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an architectural design dissertation by Ingmar C. Büchner

LATENT POTENTIAL: A POST-INDUSTRIAL ARTEFACT

[RE]GENERATING RESOURCES FROM A DEPLETED QUARRY

ARCHITECTURE AS INTERFACE OF EXCHANGE BETWEEN PEOPLE AND RESOURCES

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By **Ingmar C. Büchner**

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

Department of Architecture,
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University of Pretoria
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Programme: Integrated Natural Resource Facility
Site description: The old Rosema & Klaver clay quarry & brickworks, located between the suburbs of Monument Park & Waterkloof Ridge.
Site Location: Waterkloof 428-JR Pretoria
Address: Skilpad Rd, Monument Park, Pretoria
Coordinates: 25°48'25.64" S; 28°14'16.84" E, elev. 1479m

Research Field: Environmental Potential + Heritage and Cultural Landscapes

Client(s): The Department of Agriculture, Forestry and Fisheries (DAFF)
The Tilapia Aquaculture Association of South Africa (TAASA)
The Council for Scientific and Industrial Research (CSIR)

Keywords: Post-industrial, integrated aquaculture, resilience, regenerative, industrial heritage

Architectural Theoretical Premise:
Resilience and Regenerative theory is synthesised with that of Industrial Heritage, to formulate an appropriate theoretical premise for the regeneration of post-industrial latent artefacts.

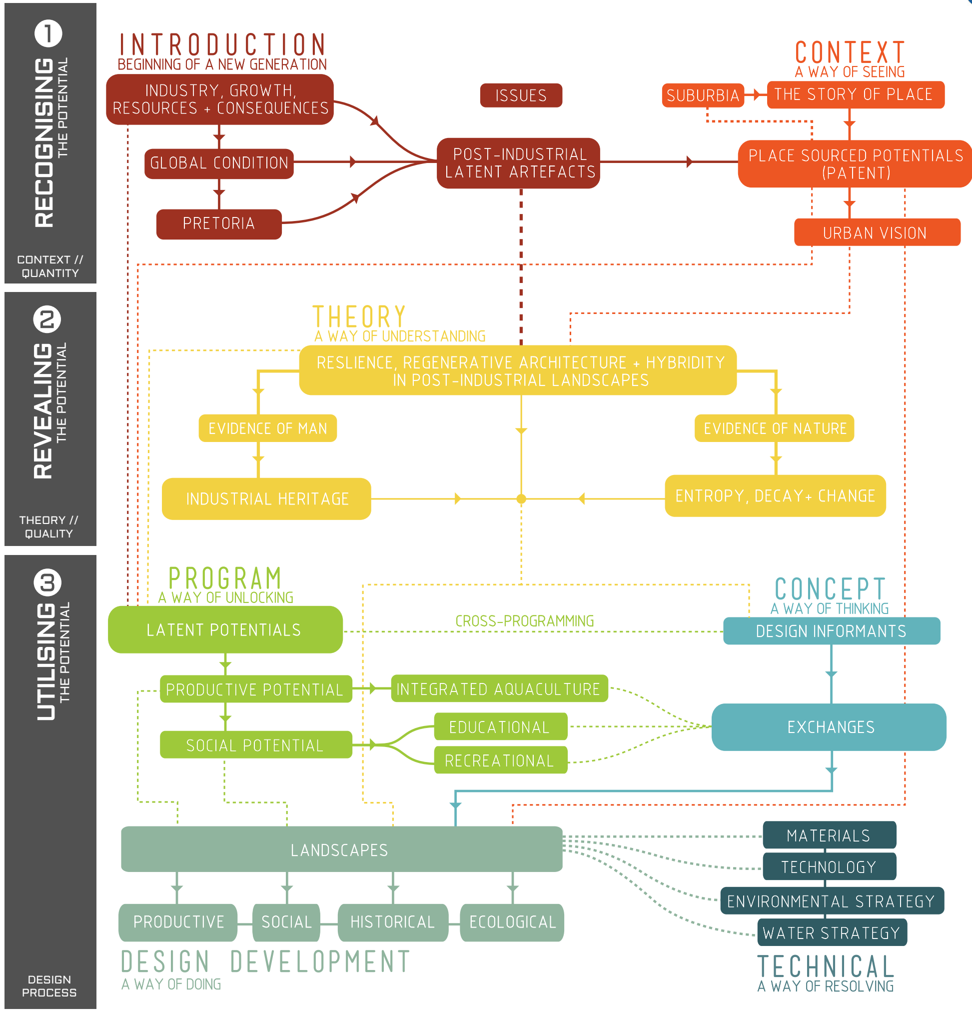
Architectural Approach:
The exploration of Regenerative Architecture as a means of re-imagining the potential of a Post-Industrial Latent Artefact to act as a spatial interface between people and resources

ABSTRACT

The continuing industrialisation of global society, specifically in developing countries, has resulted in the ongoing extraction of the earth's resources to feed the ever increasing demand for economic growth. What will happen when resources become scarce and unobtainable? What will happen when population growth becomes unmanageable? What will happen when the quality of life becomes displaced by the quantity thereof? The effects of such exploitation are already evident, and the longer solutions toward growing global populations and diminishing natural resources are postponed, the bleaker the future for modern human civilisation becomes. Many tipping points are being approached; some have already been passed. Now is the time to innovate and to find alternatives, as ways to redefine the relationships between people and resources.

This dissertation is an investigation of a post-industrial artefact, an obsolete clay brick quarry and brickworks amidst the suburbs on the southern edge of Pretoria. It has undergone constant changes over the last century and quite noticeably during the last decade, as it lies latent in its obsolescence. The effects of time can be observed in the natural processes of decay, entropy and change, as well as in human development and growth. The history imprinted onto the site tells us about the dynamic patterns and relationships between man and his natural environment, seen in this now Post-Industrial Latent Artefact (P.I.L.A.), and hints toward a path for its future. The principles of Regenerative Design are employed to assist in finding and utilising potential within the P.I.L.A. A new life for the site is found by accessing its inherent potential, while the importance of Industrial Heritage is acknowledged. The programme, as latent potential, is generated through the uncovering of the site's patent potentials, in response to global resource concerns and urban resilience. The architectural design is generated through the conceptual basis of exchanges between knowledge, heritage, the social, the bio-physical, the programmatic, and the tectonic. A social spine is intersected and paralleled by areas of new production, in contrast with areas of historical production, which are all supported by an enhanced ecology and tied together into a new synthetic landscape.

For my parents and their abundance in love and care.



00 Preface

Part 1 – RECOGNISING THE POTENTIAL // QUANTITY

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RECOGNISING

THE POTENTIAL // QUANTITY

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CHAPTER 1:
THE BEGINNING OF A NEW GENERATION

INTRODUCTION

1.1 INDUSTRY, GROWTH, RESOURCES + CONSEQUENCES

"... [N]ature ... a certain appreciation for what it represents; that we come from nature and we have to understand what it is, so [as] not to harm it and ultimately harm ourselves. There is an importance to have a certain reverence [for] what nature is, because we are connected to it and we are part of it, and if we destroy nature, we destroy ourselves. Maybe the new landscape of our time ... is the landscape that we change. The one that we disrupt in pursuit of progress ... [L]ook at the industrial landscape as a way of defining who we are and our relationship to the planet. It is this thing that is growing, and it is part of our economy, it is part of our politics, and it's a part of how we elect our governments, it is part of everything we do. It is this big machine that started rolling ..."
(Edward Burtynsky in the documentary Manufactured Landscapes, 2006)

1.1.1 GLOBAL CONDITION

Since the Industrial Revolution and the onset of globalisation, the human population has experienced unprecedented growth and great technological and economic advancements. After 1760, hand-production methods shifted to new machine manufacturing processes (Ashton, 1948:1). The improved quantities, efficiency and speeds at which industries could operate were a major landmark in the historical progress of humanity, and set a path toward a long period of exponential growth (Ashton, 1948:3). During the late 19th century, globalisation allowed for this phenomenon to spread across the entire globe, and its effects can now be seen everywhere, in the sizes of our cities and the exploitation of natural environments for resources. The critical flaw is that continued economic growth is not sustainable, if at all even possible. It is becoming accepted that "our foreseeable futures will not be like our recent pasts", and according to "leading analysts of all the major resource domains – water, food, material resources and energy – our global industrial and financial models, based largely on the assumption of endless growth, are taking human societies to the brink of a series of chronic shortages and insecurities" (Goodbun, Till & Iossifova, 2012:8).

With increasing global populations, estimated to reach 8.9 billion by the year 2050 (United Nations, 2004:4), and with current concerns for resource availability, the approach of peak oil reserves being depleted, dwindling global economies, climate change, the disappearance of natural eco-systems and oceanic fish stocks, the future stability of civilisation seems to be at risk, and resource security will become a major issue. A new world-view of the human habitat is necessary to influence the planning of cities and the design of buildings. In the Stockholm Resilience Centre's "Planetary Boundaries Framework" a set of nine planetary boundaries are described, three of which have already exceeded their tipping points – "climate change, biodiversity loss, and nitrogen levels" – and another three that are very close to exceeding their limits: "ozone depletion, ocean acidification and land use" (Stockholm Resilience Centre, 2009). These benchmarks are only an interpretation of existing data, therefore the "existing systemic stresses are expected to transform and intensify in unpredictable ways as a result of climate disruption and ecosystem shifts" (Goodbun et al., 2012:8).

Humans have always been dependent on natural systems for producing food and energy resources, and to manufacture products to drive economies. The modernisation of global society can be seen as an attempt to become distanced from nature, often displacing it in favour of vast urban developments, reserving it only for its resources, and discarding any other value it might hold for humans. Therefore the need exists for humans to pursue a state of urban resilience, to either adapt to or absorb inevitable change, and to break away from static and fragile configurations.

It could be possible to develop an alternative model for the relationship between people and natural resources through regenerative development, which aims to simultaneously maintain healthy social, ecological and economic systems, This model would also contribute to the resilience of an urban system by improving its capacity to absorb and adapt to future disturbances.

1.1.2 POST - INDUSTRIAL LATENT ARTEFACTS (P.I.L.A.'S)

While there are general consequences associated with industrialisation, such as resource scarcity and effects on the biophysical environment, there are much more patent, physical consequences of industrialisation, and more specifically of post-industrialisation. Once an industry has ceased to operate, the resulting process of decay and the infiltration of "industrial-nature" (Tempel, 2012:146) is initiated. Manufacturing technologies become obsolete, mines and resources become depleted, socio-economic conditions change and industrial cities are abandoned. "Once behemoth structures at the social and economic heart of industrialisation, these buildings now lie in ruins" (Mah, 2012:3). There are many reasons why an industry might cease to exist, but the consequences and remnants thereof are more often than not persistent.

These consequences are known as: brownfields, manufactured landscapes, industrial landscapes, manufactured sites (Niall, 2001) and post-industrial latent spaces (Allen, 2012:157). Our cities are littered with industrial remnants, legacies which reveal our dependence on resources. These histories of extraction, destruction and manipulation of landscapes ultimately lead us onto a path toward an inevitable resource crisis. The effects of time and nature start manipulating these industrial remnants, "the layers of human detritus peel away and materials and structures begin a temporal existence abstracted by time" (Allen, 2012:157).

For this dissertation, the term "artefact" has been assigned to the concept of all industrial consequences, not as an archaeological notion, but as a way to directly link them to their origin - as man-made, and as the consequence of man's dependence on resources. By recognising the many industrial remnants in cities as being the direct results of human action, especially that of manufacturing and resource extraction, it becomes imperative for humans to take responsibility for managing these consequences.

This dissertation not only identifies and acknowledges the existence of Post-Industrial Latent Artefacts, but aims to develop a process for understanding and utilising the inherent latent potential within these sites. The regenerative potentials will be investigated in subsequent chapters and demonstrated in the design exploration.

A site was chosen within the City of Tshwane to demonstrate a process through which latent post-industrial potential can be utilised. A Post-Industrial Latent Artefact (P.I.L.A.) - the Rosema & Klaver open-pit clay extraction quarry and brickworks - is waiting to be rediscovered in the midst of Pretoria's suburbs. The history of this site tells a story of "spatial" conflict between nature, industry and community.

fig 1.1 Manufactured Landscape, by Edward Burtynsky (2006)

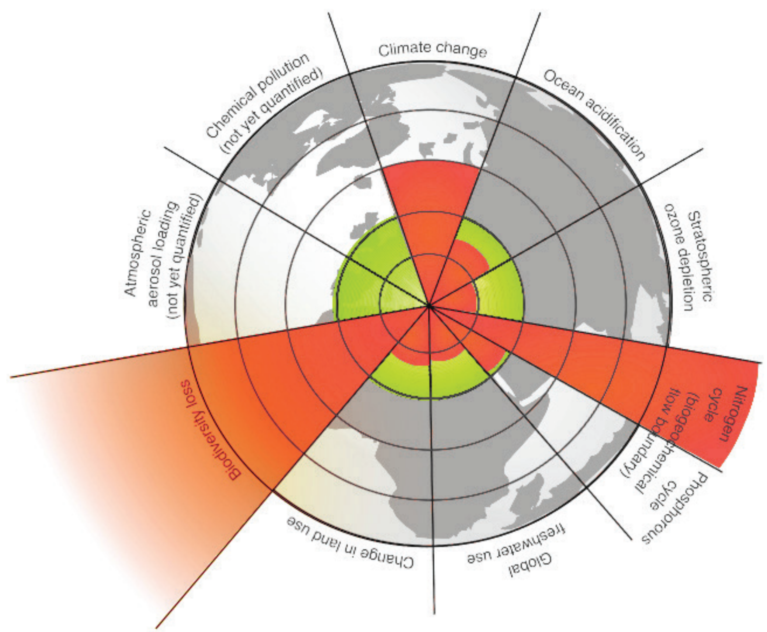


fig1.2 Planetary Boundaries (Stockholm Resilience Centre, 2009)

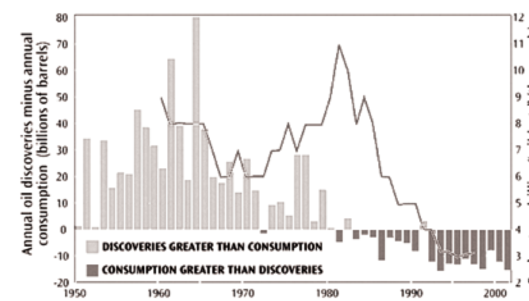


fig 13.2 Exploration - Discovery - Consumption (Association for te study of Peak Oil <www.asponews.org>

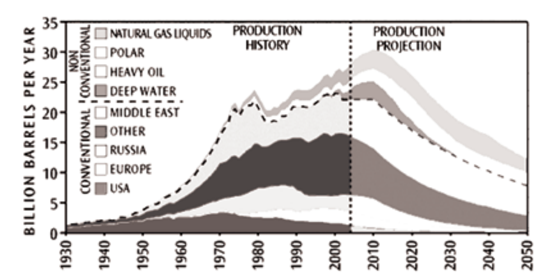


fig 13.1 World Liquid oil and gas depletion projections - 2004 (Association for te study of Peak Oil <www.asponews.org>

1.2 PROBLEM STATEMENT

This dissertation is guided by the overarching issue of the Post-Industrial Latent Artefact (P.I.L.A.) as industrial heritage, and also as a catalyst for regenerative design aimed at addressing urban resilience within suburban communities.

1.2.1 GENERAL ISSUE

Post-Industrial Latent Artefacts are the remnants and legacies of the industries that contributed to the construction of the Modern world. More specifically, the Rosema & Klaver open-pit mine used to be a site where the harvesting of raw clay material for the on-site production of masonry bricks took place. This activity contributed to the establishment of a new resource which allowed for urban development and local suburban sprawl/growth. Since the demise of the quarry and brickworks during the mid-90s, the site has become a different type of resource, a new habitat, which holds other types of resources and potentials for the current suburban context, the regional urban framework, and for the inevitable transformation and projected growth which the peripheries of Pretoria will experience in the foreseeable future. Post-Industrial Latent Artefacts need to be valued for what they can offer in an age of pressing resource scarcities and environmental concerns.

1.2.2 URBAN ISSUE

The latent potential and value of the site offer opportunities for regeneration which can create new social, ecological, economic, energy and food resources, capable of addressing current and future issues associated with the suburban condition. The densely vegetated site stands in stark contrast to the surrounding fenced-off residential edges, rarely allowing a glimpse of the interior of the site. The P.I.L.A. is hardly visible, it is not accessible, its potential goes unnoticed, and it is plagued with stigma. This is why it is threatened. The intention of the proposed thesis project is to create awareness of the values and potential which this site (as well as other similar P.I.L.A.'s) can offer surrounding communities, to transcend suburban planning policies, and to avoid the seemingly inevitable fate of succumbing to suburban sprawl by becoming a homogeneous residential estate. Such an estate would become that which it once helped to create, catering for the prosperous, and resulting in the loss of the next stage that might have led toward a resilient urban community. The question of how new development and architecture can be created on this site, while allowing for the abundance of natural processes to continue and become part of the process, will be addressed by the notion of "hybridity".

1.2.3 ARCHITECTURAL ISSUE

How can architecture help to address the disconnectedness of this place and enable the process of unlocking the latent social-ecological potential, revealing that potential, utilising that potential and getting people involved in it? By creating interfaces of exchange, it could be possible to re-establish a connection between people and resources. Awareness must be created around the central issue of industrial heritage, and the natural processes which affect it. A new model for renewable resource production can be informed by the realisation of hybridity and the integration of the natural and the man-made. The architectural issue pursues the development of an architecture which would allow the man-made and the natural to become inseparable, supporting each other, giving life to each other, all within a framework of understanding and acknowledging industrial heritage and urban resilience, thereby no longer denying the human condition.

1.3 INTENTIONS OF THE DISSERTATION

This dissertation intends to illustrate a design intervention related to the objectives of an NRF project aimed at identifying interventions that would contribute to the resilience and regeneration of the social-ecological system in the study area.

The initial goal is to recognise the regenerative potential of a Post-Industrial Latent Artefact, an abandoned open-pit quarry within the suburban fabric. Theoretical principles of resilience, regenerative development and industrial heritage will be applied to find life in a forgotten resource, revealing and utilising potential through an integrated architectural interface. In response to the site, an architecture is to be developed which can integrate the immediate community and connect them to the natural processes which contribute to their well-being, promoting social and resource exchanges. Suburban encroachment which could lead to the destruction of the site's inherent potential must be prevented; therefore a future strategy for urban and local reorganisation is foreseen. This strategy will lead the site into its fourth incarnation, one of hybridity between human and non-human relationships, toward a social-ecological reorganisation.

1.4 RESEARCH QUESTIONS

What approaches can be utilised to determine whether the latent potential of industrial heritage can be harnessed to contribute to the resilience of urban communities? Is it possible to apply regenerative design principles to the practice of regenerating Post-Industrial Latent Artefacts, for the mutual benefit of all components in an urban system?

Current (sub)urban culture is disconnected from resources and displays a lack of environmental responsibility and awareness. Can architecture instigate a culture of involvement, contribution and awareness, to integrate people with their own life giving processes, in order to liberate them from their dependence on centralised industries?

A critical resource awareness demands innovation, initiative and adaptation within our human habitats. The world is changing, therefore communities need to change with it. To what extent can decentralised micro-scale production processes for food, energy, and high-value products become integrated to operate in parallel with one another, and with a community, while utilising the fundamental principles of industrial ecology?
How can architecture establish this interface between people and natural resources, whereby social interaction is advocated as a critical component in the success of re-typologised, decentralised resource production activities within urban communities?

1.5 THESIS QUESTION

Can regenerative architecture provide a spatial interface of hybridity for exchanges between people, natural resources, production and memory? Hybridity suggests that society does not stand apart from life-giving processes; can a closed loop industrial system rooted in natural systems therefore be integrated into cultural and social structures to facilitate a system of which the product is greater than the sum of its parts, which will not only have material resource benefits, but also other intangible exchanges resulting in greater psychological benefits for urban communities?

1.6 RESEARCH METHODOLOGY

The research methodologies utilised in this dissertation to answer the thesis question and to develop an appropriate design response are described in the following section.

Content analysis, secondary data analysis, comparative analysis, and historical studies were all utilised in a thorough investigation of the post-industrial site. Photography was the primary medium used to capture qualitative data concerning the current condition of the site. Historic imagery and the cross-referencing of the industrial ruins with a similar and currently active facility contributed to the understanding of the site's past, and to some extent to its reconstruction.

Evaluative research/appraisals allowed for an understanding of the current development proposals for the site and its surroundings, whether such proposals are appropriate, and where alternatives or improvements can be considered.

Literature reviews, and the investigation of critical theories, contributed to the dissertation's theory development. Pertinent literature related to urban resilience, regenerative design, and industrial heritage were researched to develop an appropriate architectural design response to conditions on the site.

Case studies and interdisciplinary research allowed for an understanding of certain key aspects of the chosen programme and productive processes.

A conceptual design approach was developed which was refined into a tectonic concept.

1.7 DELIMITATIONS OF THE STUDY

This dissertation does not propose a general methodology for dealing with P.I.L.A.'s. It deals with a very specific site and the proposal for any other site would require its own detailed investigation, as each P.I.L.A. is unique. The investigations focus on utilising the inherent potential within a P.I.L.A., more specifically the regeneration of a post-industrial quarry in a very specific suburban context. The process seeks to reintroduce urban communities to natural processes by integrating people, production diversity and biodiversity within an area with a rich history of industrial heritage. Cross-programming between social space and resource production is prioritised in parallel with the conservation of industrial heritage.

It needs to be stated that the author is in no way an expert on each of the production aspects. What is most important are the potentials of the cross-programming thereof. The extent of integrated production processes is limited by the time available for this design dissertation. It is not necessarily a refined investigation into the efficient integration of multiple natural resource production processes, but rather a notion toward its possibilities. It does however draw upon a chosen set of production processes which are known or which show potential for effective integration, namely aquaculture, sericulture, algaculture and fungiculture. The nature of this dissertation, being focused on architectural design, merely utilises the chosen processes as a basis to demonstrate and inform design decisions and to effectively utilise the potentials present on site. There could be many possible variations in integrated resource production, but the chosen examples were sufficient for the scope of this dissertation.

CONTEXT

2.1 THE GROWTH OF PRETORIA

The research laboratory for this dissertation is situated within the City of Tshwane. This dissertation partly investigates a re-conceptualisation of the suburban condition, in order to understand how it came into being, and how the history of Pretoria's urban development and suburban sprawl ran parallel with its industrialisation.

After the discovery of gold in 1886, there was a great influx of professionals to Pretoria. Industries started to develop and the cost of land started to rise. During the 1890s, Pretoria became connected via train routes to other cities and towns in South Africa, creating opportunities for increased trade and industrial development. People preferred to settle at the edges of the city next to open fields to uphold the farming tradition, a trend which resulted in a horizontally fragmented growth pattern (urban sprawl). The growth of upper class neighbourhoods took place towards the south-east, further away from industrial sites such as Iskor and the train tracks. In 1890, Julius Jeppe and Sir Abe Bailey founded a company named S.A. Townships, Mining and Finance Co. Ltd. Their goal was to develop the land between Pretoria and Johannesburg as residential townships. Areas such as Waterkloof, Waterkloof Extension, Waterkloof Ridge, Hardingsplaas and Magnolia Dell all belonged to this company, and were divided in land parcels sized about 35m by 7m.

2.2 THE GREATER URBAN CONTEXT

2.2.1 SITE LOCATION

The abandoned Rosema & Klaver brickworks and quarry is situated within the Greater City of Tshwane Metropolitan Municipality, with a population of about 2.9 million (Statistics South Africa, 2011). It lies roughly 8km from the heart of the Pretoria Central Business District (CBD) in a south-easterly direction, opposite the Waterkloof Air Force Base. It seems juxtaposed with its surrounding context, sitting between the suburban boundaries of Monument Park and Waterkloof Ridge, bound by Elephant Road to the north, Orion Road to the East, Skilpad Road to the west, and residential areas directly outside the southern boundary (Seaton Thomson and Associates, 2003:2).

2.2.2 INFRASTRUCTURE

Regionally the site is easily accessible, being situated close to the nexus of the R21 and N1 freeways. The R21 is the gateway to Oliver Tambo International Airport, and reaches into the Pretoria CBD past Fountains Valley. The N1 forms the economic spine of the greater Gauteng Province, connecting Pretoria and Johannesburg with a commercial corridor (Van den Berg, 2013). A bus stop is situated on the corner of the site, at the crossing of Elephant and Skilpad Roads. Municipal services are implemented extensively in the suburban fabric.

2.2.3 LAND USE

The P.I.L.A., a relatively large privately owned industrial landscape of roughly 50 hectares, is currently zoned as an agricultural site, a remnant of its previous existence. It is separated from the surrounding community by a densely vegetated edge and a fence. The surrounding suburban condition is characterised by the homogeny of private residences that house middle to upper class citizens, "with small nodes of commercial, business and institutional activities" (Seaton et al., 2003:3). The primary facilities available to the community are a filling station on the corner of Elephant and Skilpad Roads to fuel the excessive use of private automobiles; the Monument Park Junior Tennis Centre opposite; and a business node located to the north-west of the site, consisting of the Monument Park shopping centre and a number of office developments.

2.2.4 ECOLOGICAL NETWORK

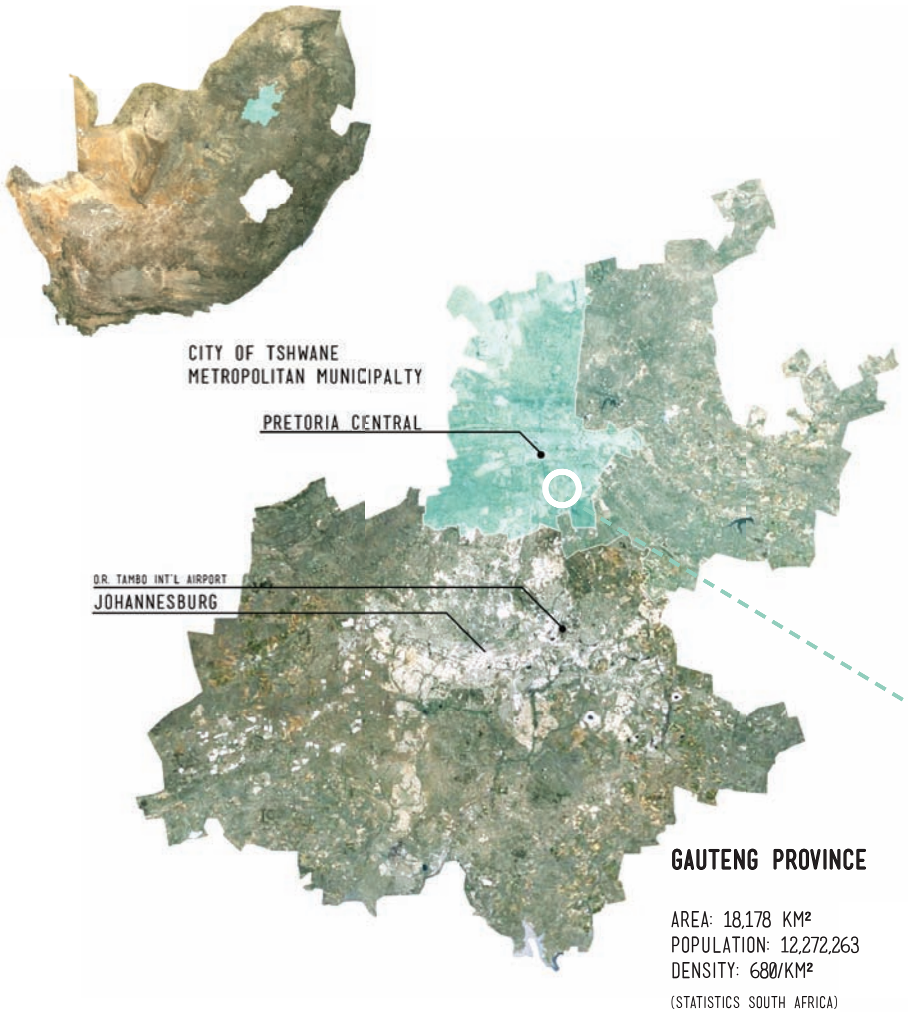
The site edges onto the east side of the R21 freeway, bordering an open green space reserve from which the Apies River emerges, and where the suburb of Monument Park transitions into Waterkloof Ridge. The southern boundary of Groenkloof Nature Reserve is about 1.5km further north along this corridor, which suggests the potential for it to form part of a larger ecological network which could host and support increased biodiversity within the suburban fabric.

1900 - 1904

1908 - 1910

1930 - 1934

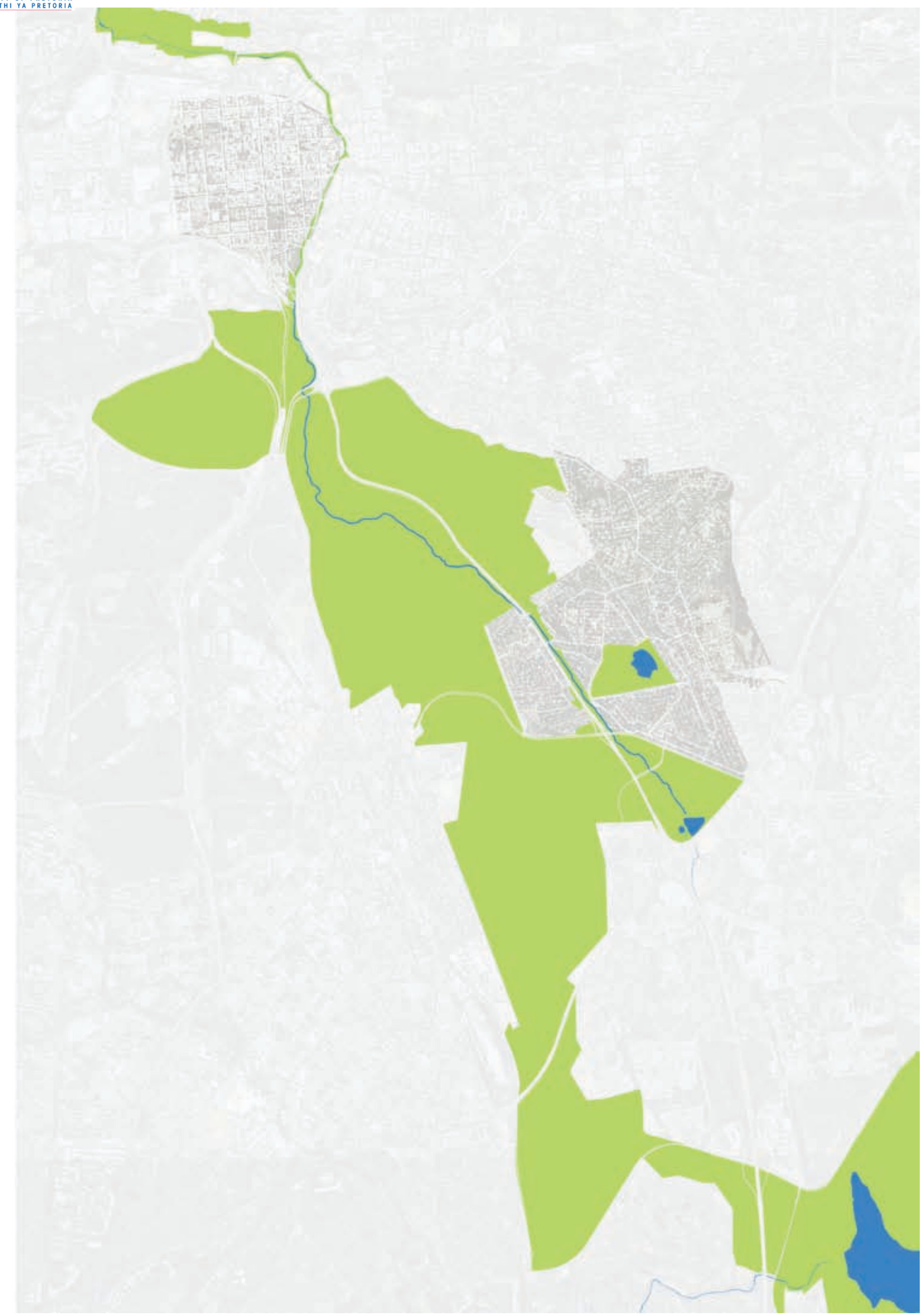
1947 - 1950



CURRENT MUNICIPAL AREA

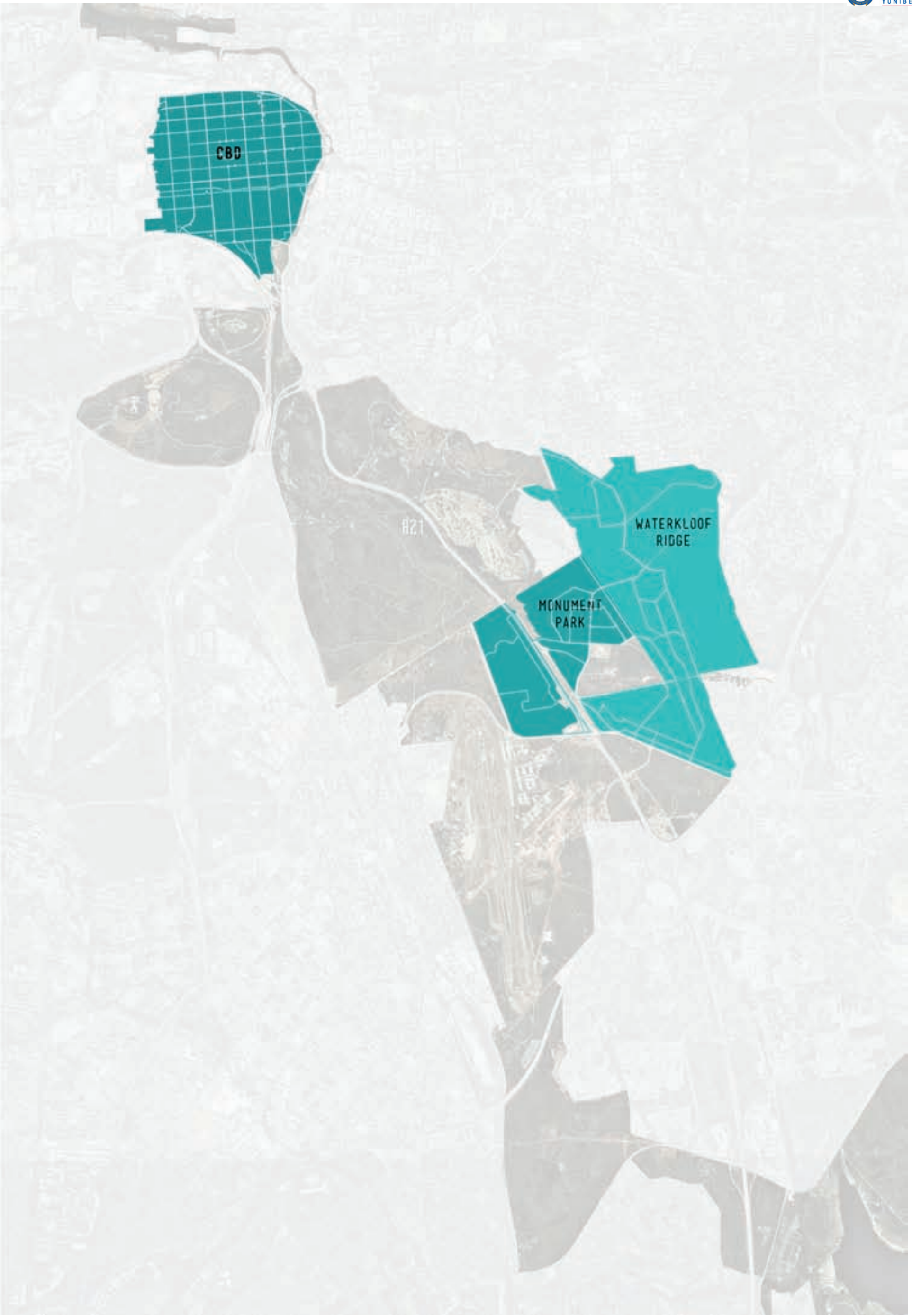
top: fig2.2 Site's Location, by Author(2013), sourced from Google Earth.
left: fig2.1 Pretoria's Growth and Density

URBAN FABRIC



ECOLOGICAL NETWORK

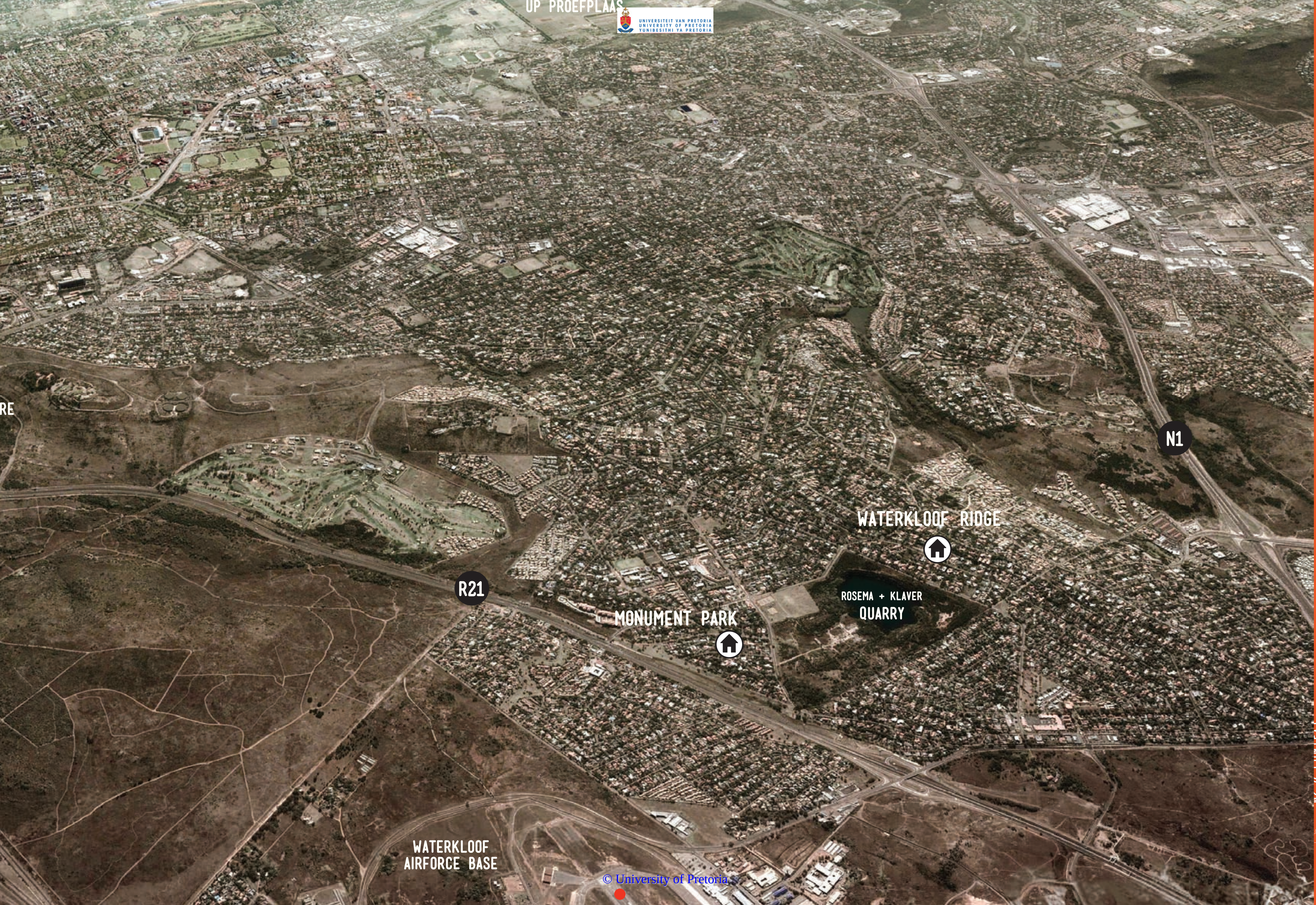
fig 23 Urban fabric, Ecological Network, Human settlement, Transportation network, byAuthor (2013)



HUMAN SETTLEMENT

TRANSPORTATION NETWORK

top: fig 2.4 Photograph of Pretoria South East , Photograph courtesy of Chris Büchner (2013)
right: fig 2.5 Spatial 3D of Pretoria. Image by Author (2013) sourced from Google Earth (2013)


UP PROEFPLAAS
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
RE
N1
WATERKLOOF RIDGE
ROSEMA + KLAVER
QUARRY
R21
MONUMENT PARK
WATERKLOOF
AIRFORCE BASE
© University of Pretoria

2.3 LOCAL SUB - URBAN CONTEXT

"Slums may well be breeding grounds of crime, but middle class suburbs are incubators of apathy and delirium."
(Cyril Connolly, nd)

Privacy is a defining characteristic of suburbia, as it is separated into spaces for private dwelling. It cultivates an anti-social orientation toward the private and the self, and a neglect of direct communal relationships with one's neighbour. While this is not always the case, there is very little motivation in the prosperous middle to upper class communities in this age for anyone to get to know their neighbour and to get involved with their communities. This, the epitome of consumer culture, is often accompanied by apathy toward environmental issues and responsibility for resources.

Waterkloof Ridge occupies an area of 6.16km^2, and has a population of about 6630 in 2301 households (Statistics South Africa, 2003), at an average of 2.88 people per household. Monument Park occupies an area of 3.28km^2, and has a population of 5035 in 1913 households (Statistics South Africa, 2003), at an average of 2.63 people per household. With a surrounding community of more than 11 665 people in an area of 9.44km^2, it seems evident that there is a relatively significant amount of social capital in the area, which could potentially benefit from the quarry site being turned into a public amenity. According to Tshwane's projected future population growth, increases in population will see an even greater rise in social capital, which could not only benefit from this P.I.L.A., but will seriously require additional public amenities beyond the homogeny of suburbia, in order to attain sustainable living standards.

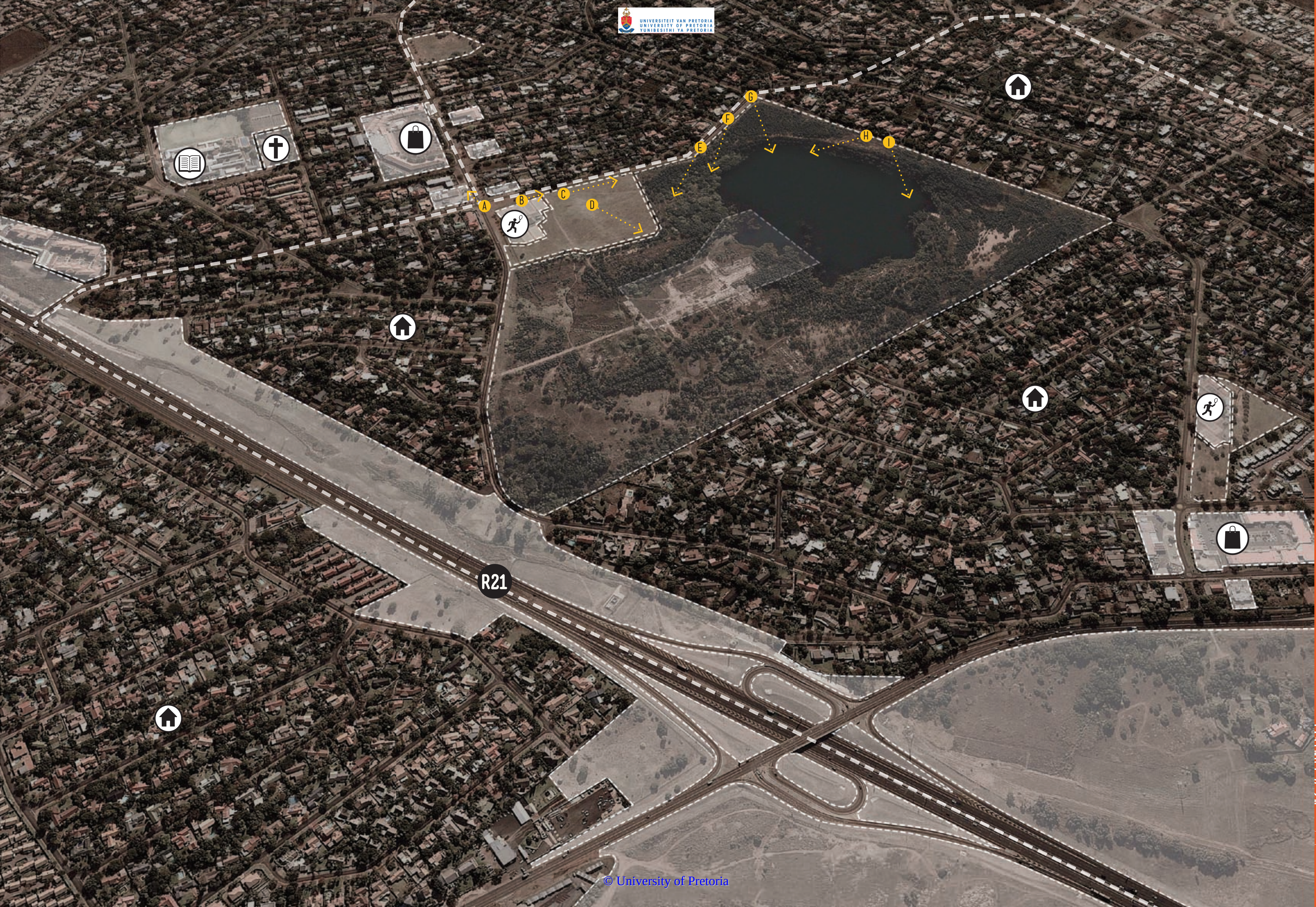
To understand how this place came to be in this curiously juxtaposed existence, its story needs to be told

fig 2.6.1

fig 2.6.2

fig 2.63

top: fig 2.6.1-2.69 Local edges, by Author (2013)
right: fig 2.7 Spatial 3D of local conditions. Image by Author (2013) sourced from Google Earth (2013)



A
B
C
D
E
F
G
H
I
R21

fig 2.6.4

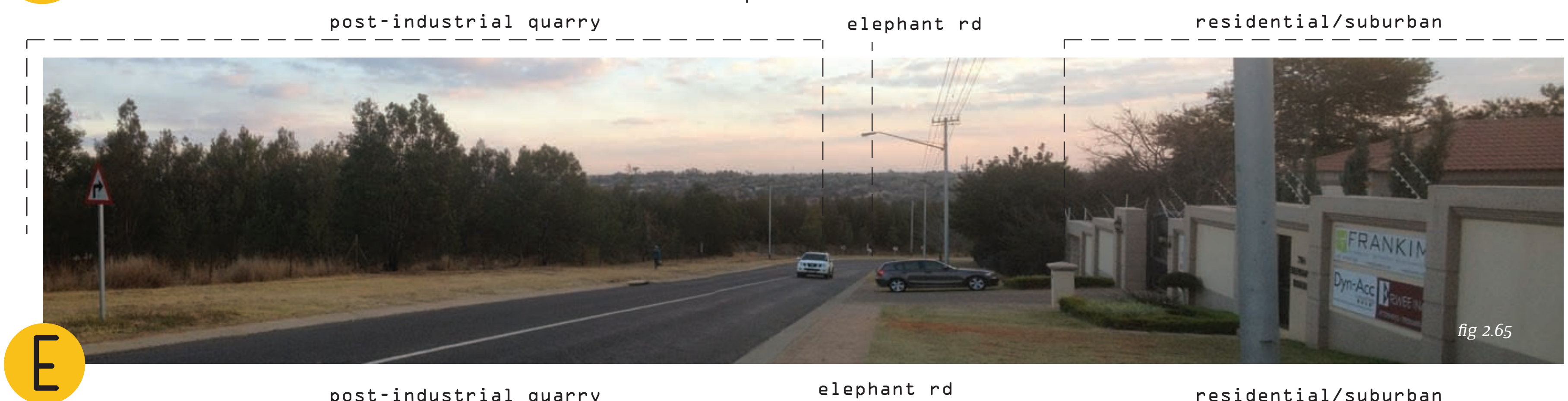


fig 2.65

fig 2.6.6

fig 2.67

fig 2.6.8

fig 2.69

2.4 THE STORY OF PLACE

The site has experienced many different eras in relation to humans and non-humans, each of which has left its mark and still persists in some way. During these generations, the site has played different roles: from ecological habitat, to resource deposit and productive industry, to a natural though broken reclaimed habitat. These roles which the site has played are acknowledged for their importance and their effects, all of which will enhance its new purpose as a productive social-ecological habitat.

2.4.1 PRE - INDUSTRIAL (PRIOR TO 1945)

The area was a very different place prior to the establishment of mining and manufacturing processes and the growth of Pretoria's suburbs. The area was still largely characterised by the properties of Pretoria's natural biome within the temperate Highveld grassland region. Agricultural activity occurred on farms in the area in support of Pretoria's early population.

2.4.2 INDUSTRIAL (1945 - 1995)

In 1935, Roelf Rosema and Dirk Klaver immigrated to South Africa from Holland, where they had formed a partnership in the building industry. In 1942 they founded Rosema & Klaver (Pty) Ltd., and purchased part of the Waterkloof farm near Pretoria central, where they established their own brickworks and open-pit clay mine. For a period during the Second World War, Roelf and Dirk went back to serve in Holland, after which they returned to Pretoria to continue their brick-making enterprise.

In 1951 they purchased their first wire-cut brick-making machine, which increased the company's production yield. A continuous and dedicated kiln-oven structure was completed and operational by 1958, after which a second kiln-oven structure was completed in 1960. Monthly brick production reached the 5,000,000 milestone by April 1964, and in the following year, up to 30 June 1965, a total of 60,000,000 bricks were manufactured. During this period, the surrounding agricultural land was transformed into residential lots. This peri-urban configuration soon succumbed to suburban sprawl and by the 70s the entire quarry site was almost completely surrounded by houses. At some point during the excavation processes, a subterranean cavity connected to water aquifers was exposed and ground water emerged into the open-pit mine. This water was pumped out and utilised in the mining processes (see page 45).

By the time the suburban community was well established around the quarry, tensions arose between the industry and the community as a result of conflicting land uses. The noise, dust and visual impact from the clay excavation and transportation activities became problematic for the local residents. During that time, Black Wattle trees were densely planted on the edges of the site to reduce the effects of dust (Rehabilitation & Development Plan for Rosema & Klaver Quarry, [n.d.]:1). Continuous community pressure led to a court order, allowing the industrial activity to continue only for a period of another 10 years, from 31 December 1980 to 31 December 1990 (City Council of Pretoria, 1981:1). After this order was appealed, the period of operation was increased to 15 years, and the brickworks activity was scheduled to cease on 31 December 1995.

The story of the site's industrial generation is about the exploitation of resources for production. It describes a story of tension between man's ideals, industry and nature. The site gave the resources for many homes and suburbs to be built, until the eventual depletion and abandonment of the natural resources, which opened up the opportunity for the site's next generation.

fig 29

fig 2.10

fig 2.14

fig 2.11

fig 2.14

fig 2.12

fig 2.15

fig 2.16

fig 2.17

fig 2.18

fig 2.19

fig 2.20

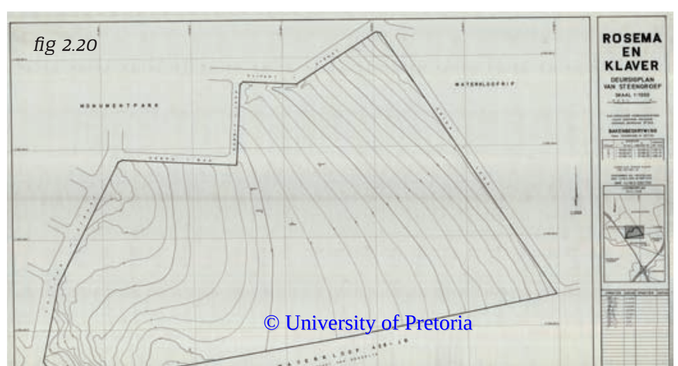


fig 2.21

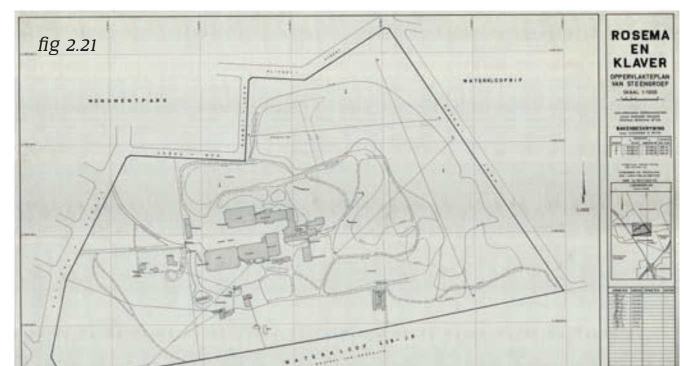


fig 2.8 Roelf Rosema & Dirk Klaver
fig 2.9 Fig Wire Cut machine
fig 2.10, 2.11, 2.17 Brick yard
fig 2.12- 2.14 Excavations
fig 2.15, 2.16, 2.18n The old Industrial structures
fig 2.19 KIln ovens
fig 2.20 Site's pre-industrial contours
fig 2.21 Documented extents of industrial ecitivty

(Rosema + Klaver Archives, 2013)

2.4.3 POST - INDUSTRIAL (1995 TO THE PRESENT)

Due to the combined difficulties brought on by aging technology, labour intensive processes, difficult economic and labour conditions, complaints from the surrounding community, and the emergence of subterranean water, the clay mining and brick manufacturing processes inevitably ceased (Plan Medewerkers, [n.d.]:357).

Within a matter of two decades, an industrial wasteland was being transformed by nature into an isolated urban utopia, where one may easily forget that man's hands had once carved through this landscape. As potable water filled the reservoir, natural processes were no longer constrained by human disturbance and were able to flourish.

The most noticeable characteristic of this Post-Industrial Latent Artefact has become evident over the last two decades, seen through the effects of time: decay, entropy and change as processes of nature lead to a dynamic transformation. Time is expressed and understood through its accumulative effects on the remaining industrial ruins and the manufactured landscape - a palimpsest of many generations constituted of extraction, production, abandonment, and nature.

Much of the brickworks were demolished after industrial activity on site ceased. According to the then City Council (City Council of Pretoria, 1981:3), all of the remaining structures, or those chosen by the Director of Town planning and Architecture, had to be demolished to allow for future development. There were also safety concerns about the large vacant structures being inhabited by vagrants. Only a few structures currently remain intact: the water tower, the hammer mill, the dust stores and some concrete structures. It is still unclear why these were saved from destruction instead of the large structures housing the kiln-ovens, of which only the concrete slabs and two large brick monoliths remain.

The story of the site's post-industrial generation is a story of healing, as nature started to take over. Regenerative processes are integral to natural systems, and this site provides a narrative metaphor for how interconnected ecologies and systems of life can return to areas that humans no longer value. A story devoid of humans would seem to be the most positive outcome for this site and its natural regeneration, but there could be an alternative ending, one which does not banish the human race from the planet, but one which sees human activity as a positive "natural" force that could actually embrace the regenerative processes, for the healing of both nature and humans. This dissertation seeks to find such an alternative ending as a next generation.

REKORD EAST FRIDAY AUGUST 2, 2013 3

Quarry a crime cesspit

Ané Roux

Crime, falling property values and continued health risks torment the suburbs surrounding the deserted quarry in Monument Park.

A public meeting to discuss residents' options in resolving the continued burden of dealing with this unsightly and unsafe property will be held on Wednesday evening (31 July) at the Dutch Reformed Church in Monument Park at 18:30 on 31 July.

According to Ward Councillor Bronwyn Engelbrecht, who is leading the charge in clearing the quarry, criminals often use the quarry as an escape route and a hideaway from police. Although surrounded by a fence to keep trespassers from entering the private property, she said that little could be done by the metro and South African police to rid the area of the squatters. She added that residents' only alternative was to consider legal action, as police operations seemed ineffective.

"We need better cooperation from the owner and the metro. I believe that millions in rates and taxes are owed yet nothing is done by the metro to recover those amounts or to take legal action against the owner for the upkeep and security of his property."

Meanwhile, the owner of the property, John le Warne, said the property was valued more than the outstanding rates and taxes owed to the metro and that plans to develop the property as one of the most exclusive estates in Pretoria were still underway.

"We are a conglomerate who owns 60% of the property, but without the remaining deeds we cannot develop. There is a legal matter regarding the property and we have been litigating for the past nine years. I do, however, want to stress that development for an exclusive waterfront estate is still on the cards."

Le Warne denied allegations of squatters and criminals living on the property. "We erected fences at great costs around the property to secure it from criminals and squatters. We do not have squatters on the property," he told *Rekord*.

(Above) A map illustration of the size of the property (*Google Earth*).

(Left) Ward Councillor Bronwyn Engelbrecht is leading the charge in getting questions regarding the quarry answered.

fig 2.22 Quarry a crime cesspit (Rekord East, 2013)

2 REKORD OOS VRYDAG 9 AUGUSTUS 2013 www.looklocal.co.za

Concern over derelict quarry on the rise

Ané Roux

A storm is brewing in Monument Park over a derelict quarry, and residents are now considering legal action against the metro.

A public meeting to discuss residents' options regarding the security threat posed by the quarry in the heart of the suburb became unruly as residents aired their frustrations against the metro. They accused the metro of failing to collect rates and taxes from the owners of the property on which the quarry is situated. They also blamed the metro for the high incidence of crime in the area because it failed to remove squatters and vagrants living on the derelict property.

The residents association's chairman, Conrad van Dyk, called on all residents to align a collective effort to hold the metro accountable.

"If we as responsible homeowners do not pay our monthly bills, we are quickly given notices and our water and lights are switched off. Why is the metro slack to act against the owners of this quarry? The outstanding rates and taxes are l[illegible]to accumulate while we as residents have to fight off the scourge of criminals hiding on the property."

Nick Nicolao of the community-policing forum agreed with Van Dyk and said that residents had to come up with a viable solution to compel the metro to enforce its own by-laws. "The metro is failing us because it is not enforcing it own by-laws by removing squatters and taking legal action against the owners of this property to recover the outstanding debt. Our lives and the value of our properties are at stake as long as this quarry remains. More squatters will move in," he said.

Ward councillor Bronwyn Engelbrecht echoed the residents' sentiments during the meeting saying that they are tired of the metro's ineffectiveness regarding this issue.

"The mayor has ignored my questions and pleas to act against the owners of this property. I even tabled a motion that the property be sold in execution to recover the outstanding debt. The speaker rejected my motion saying the cost implications were too great. Legal action by the residents is now the only option to secure their safety as the metro has failed them," she said.

It is believed that around 300 squatters are currently living on the 48-hectare property. The estimated outstanding debt is around R2,5 million with an interest escalating at roughly R15 000 per month. The metro was unable to comment at the time of going to print.

Residents of Monument Park and surrounding suburbs gather to consider their options regarding a quarry.

fig 2.23 Concern over derelict quarry on the rise (Rekord East, 2013)

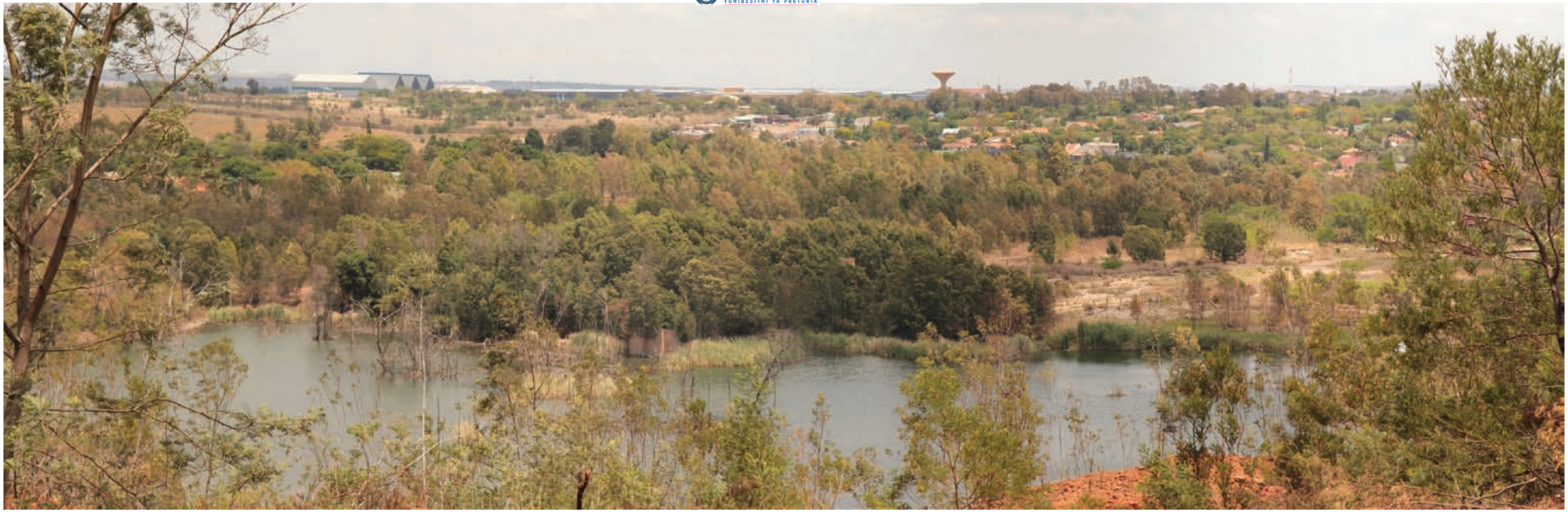


fig 2.24 View over quarry Photograph by Author (2013)

fig 2.25 A new wetland habitat is born, Photograph by Author (2013)

fig 2.26 Aerial view of quarry, courtesy of Johan Moolman (2012)

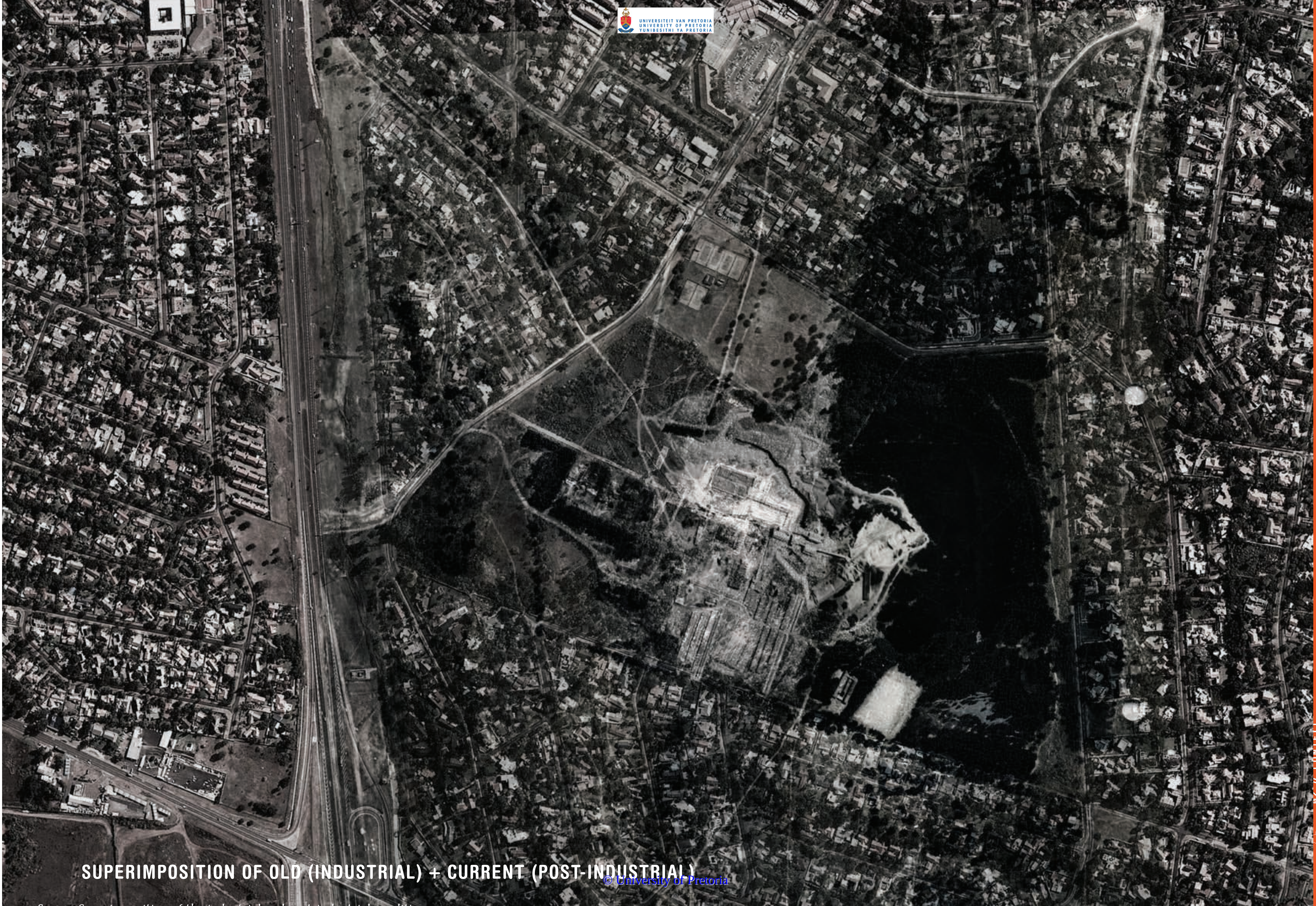
*IMAGES NOT TO SCALE

fig 2.27 Aerial of early industrial activity, Rosema + Klaver Archives (2013)

fig 2.28 Aerial of current post-industrial condition (Google Earth, 2013)

EARLY INDUSTRIAL ACTIVITY SURROUNDED BY AGRICULTURE + THE NATURAL
(1958)

POST-INDUSTRIAL STATE SURROUNDED BY SPRAWL
(2013)



SUPERIMPOSITION OF OLD (INDUSTRIAL) + CURRENT (POST-INDUSTRIAL)

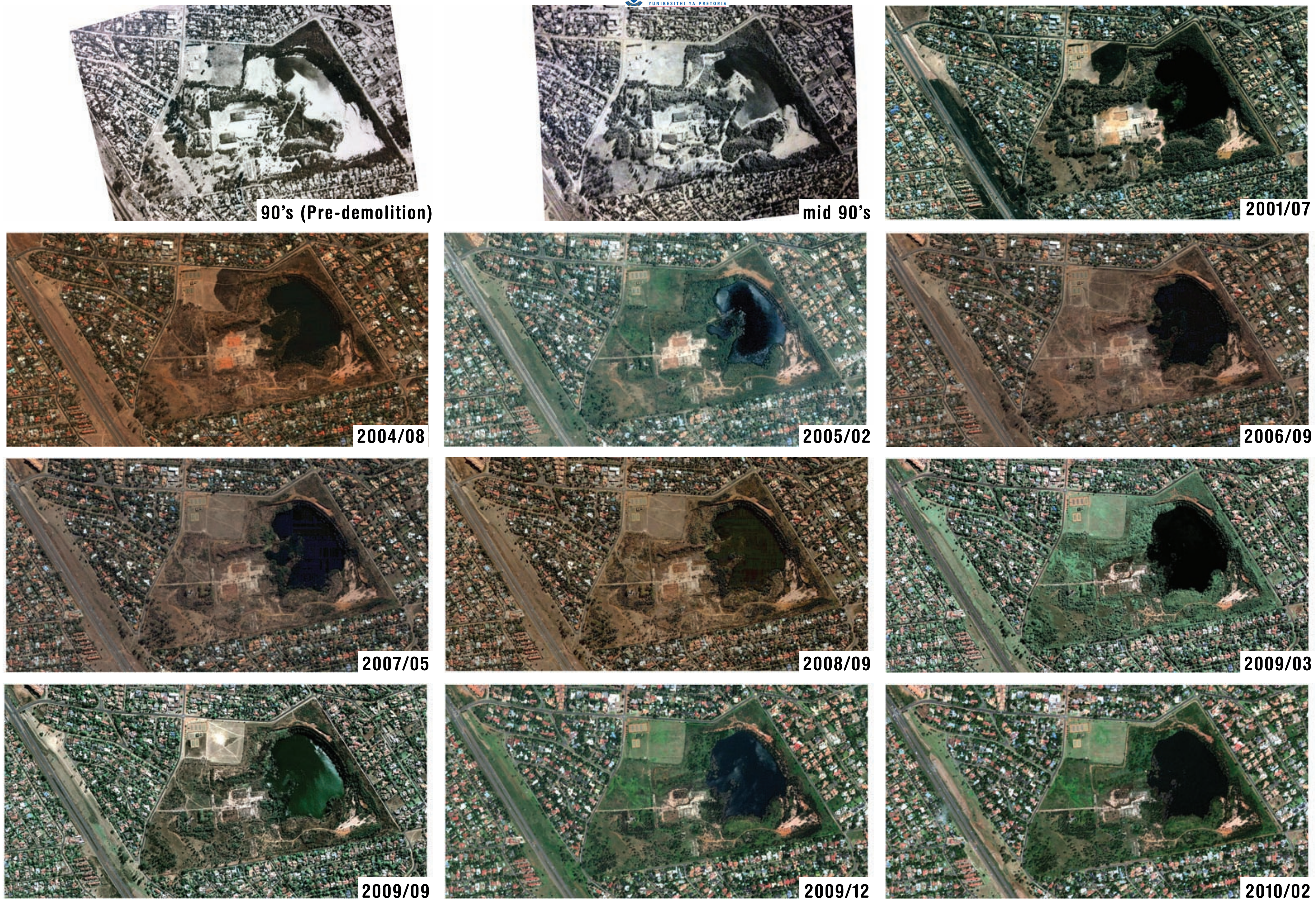


fig 230 A process of decay, entropy and change over the last two decades, from industrial to post-industrial, sourced from Google Earth (2013)

TIME LAPSE EXPOSURE
(1990's-2013)

2.4.4 THE ADAPTIVE CYCLE

This site's story of place can be understood as a series of generations of hybrid conditions existing between man and nature, configured into a layered narrative. So far, three distinct generations of hybridity have been identified: Pre-Industrial, Industrial, and Post-Industrial. Because of various socio-economic changes and disruptions, each generation came to an end or evolved into another. This dynamic can be understood through Holling's theory on the adaptive cycle and panarchy (Holling et al., 2002), which provides "an organising framework for theory dealing with cross-scale dynamics in natural and social systems" (Du Plessis, 2011:7). There are four distinct phases in an adaptive renewal cycle, namely "breakdown and release, re-organisation, growth and exploitation, and conservation" (Du Plessis, 2011:7). So what comes next?

Understanding the site's story of place as a series of adaptive cycles allows for a holistic understanding of how the current condition came into being, as well as where the future condition of the site could or should be heading. This will inform the development of a strategy for unlocking the site's fourth generation of hybridity, which will involve a social-ecological reorganisation. To anticipate the site's next generation of hybridity a good understanding of its current state and its predicted future must be realised.

fig 2.31 Generations of hybridity up to current state

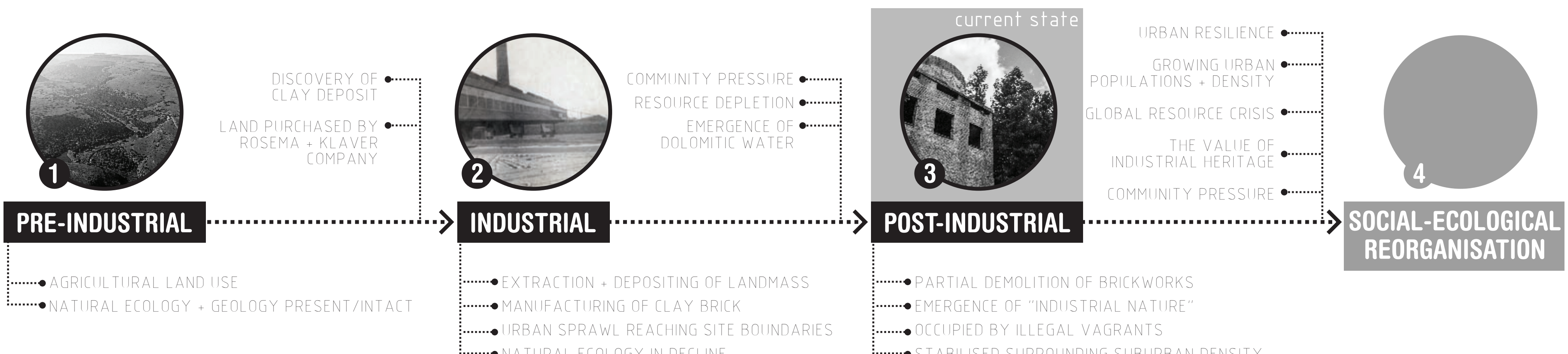


fig 2.32 The adaptive cycle of the quarry site, by Author (2013)

GENERATIONS OF " MAN - NATURE " HYBRIDITY + REORGANISATION

1 **PRE-INDUSTRIAL** (AGRICULTURAL/NATURAL)
2 **INDUSTRIAL** (EXTRACTION/SPRAWL)
3 **POST-INDUSTRIAL** (INDUSTRIAL NATURE/SUBURBAN)
4 **SOCIAL-ECOLOGICAL REORGANISATION** (NEW PROPOSAL)

Fig Changes in Man/Nature relationship,

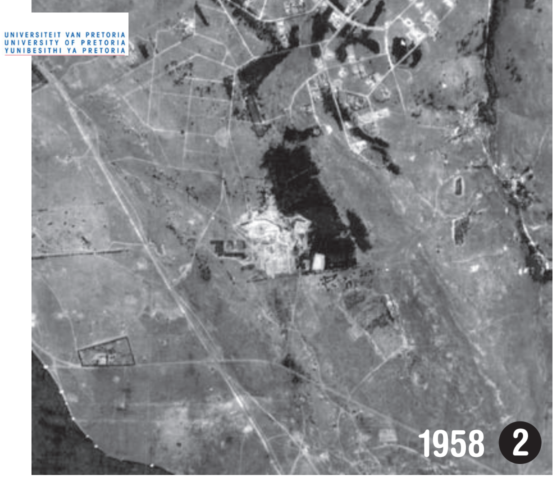


fig 233 progression of site's development, courtesy of UP aerial archives (2013)

2.5 THE TSHWANE RSDF + CRITIQUE

The Tshwane RSDF 2013, Region 3 was studied to gain an understanding of how the urban space surrounding the site is expected to be reorganised in the near future, mainly as a result of changing socio-economic conditions and concerns regarding sustainability.

The RSDF was in a recent article entitled "Development goes ahead", which appeared in the Pretoria East Rekord of 3 May 2013. The Tshwane RSDF 2013 proposal for the quarry site has been by criticised the public, specifically by the suburban communities affected by the new development proposal. The proposed framework seems to be going ahead despite fears of the suburban areas of Pretoria becoming "grid-locked with traffic, densified with high-rises and over-developed with office blocks" (Roux, 2013:1). Some of the flaws, highlighted by town planner Erik Buiten, are that "[o]ffice development in residential areas is never a good idea and as residents we do not want these monstrosities invading our residential areas. We suggest that the Metro encourages developers to consider mixed-usage development. This means that there are residential units as well as business units in the new development, which will diminish the creation of dead corridors in the suburbs".

It is important to note that residents are not opposed to development in the area; they do recognise the "practical and profitable" opportunities available. It must be realised that "densification and compaction" (Roux, 2013:2), the Tshwane council's approach to development, is inevitable considering the predicted population growth of South Africa. The Tshwane Metro seems to ignore the quality of suburban spaces and the social impact of their proposal. Future development can be guided in a much more responsible manner, by considering mixed-use development.

It has been noted that the 2013 RSDF document contains contradictory facts, "with the written document saying one thing, while the maps present another picture. What used to be Business 1, was suddenly turned into cores and nodes, [with] densification within a residential area allowing up to 200 units per hectare. The proposal furthermore fails to add planning for schools, police stations and social and sporting facilities" (Roux, 2013:2).

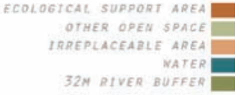
Office edges are proposed to border on some of the peripheries of the old quarry site, while the site itself is zoned as mixed use. A far more appropriate plan would be to have the edge corridors zoned as mixed use for residential, office, and commercial purposes, while retaining the old quarry site as a public amenity which can directly benefit the entire local community.

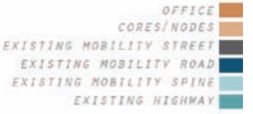
2.6 PENDING RESIDENTIAL DEVELOPMENT

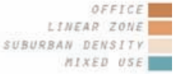
A residential development, named Waterkloof Marina, is currently proposed for the existing site. It clearly reflects the current mindset of land development in the region, and displays a lack of any concern for industrial heritage, as well as for the potential value natural environments have for urban communities, by merely replacing these with housing.

The Waterkloof Marina residential estate proposes a group housing development, on a single stand of a predominantly residential township, consisting of 293 units (Residential 1) varying between 800-1500 square metres. Additional uses include a single stand to incorporate a restaurant, clubhouse, convenience store and a small office component (Seaton et al., 2003:2).

The irregular topography is to be levelled by bulk earthworks to ensure more even contours, by removing all if not most of the vegetation on site and losing a considerable amount of the site's character. The proposal provides only two entrances with security control points for the entire housing estate, one at Orion Street and the other on Skilpad Road, essentially turning the entire development into another isolated and gated community.





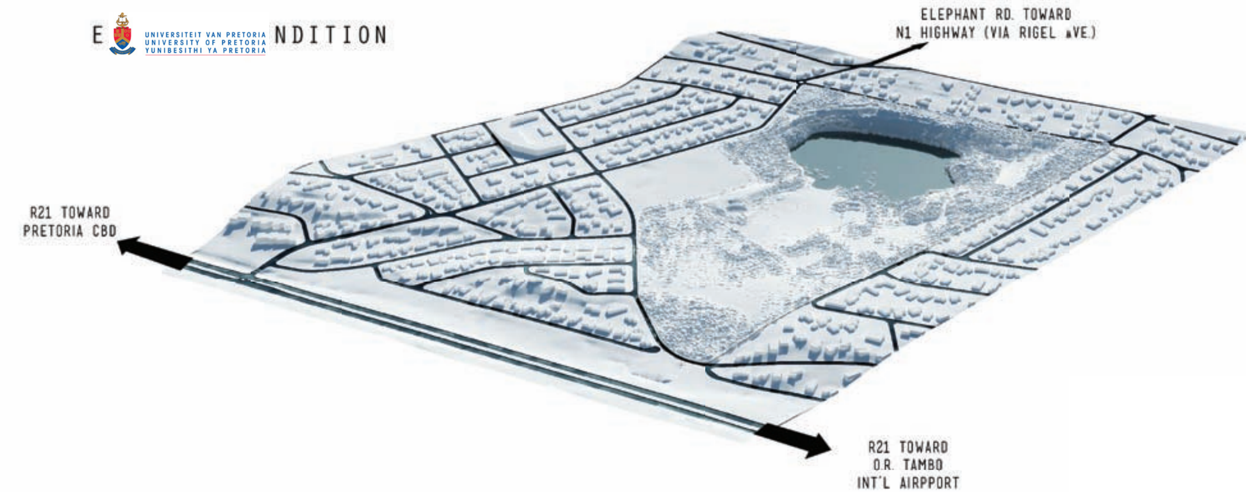


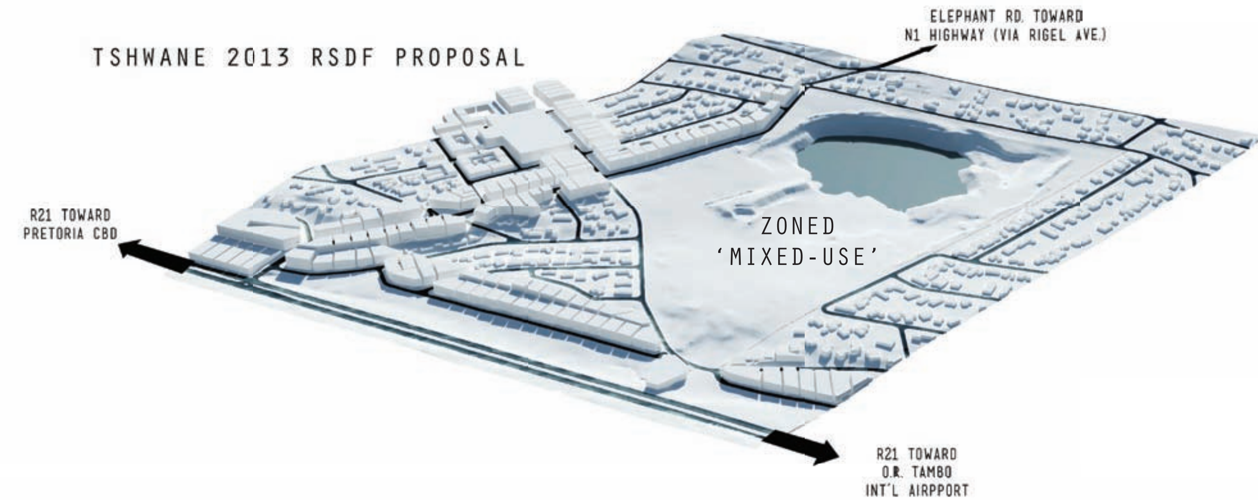
right: fig 234 Tshwane 2013 RSDF (Tinus vd Merwe, 2013)
far right: fig 235 Density comparisons to alternatie site developments, by Author (2013

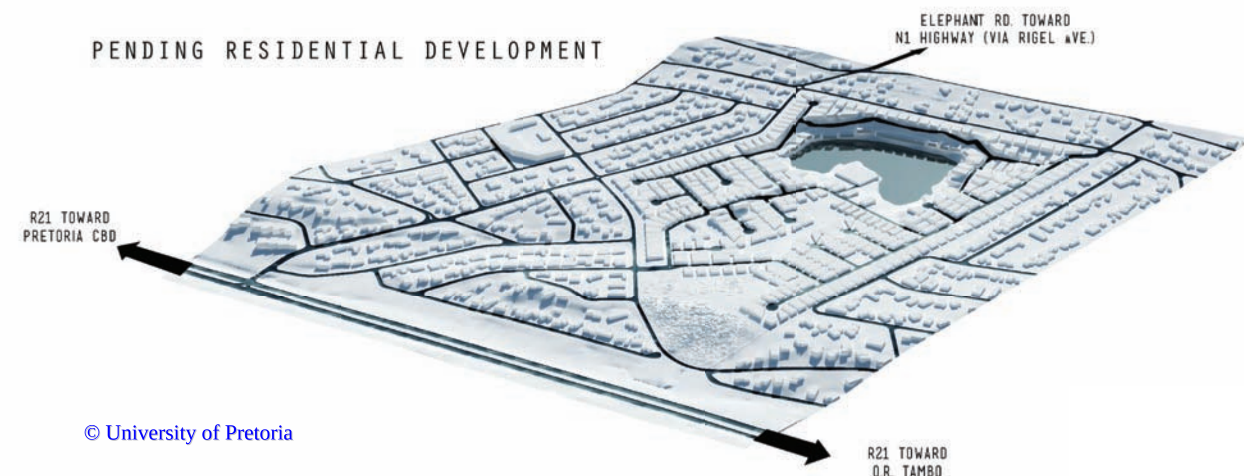

OPEN SPACE FRAMEWORK


NODAL DEVELOPMEN PLAN


DENSITY DEVELOPMENT PLAN


E
NDITION
ELEPHANT RD. TOWARD
N1 HIGHWAY (VIA RIGEL AVE.)
R21 TOWARD
PRETORIA CBD
R21 TOWARD
O.R. TAMBO
INT'L AIRPPORT


TSHWANE 2013 RSDF PROPOSAL
ELEPHANT RD. TOWARD
N1 HIGHWAY (VIA RIGEL AVE.)
R21 TOWARD
PRETORIA CBD
ZONED
'MIXED-USE'
R21 TOWARD
O.R. TAMBO
INT'L AIRPPORT


PENDING RESIDENTIAL DEVELOPMENT
ELEPHANT RD. TOWARD
N1 HIGHWAY (VIA RIGEL AVE.)
R21 TOWARD
PRETORIA CBD
R21 TOWARD
O.R. TAMBO

The zoning application by the developers aims to change the land use from "zoned conservation area or open space, to any other land use" (Seaton et al., 2003:10). In addition to being a conservation area, the site still retains its original zoning for agricultural land use. The conservation area and open space are far more valuable to future communities than that which this development proposes. Conservation areas are critical. Certain areas of the site which are evidently brownfield sites should rather be utilised for productive and social land uses, in alignment with the conservation / agricultural duality.

There are many contradictions in the justification of this proposal when considering the claimed alignments with the Development Facilitation Act and Local Policies, when it states principles such as: "promote the availability of residential and employment opportunities in close proximity to or integrated with each other", "optimise the use of existing resources, including such resources relating to agriculture, land minerals, bulk infrastructure, roads, transportation and social facilities", " promote a diverse combination of land uses, also at the level of individual erven or subdivision of land", and "encourage environmentally sustainable land development practices and processes".

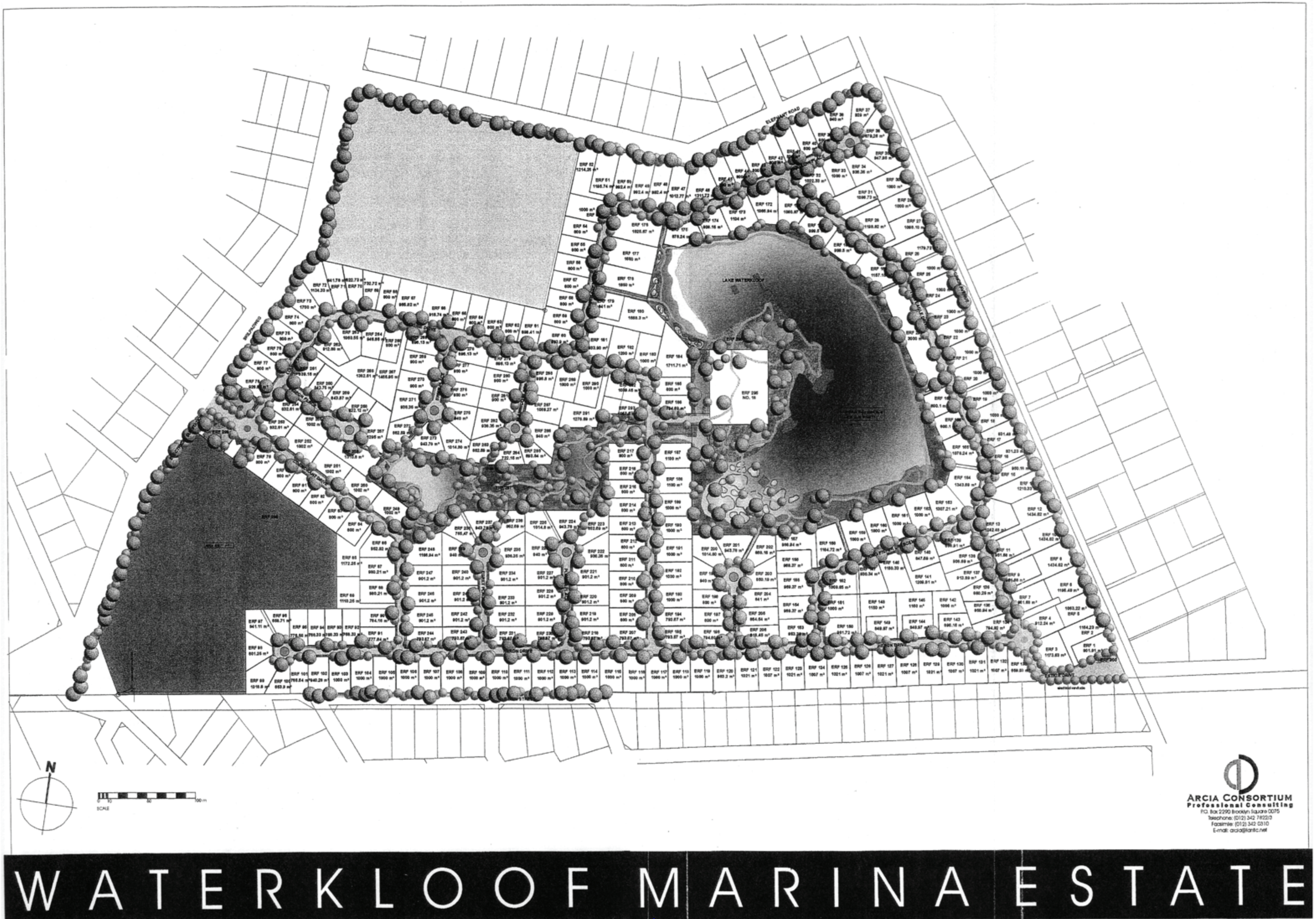
The proposal claims to optimise the use of existing resources, including infrastructure, and to ensure economic use of currently valuable, underutilised land (Seaton et al., 2003:3), but the degree in which this site is understood as a resource is clearly limited. There are some alarming claims about the development being 'sustainable': " the development can be considered sustainable, as there is currently no active use of the land since the quarrying activities were terminated many years ago". Conservation of this land as an ecological habitat and green lung would be far more 'sustainable'. "It was ascertained that the development proposal for the site should conform [to] the principles of the Development Facilitation Act (Seaton et al., 2003:4), to be supported by Council in terms of the densification within the built up urban area" (Seaton et al., 2003:4). The most ironic contradiction is that the DFA states that it would discourage "urban sprawl in urban areas and contribute to the development of more compact towns and cities. This residential proposal does not aid densification; it merely extends low-density housing by displacing land which could potentially, as a public amenity, support the densification of the existing housing footprints. The proposal also claims to create an open space link between the quarry and the south-western corner. This is clearly not reflected in the plan.

The environmental management programme (E.M.P.) recommends measures and actions to be taken to "increase and enhance the site's natural habitat and flora" (Seaton et al., 2003:5). In no way does the proposed residential development support this principle; it is in fact contradictory. The E.M.P. recommends the development as having an "acceptable and high quality visual identity" (Seaton et al., 2003:5). The aesthetic visual quality is of course a subjective matter, but for this author the current landscape, lush in vegetation and natural presence, is considered much more appealing than the type of invasive residential development being proposed. One recommendation in the E.M.P., which is of high importance and relevance, is the management of storm water to limit any downstream impacts.

The most alarming aspect of the entire proposal is the complete lack of acknowledgement of industrial heritage. "The site contains no structures or sites of valuable or important cultural, historical or archaeological value. Existing structures on the site are mostly vandalised and in poor condition. These will be demolished and removed" (Seaton et al., 2003:25).

It is believed that this site has far more potential than what has been reported, and for it to become an exclusive residential estate would not only be an environmental crime, but would lose the struggle toward urban resilience in Pretoria. Fortunately, the development is currently on hold due to legal complications concerning ownership and outstanding land taxes, so there might still be some hope for this site after all. The next section will identify the different levels of inherent potentials on the site. Through these potentials, an alternative future for the quarry will be envisioned.

fig 236 Plan of Waterkloof Marina development proposal (Nico vd Meulen Architects, 2003)


N
ARCIA CONSORTIUM
Professional Consulting
WATERKLOOF MARINA ESTATE

2.7 THE PLACE - SOURCED POTENTIAL

Mapping was carried out in accordance with the concept of "place-sourced potential" (Regenesis Group, [n.d.]), described in the "Regenerative Development Framework" by the Regenesis Group as being "grounded in a rich patterned understanding of place, and a vision of role and potential within that place" (Regenesis Group, [n.d.]). "Potential is a way of conceptualizing that gap between what something is and what it could be if it could fully realize its purpose the inherent ability or capacity for growth, development, or coming into being that has not been used or manifested" (Regenesis Group, [n.d.]). By following this approach, the initial architectural concept can be seen as resourceful toward that which is already inherent in the site's potential.

For the purposes of this dissertation, a focus area on the site has been identified for detailed investigation and architectural exploration. The area was chosen for the high potential value of the identified resource, which can be utilised for the site's regeneration. The land to the west of the water body hosts the last physical remains of the industrial manufacturing processes which previously took place there. It is contained by a large berm (puinhoop) on the northern edge, resulting from the depositing of waste material from the excavation and industrial processes. Between the berm and the remaining concrete foundations of the demolished clay brick ovens lies a temporary wetland area which experiences flooding during high rainfall periods. It acts as the surface overflow path for water as it flows west toward the Apies River. The choice of placement and articulation of the focus area is also informed by the exchanges and interactions which will occur in concert with other projects designed as part of the urban vision for the entire site.

The existing physical (patent) potentials, which can be harnessed to liberate the site from its latency, are documented according to what it was, what it is used for at the moment (such as recreation, illegal/vagrant housing, sports), and what it can ultimately be. The hierarchy revealed by mapping will partly determine the hierarchy of design informants.

2.7.1 SOCIAL POTENTIAL

The surrounding residential communities hold immense deposits of social capital. Humans are a highly social species, and the nature of suburbia leaves much to be desired when it comes to recreational and social diversity. Regenerative development relies more on people than on technology. Where conventional industry might rely on automation and machinery, regenerative philosophy states that the direct contribution of humans has the potential to ameliorate many sustainability issues and relieve global resource pressures. This immense social capital can be harnessed to contribute directly to the potential of urban resilience. Suburbia offers three very valuable resources, namely people, land and infrastructure. The typical suburban garden can function beyond its conventional recreational use and become productive. Many suburban gardens have swimming pools, which can easily be converted into productive (agricultural) ponds.

fig 2.37 View of Voortrekker Monument, Photograph by Author (2013)

top: fig 2.38 View of wetland, Photograph by Author (2013)
right: fig 2.39 Aerial of P.I.L.A., by Author, sourced from the Geography Department, UP (2013)

2.7.2 HISTORICAL PHYSICAL POTENTIAL

On first inspection of the site, it seems to be a natural landscape, not yet disturbed by human development. But soon after noticing the curious nature of the landforms, the isolated existence of the water body, and the homogeneous abundance of the invasive Black Wattle, it becomes evident how "unnatural" this site actually is. The last remains of the history of the site are revealed within the wattle forests - ruins of a forgotten industry overgrown by dominant nature. Beyond the first impression of its natural appearance, evidence of man's hands can be seen everywhere, as they have carved into, transformed and exploited the natural resources.

The Rosema & Klaver quarry and brickworks in Monument Park is possibly one of the last examples of the use of coal-fired brick production technology in South Africa. Rosema & Klaver still own another quarry and brickworks in Eersterust. Now operating as Era Bricks, it was of great value in informing an understanding of the historical Monument Park quarry and brickworks, as it is still operating with the same old technology. Without knowledge of this, the interpretation of the remaining structures at Monument Park would not have been as detailed or accurate as it is. In the historical site analysis, Era Bricks in Eersterust is used as a lens for understanding the heritage potential of the site, as it, too, is nearing obsolescence.

There is a story here, one which is soon to be consumed by the failure of memory and people's willingness to forget. Therefore the first potential which needs to be realised is that of the site's history, how it came to be what it is today, and how it can be understood through the relics of its past which still remain.

With the assistance of an ex Rosema & Klaver employee, Mrs. Aggenbag, the mine's old survey plans and historical photographs were rediscovered. With the aid of these, it became possible to interpret what the ruins once were, and to cross reference the ruins with the structures of Era Bricks in Eersterust, which reflects almost exactly the technologies used at the Monument Park/Waterkloof Ridge quarry.

The ruins complex consists of a water tower, concrete dust stores (stofstore), a hammer mill building, concrete columns and beams remaining from the brick extrusion and cutting hall, a concrete slab with steel tracks remaining from the drying oven structure, two brick monoliths as the only remaining fabric of the kiln structure, and some concrete columns from the southern kiln structures and workshop. There is a farm house in a very dilapidated condition which has been inhabited by vagrants. A boat jetty, supposedly built after industrial activity had ceased, is located at the most logical/convenient point for vehicular access, providing unobstructed entry into the water at the deepest and steepest point. This is a functional potential which can inform a decision on how the new intervention can interact with the water.

The industrial heritage structures have high functional potential as infrastructure, as well as potential for communicating knowledge of the site's past and the effects of time. The site has attained certain experiential qualities through its post-industrial regeneration. High tree canopies enclosing the ruined structures create an atmospheric sense of time, dappled light filters through the leaves as cool air settles in the abandoned spaces as one meanders through the ruins. The lush vegetation at the water's edge inspires a sense of pristine wilderness, while the disintegrating concrete slabs revealed every so often among the wild grasses is a reminder of the site's mysterious past.
From certain central and elevated areas of the site, a view of the Voortrekker Monument toward the west can also be attained, creating a visual link to another aspect of Pretoria's heritage.

fig 240 the physical components of the site's industrial heritage, by Author (2013)

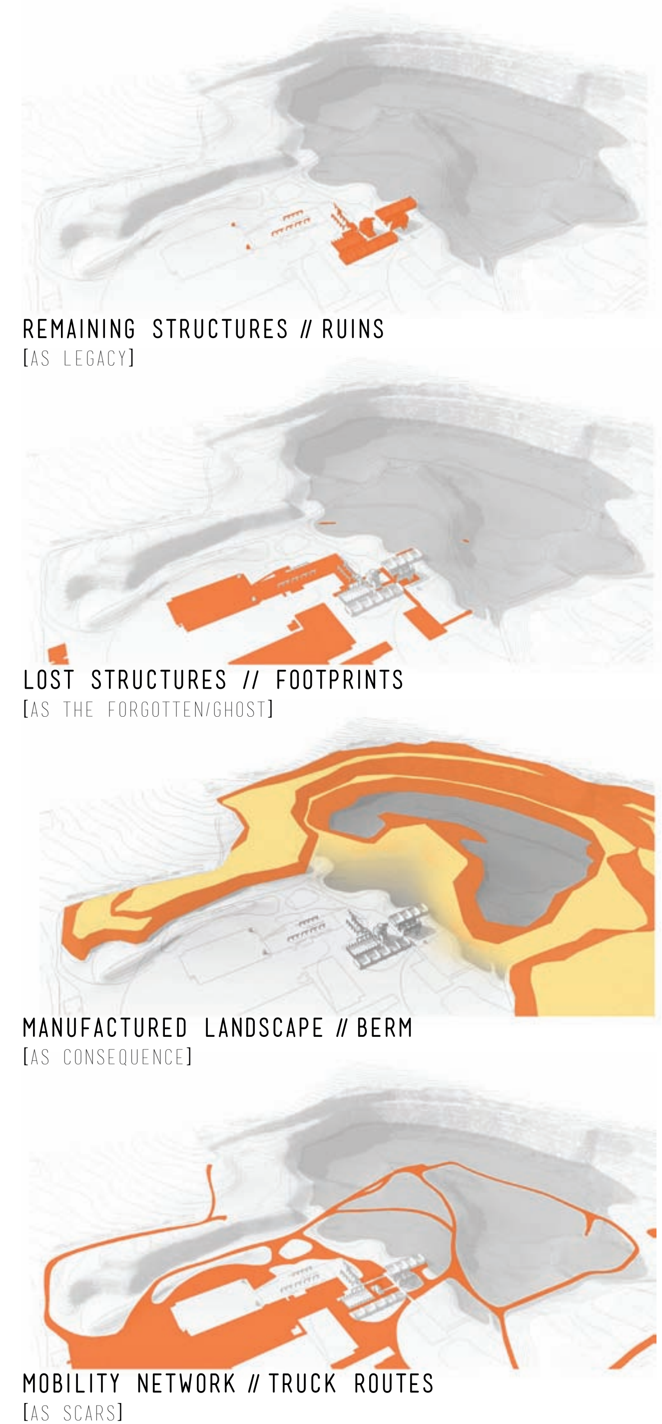
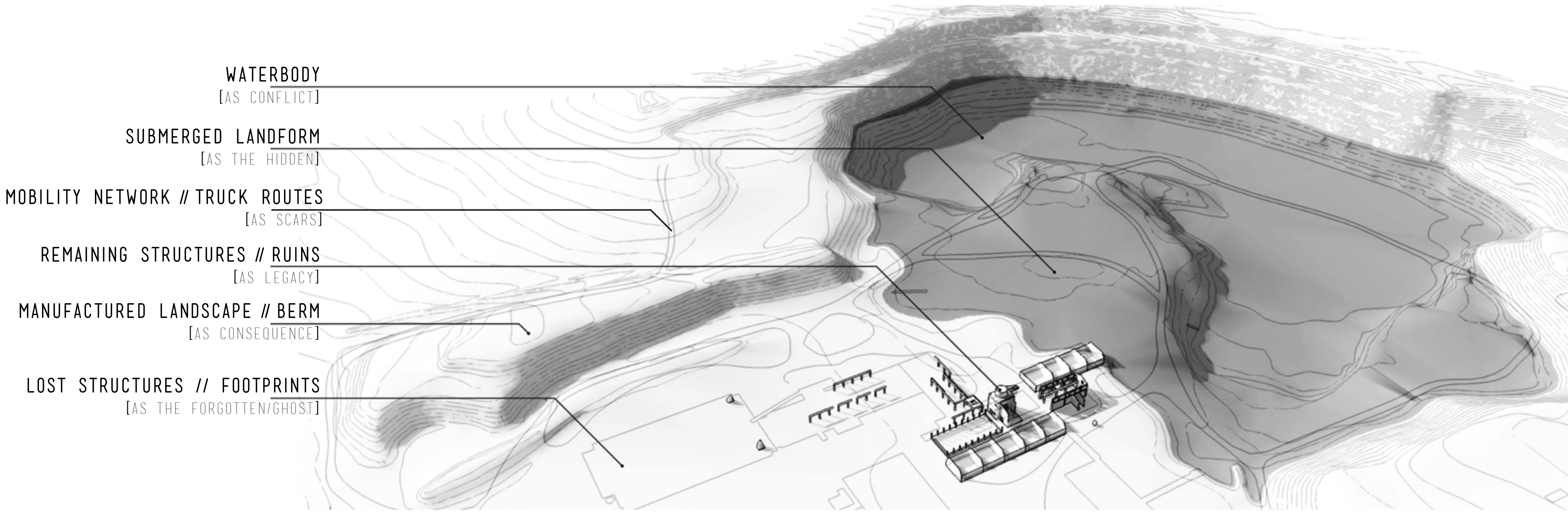


fig 241 the physical components of the site's industrial heritage, by Author (2013)



REMAINING STRUCTURES // RUINS
[AS LEGACY]

LOST STRUCTURES // FOOTPRINTS
[AS THE FORGOTTEN/GHOST]

MANUFACTURED LANDSCAPE // BERM
[AS CONSEQUENCE]

MOBILITY NETWORK // TRUCK ROUTES
[AS SCARS]

fig 242 Qualities of the physical components of the site's industrial heritage, Photographs by Author (2013)

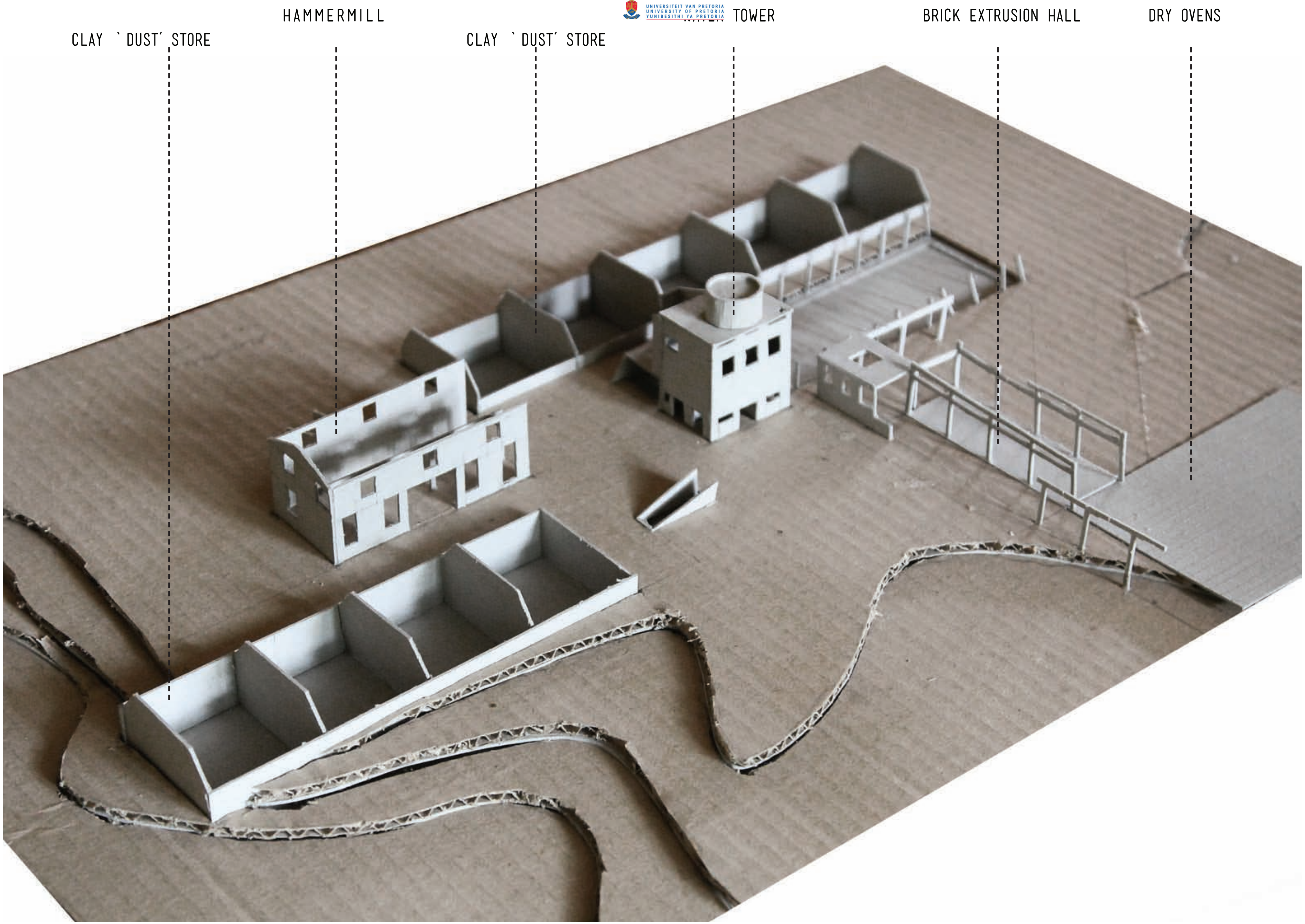


fig 243 Model representing north eastern view of industrial ruins, by Author (2013)

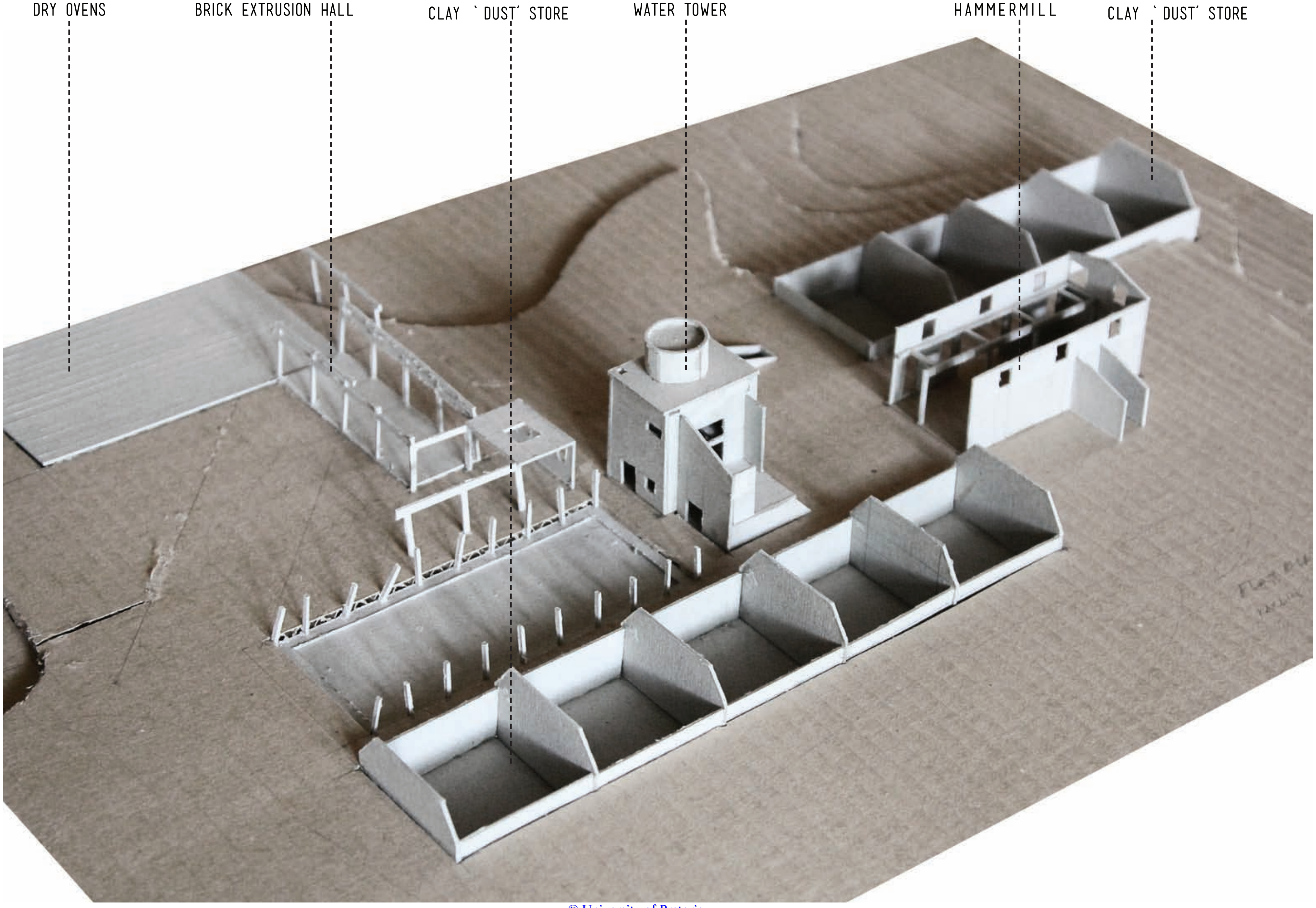
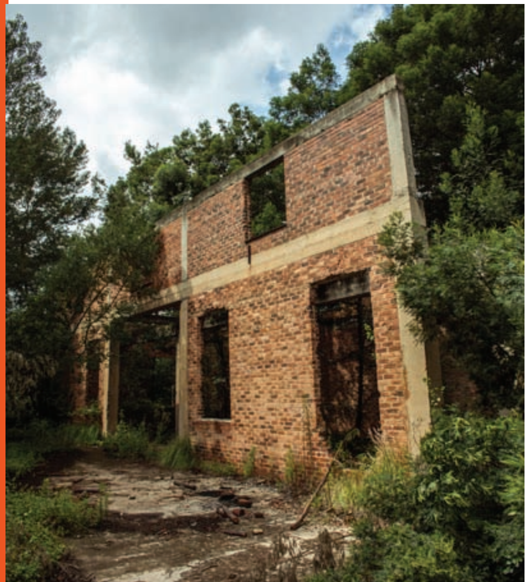


fig 244 Model representing south western view of industrial ruins, by Author (2013)

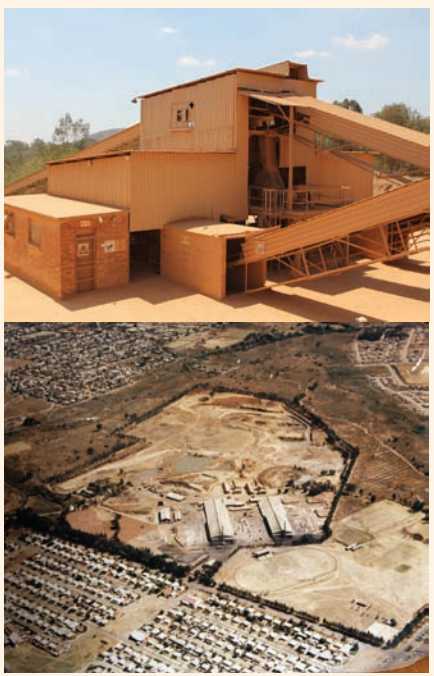
ERA BRICKS, EERSTERUS



HAMMERMILL

CLAY 'DUST' STORE

WATER TOWER



QUARRY

fig 245 Cross-referencing of Rosema + Klaver quarry in Waterkloof Ridge and the ERA Bricks facility in Eersterus, photographs by Author (2013)

BRICK EXTRUSION HALL

DRY OVENS

KILN OVENS

2.7.2.1 THE MATERIALITY OF THE HERITAGE FABRIC

2.7.2.1.1 BRICK

It seems ironic how the bricks which once hosted the brickworks have outlived the industry it once housed, spreading seed almost like an organism throughout the city, manifesting "children" in buildings, and these continuing their existence long after the "mother" has perished.
Perhaps these last remaining bricks, still passively contributing to the persistence of the walls, now remain standing in formation, only to contain nothing more than the nature which has unfolded around it.

The bricks that remain scattered on the ground, those that were unfortunate enough to have lost their purpose within a structure at the time the ovens were demolished, now persist among the grasses and weeds, abandoned and suspended in dysfunction.

2.7.2.1.2 CONCRETE

The remaining columns, beams and walls reveal evidence of well-executed concrete craftsmanship. Despite the utilitarian/industrial purpose, attention to detail is evident.

The wood grain of the off-shutter concrete holds the imprints of a well-executed shuttering technique, frozen in the moment when liquid concrete cured against a timber shutter, destined to preserve its "fingerprints" for decades to come, and a lasting memory of how two materials exchanged properties and purpose to become architecture. The endurance of the concrete gives testament to the existence of degradable timber, to which the concrete owes its lasting form.

2.7.2.1.3 CLAY

Unprocessed clay remains scattered among the ruins and inside the concrete dust stores. Forgotten by the industry, the clay lies harvested yet frozen in time when industrial activity finally ceased, and now plays host to accidental nature.

To further understand the values of the heritage potential beyond the material descriptions, refer to Chapter 3, Section 3.3: Industrial Heritage within the Post-Industrial Landscape.

CONCRETE

CONCRETE + BRICK INFILL

CLAY / SHALE

fig 2.46 Materiality of the industrial heritage, photographs by Author (2013) *fig 247 Materiality of the industr[illegible] photographs by Author (2013)*

CONCRETE STRUCTURE IN CLAY SOIL

CLAY DUST DEPOSITS IN STORES

BRICK STRUCTURE

2.7.3 BIO - PHYSICAL POTENTIAL

The site contains many biophysical, environmental and ecological potentials resulting from natural and mining processes.

2.7.3.1 WATER

An expert in Pretoria's hydrology, Matthys Dippenaar, of the Department of Geology at the University of Pretoria, has concluded that the water on site originates from dolomitic ground structures which were exposed during mining activities. According to the Seaton Thomson environmental report (2003), "the dolomitic component is a good aquifer with a high water yielding capacity, high storage and high recharge potential and must be protected from pollution or abstraction" (Seaton et al., 2003:24). If this dolomitic formation is responsible for the emergence of the water, as Dippenaar believes, this would explain the stability of the water level throughout the year, as groundwater pressures are keeping the water level stable despite evaporation. This means that the water level can be assumed to remain stable for hundreds of years to come. The only instability concerning the water level is introduced by rainfall events, resulting in an overflow toward the catchment of the Apies River. The potential here is to prevent storm water from polluting the clean quarry water, and to regulate the overflow through a permanent wetland that can also potentially purify the water.

The presence of water has allowed for the transformation of the site from a dusty quarry into an incredibly green space surrounded by urban sprawl. A ripple effect has been initiated by the water (and by the industrial activity preceding that). The water itself has its own latent potentials for giving effect to other entities on a biophysical level. On a social level, one can use the latent potential of this quarry to redevelop the whole area/suburb. One would have a community that did not exist before, drawing life from the quarry. Productive potential exists, hinting toward the potential of fish breeding/aquaculture.

2.7.3.2 LANDFORM

The south-western corner of the site contains dolomite which, although not conducive to development, holds a potential greater than that of development. It contains some rare indigenous rock specimens and flora, therefore the south-western corner is to be retained as an open space and a link to the greater ecological network. The remainder of the site has an underlying geology of shale more than 50m thick (Seaton et al., 2003:3). According to geotechnical investigations, the stability of the area surrounding the quarry is considered acceptable for development, as the "shale bedrock is covered by potentially collapsible gravelly, clayey sand and fill, consisting of spoil from the brick works" (Seaton et al., 2003:21). On the central and eastern parts of the site that contain this infill, the foundation recommendations include: "the founding of structures on the shale bedrock, removing unsuitable material up to a depth and width of 1,5m times the foundation width. Below normal founding depth and backfilling the excavation with competent, compacted material" (Seaton et al., 2003:22).

A deep excavation, i.e. the quarry, is located toward the eastern side of the site and is currently filled with fresh ground water. There is a 26 meter high terraced embankment on the northern extremity, indicating the occurrence of localised wedge failures; however, these do not affect the overall stability of the slope. The direction of the slope generally runs down from east to west. There are no potentially expansive materials present on site. Some materials have a moderate clay content at least suitable as fill (Seaton et al., 2003:2).

There are numerous tracks and roads across the site, and in certain areas a large amount of mining litter and rubble has been dumped. The site is seemingly pollution free, contrary to what would be expected of mining sites, but since this was a clay quarry, the by-products were few and consisted mostly of clean brick waste. There is no sign of coal waste. There is evidence of informal settlement and squatting, which has generated some rubbish and litter.

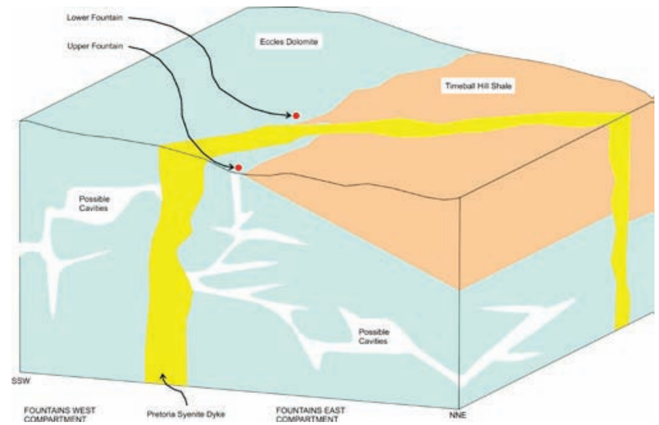
2.7.3.3 ECOLOGY

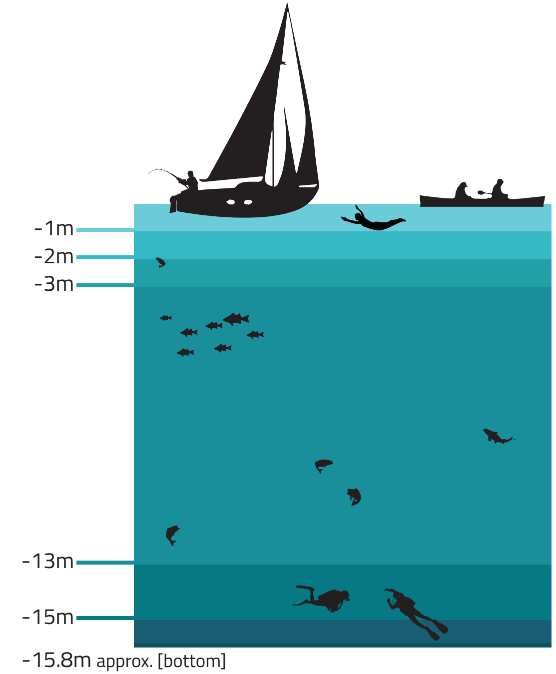
The fauna and flora on site are currently lacking in biodiversity, because of the homogeneity of the invasive Black Wattle forest and disturbances due to past mining activity; this despite the fact that the rehabilitation plan claims that the species was supposed to have been removed from the site after industrial activity had ceased (Rehabilitation & Development Plan for Rosema & Klaver Quarry, [n.d.]:10). Although invasive, the Black Wattle trees do have aesthetic value, especially among the ruins, and the older trees with high canopies may be retained as part of the heritage landscape. Younger trees can be removed and replaced by indigenous species over a period of time. The wattles also have a functional potential as a material resource: wattle has been used extensively for furniture and even boat building.

There is little remaining indigenous fauna on site, although bird life in the wider area is abundant due to the variety of trees (Seaton Thomson, 2003:19). Many indigenous flora species can be reintroduced to the site to attract indigenous fauna, especially birds. A major ecological potential lies in the temporary wetland, which forms during storm water run-off events. The potential exists to establish it as a permanent wetland which could support its own habitat while mitigating the effects of storm water run-off from the quarry water body.

The quarry dam contains some Bass and Carp species introduced for recreational purposes, and could serve as a potential generator for social activity for the wider public.

fig 250 Origin of water thrugh dolimitic ground formations (Matthysen Dippenaar, 2013)





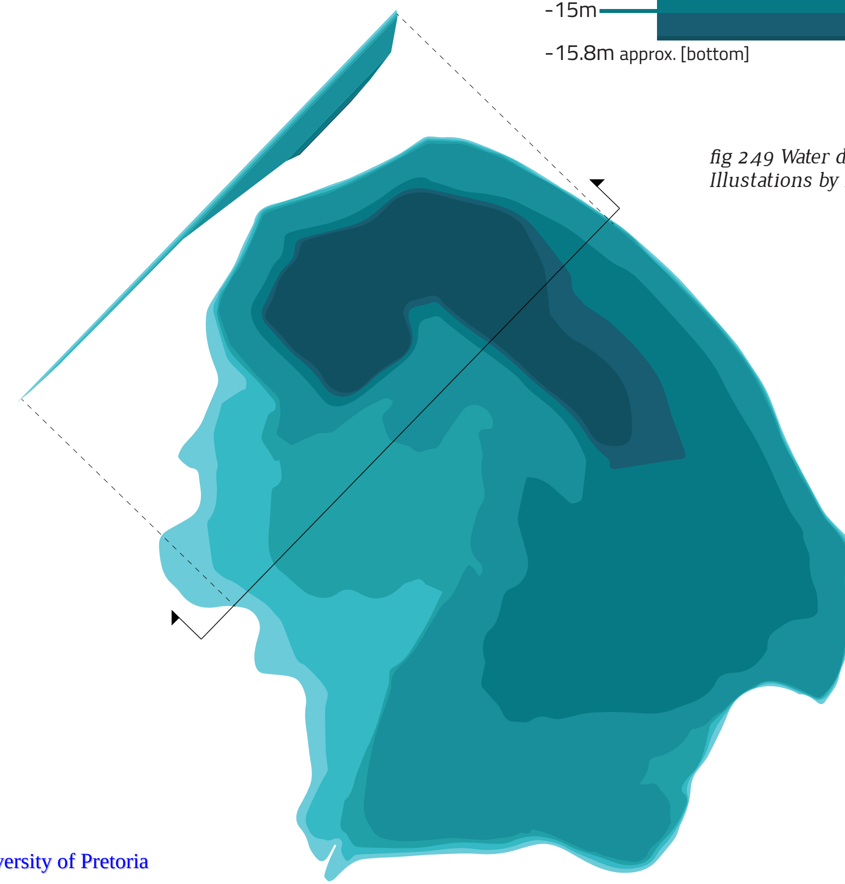


fig 249 Water depth analysis, Illustations by Author (2013)

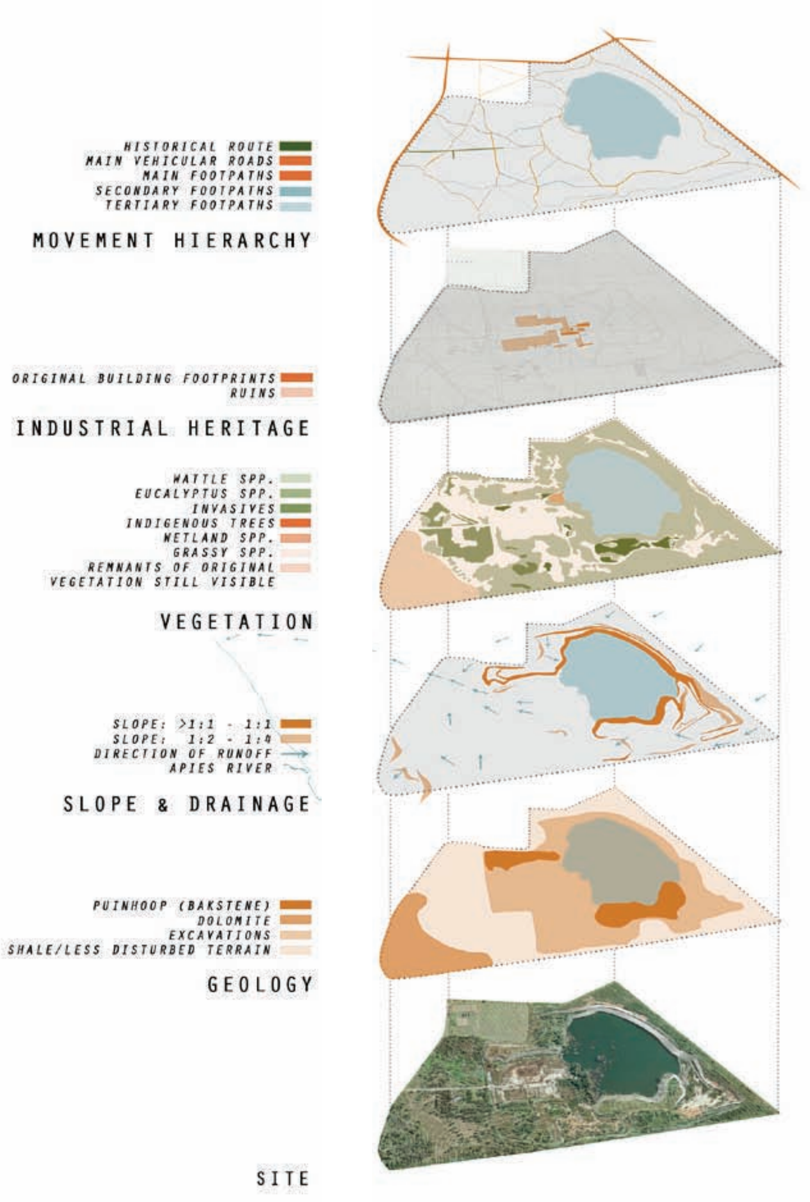


fig 248 ecological mapping layers, Ilze Labuschagne (2013)

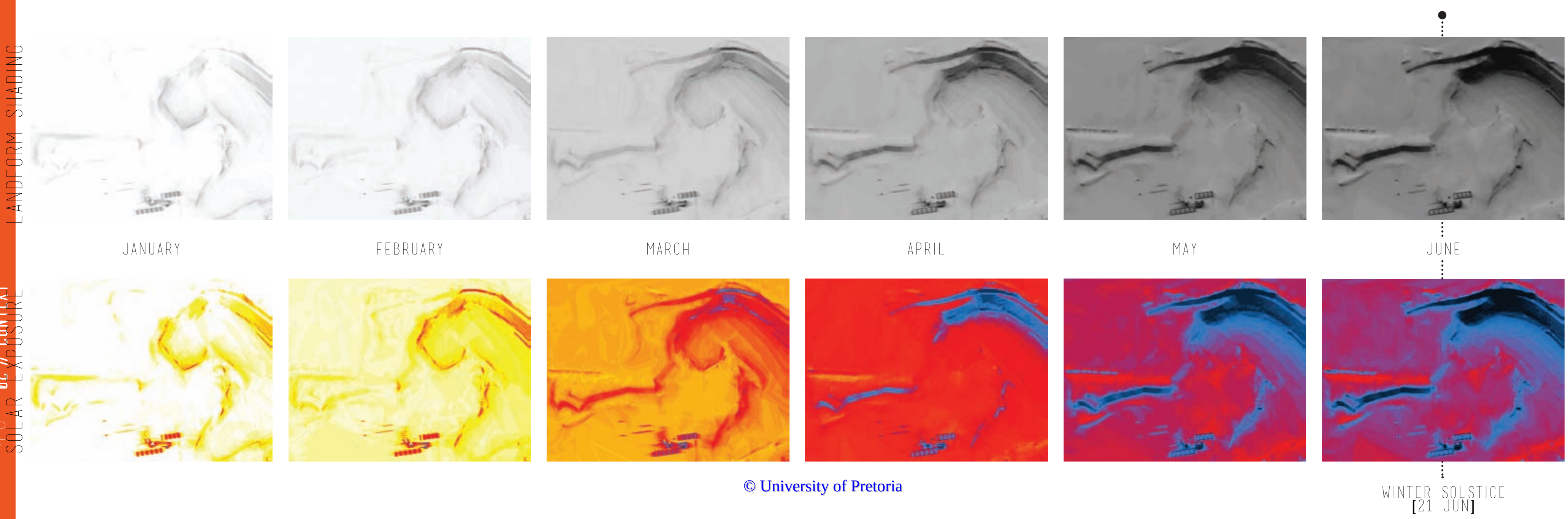
2.7.3.4 CLIMATE

The climate of the area is generally moderate, with hot summers and mild winters typical of Highveld weather conditions. Summer rain varies between 650mm and 750mm per year, whilst temperatures vary between -12°C and 39°C. Frost occurs during winter in the period between 1 June and 15 August, and on average hail occurs on about 1 day a year (Seaton et al., 2003:18).

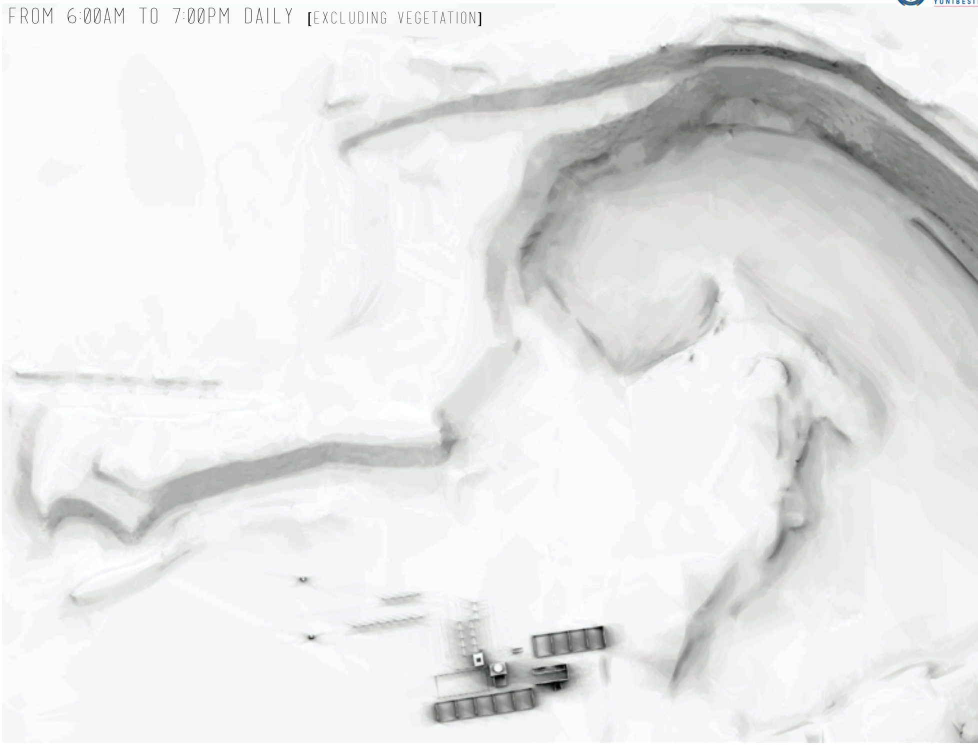
The prevailing wind direction in the months between September and March is east to north-east, while in the winter months it blows predominantly from an east-south-easterly direction. The average wind speed is 4 meters per second.

The site's micro climate has some noticeable characteristics. Due to the depth of the excavation in relation to the elevation of the surrounding environment, "[c]old air will drain into the site from the north and east sides and much of the cold air will pool in the pit forming a frost pocket. Cold air drainage from this pool will be to the west forming a cold belt along the line of the ancient stream bed. In winter the near verticality of the south facing slope will cause extensive shadows in the pit, causing the area to remain cold most of the day" (Rehabilitation & Development Plan for Rosema & Klaver Quarry, [n.d.]:13). The implications of this for the project are that any habitable development will need to fully utilise and maximise exposure to available sunlight during the winter period. Public spaces near the pit and the south-facing embankments will need to allow for direct sunlight to heat habitable areas.

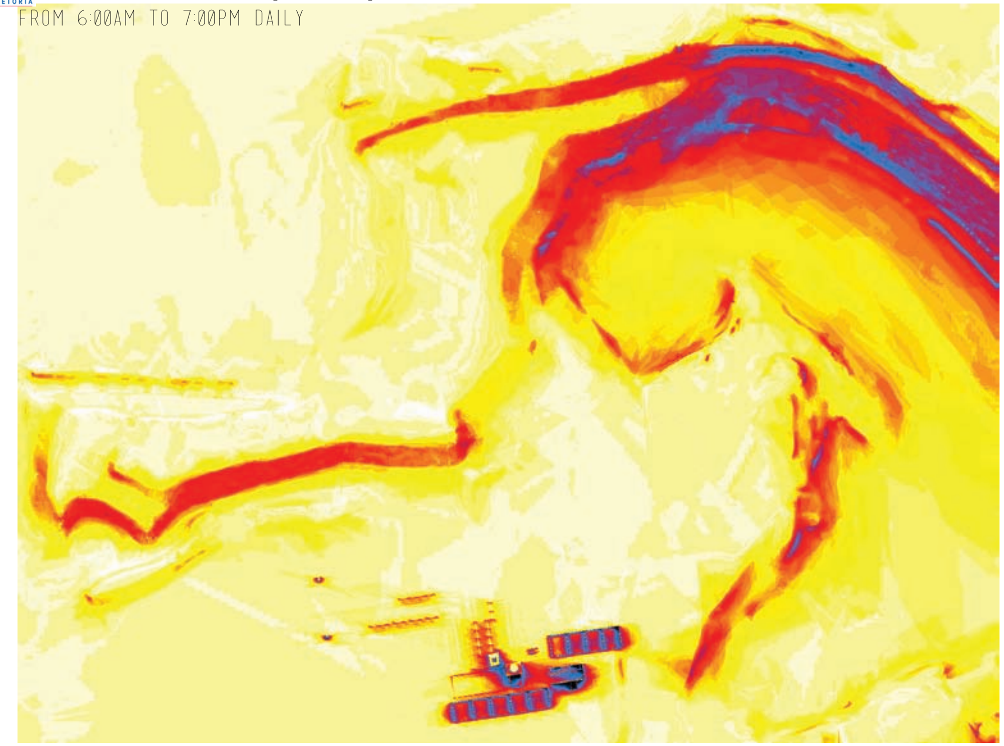
bottom and right:
fig 251 Solar and shades studes of the Rosema + Klaver quarry, by Author (2013)



AVERAGED ANNUAL AMOUNT OF LANDFORM SHADING [JAN - DEC]
FROM 6:00AM TO 7:00PM DAILY [EXCLUDING VEGETATION]

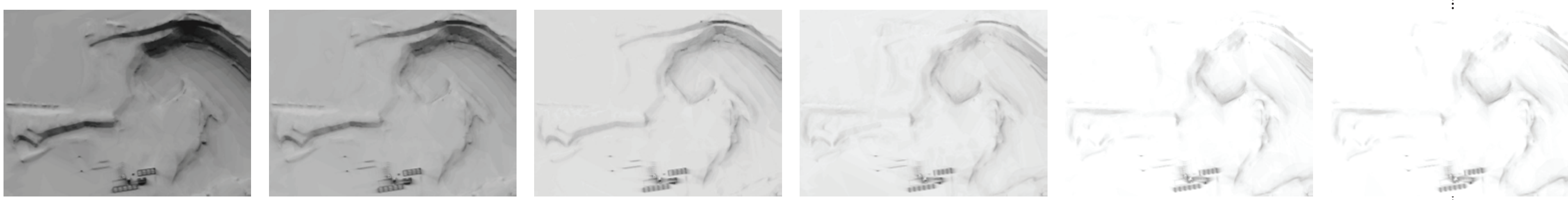


NUAL SOLAR EXPOSURE [JAN - DEC]
FROM 6:00AM TO 7:00PM DAILY



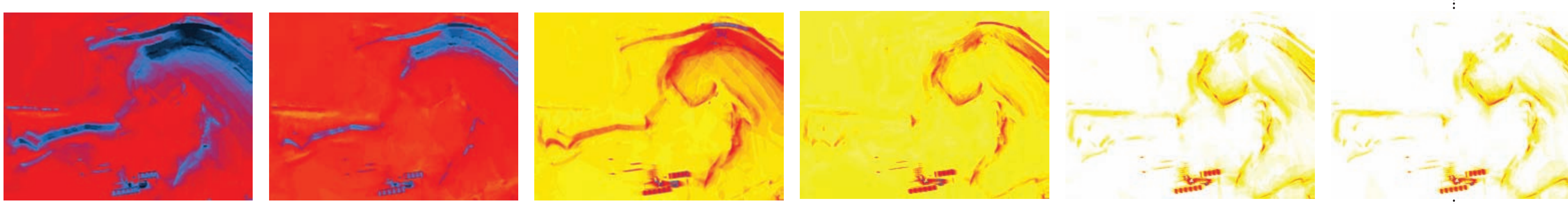
0% 100%

LANDFORM SHADING



JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER

SOLAR EXPOSURE



SUMMER SOLSTICE
[21 DEC]

2.8 URBAN VISION: SILENT INDUSTRY - PRODUCTIVE PARK AS ALTERNATIVE TYPOLOGY

The Tshwane 2013 RSDF describes many inevitable outcomes for future urban planning practices, but it falls short in some cases and is often contradictory. The RSDF has been criticised and adjusted to be more appropriate and responsive to local conditions. An entirely new vision for the site has been developed as a regenerative strategy, to fully utilise the inherent potentials and to address the pressing urban and local concerns and needs.

The pressures of population growth, housing and urban sprawl require reconsideration of the way urban settlements are planned. If the current practice of horizontal suburban spread continues, we will find ourselves in an increasingly disconnected system. Considering the issues of suburbia - of lacking a sense of community and lacking acknowledged natural resources - a community space with resources can be introduced by building on the latent potentials of the site.

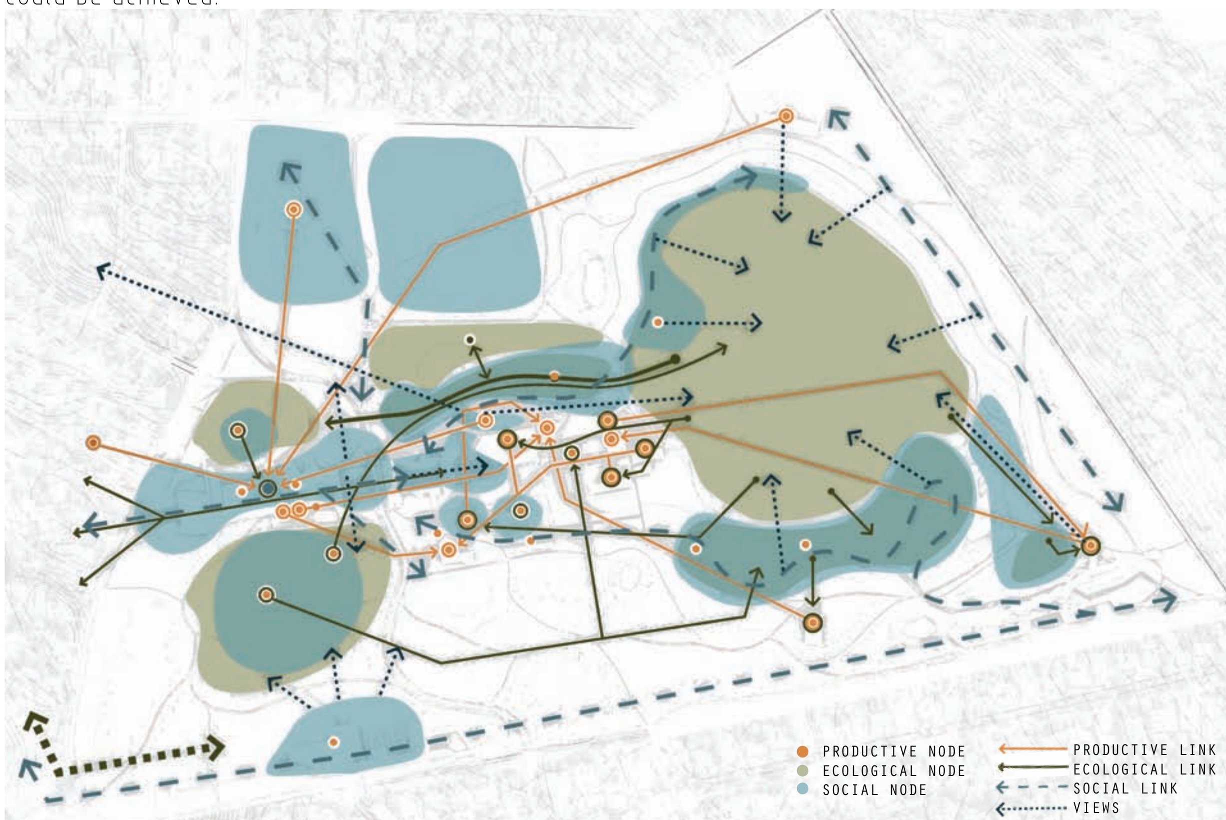
By finding opportunities within the old quarry site, it becomes possible to guide future growth in a more regenerative and resilient manner, to consider often neglected aspects of urban living and to restore opportunities which have been lost. The goal is to re-conceptualise the suburban condition to become a healthier urban environment. The site is to provide a central public amenity for the local community, forming part of a greater network of such green lung / production nodes across the entire urban fabric of Pretoria.

The energy of the site becomes dissipated from high energy outside to low energy inside. By identifying the various high and low energy zones surrounding the site it becomes possible to utilise site-specific potentials appropriate to the types of energy. Similar to Olmsted's vision for New York's Central Park, dating back to 1857, a configuration exists between high energy edges and the pavilions in the core, with routes throughout, maintaining the public amenity as a green lung. The vision of the proposed project is to become a precedent for the "productive green lung development typology".

The Region 3 spatial development framework has been used as a basis to inform the group urban vision1 for the site, and to realise the inevitable densification of the suburban fabric. This framework is, however, incomplete and contradictory. The new alternative framework proposal aims to improve on the Tshwane 2013 RSDF for the Monument Park and Waterkloof Ridge suburbs, to alternate with the proposed framework where deemed appropriate, and to further strengthen the regenerative urban possibilities which could be achieved.

bottom:
fig 252 Integrated networks in urban vision, Illustration by Author (2013)

right:
fig 253 Silent Industrey, Urban Vision masterplan (Ilze Labuschagne, 2013)



1. Refer to Appendix, - Silent Industry, for a complete description of the vision and the people involved fig 254 Alterations to Tshwane RSDF (Tinus vd Merwe, 2013)

REVEALING 2

THE POTENTIAL // QUALITY

CHAPTER 3:
A WAY OF UNDERSTANDING

THEORY

3.1 A RESILIENT + REGENERATIVE DEPARTURE TOWARD HYBRIDITY

To truly understand the site and the various processes it has undergone over the last century, an attempt at a theoretical and often philosophical understanding will be made in the subsequent chapter. This will illuminate an understanding of the industrial past, what preceded it, and what has happened to it until now, and how and why it happened. This process will identify critical aspects and inform decisions on how to go forward towards regenerating the site.

As this dissertation found its genesis as part of a greater National Research Foundation (NRF) project to investigate design strategies for urban resilience and regenerative development, it must be understood that the research is inherently biased toward the goals of this NRF project. However, this very genesis provided solutions and a lens for viewing the project that offer valuable strategies for architectural design processes in any situation.

3.1.1 THE ECOLOGICAL WORLDVIEW + REGENERATIVE DEVELOPMENT

In recent decades, the Built Environment's response to environmental issues has been to adopt the concept of "sustainability". This has led to the development of obscure rating systems and "green" marketing strategies aimed at sustaining current building practice, with the supplementation of sustainable technologies as a way to counter its negative impacts. While effective progress has been made, the core issue still lies in the modern world view, which Du Plessis describes as a "reductionist and mechanistic worldview" that sees man as separate from nature, "inadequate in coping with the reality of cities as complex social-ecological systems" (Du Plessis, 2011:1). A new 'whole/living systems or ecological' world view needs to be realised to transcend the limitations of sustainability, toward the promise of resilience "that explicitly engage[s] with the city as a complex adaptive system in which humans co-evolve with other entities in the system" (Du Plessis, 2011:1).

An ecological world view aims to identify how all living entities "can contribute to creating a healthy and resilient social-ecological system that can regenerate itself" (Du Plessis, 2011:2). It has inspired a revitalised interest in 'ecological urbanism', describing cities as part of the natural world, as habitats and urban eco-systems, which are "dynamic and interconnected; every city has a deep, enduring context; urban design is a tool of human adaptation" (Spirn, 2012:6). Ecological urbanism has the potential to greatly improve the resilience of urban environments which, as eco-systems, must "withstand disturbance and assimilate waste. Resilience is a measure of the system's capacity to absorb change" (Spirn, 1984:245), which all ecosystems inevitably experience. "Buildings and settlements are not 'objects' or assemblages of technology and materials, but amalgamations and concentrations of many systems with energy and material flows, not unlike living organisms with metabolisms" (Reed & Mang, 2003:5). These systems need to be managed appropriately, or else negligence thereof would certainly cause them to fail.

Regenerative development accepts that "humans, their artefacts and cultural constructs are an inherent part of ecosystems; and their actions should contribute positively to the functioning and evolution of ecosystems and bio-geological cycles, enabling the self-healing processes of nature" (Du Plessis, 2012:17). But, according to Reed, human systems encourage activity that undermines natural regenerative capacity by "disregarding the fundamental principles that govern natural systems ... the self-organising, self-healing, and regenerative capability of natural systems is diminished by human-created systems" (Reed et al., 2003:1). To create regenerative systems, humans must learn to co-evolve with natural and living systems. "To continue to thrive and evolve we need to redesign our systems to obey the laws of nature to create systems that can co-evolve with and enhance the evolutionary capability of natural systems" (Reed et al., 2003:1).

The co-evolution of human and natural systems relies on 'relationships' which form the basis of the most important concept for an ecological world view, since any possible condition exists because of specific relationships, or an event of 'exchange' between entities within a complex ecosystemic web. Human activity needs to be aligned with the processes of nature, to result "in cities that are embedded in and contributing to natural processes of creation, evolution and regeneration" (Du Plessis, 2012:5). If cities are habitats for all species, not only humans, then they must allow all of an organism's functions to thrive, such as "reproduction and growth, movement and exchange, communication, making and building, teaching and learning, work and play, reflection and worship" (Spirn, 2011:9). This would contribute greatly to an enhanced urban biodiversity, which is also beneficial to humans as "the presence of urban wildlife is closely linked to human wellbeing" (Spirn, 2011:9). This is supported by the science of Biophilia, which investigates the inherent positive effects experienced by humans in the presence of nature.

Effective exchanges between urban form and natural processes are critical for co-evolution, and the key to these exchanges are "air (heat transfer and flow), earth (geology and soils), life (reproduction, growth and behaviour), and ecosystems (flows of energy, information and materials, succession of plant species and behaviour of plants and animals). Ignoring natural processes leads to harmful consequences, including the failure of planners to accommodate dynamic change" (Spirn, 2012:8).

The processes of nature, the environmental exchanges, the "hydrological cycle, the nutrient cycle, and the food chain" (Spirn, 2012:10) are essential to sustaining human life. The built environment must become integrated into these systems to ensure mutual benefit for life on earth. The cycles "link us to the environment in which we live and to the other organisms that share our habitat [ ] the urban landscape affords abundant opportunities to celebrate these cycles, to make legible and tangible the connections they forge" (Spirn, 2012:10).

Regenerative development is all about involving the surrounding communities, human and non-human, in a larger integrated network which allows the human community "to see and understand the implications of the patterns and dynamic flows of resources and energies that have shaped and are shaping a living system" (Mang et al., 2012:36). This exposure creates new potential for communities to engage, where "citizens move from passive consumers, to actively 'owning' responsibility for their continuing sustainability as well as that of their community and their place" (Mang et al., 2012:36). Being aware of natural processes can also ground a community in a sense of time and belonging. As Spirn explains, "[d]esign that makes visible the operation of natural processes and their temporal cycles contributes to the experience of being connected to rather than separate from the past and the future" (Spirn, 2012:10).

According to Spirn (2012:12), there are many ways of managing ecosystems: preservation retains the system's current state; conservation manages the ecosystem for 'wise use' by humans; restoration reconstructs or repairs damaged ecosystems; renewal improves an ecosystem's condition "through the introduction of a wholly new element". These strategies can be harnessed through regenerative development by identifying the inherent potential within certain local eco-systems. Through regenerative development, it becomes evident just how important it is to understand site specific ecosystems, each with its own 'story of place'. Du Plessis (2012:16) asserts that for a design to be ecological, it must respond to local conditions, adapt to changing conditions and employ decentralised approaches. Regenesis utilises the concept of 'place-sourced potentials' to inform 'place-based design', which "not only uses resource efficiency as an approach but requires an awareness of what gives health to a place" (Reed et al., 2003:7). "Place is defined here as the unique, multi-layered network of living systems within a geographic region that results from the complex interactions, through time, of the natural ecology and culture" (Mang et al., 2012:28). The individual story of place becomes a catalyst for future regenerative development. "Stories have the power to deepen connections to the underlying intrinsic beauty and value that a place has to offer. In addition, they can create collective identity, meaning, and purpose to bridge divides and foster collaboration" (Mang et al., 2012:30).

Regenerative development investigates what potential a certain entity has to offer "in relation to the larger systems in which an entity is nested. A regenerative design works to develop patterns of relationship between the entity and the larger system that generate a cascade of capacity development up and down system scales" (Mang et al., 2012:30). This type of development often has the capacity to heal "the damage caused by source-to-sink one-way flows, and [create] self-renewing resource systems" (Mang et al., 2012:28). This is especially relevant for post-industrial sites such as quarries, where resource extraction once occurred, and that have been abandoned and left with a broken ecosystem. But other newly generated entities, such as the emergence of natural entities, could serve as a valuable place-sourced potential to regenerate the social-ecological systems within which the site is nested. "Designing for pattern harmony optimises the presence of people in the landscape, weaving what is built into the living fabric of the land and local community. Pattern harmony means buildings and infrastructure improve land and ecosystems, and the unique attributes of the land improve the built environment and those who inhabit it" ((Mang et al., 2012:30).

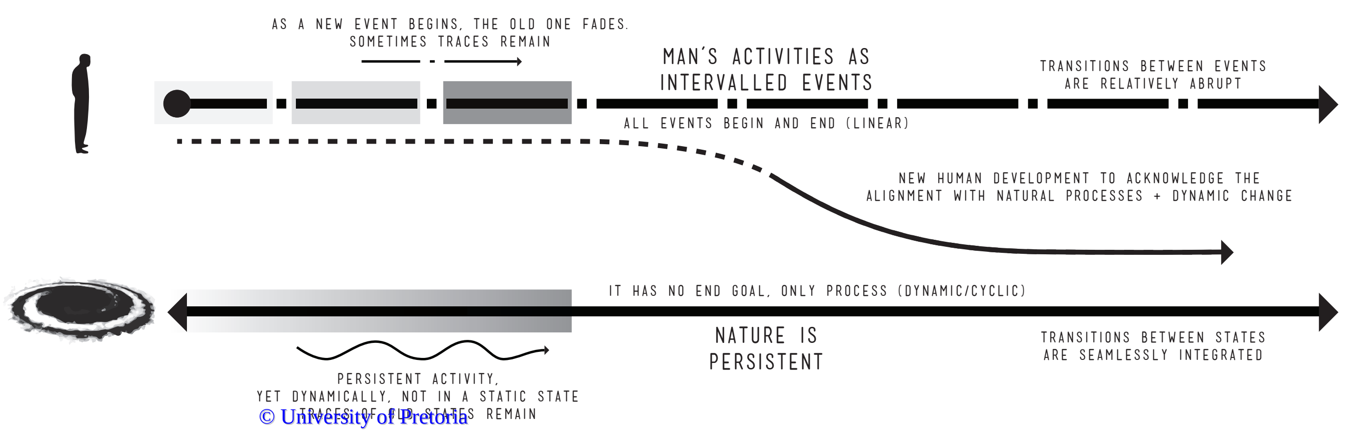
It can be concluded that regenerative practitioners are designers of ecosystems that "integrate natural and human living systems or create and sustain greater health for both" (Mang et al., 2012:26).

3.1.2 HYBRIDITY

In response to the previous sections, relationships can be determined by learning from the dynamic changes on the site that resulted from the natural systems and changing social-economic processes as these relate to the old human interferences. A relationship exists between the built environment as an extension of human ideals - the manifestation of social constructs - and that of nature's processes. Architecture is generally a static implementation of an ideal object state to politicise and declare man's presence and static ideals. Nature, however, has no sympathy with human ideals, and sees all matter as part of its own processes. If what we imagine a building to be does not acknowledge the existence of nature's processes, then our buildings will certainly experience non-ideal changes, as made evident by the principles of regenerative development. It is understood that the site has already gone through various generations of human and non-human hybridity. The condition of the states of hybridity, whether they are symbiotic or parasitic, ultimately defines the regenerative capacity of the site, in which case a symbiotic hybridity is far more favourable. In the spirit of the ecological world view, how great could the impacts be if humans thought of themselves and architecture as extensions of the "natural" environment and components within the natural order of things, as being part of natural systems, so that humans, architecture and nature all form part of a greater integrated, distributed system? A regenerative design practitioner now specialises in the hybridisation of human settlement. The barriers between human and non-human become irrelevant as each has its own role to play, a role which can be interchanged between different types of entities, as described in Bruno Latour's writings on Actor Network Theory (ANT). By using Latour's theories as a theoretical approach to understand the "social" context of humans and non-humans, it becomes clear that a hybrid condition exists. "Social, for ANT, is the name of a type of momentary association which is characterized by the way it gathers together into new shapes" (Latour, 2005:64). Therefore, according to ANT, everything plays a role within a system, whether it be a human or non-human "actor" or "actant", it is merely a component within a greater "social" system; therefore it can be concluded that society does not stand apart from nature and its life giving processes.

When acknowledging humans and human creations, such as architecture, as being inescapably defined within the scope of the "natural", it needs to be realised that all that applies to nature also applies to humans and our creations. Perhaps the most important, yet often denied, reality of nature is its temporality through entropy and inevitable decay.

MAN:
(noun) Any living or extinct member of the family Hominidae characterised by superior intelligence, articulate speech, and erect carriage.
[WORDWEB]



NATURE:
(noun) a casual agent creating and controlling things in the universe
(noun) the natural physical world including plants, animals and landscapes etc.
[WOLFRAM ALPHA]

fig 3.1 Activities of Man's vs Nature's. Illustration by Author (April 2013)

3.2 ENTROPY, DECAY + CHANGE

> *Ever since science has come to realise that the two concepts of matter and energy, formerly kept rigidly apart, are merely different states of the same primary element, that in the order of the world nothing takes place without relativity to the cosmos, without relationships to the whole -*
>
> *- Erich Mendelsohn, architect (Conrads, 1970:72)*

If matter is energy, and matter is what composes material resources which ultimately become articulated into architectural space, then surely architecture must be an articulation of energy. Energy is best described by the laws of thermodynamics, which accounts for energy's transformation from one phase into another. Not only are these laws applicable to the efficiency of heat engines, but to an "enormously wide range of phenomena reaching as far as the processes of life" (Atkins, 2010:xi). The most notable law to be understood for the purposes of this dissertation is the second law: "In all energy exchanges, if no energy enters or leaves the system, the potential energy of the state will always be less than that of the initial state. This is also commonly referred to as entropy. Entropy is a measure of disorder" (www.emc.maricopa.edu).

In 1865, Clausius, a German mathematician and physicist (Cardwell, 1971:5), coined the term 'entropy', naming it after the Greek word for 'transformation', '\τροπη/trope', referring to irreversible heat loss. It was deliberately chosen to be similar to the word 'energy', as the two quantities were so closely related in physical significance (Laidler, 1995). Atkins claims that the second law provides a fundamental understanding of why any change occurs, not only in terms of chemical reactions, but even the "most exquisite consequences of the acts of literary, artistic, and musical creativity that enhance our culture" (Atkins, 2010:37). Architecture can be excluded neither from the dynamics of energy, nor from the dynamics of change and transformation; therefore architecture certainly experiences entropy.

Ben-Naim (2012:6) describes how entropy occurs on two different scales, microscopic and macroscopic. Entropy not only occurs on the molecular level with energy exchanges between atoms (the microscopic), but also on a macroscopic scale, observable through a "tangible piece of matter that you can see and work with". It occurs in complex and dynamic exchanges between objects of matter within a system, such as the material manifestation of architecture tied to its societal ideals.

Boltzman, an Austrian physicist of the late 19th century, stated that "the system when left to itself, rapidly proceeds to the disordered, most probable states" (Ben-Naim, 2012:12).This statement was further refined by Ben-Naim, who considered the association which exists between entropy and disorder as a "metaphoric description". "The second law states that if we remove any constraint within the system in such a way that the system evolves from the initial constrained equilibrium to the final unconstrained equilibrium, the entropy will increase" (Ben-Naim, 2012:8).

For example, the built environment, as a strictly controlled system, is in an initial state of equilibrium while it is used and maintained by humans. An industrial site is kept within strict parameters to maintain the most efficient conditions for the industry's operations, in an isolated, almost abstracted space, and with complete disregard for the external natural systems in its surrounding context. Human activity is the factor keeping the system in a constrained equilibrium. Once human activity ceases on a particular site (as a system), a new equilibrium is reached, a state which prefers unconstrained conditions as the entropy increases. This is where one would often find that nature flourishes in abandoned industrial areas. Finally, the system components which have been refused entry into the previously isolated system are now capable of interacting with the other components, and a new state of equilibrium is reached, in a seemingly disordered "entropic condition". The industrial ruins become continuously transformed through natural processes, beyond their initial industrial intent, and are now submerged in the surrounding natural systems.

"How important is it - if at all - for architects to consider the ultimate decay of the buildings they design?", a question posed by the late experimental architect Lebbeus Woods (2012). He sees a new building as the realisation of an architect's "ideals, hopes and aspirations". As the building decays, so do they, therefore they try to avoid it at all costs by "careful selection of materials, systems, and methods of assembly that will withstand the forces of nature continually attacking them" (Woods, 2012). He defines this 'entropy' as "a tendency to decay, inherent in materials and systems themselves". It is not something which can be escaped, and all buildings will ultimately decay.

In an interview with Alison Sky, land artist Robert Smithson shared some of his views on entropy, one of his obsessions (Smithson, 1973). He believes entropy to be a contradiction of the mechanistic world view, as he believes that that world can be seen as "a closed system which eventually deteriorates and starts to break apart and there's no way that you can really piece it back together again. One might even say that the whole energy crisis is a form of entropy. The earth being the closed system, there's only a certain amount of resources ..." (Smithson, 1973). Sky responded with her observation that entropy could actually be a type of "metamorphosis, or a continual process in which elements are undergoing change, but in an evolutionary sense" (Smithson, 1973).

The obvious question an architect could ask in this case would probably be, "How can we prevent this from happening?", but a more logical and alternative question is proposed: "How can we acknowledge this, and allow for it in a way in which we would not have conflicts of interest with nature, but rather, change and decay with nature, as it sees fit, if at all possible?" After all, there is nothing more honest than nature itself; if we listen to it, then we can no longer lie and mislead ourselves into false hopes of everlasting endurance and immortality of our ideals. Smithson said, "Architects tend to be idealists, and not dialecticians. I propose a dialectics of entropic change" (www.robertsmithson.com). Many architects find comfort in a delusion of endurance, in which their architecture has eternal glory and effect, a kind of legacy which would outlive their relatively short lives, and as a result immortalise them. "Buckminster Fuller also has a notion of entropy as a kind of devil that he must fight against and recycle" (Smithson, 1973). The dynamics of nature does not allow for such a static world view. In nature, the organisms that tend to survive and persist are the ones with a stronger threshold for adaptability and change. They are capable of responding to a dynamic environment, and do not attempt to persist in a static state. Now, of course architecture is not a living organism, or at least not in the conventional sense, but it does exist within a dynamic environment consisting of social, economic and ecological actors in constant flux, where the architecture itself becomes an actor in constant exchange with these other physical and non-physical spheres. These three spheres of the human world are not static and experience inevitable change; therefore the architecture must either respond accordingly, or at least accept its inevitable fate or leave enough room for the unknown disturbances to be accounted for, in order to reinforce urban resilience.

Lebbeus Woods believes that there are three ways of dealing with this entropic condition of architecture. The first is not much different than the current and most common approach, that of denial. Much like how we deny "our own inevitable decay and extinction [and] proceed in life as though we will live forever". He states that without some promise of endurance, architects would become "paralyzed by despair"; this is perhaps why Woods himself never really bothered to build anything, as he knew all too well what the inevitable fate of his buildings would be. He, too, recently passed away, which leads to the second approach of dealing with this entropy, which is to "embrace or at least accept decay". Woods does however find the "romantic fascination with ruins problematic". He feels the "evocative power of ruins" is often exploited for "ideological, religious and political purposes", but they are rarely used to "advance knowledge".

Woods proposes a third, and the toughest, approach to dealing with "the acceptance of the decay of buildings". Architecture has the ability to "inform our understanding of the human condition and enhance its experience". The way in which he proposes this to be possible is to "include in design a degree of complexity, even of contradiction embodied in the simultaneous processes of growth and decay in our buildings, that heightens and intensifies our humanity" (Woods, 2012).

The design process should, in a way, include design for decay as a palimpsest approach, as an "inevitable architecture", as Woods would call it, by integrating the form into a future generation, so as to not have cycles of new buildings decaying and eventually being entirely replaced, but by introducing this complexity of a layered perception of time, a continual growth. As one "generation" decays a new generation is introduced to interact with the scheme in a genetic relationship with the old, which creates a genealogy and narrative through which the human condition can be understood through architecture. An existing example of this can be seen in Rome, as Smithson describes it: "Ruins melt and merge into new structures, and you get this marvellous and energetic juxtaposition occurring – with accident a large part of the whole process" (Smithson, 1973). He refers to the earthquake in Anchorage, Alaska, "that was responsible for creating a park" (Smithson, 1973). Accidents, or unexpected events and disasters, have an "inherent energy level" which,

fig 3.2 Man's ideals versus entropy nature's processes, by Author (2013)
top: Brick collected at Rosema + Klaver Quarry
bottom 3: eroded bricks collected on a beach at Lambert's Bay

when considering Anchorage, had "an interesting way of dealing with the unexpected, and incorporating that into the community" (Smithson, 1973).

The unexpected event of uncovering ground water through the open-pit mining operation at the Rosema & Klaver quarry eventually contributed to the pressures to decommission the mine. The inherent energy within this unexpected "mistake" which ended one process (of mining) now holds the potential to support a new process of life, which can be integrated with the community. It might be best to work with what the mine consequently transformed into – not as a result of human intent, but as a continuation of the entropic flow – instead of rehabilitating the mine to its original "natural" state. Smithson identifies this problem with mine reclamation: "It seems that when they made up the laws for mining reclamation they wanted to put back the mines the way they were before they mined them. Now that's a real Humpty Dumpty way of doing things. You can imagine the result when they try to deal with the Bingham pit in Utah (America) which is a pit one mile deep and three miles across. Now the idea of the law being so general and not really dealing with a specific site like that seems unfortunate and now of course one would wonder where they were going to get the material to fill that pit in" (Smithson, 1973).

There is definite value and purpose in the rehabilitation of post-mining sites back to their "natural states", but there needs to be recognition of when that would indeed be appropriate. There are certainly cases where previous conditions would not function within "new" surrounding conditions, in which case the mine could be reclaimed in a different way, a more appropriate way, which would not deny the convenience of the potential energy inherent in the accident, mistake or disturbance, but rather take advantage of the opportunity created through the initial destruction. Or when considering the vast open-pit mines which would require incomprehensible amounts of material for "back-fill", it must be asked, would that not just create an entirely new and even greater disturbance elsewhere? Starting anew from the point where activity ceased could be seen as a way to extend the value of mining operations and to make up for its linear extraction, to bring back value to the site, and turn the process of extraction in favour of communities and the environment, and not to their further degradation. Smithson states that it is "an attempt to recover a frontier or a wilderness that no longer exists. Here we have to accept the entropic situation and more or less learn how to reincorporate these things that seem ugly" (Smithson, 1973). This could be a positive perspective on dealing with humanity's vast amount of post-industrial and mining sites.

Smithson concludes with an interesting commentary on the way we as humans perceive ourselves as being separate from nature. "Niagara [Falls] looks like a giant open pit quarry, it has high walls which offend people greatly in the strip mining regions. There are defects called 'high walls' that exist in the strip mining areas and there's a desire on the part of the ecologist to slope these down. The cliffs all around Niagara suggest excavation and mining, but it's just the work of nature. So there's confusion between man and nature. Is man a part of nature? Is man not a part of nature?" (Smithson, 1973).

If man is a part of nature, then open-pit mines are just another "natural land form", perhaps not produced through geological processes but, in the same way one would consider a termite's nest "natural", they have been constructed by living entities with a self-serving goal. It might be argued that termites act purely out of an instinctual drive to gather dust and deposit it into a functionally suitable form for their own survival, but to what extent can one argue that humanity's need to extract resources from the earth and to deposit them elsewhere in another form, for use in shaping our habitat, is not similarly instinctual? This would reinforce the concept of hybridity. Perhaps the big difference is that while many natural phenomena are in harmony with other natural processes, human activity is more often than not experienced as parasitic, without consideration of environmental and social consequences. The concern with how "natural" human activity can become a symbiotic phenomenon is addressed by the application of previously discussed regenerative principles, as a primary strategy for giving back and not just taking, and for allowing life to thrive where it was once constrained and limited.

Entropy is not a destructive force; it is a dynamic one. It is a condition that reminds humans that nature is inescapable. An architecture which accepts this truth must inherently accept the complexities of decay, change and transformation, and should not shy away from spaces which express a layering of time and its effects through nature. Therefore, the way forward into a new generation, a new architecture, can be informed by feeding off the site's entropic narrative, which leads to various states of energies and potentials, whether latent or patent. A large part of this entropic narrative lies in the origins of the site, and therefore at this point emphasis must be placed on the previous generation, to realise the potential contained in the industrial heritage.

3.3 INDUSTRIAL HERITAGE IN THE POST-INDUSTRIAL LANDSCAPE

The following section describes industrial heritage theory as it is applied to the post-industrial landscape. Acts and charters are investigated which can inform a design strategy, a program and an architecture to support the intention to regenerate the site and to create exchange between humans and non-humans. Considering Latour's actor network theory in the context of industrial heritage, it becomes possible to consider heritage as being an actor of time. It is what connects us to the past and allows us to become connected to the future. It acts as a guide. Heritage not only reminds a civilisation of where it came from, but also perpetuates it and leads it towards a future condition. A progression must be read in history to understand its flow, in order to not destroy valuable heritage of previous generations by replacing it with new buildings and environments, nor to attempt to seamlessly subsume the old with the new, but to continue the narrative legacy introduced by it, and to indicate the flow, in order to establish a dynamic relationship between the old and the new. After many generations, a rich history can be read within cities, and the human condition can be understood as a hybrid of many generations of dynamic processes between humans, nature and their predecessors.

Heritage has always been regarded as important, but the emergence of industrial heritage seems to not yet be so well accepted in general society. "It is only in the last fifty years or so that industrial heritage – recognition and valuing of the material evidence of industrialisation – has begun to figure in our consciousness" (Cossons, 2012:7). "The industrial landscape is a misunderstood heritage: at worst, urban rustbelt, dangerous, a toxic wilderness; at best, an outstanding historical resource to be re-used, regenerating communities, offering real richness and opportunity, reinforcing cultural identity and creating new commercial prospects" (Cossons, 2012:14). This is the exact case at the Rosema & Klaver quarry. It raises a concern. While industrial ruins can possibly be considered the great monuments of our time, the loss of industrial heritage due to its not being acknowledged would lead to an inevitable loss of knowledge, an entropy of information, and ultimately our modern civilization easily becoming just as obscured as the ancient civilizations.

The International Committee for the Conservation of the Industrial Heritage (TICCIH) attempts to offer a solution to the often tough question of "how the heritage of industry gets treated alongside other more familiar or amenable remains of our past, and what sort of tools and resources can and should be applied to keep it in good shape both for now and in the future" (Douet, 2012:3). Dealing with industrial heritage as a cultural legacy is described as being difficult, because of its "technical complexity, its economic weight, its scale and magnitude, its social consequences as well as the negative perceptions that sometimes hamper its appreciation" (Douet, 2012:1). Its complexity becomes evident when considering its social relevance and conflicts.

Industrial heritage allows for an understanding of "human development and history [I]t gives us the chance to reflect on the use, or perhaps abuse, of our resources. It also allows us to reflect upon the pollution and destruction of our environment, social and economic changes, our changing perception of technology and the debates concerning priorities in our society" (Tempel, 2012:142). "The industrial heritage is a complex amalgam of places and people, processes and practices, which continues to defy explanation of its origins and astounds in the effects of its subsequent development and decay" (Cossons, 2012:7). Tempel describes how industrial processes have been shaping the landscape for hundreds of years, with prolonged consequences for the "ecology of all environmental media" (Tempel, 2012:142). The extraction of natural resources "has left behind particular landscape evidence which cannot be ignored. Often irreparable, long term environmental damage has been done and extensive social problems have been created as a result of the exploitation of these resources" (Tempel, 2012:143).

It could be said that industrial heritage has as much cultural relevance as any other form of heritage, but it needs to be realised that the "techniques of preservation and conservation built up over many years in the wider historic environment sector do not necessarily meet the demands of industrial heritage" (Cossons, 2012:8). The environments surrounding industrial artefacts and structures are often manipulated by industry; thus, because they tell a complete story, the landscapes are critical to understanding the heritage. At the Rosema & Klaver quarry, the entire landscape, which now seems 'natural', is a direct result of the excavation works attributed to the industrial processes. "An industrial landscape is a type of cultural landscape, which may be defined simply as a landscape that has been modified by the effects of human activity" (Stuart, 2012:48). Cossons describes the different aspects of industrial heritage value: "the material heritage has intrinsic value as evidence of the past [it] is of wider social and cultural significance as part of the record of people's lives [it] provides an important sense of history and identity [it] may have technological and scientific value in the history of manufacturing, engineering and construction, or have aesthetic qualities deriving from its architecture, design and planning [it] may offer identity for a community or provide the signature for a place" (Cossons, 2012:8). It defines the context and offers "prolific evidence of an evolving community, from pre-industrial roots to post-industrial decay" (Cossons, 2012:9). It also plays an important role in the regeneration of urban spaces, "where an understanding of the past can liberate a resource for the future. The new urbanism [involves] a growing recognition that human habitats and the web of history afford creative synergies " (Cossons, 2012:15).

"Yet old industrial sites are invested with more than cultural meanings: they are the remnants left behind in the wake of deindustrialization Despite their state of disuse, abandoned industrial sites remain connected with the urban fabric that surrounds them: with communities; with collective memory; and with people's health, livelihoods, and stories" (Mah, 2012:3). It is important to understand the "relationship between industrial ruination, community, and place, specifically, the landscapes (socio-economic and cultural geographies) and legacies (the long term socio-economic and psychological implications for people and places) for the interrelated processes of industrial ruination and urban decline" (Mah, 2012:3).

Due to the nature of industrial obsolescence, which tends to lead toward partial disassembly and the selling of machinery for economic relief, most industrial buildings considered as heritage "are thus empty husks, devoid of the life and activity that went on in them and which were the reasons for their existence" (Cossons, 2012:9). As in the case of the Rosema & Klaver quarry, the once industrial 'life' has been replaced by a naturally regenerated life. Much of the industrial heritage lies intangibly intertwined in the story of place, symbolised only by the last material remains. The documentation of this story, in oral accounts by old workers or people from the surrounding community, becomes highly important.

Another value which the TICCIH highlights is that of the "intrinsic evidential value" of a place, which confronts us with the "transformational consequences" caused by industrialisation (Douet, 2012:1). Usually when an industrial plant closes down or a mine is abandoned, "the remediation of environmental contamination takes priority over heritage preservation" (Tempel, 2012:142). Alternatively, the heritage is "abandoned, re-used, regenerated, sold, or demolished never static in a constant state of change across time and space" (Mah, 2012:3). According to Mah (2012:3), when describing the decay of industrial heritage it is best to use the term "ruination" rather than ruins, "because the word 'ruination' captures a process as well as a form".

The processes of deindustrialisation now threaten "the landscapes that have evolved through industrialisation" (Tempel, 2012:143), but these are still worthy of protection. The landscapes themselves turn into intriguing spaces with alluring qualities, as industrial nature starts to set in. This refers to the "regeneration of natural vegetation on industrial sites abandoned, disused or remediated. Worthless industrial buildings and plant often become integrated into the general picture of landscape as landmarks, sculptures or even as 'picturesque' ruins" (Tempel, 2012:146).

Okada postulates that "the landscape of industrial abandonment" has aesthetic value. "[It] should not be limited only to the story or meaning behind [its] existence. The landscape created by the decayed or rugged surfaces could be another value of industrial heritage" (Okada, 2012:149). He observes that if heritage has experienced the passing of time, another important factor is added to its preservation. Okada finds two approaches from Europe and Asia to the "appreciation of the aesthetics of ruins" (Okada, 2012:152). Eighteenth-century Picturesque gardens reflect the "elegance of ephemera" as a metaphysical representation of the notions of "change, transition, decay or wilderness". The Japanese 'Wabi-Sabi' aesthetic pursues the fine sensibilities of 'Wabi', a "simple, austere, serene or transcendental frame of mind", within 'Sabi', "loneliness, resignation, and tranquillity" (Okada, 2012:153). The 'Wabi-Sabi' aesthetic appreciates an "aesthetic value in something old and crude", suggesting that industrial ruins have a "naturally generated value worth preserving" (Okada, 2012:153).

It might seem contradictory to consider "the preservation of industrial monuments, considering the constant conflict between economy and ecology" (Tempel, 2012:143), but it can be an environmentally sustainable action. Watson states that "building

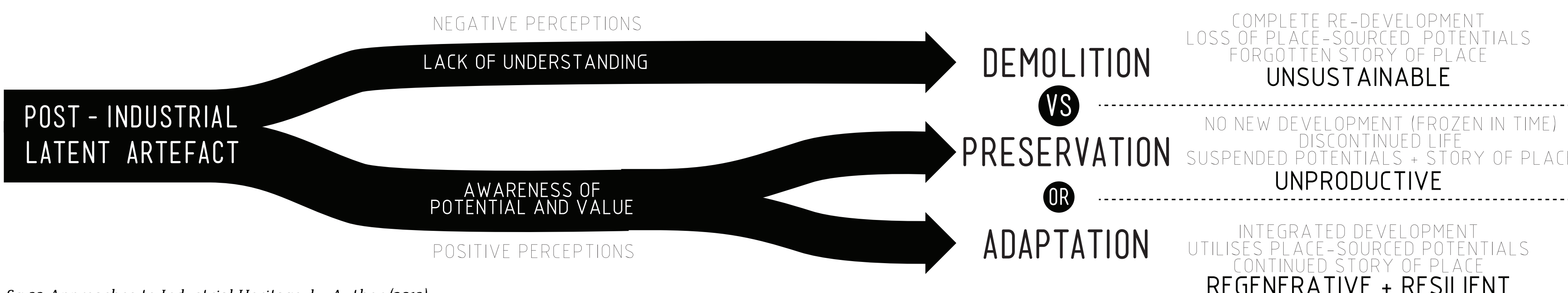


fig 33 Approaches to Industrial Heritage, by Author (2013)

preservation or conservation saves energy by taking advantage of the non-recoverable energy embodied in a building, and extending the use of it. It is a paradox that building conservation is not about the past. It is about the future. Industrial buildings can and ought to be an opportunity for change" (Watson, 2012:136).

Popular strategies toward industrial heritage sites tend to lean toward "adapting and re-purposing". Additionally, "historical industry" is proving to be effective as tourist destinations, and hold valuable educational resources for educational institutions. "Adaptive re-use is often mentioned as a tool with which to preserve threatened values and presented as a sustainable development strategy" (Fragner, 2012:110).

Fragner states that to convert a structure "to serve a different purpose almost always requires interventions and changes to adapt it to the new function. How far such interventions go will determine if the conversion and functional transformation is not, paradoxically, to efface the assets that led to the decision to conserve the industrial site in the first place" (Fragner, 2012:110).

Peter Latz proposes a new method for dealing with "run-down industrial areas and open-cast mines [O]ne that accepts their physical qualities but also their destroyed nature and topography. This new vision should not be one of 're-cultivation', for this approach negates the qualities that they currently possess and destroys them for a second time. The vision for a new landscape should seek its justification exactly within the existing forms of demolition and exhaustion" (Latz, 2001:158). This approach is exactly what needs to be applied to the Rosema & Klaver quarry site, as a means to remember the consequences of industrial devastation, but also to find new life and purpose within the existing condition.

3.3.1 THE NIZHNY TAGIL CHARTER FOR INDUSTRIAL HERITAGE

The Nizhny Tagil Charter is the international standard for the study, documentation, conservation and interpretation of industrial heritage. It was adopted in 2003 by the TICCIH in Nizhny Tagil, Russia. The charter recognises the industrial revolution as a phenomenon which has affected all forms of life on the planet up to the present day, and states that "the material evidence of these profound changes is of universal human value, and the importance of the study and conservation of this evidence must be recognised" (The Nizhny Tagil Charter for the Industrial Heritage, 2003:1). The following section contains extracts from the charter which are especially relevant to this design dissertation (the full text is given in Appendix E).

4.III. Sympathetic adaptation and re-use may be an appropriate and a cost-effective way of ensuring the survival of industrial buildings, and should be encouraged.

5.I. Conservation of the industrial heritage depends on preserving functional integrity, and interventions to an industrial site should therefore aim to maintain this as far as possible. The value and authenticity of an industrial site may be greatly reduced if machinery or components are removed, or if subsidiary elements which form part of a whole site are destroyed.

5.II. The conservation of industrial sites requires a thorough knowledge of the purpose or purposes to which they were put, and of the various industrial processes which may have taken place there -

5.IV. The adaptation of an industrial site to a new use to ensure its conservation is usually acceptable except in the case of sites of especial historical significance. New uses should respect the significant material and maintain original patterns of circulation and activity, and should be compatible as much as possible with the original principal use. An area that interprets the former use is recommended.

5.V. Continuing to adapt and use industrial buildings avoids wasting energy and contributes to sustainable development. Industrial heritage can have an important role in the economic regeneration of decayed or declining areas -

5.VI. Interventions should be reversible and have a minimal impact. Any unavoidable changes should be documented and significant elements that are removed should be recorded and stored safely. Many industrial processes confer a patina that is integral to the integrity and interest of the site.

5.VIII. The human skills involved in many old or obsolete industrial processes are a critically important resource whose loss may be irreplaceable. They need to be carefully recorded and transmitted to younger generations.

5.IX. Preservation of documentary records, company *archives, building plans, as well sample specimens of industrial products should be encouraged.*

3.3.2 THE NATIONAL HERITAGE RESOURCES ACT

The South African National Heritage Resources Act (No. 25 of 1999) was consulted to understand the local legislative context in which heritage resources can be identified and protected. According to this act the old Rosema & Klaver quarry can be considered a national heritage resource. The act states that "those heritage resources of South Africa which are of cultural significance or other value for the present community and for future generations must be considered part of the national estate " (South Africa, 1999:7). Resources which are considered to be part of the national estate are subject to heritage resources management. The quarry site has been identified as part of the national estate since the place, structures and landscape all bear significance for the development and patterns of the surrounding community, and for the industrial and physical development of Pretoria. It retains physical remnants and consequences of an industrial technology which has since become obsolete, from which knowledge about past practices in the built environment can be gained. These facts are supported by the following clauses:

3. (2) (a) places, buildings, structures and equipment of cultural significance
3. (2) (d) landscapes and natural features of cultural significance
3. (3) (a) its importance to the community, or pattern of South African history
3. (3) (b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage
3. (3) (c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.
(South Africa, 1999:8)

Thus the cultural landscape within which the site is located must be recognised as an indispensable and important actor concerning the origins of South African society, and more specifically the origins and patterns of the actual site and its surrounding area. It must therefore be appreciated for what it is, and developed accordingly to promote its research, education and tourism potential, as supported by the following clauses:

5. (1) (a) Heritage sources have lasting value in their own right and provide evidence of the origins of South African society and as they are valuable, finite, non-renewable and irreplaceable they must be carefully managed to ensure their survival.
5. (5) Heritage resources contribute significantly to research, education and tourism and they must be developed and presented for these purposes in a way that ensures dignity and respect for cultural values.

The remaining structures must be respected and valued for their embodied and persistent value and the meanings they represent. The Act clearly states in clause 34.1 that "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority" (South Africa, 1999:28). The oldest structures on the site predate 1951; it is therefore critical to identify the value of the remaining structures to establish the site's integrity as a heritage resource and to determine an approach for new development.

3.3.3 THE HERITAGE VALUE OF THE SITE

From the previous discussions it is now evident that the old Rosema & Klaver quarry site has intrinsic heritage value. Post-industrial latent artefacts like these are responsible for the modern world that we live in. Their remnants contain information about our progress as a civilisation, and they offer potential opportunities for regenerative development to take them forward into a future of heightened awareness of industrial consequences and responsibility towards resources. An appropriate approach can now be developed for this site in response to its value.

The industrial heritage of the quarry and brickworks represents the memory and knowledge of forgotten technology. It becomes an issue to conserve this knowledge and industrial legacy so as to understand why the site is what it is, how our modern society, cities and built environment manifested through natural materials, and how these finite sources eventually became depleted. This is important to remember, so that it can demonstrate to future generations that it is necessary to work more responsibly with our natural resources and within our biophysical realm.

Currently very little concern is expressed by the community toward the site's heritage value, which certainly exists, but is not acknowledged. It is understood that there is in fact a conflict of interest between the once active industry and the surrounding community which contributed to the closure of this mine. It thus becomes evident just how distorted the community's heritage values are, which creates an even greater need for heritage awareness if the heritage is to be saved or protected from future development, so that the "historic material of industry" can be treated appropriately.

The site has already seen a great deal of demolition and loss of material heritage, therefore the few remaining 'structures' need to be treated sensitively. These, though seemingly decayed, are structurally sound and may easily be adaptively reused, as their flexible nature contributes to their functional value.

As described in the previous sections, the entire industrial complex, or what remains of it, carries significant aesthetic value. The integrity of the remaining heritage structures lies in their organisation as a complex; therefore it is important to maintain their visual identity from a central viewpoint, surrounded by the tall, mature Black Wattle trees which are also testament to the industrial heritage. Attachment of new fabric can occur behind the structures, where these are no longer read as a group. This provides an opportunity to use some of the old brick and concrete walls in a new architectural intervention as a means to re-use the heritage materiality and embodied energy. The spatial hierarchy of the industrial heritage hence becomes inverted. The interior space of the hammer mill, now missing its original roof and overgrown with vegetation, could become an exterior room. Where attachment does occur, independence must be maintained between the old and the new by creating contrast, and allowing for a clear progression of time as part of the site's narrative. This can also be achieved by offsetting the boundaries and thresholds of the old from the new. By preserving these structures in parallel to a new programme, they become a type of passive museum, a physical and didactic archive of the site's past in the presence of its future.

The concrete dust pits are very important elements in terms of heritage, as they are highly functional and also hold aesthetic value due to their craftsmanship. Very little needs to be done to their external appearance; they should be given room to breathe within the 'industrial nature' context, while their internal spaces can be re-purposed to house a new function, in line with their original use and integrity as containers for clay dust. In this way they can continue their life, but in an adapted manner. Attaching to them will destroy their integrity as objects in the landscape.

The water tower is a somewhat iconic structure, and along with its aesthetic value it also has functional potential with some usable floor space, and can be adapted internally while maintaining its decayed exterior appearance.

The last remaining evidence of the old northern kiln oven structure is the two brick monoliths. They once supported steel columns; now they support only a memory. These monoliths are to be retained and framed. The remnants of the highly degraded concrete slabs convey a memory of structures now lost. The slabs of the drying ovens still have some of the steel cart tracks embedded in them, and they too can be retained and framed to form exterior spaces together with the freestanding concrete grid structures, to become inverted spaces where industrial heritage used to stand, and industrial nature now persists, as the regenerated grasses and shrubs grow freely from them.

The landscape itself provides evidence of past activities. The berm, an unnatural landform, can continue its existence as a pseudo-natural landmass, perhaps re-purposed to host a variety of indigenous plant species. The parts of the landscape with the most disturbed surfaces, where structures once stood, are to be used for new development to utilise its associated embodied energies. Below the water level lies an entire industrial landscape, which used to be rife with excavation activity. This underwater landscape still hosts semi-submerged trees (now dead) and contours shaped by the old dirt roads, which can be memorialised and reflected on the surface of the water through some kind of structural intervention, as a memory of past movement projected into the present. Additionally, where missing structures once stood, a memorial sign can be introduced by utilising the loose brick material found on site as surface finishes.

It is understood that both resilience and industrial heritage prefer adaptation as an effective strategy for conservation and resilient social-ecological systems. The heritage is therefore celebrated while being re-utilised and adapted to change.

3.4 THEORETICAL CASE - STUDY

The theoretical case study was chosen for two different merits: firstly for having successfully interpreted and regenerated a post-industrial landscape, and secondly for being in line with the principles of Regenerative Development. These two criteria often overlap and exponentially complement one another.

EMSCHER PARK/LANDSCAPE PARK DUISBURG - NORD, GERMANY

The strategies and principles used in the design approach for regenerating the Emscher Park in Germany describe a process which can effectively be applied to the Rosema & Klaver site. Emscher Park is a vast 800 square kilometre "brownfield landscape of the Ruhr valley in north west Germany, heartland of Europe's coal and steel industries" (Cossons, 2012:13). Architectural redevelopment through "local and private initiatives" (Cossons, 2012:13) is encouraged for the individual sites within the vast macro-structure of the landscape. A major issue on the site was the removal of polluted remnants and toxic heavy metal hydrocarbons, but through selective strategies of bioremediation the landscape has been transformed with many green spaces in between the ruins of old steel structures, gas holders, mine frames, waste heaps, concrete stores and pipelines which "were retained as monuments in the landscape" (Cossons, 2012:13).

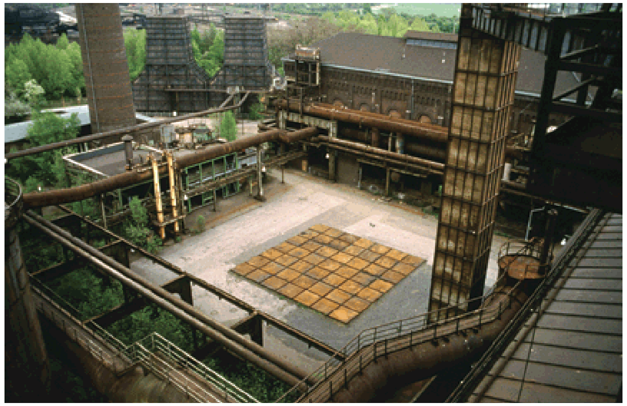
Neil Cossons describes how Emscher Park is characterised by four fundamental principles (Cossons, 2012:13):

fig 3.4.1 Emscher Park (Christa Panick, nd)

1.The re-use of brownfield land makes good use of dereliction and prevents the exploitation of previously undeveloped greenfields.
2. Existing buildings can be saved, extending their lives, in preference to building completely new structures.
3. Ecologically sound building practices for new buildings and for adaptive reuse must be employed.
4. The region's production and employment structure must be transformed toward environmentally friendly methods.

Emscher Park is an excellent example to demonstrate the "assimilation and integration of industrial ruins into a living environment" (Okada, 2012:151). The aim of the International Building Exhibition Emscher Park (IBA) is to restore a "fundamental ecological base" (Latz, 2001:150) which can allow for the reintegration of the previous industrial area with natural processes and ecosystems. The approach of reusing and rehabilitating the existing landscape and structures allowed the developers and designers to "integrate, shape, develop and rethink the existing patterns that were formed by its previous industrial use, and suggests a new interpretation with a new syntax" (Latz, 2001:150).

fig 3.4.2 Emscher Park (Michael Latz, nd)



A catwalk frames the industrial ruins on the upper level of the "railway park". It provides views toward the old blast furnaces and "sintering place", but "more importantly, the catwalk gives views into the gardens" (Latz, 2001:157). A raised catwalk is an ideal method for elevating the public's experience, to facilitate a holistic understanding of the site by providing views and scenes which would otherwise not be possible to take in.

Peter Latz identifies two themes of metamorphosis at Emscher. 'Physical nature' becomes a symbolic theme, demonstrating metamorphosis through natural physical processes expressed by continuously eroding and rusting steel plates. The second theme is that of 'utilisation' of what the place and park already is. Utilisation is a "working method of adaptation and interpretation, a metamorphosis of industrial structures, without destroying them" (Latz, 2001:151).

The primary factor contributing to the park's success in attracting visitors is its "unique atmosphere" (Latz, 2001:159), to which the preserved blast furnaces make a major contribution.

The study of Emscher Park highlights key approaches which can successfully draw public attention to environmental and industrial heritage concerns.

UTILISING

THE POTENTIAL // PROCESS

3

PROGRAMME

4.1 THE PROGRAMME

Initiated by the patent potentials, with the addition of new compatible external sources to unleash the site's latent potential, the programme is developed.

4.1.2 WATER AS ENABLER

The coincidental appearance of water in this once open-pit mine has unleashed vast potential for the benefit of humans and resources. Not only does water signify a potential in itself, it also serves as an enabler capable of activating diverse processes and activities through various interactions.

The programmatic response of this dissertation is informed and developed by the many existing potentials inherent in the site, as discussed in the preceding chapters. The presence of water is the primary inspiration for future development as it has already initiated a process of post-industrial regeneration. The following chapter will describe how a contextually derived programme has been formulated to address the existing social conditions in the surrounding community, while considering the primary issue of urban resilience and the country's interest in developing alternative food and energy sources as a response to global energy, nutritional and economic concerns.

It can be said that the consequential emergence of water on this once industrial site has inspired a contextually derived programme. This programme will inform a regenerative architecture which would allow for the reorganisation of the community's suburban condition into a new hybrid generator full of potential to further future urban resilience.

4.1.3 PROGRAMMATIC CRITERIA

In developing a programme for this site, certain criteria need to be met:

1) Consider existing "patent" potentials to incorporate what the area has to offer, so that a programme can be derived from the existing conditions:
- Industrial Heritage + infrastructure
- A large fresh/clean water body
- Green open space
- The surrounding residential community

2) Consider what the area/community is lacking:
- Diversity in land use
- Recreational amenities
- Biodiversity + ecological integrity
- Future resource security

3) Utilise the site's spatial latency to reintegrate the people of the community with one another as well as within an ecological framework.
4) Address the general urban concern regarding urban resilience.
5) Reveal the site's sense of place and initiate a strong sense of community.

It becomes apparent that two simultaneous programmes need to be established. These can be simplified into fundamental categories: "Productive" and "Recreational". By superimposing the productive onto the recreational programme, the third and perhaps most crucial programme is devised, i.e. "Educational". The duality between production and recreation promotes a sense of awareness, and allows for a type of incidental / passive education. By being exposed and directly introduced to productive processes on an everyday basis, greater knowledge and responsibility is fostered. This leads to a programme which simultaneously cross-programmes recreation, production and education into an integrated framework contributing to the urban resilience of suburban communities in transition, and resulting in an Integrated Natural Resource Facility.

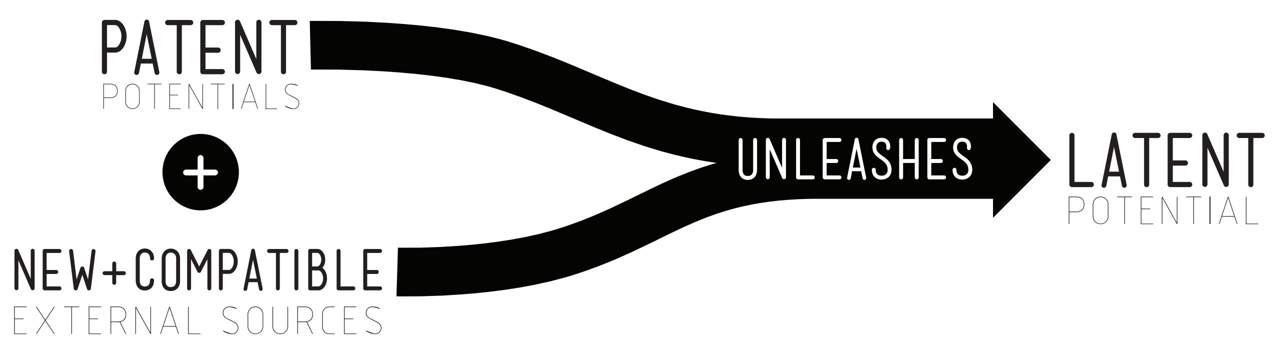


fig 4.1 Unlocking latent potential, Illustration by Author (2013)

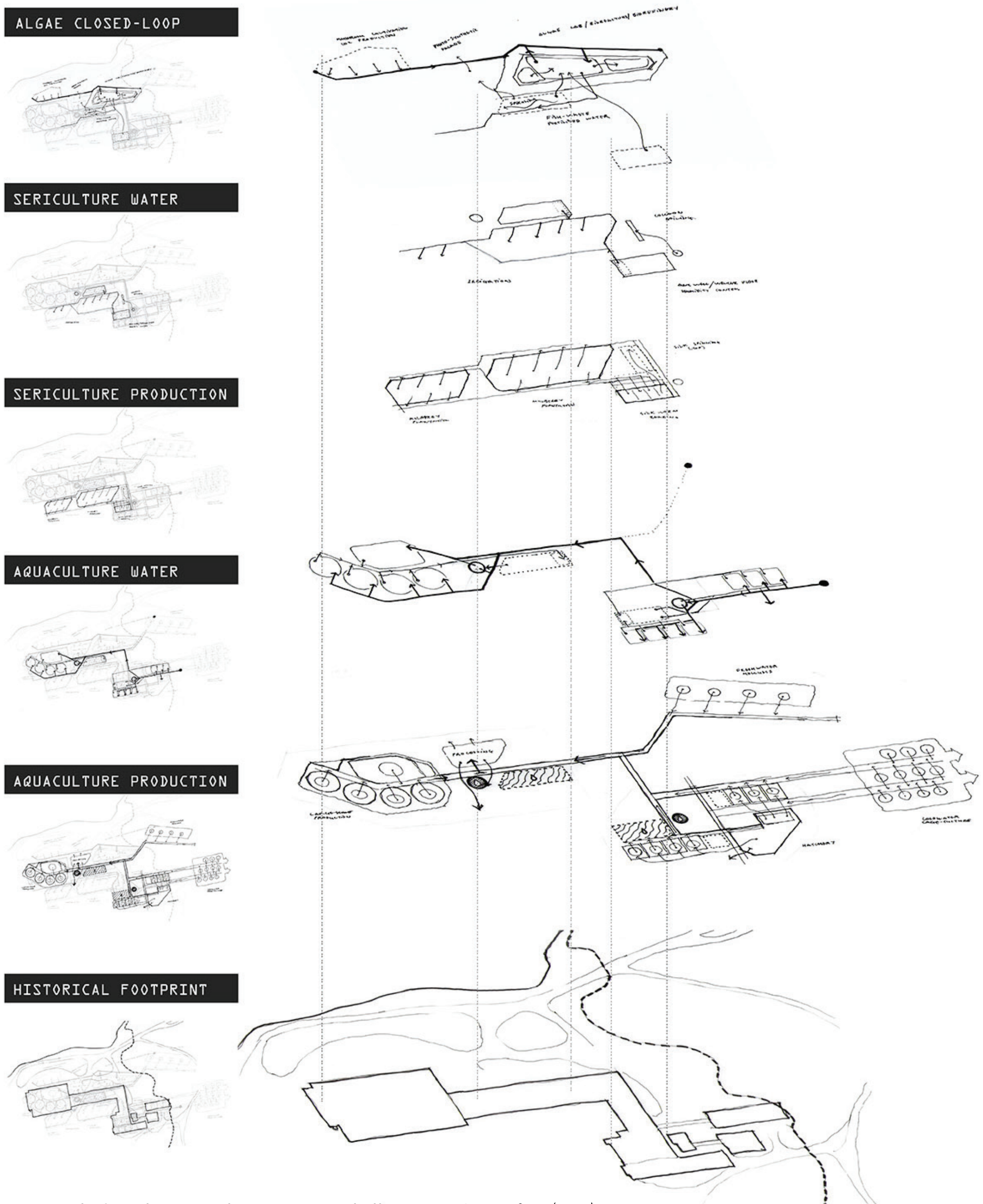


fig 4.2 Unlocking latent productive potential, Illustration by Author (2013)

4.2 PRODUCTION POTENTIAL

Why integrated resource production? On considering the remaining functional infrastructure of the industrial heritage, the available land area, the abundance of fresh water, and the large consumer network surrounding the site, it becomes evident that the production potential of the site is highly valuable and needs to be utilised. We can no longer solely depend on the importation of resources. Localisation and decentralisation will not only contribute to the resilience of a city, but could diminish embodied energy and increase production efficiency. Localised integrated/closed-loop production has the potential to become a catalyst for an environmentally sound industry, socially responsible action, and an economically viable venture. The benefits of integrated resource production include the minimization of waste products, less strain on the local environment, decreased use of artificial fertilizers and pesticides, increased and diversified production, decreased dependence on external production inputs and increased productivity and efficiency (Hilbrands et al., 1998:6).

4.2.1 INTEGRATED RESOURCE PRODUCTION

At first sight an extremely complex range of matter and energy linkages among pond, dike, and the general environment ... In reality, however, the components of the system are amenable to relatively easy integration (Ruddle, 1988:7).

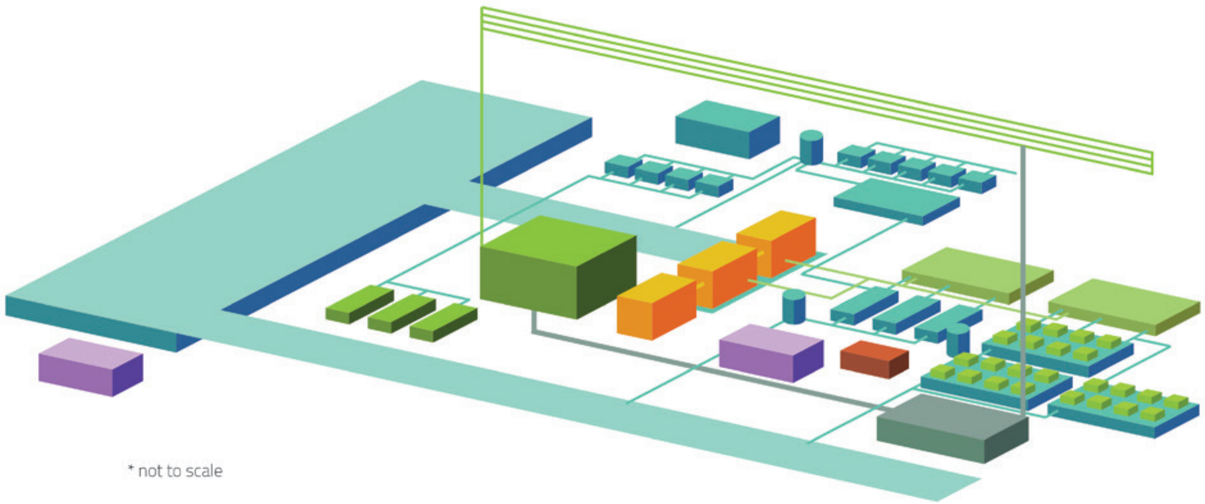
Integrated farming is an ancient practice in South China; therefore the traditional practices in integrated agriculture-aquaculture in the Zhujiang Delta are investigated to demonstrate the potential in integrated resource production for food, energy and materials. The Chinese system is known as the dike-pond system. In South China, there are two motives for their integrated systems: "national policy, which encourages diversified self-reliance in food and basic raw materials production, and their philosophical belief that the by-product/waste from one resource must, wherever possible, become an input into another resource" (Ruddle, 1988:4).

At the heart of the system is the pond which produces and maintains fish polycultures, mostly species of Carp. Organically enriched mud used to fertilize crops is dug from the pond bottom, known as the dike (Ruddle, 1988:8), where the nutrient flow of the fish pond system is extended into a diversity of sub-systems. A range of linked sub-systems is supported by the aquaculture systems, and vice-versa. These sub-systems, with their own wastes, often tie back into the pond system as food for the fish, or into other resource uses. Traditionally, the main cropping sub-systems are mulberry and sugar cane, which are irrigated with nutrient-rich pond water and fertilized with pond mud. The pond mud is also typically used to make mud beds for mushroom cultivation on the floor of the silkworm shed in winter (Ruddle, 1988:9) when silkworms cannot be raised, after which the spent nutrient-rich mud bed on which the mushrooms were raised is used to "fertilize vegetables, fruit trees and grasses" (Ruddle, 1988:9). This promotes seasonality in the production process. Seasonality can also be seen in the inter-cropping and rotation of fruit, vegetables and oil-seeds on the principal mulberry fields. Vegetables and grasses are fundamental components, as they are "essential food for fish and human consumption and marketing" (Ruddle, 1988:10). These principles can all be adapted and applied to the more modern intensive technologies of aquaponics, for which many sophisticated techniques exist.

Mulberry cultivation is practiced with the principal objective of producing leaves as feed for the silkworms (Ruddle, 1988:9). After the leaves have been stripped and the branches pruned, the mulberry bark is harvested to produce paper, and the sticks are used "to support climbing vegetables and for firewood" (Ruddle, 1988:9). The silkworms are reared in special sheds, designed to suit their optimal climate, after which their cocoons are sent to a filature to produce raw silk yarn. The waste water, cocoon waste and dead larvae from the cocoon boiling process are then reintroduced into the pond as fish feed. Silkworm excrement is mixed with the remaining old and dry mulberry leaves from the rearing sheds and also used as fish feed (Ruddle, 1988:9).

Ruddle (1988:10) observed that the system itself is capable of meeting the "basic food and shelter needs of human settlement". Local food sufficiency assures a balanced diet and provides produce for local free-trading markets; fuel needs are met; and by-products are used to manufacture materials to construct homes and furniture, such as bamboo and unglazed tiles and bricks made from dike mud. These systems depend on the "household responsibility system" (Ruddle, 1988:11), which relies on families to each play their part in managing and contributing to the production crops, which allows for "other basic social and physical needs [to be] satisfied within the commune" (Ruddle, 1988:10). This can all suggest a new typology for productive social-ecological urban centres within modern urban configurations and communities, which seems especially appealing and applicable to the improvement of current suburban communities.

The concept of traditional Chinese integrated aquaculture farming practices is used as a fundamental principle to inform the process of unlocking the site's productive potential, but it is adapted to respond to the current cultural and technological context of South Africa, such as the development of alternative and renewable energy sources (e.g. algae), and the supported development of rural communities. In the subsequent sections, descriptions are given of the productive programme to be ultimately expressed and housed by the architectural design. The chosen processes are meant to diversify the product range and to demonstrate the potential of post-industrial sites to become decentralised community resource fig 4.3 Systems diagram of integrated aquaculture resources, Illustration by Author (2013)



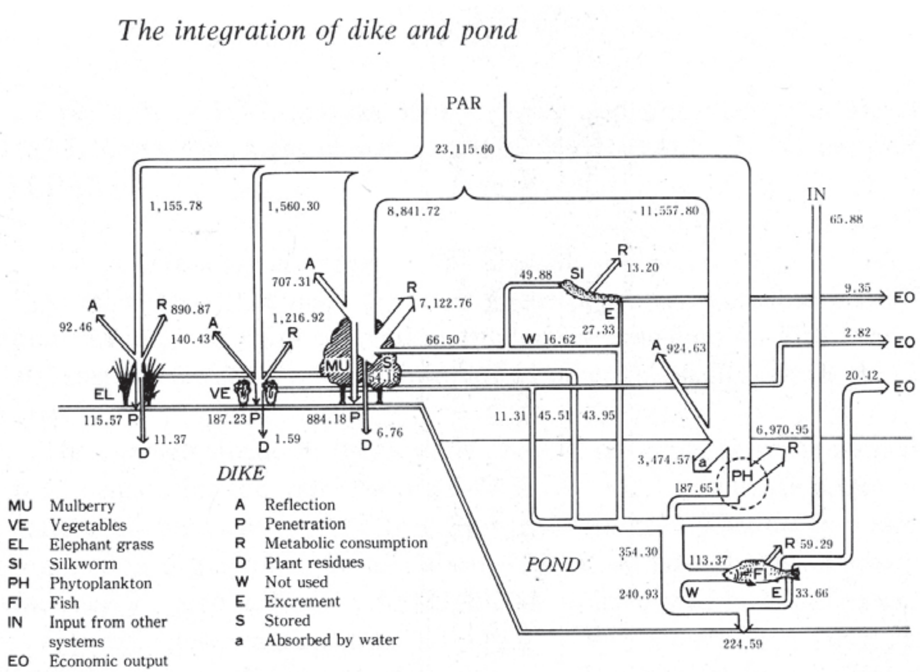


fig 4.4 energy flow in the mulberry dike pond system (Ruddle, 1988:81)

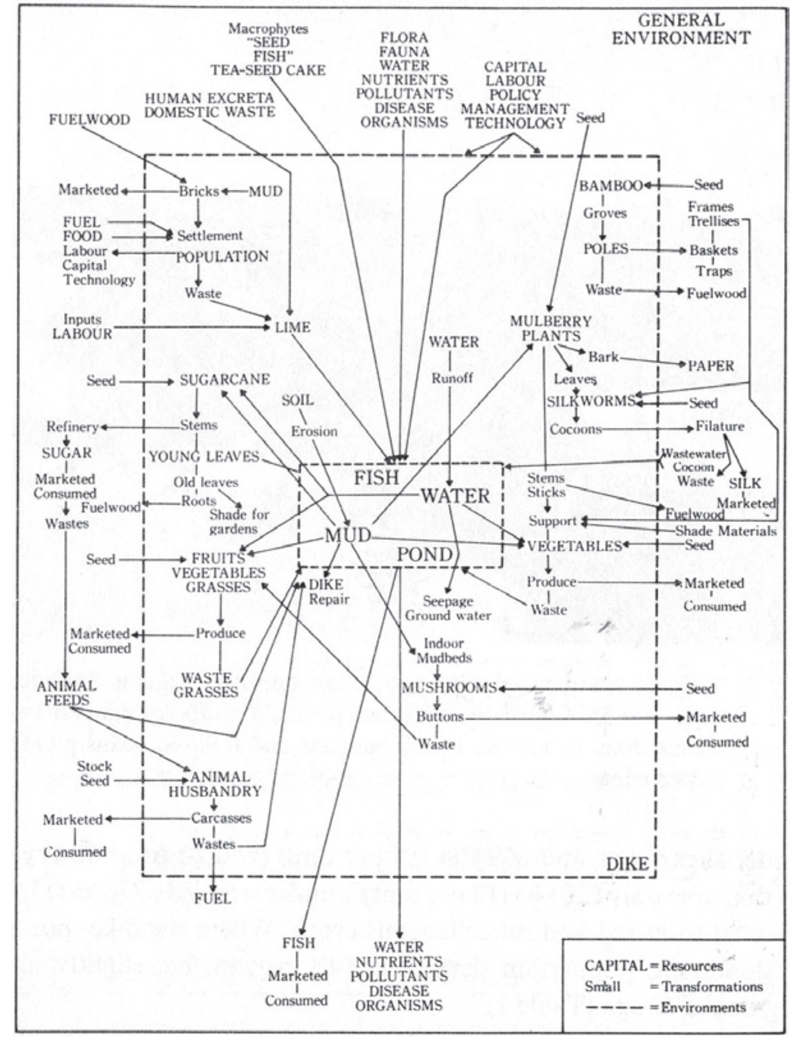


fig 45 Energy and Matter linkages in the dike-pond system (Ruddle, 1988:8)

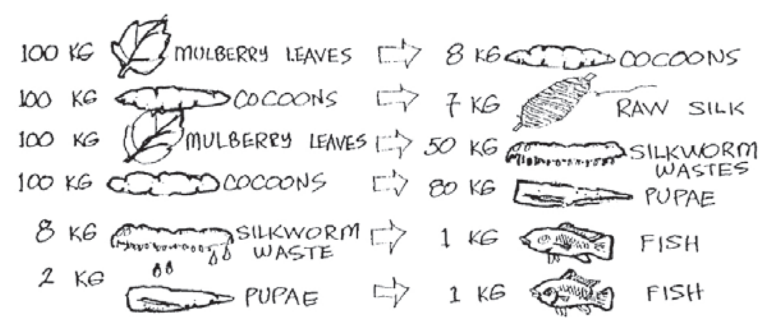


fig 4.6 Food conversions for products in an integrated fish-mulberry-silk system (Hilbrands, 1998)

nodes to produce various types of resources symbiotically - resources such as food, energy, and economically valuable products and materials.

4.2.2 AQUACULTURE/POND SYSTEM

"Give a man a fish and you feed him for a day. Teach a man to fish and you feed him till stocks run out. Teach a man to grow fish and you feed him for a lifetime."

(Anonymous)

In the days when the old quarrymen prepared for the disassembly of the mining operations, they thought it to be appropriate to introduce freshwater Bass and Carp species into the pure waters of the quarry as a step toward the site's "natural rehabilitation", and also as a way to entertain themselves through recreational fishing. Little would they have guessed what their actions would inspire more than two decades later, in an era when commercial fish farming would be actively pursued in the Gauteng region to feed the growing population.

At a recent seminar held by the Gauteng Department of Agriculture and Rural Development [GDARD] and the National Department of Agriculture, Forestry and Fisheries [DAFF], "investment opportunities in the aquaculture field in the province" (www.gdard.gpg.gov.za) were discussed. According to department officials, there still lies a lot of development ahead for the aquaculture industry in the province, with major concerns being: "public awareness, capacity building of officers tasked with the responsibility of developing aquaculture projects, establishment of an aquaculture unit with aquatic scientists, engineers and veterinary officials, allocation of funds, research, and an understanding of the legislation and drafting of the provincial strategy" (www.gdard.gpg.gov.za).

Many people are sceptical about the prospects of fish farming in the temperate/subtropical climate of Pretoria, due to the annual and diurnal temperature fluctuations, but with advances in building technologies to regulate indoor climatic conditions and with specialised fish breeds becoming increasingly robust under extreme conditions, aquaculture is steadily becoming an emerging industry in the Tshwane region. Because of the threat of oceanic fish stock depletion, it becomes clear that aquaculture will become an increasing necessity in the future, especially when considering the embodied energy of inland fish consumption.

A fish hatchery and nursery is to be built that can supplement the production of independent "backyard" aquaculture projects and other types of farms. Additional fish production will occur on site on a subsistence level, as a means to supply food to the local community as well as on site for visitors. The purpose is not to produce fish on a massive industrial scale for export to greater national markets and other regions, but rather to develop innovative techniques and methods of sustainable production for local markets and to support the production of independent integrated aquaculture resources. Decentralising the aquaculture industry is a stepping stone toward local distributed resource production and independence.

Cage culture is also introduced to the existing water body as a means to experiment with local aquaculture production in open water bodies with fresh cold water species. The concern of increased fish wastes is mitigated by appropriately designed cages which capture the waste and then transport it to the drum filter, where the solids and water are separated along with other local aquaculture wastes, and then linked into the rest of the integrated systems.

The culture of freshwater mollusks is introduced into the existing water body as a possible biofilter and to provide a valuable ecosystem service: "mollusks play an important role in the removal of suspended particulate matter" and they are useful "to reduce algal blooms and in the treatment of drinking water" (McIvor, 2004:viii).

An indigenous species to South Africa is the Sphaeriidae pill clam, Pisidium langleyanum, which is well represented in Gauteng. This species can utilise a diverse range of aquatic habitats such as "springs, small creeks and peat bogs where no other bivalves can survive" (De Kock & Wolmarans, 2008:1). Little is known about the conservation status of the South African Sphaeriidae, although elsewhere in the world it is reported that "native freshwater burrowing bivalves are threatened and declining at a catastrophic rate [The] significant decrease of species richness and density of bivalves [is] due to climatic change" (De Kock et al., 2008:3). It is an important species because it could be used for monitoring environmental conditions and to indicate heavy metal pollution. It is therefore considered to cultivate this mollusk species for its eco-systemic services and to conserve it.

Freshwater mollusks can then be harvested for their meat which can be processed for fish feed or, depending on the quality of the species, even be considered for human consumption. A by-product from its culture is the shells, which have a high calcium carbonate content and which can be ground and used in the manufacture of stronger and lighter hollow concrete blocks (Arcero et al., 2013:iii), concrete tiles, and alternative mortar adhesives (Bato Balani, 2004:17). The crushed shells can also be used as an "alternative liming material to restore soil chemical and microbial properties in upland soil and to increase crop productivity" (Hamester et al., 2012:1). This can be advantageous in the bioremediation of the quarry site, as Black Wattle increases soil acidity. The shells are also useful as a filler in polymers, based on the thermal, chemical and physical properties of calcium carbonate (Hamester et al., 2012:1).

fig 4.8 Aquaculture water system, Illustration by Author (2013)

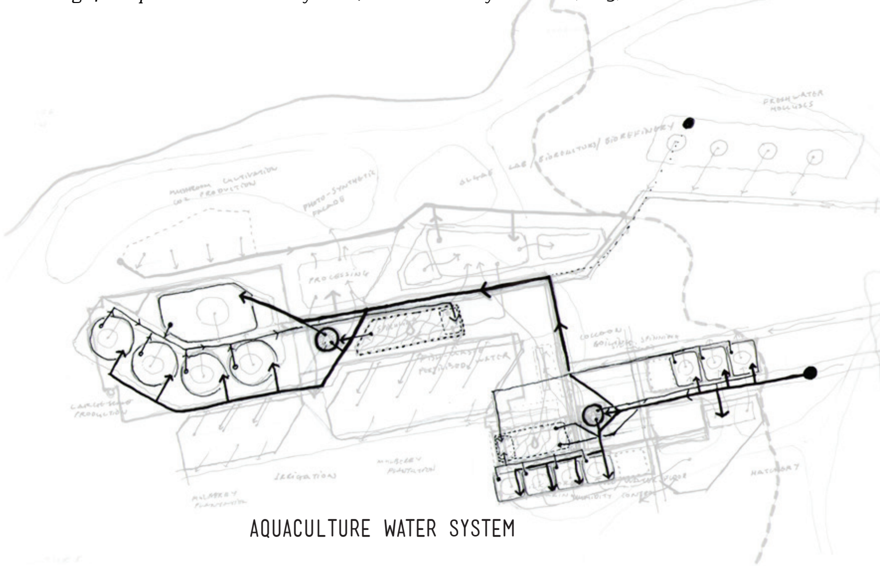
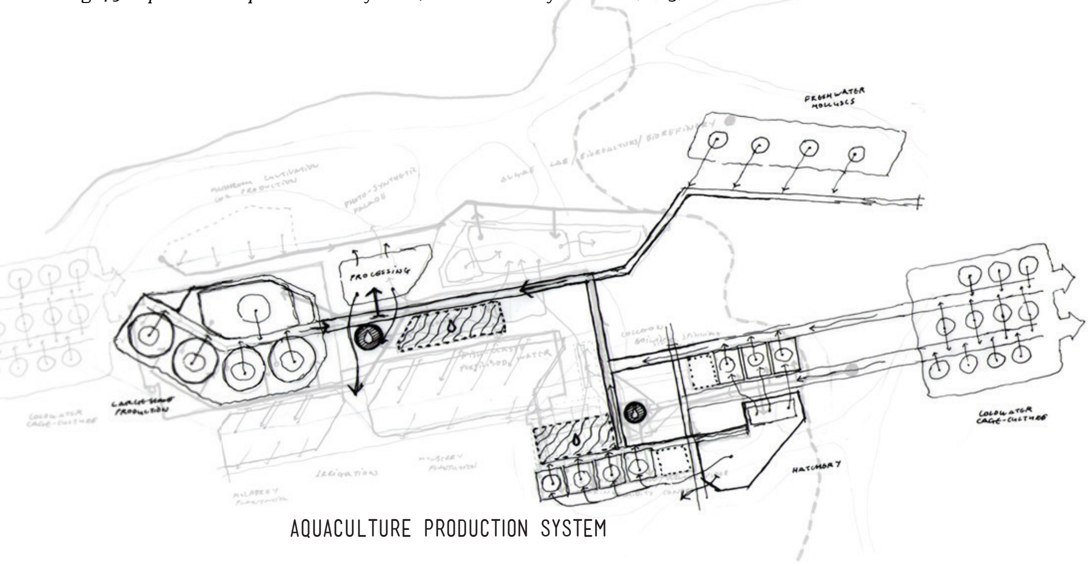


fig 4.9 Aquaculture production system, Illustration by Author (2013)



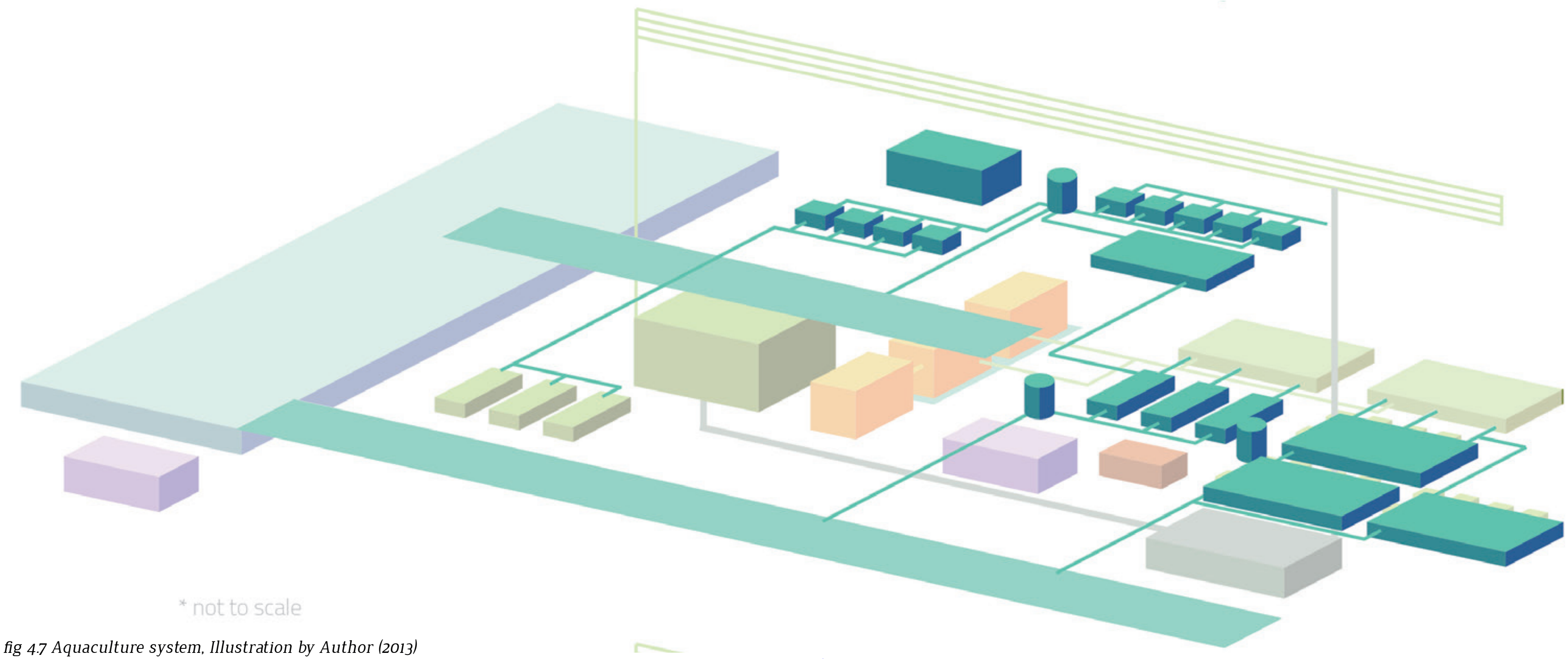


fig 4.7 Aquaculture system, Illustration by Author (2013)

4.2.2.1 THE HATCHERY + NURSERY

A state of the art Tilapia fingerling hatchery is to be established in the Tshwane Region. This hatchery utilizes the clean fresh water available and is sized to expand the Tilapia farming industry. A working fish farm training centre is established in conjunction with the hatchery, where fish farmers can complete a vocational training course. The hatchery houses a laboratory for performing the fertilisation procedure, an incubation area, and rearing facilities for fry and fingerlings. A distribution centre forms part of this facility to distribute the young fry to external farms and independent producers.

4.2.2.2 AQUACULTURE CASE - STUDY

A visit was paid to the Davidson Fishery east of Pretoria out on Lynnwood Road, to gain an understanding of how aquaculture can be practiced sustainably in the Gauteng region. It is a pioneering African Tilapia fish farm, one of the first of its kind in Pretoria, and has only been operating since mid-2013. It claims to have the most innovative technology in the region for this type of commercial aquaculture. At the foundation of the system is the ability to maintain a constant and controlled environment, by rearing the fish in a greenhouse structure. This structure has at least 3 goals: to house the equipment and rearing facilities, to regulate the interior climate, and to exclude external environmental hazards detrimental to the fish.

The facility currently has 2 greenhouse structures housing brood-stock tanks, fingerling tanks, grow-out tanks, quarantine tanks and a water filtration and treatment system for treating the recirculating water. The farm is highly efficient in water usage and only needs to introduce approximately 1000 litres of new water a day to augment losses occurring through evaporation, spillage and during the separation of water from solid waste. This solid waste is diverted to a 3m deep sludge pit which stores the nutrients for the fertilisation of a green pepper field. The remaining water, after the drum filter has removed the solids, is channelled through gravel biofilter troughs which use microbial organisms to clean the water. Duckweed growing on the water's surface absorbs any excess nutrients, and is later fed back to the fishes. The different grades of fish feed are stored in a separately contained space free of humidity.

The hatchery and nursery operate on a 10 week cycle, therefore 10 fingerling tanks are used for rearing the Tilapia fry, each of which has the capacity to contain up to 10 000 fish, after which they are either transported to the 50 000 litre grow-out tanks or sold to other farmers. The 50 000 litre grow-out tanks can hold between 9 000 and 10 000 fish, with a 1% casualty rate. Within 6 months a fish can be reared up to a weight of 1 kilogram. The farm currently has 4 grow-out tanks, meaning it can produce 6 tons of fish a month, excluding the fingerlings sold to other farmers. During harvest time, 30 000 litres are pumped out into 3 separate 10 000 litre tanks, leaving only 20 000 litres in the ponds, which makes harvesting and catching the fish far more manageable.

The greenhouses need to maintain a temperature of 28 degrees Celsius, and due to the high humidity and temperature, it is reported that it seems to rain inside these greenhouse structures in the early mornings as a result of condensation. Air plants and orchids can therefore be grown inside, supported by the structure. During the summer months the sliding doors of the greenhouses are left open and ventilation doors on hinges are opened to prevent the space and water tanks from overheating.

This is a good model to follow for any future aquaculture projects in the region.

4.2.2.3 THE PROCESSING PLANT

Once the adult fish have been harvested from the grow-out ponds they are transported along the production track and lifted toward the fish processing plant. A sanitation area ensures the required levels of hygiene before employees work with the fish meat. The fish are placed into an ice bath as a humane method of euthanisation; after about 15 minutes they are dead and taken to the band-saw operator where they are beheaded (Nelson et al., 1982:221). They are then gutted and moved to the scaling, skinning and filleting stations equipped with the appropriate filleting knives and tools. As a by-product, Tilapia skin can be made into leather. Finally, the fish fillets are washed and chilled to be either taken straight to the restaurant as fresh produce, to the fish mongers to be sold to the general public, or packaged and stored in the cold store for future use or to be dispatched to other local restaurants.

Fresh fish which are to be displayed at the fish monger's shop must be kept in a properly designed retail display. The display must be screened against the sun and shielded from draughts. The fishes must be stacked in thin layers in a cool pool of air with ice below and around the fish and sprinkled over it. An unrestricted wide drain must allow for the drainage of molten ice and prevent the collection of water (Burgess, 1967:260).

fig 4.10-4.15 Davidson Fishery, Photographs by Author (2013)

fig 4.11 Aquaculture greenhouses
fig 4.12 Airplants hung within greenhouse structures
fig 4.13 Grow out ponds, quarantine ponds, Broodstock tanks
fig 4.14 Drumfilter
fig 4.15 Integrated reenpepper garden and fish waste storage

fig 4.10


fig 4.11


fig 4.12


fig 4.13


fig 4.14


fig 4.15

4.2.3 ALGACULTURE SUB - SYSTEM

Algae are a diverse resource, and hold many benefits for the integration of fish based aquaculture - as a highly nutritious and sustainable feedstock, and as a strategy for water treatment. Algaculture could yield valuable co-products as well as energy resources.

"Growing food in cities and urban areas may become critical as fuel costs rise, making transported food increasingly expensive [O]n a small land area, a community could meet a portion of its food requirements from microalgae, freeing cropland for community recreation or reforestation" (www.algaeindustrymagazine.com). Innovative, inexpensive and efficient small-scale algae farming systems can be found in France where there are over 100 algae microfarmers. A school curriculum for growing algae indicates that algae microfarms for local family and community cultivation is likely to become a reality, and will potentially support independent local economies, as "these small growers are selling their own products directly in their local region" (www.algaeindustrymagazine.com).

According to a report by the International Energy Agency (IEA) Bioenergy publication, "the last few years have seen a renewed interest and a great increase in activity in algae as a sustainable source of energy" (IEA Bioenergy, 2010:2). "Worldwide diesel demand is currently not met by Biodiesel produced from current oilseed, therefore alternative and more productive sources of renewable oils are required to meet the challenge of increasing demand for higher energy density liquid transportation fuels" (IEA Bioenergy, 2010:2). Microalgae have the capacity to be converted into a variety of fuels. Up to 50% of its mass can be harvested as oil. "Coupled with a rapid growth rate, microalgae can produce 10-100 times more oil than terrestrial oilseed plants [and] can be cultivated on non-arable land which has little to no use ... [Microalgae are] also capable of using a variety of different water sources including fresh, brackish, saline, and waste water, and can use waste CO sources as a critical nutrient" (IEA Bioenergy, 2010:2). The relatively low efficiency of photosynthesis is what limits oil production from microalgae, as it "must first and foremost obey the laws of thermodynamics" (IEA Bioenergy, 2010:3). The productivity of photosynthesis is limited by the availability of CO22, water, mineral nutrients, and the ambient temperature. By increasing the CO2 level, the efficiency of photosynthesis is increased and leads to higher biomass yields per unit of land surface (IEA Bioenergy, 2010:4).

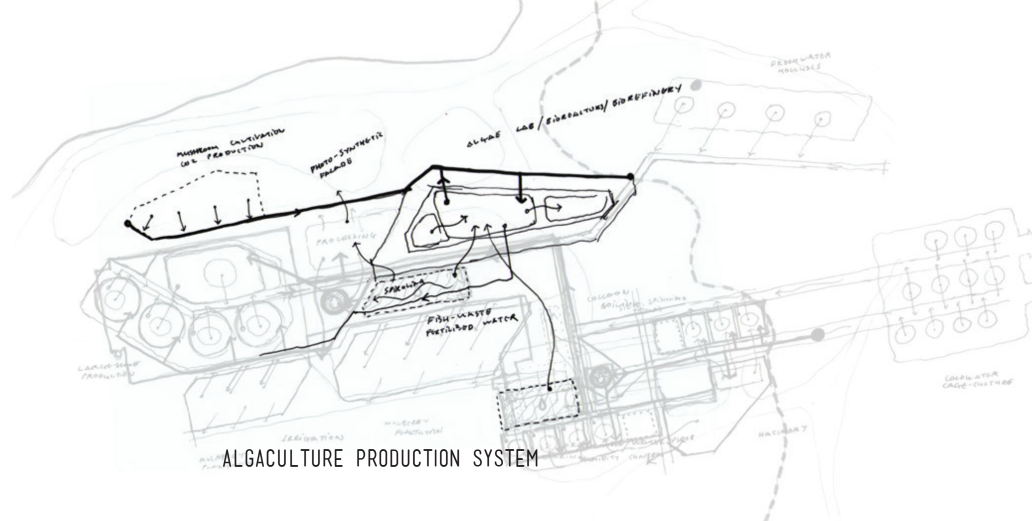
While the programme for this dissertation does not include the on-site large-scale production of renewable algae-sourced energy, it enables the research and development of this promising resource, its integration with other processes, as well as the small-scale local production of energy products together with high-value co-products. This allows for a flexible and resilient system with varying reliable inputs and outputs, with the capacity to produce algae as food, energy, and high value products. "Production of energy products along with co-products will be important and add robustness to business models. On the input side, algae production can have links to CO2 absorption or links to waste water treatment" (IEA Bioenergy, 2010:10). "The best solution is the synergy of algae biofuels production and wastewater treatment, since wastes can provide a regular supply of water and nutrients (C, N, and P), which can be efficiently recovered by algae [E]xisting technologies for algae wastewater treatment could be combined with biofuels production" (IEA Bioenergy, 2010:10). This emphasises the productive opportunity of integrating microalgae cultivation with the waste water treatment strategy of aquaculture, which produces high quantities of 'fertilised' water in which algal cultures can flourish.

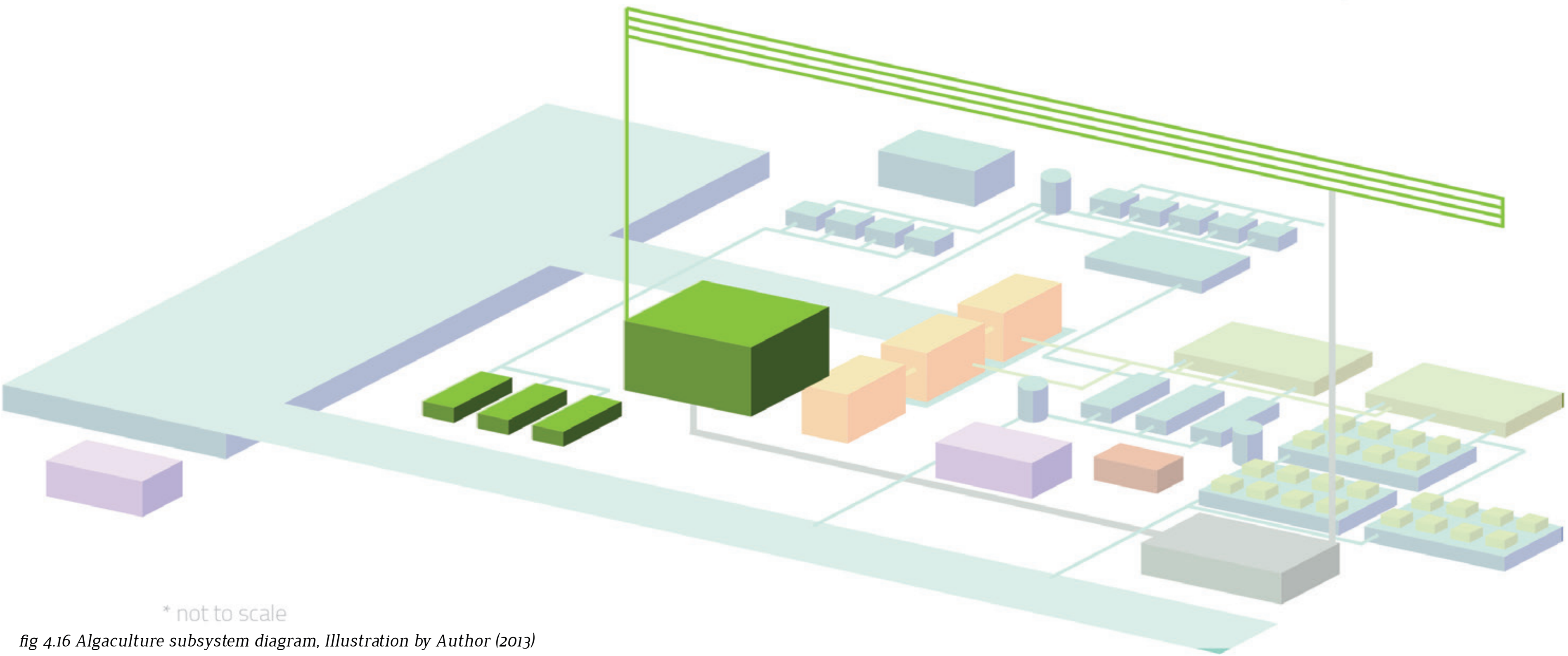
The utilisation of algal residual co-products as high-value products could "make algae based biofuels more economically viable" (www.oilgae.com). Emerging technologies based on various algae strains utilise the algal residue to make products such as nutraceuticals, fertilizer and animal (aquaculture) feed, pharmaceuticals, hydrocolloids, biopolymers and bioplastics, cosmetics, pigments, and applications for bioremediation (wastewater treatment and CO2 capture). Currently, nutraceuticals are among the primary uses for algae. Among the most popular is the highly nutritious superfood spirulina, which is not only used in human supplemented diets but also as a healthy fish and animal feed (IEA Bioenergy, 2010:10).

The preferred method of algae cultivation for this dissertation is with photobioreactors (PBRs). Open pond raceways are the current commercial practice, but require vast expanses of land. Closed photobioreactors offer advantages over open ponds, such as better control, large surface-to-volume ratio, reduction in evaporation of growth medium, better protection from outside contamination, higher biomass, and diverse algae species (IEA Bioenergy, 2010:11). The use of PBRs requires a structurally contained plant to house the operations, similar to a traditional greenhouse. Flat panel algae bioreactors can be built into building components; thereby the production process is integrated into a "living" facade.

Even though it seems promising, producing algae-based biofuels still requires more "R&D and careful step-by-step development" (IEA Bioenergy, 2010:2), and "there are still many technical challenges that need to be overcome before this technology can be commercialised at a sufficiently large scale" (IEA Bioenergy, 2010:3). In South Africa, the CSIR is at the forefront of algal biodiesel research "to prove that Biodiesel harvested from lipid-producing cells of certain algae can succeed fossil fuels as an alternative source of energy" (CSIR, 2008). "Spurred on by the threat to national energy security from rising fuel prices, development of the Kyoto Protocol and South African environmental strategies" (CSIR, 2008), the CSIR's research indicates that "South Africa is a likely hot-spot for algal oil producing strain diversity" (CSIR, 2008). They have initiated "process development in laboratory scale systems" (CSIR, 2008), but additional funding is necessary to "allow more rapid research progress and human capacity development in this area" (CSIR, 2008). They also stress the importance of training in the area: "several MSc and PhD students can be trained in preparation for the skills required for commercial implementation of such a technology". To support the CSIR's research and development goals, the building hosts algae R & D labs, an integrated photobioreactor plant and an algae oil biorefinery, "a facility that integrates biomass conversion processes and equipment to produce fuels, power, and chemicals from biomass" (www.oilgae.com).

fig 4.17 Algaculture production diagram, Illustration by Author (2013)





* not to scale

fig 4.16 Algaculture subsystem diagram, Illustration by Author (2013)

4.2.4 MORICULTURE SUB - SYSTEM

Mulberry trees are the foundation of sericulture, and represent the primary connection between the aquaculture and sericulture systems. Mulberry trees can produce about 370kg of leaves per 100m2 of plantation, which are fed to silkworms to produce about 27kg of silkworm cocoons, with a total of 185kg of silkworm waste in the form of manure and skins (Hilbrands et al., 1998:18).

The mulberry tree itself grows best at 25-30 C and at a relative humidity of 65-80% (Ruddle et al., 1988:50), and needs sunlight for 5 to 12 hours a day. Mulberries, which are a highly nutritious fruit, can be used in the production of jam, jelly, pulp, fruit drinks, fruit sauce, cake, fruit tea, fruit powder, fruit wine, food colourant, as a diabetes control agent, as ruminant livestock feed and in the pharmaceutical industry. Mulberry leaves are also known to be used as a tea for human consumption, and holds many health benefits. The silkworms' mulberry diet can be supplemented by soaking the leaves in spirulina algae for increased quality and yield (Roger et al., 1984). The best type of plantation is the paired row system, which utilises a spacing of (90 + 150) cm x 60 cm (www.indg.in).

4.2.5 SERICULTURE SUB - SYSTEM

As a sub-system of the bigger aquaculture operations, the sericulture component is not on the scale of industrial mass production, but rather functions as an artisanal industry meant to supplement the productive potential of the site and to efficiently maintain the closed-loop nutrient flow in the production processes.

Sericulture is a proven industry when it comes to its symbiotic relationship with aquaculture. Sericulture also holds great promise as an emerging industry in South Africa. This project could therefore become a catalyst for its regional growth and development, and pioneer the Tshwane regional silk industry.

Silkworms (Bombyx mori) have a rather peculiar cultural significance in South Africa. Most South African children would have come into contact with them at some stage at school or through friends, and they have become somewhat of a cultural phenomenon among most South Africans, who have fond memories of rearing their own worms and having kept them as pets, experiencing their full life cycle and understanding the metamorphosis of these creatures through a type of recreational yet educational endeavour. But little do most children realise the full potential of these tiny creatures which they hold in their hands: the potential to harvest their silk for economic benefit. Mulberry trees, which are the worm's only recommended food, already grow in many suburban gardens and streets in Pretoria.

Silk is a high-value but low-volume product, accounting for only 0.2 % of the world's total textile production. "Silk production is regarded as an important tool for the economic development of a country, as it is a labour intensive and high-income generating industry that churns out value-added products of economic importance. Developing countries rely on it for employment generation, especially in rural sectors" (http://www.csb.gov.in/silk-sericulture/silk/).

Beyond its traditional and historic use as a textile, silk has come a long way in modern science and technology. It is somewhat of a super material with many applications. Its possibilities are yet to be explored fully, and therefore the breeding, harvesting and processing of silk is an industry which holds much promise and potential for a developing country's economy - from the traditional practices of mulberry cultivation, silkworm rearing, and silk reeling and textile production, to the advanced experimentation of materials engineering. Silk offers a dynamic process and various opportunities for space making.

fig 4.19 Seri + Moriculture water diagram, Illustration by Author (2013)

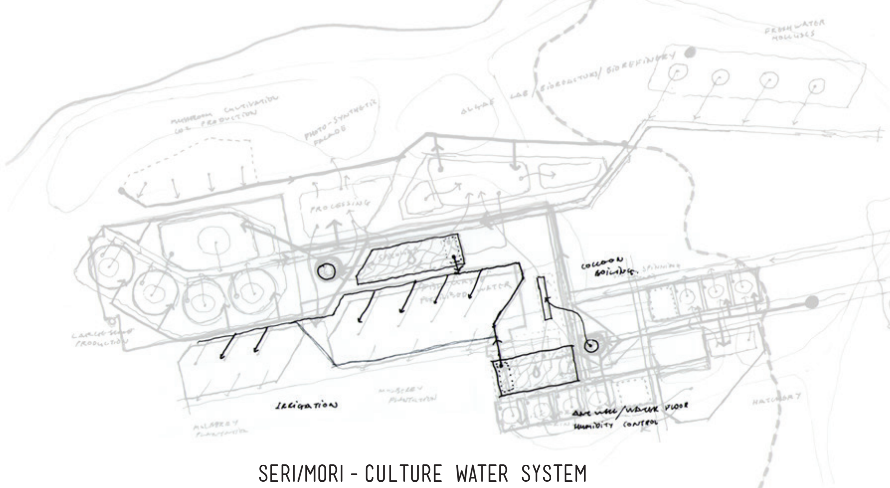
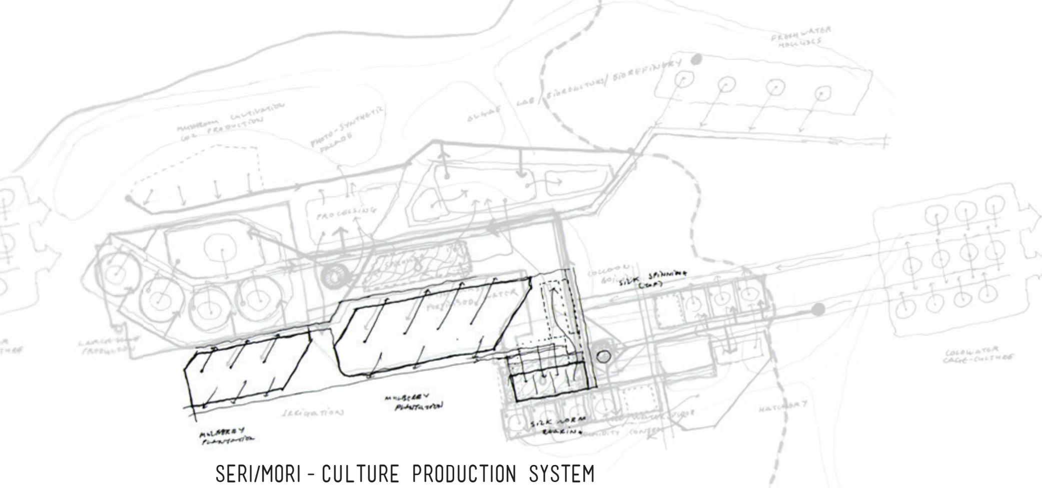


fig 4.20 Seri + Moriculture production diagram, Illustration by Author (2013)



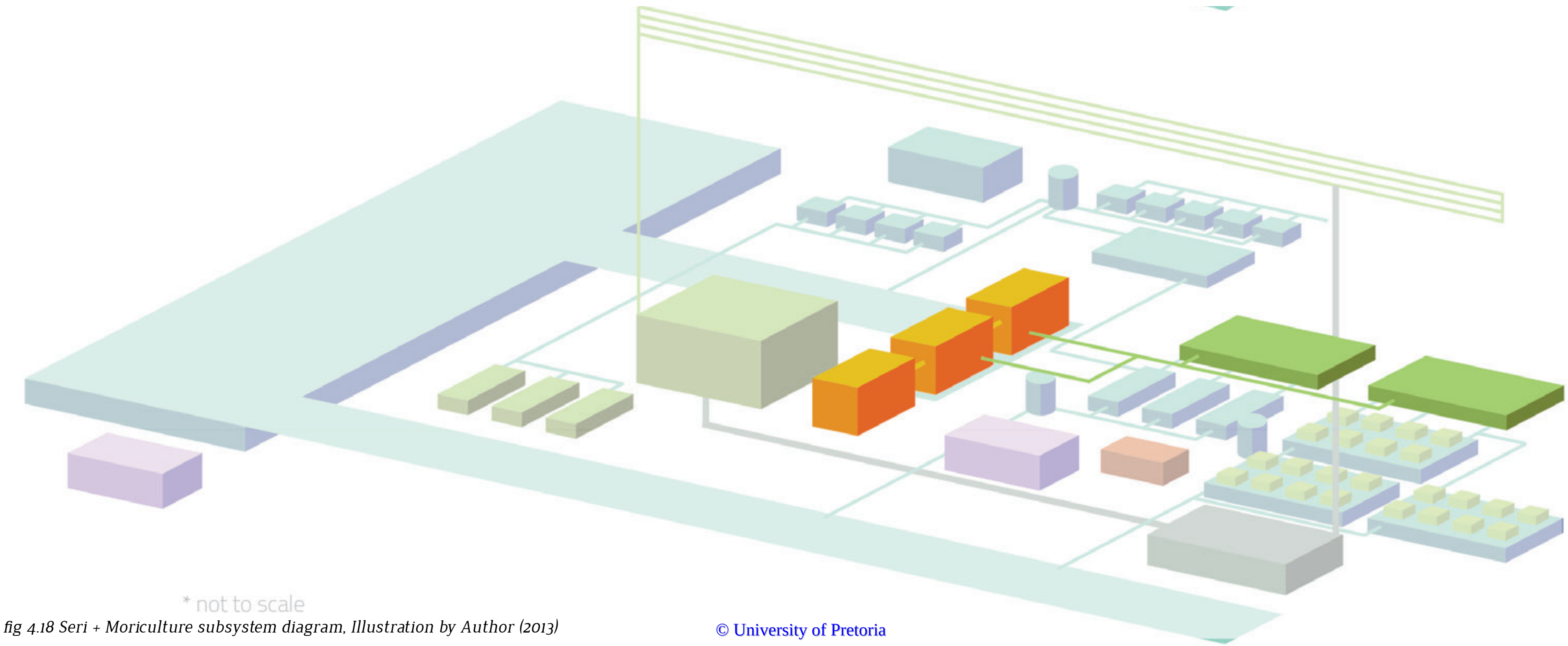


fig 4.18 Seri + Moriculture subsystem diagram, Illustration by Author (2013)

4.2.5.1 THE PROCESS OF REARING SILKWORMS

Silkworms are delicate, domesticated insects which cannot tolerate diurnal and seasonal fluctuations; therefore they are reared in special rearing houses where the effects of natural changes in environmental conditions outside are reduced to the minimum so that the silkworms can thrive under uniform conditions.

4.2.5.1.1 PRODUCTION OF EGGS

The production process for the 'disease free laying' of silkworm eggs, called 'industrial seeds', is carried out in special 'grainages' (www.inseda.org).
The procedures in a grainage are: rearing of parental seed cocoons, seed cocoon preservation, separation of sexes, moth emergences, pairing, and laying of eggs. The eggs are then transported to the rearing facility in 'black boxes' (www.inseda.org).

4.2.5.1.2 YOUNG AGE REARING

Also known as 'chawki' rearing, this is the stage in which newly hatched larvae are reared to their 3rd stage, over a period of 8-9 days. A separate chawki rearing room is recommended to facilitate optimum temperature, humidity and hygienic conditions. A higher temperature of 27º C and a humidity of 80-85% are required.

4.2.5.1.3 LATE AGE REARING

The rearing of silkworms from the 3rd stage to the final 5th stage requires temperature conditions to be decreased from 26º C to 24º C, and humidity to be decreased from 75-80% to 70-65% respectively. The larger worms are transferred from small rearing trays to larger trays.

4.2.5.1.4 MOUNTING OF WORMS

'Ripe worms' are placed on mountages or 'chandrikas' that are traditionally made from bamboo, but can also be made from waste mulberry timber or Back Wattle timber. About 1000 worms can be mounted on a chandrika 1.8 x 1.2m in size. At this stage a temperature of 24º C is maintained at a humidity of 60-65%. After 2 to 3 days the spinning is complete, at which point cocoons can be chosen to be taken to the grainage for the production of healthy seed stock; otherwise they are harvested and deflossed for silk production.

4.2.5.1.5 REELING

Once the cocoons have arrived at the 'filature' they are ready to be reeled, which is a "process of unwinding the continuous filaments from cocoons in the form of yarn" (Sericulture Manual, [n.d.]:44). This is done by cooking the cocoons via the 'floating-system'. The loose silk strands are reeled into a continuous thread of yarn which is finally collected as a spool of raw silk. Raw silk is the intended final product for this dissertation's programme, as it has many possible uses at this point and could be sold as a high-value commodity, but an on-site facility for the small scale production and demonstration of silk textiles with looms and natural dyeing is also considered, to facilitate the production of local products as well as materials to be utilised within the architectural intervention.

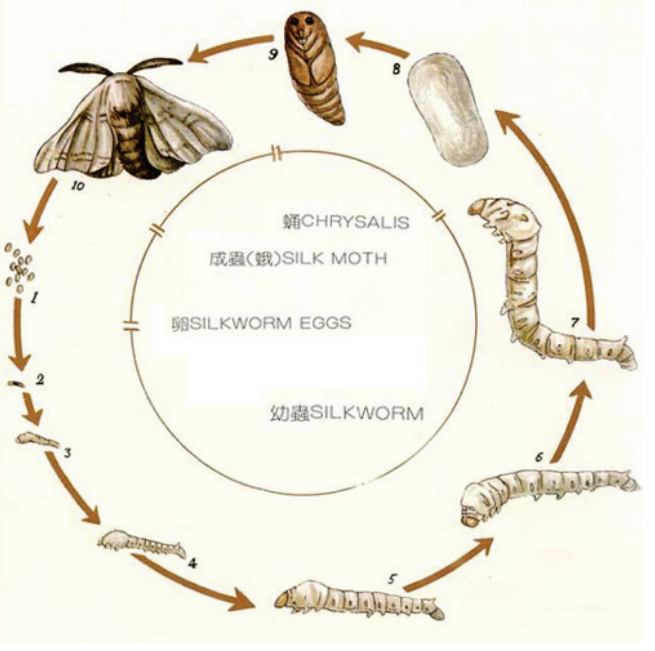
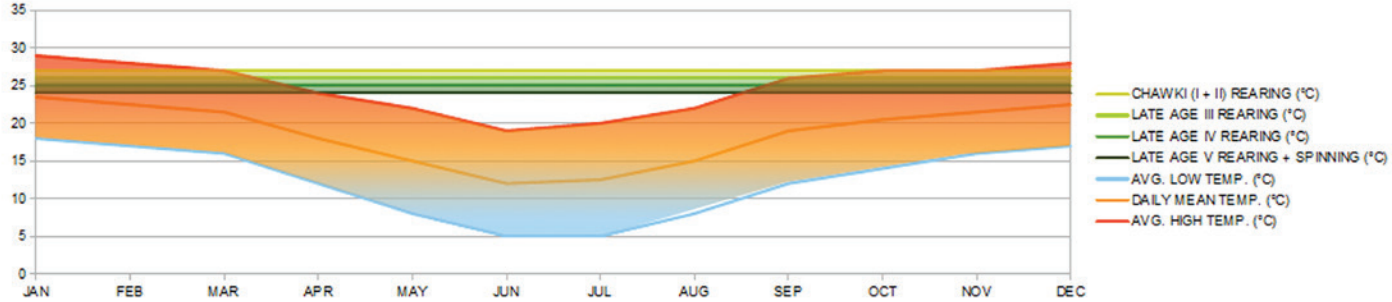
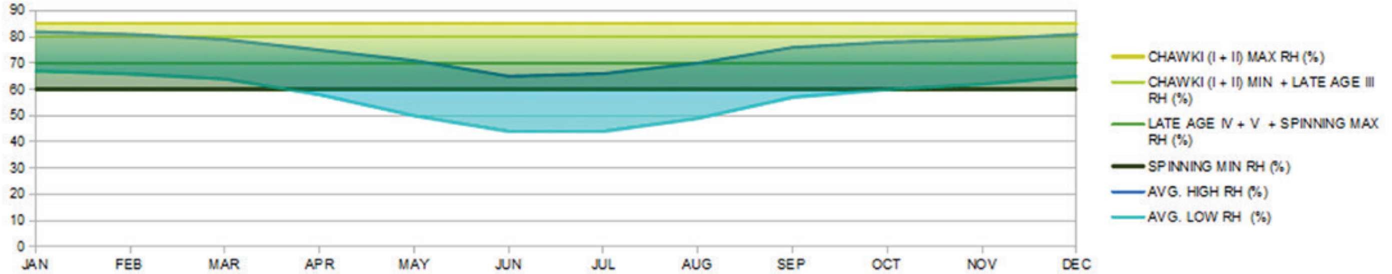


fig 4.21 Silkworm growth phases (www.mandarinforme.com)



TEMPERATURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CHAWKI (I + II) REARING (°C)	27	27	27	27	27	27	27	27	27	27	27	27
LATE AGE III REARING (°C)	26	26	26	26	26	26	26	26	26	26	26	26
LATE AGE IV REARING (°C)	25	25	25	25	25	25	25	25	25	25	25	25
LATE AGE V REARING + SPINNING (°C)	24	24	24	24	24	24	24	24	24	24	24	24
AVG. LOW TEMP. (°C)	18	17	16	12	8	5	5	8	12	14	16	17
DAILY MEAN TEMP. (°C)	23.5	22.5	21.5	18	15	12	12.5	15	19	20.5	21.5	22.5
AVG. HIGH TEMP. (°C)	29	28	27	24	22	19	20	22	26	27	27	28

fig 4.22 Silkworm temperature rearing conditions, byAuthor (2013),



RELATIVE HUMIDTY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CHAWKI (I + II) MAX RH (%)	85	85	85	85	85	85	85	85	85	85	85	85
CHAWKI (I + II) MIN + LATE AGE III RH (%)	80	80	80	80	80	80	80	80	80	80	80	80
LATE AGE IV + V + SPINNING MAX RH (%)	70	70	70	70	70	70	70	70	70	70	70	70
SPINNING MIN RH (%)	60	60	60	60	60	60	60	60	60	60	60	60
AVG. HIGH RH (%)	82	81	79	75	71	65	66	70	76	78	79	81
AVG. LOW RH (%)	67	66	64	58	50	44	44	49	57	60	62	65

RAINFALL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
AVG. RAINFALL (mm)	129.5	96.5	86.4	45.7	20.3	7.6	7.6	7.6	20.3	66	109.2	111.8

fig 4.23 Silkworm relative humidity rearing conditions, by Author (2013)

55.2.5.2 THE ARCHITECTURE OF SILK

A farmer with 1 - 2 acres (4047 - 8094m2) of mulberry trees needs to build a rearing house designed for approximately 200 dfls (disease free layings). This house is comprised of a rearing room (11 x 6m) to accommodate the rearing of silkworms on trays supported by rearing stands, which can be made from locally available Black Wattle timber at standard sizes of 2.5m high, 1.5m long and 0.65m deep. A separate chawki room (2.4 x 1.8m) allows for the dedicated rearing of young-age worms. An ante room (3m x 3m) provides for the washing of hands and disinfecting of legs before employees enter the rearing area. A storage area (3m x 6m) is required for the storage and preservation of mulberry leaves, which is preferably maintained at a low temperature and high humidity to maintain freshness (www.teriin.org). Storage must provide for spinning frames/mountages, spray pumps, disinfectants, polythene paper, secateurs and pruning saws (www.arenet.or.ug).

The rearing house should be placed close to the mulberry garden to make leaf delivery easy. The location should be surrounded by trees to control humidity, wind and temperature and to protect the walls and the roof from afternoon sun. The silkworm rearing house should be located in an elevated place to avoid moisture migration through the floors, provide good cross ventilation, and facilitate drainage of the water during cleaning and disinfection. The house is to be oriented on a north-south axis. East and west walls must be fully shaded to cut down direct solar heat gains. The orientation or position of a rearing house should be such that the door is easily accessible. The roof should cover a veranda of at least 60cm wide and the veranda floor should be cemented to form a rain splash apron all around the house. The rearing house should have adequate lighting arrangements for working at night (www.arenet.or.ug).

The structure and materials of the rearing house play a vital role in the maintenance of temperature and humidity during silkworm rearing to produce quality seed cocoons. The required temperature for the optimal growth of silkworms ranges between 23 and 28° C, and the desired relative humidity is in the range of 70 to 85%. It is critical to avoid damp conditions, stagnation of air, direct and strong air flows, and exposure to bright and direct sunlight. Permanent materials should ensure durability, minimum maintenance and ease of disinfection. A ceiling to reduce heat radiation may be of soft board, plywood, plastic or papyrus mats, depending on the availability and affordability of these materials. The floor should be of concrete, with cement, aggregate and sand in a ratio of 1:3:6 respectively, and the screed should be of a concentrated cement mixture to avoid wear and allow for hygiene maintenance. A continuous 10-15cm deep water channel along the walls inside the rearing hall helps to keep ants away from the silkworms. The water channel also maintains the humidity and enables water drainage during cleaning and disinfection. Design strategies to address the environmental requirements of the rearing house are the following: an insulated building envelope (walls and roof), east and west walls shaded externally, roof insulation, the air inlet in the north wall covered with wet gunny bags for added humidity and evaporative cooling in dry summer months, natural ventilation, and evaporative cooling (www.teriin.org).

5.2.5.3 SERICULTURE CASE STUDIES

ANGKOR SILK FARM, CAMBODIA

During a tour through South-East Asia in 2011, a Cambodian silk farm was visited to gain understanding of the processes of silk farming. All of the facilities, from mulberry cultivation, silkworm rearing, silk thread reeling, textile dyeing and silk product distribution and even a small museum exhibit, are located on site in a tightly configured complex. The rearing houses stand on stilts, and where the stilts touch the ground, they are surrounded by a narrow water channel to prevent ants from climbing into the houses.

GRASKOP SILK FARM, SOUTH AFRICA

To understand silk farming practices in South Africa in comparison to its Asian counterparts, the practices at the silk farm and weavery facilities in Graskop were observed and documented. At this farm they do not practice boiling of the live cookings for a continuous thread; they strive to preserve the pupae inside by cutting the cocoon open with a razor blade and allowing the moth to hatch for continued reproduction. This limits the length and quality of the silk thread, and therefore limits the production of this farm to mainly silk stuffed duvets. They also have relatively small mulberry plantations, just sufficient for one season's rearing requirements.

The rearing houses are of basic construction: brick plastered walls and a galvanised steel roof on timber pole trusses. Glass sliding doors on the long edges of the building on both sides allow for access and complete cross ventilation. Additional ventilation outlets are placed high at the far ends of the building. The internal rearing stands are placed in cans filled with water to keep ants from climbing onto the rearing beds. Compared to the Cambodian silk farm, the Graskop farm does not seem as well configured, but does offer insight into the silk industry as a potential for an economically viable tourist-driven destination.

The weavery in Graskop, in a different location, is mostly for demonstration purposes and houses old looms for display. The Graskop weavery also produces wild silk products harvested from the mopani worm, which provides a rougher, darker silk. The mopani worm cannot be domesticated, so production is on a small scale, but creates jobs though the collection of the wild cocoons.

ANGKOR SILK FARM, CAMBODIA

fig 4.24.1


fig 4.24.2


fig 4.243

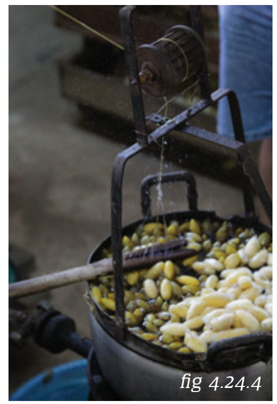


fig 4.24.4


fig 4.245


fig 4.24.6

fig 4.24.1 - 4.24.8 Angkor silk farm, Cambodia, Photgraphs by Author (2011)

fig 2.24.2 Ant-well staircase stilt
fig 4.243 - 4.24.4 Boiling of coccons
fig 4.245 Coccoon spinning mountage
fig 4.24.6 Hand weaving silk
fig 4.247 - 4.24.8 Rearing beds

fig 4.25.1 - 4.25.4 Graskop silk farm, South Africa, Photgraphs by Author (2011)

fig 4.25.2 Rearing stands in rearing house
fig 4.25.3 Raw silk
fig 4.25.4 Lady preparing a silk garment with loom


fig 4.247


fig 4.248

GRASKOP SILK FARM, SOUTH AFRICA


fig 4.25.1


fig 4.25.2

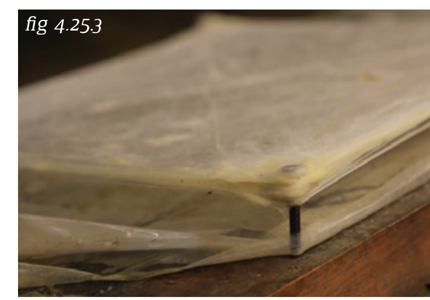


fig 4.253

fig 4.25.4

4.2.6 FUNGICULTURE SUB - SYSTEM

Mushrooms are grown to assist the growth of algae and to produce an additional food resource. Carbon dioxide produced by the mushrooms is utilised to stimulate the growth of algae. Oxygen produced by the algae is utilised to supplement the growth of the mushrooms (Baker et al., 2011:24). Other agricultural wastes on site are used as a substrate to produce a crop of "fast growing, high value edible and medicinal mushrooms" (Baker et al., 2011:24). The mycelium-enriched substrate waste from the mushroom growing process is used as a raw feed stock for manufacturing high-grade Tilapia feed pellets (www.alohaecowas.com). "The residual substrate material remaining at the mushroom farms after all edible mushroom crops have been harvested is used as a base for the fish food. This waste material which has been bio-converted from the cellulose crop residue contains approximately 35% protein by the time the mushroom harvest is complete, and is ideal for fish and animal food" (www.alohaecowas.com). The mycelium substrate is also mixed with the mulberry and silk worm wastes from the sericulture sub-system, spirulina algae from the algae sub-system, and mag meal produced on site as a product from another facility which forms part of the urban framework, to produce highly nutritious and organic fish feed. The end products derived from the fungiculture sub-system are mushroom spawn, pelleted tilapia feed, fresh mushrooms and carbon dioxide for algae growth.

Mushrooms are cultivated in 3 stages. Spawning is the period when the chosen substrate becomes permeated with spores and placed in a warm and dark place to allow for the germination and growth of mycelium (Baker et al., 2011:24). Primordia formation and fruit body development is the period during which the mycelium is placed in a space with indirect sunlight and a lower air temperature (Baker et al., 2011:24). At this stage, the mycelium will start to form mushrooms. During the final stage, called 'cropping', the first pinheads are grown into adulthood, during which "a lot of fresh air and a somewhat lower humidity is preferred" (Baker et al., 2011:24). "To grow mushrooms economically all year round, growing rooms must be well insulated and purpose built to ensure maximum yield and quality of mushrooms. There are three main types of growing room systems, these being the shelf system, tray system and the bag system" (www.mushroominfo.co.za).

The mushrooms are grown in 2 separate areas. Spawning occurs in a separate mushroom spawning room, and primordia formation and cropping occur in separate grow rooms (Baker et al., 2011:24). A large variety of mushrooms can be cultured, each type requiring varying climatic conditions to grow; therefore separate growing rooms are needed to enable control over individual climatic conditions.

Mushroom cultivation requires a clean room, an inoculation room, mushroom growing rooms (8-10), storage space for equipment and supplies such as large autoclaves for substrate processing, boiler, shredder, dryer and hand tools, laboratory and clean room equipment such as spawn growing bags, mushroom growing bags or containers, transport and shipping boxes, processing containers, and local substrate material (www.alohaecowas.com).

4.3 SOCIAL/RECREATIONAL POTENTIAL

The surrounding community hosts a large amount of social capital, and considering the projected increase in density of Pretoria's suburban regions, the social capital will become even higher. Large urban populations will increase pressures on resources but also provide opportunities for people to become part of the solution, to be involved in production, and to utilise the surrounding urban/suburban fabric on residential properties as part of the productive landscape and as extensions of the distributed resource production. All of the above are supported by the Integrated Resource Centre as a hub for exchanges of knowledge, "seeds", community, and other resources.

Beyond its productive potential, the second yet equally important and relevant potential which this site will hold for the community, is as a recreational park, as defined by the group urban vision. This public amenity will support many outdoor activities commonly associated with the typology, such as exercise, relaxation and utilising the biophilic qualities of the site to support a stronger connection with nature within an urban environment. As with the productive potential, the core value of the recreational potential lies in the presence of fresh water, and water recreation will be a key attraction of the new programme. The various cycling and walking routes connect to a waterfront edge which defines the water boundary as a public interface. At the thresholds between land and water people can participate in swimming and fishing activities. Canoeing and scuba diving are also highly popular physical activities to be accommodated in the programme. The architecture would support these activities by offering areas of refreshment and shelter as it connects to the exploration routes. More formal spaces such a restaurant and a food shop and allocated trading and event spaces will attract more people and support the social activities. The site also has the potential to host a local farmer's market where producers of the community can trade/sell their produce. An architectural interface within this suburban fabric can promote the development of social and resource exchange within the private community.

4.4 EDUCATIONAL POTENTIAL

While the site offers possibilities for incidental exposure and awareness of the integrated production processes, there is also the potential to incorporate more formal educational facilities for people wanting to learn in more detail about the skills involved in independent resource production. Training is provided on a small scale for locals wishing to learn about silk rearing and spinning or DIY home aquaponic farms. Formal training courses and professional training, for people wanting to work on site or for those wanting to start up their own integrated farm elsewhere, are all provided at this facility. The facility also supports a greater network for rural development of these technologies and will become a regional hub for research and innovation.

While the on-site production of resources is limited to local consumption, the "knowledge production" would be widespread and far reaching. A training facility will host seminar and classrooms, a demonstration workshop, multipurpose flexible halls for rent to the community for private events, a culinary workshop, dedicated routes and observation decks to view the integrated processes, and a cafeteria space.

In each phase of the process new jobs will be created in teaching, farming, packaging, transport, selling and export. All of the resultant income will be poured into the local economy, which will create more jobs and income and promote regional development of the innovative technologies.

4.5 PROGRAM SUMMARY

INTEGRATED NATURAL RESOURCE FACILITY – A platform of exchange between people and resources

We need to give them an alternative. We need to try new business models, integrated in nature. We can even say this farm is a centre for the production of micro algae, and our fish is like a sub-product. Its just one part of a whole, of a natural whole. This is a model for the future of this land and for the people of this land.
Miguel Medialdea, Head Biologist, Veta La Palma fish farm (www.vetalapalma.es)

The scheme includes facilities for the cultivation and demonstration of the symbiotic integration of natural resources, with supporting facilities of public leisure and water recreation, and various degrees of education (incidental, informal, and formal). The integrated natural resource centre is to exist symbiotically within a public park. Renewable resource production becomes synonymous with public recreation in the form of integrated cross-programming, where social awareness and contribution supports an ecologically sensitive industry.

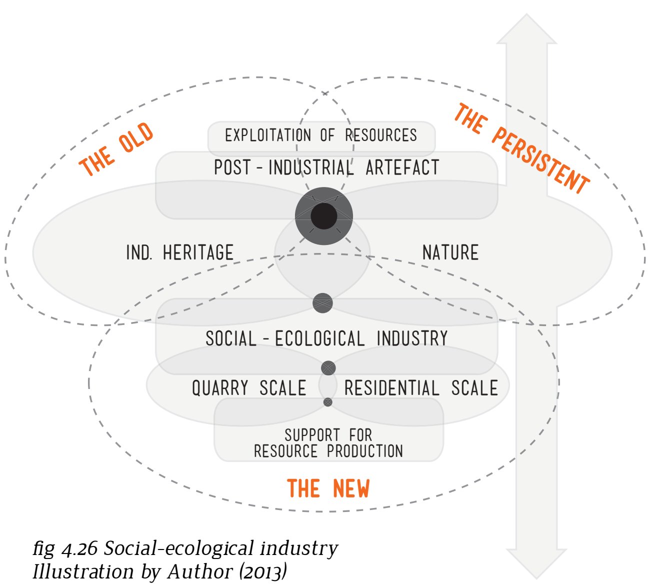


fig 4.26 Social-ecological industry
Illustration by Author (2013)

The separation of urban spatiality from that of production has resulted in a society disconnected from the ritual practices of life. Industry and production rooted in natural systems can possibly be integrated with human and social structures and networks, resulting in a system of which the product is greater than the sum of its parts. The usage of urban space must become diversified while remaining mindful of the role that nature plays within the urban environment, and how necessary nature is for human well-being. Sustainable resource production can be integrated into the fabric of local urban communities, to ease the strain on the Earth's limited resource stocks, and to become liberated from dependence on non-renewable resources.

In the suburbs of Pretoria, with most children learning how to nurture silkworms and pet fish from a young age, why can't these practices be realised in more meaningful endeavours for economic production? Global issues such as the energy crisis, food scarcity, and job security in a failing financial/capitalist system can actually be addressed, to some extent, by these "hobbies" which are already being practiced on a very small scale. All that is needed is some re-conceptualisation of how it is practiced and on what scale. There is huge potential for a hobby to turn into a regenerative social-ecological industry. A programme of urban aquaculture has been devised, where integrated systems of production and the public / social realm meet and prompt exchanges.

A public community centre is established for the production of resource "seeds" (fish fingerlings, silkworm eggs, algae strains, plants) which promote the decentralisation of industry and the distributed resource independence of Pretoria, allowing for a more resilient city and resource model, and safeguarding against future resource stresses and shocks. Social-ecological industry, based on the principles of industrial ecology, becomes a means for resource production. Industrial ecology learns from nature; it employs a closed-loop system joining different processes, similar to what would occur in natural systems utilising waste as resources. Within the scope of this dissertation, an architectural intervention could facilitate a relationship with the community and its resource needs, and facilitate an exchange between the different actors. The architecture becomes an experimental resource hatchery, where research, experimentation and development is focused toward the production of resource "seeds" for decentralised resource distribution within the urban fabric, and resource networks of the local and greater urban system. Resources are defined in terms of food and nutrition for feeding a growing population sustainably, energy for providing for a technologically advanced civilisation, and high-value products which could hold economic benefits for driving a local product-based economy. Another exportable commodity would be "highly trained technical service personnel who will have the skills to set up similar integrated aquaculture program[mes] in other areas" (http://www.alohaecowas.com).

The integrated resources have been chosen either for their tried-and-tested efficiency and successful applications in existing technologies, or for their promising potential as emerging technologies which require continued research and development. The specific resource production industries under investigation for the purposes of this dissertation involve the following: aquaculture, sericulture, algaculture and fungiculture, as well as the application of aquaponic systems for horticultural produce.

The programme is a systemic intervention, with the goal of localising resources by establishing a direct relationship between people and resources. Resources have the potential to become democratised by exposing the public to the potentials of extending the energy flow through the production of resources within a community. The programme becomes a support infrastructure for community resource independence, while offering a support service to rural and surrounding communities. Not only will the facilities address the immediate/local needs, but they will act as the core of a support network for the rural and urban development of similar integrated production opportunities. Therefore regional access to the facility is of high importance.

Resource cultivation can become subsumed within suburban and ultimately urban culture. This dissertation promotes a resource culture, a culture of resource cultivation. As a resource centre, the building becomes a necessary stepping stone for connecting people to resource responsibility and independence. It is what people need - to become aware, and to learn, to get a fundamental basis of support. Most urban dwellers lack the basic knowledge and exposure to independent resource production to become aware of the possibilities thereof. An industry can be created which requests public engagement and participation and results in a type of didactic education of ecology, heritage and industry simultaneously. If the goal is to change people's behaviour to a higher degree of responsibility and contribution, then they will need to become informed about the processes which contribute to their existence. Perhaps the driver to behavioural change could indeed be knowledge. The public is encouraged to participate, while giving a purpose to their participation. By involving the community in the production processes and ultimately the ecological fabric of their environment, a greater sense of community and contribution can be established. The intent is to re-establish a tangible connection to and responsibility between people and the biophysical and socially integrated systems which provide the resources for their lives.

4.6 CLIENTS

Due to the complexity and the multi-disciplinary nature of this facility, it is evident that this project would not have a single client, but rather multiple stakeholders and investors.

The project is to be a collaborative initiative supported by the Department of Agriculture, Forestry and Fisheries (DAFF). The CSIR is to be involved with the research interests associated with the production technologies of algaculture, aquaculture, sericulture, and additional integrated resources. Private business enterprises will be invited to become stakeholders in the management and operation of the commercial operations. The South African Tilapia Association will also be an active stakeholder in supporting the regional development of Tilapia aquaculture.

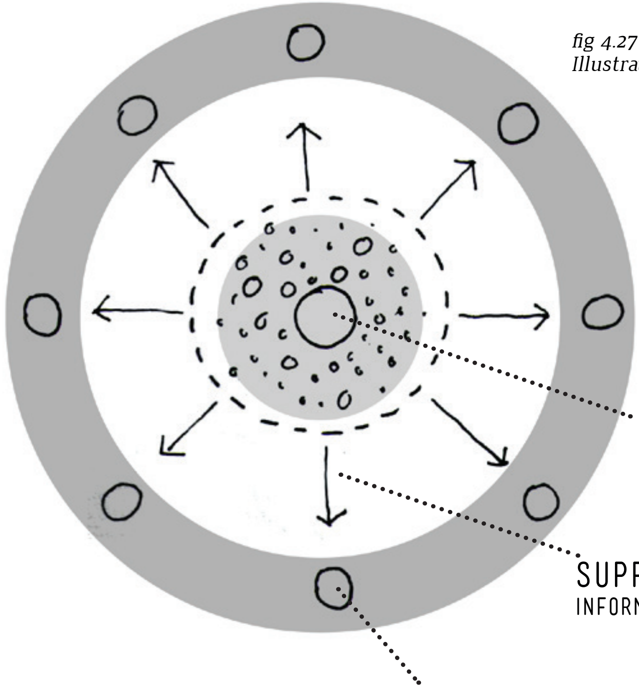


fig 4.27 Greeater Urban role
Illustration by Author (2013)

CONCEPT

5.1 SUMMARY OF DESIGN INFORMANTS

5.1.1 PATENT SITE POTENTIALS:

The social capital, historical remains, biophysical conditions and urban framework are all patent potentials, the presence of which offers physical informants for direct and tangible design responses.

5.1.2 LATENT PROGRAMME POTENTIALS:

The latent potentials unlocked via the patent potentials become design informants when the exchanges between the many aspects of the program - such as the productive potentials of aquaculture, algaculture, sericulture, fungiculture, the social potential of recreation and resource exchange, and the educational potential ranging from passive awareness to formal education - are understood.

5.1.3 THEORETICAL POTENTIALS:

5.1.3.1 RESILIENCE, HYBRIDITY + REGENERATIVE DEVELOPMENT:

To be resilient, a system must withstand disturbances and assimilate waste. Humans must learn to co-evolve with natural and living systems, so that human activity can be aligned with the processes of nature, in order to contribute positively to the functioning and evolution of ecosystems, and thus enable the self-healing capacity of nature. The built environment must become integrated with these processes - the hydrological cycle, the nutrient cycle, and the food chain - and must make visible the operation of these processes and their temporal cycles. Eco-systems must be managed and conserved, or created where necessary. The effective exchanges between urban form and natural processes are critical for their co-evolution; therefore cities as habitats must accommodate all species and enhance urban biodiversity, from which the positive effects of biophilia (an affinity for the natural world) may be experienced. When the story of a place is understood, it will deepen the connections to the underlying intrinsic beauty and value that a place has to offer, and will assist in developing relationship patterns between the entity and the larger system. It is critical to respond to local conditions, to adapt to changing conditions and to employ decentralised approaches. Pattern harmony builds infrastructure to improve land and ecosystems, and the unique attributes of the land improves the built environment and those who inhabit it. To be regenerative, the project must heal the damage caused by historical one-way flows and create self-renewing resource systems.

5.1.3.2 ENTROPY + EMERGENCE:

Entropy is accepted as a condition of industrial heritage and a future condition of all materials and architecture. It communicates the layering of change over time, and a delayed historic presence, as spatial latency. Entropy is evidence of the persistence of nature through time; thus to design for decay as an inevitable architecture is to "[i]nclude in design a degree of complexity, even of contradiction embodied in the simultaneous processes of growth and decay in our buildings, that heightens and intensifies our humanity" (Woods, 2012). This designed complexity is a continuation of the entropic flow; "ruins melt and merge into new structures, to get a marvellous energetic juxtaposition occurring, with accident a large part of the whole process" (Smithson, 1973).

5.1.3.3 INDUSTRIAL HERITAGE:

The narrative legacy introduced by the industrial heritage is to be continued, to indicate a flow, and to establish a dynamic relationship between the old and the new, for which the landscape is critical for understanding the heritage. It is not only the heritage that is important, but also the conferred patina that is integral to the integrity and interest of the site. Adaptive reuse is the chosen tool with which to preserve the threatened values of the industrial heritage. Building conservation saves energy by taking advantage of the non-recoverable energy embodied in a building and extending the use of it, making it a cost-effective and sustainable development strategy that ensures the survival of industrial buildings. It is important to preserve functional integrity, and new uses should respect significant materials and maintain original patterns of circulation and activity. Interventions should be reversible and have minimum impact. The value of industrial heritage can be understood through the contrast of the new fabric which attaches to the old. The few remaining structures need to be treated sensitively. It is important to maintain the visual identity of the site as a complex of industrial structures. Attachment can occur behind the structures, with the reuse of some of the old brick and concrete walls. Where attachment occurs, independence must be maintained between the old and the new, by offsetting the boundaries and thresholds and allowing for a clear progression of time as part of the site's narrative. Very little, if anything, must be done to the external appearance of the ruins, to maintain the patina of decay, giving it room to breathe in its landscape. Where appropriate, internal spaces can be re-purposed in line with the original integrity and elements can be retained and framed. Where heritage is forgotten and intangible, strategies should be employed to remember and reflect the values.

The investigated theories, all of which contain specific principles, have been synthesised and developed into a design approach. The result is a holistic concept through which the site's potentials can be viewed, understood and utilised, by means of exchanges within the varying degrees of established 'landscapes'. This conceptual lens is explored in the following sections.

HIERARCHY OF DESIGN INFORMANTS

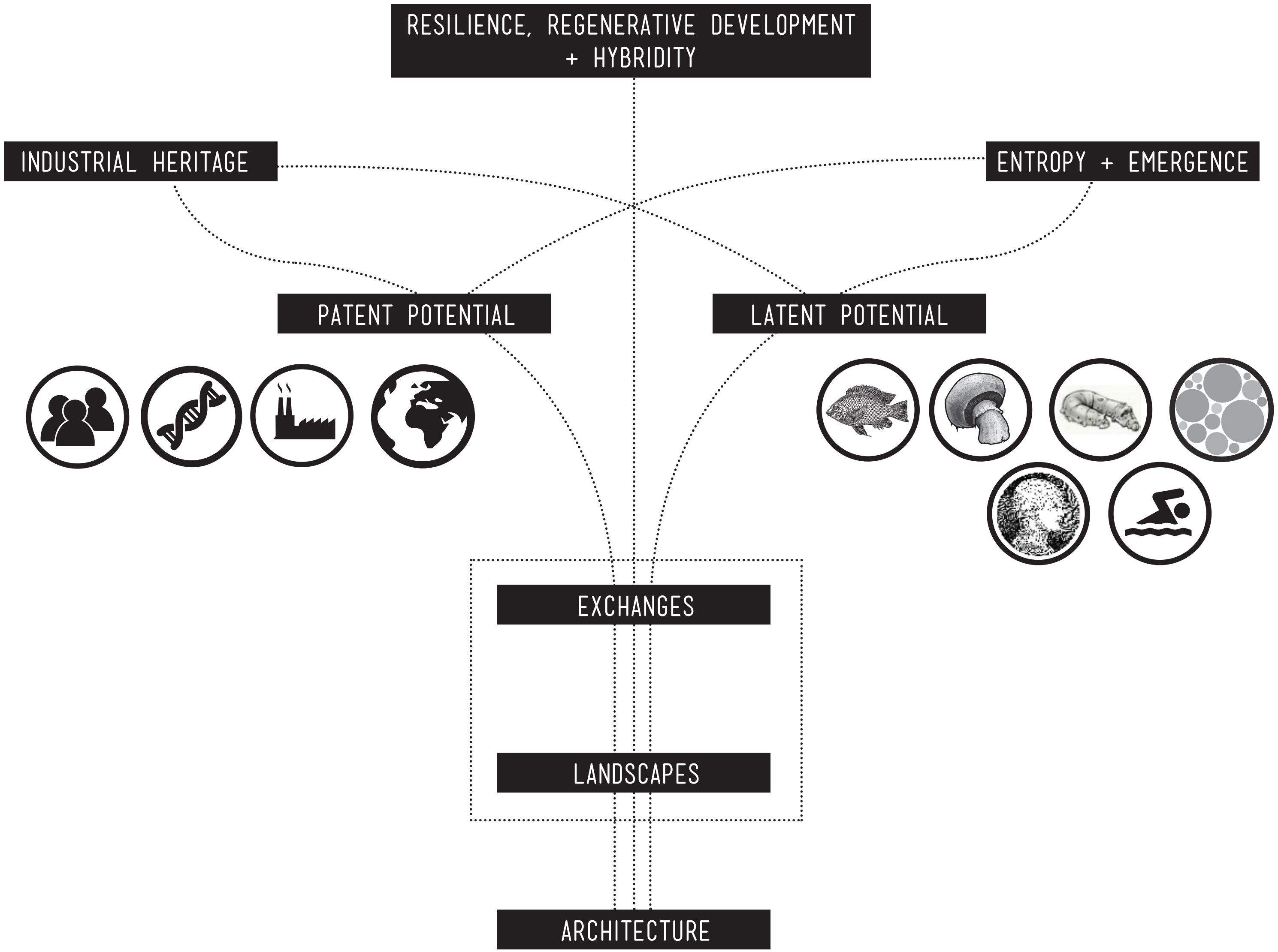


fig 5.1 Design informants, Illustration by Author (2013)

5.2 EXCHANGES

"Energy cannot be created or destroyed; it can only be changed from one form to another."
(Albert Einstein, s.a.)

As explained in one of the previous sections, energy does not simply appear; it is transferred. In the case of architecture, this metaphoric "energy", the inherent potentials, characteristics and purpose, may determine the qualities of a space, as it would an element's properties. Energy is an "exchange" between "actors". Energy which becomes active in a state of exchange, a kinetic energy, must find its origin somewhere. The following chapter explores how all the previously identified "actors" as potential informants will serve as this origin, which can initiate a process of exchanges to create a dynamic, "living" architecture, through which all these exchanges and relationships will contribute to the regeneration of the site. The concept, as it develops, sees the emergence of architectural form from the previously discussed theories and relevant approaches.

ex·change / iks cheynj/Verb
1. Give to, and receive from, one another
2. Hand over one and receive another, approximately equivalent

The concept of "exchanges" is used to guide the development of the architectural design process, as a way to understand the diverse relationships between the many components and actors within the scheme to be expressed through the architecture. An exchange is an event of transfer, where one "actor" with unique qualities relates to another, often completely different, "actor". A relationship exists at the point where they become acquainted. Architecture becomes the mediator which facilitates these exchanges, as they become enabled and/or amplified as a translation into form and space. Holistically, there are numerous relationships and exchanges to be potentially expressed through the new architectural intervention, as a response to the existing conditions and as a direct result of the industrial heritage and its indirect consequences.

HIERARCHY OF EXCHANGES :

1. Knowledge
2. Heritage
3. Social
4. Bio-Physical
5. programmatic
6. Tectonic

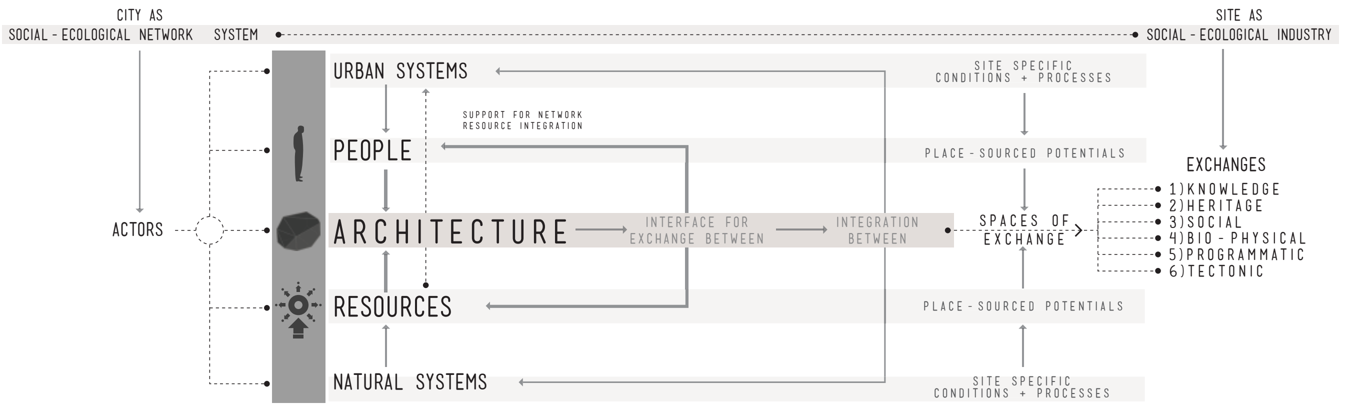


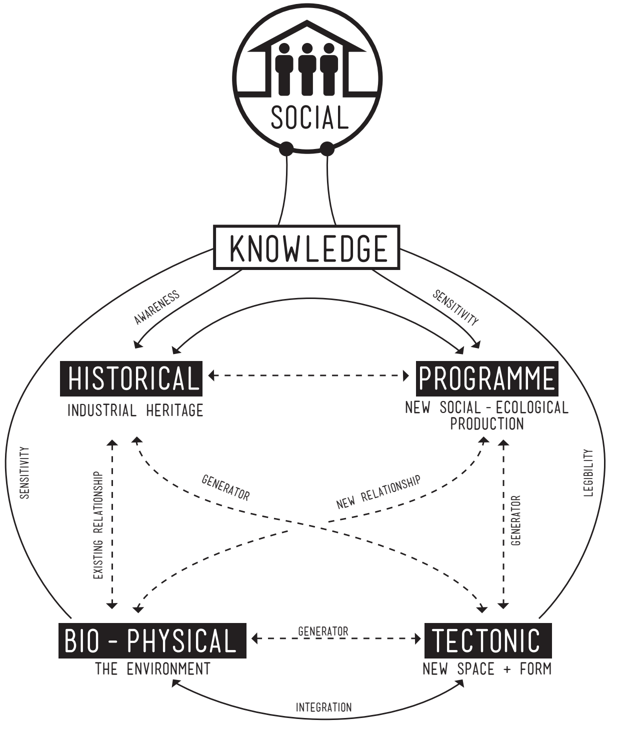
fig 5.2 Realising the exchanges,
Illustration by Author (2013)

KNOWLEDGE:

Knowledge becomes a key exchange between all of the elements. Knowledge of the site's history is conveyed by the retained structures and landforms. Knowledge of integrated resource technologies is communicated through various levels of education, from observation to active participation and demonstrations. Most importantly, an overall knowledge is gained about how resources, heritage, time and nature are all inescapably interconnected. Everything else is subservient to knowledge

HERITAGE:

There are three conditions to the industrial heritage: the remaining ruins/extant fabric, as a physical legacy; the forgotten and demolished structures as a ghost; and the landform, a manufactured landscape, as a consequence.



SOCIAL:

People are perhaps the most important, as they are the mobile actors and carriers of knowledge as a resource, absorbing this resource, mobilising it within the site, _spreading _it into the urban fabric, perpetuating the energy of the site beyond its boundaries, and depositing translations of it onto other sites with similar effect. They are the mediators between the internal systems on site, and the external greater urban systems; they complete the system as a whole. Without these actors the entire initiative would be futile. The majority of these exchanges occur at the intersection of people and resources; therefore all of the exchanges mediated through the architecture should be directed toward the flow of people.

BIOPHYSICAL:

The biophysical elements, defined as the four spheres of Atmosphere (air & wind), Hydrosphere (water), Lithosphere (soil) and Biosphere (life; fauna and flora), define the ecological and environmental systems with which any new intervention will undeniably be in constant exchange with.

PROGRAMMATIC:

Within the new programme there are tightly integrated exchanges between the resource production processes and the social functions. These new production processes (aquaculture, algaculture, sericulture, fungiculture) are at the heart of the new intervention and the social activities operate in parallel and in mutual complementary conditions. Simultaneity between the historical brick processes and the new integrated resource processes is to be expressed through the design.

TECTONIC:

The architecture and space is inevitably expressed through structure and form. The physical components to the architecture which house all the various functions and activities are also in constant exchange between junctions and thresholds. Where one condition exchanges with and transfers into another, this becomes reflected through the tectonic language of the architecture. None of the identified potentials exist in isolation and should therefore not be considered as separate from one another. The story of the site combines them all as causes, consequences and conflicts. It is therefore important to consider how the architecture would respond to and utilise all of the potentials, not as separate elements, but as relationships between the actors. The architecture becomes the medium for manifesting formal exchanges to communicate these relationships.

With the addition of the overarching theoretical informants, the concept of exchanges can be articulated into a concept of spatial exchanges between the diverse programmatic functions. By cross-programming different relationships between programmes, a passive knowledge and understanding of these relationships can be gained. Applying this to a conceptual spatial framework, these exchanges can be configured in such a way that a Social Spine is intersected and paralleled by New Production, in contrast to the Historical Production, which are all supported by an Enhanced Ecology.

5.3 THE LANDSCAPES

The previously described knowledge, heritage, social, biophysical, programmatic and tectonic spatial exchanges occurring in and between the social, production, historical and ecological conditions on site are encapsulated in the architecture. They give rise to and are caused by the latent and patent potentials revealed and utilised on site. These potentials and their exchanges, whether latent or patent, are now so inextricably intertwined that they have created an entirely new hybrid landscape. This regenerative, social-ecological landscape can be understood as the culmination of the expression of the exchanges of the past, present and future in material form. It is a Synthetic Landscape in a state of symbiosis with the natural landscape, and consists of the Social Landscape, the Ecological Landscape, the Historical Landscape, the Productive Landscape and the resultant Synthetic Landscape.

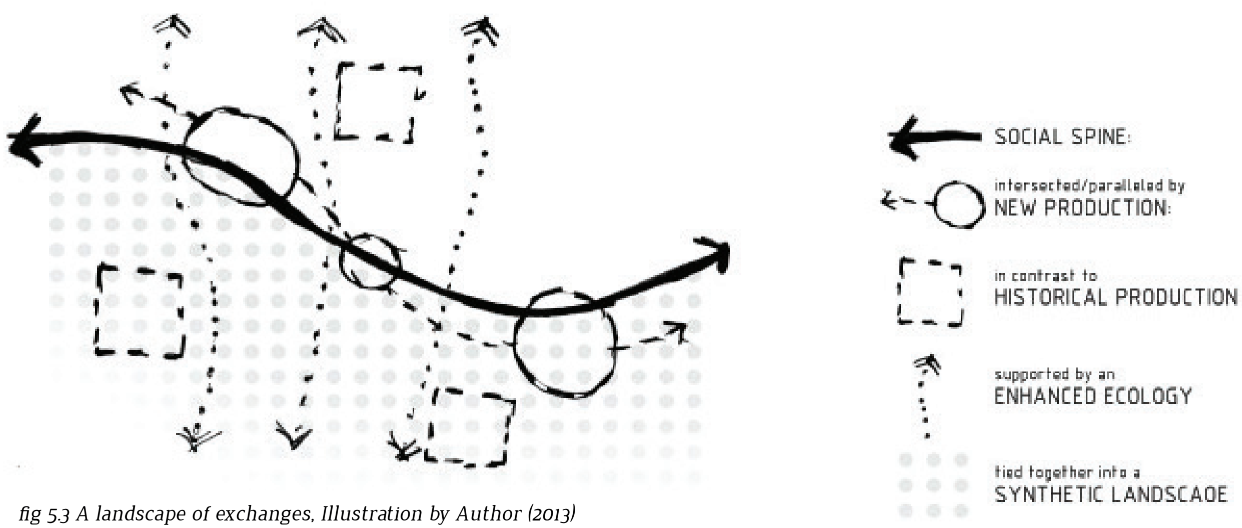


fig 5.3 A landscape of exchanges, Illustration by Author (2013)

CHAPTER 6:
A WAY OF DOING

DESIGN

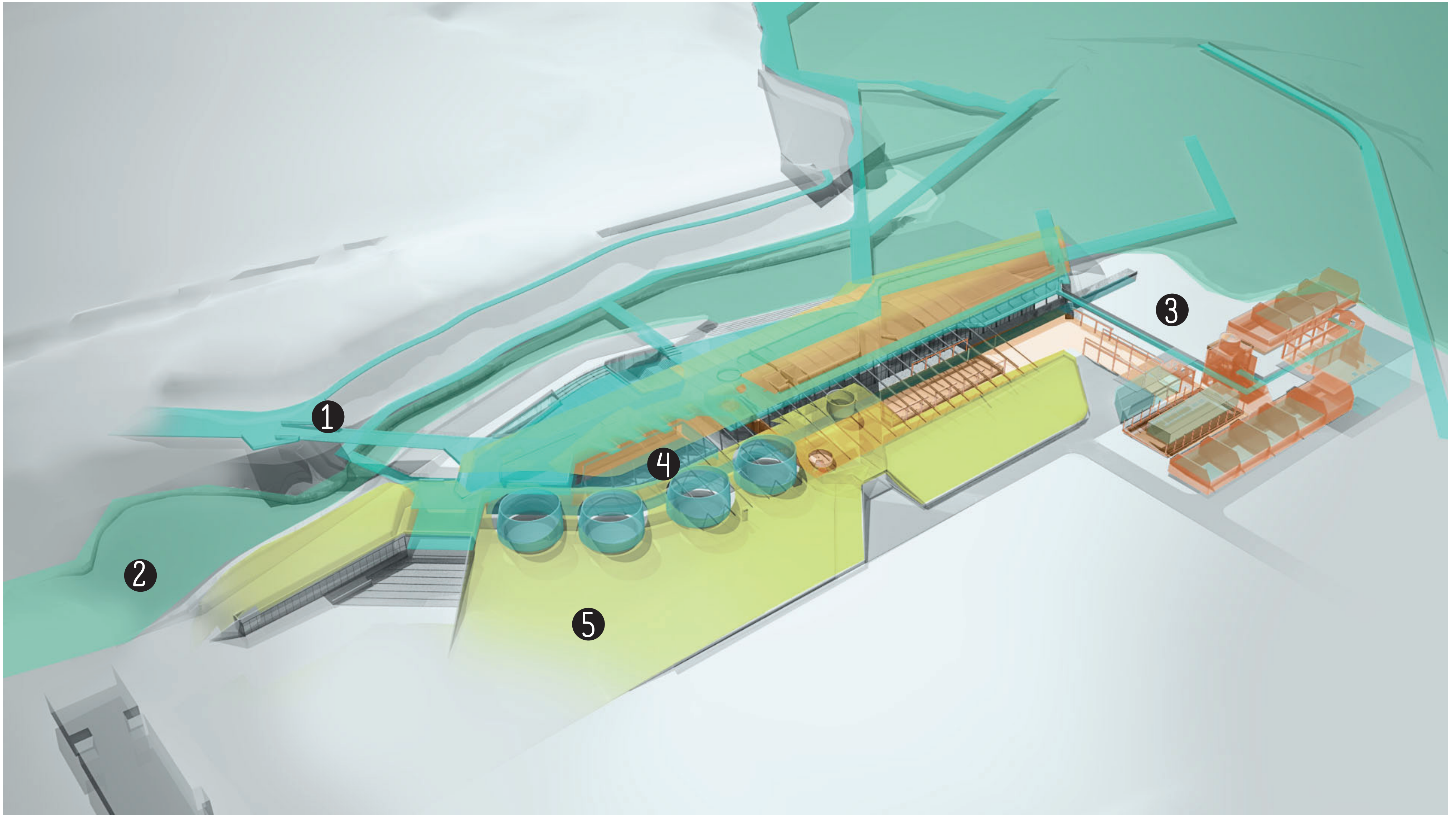
6.1 DESIGN FRAMEWORK

"They once harvested clay and made bricks here to create our city. Now we create resources to support it" (Author).

The design strategy for this thesis project is to develop the most disturbed areas of the site, and the areas which hold the most potential for regenerating a local eco-system. The entire site has been disturbed to some extent, but certain areas have been more successful at regenerating naturally. The area which contains most of the remaining heritage structures and hard surfaces is a prime brownfield site to be regenerated and conserved simultaneously. The specific site has two physical conditions that have to be dealt with, that of 'tradition', i.e. the heritage structures, and that of the surrounding 'natural' landscape. This dissertation's architectural design goal is partly to demonstrate a degree of control over 'tradition' as heritage, and landscape as 'natural'. As polar ends to site conditions these two aspects need to be treated uniquely, yet are integrated into the same design framework. This is achieved through implementing the complete conceptual framework of 'Landscapes'.

Each of the landscapes makes exchanges with one another but also exchanges within themselves. The following descriptions of the exchanges within the landscapes exclude knowledge, as it is not unique to each landscape. It is a general overarching exchange that occurs passively through exposure and awareness (except for the formal training facilities which foster more direct and literal exchanges of knowledge).

fig 6.1 The landscapes, Illustration by Author (2013)



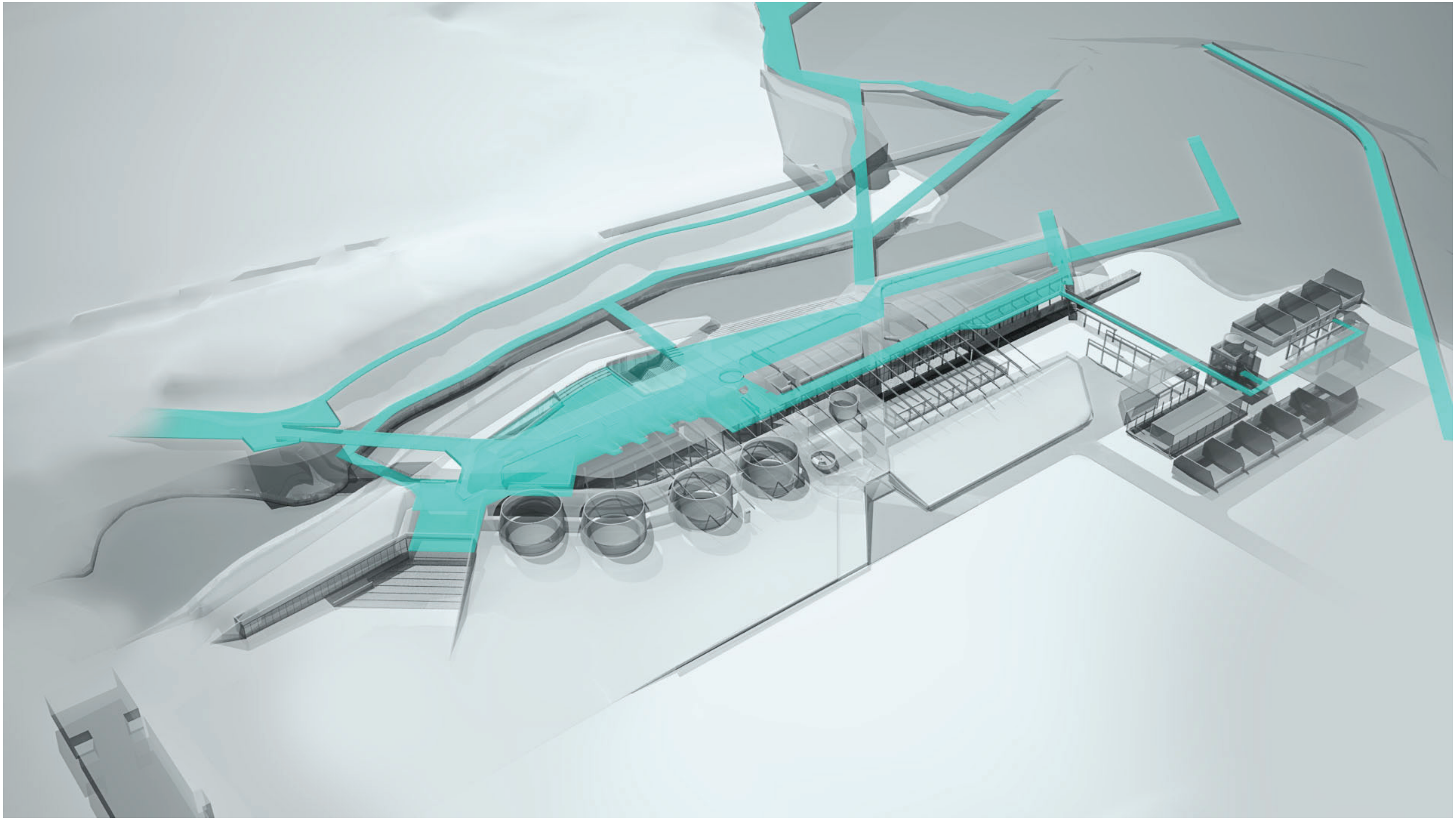
1 - SOCIAL LANDSCAPE
2 - ECOLOGICAL LANDSCAPE
3 - HISTORICAL LANDSCAPE
4 - PRODUCTIVE LANDSCAPE
5 - SYNTHETIC LANDSCAPE

6.1.1 SOCIAL LANDSCAPE

The social landscape is defined as all the spaces which host human components, including people participating in either recreational, educational or professional activities.

Social exchanges - the social landscape allows opportunities for social interaction to thrive.
Heritage exchanges - the industrial heritage exchanges memory and knowledge of the past to the people who perceive it.
Biophysical exchanges - people are immersed in nature and its processes, experiencing the positive psychological effects known as biophilia.
Programmatic exchanges - the opportunities for social exchanges with the building and the surrounding community are the key drivers for maintaining the site as a public amenity.
Tectonic exchanges - the social landscape is complemented by the haptic and environmental qualities of space expressed through materiality and tectonics.

fig 6.2 The social landscape, Illustration by Author (2013)



1

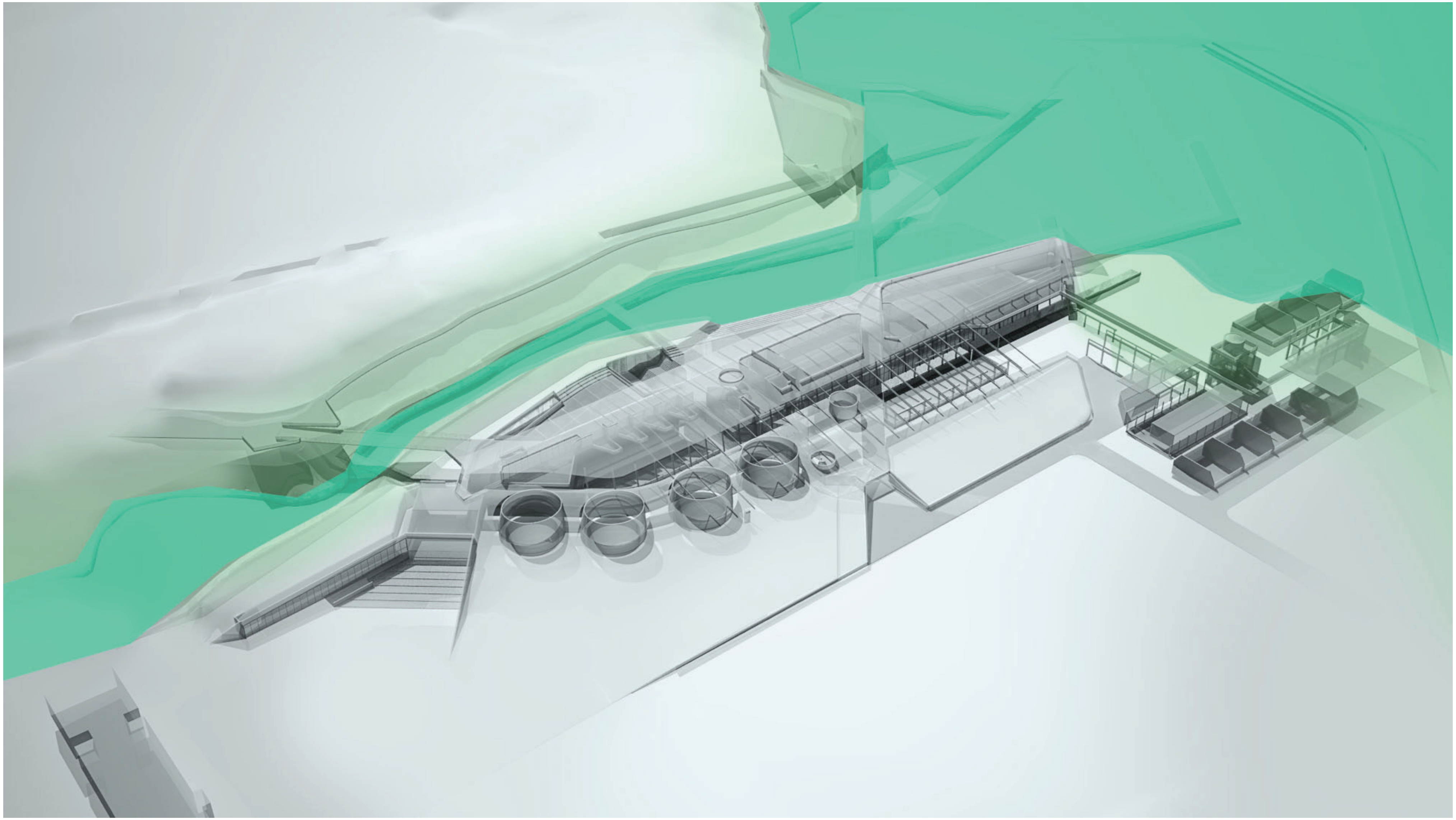
SOCIAL LANDSCAPE

6.1.2 ECOLOGICAL LANDSCAPE

The ecological landscape, which includes people, hosts all other forms of life and natural processes to allow them to become integrated with architectural space.

Biophysical exchanges - the ecological landscape consists of all biophysical conditions on which its health is entirely dependent.
Social exchanges - people, when aware of the environment and its importance, will instil a culture of stewardship over the earth's ecology.
Heritage exchanges - the natural landscape and its ecological condition has been greatly impacted by the industrial processes. The landform, having been manufactured by the excavations, contains memory of the heritage. The industrial forms of the landscape now host new life.
Programmatic exchanges - recreational activity is fuelled by the presence of nature and is a valuable exchange for the site's new purpose.
Tectonic exchanges - the ecological landscape is integrated into the new tectonics, promoting the increased habitation of species and biodiversity.

fig 6.3 The ecological landscape, Illustration by Author (2013)



2

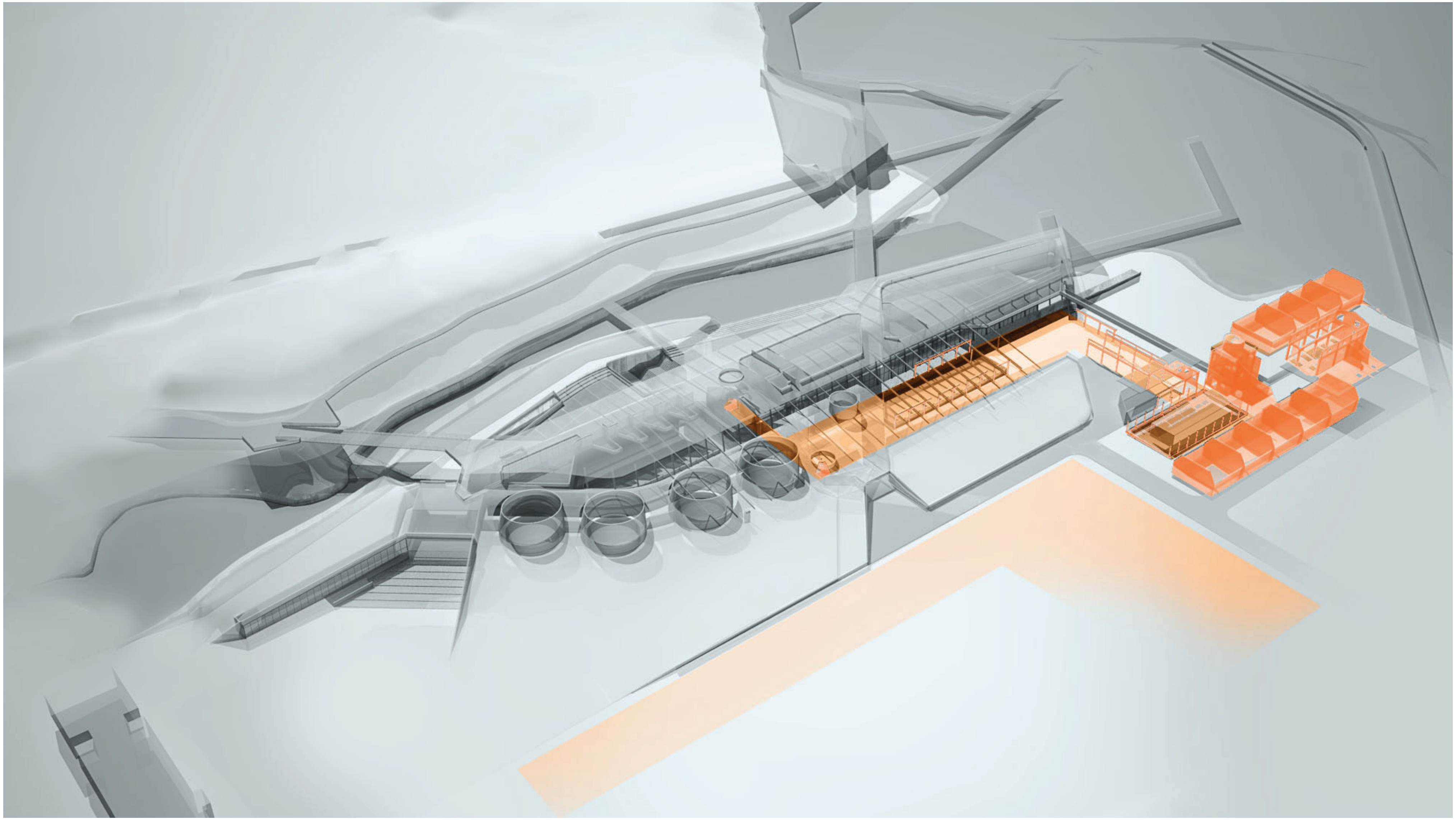
ECOLOGICAL LANDSCAPE

6.1.3 HISTORICAL LANDSCAPE

The historical landscape hosts all the remnants and memories of the past industrial processes and their consequences, ranging from the ruined structures to the landforms.

Heritage exchanges - the historical landscape itself is dependent on the conservation of the remnants of the industrial processes.
Social exchanges - social awareness of the historical landscape ensures its conservation and maintains its value.
Biophysical exchanges - the quality of the biophysical effects is evident in the ruined structures. Exchanges of time and nature and the resultant patina are allowed to continue.
Programmatic exchanges - the adaptive reuse of the remaining historical structures with new productive exchanges allows them to gain a new life and a continued existence as resource-rich industrial artefacts.
Tectonic exchanges - the extant fabric of the heritage is conserved and reused.

fig 64 The historical landscape, Illustration by Author (2013)



3

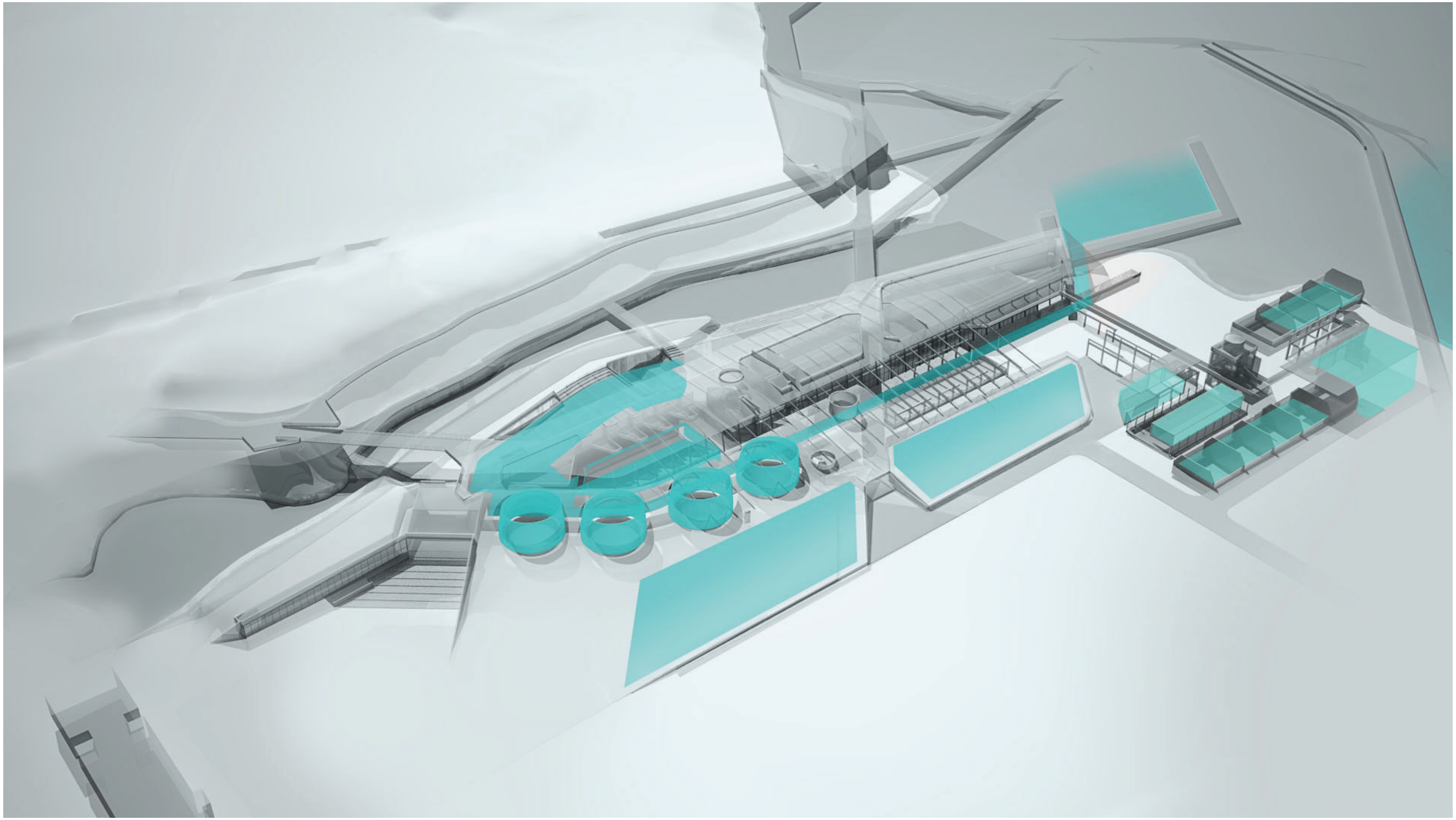
HISTORICAL LANDSCAPE

6.1.4 PRODUCTIVE LANDSCAPE

The productive landscape is the lifeblood of the new building. The various processes integrated into one another, like organs in a body, generate forms and spaces, but also drive processes as part of the building's systems.

Programmatic exchanges - the productive landscape needs to be efficient in itself and be integrated extensively with the other programmes.
Social exchanges - exchanges between people and resources are the primary narrative of the building. Social and productive spaces are shared and intersected.
Heritage exchanges - the presence of extant industrial fabric allows for cost-effective reuse and opportunities for new aquacultural processes.
Biophysical exchanges - the biophysical elements play a critical role in providing the climatic conditions for effective natural resource production by exchanging its biophysical energies with fish, algae, plants and silkworms.
Tectonic exchanges - the productive landscape, while commemorating the industrial heritage tectonically, must in itself be robust and low maintenance.

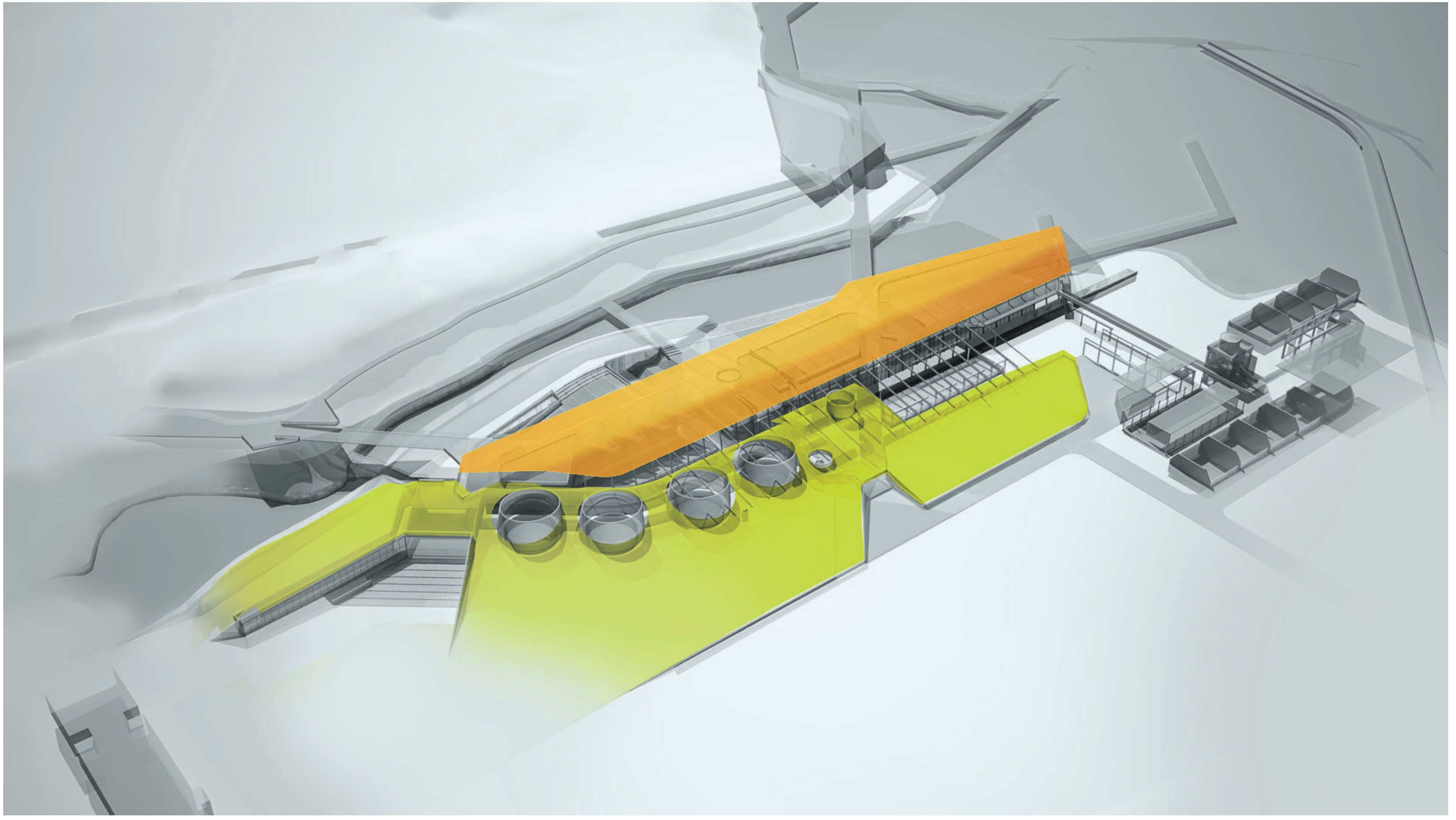
fig 65 The productive landscape, Illustration by Author (2013)



4

PRODUCTIVE LANDSCAPE

fig 6.6 The synthetic landscape, Illustration by Author (2013)



5

SYNTHETIC LANDSCAPE

6.2 AESTHETIC CASE STUDY

YOKOHAMA INTERNATIONAL PORT TERMINAL

BY FOREIGN OFFICE ARCHITECTS

The Yokohama International Port Terminal, designed by Foreign Office Architects, creates a public waterfront along a continuous structure as an extension of the urban ground plane. It extends from two urban parks and transitions from land to sea. The building seems to be a hybrid of building and landscape, where a single surface is articulated and morphed to fit around the circulation patterns and programme. "[T]he Port Terminal is intentionally low-profile, deferring to the floating hotels; from a distance it resembles an earthwork more than a building" (Webb, 2003:35). The building is "constructed as a systematic transformation of the lines of the circulation diagram into a folded and bifurcated surface. These folds produce covered surfaces where the different parts of the program can be hosted" (Arcspace, 2007). The terminal is designed as an extension of the pier ground, simultaneously hosting the terminal functions" (Archello, 2011), and the upper public/civic level of the terminal is designed as an urban park.

fig 6.7 Yokohama international terminal, Foreign Office Architects (FOA, nd)

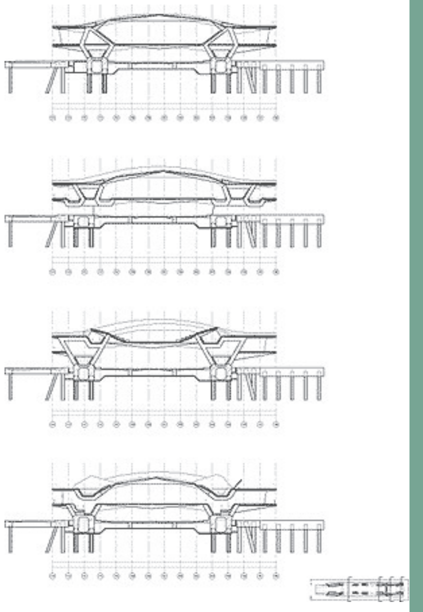


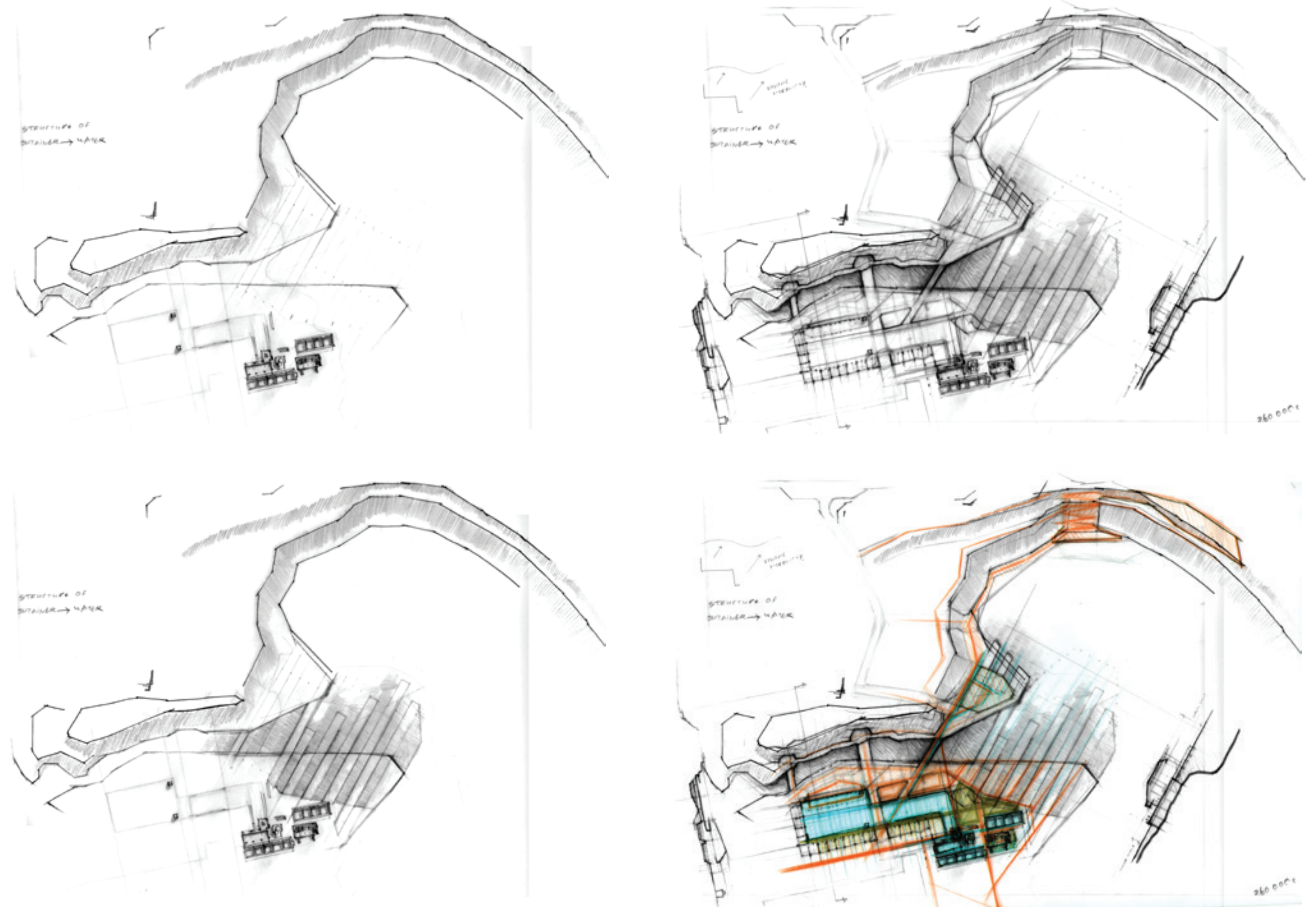
fig 6.8 Yokohama international terminal section Foreign Office Architects (FOA, nd)

6.2 DESIGN ITERATIONS

The design process saw various iterations, with many instances of rediscovery and interpretation of the design informants and conceptual drivers. Throughout the development of this dissertation, the first conceptual iterations provided a foundation for the various programmatic iterations, with the final iterations being concerned with form. The following is a brief overview of the development of the main iterations throughout the year:

FIRST CONCEPTUAL DESIGN SKETCHES (MARCH)

The first design ideas visualised the construction of the permanent wetland as a social and ecological interface, extending onto the edge of the water body. The new aquaculture production processes were conceptualised and applied in relation to the existing industrial heritage footprint and the historic flow of the production processes. This iteration was still very diagrammatic and divorced from an appropriate sense of scale.



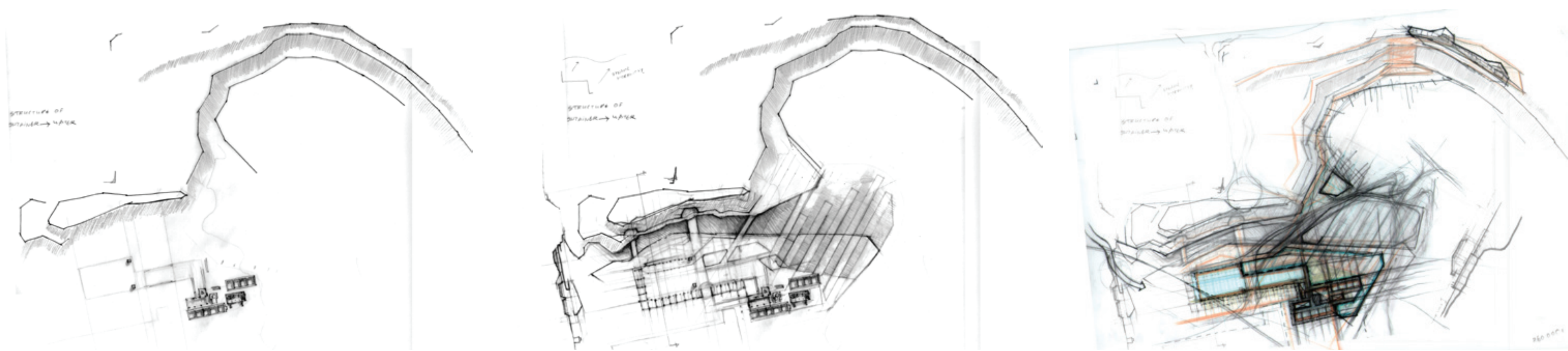
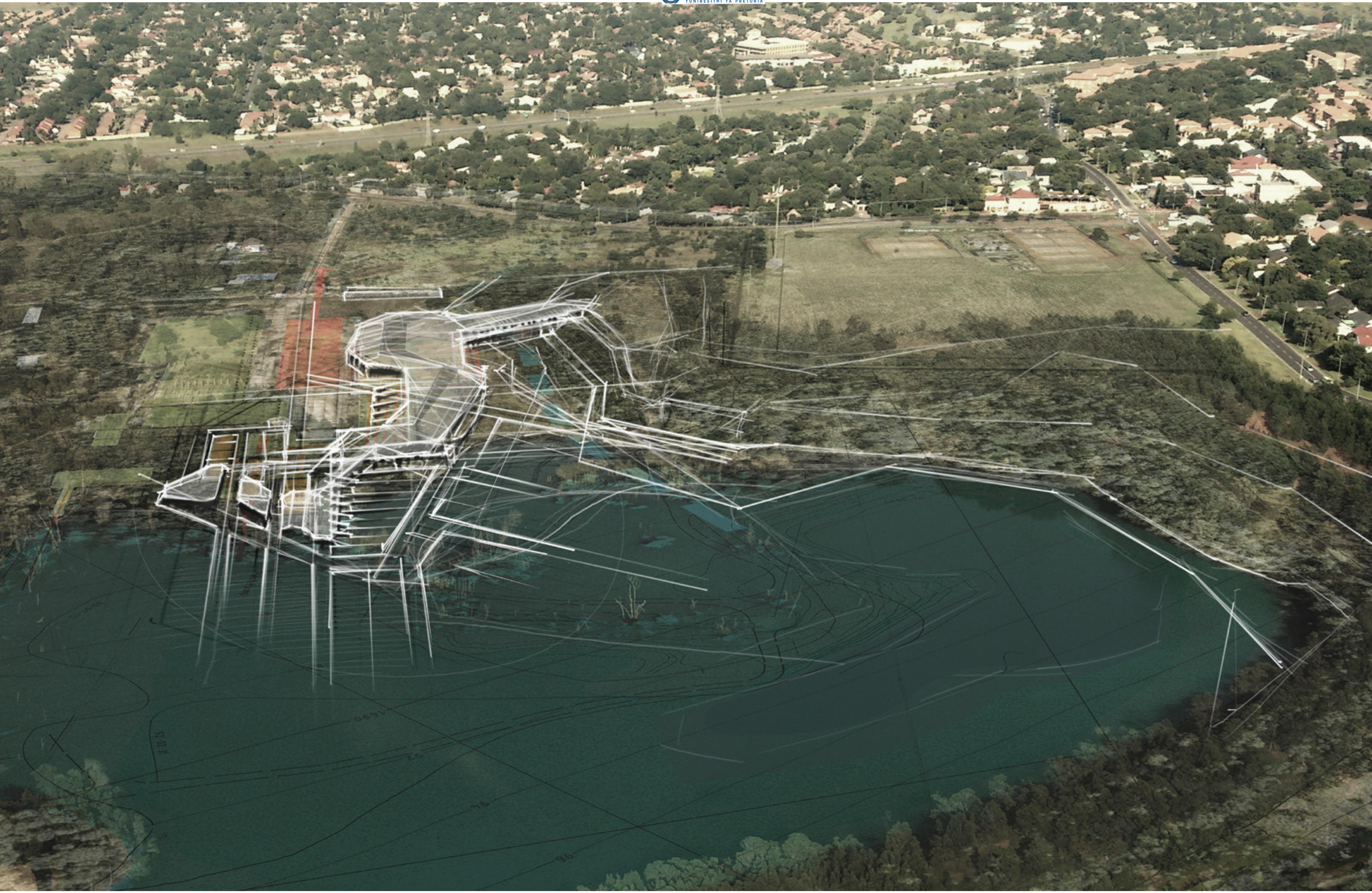


fig 6.9 First concept design sketches, Illustrations by Author (2013)



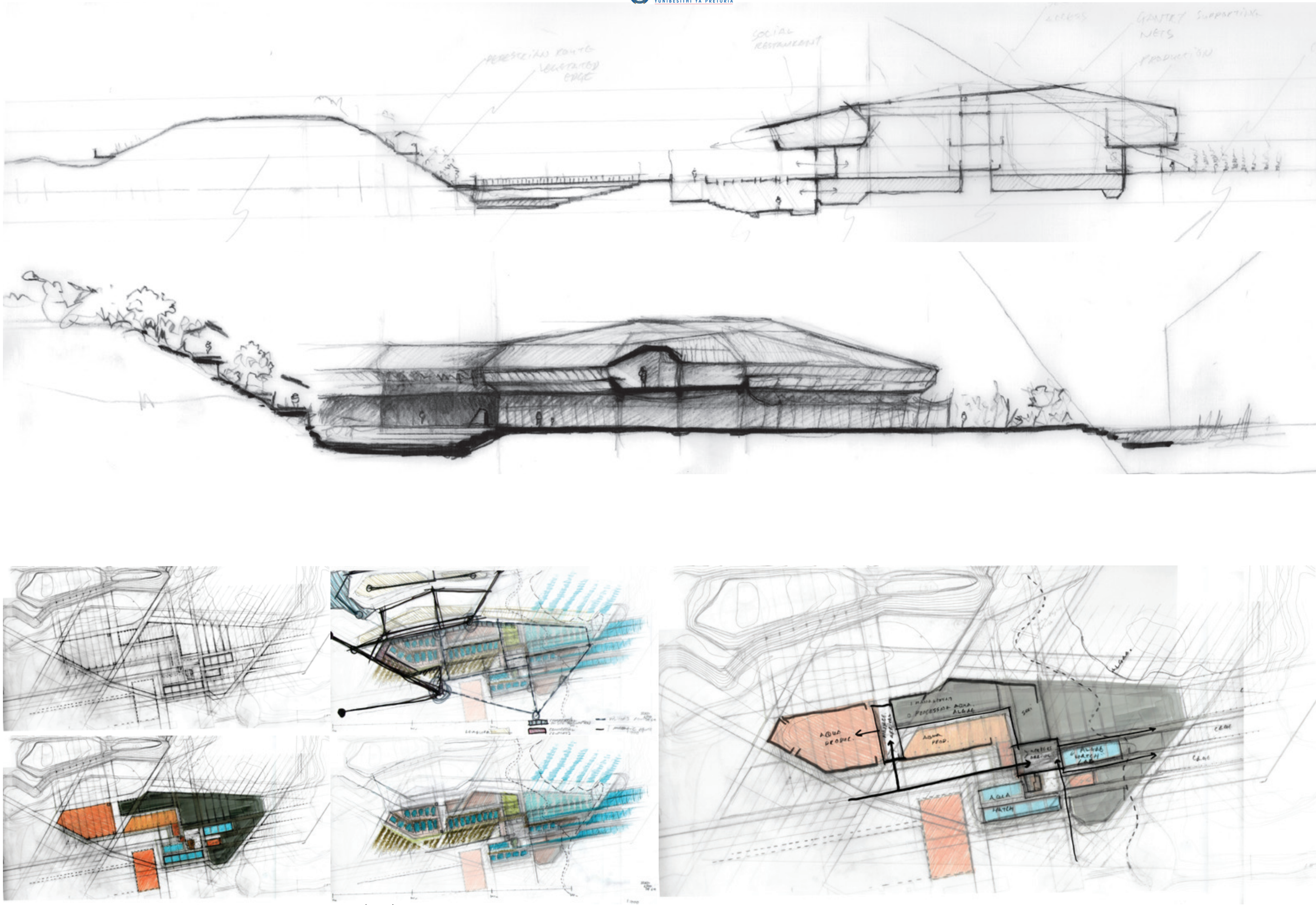
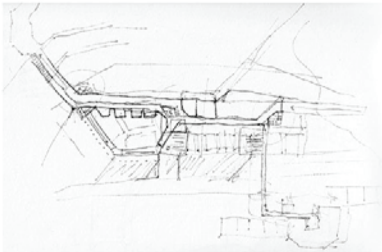
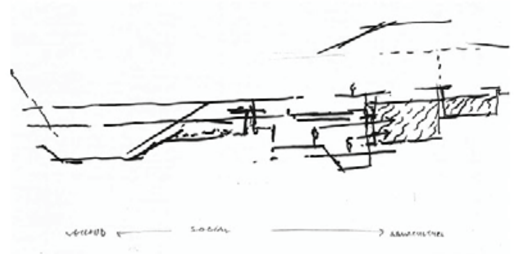
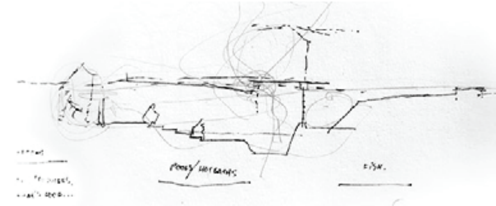
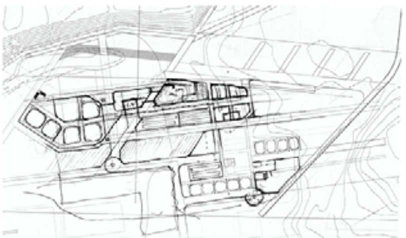


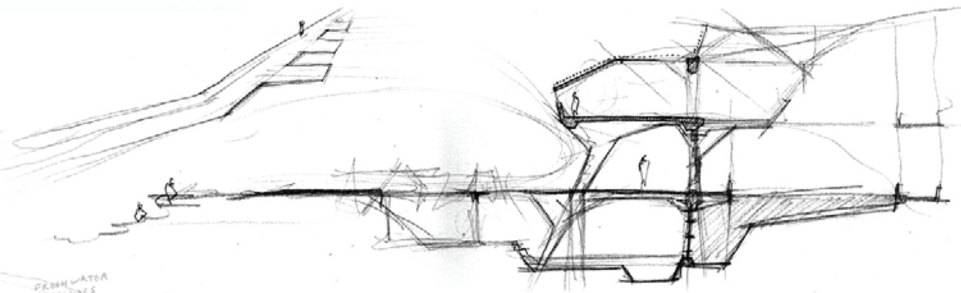
fig 6.11 Design development sketches, Illustrations by Author (2013)

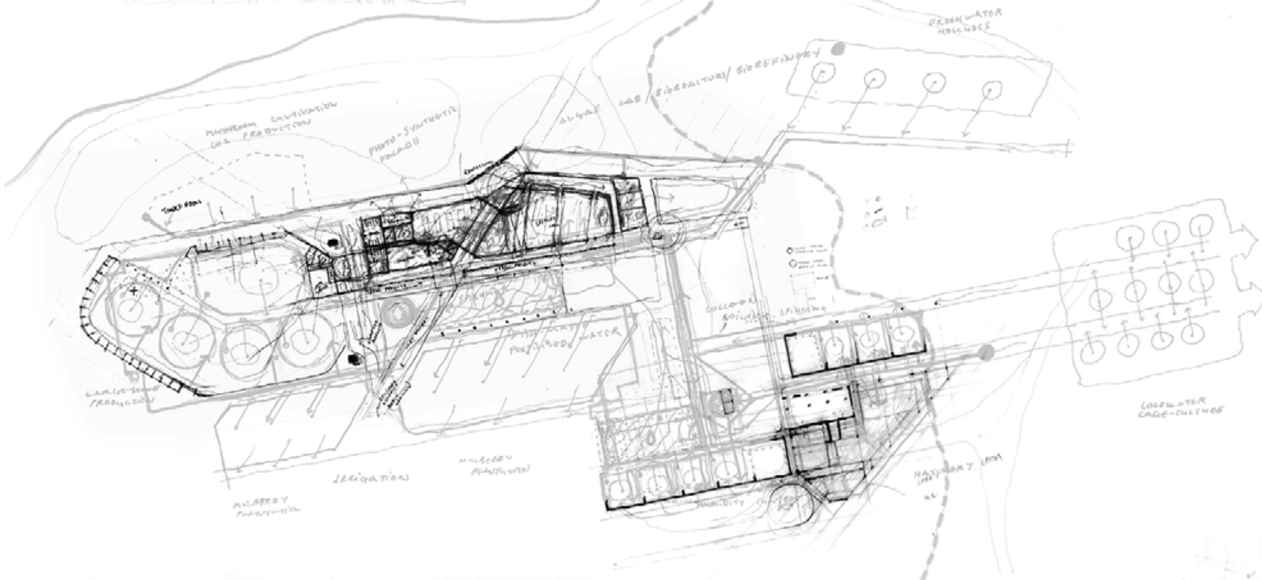


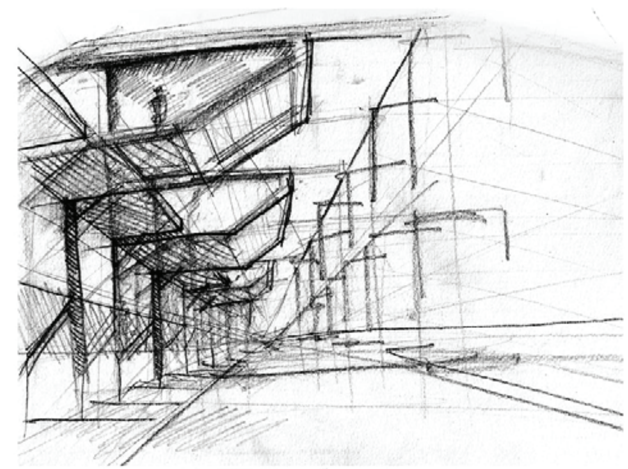


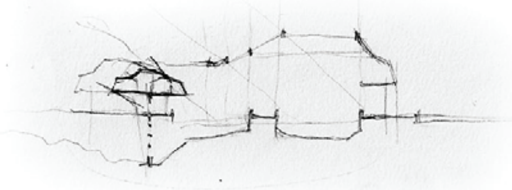


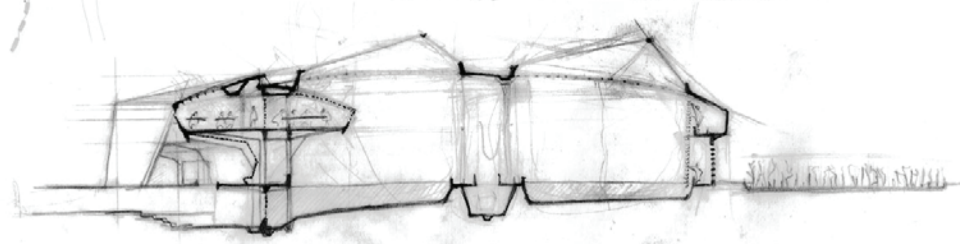












FIRST CONCEPTUAL MODEL (APRIL)

An architectural form and language was being developed and generated in response to the site and the theoretical informants. The formulation of the synthetic landscape as building and roof surface began to emerge. The junction between the intervention as a heritage response and the new structure in response to the landscape was not yet solved effectively. The interpretation of the exchanges between heritage, tectonics and landscape needed to be refined. While still relatively diagrammatic, this iteration indicated a response to the industrial heritage which did not yet seem appropriate for the conservation of its values.

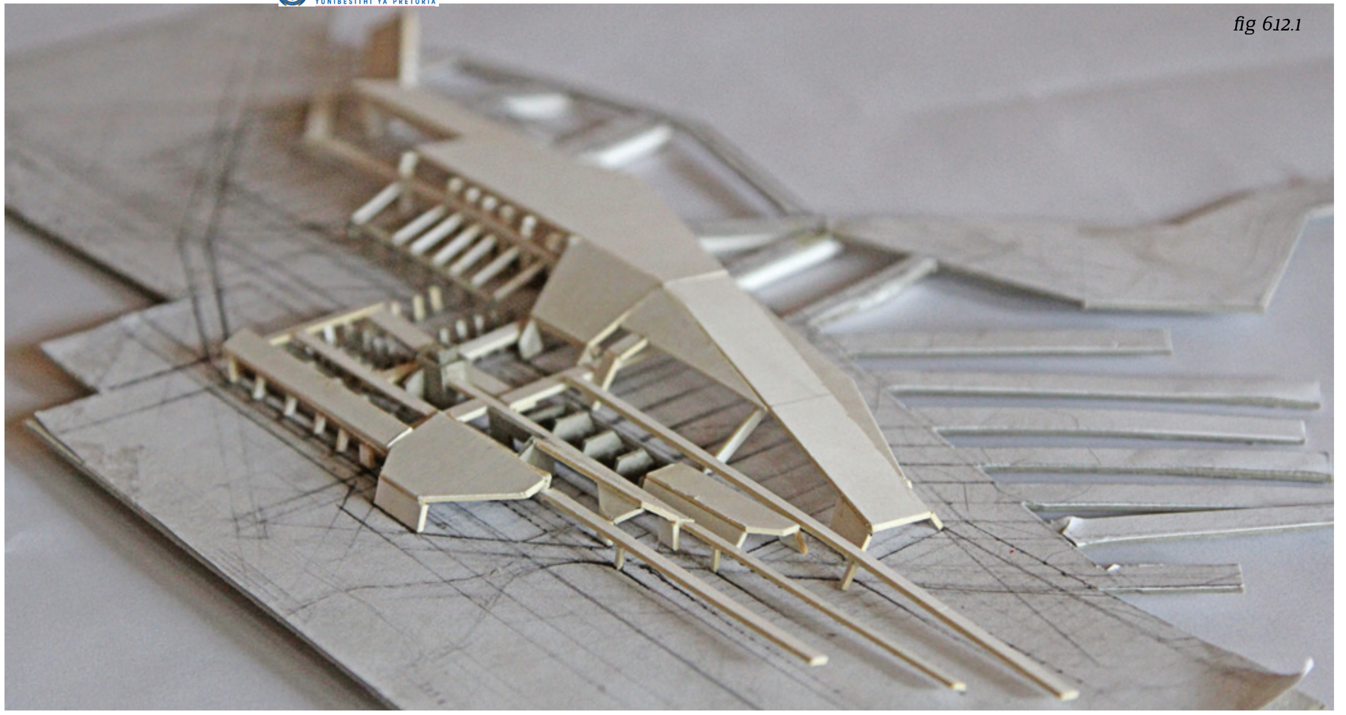


fig 6.12.1

fig 6.12.1-6.123 Conceptual model by Author (2013)

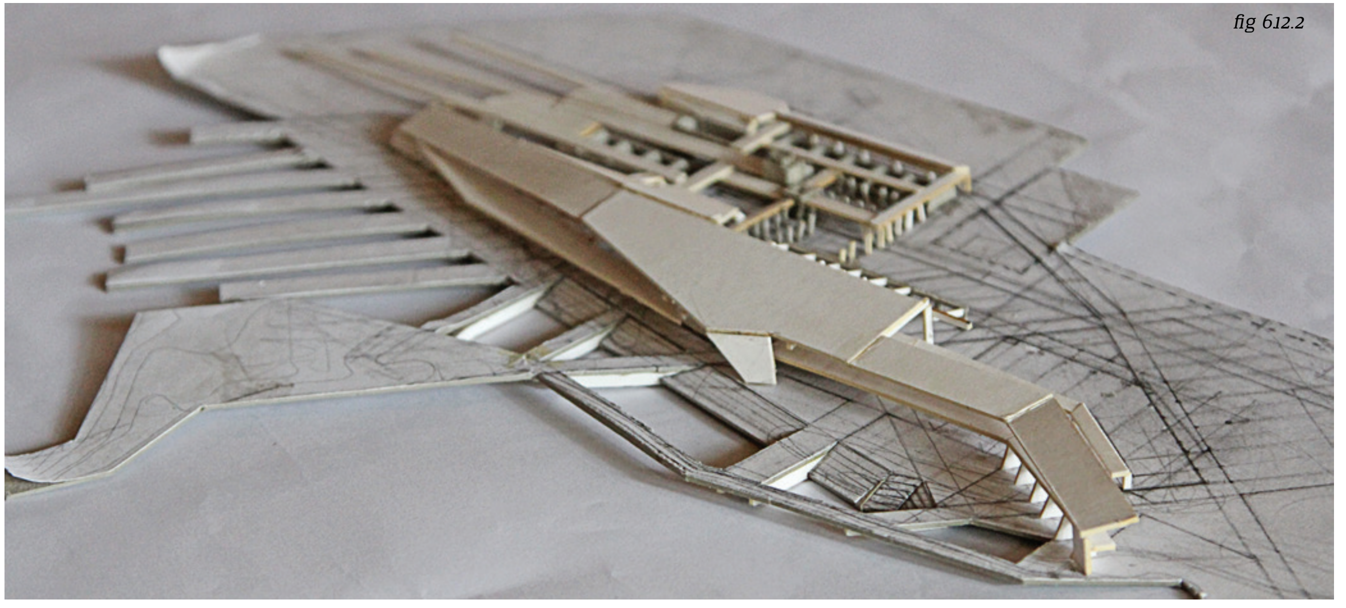
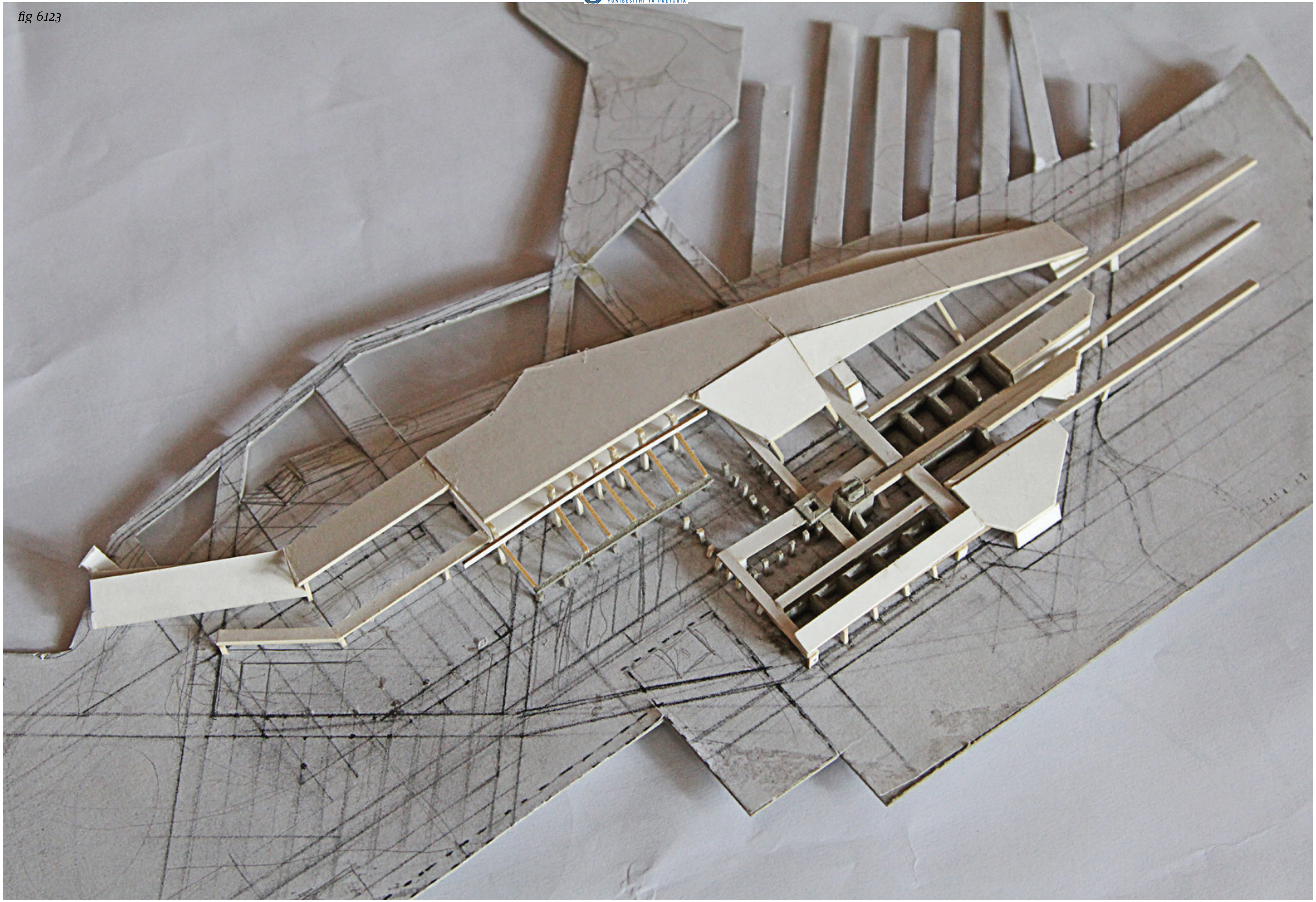


fig 6.12.2

fig 6123



AUGUST DESIGN CRIT

This iteration displayed many formal refinements and detailed planning resolutions. The establishment of the sericulture and hatchery programmes as part of the productive reuse was done with sensitivity toward the industrial heritage. A social spine in the form of a footbridge was drawn from the berm to intersect with the new production facilities. A restaurant was also located here to allow for exchanges between social and productive areas. Another social and productive exchange in the form of an aquarium was introduced below ground level. This iteration was not yet successful at achieving the desired ecological/natural exchanges with the productive and social landscapes.

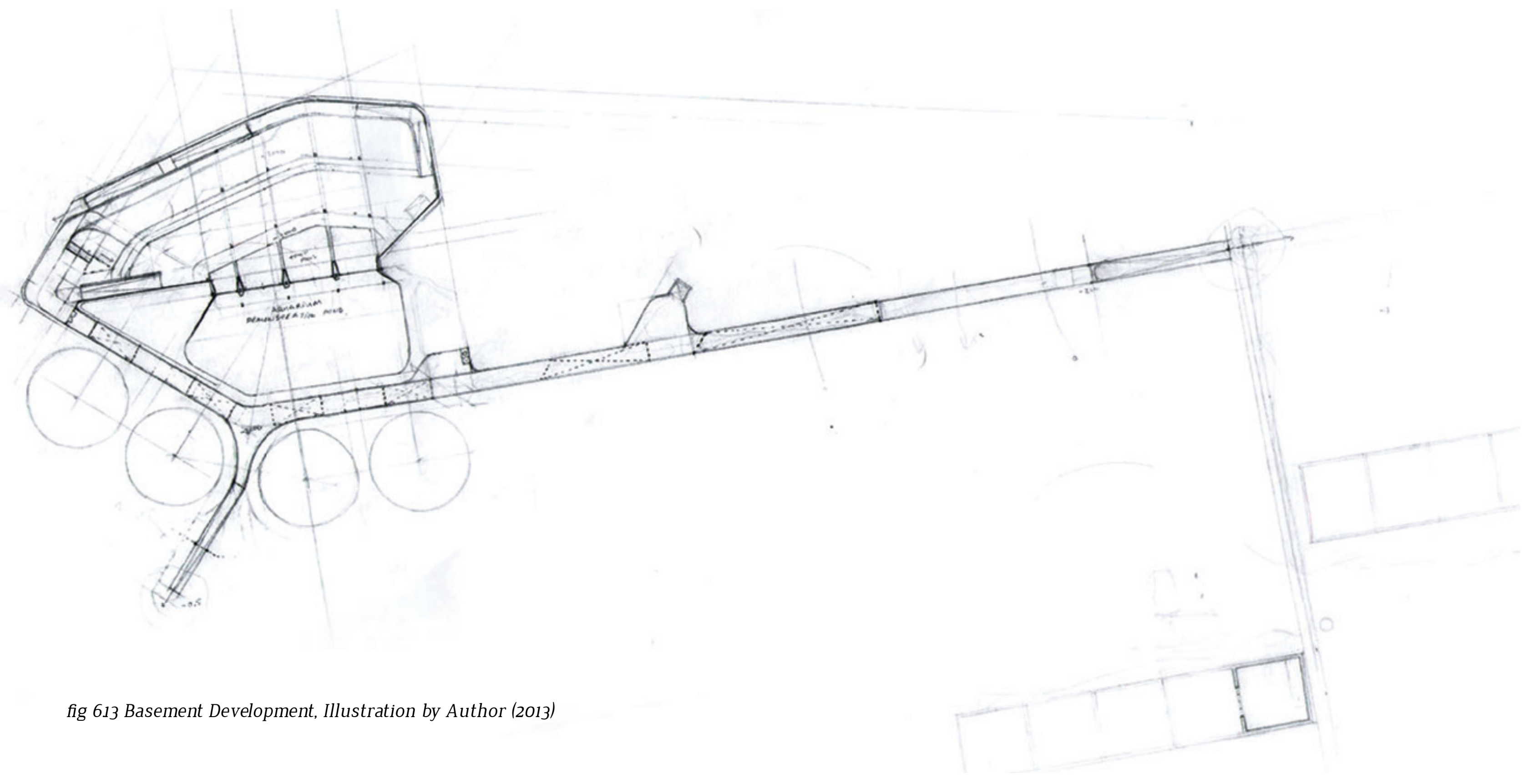


fig 613 Basement Development, Illustration by Author (2013)

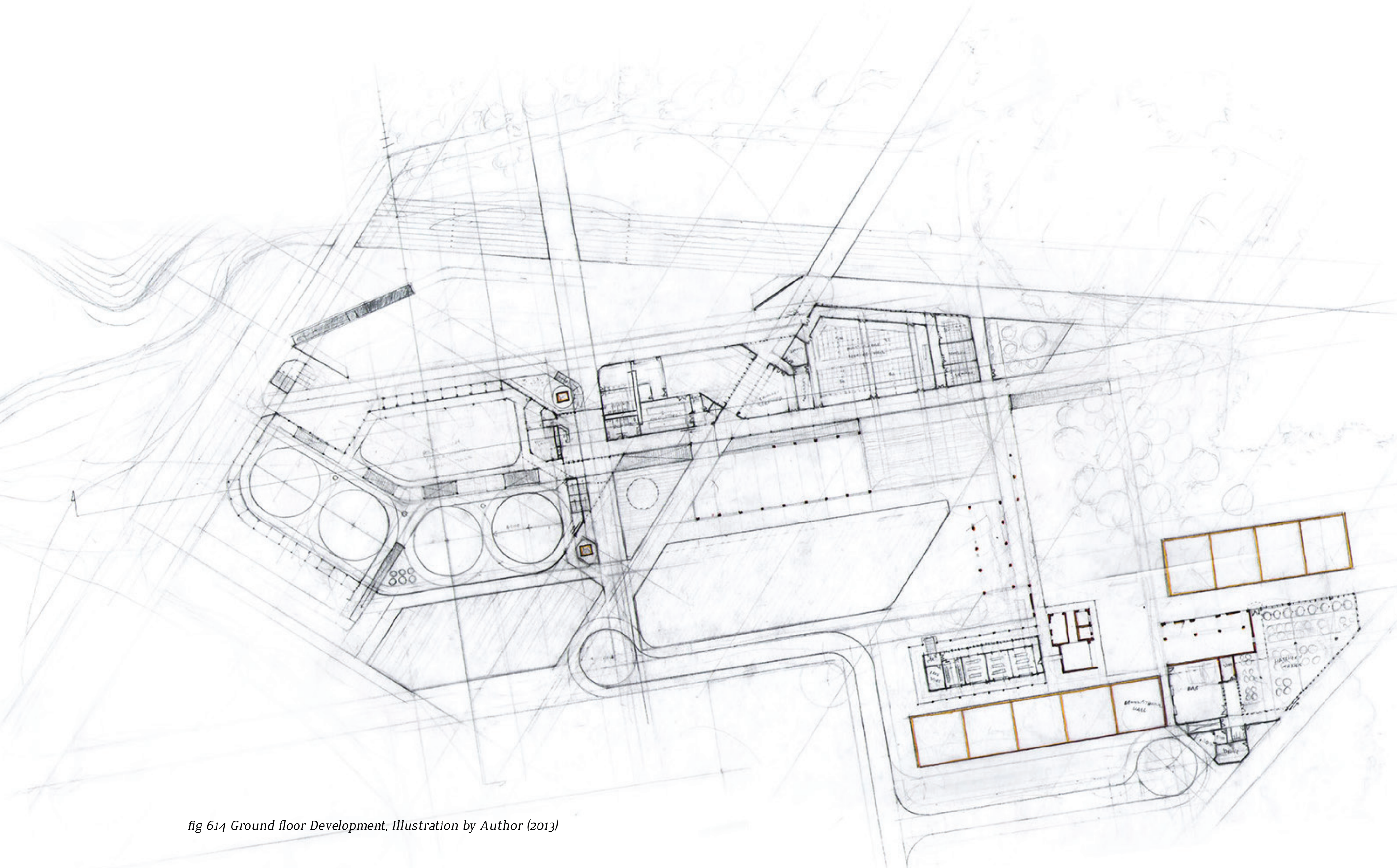


fig 614 Ground floor Development, Illustration by Author (2013)

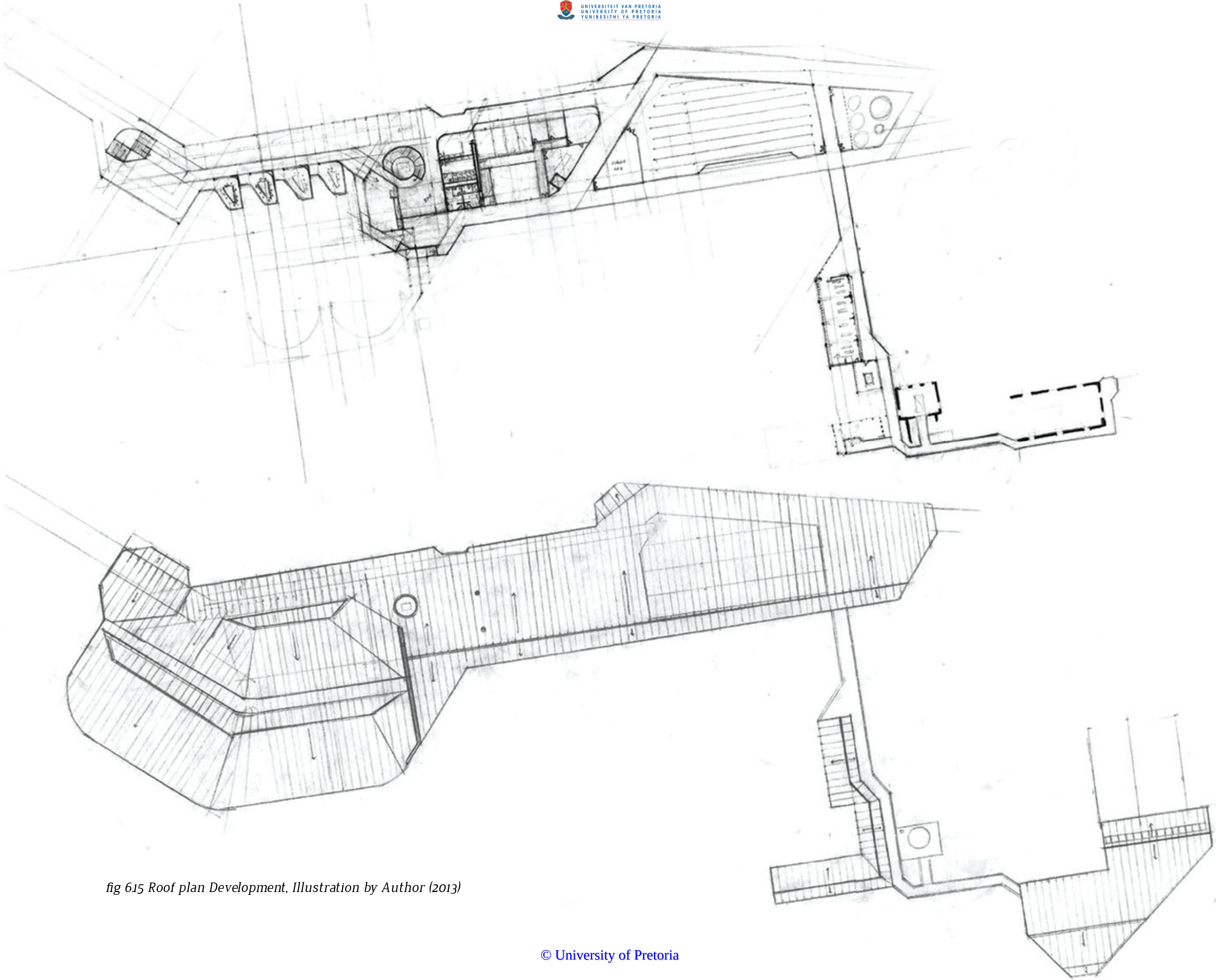


fig 6.15 Roof plan Development, Illustration by Author (2013)

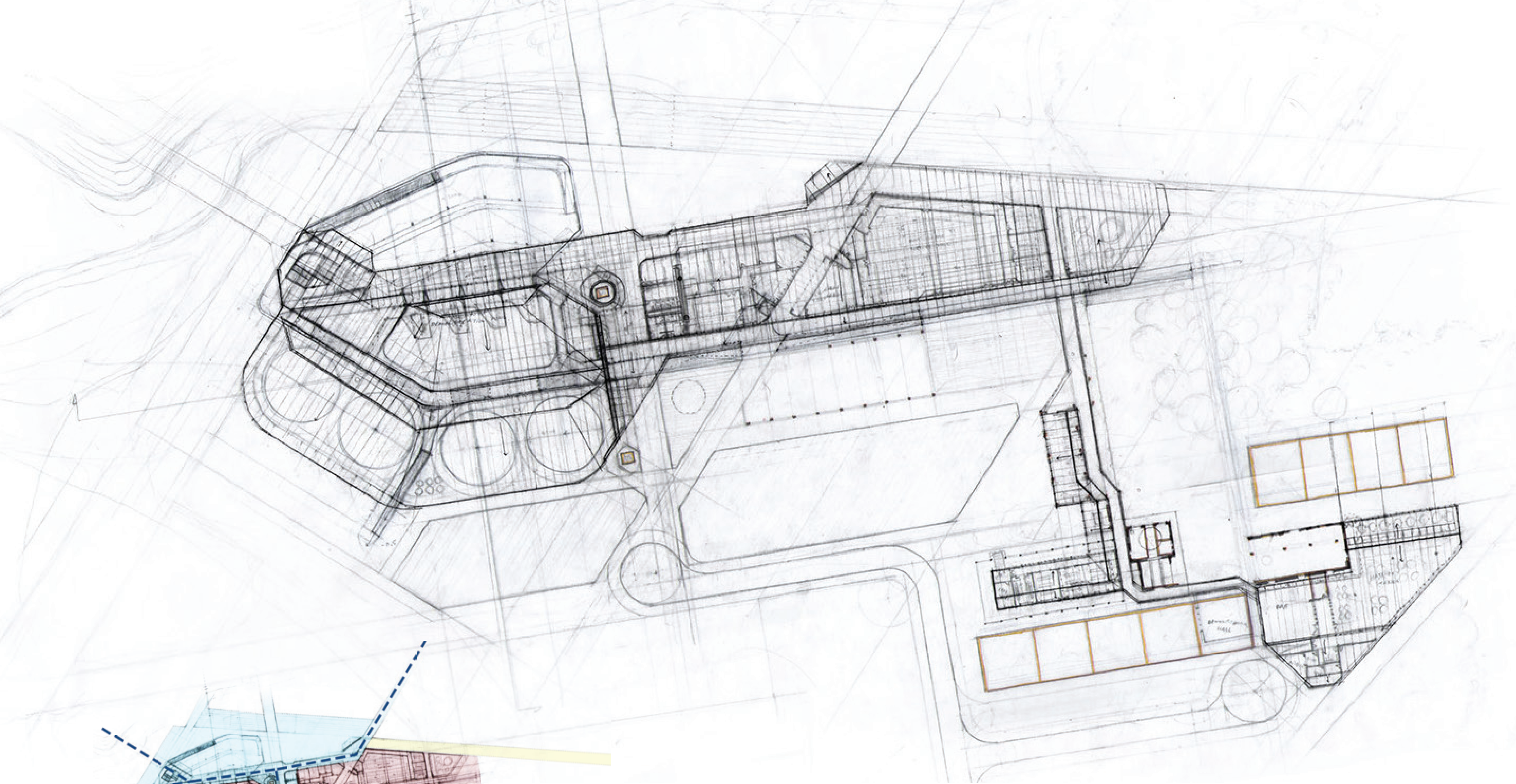


fig 617 layered plans, Illustration by Author (2013)

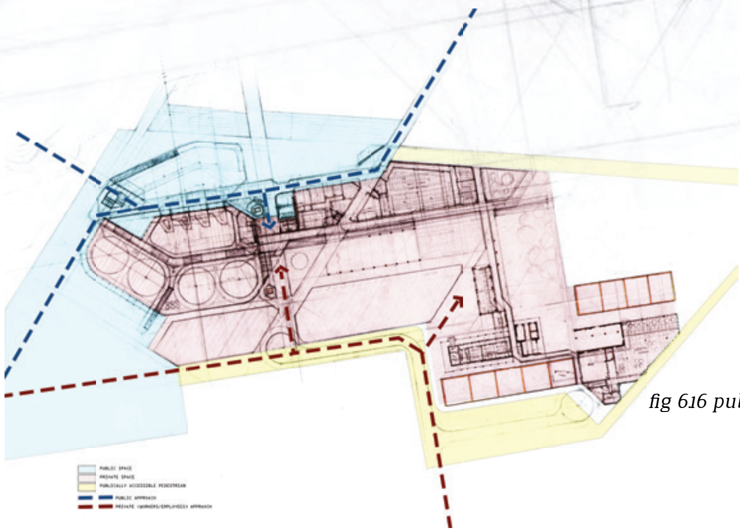


fig 616 public vs private, Illustration by Author (2013)

FINAL DESIGN ITERATION (OCTOBER)

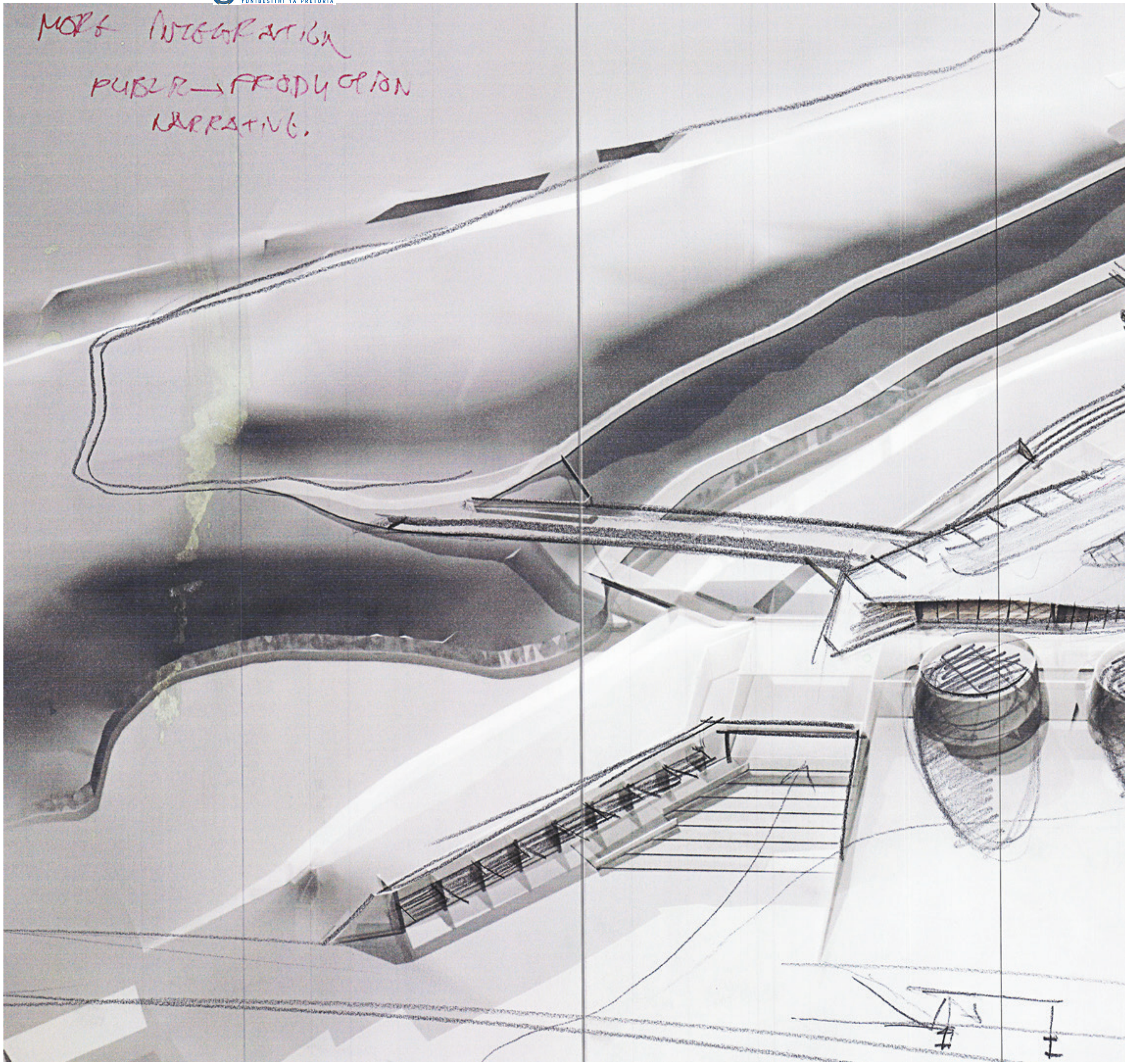
The final design iteration completed the concept of the synthetic landscape as a means to blend the new structure into the landscape and dissolving it into the industrial heritage. Productive aquaculture ponds encapsulated within climatically controlled cylinders penetrate through the landscape hosting the mulberry fields. This iteration allowed for the productive exchanges between the tectonics, landscape and heritage, and deeper exchanges between the social and ecological landscapes. The final design solution is described in full in the next section.

6.4 DESIGN RESOLUTION

The project was planned to be implemented in two distinct phases:

PHASE 1

Constructed wetland - as part of the site's storm water management, the current overflow and temporary wetland is transformed into a permanent constructed wetland in conjunction with rainwater run-off channels to prevent the further contamination of the water body. It simultaneously stabilises the water level and functions as an ecological support system, planted with indigenous wetland species to attract birds and other organisms to fulfil the need for biodiversity. The wetland, once established, holds many social opportunities for recreation and immersion in nature. As a social and ecological system it becomes the foundation for the co-evolution of human public space and nature, and leads towards the edge of the large water body as a waterfront, which can be utilised for further casual recreation such has fishing, swimming, scuba diving and canoeing, all of which are supported by the boathouse, and connected to the landscape and its recreational routes. This will prepare the site for social integration and its purpose as a productive park, where people may enjoy the presence of nature and become aware of the industrial heritage.



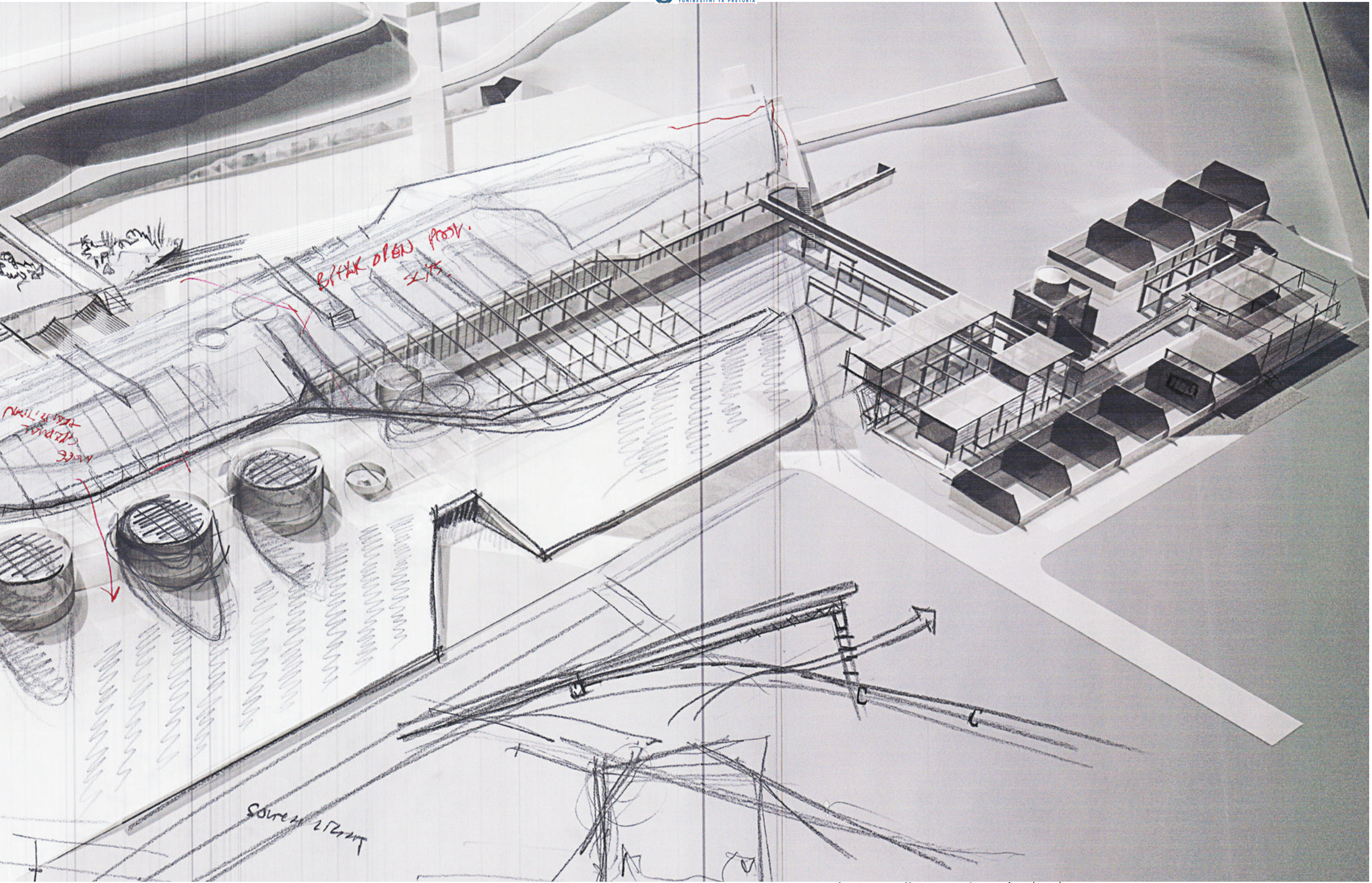


fig 618 final iteration, Illustration by Author (2013)

Hatchery + Nursery - the first productive phase would be the adaptive reuse of the remnants of the industrial heritage by the establishment of the hatchery and nursery. These would facilitate the production of fish fry, silkworm eggs, aquatic species such as fresh water mollusks, and algae as feedstock. The new structural intervention of weathering steel and timber contrasts with the old brick and concrete structures by sitting lightly above and touching them minimally. It can be disassembled. The interiors of the concrete clay stores are prepared to facilitate water services for fish production. One of the clay stores is preserved in its current post-industrial state in a notion to retain the qualities of the entropic space and as a reminder that these stores had a previous life. Another clay store is adapted for use as a demonstration workshop with views through the concrete wall into one of the production tanks used as an aquarium. The sericulture rearing house stands on stilts above an extant sunken foundation covered with clay and overgrown by Black Wattles, which is partially used as a rainwater retention pond. The water surrounding the stilts prevents ants from crawling up to the silkworm rearing beds, and the surrounding trees ensure the shading requirements for the sericulture program. The silk filature adjacent to the rearing house extends out of the vegetated area and reveals the new structure from the Black Wattle 'forest'.

All of the above initiate the support infrastructure for the regional production of distributed and integrated aquaculture, while addressing the immediate concern of the conservation of the site's industrial heritage through its adaptive reuse. Simultaneously, freshwater mussels will be introduced into the main water body to serve as biofilters to initiate a process of maintaining water quality. Silk is already being produced as a high-value product.

PHASE 2

The second phase of the project is implemented once the hatchery and nursery have proved to be a successful economic venture. Capital gains from the current venture, in addition to external investments and subsidies, will be invested into the development of larger production facilities to complement the additional public social programmes and exchanges. The fresh water mussel shells, harvested and collected during the operation of the first phase, are processed to be used in the construction of the new structure. Remaining bricks scattered on the site are also utilised for surfaces and paving at the thresholds of where the old industry used to be, to serve as a reminder of their contribution to the new life of the site. Portions of extant concrete slabs are recycled as aggregate for new concrete structures.

New social and productive development on disturbed areas - operating parallel to public recreation areas is the network for integrated resource production. The most disturbed area, the footprint of the old kiln oven structure which hosts nothing but badly disintegrated concrete slabs and some wild grasses, weeds and bushes, is chosen to accommodate this new phase. It is utilised to host the main aquaculture production facility. This structure helps to frame the public wetland space in conjunction with the berm and is similar in scale. Formalised space for a local farmer's market is provided as the central core of the site's urban vision next to the park's proposed information centre. This public space extends through the 'synthetic landscape' into a 'biophilically' enhanced public space, which complements the constructed wetland as a socially and ecologically integrated environment. It also hosts a public amphitheatre which slopes down toward the aquarium (revealing the productive processes inside to the public) and below the water surface of the aquaculture hall. The aquarium also hosts touch pools which people can interact with by feeling the sensation of macro algae as it purifies the water. Tiny 'doctor-fish' are in a separate touch pool which serves as a foot spa in which they nibble on your feet, and another pool may contain bioluminescent algae which light up when they are disturbed. The aquarium space lies adjacent to the mushroom cultivation rooms which benefit from the high humidity and dark, cave-like conditions. Bioluminescent fungi are grown on the concrete structure in the social aquarium space.

Responses to the heritage are contrasted, framed and placed among the ruins, giving the tectonic language priority, whereas responses to the landform are grounded and merged with the landscape, giving the stereotomic language priority.

The synthetic landscape extending from the ruined concrete slabs provides public seating at its edge and hosts the inter-cropped mulberry fields, organised in such a way as to utilise the fertilised water from the aquaculture facility. As the public traverses this productive park, they are confronted - before them and at their feet - by the weight of industrial consequence. Old concrete foundations, retained as a public route for walking or sitting at the building's edge, reveals how the new synthetic landscape emerges from the industrial history. The northern edge provides shaded public seating. The two remaining brick monoliths are retained for their value as monuments to the memory of the old industry, and are framed by vertical circulation routes. They are suggestive of the beginnings and ends of new production and stand as symbols of a productive threshold. The substructure of the drying ovens is retained and framed as an external courtyard, north of which is a continuation of the new structure which on the ground floor houses processing facilities for the aquaculture programme, linked to a fish monger's shop facing the wetland, where people may purchase fish and other local produce.

Next to the processing facility are formal training and research facilities as well as an aquaculture culinary workshop, which supports the development, education and demonstration of integrated aquaculture technologies. Flexible and partitioned multi-purpose halls on the edge of the water body can be utilised by the community for events. Administrative facilities are located on the first floor above the processing facility, to manage the processes as well as to accommodate research professionals. Located on the first floor next to the administration area is a highly specialised algae laboratory linked to an algae photobioreactor plant integrated with the building and production water treatment services, which are in turn integrated with flat-panel photobioreactors on the roof. These extend along the social spine and cast algae-green tinted daylight to add a 'productive quality' to the social space.

The new structure complements the existing berm and is extended towards it with a vierendeel truss footbridge, serving as a pedestrian connection to the greater park and as access for the local community, delivering them to a restaurant which introduces them to the many aspects of the site's new social-ecological reorganisation. The public is presented with the site's enhanced ecology on the upper decks from where they may observe the increased biodiversity and bird life supported by the wetland. They are immersed in the production environment on platforms penetrating into the contained productive landscape as part of the restaurant. A view toward the Voortrekker Monument is provided from the westernmost decks and, looking east, the new structure frames the water body.

While public access and circulation are focused along the wetland through the synthetic landscape and over the bridge, private access for employees and professionals is located at the southern thresholds which provide direct access to the facilities.

The public may choose to continue on the route on the upper level which will further introduce them to exchanges between the ecological and productive processes. They may peer into the vast algae plant and are ultimately guided by means of a raised walkway over the ruins to become immersed in the conserved and serene post-industrial landscape, where exchanges between the historic fabric and the new productive facilities of the hatchery and sericulture rearing house and filature can be observed.

In conclusion, the formal architectural responses are determined by the varying landscapes. The synthetic landscape becomes the mediator between internal and external conditions and establishes a deep threshold, transitioning from the historic (more private) to new production and the ecological landscape (more public). The historical landscape, emerging from the south, facilitates the servant spaces where most of the professional and support programmes are housed in relation to the production facilities. The served spaces are all hosted along the northern edges at the thresholds to the ecological landscapes and the social landscapes, and follow the social spine across the production spaces and the routes throughout the site.

The public spaces range from open exterior spaces to semi-enclosed spaces, mostly exposed to environmental conditions, whereas the private spaces are contained and internalized under much more controlled internal conditions.

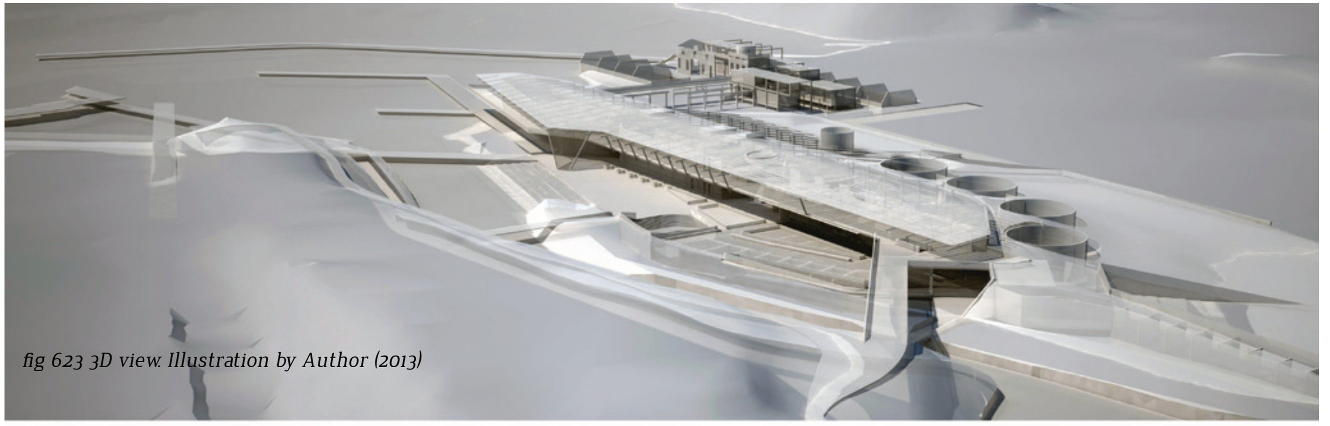


fig 623 3D view. Illustration by Author (2013)

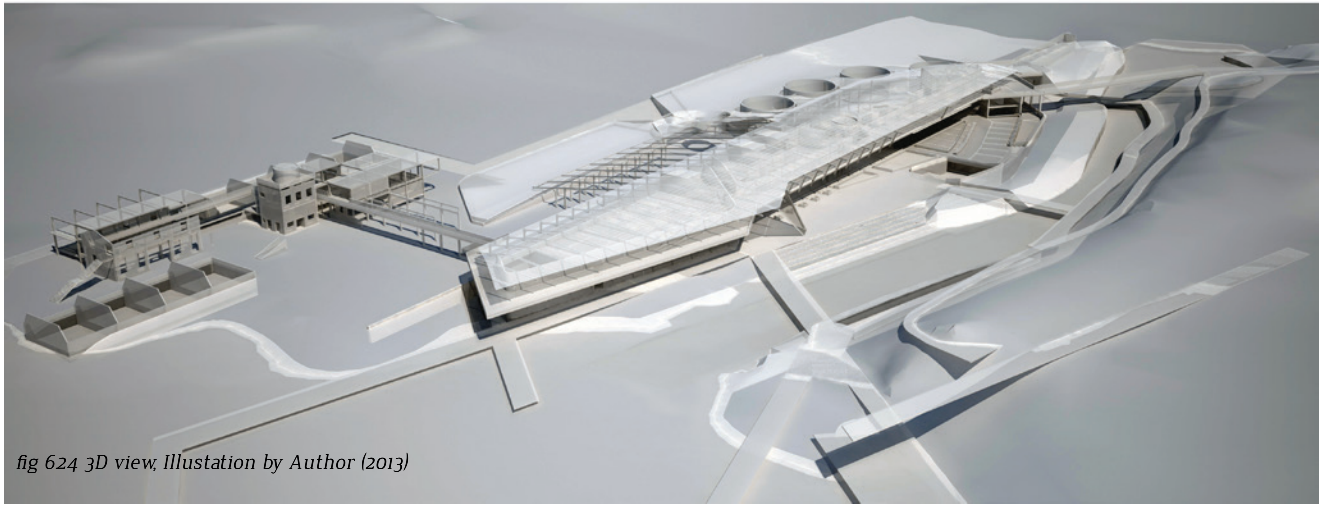


fig 624 3D view, Illustation by Author (2013)

fig 619 Ground floor plan, by Author (2013)

* NOT TO SCALE

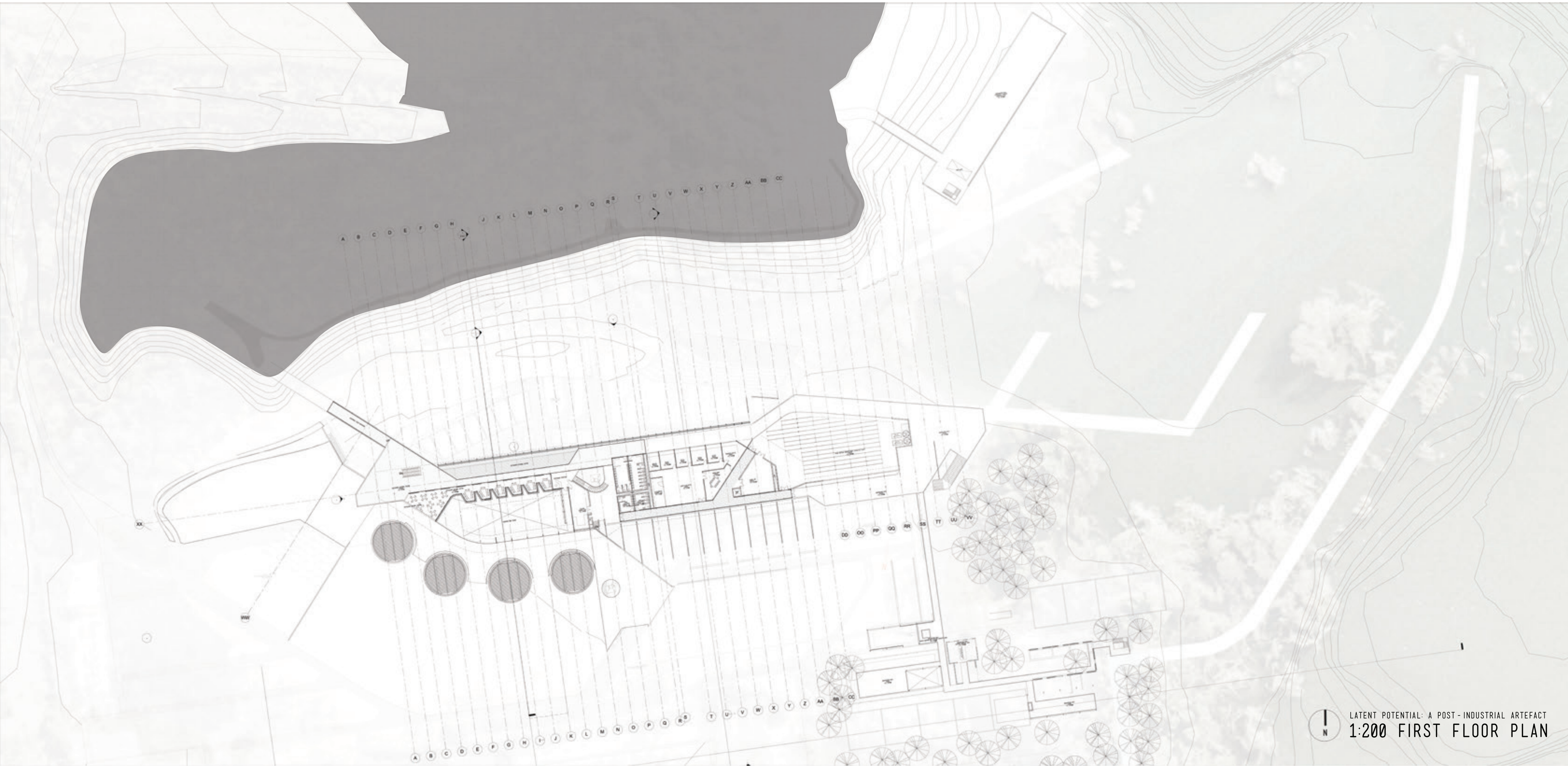


fig 620 First floor plan, by Author (2013)

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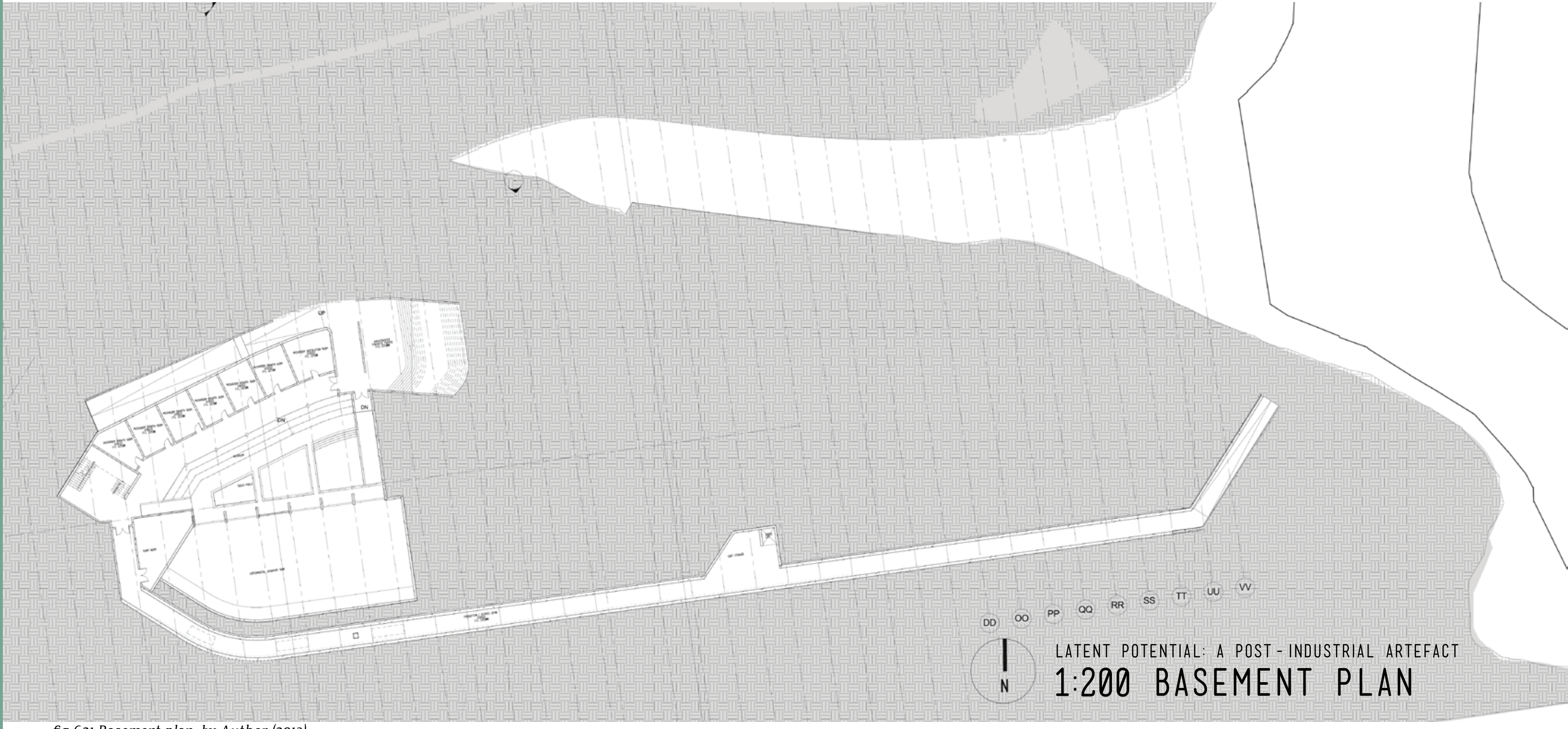

fig 621 Basement plan, by Author (2013)

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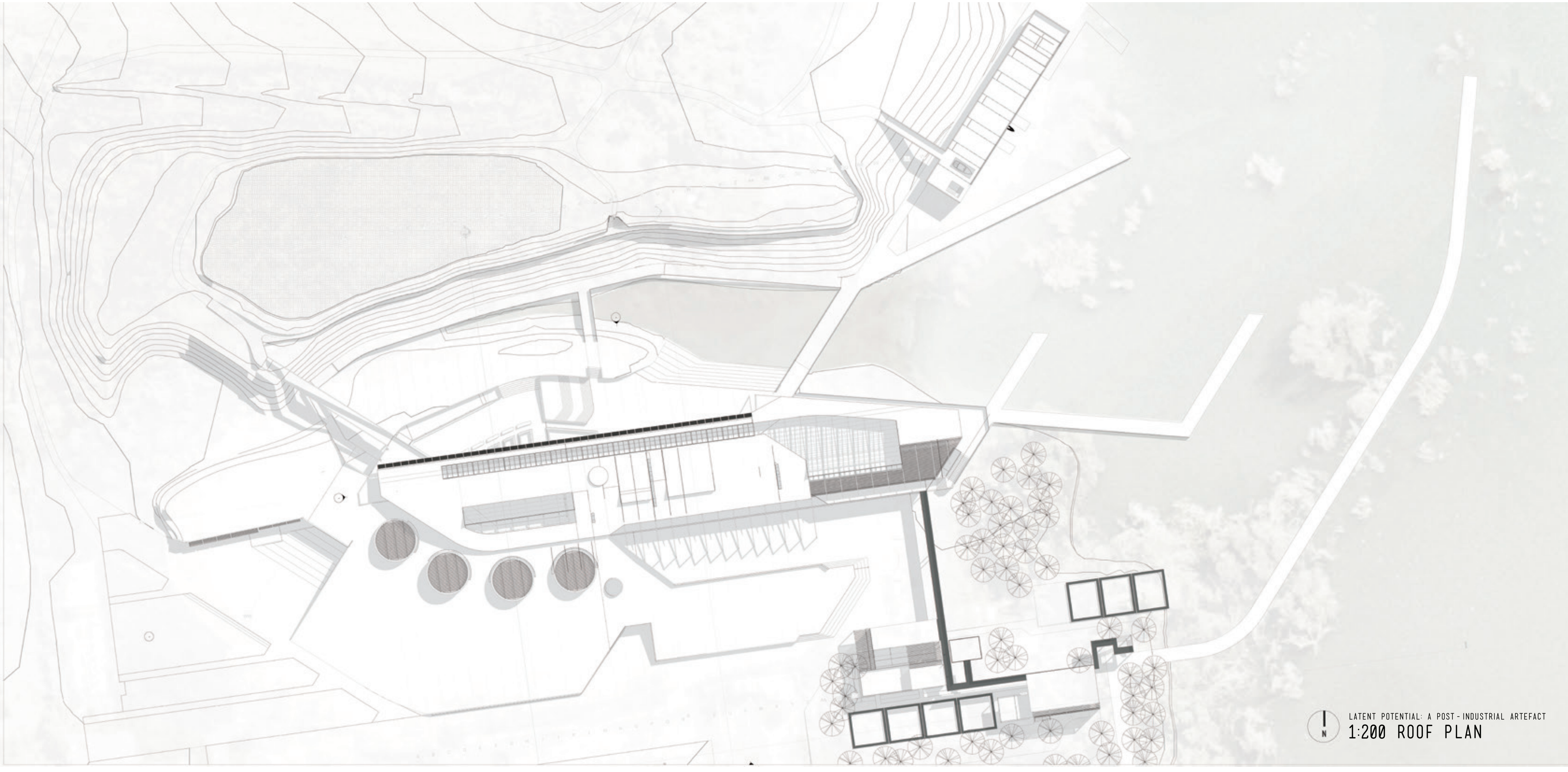

fig 6.22 Roof plan, by Author (2013)

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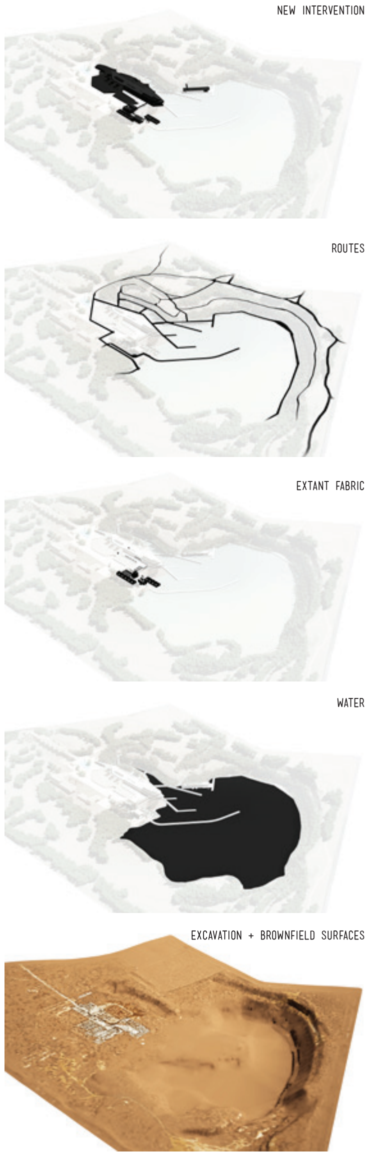


fig 6.25 3D site plan, by Author (2013)

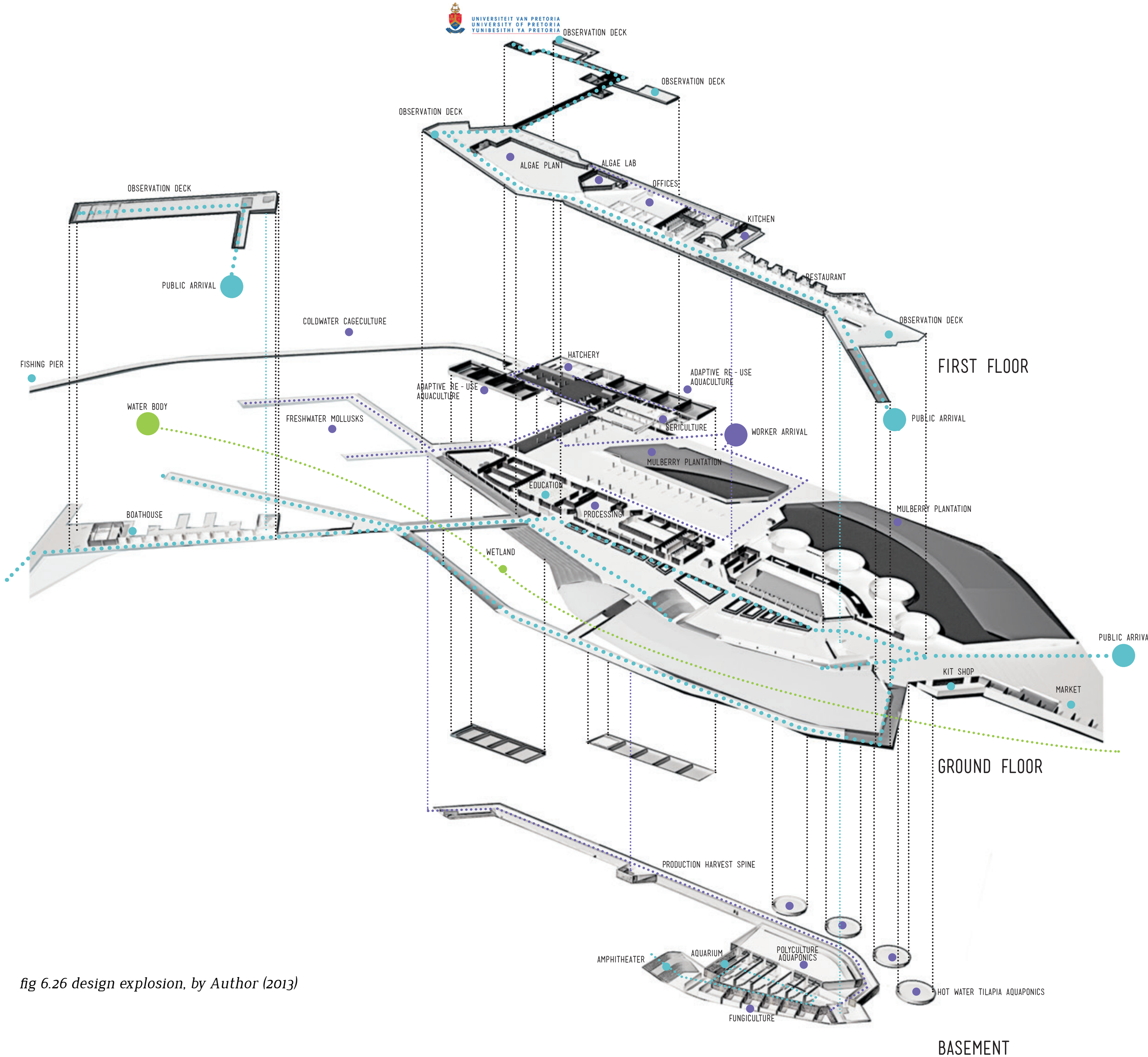


fig 6.26 design explosion, by Author (2013)

fig 6.27 site visualisation, by Author (2013)

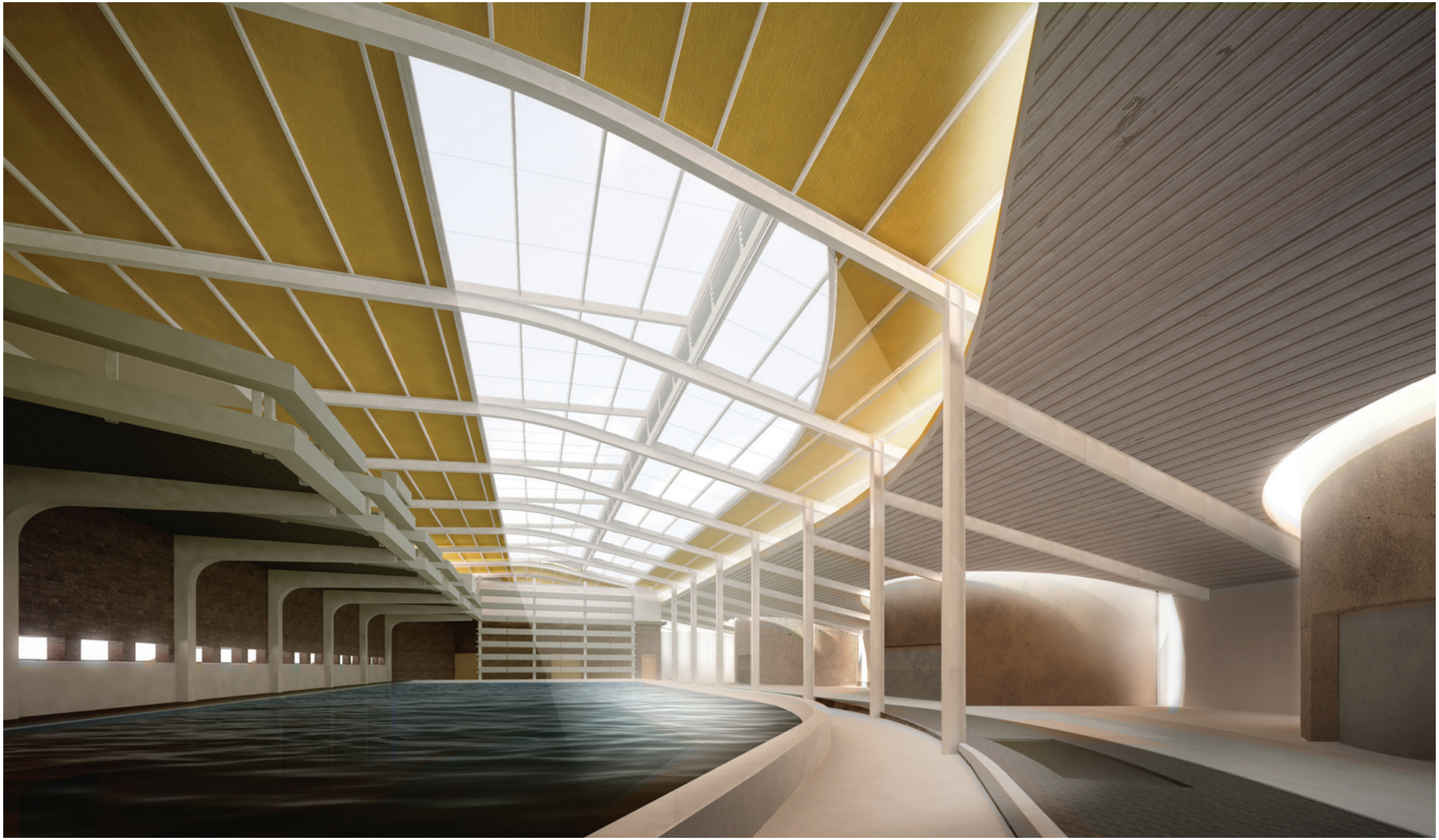


fig 6.28 aquaculture hall visualisation, by Author (2013)

CHAPTER 7:
A WAY OF RESOLVING

TECHNICAL

7.1 TECTONIC CONCEPT

The tectonic concept is derived from the intentions of the original design concept. The physical manifestation of architectural form through the configuration of materials and technology is informed by the specific intentions, relationships and exchanges between the Ecological Landscape, Heritage Landscape, Productive Landscape and Social Landscape, all of which are tied together or stand in relation to a new Synthetic Landscape which exists in symbiosis with the Natural Landscape.

The technical chapter of this document explores the technical resolution of a specific part of the building in more detail. Throughout this resolution, the tectonic concept of exchanges between landscapes is considered. The material selection and construction allows for an enhanced ecological landscape for improved biodiversity, the efficient and optimised operation of the productive social-ecological landscape, the mindful acknowledgement and celebration of the heritage landscape, and a comfortable and experientially qualitative social landscape. The synthetic landscape ultimately becomes the vessel where many of the exchanges take place, and is expressed as a tectonic surface in relationship with the surrounding context.

7.2 MATERIALITY: SELECTION + PALETTE

Materials were selected on the premise of the landscapes and the exchanges between them. The properties of these materials support the functional aspects of the various landscapes, whereas the haptic qualities of the materials communicate the spatial properties of the landscapes and their respective purposes.

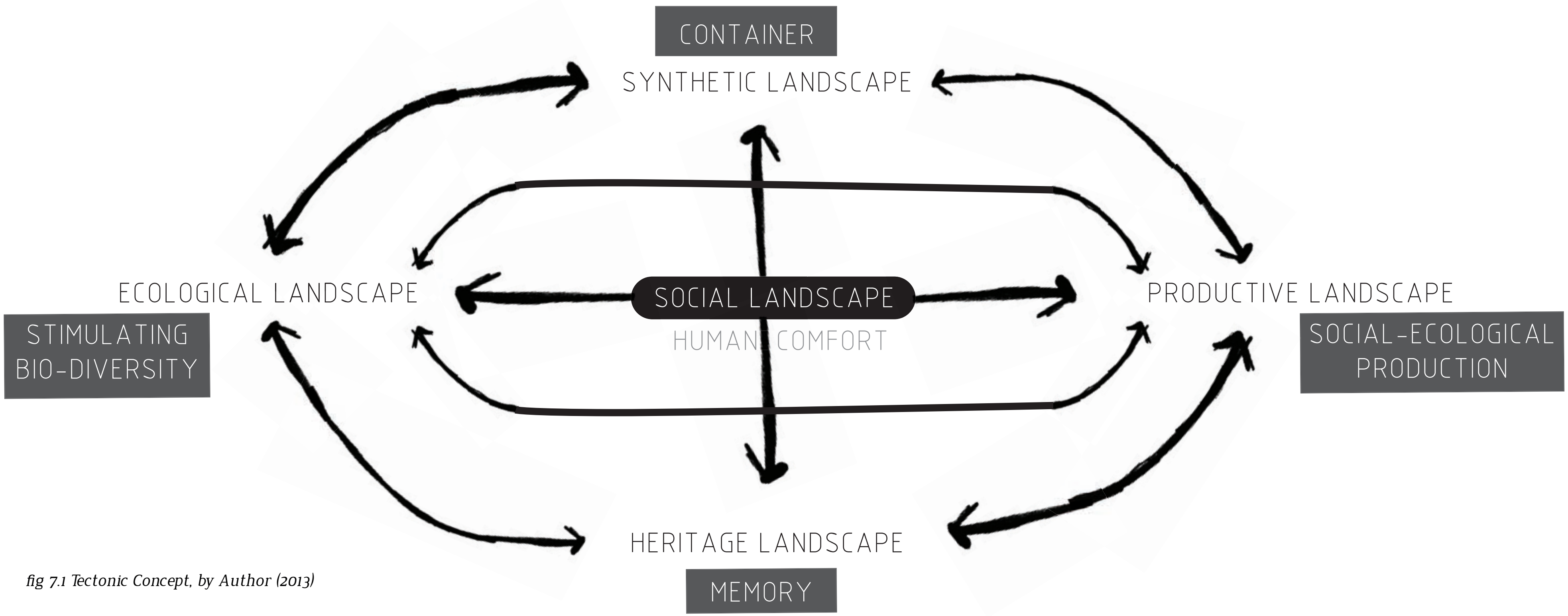


fig 7.1 Tectonic Concept, by Author (2013)

7.2.1 HISTORICAL LANDSCAPE

The historical landscape retains and utilises extant heritage materials: loose, broken and whole bricks, exposed and decayed concrete slabs, and the intact brick and concrete structures. Wood from the abundant Black Wattle trees is used for timber finishes, furniture and in the tanning and dyeing of silk.

New materials are introduced to contrast with the existing while allowing a continuation of natural processes to affect the appearances of structures. Steel, timber and weathering steel (Cor-ten) are used to eventually form part of the entropic narrative of the site, while the tectonic structures and surfaces contrast with the existing stereotomic brick and concrete structures and surfaces.

BRICK + CONCRETE
ADAPTIVE RE - USE

WEATHERING STEEL
CLADDING

TIMBER INFILL

"Not to see finishing as the final moment of construction but to see the unending deterioration of a finish that results from weathering, the continuous metamorphosis of the building itself as part of its beginning and its ever changing 'finish'" (Mostafavi, 1993:16).

"In the time after construction, buildings take on the qualities of the place wherein they are sited, their colors and surface textures being modified by and in turn modifying landscape" (Mostafavi, 1993:68). Weathering deeply embeds architecture in place.

"Weathering steel (Cor-ten) when exposed to the elements [i]ts surface colour changes to earthy red, the evenness of which cannot be produced artificially. The speed of this process varies from place to place and is dependent upon both atmospheric and geographic conditions as well as the season of the year. The rusty patina that develops within a few months grows darker in time. The oxide surface is supposed to resist further corrosion and preserve the structural strength of the steel" (Mostafavi, 1993:104).

"Weathering reminds one that the surface of a building is ever changing. While a potential nuisance, the transformation of a building's surface can also be positive in that it can allow one to recognise the necessity of change, and to desire to overcome fate - an aspiration that dominated much of modernist architectural thought through its resistance to time" (Mostafavi, 1993:104).

7.2.2 ECOLOGICAL LANDSCAPE

Bioconcrete, a type of biological concrete developed and patented by researchers at the Structural Technology Group of the Universitat Politècnica de Catalunya, supports the natural, accelerated growth of pigmented organisms such as "certain families of microalgae, fungi, lichens and mosses" (UPC, 2012), resulting in "a beautiful, living patina that transforms throughout the seasons" (Brownell, 2013). The biological concrete offers "favourable environmental, thermal and aesthetic properties and absorbs and reduces atmospheric CO2 while capturing solar radiation [and] regulating thermal conductivity inside the buildings" (UPC, 2012).

The material comes in the form of a multi-layered panel. A structural concrete layer is made from two types of cement: conventional carbonated concrete (based on Portland cement), and a magnesium phosphate cement (MPC). A waterproofing layer protects the structural layer from possible water damage. The biological layer "facilitates the development of biological organisms and allows water to accumulate, aiding retention and expelling moisture; since it has the capacity to capture and store rainwater [a] discontinuous coating layer with a reverse waterproofing function permits the entry of rainwater and prevents it from escaping, aimed to obtain biological growth" (UPC, 2012).

Permeable concrete paving allows storm water to slowly filter through the surface, reducing run-off, trapping suspended solids, and removing pollutants from the water. Vegetation and grasses are also allowed to grow in between the pavers providing a hard surface to support vehicular and pedestrian traffic.

PERMEABLE PAVING

BIO - CONCRETE

7.2.3 PRODUCTIVE LANDSCAPE

Concrete, a robust and low-maintenance material, can facilitate the requirements of productive environments for hardiness, and its thermal mass ensures a regulated internal climate.

Polycarbonate is a very durable plastic with a long life cycle. Multi-wall sheets made of polycarbonate have a lower unit weight than glass, enabling savings in transport and reducing the need for supporting structures. Polycarbonate sheeting lets in light, but insulates well against heat, allowing energy savings.

Galvanised steel is used in most of the aquaculture production facilities to prevent the humid conditions from corroding the structure. While corrosion and decay are promoted in the social and ecological spaces, it must be controlled to ensure longevity and a maintenance free production environment.

7.2.4 SOCIAL LANDSCAPE

Bamboo plywood is a sustainable alternative to traditional ply. It is used to support roof sheeting while simultaneously providing an insulating layer. Its surface qualities also contribute to the haptic qualities of the social spaces.

Silk, a textile produced on site, has traditionally been used in many cultures for its elegant qualities: being soft to the touch, translucent when light shines through it, and lightweight. The use of silk not only expresses how the building integrates production potential with architectural space, but also provides the social spaces with the fabric's haptic qualities.

fig 7.2 Material Palette, by Author (2013)

7.3 TECHNOLOGICAL CASE - STUDY

The Bio Intelligent Quotient (BIQ) House, a 15-apartment four-storey residential building completed in April 2013 in Hamburg, Germany, claims to be the first 100% algae-powered building. Josef Hargrave, a consultant on Arup's Foresight and Innovation team, believes that "[b]y producing food and energy, and providing clean air and water, buildings can evolve from being passive shells into adaptive and responsive organisms – living and breathing structures supporting the cities of tomorrow" (Future Timeline, 2013).
The technology known as SolarLeaf essentially creates a photosynthetic skin on the facade of a building. The system cultivates microalgae integrated into a total of 129 bioreactors over 200m^2 of "flat panel glass bioreactors measuring 2.5m x 0.7m [which generate] biomass and heat as renewable energy resources. At the same time, the system integrates additional functionality such as dynamic shading, thermal insulation and noise abatement The heart of the system is the fully automated energy management centre where solar thermal heat and algae are harvested in a closed loop to be stored and used to generate hot water" (Arup, 2013).

It is believed that "such 'living' buildings could actually produce more resources than they consume" (Future Timeline, 2013).

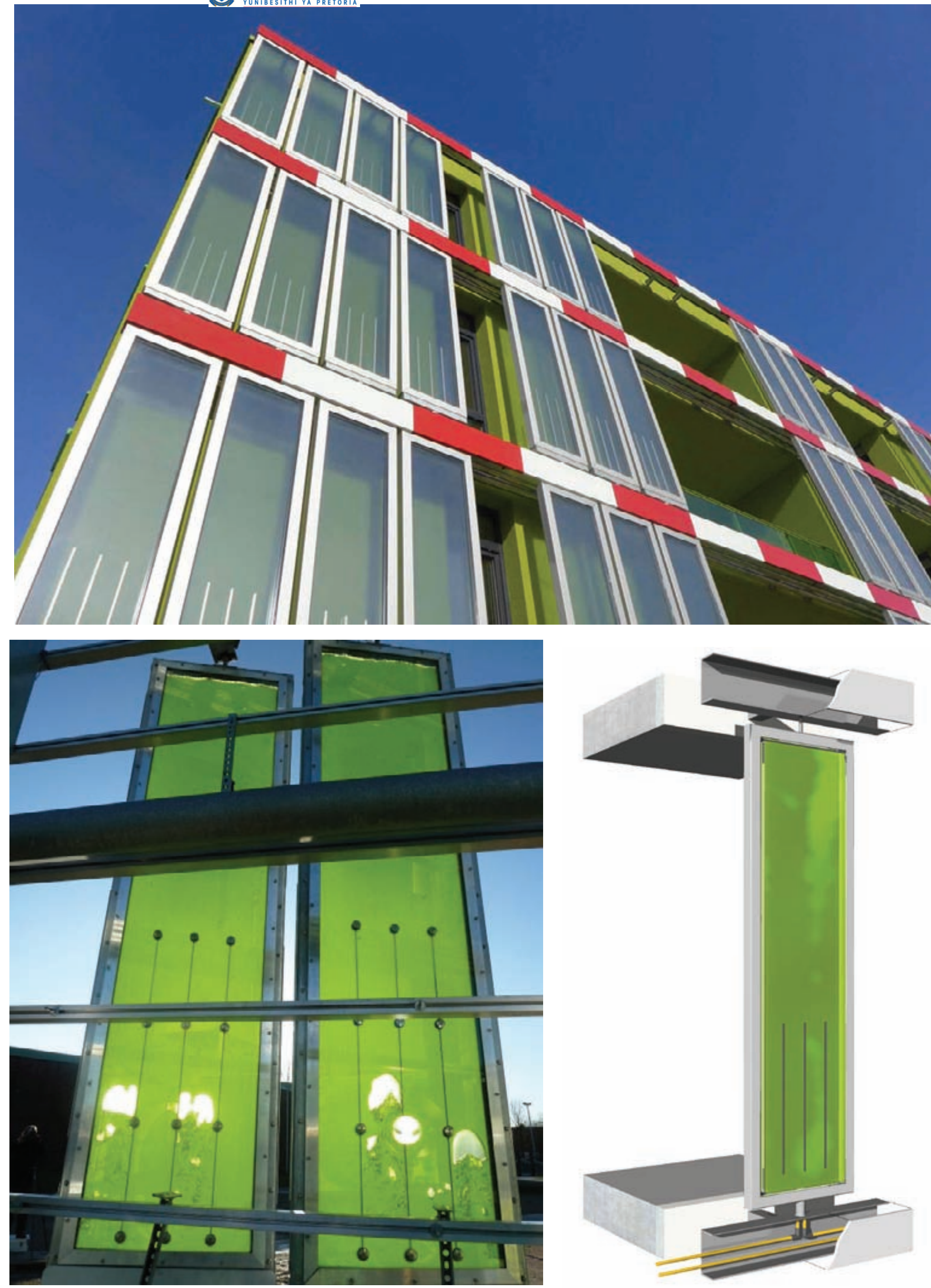


fig 73 BIQ House, (ARUP 2013)

7.4 TECHNOLOGY + ENVIRONMENTAL STRATEGY

7.4.1 TECHNOLOGY

The structural approach for the historical intervention is to implement a three-dimensional structural steel grid around and over some of the ruins. This grid allows for any new facilities to be lifted off of the ground, which is itself subject to a continuing and layered process of entropy which must not be disturbed, if possible. The steel grid, which is bolted together, can be disassembled for adaptive reuse in the future, also out of sensitivity towards the industrial heritage. The structure avoids touching the historical fabric where possible, to maintain an independent narrative identity. This primary structure supports the secondary structure of purlins and cladding rails, which in turn support the tertiary rigid foam insulation and weathering steel cladding. Alternatively, the steel grid has timber infill which shades the glazed or open edges where appropriate.

Among the ruins the tectonic language becomes integrated and transformed into the new synthetic landscape. Taking a lead from the spacing of the historical concrete columns, the new steel structure merges with the geomorphological synthetic landscape. The deepening of the constructed wetland and the excavation of the aquaculture tanks has produced a large quantity of soil to be contained by retaining walls to form the lower part of the synthetic landscape. Brick and concrete are used to support the thresholds occurring through and underneath this new landmass. As the upper portion of the synthetic landscape, a steel sheet roof hovers slightly above the landmass and shades the social areas. Where direct sunlight is required for production, polycarbonate sheeting is alternated with the steel roof sheeting. The flat steel sheeting jointed with up-stand seams is supported by bamboo ply placed on top of the purlins. This provides a sustainably sourced structural support for the roof sheeting but also adds some insulation to prevent the steel sheeting from radiating solar heat down into the public areas.

Tanked concrete basement construction is utilised for the aquarium, which is dug down into the earth. Concrete column fins framing the aquarium display extend out from this basement where they become sculpted to form a public seating edge clad in timber. These concrete columns reach up to support the social spine on the first floor on the northern edge. The bridge belonging to the structure and extending toward the landscape is of steel construction, and its supporting vierendeel truss forms the balustrades.

The detailing of the section running through the aquarium, the northern restaurant edge, the aquaculture production pods and the mulberry fields displays the entire range of exchanges between the different conceptual landscapes. The historical landscape is expressed technologically through the exchanges between new industry and the synthetic landscape. The new production facility is located where the previous kiln firing ovens used to be. The footprint is reused and remembered by the surface treatment of bricks found on site. The transition from the retained concrete slabs to the synthetic landscape expresses an exchange with the new activity of producing mulberries surrounded by other fauna and flora. The concrete pods hosting the aquaponics of the productive landscape has a steel edge coping. An exchange between tectonics and production occurs when the steel is allowed to rust and decay, releasing iron slowly into the soil to meet the nutritional requirements of the mulberries. The rust stains on the concrete surface illustrate this exchange, and indicate the dynamics of natural processes in architecture. After a couple of decades, once the steel has degraded too much, it may be replaced with new coping or, depending on the operational state of the facility, be kept in its entropic state to allow for a new layer of development.

7.4.2 ENVIRONMENTAL STRATEGY

The thermal mass of the concrete shell of the production ponds allows for a constant and regulated internal climate. Adjustable louvres shade the polycarbonate sheeting during summer to prevent overheating of the interior, while allowing for direct solar gain during winter, and continued production of tilapia throughout the colder months. Geothermal pipes embedded three meters down into the landmass of the synthetic landscape provide these pods with a regulated supply of fresh air.

Ecological exchanges occur with the social spine on the northern edge at the wetland, where birds and insects can take shelter among the vegetated areas. Here bioconcrete is used to promote the growth of moss and lichens. Environmental exchanges are described as part of the passive environmental strategy. The biophysical element of air is allowed to flow through the porous northern facade into the shaded semi-external space of the restaurant. The permeable facade also allows for a deeper visual connection between the public on the upper level and the landscape across and below it. The flat-panel algae photobioreactors (FPBs) are integrated in series into the roof structure at the northern edge, where solar panels are also mounted. The algae FPBs filter the sunlight into the restaurant edge. The exchange allows the algae to experience photosynthesis, while daylighting is extended for the public. The translucent and flexible silk textile suspended from the ceiling allows the public to choose how much filtered sunlight they want to be exposed to.

The building is designed to optimise sun exposure over the entire public space during winter, up to the edge of the building on the ground floor. During summer the detailing allows for a much greater surface area of shading.

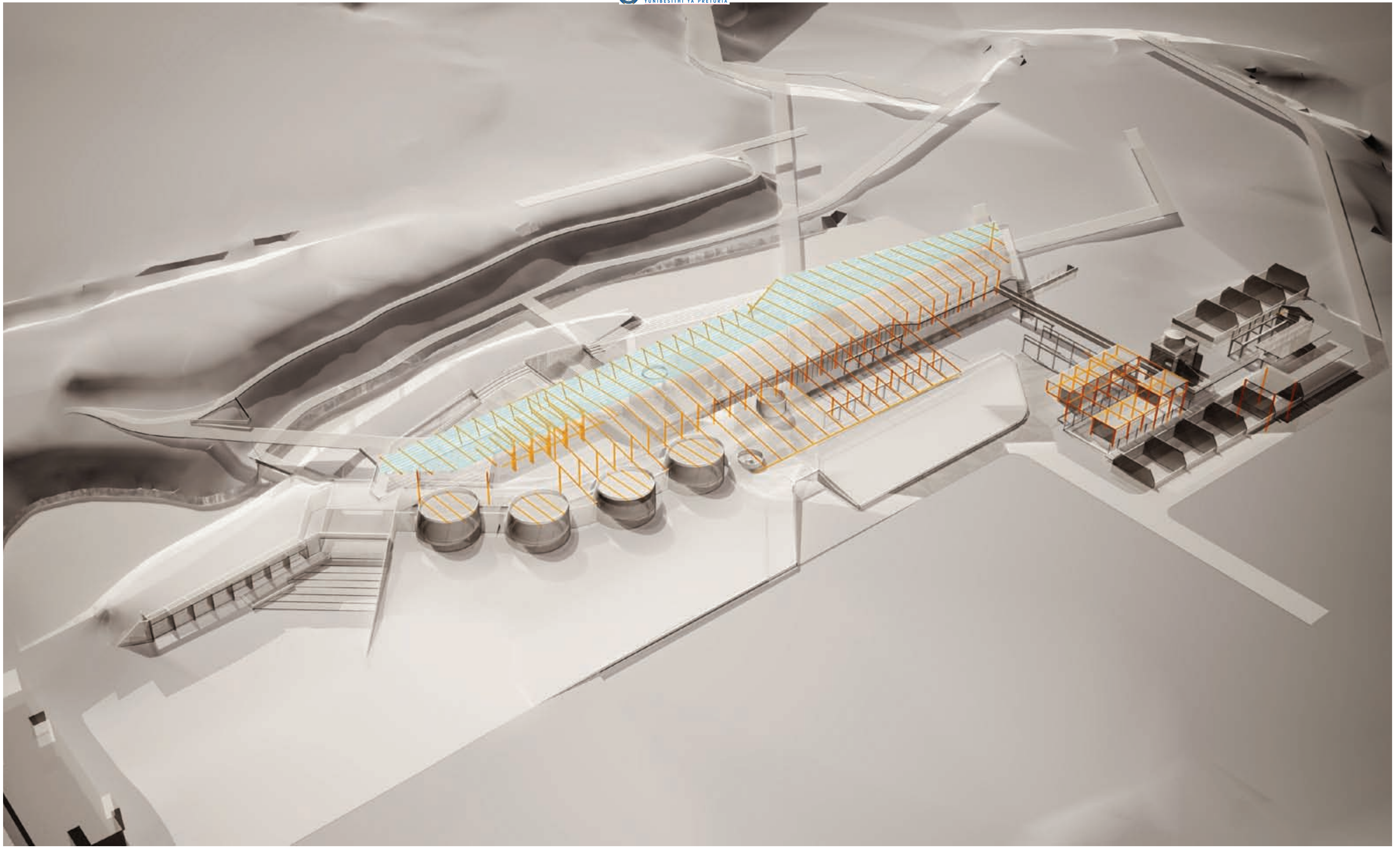


fig 7.4 Structure, by Author 2013

STRUCTURE

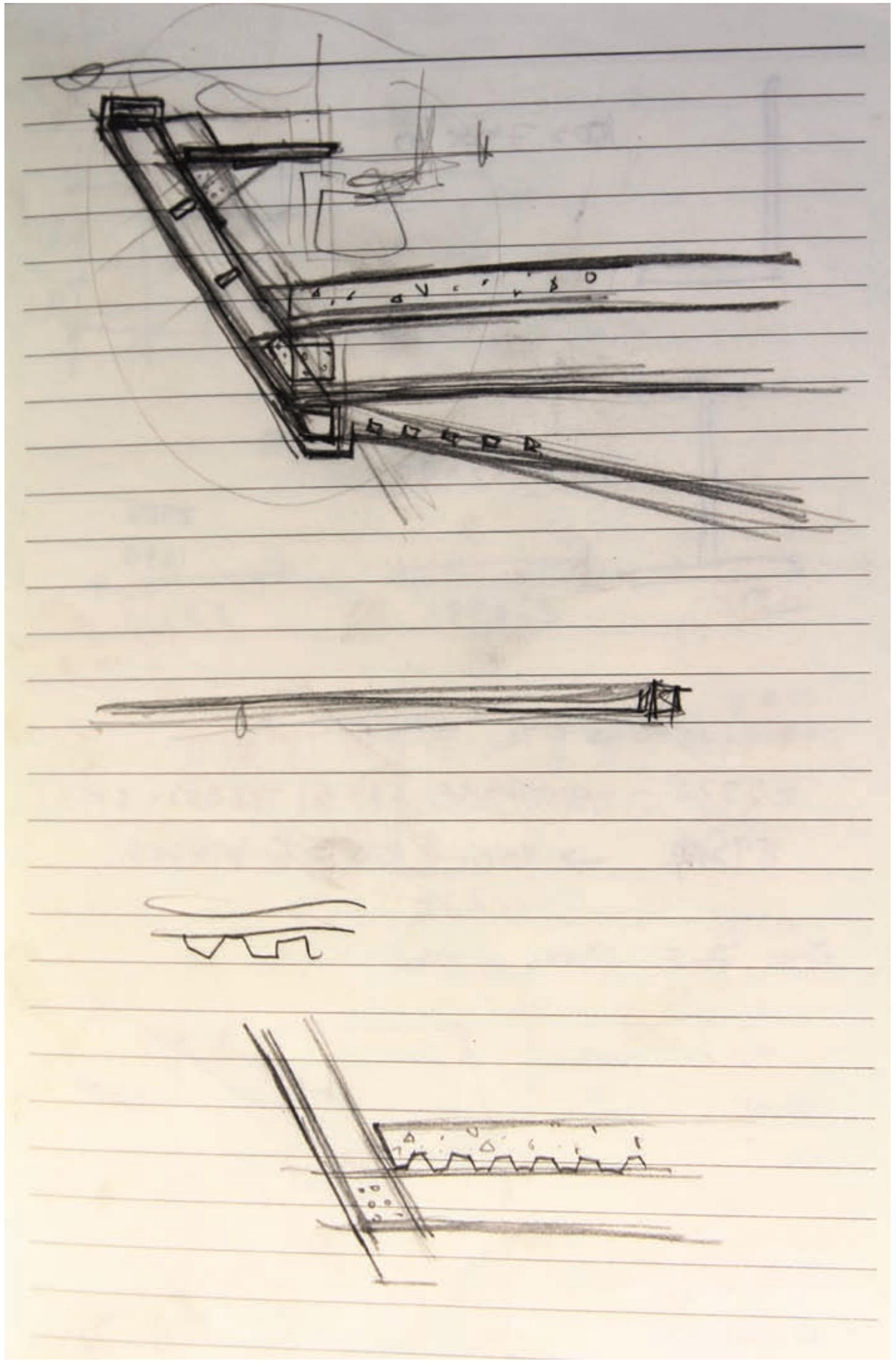
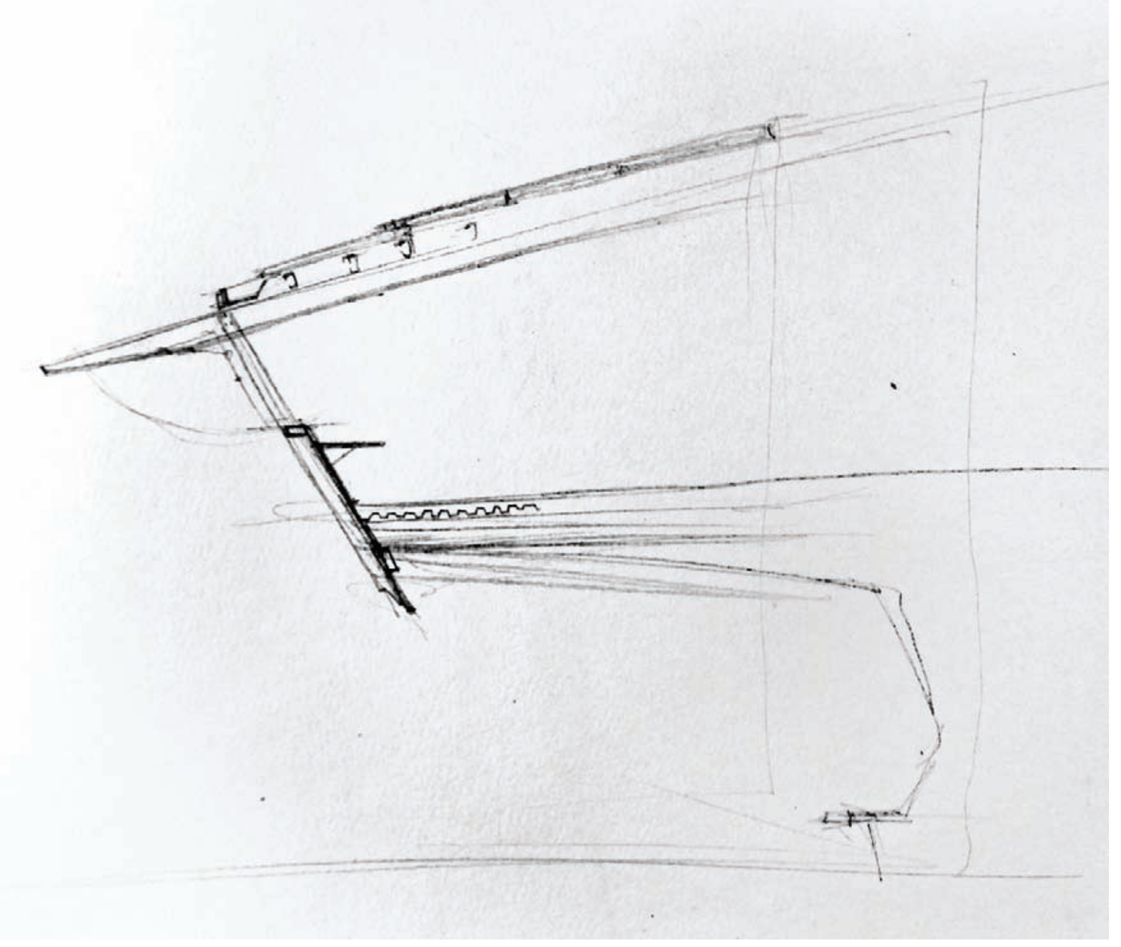


fig 75 Technical Detail Development, by Author 2013



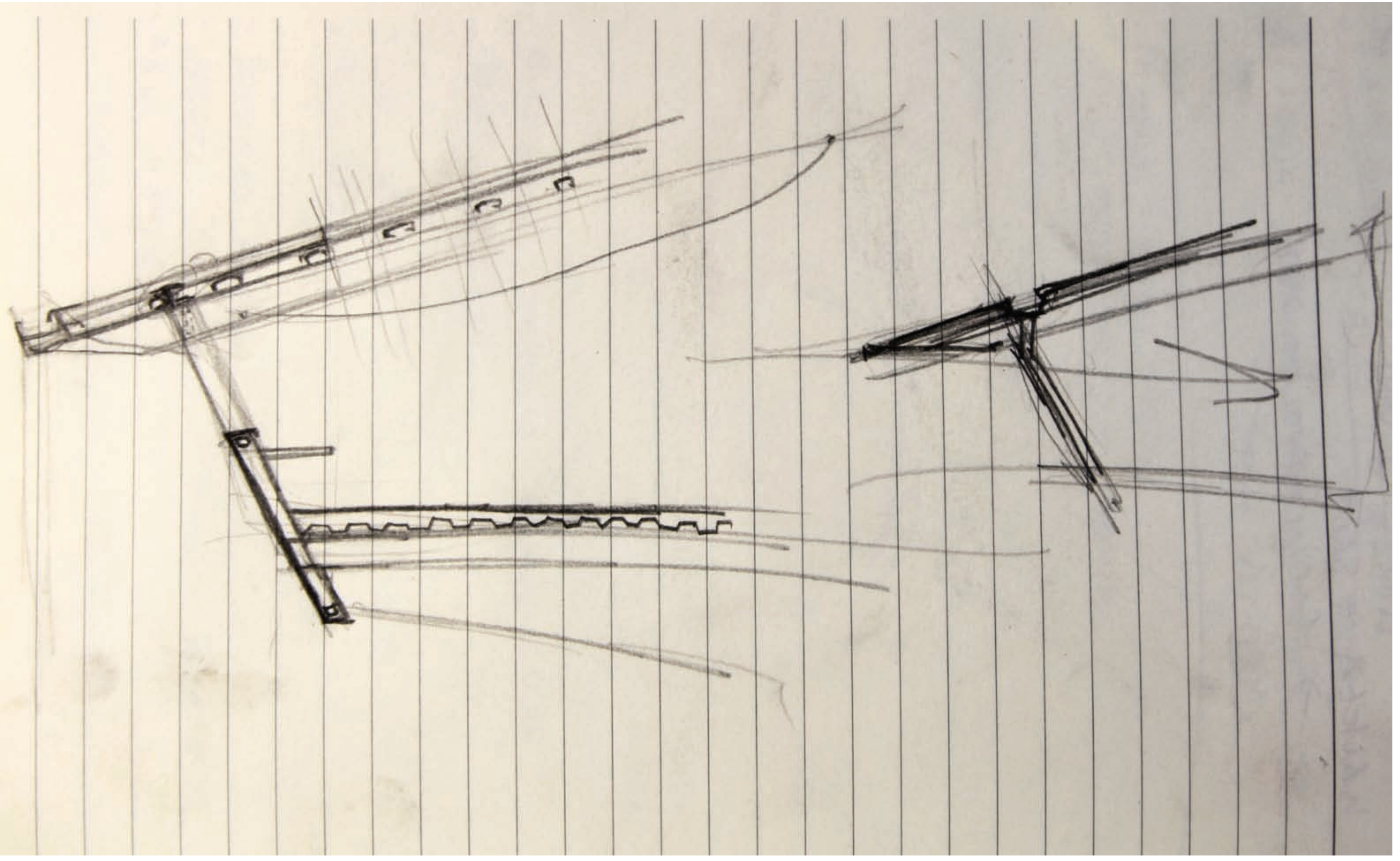


fig 7.6 Technical Detail Development, by Author 2013

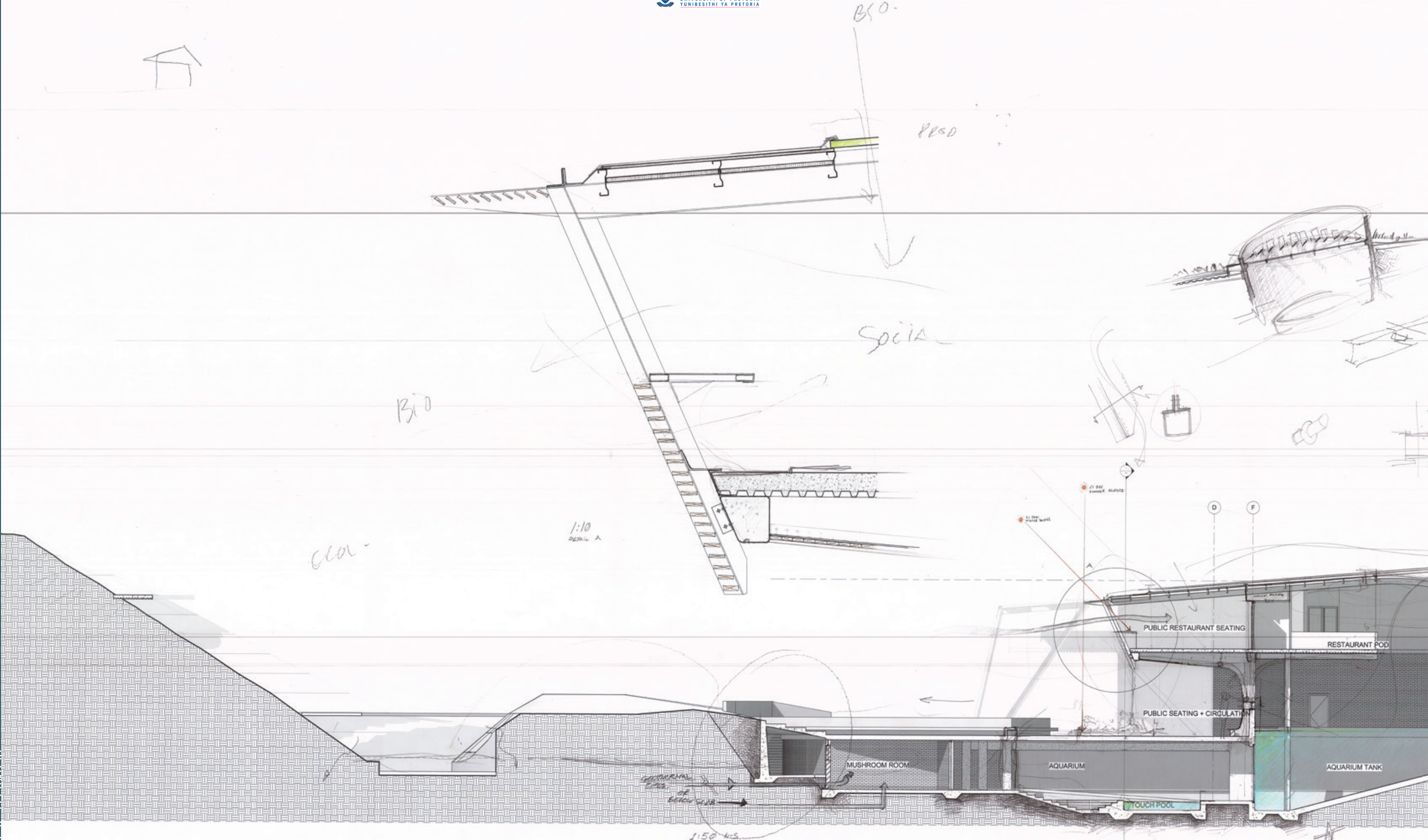
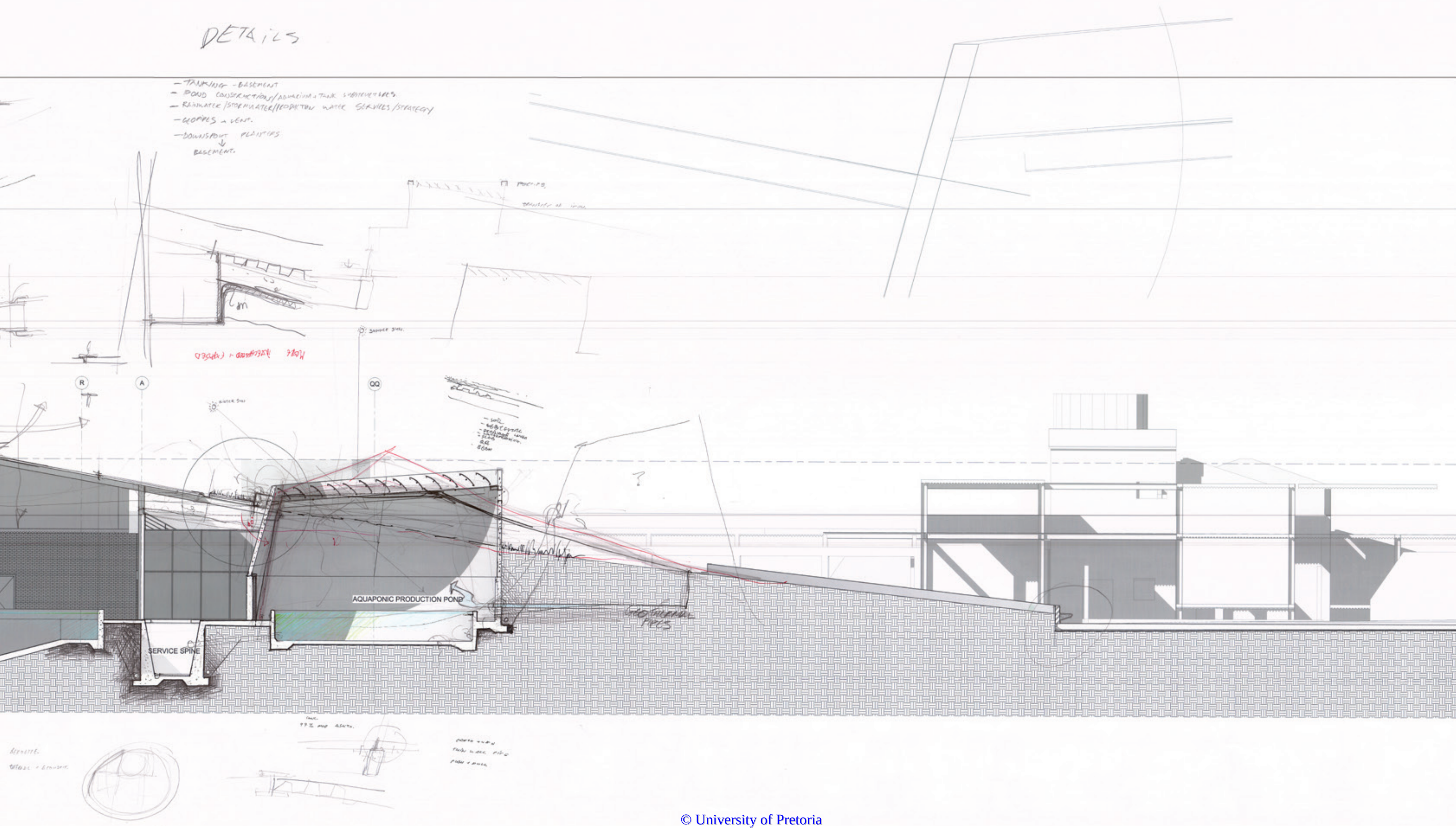


fig 77 Section Development, by Author 2013


DETAILS
AQUAPONIC PRODUCTION POND
SERVICE SPINE

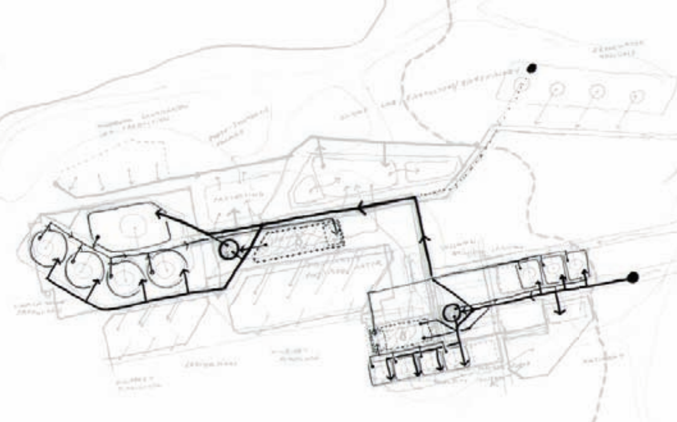
7.5 WATER SERVICES

Although the availability of fresh water is not a concern on this site due to an abundant, constant groundwater supply, water conservation strategies must still be employed. The excessive extraction of water from the water body may have unintended environmental consequences, and the exploitation of this natural resource must not be encouraged. It may however be utilised periodically for the initial filling of the aquaculture production tanks, which may then begin to recirculate the water in the relatively closed-loop system wherein the water may be conditioned to be appropriate for aquaculture. After inevitable water losses during treatment and harvesting, the water storage tanks which replenish the clean water tanks may have to be slightly supplemented with additional water from the water body.

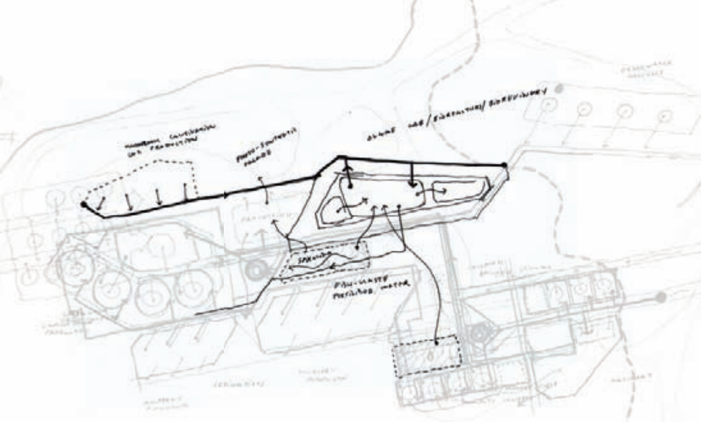
The entire building's water services for production are integrated. There are two primary clean water supply sources: one is the reused water tower of the old industrial heritage serving the hatchery and cold-water ponds; the other is a new tower serving the warm-water ponds and aquarium. The fertilised waste water derived from the aquaculture ponds is transported to the centrally located drum filter which separates the solids from the water. The solids sludge is stored in an airtight container for crop fertilisation purposes. The remaining water is then pumped to the algae plant, where it is circulated inside the photobioreactors which produce algae and simultaneously purify the water. The water is removed from the algae biomass during the algae processing and is passed through an ultraviolet (UV) filter to ensure it is disinfected against any microbial pathogens. After passing through an activated carbon filter, the water is returned to the primary water supplies.

During the rainfall months rainwater is harvested from the structure's roofs. This prevents excessive amounts of run-off which could lead to flooding of pedestrian areas, and allows for the conservative use of water in public and private ablution facilities, change rooms, and showers. The grey water from showers and wash basins is collected, filtered and used for irrigation. Black water from the ablution facilities is transported to septic tanks to be treated.

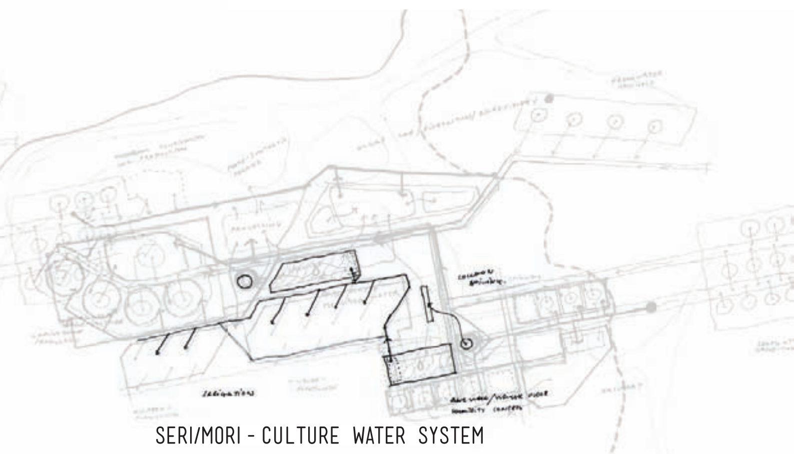
In the event of rainfall, water collected in the water body slowly discharges through the constructed wetland, maintaining a constant water level with an overflow leading to a retention pond just west of it. Any additional run-off in the case of heavy rainfalls is diverted toward the Apies River channel.



AQUACULTURE WATER SYSTEM



ALGACULTURE WATER SYSTEM



SERI/MORI - CULTURE WATER SYSTEM

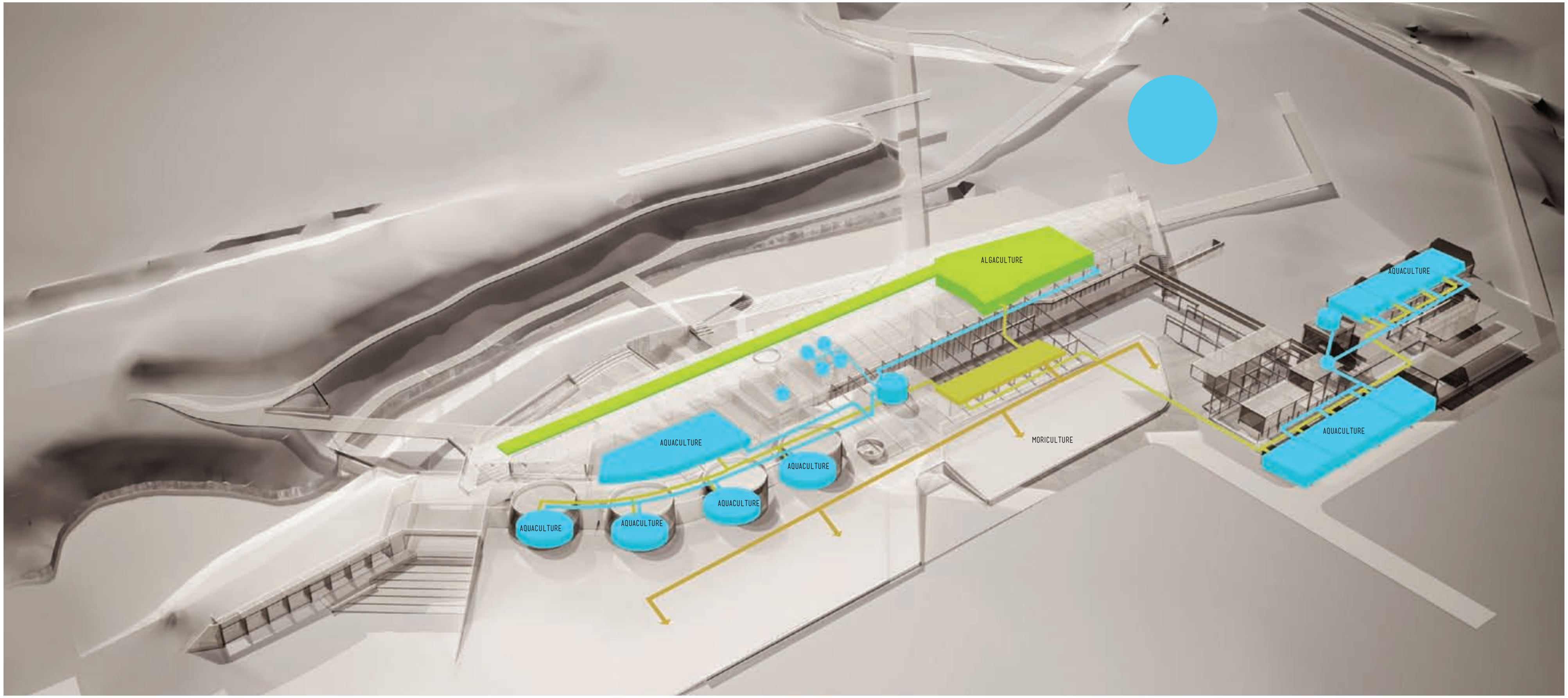


fig 7.8 Water Services, by Author 2013

- FRESH/CLEAN WATER
- ALGAE INTEGRATED WATER TREATMENT
- `FERTILISED' POND WATER

WATER SERVICES

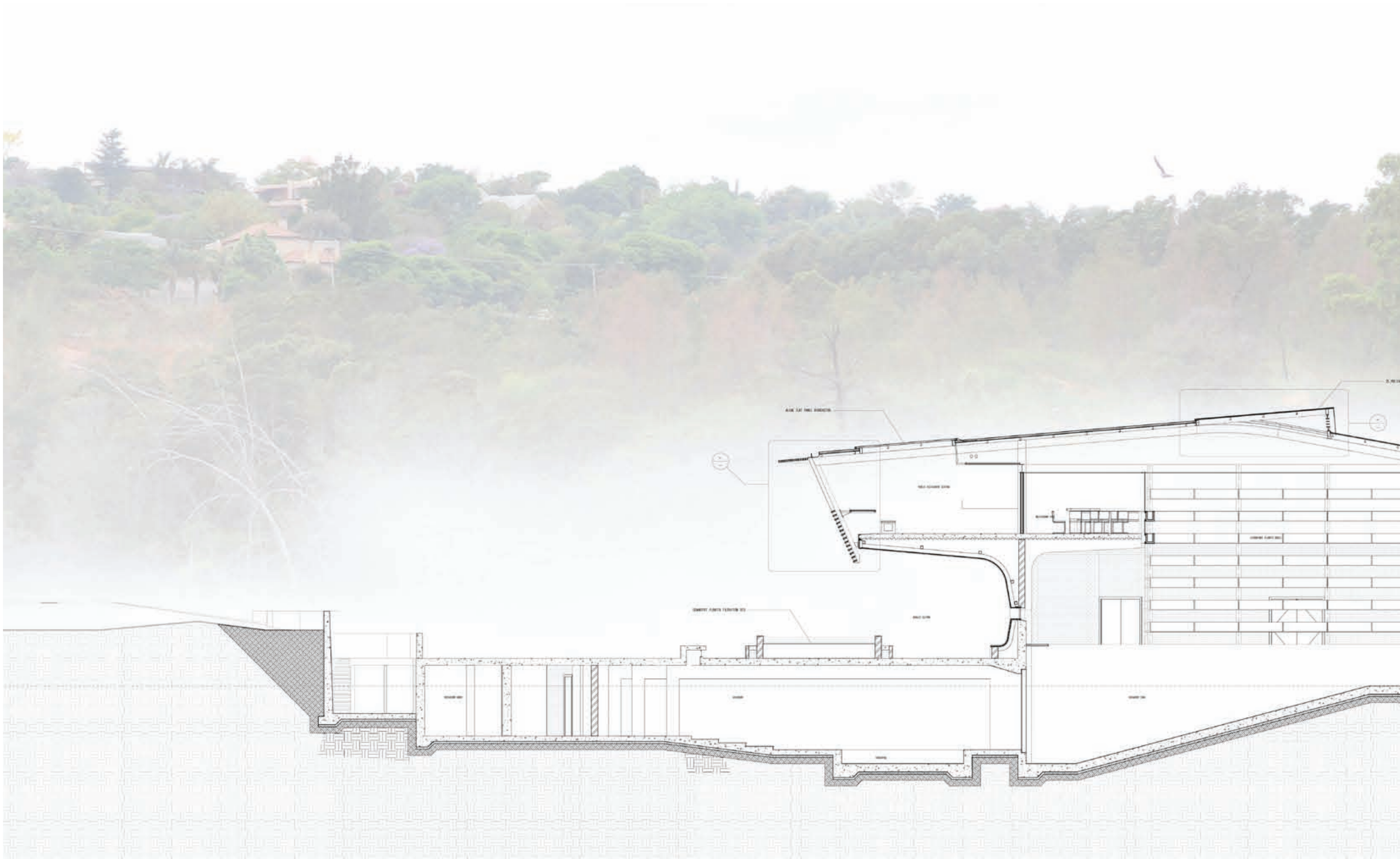


fig 79 Technical Section, by Author 2013

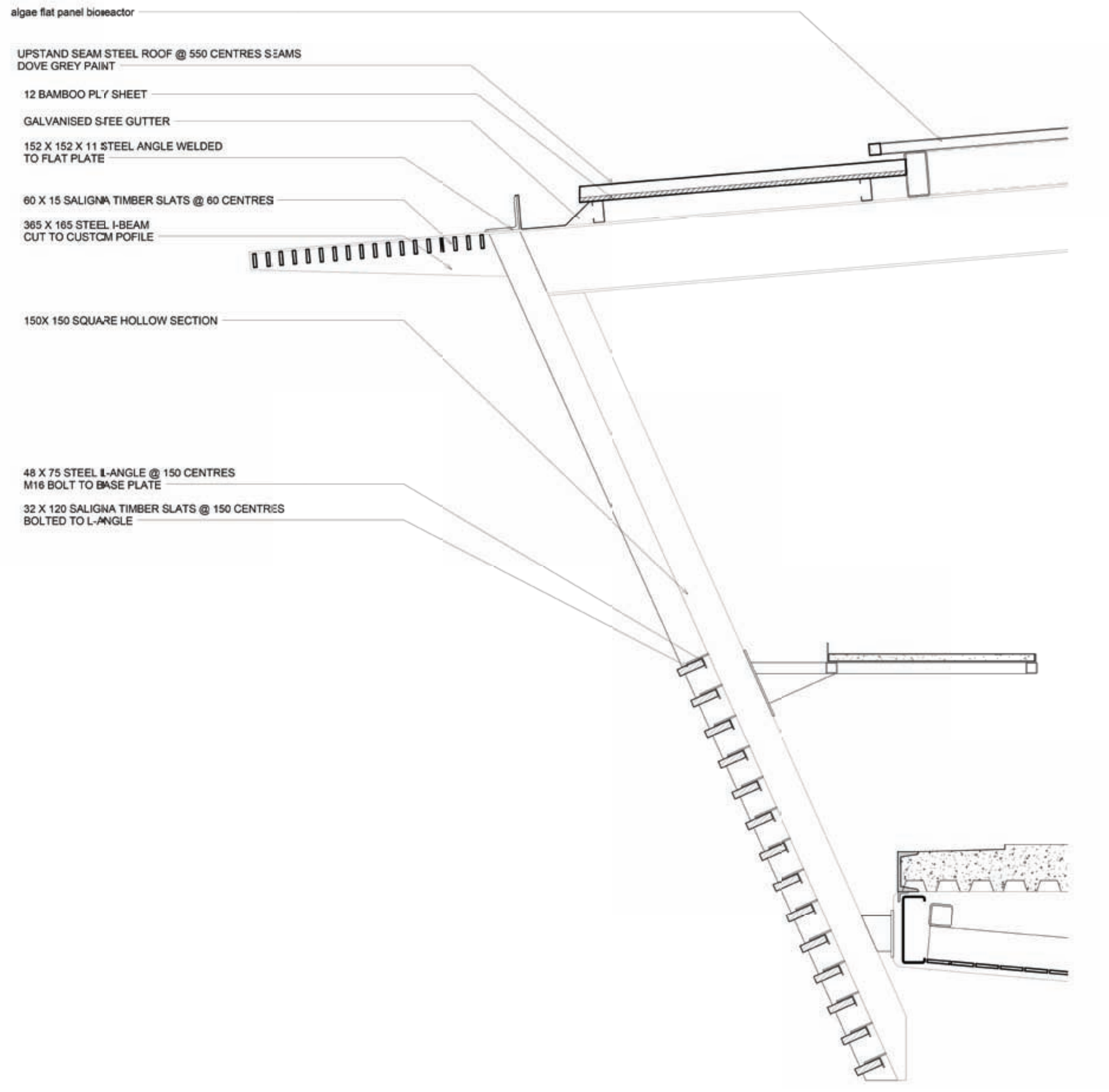
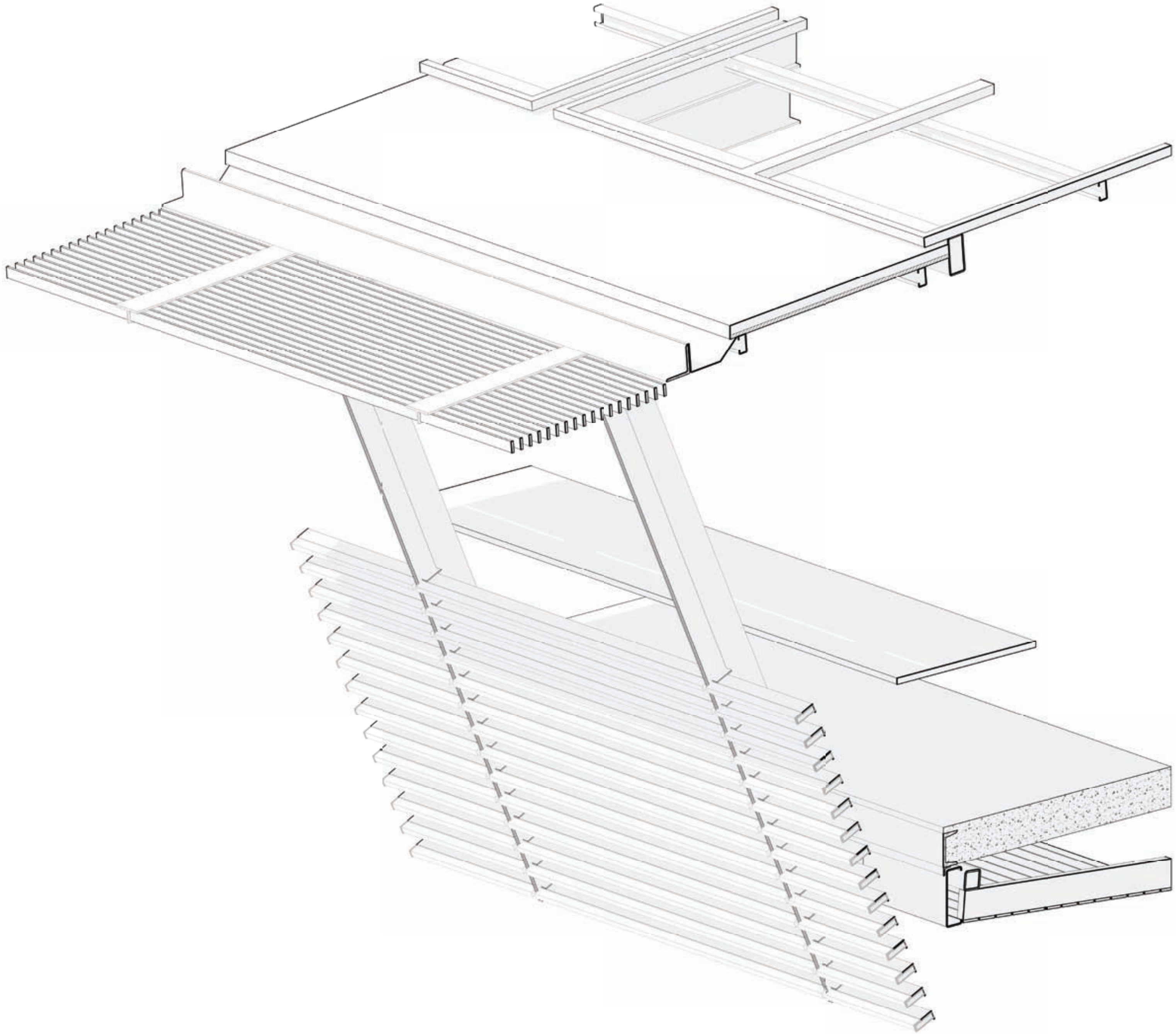


fig 7.10 Detail, by Author 2013



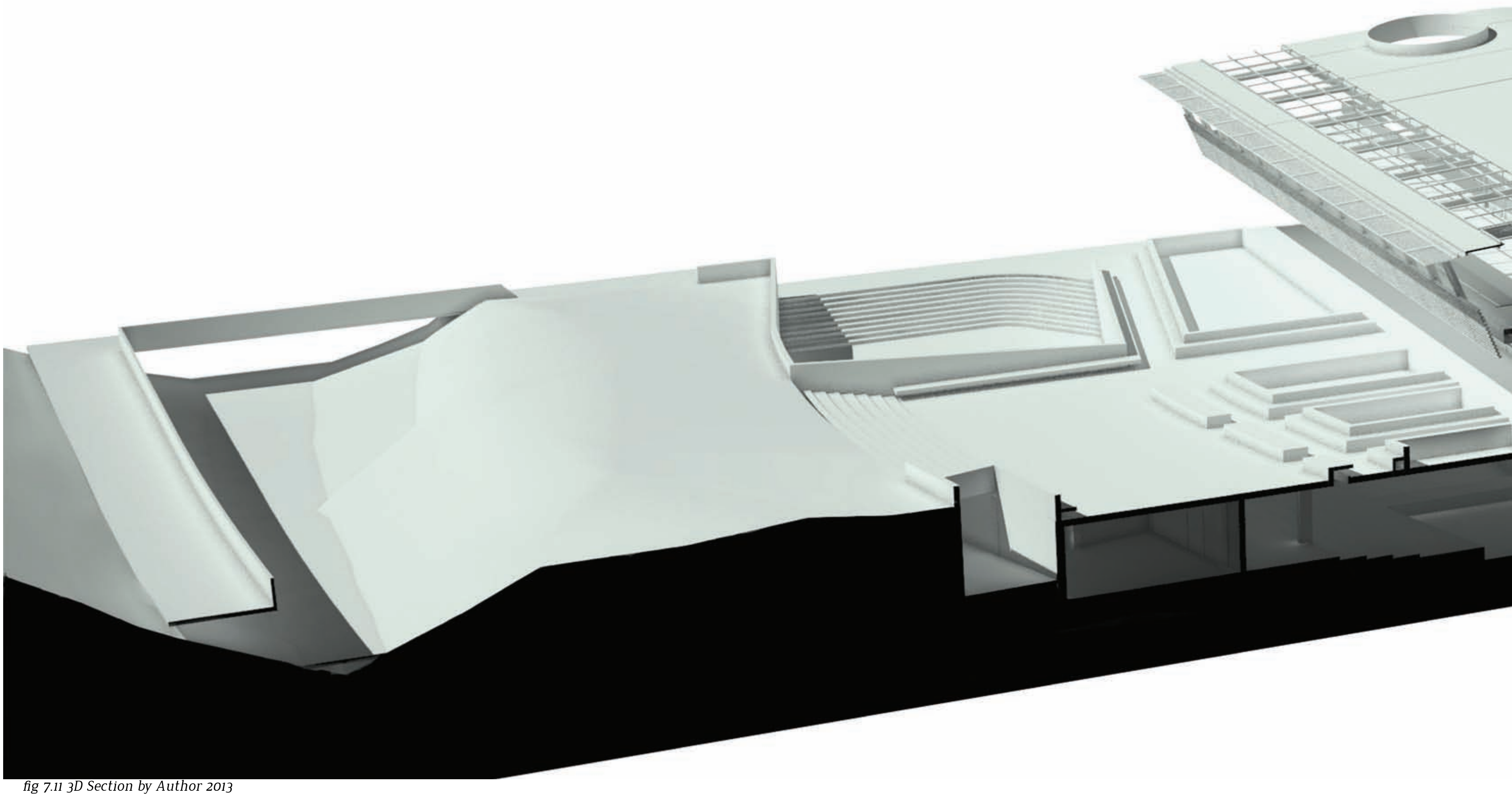
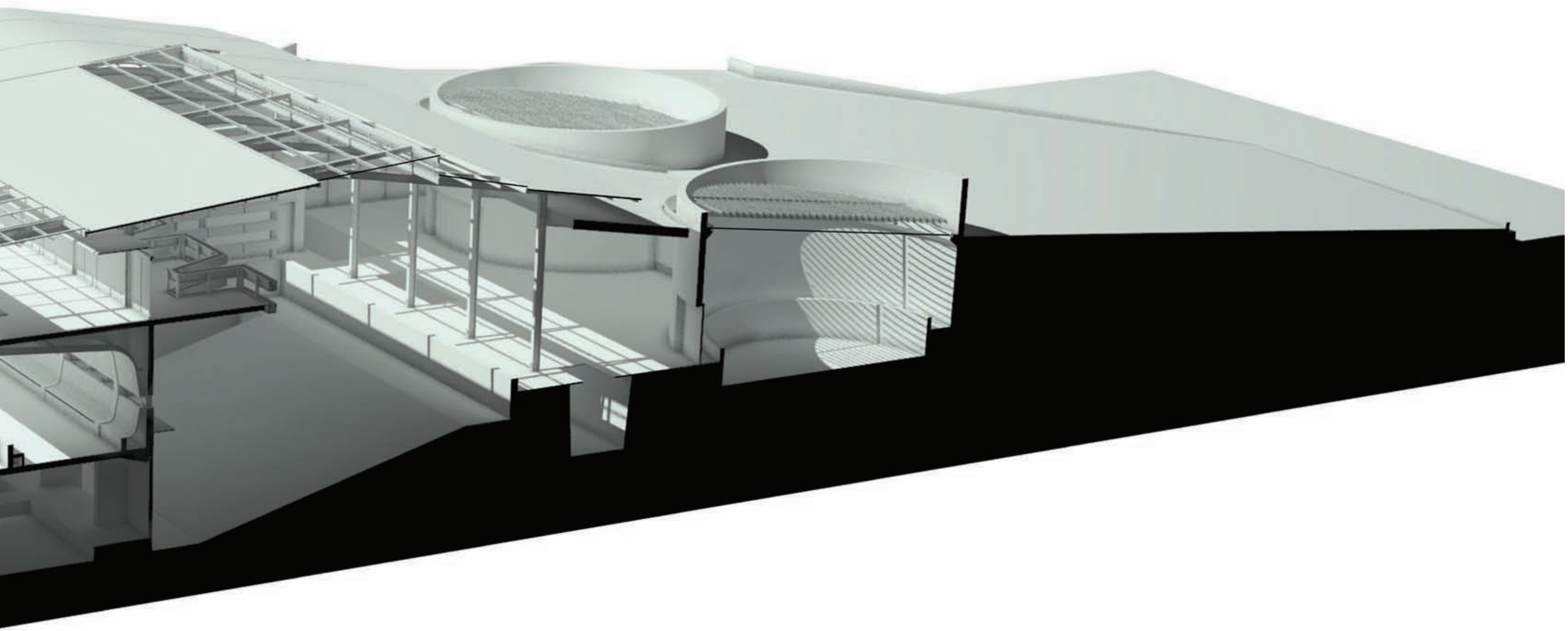


fig 7.11 3D Section by Author 2013



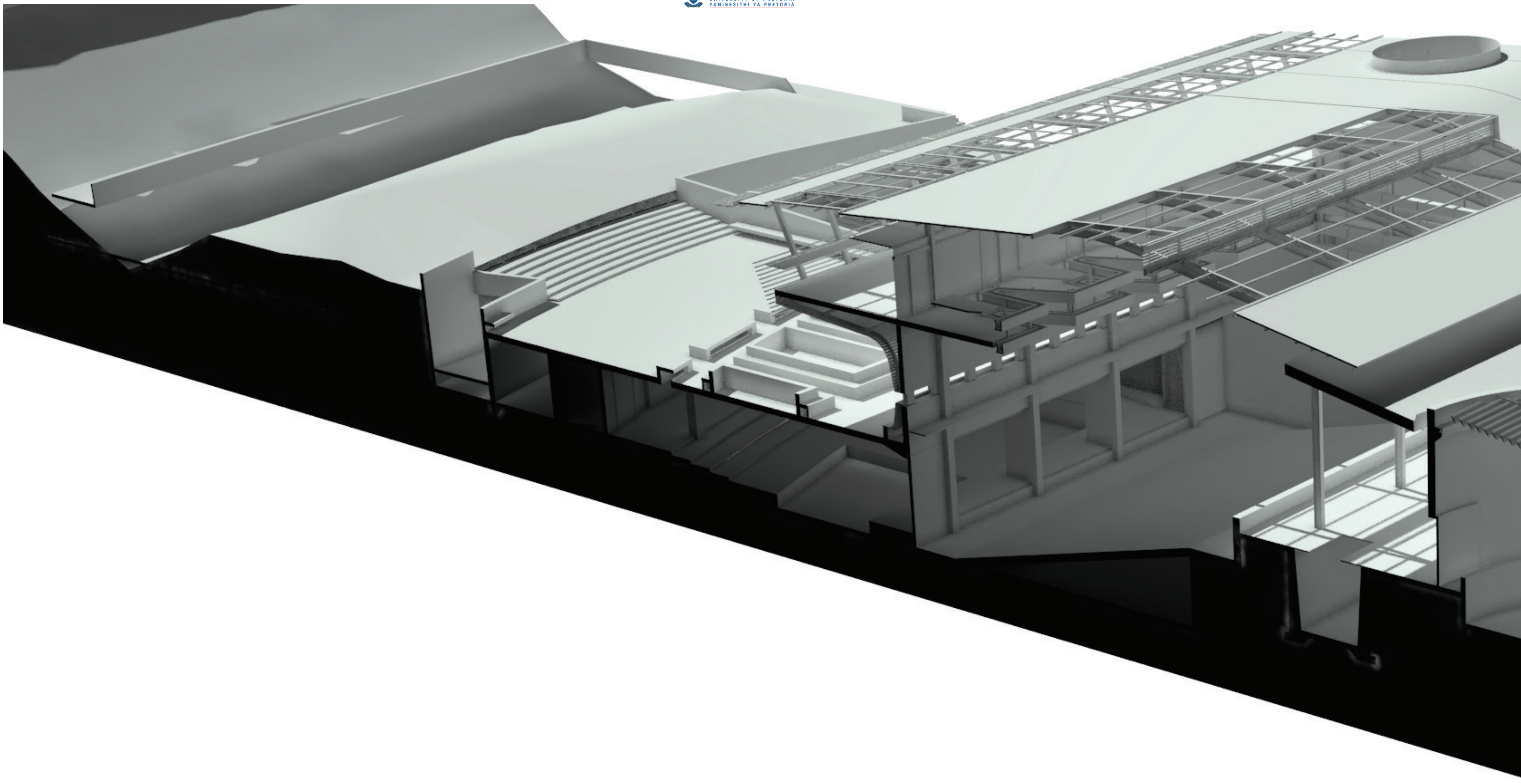


fig 7.12 3D Section by Author 2013

8. CONCLUSION

This dissertation is concerned with finding potential and opportunity in the remnants and legacy of a Post-Industrial Latent Artefact, by addressing issues of increasing urban populations and sprawl. It considers ecological concerns as well as the pressures related to the dependence on and consumption of global resources. Through this process, it aims to find a means to re-regenerate the local and urban conditions and the quality of (sub)urban life by re-conceptualising the sub-urban condition through integration with social-ecological industries within local place-sourced potentials.

It can be concluded that, by utilising regenerative and resilience theory in conjunction with that of industrial heritage, a regenerative architecture can be developed as a unique response to a Post-Industrial-Latent-Artefact which provides a spatial interface of hybridity for exchanges between people, natural resources, production and memory. It is postulated that architecture can instigate a culture of involvement, contribution and awareness, to integrate people with their own life-giving processes in order to become liberated from dependence on centralised industries, by integrating them with decentralised micro-scale production processes of food, energy and high-value products. The architectural process and design response developed in this dissertation identifies that architecture can establish an interface between people and natural resources, where social interaction is advocated as a critical component in the success of the re-typologised mode for decentralised resource production within urban communities.

The study has contributed to the development of regenerative design strategies for localised architectural interventions, specific to those in the context of Post-Industrial Latent Artefacts and the transforming suburban landscape. Industrial heritage was harnessed as a positive actor for change toward resilient urban communities. The integration of renewable resource production and recreational social space was investigated as a means to generate an architectural design capable of transforming the suburban condition for both human and non-human species toward a healthier eco-system.

The exact strategies and design responses have not been proven in practice, as this dissertation is a theoretical investigation. Practical experimentations with the integration of public architectural space and that of natural resource production would have to be investigated. There is still major potential for the further integration of productive processes in public spaces shared by people and the ecological landscape, which can and must be investigated.

"Our livelihood is intimately tied to the food we eat, water we drink and places where we recreate.
That's why we have to promote responsibility and conservation when it comes to our natural resources."
- Mark Udall ‹

REFERENCES

Allen, B., 2012. Post-Industrial Latent Space. Volume #31: Guilty Landscapes 31, 157-159.

Arcero, C., Lim, K., Mabasa, J., Marquez, A., Sonza, E., 2013. Feasibility of Mussel Shells in Making Hollow Blocks. Lourdes School of Mandaluyong.

Archello, 2011. Yokohama international port terminal. Accessed on 20 September 2013, at <http://www.archello.com/en/project/yokohama-international-port-terminal>

Arcspace, 2007. Yokohama international port terminal, April 05, 2007. Accessed on 20S September 2013, at <http://www.arcspace.com/features/foreign-office-architects/yokohama-international-port-terminal/>

Arup, 2013. World first bio-reactive façade debuts in Hamburg. Accessed on 20 June 2013 at <http://www.arup.com/News/2013_03_March/22_March_Hamburg_debut_for_first_bio_reactive_facade.aspx integrated algae-based system>

Atkins, P., 2010. The laws of thermodynamics. Oxford Univ. Press, Oxford.

Ashton, T.S., 1997. The industrial revolution, 1760-1830, 1997 ed. ed. Oxford University Press, Oxford ; New York.

Baker, C., Sampson, J., Dodd, N., Maurel, C., 2011. Alpha Farm: A scalable schematic design. URBED.

Ben-Naim, A., 2012. Entropy and the second law: interpretation and miss-interpretations. WS, World Scientific, Singapore ; London.

Burgess, G.H.O., 1967. Fish Handling and Processing. First Edition. Chemical Publishing Company

Burtynsky, E., 2006. Manufactured Landscapes (documentary)

Cardwell, D.S.L., 1971. From Watt to Clausius: the rise of thermodynamics in the early industrial age. Heinemann Educational, London.

Charsley, S.R., 1982. Culture and sericulture: social anthropology and development in a South Indian livestock industry, Studies in anthropology. Academic Press, London ; New York, N.Y.

Conrads, U., 1970. Erich Mendelsohn: Dynamics and function (excerpt). programmes and manifestoes on 20th-century architecture, 1st English language ed. ed. MIT Press, Cambridge, Mass. P72-73.

Cossons, N., 2012. Why preserve the industrial heritage?. Industrial heritage re-tooled: the TICCIH guide to industrial heritage conservation. P16-16.- Carnegie Publishing Ltd, Lancaster.

De Kock, K.N.; Wolmarans, C.T., 2008. Distribution of the pill clam Pisidium langleyanum Melvill & Ponsonby, 1891 (Bivalvia: Sphaeriidae) in South Africa. Water SA (Online), Pretoria, v. 34, n. 5, Oct. 2008 . Available from <http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S1816-79502008000500012&lng=en&nrm=iso>. access on 18 Oct. 2013.

Douet, J., 2012. Industrial heritage re-tooled: the TICCIH guide to industrial heritage conservation. Carnegie Publishing Ltd, Lancaster.

Du Plessis, C. 2011. Shifting paradigms to study urban sustainability.In proceedings Vol 1: SB11- World Sustainable Building Conference, October 18 - 21, Helsinki, Finland.

Du Plessis, C. 2012. Towards a regenerative paradigm for the built environment, Building Research & Information, 40:1, 7-22

Farabee, M.J., 2001. LAWS OF THERMODYNAMICS [WWW Document]. URL http://www.emc.maricopa.edu/faculty/farabee/biobk/biobookener1.html (accessed 6.2.13).

Fragner, B., 2012. Adaptive re-use. Industrial heritage re-tooled: the TICCIH guide to industrial heritage conservation. p110-117. Carnegie Publishing Ltd, Lancaster.

Future Timeline, 2013. The world's first algae-powered building, 13 April 2013. Accessed on 20 June 2013, at <http://www.futuretimeline.net/blog/2013/april.htm#.UmJyGxBl-1w>

HAMESTER, M., BALZER, P., BECKER, D., 2012. Characterization of calcium carbonate obtained from oyster and mussel shells and incorporation in polypropylene. Mat. Res., São Carlos , v. 15, n. 2, Apr. 2012 . access on 17 October 2013 at <http://www.scielo.br/scielo.php?script=sci__arttext&pid=S1516-14392012000200006&lng=en&nrm=iso>

Hilbrands, A., Yzerman, C., Agromisa (Organization), 1998. On-farm fish culture. Agromisa, Wageningen, Netherlands.

HOLLING, C. S., GUNDERSON, L. H. and PETERSON, G. D., 2002. 'Sustainability and Panarchies', in Gunderson, L. H. & Holling, C. S., Panarchy. Understanding transformations in human and natural systems, Washington DC, Island Press, pp. 63-102.

Holling, C.S., 2002. Panarchy: understanding transformations in human and natural systems. Island Press, Washington, DC.

Joubert, F.G., Mentz, J.P., 1971. Verslag oor navorsing ten opsigte van die groei van Pretoria volgens sy geboue en geboude areas tot en met 1970.

Kirkwood, N., 2001. Manufactured sites: rethinking the post-industrial landscape. Taylor & Francis, London; New York.

Latour, B., 2005. Reassembling the social: an introduction to actor-network-theory. Oxford University Press, Oxford; New York.

Latz, P., 2001. Landscape Park Duisburg-Nord: The metamorphosis of an industrial site. Chapter 11 in; Manufactured sites: rethinking the post-industrial landscape. P.150-161. Taylor & Francis, London; New York.

Mah, A., 2012. Industrial ruination, community, and place: landscapes and legacies of urban decline. University of Toronto Press, Toronto.

Mang, P., Reed, B., 2012. Designing from place: a regenerative framework and methodology, Building Research & Information, 40:1, 23-38

McIvor, A.L., 2004. Freshwater mussels as biofilters. PhD thesis, Dep't of Zoology, University of CamBridge.

Nelson, R.G., Behrends, L.L., 1982. CASE STUDY OF TWO SMALL-SCALE TILAPIA PROCESSING OPERATIONS. Journal of the World Mariculture Society 13, 221-226.

Okada, M., 2012. Industrial ruins. Industrial heritage re-tooled: the TICCIH guide to industrial heritage conservation. p149-154. Carnegie Publishing Ltd, Lancaster.

Reed, W., Eisenberg D., 2003. Regenerative Design: Toward the Re-Integration of Human Systems within Nature.

Roger, F., Chen, R., 1984. The consumption and utilization of the spiral blue-green algae Spirulina platensis in artificial diets by the silkworm, Bombyx mori. Department of Entomology, National Chung Hsing University, Taichung, Taiwan 400, Republic of China.

Roux, A., 2013. Development goes ahead. Rekord Pretoria East.

Ruddle, K., 1988. Integrated agriculture-aquaculture in South China: the dike-pond system of the Zhujiang Delta. Cambridge University Press, Cambridge [Cambridgeshire] ; New York.

Seaton Thomson and Associates, 2003. Scoping Report for the Proposed Development of Remaining Extent of the Farm Waterkloof 428-JR: Waterkloof Marina Estate.

Smithson, R., 1973. Entropy made visible [WWW Document]. Selected interviews with Robert Smithson. URL http://www.robertsmithson.com/essays/entropy.htm (accessed 5.31.13).

Spirn, A., 2012. ECOLOGICAL URBANISM : A FRAMEWORK FOR THE DESIGN OF RESILIENT CITIES.

Stockholm Resilience Centre, 2009.Planetary Boundaries. Accessed on 18 October 2013, at <http://www.stockholmresilience.org/planetary-boundaries>

Stuart, I., 2012. Identifying industrial landscapes. Industrial heritage re-tooled: the TICCIH guide to industrial heritage conservation. P48-54. Carnegie Publishing Ltd, Lancaster.

Tempel, N., 2012. Post-industrial landscapes. Industrial heritage re-tooled: the TICCIH guide to industrial heritage conservation. p142-148. Carnegie Publishing Ltd, Lancaster.

Udall, M., 2012. Celebrating Earth Day.The Huffington Post. Accessed on 19 October 2013 at <http://www.huffingtonpost.com/sen.-mark-udall/celebrating-earth-day_b_1444073.html>

United Nations, 2004. World Population to 2300. Department of Economic and Social Affairs, Population Division. New York. Accessed on 12 June 2013 at <http://www.un.org/esa/population/publications/longrange2/WorldPop2300final.pdf>

Watson, M., 2012. Adaptive re-use and embodied energy. Industrial heritage re-tooled: the TICCIH guide to industrial heritage conservation. p136-141. Carnegie Publishing Ltd, Lancaster.

Webb, M. 2003. Cruise Control. Architectural Review. January 2003. p. 26-35

Woods, L., 2012. Inevitable Architecture. Available from: <http://lebbeuswoods.wordpress.com/2012/07/09/inevitable-architecture/> [Accessed: 6 March 2013].

(http://www.un.org/esa/population/publications/longrange2/WorldPop2300final.pdf)

http://www.statssa.gov.za/ - Tshwane census info

http://ww.census.adrianfirth.com/place/77612139 - Waterkloof Ridge Census

Lettie vd. Berg, interview, 2013

Cyril Connolly. (n.d.). BrainyQuote.com. Retrieved October 18, 2013, from BrainyQuote.com Web site: http://www.brainyquote.com/quotes/quotes/c/cyrilconno136808.html Read more at http://www.brainyquote.com/citation/quotes/quotes/c/cyrilconno136808.html#UsKtLQJ3G9PrfX3g.99

Statistics South Africa, 2003. Census 2001: Census in Brief. Accessed on 13 March 2013 at <http://www.statssa.gov.za/census01/html/CInbrief/CIB2001.pdf>

Regenerative Development Framework. Accessed 17 January 2013 at <http://www.regenesisgroup.com/RegenerativeDevelopment/TRPSeriesSession1>

Aansoek om vergunningsgebruik: 'n Gedeelte van die Plaas Waterkloof 428-JR. City Council of Pretoria. 17 November 1981.

Appél: Gedeelte 43 van die Plaas Waterkloof 478-JR: Rosema an Klaver (EDMS) BPK. Departement van Plaaslikke Bestuur. 2 November 1982

Rehabilitation & Development Plan for Rosema & Klaver Quarry.

Plan Medewerkers, nd. Rosema & Klaver Steengroef Aksieplan

The Nizhny Tagil Charter for the Industrial Heritage / July, 2003 - nizhny-tagil-charter-e.pdf [WWW Document], n.d. URL http://www.icomos.org/18thapril/2006/nizhny-tagil-charter-e.pdf (accessed 6.2.13).

National Heritage Resources Act, Act 25 of 1999, Government Notice 506, Republic of South Africa Government Gazette, Vol. 406, No 19974, Cape Town, 28 April 1999

earthrise - Veta La Palma, 'Algae-Culture' fish farm, 6 April 2012)(http://www.youtube.com/watch?v=pzoY7lMQAVM

Gauteng Department of Agriculture and Rural Development (GDARD). Gauteng explores fishing farming. Date: 12/10/2012 Accessed 19 April 2013; http://www.gdard.gpg.gov.za/MediaRoom/News/Pages/Gautengexploresfishingfarming.aspx

The Feasibility of a mollusk shell-based adhesive as a substitute for mortar:Bato balani, Sophomore vol. 24, no. 2, SY 2004-2005. Accessed on 17 October 2013 at <http://scinet.dost.gov.ph/union/ShowSearchResult.php?s=2&f=&p=&x=&page=&sid=1&id=The+Feasibility+of+a+mollusk+shell-based+adhesive+as+a+substitute+for+mortar&Mtype=PROJECTS>

[CSIR e-News: CSIR counted among the best in algal biodiesel research, October 2008 [WWW Document], n.d. URL http://www.csir.co.za/enews/2008_oct/bio_01.html (accessed 7.11.13).]

IEA Bioenergy, 2010. Algae - The Future for Bioenergy (No. ExCo:2010:02).

http://www.oilgae.com/non_fuel_products/non_fuel_products_from_algae.html

http://www.oilgae.com/ref/glos/biorefinery.html - Biorefinery - Definition, Glossary, Details - Oilgae
http://www.algaeindustrymagazine.com/scalable-algae-microfarms-part-1/- Why algae microfarms are emerging today

http://www.alohaecowas.com/ - Diversified Agriculture Proposal

Silkworm Rearing (Mulberry). Booklet No. 448. Accesessed on 15 march 2013, at <http://www.inseda.org/Additional%20material/CD%20-%20Agriculture%20and%20Environment%20Education/67-Sericulture%20(SERS)/Silkworm%20Rearing-Mulberry-448.doc>

Sericulture Manual: Standard operating porcedures. Published by Directorate of Sericulture, Assam.

How to cultivate mulberry and rear silkworm - The best practices. Accessesed 15 March 2013 at http://www.indg.in/pdf-files/how-togrow-best-silk.pdf

Silk Worm Rearing . Accessed on 18 August 2013, at <http://www.csrtimys.res.in/sites/default/files/menufiles/phamplet-rh.pdf>

Development of solar passive building for silkworm seed crop rearing. Accessed on 12 August 2013 at <http://www.teriin.org/upfiles/pub/papers/Indian_silk_20130322163405.pdf>

(www.arenet.or.ug/answer.php?id=839) - Agriculture research Extension Network
Source: A Guide to Sericulture practices in Uganda Vol. 4 Rearing house construction and equipment

(http://www.arenet.or.ug/answer.php?id=838) -
Source: Silk Farming in Uganda. Sericulture. What You Need To Know by MAAIF

Universitat Politècnica de Catalunya, 2012. Researchers at the UPC develop a biological concrete for constructing "living" façades with lichens, mosses and other microorganisms .http://www.upc.edu/saladepremsa/saladepremsa/al-dia/mes-noticies/researchers-at-the-upc-develop-a-biological-concrete-for-constructing-201cliving201d-facades-with-lichens-mosses-and-other-microorganisms

Brownell, B., 2013. Biological Concrete for Living Façades, January 22, 2013. Ecobuilding Pulse. http://www.ecobuildingpulse.com/concrete/biological-concrete-for-living-fa-ades.aspx

Mostafavi, M., 1993. On weathering: the life of buildings in time. MIT Press, Cambridge, Mass.

In accordance with Regulation 4(e) 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.

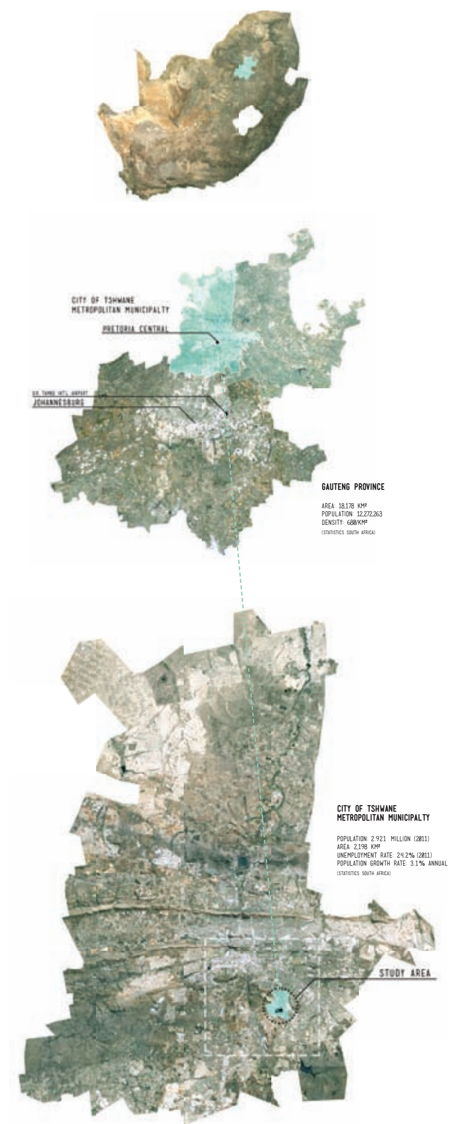
I further state that no part of my thesis has already been, or is currently being, submitted for any such degree, diploma or other qualification.

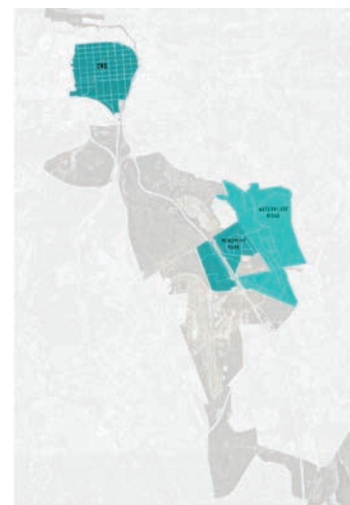
I further declare that this thesis is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

Ingmar Büchner
November 2013

"Give a man a fish and you feed him for a day. Teach a man to fish and you feed him till stocks run out. Teach a man to grow fish and you feed him for a lifetime."

GREATER URBAN CONTEXT





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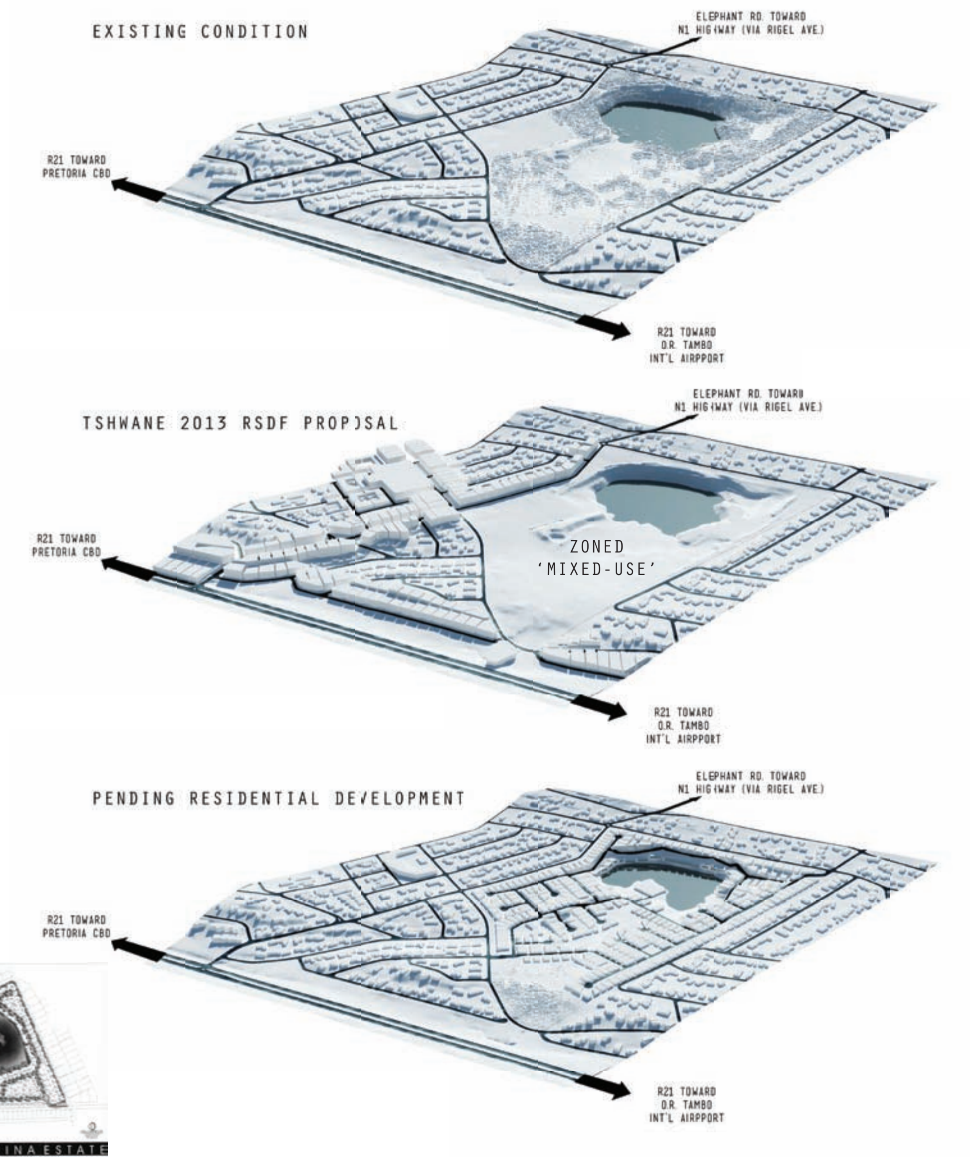
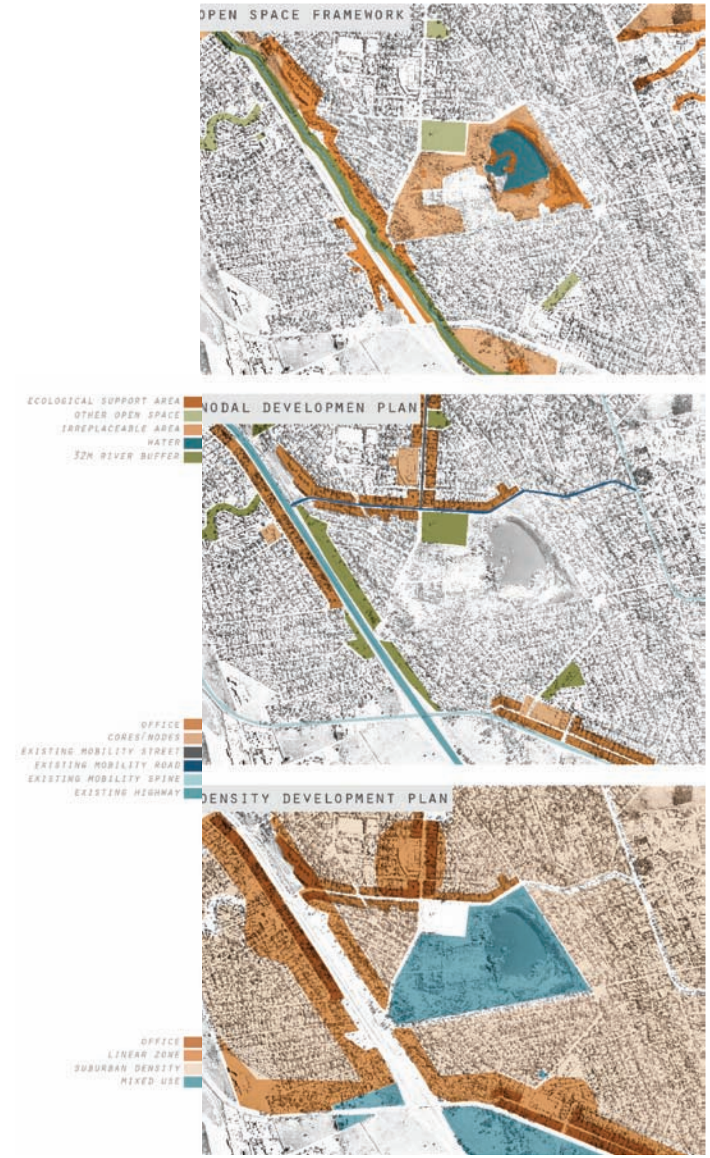
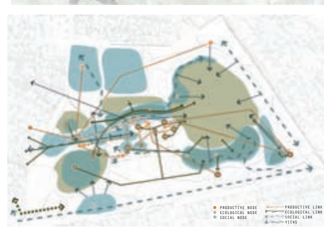




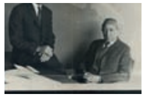
PROPOSED URBAN VISION



LATENT POTENTIAL: A POST - INDUSTRIAL ARTEFACT

STORY OF PLACE

ABANDONED INDUSTRY



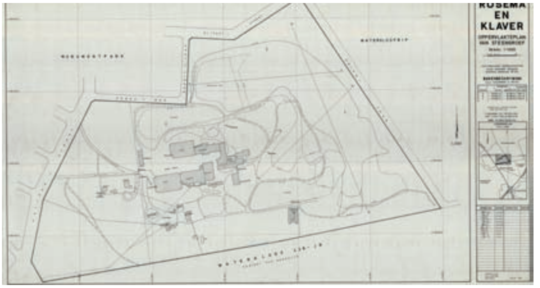











EARLY INDUSTRIAL ACTIVITY SURROUNDED BY AGRICULTURE + THE


Quarry a crime cesspit

Concern over derelict quarry on the rise

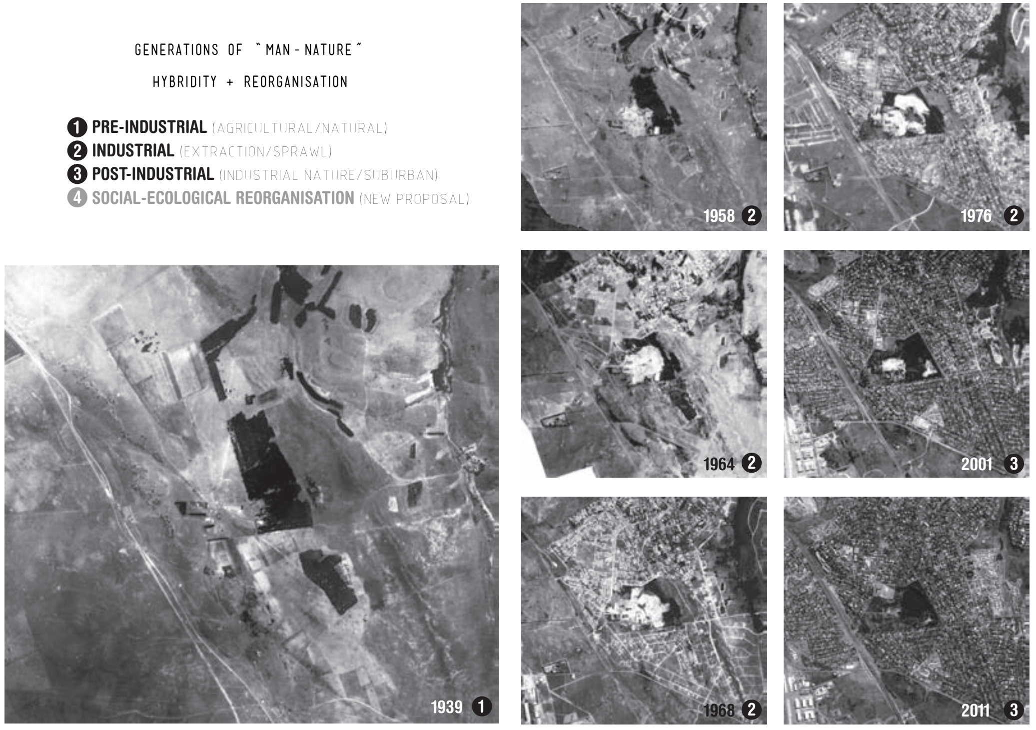
Groef knou spogbuurt

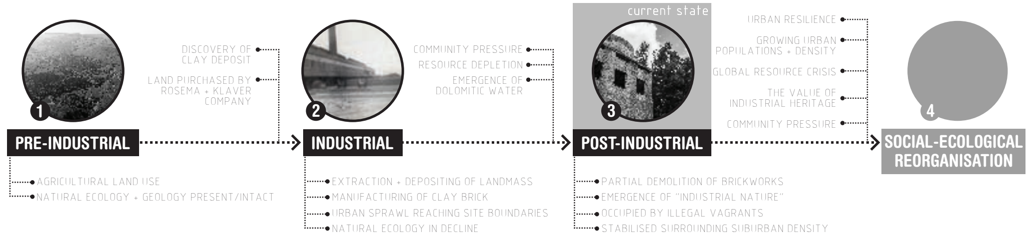
GENERATIONS OF HYBRIDITY

GENERATIONS OF " MAN - NATURE "

HYBRIDITY + REORGANISATION

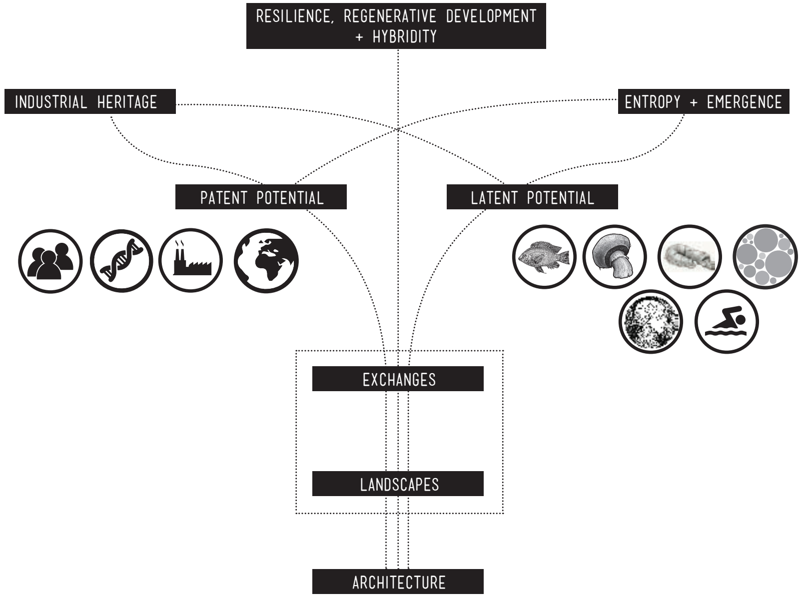
1. **PRE-INDUSTRIAL** (AGRICULTURAL/NATURAL)
2. **INDUSTRIAL** (EXTRACTION/SPRAWL)
3. **POST-INDUSTRIAL** (INDUSTRIAL NATURE/SUBURBAN)
4. **SOCIAL-ECOLOGICAL REORGANISATION** (NEW PROPOSAL)



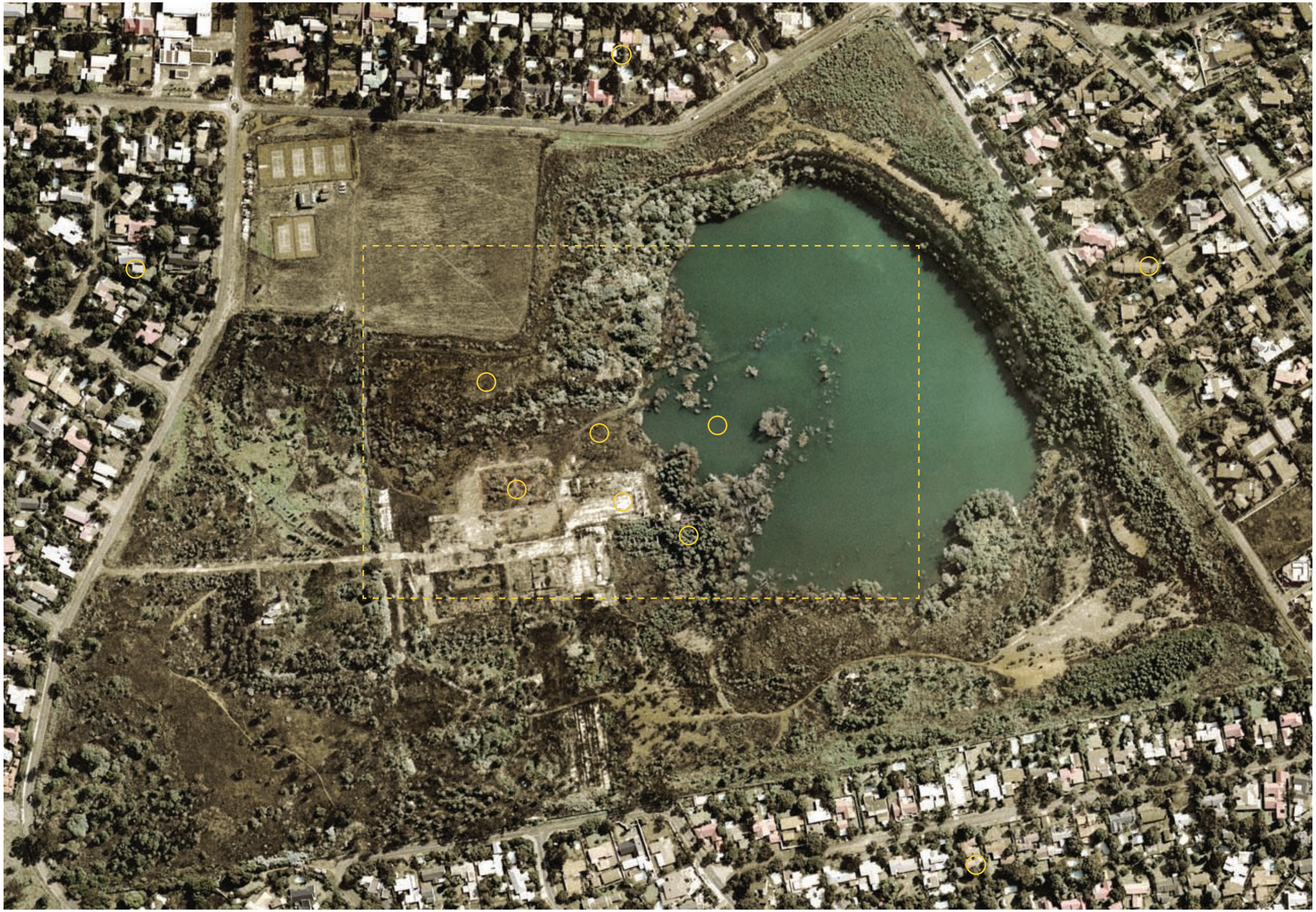


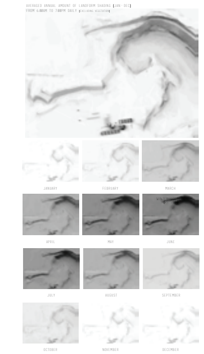
HIERARCHY OF DESIGN INFORMANTS

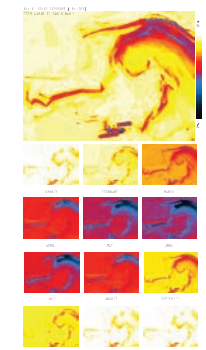
TO INFLUENCE THE 4TH GENERATION'S REORGANISATION

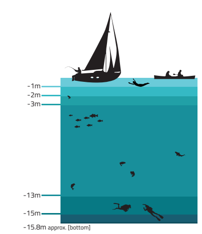


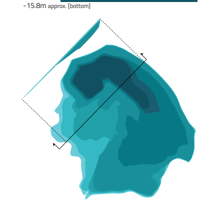
PATENT POTENTIAL



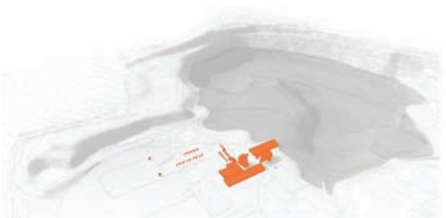




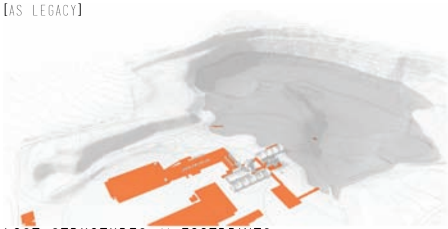




HISTORICAL POTENTIAL



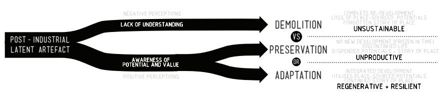
REMAINING STRUCTURES // RUINS
[AS LEGACY]

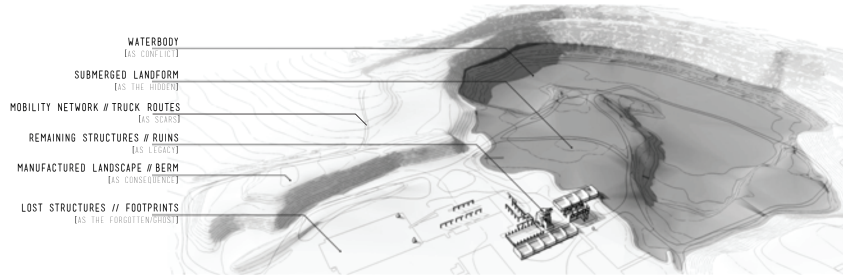


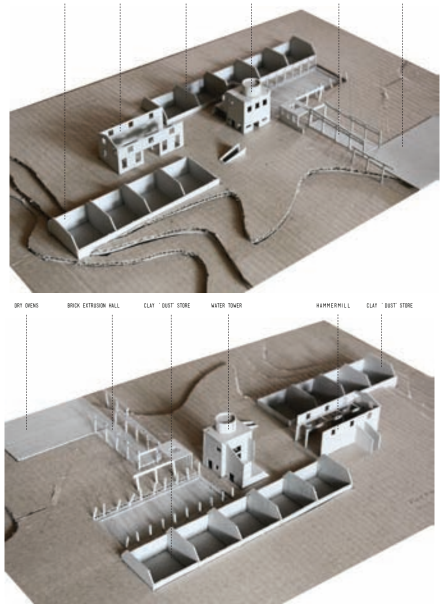
LOST STRUCTURES // FOOTPRINTS
[AS THE FORGOTTEN/GHOST]

MANUFACTURED LANDSCAPE // BERM
[AS CONSEQUENCE]

MOBILITY NETWORK // TRUCK ROUTES
[AS SCARS]





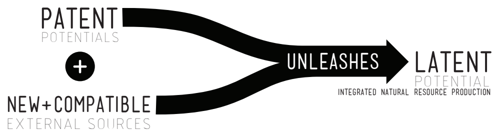


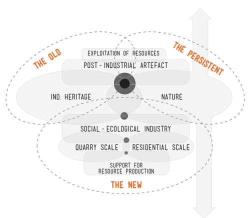
REMAINING STRUCTURES // RUINS [AS LEGACY] | LOST STRUCTURES // FOOTPRINTS [AS THE FORGOTTEN/GHOST] | MANUFACTURED LANDSCAPE // BERM [AS CONSEQUENCE] | MOBILITY NETWORK // TRUCK ROUTES [AS SCARS]

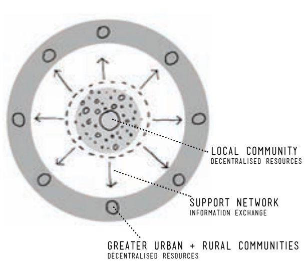
QUARRY

fig 2.45 Cross-referencing of Rosema + Klaver quarry in Waterkloof Ridge and the ERA Bricks facility in Eersterus, photographs by Author (2013)

LATENT PRODUCTIVE POTENTIAL



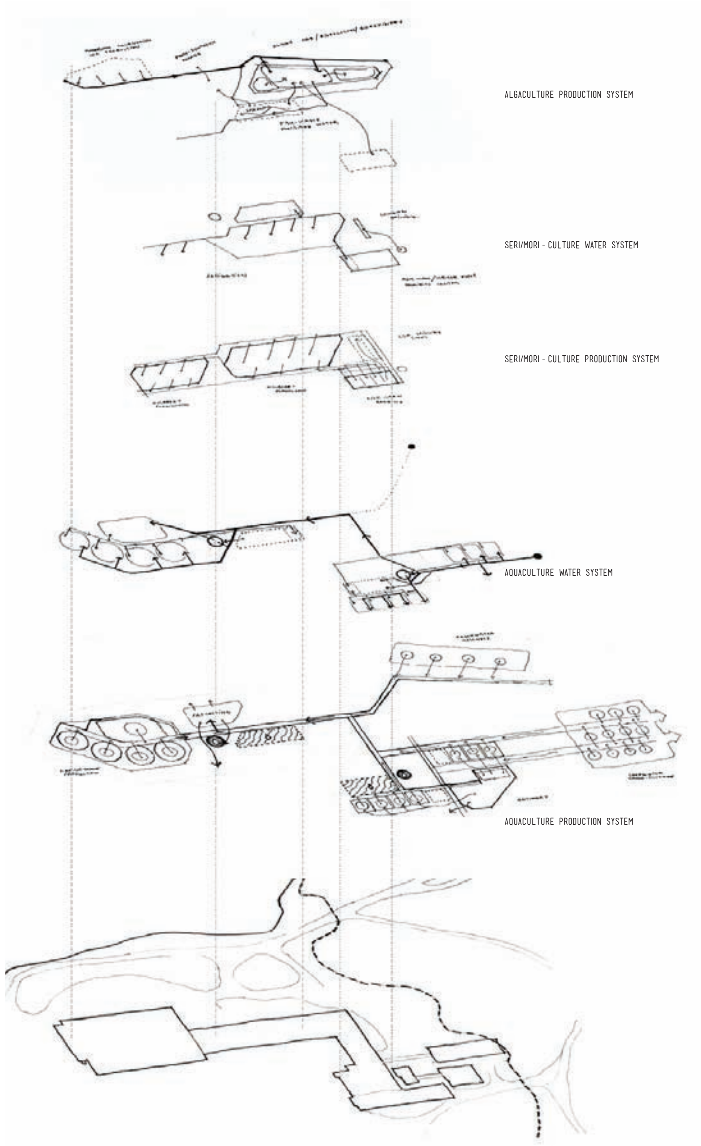


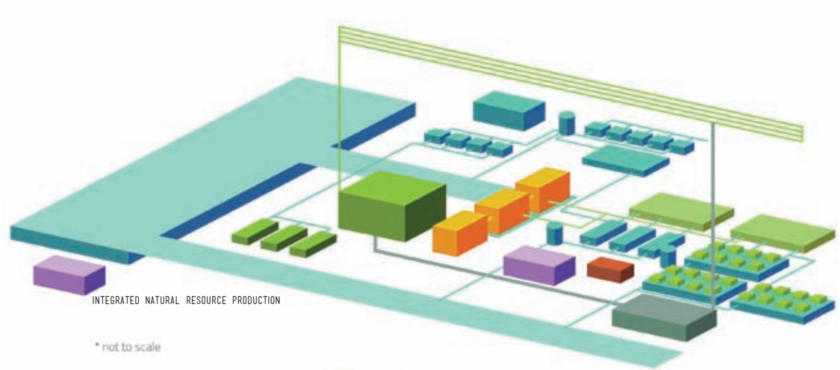


FLAT PANEL PHOTO BIOREACTOR FACADE, BIQ HOUSE, HAMBURG GERMANY

ANGKOR SILK FARM, CAMBODIA

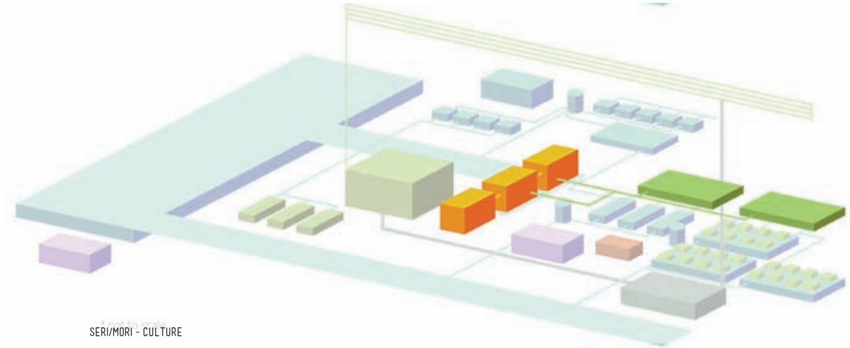
GRASKOP SILK FARM, SOUTH AFRICA



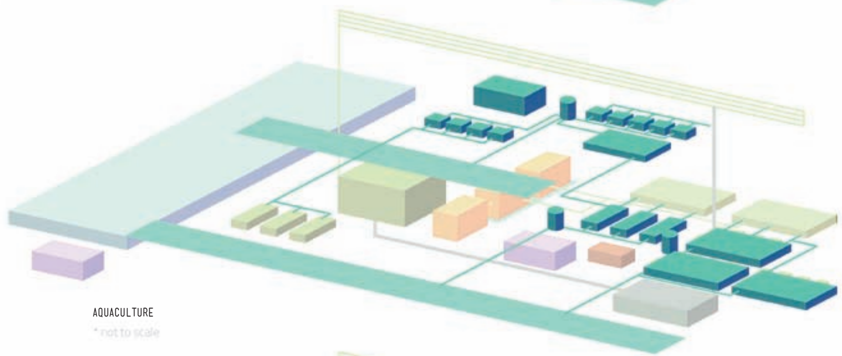


INTEGRATED NATURAL RESOURCE PRODUCTION

* not to scale

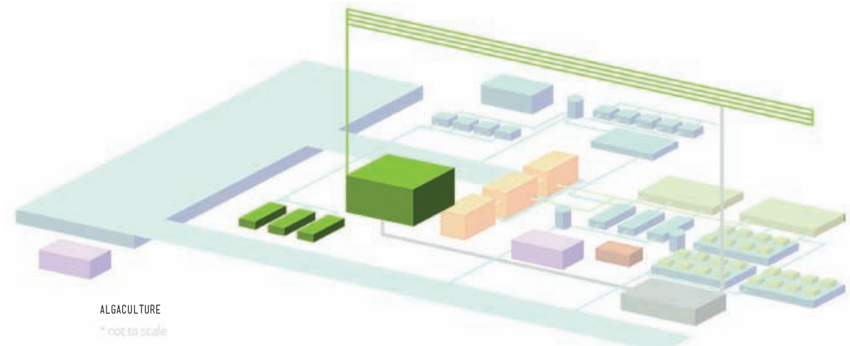


SERI/MORI - CULTURE



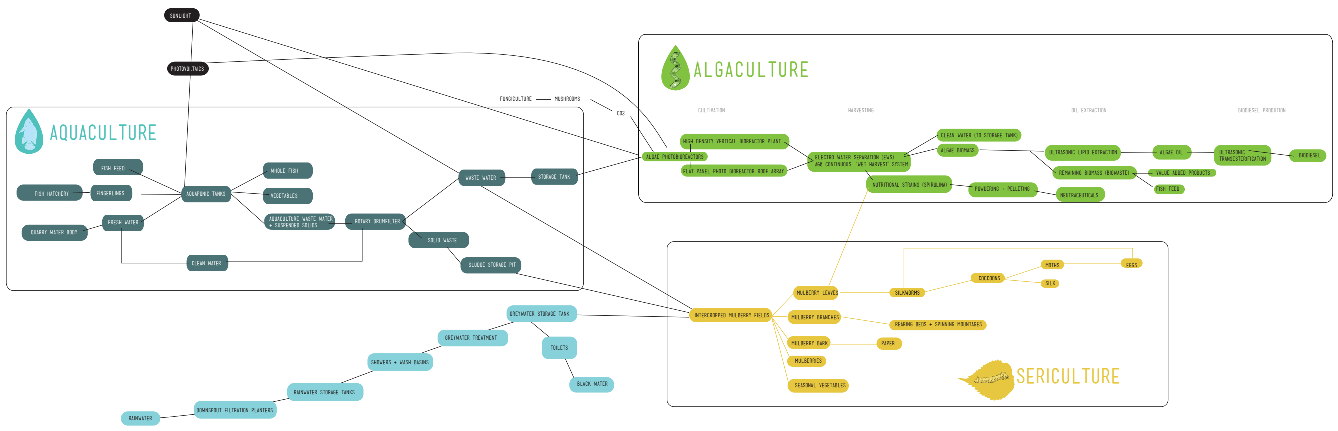
AQUACULTURE

* not to scale

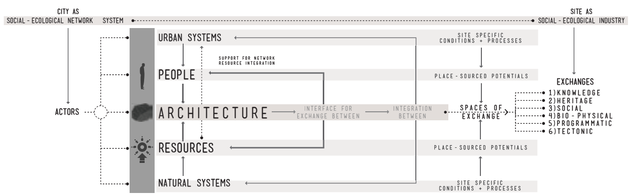


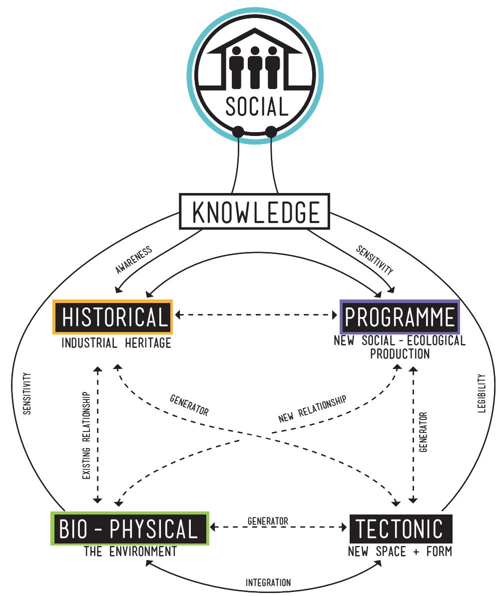
ALGACULTURE

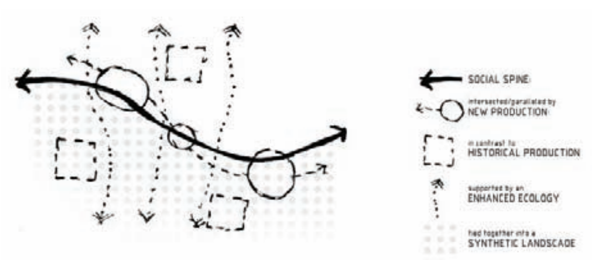
* not to scale

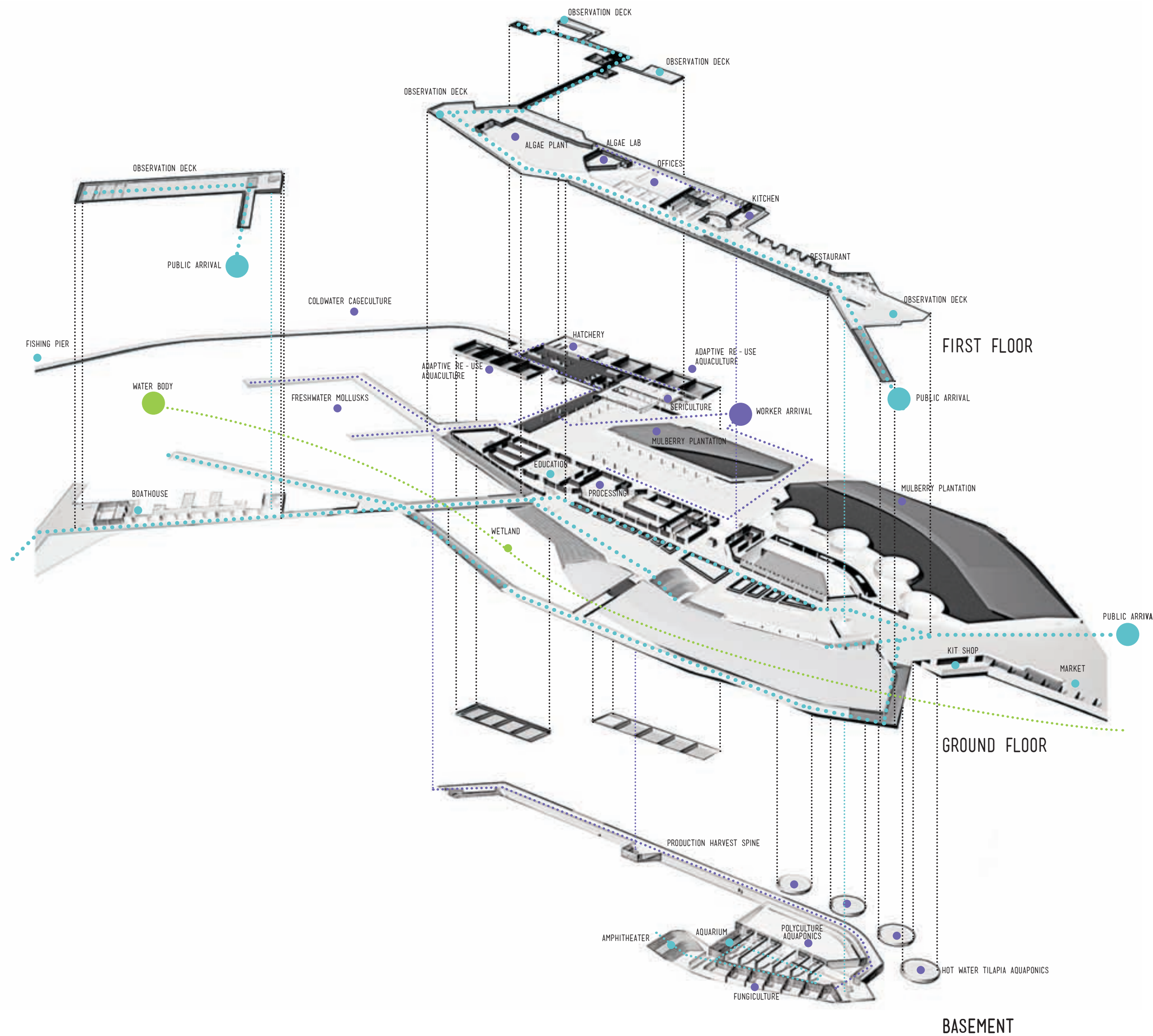


EXCHANGES

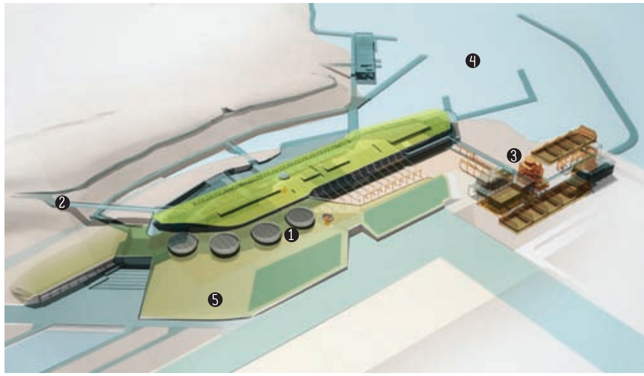

CITY AS SOCIAL - ECOLOGICAL NETWORK SYSTEM
SITE AS SOCIAL - ECOLOGICAL INDUSTRY
URBAN SYSTEMS
PEOPLE
ARCHITECTURE
RESOURCES
NATURAL SYSTEMS
ACTORS
SITE SPECIFIC CONDITIONS + PROCESSES
PLACE - SOURCED POTENTIALS
SPACES OF EXCHANGE
EXCHANGES
1)KNOWLEDGE
2)HERITAGE
3)SOCIAL
4)BIO - PHYSICAL
5)PROGRAMMATIC
6)TECTONIC

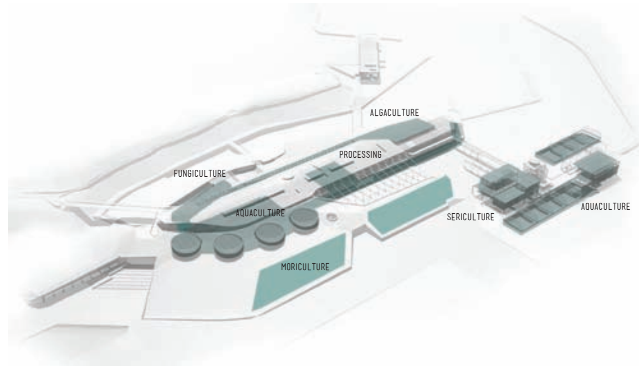

SOCIAL
KNOWLEDGE
AWARENESS
SENSITIVITY
HISTORICAL
INDUSTRIAL HERITAGE
PROGRAMME
NEW SOCIAL - ECOLOGICAL PRODUCTION
SENSITIVITY
LEGIBILITY
EXISTING RELATIONSHIP
GENERATOR
NEW RELATIONSHIP
GENERATOR
BIO - PHYSICAL
THE ENVIRONMENT
GENERATOR
TECTONIC
NEW SPACE + FORM
INTEGRATION


SOCIAL SPINE
intersected/paralleled by NEW PRODUCTION
in contrast to HISTORICAL PRODUCTION
supported by an ENHANCED ECOLOGY
tied together into a SYNTHETIC LANDSCAPE

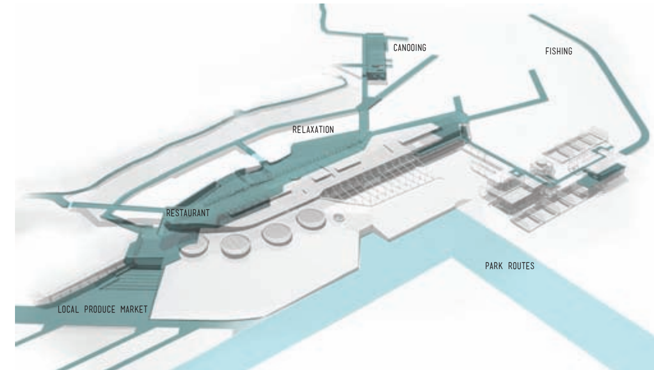

OBSERVATION DECK
OBSERVATION DECK
OBSERVATION DECK
ALGAE PLANT
ALGAE LAB
OFFICES
KITCHEN
RESTAURANT
OBSERVATION DECK
OBSERVATION DECK
PUBLIC ARRIVAL
COLDWATER CAGECULTURE
FISHING PIER
HATCHERY
ADAPTIVE RE - USE AQUACULTURE
ADAPTIVE RE - USE AQUACULTURE
FIRST FLOOR
WATER BODY
FRESHWATER MOLLUSKS
SERICULTURE
WORKER ARRIVAL
PUBLIC ARRIVAL
MULBERRY PLANTATION
EDUCATION
BOATHOUSE
PROCESSING
MULBERRY PLANTATION
WETLAND
PUBLIC ARRIVAL
KIT SHOP
MARKET
GROUND FLOOR
PRODUCTION HARVEST SPINE
AMPHITHEATER
AQUARIUM
POLYCULTURE AQUAPONICS
HOT WATER TILAPIA AQUAPONICS
FUNGICULTURE
BASEMENT

INTEGRATED LANDSCAPES

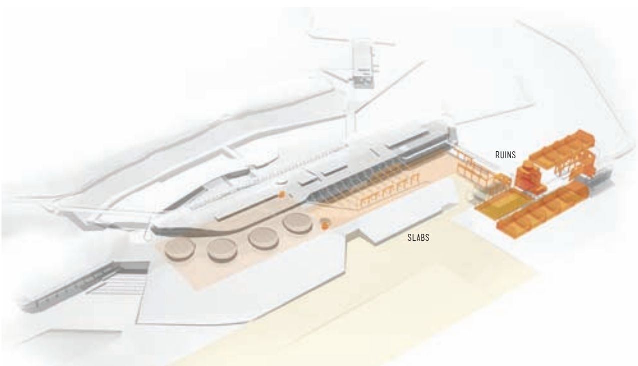




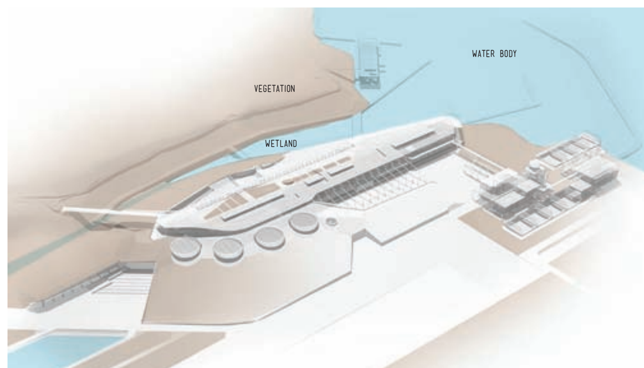
1 PRODUCTIVE LANDSCAPE



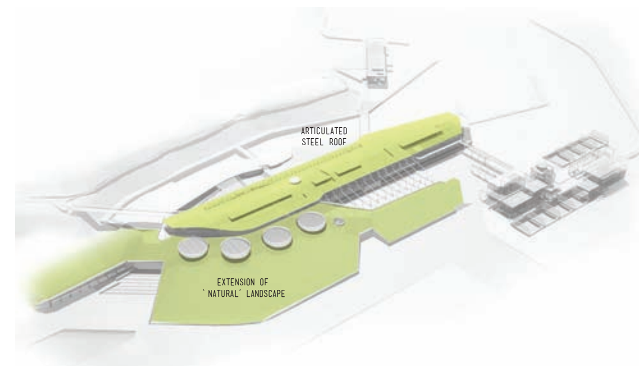
2 SOCIAL LANDSCAPE



3 HISTORICAL LANDSCAPE



4 ECOLOGICAL LANDSCAPE



5 SYNTHETIC LANDSCAPE

DESIGN

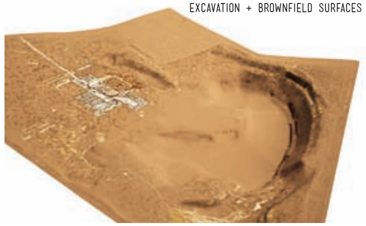
NEW INTERVENTION

ROUTES

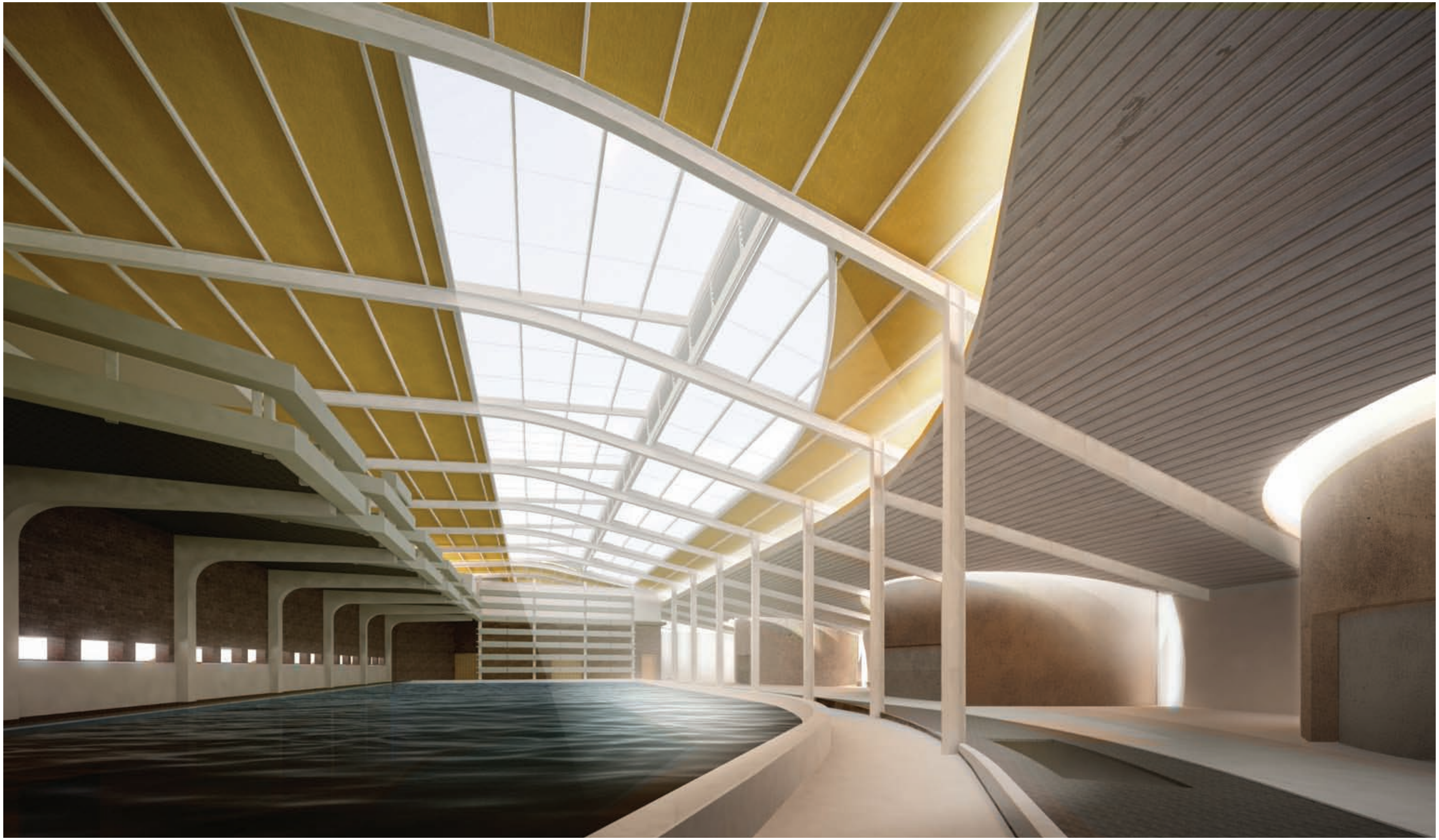
EXTANT FABRIC

WATER

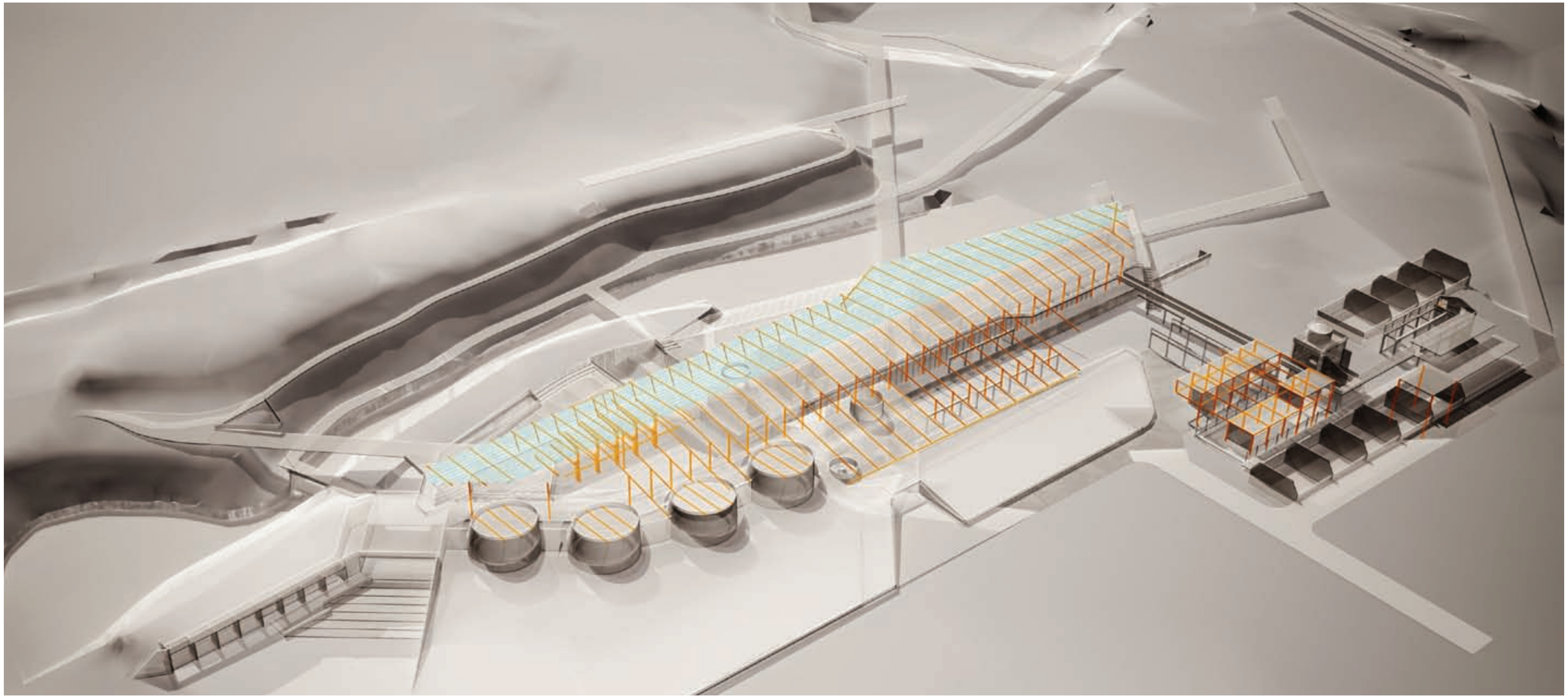
EXCAVATION + BROWNFIELD SURFACES

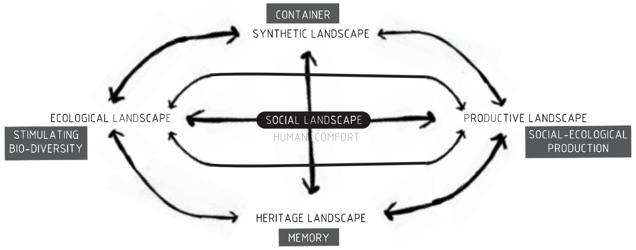


AQUACULTURE HALL INTERIOR

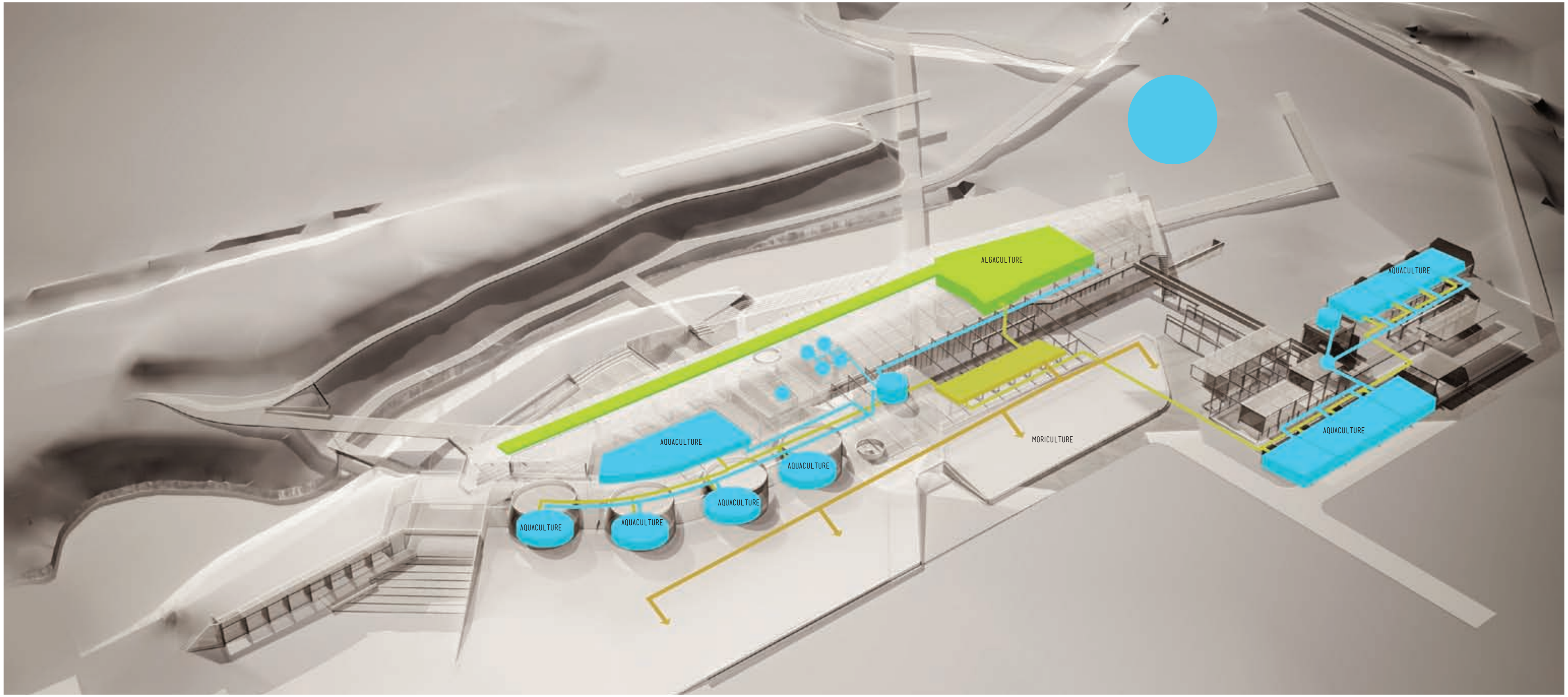


DESIGN




CONTAINER
SYNTHETIC LANDSCAPE
ECOLOGICAL LANDSCAPE
STIMULATING BIO-DIVERSITY
SOCIAL LANDSCAPE
HUMAN COMFORT
PRODUCTIVE LANDSCAPE
SOCIAL-ECOLOGICAL PRODUCTION
HERITAGE LANDSCAPE
MEMORY


ECOLOGICAL LANDSCAPE
PERMEABLE PAVING
BIO - CONCRETE
HERITAGE LANDSCAPE
WEATHERING STEEL CLADDING
TIMBER INFILL
BRICK + CONCRETE ADAPTIVE RE - USE
PRODUCTIVE LANDSCAPE
POLY - CARBONATE GLAZING
GALVANISED STEE SURFACES
CONCRETE + FIBRE CEMENT
SOCIAL LANDSCAPE
BAMBOO PLYWOOD
TIMBER SURFACES
SILK TEXTILES
SYNTHETIC LANDSCAPE
BRICK
RED CLAY STAINED COCRETE
STEEL ROOF SHETING

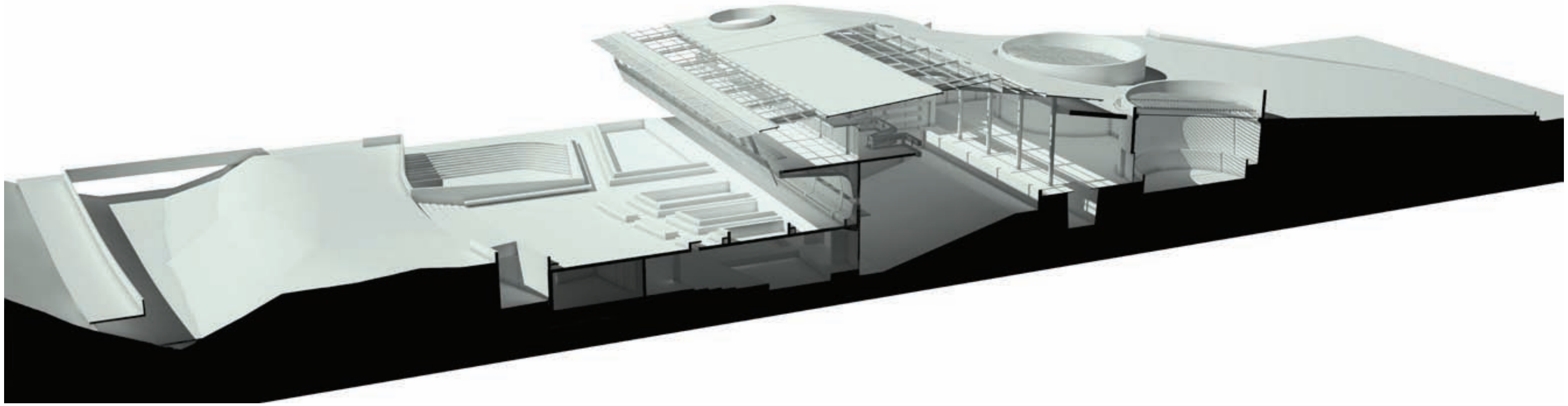


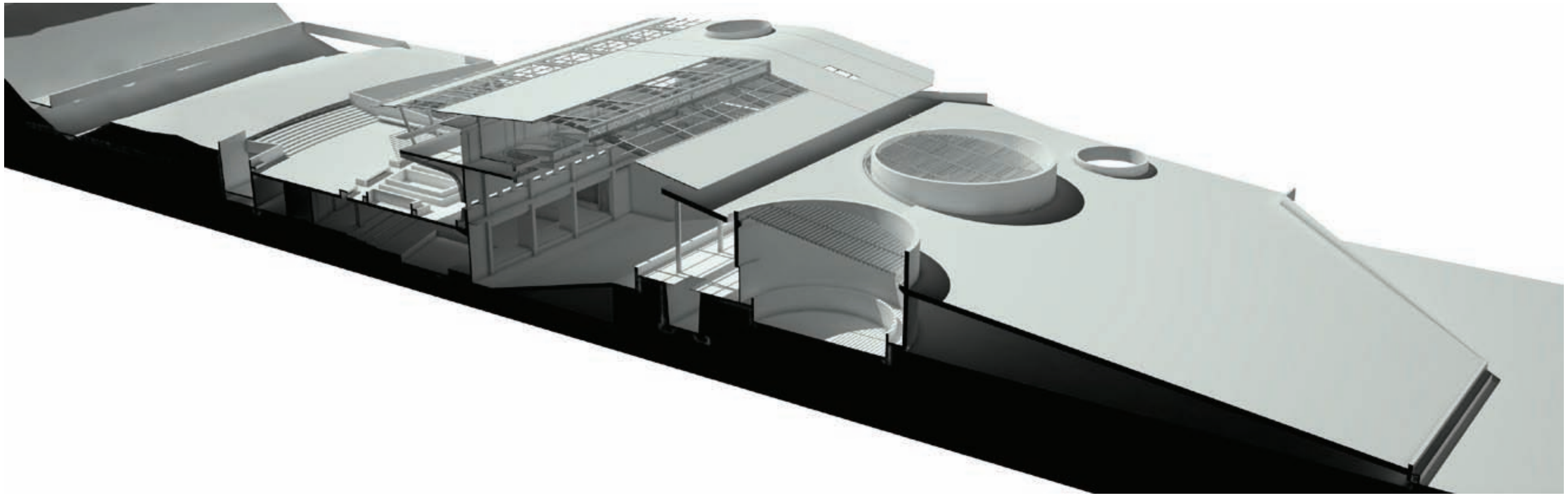
FRESH/CLEAN WATER

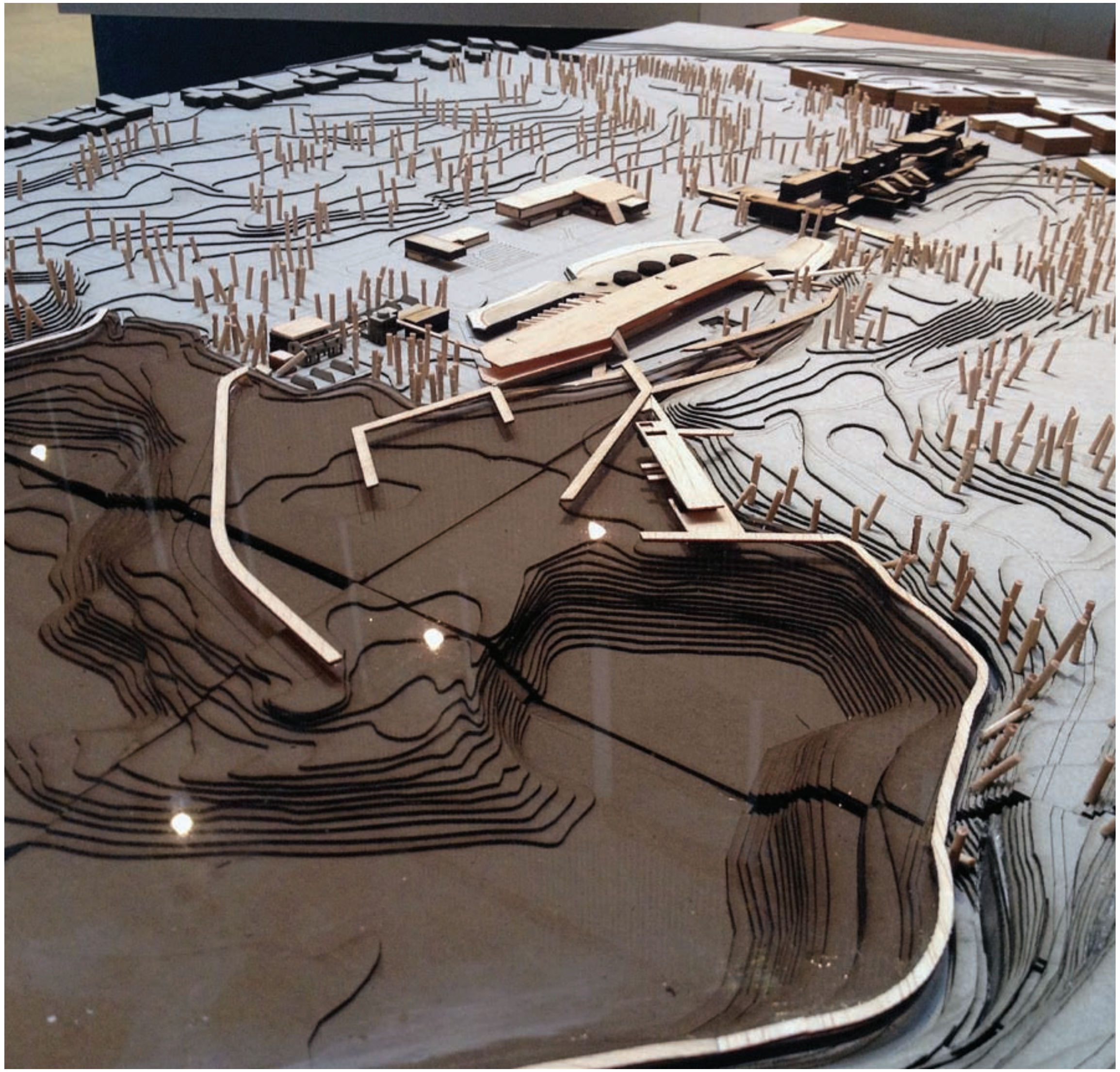
ALGAE INTEGRATED WATER TREATMENT

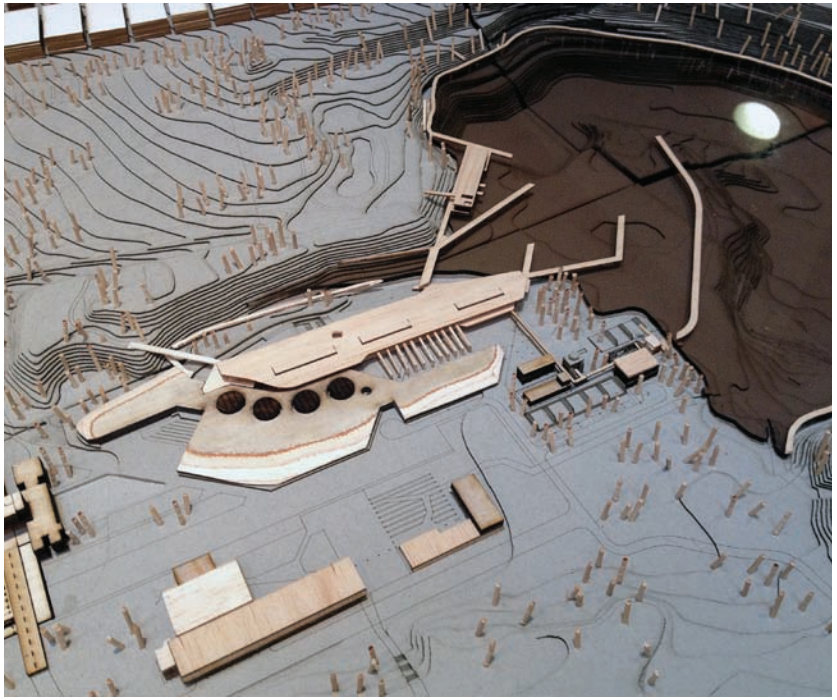
'FERTILISED' POND WATER

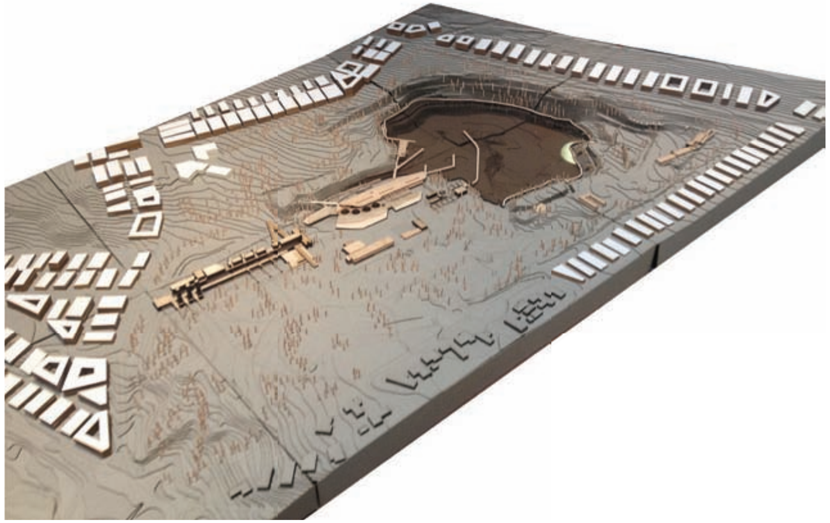
ENVIRONMENTAL SYSTEMS

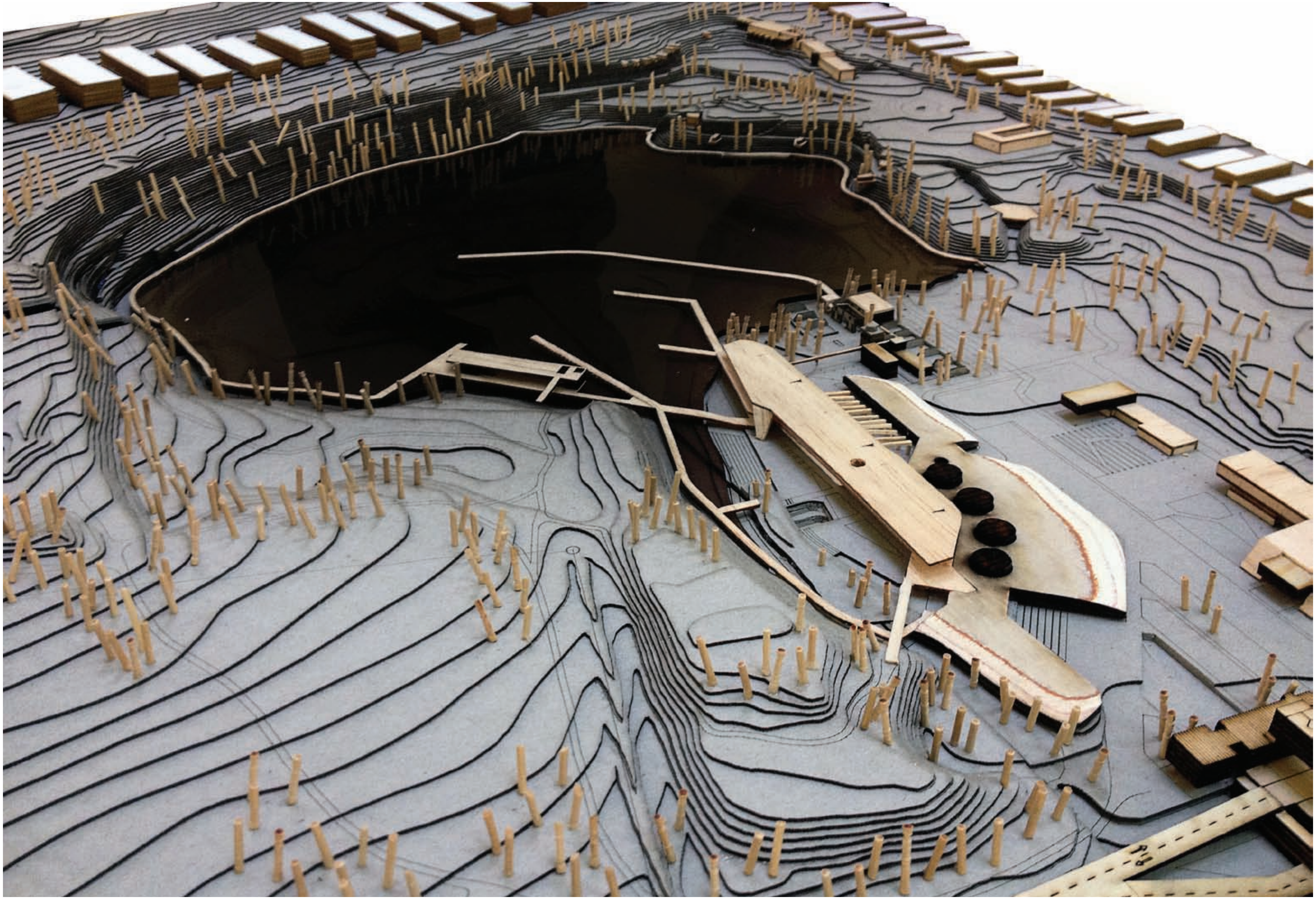


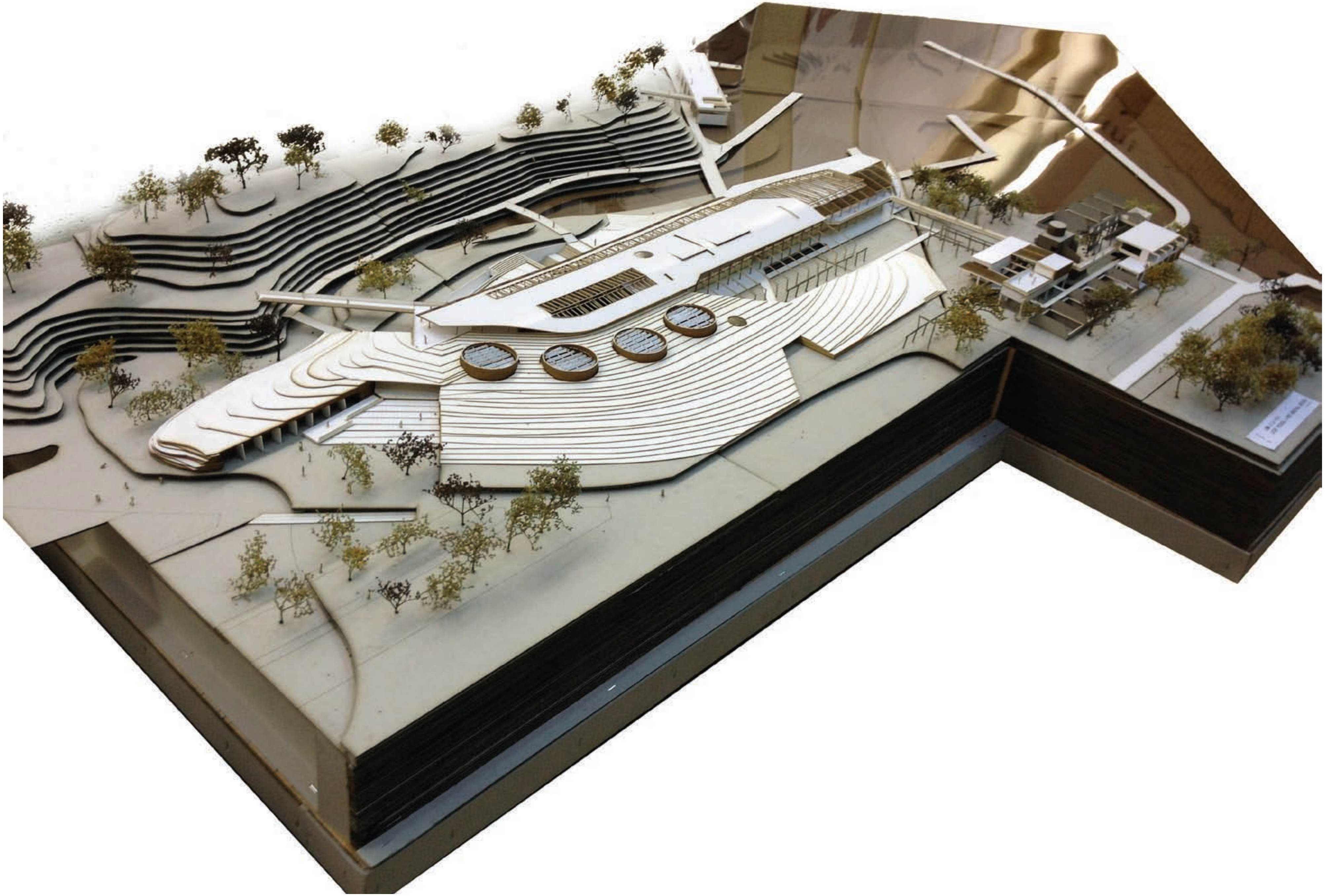


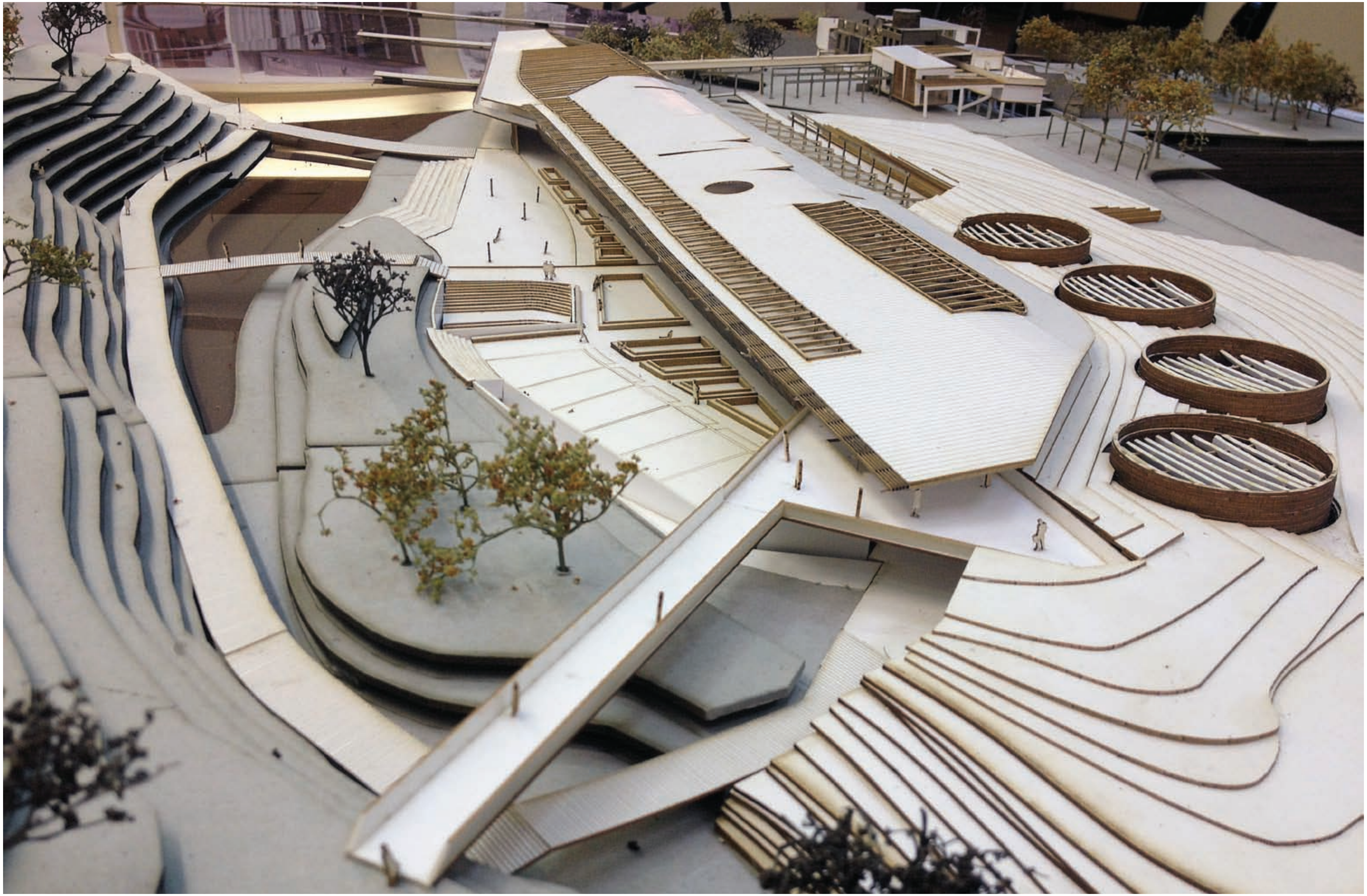


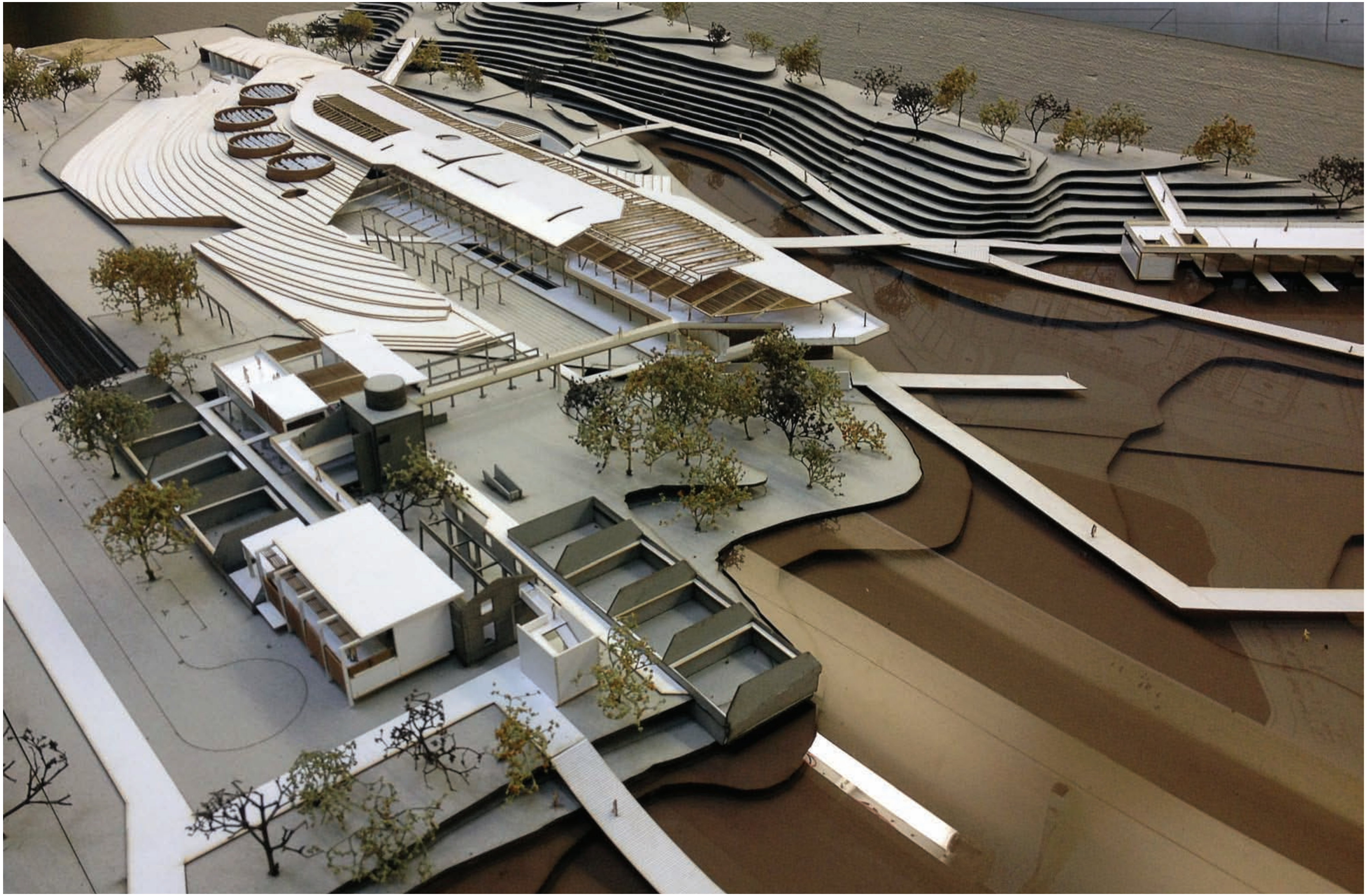












GROUP VISION

Elita van Graan 99020417 | Ingmar Büchner 27156452 | Ilze Labuschagne 28181728 | Tinus vd Merwe 29100233

CONTENTS:

SILENT INDUSTRY:
PRODUCTIVE PARK AS ALTERNATIVE TYPOLOGY

This urban vision proposal forms part of the MArch(Prof) and ML(Prof) masters programs at the Department of Architecture, University of Pretoria, to be considered as supplementary to the relevant dissertations.

The dpcument investigates the development of a productive park as an alternative typology to conventional industrial and recreational development, at the post-industrial Rosema + Klaver quarry and brickworks in the suburbs of Monument Park and Waterkloof Ridge, Pretoria.

* The projects of Tinus vd Merwe and Ingmar Büchner stemming from this vision forms part of a greater NRF research initiative.

The financial assistance of the National Research Foundation (NRF) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author(s) and are not necessarily to be attributed to the NRF.

PART 1
THE CONDITION

INTRODUCTION

SILENT INDUSTRY

As part of the industrial development of Pretoria during the early twentieth century, the old quarry site in Monument Park found its vocation under human hands. It's story starts with the giving of resources, which was instigated and exploited by industry, and the voice of the landscape itself was silenced. This brings to mind Rachel Carson's book 'Silent Spring', in which she eloquently describes the detrimental aftermath that this kind of imposition can have on all biological life.

The collective vision presented here gives an alternative: A 'productive park', in which the flourishing of natural ecosystems takes precedence, and recreation and new forms of production sensitively benefits from these available resources, while unrelentingly giving back to ensure the environment's prosperity. The natural world thus becomes the audible voice, and industry, silent.

THE CONDITIONS

INDUSTRIAL HERITAGE

URBAN

ECOLOGICAL

INDUSTRIAL HERITAGE

CURRENT STATUS AND BACKGROUND ON HISTORY AND INDUSTRY
CRITIQUE ON CURRENT CONDITIONS: INDUSTRIAL HERITAGE

The current model of industry is outdated and unsustainable with aggregated colonies of industry on the perimeters of the urban context. In parallel this forgotten industrial land has an unwritten historical narrative of brickmaking but with no acknowledgement of industrial heritage and its consequences. The development schemes for the site as well as the local community do not recognise the previous historical mining activities on the site, or how these have contributed to our current culture of consumption. Our age is very different, and it requires us to do things differently. We need to be aware of our past mistakes and expose their aftermaths.

HISTORY

Pretoria

The Pretoria region was initially occupied by the southern Ndebele people 300 to 400 years ago. Although some Tswana tribes returned to the Apies River area after the departure of the Ndebele, there is no evidence of large communities occupying the area that is now the Pretoria municipality. The first White inhabitants to settle in Pretoria, in 1840, were the brothers Lucas and Gert Bronkhorst, who registered the farms "Groenkloof" and "Elandspoort." (www.sahistory.org.za).

Groenkloof encompassed the Fountains Valley area, while Elandspoort extended from the south to Daspoortrand in the north and from Pretoria west through to Hatfield in the east. On November 1853, the two farms were declared a town, which came to be known as Pretoria. (www.sahistory.org.za). In 1852 the South African Republic was established and Pretoria was proclaimed its capital in 1855. (www.sahistory.org.za).


1950 - 1970
ABOVE: ROELF ROSEMA AND DIRK KLAVER
RIGHT: AERIAL VIEW OF THE ROSEMA & KLAVER FACTORY


1950 - 1970
IMAGES OF THE OLD WATERKLOOF BRICK FACTORY SHOWING THE PRODUCTION OF CLAY BRICKS


IMAGES OF THE OLD WATERKLOOF BRICK FACTORY AND THE MINING OF CLAY

SITE

Clay was discovered in the Waterkloof area, which at the time was agricultural land. In 1930 Roelf Rosema and Dirk Klaver, a brick-making company still existent today, bought the land, which stretched from Waterkloof Ridge in the North to just a few kilometres South of where the site is located today. In 1942 mining started on the newly purchased land and the company built a brick factory on site around the same time.

Many of the traditional face-brick buildings in and around Pretoria were build with the Rosema & Klaver bricks manufactured on site. The company grew, and because of Waterkloof becoming more of a desired residential neighbourhood, Rosema & Klaver saw the opportunity of developing what is today known as Monument Park. a Shopping center was also build 400meters east to the site, which the company still owns today. Although the development was seen as an asset to both company and the people, the people who settled in and around the site (Monument Park and Waterkloof Ridge) complained about the dust and noise caused by the quarrying process, and black wattle trees were planted as barrier on the edges as an attempt to solve the problem. The pressure from the community did however not cease, and a court notice was given in the 1980's that the quarry had 10 years to close down production. At the same time an underground water source was struck, which became problematic. Matthys Dippenaar explained that the site is located on a dolomitic chamber, which sits under a shale layer. These dolomitic chambers are filled with water. It is assumed that one of these chambers was hit during the mining process. Clean water had to be pumped out continiously, as the clay needed to be dry in the initial steps of the brick-making process. Mining thus became extremely uneconomic. In 1993 the labourers had a strike. The quarry was finally closed down in that same year. Most of the structures had been demolished in the following years, but some parts of the structures are still in tact. These are now occupied by temporary vagrants and vegetation had completely enveloped every piece of man-made structure left.

1950 - 1960
IMAGE OF THE OLD ROSEMA & KLAVER CLAYBRICK FACTORY. WATERKLOOF

1987 PLANS OVER-LAYED ON AND AERIAL PHOTO OF THE OLD WATERKLOOF BRICK FACTORY INDICATING THE ECOLOGICAL AND INDUSTRIAL RELATIONSHIPS AT THE TIME

1990 - 2013
AN AERIAL PHOTO OF THE OLD WATERKLOOF BRICK FACTORY OVERLAYED ON THE EXISTING SUBURBAN FABRIC COMPARING PAST AND PRESENT ECOLOGICAL AND URBAN CHARACTER

TIMELINE: THE BIRTH OF PRETORIA

1825	Mzilikazi's arrival in Transvaal region
1836	Andries Potgieter's arrives in the area north of the Vaal
1840	First permanent White inhabitants arrive in the Pretoria area
1855	Pretoria founded and established as the capital of ZAR, named after General Andries Pretorius
1856	Andries Du Toit pegs out Pretoria town
1857	Marthinus Wessels Pretorius, the son of Andries Pretorius, is elected first President of ZAR
1883	Paul Kruger elected President of ZAR
1893	First Portland Cement Factory built at Daspoort
1899	Outbreak of South African War
1928	ISCOR is established
1942	Rosema and Klaver purchase land Mining on site commence
1980	Court notice that quarry had 10 years to close down production
1993	Rosema & Klaver Waterkloof Quarry closes
1994	Nelson Mandela becomes new democratic president of South Africa

(www.sahistory.org.za)

2013
IMAGES OF THE SITE PERIMETER INDICATING THE CURRENT EDGE CONDITION AND REALTIONSHIP BETWEEN SITE AND NEIGHBOURING SUBURBAN FABRIC

2013
IMAGES OF THE EXISTING SITE INDICATING THE CURRENT DETERIORATED CONDITIONS. THE STRUCTURES WAS DEMOLISHED IN 1993 AND SINCE THEN RUINS HAS BECOME HABITAT TO BOTH HUMAN AND PLANT WITH A FORGOTTEN HISTORICAL CONTENT

2013
IMAGES OF THE EXISTING SITE INDICATING WHAT WAS AND WHAT IS. A RICH HISTORICAL NARRATIVE HAS BEEN LOST AND THE SITE HAS BECOME ALIENATED WITHIN THE SUBURBAN CONTEXT. THE SUBURBS OF MONUMENT PARK AND WATERKLOOF RIDGE KEEPING THIS SECRET OF THE CONSEQUENCES OF INDUSTRY

INDUSTRIAL DEVELOPMENT IN PRETORIA

Industrial development in Pretoria

Because of its geographical position on the highveld, and its proximity to the Witwatersrand gold fields, Pretoria was never able to develop an industrial base in its own right, and has always remained a city populated by government employees. During the apartheid era attempts were made to artificially give it an industrial base. This was implemented using the Physical Planning Act of 1967.

This Act regulated the diversion of industrial development away from the city centers to the city edges. The intention was to attract workers directly from the homelands (townships) and as a means of providing cheap labour to the factories but also as to divert the labour flow away from the city hence reducing labour migrancy. These industrial centers created a prominent buffer between the townships and the suburban developments, which resulted in the townships being cut off from the inner city. (www.sahistory.org.za)

MAP OF THE OLDER PRETORIA SHOWING AND THE FUTURE POSITION OF THE ROSEMA & KLAVER BRICK FACTORY IN RELATION TO THE CITY CENTRE. THE BLUE FILL INDICATE THE POSITION OF THE THEN FUTURE WATERKLOOF BRICK QUARRY.

1900 - CURRENT DAY
MAPS INDICATING INDUSTRIAL DEVELOPMENTS AND GROWTH IN AND AROUND THE CITY OF PRETORIA

THE IMAGERY CLEARLY INDICATE THE CURRENT MODEL OF INDUSTRY WHICH FACILITATE POCKETS OF INDUSTRIAL DEVELOPMENT ON THE PERIMETERS OF THE URBAN CONTEXT

2013
ABOVE: COMPARATIVE IMAGES OF THE STILL OPERATIONAL EERSTERUST ROSEMA & KLAVER BRICK QUARRY. THE WATERKLOOF QUARRY OPERATED IN THE SAME MANNER WITH SIMILAR STRUCTURES WHICH FACILITATED THE PROCESS BRICKMAKING.

CURRENT DAY
RIGHT: PLOTTED BRICK MANUFACTURES AND INDUSTRIES

URBAN

REGIONAL SPATIAL DEVELOPMENT FRAMEWORK [RSDF] OF 2013: REGION 3

The Monument Park site falls under Region 3 of the RSDF proposed by the City of Tshwane. From this document, 3 'maps' have been identified, each describing different aspects relevant to the site. These maps will then be compared with what was found on site, and amendments will be proposed as seen fit.

MAP 1: OPEN SPACE FRAMEWORK

Open space attributes that are part of the context of the site, and the site itself, are indicated on fig(?). The specific attributes that fall on the site are 'ecological support area', which dominated the south-eastern corner and parts around the lake, 'irreplaceable area' as most of the coverage of the site, 'water', where the lake is located, and 'other open space' located on the north-western corner where the tennis club is currently situated. The river running along the R21 highway is bordered by a '32 metre river buffer', which in turn is lined against another ecological support area on the northern edge. The RSDF document is not clear about what is meant with both ecological support- and irreplaceable areas, but judging from the terms used, it can be assumed that these areas need to be approached with sensitivity and informed intentions. The document does speak about 'Heritage and Cultural Sites' and 'Open Space and Conservation Areas' and describes these as irreplaceable.

MAP 2: NODAL DEVELOPMENT PLAN

A diversity of road strategies are proposed in the surrounding area of the site. The 'highway' is described as having no direct access to any land uses, and it accommodates "mainly national, regional and longer distance metropolitan trips" (2013: 52). Access is restricted to interchanges only.
The 'mobility spine' acts as an arterial along which traffic flows with minimum interruption (2013: 52). It is usually of two lines of opposite vehicle flow. Nodal development happens at the intersections, and land use along its length is mixed (with indirect and not direct access to the spine), with BRT stations at relevant points. No street parking is permitted along these routes, and pedestrian movement is restricted.
A 'mobility road' is characterised by through traffic, with medium to high density residential development along its length, and mixed use at its nodes (2013: 53). It plays a "collector and distributor function", though trips are of a short distance. Public transport is important on this route, so necessary facilities should be provided.
An 'activity spine' has slower moving traffic due to very important activity along its length (2013: 54). Land use is varied, from non-residential to medium to higher density residential, in order to create "vibrancy and specific identity." Urban design guidelines (provided in the document) are important to refer to in the treatment of interfaces with lower intensity residential developments. The street is pedestrian and cyclist orientated, calming of vehicular traffic at interchanges, with on-street parking where required.
The last of these routes is the 'activity street' (2013: 54), which mainly acts as a local collector road within a suburban fabric, and is characterised by "small scale local economic activities and social amenities. Low to medium density residential development is associated with this route, and mixed use activity is focused on community service and economic opportunity.

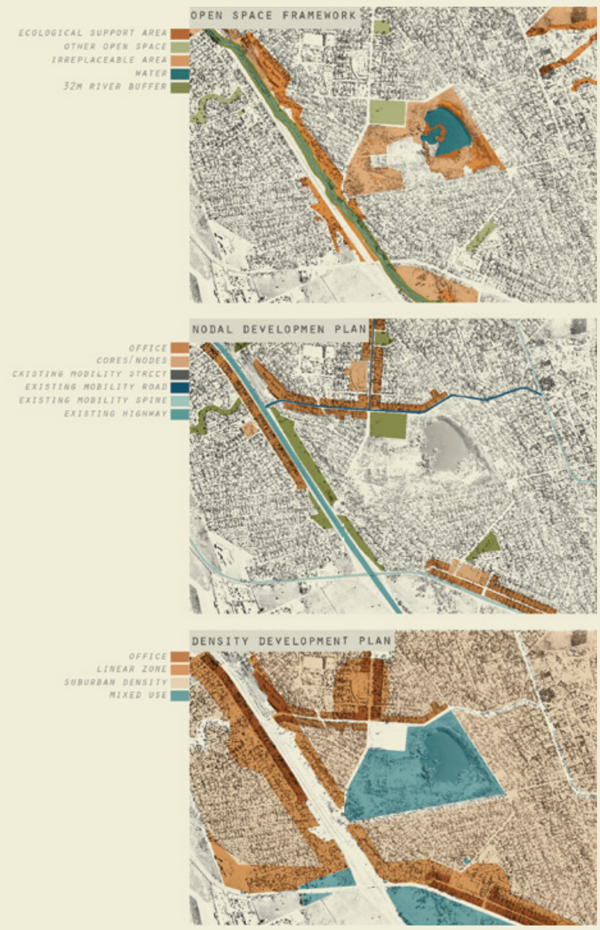
The routes from this list that directly influence the site are the mobility road and the activity street (these have been identified as existing; see figure ?). Along the mobility road is zoned 'office' use, and a 'node/core' is identified next to the activity street, which is the shopping centre owned by Rosema & Klaver. Also proposed is an new off-ramp that will feed vehicles directly from the R21 highway.

MAP 3: DENSITY DEVELOPMENT PLAN

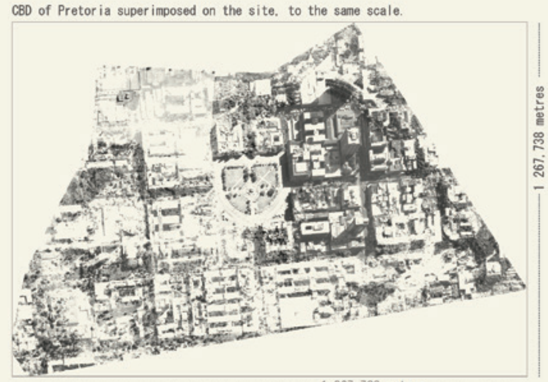
This map shows the density zoning proposed for the future development of the area. 'Linear zones' refer to high intensity activity located along major routes (2013: 61), with a 200m walking distance form public transport and a residential density of 80 units/ha. Typical housing typologies associated with this zone will be medium rise apartment buildings, walk-ups and duplexes.

Most of the rest of the area is zoned as 'suburban density', referring to the existing conditions. The document does however also speak about this area as a 'suburban densification zone', which identifies the potential for moderate densification as the area is located within a 25km radius of the CBD (2013: 62). Residential density prescribed for these zones are no more than 25 units/ha, with exception made to nodal areas within the suburban fabric, which rises to 200 units/ha. The linear zone proposes "a particularly urban environment", and the suburban densification zone is distinctly suburban (2013: 62).

According to the map, the old quarry site itself is zoned as 'mixed-use'. As read in the document, this refers to uses such as "offices/commercial/residential/industrial/retail/entertainment/institutional ect."



CBD of Pretoria superimposed on the site, to the same scale.



A comparison is drawn between the residential density of Sunnyside and that of Monument Park. If the site were to densify as proposed by the RSDF framework, a condition somewhere between these two extremes might develop. With the opportunity for investment into an area such as that in which the site is located, the pressure of development can increase dramatically, and irresponsible interventions driven by free market models need to be monitored and kept accountable.

DEVELOPMENT PROPOSAL

A development proposal for the site had been prepared by Arcia Consortium (2003), with an EIA report done by Seaton Thompson and Associates (2003). The design proposal of the buildings had been prepared by Nico van der Meulen Architects.

DESCRIPTION OF THE PROJECT (2003: 12)

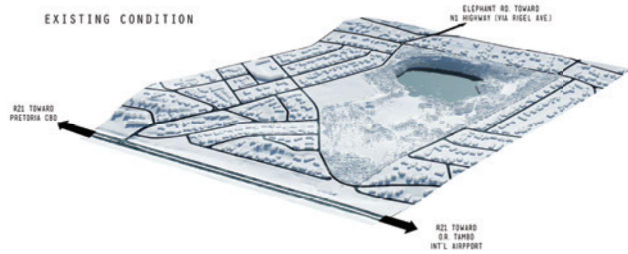
On the old brick quarry site in Monument Park, which is ±50 ha with an existing but abandoned quarry of ±17 ha, which has a "26 metre high terraced embankment on the northern extremity" (2003: 12), a development project is proposed:

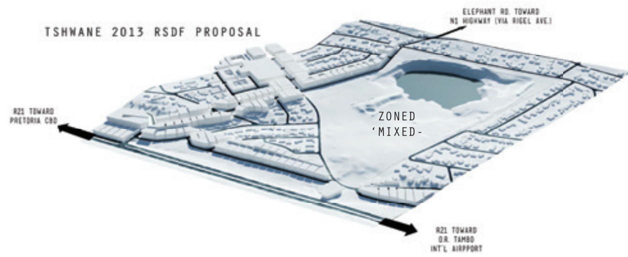
> "The purpose of the project is to establish a predominantly residential township, which will consist of 293 residential stands. These will be mostly 'Residential 1' stands varying in area between ±800m2 and ±1500m2." (2003: 12)

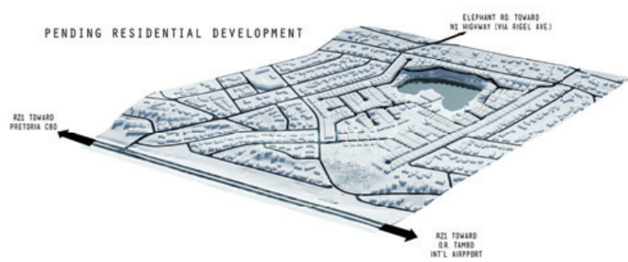
There are also additional uses suggested, which will be incorporated on a single stand and will include "a restaurant, clubhouse, convenience store, as well as a small office component" (2003: 12). This will be the only 'business component' of the site. Area for open space have also been incorporated. The 'actual nett density' of the proposal, after the subtraction of the existing lake and the area on the south-west corner containing "poor dolomitic conditions", is ±31 units per hectare. The lake of the quarry will be retained as 'open space' and retained as an "ornamental feature with minimal alterations". However, "no recreation activities of any nature are to be permitted in the lake" (2003: 13, emphasis added). The dolomitic part of the site coincidentally contains most of the only indigenous tree species on site, and will thus also be proclaimed as open space. A link between these two components is proposed.

In order to "level the irregular topography created from the quarrying operations", it is proposed that leveling and bulk earth works be undertaken (2003: 13). This will ensure that the original nature of the topography is restored.

The development will be "fully serviced with water borne sewerage, water and electricity" (2003: 14). These are already present in the adjoining streets. Access to the site will be given by two controlled access gates, one on Skilpad road and the other on Orion Lane. The development will be closed off with "a highly attractive, architecturally designed wall" (2003: 41)







EVALUATION AND CRITIQUE

The study includes an abstract of The Development Facilitation Act (2003: 16,17). A brief discussion of this will be given, along with a consequent critique of the development plan.

The Development Facilitation Act (2003: 16)

i) policy, administrative practice and laws should provide for urban and rural development adn should facilitate the development of formal and informal settlements.

ii) policy, administrative practice and laws should discourage the illegal occupation of land, with due recognition of informal land development practices.

iii) policy, administrative practice and laws should promote efficient and integrated land development in terms of:

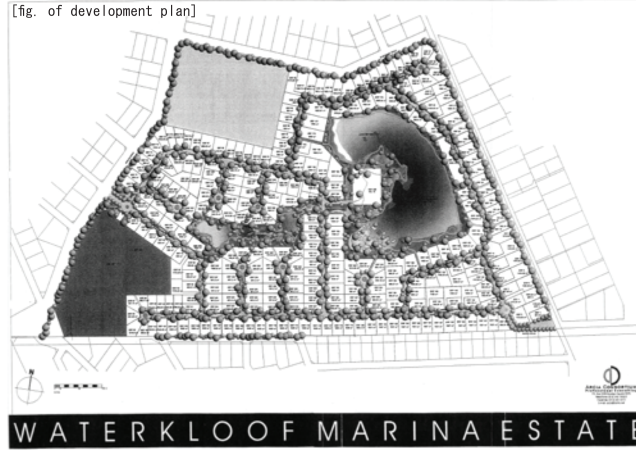
the integration of the social, economic, institutional and physical aspects of land development;
promote the availability of residential and employment opportunities in close proximity to or integrated with each other;
optimise the use of existing resources including such resources relating to agriculture, land, minerals, bulk infrastructure, roads, transportation and social facilities;
promote a diverse combination of land uses, also at the level of individual erven or subdivisions of land;
discourage the phenomenon of "urban sprawl" in urban areas and contribute to the development of more compact towns and cities;
contribute to the correction of the historically distorted spatial patterns of settlement in the Republic and to the optimum use of existing infrastructure in excess of current needs;
encourage environmentally sustainable land development practices and processes.

The proposal's response to the DFA reads as follows:

> "The proposed development of the site is consistent with many of the principles of the DFA, inasmuch as it will optimise the use of existing resources including infrastrucuture and will ensure economic use of currently valuable, under utilised land. The development can be considered to be environmentally sustainable, as there is currently no active use of the land since the quarrying activities were terminated many years ago." (2003: 17)

The dissertation is critical of the following: Firstly, that the DFA does not include a phrase stating that any of the requirements can be overlooked if so desired, but that "policy, administrative practice and laws should promote efficient and integrated land development in term of" the points mentioned above. Secondly, in light of these requirements, although there is a piece of land allocated to more than one use, the proposal is not clear and deliberate in its zoning of integrated social, economic and institutional uses, as the 'business component' of the development is not indicated on the master plan, and it is located away from the existing activities present on the edges of the site. What makes the integration even less existent is the wall that is proposed to be built all around the development. Thirdly, the proposal ignores the existing resources present on the land, which includes the clay left over on the south-eastern corner, and also the land as a resource itself, with its dynamic topography, established ecosystems, open space for introducing fitting plant species to increase biodiversity, and dormant potential for becoming a recreational asset to the surrounding area. And also the historical value of the site is not seen as a resource that could positively contribute to the community. Fourth, its refusal to discourage urban sprawl, as the nature of the development is to implement the current residential model onto valuablel open land. This is in itself a form of spatial planning that is as much characteristic of the settlement patterns implemented during Apartheid as the low-cost housing schemes located away from the city. And fifth, that the proposal's claim of being 'environmentally sustainable' is dismally misplaced because of the points mentioned above, and its reasons for being so irrelevant.

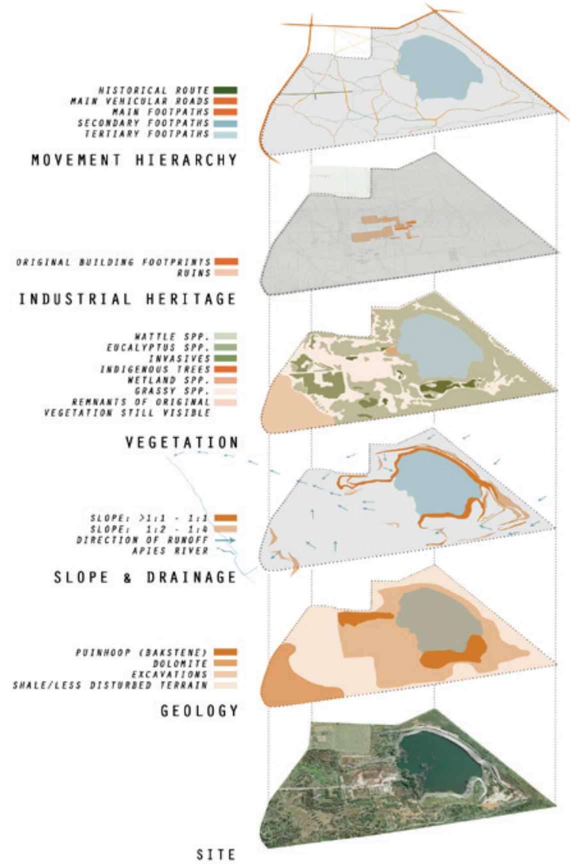
[fig. of development plan]



ECOLOGICAL

CURRENT ECOLOGICAL STATUS:

The Old Rosema & Klaver Brickworks quarry portrays a landscape of various ecological characteristics. Analytical research of these characteristics are shown in the illustration below, indicating the existing geology, slope and drainage, vegetation, ruins, and movement hierarchy found on site. Movement hierarchy were incorporated in this analysis indicating how pedestrian movement are influenced by the landform (slope) and vegetation, and not only by physical structures of the surrounding context of the site. This analytical information gives a good basis for further decision making in the framework development.



MAIN ISSUES IDENTIFIED:
SITE SPECIFIC:

1. LACK OF BIODIVERSITY ON SITE:
Most of the current Rosema & Klaver Brickworks quarry is covered in invasive aliens (listed below). Leonie Joubert (2001:12) states that the scientific perspective of the country's top specialists on invasive alien species is that they pose the single greatest threat to South Africa's rich biological diversity. An alien invasive can be defined as an organism that is found outside of its natural ecosystem. These species arrive in a place by intentional or unintentional human involvement. Another important characteristic of an alien invasive is that it has the potential to "cause harm to the environment, economies, or human health" (Joubert 2001:16).

Alien invasive species found on the site is therefore a threat to the sites biological diversity and additionally they tend to use more than their fair share of water, according to Joubert (2001:18). A specific dominating invasive alien on the site is the Black wattle (Acacia mearnsii). This species has invaded more than 2.5 million ha in South Africa and is therefore a serious invader species. This tree increases the nitrogen levels in soil due to its voracious appetite for water, and so even after the trees have been cleared from an area it could take decades for the soil to return to its original nitrogen levels (Joubert 2001:70).

The following exotic flora was recorded at the site, by Wetland Consulting Services in 2000 (Marneweck 2000:7):

Species
Acacia dealbata
Acacia mearnsii
Achranthes aspera
Amaranthus hybridus
Araujia sericifera
Arundo donax
Bidens pilosa
Caesalpinia sp.
Chloris gayana
Chromolaena odorata
Cynodon niemfuesis
Eucalyptus sp.
Jacaranda mimosifoia

Lantana camara
Melia azedarach
Morus alba
Pennisetum clandestinum
Pennisetum setaceum
Plantago lanceolata
Pseudognaphalium luteo-album
Quercus sp.
Salix babylnica
Solanum mauritianum
Sorghum halapense
Tagetes minuta
Verbena brasiliensis
Zinnia peruviana

The following bird species were recorded on site by Wetland Consulting Services, and are likely to occur on the property during the time of the site visit (Marneweck 2000:13):

Scientific Name	Common Name
Tachybaptus ruficollis	Dabchick
Phalacrocorax africanus	Reed cormorant
Ardea melanocephala	Blackheaded heron
Butorides striatus	Greenbached heron
Bostrychia hagedash	Hadeda ibis
Elanus caeruleus	Blackshouldered kite
Numida meleagris	Helmeted guineafowl
Fulica cristata	Redknobbed cool
Gallinule chloropus	Moorhen
Vanellus coronatus	Crowned plover
Vanellus senegallus	Wattled plover
Columba arquatrix	Rameron pigeon
Streptopelia semitorquata	Redeyed dove
Streptopelia capicola	Cape turtle dove
Streptopelia senegalensis	Laughing dove
Corythaixoides concolor	Grey lourie
Colius striatus	Spechled mousebird
Phoeniculus purpureus	Redbilled woodhoopoe
Upupa epops	Hoopoe
Trachyphonus vaillantii	Crested barbet
Lybius torquatus	Blackcollared barbet
Jynx ruficollis	Redthroated wryneck
Dendropicos fuscescens	Cardinal woodpecker
Dicrurus adsimilis	Forktailed drongo
Oriolus larvatus	Blackheaded oriole
Turdoides barbatus	Blackeyed bulbu
Turdus olivaceus	Southern olive thrush
Cercomela familiaris	Familiar chat
Cossypha caffra	Cape robin
Sylvietta rufescens	Longbilled crombec
Prinia subflava	Tawnyflanked prinia
Muscicapa striata	Spotted flycatcher
Sigelus silens	Fiscal flycatcher
Terpsiphone viridis	Paradise flycatcher
Zosterops pallidus	Cape white-eye
Motacilla capensis	Cape wagtail
Lanius collaris	Fiscal shrike
Laniarius ferrugineus	Southern boubou
Tchagra australis	Threestreaked tchagra
Telophorus zeylonus	Bokmakierie
Lamprotornis nitens	Glossy starling
Onychognatus morio	Redwinged starling
Acridotheres tristis	Indian myna
Nactarinia taletala	Whitebellied sunbird
Passer melanurus	Cape sparrow
Passer domesticus	House sparrow
Passer griseus	Greyheaded sparrow
Ploceus velatus	Southern masked weaver
Ploceus velatus	Spottedbackeed weaver
Lagonosticta rubricata	Bluebilled firefinch
Spermestes cucullatus	Bronze manikin
Serinus gularis	Streakyheaded canary

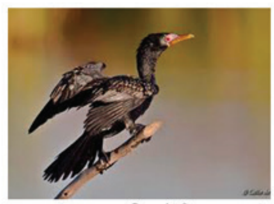
These bird species would likely be sustained in a landscape with a more diverse plant life that provides more variety in food and shelter. If biological diversity on site can be increased these species will flourish on site and hopefully increase in numbers.

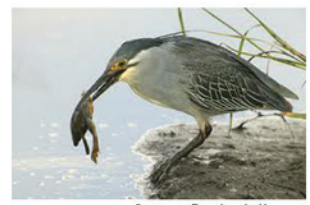

Arrow Marked Babbler


Red Knobbed Coot


Laughing Dove


Cape Robin


Reed Cormarant


Green Backed Heron

2. HYDROLOGY ON SITE:

The area that has been quarried is currently filled with fresh water. When interviewed on 23 April 2013, Mr. Matthys Dippenaar, a hydrogeologist at the University of Pretoria, confirmed that the water level is constant and will not fluctuate except when surface runoff flows into it. This occurred due to the quarrying process where groundwater from the lower dolomite layer filled the opening formed within the shale layer located on top of the dolomite (see illustration provided by Matthys Dippenaar).

The overall drainage on site occurs towards the western edge (Skilpad Road) due to the site' s current overall slope. In the central part of the site most drainage occur to a western direction and then towards a north western direction where storm water enters the local storm water channels on street level in Skilpad Road and drains towards the Apies River, located west of the site and neighbourhood, and east of the R21 highway. When the water body overflows during rainstorms, the overflow flows along the central 'puinhoop' in a western direction and enters the storm water channel at street level as described above.

Various opportunities do exist on site to capture storm water runoff in order to create detention ponds to ensure keeping as much storm water on site, increase infiltration, and create wetland scenarios which promotes a variety of habitats for plant, insect, bird and animal life.

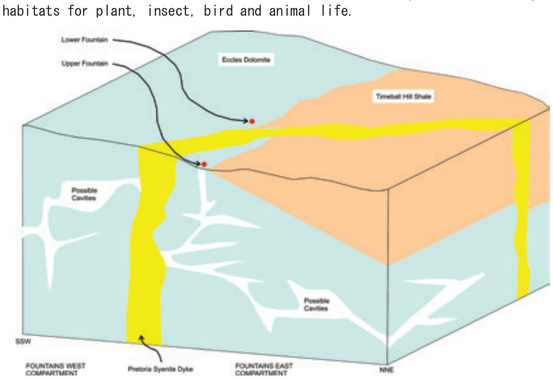
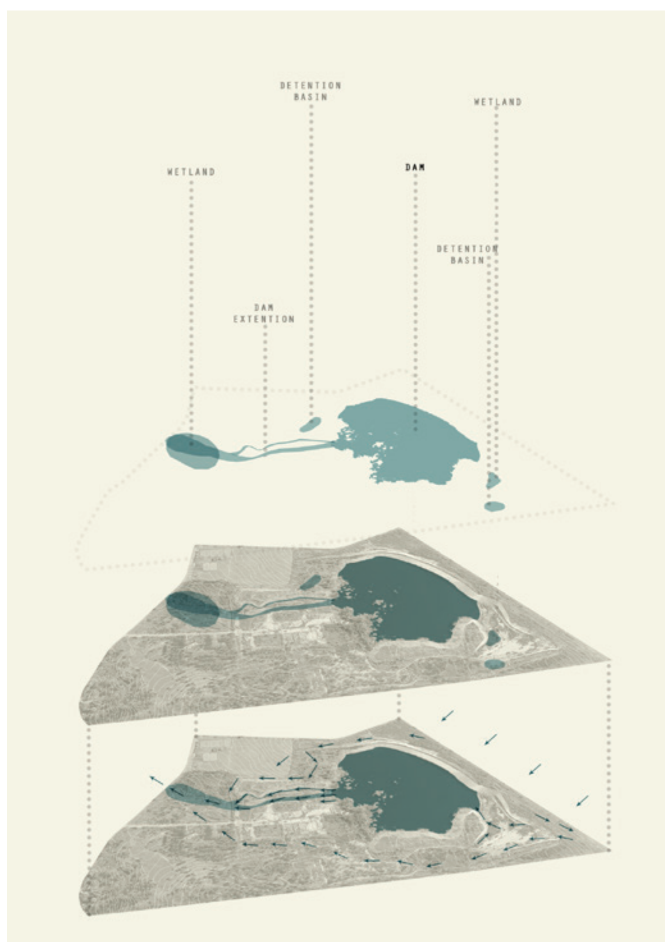


Figure_: Groundwater situated in dolomite layer (Blue) with shale layer located on top of it (Orange) (Dippenaar, 2013).



URBAN SCALE:
LACK OF CONNECTED URBAN GREEN SPACES:

The Old Rosema & Klaver Brickworks quarry is situated between large demarcated green open spaces, such as Groenkloof nature Reserve (to the north) and Rietvlei Nature Reserve (to the south). The site also has a link towards the Apies River on its south western corner. This river and its attributes link these two major nature reserves. Unfortunately the Rosema site lacks biodiversity and is ecologically unconnected to the local green spaces in the neighbourhood, as well as in the greater urban context. When linked to other green spaces with green corridors it will aid in the site as well as the cities biodiversity. The fragmentation of open green spaces has a very high impact on biodiversity, according to Farinha-Marques (2011:49):

"The isolation of the fragment seems to have a more negative influence over time on species diversity than the size of the fragment.. Additionally, habitat fragmentation and isolation increase the risk of species extinction, by increasing the probability of genetic diversity loss through inbreeding depression and genetic drift".

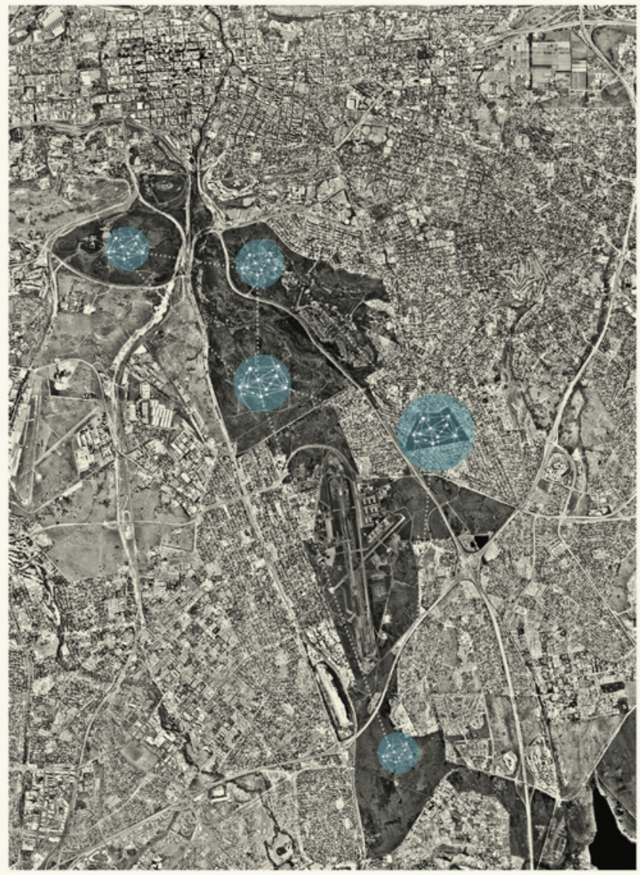
PART 2
THE VISION

INDUSTRY

RESPONSE TO CURRENT HISTORICAL AND INDUSTRIAL CONDITIONS

The Intention is to de-centralise these pockets of industry and rescript the current model of centralised industries based on eco-systemic thinking and principles. Where the intention is to have dispersed but also interconnected alternative industries within a bigger green network working as a whole. The objective will be to create a production network with a network of knitted social, cultural, natural and historical exchanges.

The new schemes proposed are expected to take the history and the existing ruins into account in the design of the new buildings. Past activity will also inform the new processes on site, and will be reinterpreted into functions that offer a regenerative transformation of the site and the well-being of the surrounding community.



RIGHT:
CURRENT DAY ROSEMA & KLAVER SITE SHOWN IN CONTEXT TO THE PROPOSED "GREEN LUNG".THE DIAGRAM IS A VISUAL REPRESENTATION OF THE PROPOSED "DE-CENTRALISATION OF INDUSTRY" CONCEPT. THE INTENTION IS TO HAVE SMALLER PRODUCTIVE CELLS WORKING AS A INTERCONNECTED MANUFACTURING SYSTEM. A PRODUCTIVE NETWORK WITHIN THE URBAN AND NATURAL CONTEXT AS OPPOSED TO THE OLD MODEL.

URBAN

EVALUATION AND CRITIQUE

The dissertation accepts some of what is proposed by the RSDF, but rejects most of the zoning of both routes and land uses, given the descriptions in the document itself. Those are described below:

Even though the Open Space Framework (Map 1) indicates 'irreplaceable' and 'ecological support' areas on the site, the Density Development Plan (Map 3) zones the site as 'mixed use', which gives freedom for any type of development to take place. As identified by the analysis done by the author and group members, the site does fall under the category of 'Heritage and Cultural Sites', as well as 'Open Space'. As the site is labelled as irreplaceable by the open space framework, which the dissertation supports, the zoning of mixed use becomes a contradiction.

The description of a mobility road's function includes mixed use and residential, and the RSDF zones the areas along the mobility road running north of the site as purely 'office'. This is another contradiction that the dissertation rejects.

The 'linear zones' indicated on the proposal are not placed on intensely active routes, but along the highway, which has high vehicular activity, but no pedestrian or cycling activity, which makes it inaccessible to the local community.

The off-ramp from the highway proposed in the RSDF is illogical, because no off-ramp can be place in such close proximity to an on-ramp.

To zone the northern section of Skilpad Road (the one running along the western side of the site) as 'activity street' seems unjustified, because many activities are associated with this route, including public transport already existing (many bus and taxi stops were found in the context analysis). It's intersection with a 'mobility road' will also be difficult to deal with sensitively, considering the contrast in vehicular traffic intensity.

SUGGESTIONS FOR ALTERATION

The following alterations have been identified that the dissertation argues to be more suitable to both the existing conditions and the possible future ones:

[fig. of alteration 1]

Most of the zoning for the routes as proposed will be accepted, except for that of Skilpad Road. This will be rezoned as an 'activity spine', using the description given in the document (2013: 54). This will allow the accommodation of pedestrian and cyclist movement, along with public transport, and will promote vibrant activity. Also, this route is extended southward to link with the other commercial node, and looped to ensure efficient traffic flow. Together with this, as an extension of the same strategy, the parts zoned as office use in the RSDF will be rezoned to mixed use, with a density of 6-8 storeys, which will also contribute to the various functions needed in the area. The proposed offramp will be removed.

As part of the larger scale 'green network' discussed in this chapter, the open land running with the river will be demarcated as Ecological/ Recreational Support Artery, which links the old quarry site to the Groenkloof Conservation area to the north and Roetvlei Dam Conservation area to the south. The site itself consequently becomes an Ecological/ Recreational Organ, and will then function as part of this larger network. Access to this network will be via bicycle and pedestrian routes.

[fig. of alteration 2]

The description of 'suburban densification zone' is one that the thesis accepts, and most of where this is proposed is kept as is. The 'linear zones', however, have been relocated to more relevant parts of the fabric, that being along the length of the newly proposed 'activity spine', and other places where the character of the route requires a higher density. Specificity to the linear zone's density will be proposed as 4 storeys, as influx of residents and businesses in the area will need to be accommodated. An additional residential density is added to ensure that important views (the one from the site to the Voortrekker Monument particularly) are not obstructed.

ECOLOGICAL

A. RESPONSE TO ECOLOGICAL STATUS:

INCREASE BIODIVERSITY ON SITE:
Red Data species (listed below) which may occur on site as provided by the Department of Africulture, Conservation and Environment, can be attempted to be re-established on site.

Scientific Name
Flora
Asclepias eminens
Asclepias fallax
Bowiea volubilis
Ceropegia conrathii
Cleome conrathii
Cynanchum virens
Eulophia welwitschii
Habenaria kraenslliniana
Hyparrhenia nyassae
Parapodium costatum
Rhynchosia nitens
Tristachya biseriata

Another attempt to re-establish indigenous species on the site is to choose species from vegetation types that was likely to be found in this area and on the site before any industrial activities started. The two vegetation types identified are SVcb 10 Gauteng Shale Mountain Bushveld (Mucina & Rutherford 2006:466-467) and Gh 15 Carletonville Dolomite Grassland (Mucina & Rutherford 2006:388) and was chosen after consulting Mucina & Rutherford's book, The vegetation of South Africa, Lesotho and Swaziland. The two vegetation types were identified due to the two soil types existing on the site, namely, shale and dolomite.

ECOLOGICAL

CONSIDER SITE AS ONE OF GAUTENG' S RIDGES:

The quartzite ridges of Gauteng, together with the Drakensberg Escarpment, should be regarded as one of the most important natural assets in the entire region of the northern provinces of South Africa. They are characterized by a unique plant species composition that is found nowhere else in South Africa or the world (Pfab, 2001)).

The term "ridge" refers loosely to hills, koppies, mountains, kloofs, & gorges and is characterised by slopes of 5° or more (i.e. > 8.8%, > 1 in 11 gradient).

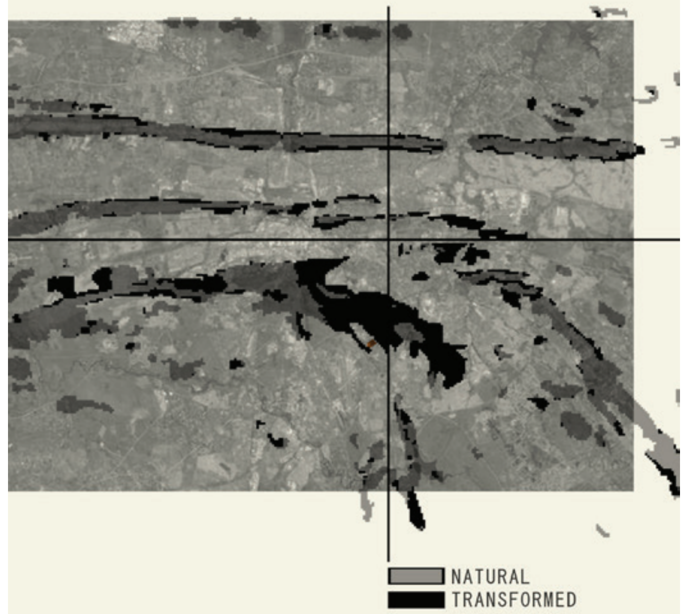
Ridges are landscapes composed of spatially heterogeneous abiotic conditions providing a greater diversity of potential niches for plants and animals than a homogeneous landscape would.

Ridges are particularly suitable for providing a future refuge for biodiversity in an urbanized landscape as they function as islands even within a natural landscape due to their structural and environmental isolation from the landscape (Pfab, 2001).

Ridges are habitat for red data/threatened species:
- 65% of red data plant species have been recorded growing on ridges in Gauteng
- 71% of Gauteng' s endemic plant species have been recorded on ridges

In Gauteng ridges are important wildlife corridors. Natural corridors, which are present in un-fragmented landscapes, such as rivers, riparian zones and topographic features, should be retained following fragmentation (Pfab, 2001).

Due to The Rosema & Klaver site' s new character and steep shale cliffs, these new landforms provide similar micro climates than those of the endangered ridges of Gauteng. It would be a great opportunity to re-establish vegetation similar to those species found on the ridges. So another area can be created wherein these endangered species can grow, be protected, and possibly increase in numbers.



ECOLOGICAL

KEEP SITE AS GREEN OPEN SPACE FOR ITS ECOSYSTEMS SERVICES:

The following definitions explain the meanings of the following important term (TEEB 2010):

Biodiversity is the variety of life on earth - at the level of ecosystems, but also at the level of the components of ecosystems.

Ecosystem is a way of describing nature' s functioning and it consists of components (plants, animals, microorganisms, water, air etc.) as well as the interactions between these components.

Ecosystem services are the benefits that humans derive from nature.

They can be divided into 4 categories and the following ecosystem services are applicable to the Rosema & Klaver site and the Silent Industry Framework Proposal (TEEB 2010):

<ins>They can be divided into 4 categories:</ins>

<ins>Provisioning services:</ins>
- Raw Materials
- Fresh Water
- Medicinal resources

<ins>Regulating services:</ins>
- Local climate & air quality regulation
- Carbon sequestration & storage
- Waste-Water treatment
- Erosion prevention & maintenance of soil fertility
- Pollination

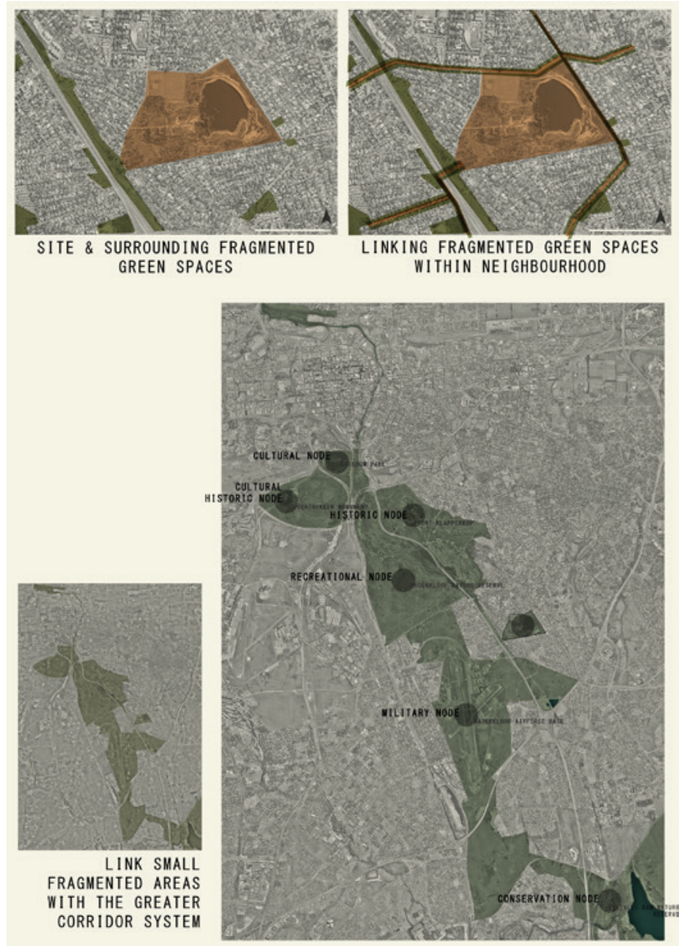
<ins>Habitat/Supporting services:</ins>
- Habitats for species
- Maintenance of genetic diversity

<ins>Cultural services:</ins>
- Recreation & mental & physical health
- Aesthetic appreciation & inspiration for culture, art & design
- Spiritual experience & sense of place

ECOLOGICAL

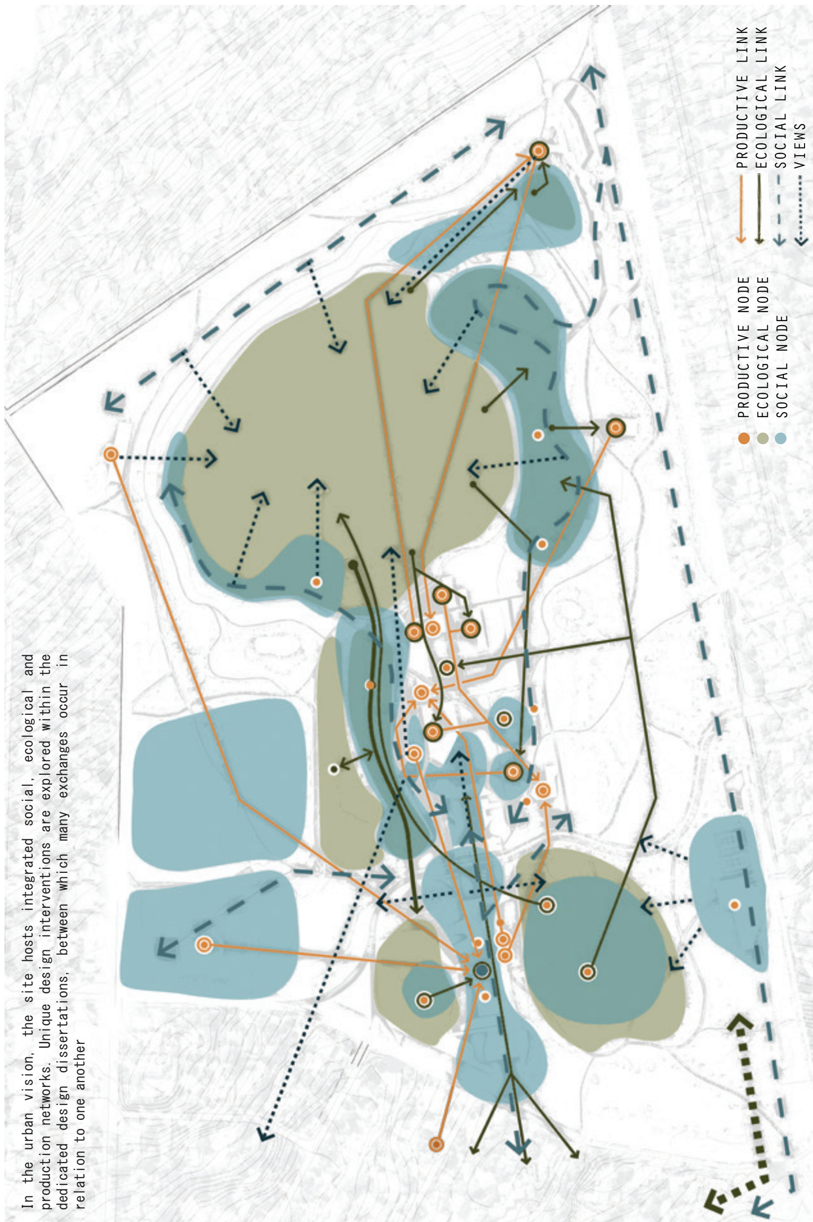
CONNECT URBAN GREEN SPACES:

When the green spaces in the surrounding areas around the site are connected, as well as on an urban scale, it will increase urban biodiversity in the city of Pretoria to a great extent. The proposed connected green open space system functions as a green lung, giving life to the surrounding city's fauna and flora. Due to this increase in green infrastructure the citizens of Pretoria will live in a healthy urban environment.



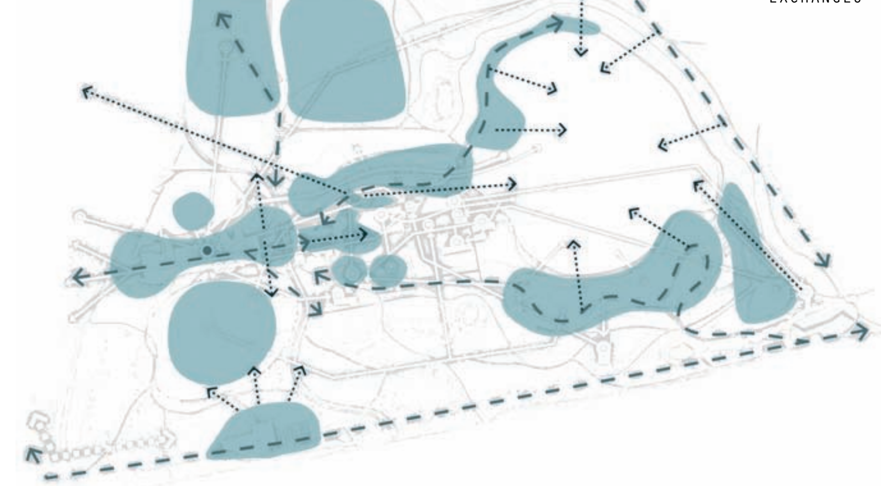
INTEGRATED NETWORKS

In the urban vision, the site hosts integrated social, ecological and production networks. Unique design interventions are explored within the dedicated design dissertations, between which many exchanges occur in relation to one another

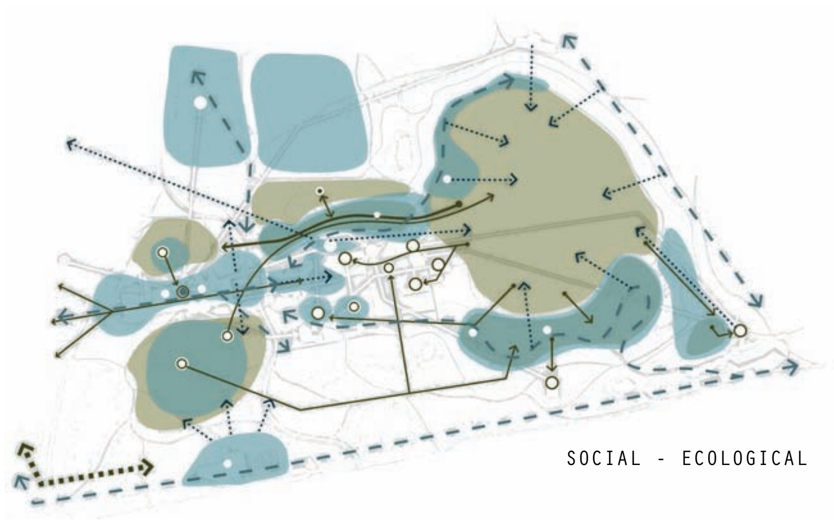


PRODUCTIVE EXCHANGES

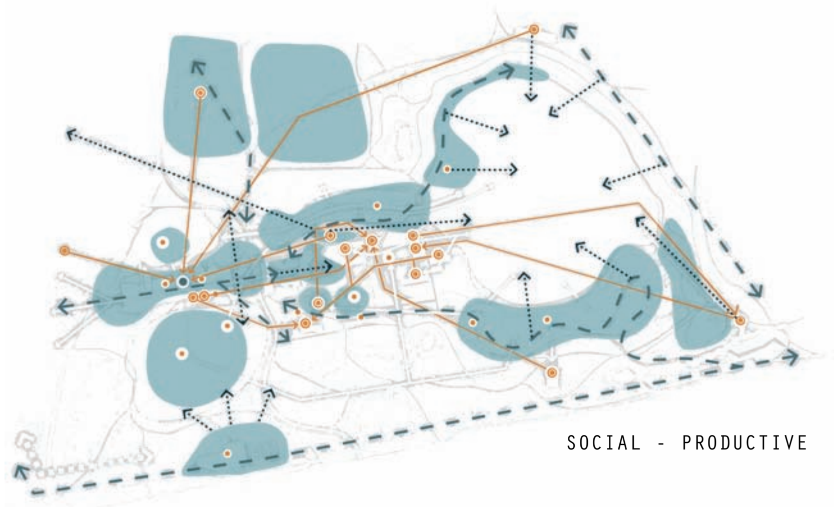
SOCIAL EXCHANGES




ECOLOGICAL
EXCHANGES


SOCIAL - ECOLOGICAL


PRODUCTIVE - ECOLOGICAL


SOCIAL - PRODUCTIVE

BIBLIOGRAPHY

Carson, R. 1962. *Silent Spring*. Houghton Mifflin: Boston

SOUTH AFRICAN HISTORY. 2013. [online] Available at: (http://www.sahistory.org.za/topic/pretoria-timeline-1800-2009) [Accessed 15 October 2013]

SOUTH AFRICAN HISTORY. 2013. [online] Available at: (www.sahistory.org.za/article/segregated-city-2?page=9) [Accessed 15 October 2013]

Farinha-Marques, J.M. Lameiras, C. Fernandes, S. Silva & F. Guilherme, 2011, *‘Urban biodiversity: a review of current concepts and contributions to multidisciplinary approaches’, Innovation: The European Journal of Social Science Research*, 24:3, pp. 249, viewed on 18 October 2013, <http://dx.doi.org/10.1080/13511610.2011.592062>.

Marneweck, G.C., 2000, *Specialist Scoping Report: Preliminary Ecological Survey of the Remainder of the Farm Waterkloof 428 JR*, Monument Park Extension 12, Wetland Consulting Services, pp. 7, 13.

Loney, B. and Hobbs, R.J. (1991) *Management of vegetation corridors: maintenance, rehabilitation and establishment*. Pp 299-311 in Nature Conservation 2: the Role of Corridors, edited by D.A. Saunders and R.J. Hobbs. Surrey Beatty and Sons, Chipping Norton, N.S.W. ISBN: 094-9-324-353

Joubert, L., 2001, *Invaded: The biological invasion of South Africa*, Wits University Press, Johannesburg, South Africa.

Mucina, L., & Rutherford, M.C. (eds), 2010, *The vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, South African National Biodiversity Institute (SANBI)*, Pretoria, pp. 388, 463-464.

Pfab, M., 2001, *Development Guidelines for Ridges*, Department of Agriculture, Conservation, Environment and Land Affairs.

TEEB - *The Economics of Biodiversity*, 2010, TEEB Manual for Cities: Ecosystem Services in Urban Management.

D. TSHWANE RSDF 2013 EXTRACTS

The following extracted material from the 2013 Tshwane RSDF will be critiqued and improved on where seen relevant, as part of the proposed urban vision for the quarry site.
(TSHWANE REGIONAL SPATIAL DEVELOPMENT FRAMEWORK 2013: Region 3)

-EXTRACTS FROM TSHWANE RSDF-

Strategy of the City of Tshwane

2.1.1 THE VISION
The vision of the City of Tshwane is to become the African Capital City of Excellence. Seven strategic objectives have been identified in order to respond to the vision:
1. Provide basic services, roads and stormwater
2. Economic Growth and Development and Job Creation
3. Sustainable communities with clean, healthy and safe environment and integrated social services
4. Foster Participatory Democracy and Batho Pele (People First) principles
5. Promote Sound Governance
6. Ensure financial sustainability
7. Organisational Development and Transformation

2.1.2 THE SPATIAL VISION
The Spatial Vision of the City of Tshwane is to conduct integrated planning, maximising on spatial efficiencies for optimal service delivery.
This will be addressed through spatial interventions:
84h Addressing social needs
84h Restructuring of a spatially inefficient City
84h Promotion of sustainable use of land resources
84h Strategic direction around infrastructure provision
84h Creating opportunities for both rural and urban areas

2.1.3 GAUTENG SPATIAL DEVELOPMENT FRAMEWORK
The G2055 initiative is an initiative aimed at preparing the Gauteng City Region for a population of approximately 28 million people by 2055. The G2055 vision is for Gauteng to have a strong knowledge capital, be the hub of innovation to Africa, be a livable, prosperous, competitive, equitable, accessible and sustainable City region. The initiative is spatially addressed in the Gauteng Spatial Development Framework (approved in February 2011).
The Gauteng Spatial Development Framework (GSDF) provides a common future spatial structure for the Gauteng Province and is clear on the fact that growth must be structured and directed; not merely accepted and accommodated and thus it informs and guides the Tshwane MSDF with specific regard to the location and nature of the physical development in the province.

The RSDF and MSDF respond primarily to:
84h Strategic Objective 2 (Economic growth and development):
o Provide strategic direction around infrastructure provision
o Guide developers and investors to appropriate investment localities
o Compile rural development programmes to improve livelihoods and stimulate employment
84h Strategic Objective 3 (sustainable communities with clean healthy and safe environment and integrated social services):
o Restructure the spatially inefficient City through compaction, densification and transport orientated development.
o Promote sustainable use of land resources
o Manage growth

The following five critical factors were identified in the GSDF:
84h Contained urban growth
84h Resource based economic development (resulting in the identification of the economic core)
84h Re-direction of urban growth (stabilize /limit growth in economically non-viable areas, achieve growth on the land within the economic growth sphere)
84h Protection of rural areas and enhancement of tourism and agricultural related activities
84h Increased access and mobility.

The primary structuring elements identified within the GSDF are those of:
84h urban mixed-use activity nodes
84h open space and green system
84h public transit and movement routes
84h urban corridors and activity spines

4.11.3 SUBURBAN DENSIFICATION ZONES
(density 10 - 200 units/ha)
Suburban Densification Zones are those existing suburban areas where there is potential for moderate densification because of the area's strategic location within the city (within a 25 km radius of the CBD). This zone makes for good application in areas that are close to places of employment, major retail centres and prominent transport routes, but where it is still desirable and warranted to maintain a suburban character. These areas are indicated in yellow on the Densification Map. The maximum densities in these areas will be restricted to 25 dwelling-units per hectare. The exceptions will be the nodal areas within the suburban areas were densities of up to 200 units / dwelling-units per hectare can be supported depending on available public transport.
Whereas the Concentration and Linear Zones proposes a particular urban environment, both the Suburban Densification Zone and the Low Density Zone are distinctly suburban zones.
In Suburban Densification zones the core principles of

densification are:

84h Densification must contribute to the provision of lifestyle choices within the specific area, for example provision must be made for all the lifestyle phases from young working people and students, families with young children, and elderly people;

84h Appropriate higher density housing opportunities at appropriate locations must be provided for all income groups to promote the aims of social integration;

84h Specific areas of opportunity or need for restructuring should be identified (areas that should not be densified for specific reasons should also be identified);

84h Areas targeted for densification should be treated as whole environments, i.e. densification should not happen in isolation but as part of a larger programme aimed at creating a suitable high density environment;

84h Areas targeted for densification should be well served by public transport, or have the potential to be well served by public transport in future. Pedestrianisation must be included into the densification process;

84h Areas targeted for densification should be well served by social facilities such as education, open space, recreation etc. or should have the potential to be well served by social facilities;

84h Preserve and enhance open space, farmland, natural beauty and critical environmental areas;

84h Encourage community and stakeholder collaboration; and

84h Retain, enhance and encourage cultural assets.

The various housing and densification typologies must be employed in a structured manner within this zone, with cluster housing and apartments located adjacent to strategic points within the neighbourhood such as local nodes, public transport facilities on a major public transport route, education facilities and parks. These developments will be subject to urban design principles and site development plans.

In essence, within this zone the urban form remains the same as it currently is, only with an increase in general density and a change in typology and density around strategic points within these areas.

2.5 ENVIRONMENTAL STRUCTURING CONCEPT

2.5.1 HERITAGE AND CULTURAL SITES

Tshwane's urban form and identity is closely linked to the influence of its natural and cultural elements. The developed areas are intimately intertwined with large open spaces, creating a city with a unique character. The spatial development of the city should continue to value the role and prominence of the natural environment that sustains and informs the city. The natural structuring elements of Tshwane are those physical features that have to a great extent influenced the historical growth and settlement development pattern and that have an important ecological role to play in the ecological integrity of the metropolitan area.

With regard to the cultural heritage of the city, conservation worthy, distinct/unique areas reflect the continual changes in the socio-economic status, value systems, lifestyles, habits, aesthetic criteria and social interactions of their inhabitants over decades and sometimes centuries. They are therefore important elements of the community's collective memory and their sense of identity. The uniqueness of these areas, which has arisen from the unique geographical, topographical, social, cultural, political, historical, economic and other circumstances in which they were developed, has the potential of attracting both locals and tourists, and inspiring future developments.

In terms of the cultural heritage of the city, certain areas are identified as unique areas, including the Union Buildings Precinct, Church Square, Marabastad, Bryntirion/Lisdogan Park/Eastwood and Irene Village. Precinct plans must be compiled for these areas to determine in detail which features (topographical characteristics, landscaping, layout elements, land uses, activities, structures, architectural features, etc.) make each of these areas unique and conservation worthy, and compile a set of development guidelines, controls and incentives aimed at the preservation, enhancement and utilisation of those features and further development of the areas.

Special sites such as memorials, gardens of remembrance, walls of remembrance, markers, triumphal arches, water features, monuments, statues, museums, forts, battlefields, cemeteries, mausoleums, cenotaphs, etc. that symbolise people's values, beliefs, aspirations, important personalities and important historical events are needed. It is particularly important for Tshwane, which houses the Capital of South Africa, to project the image of the entire nation and to reflect, therefore, the values, beliefs, history, achievements and aspirations of all South African racial, ethnic, religious, gender and other cultural groups.

The heritage, both natural and cultural, is a valuable, finite, non-renewable and irreplaceable resource which must be carefully managed. Every generation has a moral responsibility to act as a trustee of the natural and cultural heritage for following generations. In a spatial context, areas with distinct and unique character, as well as places and structures of definite historical, aesthetical or symbolical merit have to be conserved in order to:

84h provide the necessary link between the city and its past, as well as current residents and their ancestors

84h create a sense of place

84h establish a system of lasting points of reference

84h nourish the sense of belonging to the city and boost the civic pride

84h enhance the uniqueness, identity and attractiveness of the city.

2.5.2 OPEN SPACE AND CONSERVATION AREAS

A well-defined open space network is an important and integral part of the Spatial Development Concept of the MSDF.

The Tshwane Open Space Framework (TOSF) was approved in November 2005. The Framework will need to be reviewed and updated to include the newly incorporated areas of Tshwane.

The development of an open space network is an integral part of shaping the city. Ecological resources are irreplaceable and should thus be one of the major structuring elements guiding the development of the city instead of unplanned urban growth taking precedence and open space becoming merely land that is not desirable for urban development and thus 'left over' space. An important step in shaping urban form is thus the determination

of an open space network, which contains natural processes and systems.

The open space network is concerned with the spatial structure of green areas in the urban landscape and with all planning activities that are essential to create conditions for green areas to perform ecological services and to contribute to the quality of urban life. It is thus used to indicate the position of green areas in the urban landscape. As such it has spatial, social and technical dimensions. An open space network is also a planning concept, indicating the intention to develop planning and management tools for the structural role of green areas in the urban fabric and the urban organization.

An open space network contains not only the elements that constitute the open space in itself (vegetation, water, animals, natural materials etc.), but above all how the various open spaces are shaped in relation to the concepts of distribution and organization, to form a system of open spaces. An open space network incorporates a wide variety of open spaces into one system. Open spaces cease to be discreet elements within the city but together form a network in which each component contributes to the whole.

It must be stressed that an open space network does not focus only on 'green' spaces, but also on more urban or 'brown' spaces as well as spaces that contribute to the place-making of the city.

From a city-planning perspective open spaces have various important functions:

Residential (within the natural areas where you find irreplaceable, important and highly ecological sensitive sites): Environmental Development or service centres aimed at the local market, and which are situated at a service delivery centre or central place to the community.

Estates where the primary focus is the conservation of the natural resource (open space). Conservation in this sense must not be seen as only protecting special or sensitive environments, but conserving open space as a valuable resource itself. The residential development is seen as a mechanism to protect and enhance the open space character and not as an end in itself. Special conditions shall apply in the consideration and approval of such developments, including the following: Dwelling units shall be grouped together in as few clusters as possible; a Strategic Environmental Assessment shall be done to determine the open space, the position of the clusters, the position of ancillary uses, roads; conservation conditions shall be strictly adhered to; conditions shall be set for the design, character and overall relationship with its environment.

MIXED USE

84h Refers to land uses such as offices/commercial/ residential/ industrial/retail/entertainment/ institutional ect. It also refers to a mix of uses within a specific area (node or corridor). The advantage of mixed uses is that access and convenience are increased as transportation distances are decreased. The combination depends on the specific area. A mixed-use could refer to retail at street level, institutional on the floor above and residential on the upper floors, or only use per erf. Principles regarding retail, commercial and industrial uses / rights are still applicable as indicated in this document. Mixed land use in an industrial area could include industry, commercial and retail uses.

2.5.3.4 Vision

The framework formulated for the Tshwane Rural Component will:

84h Ensure food security by maximizing the use and management of natural and other resources.

84h Create vibrant, equitable and sustainable rural communities.

84h Contribute towards the redistribution and sustainable use of all potential agricultural land.

84h Support rural economies through agriculture and, where possible, through mining, tourism and agro processing.

84h Create employment and business opportunities for the existing rural population.

84h Aim to prevent natural disasters like erosion and pollution and other detrimental effects on natural resources.

84h Formalize residential settlements according to the Rural Component Framework.

84h Provide accessibility to community facilities, work opportunities and housing for all.

84h Maintain acceptable standards for roads and other modes of transport.

84h Provide public transport as a service in the more densely populated rural areas.

84h Identify multi-purpose community centres to provide for business, medical, educational, recreational, social and other needs at the most optimum and accessible locations.

84h Address adequate and respectable services to improve living conditions.

E. NIZHNY TAGEL CHARTER

THE NIZHNY TAGIL CHARTER FOR THE INDUSTRIAL HERITAGE

July 2003

TICCIH is the world organisation representing industrial heritage and is special adviser to ICOMOS on industrial heritage. This charter was originated by TICCIH and will be presented to ICOMOS for ratification and for eventual approval by UNESCO.

Preamble

The earliest periods of human history are defined by the archaeological evidence for fundamental changes in the ways in which people made objects, and the importance of conserving and studying the evidence of these changes is universally accepted.
From the Middle Ages, innovations in Europe in the use of energy and in trade and commerce led to a change towards the end of the 18 th century just as profound as that between the Neolithic and Bronze Ages, with developments in the social, technical and economic circumstances of manufacturing sufficiently rapid and profound to be called a revolution. The Industrial Revolution was the beginning of a historical phenomenon that has affected an ever-greater part of the human population, as well as all the other forms of life on our planet, and that continues to the present day.
The material evidence of these profound changes is of universal human value, and the importance of the study and conservation of this evidence must be recognised.
The delegates assembled for the 2003 TICCIH Congress in Russia wish therefore to assert that the buildings and structures built for industrial activities, the processes and tools used within them and the towns and landscapes in which they are located, along with all their other tangible and intangible manifestations, are of fundamental importance. They should be studied, their history should be taught, their meaning and significance should be probed and made clear for everyone, and the most significant and characteristic examples should be identified, protected and maintained, in accordance with the spirit of the Venice Charter [1], for the use and benefit of today and of the future.
1. Definition of industrial heritage
Industrial heritage consists of the remains of industrial culture which are of historical, technological, social, architectural or scientific value. These remains consist of buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted and used, transport and all its infrastructure, as well as places used for social activities related to industry such as housing, religious worship or education.
Industrial archaeology is an interdisciplinary method of studying all the evidence, material and immaterial, of documents, artefacts, stratigraphy and structures, human settlements and natural and urban landscapes [2], created for or by industrial processes. It makes use of those methods of investigation that are most suitable to increase understanding of the industrial past and present.
The historical period of principal interest extends forward from the beginning of the Industrial Revolution in the second half of the eighteenth century up to and including the present day, while also examining its earlier pre-industrial and proto-industrial roots. In addition it draws on the study of work and working techniques encompassed by the history of technology.
2. Values of industrial heritage
I. The industrial heritage is the evidence of activities which had and continue to have profound historical consequences. The motives for protecting the industrial heritage are based on the universal value of this evidence, rather than on the singularity of unique sites.
II. The industrial heritage is of social value as part of the record of the lives of ordinary men and women, and as such it provides an important sense of identity. It is of technological and scientific value in the history of manufacturing, engineering, construction, and it may have considerable aesthetic value for the quality of its architecture, design or planning.
III. These values are intrinsic to the site itself, its fabric, components, machinery and setting, in the industrial landscape, in written documentation, and also in the intangible records of industry contained in human memories and customs.
IV. Rarity, in terms of the survival of particular processes, site typologies or landscapes, adds particular value and should be carefully assessed. Early or pioneering examples are of especial value.
3. The importance of identification, recording and research
I. Every territory should identify, record and protect the industrial remains that it wants to preserve for future generations.
II. Surveys of areas and of different industrial typologies should identify the extent of the industrial heritage. Using this information, inventories should be created of all the sites that have been identified. They should be devised to be easily searchable and should be freely accessible to the public. Computerisation and on-line access are valuable objectives.
III. Recording is a fundamental part of the study of industrial heritage. A full record of the physical features and condition of a site should be made and placed in a public archive before any interventions are made. Much information can be gained if recording is carried out before a process or site has ceased operation. Records should include descriptions, drawings, photographs and video film of moving objects, with references to supporting documentation. Peoples' memories are a unique and irreplaceable resource which should also be recorded when they are available.
IV. Archaeological investigation of historic industrial sites is a fundamental technique for their study. It should be carried out to the same high standards as that of sites from other historical or cultural periods.
V. Programmes of historical research are needed to support policies for the protection of the industrial heritage. Because of the interdependency of many industrial activities, international studies can help identify sites and types of sites of world importance.
VI. The criteria for assessing industrial buildings should be defined and published so as to achieve general public acceptance of rational and consistent standards. On the basis of appropriate research, these criteria should be used to identify the most important surviving landscapes, settlements, sites, typologies, buildings, structures, machines and processes.
VII. Those sites and structures that are identified as important should be protected by legal measures that are sufficiently strong to ensure the conservation of their significance. The World Heritage List of UNESCO should give due recognition to the tremendous impact that industrialisation has had on human culture.
VIII. The value of significant sites should be defined and guidelines for future interventions

established. Any legal, administrative and financial measures that are necessary to maintain their value should be put in place.
IX. Sites that are at risk should be identified so that appropriate measures can be taken to reduce that risk and facilitate suitable schemes for repairing or re-using them.
X. International co-operation is a particularly appropriate approach to the conservation of the industrial heritage through co-ordinated initiatives and sharing resources. Compatible criteria should be developed to compile international inventories and databases.
4. Legal protection
I. The industrial heritage should be seen as an integral part of the cultural heritage in general.
Nevertheless, its legal protection should take into account the special nature of the industrial heritage.
It should be capable of protecting plant and machinery, below-ground elements, standing structures, complexes and ensembles of buildings, and industrial landscapes. Areas of industrial waste should be considered for their potential archaeological as well as ecological value.
II. Programmes for the conservation of the industrial heritage should be integrated into policies for economic development and into regional and national planning.
III. The most important sites should be fully protected and no interventions allowed that compromise their historical integrity or the authenticity of their fabric.
Sympathetic adaptation and re-use may be an appropriate and a cost-effective way of ensuring the survival of industrial buildings, and should be encouraged by appropriate legal controls, technical advice, tax incentives and grants.
IV. Industrial communities which are threatened by rapid structural change should be supported by central and local government authorities. Potential threats to the industrial heritage from such changes should be anticipated and plans prepared to avoid the need for emergency actions.
V. Procedures should be established for responding quickly to the closure of important industrial sites to prevent the removal or destruction of significant elements. The competent authorities should have statutory powers to intervene when necessary to protect important threatened sites.
VI. Government should have specialist advisory bodies that can give independent advice on questions relating to the protection and conservation of industrial heritage, and their opinions should be sought on all important cases.
VII. Every effort should be made to ensure the consultation and participation of local communities in the protection and conservation of their local industrial heritage.
VIII. Associations and societies of volunteers have an important role in identifying sites, promoting public participation in industrial conservation and disseminating information and research, and as such are indispensable actors in the theatre of industrial heritage.
5. Maintenance and conservation
I. Conservation of the industrial heritage depends on preserving functional integrity, and interventions to an industrial site should therefore aim to maintain this as far as possible. The value and authenticity of an industrial site may be greatly reduced if machinery or components are removed, or if subsidiary elements which form part of a whole site are destroyed.
II. The conservation of industrial sites requires a thorough knowledge of the purpose or purposes to which they were put, and of the various industrial processes which may have taken place there. These may have changed over time, but all former uses should be examined and assessed.
III. Preservation in situ should always be given priority consideration. Dismantling and relocating a building or structure are only acceptable when the destruction of the site is required by overwhelming economic or social needs.
IV. The adaptation of an industrial site to a new use to ensure its conservation is usually acceptable except in the case of sites of especial historical significance. New uses should respect the significant material and maintain original patterns of circulation and activity, and should be compatible as much as possible with the original or principal use. An area that interprets the former use is recommended.
V. Continuing to adapt and use industrial buildings avoids wasting energy and contributes to sustainable development. Industrial heritage can have an important role in the economic regeneration of decayed or declining areas. The continuity that re-use implies may provide psychological stability for communities facing the sudden end a long-standing sources of employment.
VI. Interventions should be reversible and have a minimal impact. Any unavoidable changes should be documented and significant elements that are removed should be recorded and stored safely. Many industrial processes confer a patina that is integral to the integrity and interest of the site.
VII. Reconstruction, or returning to a previous known state, should be considered an exceptional intervention and one which is only appropriate if it benefits the integrity of the whole site, or in the case of the destruction of a major site by violence.
VIII. The human skills involved in many old or obsolete industrial processes are a critically important resource whose loss may be irreplaceable. They need to be carefully recorded and transmitted to younger generations.
IX. Preservation of documentary records, company archives, building plans, as well as sample specimens of industrial products should be encouraged.
6. Education and training
I. Specialist professional training in the methodological, theoretical and historical aspects of industrial heritage should be taught at technical and university levels.
II. Specific educational material about the industrial past and its heritage should be produced by and for students at primary and secondary level.
7. Presentation and interpretation
I. Public interest and affection for the industrial heritage and appreciation of its values are the surest ways to conserve it. Public authorities should actively explain the meaning and value of industrial sites through publications, exhibitions, television, the Internet and other media, by providing sustainable access to important sites and by promoting tourism in industrial areas.
II. Specialist industrial and technical museums and conserved industrial sites are both important means of protecting and interpreting the industrial heritage.
III. Regional and international routes of industrial heritage can highlight the continual transfer of industrial technology and the large-scale movement of people that can be caused by it.
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[1] The ICOMOS 'Venice Charter for the Conservation and Restoration of Monuments and Sites', 1964
[2] For convenience, 'sites' will be taken to mean landscapes, complexes, buildings, structures and machines unless these terms are used in a more specific way.