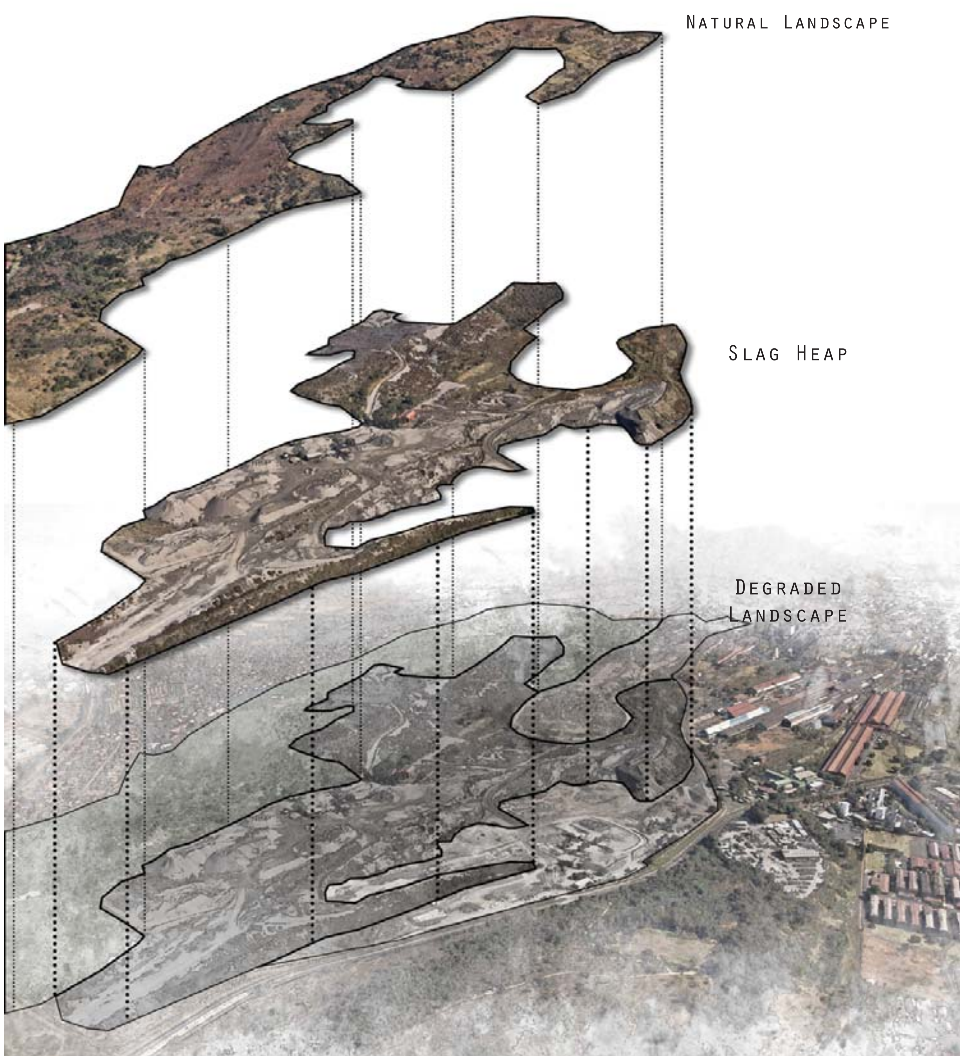
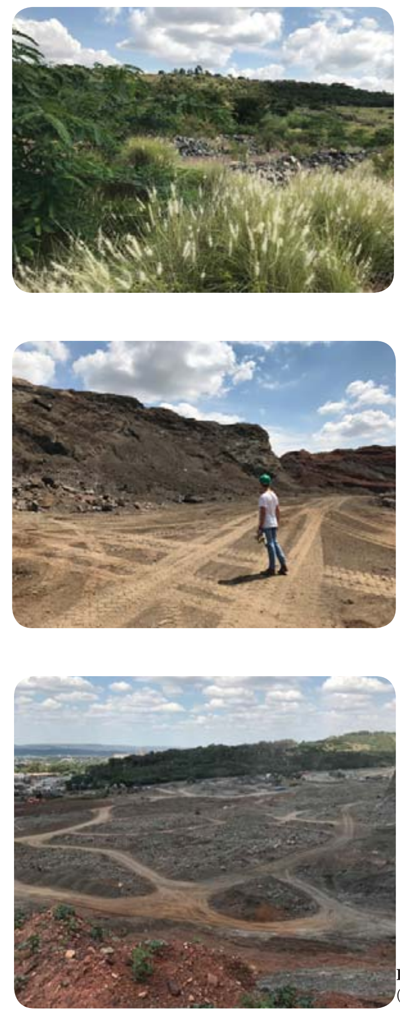


Figure 23. Aerial view of site showing the different environmental conditions. (Google Earth edited by Author, 2018)



Natural Landscape

The souther region of the site is densely populated with vegetation. There are however parts that have been used for dumping of industrial by products. There is also a variety of invasive plant species.

Slag Heap

The slag heap occupies most of the eastern part of the site. Parts of the slag heap are populated with plant species but newly excavated regions are barren. The slag heap, due its high metallic content, poses a threat to subterranean water systems. This threat can be alleviated by partial excavation of the slag heap, stabilisation (using clay soil) and propagation of phyto-remediative plant species.

Degraded Landscape

Large parts of the slag heap have been excavated but now exist as barren landscape that contain no biodiversity. These areas need to be repopulated with vegetation to re-establish ecological complexity.

Figure 24. Site Photos showing the different environmental conditions. (Author, 2018)

Site Vegetation

Invasive Plant Species


Pennisetum setaceum


Albizia procera

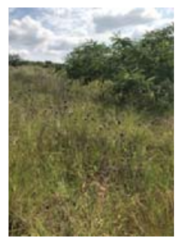

Ipomoea purpurea


Acacia mearnsii_Black wattle


Schinus molle


Tithonia rotundifolia


Arundo donax


Campuloclinium macrocephalum


Senna pendula


Schinus molle


Datura ferox

Figure 25. Site Photos showing the different types of vegetation. (Photos by Pienaar,H, 2018)

Micro Analysis Focus Area

Site Location

Figure 26. Site Map showing focus area. (Author, 2018)

The focus area of this disertation is the slag heap that functioned as a dumping ground for steel slag. The site is located towards the west of the slag heap and was selected due to the heavily degraded condition of the site and the need for it to be rehabilitated.

Figure 27. Site Photos showing slag heap (Author, 2018)

Site Morphology

Excavation of slag heap since 2004

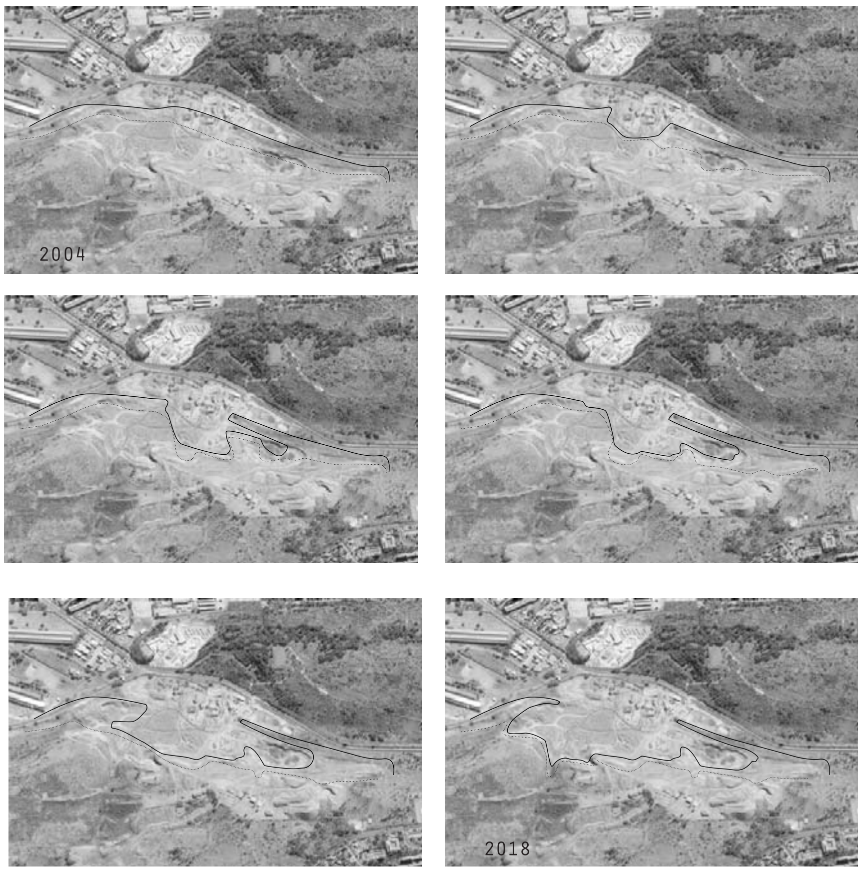


Figure 28. Diagram showing excavation of slag heap over time. (Author, 2018)

Slag heap before excavation

Semi-excavated slag heap

Figure 29. Section diagram showing excavation of slag heap over time. (Author, 2018)

Site Climatic Condition

Average Temperature and Precipitation

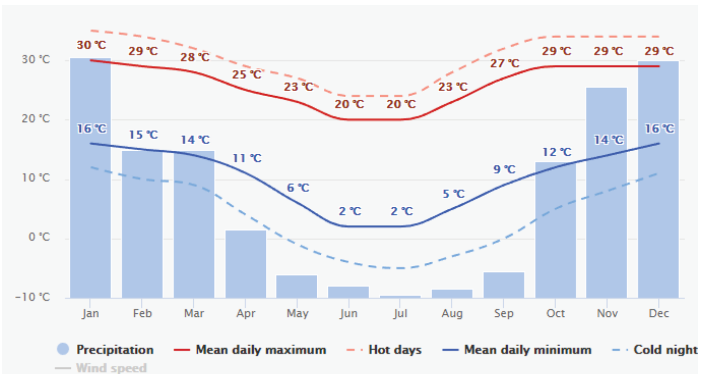


Figure 30. Chart showing temperature and precipitation (Online: https://www.meteoblue.com/en/weather/forecast/modelclimate/pretoria_south-africa_964137, accessed 2018)

Maximum temperatures

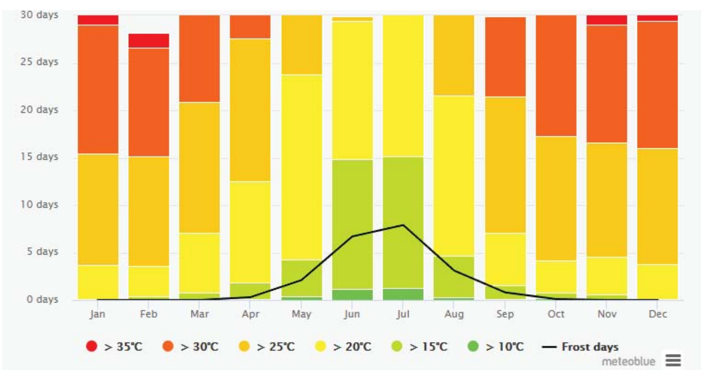


Figure 31. Chart showing temperature. (Online: https://www.meteoblue.com/en/weather/forecast/modelclimate/pretoria_south-africa_964137, accessed 2018)

Precipitation amounts

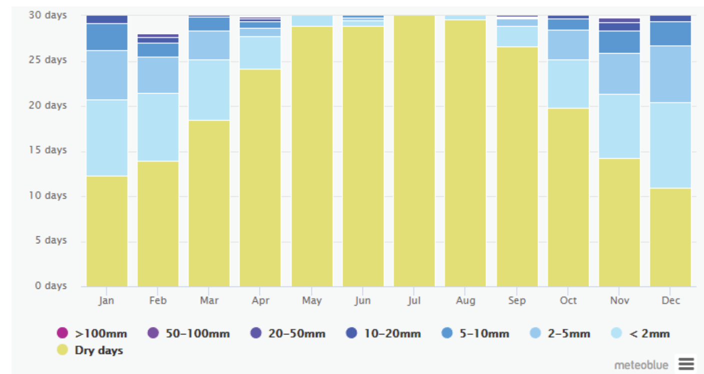


Figure 33. Chart showing precipitation amounts(Online: https://www.meteoblue.com/en/weather/forecast/modelclimate/pretoria_south-africa_964137, accessed 2018)

Wind Rose

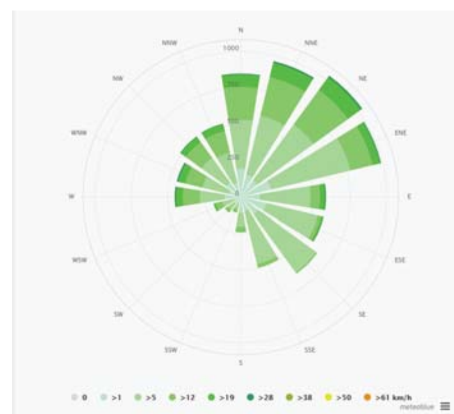


Figure 32. Chart showing Wind speed and direction. (Online: https://www.meteoblue.com/en/weather/forecast/modelclimate/pretoria_south-africa_964137, accessed 2018)

Pretoria is situated at about 1350m above mean sea level. Owing to its high altitude, it has a dry subtropical climate that is characterised by hot rainy summers that persist for long periods compared to winter. Winter periods are dry and relatively cool. Pretoria experiences a drop in temperature in the evening periods. (Pretoria.com, n.d.)


Figure 34. Site Photo showing old machinery in the landscape. (Author, 2018)

Chapter 3 Theory

Introduction

In this section, environmental and heritage theory will be visited and synthesised into a new rehabilitation strategy that is a proponent of heritage conservation and natural remediation. It will seek to effect deep ecological remediation, that addresses the cause of natural degradation, and establish a framework that facilitates symbiotic relationships between humans and nature. The theory discussion will be launched by an appraisal of the worldview in which industry evolved. Ecosystemic thinking will then be discussed, framing the rest of the discussion in which regeneration, biophilia and heritage conservation will be discussed.

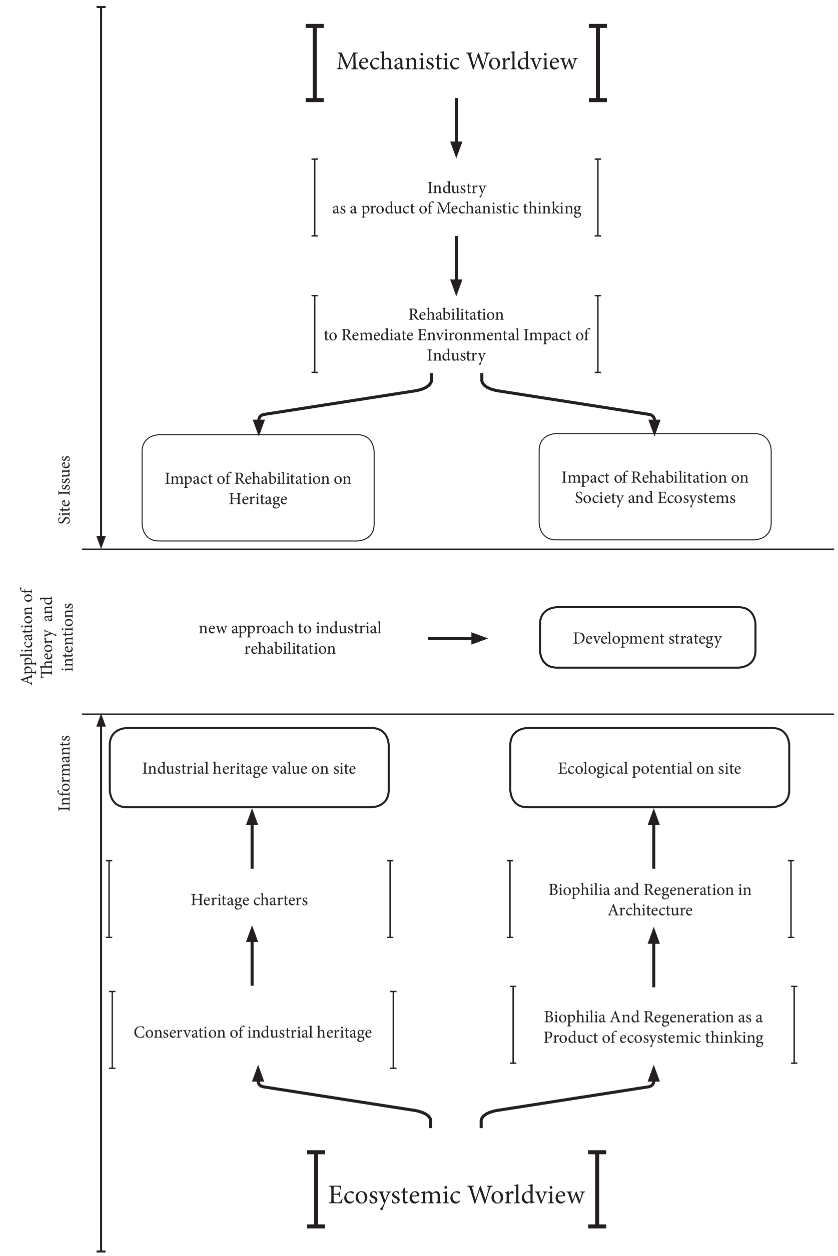


Figure 35. Diagram of the theoretical structure of the chapter. (Author, 2018)

THE WORLDVIEW THAT PERPETUATES NATURAL DEGRADATION

The mechanistic worldview

Industry evolved during a time defined by a mechanistic worldview in which mankind assumed a position of superiority over nature.
The notion of mankind's supremacy on earth dates back to classical times with the emergence of Humanism. Humanism was eloquently summed up by Protagoras who stated that "man is the measure of all things". Propagation of this idea elevated mankind's self-awareness to a sovereign state in which nature could be exploited for human endeavours (Marien and Fleming: 272). Rationalism also gained prevalence during this time, sparking enquiry into the workings of the universe. In this period the dynamic nature of the solar system was confirmed leading to the promulgation of Newtons laws that defined the workings of the universe in mechanical terms (Marien and Fleming, 2005: 412). This mechanistic paradigm resulted in an objective view of nature in which all phenomena could be mathematically calculated. It paved the way for major technological advancement which catalysed the emergence of the industrial revolution. Technological advancement, a shallow understanding of nature and the belief that mankind was superior to nature, made it both permissible and possible to extract and process natural resources at a monolithic scale.

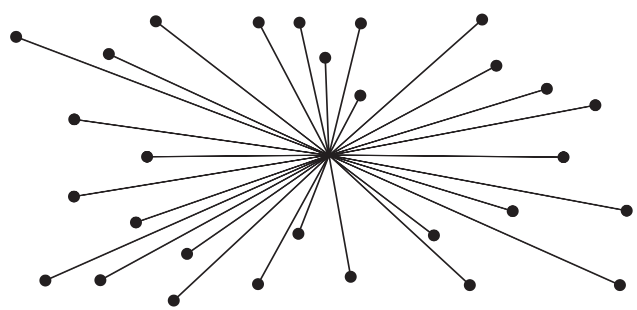


Figure 36. Diagram showing mechanistic thinking pattern. (Author, 2018)

The result of industry within a mechanistic worldview

Schumacher (1973: 14), an economic theoretician, describes how mechanistic thinking has facilitated an economic and political environment that regards natural resources as infinite income to be used for the sustenance of unrestricted development. He describes nature and natural resources as finite capital and expresses the precariousness of unrestricted development and exploitation. The subject of natural exploitation and severed proximity to nature is also discussed by David Orr. Orr (1994: 39) describes how mankind in its modern endeavours systematically lost its reverence for nature and needed to separate itself from nature to attain optimal development. He blames this demise on the propagation of biophobia (the unease caused by untamed nature); a prerequisite for the casual exploitation of nature for capital gain. Mechanistic thinking has resulted in a system of degenerative exploitation that negates the deep impact of human intervention on the ecology. It has set into motion a society bent on perpetual development and has severed mankind's reverence for nature. The evolution of industry within a mechanistic worldview has effected extensive natural degradation evident in numerous brownfield sites globally that are unfit for habitation.
The supply of natural resources essential for industry and life itself has been compromised. Natural sinks have reached their outer capacity to absorb human impacts thus resulting in a precarious ecological state that cannot support human development and longevity (Du Plessis and Hes, 2014: 12). Industry, and its parasitic relationship with the environment, has created a condition that necessitates rehabilitation to intentionally remediate the impact of past natural degradation.

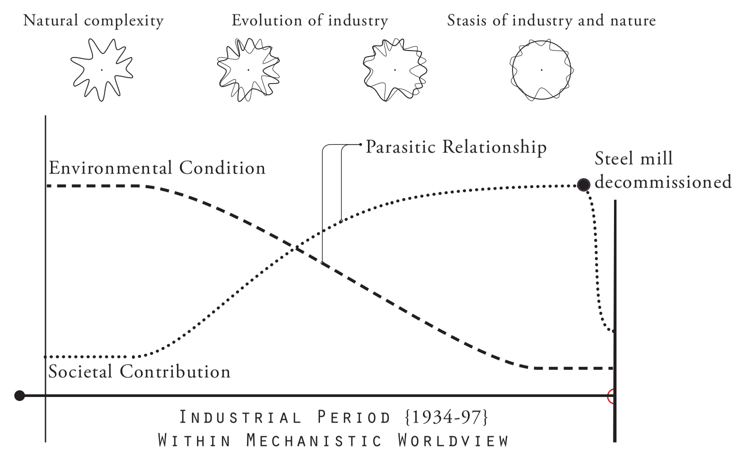


Figure 37. Diagram showing the decline of environmental condition as a result of industry. (Author, 2018)

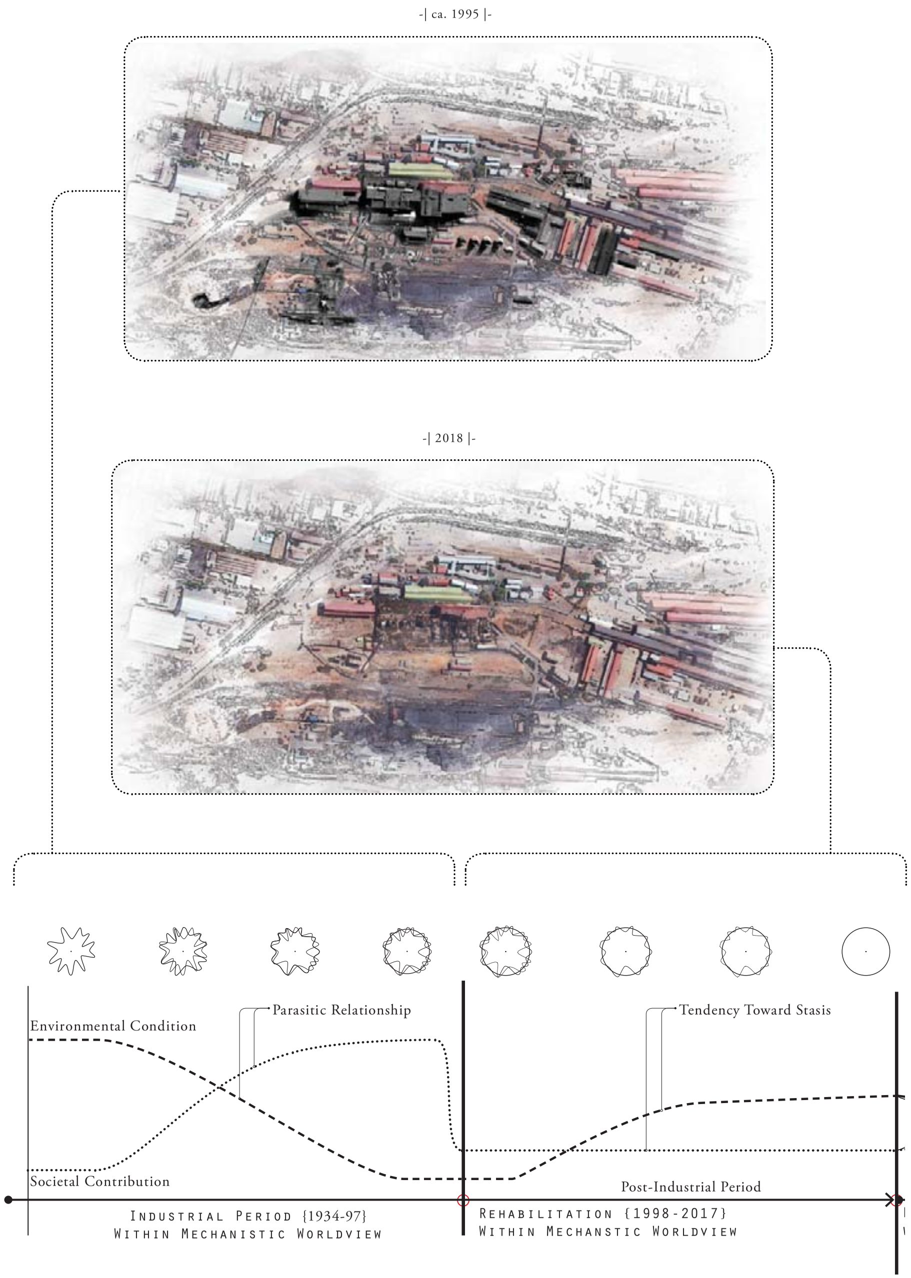


Figure 38. Diagram showing the impact of rehabilitation. (Author, 2018)

ADDRESSING THE AFTERMATH OF MECHANISTIC INDUSTRY

Rehabilitation

Rehabilitation is a post-industrial activity aimed at restoring the environment that was damaged during an industries operation. Rehabilitation is enforced by environmental conservation legislation but is rooted within mechanistic thinking evident in its negation of the deep and wide impact of industry, and its disregard of human artefacts as part of the ecology. Tempel (2012:142) states that post-industrial remediation often aims to erase all traces of past industrial activity thus disregarding industrial heritage that may be present. He regards this approach as “hasty and indefensible”. In general, rehabilitation only addresses the symptoms of natural degradation. Its hasty implementation fails to consider alternative approaches that may facilitate new ecological exchanges that conserve heritage and maintain the productivity of a site. Its implementation effects shallow restoration, ignoring the deep, broader ecological degradation that may have resulted from industry. In this sense, rehabilitation is merely a tool used to cover the footprints of mechanistic manifestations in the landscape.

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Impact of rehabilitation at the Pretoria Metal Works

Rehabilitation at the Pretoria Metal Works has resulted in a major loss of industrial heritage owing to the demolition of decommissioned buildings. It has, however, been successful in remediating parts of the site, but these areas now exist as static voids that are still removed from the greater ecology (figure x). The extent of demolition can be seen in figure X which shows built fabric that existed before the decommissioning of the steel mill and built fabric that exists today. Figure x shows the ongoing rehabilitation on the east of the site where the slag heap is situated. The slag heap has undergone extensive excavation over the past decade. Excavated areas, where the natural ground level has been restored, are barren and void of any ecological exchanges.

Figure 39. Site photo of static voids that are the result of demolition. (Author, 2018)

Figure 40. Site photo showing the degraded nature of the excavated slag heap. (Author, 2018)

ESTABLISHING A NEW APPROACH

The impact of a mechanistic worldview on the landscape is clearly visible at the Pretoria Metal Works. The shortcomings of the current rehabilitation programme make it evident that a new approach to the environment is needed to effect deep restoration of the ecology. Such an approach will need to remediate natural degradation but also establish new relationships between humans and nature to prevent future degradation. This approach will also need to be sensitive to the industrial heritage of the site. To achieve such objectives, an ecosystemic approach must be applied to project the site into a state of symbiosis with its environment.

Ecosystemic thinking

Since the industrial revolution mankind's perception of its place in the natural environment has evolved to a point where an awareness exists of the interdependent existence of all living organisms. This ecosystemic worldview denounces the notion that the biosphere can be understood as a collection of isolated parts and favours an understanding of the ecological gestalt (Capra, 1996: 6). Over the past few decades ecosystemic thinking crystallised into paradigms that recognise the inherent interconnectedness of all phenomena. These paradigms perceive human life as fundamentally embedded in the natural environment and dependent on its cyclical processes. These paradigms elicit a deep understanding of ecology that recognises the far-reaching impacts of societal development on the ecology. An ecosystemic approach to development will inherently handle human artefacts and cultural constructs as part of ecosystems and will act considerately when facilitating the evolution of a living system (du Plessis, 2012: 17) (Reed, 2007: 677). Biophilia, regeneration and heritage conservation theory will now be discussed as theories within ecosystemic thinking.

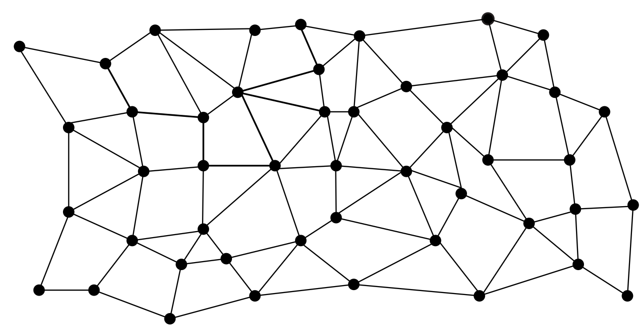


Figure 41. Diagram illustrating ecosystemic thinking pattern. (Author, 2018)

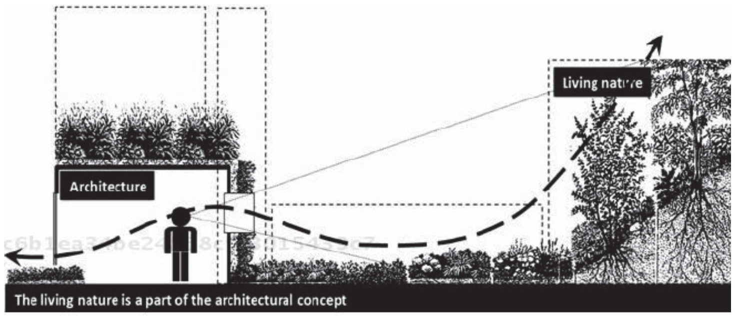


Figure 42. Diagram of biophilia in architecture concept. (Almusaed, 2011)

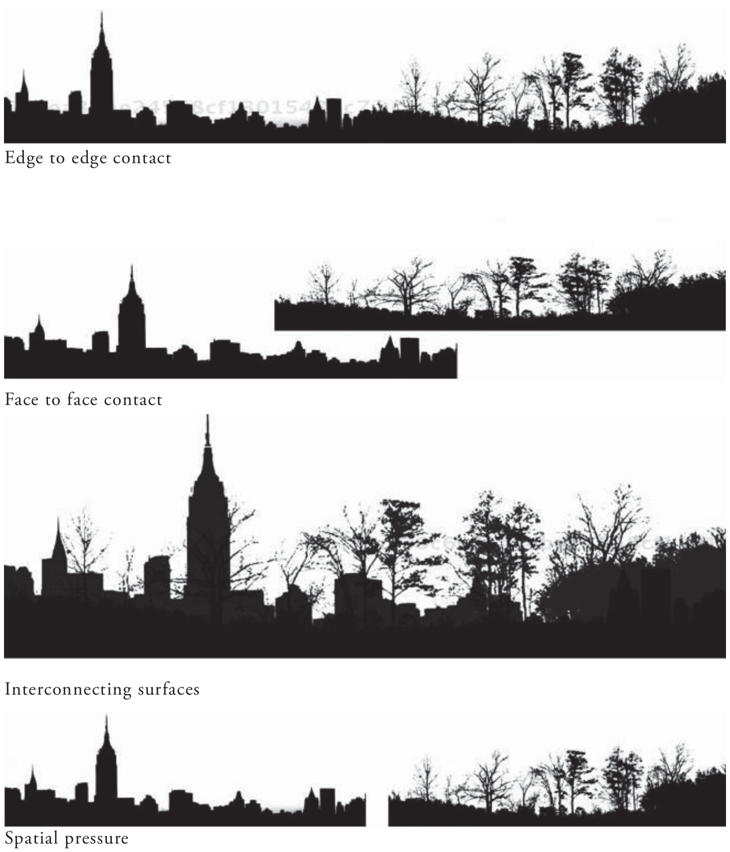


Figure 43. Illustration of ArcelorMittal buildings in their transitory state (Almusaed, 2011)

Biophilia and regeneration

Biophilia

Biophilia in its contemporary understanding is not a new approach to the environment. Orr (1994: 39) states that biophilia is inscribed in the human brain and is evident in people's involuntary attraction to natural landscapes. Kellert (Kellert, 1993: 425) stresses the importance of re-establishing biophilia as a central paradigm in society and reveres it as the only way to save the earth from its fatal demise. Orr (1994: 39) suggests that biophilia can be reinstated if an "ecological enlightenment" were to occur in which people abandon the economic and sensual pursuits of modernity and adopt new ways of living with nature. He stresses the importance of identity of place and accessibility to natural spaces that facilitate interactions between humans and nature. He proposes the restoration of natural history of place and intertwinement of ecology and urban fabric. To address the cause of natural degradation biophilia needs to be instated as a base paradigm which supports the implementation and sustenance of regenerative development.

Biophilia in architecture

Biophilic architecture aims to address the distant proximity between man and architecture by making spaces for interaction with nature more accessible. Its application seeks to create connections that embed humans within the natural environment in which they evolved (Orr, 1994: 38). Kellert (1993: 227) postulates that the deep affiliation humans naturally have toward nature hails from their evolution in the natural environment. Its use as an architectural informant expresses reverence of nature but also has the potential to inspire a greater respect for nature. Biophilic architecture is not just about facilitating proximity to nature but also about celebrating the poetics of nature and eliciting its beauty and power as a life-giving force. This can be achieved through simple spatial articulation like the use of light to create shadow patterns or accentuation of water flow in a fountain.

Kellert (1993: 230) describes the moving through space and the physiological processes that occur parallel to the interaction with physical and nonphysical form. Nature exists in a state of flux and its dynamicity is experienced through movement in natural spaces. One needs to move through nature to experience the changing of light, progression between quiet and sound filled space, a sense of openness and vulnerability as well as intimacy and solace. Almusaed (2011: 40) sets out a framework for biophilic architecture in which nature is celebrated through dynamic interaction with space. Spatial pressure is the first part in the framework and entails shared visual traits between architecture and nature. Architecture can respond to physical traits of nature such as texture or shape. Edge to edge contact addresses the articulation of connections between built forms and nature that express buildings as an extension of nature. Face to face contact relates to conditions where natural spaces are expressed in between built spaces. Finally, interconnecting surfaces relates to the merging of nature and built form where overlaps between natural spaces and built spaces occur.

Principles of biophilic design can facilitate the creation of environments where humans are reconciled with nature. Regeneration provides an operational proximity to nature where biophilia celebrates nature and inspires a renewed reverence for nature.

In this sense the application of biophilia can facilitate a shift in our understanding of nature and foster a transition to an ecosystemic approach to the environment.

Regeneration

Regenerative thinking is a result of the shift from a mechanistic to an ecological worldview (du Plessis, 2012: 7). Regeneration as a design methodology endeavours to embed human processes within a living system that exists as a dynamic network of symbiotic. Regeneration is launched on the premise that humans are embedded within the natural environment and its networks of exchanges. This notion has long been in existence but has found new applications in contemporary society as a way to conserve the environment by establishing mutualistic relationships between humans and nature. Architecture based on principles of regeneration makes use of natural resources within its inner capacity of provision whilst actively contributing to the longevity of its local environment.

Regeneration theory will inform the establishment of symbiotic operational relationships with the environment that remediate degradation and maintain sustainable future development.

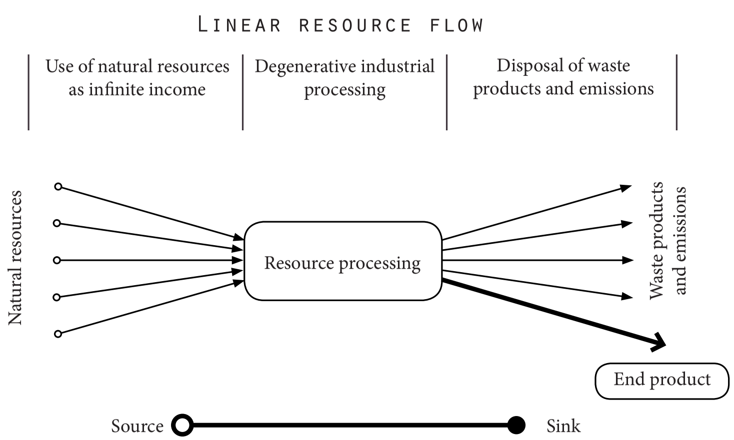


Figure 44. Diagram of the linear resource flow of degenerative industry. (Author, 2018)

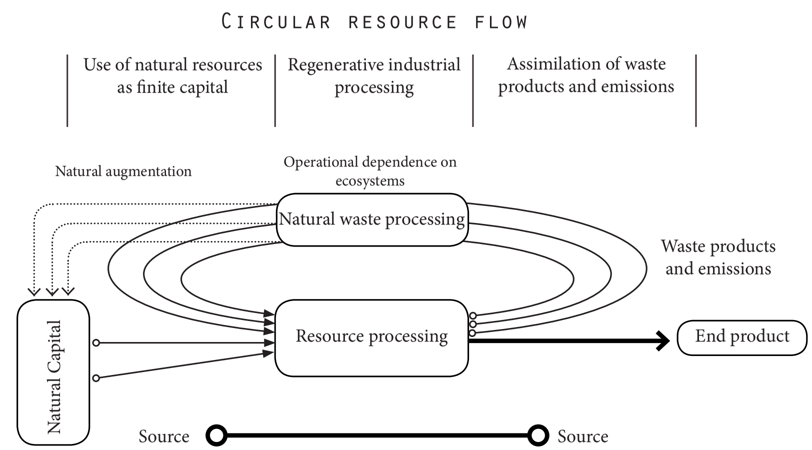


Figure 45. Diagram of the circular resource flow of regenerative industry. (Author, 2018)

Regeneration in architecture

A regenerative designer is described by Mang and Reed (2012: 26) as someone who designs an ecosystem in such a way that human and living systems coalesce to sustains the health of both systems. This design process requires different levels of thinking and intervention to sustain the extant ecosystems while finding possible sources of potential that can be extracted to form new interactions that facilitate coevolution. The intervention process, which is traditionally seen as the last step, is proceeded by operations that maintain existing living systems and the continued regeneration and evolution of new living systems. The regenerative methodology by Mang and Reed describe three tiers that together form regenerative living systems. These are an understanding of place, design harmony and co-evolution of human and living systems (Mang and Reed, 2012: 25).

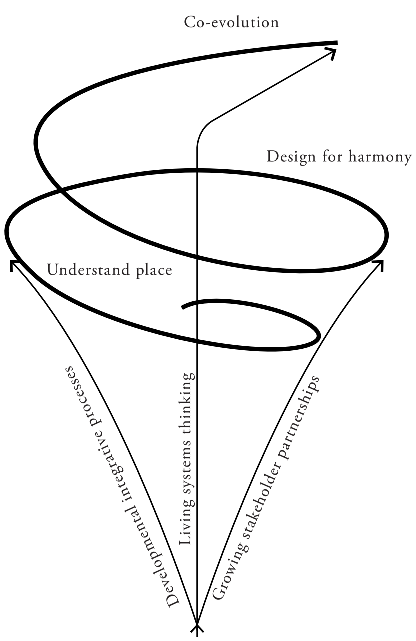


Figure 46. Diagram illustrating the regenerative framework. (Mang and Reed, 2012 adapted by author , 2018)

Place

In the field of regeneration place is understood as more than a mere collection of geographical attributes. Place is defined as a complex network of living systems within the physical environment that express their interactions on the landscape over time (Mang and Reed, 2012: 28). Places have inherent potential for symbiosis as well as existing patterns of living systems that need to be understood to extract potential and establish coevolution.
To understand a place, tools such as living systems thinking and "story of place" are used. Living systems thinking is a way of seeing a place from an ecosystemic perspective to identify areas of potential and possible intervention that will rearrange the systems to unleash symbiotic potential. Story of place sketches a narrative of place and interactions between the biosphere, climate, geological systems as well as humans and their artefacts over time. This tool allows the designer to project patterns of the past into the future and facilitates contextual intervention. (Mang and Reed, 2012: 29).

Harmony

Design that facilitates coevolutionary harmony intertwines living fabric of the land with built fabric in a way that unleashes latent potential. Whilst doing so it also augments ecosystems, unique place traits and the built environment. Haggard (2002: 28) proposes that regenerative design can achieve such harmony by addressing the core that organises the dynamics of place.
This requires interventions that are approach driven as opposed to being technologically driven (as in the case of green buildings). He summarizes the principles of regenerative design as, amongst others, the application of knowledge gained from nature, implementation of design to extract "free energy" on site and finding points where nature will benefit from development (Haggard, 2002: 29).
These principles are reduced into practical applications by Lyle (1994: 38). He proposes the design of building systems that use natures capacity to clean water, process waste, convert energy and cycle nutrients to facilitate building efficiency and environmental augmentation.

Coevolution

Regenerative design methodology can be applied in the field of rehabilitation to facilitate conditions for coevolution between humans and the natural environment. These principles can be applied to tap into extant living systems and facilitate new living systems that restore ecological complexity and remediate natural degradation.

Application of regeneration and biophilia

The theories discussed above will be implemented in the development of a new rehabilitation strategy. Biophilia will be implemented as an approach that addresses the mechanistic worldview and will act to inspire a renewed reverence for nature. Regeneration will be implemented as an approach that will facilitate the remediation of the site and establish new mutualistic relationships that will maintain sustainable future development.

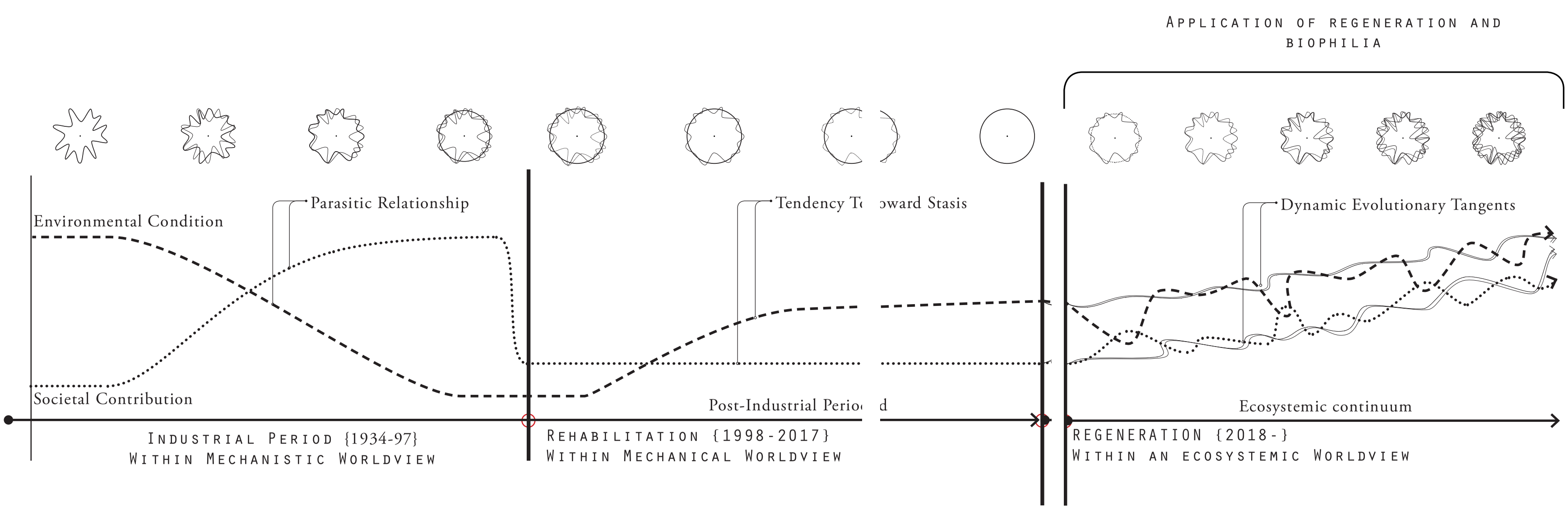


Figure 47. Diagram showing the application of biophilia and regeneration in response to site issues. (Author, 2018)

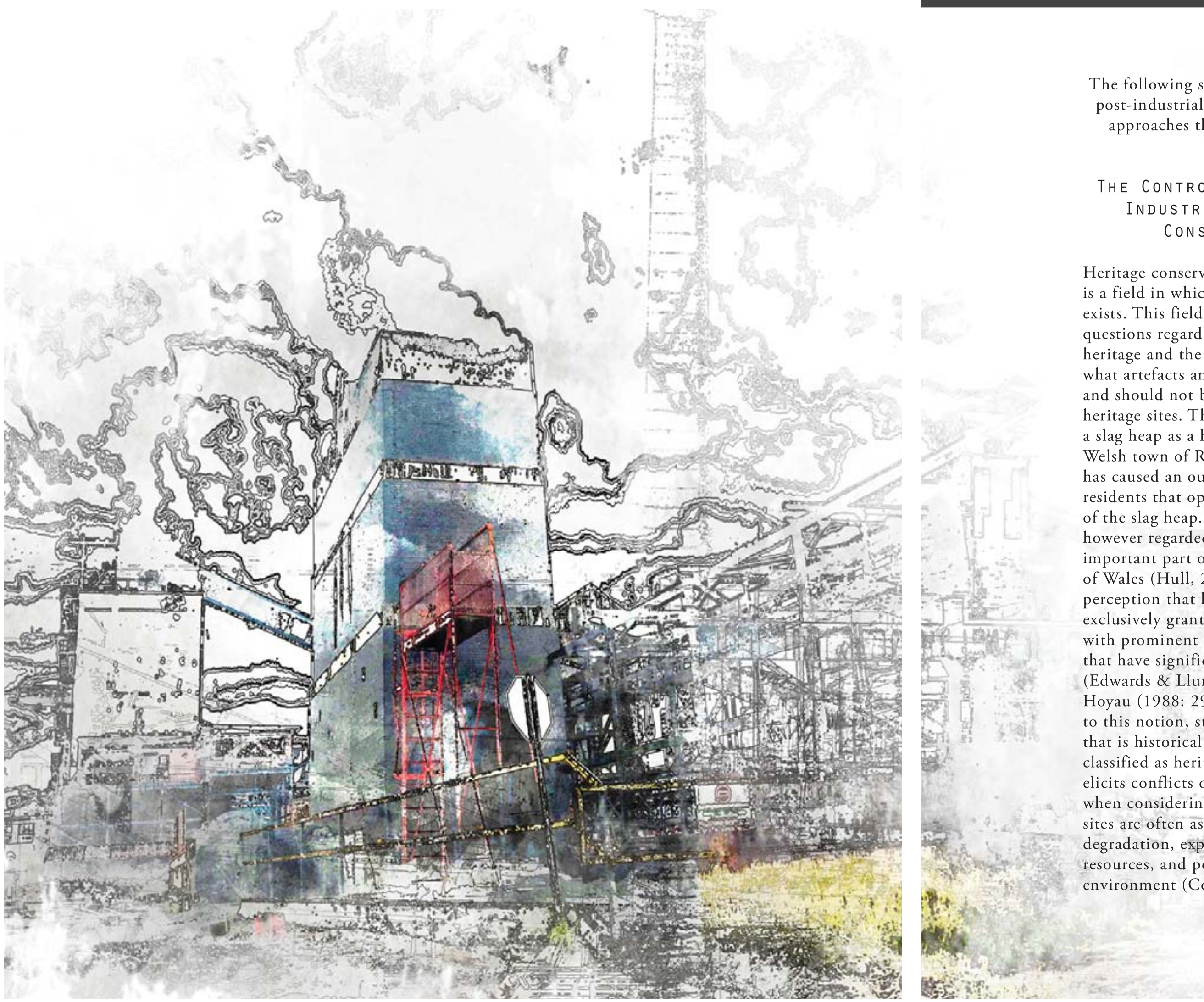


Figure 48. Conceptual illustration of the narratives embedded in site buildings. (Author, 2018)

THE VALUE OF POST-INDUSTRIAL SITES

The following section will be launched with a discussion of the heritage value of post-industrial sites. This will be followed by a review of heritage conservation approaches that will inform a strategy to conserve industrial heritage at the Pretoria Metal Works site.

The Controversy Of Post-Industrial Heritage Conservation

Heritage conservation and preservation is a field in which much controversy exists. This field raises contentious questions regarding the classification of heritage and the process of determining what artefacts and landscapes should and should not be considered as heritage sites. The classification of a slag heap as a heritage site in the Welsh town of Rhostyllen in 2008 has caused an outrage amongst local residents that opted for the excavation of the slag heap. Heritage authorities however regarded the mound as an important part of the industrial history of Wales (Hull, 2008). It is a general perception that heritage significance is exclusively granted to places associated with prominent historical events or that have significant aesthetic value (Edwards & Llurdes i Coit, 1996). Hoyau (1988: 29-30), in response to this notion, states that anything that is historical evidence can be classified as heritage. Hoyau's notion elicits conflicts of interest especially when considering that industrial sites are often associated with natural degradation, exploitation of natural resources, and pollution of the greater environment (Cole, 2010: 480).

The value of post-industrial sites

Walter Benjamin, as quoted by Tempel (2012: 142) states that "Landscapes give us an informative impression about the economic and technical development of a particular society; they are, in fact, more informative as they give us a comprehensive, detailed and precise account of the state of the environment in a far better way than any museum could possibly do." This understanding of altered landscapes recognises the positive value of post-industrial landforms as evidence of social and economic constructs of a society. The destructive legacy of industrial sites, that elicit negative associations, are themselves reminders of the impact of human intervention on the landscape. These sites evoke opportunities for reflection upon the degradation of the environment and socio-economic changes in society (Tempel, 2012: 142). In this regard, post-industrial sites have the potential to become agents of a societal shift toward ecosystemic development by demonstrating the outcome of the current tangent of development.
The Nizhny Tagil Charter For The Industrial Heritage (TICCIH, 2003) also stresses the importance of post-industrial heritage conservation.
It states that Industrial heritage

contributes not only to the physical but also to the social characteristics of a place. Its value resides in its existence as evidence of past processes that contributed vastly to the development of society. Industrial structures also exist as a record of the lives of working-class people who contributed to the societal development. Many of the industrial typologies and processes expressed in the landscape contribute to an environment's unique sense of place and give a sense of a place's evolution (TICCIH, 2003). The conservation of post-industrial heritage, though controversial from a traditional point of view, is evidently very important.

Heritage charters

Regeneration in its deep understanding of place and acknowledgement of human artefacts, as part of the ecology of a place, necessitates the conservation of extant heritage. The Nizhny Tagil Charter For The Industrial Heritage (TICCIH, 2003) outlines an approach for the conservation of industrial heritage. It regards the functional integrity of heritage structures as the driver for conservation and thus states that an industrial heritage site should maintain functionality. However, new uses must respect built-fabric and maintain the character of place in terms of circulation and activity and new uses should, as far as possible, be compatible with existing spaces.
This approach allows evolution to take place and, if applied with principles of regeneration, may facilitate the transformation of existing building into agents of rehabilitation instead of them being demolished for the sake of rehabilitation.

Heritage Value Of The Pretoria Metal Works

Considering the discussion of heritage value, it is clear that the heritage value of post-industrial sites resides in their existence as evidence of past social, economic, and technical constructs and are representative of human's interaction with the landscape. They also provide insight into the worldviews and paradigms that inform the way humans alter the physical environment. The heritage value of the Pretoria Metal works will thus by analysed from a wholistic perspective, viewing the entire site as a landscape that was altered to suit the functioning of steel production. Buildings and landscape will be regarded as parts of a larger system, informed by social, economic, and technological development within a mechanistic worldview.

The Pretoria Metal Works, in its evolution over the past century, has made a significant mark on the landscape. Its evolution witnessed the departure of the union government, the establishment of the Republic of South Africa and the change from the Apartheid state to a democratic and inclusive state. The changes in the South African and Pretoria social, political, and economic environment influenced the building of this industrial artefact and is inextricably intertwined with the landscape. This industrial landscape contains both tangible heritage, that is expressed overtly, and intangible heritage that is implicitly embedded within the tangible fabric.

Tangible Heritage
A part of society's evolution that is expressed in the landscape is the technological evolution of the era. Since its initial construction as a steel mill, it has undergone several expansions and conversions to stay up to date with global technological trends. The technological continuum is expressed in a palimpsest of structures resulting from the continuing layering of new buildings and industrial fabric. The layering of built fabric includes architecture, ranging from pre-modern to post modern times, expressing the presence of man on the site over a period defined by unprecedented changes in architecture.

Intangible Heritage
The degradation of the natural landscape reveals a narrative about man's mechanistic worldview and how the landscape has changed, as a result of this, over time. The idea that humankind is apart from and dominant over nature is clearly expressed in the way manmade structures were streamlined for efficiency of exploitation. The wasteful process of steel-making is manifested in the layout of the site. The primary production functions, where natural resources are processed, reside toward the west of the site. Secondary production functions are located towards the middle and the enormous dumping site towards the east of the site. The process is unapologetically expressed in the long industrial buildings that dislocate the north and south parts of the site.
The site is also representative of the

political climate in which it evolved. The establishment of the steel mill was the result of plans to provide employment for the white population of South Africa. This renders its very existence as the result of the political climate. The areas around the site were developed into neighbourhoods to house workers of the mill. The housing for white workers was closer to the city and far superior to the boarding compounds erected to accommodate black workers. The presence of the steel mill, in this regard, impacted the development of segregated neighbourhoods. Also indicative of the apartheid era was the innovation of technology that was implemented to offset resource shortages that resulted from sanctions imposed against South Africa. The Pretoria steel mill was the first in the world to implement the Corex process of steel production that required significantly less coking coal, which was in short supply and necessary for the operations at Sasol.

The Pretoria steel mill, being the first in the country, catalysed industry with the provision of steel that was vital for the building industry as well as other heavy and light industries. Up until the late 90's the steel industry contributed significantly to the economy, offering employment to tens of thousands of South Africans. The decline of the steel industry in South Africa is reflected in the largely abandoned and static state of the site.

In general, the physical heritage fabric in the landscape is significant in its reflection of the evolution of Pretoria and South Africa. It is, however, the gestalt of the landscape and what it represents that is most significant. Embedded in the landscape is the story of man and its interaction with the environment over the last century. It is important that the physical fabric of the site is conserved when one considers the intertwined nature of memory and place. It is important that these narratives are accessible to current and future generations as it facilitates an objective understanding of the continuum of humankind's evolution in place. Most important is the opportunity for people to learn from the mistakes and successes of previous generations.

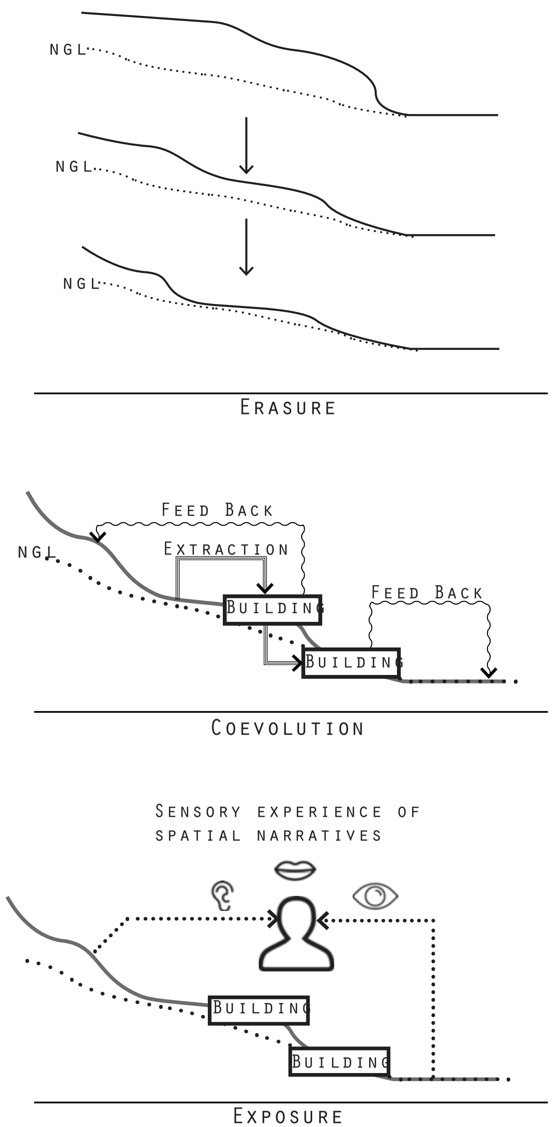


Figure 49. Diagram illustrating the new rehabilitation strategy. (Author, 2018)

New Strategy for Rehabilitation

In the following section, a new strategy for the rehabilitation of the Pretoria Metal Works will be developed. The theory discussed will be implemented into an approach that conserves and exposes the heritage of the site whilst remediating natural degradation and establishing conditions for sustainable development. The strategy involves the application of three processes namely: erasure, coevolution, and exposure.

Erasure

This part of the strategy is related to the undoing of ecological degradation and removal of site elements that may inhibit the restoration of ecological complexity. This process, unlike the current rehabilitation programme, will seek to conserve built fabric on site and recalibrate their impact on the environment so that they become agents of symbiosis embedded within the local living systems. Erasure is aimed at forming a foundation for coevolution to take root and will be actioned through programmes that extract contaminants and facilitate the emergence of biodiversity.

On site, erasure will be implemented to address the contamination caused by the slag heap and the urban dislocation caused by the long buildings toward the middle of the site. New architectural devices will also be implemented that aid the assimilation of waste and cleaning of water.

Coevolution

Coevolution deals with new regenerative relationships established between place and the living systems that it hosts. Programmes related to coevolution will make use of the landscape for the benefit of humans and nature alike. These programmes will follow the regenerative guidelines, set out by Mang and Reed, to be embedded in the local network of living systems. They will also aim to facilitate an increase in ecological complexity. Coevolution will include productive programmes that rely on symbiotic transactions with its place and natural environment.

On site, coevolution will be applied through the recalibration of existing buildings and construction of new buildings. Technologies will be implemented that facilitate closed loop resource flows between buildings and their new functions.

Exposure

Exposure deals with the articulation of the ‘story of place’. It aims to facilitate architecture that exposes the implicit narratives of the site to create an awareness of the evolution of the place and the industrial processes that are expressed in the landscape. It seeks to do this in a way that educates the public by exhibiting the impact of mechanistic and ecosystemic thinking on the landscape. The effects of these worldviews are contrasted to show the detrimental impact of mechanistic thinking and the prolific impact of ecosystemic thinking. The symbiotic exchanges between the architecture and nature will be articulated to create an awareness of humankind’s part in nature. This will be applied through the insertion of new interventions that expose the heritage value of place. These interventions will aim to create an experiential interface that facilitates public engagement with place.

Figure 50. Site photo showing ground condition of the slag heap. (Author, 2018)

Chapter 4 Urban and Site Vision

Urban framework proposal

The urban framework proposal will respond to the rehabilitation strategy set out in the previous chapter by addressing the urban issues that have been identified. The aim of the urban framework is to integrate the urban fabric of the site to that of the greater region. It also aims to effect greater resilience to ensure a multiplicity of interactions that will activate static voids and maintain site productivity. Interventions will be calibrated to participate actively in the rehabilitation process. Once rehabilitation is achieved, the urban condition will maintain regenerative operations that facilitate positive ecological evolution.

Urban Rehabilitation Strategy

Erasure

Erasure will address the contamination caused by the slag heap and the urban dislocation caused by the secondary production building that create a barrier between the external and internal urban condition.

The slag heap

The slag heap, though considered as a heritage landform, will need to be extensively excavated as it poses a major contamination threat to the environment. It is, however, of great importance that its significance as a manifestation of a mechanistic worldview be retained. Parts of the slag heap will, therefore, be retained that preserve the memory of its existence and will be supplemented by interventions that describe the processes that effected its existence. These parts will be stabilised to prevent water contamination by the propagation of phytoremediation plant species that extract metallic oxides from the slag. Parts of the retained slag heap will be capped selectively with clay soil that prevents water seepage through the slag into subterranean water systems. This process will maintain the heritage value of the slag heap but also neutralise its threat to the environment. The slag that is excavated will be used as a raw material in the production of ceramic products such as bricks, tiles, and houseware.

Secondary production buildings

The secondary production buildings, where steel is processed into steel products, are problematic due to their massive scale and length across the site. They will need to be adapted into smaller parts that allow for a greater diversity of programmes and north-south access to the site. These buildings will be segmented in a way that accommodates circulation routes and the insertion of a variety of smaller scale producers that are necessary to create a more resilient urban condition. The portal structure production typology, however, will be intentionally retained and the memory of the longitudinal nature of the buildings will be celebrated through new interventions that reference this past condition.

Current urban condition of site

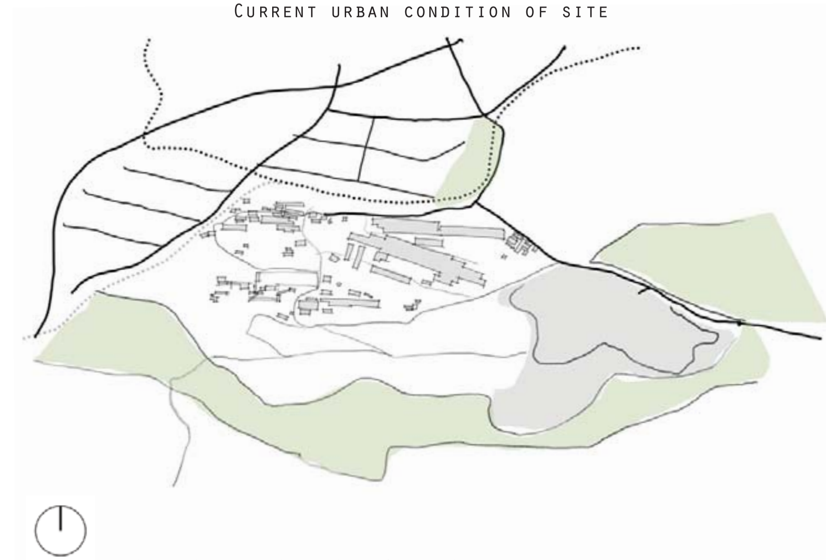


Figure 52. Diagram showing the current urban condition of site. (Author, 2018)

Parts of existing buildings to be demolished to facilitate natural extension and accessibility

Figure 51. Diagram showing area of secondary production buildings to be demolished to create new connections to the surrounding urban condition (Author, 2018)

Coevolution

Coevolution will be implemented through the inclusion of new programmes on site. These programmes will be operationally embedded in the ecological exchanges of the site. Buildings will interact with the living systems of the ecology, extracting potential whilst feeding the ecology. This will entail the establishment of closed loop systems used for the production of energy, water collection and purification and waste assimilation. This process will aim to create buildings that use environmental energy for their functioning but also release rehabilitative energy that facilitate a restoration of ecological complexity. The following programmes will be implemented in the urban framework and will all seek to achieve the above objectives:

Urban programs

The urban framework is envisioned as a mixed-use productive precinct that includes industrial, commercial, educational, recreational, and residential programmes.

Industrial Buildings

Existing industrial buildings will be altered to suit the greater objectives of the urban framework. If buildings are unsuitable for continued industrial operation, they will be re-used adaptively in a way that references them as manifestations of past social, economic and technical constructs. Buildings that maintain industrial productivity will also be articulated to express their existence as cultural artefacts.

Commercial Buildings

New commercial buildings are proposed that facilitate an onsite production to consumption loop. The inclusion of primary, secondary and tertiary production will extract maximum economic value from industrial processes and will facilitate the inclusion of public consumers on site.

Educational Buildings

Educational functions will be included in the form of vocational and artisanal training centres. This proximity between industry and education will facilitate in-house training and aims to create skills that will maintain the regenerative operation of the site.

Recreational Facilities

The inclusion of recreational facilities aims to create an environment in which the public can engage experientially with the site, its landscape, and its sense of place. This will create opportunities for the sensory communication of the site's heritage value and facilitate proximity with the natural landscape.

Residential Buildings

The inclusion of residential buildings on site aims to create an urban condition that is activated for the full duration of a day. Such a condition will complement other programmes on site, avoiding the dormant evening condition of the site in its current state. This condition will also alleviate the strain that pendulum migration places on transportation systems.

New circulation routes to increase accessibility and facilitate programmatic diversity

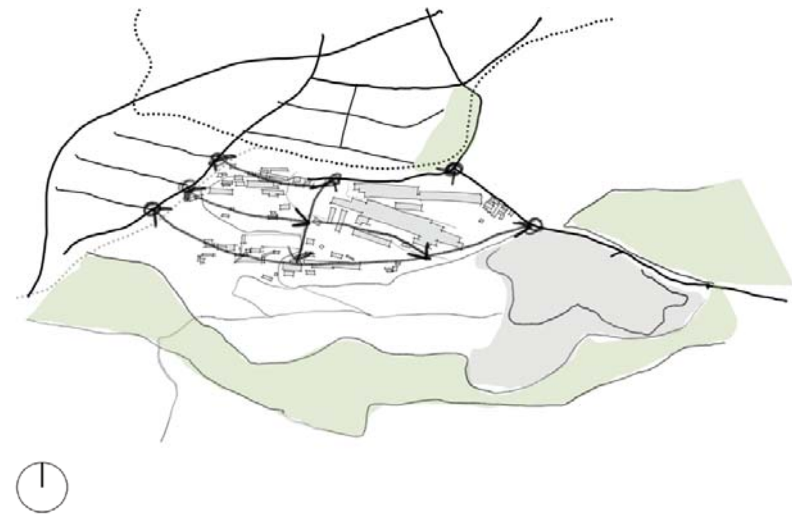


Figure 54. Diagrams showing new circulation routes to facilitate the implementation of a diversity of new programmes (Author, 2018)

Extension of landscape through site to facilitate symbiosis

Figure 53. Diagram showing the extension of nature through the site to re-establish ecological complexity (Author, 2018)

Exposure

The exposure part of the strategy will be implemented to expose the mechanistic and ecosystemic narratives of the site. The mechanistic heritage and narratives of the site will be exhibited along the production process axis that is projected on to the site. An awareness of this past process will be created through the implementation of circulation routes that follow the axis of past production. Small scale urban innovations such as bus stops, street lighting and furniture will also change along the production axis, alluding conceptually to the past processes and worldview embedded in the site.

The ecosystemic worldview that informs the new development of the site will also be exposed by celebrating the parts of the building that interact with the living systems of the site. The technology that supports regeneration and coevolution will be exposed to reveal symbiotic interactions. Connections to the historic fabric of the site will also be emphasised to create an awareness of the old built fabric in contrast to new built fabric.

New urban nodes that engage with heritage and expose heritage value and narratives

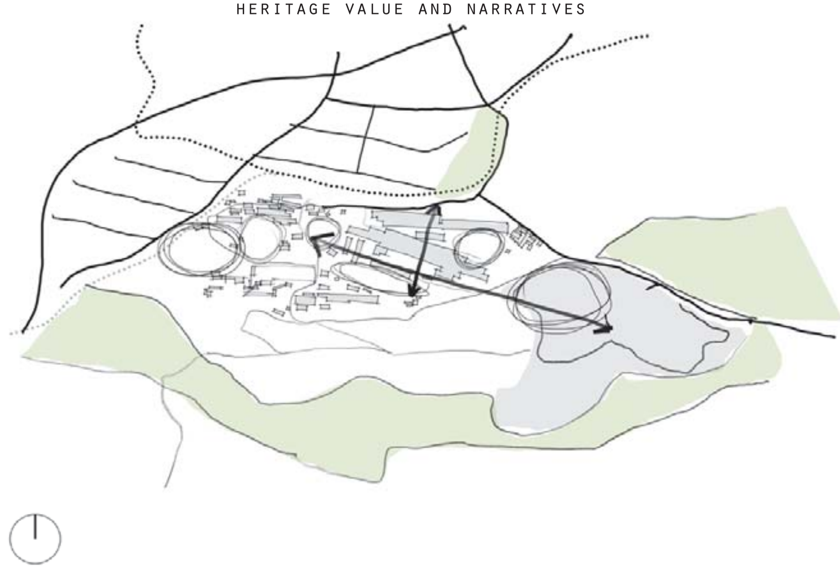


Figure 55. Diagram showing new development to occur in urban voids that will engage with the site heritage and expose heritage value (Author, 2018)

Site In Its Current State

Figure 56. Model of site in its current condition. (Author, 2018)

Extension of nature through site

Figure 57. Model of site showing nature extended through demolished gaps of the secondary industrial buildings. (Author, 2018)

New road network to facilitate accessibility

Figure 58. Model showing new road network implemented on site to facilitate accessibility. (Author, 2018)

New built fabric that engages with site heritage and house diverse programmes

Figure 59. Model showing new additions to the built fabric on site that will house a diversity of new programmes (Author, 2018)

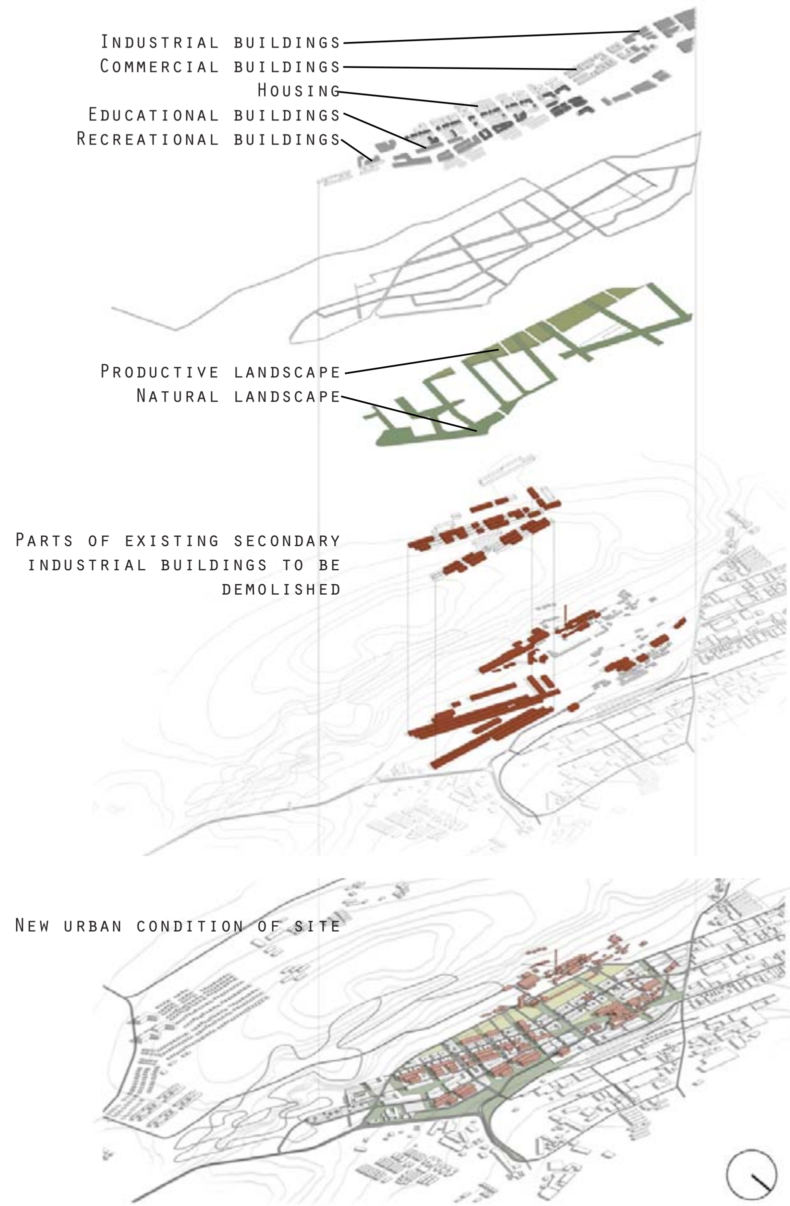


Figure 60. Layered model showing all the new additions to the site. (Author, 2018)

Urban framework site plan

Figure 61. Diagram showing urban framework. (Author, 2018)

Precedent study

Landscape park Duisburg-Nord

Figure 62. Photo showing Overgrown industrial structures and remediated river (online: /www.urbangreenbluegrids.com/projects/landscape-park-duisburg-nord/. accessed 2018)

Figure 63. Photo showing cistern used as wetlands (online: /www.urbangreenbluegrids.com/projects/landscape-park-duisburg-nord/. accessed 2018)

Figure 64. Photo showing ndustrial buildings in landscape (online: /www.urbangreenbluegrids.com/projects/landscape-park-duisburg-nord/. accessed 2018)

The Duisburg-Nord Landscape park was developed during the 1990's as part of the 'Internationale Bauausstellung Emscherpark', that sought to reinvigorate the ecology, economy and social condition of the post-industrial region. It is located on a site that previously functioned as an iron smelter. The site now functions as a recreational park with an array of densely populated plant species that were propagated on the site. Industrial structures were retained and form a key part of the sites identity. Water collection and purification systems form an important part of the project and is exposed in the public realm to facilitate public engagement with the system.
A similar approach can be implemented at the Pretoria Metal Works to effect rehabilitation and allows for public engagement with the heritage of the site. (urbangreenbluegrids, n.d)

Site precinct vision

The following section describes the intentions for the focus area of this dissertation which is the slag heap. The precinct will be situated on the eastern edge of the urban framework where the slag heap meets the urban fabric. The precinct will be approached as an interface between the urban condition and the rehabilitated natural condition. The precinct will include industrial, educational, recreational and housing programmes, that will engage with the heritage of the slag heap. The programmes will also act synergistically with each other to form looped systems. The precinct vision will also respond to the rehabilitation strategy outlined in chapter 3 and will be implemented incrementally to facilitate an emergent and evolving architecture.

The precinct is situated as one of many urban parcels that together form the urban framework. It is envisaged as a commercial, educational, and recreational platform that creates an interface between industry, nature, the heritage of the site and the public. A medium to small scale, production economy is proposed for the precinct in which products are manufactured and sold directly to the public. This will include the manufacturing of ceramic products made from slag and agricultural produce that taps into the proposed water collection system on site. The skills required for industry are cultivated on site and accommodated with the establishment of artisanal training facilities. The proposed recreation park is envisioned as an experiential interface that facilitates engagement with the landscape and production processes. It will include cycling and jogging trails that traverse the slag heap and rehabilitated natural spaces. Also included are spaces for consumption of agricultural produce and other consumables. Circulation routes that facilitate a phenomenological experience of the site's heritage will connect the different spaces of the precinct. Housing is also provided for students and people whom work on site and in the city.

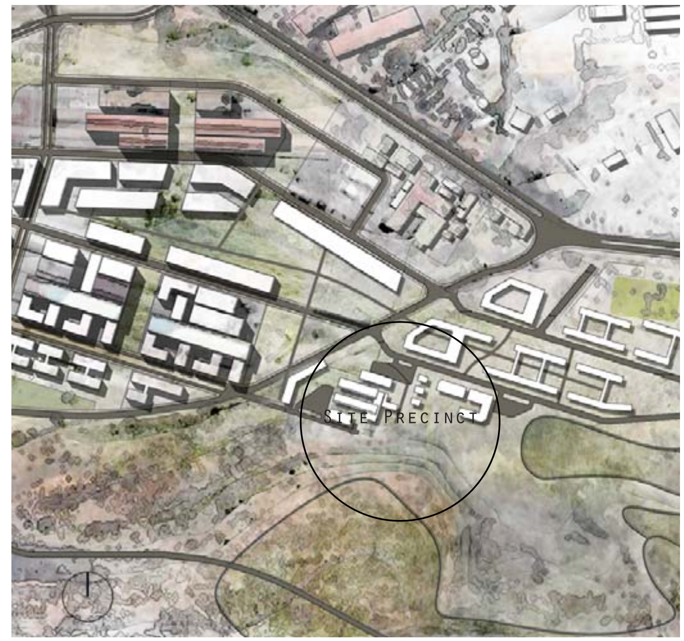


Figure 65. Diagram showing site precinct locality. (Author, 2018)

Concept

The precinct will be arranged along the industrial axis of the past steel-making process and a "nature" axis that intersects it perpendicularly. These axes are representative of the old, mechanistic narrative expressed on site and the new, ecosystemic narrative that addresses the impact of the old narrative.

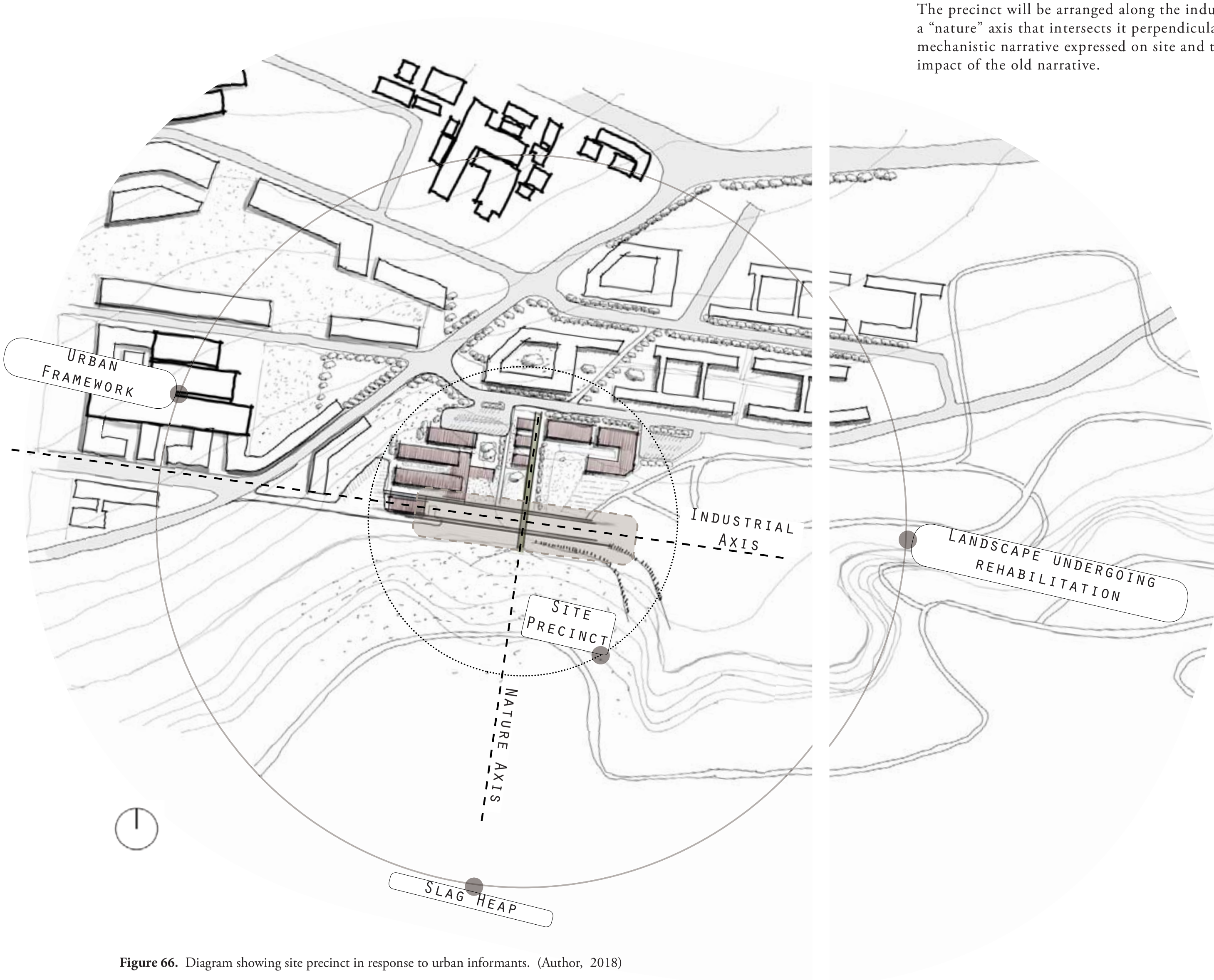


Figure 66. Diagram showing site precinct in response to urban informants. (Author, 2018)

Arrangement of spaces

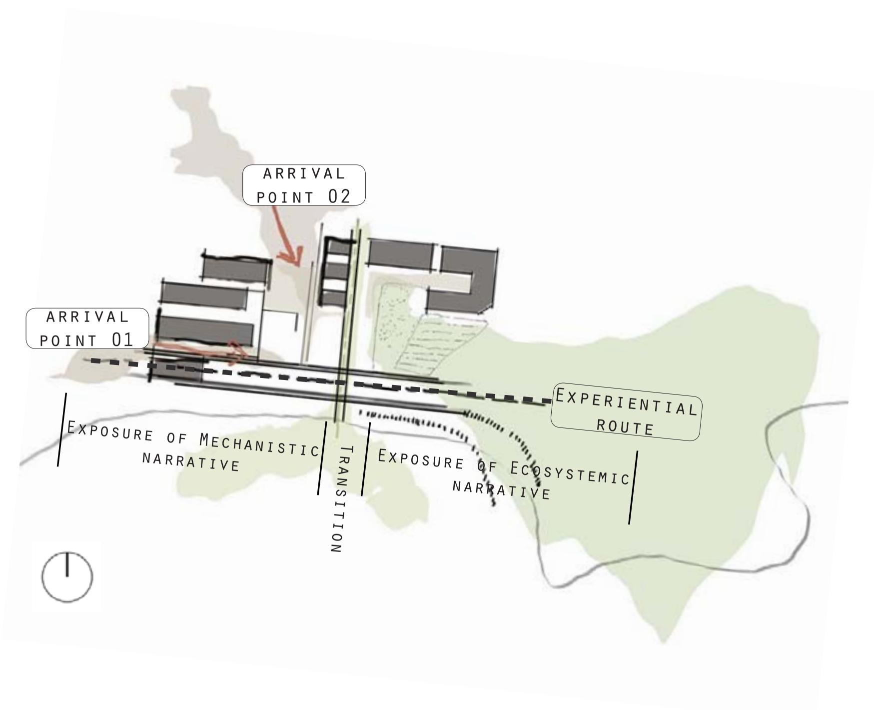


Figure 67. Diagram showing expression of narratives on site and spatial arragement. (Author, 2018)

Site Programmes

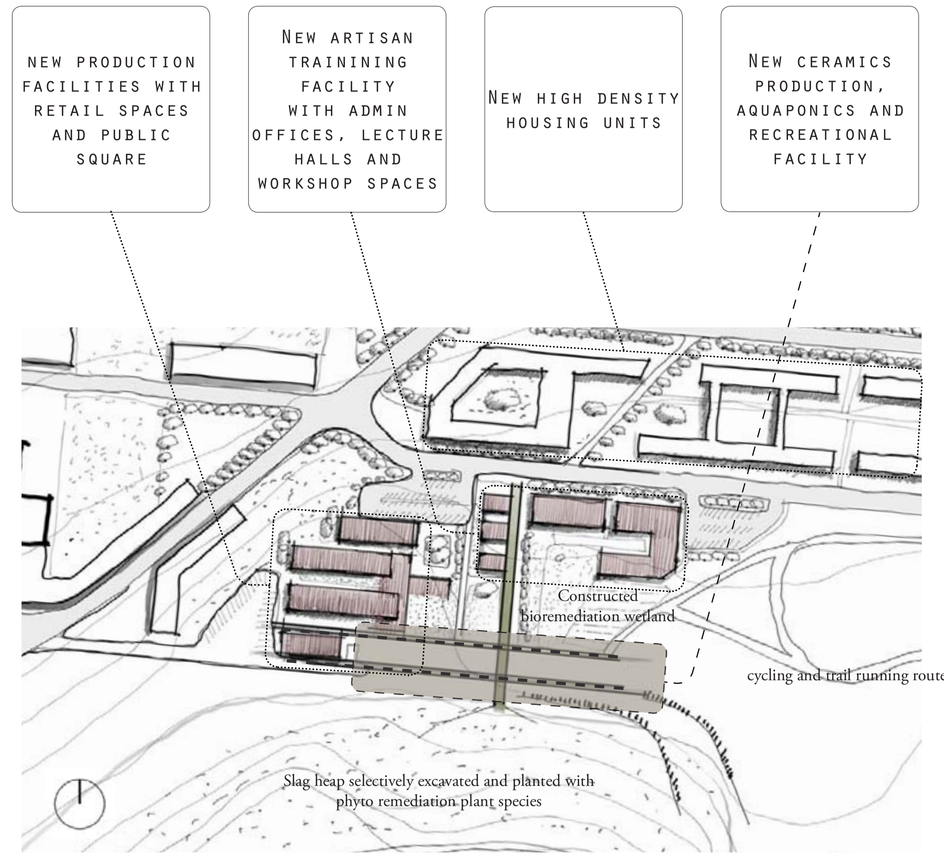


Figure 68. Diagram showing site precinct programmes. (Author, 2018)

Figure 69. Site photo showing the appearance of steel slag. (Author, 2018)

Chapter 5 Program

Figure 70. Illustration of ArcelorMittal buildings in their transitory state (Author, 2018)

Programmatic informants

Steel Slag

Steel slag heaps are found across the world in areas where steel is manufactured. Large volumes of steel slag are produced per unit of steel which results in the formation of massive steel slag heaps. The massive scale of these heaps, together with the fact that they are visually displeasing and an environmental contaminant, has made them largely problematic. Investigations into the use of slag as a resource for production have been done and several uses have been found. The porous and robust nature of steel slag makes it ideal for use as aggregate for concrete products. It has also been found to be an appropriate material for the production of ceramic and glass products (Nell,1970: 368).

Steel Slag as Resource

To date, the slag heap on site has been excavated and processed into aggregate. This process, though effective in restoring the natural ground level, does not extract the full economic potential of steel slag. Potential exists for the primary, secondary, and tertiary processing of steel slag. The manufacturing of slag bricks and slag ceramics extracts the full economic potential of the slag and provides the opportunity for employment and skills development.

Slag heap as sports and recreational park

The slag heap at the Pretoria Steel Works is located on the periphery of the city and is proximate to the Voortrekker Monument, Groenkloof Nature Reserve and Fort Klapperkop. These places are used on a daily basis for sports and recreational activities such as trail running, mountain and road cycling, and trail walking. The slag heap's sloped terrain, proximity to nature and vast views of the city also makes it ideal to function as a place of sports and recreation that offers an escape from the city.

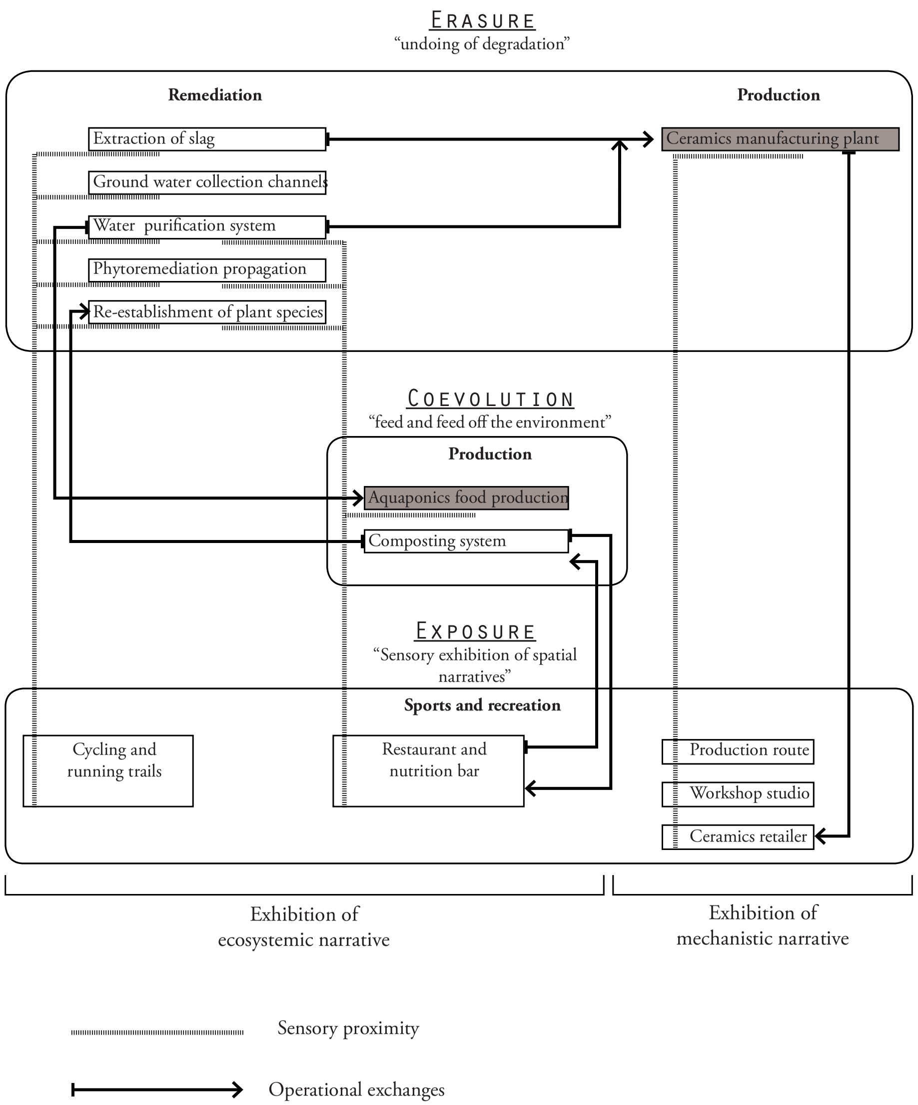
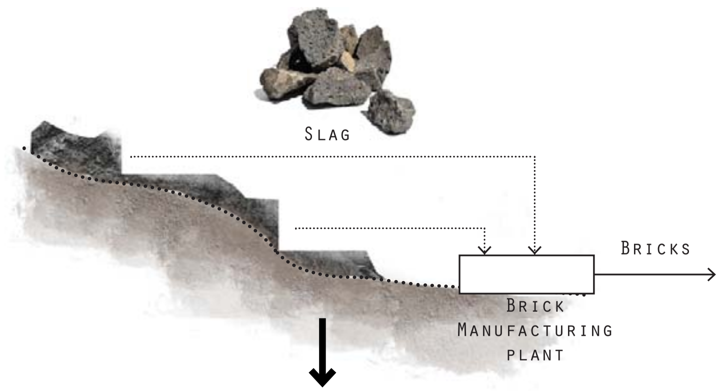


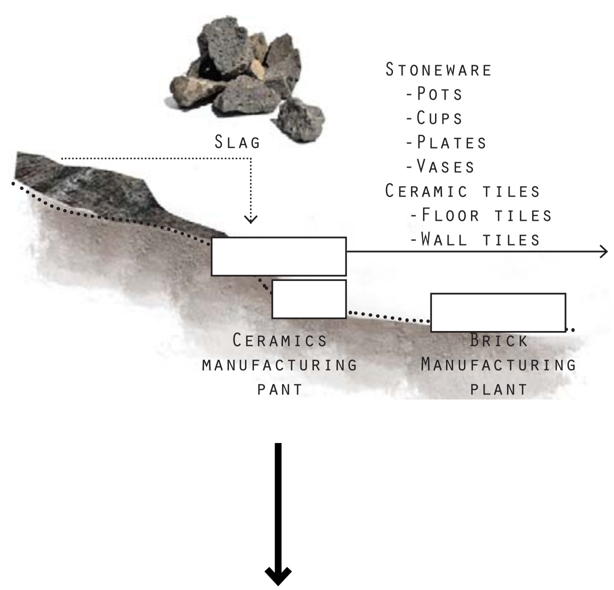
Figure 71. Diagram showing the relationships between programmes. (Author, 2018)

PROGRAMS

The proposed building will host a slag ceramic manufacturer, an aquaponics food producer and a sports and recreational hub. The ceramic manufacturer will produce ceramic articles using slag that is excavated from site as part of the rehabilitation program. These articles will be sold by a retailer on site. The sports and recreational hub provides a spaces for interaction with the landscape and will include cycling and trail running routes that extend into the slag heap (that is undergoing rehabilitation). Facilities such as change rooms and showers that accommodate athletes will be provided. It will also include a restaurant and nourishment bar where the produce from the aquaponics system can be consumed.

The proposed programmes will form circular resource flow loops that in which waste and by-products are used productively and for the augmentation of the environment.





Brick manufacturing as catalyst for erasure

A brick-manufacturing plant is proposed as the first phase of intervention that will extract slag from the site incrementally and recycle it into bricks. The robust and porous nature of slag requires minimal additional resources and offers an economic opportunity and job creation. The brick-making process will excavate the slag heap to the extent that it no longer inhibits future coevolution. Parts of the slag heap will be retained as evidence of past industrial processes. The manufacturing facility will be designed to facilitate an evolutionary process that facilitates the emergence of new programmes once the brick-making process has taken root.

Slag Ceramic manufacturer as continuation of erasure

Steel slag has been found to be an appropriate material for the manufacturing of ceramic and glass products. A study done on the use of steel slag for the production of ceramics found that it is an equally viable material to make ceramics when compared to traditional materials. The benefit of using slag to make ceramics in the context of the Pretoria steel works is that it transforms the low value slag into high value articles. This increases the economic incentive of excavating slag from the site as part of rehabilitation.

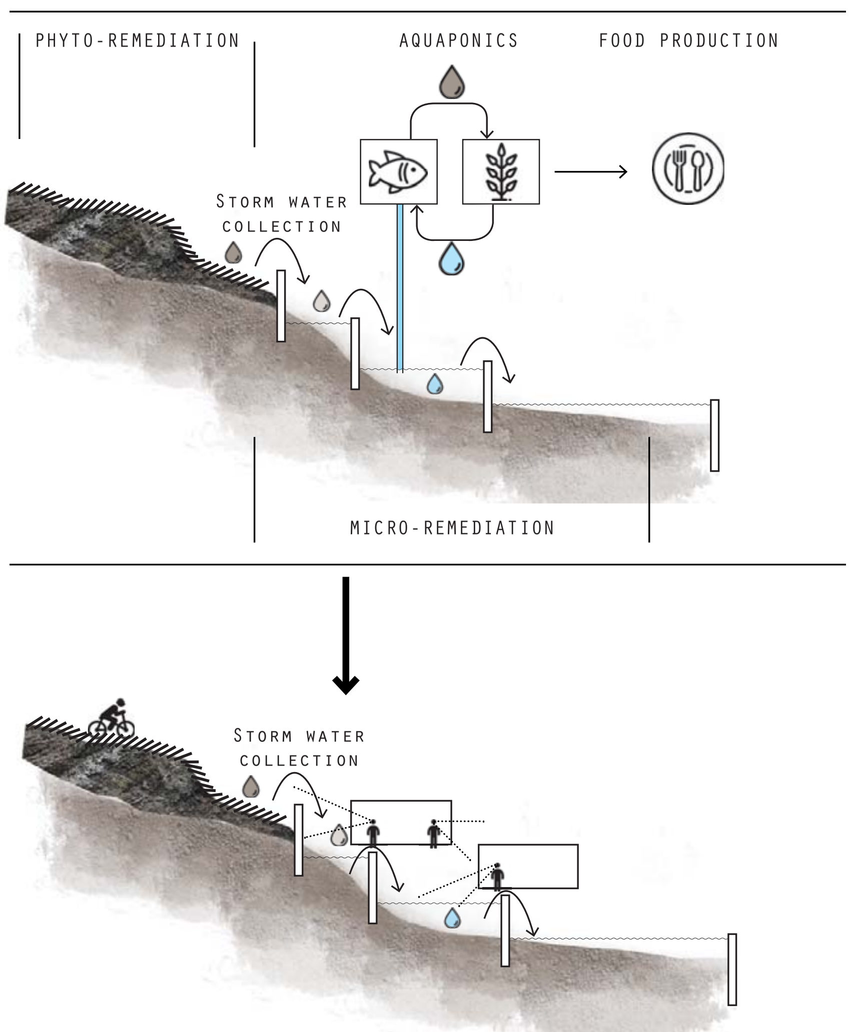


Figure 72. Diagram showing programmatic implementation of new rehabilitation strategy. (Author, 2018)

Coevolution

Aquaponics as a driver of coevolution

An aquaponics food producer is proposed as a driver of coevolution. This form of food production relies on the establishment of an ecosystem to maintain chemical balances for the growth of both fauna and flora. In this way, humans rely on nature to regulate the system, while benefiting from its produce. This ecosystem will be extended into the landscape to assist in re-establishing external ecosystems. The aquaponics system will make use of water collected on site for the cultivation of crops and fish. The water will be purified using a bioremediation process, that also exists as an ecosystem, where natural processes are used to benefit both man and nature. Surplus water will be used to catalyse the re-establishment of plant species on the greater site.

Exposure

Sports and recreational hub as driver of exposure

A sports and recreational hub is proposed for the site that will make use of existing roads on the slag heap that were used for excavation vehicles and reporpose them as cyling, and trail running routes. This will facilitae engagement with the landscape and will expose the rehabilitation process occuring in the landscape. The recreational hub will include a restaurant and a nourishment bar that uses food produced on site. These spaces will exhibit the processes involved in producing the food. The Buildings interation with the ecology will also be haptically exhibited creating an internal natural condition in which occupants experience sensory proximity with nature.

Ceramics Manufacturing plant

Ceramic Production In South Africa

The production of ceramics in South Africa can be traced back to the pre-colonial era, evident in fired clay pots made by the Khoi Khoi people over 2000 years ago. The making of ceramic products evolved into an entire industry during the colonial era with the arrival of thousands of European settlers. Ceramic products such as fired clay bricks, roof and floor tiles were essential for the construction of new settlements that accommodated the influx of settlers. The industry continued to evolve, implementing new technology to achieve greater output and efficiency. Today the ceramics industry is the largest consumer of clay and mineral resources and contributes significantly to the production sector of the South African economy. Fired clay bricks, ceramic tiles as well as ceramic sanitary and whiteware are amongst the most articles that are produced most frequently. The ceramics industry is a major supplier of the building industry and has grown significantly over the past decades to maintain a steady supply of building materials.

Ceramic Making Process

The ceramic-making process consists of the mixing of clay and other minerals which is then moulded and fired to produce the desired end product. Different types of raw materials, moulding processes and firing methods are used on varying scales of complexity to produce wide varieties of ceramic products. The process can be quite simple when producing basic pottery and very complex when making precision ceramic products such as dental implants and aeronautical components. Ceramic products used for household and building purposes are generally produced on a large scale and employ a production method that is suited for mass production. The process begins with the mining of raw clay and mineral materials. These materials are batched according to weight and colour and mixed to achieve a desired strength and colour. The material then undergoes a grinding process in which the material is mixed with water and ground to a fine consistency. Water is removed from the mixture leaving behind a powder. This powder is mixed with binding agents and is then moulded using a variety of methods, depending on the end product. A punch mould, mounted to a hydraulic press, is used for tiles, while injection or extrusion moulds are used for making vessels and ceramic profiles. The moulded product is left to dry and is then glazed and fired in a kiln. The ceramic end products are inspected and packaged.

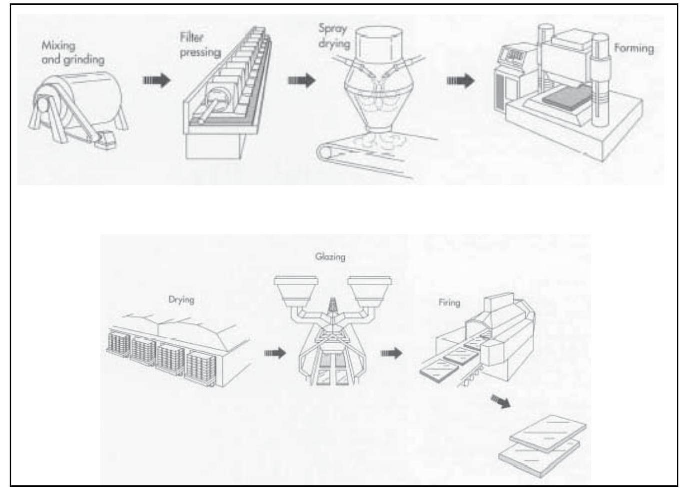


Figure 73. Diagram showing the ceramic manufacturing process. (http://www.madehow.com/images/hpm_0000_0001_0_img0058.jpg, accessed 2018)

Program intention

A ceramics manufacturing plant is proposed for the site that will use slag from the slag heap as a primary material. Manufacturing will take place at various scales to achieve maximum extraction of the potential that the slag heap has to offer. Large scale manufacturing will ensure sufficient excavation of the slag heap for the purposes of rehabilitation. Large scale manufacturing will involve the making of bricks and ceramic tiles. Medium scale production will be aimed at promoting craftsmanship and, thus, will include more human resources in the manufacturing process. This scale of production will include the making of homeware such as pots, cups, plates, and other decorative articles. Human-operated machines will be used for the casting and firing of the ceramics where painting, glazing and mould-making will be done by hand. This combination of large and medium scale production will ensure extraction of the slag's economic potential but also potential that exists for the promotion of craftsmanship.

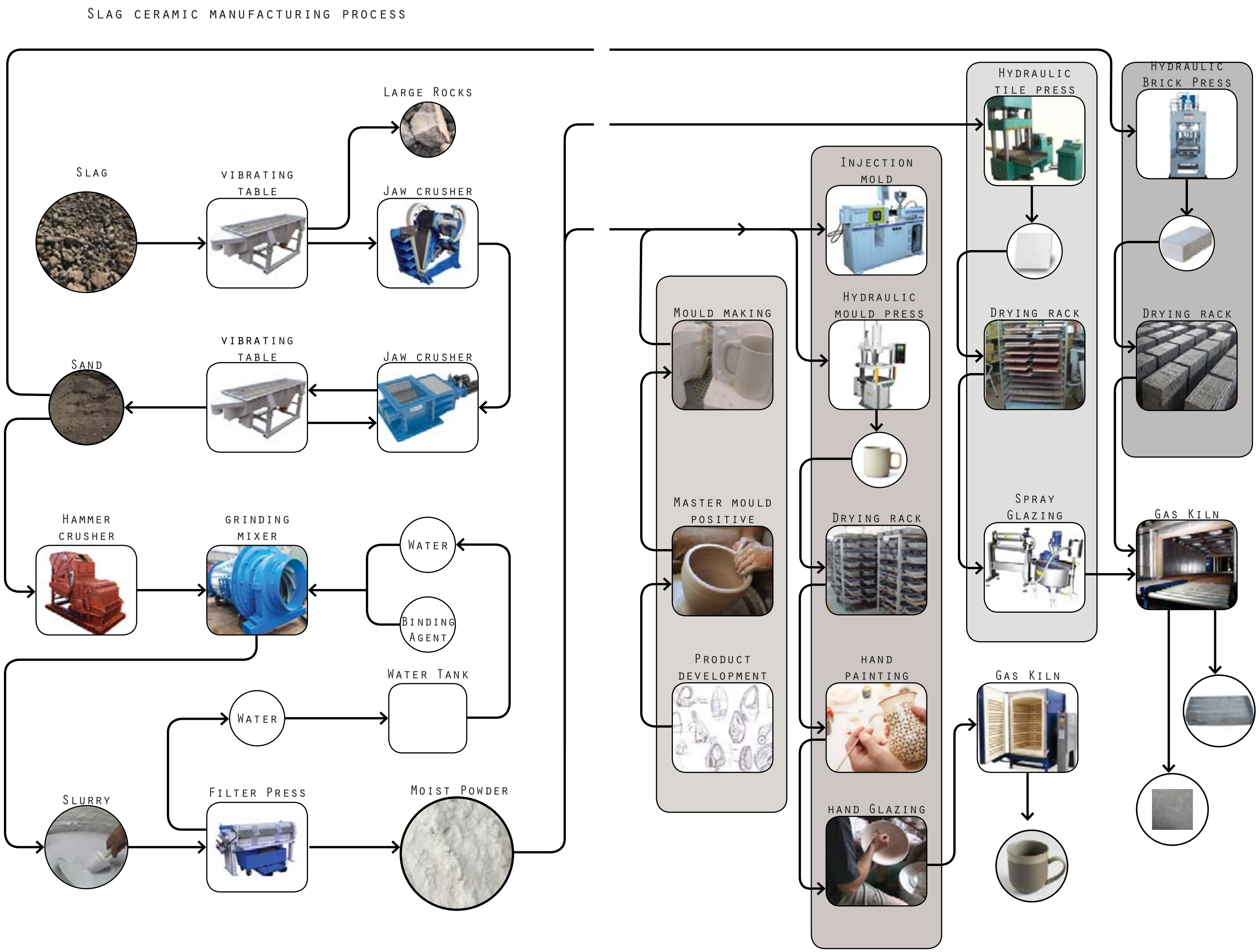


Figure 74. Diagram showing the ceramic manufacturing process on site. (Author, 2018)

Figure 75. Site photo of slag heap (Author, 2018)

CHAPTER 6 Design Development

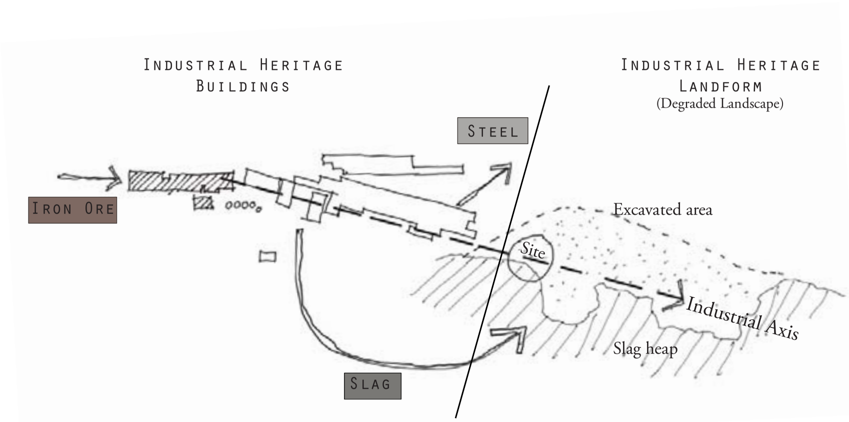


Figure 76. Diagram showing the relationship between industry and the landscape. (Author, 2018)

Introduction

In this section, the development of an architectural response to the new rehabilitation framework, set out in chapter 3, will be documented. The aim of this architectural response is to mediate the conflicting objectives of post-industrial rehabilitation and industrial heritage conservation. This is done to create a condition in which site productivity is maintained, active remediation and augmentation of the natural landscape occurs, and valuable heritage is conserved and exhibited experientially. The area of focus will be the slag heap, situated at the end of the industrial axis, that functioned as a dumping site of waste materials. The design of the proposed architecture will respond to informants that relate to the industrial heritage of the site and physical conditions that are the result of past industrial processes. The informants include:
-The industrial axis (as the embodiment of the mechanistic worldview)

-The slag heap (as the result of mechanistic linear resource flows)

-
Nature's interaction with the slag heap (as a source of remediative potential)
These informants will guide the formulation of architectural intentions, which will be synthesised into a conceptual framework, that will facilitate spatial expression of architecture.

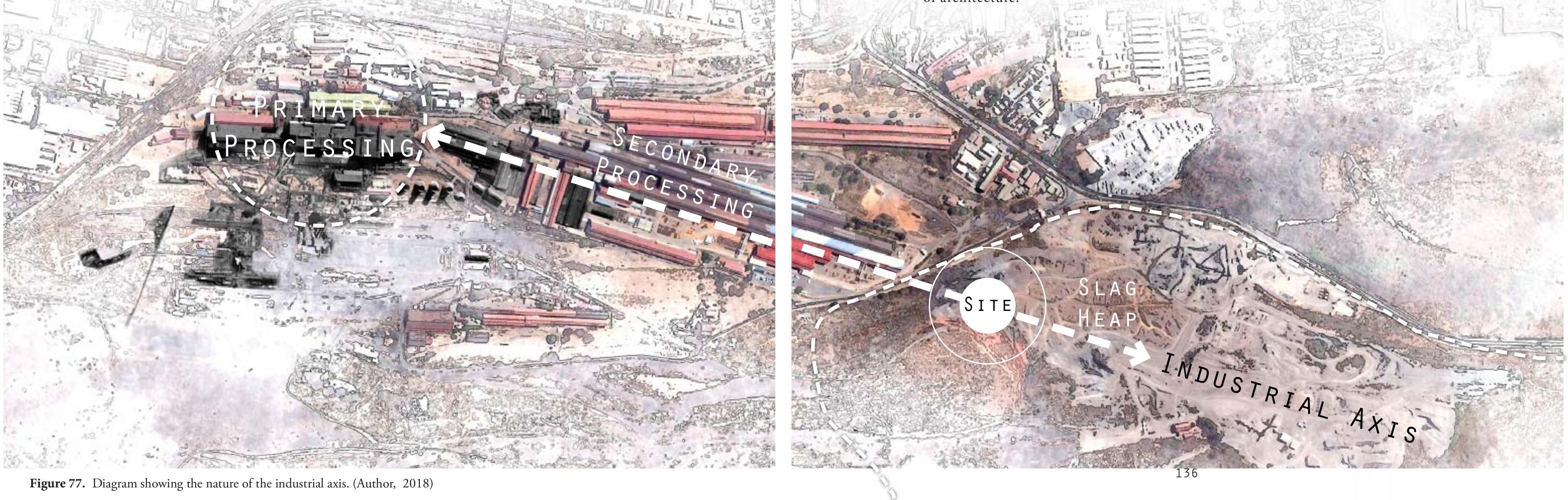


Figure 77. Diagram showing the nature of the industrial axis. (Author, 2018)

Expression Of The Mechanistic Narrative

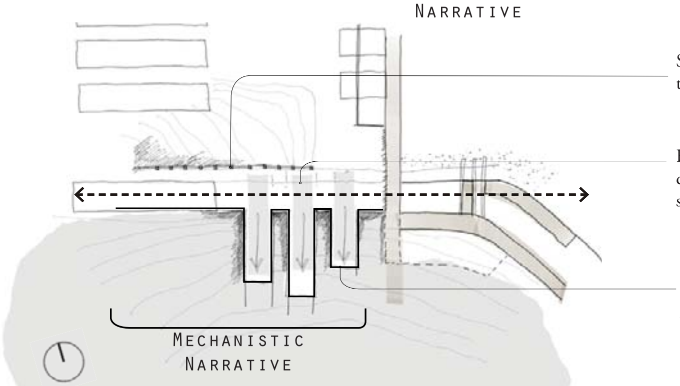


Figure 78. Diagram showing the expression of the mechanistic narrative. (Author, 2018)

Expression Of The Ecosystemic Narrative

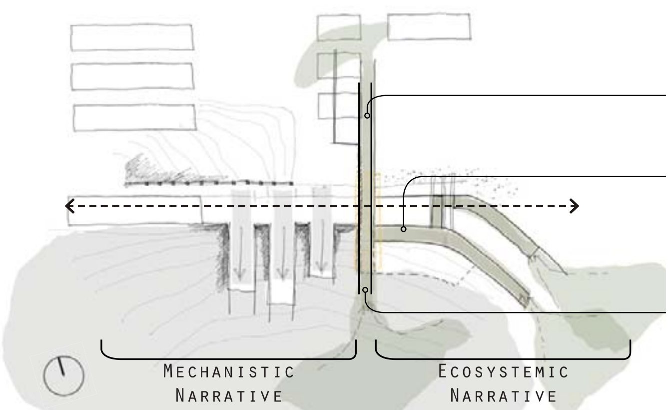


Figure 79. Diagram showing the expression of the ecosystemic narrative. (Author, 2018)

The proposed building will be situated on the axis of past industry and will express a transition from the mechanistic worldview, in which industry was birthed, to a new ecosystemic worldview in which humans and nature are reconciled. This datum aims to communicate the destructive impact of the mechanistic worldview and the constructive and cathartic impact of an ecosystemic approach. Architectural components, namely form, structure and material, will be poetically articulated to express humans' approach to the natural environment within each worldview. The respective environmental impact of each approach will also be expressed. The expression of these architectural components will create spaces that offer a phenomenological experience of the mechanistic and ecosystemic narratives expressed on site.

Expression Of The Mechanistic Narrative

The form of this part of the building will express the parasitic and exploitative approach to nature within a mechanistic worldview. The building will be articulated as an invasive structure that sits on top of the landscape, expressing the perception of dominance over nature that epitomises the mechanistic worldview. The building will further express this parasitic relationship through form that is articulated incisively into the landscape along the industrial axis. This incision will reference industrial processes that resulted in the existence of the slag heap.

Expression Of A Transition From Mechanistic To Ecosystemic

This part of the building is situated between the parts of the building that express mechanistic and ecosystemic narratives. This in-between space will be articulated as a major threshold between space that expresses destruction and space that expresses catharsis and reconciliation with nature. This threshold space will be expressed as an extension of the landscape over the building under which occupants move to the ecosystemic side of the building. This extension of landscape over building expresses a paradigm shift from dominance over nature to dependence on nature. This space will be designed to facilitate experiential intimacy with nature by exposing the prolific and ephemeral characteristics of nature. Movement through this space will allow views of both parts of the building to evoke an inner process of contrasting the two narratives. This space transports occupants into the landscape to a state of complete submersion before transitioning to destination spaces.

Expression Of The Ecosystemic Narrative

This part of the building will be articulated to express an awareness of the interdependence between nature and humans. The building will be embedded in the landscape, following the contours of the topography. The building's structure is articulated to express co-operation between building and natural systems and is designed to be eco-systemically intertwined with nature. The building will be structured to facilitate the growth of new ecosystems that catalyse the augmentation of the degraded landscape.

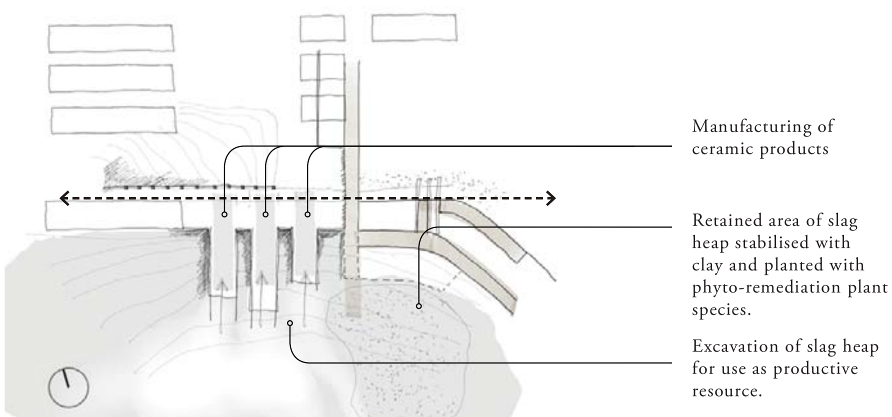


Figure 80. Diagram showing the excavation of the slag heap by the building.

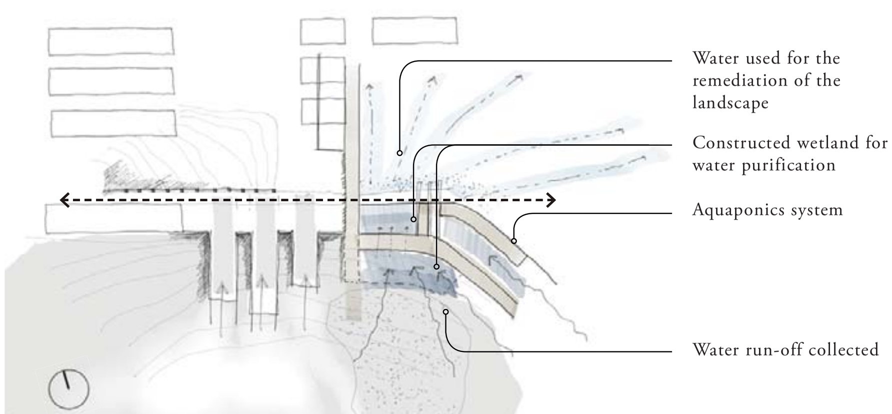


Figure 81. Diagram showing the building as water collector. (Author, 2018)

The aim of employing architecture as a productive remediator is to neutralise environmental threats and re-establish ecological complexity of place, while extracting productive value from this process. To neutralise the environmental threat of the slag heap, the building will be designed to excavate the slag heap and use the excavated slag as a production resource for the manufacturing of ceramics. As discussed, parts of the slag heap will be retained owing to its heritage value. These areas will be stabilised using clay soil, that prevents water seepage, and planted with phyto-remediative plant species, that extract harmful, metallic oxides. The use of clay soil to stabilise the slagheap will result in increased rain water run-off. The building will be designed to channel, collect, purify, and store this water and use it as a resource for remediation and production. The water will be used to facilitate the re-establishment of native plant species on site which will act as an ecological foundation supporting new insect and bird populations. An aquaponics system for food production will be established on site that will also make use of the water collected by the building. This system depends on an internal ecology in which the agricultural component assimilates waste, produced by the aquacultural component, to ensure prolific conditions for both components.

The architecture's form will be articulated to express the extraction and processing of the slag. The water collection, purification and storage process will also be expressed and exhibited by the architecture. Parts of the building will be articulated as a constructed wetland, thus integrating building and nature. This expression embeds the building within the landscape and facilitates operational and sensory proximity between building occupants and nature.

Internal and External Natural Condition

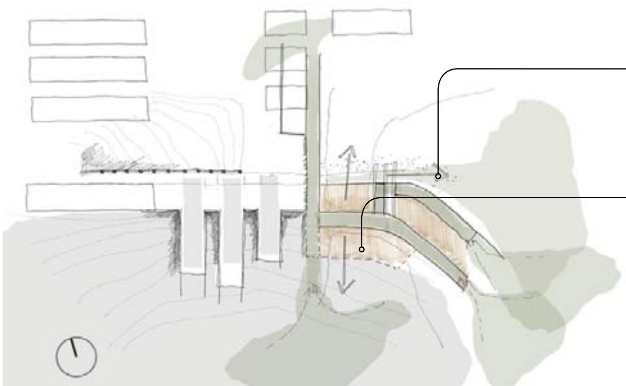


Figure 82. Diagram showing the internal and external natural condition. (Author, 2018)

As discussed in chapter 3, the distant proximity between humankind and nature is concerning and needs to be addressed to espouse a renewed reverence for nature. In response to this issue, the proposed building will be designed to facilitate sensory proximity between nature and humans. The design of the architecture will create an inner and outer natural condition which aims to elicit reverence for nature.

The inner condition exists where the building is integrated with nature. These spaces are articulated to exhibit the ecological systems at work that form part of the remediation process and will be focused at celebrating the dynamicity of nature. Structures and materials will allow for the growth of plant species on the building and will emphasise the flow of water. Natural events like rainstorms will activate water reticulation systems and will be celebrated as an event by the architecture. The rotation of seasons will also change the natural condition within the building creating a dynamic internal landscape condition.

The outer natural condition consists of the retained slag heap landforms and areas that have been excavated. These spaces will facilitate activities such as hiking, trail running and cycling and thereby create an environment for the sensory enjoyment of nature. The rehabilitation of these areas will also be exposed by contrasting the restored natural landscape with the areas of the slag heap that were retained.

Programmatic and Spatial Synthesis.

As discussed in the programme chapter, the building will host a ceramics manufacturer, an aquaponics food producer and restaurant, and a sports and recreational hub. These programmes will be incorporated into the experiential datum to complement the respective narrative.

Production Zone as Part of the Mechanistic Narrative

The production zone will host the manufacturing of ceramic items and will be arranged from large scale production on the side closest to existing industry to smaller scale production that is integrated with public spaces towards the centre of the building. This manufacturing process will complement the expression of the mechanistic narrative by extracting slag from the slag heap in a way that extends incisively into the landscape, thus exposing the source of natural resources used for production. The production process and its extractive and incisive expression into the landscape will be exhibited through circulation routes accessible by the public. These routes will be adjacent to, and immediately proximate to, the industrial axis incision and will be the platform for the communication of the mechanistic worldview.

The sports and recreational hub will be situated towards the centre of the building at different levels. At each level, occupants will have visual access to different parts of the building's interaction with natural systems. The spaces will facilitate a haptic experience of the building's changing nature as it interacts with the natural environment.

The restaurant and nutrition bar are situated to provide visual access to the systems that form part of the food production process. This aims to create an awareness of the operational symbiosis with nature and the end product that is consumed in the form of food. These spaces are also aimed at facilitating proximity to nature and will thus provide physical access to the vegetation and water systems that are hosted in the building.

Food Production Zone

The aquaponics system is located on the eastern side of the building at the end of the industrial axis. This section of the building deviates from the axis and starts to follow the curve of the hill in which the building is imbedded. The end of the building will be articulated to blend into the landscape, signifying reconciliation with nature.

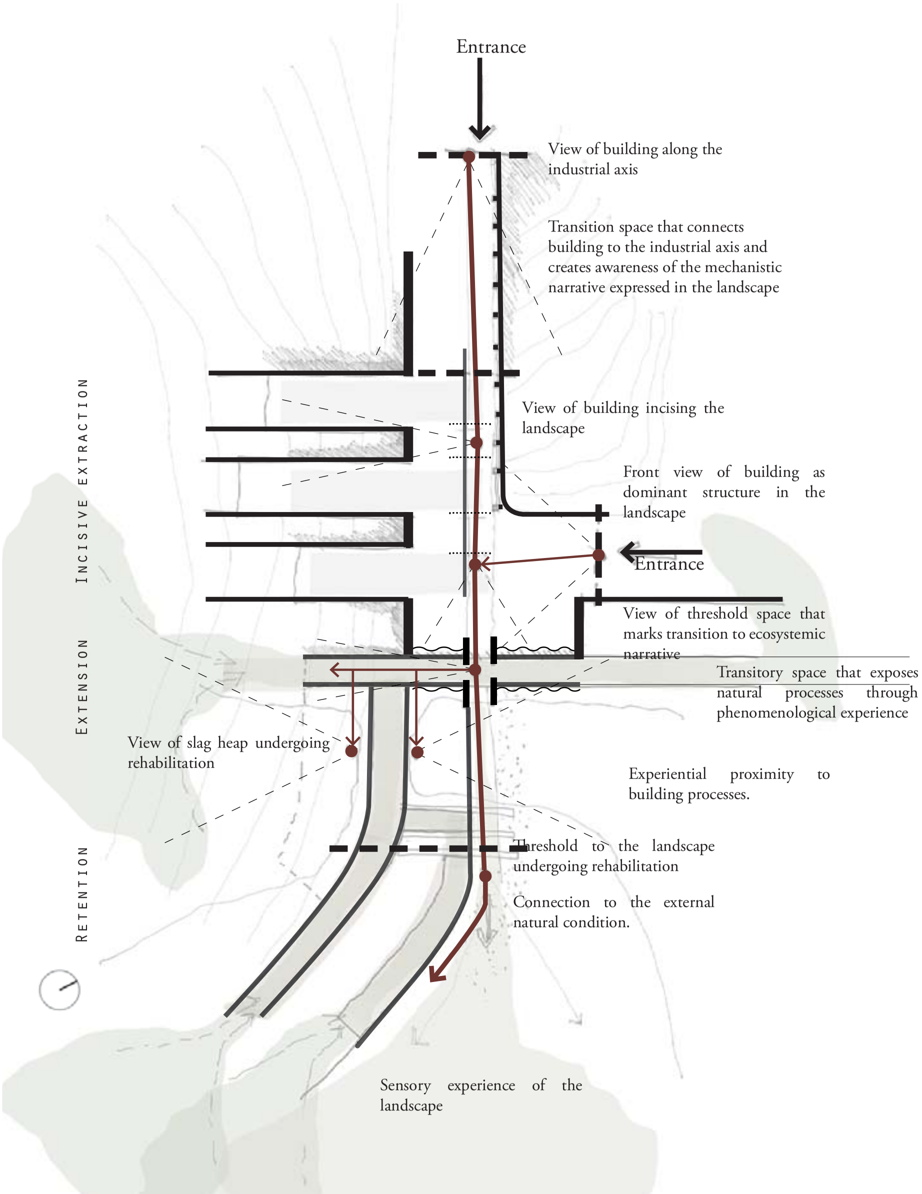


Figure 83. Diagram showing spatial progression. (Author, 2018)

Concept

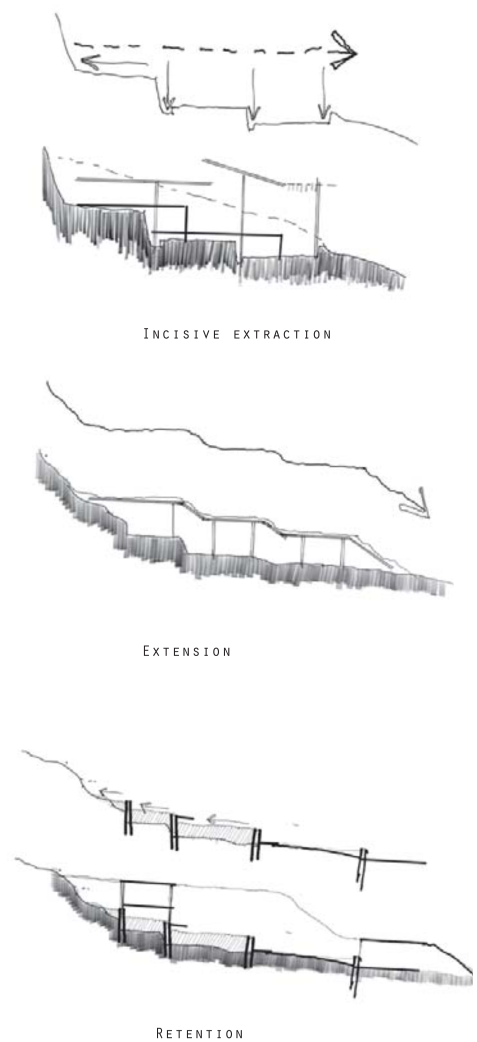


Figure 84. Concept diagrams (Author, 2018)

The concept of incisive extraction, extension, and retention was developed as a synthesis of the design intentions and the rehabilitation strategy. Incisive extraction is aimed at communicating the punitive impact of mechanistic industry on the environment and is articulated by incisions that extend into the landscape. These incisions form the platform of the production facilities and define the direction of slag extraction that forms part of the erasure strategy. An incision is also articulated along the industrial axis that makes reference to the industry that is responsible for the degraded condition of the site. Vertical steel elements pierce the landscape along this incision referencing the linear resource flow relationship between the steel and the slag heap. The lower region of the building is expressed as a solid base that reads as an imposing structure that sits in the void formed by an incision. A steel structure rests on this base and extends perpendicularly into the landscape incisions.

Extension is aimed at communicating a transition from mechanistic to ecosystemic spaces. The extension of the landscape over the building expresses a reverence for nature and creates a sense that the building is embedded in the landscape.

This space becomes an important threshold that emphasises the movement under the landscape, through to a space defined by an ecosystemic worldview.

Retention is aimed at defining the buildings interaction with the landscape. The building is articulated to retain ground water runoff and release it into the environment over an extended period to effect remediation. Water is also retained so that it can be used productively. Retention zones become spaces that host ecologies that serve to purify the water and exposes this process to the public realm.

Precedent study

Brion Tomb and Sanctuary by Carlo Scarpa

Figure 85. Photo showing landscaping over building.vv (Prosdocimo. D, 2018)

Figure 86. Photo showing weathered state of building. (Prosdocimo. D, 2018)

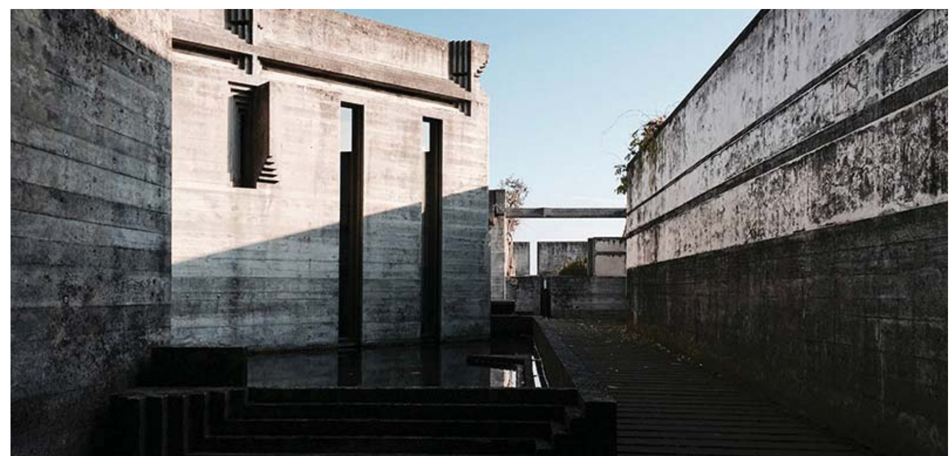


Figure 87. Photo showing Courtyard with reflection pool. (Prosdocimo. D, 2018)

Initial Concept sketches

Figure 88. Initial concept section sketch. (Author, 2018)

Figure 89. Initial concept plan sketch. (Author, 2018)

Maquette 01

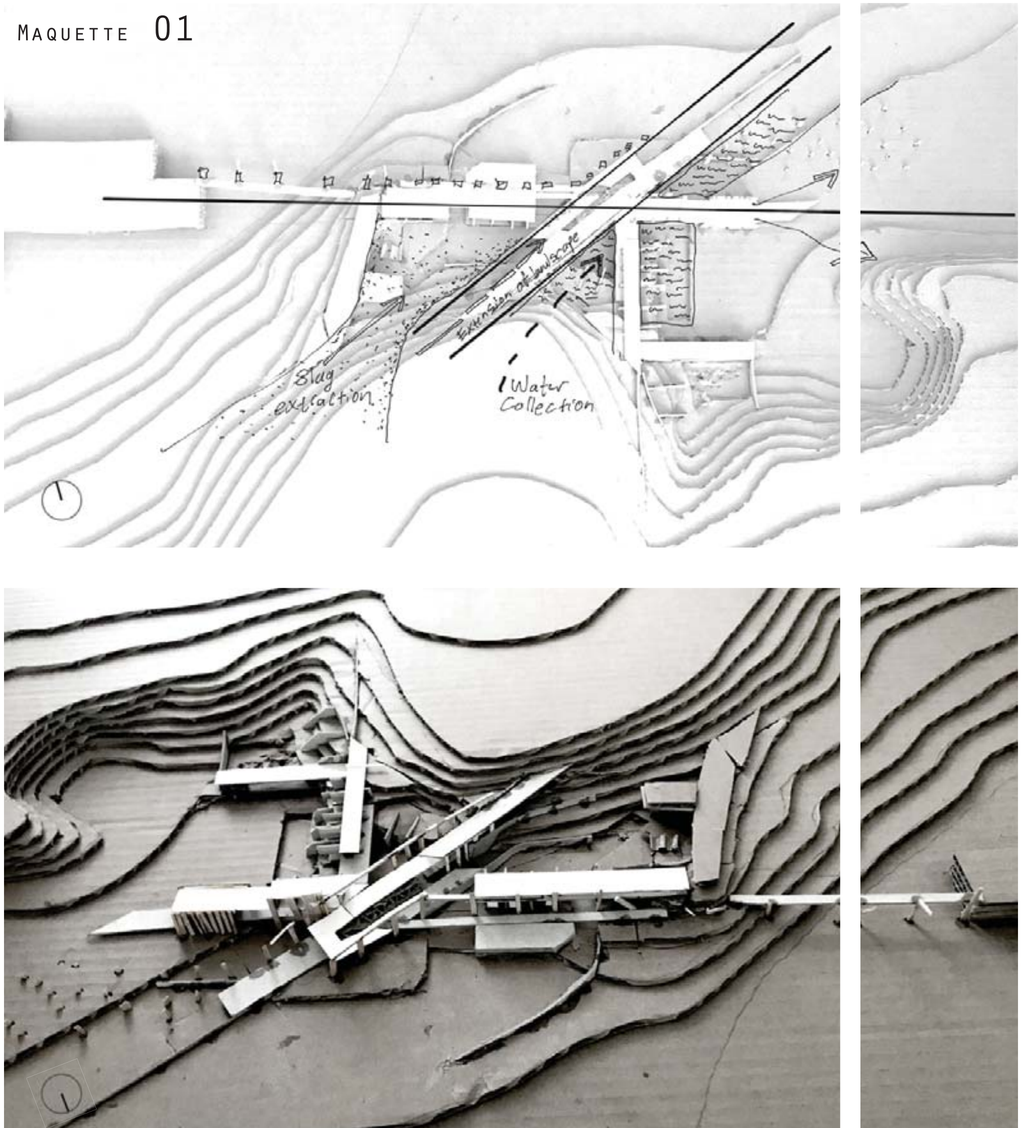
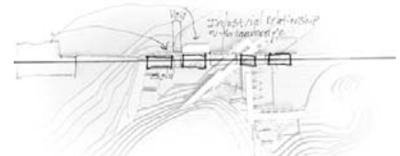
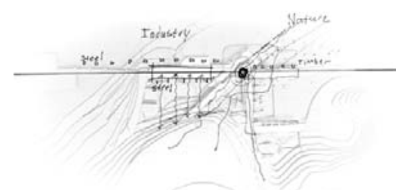


Figure 90. Photos of maquette 01. (Author, 2018)

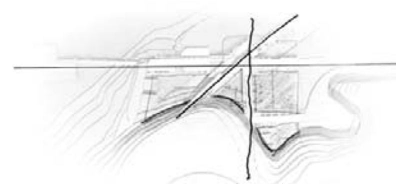


Industrial Relationship with the Landscape

Industrial Expression on The Landscape



Industrial Degradation Contrasted With Natural Symbiosis



Negative spaces as Remnants of Devolution

Natural Interaction With Landscape

Figure 91. Diagram showing concept development. (Author, 2018)

Reflection

Iteration 01 explored the expression of mechanistic and ecosystemic narratives on site. It also explored relationships that can be established between the landscape and building. It focused specifically on water collection and how the building itself can become a collector of ground water runoff. This iteration started to engage with the industrial axis as an important informant. Design principles were established that would be investigated further throughout the design process.

The scale of the building in this iteration was too large and its tectonics did not effectively differentiate between the ecosystemic and mechanistic narratives that need to be expressed.

Iteration 02

Maquette 02

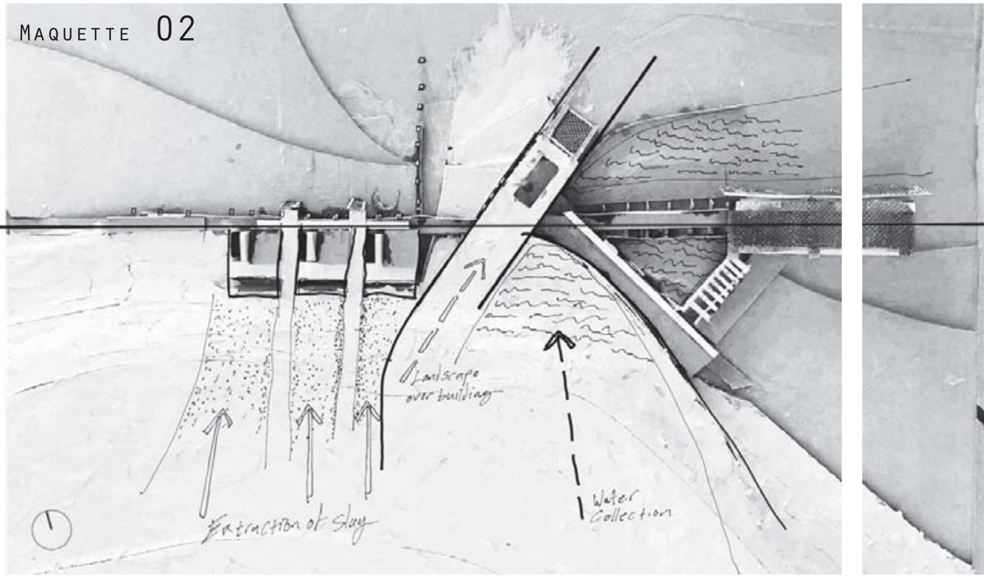


Figure 92. Photo of maquette 2 (Author, 2018)

Plan sketch

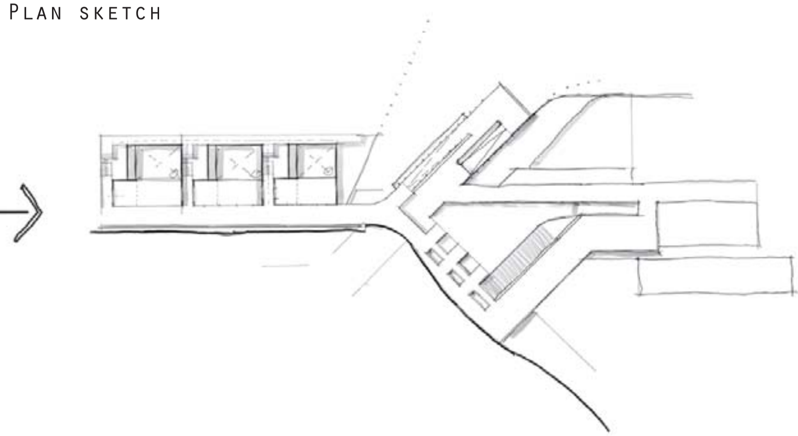


Figure 93. Iteration 02 plan sketch. (Author, 2018)

Concept sketch

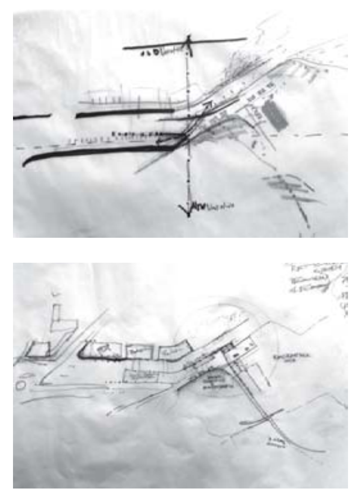


Figure 94. Iteration 2 concept sketches (Author, 2018)

Reflection

In this iteration a more appropriate scale was established. A more succinct architectural language was developed that better expresses mechanistic and ecosystemic narratives. The use of an incisive architectural language for the expression of the mechanistic narrative was developed. The transition between the mechanistic and ecosystemic parts of the building was better defined and established as an overhead threshold that became an extension of the landscape. The idea of the building becoming a retainer of collected rainwater was developed.

The architectural language of this iteration was still not concise enough and needed to be refined. The buildings connection with the landscape also needed to be refined.

Development of Iteration 03

Spatial exploration sketches

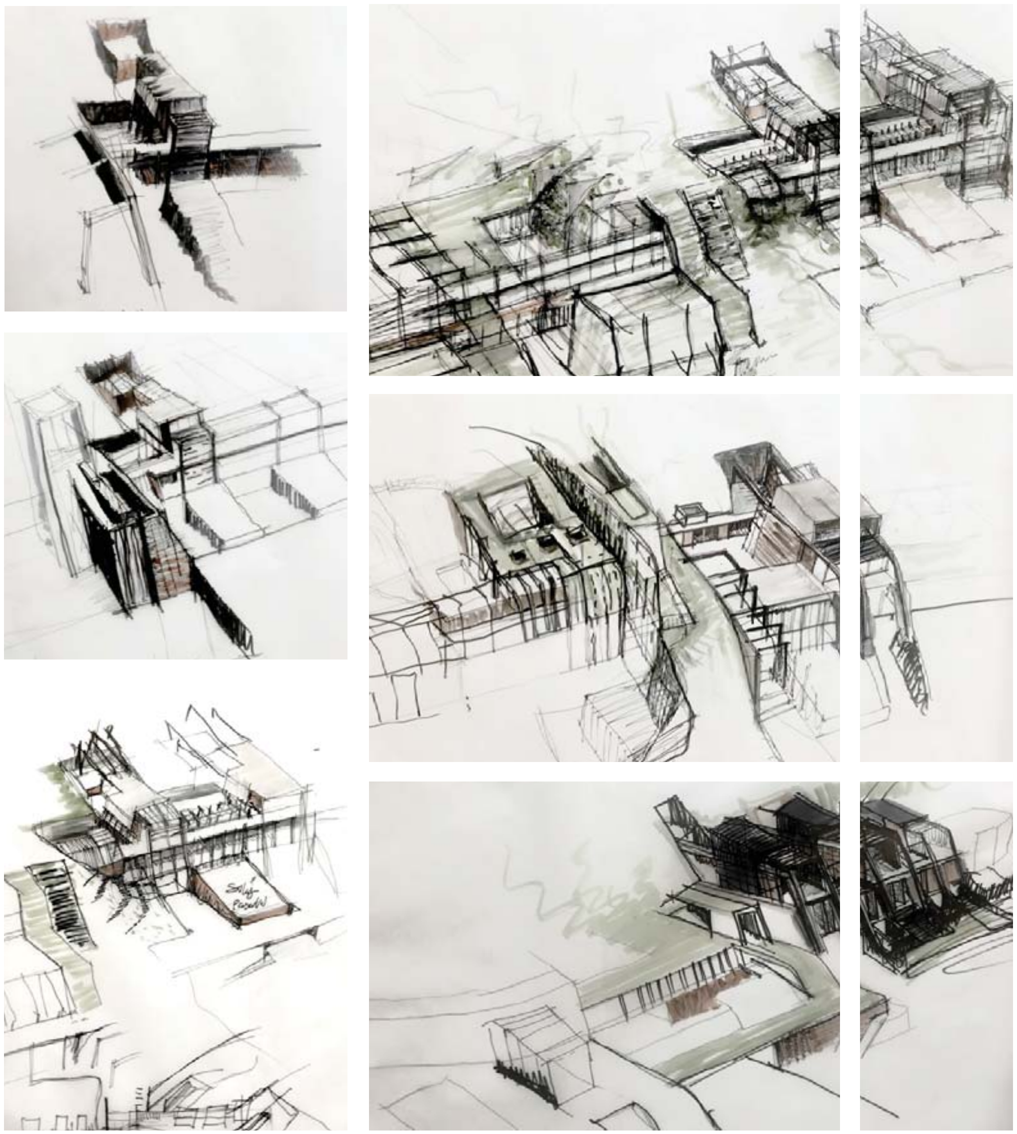


Figure 95. Development sketches of iteration 3 (Author, 2018)

Reflection

Ways of expressing narratives through architecture were explored through drawing. The expression of the mechanistic narrative through incision was further explored and refined. The idea of extending the landscape over the building in reverence of nature was also developed. The transition space was shifted to run perpendicular to the industrial axis to better articulate it as a transition space. Different ways of extending the landscape over this space was also explored. A tectonic language of the buildings structure started to emerge.

Iteration 03

Maquette 03

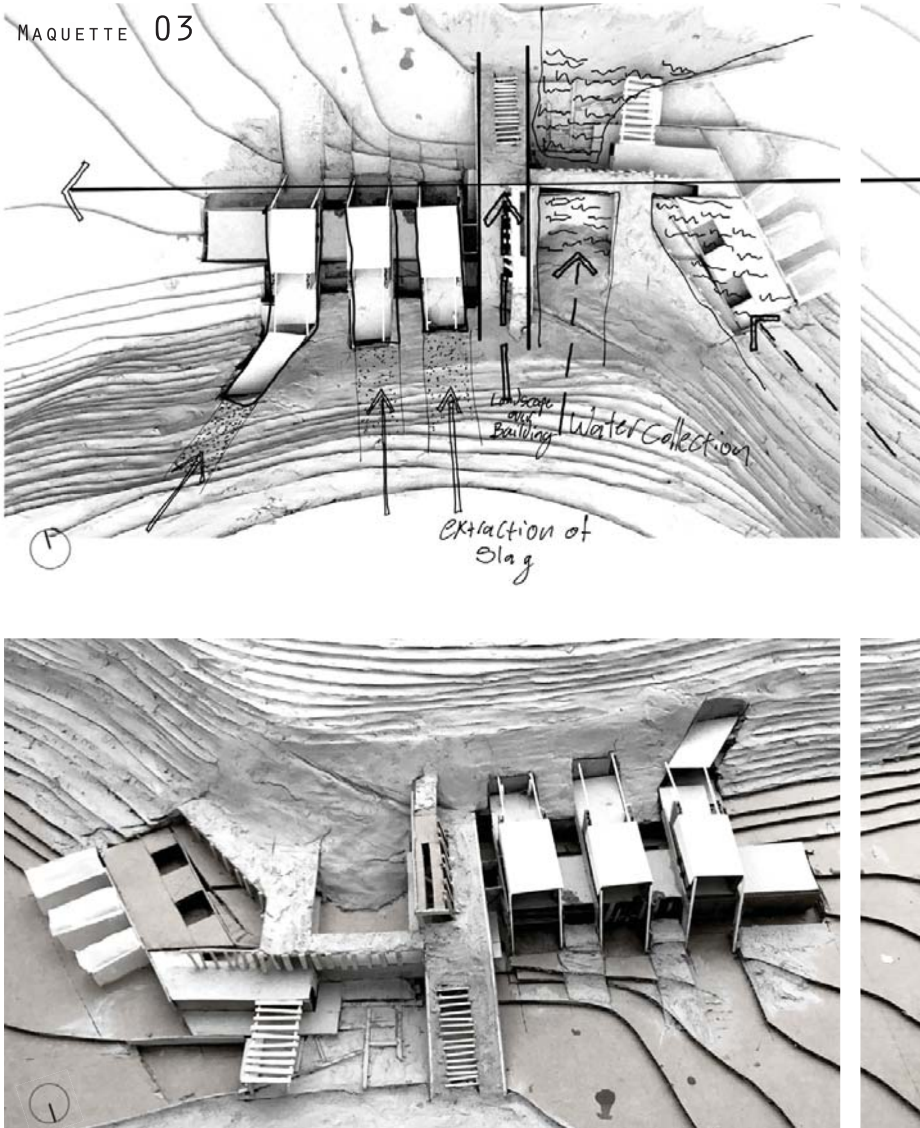


Figure 96. Photos of maquette 3 (Author, 2018)

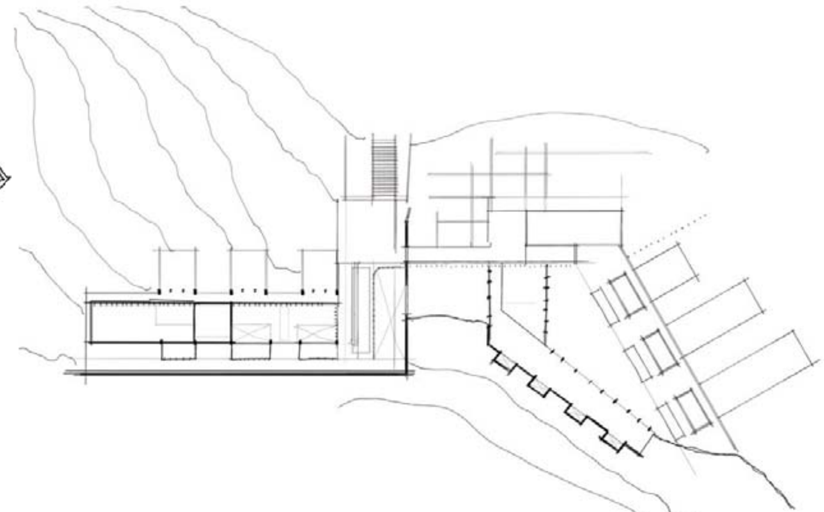


Figure 97. Sketch of iteration 03 plan. (Author, 2018)

Reflection

The principles determined in the spatial development sketches were applied in this iteration. A succinct architectural language that expresses narrative emerged in through the building of this maquette. This iteration was focused at creating spaces that facilitate sensory experience of nature and the buildings interaction with nature. A courtyard was developed that created a semi enclosed natural space that facilitates proximity between building occupants and the natural condition of the site.

The integrity of the industrial axis was lost in this iteration and the building started to read as separate buildings.

Iteration 04

Building Plans

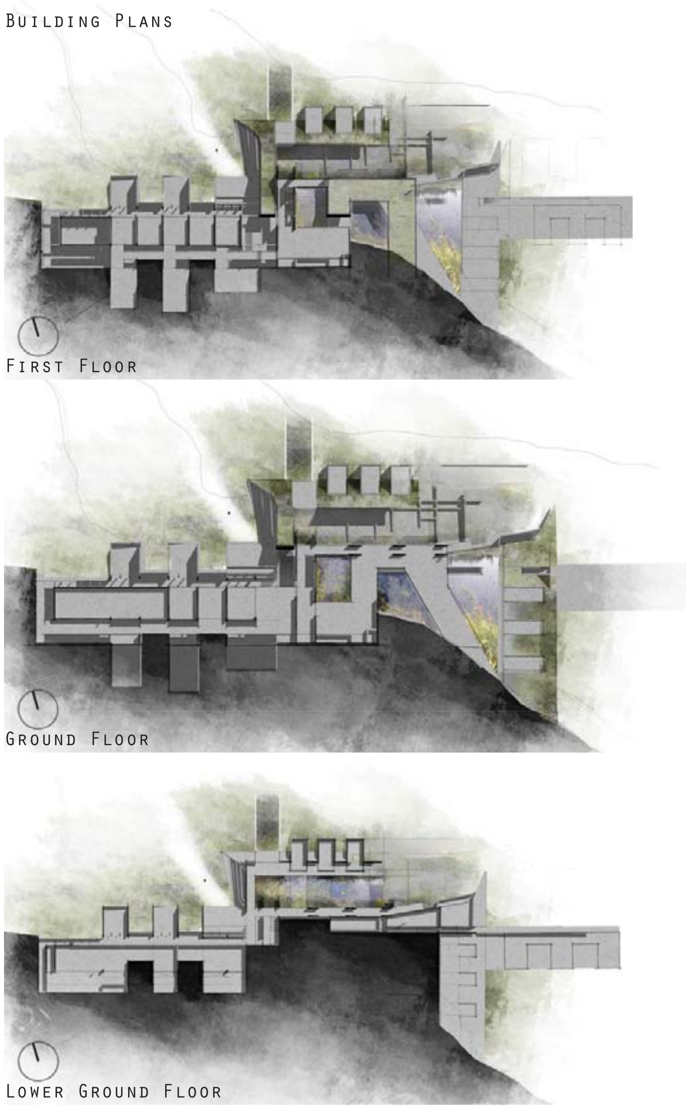


Figure 98. Iteration 4 plans (Author, 2018)

Summary of Architectural response Diagrams

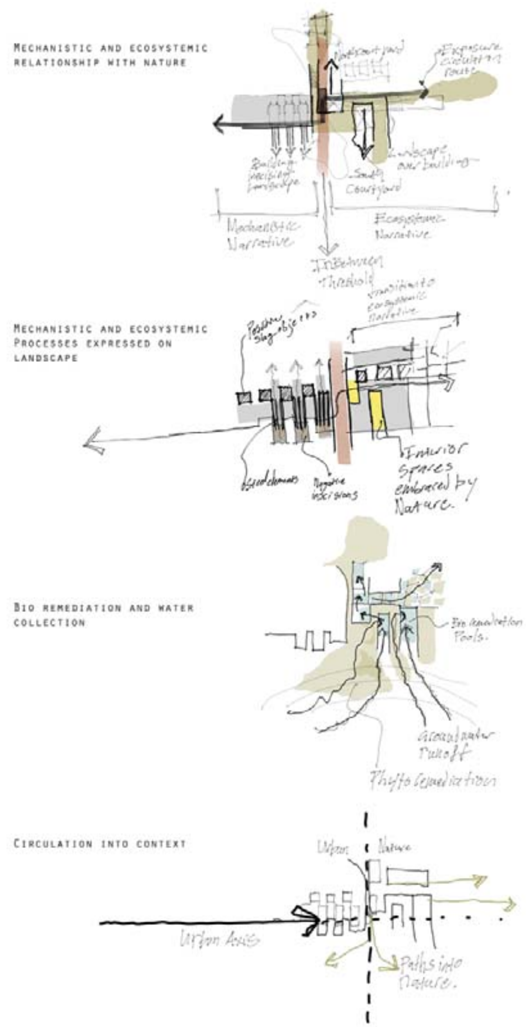


Figure 99. Summary of iteration 4 informants and responses. (Author, 2018)

Reflection

In this iteration the architectural responses were summarised and applied to the plans sections and perspectives of the building. At this stage the programmes were finalised and spatial development was aimed at the development of plans to accommodate the programmes. Production programmes were placed towards the west of the building and recreational programmes toward the east. The transition space (seen in the section perspectives) at the centre of the building was further developed to create a space that facilitates a heightened sensory experience of the buildings interaction with nature. To achieve this a tower structure was added to achieve spatial emphasis.

The newly added tower was not a successful spatial addition owing to the fact that it reduced the clarity of expression of other architectural elements. The plan was also too small to accommodate all programmes.

Section Perspectives

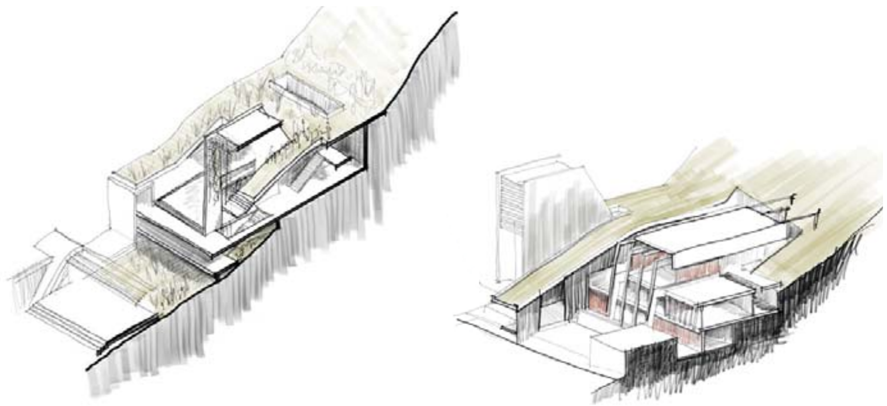


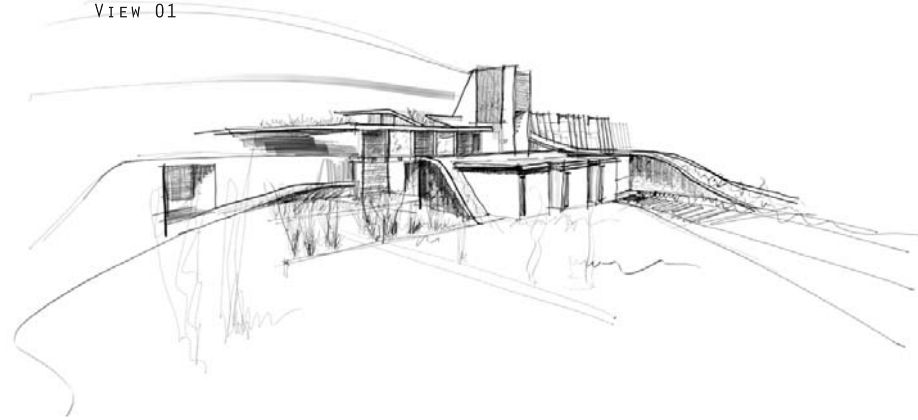
Figure 101. Iteration 4 section perspective drawings. (Author, 2018)

Site Perspective

Figure 100. Iteration 4 site perspective. (Author, 2018)

Perspective Drawings

View 01



View 02

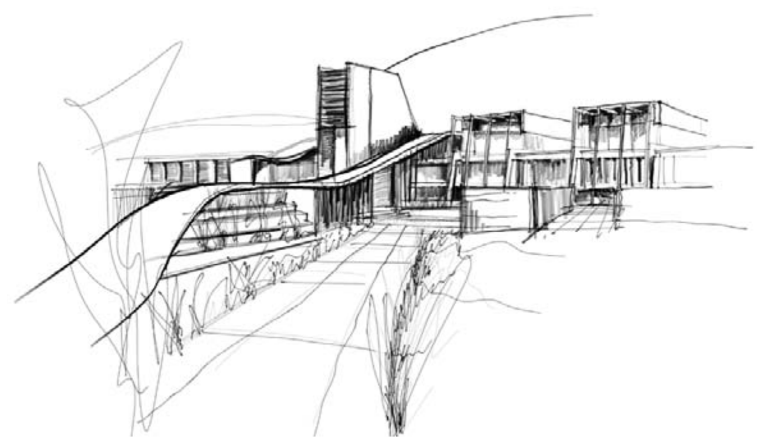
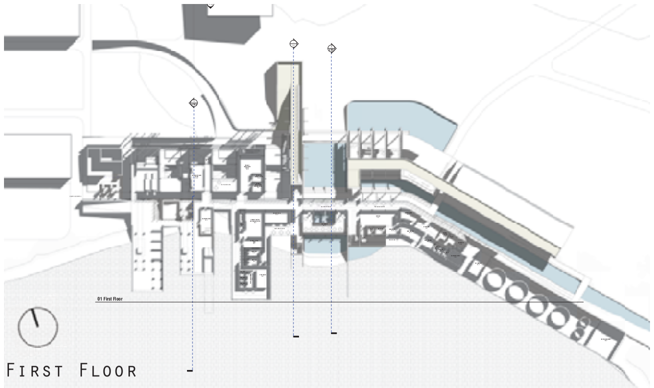
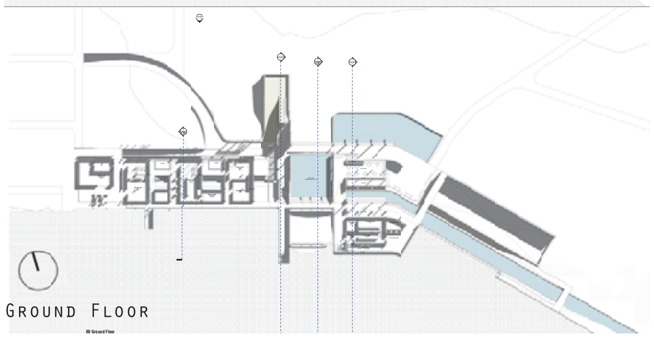


Figure 102. Iteration 4 perspective drawings. (Author, 2018)

Iteration 05

Building Plans





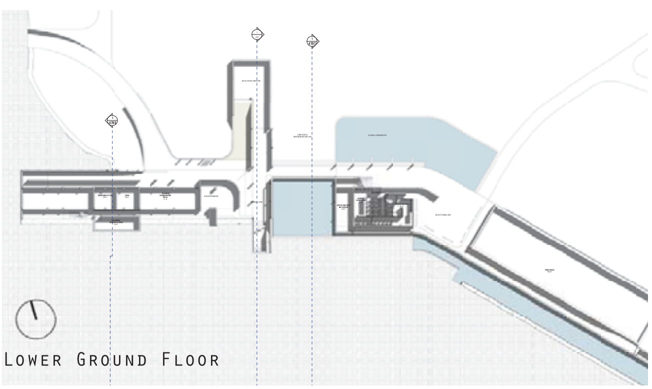


Figure 103. Iteration 5 floor plans. (Author, 2018)

Building Perspectives

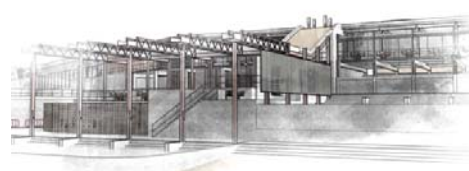


Figure 104. Iteration 5 perspective drawings. (Author, 2018)

Reflection

The plan in this iteration was expanded to accommodate all the programmes that did not fit in the previous iteration. Development focused on the buildings connection to its surroundings, circulation, and access. The concepts of incision, extension, and retention were explored three dimensionally seen in the building perspectives. Incision is expressed by perspective one, where retainer wall extend into the landscape. Extension is expressed by perspective 2 with the articulation of the landscape over the building towards the left. Retention is expressed by perspective three where the retainer walls that contain groundwater runoff is seen.

The buildings connection to its urban context needed to be revisited and refined to facilitate better access to the building.

Section A-A

Figure 105. Iteration 5 section A-A. (Author, 2018)

Section B-B

Figure 106. Iteration 5 section B-B. (Author, 2018)

SITE PERSPECTIVE

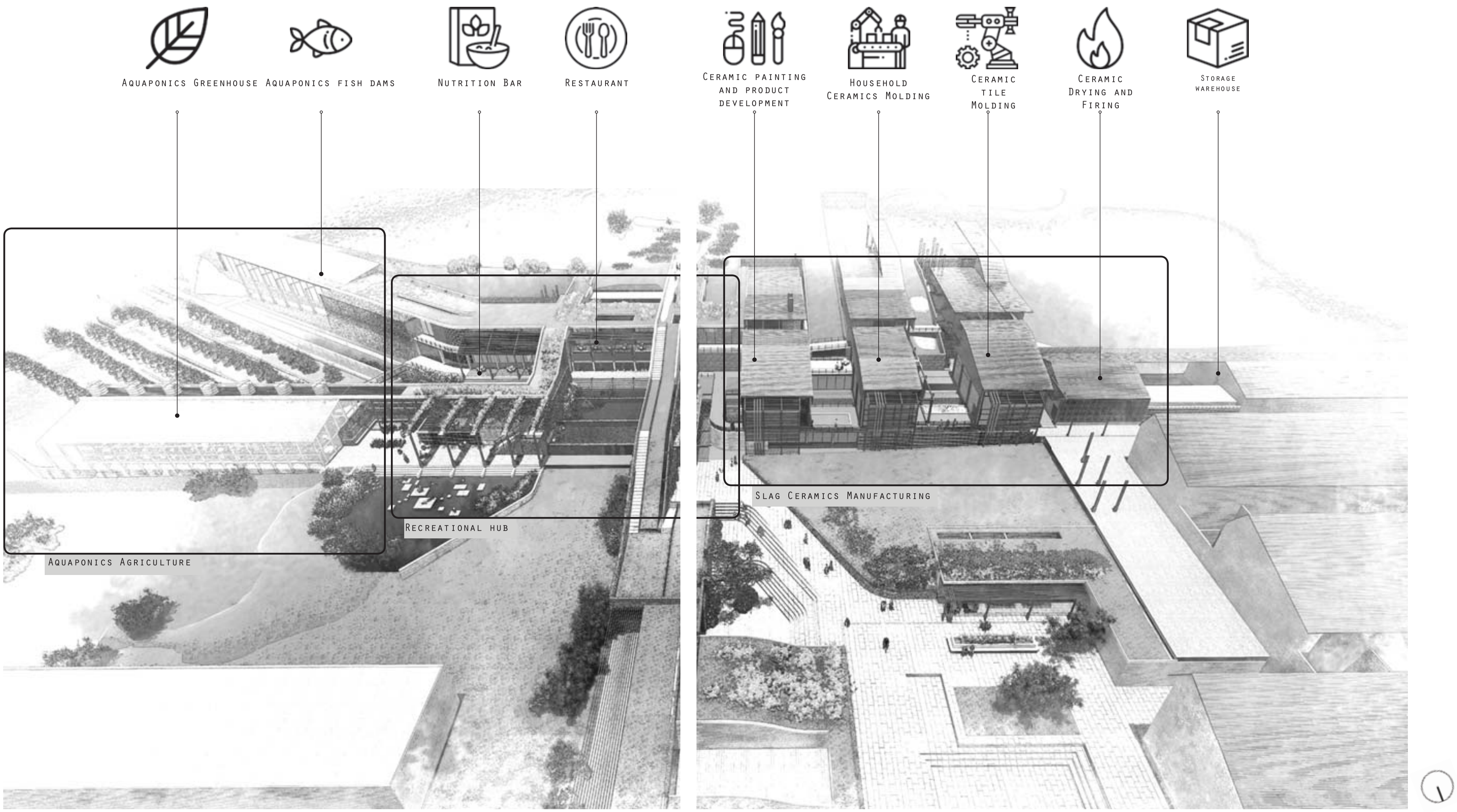


Figure 107. Final design site perspective drawing. (Author, 2018)

Site Plan

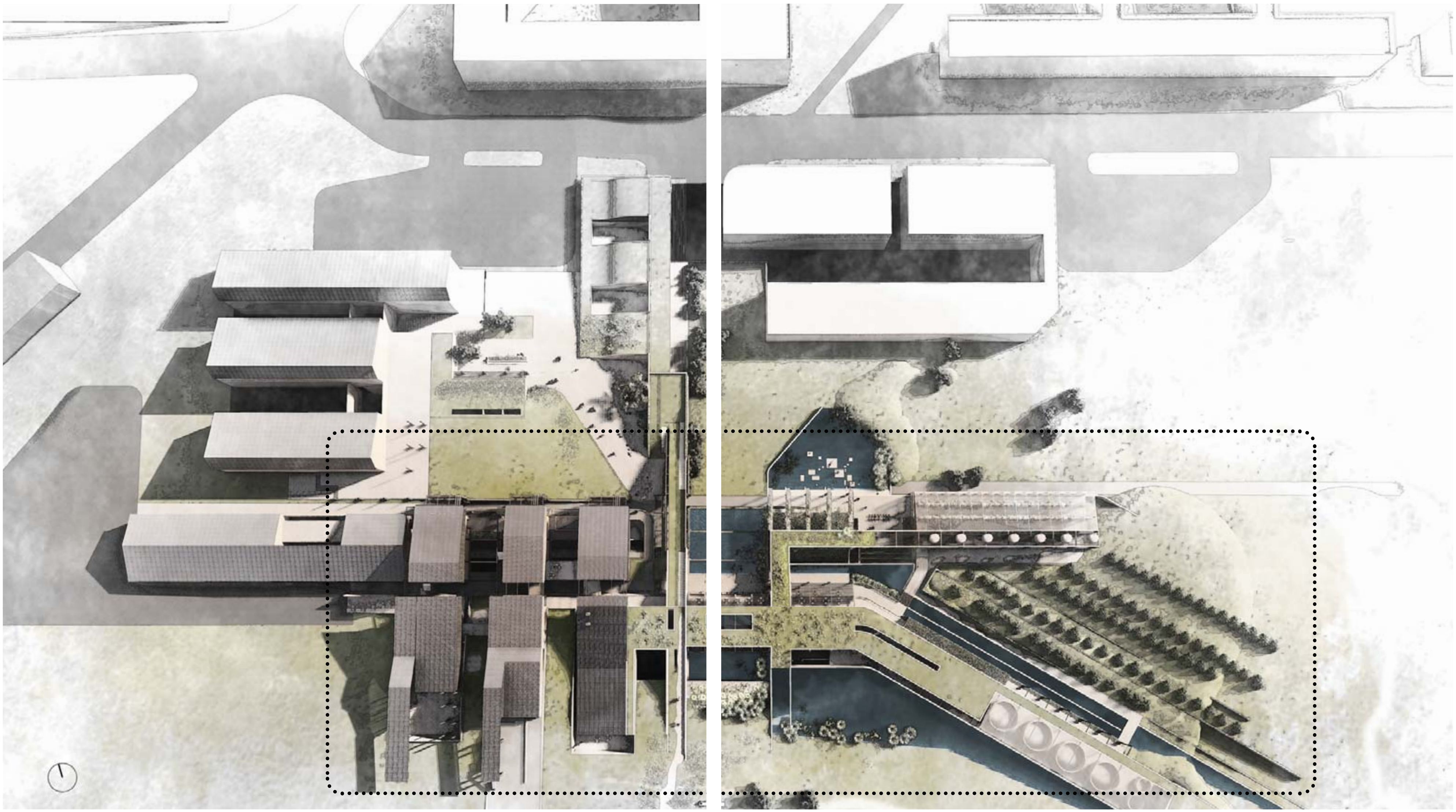


Figure 108. Final design site plan drawing. (Author, 2018)

Circulation and Access

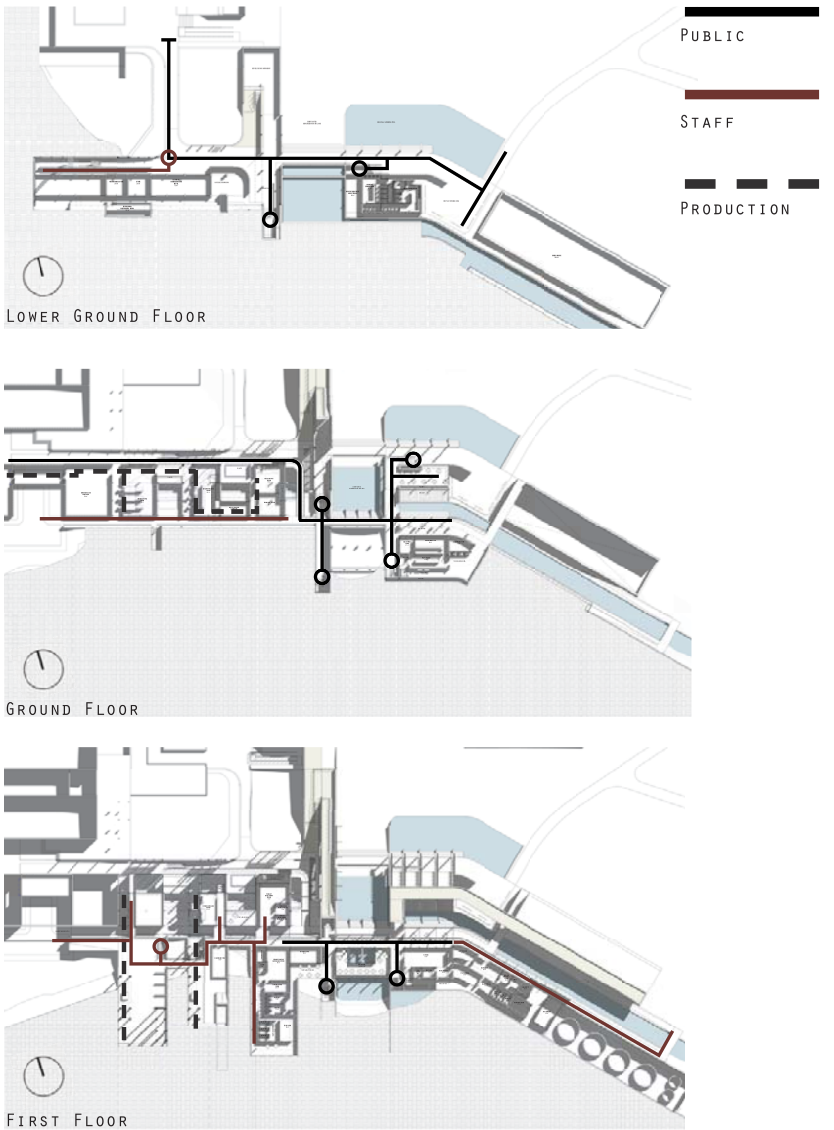


Figure 109. Final design Access and circulation drawings. (Author, 2018)

Production Process

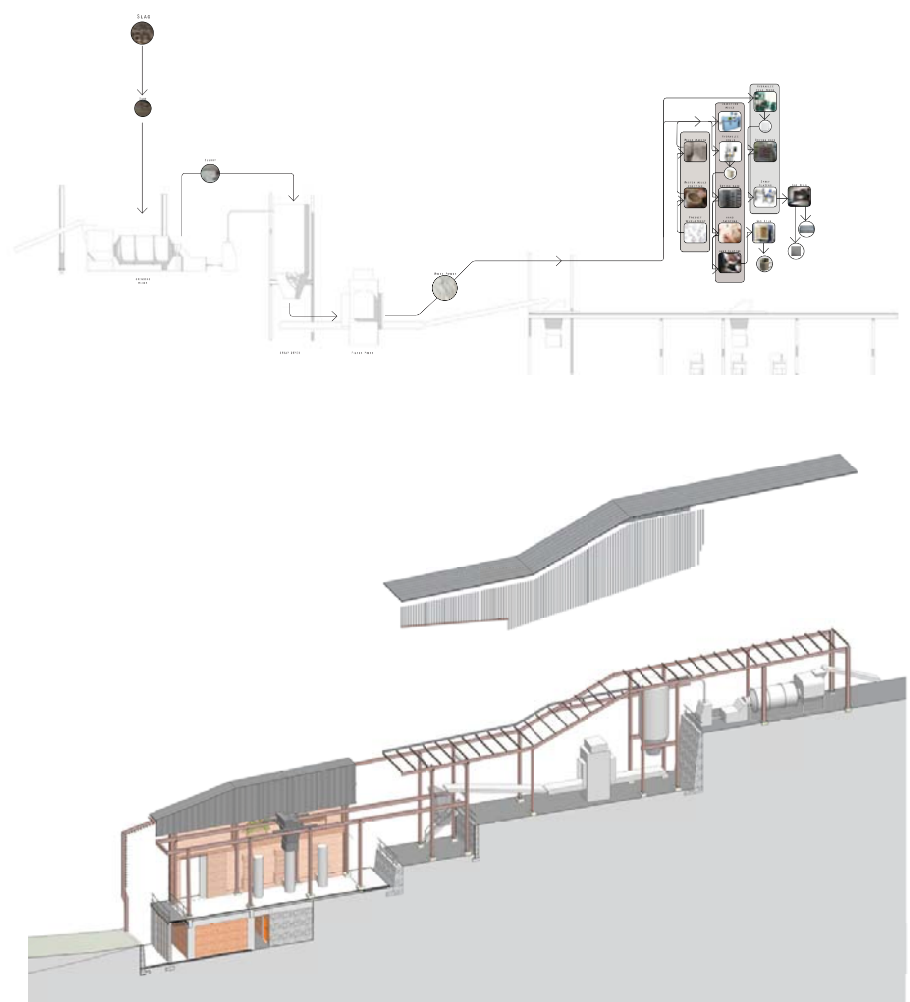


Figure 110. Final design site production process drawing. (Author, 2018)

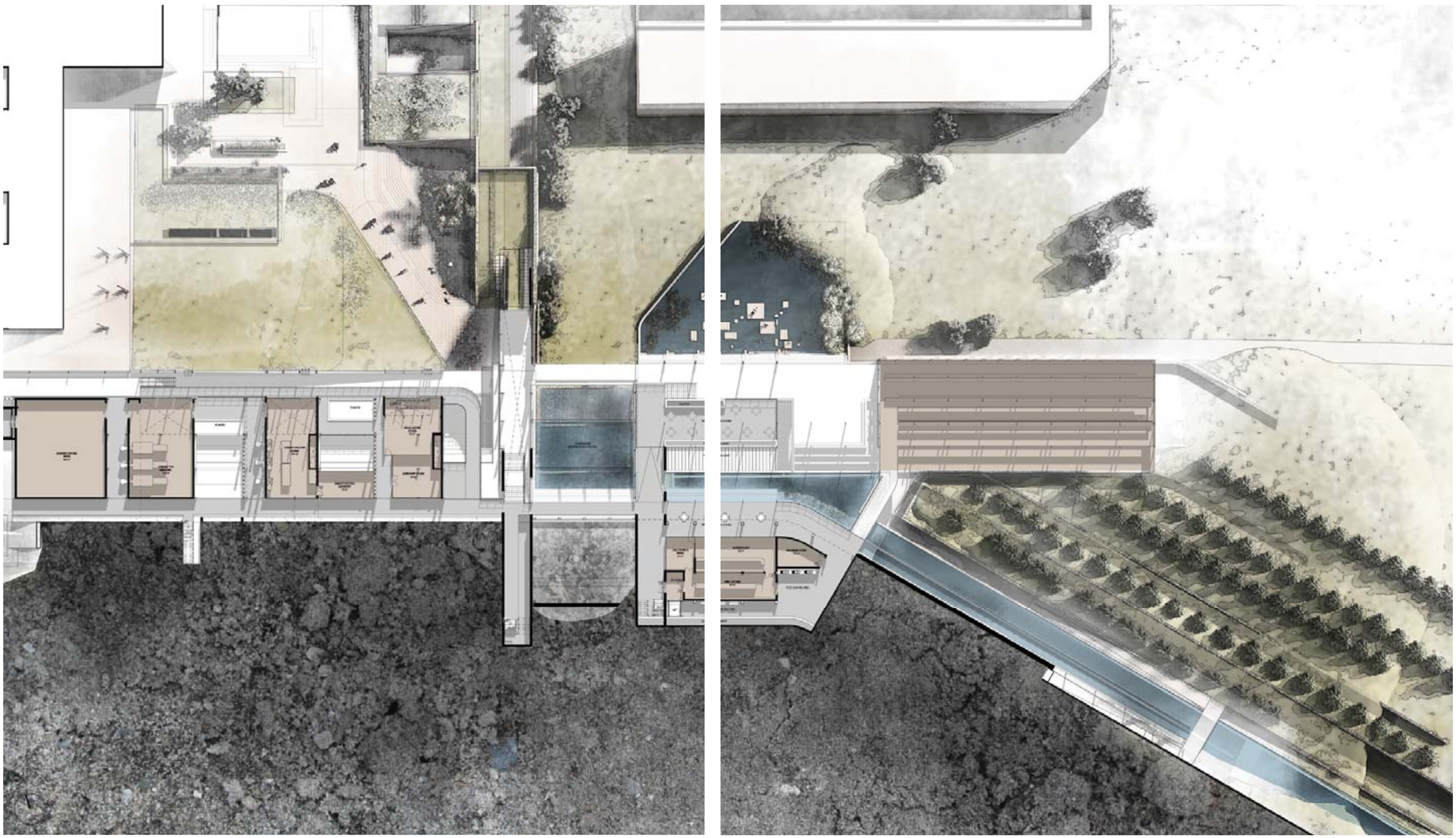


Figure 111. Final design ground floor plan. (Author, 2018)

First Floor Plan

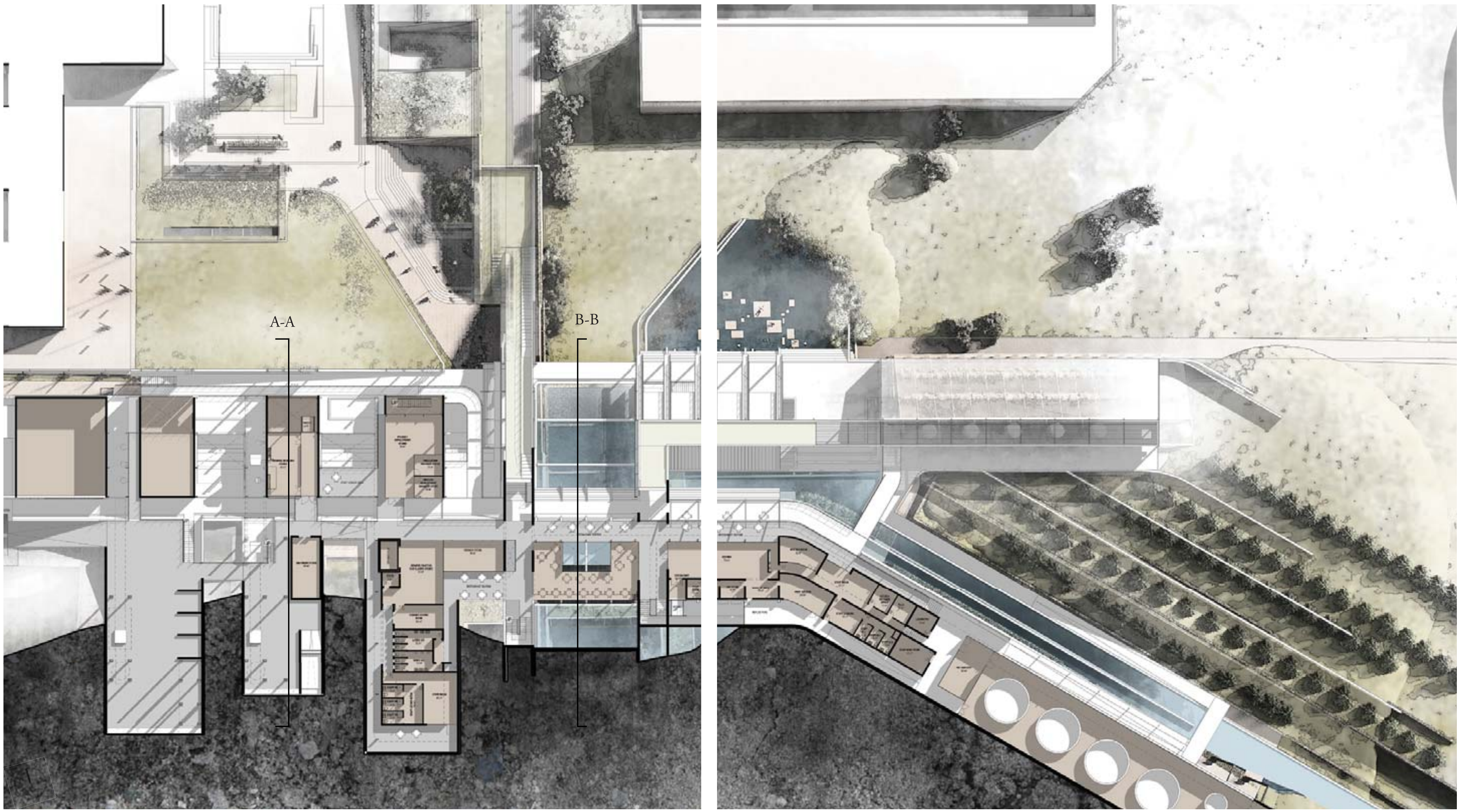


Figure 112. Final design first floor plan.(Author, 2018)

SECTION A-A

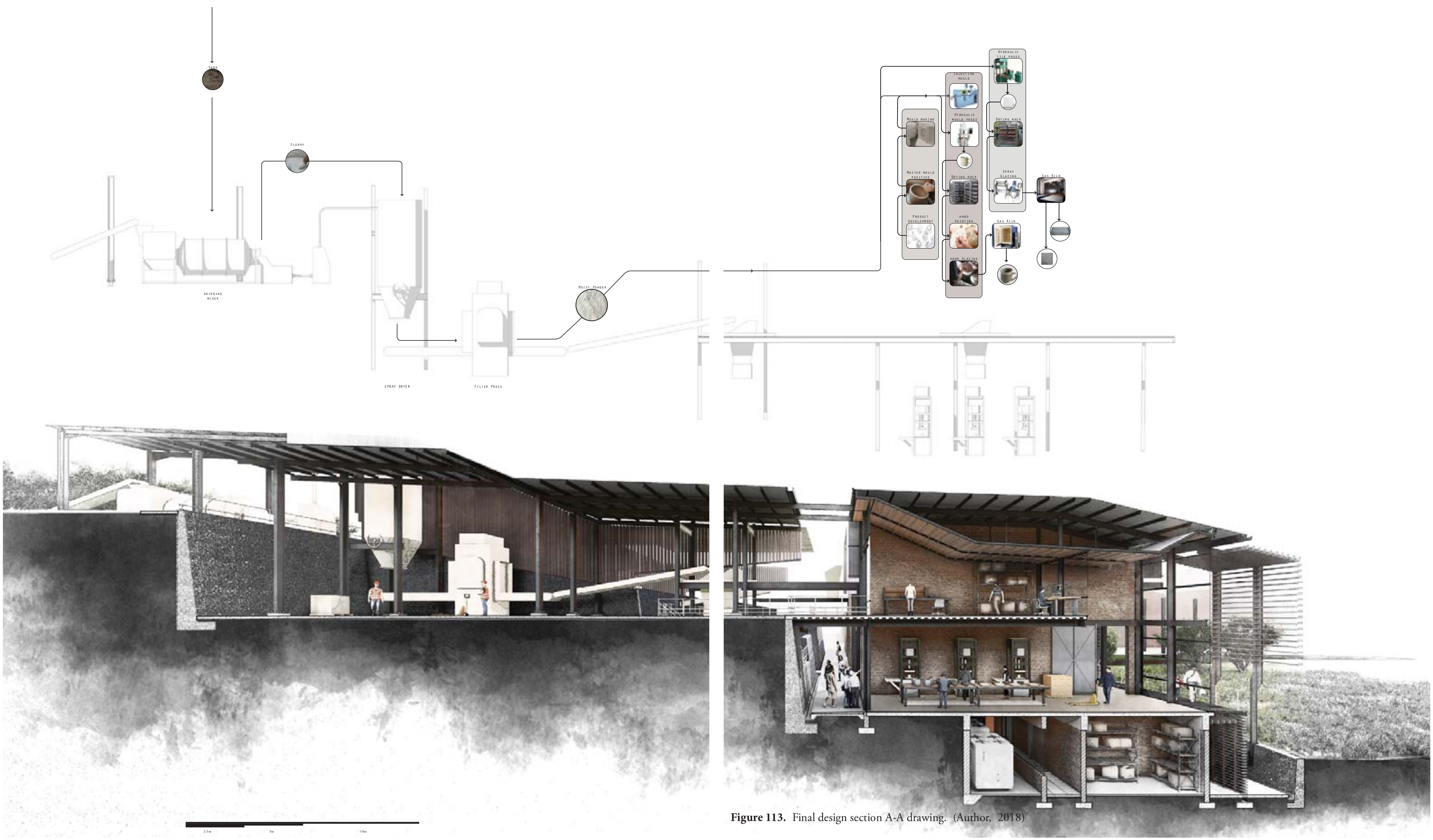


Figure 113. Final design section A-A drawing. (Author, 2018)

SECTION B-B

Figure 114. Final design section B-B drawing. (Author, 2018)

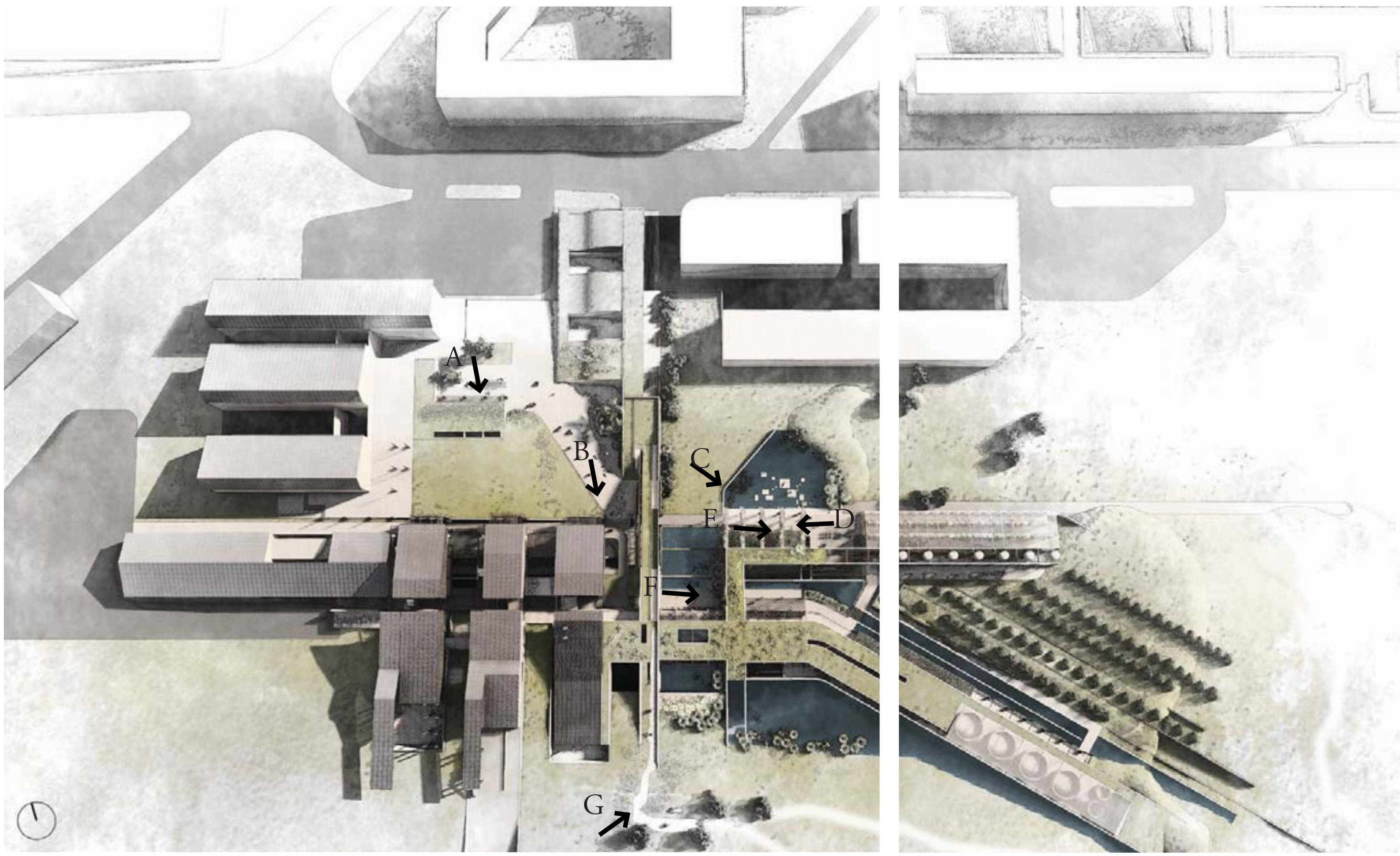


Figure 115. Final design indicating location of perspectives. (Author, 2018)

VIEW A **Figure 116.** Final design Perspective A. (Author, 2018)

VIEW B

Figure 117. Final design Perspective B. (Author, 2018)

VIEW C

Figure 118. Final design Perspective C. (Author, 2018)

VIEW D

Figure 119. Final design Perspective D. (Author, 2018)

VIEW E

Figure 120. Final design Perspective E. (Author, 2018)

VIEW F

Figure 121. Final design Perspective F. (Author, 2018)

VIEW G

Figure 122. Final design Perspective G. (Author, 2018)


Figure 123. Site photo of weathered steel structure. (Author, 2018)

CHAPTER7 Techne

Technical Concept

Introduction

In this section the technical expression of the architecture will be discussed. The technology of the building will be approached as an extension of the design. It will address the technical construction of the design but in a way that transcends mere practicality. The technology will be implemented to facilitate an understanding of the sites embedded narratives through a sensory spatial experience. Furthermore, it will practically facilitate the remediation of the site and establish conditions for sustainable habitation of the site.

The conceptual framework that is used to give expression to the mechanistic and ecosystemic narratives of the site will be extended to give form to the proposed technology. These concepts namely: incisive extraction, extension, and retention will be applied at various scales defining the way the building operates, interacts with its environment and how structural connections are approached. Their purpose is thus twofold in that they facilitate the operation of the building and exhibit narratives of humankind's treatment of the site.

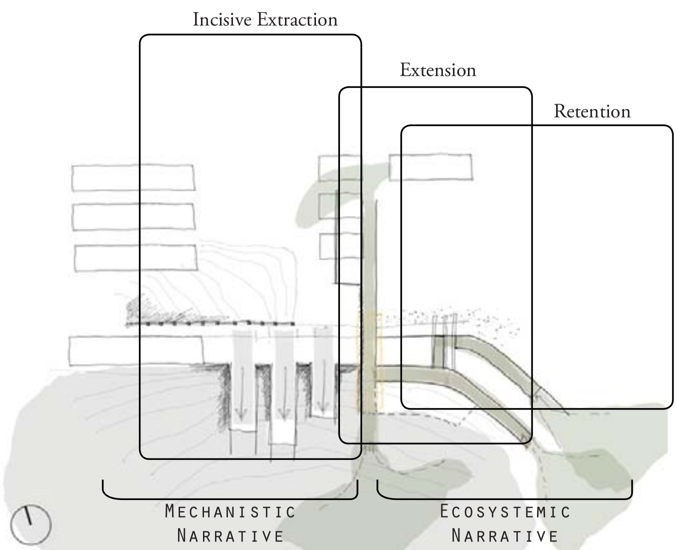


Figure 124. Diagram showing concept locality on plan. (Author, 2018)

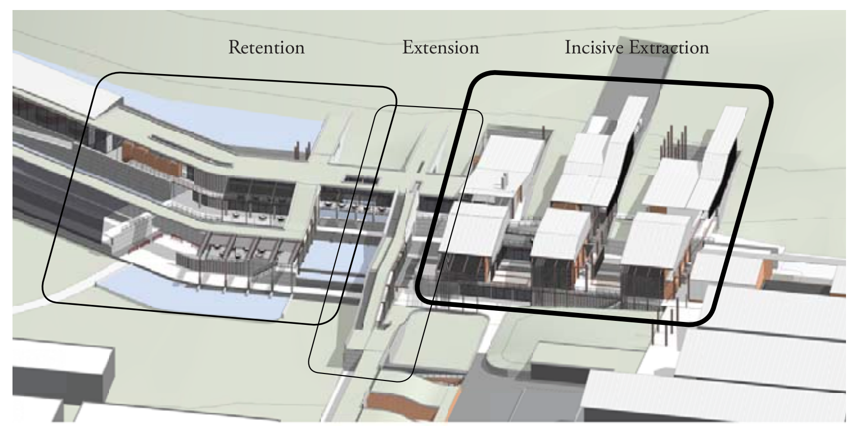


Figure 125. Diagram showing concept locality in aerial perspective. (Author, 2018)

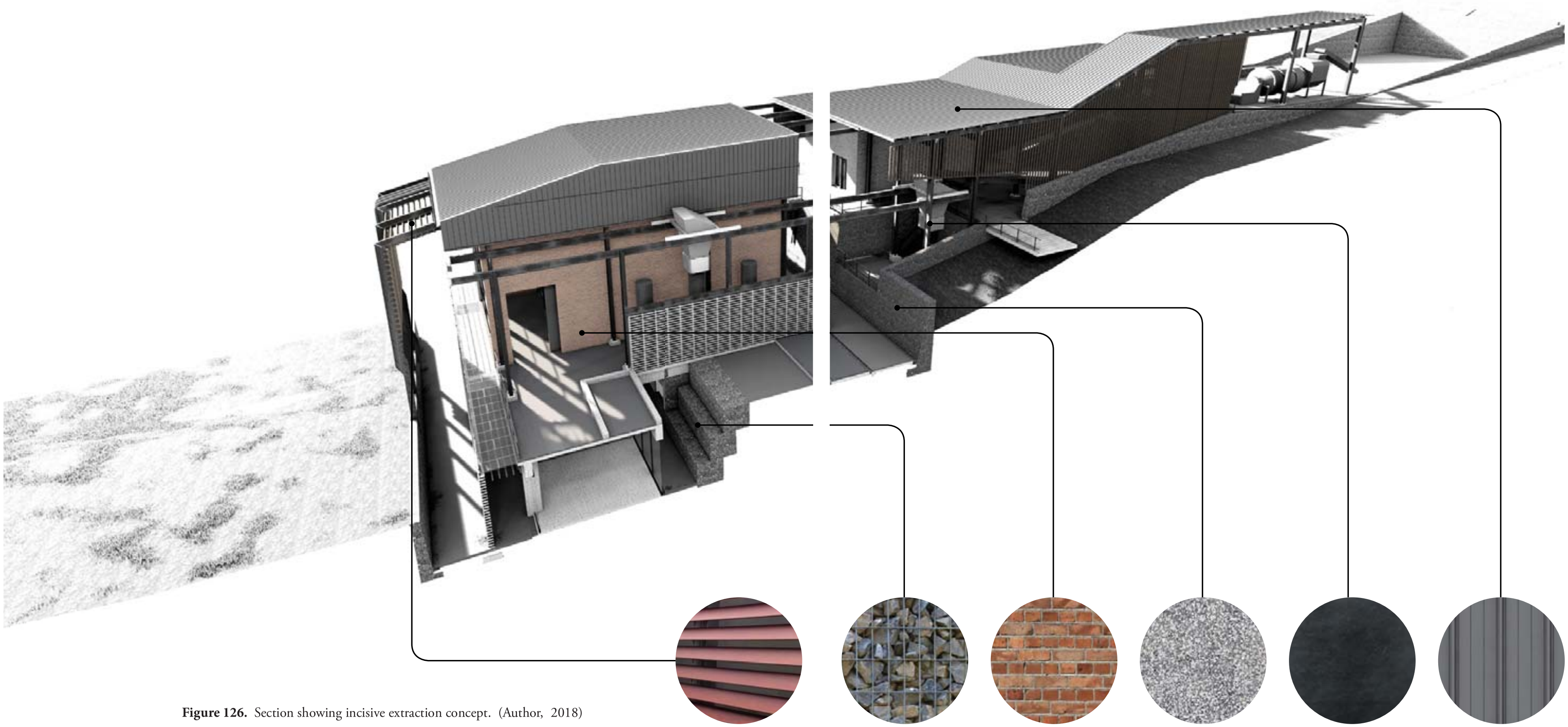


Figure 126. Section showing incisive extraction concept. (Author, 2018)

Incisive extraction

The concept of incisive extraction will give expression to the slag ceramics manufacturing building. It expresses and facilitates the process in which slag is extracted from the environment, as part of rehabilitation, while making reference to the industrial axis and its mechanistic treatment of the environment. Incisions into the landscape will form the base on which the building stands. The lower region of the building is articulated as a stereotomic dominant structure that invades the landscape. This will form a platform for a light steel structure that is articulated to pierce the landscape, exhibiting steel as the source of degradation of the landscape. This theme is further expressed by structures that process, and transport slag to the building. These structures will extend from the incisions and continue alongside the length of the building.

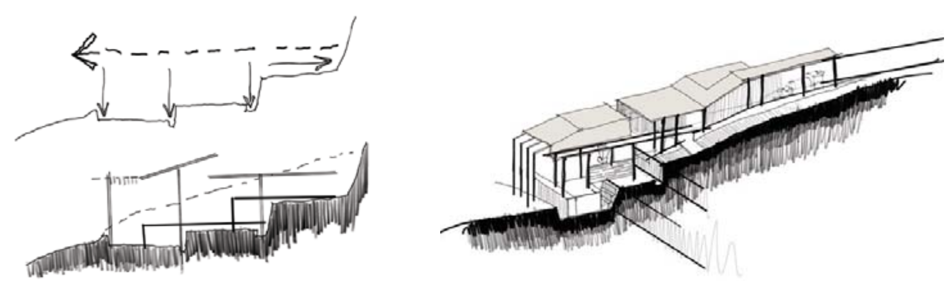


Figure 127. Incisive extraction concept sketch. (Author, 2018)

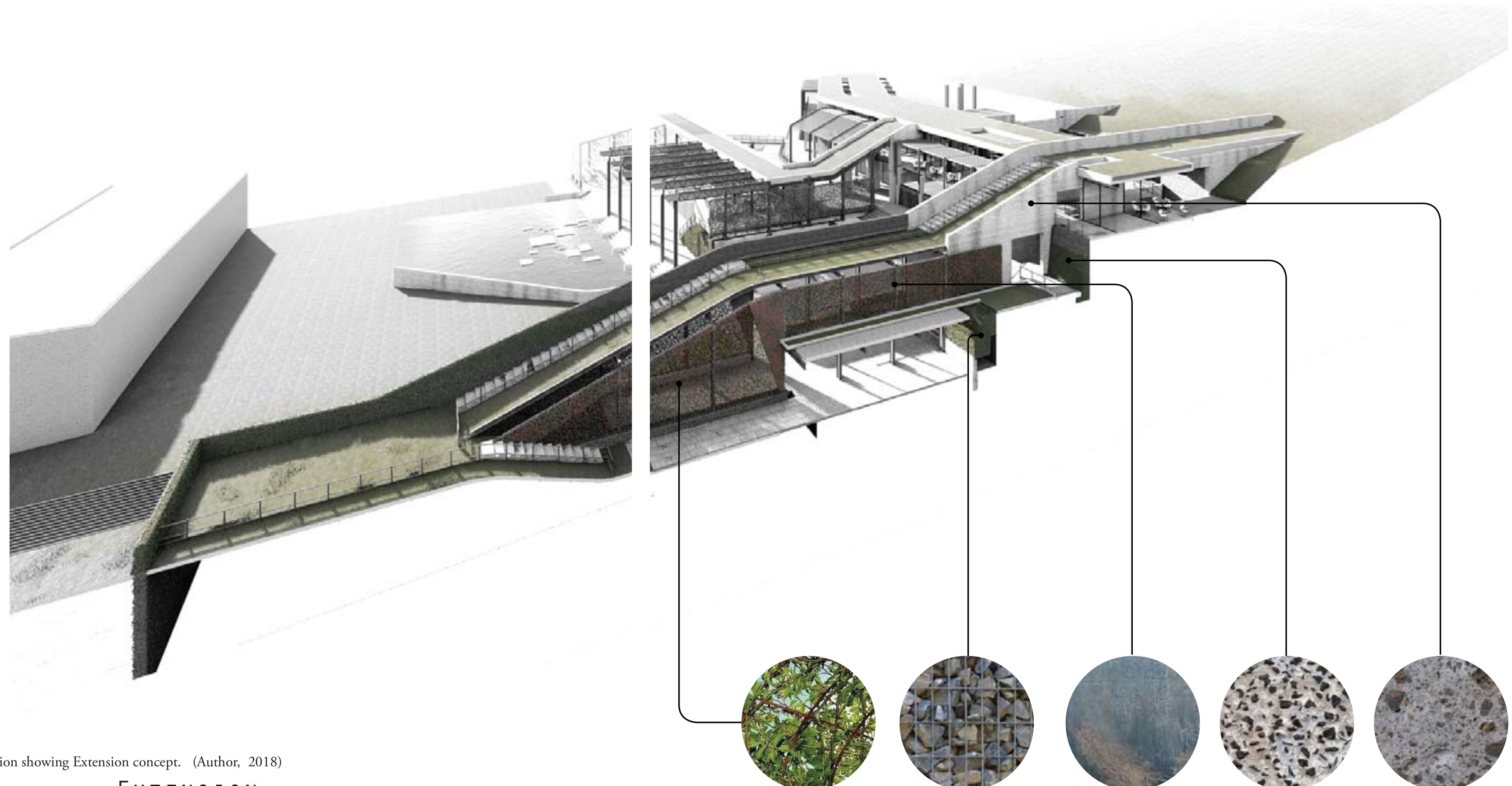


Figure 128. Section showing Extension concept. (Author, 2018)

Extension

The concept of extension will give expression to the technology of spaces that exhibit an ecosystemic relationship with the environment. The landscape will be extended over these parts of the building, forming a roof which is supported by building structures. The technology of these parts of the building will be articulated as extensions of the landscape and will exist in contrast to the incisive parts of the building. This articulation expresses the ecosystemic notion of the mutual inclusivity of humankind and nature. It also celebrates nature elevating it over the building.

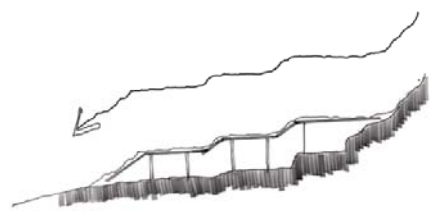


Figure 129. Extension concept sketch. (Author, 2018)

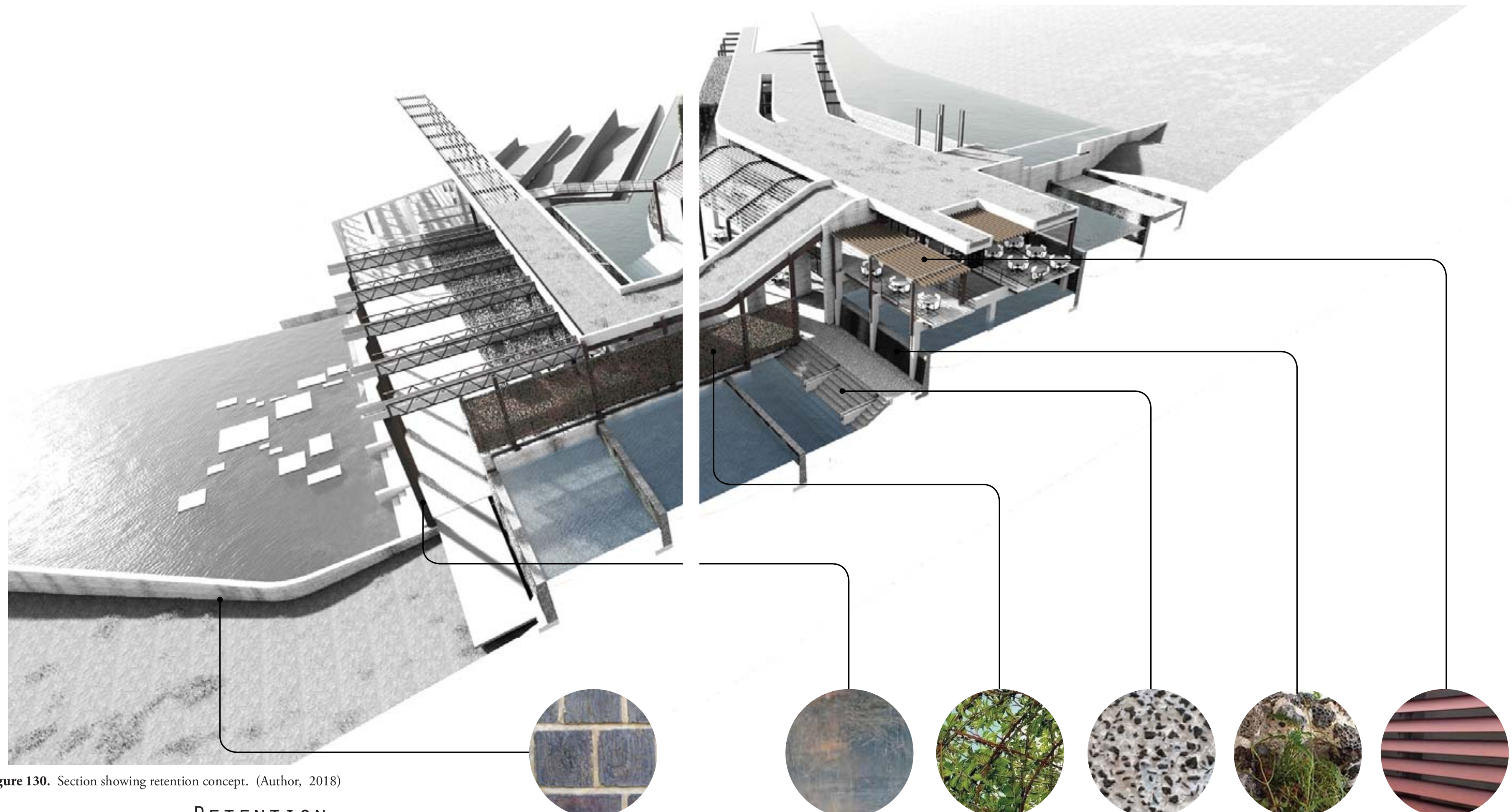


Figure 130. Section showing retention concept. (Author, 2018)

Retention

The concept of retention will give expression to the technology of the water collection system that is intertwined with the building. These structures will collect and retain storm water so that the full potential of the water as a resource for production and remediation can be utilised.

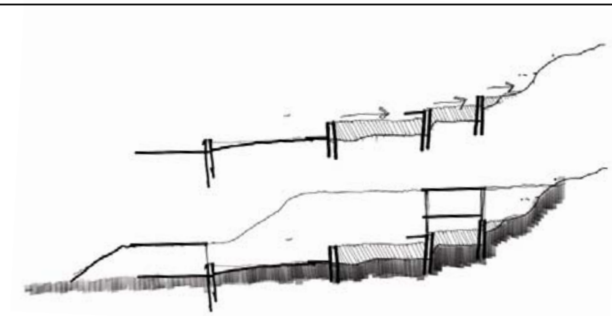


Figure 131. Retention concept sketch. (Author, 2018)

MATERIAL PALLET

Exposed Aggregate Concrete (with varying degrees of roughness)

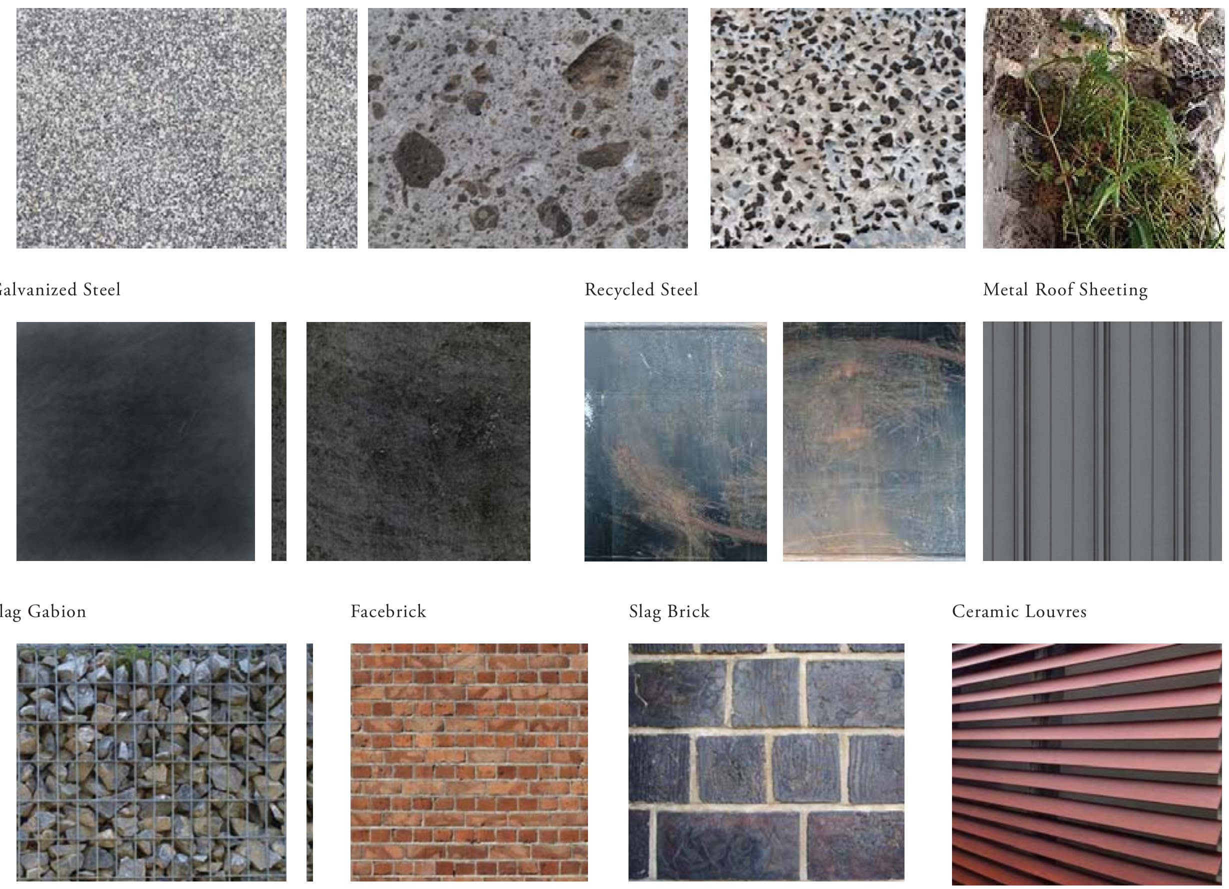


Figure 132. Material pallet illustration. (Author, 2018)

Material Choice Substantiation

The materials that were chosen for the proposed building were selected on grounds of their contribution to the heritage value of the architecture, their conceptual value, and their local availability. Materials play an important role in facilitating a sensory experience of the building's heritage value and the mechanistic and ecosystemic narratives portrayed. The material palate will change as one moves through the building along the industrial axis route. Smooth and ridged materials are used in the portrayal of the mechanistic section of the building and become more porous as one approaches the threshold to the ecosystemic section of the building. From this point materials become porous to the extent that it can host vegetation and become part of the surrounding ecology.

Concrete

Concrete will be used for the construction of structural elements such as beams, columns, and retaining walls. Slag will be used as an aggregate for the concrete thus reducing dependence on external building resources. Parts of the building will make use of exposed aggregate insitu cast concrete. The size of aggregate particles will be controlled to create varying degrees of roughness of surfaces, increasing in roughness towards the east of the building. (the ecosystemic section)

Slag ceramic tiles

Ceramic tiles made from slag will be produced by the building and will be used as a floor finish throughout the building. The grip of the tiles will be varied to differentiate spaces and to create a non-slip surface where it is required

Steel

Steel will be used in the construction of the building but will also be used a poetic device making reference to the steel manufacturing history of the site. It will also be implemented to express the steel making process as the origin of the natural degradation. As mentioned in the urban framework, parts of the steel processing buildings will be demolished to accommodate new development of the region. The steel from these steel frame structures will be reused for the construction of the new building. This reuse of steel will also contribute to the heritage value of the building. The way steel is used will change as one moves through the building. At the mechanistic section of the building steel is used as a structural element that pierces the landscape. At the ecosystemic section of the building steel is used to support the extension of the landscape over the building. This change in use signifies a new approach to the landscape by using steel, a past agent of natural degradation, as an agent of natural restoration.

Facebrick

Red facebrick will be used for parts of the building, making reference to existing buildings on site that are constructed from the same material. Use of this material creates a link between existing structures along the industrial axis and the new building thereby visually situating the building on this axis. Red face brick will specifically be used for the mechanistic section of the building since it is associated with industry on site.

Slag bricks

Slag is a suitable material for the making of fired bricks and concrete blocks. The slag bricks will be produced on site by the proposed brick manufacturing plant that is constructed to initiate the excavation of the slag heap. The building material is thus a product of the rehabilitation of the site. These bricks will be used throughout the building to express the building as a product of the sites rehabilitation.

Ceramic louvres

Ceramic louvres will be produced by the proposed ceramic manufacturing plant. These louvres will be used as shading devices for exterior public areas and for glazed parts of the building.

Sheet metal will be used for the roofing of the industrial parts of the building. Its use makes reference to existing site buildings that use the same material. Steel sheeting from demolished buildings on site will also be used but only as a wall material for areas that don't require a sealed building envelope.

Slag gabions

Large segments of slag will be collected from site and packed in steel wire cages to make gabions. These gabions will serve as retaining structures for parts of the building. The gabions make direct reference to the slag on site and help preserve the presence of slag on site.

STRUCTURE

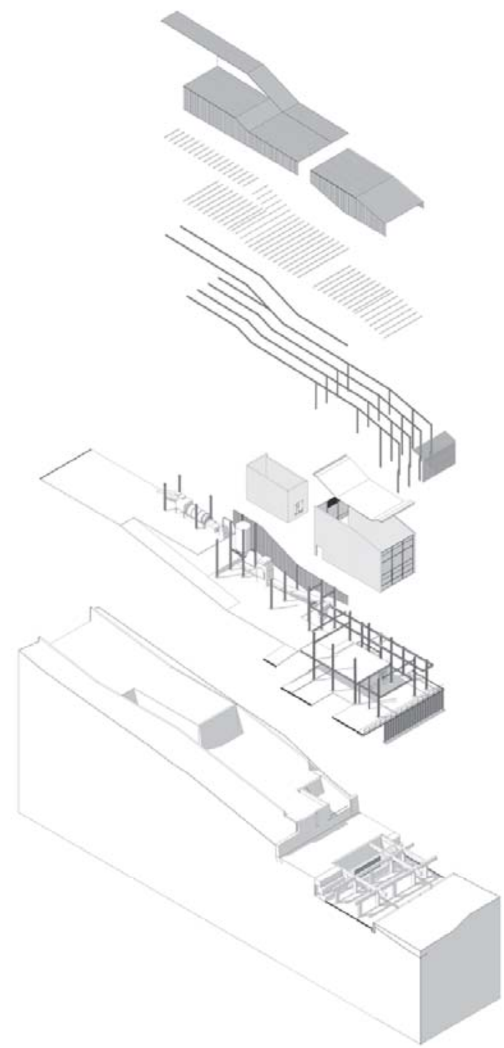


Figure 133. Building structure drawing. (Author, 2018)

DETAILS

Figure 134. Technification section A-A. (Author, 2018)

DETAIL 01

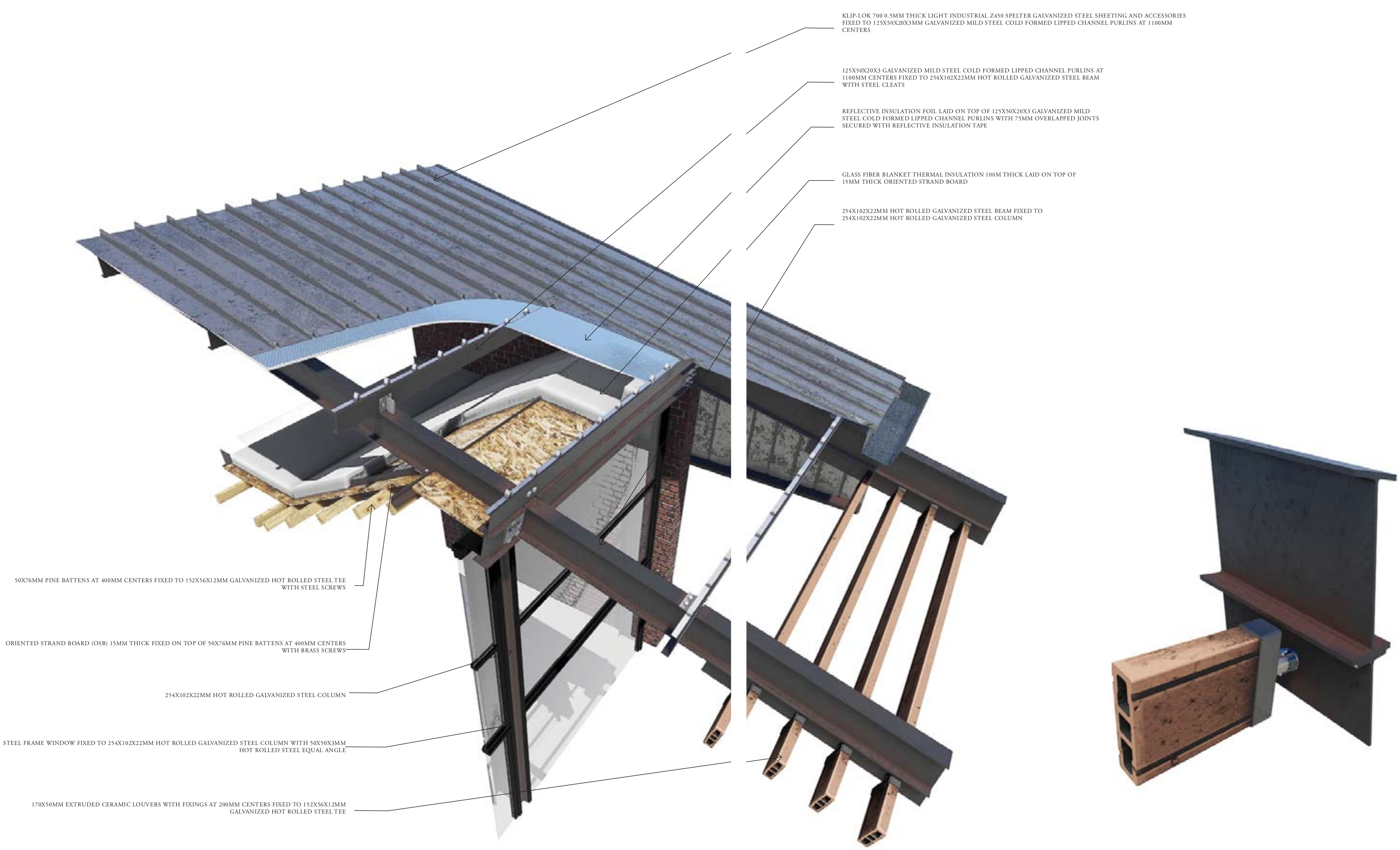


Figure 135. Detail 01 (Author, 2018)

DETAIL 02

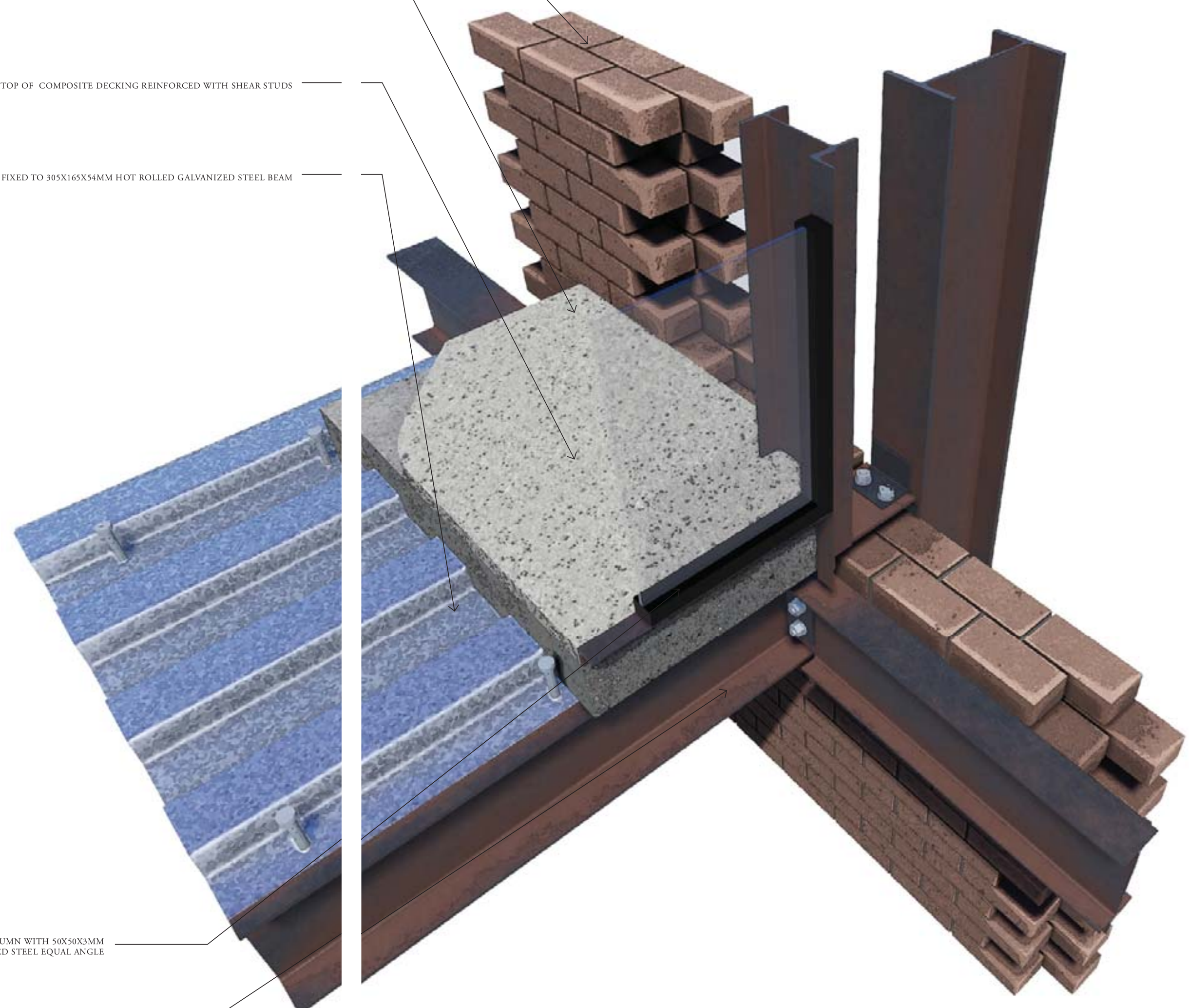


Figure 136. Detail 02 (Author, 2018)

DETAIL 03

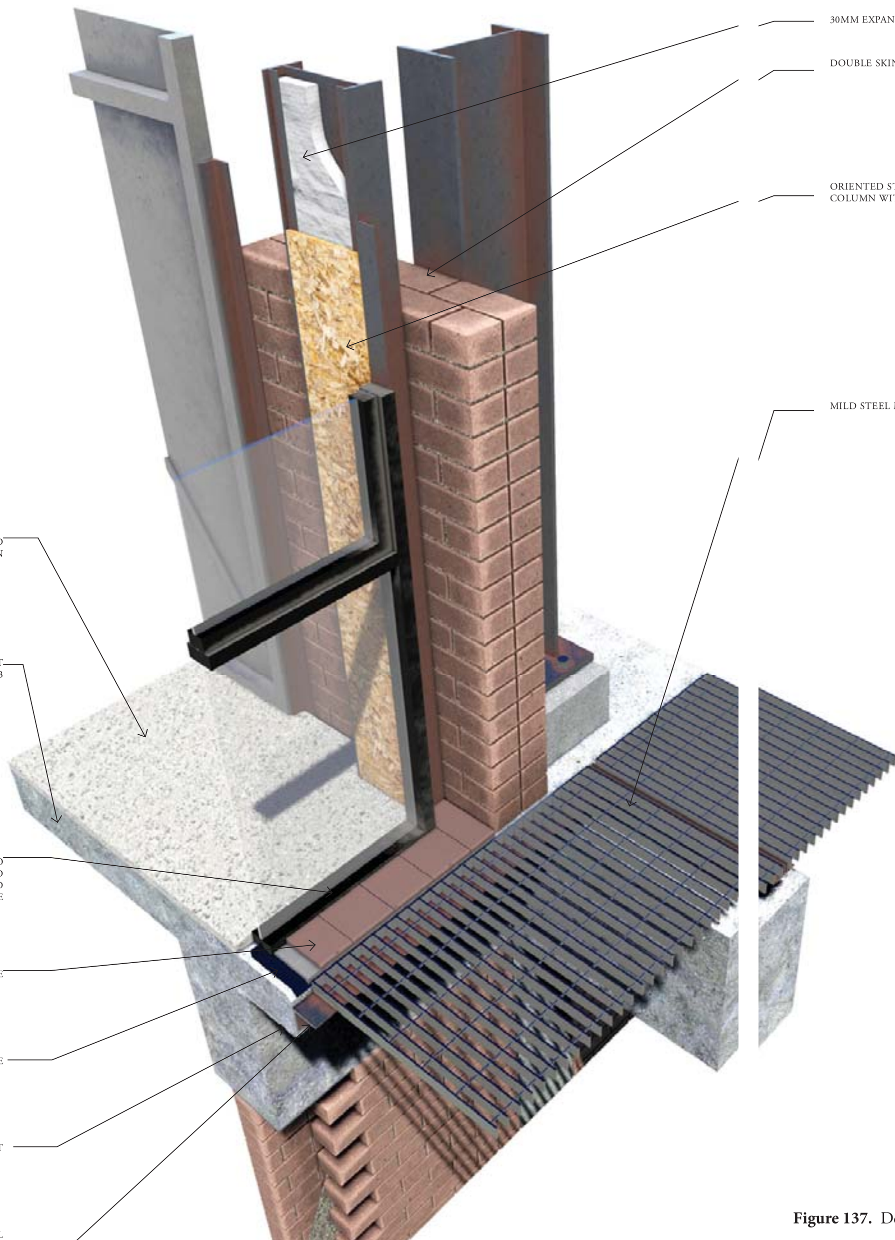


Figure 137. Detail 03 (Author, 2018)

DETAIL 04

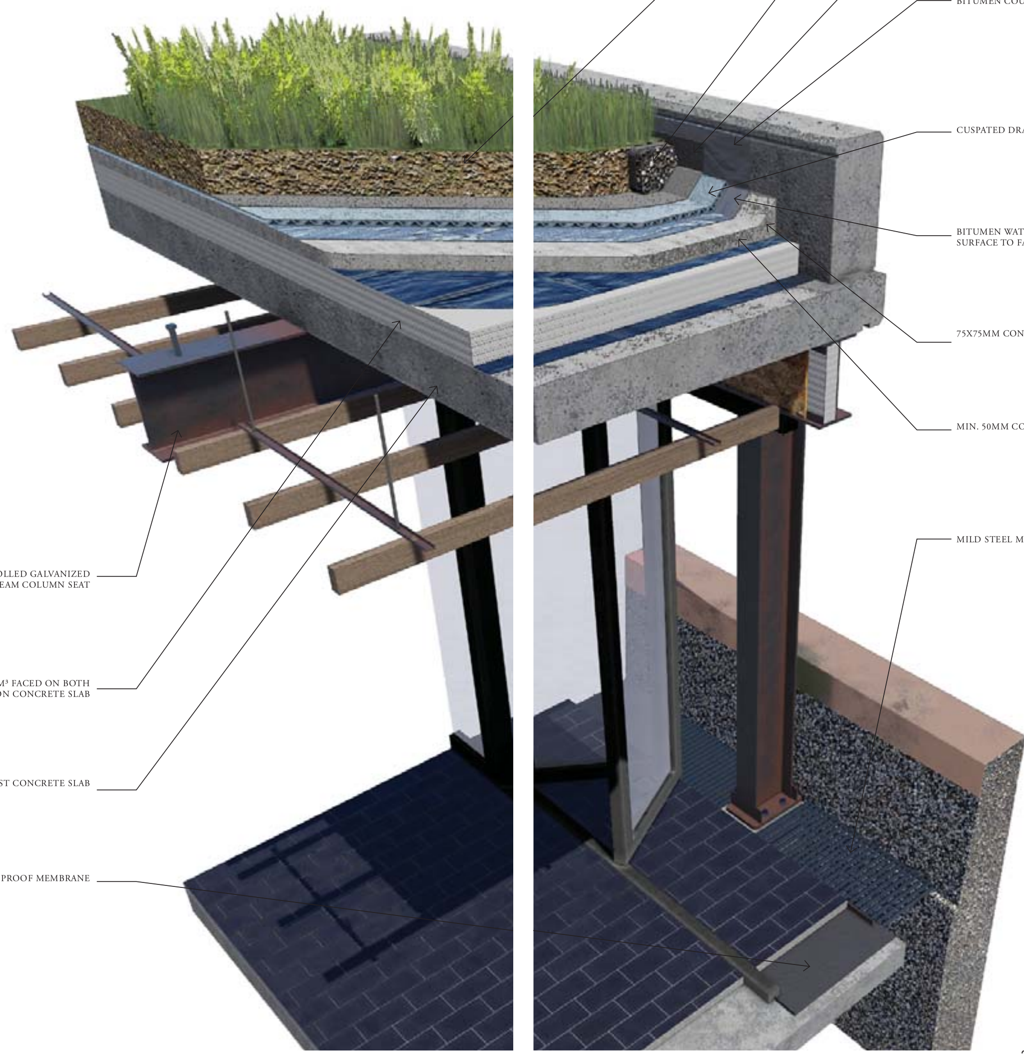


Figure 138. Detail 04 (Author, 2018)

Systems

Water system

The water strategy involves the collection of ground and roof water runoff, and grey water. The water will be used productively for the aquaponics system and the ceramic production process. Water will also be used for irrigation, to re-establish plant species on the degraded site, and for the building's water closets.

Ground water run-off collection

The use of clay soil to stabilise parts of the slag heap will result in greater quantities of ground water runoff due to the reduced porosity of the ground. This water will however still contain metallic oxides from exposure to retained parts of the slag heap. This water is collected by channelling ground water to a reservoir. This water will run through an aerated microbial-remediation filter. The filter hosts specific types of bacteria that break down metallic oxides. The filter requires organic material, to host the bacteria, which will be provided by organic waste from the restaurant. After microbial filtration, water is stored in open reservoirs that function as constructed wetlands. From here water is pumped to elevated tanks that supply the aquaponics system and ceramic manufacturer with water.

Grey water Collection

Grey water is collected from basins and showers. Water is stored in an underground tank after passing through a grease trap. Collected water is pumped to an elevated tank that supplies the buildings water closets.

Roof water runoff

All water collected from sheet metal roofs will be passed through a bio filter consisting of layers of sand and gravel. This filtration system is integrated in the design of the planted roofs. Water collected from the planted roof will thus be purified by the gravel and sand layers that host vegetation. All collected water is further purified using a uv filter, and pumped to an elevated tank that supplies potable water to basins.

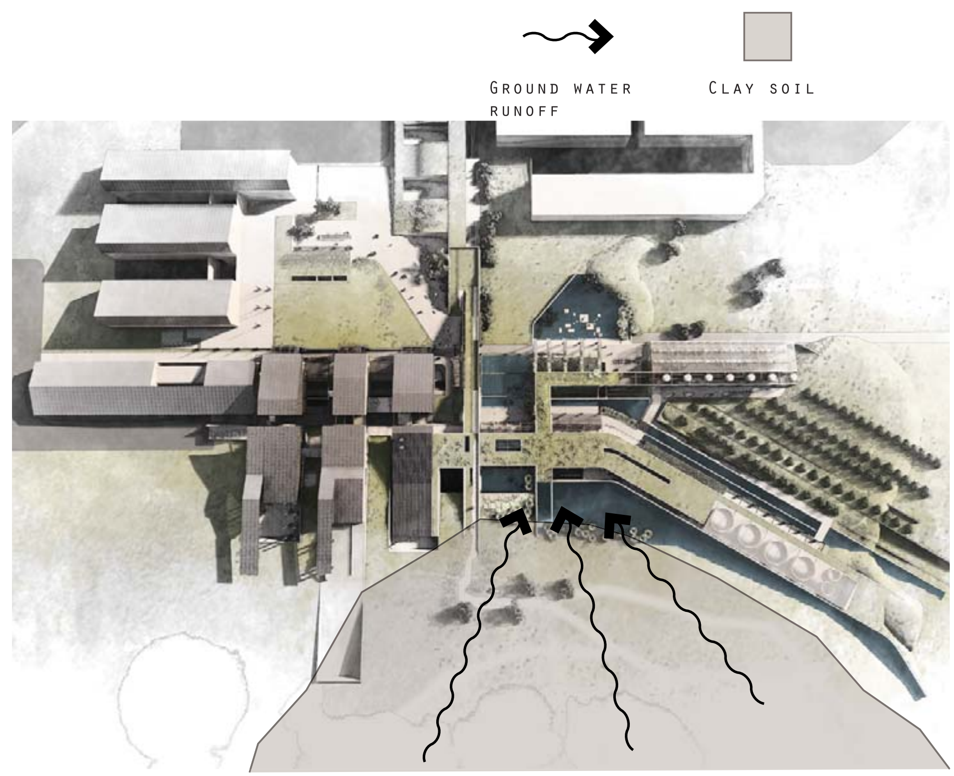


Figure 139. Plan diagram showing water collection sources. (Author, 2018)

Figure 140. Section diagram showing water system. (Author, 2018)

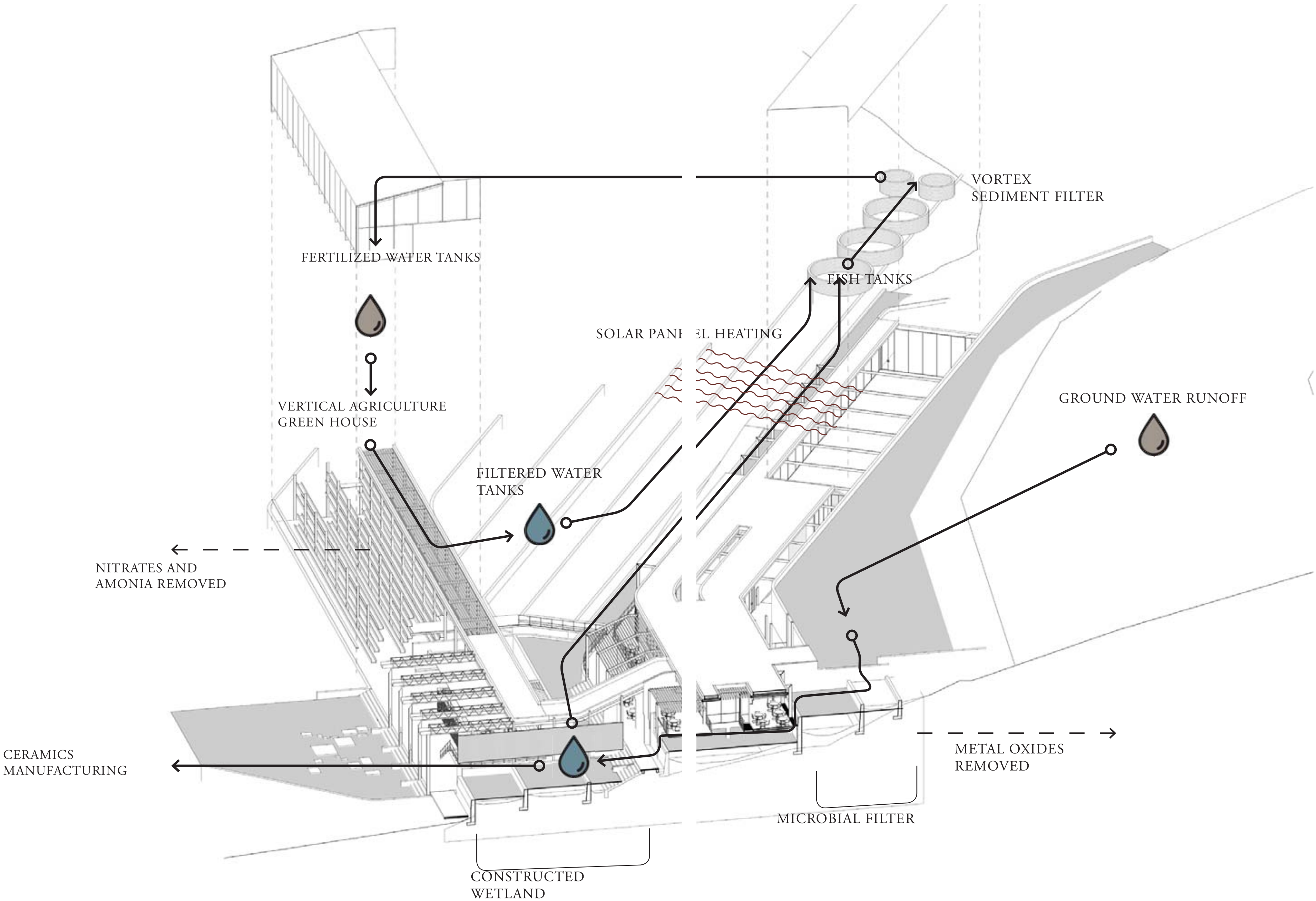


Figure 141. Section diagram showing water system. (Author, 2018)

Geothermal Heating/ Cooling System

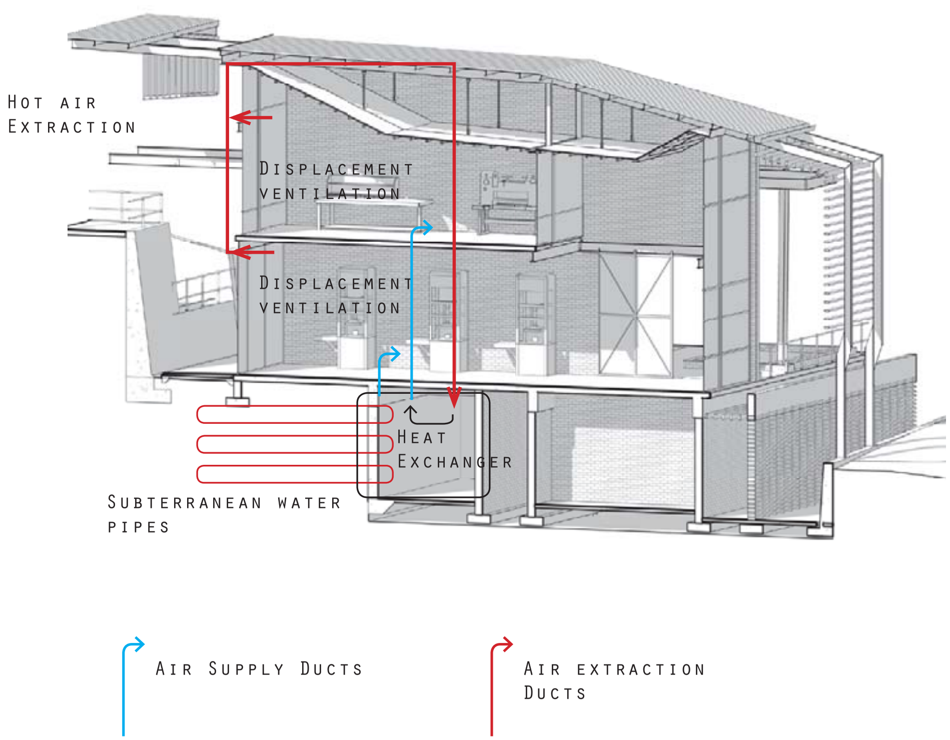


Figure 142. Diagram showing geothermal environmental comfort system. (Author, 2018)

Chapter 8 Conclusion

Conclusion

This dissertation was aimed at establishing a new approach to rehabilitation at the Pretoria Metal works that conserved the sites industrial heritage while remediating natural degradation. It challenged the idea that rehabilitation should entail the removal of all evidence of past industry and questioned conventional rehabilitation's success in re-establishing ecological complexity. A study of the evolution of industry revealed it as a product of a mechanistic thinking. It was determined that an ecosystemic approach was necessary to address the residual impact of mechanistic industry and propagate a social environment in which humankind revered itself as part of the natural environment and its ecosystems. Regeneration and biophilia were identified as appropriate theories that could be applied to remediate degradation and propagate new symbiotic relationships with the natural environment. Heritage theory was also visited which revealed the significance of industrial heritage and conservation strategies that could be applied. It was found to be congruent with biophilia and regeneration theory in its understanding of human artefacts as part of the ecosystem.
These theories were synthesised into an alternative rehabilitation strategy in which rehabilitation would become a resultant by-product of continued site productivity. This strategy was aimed at restoring a reverence of nature through sensory experience and establishing symbiotic operational exchanges between building and site. It was also aimed at conserving heritage by making it accessible to the public and exposing the value of industrial heritage. A design approach was developed that sought to facilitate an understanding of the evolution of place by exhibiting the narrative of how the site, in its degraded state, came into being. It referenced industry, within a mechanistic worldview, as the source of degradation and demonstrated the remediative potential of an ecosystemic approach to development. The architecture demonstrated how productive buildings can actively remediate a site while facilitating proximity to nature and exposing site narratives and heritage value.
This dissertation provides an approach to rehabilitation that can be applied to other post-industrial sites where tension exists between rehabilitation and heritage conservation. It demonstrates the potential of architecture to become an agent of remediation and challenges the idea that human artefacts need to be removed from the environment to attain remediation. It also provides an example of how architecture can engage with and expose implicit heritage value and create a sensory understanding of place.

Final Presentation 21 Nov.

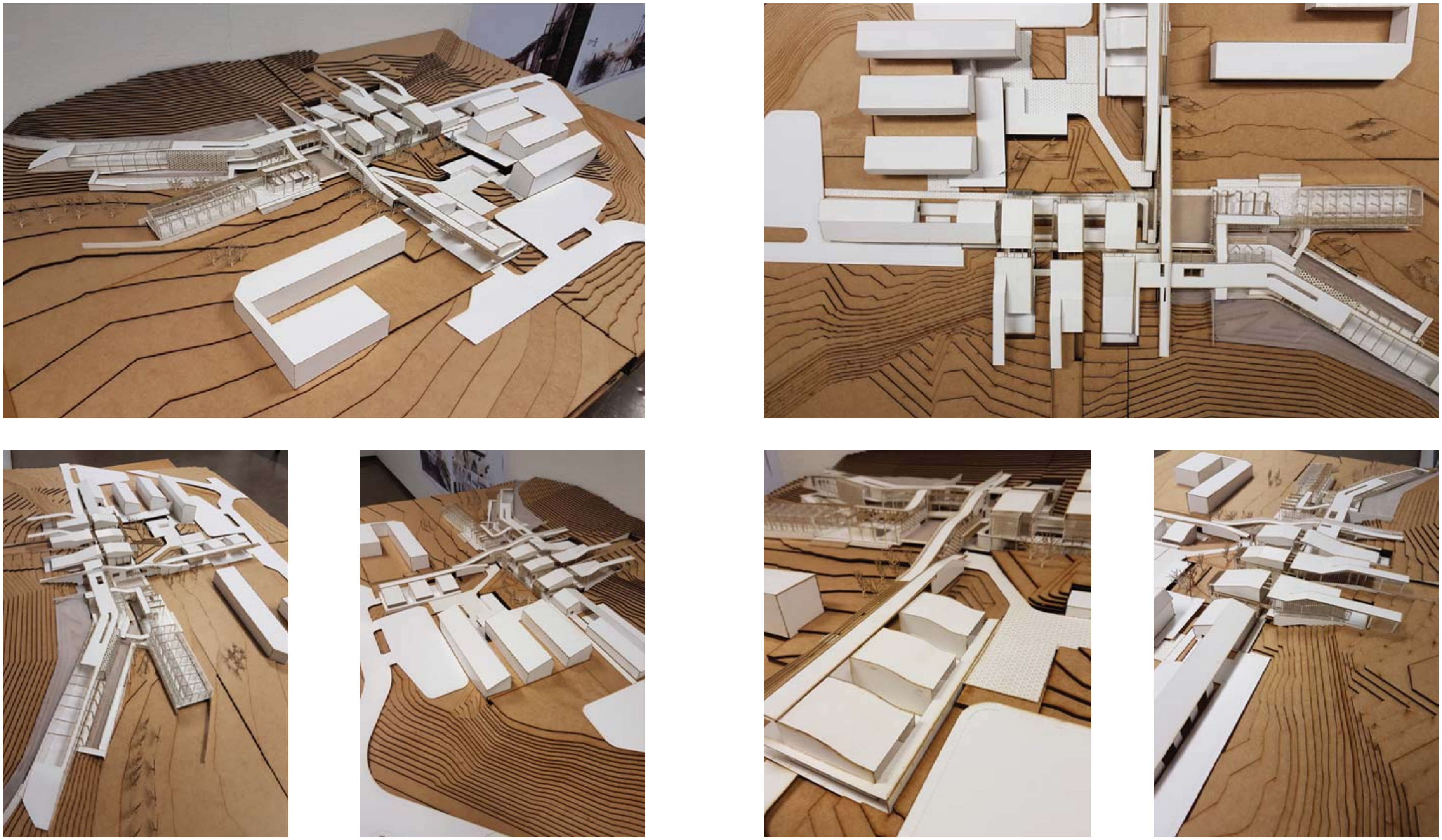


Figure 143. Final model. (Author, 2018)

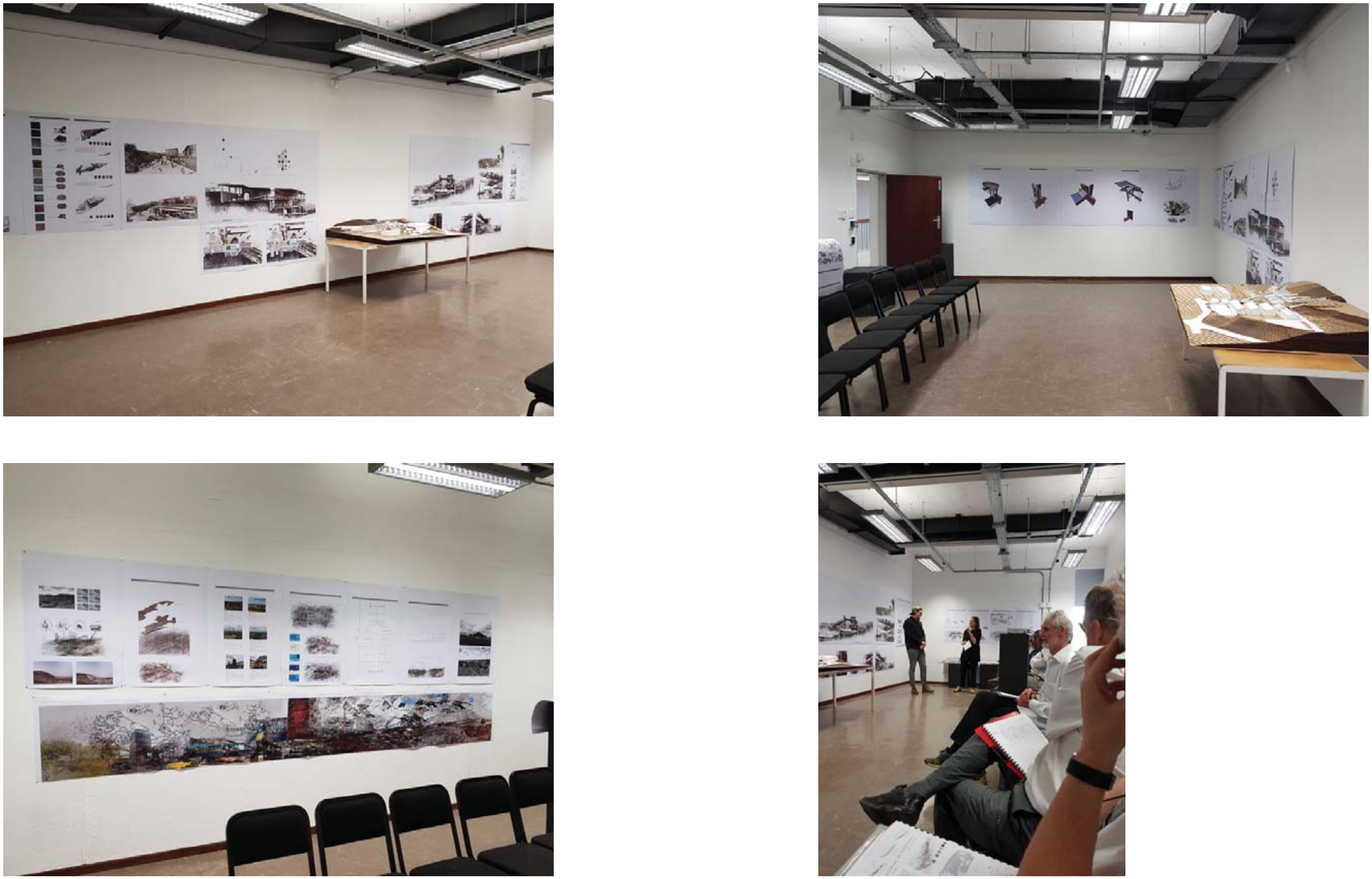


Figure 144. Final pin up. (Author, 2018)

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