



*To use sustainable landscape architecture principles and techniques to create a living environment in which a community may embrace methods of living differently.*

Master in Landscape Architecture

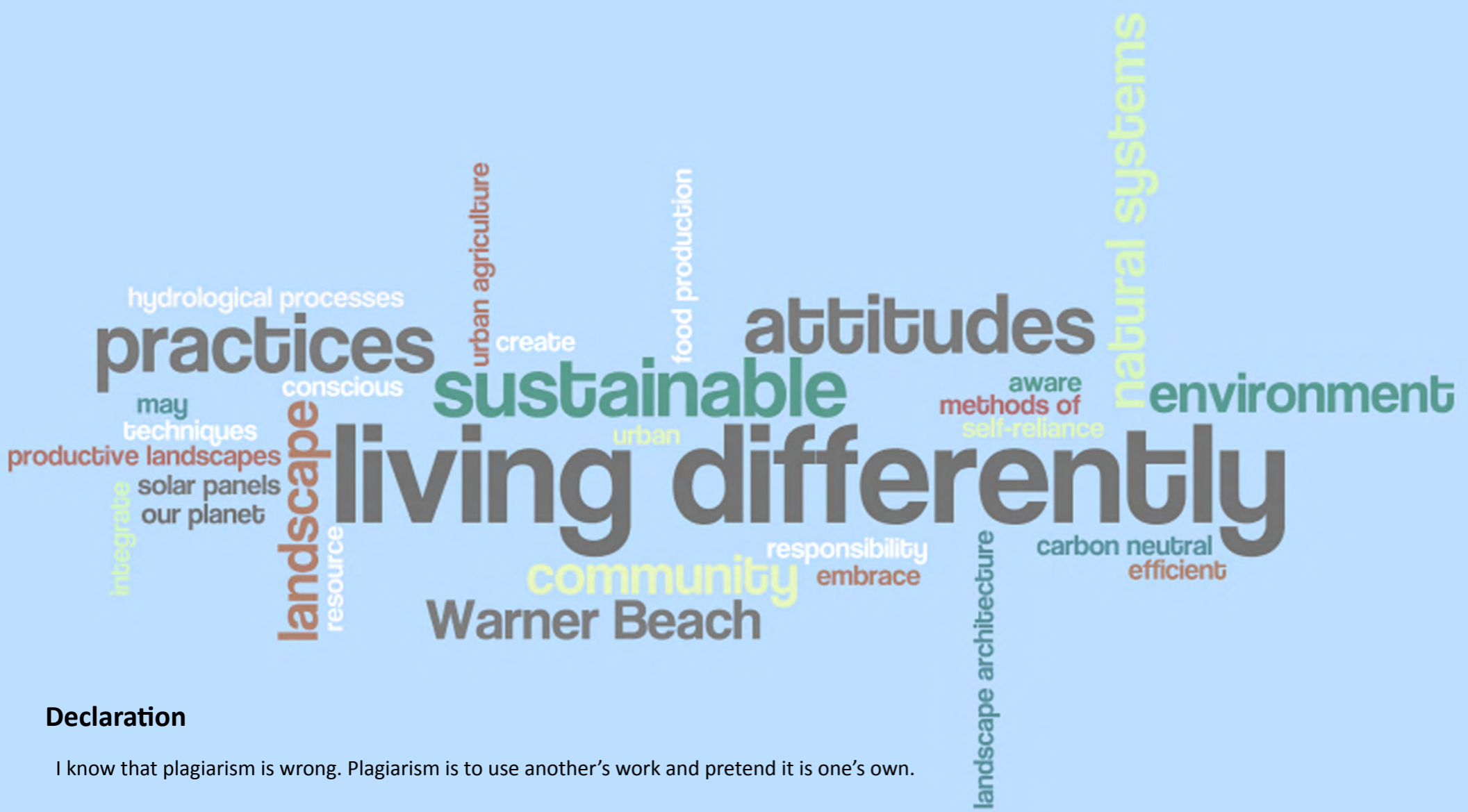
University of Cape Town

**LIVING DIFFERENTLY  
DISSERTATION 2008**

Christine Thorne

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.



### Declaration

I know that plagiarism is wrong. Plagiarism is to use another's work and pretend it is one's own.

I have used the Harvard convention for citation and referencing. Each contribution to, and quotation in, this dissertation from the works of other people has been attributed, and has been cited and referenced.

This dissertation is my own work.

I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

# Contents

→ Topic and introduction

Literature review

Design principles

River basin analysis

Site selection

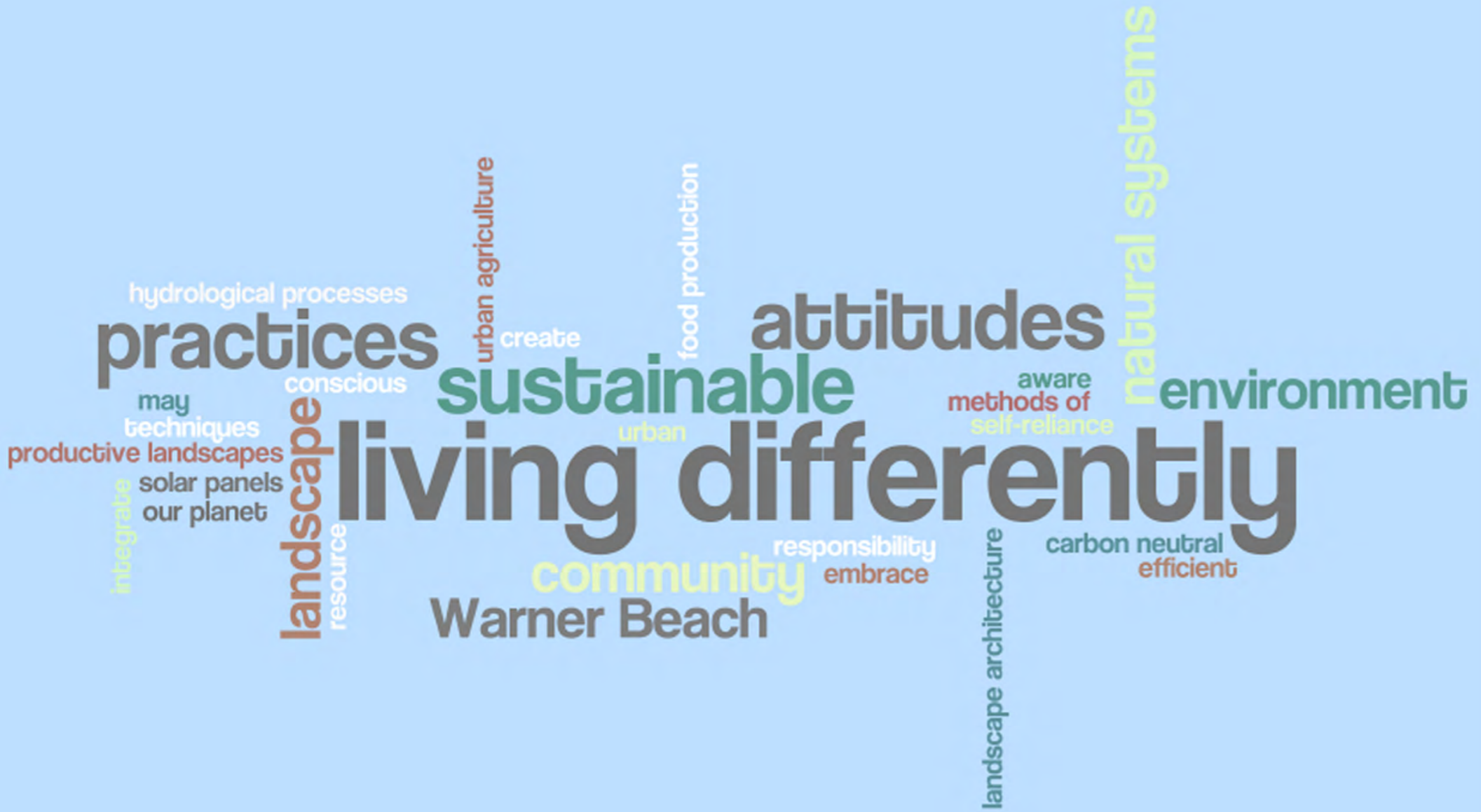
Site design

Precinct design

Construction details

Conclusion

References



*Disclaimer: What this thesis is not: Global warming is not a driving force of this dissertation despite the evidence that global warming may be attributed to carbon emissions. The reason that global warming is not being emphasised as a generator for change is that there is a possibility that the global climate is changing regardless of human activity. While it is commendable for people to reduce their carbon emissions in order to reduce global warming:*

- a. it could be a futile exercise if global warming continued naturally anyway and*
- b. lifestyle change is about an attitude towards the earth and how we should be living on it. Sustainable living should emanate from a respect for the earth, not out of fear of changing climates.*

*Global warming is also a symptom, not a cause, of unsustainable lifestyles. Finding solutions to current and immediate issues such as energy and food crises and learning to live in tune with natural systems will automatically create the adjustments needed for the reduction of global warming (at least caused by humans – if the world is heating up naturally anyway there is not a lot we can do).*

# Introduction

## Contextualising the topic

Society today is structured in a way that supports centralised authorities who devise systems for living (eg: food supply, energy sources) that are not necessarily in keeping with sustainable processes. South Africa is facing a severe energy crisis and the current solution to this problem is to build more energy plants that are heavily dependent on non-renewable resources. The global economic situation is heading towards a recession and South Africa will be greatly affected. The general public seems to be responding to these problems by trying to solve these problems individually eg: buying a generator for their home or installing solar panels on the roof, but these solutions are impractical if not expensive.

Rates of energy and resource consumption worldwide follow an exponential growth curve. Already there are noticeable effects of this unsustainable way of living and there is substantial evidence that we are causing often irreparable damage to the planet that supports our livelihoods. To reduce our impact on the planet we should begin to live in a system of closed metabolic cycles that follow patterns of natural systems.



1 South Africa's energy crisis



2 Food riots in Haiti



3



4 Food queues in Zimbabwe

Therefore, the key problems that have prompted this dissertation are:

1. The impending global food and energy crises
2. Unsustainable living – in terms of attitudes, such as ignorance of natural systems, and practices, the excessive consumption of resources and production of waste

## Nature of enquiry

Based on these problems, this dissertation will begin to explore what would happen if certain lifestyle habits changed. If people did start living differently, communities could integrate with natural systems and collectively create sustainable systems that also provided carbon neutral energy and sustainable food supplies. (Although it is explained later, for now it is assumed that landscape architecture plays an important role in creating landscapes of different living.) Because this is a landscape architecture dissertation it is focused on the spatial manifestation of living differently, ie. what will it look like?

## Design brief

Topic: **To use sustainable landscape architecture principles and techniques to create an efficient environment in which a community may embrace methods of living differently.**

Because retrofitting sustainable measures to an existing community will be limiting in terms of presenting a thesis, the design for a community will be new but (and this is essential) it must integrate and connect into an existing community.

The final product should include the design for a dense community of dwellings (ie. urban residential and not an isolated rural community) that:

- works within hydrological processes
- aims toward being carbon neutral
- is self-reliant in terms of food production, “waste” disposal and energy production (closed metabolic systems) and

- contains an education centre/prototype bordering an existing unsustainable area (in order to integrate systems)

In terms of scale, the community must be pedestrian-scaled for walking distances ie. between 200-800m diameter with a coherent neighbourhood should not have a population greater than 500 people.

## Physical context for design

I have become convinced that current ways of living cannot be continued indefinitely. As a landscape architect I have a responsibility (because of an understanding of natural systems) to promote sustainable lifestyles. Yet how could I impose values on others that I have not explored in my own life? Therefore it is vital that the context for this project should have particular relevance to my own lifestyle and so the context for this project is the one in which I grew up: Warner Beach.

Warner Beach is a coastal town in KwaZulu-Natal, 30 minutes south of the centre of Durban. Warner Beach is a linearly arranged town that runs parallel to the coast and much of its identity and economy is based on its coastal location. The area is bounded by a river in the north, while the south and west borders run into sugar cane fields.

## Structure of thesis

There are 4 parts to the thesis:

1. A literature review
2. An analysis at the river basin scale
3. A local plan for the chosen site that is integrated into a design for Warner Beach
4. A precinct design and associated construction details



hydrological processes  
practices  
may techniques  
productive landscapes  
solar panels  
our planet  
integrate  
landscape  
resource  
conscious  
urban agriculture  
create  
food production  
attitudes  
sustainable  
urban  
living differently  
responsibility  
embrace  
Warner Beach  
landscape architecture  
aware methods of self-reliance  
carbon neutral  
efficient  
natural systems  
environment

*“In many ways, the modern suburbs it has devised and constructed bring to mind the worst features of the great plantations that have dominated most of human history. Like plantations, they are organized around the large-scale, preplanned production of a single crop or product. Look at them: monocultural housing tracts, erected on ever-larger scales, like so many endless fields of cabbages. Standardized shopping centers multiplying like so many flocks of sheep. In the realm of transportation, limitations of the old plantation-to-seaport rail corridors have been inappropriately adapted for travellers who need unlimited access to countless micro-destinations -- not limited access to relatively few macro-destinations.*

*Fortunately, there is one planning profession that understands the vibrancy of the old-fashioned office tower and the need to liberate itself from the monotony and rigidity of the plantation mentality. That profession is landscape architecture.”*

Jane Jacobs, 2004

# Contents

Topic and introduction

➔ Literature review

Design principles

River basin analysis

Site selection

Site design

Precinct design

Construction details

Conclusion

References

## Introduction to literature review

This literature review follows an argument that first aims to explain and describe the unsustainable attitudes and practices of urban lifestyles in order to understand the critical aspects that most need to change. It then studies a series of theories and practices of how other people have suggested that we understand and discontinue unsustainable living. These external sources also identify the critical reasons why such a dissertation may be a worthwhile contribution to its landscape field as it attempts to fill gaps within a South African context. From this information a series of design principles required for the design of a sustainable community will be developed.

## 1 Why urban lifestyles are unsustainable

Since the industrial revolution there have been major improvements to living conditions: slavery has been abolished, women have achieved independence in most countries, diseases such as smallpox have been eradicated and machines bring much efficiency and improvement to our lives. It is ironic, however, that these fantastic developments have brought new problems such as ecological and economic unsustainability (du Plessis, Lundy, & Swanepool, 2000). This literature review focuses on the key reasons why current urban lifestyles are unsustainable, highlights the seriousness of that behaviour and its effect on natural systems and serves to understand the extent to which change in lifestyle is needed.

Unsustainable lifestyles are a result of a combination of unsustainable attitudes and practices:

### 1.1 Unsustainable attitudes: Contempocentrism

Contempocentrism is “a preoccupation with the needs and opportunities of the present” (Mazmanian and Kraft, 1999:59). It is not enough just to consider the crises of the present, sustainability is also about preserving resources not just for current generations, but for the future too. In order for a community to be sustainable it must not compete for resources in a way that is to the detriment of other communities (both future communities and neighbouring communities).

In terms of fair earth share: from satellite imaging it is possible to calculate the total amount of biologically productive sea and land that we should be using. This total comes to 12.6 billion hectares (roughly a quarter of the world’s surface) but we are currently using 14.1 billion hectares to support global consumption levels (Desai, 2007). Assuming we should preserve even 10% of this land for wildlife, we are overusing land by 25%, destroying forests at a rate of 2% each year and have also caused a 70% depletion in global fish stocks (Desai, 2007). There is no thought or responsibility towards conserving current resources for future generations or between current societies: the “wealthy” energy-consuming population of the world is responsible for 70% of global carbon emissions (Roseland, 2000).

*“The rich must live more simply so that the poor may simply live.”*

Janis Birkeland, 2004

#### 1.1.1 Resource consumption: Results in natural capital depletion

Many people may be very sensitive to environmental activism campaigns such as whale protection or the dangers of oil spills, yet they are often unaware of the ecology of their own urban landscape and their own resource use.

There is little consideration of food beyond “it comes from supermarkets”, water “comes from taps” and wastes are taken “away” (Roseland, Connelly, & Hendrikson, 2005).

Natural capital is the stock of natural assets that produces goods or services. It provides non-renewable resources such as minerals and fossil fuels and a set of natural resources such as the soil, atmosphere, forests, water and wetlands (Goodland & Daly, 1996). Natural capital plays another role in that it provides services in terms of waste sinks and reduces the effects of erosion and floods. These systems are important life support systems but one of their requirements is that they need to function as intact systems. Any damage or degradation to these systems will impair their ability to perform their life-saving functions. Although it bears the term “renewable resources” there is a finite capacity on natural systems to produce an infinite supply of resources. Natural systems are only able to renew their resources if the systems themselves are not polluted or overexploited (Roseland, 2000).

The global annual water consumption per person of water is 10 000 kilolitres. South Africa has less water available per person than our desert neighbours Namibia and Botswana - 1700 kilolitres per person per year (du Plessis, Lundy, & Swanepool, 2000). By 2020, two thirds of the world’s population will be affected by water shortages and it is estimated that if South Africa continues its current water usage, we will run out of water by 2015 (du Plessis, Lundy, & Swanepool, 2000).

Twenty-five years ago 13% of South Africa was arable land, today this figure sits at 10% - this amounts to less than 0.5ha per person and is exacerbated by urban sprawl, erosion, pollution, use of pesticides and chemical fertilizers (du Plessis, Lundy, & Swanepool, 2000).

### 1.1.2 Excessive waste production:

#### Results in pollution, degradation of natural systems and loss of biodiversity

South Africa produces between 340 and 480 million tonnes of waste annually. 15 million is municipal waste which means that we each produce 200kg of waste per year. This waste is transported far distances to landfill sites even though 80% of this waste is recyclable (du Plessis, Lundy, & Swanepool, 2000).

*“Our intensive farming methods have removed so many nutrients from the soil that an apple grown today has less than a twenty-sixth of the nutrients that same apple would have had eighty years ago.”*

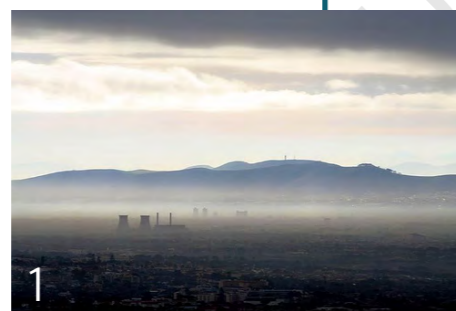
Du Plessis, Lundy & Swanepool, 2007

While natural systems are sinks (ie. they have the propensity to deal with wastes), they cannot cope with excessive over-production of wastes and result in:

Ozone depletion – which inhibits the atmosphere’s ability to protect us from harm.

Acid rain – caused by sulphur dioxide emissions particularly from cement factories and oil refineries. Acid rain causes damage to forests and crops (Roseland, Connelly, & Hendrikson, 2005).

Smog – a result of the combustion of fossil fuels. Not only does it cover cities with an unsightly yellow-brown layer, it is unhealthy to breathe and the reaction of nitrogen oxides and hydrocarbon gases with sunlight produces harmful gases that inhibit photosynthesis in plants (Roseland, Connelly, & Hendrikson, 2005).



1 Smog over Cape Town

Pollution of water sources – a result of runoff from residential, industrial and agricultural areas (Mazmanian & Kraft, 1999).

Sewerage treatment plants also have a high rate of water extraction and may put back more polluted water into the rivers and oceanst (Roseland, Connelly, & Hendrikson, 2005).

### 1.2 Unsustainable practices: The structure of urban areas (results in car dependency)

Half the world’s population lives in urban areas (Reader, 2004)

*“Cities are the defining artefacts of civilisation, but they are also dangerous parasites, with a capacity to harm regions beyond their own boundaries.”*

John Reader, 2004

and South African statistics closely follow this trend. In 2000 it was recorded that 54% of the country’s population lived in metropolitan areas (du Plessis, Lundy, & Swanepool, 2000).

This literature review assumes several facts about the suburban model. It is a:

- Predominantly residential area, of
- Low density therefore
- Very spread out, requiring
- More roads for accessibility and
- More services to line the roads.
- Greater travelling distances to shops/work etc as well as to transport goods and remove waste.



2 Typical suburbia

#### 1.2.1 Roads or paved surfaces

The physical structure of suburbia is generally associated with a high resource-consuming lifestyle (Roseland, Connelly, & Hendrikson, 2005) (Reader, 2004). Suburban areas were originally constructed using methods and technologies that were based on an abundant supply of cheap fuel and this resulted in inefficient planning and construction as well as the creation of large

*“Sprawling suburbs are environmentally unsustainable and there is not enough room on this planet, nor enough resources, to lead everyone up the suburban garden path.”*

Janis Birkeland, 2004

monofunctional expanses of land aptly described as *sprawl* (Roseland, 2000). Because of the expanded road network, more resources went into the construction of the roads and sidewalks as well as the services and utilities than in eg: a more dense area with a less extensive road network (Boyle, 2005).

Because low-density areas have more hard surfaces (roads, parking lots etc.) suburbia can create up to twice as much stormwater pollution than more dense areas (Roseland, Connelly, & Hendrikson, 2005). Flooding due to disruption of hydrological cycles can cause structural damage to buildings and damp, cracks etc.

As urban areas sprawl away further from centres and job opportunities, lengthy car journeys become the norm. Cars not only contribute to atmospheric pollution but increase congestion, increase demand for energy (fuel) and reduce potential working hours which reduces productivity and may have negative economic impacts (Roseland, Connelly, & Hendrikson, 2005). The term *automobile dependency* was first used in the 1980s by Australian researchers Peter Newman and Jeffrey Kenworthy. Automobile dependency occurs in areas where private cars are the dominant mode of transport and there is a restriction of the freedom of being able to choose alternative transport modes. This results in a snowballing effect as the preference for cars causes congestion, encourages road-widening, and supports the creation of additional parking lots (thus increasing total non-porous surfaces). Because of these changes, which also allow for smoother car journeys (less disrupted by traffic lights and pedestrian crossings), cars become more popular and development begins to respond to this car-dependent trend by creating malls that can only be accessed by cars and dependence on cars increases (Wikipedia, “Car dependency”).

The theories of Newman and Kenworthy did not attempt to totally eradicate the use of cars altogether but aimed at reducing dependency on them (Roseland, Connelly, & Hendrikson, 2005). While cars grant independence and increase accessibility they do create social inequalities because groups such as children, teenagers and the elderly are automatically disadvantaged when it comes to participation in social events that require motor transport (Roseland, Connelly, & Hendrikson, 2005). Car dependence has a directly proportional relationship to inefficient land use. Therefore, more efficiently-designed neighbourhoods where facilities are nearby, will have less dependence on cars.

Policies that increase residential density, improve public transport access and promote pedestrian and bicycle routes will aid in lessening our dependency on cars (Roseland, Connelly, & Hendrikson, 2005) (Mazmanian & Kraft, 1999).

*“Certainly it would be foolish to deny the mounting evidence that an ecological crisis of some magnitude seems to be at hand. Believing in Gaea, I believe that it is in her interest to try and keep most of the major living species on her crust from destroying themselves.”*

Kirkpatrick Sale, 2000

While our lifestyles are not sustainable, Sale (2000) has hope for our planet. Perhaps our survival will depend on our ability to find creative solutions to problems: clearly there is the need for a re-evaluation of the structure and processes of urban living. Luckily this is a subject that has been extensively researched and theorized (but less practiced).

*“Landscapes are simultaneously ecological, cultural, economic, political, poetic, ideological, and symbolic sociospatial phenomena. Landscapes are not only a container of resources, but are themselves resources. Landscapes are not simply raw materials, but they are social practices as well as commodities in their own right, differentiating themselves both internally and externally so as to promote their beauty and hide their ugliness. Landscapes are simultaneously public and personal. Landscapes are both the cursed commute and the mountain top vista and as such they both sap and renew our spirits. Landscapes have been fought over to the death as well as ignored to the point of obliteration. Landscapes are experienced multi-modally: we see, hear, taste, and touch simultaneously. While they are sometimes experienced externally as from an airplane, a mountain top, or remotely through maps and air photos, we are usually immersed in them, experiencing them, instead, from the ground plane. Finally, ‘landscape’ is a human–ecological concept that involves human agency. As such, we must admit that we do not simply live in landscapes, but that we are in essence, a functional part of landscapes. From this perspective, it is evident that there is not simply a crisis over the ecology of landscapes, but the meaning of landscape itself.”*

Thayer, 1989 in Linehan & Gross, 1998

## 2 Review of theories supporting sustainable living

This section of the literature review will describe the overall global awareness of sustainability and then will delve into the attitudes and practices of sustainable living from which a set of design principles and guidelines will be developed.

### The role of landscape architecture in sustainable living

As Thayer (1989 in Linehan & Gross 1998) points out, landscape is a palimpsest of geological, environmental and social resources that change over time and space. Because of the complexities of reading and understanding and living in landscapes, landscape architecture is one particular field that has developed a holistic attitude towards the imprint people leave on the landscape.

Landscape architecture attempts to both *respond to* and *affect* the change from unsustainable to sustainable living: this section describes *changing* attitudes and practices as both adjective and noun. There is an assumption in this thesis that change toward environmental sensitivity is inevitable but also that professions such as landscape architecture are tools towards implementing this change. Landscape architecture does not only prioritise natural landscapes and natural systems, it is also concerned with good design of spaces for people: examples of urban agriculture and new urbanism will show that landscape architecture is effective in creating efficient, sustainable urban spaces.

The following section describes theories across time and cultures that reinforce the theories of sustainable living. There is no emphasis placed on any particular theory but rather explores a body of knowledge that can be applied through landscape architectural techniques.

## 2.1 Global framework of sustainable awareness

The term “sustainable development” was first used in the 1970s (du Plessis, Lundy, & Swanepool, 2000). In June 1992 the Earth Summit UN Conference on Environment and Development was held in Rio de Janeiro. 180 countries met to agree on a framework for global sustainable development and two non-binding agreements were created – the Rio Declaration on Environment and Development and Agenda 21 (guidelines and action plans for sustainable development). Local Agenda 21 is a challenge for local communities to begin sustainable action according to its key goals (du Plessis, Lundy, & Swanepool, 2000).

In 1996 the second UN Conference for Human Settlements (Habitat II) was held in Istanbul. The Habitat Agenda set out goals and plans of action and described a sustainable human settlement:

*“A sustainable human settlement is one where all have adequate shelter, a healthy and safe environmental, basic services, and productive and freely chosen employment.”*

du Plessis, Lundy, & Swanepool, 2000

## 2.2 Changing attitudes

In order to effect change along the lines of a local Agenda 21, a change in attitude towards the way we live is required. Bioregionalism, social ecology and native views are ideas and theories that illustrate the type of attitude we should have.

### 2.2.1 Bioregionalism

The central idea of bioregionalism is place. The term “bioregionalism” is a combination of the Greek word for life, *bio* and the Latin for “territory to be ruled”, *region*. Combined, they mean “a life-territory, a place defined by its life forms, its topography and its biota, rather than by human dictates; a region governed by nature not legislation” (Sale, 2000). Bioregional

practices put up a resistance to the continuing destruction of natural systems such as forests and rivers. (Roseland, Connelly, & Hendrikson, 2005). The restoration of these systems is approached from a knowledge of how natural systems should operate and techniques that respond to their unique site and context (Roseland, Connelly, & Hendrikson, 2005).

Bioregionalism as a movement is relatively new, but its theories have its roots going back to the 1800s. Like social ecology, it is founded on classical anarchism and promotes a social organisation that maintains its own political control and self-governance (although it still pays allegiance to broader institution structures) (Roseland, 2000).

In his book, “Dwellers in the Land, the Bioregional Vision” Sale presents an argument that is based on our natural, inherent ability to care for the earth: to become “dwellers in the land”. In order to do this, Sale believes it is necessary to understand *place*, which involves understanding at least: the geology below the surface of the ground, available water sources, the local climatic conditions, seasonal cycles and planting times, biodiversity and plant-life. Once we understand what makes up a particular area we must investigate its potentials and limits: the carrying capacity of land and water sources; places that should not be developed; places that are suitable for development. Lastly we must study and appreciate human social and economic systems that have gone before us (Sale, 2000).

Sale (2000) describes the concepts of bioregionalism:

1. Knowing the land – being conscious of hydrological cycles, food production potential, local climatic conditions, potential of natural energy sources and land-use settlement patterns. Cities are part of a greater region and the cities depend on these regions for their resources. Although cities have displaced the natural habitats in order to build urban fabric, there exists the possibility, for the land space of the city to be used towards the city’s own needs eg: roof gardens, sod roofs, urban agriculture, recycling and solar and wind energy.

2. Learning the lore – our forefathers were well-rooted in the earth and over the centuries accumulated customary knowledge that modern science has taken a long time to discover (for example the benefits of herbs and plants as medicines and the orientation of structures for maximum benefit of passive solar effects).

3. Developing the potential – Sale explains that a city’s extraction of resources had “best be realised within the boundaries of the region, using all the biotic and geological resources to their fullest, constrained only by the logic of necessity and the principles of ecology.” (Sale, 2000:46) Sale believes that self-reliance is an inevitable result of bioregionalism practices – once an urban area decides to optimise its use of its locally available land and resources, it becomes less dependent on regions beyond its own.

4. Liberating the self – As a result of this unique management of a region’s resources, urban areas may seek to develop non-centralised forms of authority as well as local economic and political systems.

### 2.2.2 Social ecology

Social ecology criticises domination and hierarchy and has historically been used as a vehicle for liberation of social groups such as women and workers but also ecology. Social ecology uses human creativity and a holistic view to restore damaged ecosystems. Its principles call for equity, social justice and energy efficiency as well as promoting the formation of ecologically-conscious communities that work with nature, are self-reliant and practise participatory democracy. (Roseland, 2000).

\*See following precedent on ecovillages: Ithaca

## Precedent: EcoVillage at Ithaca, New York

**Why: Understanding lifestyles within ecovillages to determine realistic programmatic requirements for the design of a similar community**

The EcoVillage at Ithaca is located in the Finger Lakes region of upstate New York.

It was initiated by a non-profit educational organisation to develop an alternative model for suburban living that minimises ecological impacts while ensuring a healthy lifestyle.

The site is 175 acres of which 80% has been retained for green space (wildlife, recreational space and organic agriculture). 2 neighbourhoods comprising 30 homes in 15 duplexes, take up only 7 acres of the site. Also within the site is a vegetable farm, two common houses, a root cellar, community gardens, a chicken coop, a village pond, a recycling shed and a communal compost heap.

The common houses each have 10 office spaces for the use of the residents, a reuse room (instead of throwing away unwanted but re-useable items such as clothes and books, they can be taken to the reuse room for future reuse), a laundry room and a meeting space.

The houses do not face onto a road but a pedestrian walkway with play areas. The houses have photovoltaic panels on the roof. 1 bedroom homes are 922 square feet and 3 bedroom homes are 1300 square feet.

Water for the vegetable garden comes from rainwater collected from roofs and is stored in 3 interconnected 1000 gallon tanks.



Every 8 homes are linked to a generator that is heated by geothermal energy.

Residents cycle around the site (no cars are allowed except for a communal parking lot) although there are 3 cars available for shared use: residents book a timeslot and pay per mile that they drive.

(Bosjolie, 2008)

### Images:

1. 80% of the land is preserved as open space
2. Installing one of the 3 cisterns used for rainwater collection
3. The Reuse room
4. The Common house
5. At the end of the street looking back towards the Common house
6. The duplexes all have their front doors facing onto the main street
7. One of the car-share cars
8. Residents are able to cycle to work
9. The main thoroughfare through the neighbourhood is a pedestrian walkway (and not a road for vehicles)
10. One of the 10 offices in the Common house created for residents' businesses

### What has been learnt from this precedent:

- programmatic requirements for living in communal sustainable villages eg: communal spaces for offices, laundry facilities, car-share facilities, communal eating spaces
- energy networks
- systems for water storage
- prioritising pedestrian networks

### 2.2.3 Native/indigenous world views

As Sale recognised when he wrote that “learning the lore” is learning knowledge that precedes our eminent scientific advances, principles of landscape urbanism and bioregionalism have been used by indigenous settlements and ancient civilisations for longer than we perhaps realise (Roseland, 2000). Early societies understood the topography of their landscape and synchronised their lives with seasonal weather patterns. Communities were acutely aware of the natural processes around them and used this information to grow and survive.

*“The capture, storage and distribution of water inextricably bind physical and social processes into a thorny relationship between nature and society.”*

*Shannon & Manawadu, 2007*

The stone channels in Machu Picchu or the aqueducts in Rome are examples of civilisations celebrating the importance of water as a resource. In Asia, the monsoon season brings vital rains which support the rice paddies. Spiritual festivals developed to celebrate this life-giving season. In fact, many ancient cultures held rituals or religious celebrations which were tied to agricultural patterns and seasonal milestones (Zeiher, 1996).

One of the best examples of a settlement finding the balance between natural systems and the consumptive needs of a settlement is found in ancient Egypt: the annual inundation of the Nile was the foundation of the Egyptians’ agricultural system and they took advantage of the rich fertile soils deposited by the flooding river with the lightest of human intervention (Zeiher, 1996).



2 The Great Pyramid at Uxmal

Uxmal is a Mayan ruin (in Yucatan, Mexico) dating back to 6-10th century. Uxmal means “thrice built”: because the city’s water source was entirely from rainwater, the Mayans would abandon and return to the settlement as water supplies were consumed and replenished (Zeiher, 1996).

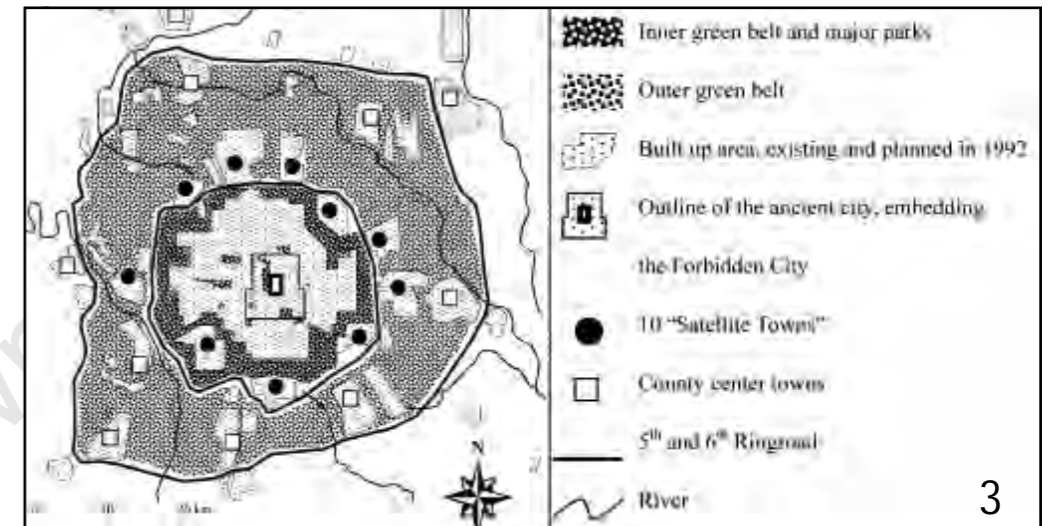


1 Terraces at Machu Picchu, Peru

## 2.3 Changing practices

### 2.3.1 Greening the city

The “Greening the City” movement attempts to protect and restore ecological systems in urban communities. Spatial interventions range from planting fruit-tree avenues to allowing streams to flow through a neighbourhood (as opposed to draining the stream or building a canal) and also planting vegetables in a community garden (Roseland, Connelly, & Hendrikson, 2005). Greening the city involves more than the creation of recreational space – it is also intended to be productive. Green space is important because it converts carbon dioxide, produces oxygen, purifies air and water, regulates micro-climates, muffles noise and protects soils and water (Li, Wang, Paulussen, & Liu, 2005). The issue in Beijing is that green space is being compromised. The 1992 Master Plan proposed a concept of two greenbelts for the city – an inner and outer greenbelt. A third of the land in the greenbelt, however, was used as residential buildings for farmers and as a result of unmonitored settlement the greenbelts have been fragmented (Li, Wang, Paulussen, & Liu, 2005). There is such pressure on the green space from population increase that



Beijing's 1992 Master Plan

the green space needs a very effective method of protection that allows a system of development that conforms to good green space patterns. Continuous green space, even if it is in wedges or networks is more effective than a large but fragmented green space (Li, Wang, Paulussen, & Liu, 2005). Because green space within urban areas tends to have aesthetic, rather than ecological or recreational value, green space is under threat from urbanization. The uneven distribution pattern of green space needs vast improvements and a continuous natural forest structure (comprising tree canopy, underlayer shrubs and herbs) would provide more ecosystem services and encourage stability in plant communities (Li, Wang, Paulussen, & Liu, 2005).

### 2.3.2 Urban ecology

Urban ecology is closely related to Greening the City as it attempts to create opportunities for urban dwellers to have a greater understanding and interaction with nature (Roseland, Connelly, & Hendrikson, 2005). Urban ecology also focuses on creating sustainable green spaces that are appropriate to the contextual climate and region (so not necessarily prohibiting exotic plants but ensuring that all plants are conducive to the water conditions of the site – water-wise in drought prone areas, and aid in soil stabilisation in flood areas - and are non-invasive) (Roseland, Connelly, & Hendrikson, 2005). Urban

ecology emphasises that green spaces should be multi-functional – recreational, wildlife habitats, places of food production and environmental cleansers (Roseland, Connelly, & Hendrikson, 2005).

*“In a sense, today’s urban landscape architects are picking up the revolutionary view of nature that dissipated more than two centuries ago, but this time around they are viewing mankind and nature as partners, with nature as the senior partner and human beings the apprentices.”*

Jane Jacobs, 2004

### 2.3.3 New Urbanism

During the energy crisis in the 1970s, there was a search for a new way of approaching urban development. There was a reaction to the monotonous sprawl that was covering America’s landscape and so a compact, mixed-use, relatively pedestrian, self-contained community development arose – new urbanism (Grant, 2006).

The key point of new urbanism is its use of passive design measures to create vibrant, efficient communities. New urbanism relies on surveillance to control behaviour rather than electric fences and imposing gates (Grant, 2006). New urbanism neighbourhoods generally have a centre and a defined edge with a fine network of interconnecting streets that accommodate a variety of uses and activities. Unlike alternative forms of development, new urbanism supports incremental development of a clear and simple, yet flexible design plan. This gradual development allows flexibility of development according to a community’s needs as opposed to master-plan structures (Grant, 2006).

New urbanism is not without criticism: while there are many admirable aspects of the communities, this type of

design creates gentrified, exclusive communities and promotes suburban growth on the urban fringe. Unlike Sale’s bioregionalist theories where communities are synchronised with natural functions of the landscape, new urbanism separates city from nature. New urbanism doesn’t create green spaces for the sake of having green space. For example, water edges are not really protected as fragile eco-systems, and the 9m buffer around wetlands tends to be ignored (Grant, 2006). “New urbanists seldom discuss habitat protection or landscape function in their pursuit of good design. Critics find that new urbanist approach to the natural environment within urban and suburban environment short-sighted.” [Grant, 2006:101]

The “urban village” is the spatial offshoot of new urbanist theory. The urban village is a form of settlement that is a reaction to sterile, monotonous developments and instead it aims at creating mixed-use, sustainable urban developments that host a variety of functions from residential and commercial to recreational and leisure facilities and community facilities. It also places emphasis on a strong sense of place, density, amenities within walking distance of the residents and participation of the residents in planning and management.

Urban villages in South Africa fall into two different categories: the first, which is more in line with the Urban Village Forum in the UK and New Urbanism in the USA, focuses on mixed-use development, pedestrian accessibility, activity corridors and development of nodes. An example of this is Alexandra in north east Johannesburg: redevelopment concentrates around selected activity corridors and nodes and creates a hierarchy of spaces from Freedom Square – the centre of the area that has major facilities such as a taxi rank, police station, sports stadium, and market. Five precincts were then identified for immediate redevelopment and the aim was to create livable, sustainable and integrated residential areas while also encouraging local economic development and cultural celebration of

local community points. Spatial devices used: large public squares, gateways, high density residential development along major routes, activity spines, commercial corridors, links to regional connectors etc. (Landman, 2007)

The second form of urban village in South Africa is epitomised by the Melrose Arch development in Johannesburg.



Melrose Arch, Johannesburg

These urban villages tend towards exclusive gated communities and while they are mixed-use, access is limited to the public – CCTV cameras and security guards patrol the “public spaces” (Landman, 2007).

## Case study: Greenwich peninsula

### Relevance

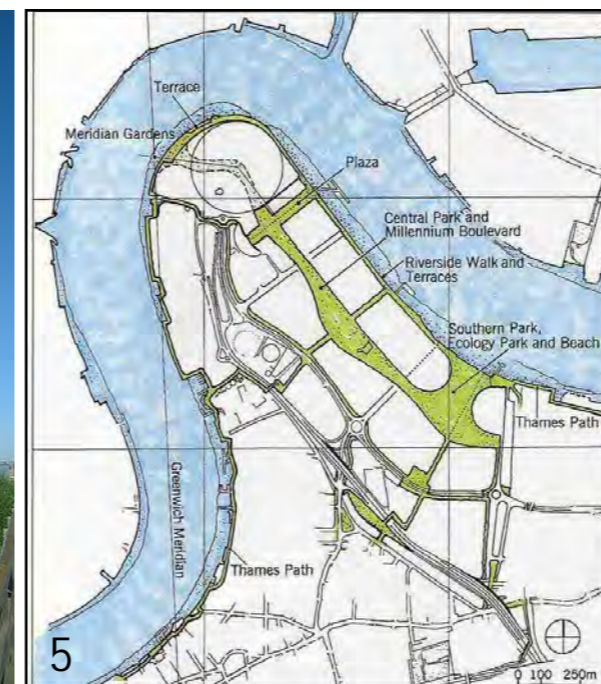
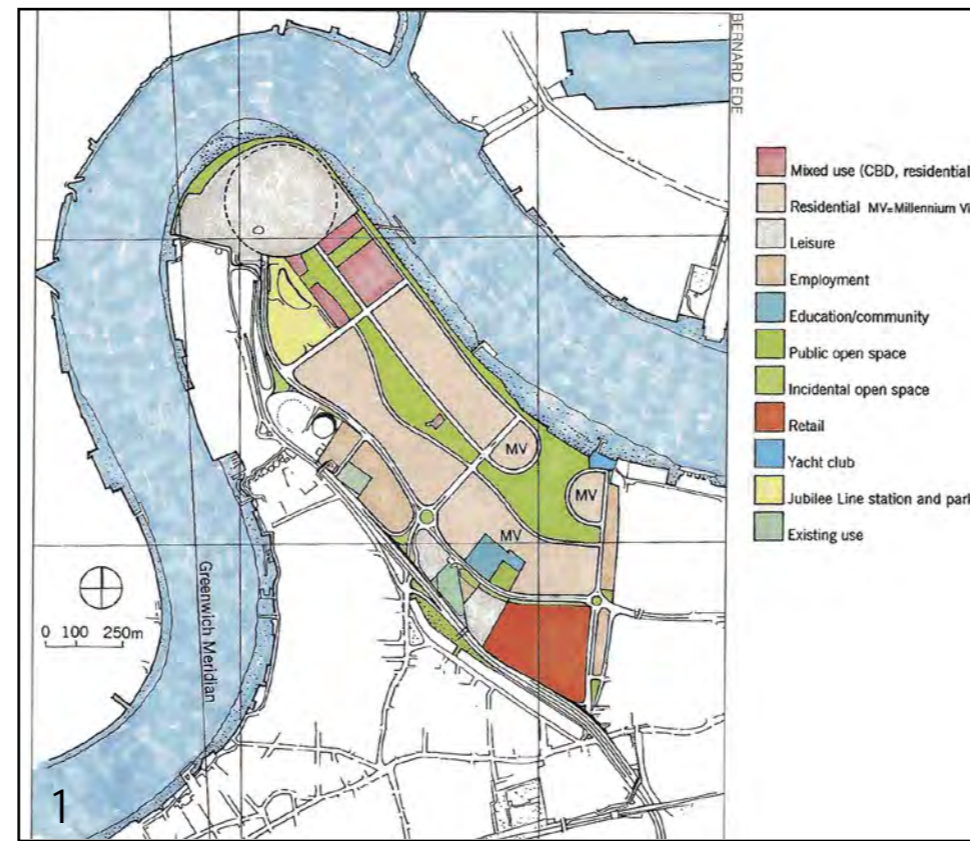
- understanding how dense urban areas can be constructed while giving natural systems a high priority, (eg: accommodating bird flight paths, constructing forests first and buildings later, restoring land before building etc) –
- non traditional design of urban space
- an example of a good pedestrian/green connection in an urban area.

### Description

Most of the theory of designing efficient, sustainable urban fabric is applied to existing cities. The Greenwich Peninsula development in London is an undeveloped brown-field site that will utilise the latest theories in urban development to create new sustainable communities.

The Greenwich peninsula is created by a meander in the Thames River at a point in the river where it widens and adopts estuarine conditions. The peninsula was originally estuarine wetland that was removed to provide land for industry. The land must now be restructured and organic material and topsoil returned to the area. The docklands are part of the East Atlantic Flyway, a waterfowl migration route, and so the habitat of these areas shall be protected.

Unlike traditional methods of defining public space by using buildings or formal elements, the peninsula will be defined by the natural and historical topography. Most of the peninsula will be covered with forest – initially with densely-planted fast-growing trees punctuated by slower-growing species. This creates a simulation of natural forest until the forest naturally establishes itself. Urbanisation will then fit into the forest later, as opposed to most landscapes where the vegetation is added in after the buildings. This tree canopy is a vital element in the landscape because it will create shelter, will prevent excessive storm water run-off, will filter and cool the air, absorb the



carbon dioxide and provide wildlife habitats and biodiversity ecosystems.

The open space corridor is designed to be continuous, comprising different spaces as well as pedestrian and cycle routes for the residents. Five main areas have been identified: the Meridian Park and Gardens (urban waterfront), the main urban Plaza, the urban Central park, the ecology park and the Riverside walk promenade.

The Central Park: This is one of the focal green spaces that will in future be bordered by residential buildings of 6 to 8 storeys. The park will be made up of interconnecting clearings within the forest while a hard surfaced area services a pedestrian promenade. The designers envisage that paths will evolve with use and will be constructed as they are needed.

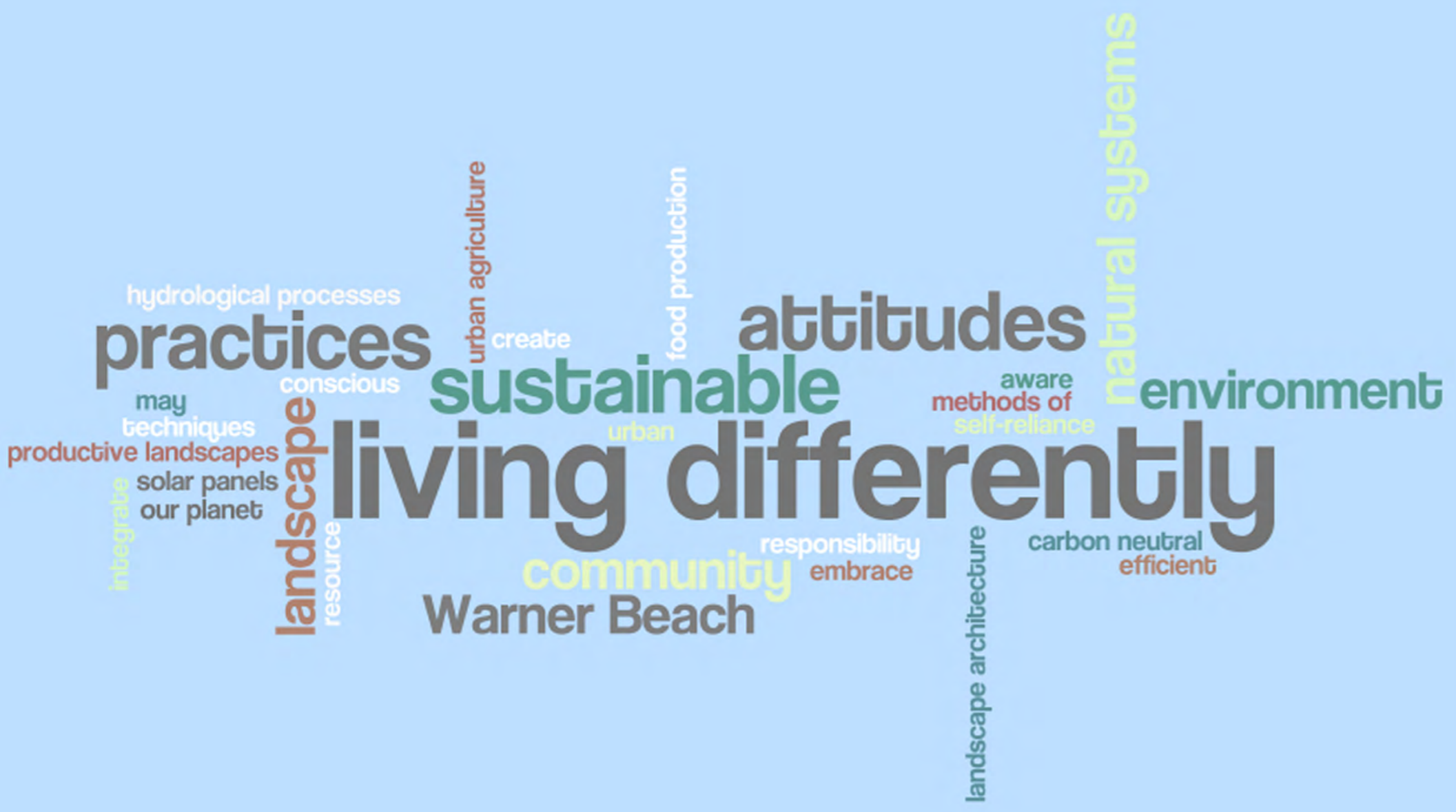
The Riverside Walkway: This 2 kilometre long promenade is a transition space between land and water and will imitate natural conditions of inter-tidal wetland and grasslands and will encourage the return of species to the peninsula.

The Southern ecology Park and Millennium Village: In this case, green and urban areas will be developed together as a showcase of sustainable development. The idea is to design a residential community that displays the latest best practices in terms of sustainable urban environments and minimises its impact on the environment through water-wise and energy-efficient schemes.

(Ede, 1998)



16



practices

sustainable

attitudes

natural systems

environment

living differently

community

Warner Beach

landscape

landscape architecture

carbon neutral  
efficient

responsibility  
embrace

methods of  
self-reliance

aware

urban

food production

urban agriculture

create

conscientious

hydrological processes

may  
techniques

productive landscapes

solar panels  
our planet

integrate

landscape  
resource

# Contents

Topic and introduction

Literature review

→ Design principles

River basin analysis

Site selection

Site design

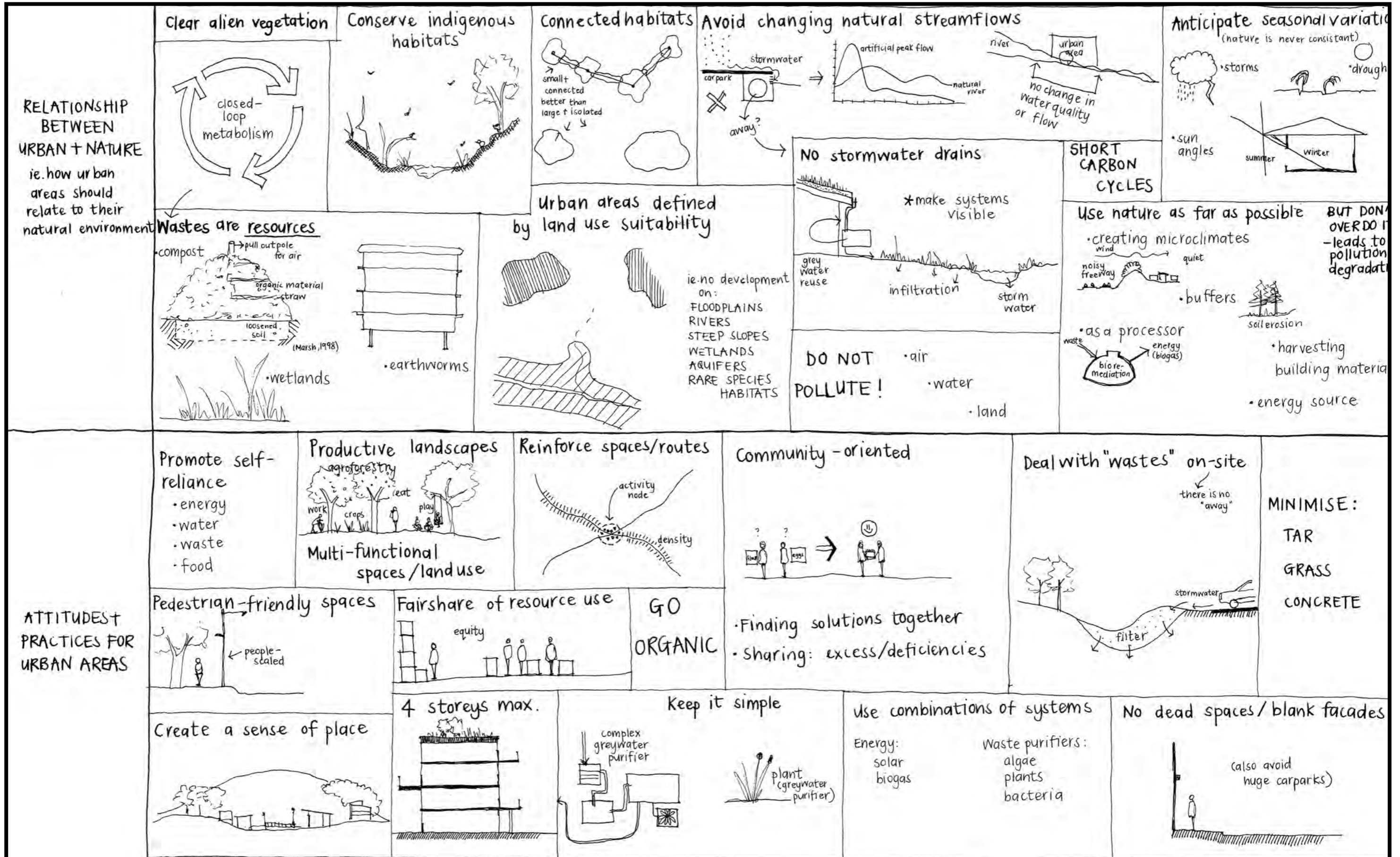
Precinct design

Construction details

Conclusion

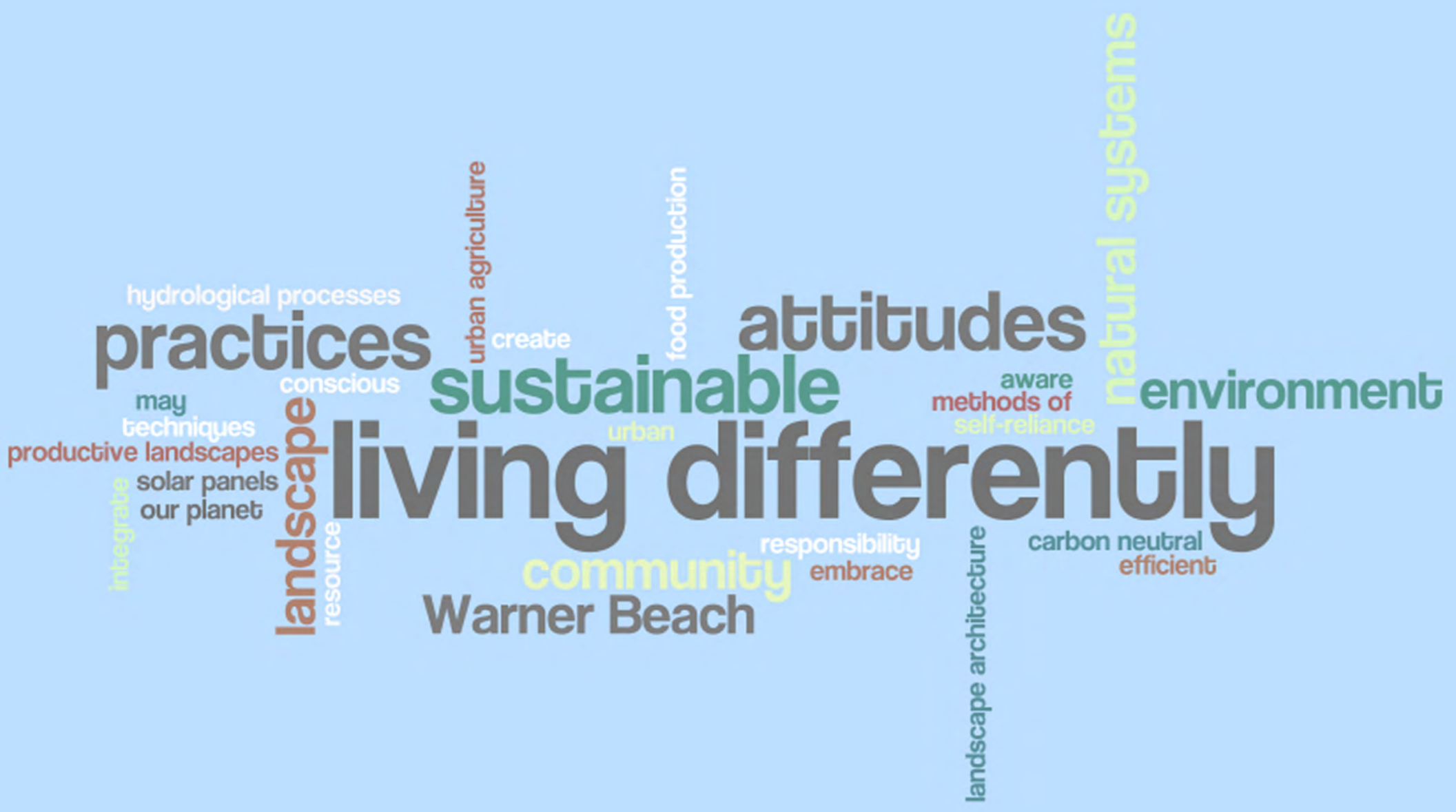


University of Cape Town





20



hydrological processes  
**practices**

urban agriculture

food production

**attitudes**

**sustainable**

natural systems

**environment**

**living differently**

may  
techniques  
productive landscapes  
solar panels  
our planet

landscape  
resource

community

Warner Beach

aware  
methods of  
self-reliance

landscape architecture

carbon neutral  
efficient

responsibility  
embrace

integrate

urban

# Contents

Topic and introduction

Literature review

Design principles

→ River basin analysis

Site selection

Site design

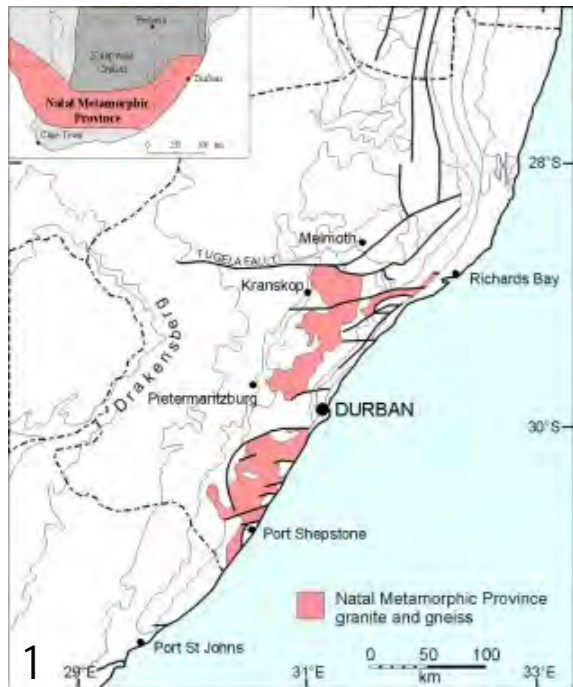
Precinct design

Construction details

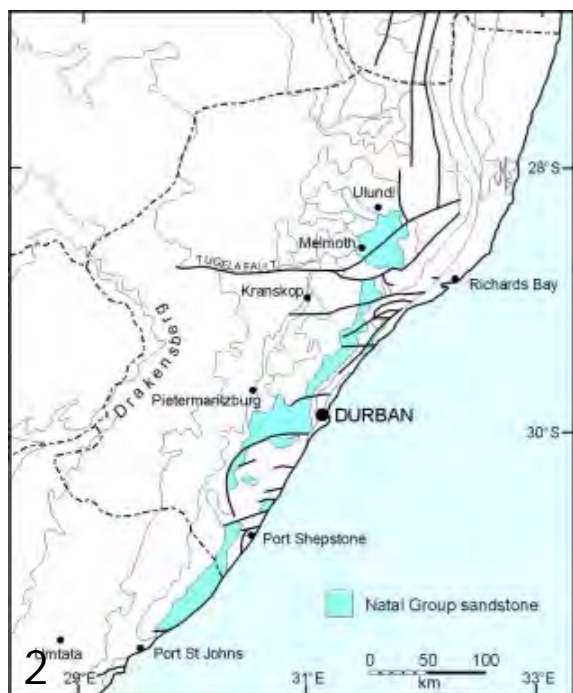
Conclusion

The following section describes and documents a method of analysis that is required to understand the broader regional context of a specific site. The context includes forces and movements (eg: geology and hydrology) that have shaped the landscape, as well as the cultural patterns of settlement that have (often subconsciously) responded to the landscape.

Kirkpatrick Sale (1991) advocated the need to organise landscapes into regions, but not as defined by political boundaries, but as natural regions defined by features of the landscape, eg: ridgelines. River basins, therefore are natural bioregions that distinguish water, climate and landforms from other regions (although there are other systems such as coastal regions that will of course cause similarities in landform types). River basins also form *landscape rooms* - areas in which one cannot see beyond the ridgeline - and could also be considered as a recognisable area that one could identify as a unique *place*.



1 Natal Metamorphic Province



2 Natal Group Sandstone

## Geological sequence (from prehistory to now):

1. Vaalbara is the Earth's theorised first supercontinent, believed to have existed 3.3 billion years ago. The Kaapvaal craton, along with the Pilbara craton of Western Australia are the only remaining pristine crust on earth dating back to 3.6-2.5 billions years ago. It is suggested that they belonged to the Vaalbara supercontinent. (Wikipedia, "Vaalbara")

The Kaapvaal craton formed and stabilised between 3.7 and 2.6 billion years ago during a magmatism and sedimentation cycle that thickened and stabilised into continental crust (Wikipedia, "Kaapvaal"). The Earth's basaltic crust was intruded by granite. The foundations of KwaZulu-Natal comprise this Kaapvaal craton (Whitmore, Meth & Uken, 2006).

Approximately 1000 million years ago, subduction and collision along the southern margin of the Kaapvaal craton produced the rocks of the Natal Metamorphic Province. The rocks were heated and deformed into a mountain range many thousands of kilometres long.

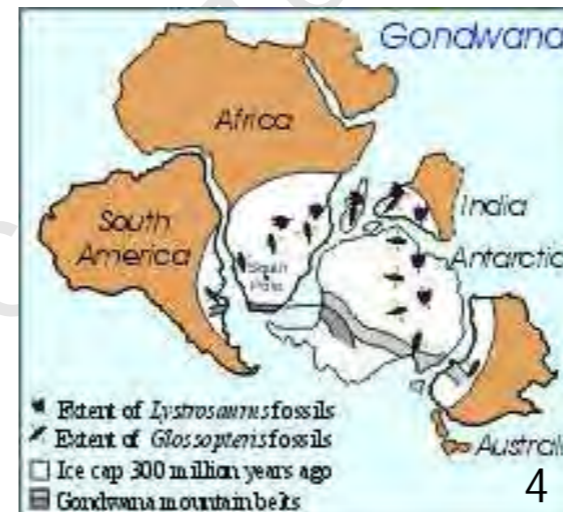
\*Subduction: the movement of one crustal plate under another so that the descending plate is "consumed"

\*Collision zone: a zone or belt where two pieces of continental crust have collided after the closure of an intervening ocean

2. 490 million years ago the first sedimentary sequence was deposited on the basement material and is known as Natal Group sandstone. "There are indications that the sediment was transported and deposited by rivers running from the north east. Close to the source, in northern KZN, deep valleys were infilled with thick accumulations of boulders and pebbles. Further south the sediment is finer-grained and forms resistant sandstone cliffs. These give rise to the table top topography seen in the Valley of



3 Pangea



4 Gondwana



5 Dwyka Group Tillite

1000 hills and Oribi gorge near Port Shepstone." (Whitmore, Meth & Uken, 2006)

3. 300-250 million years ago was the time of the supercontinent, Pangea. When it began to break up, 200-145 million years ago, two large masses, Laurasia and Gondwana were formed.

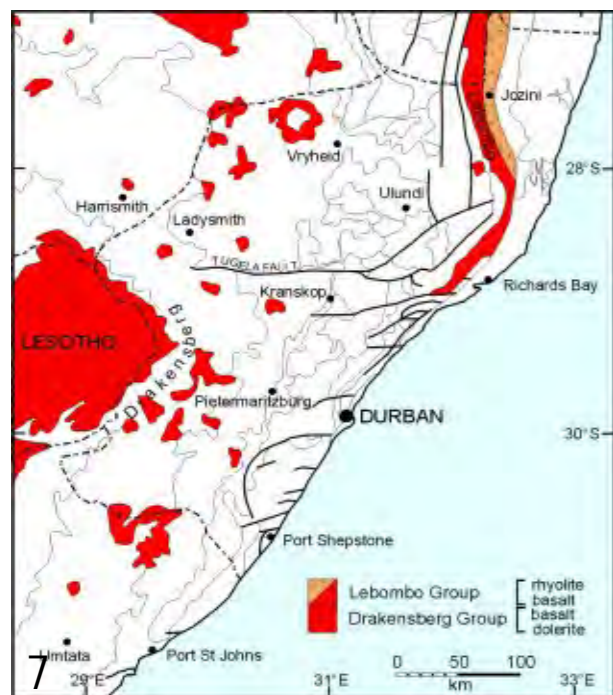
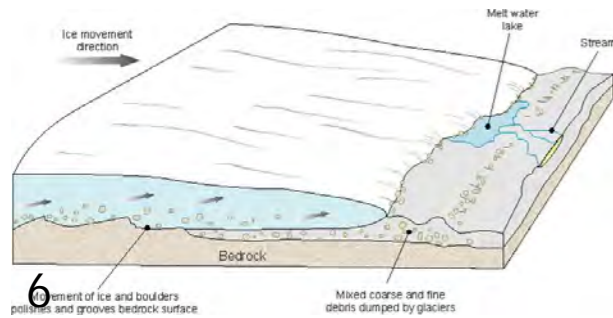
4. Similar rock sequences of the same age containing identical fossil flora show a connection of the southern continents of Antarctica, Africa, South America, Australia and India into the supercontinent, Gondwana. Gondwana extended from a point near the south pole to a point near the equator, and while there was a generally mild climate, there were glaciers in Southern Africa.

5. 300 million year ago, a thick layer of tillite was deposited over the Natal Group layer by retreating ice sheets. At this time, South Africa was still part of the supercontinent Gondwana which was situated near the iced pole and was covered in a layer of ice.

6. Rocks lying imbedded in the slowly moving ice sheets, scoured and polished the underlying rock forming what is known as "glacial pavements". Striation directions indicate that the ice flow was from north to south. The material formed by all this geological activity is known as the Dwyka Group tillite and it forms the lowest and oldest deposits in the Karoo Supergroup basin. (Whitmore, Meth & Uken, 2006)

\*glacial pavement: "bedrock surface with fine-cut, parallel or near-parallel lines made by rock fragments carried in a glacier which travelled over the bedrock" [Whitmore, Meth & Uken, 2006]

As Gondwana slowly moved north, towards the equator, there was a large sea over the Karoo basin and a thick layer of clays and silt beds were laid down. These sediments form the shales of the Pietermaritzburg Formation and are easily weathered and often are the



**Drakensberg and Lebombo Groups**



**Zululand Group Sandstone and Siltstone**

cause of slope instability.

Overlying the shale is the Vryheid formation which is characterised by light grey sandstones that were deposited along the ancient shoreline that bordered vast inland swamplands (Whitmore, Meth & Uken, 2006).

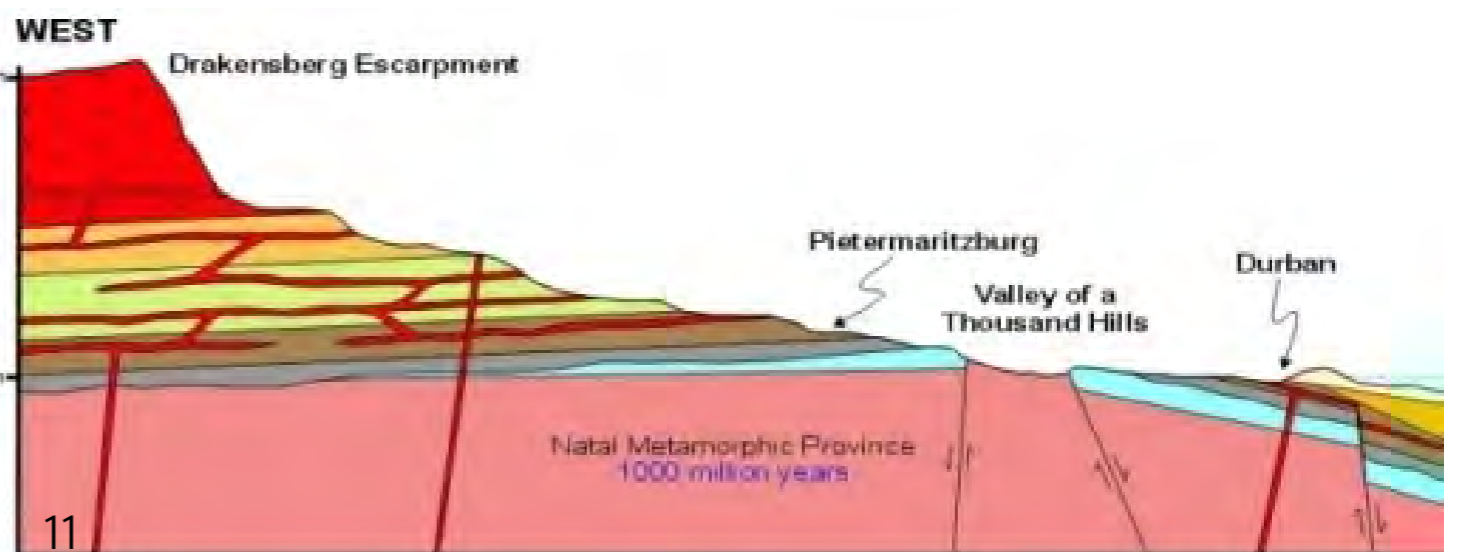
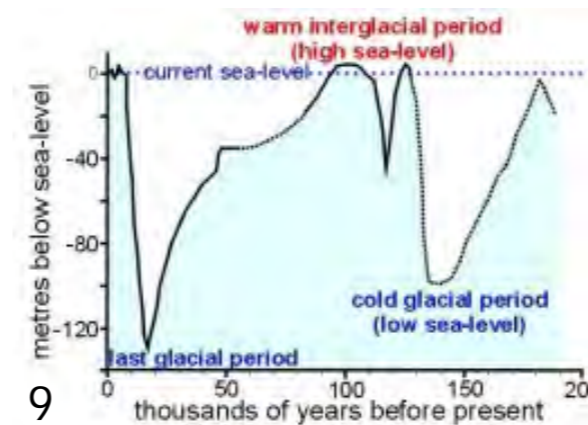
As these swampland began to dry out, they left the mudstones and sandstones of what is today known as the Beaufort Group. This layer forms the foothills of the Drakensberg escarpment and is characteristically coloured red, green and purple. These 250 million year old rocks record the largest extinction event in which approximately 95% of known species died out (Whitmore, Meth & Uken, 2006).

The Stormberg Group consists of 3 formations: the Molteno Formation (sandstone formed by rivers in a wet environment), the Elliot Formation (red mudstone that contains dinosaur fossils) and on top, the Clarens Formation (sandstone deposited as dunes in a desert environment).

7. Drakensberg and Lebombo Groups: 180 million years ago Gondwana began to break up and coinciding with this event were extensive outpourings of magma. Remnants of this magma now form the Lesotho highlands and Lebombo mountains. This magma built up a layer of basalt 1.5km thick. The magma found its way to the surface through a system of fractures where it crystallised and formed dolerite sills and dykes.

8. During the time of the Cretaceous age (145-65 million years ago), while the Indian Ocean was being formed, marine sediments of sandstone and silt were deposited, forming the Zululand Group.

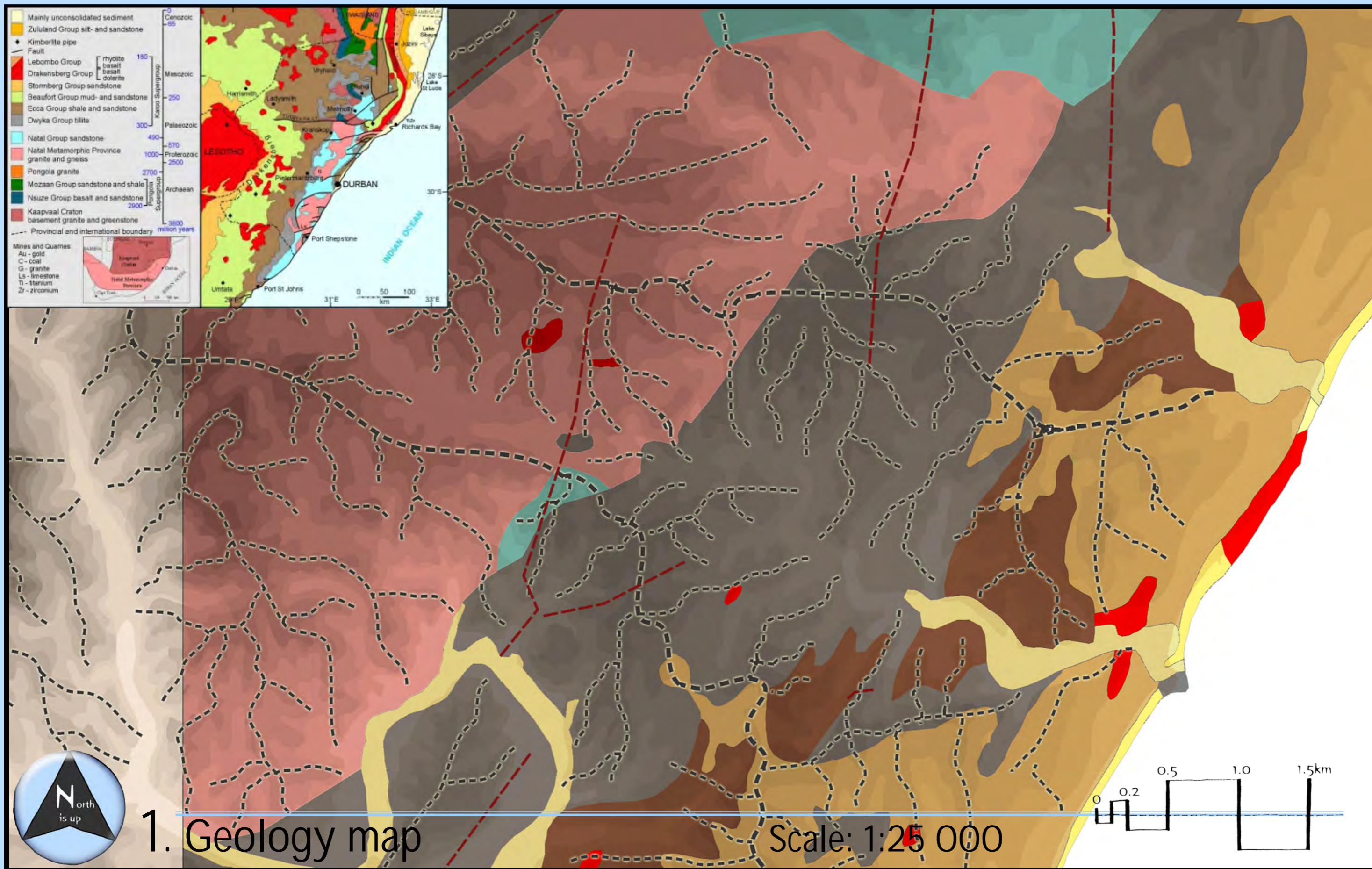
65 million years ago it is believed a meteorite hit an area in Chicxulub, Mexico and resulted in a worldwide extinction of most species. This event marks the K-T



boundary (a term given to this point between the Cretaceous and Cenozoic eras).

9. The Cenozoic era (from the K-T boundary to the present): Since the K-T boundary, sea levels began to drop and large parallel dune systems began to develop along the KZN coast. This has formed the Berea and Bluff Ridges in Durban and eroded sand from these dunes has resulted in the Berea red sand.







10. During the most recent glacial age, approximately 18 000 years ago, sea levels dropped again and were 100m below current sea levels. Because the coastline was further out to sea, rivers began to cut deep valleys to the coast. As sea levels began to rise again, these valleys were filled with unconsolidated estuarine muds and shelly sands. The implication of this today, is that bridges built across rivers near the coastline need deep foundations in order to find bedrock (Whitmore, Meth & Uken, 2006).



1. Geology map

Scale: 1:25 000

## Legend

	Aluvium Unconsolidated soil
	Beach sand and dunes Unconsolidated soil
	Berea formation Unconsolidated soil
	Karoo dolerite Drakensberg Group
	Pietermaritzberg shale Ecca Group
	Dwyka Group Tillite
	Natal Group Sandstone
	Mafic granulite Natal Metamorphic Province

## Sections of the Geological Report

### General:

The area is overlain by loose aeolian sands of the Berea Formation, the clayey sands and sandy sands, which overlies weathered and unweathered shale of the Pietermaritzburg Formation. The latter have been intruded by a Karoo-aged dolerite sill.

Potential slope instability problems may be encountered on all very steep slopes (greater than 1:3 or 18°) and especially where the shale bedrock is dipping downslope.

The upper sands of the Berea Formation are highly susceptible to erosion by wind and surface water and control of drainage is important in the area.

Founding and earthworks are not expected to be problematic but the use of pneumatic tools might be required in areas where more competent shales exist.

### Deep foundations:

Where structures are located on the loose sands of the Berea Formation or where structures are to span on cut and fill building platforms, deep foundations will be required.

Structures should be supported on ground beams spanning between piled foundations taken down to a satisfactory level into the firm clayey Berea Formation sand or weathered Pietermaritzburg Formation shale and Karoo dolerite.

### Retaining structures:

Any retaining structures required should be designed by a Structural Engineer familiar with such structures. The strength parameters for the design of the retaining structures within the Berea Formation sands should be 10kPa for cohesion and 30 for the angle of internal friction.

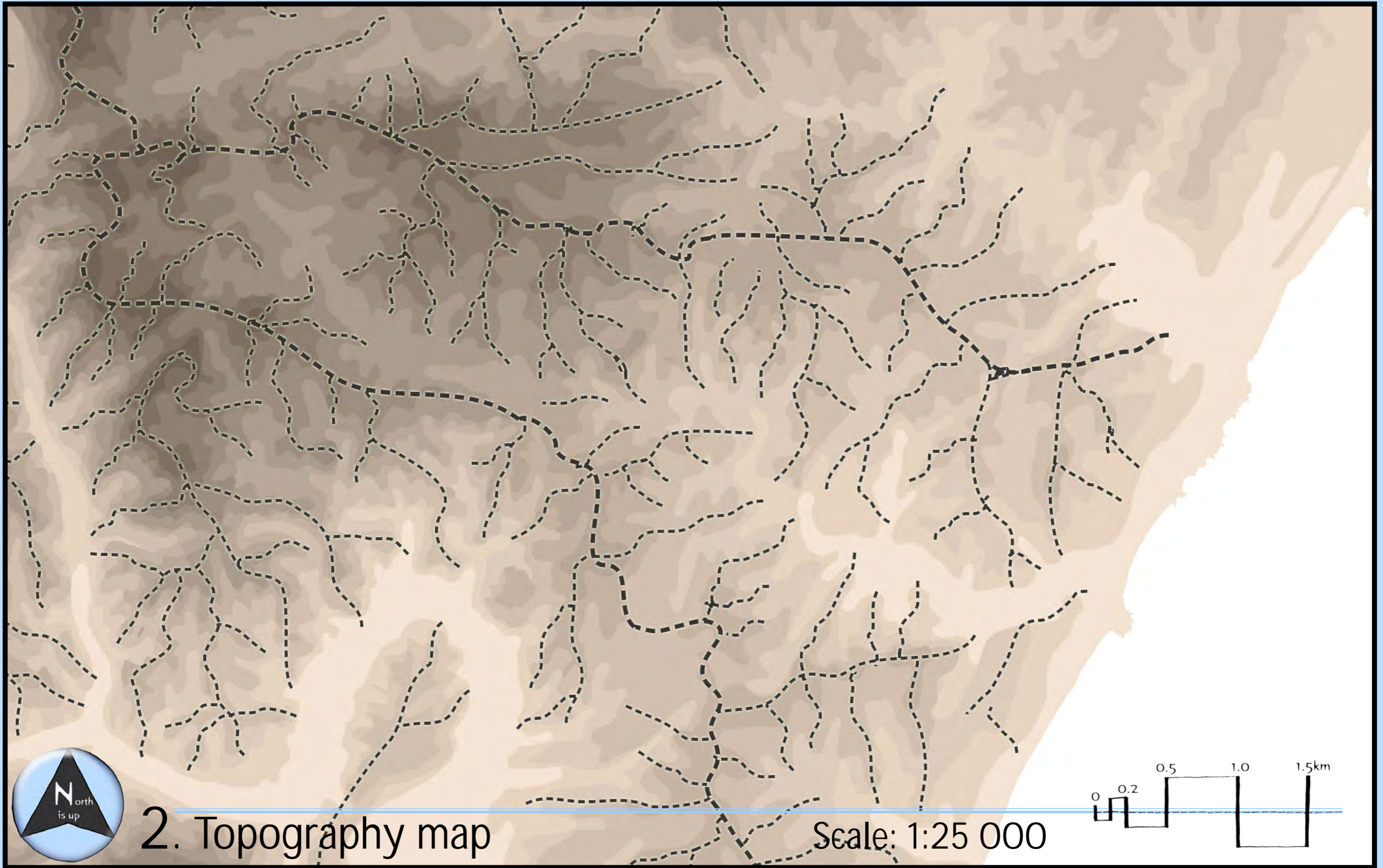
All retaining structures should be suitably damped proofed.

### Construction material:

The laboratory tests carried out on the material confirm that the colluvial clayey sand as well as the sands of the Berea Formation are suitable for bulk fills. The less clayey sand of the Berea Formation is also considered suitable for lower and upper selected layers in road and pavement construction. None of the material tested is considered suitable for subbase in road and pavement construction and this material will have to be imported from a commercial source.

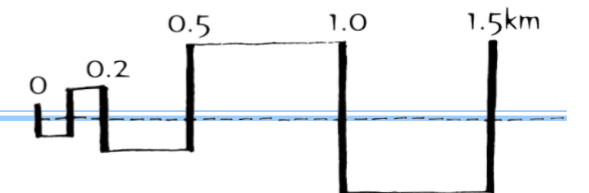
The residual silty clays are not considered suitable for fill, selected layers and subbase in roads and pavement construction.

(Herman, 2004)

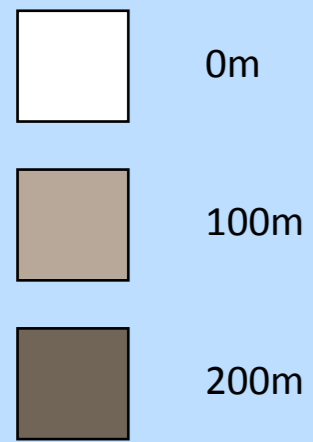


## 2. Topography map

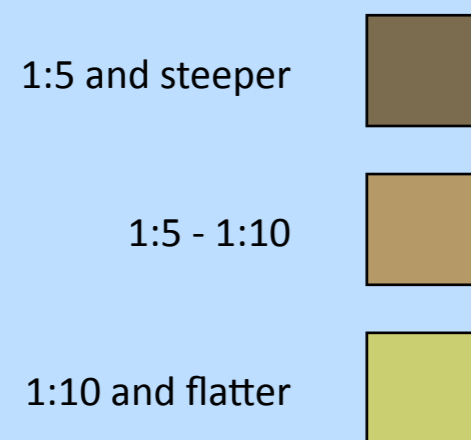
Scale: 1:25 000



Legend



Legend

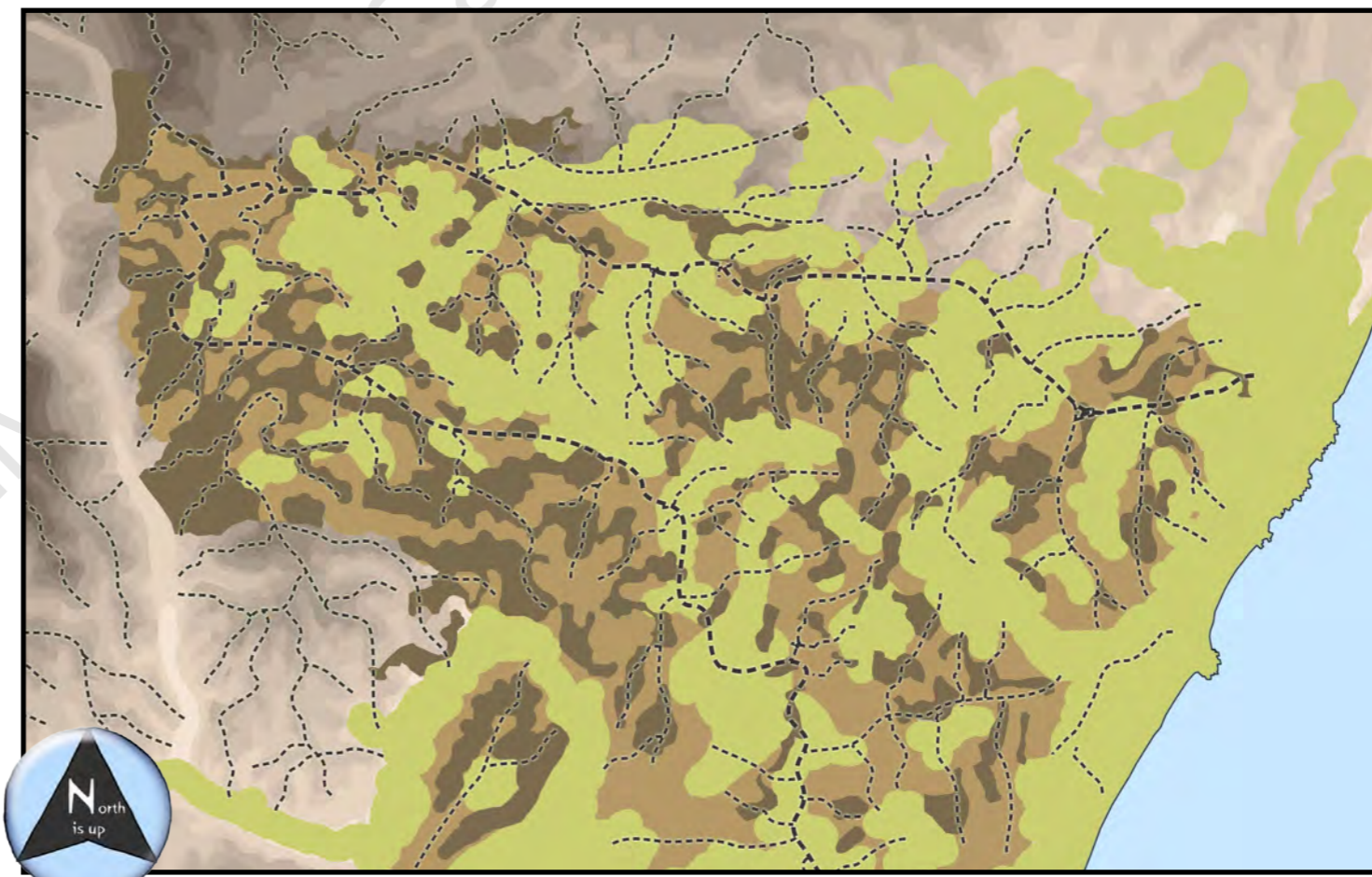


Interpreting the topography maps

One of the most useful maps at the beginning stages of river basin analysis is the contour map. First, it is needed to understand the character of the landscape eg: do contours rise evenly and constantly, or do they form a complex web of twisting valleys and hills (which give the KwaZulu-Natal coast a particular landscape form, such that northern KZN came to be known as the Valley of a 1000 Hills).

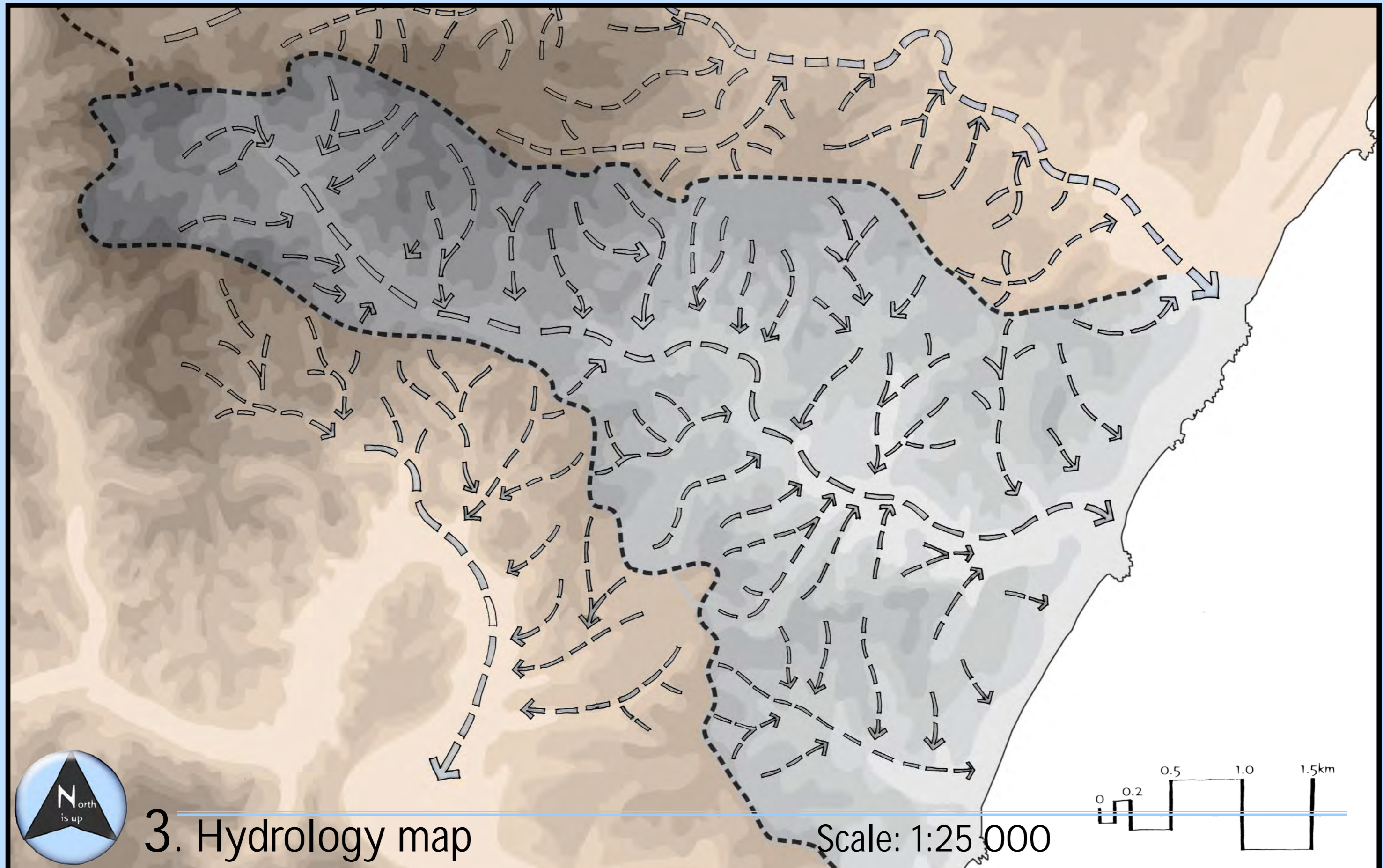
Secondly, understanding the topography of the landscape is a step toward deriving information such as ridgelines which will determine the boundaries of river catchments and drainage.

Thirdly, qualitative data can be obtained from the topography map such as the slope gradient map (below) and the slope aspect map. These maps are tools to understanding the microclimate of the river basin and form layers in a level of analysis that determines the intrinsic suitability of the site for various infrastructure and activities.



2.1. Slope gradient map

Scale: 1:50 000



### 3. Hydrology map

Scale: 1:25,000

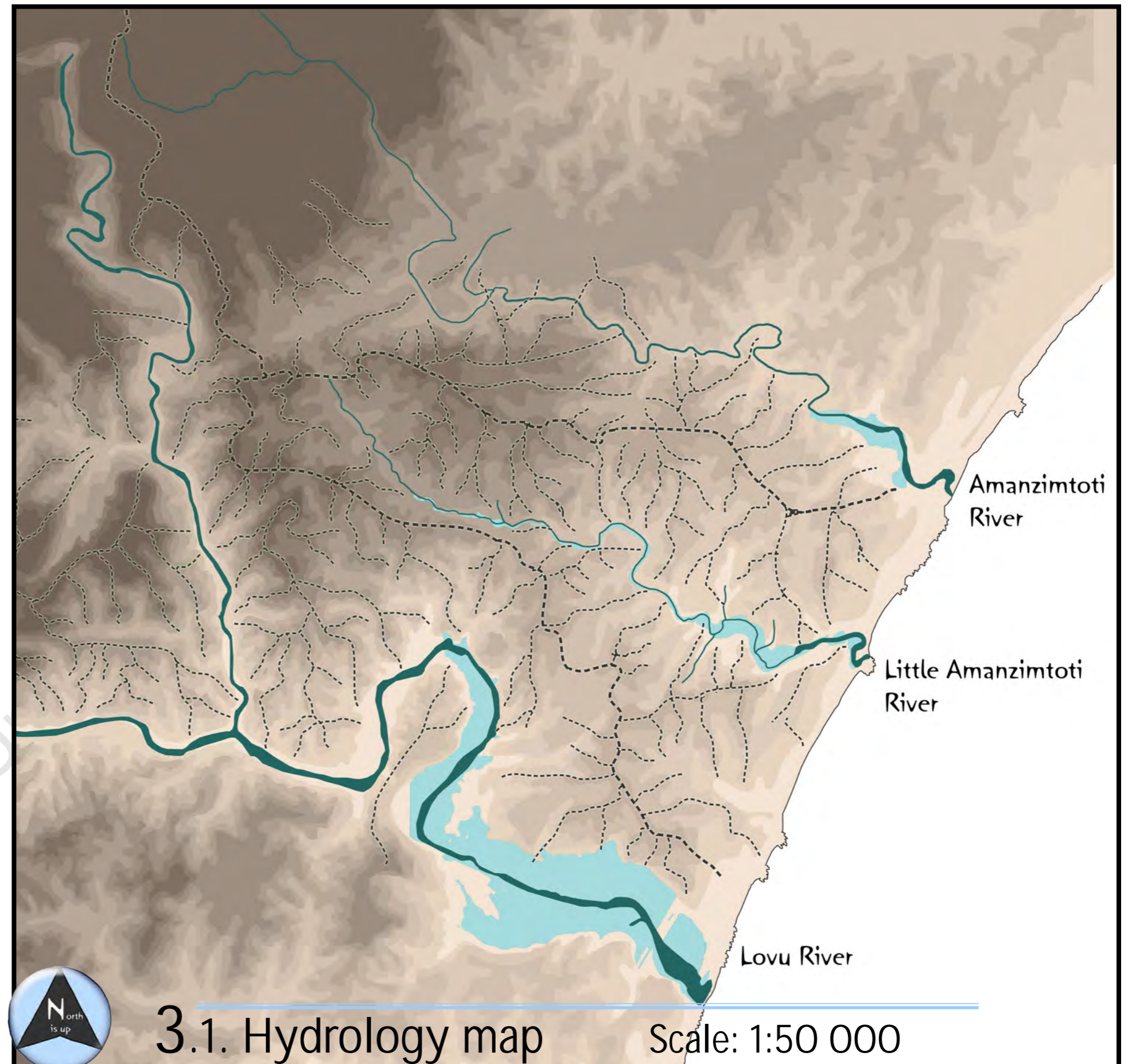
**Legend**

- Flood plain 
- River course 

**Interpreting the hydrology maps**

The ultimate aim of this river basin analysis is not to gain an understanding of the broader landscape but to choose a site on which to begin a design for “living differently”. Drainage flow is analysed in order to determine the impact of sites within their context: land use functions will affect water flow and quality downstream and it is vital to understand these potential changes.

The hydrological map will form one of the most important layers of intrinsic suitability analysis especially information such as flood plains and river courses. Recreational and non-polluting activities are generally suited to ecologically-sensitive hydrological areas.



3.1. Hydrology map

Scale: 1:50 000

## Climate description

### General information

South Africa is divided into 15 climatic regions. Durban falls in Climatic Region E. Region E is one of the wettest areas in South Africa and is warm to hot and humid. It is a subtropical climate with predominantly summer rainfall associated with atmospheric instability as a result of surface heating during the day. Because of the latitudinal position of the region, Durban experiences both tropical and temperate weather systems. Durban International Airport is the closest weather recording station, located about 15km north-east of Warner Beach.

\*tropical climates are defined as non-arid, and usually all twelve months have mean temperatures above 18° ["Tropical climate", Wikipedia]

### Surface winds

The prevailing winds along the coast are north-easterly and south-westerly with diurnal variations in the velocity and direction. (South-westerly winds are generally stronger and may be accompanied by rain). Winds from these two directions occur for more than 255 days a year. (Herman, 2004:21)

Wind velocity is greater in the afternoon throughout the year and also from August to November. Land and sea breezes have a strong influence on wind direction. Winter months tend to experience calmer conditions with light to moderate north-easterlies.

Wind direction	% frequency
North	6.6
North-east	18.8
East	6.2
South-east	3.2
South	13.5
South-west	15.0
West	2.2
North-west	1.8
Total	67.3

Mean Wind Direction and Frequency between 1958 and 1988 (Herman, 2004:21)

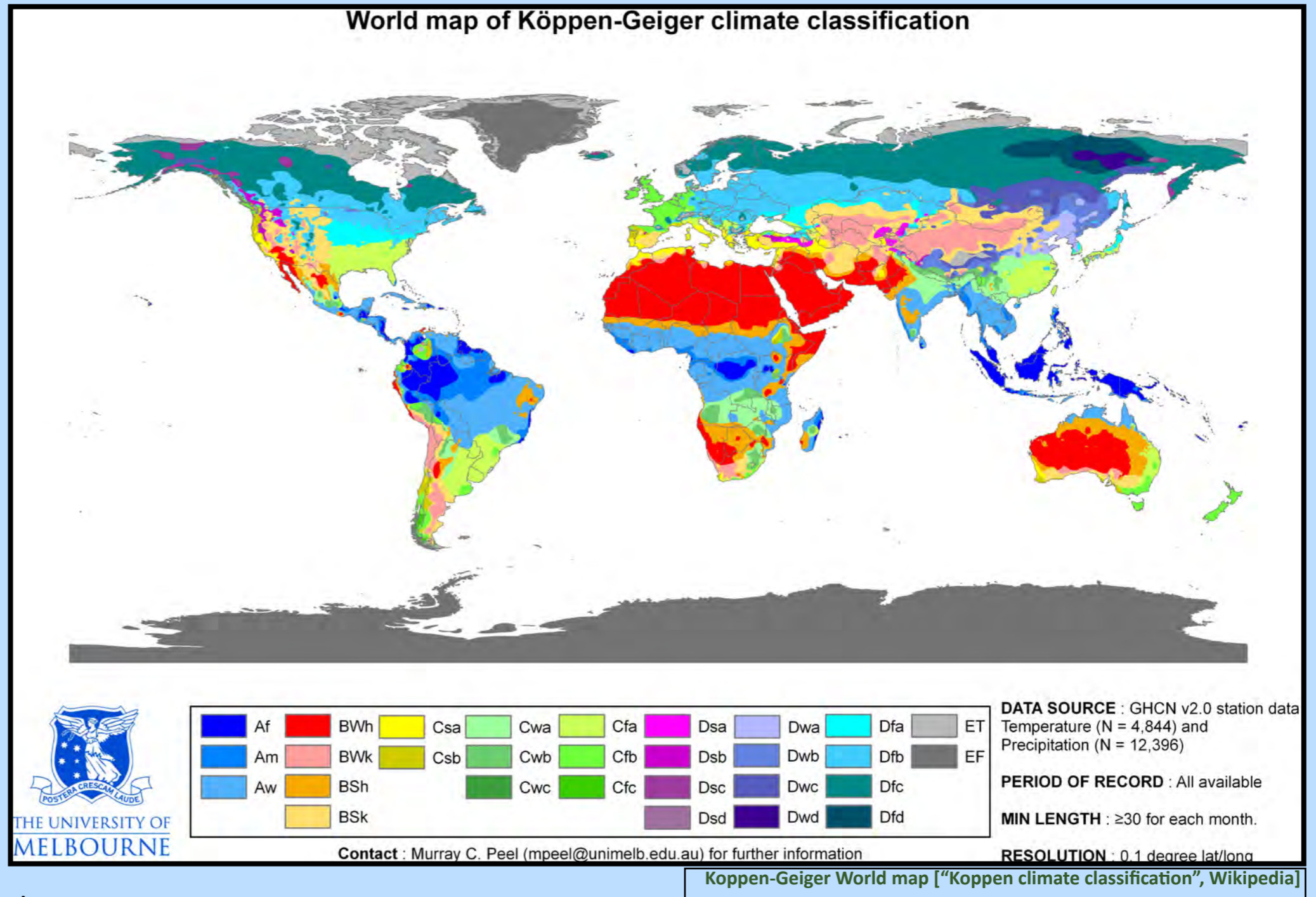
### Köppen classification

Durban has a Köppen classification of Cfa:

Group C: temperate/mesothermal climates characterised by an average temperature above 10° in the warmest months and a coldest month average between -3 and 18°C

The second letter (f): indicates precipitation patterns ie. significant precipitation in all seasons

The third letter (a): indicates the degree of summer heat, "a" indicates the warmest



**Rainfall**

Most of the rain in winter is in the form of cold fronts that move in a south-west to north-east direction. (Herman, 2004:19) Storms are prevalent on the KZN coast, and while today global warming might be blamed, there are records of torrential rainstorms and records:

- in August 1868 storms caused floods 25 feet high. (Meitiner, 1994)
- in 1917 there are records of the Isipingo Beach Golf Course

Club house (only constructed the previous year) being swept away by floods. (Meitiner, 1994)

- the “Big Deluge” 19th April 1948 - 8½ inches (212mm) of rain fell in 3 days and flooded Amanzimtoti CBD and washed a bridge away. (Meitiner, 1994)
- the total rainfall for 1978 was 1542mm which was the highest recorded rainfall in 52 years (Meitiner, 1994)
- on the 21st September 1987, 113.5mm of rain fell in 24 hours and then again a few days later 363mm fell in 4 days. (Meitiner, 1994)

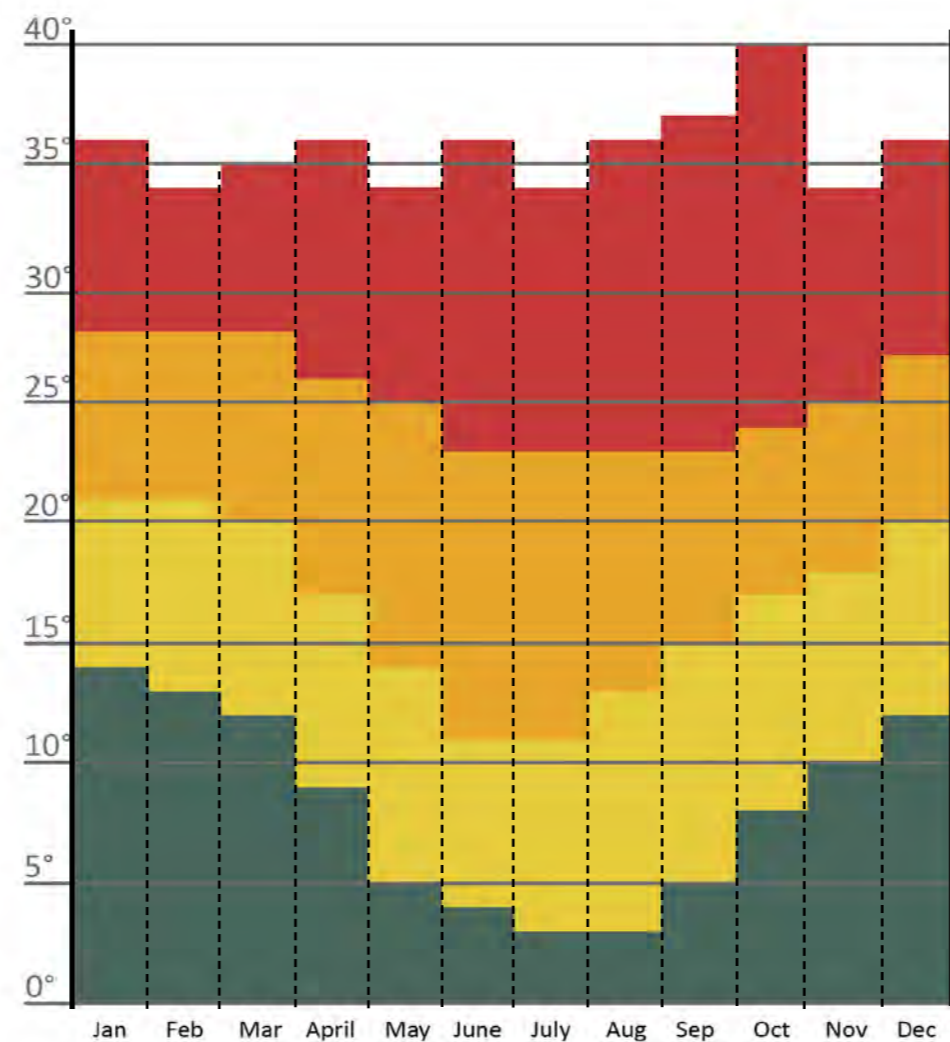
Yet there are drought prone years: in July 1992 water restrictions of 400ℓ/day were imposed until October 1993.

**Interpreting the information**

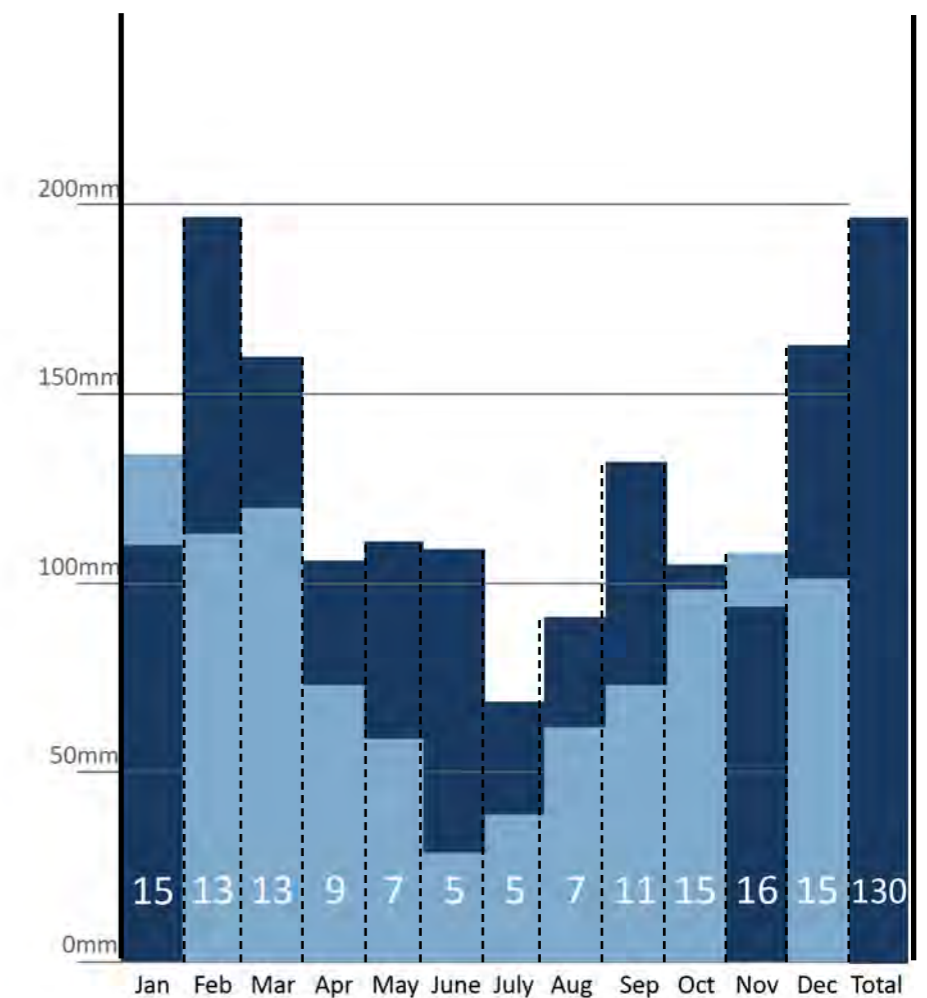
Durban has a very hot and humid climate with very high temperatures in summer, a total annual rainfall of 1009mm with a third of the year (130 days) being rain-days. This means that careful attention must be paid to detailing of spaces and use of materials eg: metals are prone to rusting because of the humidity and coastal location should be avoided. Because there is a small diurnal range in temperatures, passive cooling methods will rely heavily on onshore sea breezes. There is relatively constant rainfall throughout the year (except for June and July) but there are intense storms that can be maximised: ie. there is a high rainwater collection and storage potential.

**Legend**

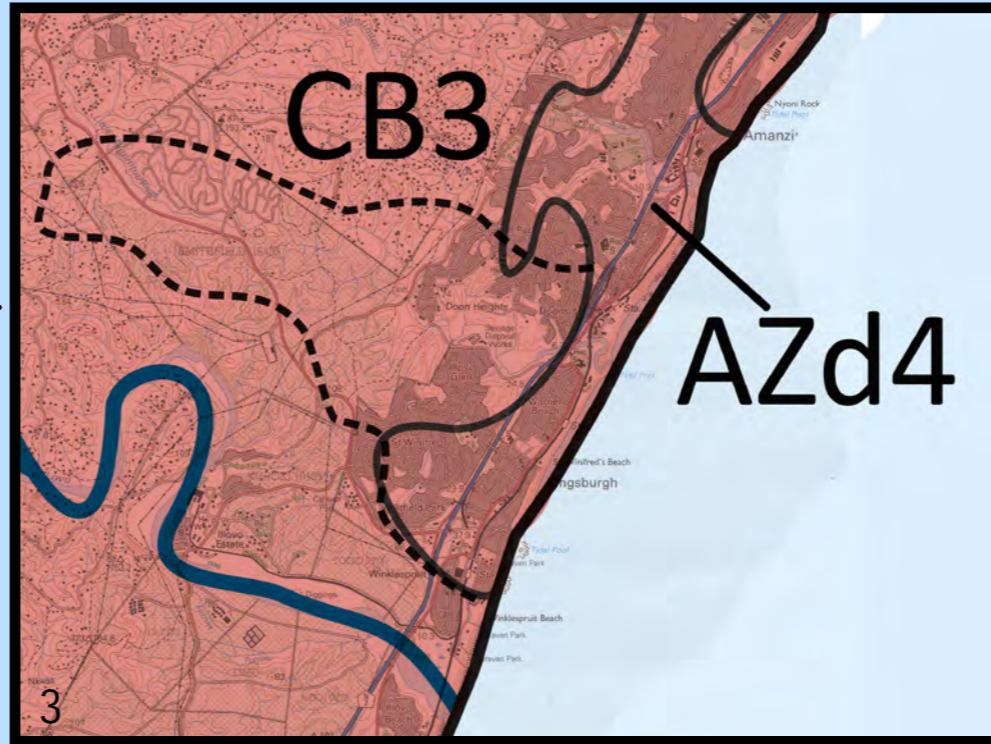
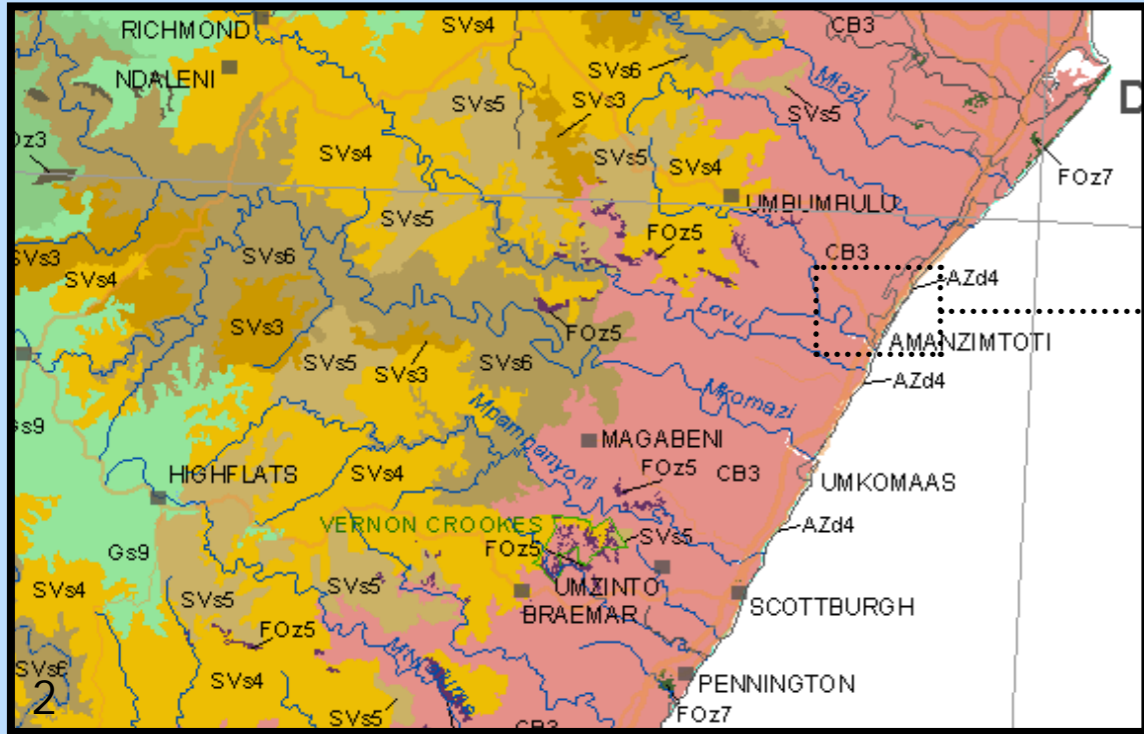
- Highest recorded temperature
- Average daily maximum temperature
- Average daily minimum temperature
- Lowest recorded temperature
- Average monthly rainfall (mm)
- Highest recorded rainfall in 24 hours
- Average no. of days rainfall ≥ 1mm **15**



Mean Climatic Data for period 1961-1990: Temperature ("Durban", South African Weather Service)



Mean Climatic Data for period 1961-1990: Rainfall ("Durban", South African Weather Service)

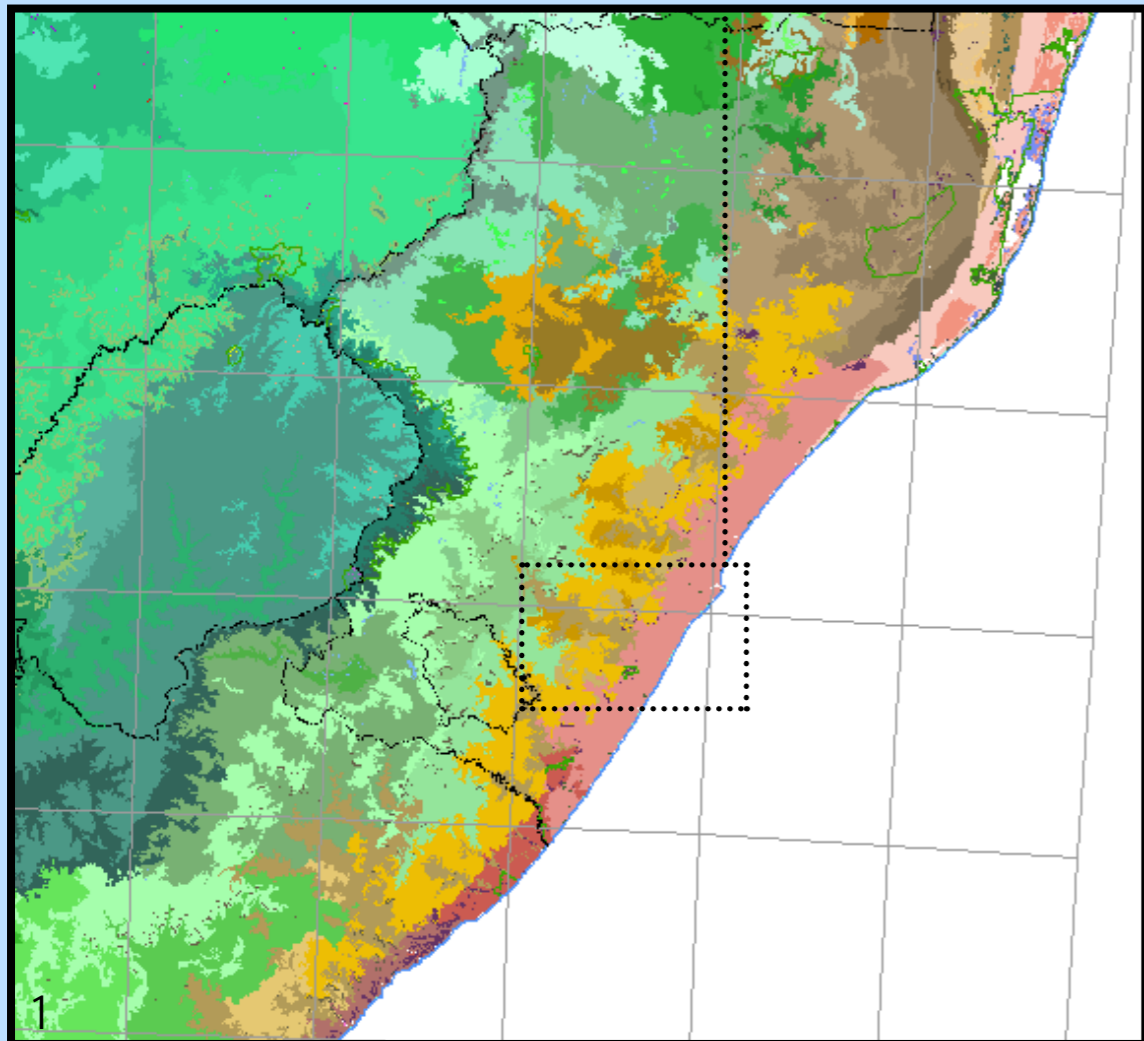


### Biome: Indian Ocean Coastal Belt

The Indian Ocean Coastal belt is 800km long, 10-35km wide and covers altitudes from 0-450m.

The vegetation is affected by:

1. Climate: rain-bearing southern and south-west winds and eastern after-noon sea-breezes
2. Tropical location: warm Agulhas current, humidity similar to tropical regions
3. Geology: Granites and gneisses and sedimentary deposits



Landuse is primarily sugarcane farming (over 88% of the cultivated area as cited by Camp 1999 in Mucina & Rutherford 2006)

The biggest threats are cultivation and afforestation as well as alien vegetation of which *Chromolaena odorata* is the main problem plant.

Within the Indian Ocean Coastal Belt the two main vegetation zones found within the study area are CB3 and AZd4:

#### CB3: KwaZulu-Natal Coastal Belt

**Total area: 6326.68km<sup>2</sup>**

The KwaZulu-Natal coastal belt vegetation zone is a long, wide coastal strip along the KZN coast from Port Edward in the south to Mtunzini in the north.

- Altitude range: 20 – 450m
- Protected area: 0.6%
- Remaining: 49.7%
- Target conservation: 25%

The biggest threats to the remaining natural vegetation are cultivation, urban sprawl and road construction. Alien vegetation is also a problem and particular problems include *Chromolaena odorata*, *Lantana camara*, *Melia azedarach* and *Solanum mauritianum*. (Mucina & Rutherford, 2006)

#### AZd4: Subtropical Seashore Vegetation (Azonal)

**Total area: 41.47km<sup>2</sup>**

This azonal vegetation type is commonly found on beaches, coastal dunes, dune slacks and coastal cliffs of subtropical coastline of Indian Ocean from Kei Mouth in the south to the border of Mozambique in the north.

- Protected area: 29.7%
- Remaining: 90.6%
- Target conservation: 20%

This is one of the least threatened vegetation areas and 30% of the area is conserved (by statute) in reserves and parks. Potential threats come from urban tourism as 10%

of the land has already been claimed by this development.  
(Mucina & Rutherford, 2006)

### Endemic or indigenous species

*Bridelia micrantha*, *Phoenix reclinata*, *Syzigium cordatum*,  
*Acacia natalitia*, *Albizia adianthifolia*, *Antidesma venosum*.

### Historical interest

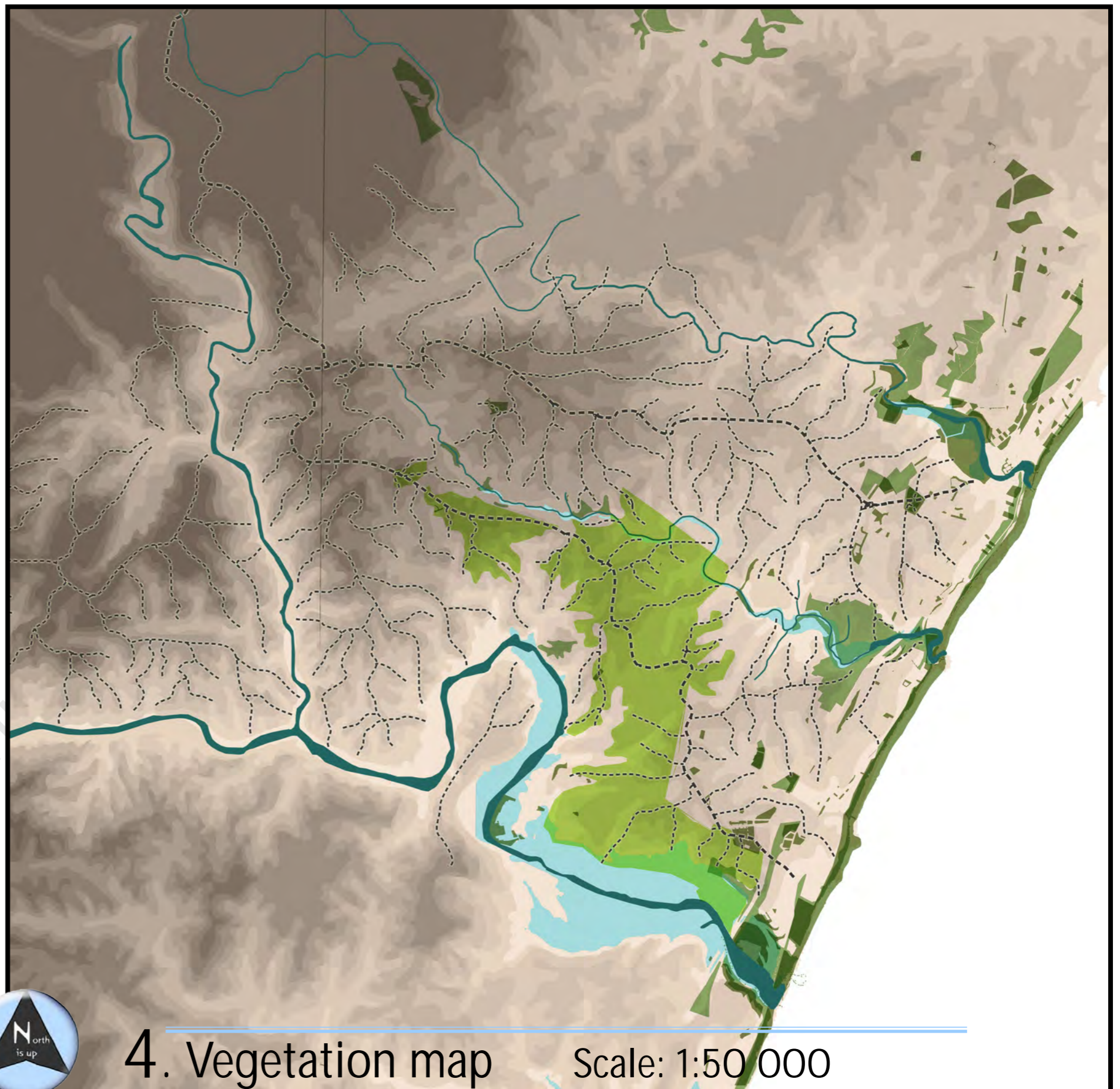
In February 1988 it was recorded that a baobab tree was alive and well and growing in Amanimtoti. It is believed that the tree, between 30-50 years, was the baobab furthest south in Africa. (Meitiner, 1994)

### Legend

Agriculture (sugarcane)



Natural vegetation (dunes, forests,  
wetlands and remnant species)



4. Vegetation map

Scale: 1:50 000



## Timeline

1300s: area inhabited by nomadic bushmen

1400: Nguni group entered KZN

1497: Vasco da Gama lands at the Bluff on 28th December

1816: Shaka becomes king of the Zulus

1841: Dick King's famous ride - he left Durban on 25th May and road 600 miles in 10 days to Grahamstown. The main road in Warner Beach, Kingsway, is named after Dick King

1847: Adams Missionary Station founded by Newton Adams

1849: The first recorded sighting of Aliwal Shoal by Captain James Anderson (after his ship nearly collided into it)

1853: First experimental crops of sugar grown in Isipingo

1856: Creation of the Natal colony on 15th July

1860: First arrival of Indians

1881: The First Boer War

1890: William Pearce started the Illovo-sugar mill. (By this time nearly 18000 acres of land was covered with sugar cane.)

1900: Winkelspruit village started: The first house was built out of materials from the dismantled Durban Yacht Club.

1907: Warner Beach was established by T.A. Warner, a Government Surveyor. The area was originally

demarcated as a settlement for pensioners and for people who suffered from depression. The land was intended to be divided into market garden plots but it soon developed into a minor holiday resort. The first school was also built in Warner Beach in 1907.

1909: Warner Beach Senior Primary School started on a farm called "Gwenva". It had 6 students and lessons were held in a chicken shed. In 1910 the school moved to its present location. A brick building was built in 1936 and became a high school until 1953.

\*1910: Bill Bailey was born in a wattle and daub house on the banks of the Amanzimtoti river at a time when there were not more than a dozen families in the area, no coastal road (only the old main road that wandered through the hills) and no motor cars. His family moved to Adams Mission before moving to Warner Beach where they opened a store and eventually expanded the business to include several more stores and a tea room. Bill and his brothers attended Warner Beach school. (Meitiner, 1994)

\*Pat Nelson remembers that in the 1910s there were less than 10 houses in Warner Beach, there were no tarred roads and all houses were made from timber and iron. Pat was one of the first students at the Warner Beach school, which also served as a church and community hall. People walked or travelled by trap and horse or donkey cart. (Meitiner, 1994)

1928: St Mary's Church was built and the original beach hotel. [Meitiner, 1994]

## Pre-colonial settlements

The naming of Amanzimtoti, the nearest town to Warner Beach, as legend explains, was attributed to Shaka, the renowned King of the Zulus. There are several tales regarding the naming of area but the commonly accepted story goes: Shaka and his army were passing through the area and stopped to rest. Shaka's attendant filled a calabash with water from a nearby stream and brought it to King Shaka. After sipping the water, Shaka is said to have exclaimed "Kanti Amanzamtoti" which means "so the water is sweet". The river has ever since been known as Amanzimtoti. The river on the northern boundary of Warner Beach is called the Little Amanzimtoti. While accurate dates are difficult to obtain from oral records, it is believed that this christening event occurred between 1816 and 1828. (Meitiner, 1994)

An extension to this legend is that Shaka was not merely passing through the area when he christened the river but that it was the location of a wild fig tree under which Shaka and his indunas used to meet. There have been two claims to the position of Shaka's indaba tree - one 150 year old fig tree that fell down in 1972 and another fig tree that fell down in 1981. (Meitiner, 1994) While the accuracy of these stories can never be proven, it highlights the fact that historically the land was part of Shaka's dominion and that fig trees are significantly revered.





## Ye Ol' Colonialism

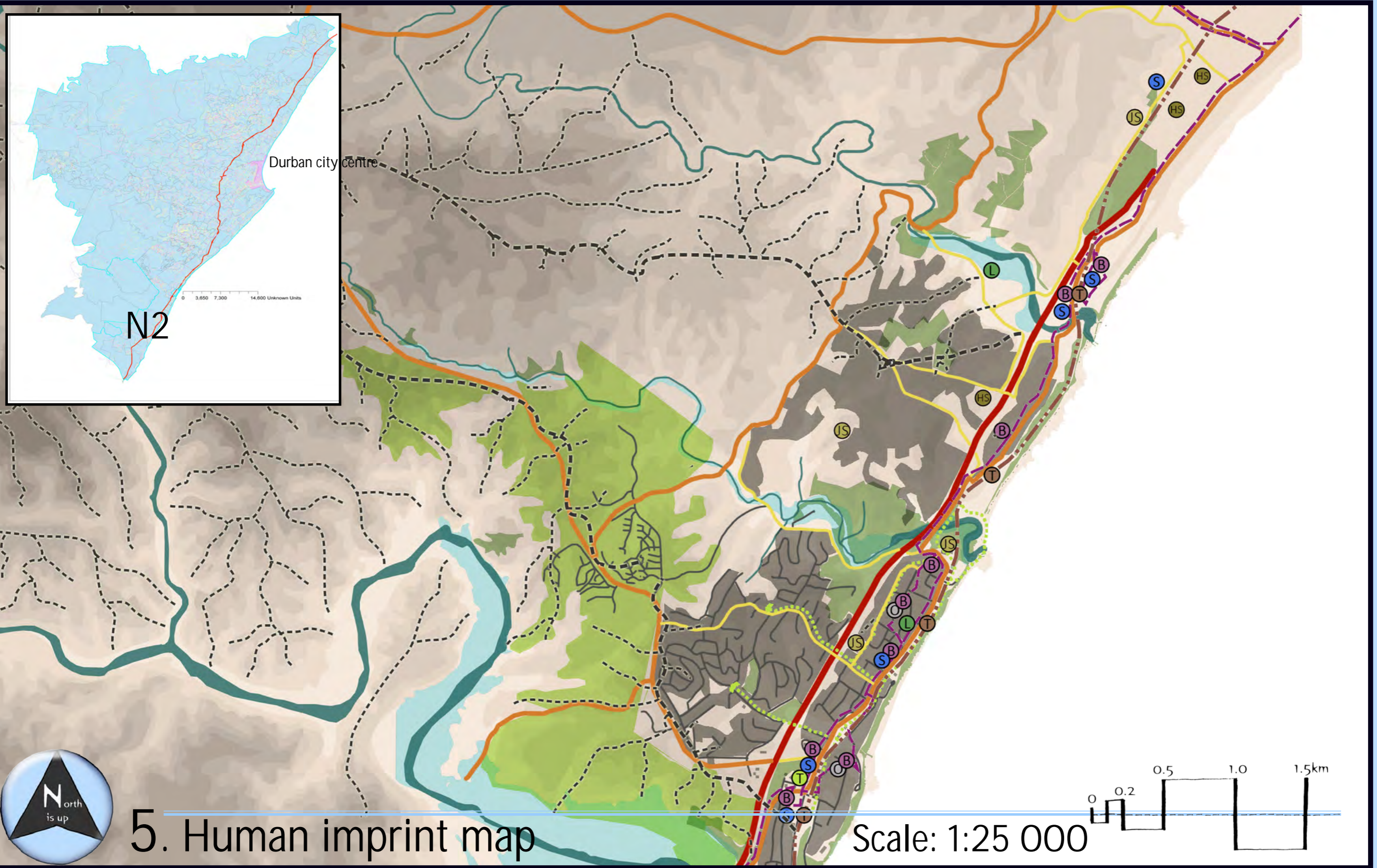
The following description of the area is cited in Meitner (1994) but was originally from "Twentieth Century Impressions of Natal", published in 1906:

*"The next stage of the journey south: - is through a veritable paradise: dense forest country alternates with beautiful patches of cultivated lands, the sugarcane bending to the breezes, flanked by long lines of banana trees, stately palms and bamboos, and after a time, the pretty little village of Amanzimtoti is reached. This is a charming little spot, and a regular resort of week-enders and picknickers. It is centered in lovely and varied scenery - sea, river, bush, islands and reedy spots - and the visitor has a boundless opportunity of following his particular line of pleasure. This place has aptly been termed the Brighton of Natal, and it is there that the people from Johannesburg love to spend their annual holiday.*

*A visitor would be hard to please if he could not find something to his taste. Be he artist, poet, or weary business man, he can rest here, for the river, which is navigable for several miles, abounds with charming pieces of scenery, cosy nooks, while the vegetation is bewildering in its profusion.*

*The botanist and the entomologist can always find something new, while lovers of the rod can satisfy their appetite to their heart's content. The village is entirely a pleasure village, since there are no manufactures, and indeed, grimy factories would look somewhat incongruous in this home of natural beauty. Excursions can be made to places in the vicinity and some shooting can also be obtained.*

*It is with a sigh of sorrow that the traveller turns away from Amanzimtoti and pursues his journey south...."*

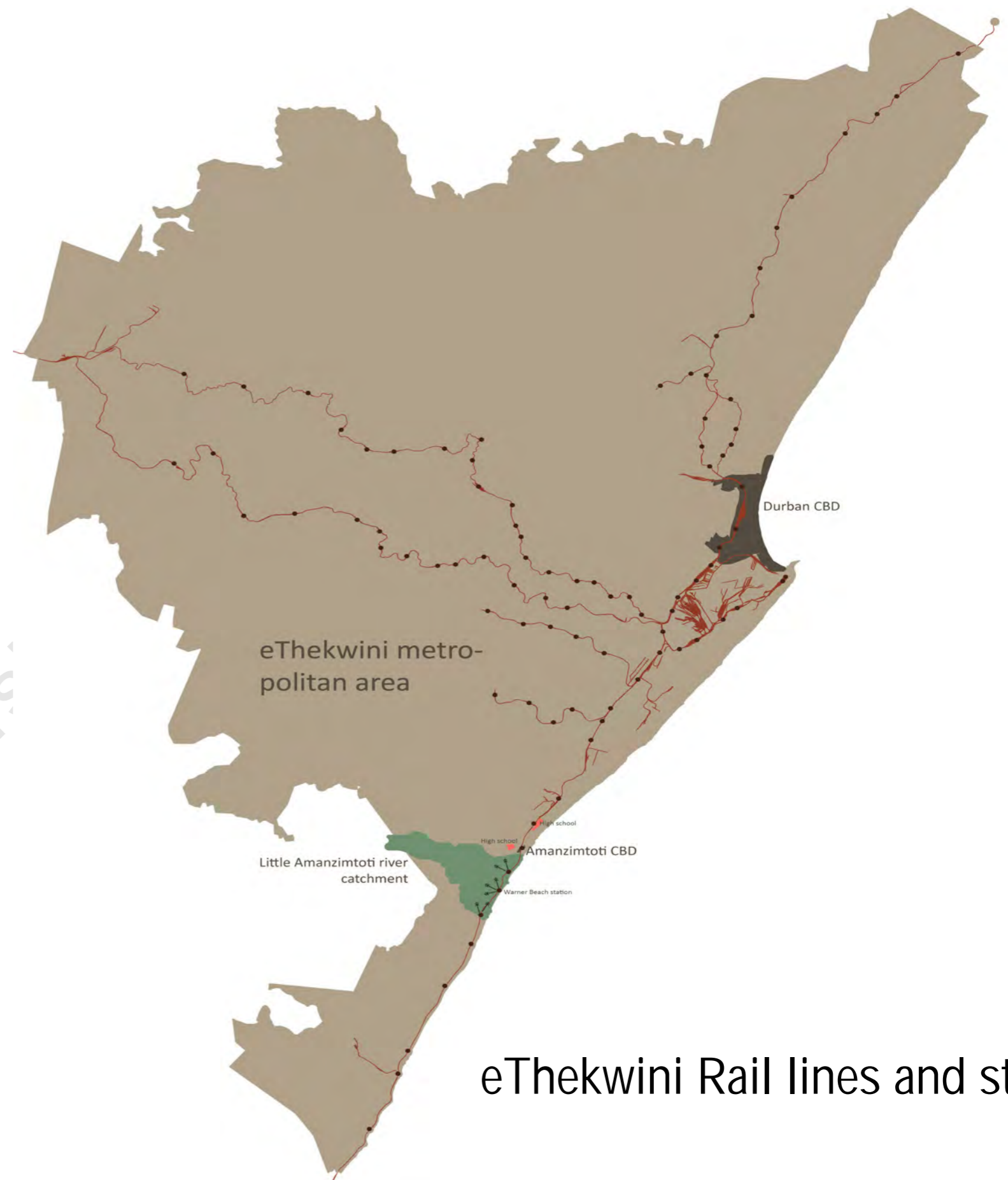


5. Human imprint map

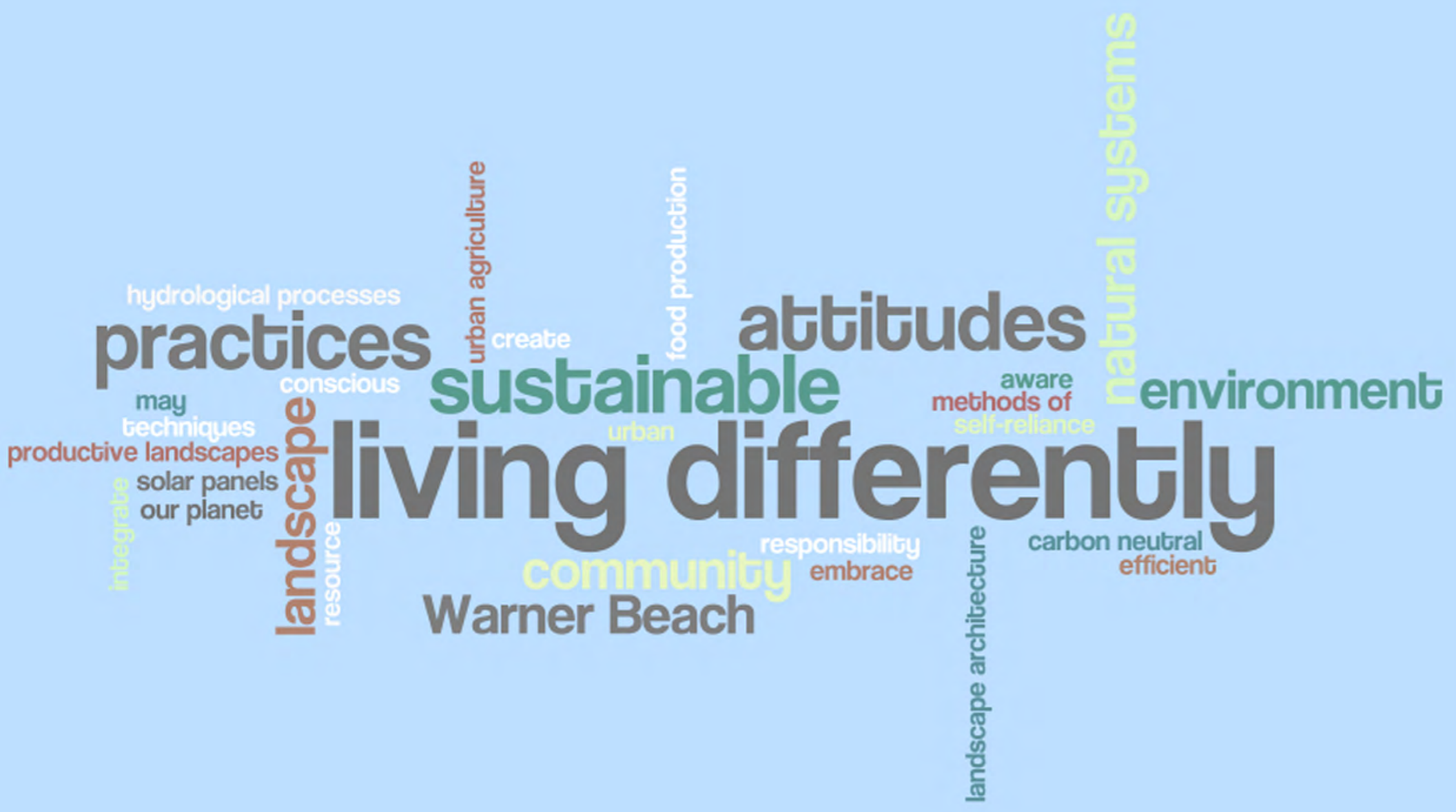
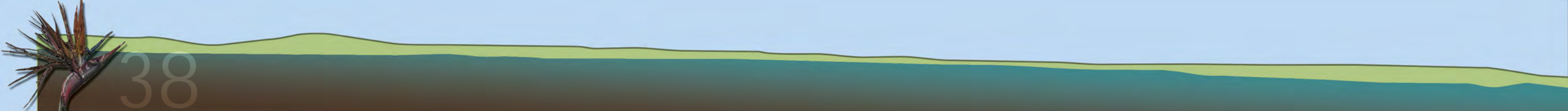
Scale: 1:25 000

Legend

- |   |                  |   |               |
|---|------------------|---|---------------|
|    | Freeway (N2)     |   |               |
|    | Arterial roads   |   |               |
|    | Collector roads  |   |               |
|    | Access roads     |   |               |
|   | Railway line     |   |               |
|  | Bus routes       |   |               |
|  | Pedestrian route |   |               |
|  | Bus stop         |  | Shopping area |
|  | Old age home     |  | Junior school |
|  | Train station    |  | High school   |
|  | Taxi rank        |  | Library       |



eThekweni Rail lines and stations



# Contents

Topic and introduction

Literature review

Design principles

River basin analysis

 Site selection

Site design

Precinct design

Construction details

Conclusion

## Project Brief

### The environment which prompted the need for this project

In an article in the April 2006 issue of Urban Green File, eThekweni's city manager, Mike Sutcliffe, voiced several concerns regarding the future of the city. In the article he states that eThekweni's population size in 2006 was 3.5 million people. Assuming a 2% growth rate for the next 20 years there will be another 2 million people in the city which will have huge implications for energy, food and housing supplies. These are not concerns for tomorrow: the global energy crisis is affecting eThekweni *today* and there is an urgent need to begin using new energy sources.

Rainfall is another pressing issue: Mike Sutcliffe (2006) says: "If rainfall decreases and rain intensity becomes greater, it is likely that water availability will also be an issue with impacts on human water consumption and on our own food security. And managing new stormwater peaks and troughs will raise a whole new set of problems for us."

### The client

A group of NGOs in the eThekweni metropolitan area have joined together to share their concerns regarding the future of urban development in the face of energy, water and food shortages. Because of their interest in urban design and landscape they have approached a landscape architect to design their vision for a new sustainable urban village.

### Future urban vision

The eThekweni municipality are exploring the option of increasing density and numbers of housing in new settlements. Yet in order to avoid increased pressure on existing settlement infrastructure and in an effort to encourage sustainability, these new developments should be as self-sufficient as possible and should also add a positive

impact to the community.

While retrofitting cities with environmentally responsible systems may eventually become the norm, as Mazmanian and Kraft (1999) point out, design innovations that are applied to existing landscapes where infrastructure exists are very often restricted by previous unsustainable decisions.

Therefore the association of NGOs has realised the role that landscape architecture can play in creating sustainable cities and has devised a brief for the design of a prototype settlement.

### Requirements

The new community design must:

- be dense (although not necessarily for density's sake: quality of spaces and suitable patterns of growth are preferred to quantitative density ratios (Roseland, 2000))
- be multi-functional and mixed-use (residential, retail, recreational spaces)
- integrate into existing urban fabric
- a community where the people can experience a sense of place
- not accommodate more than 500 people (Christopher Alexander (1997) suggests a neighbourhood of 500 people with a boundary and restricted points of access (gateways). But obviously the carrying capacity of the land ultimately dictates the number of people it can sustain)
- follow good design principles such as reduced car dependency, zero carbon emissions and reduce consumption/waste

## Description of a programme

### User-orientated spaces

The site will be inhabited by families with children, individuals, retired persons and couples all within a varied income bracket. Therefore a wide variety of spaces are needed: hard surfaces, sandy surfaces, surfaces for climbing, walking, sidewalk cafes for meeting friends, private spaces, spaces for sitting, playing, eating, cooking, laundry-drying, gardening and entertaining. (Lynch & Hack, 1985)

The types of spaces needed must encourage interaction and social networks. Jan Gehl (2001) states that *one + one = three* because activities are self-reinforcing and people attract more people.

"Children tend to play more on the streets, in parking areas, and near the entrances of dwellings than in the play areas designed for that purpose but are located in backyards of single-family houses...where there are neither traffic nor people to look at." (Gehl, 2001:27)

Because of social fields of vision, the ideal distance for front yards (based on surveys completed in Australia, Canada and Denmark) is 3,5m (Gehl 2001).

### Appropriate architecture

The site should accommodate a diverse range of housing units (but this will happen inherently because residents will build homes according to their own needs and budgets and adapt them over time), sizes and types. Houses should employ green architecture techniques and construction and for this the site should consider locating renewable forests, clay brick pits, workshops and kilns for materials.

### Associated activities

There will naturally develop a set of commercial activities on the site and these need to be strategically placed with

delivery access to these areas.

Spaces for recreation should be included in the plan: from picnic areas and small play areas for children to larger areas where a game of soccer or touch rugby could be played.

### **Agricultural requirements**

Agriculture - needs flat land, at least 2m<sup>2</sup> per person, a system of water collection and storage, sheds for tools and irrigation channels to divert water to crops.

### **Environmental standards**

There are no stormwater drains on the site therefore every roof must be able to collect rainwater. Surfaces should filter rainwater runoff eg: berms and wetlands. Textured and planted surfaces slow runoff and increase infiltration. Because Durban is prone to intense storms which could cause severe erosion, steep slopes must be covered with vegetation, preferably indigenous forests.

There will be no sewerage pipes therefore the first level of wastewater treatment is the collection of wastewater from households in biogas generators that also generate energy. The second level is onsite wastewater bioremediation - liquid from the biogas digestors is piped to constructed wetlands where it is purified. The third level is grey water recycling which takes the form of vertical wetlands.

The site is not connected to an electricity grid, therefore there is the need for solar panels, solar heated geysers, buildings grouped together to conserve heat, buildings oriented to maximise the use of sea breezes while minimising the need for air conditioners. (Durban has very low diurnal range therefore passive cooling in a humid climate is difficult.) Wind generated energy and biogas supplement the energy supply. Vertical wetlands and pergolas can be used to cool air before it enters the building as well as provide shade.

There will be no solid waste trucks therefore no garbage removal

therefore all organic "waste" (paper, vegetable scraps, waste water, garden refuse) is taken to earthworm farms, compost heaps, and biogas digestors. All other "waste" is reused and recycled at the recycling centre.

While the landscape plan is not required to design housing plans and specifications for the buildings, the landscape design must set out guidelines for massing and orientation of buildings and the manner in which they relate to the landscape in terms of facades and connections.

Because the new community will be sharing infrastructure with existing urban communities, it is important to not add undue pressure on these systems. The new urban development should rely more on pedestrian and cycle routes so as not to increase dependency on cars (Roseland, 2000).

The community is also intended to be a prototype of sustainable living and should be open for people to come and understand how they could be living. Therefore the programme should include an education/resource centre.

### **Summary of Programme**

The programme assumes that many functions can overlap or connect and do not need to be accommodated individually:

- Housing for not more than 500 people
- An educational/community centre
- Urban agriculture: Vegetable gardens, orchards, chicken coops
- Biogas energy supply for stoves, geysers and refrigerators (in order to avoid generators onsite)
- Solar/wind energy to provide energy for lights, TVs, computers etc
- Wetlands to filter waste and grey water
- Water storage tanks
- Adequate stormwater management
- Open spaces
- Recycling centre

- Pedestrian and cycle networks
- A strategy for public movement
- Viable retail/commercial area for 30 small businesses/ SoHo/restaurants
- A tree nursery/sustainable forest for harvesting of materials

## Management: Frequently Asked Questions

### Who will own the land?

The conglomerate of NGOs will jointly buy the land (once a site is chosen).

### Who will live on the land?

The type of people who are coming to live in the area range from families with children to couples, individuals, retired persons. Yet the site will also host a variety of tourists, day visitors, school children etc.

### Do you have to be a hippie to live there?

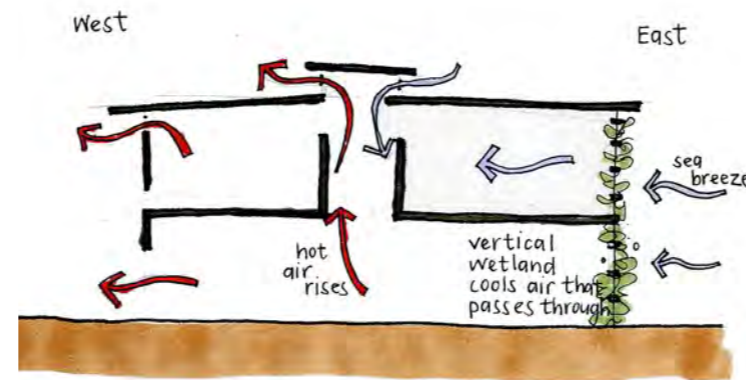
It is not a commune - while people share resources there is no obligation to share a life philosophy beyond that of a willingness to find an alternative lifestyle to conventional urban living. Each resident is entitled to go to school, study, go to work but it is assumed that people may tend towards part-time jobs that enable them to work in the community gardens etc. Residents are expected to get involved and spend a minimum of 3 hours a week working for the community (volunteer work).



### Will people build, buy or rent their own homes?

All of the above! Because the land is paid for by the NGOs, potential residents do not need to buy the land. They will be allocated a plot of land based on their needs and family size. They can then hire an architect or designer to design and construct their house (keeping within guidelines set out in the landscape plan). If one family builds a double

storey house that can accommodate two families they may rent out the other half of the house to another family.



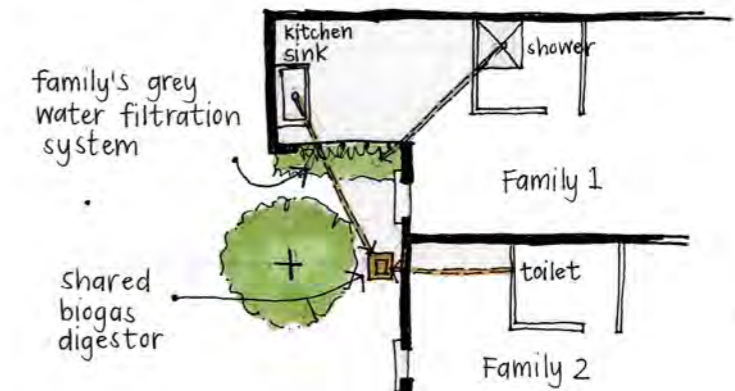
### Do residents own a share of the communal facilities and agriculture?

Community members have unlimited access to laundry facilities which are also business initiatives. They can also rent office space or run restaurants and coffee shops. Residents also have access to a cinema (which doubles up as a community meeting space).

### Who manages communal facilities?

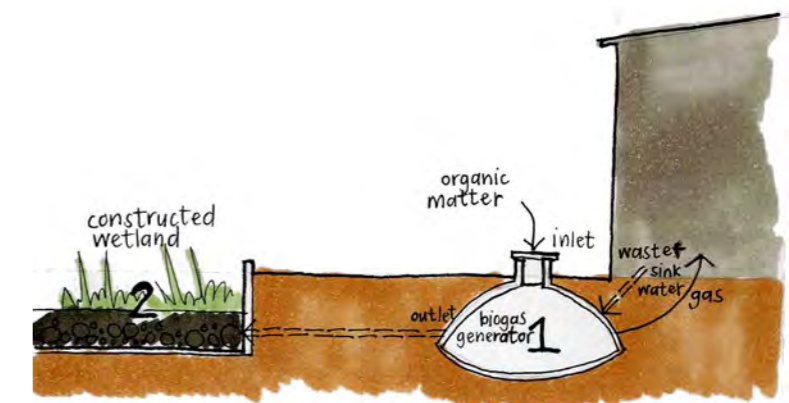
The communal facilities (workshops, bicycle centres etc) will be monitored by appointed community members. Communal agriculture is shared equally between all members of the community and residents are required to work in part of the garden - whether they are responsible for a specified piece of land or work in the entire garden is a decision that can be made by the residents. There is land available to every family for private vegetable and herb gardens. Families who want more space for private gardening are able to construct roof gardens for their specific needs.

A committee should be in charge of the landscape maintenance and may hire parties for the upkeep of the area.



### If there are no sewerage pipes, what happens to the waste water?

Two houses share a biogas digester and are responsible for the upkeep of this - the inlet will be near both houses and pipes from toilets and kitchen sink run to the digester. Each family is responsible for their own grey water recycling, compost heaps and worm farms but additional organic matter may be added to the biogas digester.



**What happens with waste that cannot be put on a compost heap?**

Other objects must be taken to the recycling centre - books, magazines, clothes, appliances etc. are taken to the reuse room in the recycling centre. Other items such as glass, tin and plastic are sorted in the recycling centre which is run as a business: contenders for this business may put in tenders which will be voted for by the community.

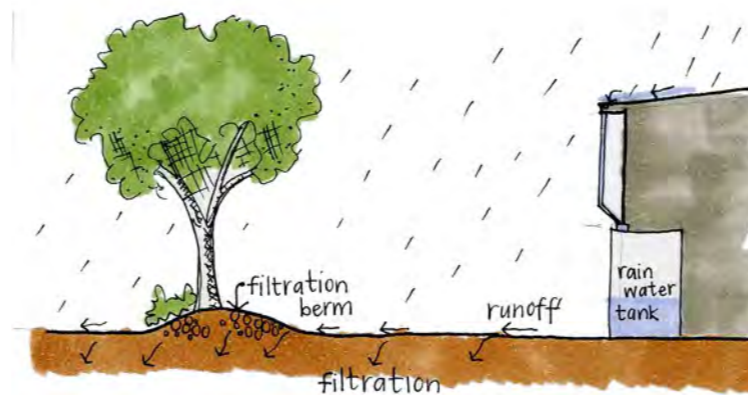
**How are crops divided up amongst residents?**

Food crops grown in the community gardens are allocated to residents on a credit basis depending on their level of involvement. Some residents may choose not to work in the community gardens and may grow their own vegetables. Excess food supplies may be traded or sold at a vegetable market. Fruit trees in public spaces may not be picked for profit but are there for the passerby.



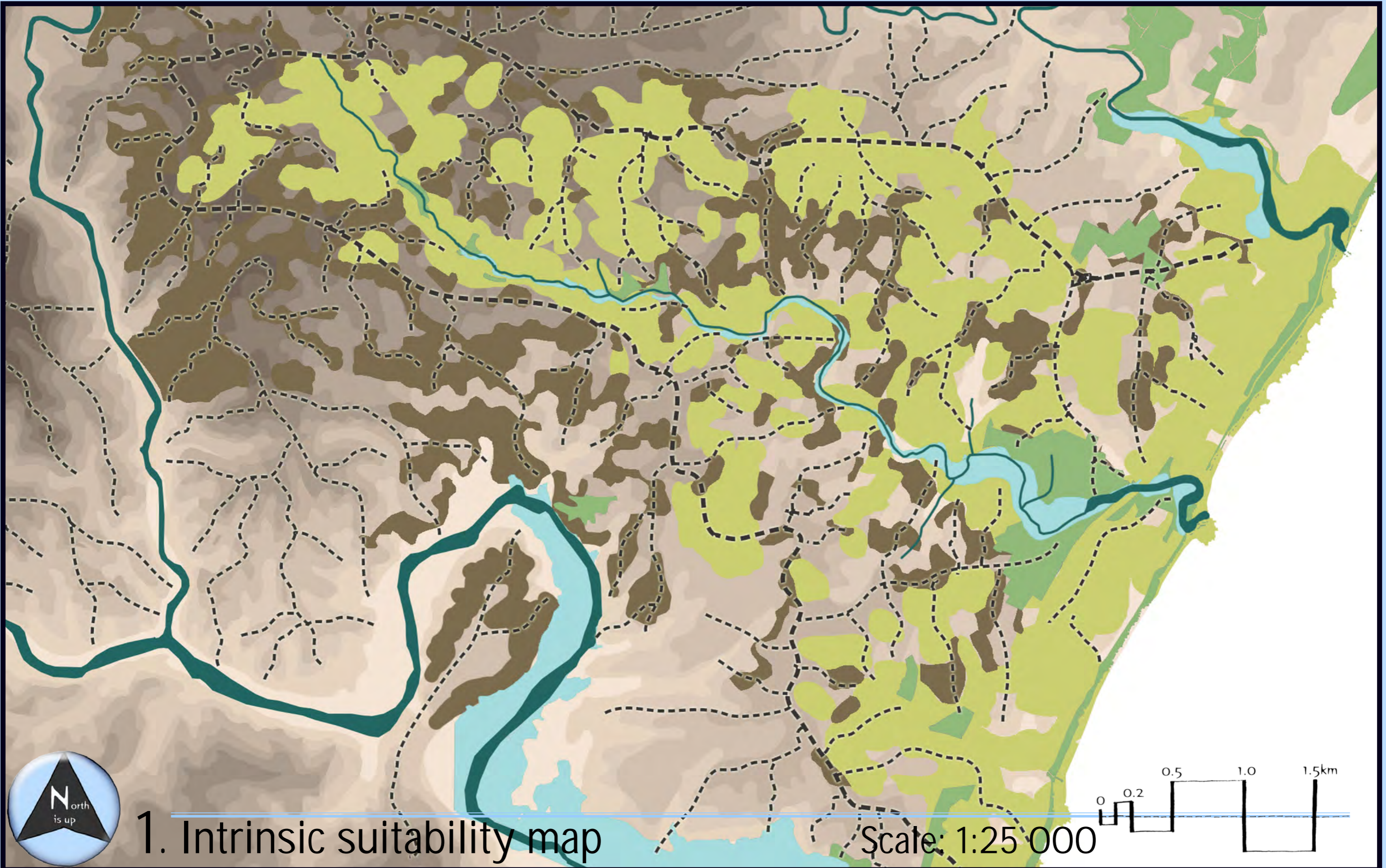
be unfair to impose levies.

There is a lot of work promotion and if there is more work needed than the community itself can cope with it can employ more people from outside the community - job creation. In fact residents in Warner Beach may want to waitress in the coffee shops or become a tour guide etc.



**Do the residents pay levies for the maintenance and upkeep of the area?**

Monetary expenses for the community may be paid for by running courses (eg: vermiculture, urban agriculture), hosting school daytrips, the recycling centre, and communally owned businesses eg: cinema. If there are excess expenditures a committee will be appointed to solve the problem - because people could theoretically enter a non-money based lifestyle it would



1. Intrinsic suitability map

Scale: 1:25 000

## Legend

	Flat land
	Forest, woodlands
	Steep slopes
	100 year floodplain
	Surface water
	Ridgelines

### Intrinsic suitability

Major natural processes are conducive to certain uses. In order to determine a location for a new development, it is essential to map the land according to McHarg's method of "intrinsic suitability for urban use" as he describes in his book, *Design With Nature* (1992). McHarg selected eight aspects of natural processes and lists them in a hierarchy of importance from the highest value of urban use to the highest intolerance of urban use:

- Flat land
- Forest, woodlands
- Steep slopes
- Aquifers
- Aquifer recharge areas
- Floodplains
- Marshes
- Surface water

(Because of lack of reliable information this project has eliminated the values of aquifers.)

#### Flat land

Slopes steeper than 12° are not suitable for agriculture. Flat land is an important resource and both agriculture and housing compete for these spaces.

#### Forests and woodlands

Despite being covered in sugar cane, it is apparent that coastal forest covered most of the river basin and was removed for urban and agricultural areas (particularly sugar cane fields). The remnants of this forest remain mostly as dune and riparian forest on hill tops or areas that were too steep to develop. Forests are important land cover because they prevent soil erosion (because of the high rainfall in Durban and the consequent run-off, soil erosion is a potential problem and so vegetation must be preserved), provide habitats to local wildlife species

(birds, vervet monkeys etc.), provide a comfortable microclimate and filter air pollution.

#### Steep slopes

These lands are also unsuitable for development because of the risk of soil erosion. The following photo is taken of a house in Warner Beach after a heavy storm and the resulting mud slide caused by careless development uphill:

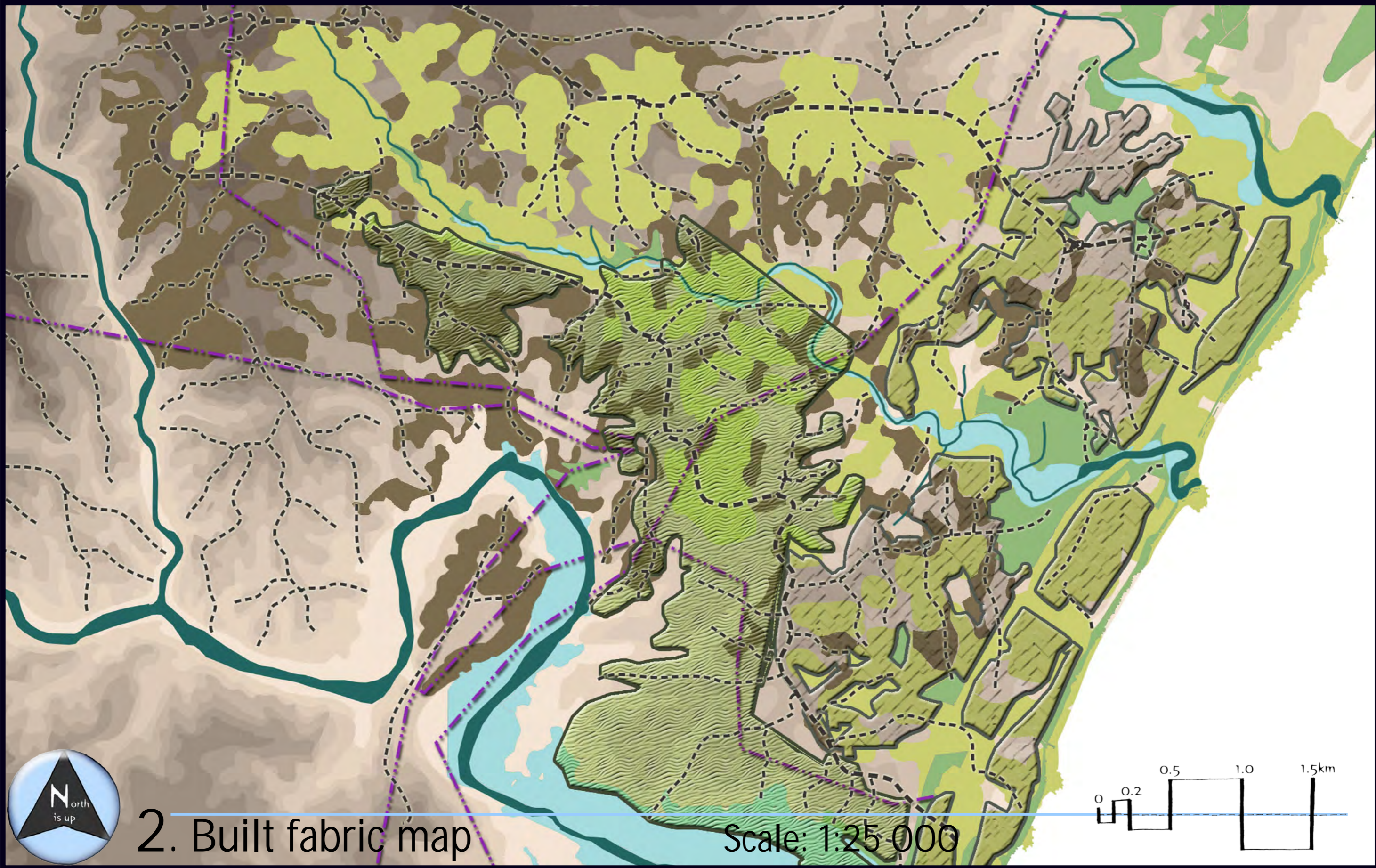


#### Floodplains

Rivers naturally flood as part of their hydrological cycles. Flooding is an unavoidable event and therefore all development should avoid the 100 year floodplains, except for activities that are conducive to flooding, for example sports and recreational facilities.

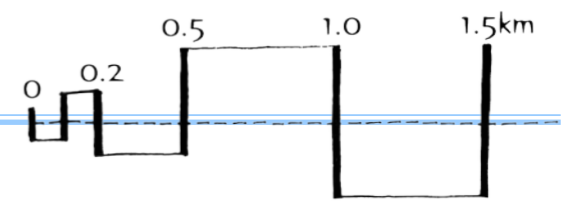
#### Marshes and Surface water

It is particularly important to maintain a high quality of surface water - any development or industry near wetlands and surface water must take care to a. not pollute it and b. not extract the water beyond its natural levels.



## 2. Built fabric map

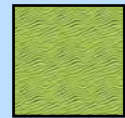
Scale: 1:25 000



## Legend



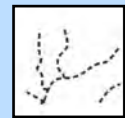
Built fabric



Sugar cane fields



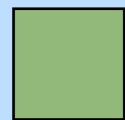
Power lines



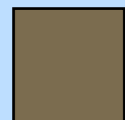
Ridgelines



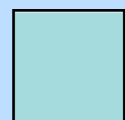
Flat land



Forests and woodlands



Steep slopes



100 year floodplain

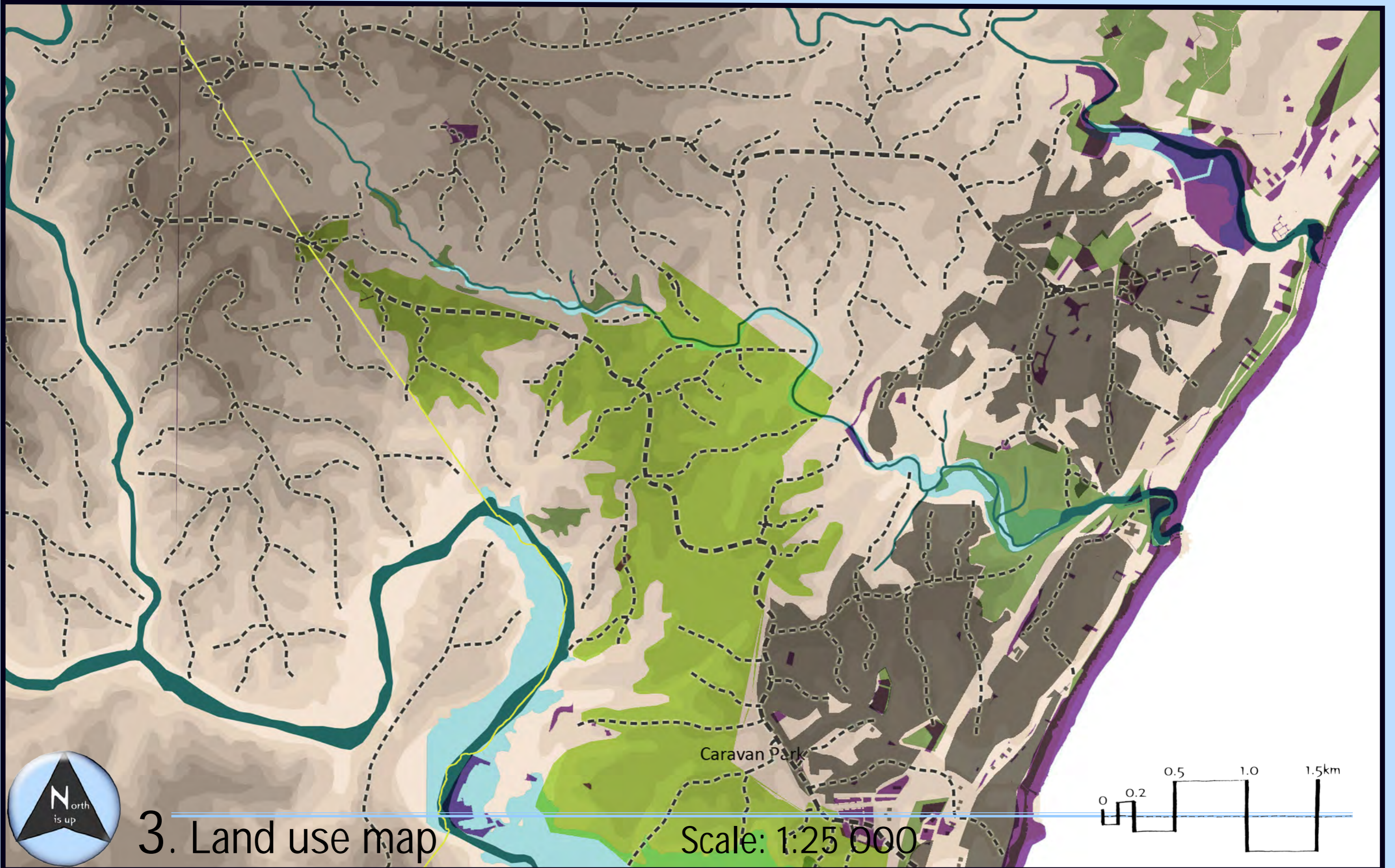
### Built fabric map

The built fabric indicated on this map shows that development has avoided the coastline and dune systems as well as rivers and floodplains.

The settlement pattern is mostly near the coast but on the higher, flat plateau of the landscape. This is probably because housing can benefit from sea views as well as the cool sea breeze.

The sugar cane fields are planted on both steep and flat slopes and are located near the Lovu river, at times even encroaching on the river's floodplain. Most of the agriculture is beyond the boundary of the Little Amanzimtoti river basin.

University of Cape Town



3. Land use map

Scale: 1:25 000

## Legend

	Forests, wetland
	Municipal-owned land
	Built up area
	Floodplains
	Sugar cane fields
	Urban edge line

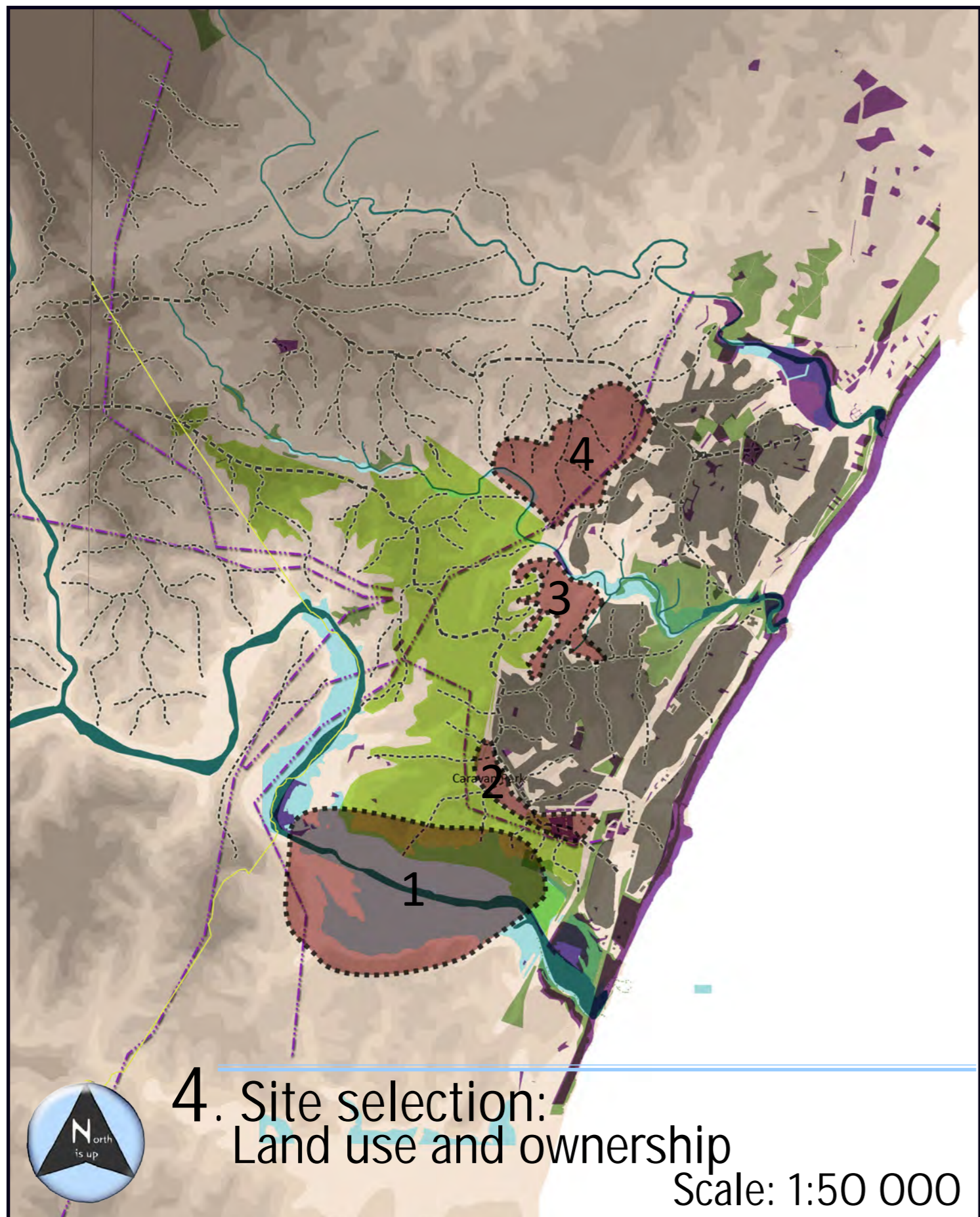
### Land cover mp

This map is best understood in conjunction with the built fabric map: it gives a greater understanding of the future development of the area.

Although the urban edge line is a political boundary, and not determined by natural systems and processes, it may become necessary to redraw a line to hold urban development.

The built fabric is mostly being confined by an agricultural buffer and while the land use remains agricultural, urban expansion is unlikely, although this does not mean it will be so indefinitely.

The municipal-owned land is limited only to the coastal dunes and wetland surrounding the Amanzimtoti river. If more natural land and habitats are to be retained, it may become necessary for more of these areas to be demarcated as undevelopable land that is protected by municipal statute. eg: there is a vast wetland alongside the Little Amanzimtoti river that could be protected and conserved.



4. Site selection: Land use and ownership  
Scale: 1:50 000

**Site selection: land use and ownership**

Four sites have been chosen as potential sites for the development of a community that will embrace methods of living differently:

**Site 1: Illovo Node**

This area has been set aside since July 1998 as a development node. The opportunities presented by the plan include:

- tourism and recreational development
- heavy and light industry development
- commercial and business development
- high and low income residential development

The plan is within a framework of planning and policy initiatives such as:

- South Local Council's Local Development Plan
- RDP and GEAR strategies
- Planning and Development Act

The site is situated on either side of the Illovo river and cuts into the edge of sugar cane fields and so does not dramatically conflict with any other particular land use or ownership.

**Site 2: Caravan park area**

This site was a caravan park that was due to be cleared to make way for a shopping centre that is no longer due to be built.

The site is situated between existing urban fabric and sugar cane fields and its south-east corner sits on municipal-owned land.

**Site 3: Urban edge**

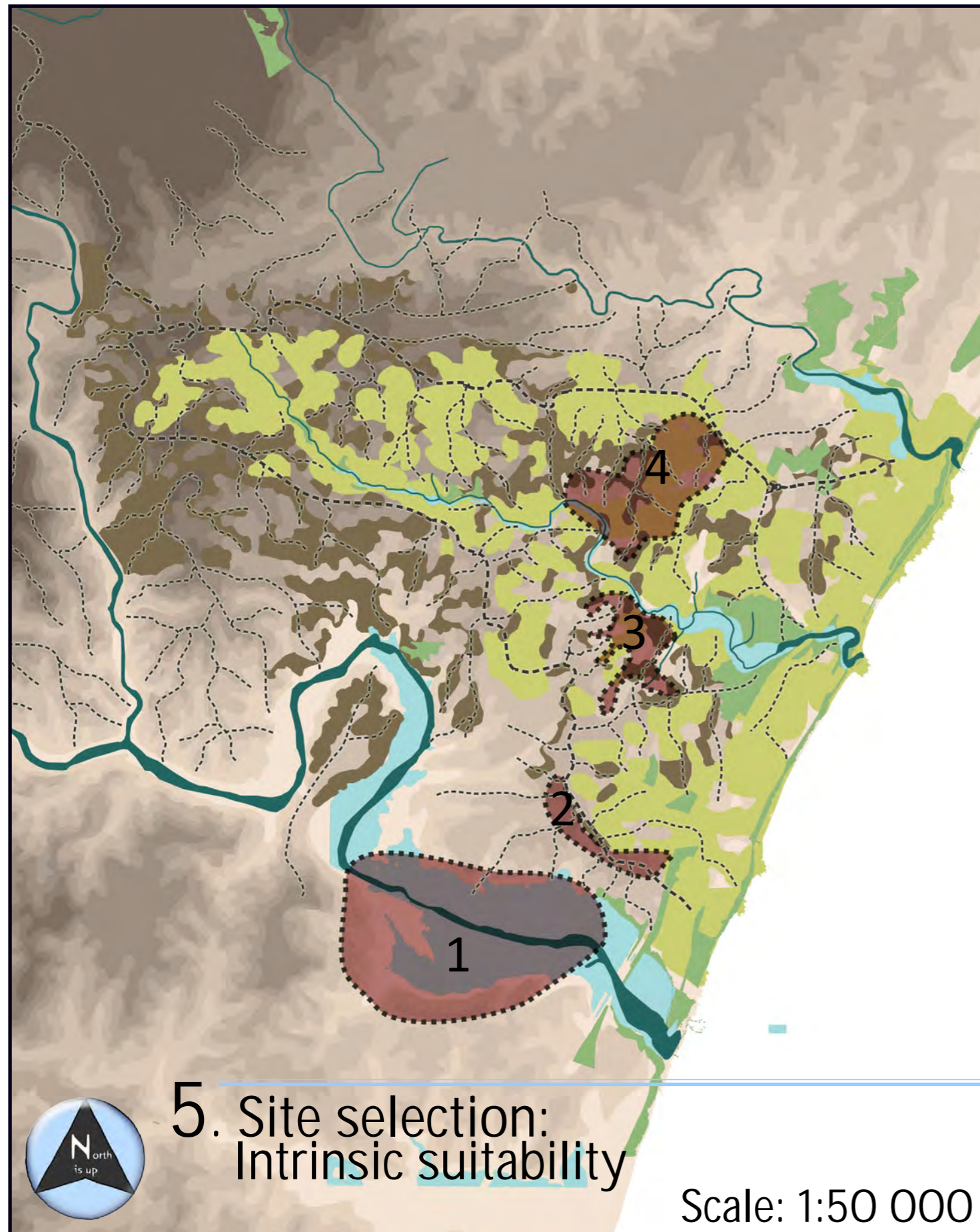
This site sits on remaining land between the river, existing urban fabric and sugar cane fields. There are very few dwellings and little infrastructure on the site.

**Site 4: Rainbow Park**

A 175 hectare development is planned for the area. It sits further inland but is bordered by the edge of urban fabric in the south east and sugar can fields in the south west.

**Legend**

- Built fabric
- Forest, woodlands
- Municipal-owned land
- 100 year floodplain
- Surface water
- Sugar cane fields



**Site selection: Intrinsic suitability**

**Site 1: Illovo Node**

This area mostly comprises floodplains which are unsuitable for development, and wetlands in the north-east. The only land suitable for development is in the south and it may be too far isolated from existing urban fabric.

**Site 2: Caravan park area**

This site is on the boundary of the river catchment area and follows the ridgeline between the Little Amanzimtoti and Lovu river catchment basins. It does not present any major

unsuitability for urban use.

**Site 3: Urban edge**

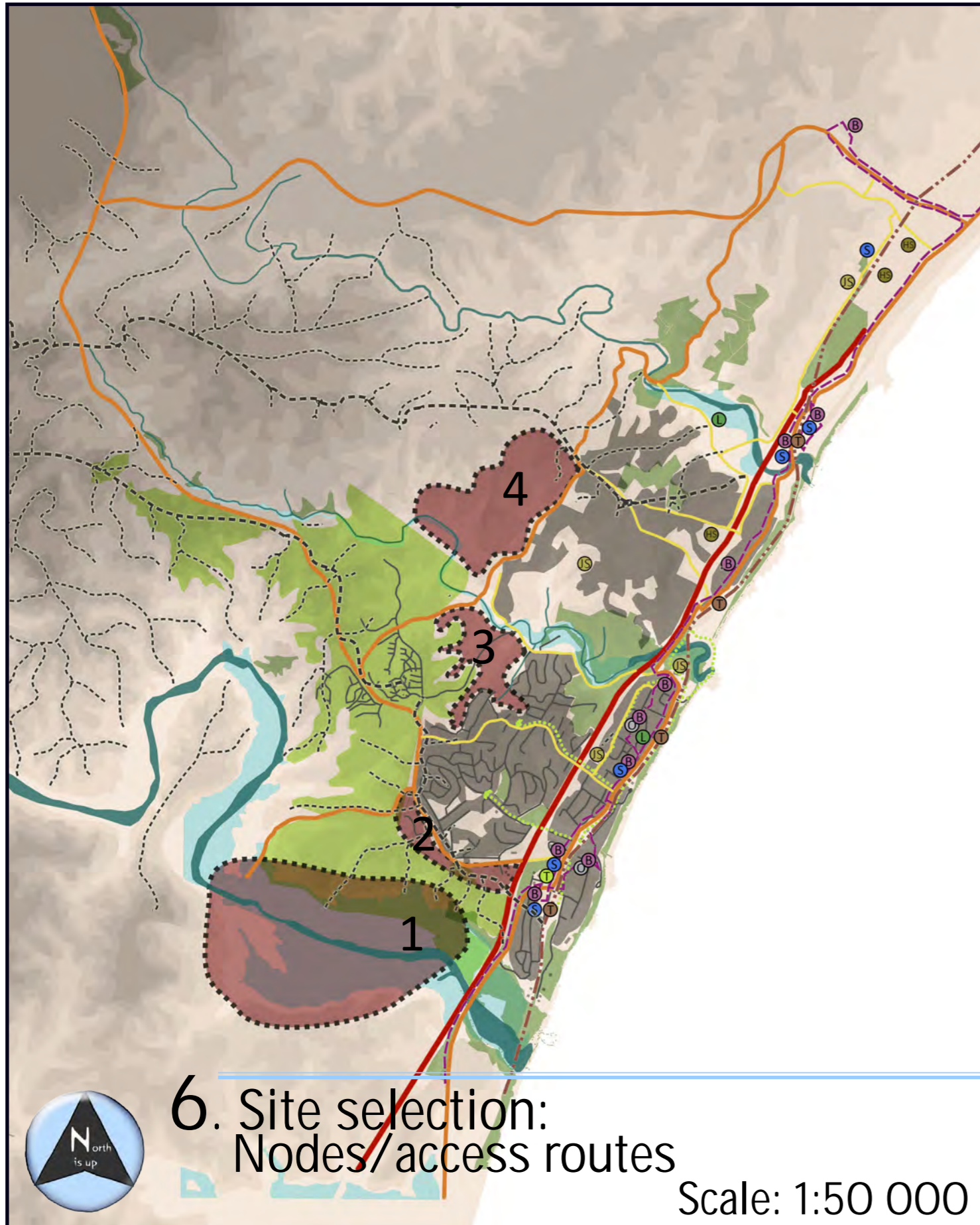
This site is just out of reach of the flood plain, so it is suitable for urban development but care must be taken regarding the quality of water and air leaving the site. The site comprises both flat and steep land.

**Site 4: Rainbow Park**

This site borders a river and flood plain in the south-west. Because the site drains directly down towards the river it will be important to treat and filter water running off the site. This site is situated on predominantly flat land which will be an advantage and will incur less development costs.

**Legend**

-  Flat land
-  Forest, woodlands
-  Steep slopes
-  100 year floodplain
-  Surface water
-  Ridgelines



**Site selection: nodes and access routes**

Access routes are vital to a settlement - inaccessible communities will not function well or attract the necessary activity levels necessary for a vibrant neighbourhood.

**Site 1: Illovo Node**

This site is very poorly connected both regionally and locally in terms of access routes and transport nodes. There is one arterial road connection to the north-west of the site.

**Site 2: Caravan park area**

An arterial road runs the length of the northern edge of the site. There is access to

the freeway, train station, taxi station and bus stops in the south-east.







**Site 3: Urban edge**

The site is well connected into the local access system. The site is bordered by arterial and connector routes, but not well connected to regional access or regional transport nodes.

**Site 4: Rainbow Park**

This site sits on the edge of the urban fabric. It is connected only to an arterial route and the end of a connector route, but it is not connected to any significant transport nodes.

**Legend**

-  Built fabric
-  Forest, woodlands
-  Sugar cane fields
-  N2 (national access)
-  Regional access routes
-  Local access routes

**Analysing the matrix:**

		slope				soil		intrinsic suitability			effect on environment				connections							
		0%	0-5%	15-25%	25+	sandy	silty	rivers	flood plain	forest/wetlands	air pollution	water pollution	sedimentation	soil erosion	freeway	arterial roads	collector roads	access roads	railway	bus routes	pedestr. routes	activity nodes
Site #1	urban	Blue				Yellow		Yellow	Red	Red	Yellow	Red	Red	Green	Yellow	Blue	Red	Green	Green	Green	Red	Red
	agriculture	Blue				Green		Blue	Yellow	Red	Green	Yellow	Yellow	Yellow	Blue				Green			
	recreation	Blue						Blue	Blue	Green	Blue	Green	Blue	Green	Yellow	Blue	Red	Green	Green	Green	Red	Red
	forestry	Blue				Blue		Blue	Yellow	Green	Blue	Blue	Blue	Blue	Yellow	Blue			Green		Red	
Site #2	urban		Blue	Yellow		Green	Green				Red	Yellow	Yellow	Red	Blue	Blue	Red	Blue	Green	Green	Yellow	Green
	agriculture		Blue	Red		Green	Green				Green	Yellow	Yellow	Yellow	Blue	Blue			Green			
	recreation		Blue	Blue							Blue	Blue	Blue	Green	Blue	Blue	Red	Blue	Green	Green	Yellow	Green
	forestry			Blue	Blue	Green	Green				Blue	Blue	Blue	Blue	Blue	Blue			Green		Yellow	
Site #3	urban	Blue	Blue	Yellow		Green		Yellow	Green		Yellow	Red	Yellow	Yellow	Red	Blue	Blue	Blue	Red	Yellow	Blue	Yellow
	agriculture	Blue	Blue	Yellow		Green		Blue	Green		Green	Yellow	Yellow	Green	Red	Blue			Red			
	recreation	Blue	Blue					Blue	Blue		Green	Green	Blue	Blue	Red	Blue	Blue	Blue	Red	Yellow	Green	Yellow
	forestry			Blue		Blue		Blue	Green		Blue	Blue	Blue	Blue	Red	Blue			Red		Green	
Site #4	urban		Blue	Blue		Green					Yellow	Green	Green	Yellow	Red	Blue	Blue	Blue	Red	Red	Red	Red
	agriculture		Blue			Green					Green	Yellow	Yellow	Yellow	Red	Blue			Red			
	recreation		Blue								Blue	Green	Blue	Green	Red	Blue	Blue	Blue	Red	Red	Red	Red
	forestry			Blue		Blue					Blue	Blue	Blue	Blue	Red	Blue			Red		Red	

**Method 1:**

This method assumes that sites should inherently have positive implications on their environment, therefore all incompatibilities will be deducted from the total score (ie. scores closer to 0 are ideal).

Method 1 is based on a value system where for all categories:

- Blue: 0 points
- Green: - 1/2 point
- Yellow: -2 points
- Red: -3 points

The results of the matrix:

- Site 1: -85.5 points
- **Site 2: -41 points**
- Site 3: -56.5 points
- Site 4 -58.5 points

**Method 2:**

In this method, categories are *weighted* based on negative values for aspects that can't be mitigated, 0 points for aspects that are negative but can be mitigated and positive points for positive aspects. Because each category has unique implications each category has a separate point system eg: because development on slopes can be controlled, it gains 0 points, yet sites within flood plains receive -20 points for unacceptable development.

Slope and soil:

- Blue: 2 points
- Green: 1/2 point
- Yellow: 1 point
- Red: 0 points

Effect on the environment:

- Blue: 3 points
- Green: 1 point
- Yellow: 0 points
- Red: -3 points

Intrinsic suitability:

- Blue: 0 points
- Green: -5 points
- Yellow: -10 points
- Red: -20 points

Access nodes and connections:

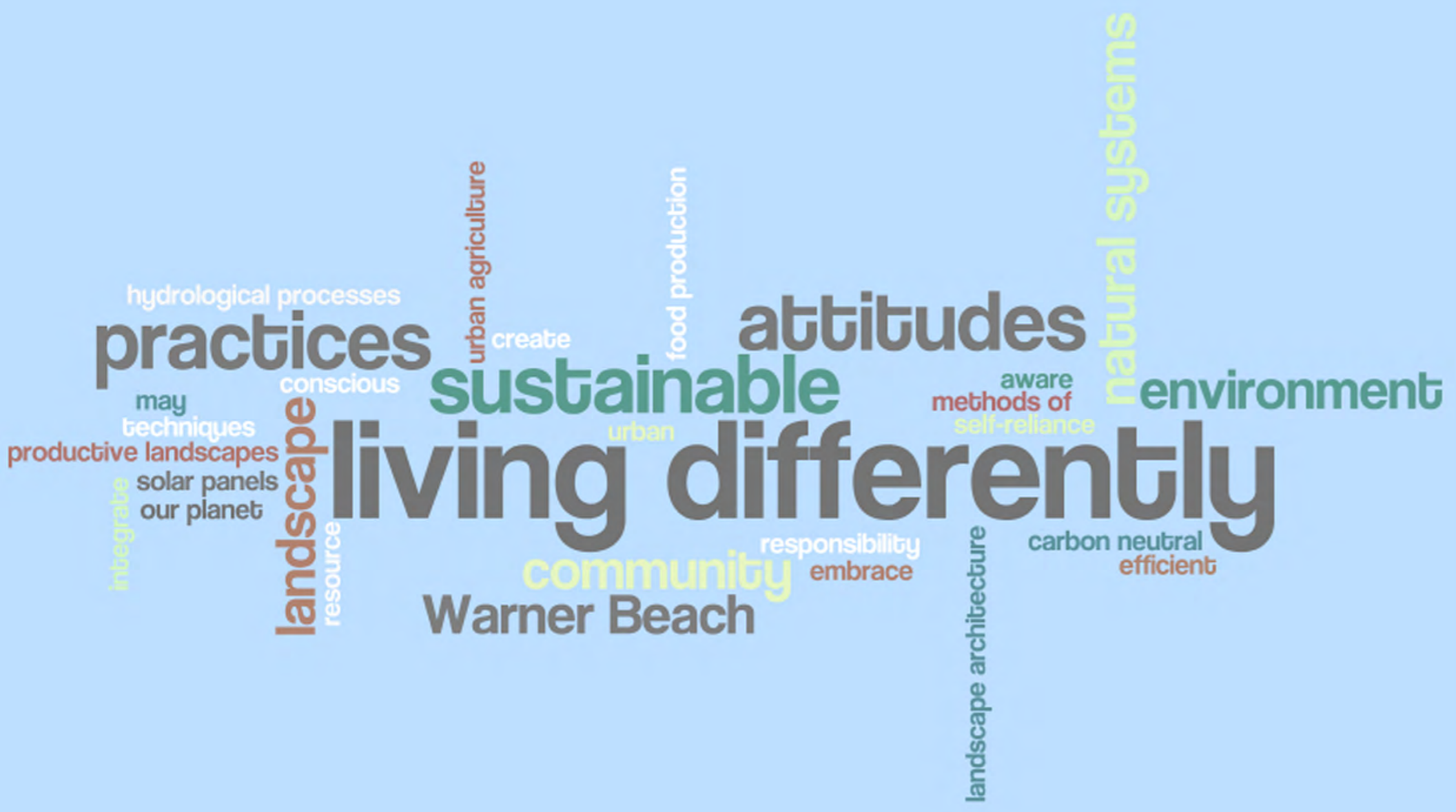
- Blue: 3 points
- Green: 0 points
- Yellow: -2 points
- Red: -5 points

Results:

- Site 1: -131.5 points
- **Site 2: 0 points**
- Site 3: -36 points
- Site 4: -28 points

**Conclusion:**

Site 2 is the most well-connected site that has the least impact on natural systems around it, and where it does have a negative impact, these effects may be mitigated through a positive landscape design.



# Contents

Topic and introduction

Literature review

Design principles

River basin analysis

Site selection

 Site design

Precinct design

Construction details

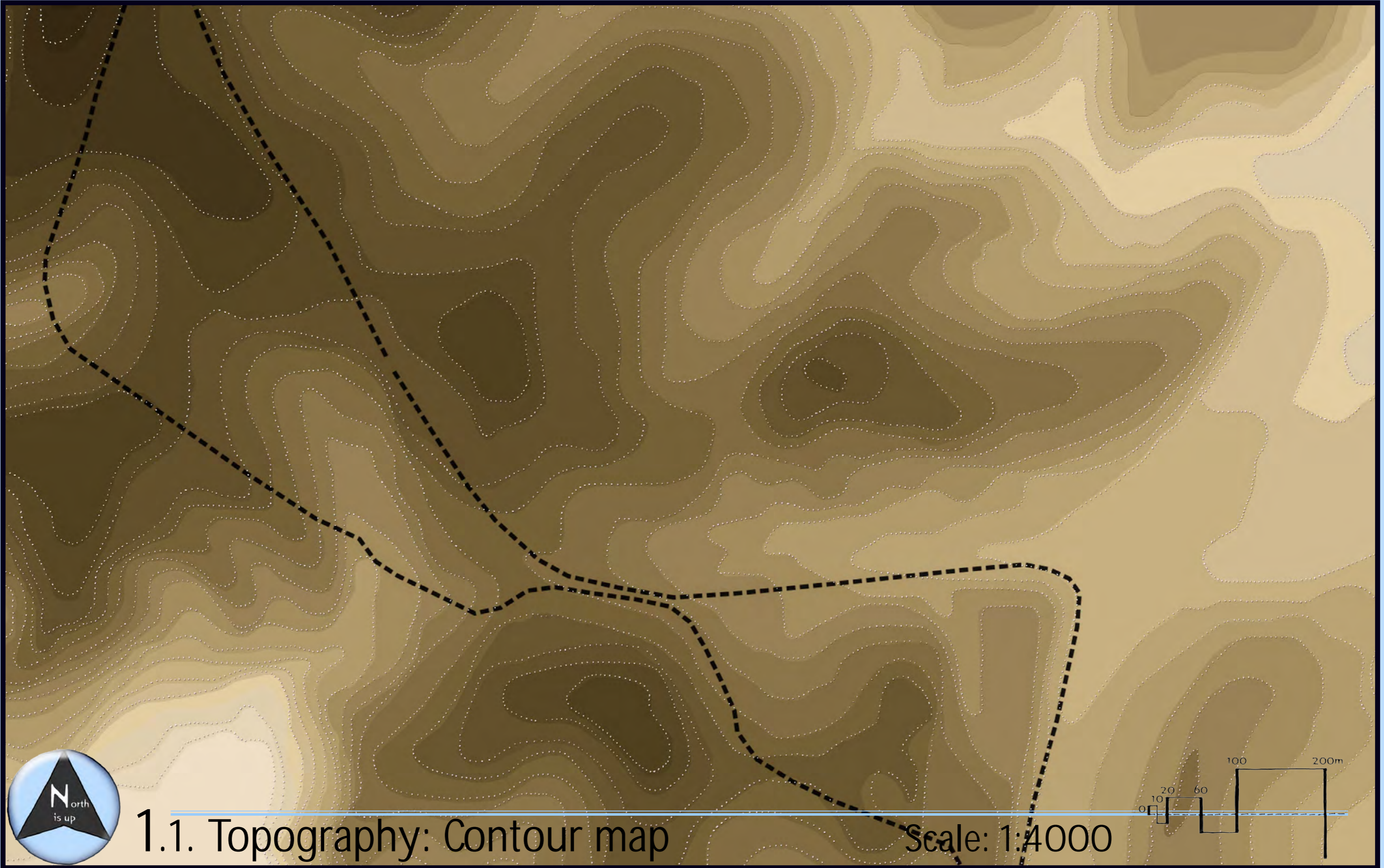
Conclusion

## Looking ahead....

Now that a site is chosen (site 2), the scale of investigation drops to 1:5000. Beginning the design process is a collection of quantitative (topography, hydrology) and qualitative (climate, impressions of the site) information about the site.

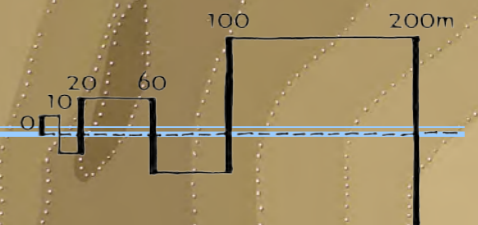
We zoom in closer to the ground and the scale drops to 1:2000 as the information is synthesised into diagrams that will inform a design for a settlement on the southern section of the site. (Because the site identified in the site selection process is clearly split in two, the southern half of the selected site will be the focus for design.)

The site design is then presented at 1:1000 and its systems and processes are extracted and analysed separately as diagrams.

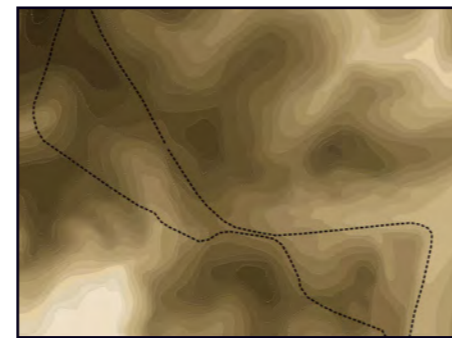
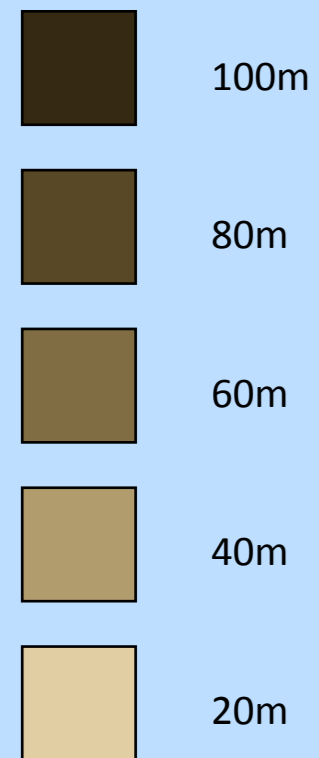


1.1. Topography: Contour map

Scale: 1:4000

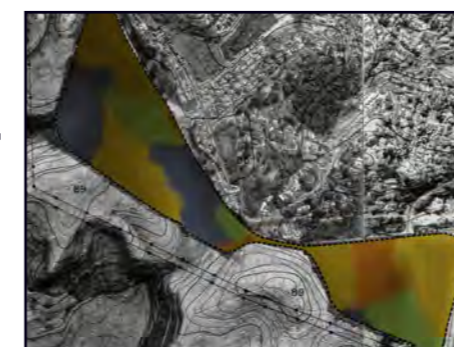
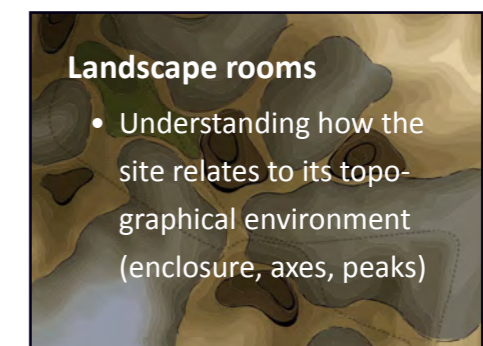
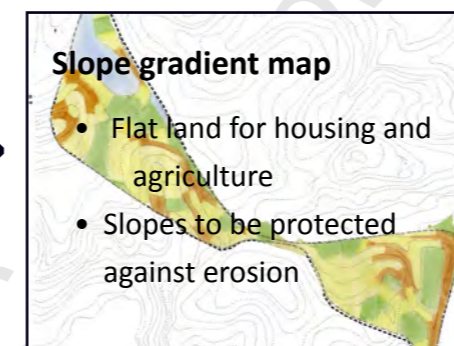
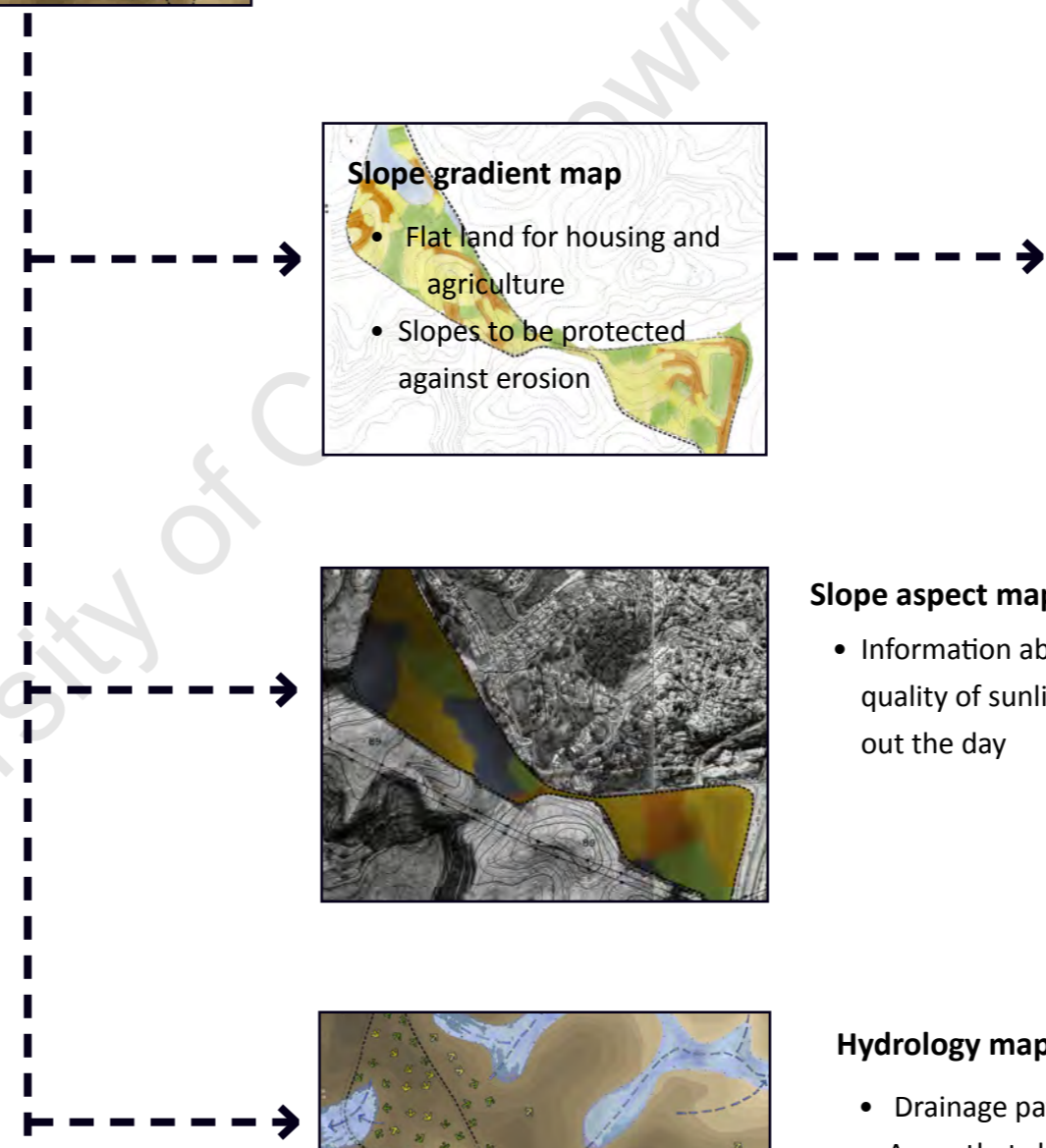


## Legend



### Relevance of the contour map

Such a seemingly simplistic set of quantitative data has a profound influence on the qualitative understanding of the conditions on the site:



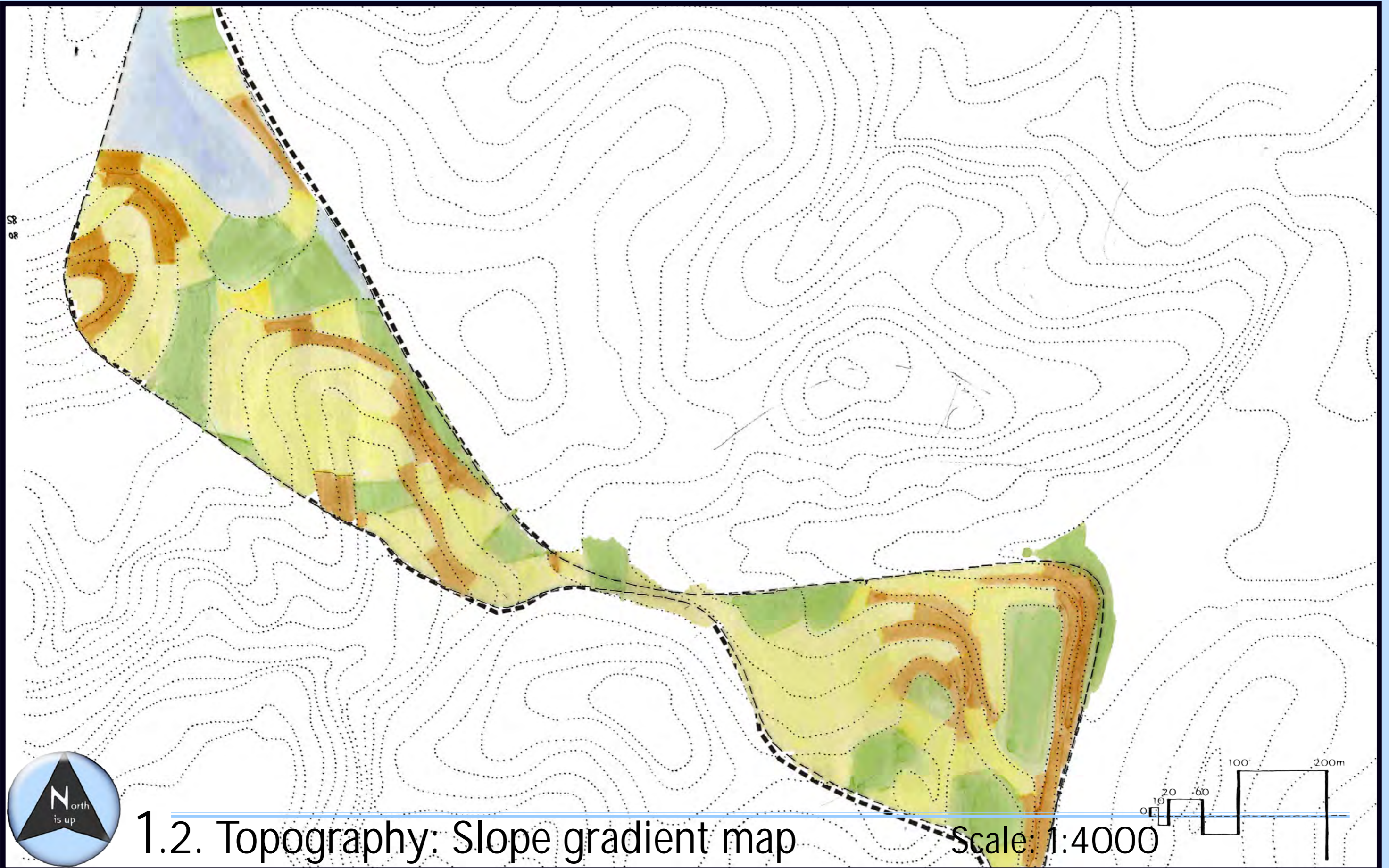
### Slope aspect map

- Information about the quality of sunlight throughout the day



### Hydrology map

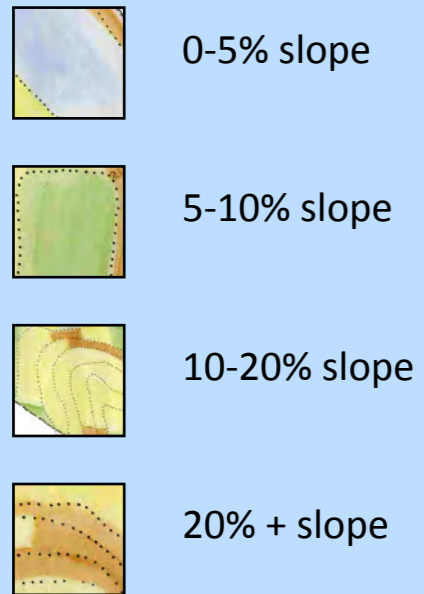
- Drainage patterns on site
- Areas that should be conserved as wetlands



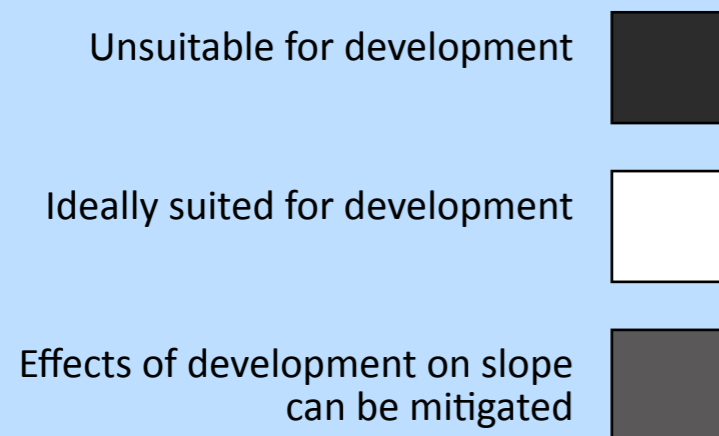
1.2. Topography: Slope gradient map

Scale: 1:4000

## Legend



## Legend



### Relevance of the slope gradient map

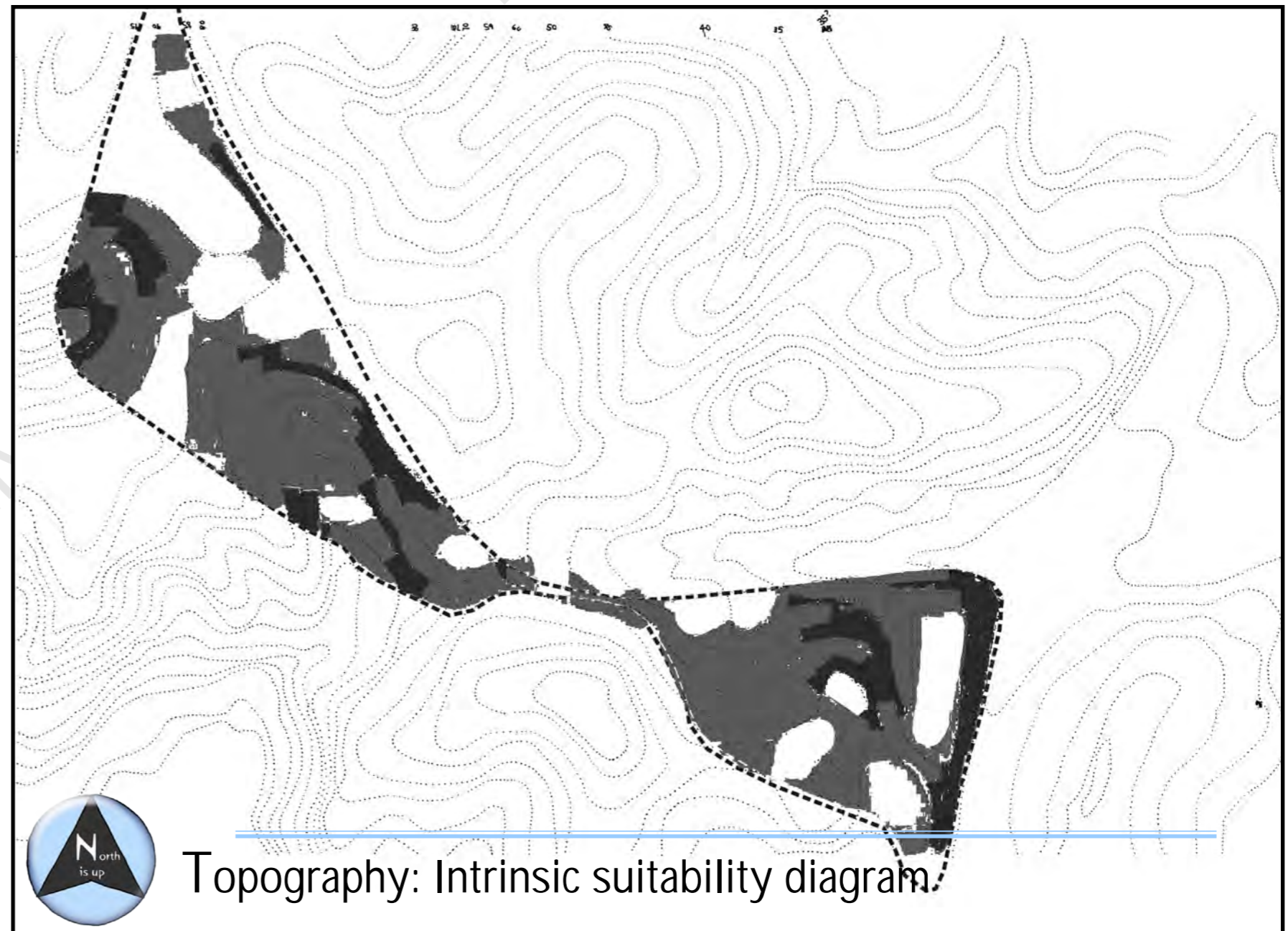
The values chosen to organise the various slope gradients were not incidental:

0-5% slopes are flat and ideally suited for housing and agriculture.

5-10% slopes are slightly steeper and still suitable for development but there will be more costs involved in terms of cutting and filling the slope.

10-20% slopes are steep enough to discourage agriculture and housing becomes quite costly. Areas such as forestry are useful for these areas because forests will stabilise the slopes to prevent erosion and could provide a renewable source of timber harvesting.

20% + slopes are very steep and unsuited to development. Because of the frequency of intense storms these steep slopes are vulnerable to erosion and should be covered with vegetation that will bind the layer of top soil and slow down rainwater runoff, thus reducing soil erosion.






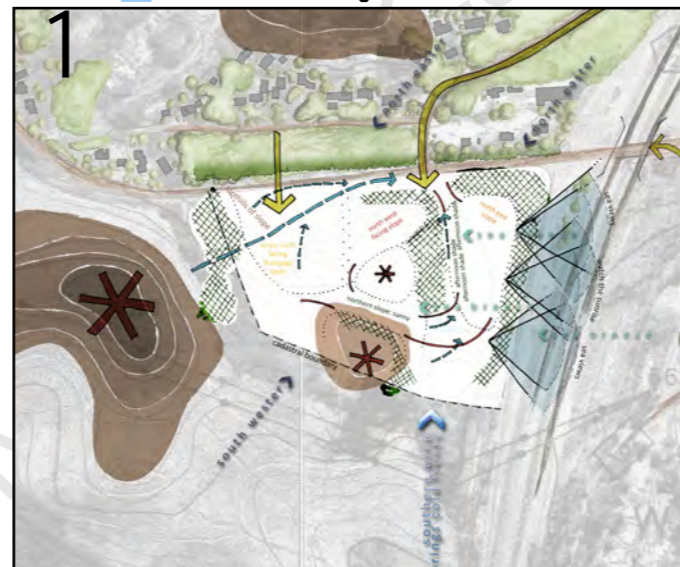
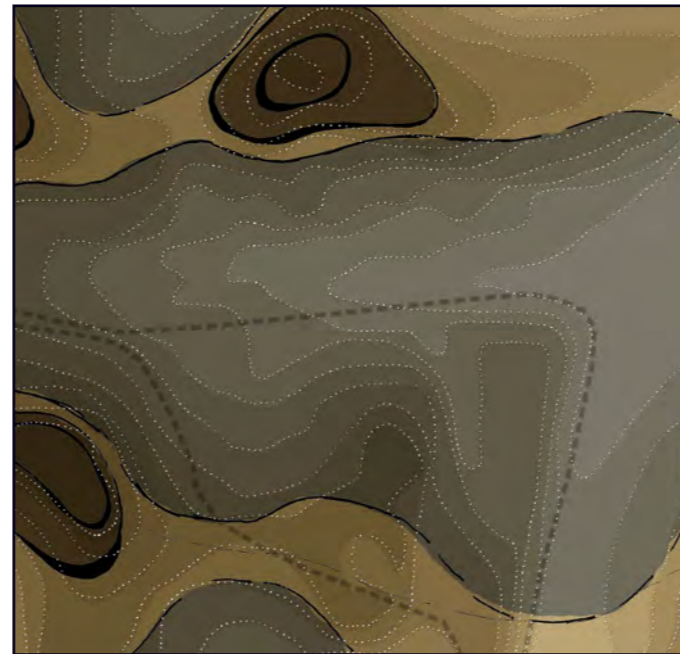


1.3. Topography: Landscape rooms map

Scale: 1:4000

## Legend

-  Contained rooms (valleys)
-  Uncontained rooms (ridges)
-  Uncontained rooms (peaks)



## Relevance of the landscape rooms map

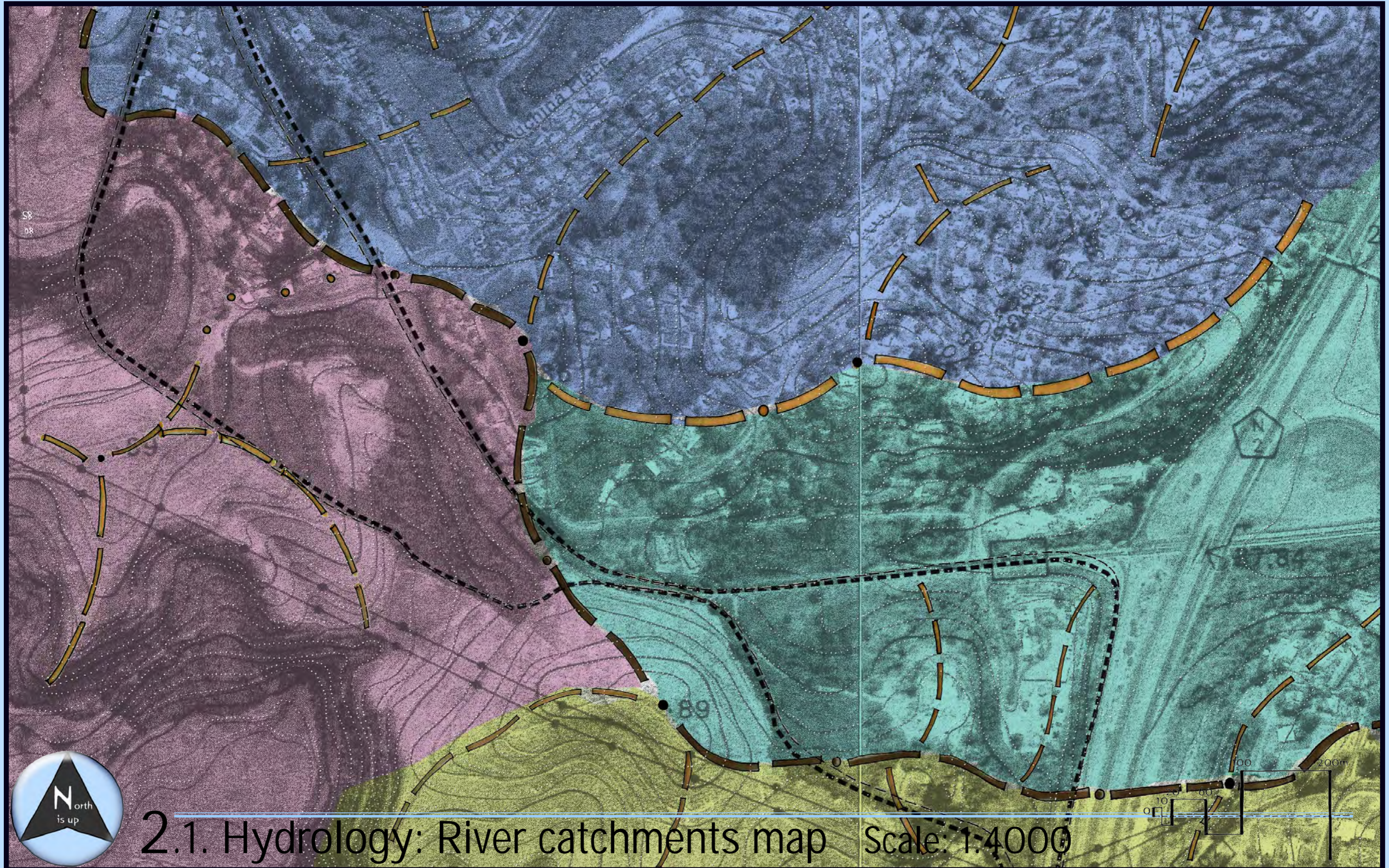
Just like rooms of a house that can be contained within 4 walls or an open plan house where rooms have less defined boundaries but still can be identified as unique spaces, landscapes can also be evaluated in terms of “rooms”.

The boundaries in landscapes are usually defined by ridgelines and particularly wide rivers. This site in particular sits very near a ridgeline defining two river basins (see diagram 2, left) and so it has few views south because the ridgeline and peaks form a backbone to the site. This ridgeline not only anchors and shelters the site from southern winds but dominates its southern skyline and creates a classical\* sense of place.

\* A balance between a cosmic (open) and romantic (narrow) landscape.








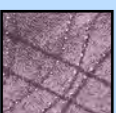

The site is bound on three sides by peaks and ridgelines while the eastern edge is open to sea views, sea breezes, sunrises and changing skies (see diagram 1, left). This information aids in orientating settlement and buildings on the site in order to maximise the views to the east.

One of the most important aspects to note is that the landscape rooms diagram shows that the site’s “landscape room” extends well beyond its cadastral boundaries. Cadastral boundaries are lines that do not exist in reality, they are legal lines that help determine ownership of land but in fact may limit the design if they are not occasionally ignored. For example, the design should consider where people are coming from, the quality of these routes ie. the design should not literally stop at the “edge” of the site.



2.1. Hydrology: River catchments map Scale: 1:40000

## Legend

-  Peak of ridgeline
-  Trough of ridgeline
-  River catchment ridgeline
-  Major ridgeline
-  Minor ridgeline
-  Little Amanzimtoti river sub-catchment A
-  Little Amanzimtoti river sub-catchment B
-  Lovu river sub-catchment A
-  Lovu river sub-catchment B

## Relevance of the river catchments map

During early design phases there is much emphasis on the context surrounding and entering the site. This map investigates the reverse: the impact the site will have on its surrounding water catchment.

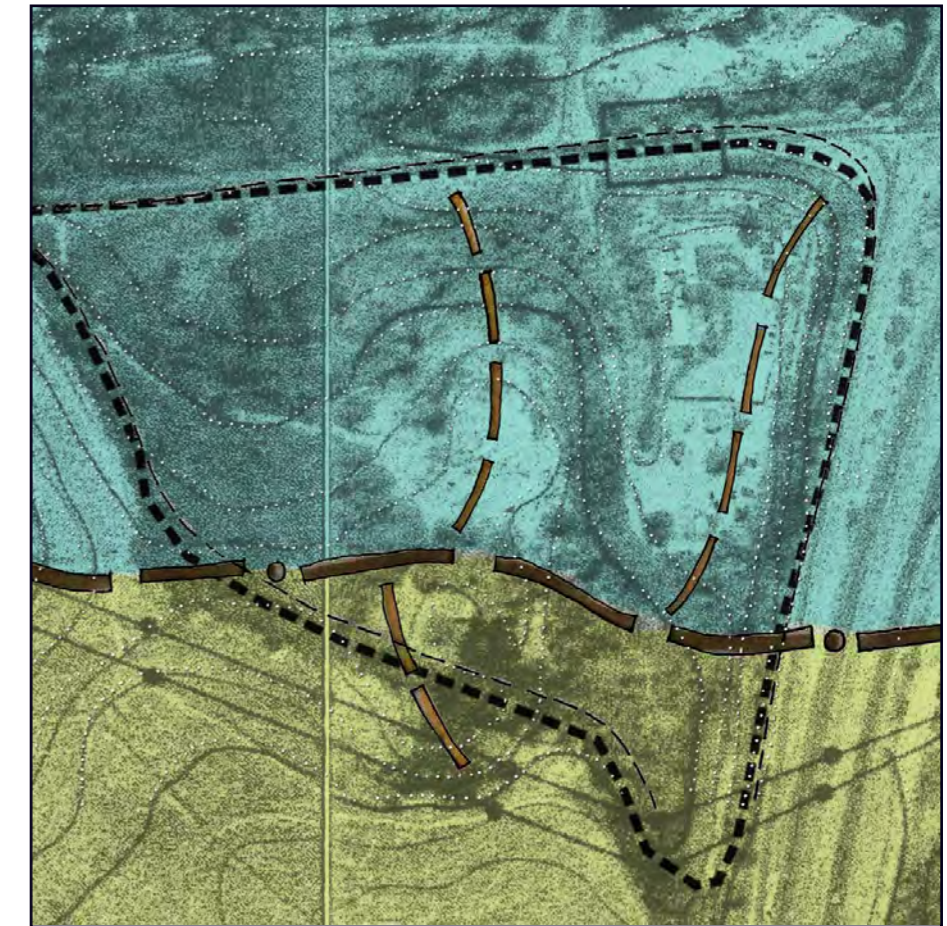
Design principles that are relevant are:

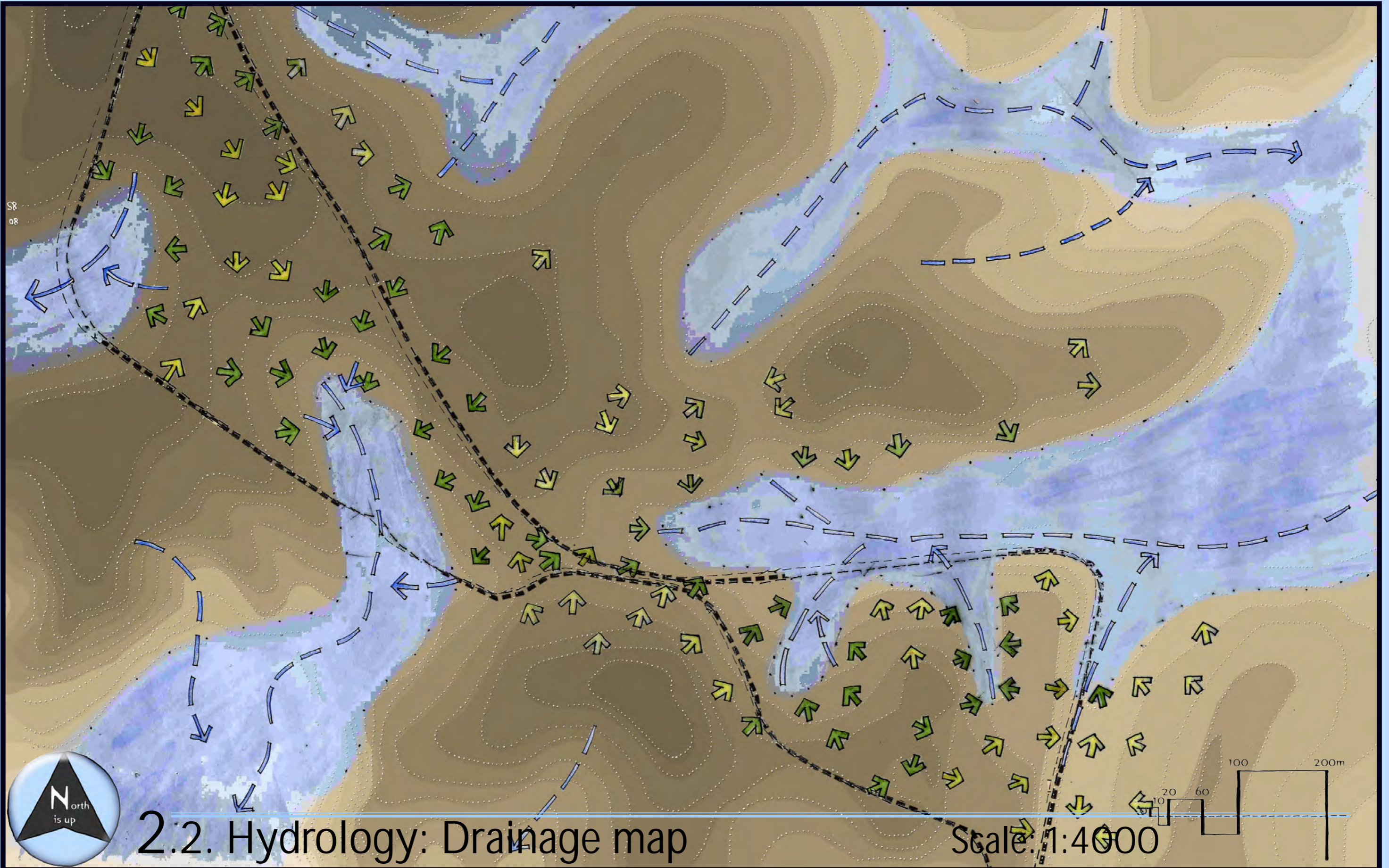
- avoid changing natural streamflows
- do not pollute water
- deal with “wastes” on-site

Therefore it is vital to understand the water patterns on the site and how water patterns will be altered on the site.

The diagram (bottom, right) is the layer of water systems on the site. Rainwater falling on the site is collected and released slowly through a series of wetlands that line the main drainage lines on the site. This ensures that there are delayed peak streamflows after storms (as occurs in nature, unlike disrupted streamflows in impermeable urban areas) and that all water leaving the site is as clean as the rain that fell on it in the first place.

Therefore the river catchments map is useful in understanding the implications of a site on its larger environment.










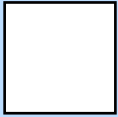

2.2. Hydrology: Drainage map

Scale: 1:4000

## Legend

-  Convergent water drainage
-  Divergent water drainage
-  Collection zone
-  Drainage channels

## Legend

- Unsuitable for development  
(Conveyance zones and floodplains) 
- Ideally suited for development  
(Upland zones) 
- Effects of development can be mitigated  
(Collection zone) 

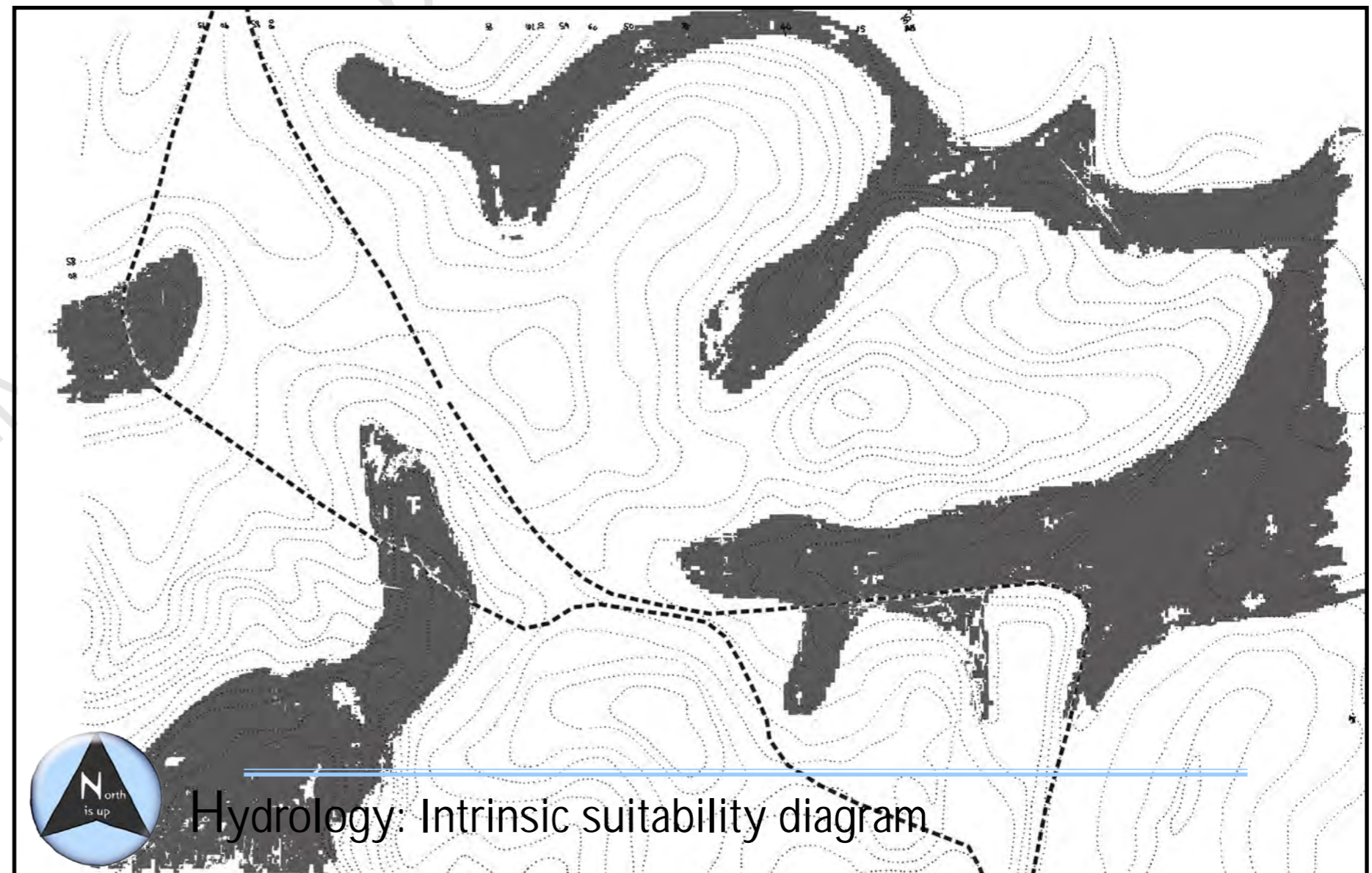
## Relevance of drainage map

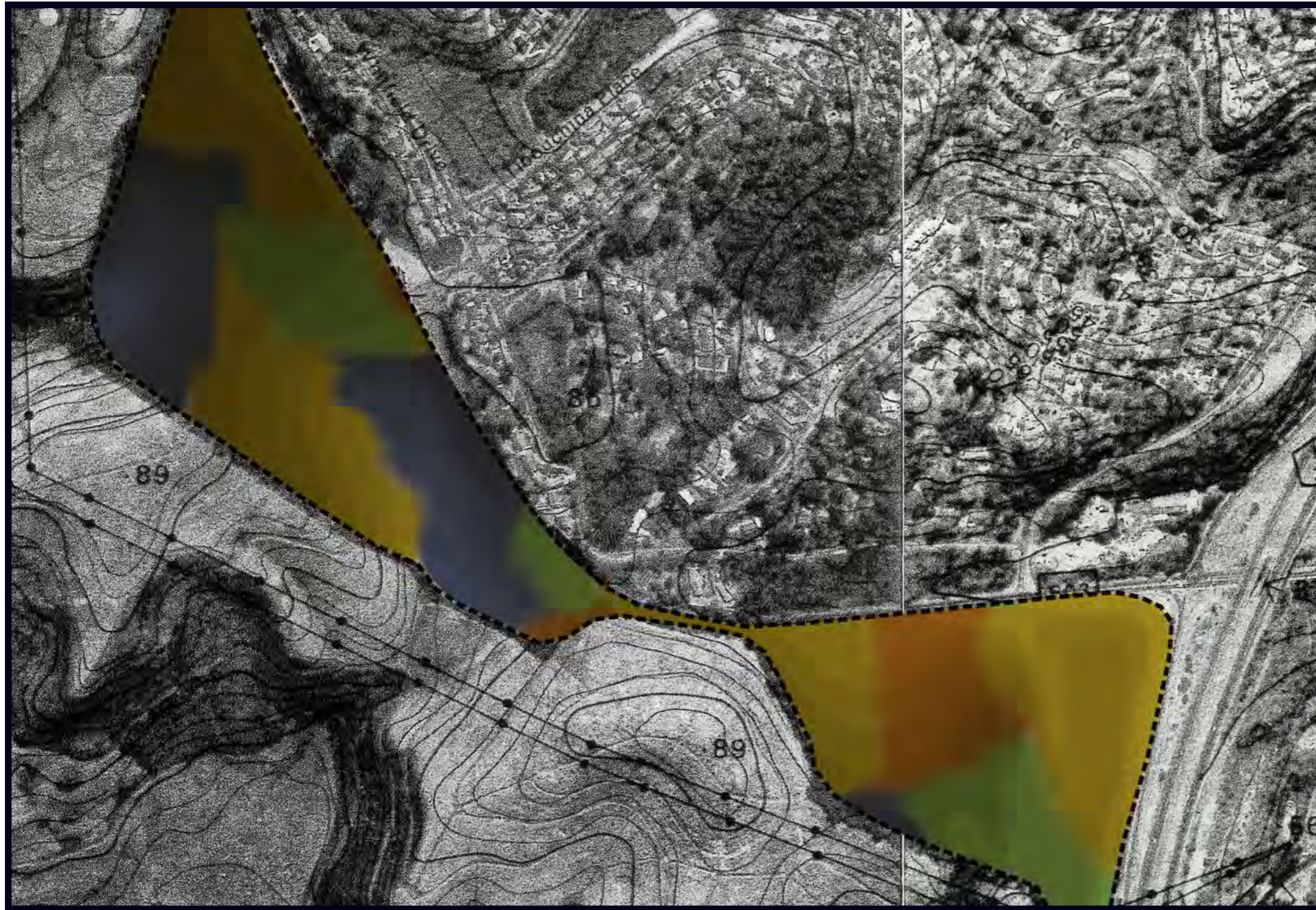
In Marsh's "Landscape Planning" (1998) he describes a method of understanding river catchments. He divides the river basin into 3 zones: an upland zone that is least susceptible to drainage problems, a collection zone where water converges during storms and a conveyance zone which comprises water courses and flood plains.

In terms of suitability for development, upland zones are less affected by drainage and are most suitable for development. While there are no conveyance zones, rivers or flood plains on the site, there are clear collection zones. While Marsh does not advocate unsuitability for devel-

opment in these areas, they are ideal locations for water filtration systems such as wetlands that will slow down runoff (increasing infiltration which prevents flooding) and clean the water running off the site.

The drainage map also analyses the direction of water runoff. If the slope the rain falls on is concave, it results in convergent drainage. Divergent drainage occurs on convex slopes. This information is useful for determining the way water could be collected in channels and used for irrigation ie. convergent drainage requires channels parallel to water flow whereas divergent drainage requires channels perpendicular to water flow.





Legend

- Windy ridges
- Eastern sea breeze
- North easter wind shadow
- South/South wester wind shadow

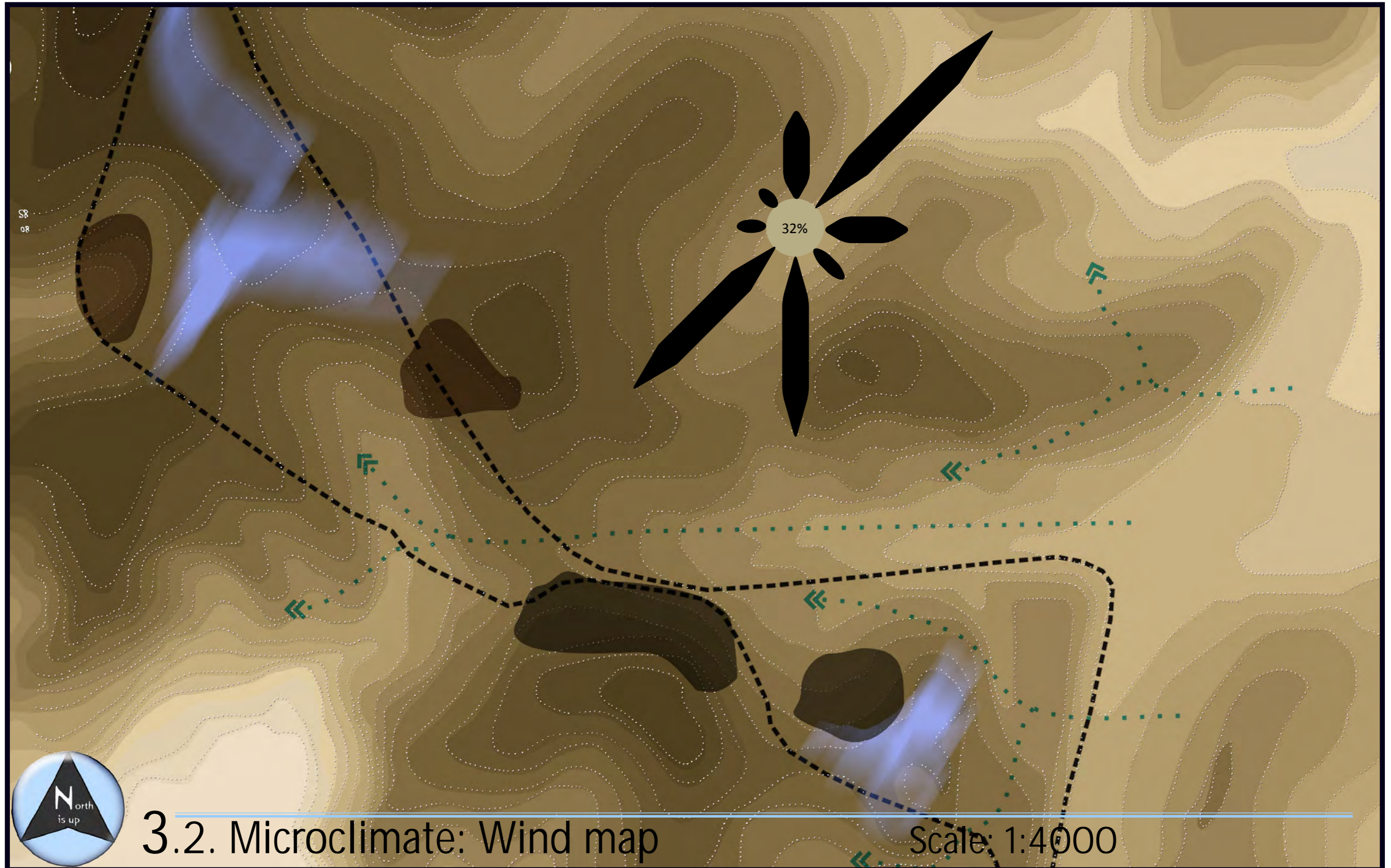
Legend

- Hot north-west slope
- Warm north-east slope
- Cold south-west slope
- Cool south-east slope



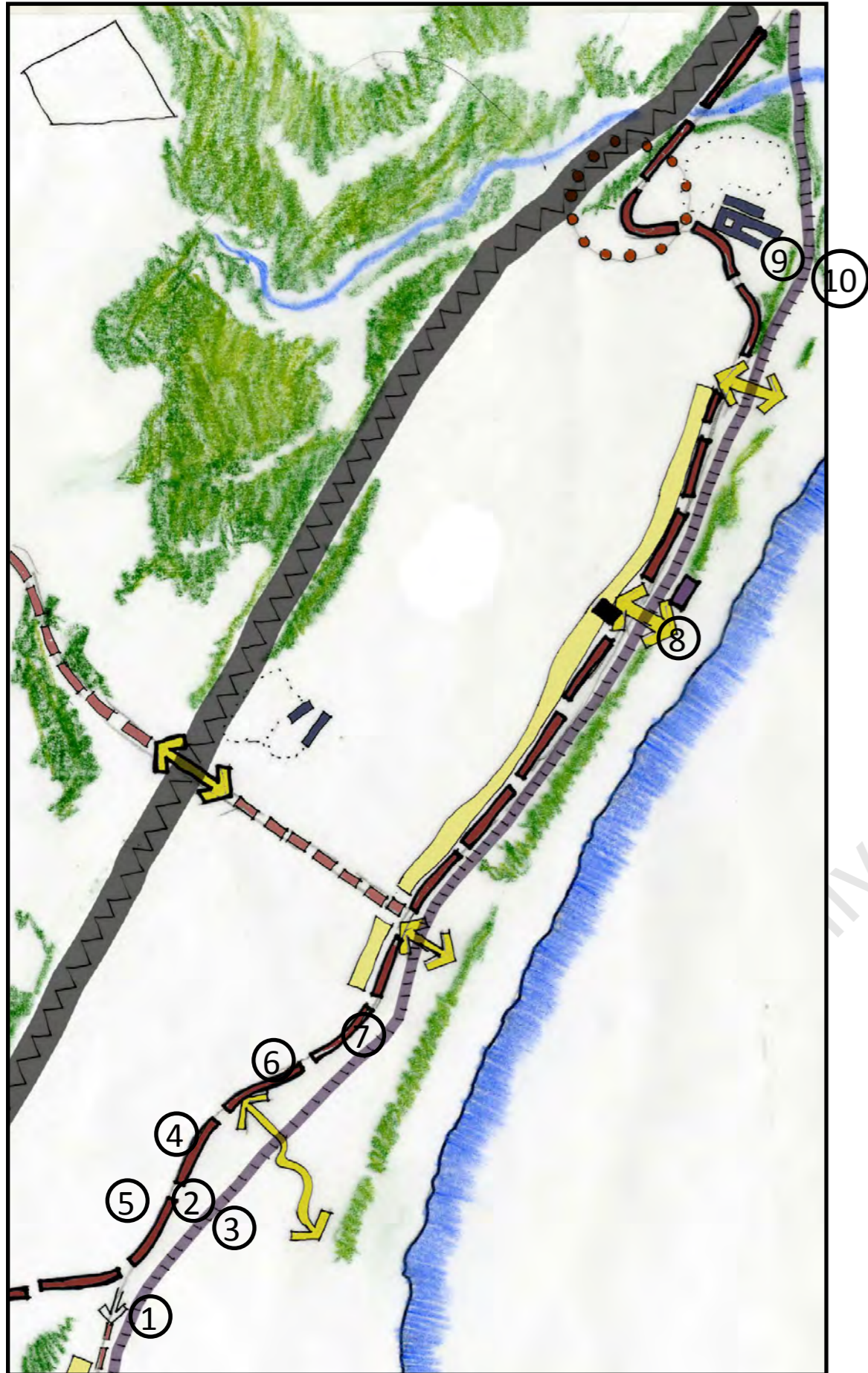
### 3.1. Microclimate: Slope aspect map

Scale: 1:5000



### 3.2. Microclimate: Wind map

Scale: 1:4000



### Developments planned for Warner Beach main road

1. There are plans to build a footbridge from the train station, providing more connectivity between the train station and the taxi-rank (still under construction).
2. Currently there is a traffic light here, plans are to move it and install a traffic circle.
3. This existing pedestrian bridge over the railway will be widened so that motor traffic from the freeway can directly access the beach. The hope is that this will reduce traffic along the main road.
4. The Amanzimtoti testing ground is to be relocated to another site thereby freeing up land for Warner Beach to use. Proposals of a town hall and sporting facilities have been considered.
5. The road in front of the municipal building will be extended, reducing traffic along main road (including delivery trucks).
6. Culvert directing storm and spring water. This drain often gets blocked resulting in hazardous flooding. If this area was converted into a play area or park that looked used and well-cared for then perhaps dumping of rubbish would decrease, causing less blockage to the drain.
7. The rail reserve, currently the source of rats, vermin, stray cats and large quantities of litter, will be given to Warner Beach. Proposals include using the extra space to widen the main road so that there are 4 lanes.
8. There are plans to extend the pedestrian bridge to the station and to create a viewing platform.
9. Upgrade of the bridge between the school and the train station.
10. There are plans to extend the road to the beach to the lagoon. This would be an ideal area to create recreational (such as a picnic site) and sporting facilities as the area is prone to flooding.



Lagoon area: potential site for sports centre upgrade and market-day facilities










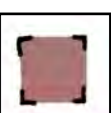
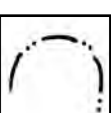


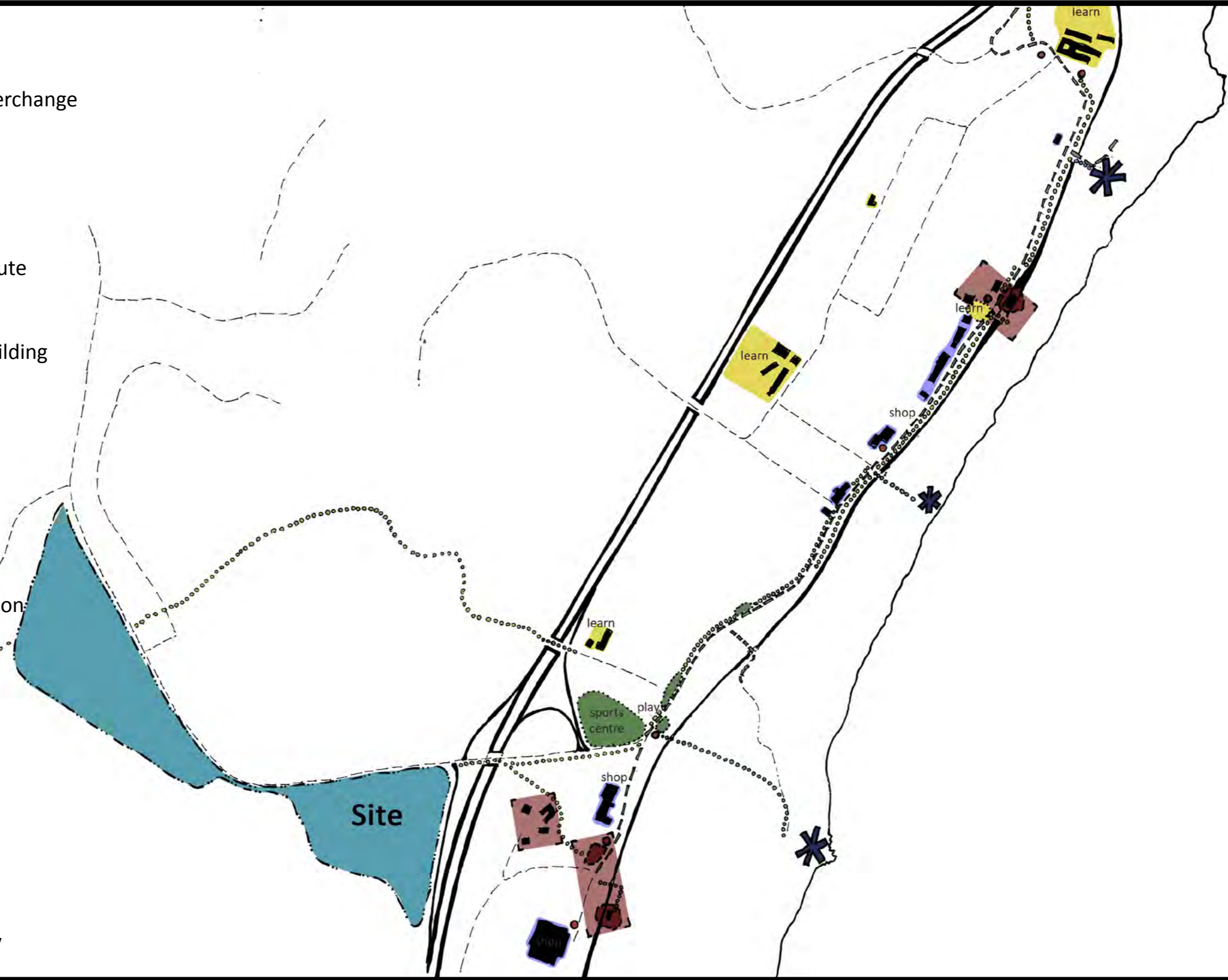
View from future viewing platform at train station

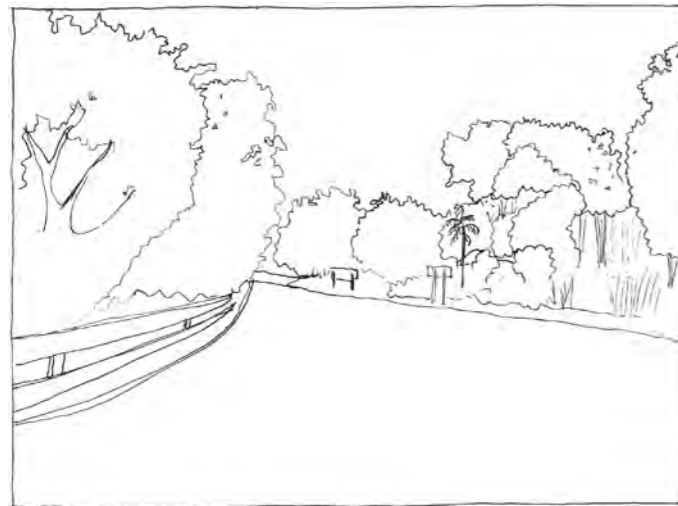


Extension of road to lagoon area

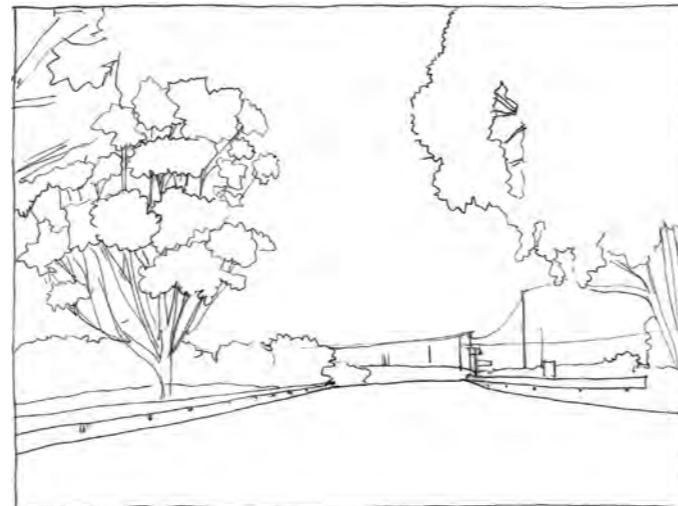
Legend

-  Transport interchange
-  Bus stop
-  Pedestrian route
-  Significant building
-  Major road
-  Minor road
-  Beach attraction
-  Activity spot
-  Barrier
-  Activity node
-  Site boundary

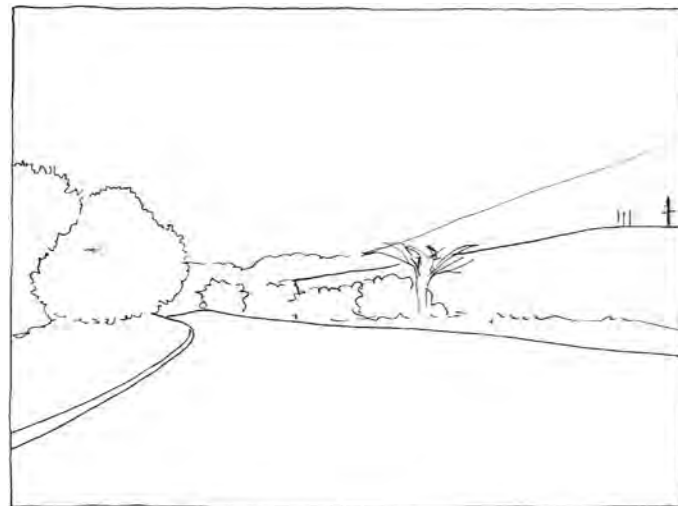
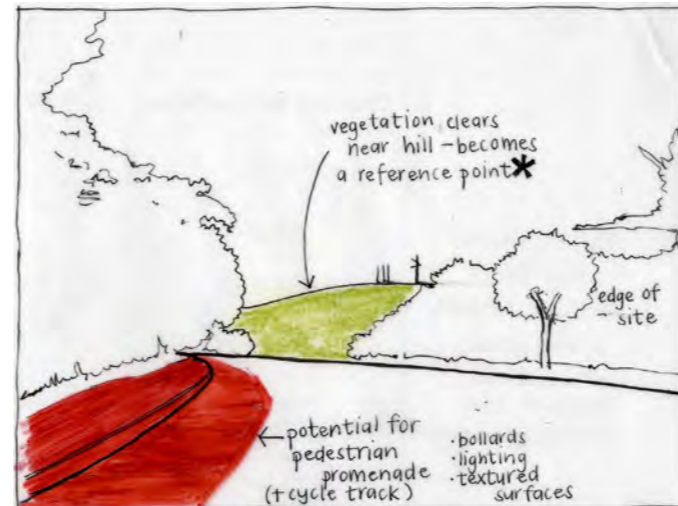




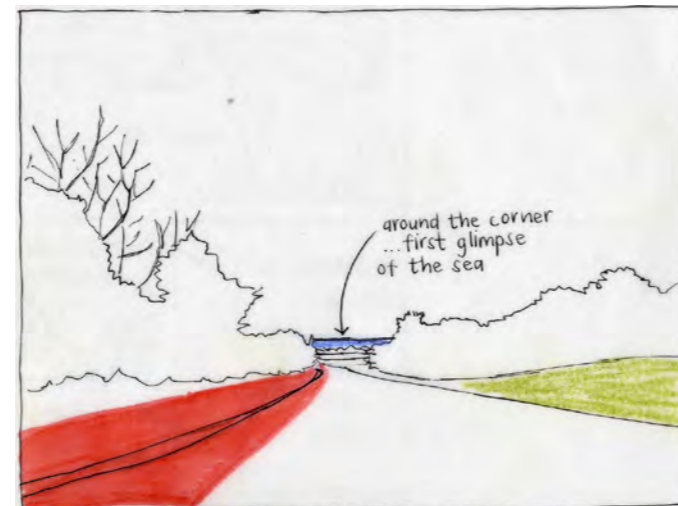
1



2



4



5



6

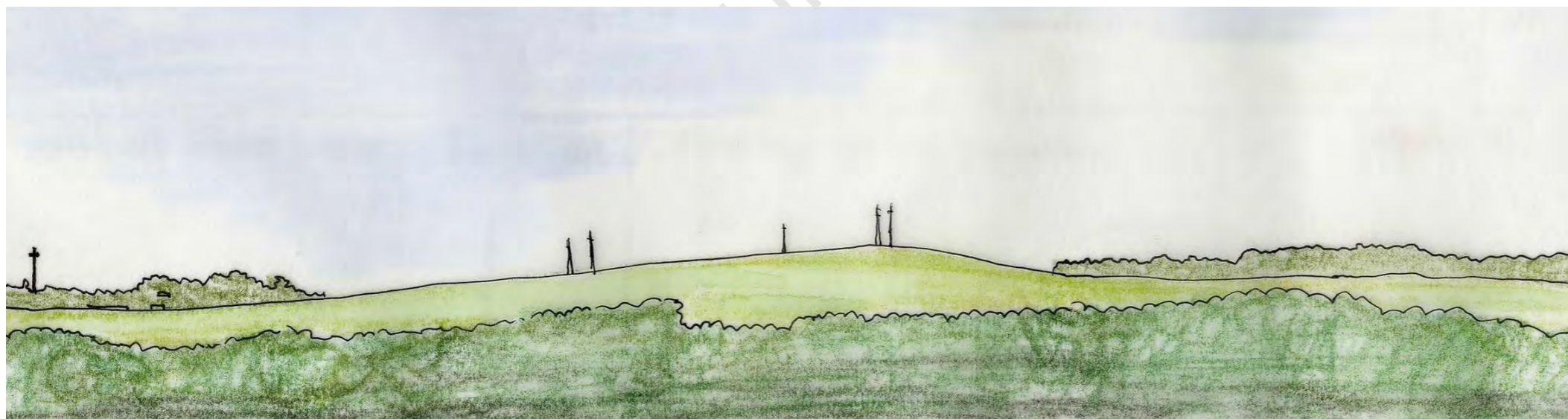


While desktop studies of the site are useful in gaining specific, located data, it is also important to gain a personal understanding of the site.

The collage on the page opposite is a collection of experiences and observations gained while walking around the site and its context.

The site is mostly covered in dense vegetation. Access points are along an existing road (see series of sketches left and key above).

Because the site is bounded in the south by a ridgeline, it is not visible from its surrounding context. The sketch (below, left) is the view from south of the site looking towards the ridgeline. (Very little of the site is visible.)





### Framework design

This masterplan for the area incorporates future ideas for development for Warner Beach and links the site into these activities.







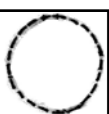



The site (1) is directly connected to the beach (2) via a pedestrian bridge over the railway (3). There is potential for an activity node to develop at this point eg: ice cream sellers, informal trade. Because of the nature of the road that runs beneath the N2 freeway (4) an alternative pedestrian and cycle route has been created that heads north through a residential area (5) passing a park (6) then crosses over the freeway (7) and is finally received by a playgarden (8). While this route is longer, it is more conducive to pedestrians and cyclists and is reinforced by an activity street (9). This street is currently residential but the plan incorporates a change towards activities that will reinforce the route: businesses, shops, cafes, tea rooms. (The section below suggests what this pedestrian route could be like.)

This activity route connects directly to the site (10) and indirectly via a new route through a forest park (11) to the site's other main entry point (12).

The site connects into other activities such as the new sports complex (13) and a new pedestrian and cycle path (14) leads residents to the Warner Beach town hall (15), taxi rank (16) and train station (17).

A series of green open spaces, playgardens and pocket parks (18) are linked via a pedestrian and cycle route (19) and lead to a wetland picnic area within sugar cane farmland (20). While the farmland is privatised, the owners have allowed controlled public access to the existing green open space because it promotes a public awareness of green spaces and is the continuation of a green corridor (one of the aspects vital to habitat creation is continuity).

### Legend

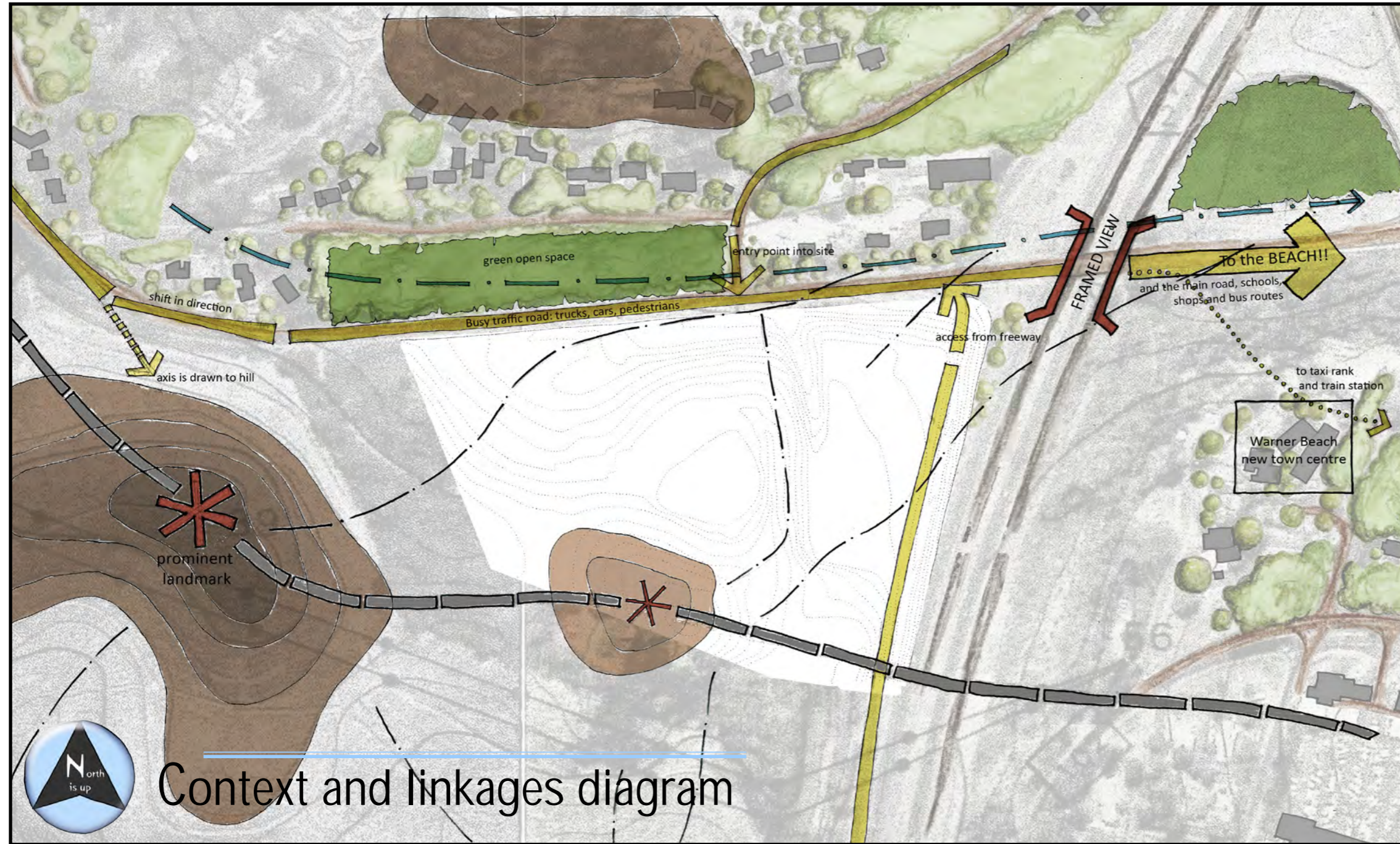
- Barrier (N2 freeway) 
- Green open space 
- Activities along road (shops etc) 
- Barrier (railway) 
- Pedestrian and cycle routes 
- Stream 
- Gateway 
- Drainage line 
- Bridge 
- Node 









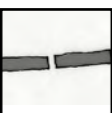
Section A-A

Scale: 1:400





**Legend**

- Main access route from site 
- Primary drainage lines 
- Secondary drainage lines 
- Peaks (topography) 
- Green open space 
- Pedestrian desire lines 
- River basin ridgeline 

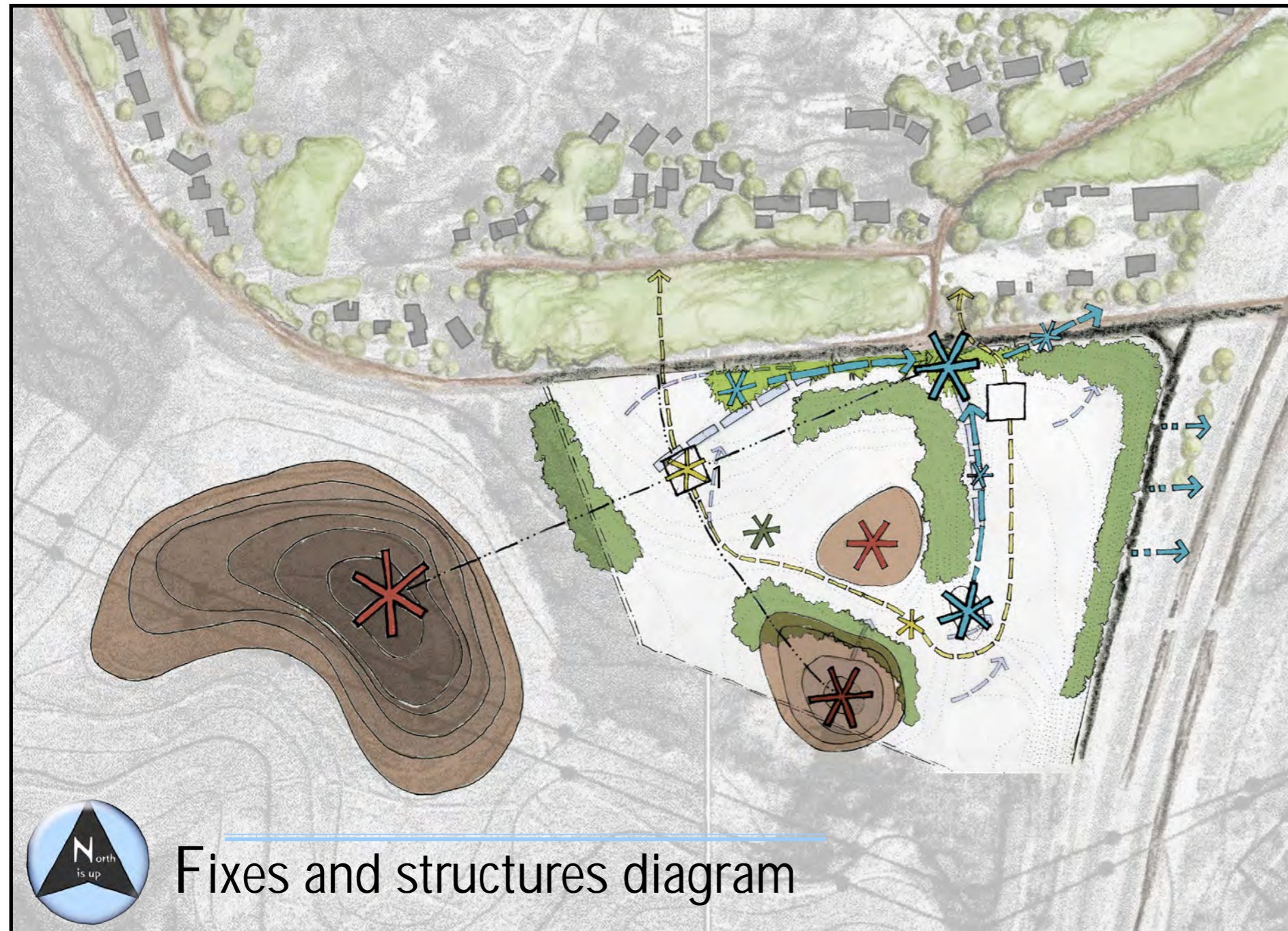
**Context and linkages diagram**

**Context and linkages diagram**




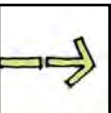



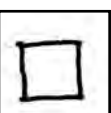

The context of the site is that it is bounded in the north and west by a suburban residential area and in the south by sugar cane fields. To the west lie local activities and nodes (town centre, transport nodes etc).

The site has a good connection to its context - there are movement routes to the beach, shops, public transport nodes, community activities and recreation. There is also a range of movement routes: the site

is 100m away from off/onramps to the N2 freeway, a main road runs past the site's northern boundary and the main road running through Warner Beach that connects it to Amanzimtoti, is 200m away. Therefore, most activities and access routes are well within walking or cycling distance from the site.



Legend

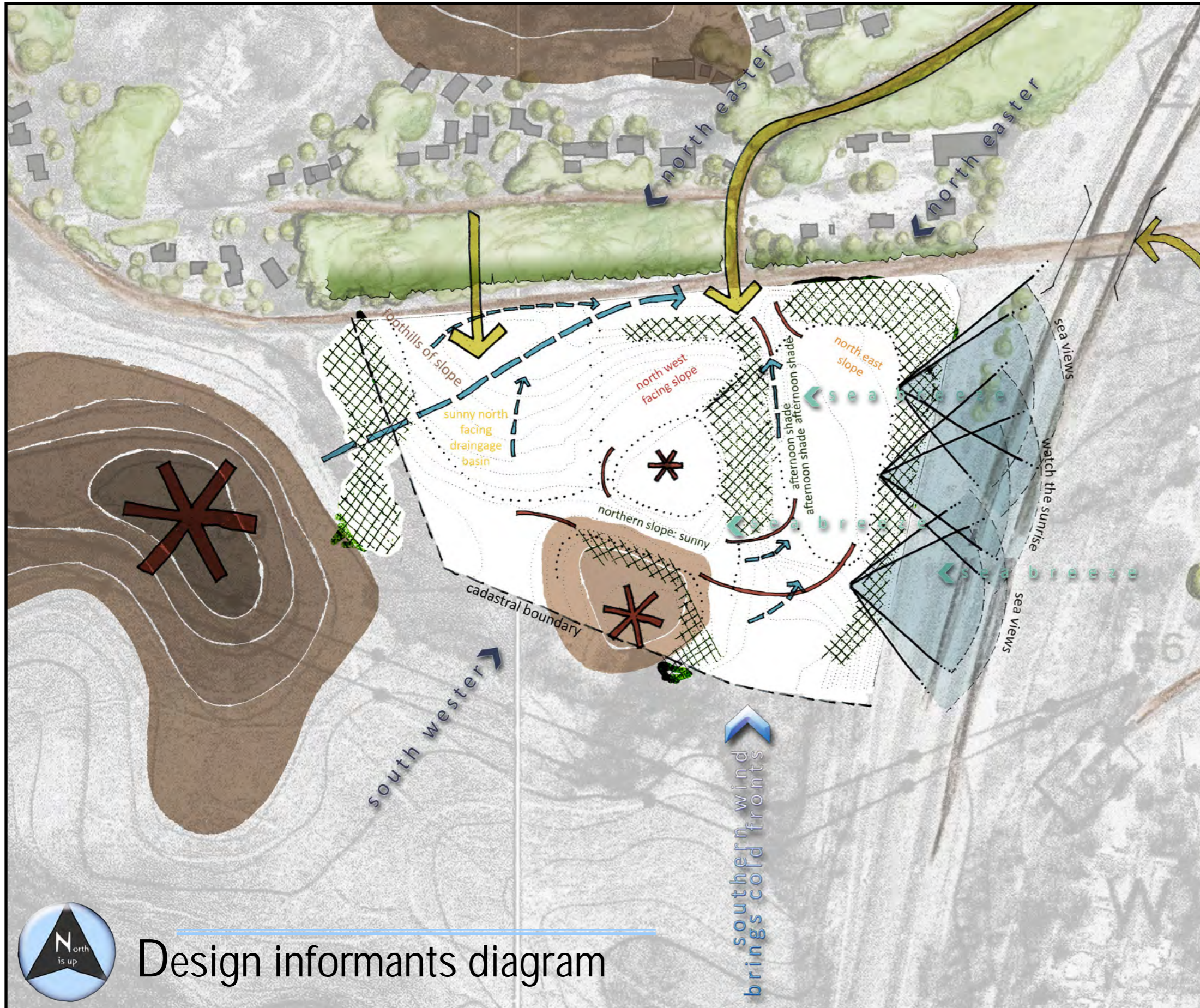
- Roads 
  - Axis lines 
  - Drainage pattern 
  - Primary pedestrian route 
  - Views of the sea 
  - Buffer zones (vegetation) 
  - Wetland 
  - Public squares 
  - Points of interest 
- Peaks Water Urban Green space

Fixes and structures diagram

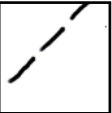
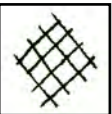





These are the elements that will structure the design. The importance of these elements is determined by the design principles set up:

- connected habitats
- urban areas defined by land use suitability
- reinforce spaces or routes
- create a sense of place

Because of the steep slopes, areas (in green) will be conserved for forests and vegetation. Drainage lines will link wetlands and together with these forested slopes, will begin to form continuous green habitats. The central urban square (1) is reinforced by a route that links the site with its context and is a point where an axis develops from the hill/peak running perpendicular to the contour lines down to the point where water drains off the site. The two smaller peaks within the site will determine a route connecting both halves of the site.



**Legend**

- Cadastral boundary 
- Buffer zone (steep slopes) 
- Gateways 
- Drainage pattern 
- Edges of landscape rooms 
- Peaks (topography) 
- Entrances onto site 

Design informants diagram

## Fitting in a programme

Now that the site has been analysed and design informants have been established, the programme (as defined in the brief) needs to be represented in a spatial form on the site. This step determines the types of relationships and connections between these uses in order to find a suitable arrangement on the site.

## Relationships between land uses

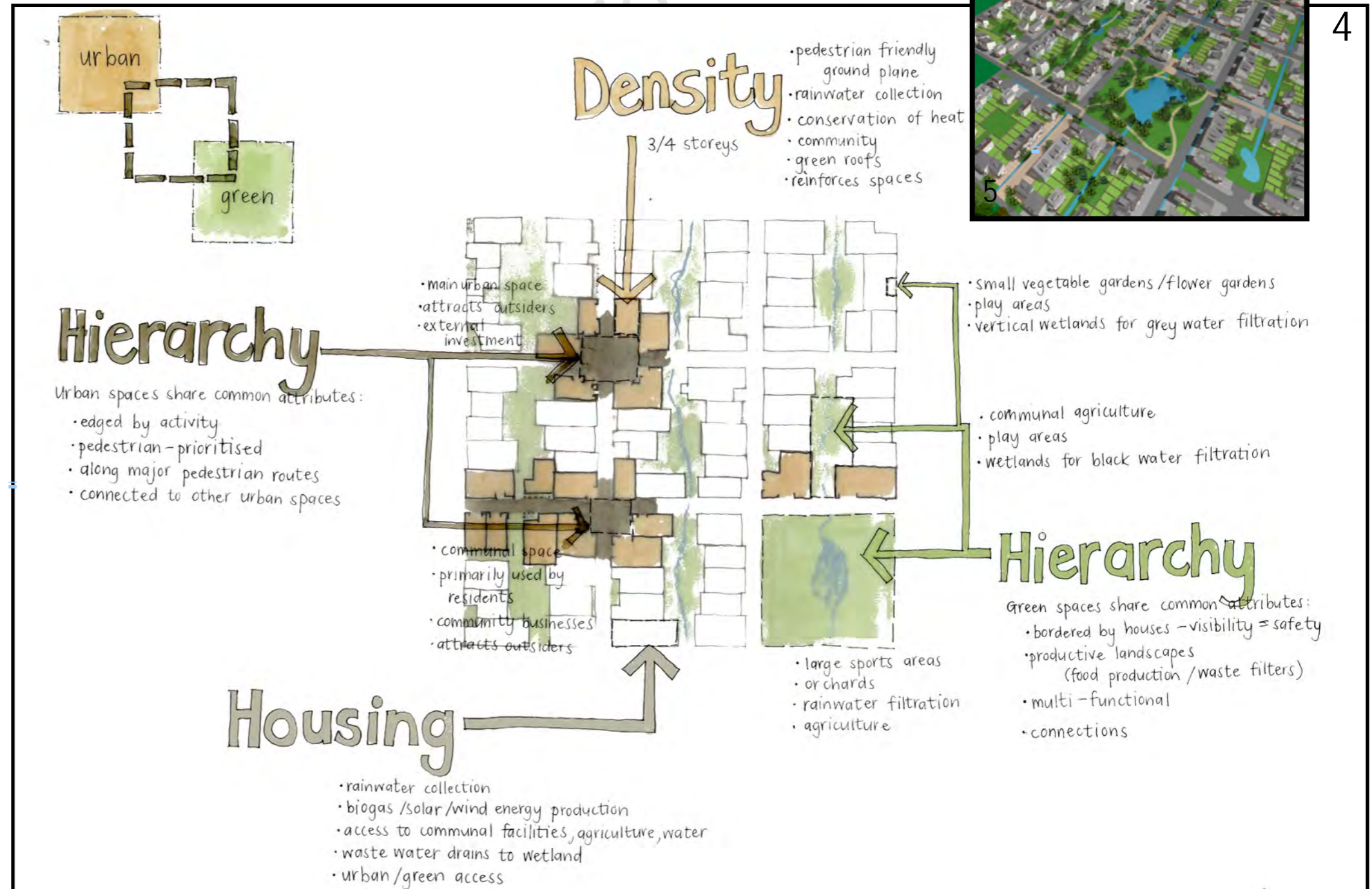
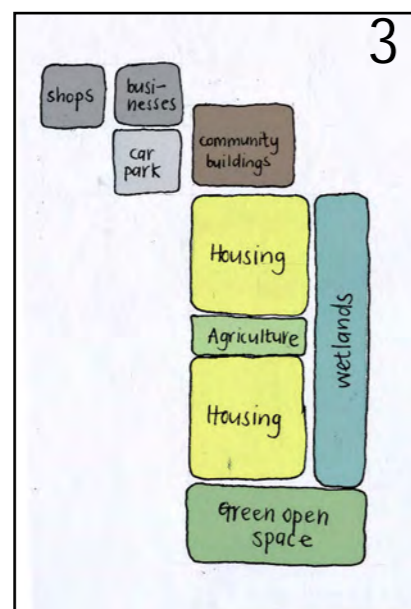
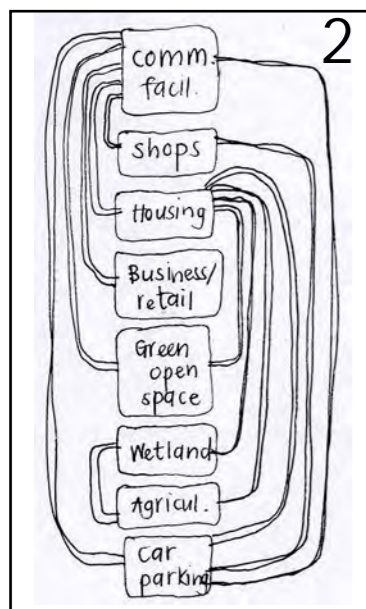
In "Site Planning" Kevin Lynch (1984) describes a method of deriving diagrams to show the relationships between land uses. Diagram 1 is a way of quantifying the need for connections between land uses and diagrams 2 and 3 are evolving a spatial representation of these connections.

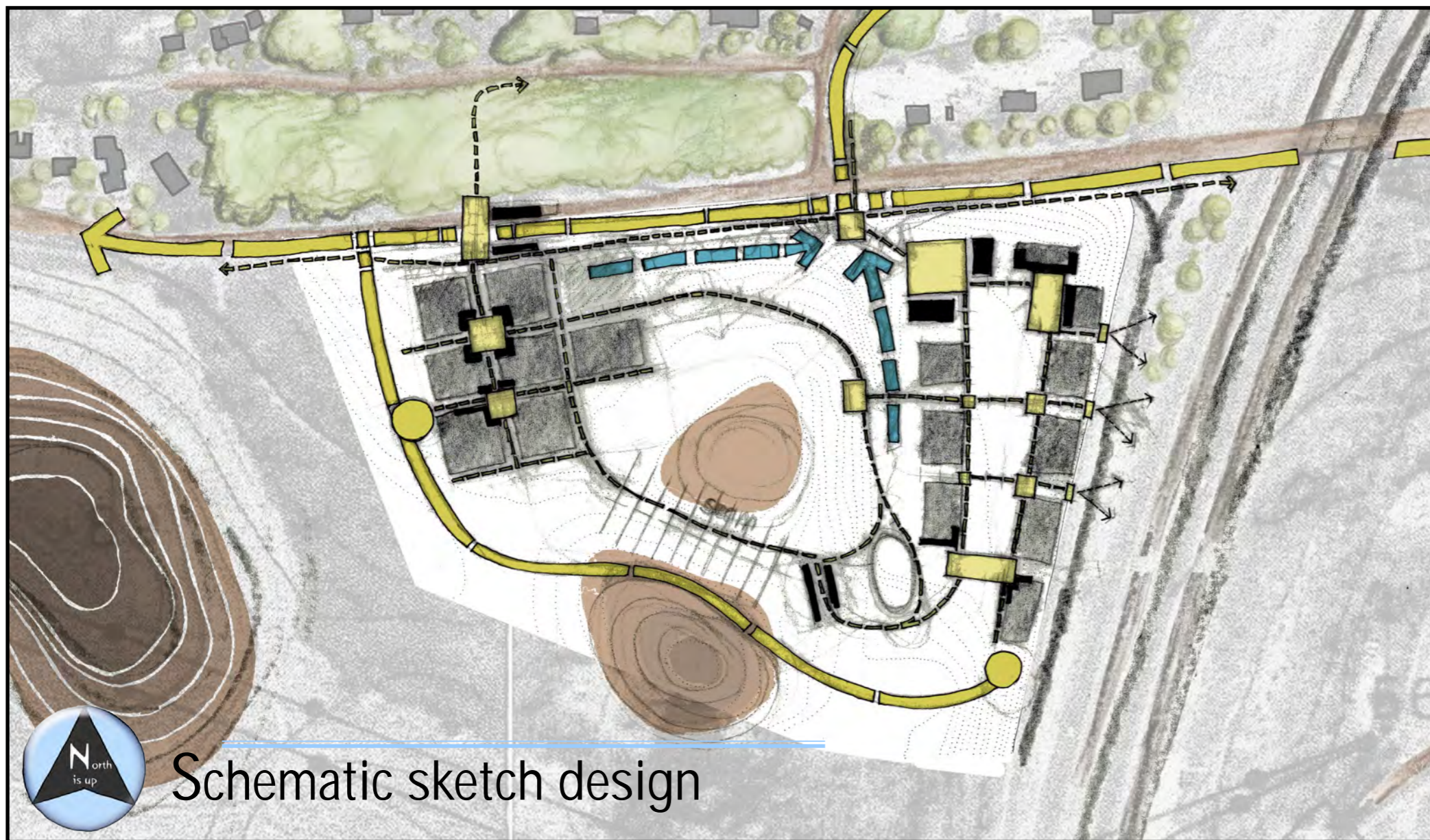
## A spatial urban form

McCormac (2006) documented a study in densities of housing in order to find a mix of housing types and densities combined with green open spaces. This diagram (inset diagram 5) has been analysed (diagram 4) according to the needs and context of this thesis in order to determine a form for a sustainable urban village. (This form will be readjusted according to the topography and drainage.)

1

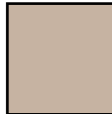









	comm. build.	shops	houses	business/retail	green open space	wetland	agric.	car parking
comm. build.	/	4	1	3	5	6	7	2
shops	4	/	1	2	6	7	5	3
houses	3	6	/	7	4	2	1	5
business/retail	2	1	4	/	5	6	7	3
green open space	4	6	1	7	/	2	3	5
wetland	4	6	1	5	2	/	3	7
agricul.	6	4	2	7	3	1	/	5
car parking	2	4	3	5	6	1	7	/





Schematic sketch design

Legend

- Paving 
- Paving 
- Timber decking 
- Laterite 
- Stone chips 
- Seating surfaces 
- Water 
- Agriculture 
- Hedges and groundcover 
- Grass (lawn) 

**Schematic sketch**

The residential areas have been divided into 2 villages (each with 40 - 50 families) but to prevent separation they are connected by movement routes and a green recreational area that forms a seam between the two villages.

Green buffers are used to shield the eastern village from pollution from the freeway in addition to the primary function of the green buffer zones - soil stabilisation.

The eastern village plays a vital role in terms of agricultural production. Because there is ample flat land on the eastern half of the site, there is a careful balance between optimising land for residences, views and for agri-

culture. The agricultural areas have been located within the settlement for accessibility and visibility (which increases security).

Access onto the site from the existing road coincides with a key drainage point, therefore impact is minimised by down playing the entrance and celebrating the arrival point up the slope at the education centre.

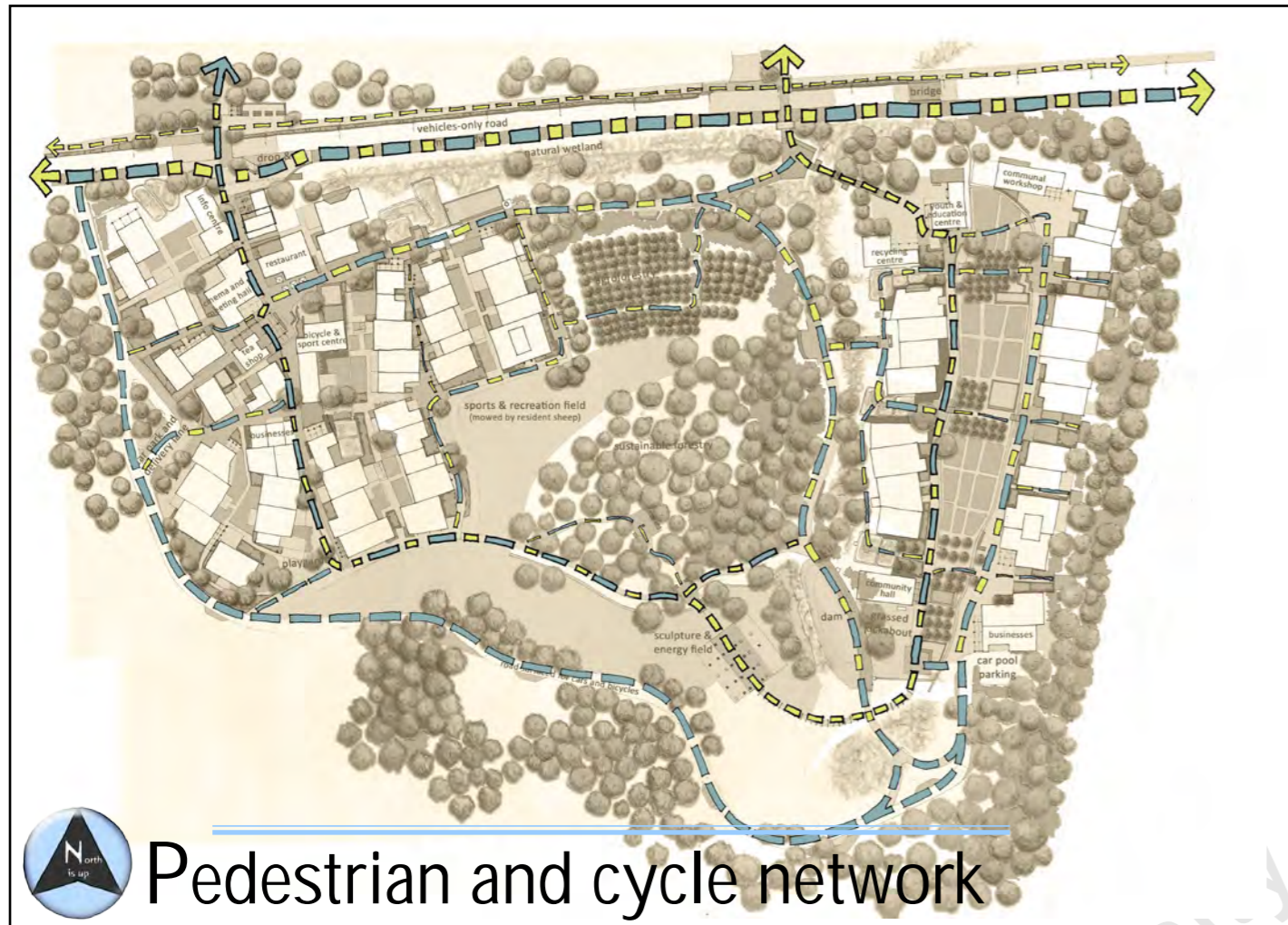
The western village is more urban and dense yet there is provision for green spaces.

The vehicle road is limited by the topography and design principles that discourages car dependency.

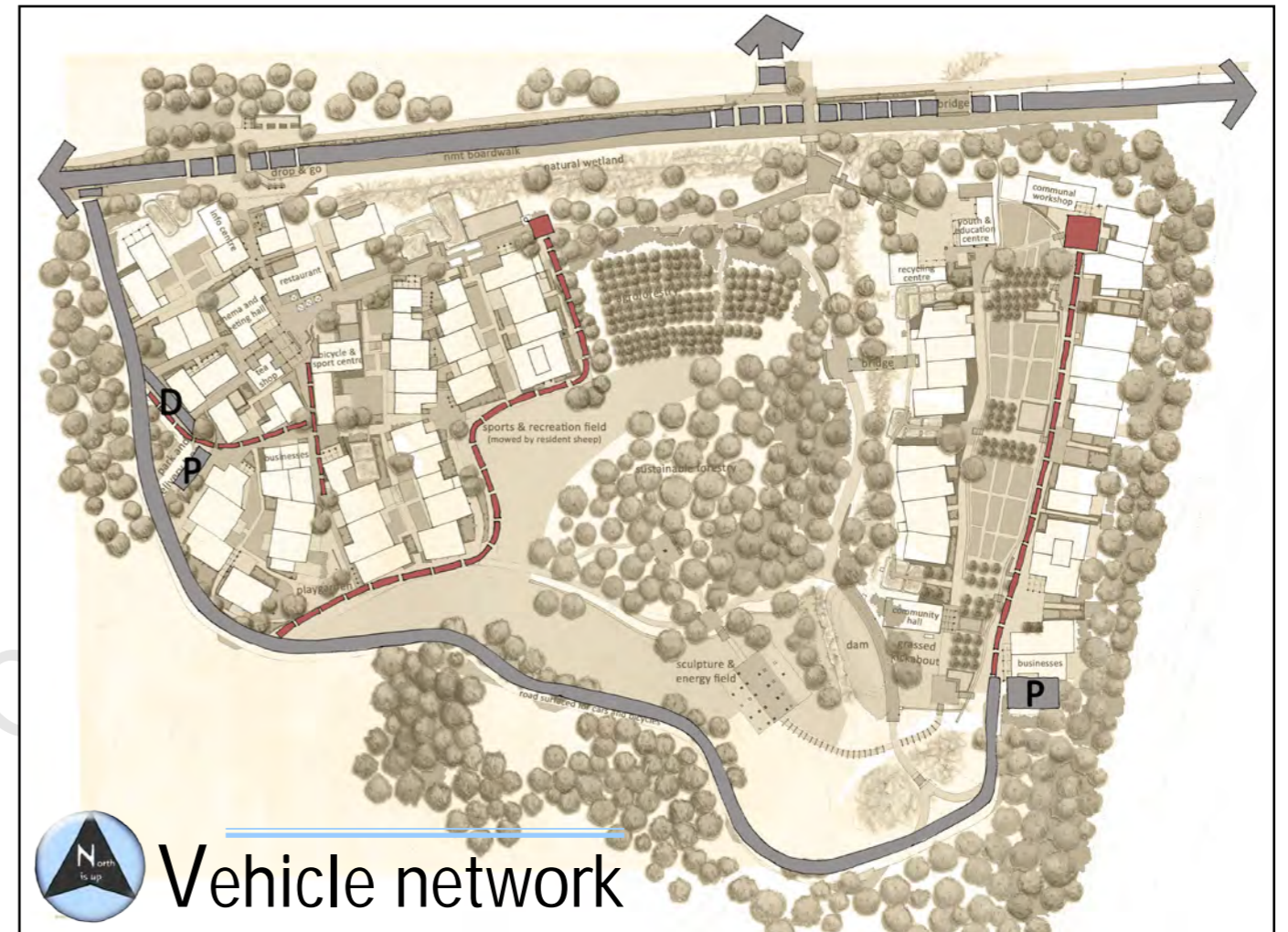


# Sketch plan

Scale: 1:1000





Pedestrian and cycle network



Vehicle network

**Legend**

-  Cycle route hierarchy
-  Pedestrian route hierarchy





**Movement networks**

It is clear that pedestrian and cycle routes dominate the movement routes of the site, while vehicle access is located at the back of the site. Even the main vehicle road to the north of the site is heavily restricted at points where pedestrian and cycle routes cross it.









While cars are limited on the site it is recognised that there will be the need for the occasional car (preferably using a sustainable fuel source!). There are two car parks on the site, ensuring that all buildings are within 150m of a car park - this has made the need to drive to one's front door unnecessary. A delivery and loading zone has been accommodated near the main urban and community squares where there are businesses and restaurants that may require deliveries by vehicle.

While all routes are completely pedestrian-orientated, there are minimum tracks of 3m to allow access for emergency vehicles.

**Legend**








-  Vehicle access
-  Access for emergency vehicles
-  Parking
-  Delivery lane

### Legend

- Green filter**  
Constructed wetland 
- Green filter**  
Natural wetland 
- Buffer zone**  
Noise buffer 
- Productive landscape**  
Agroforestry 
- Food production**  
Fruit orchards 
- Soil stabilisation**  
Hedges and groundcover 
- Food production**  
Agricultural fields 
- Recreation**  
Grass (lawn) 

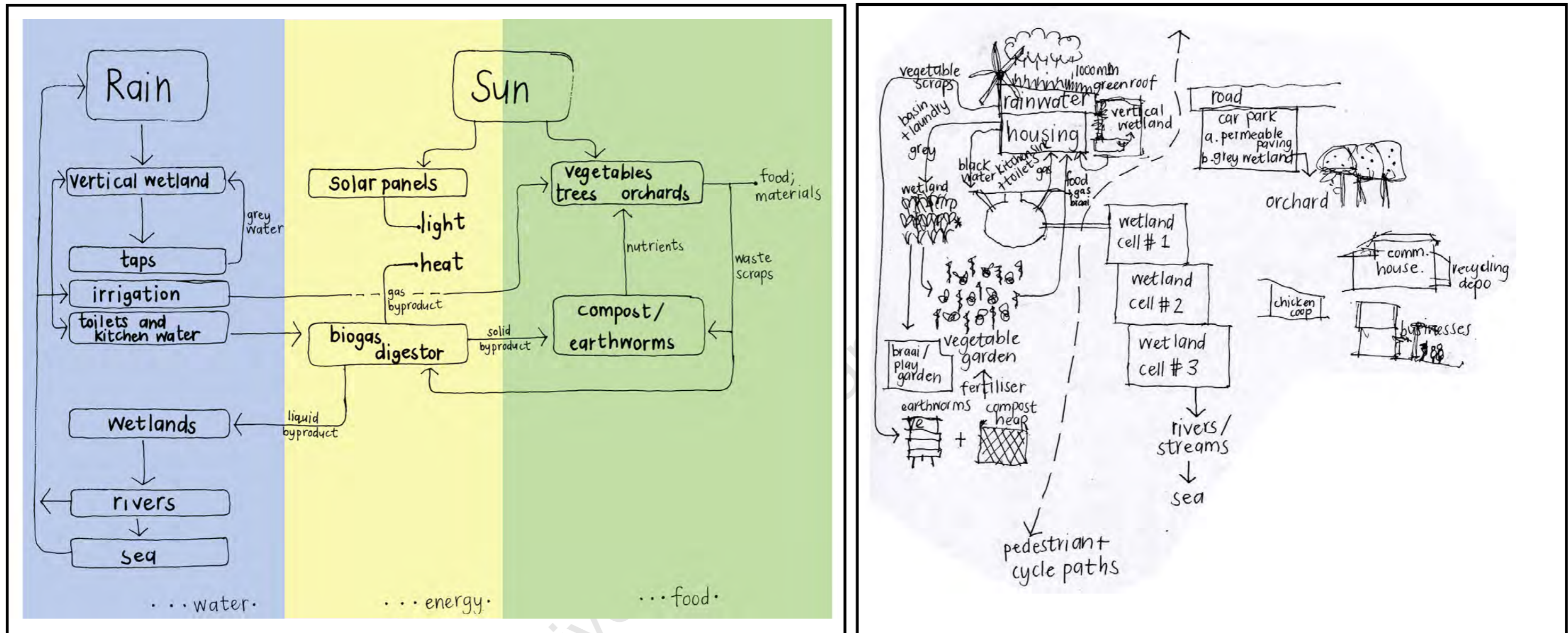


### Legend

- Direction of water flow 
- Water-inspired play area 
- Flow of filtered water 
- Rainwater collection & storage 
- Wetlands 
- Wastewater drains to wetlands 
- Storage and distribution of irrigation water 



 Water system



### The water system

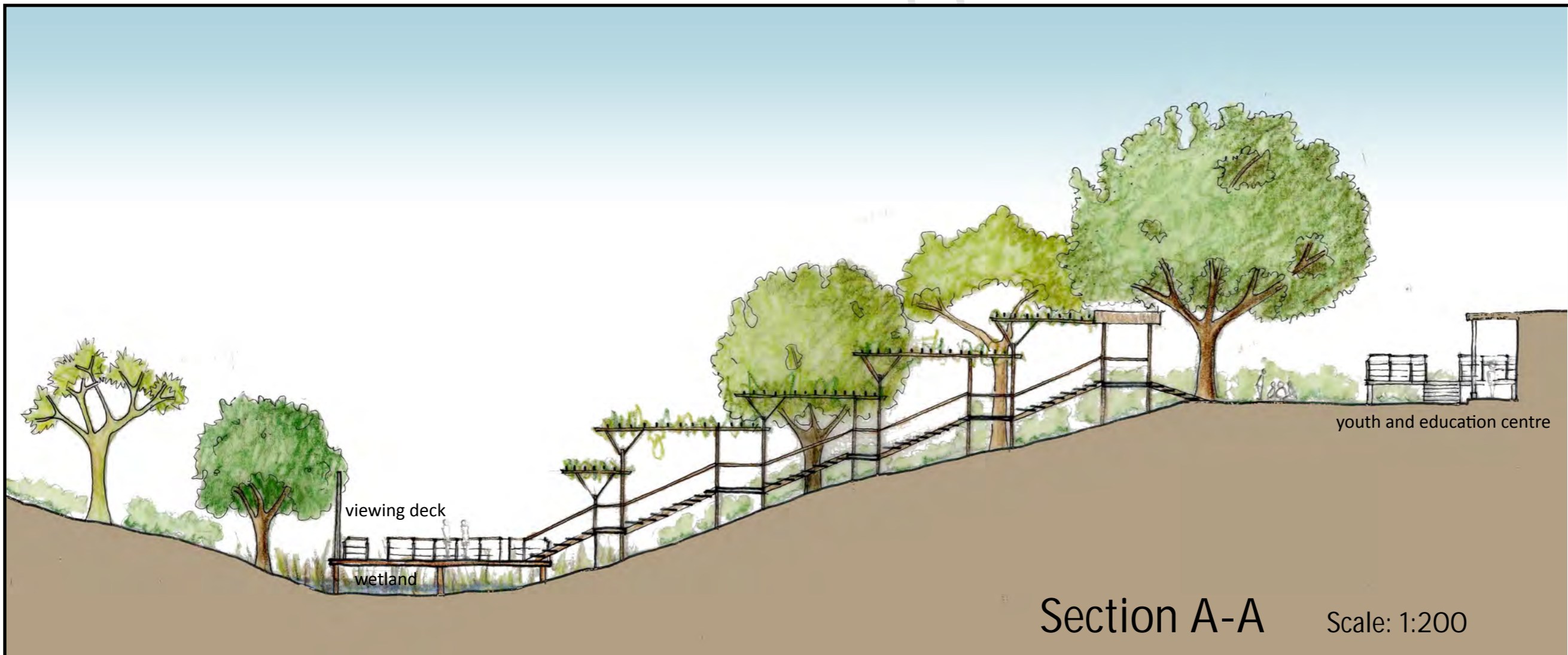
As the above diagram explains, water for households is collected and stored in rainwater tanks. This water is filtered and primarily used for drinking, flushing toilets and washing water and is reused through a grey-water filtration system. If there is an excess supply of rainwater it can be used as irrigation water.

Water from kitchen sinks and toilets is piped to a biogas digester that generates biogas that is piped back to the kitchen for use in the gas stoves. (As mentioned above, water from the shower and basins can be refiltered in a grey water vertical wetland). The biogas digestors remove 70-90% of the pathogens in the waste water before the water is piped to constructed wetlands where microbes and plants break down and remove the remaining

toxins in the water. This water can be pumped back into reservoirs for use as irrigation water or it can be allowed to flow its natural course through indigenous wetland areas.

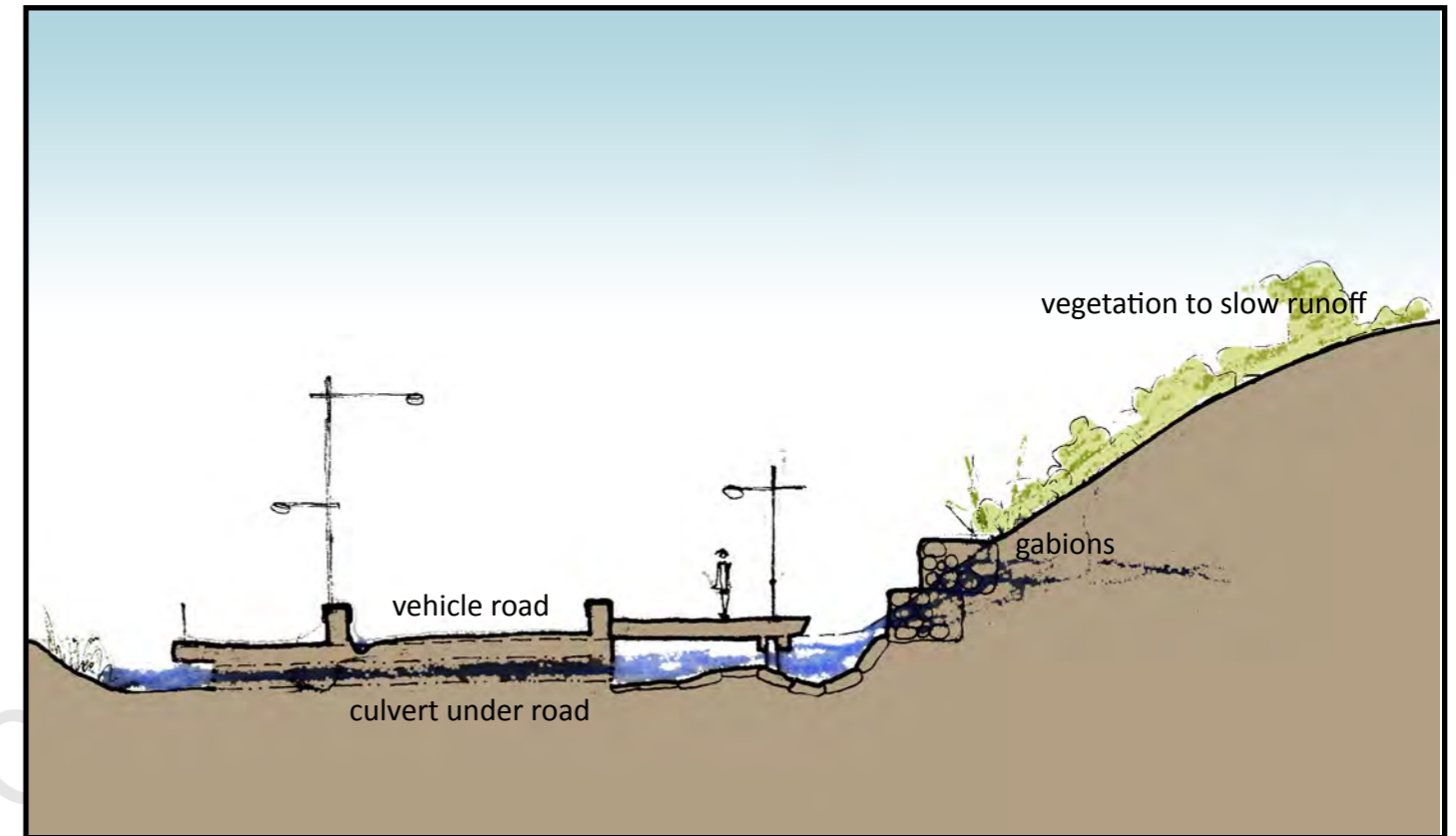
Because wetlands are used as filtration systems, water from storms may flush out the waste water before it has been adequately filtered. Therefore, stormwater is collected and stored in dams and reservoirs and slowly released or used as irrigation water (and therefore filters back into the ground). Green buffers on steep slopes also serve to slow down storm water runoff which allows more time for the water to infiltrate the soil and increases the lag on peak streamflows after storms.

# Entrances



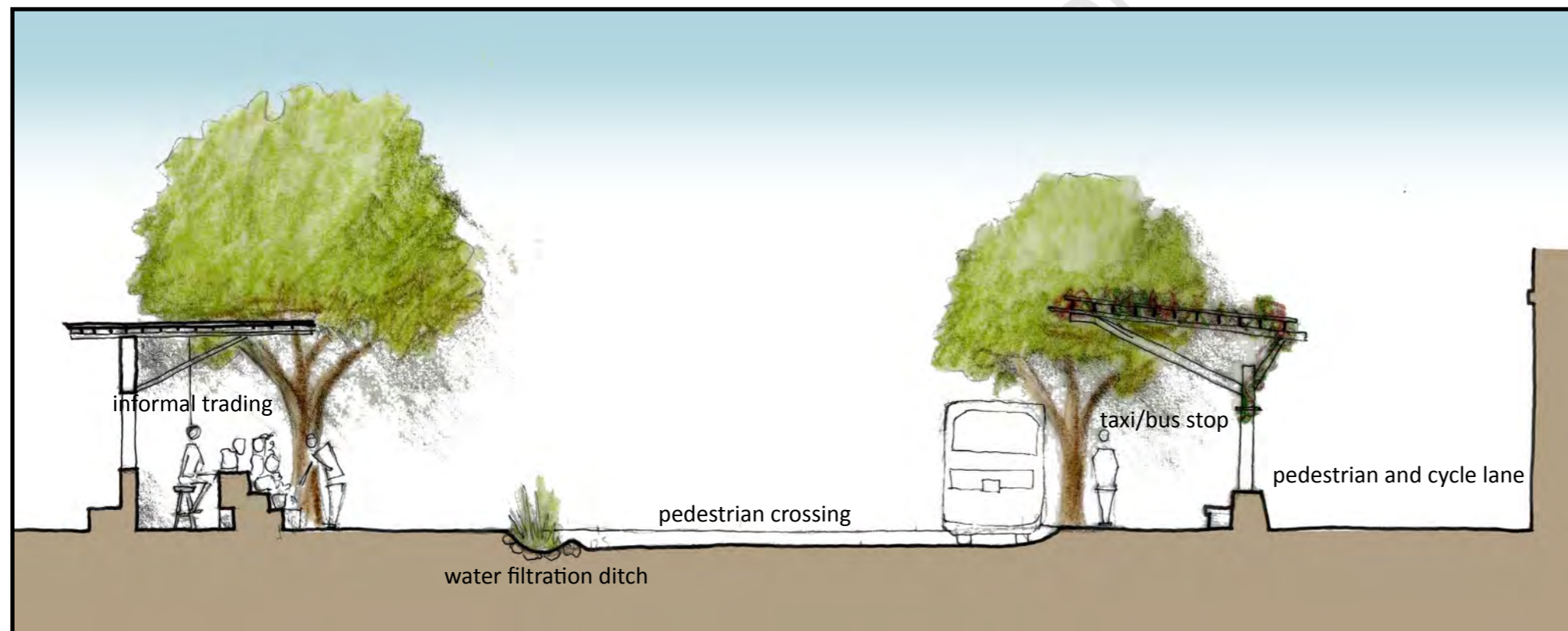
Section A-A

Scale: 1:200



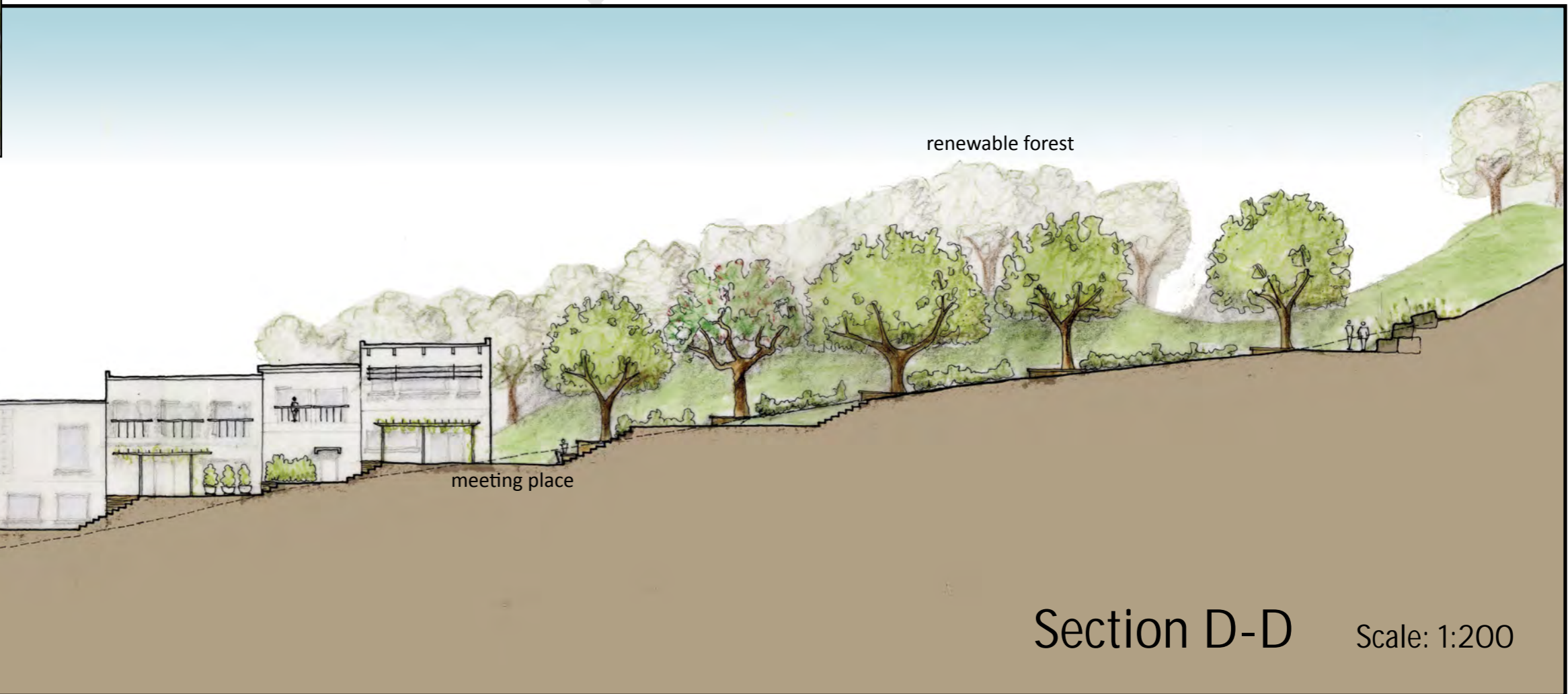
Section B-B

Scale: 1:200



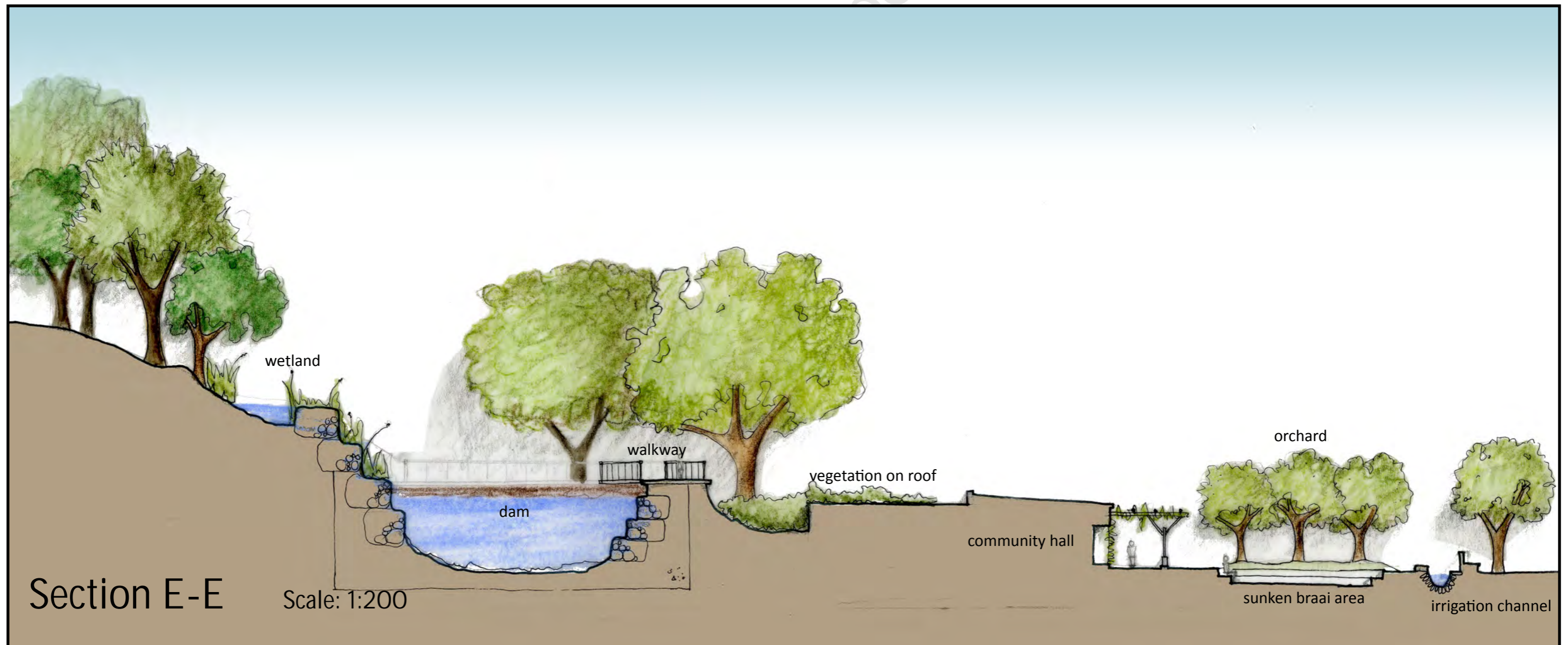
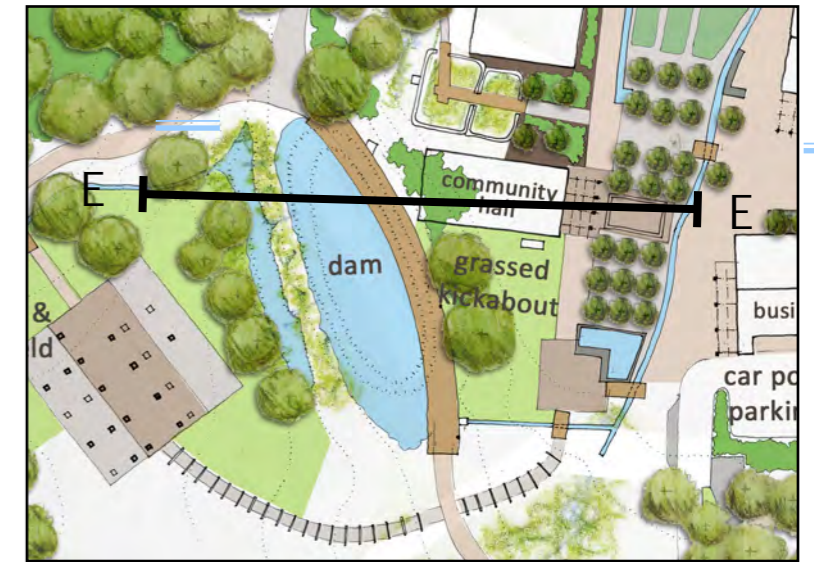
Section C-C

Scale: 1:100



Section D-D

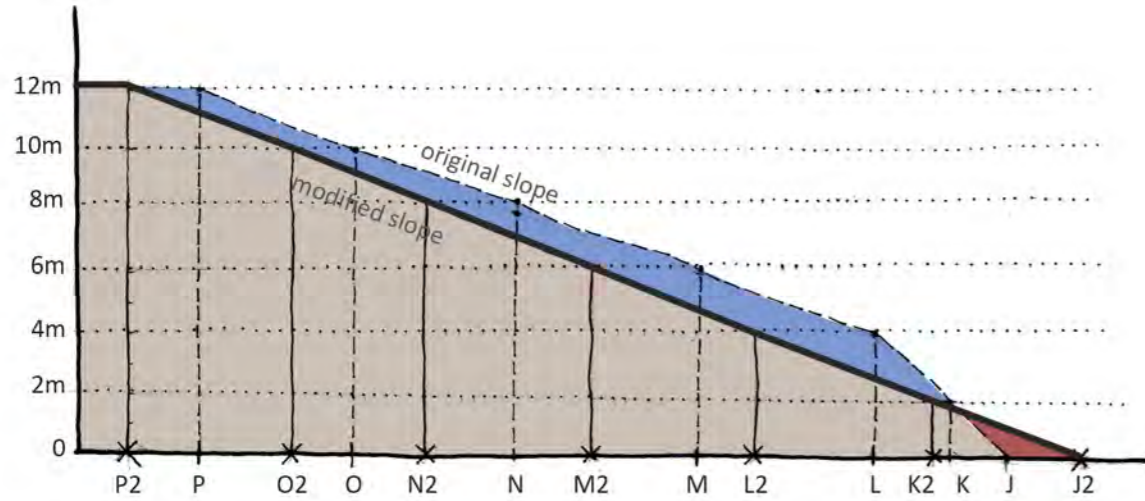
Scale: 1:200



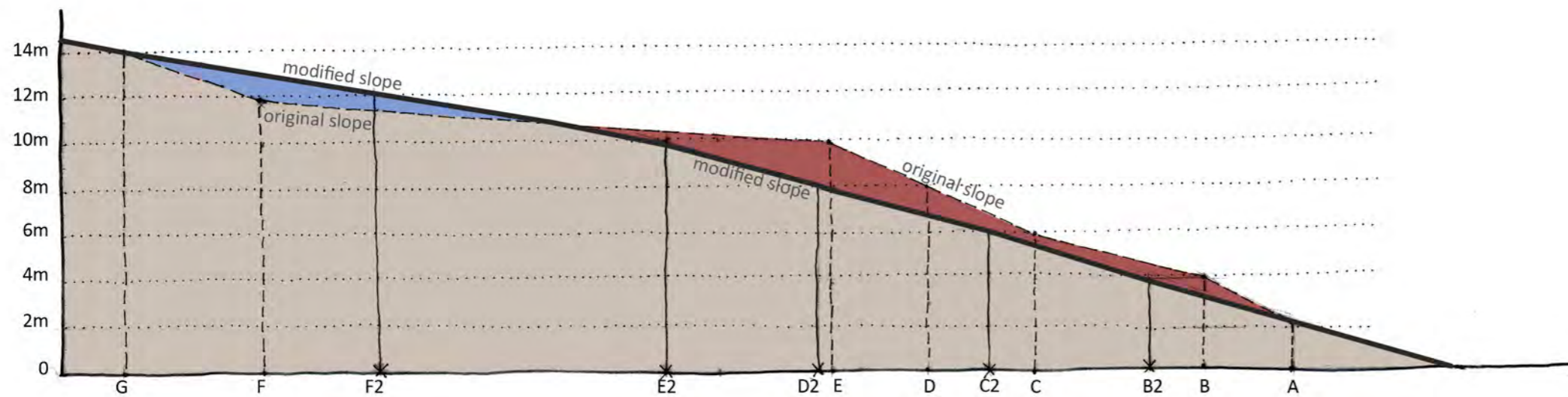
Section E-E

Scale: 1:200

# Earthworks/grading






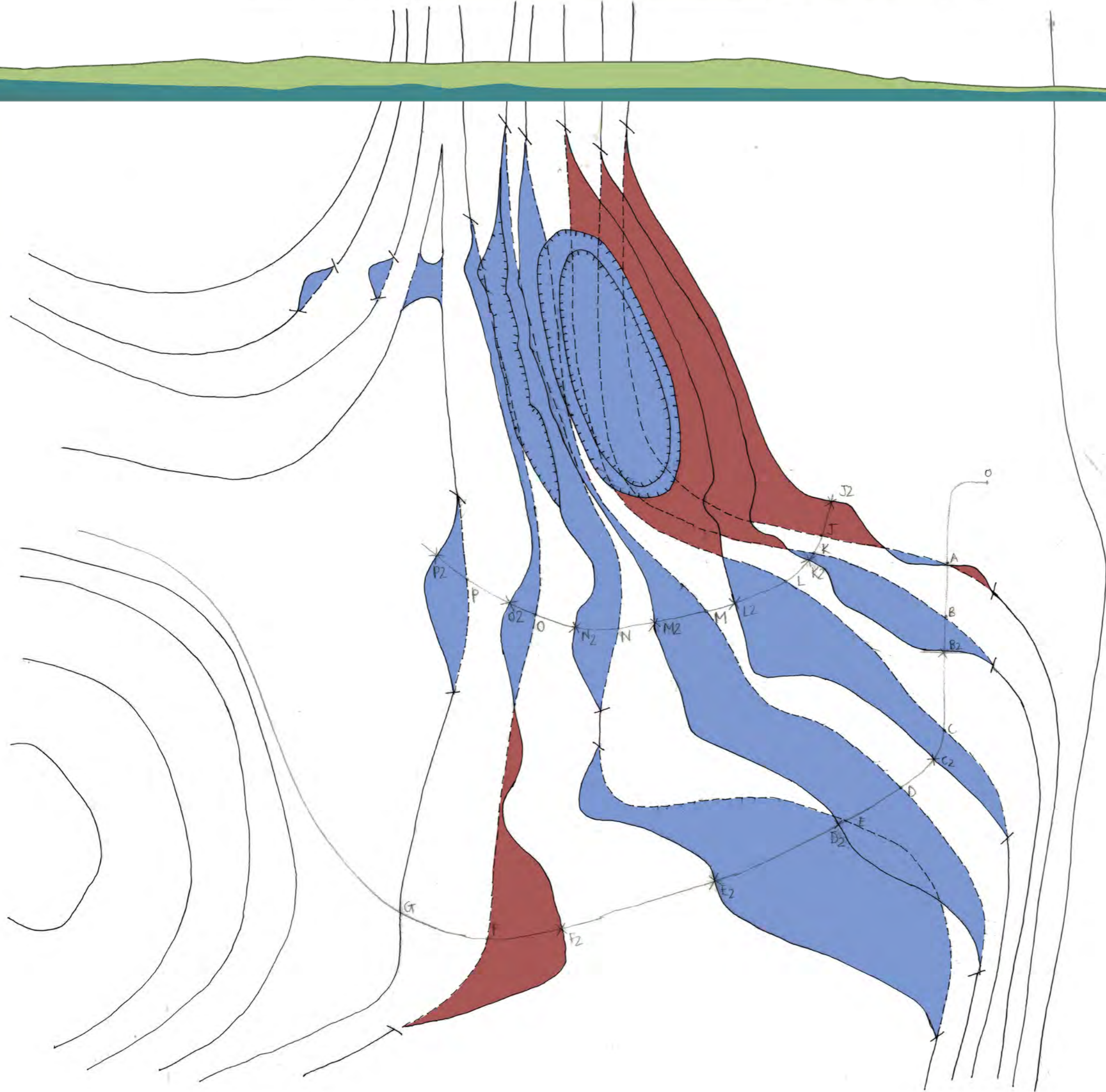
Section through pedestrian walkway Scale: 1:200  
vertical exaggeration x2



Section through road Scale: 1:200  
vertical exaggeration x2

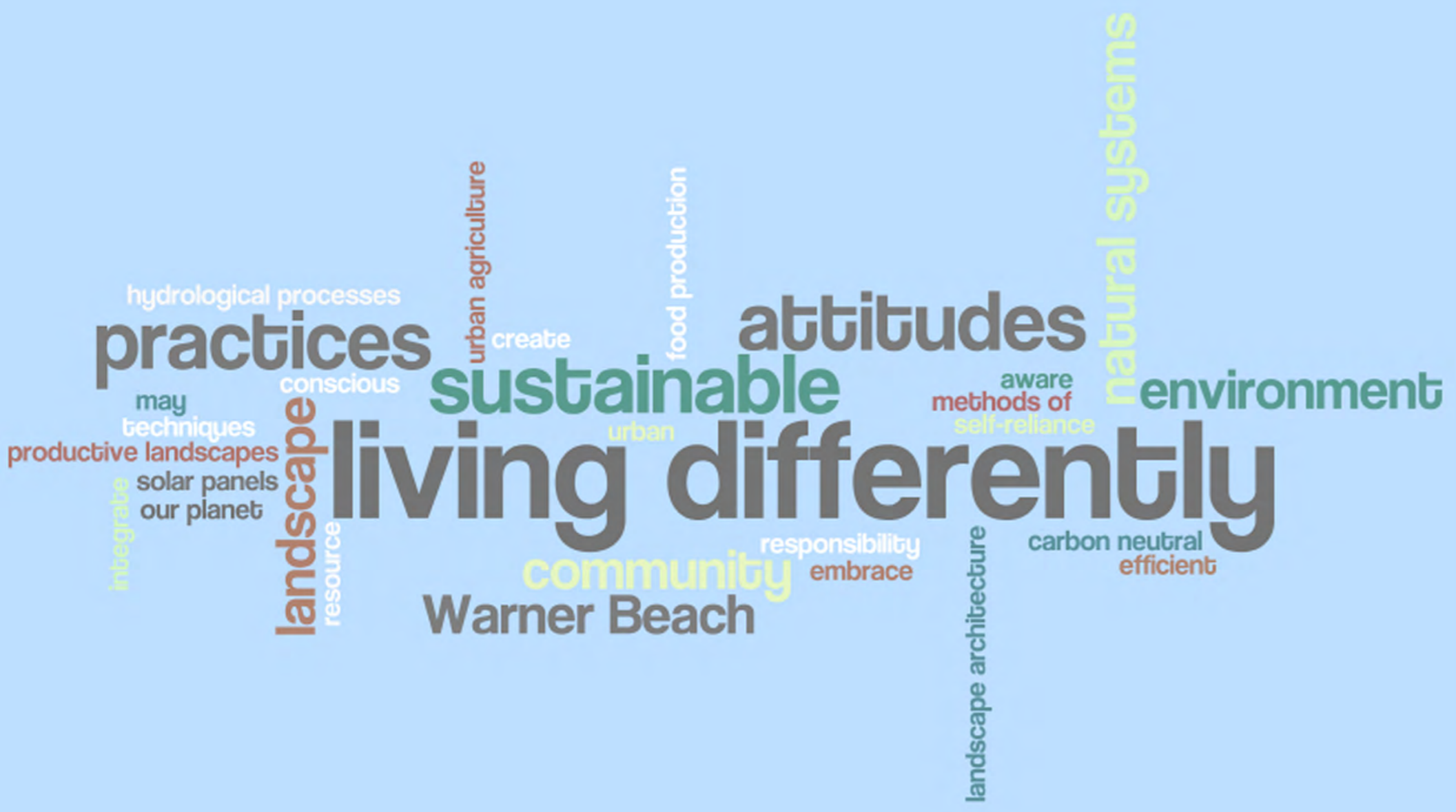
## Legend

- Contour steps down 
- Fill 
- Cut 





90



# Contents

Topic and introduction

Literature review

Design principles

River basin analysis

Site selection

Site design











➔ Precinct design

Construction details

Conclusion



**Legend**

- Paving 
- Paving 
- Timber decking 
- Laterite 
- Stone chips 
- Seating surfaces 
- Water 
- Agriculture 
- Hedges and groundcover 
- Grass (lawn) 

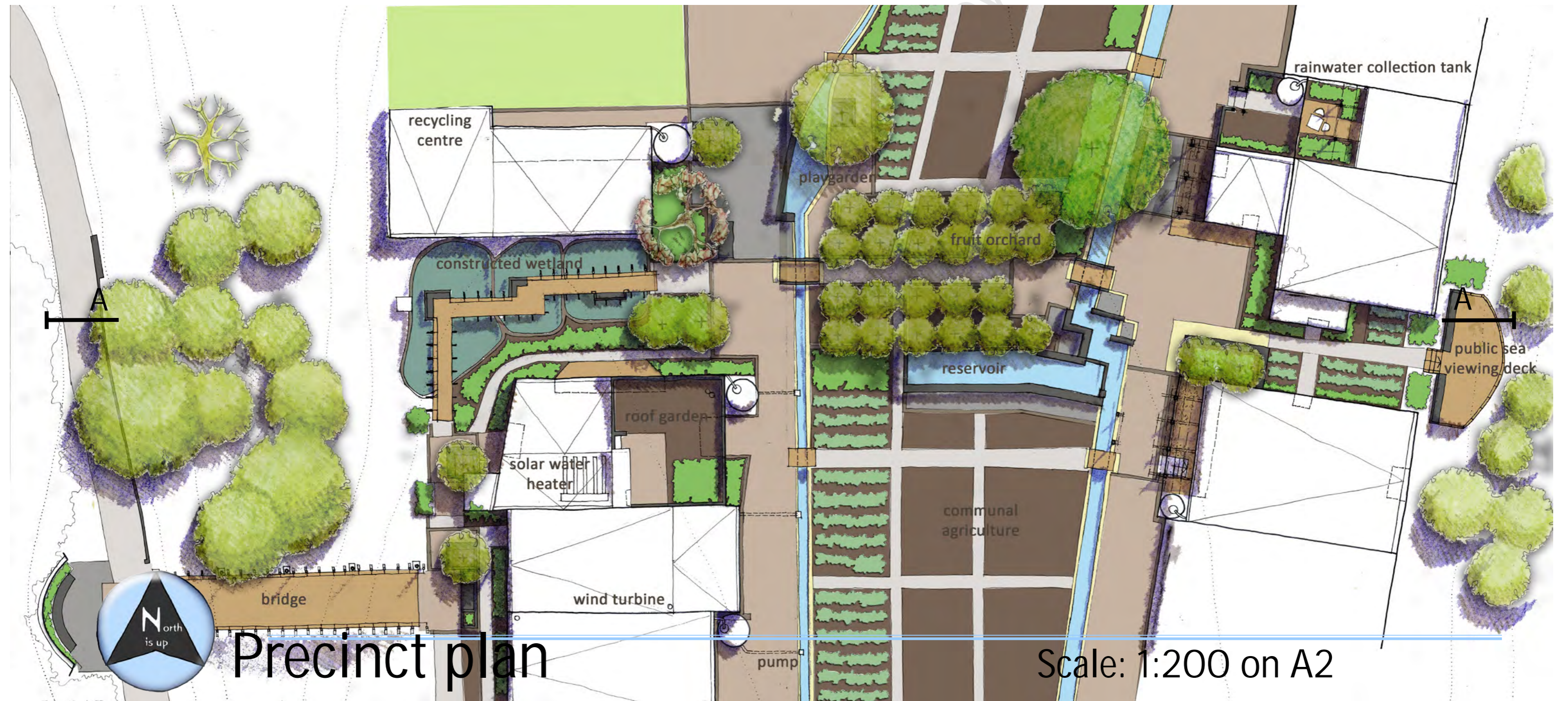
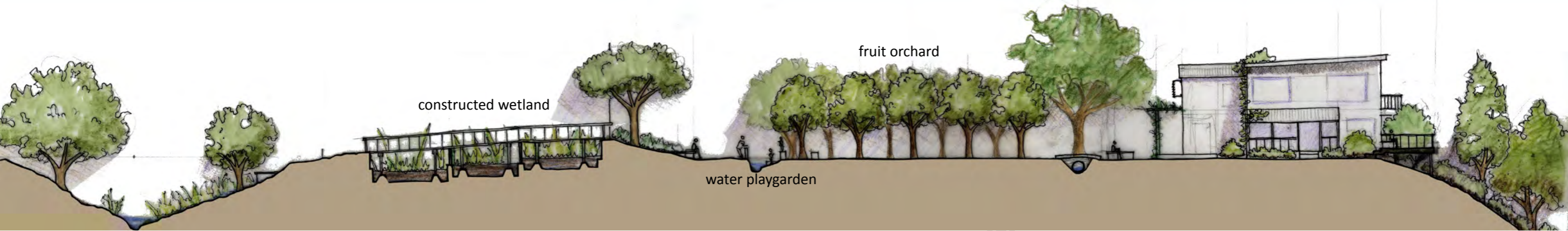


Section A-A

Scale: 1:100

# Section A-A

Scale: 1:200



# Precinct plan

Scale: 1:200 on A2



# Contents

Topic and introduction

Literature review

Design principles

River basin analysis

Site selection

Site design








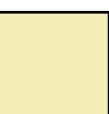


Precinct design

 Construction details

Conclusion



## Legend

Baked clay bricks	
Stone cobbles (edging)	
Timber decking	
Laterite	
Stone chips (seating areas)	
Seating surfaces	
Water	
Stone edging (irrigation)	
Wetland surface	
Grass (lawn)	

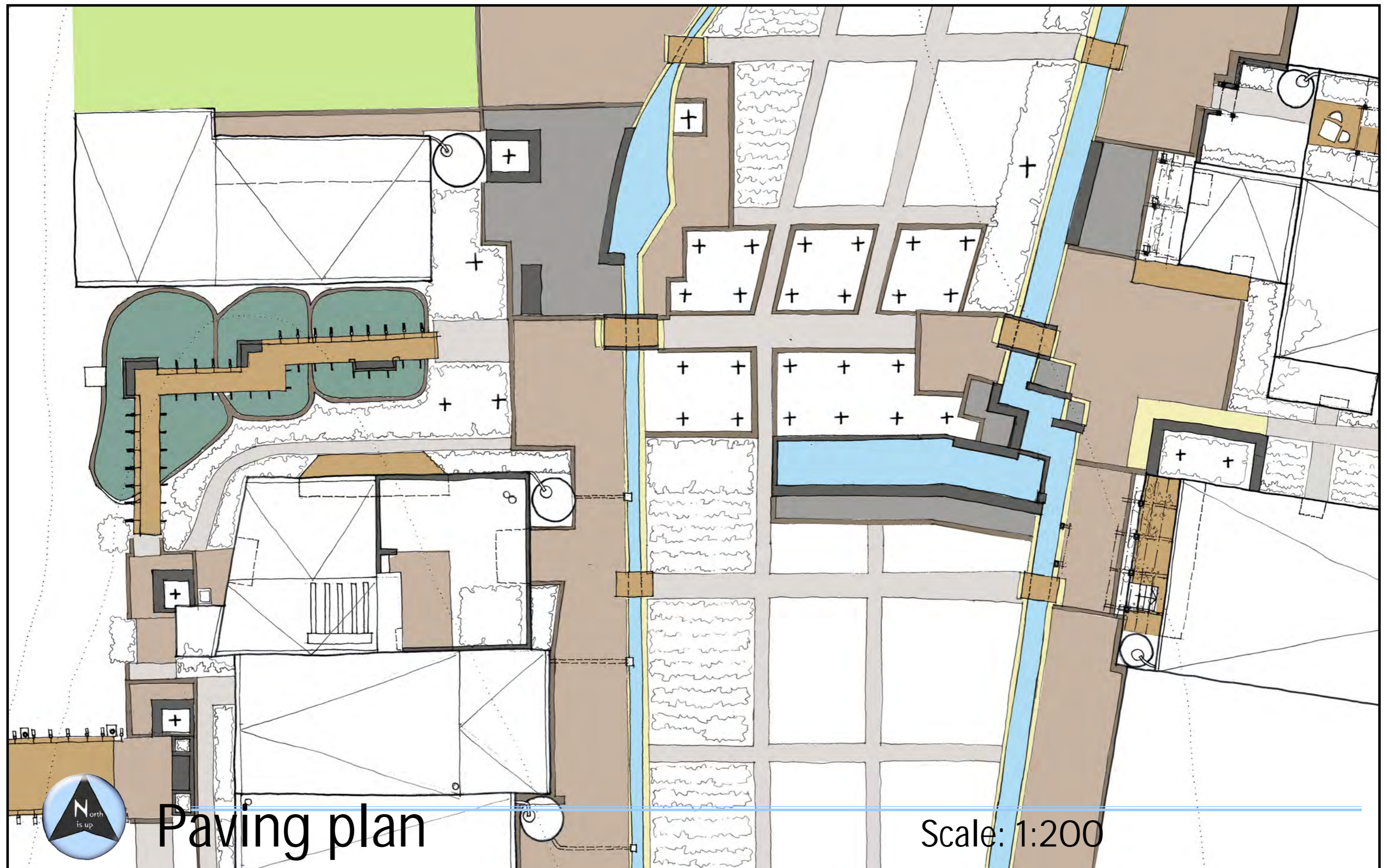
### Materials

In the spirit of sustainability, concrete is limited to foundations and footings.

Bricks and pavers are made onsite: there are colluvial clays that can be moulded and baked and sandstone cut for stone pavers.

Before siteworks begins, the site will be cleared of alien vegetation, which can be treated and used as timber once construction begins. Planted renewable forests can be selectively harvested for additional timber requirements for decking etc.

University of Cape Town



Paving plan

Scale: 1:200



### 1. Site cleared of alien vegetation

Most of the site is covered by alien vegetation, specifically *Chromolaena odorata*, *Lantana camara*, *Melia azedarach* and *Solanum mauritianum*. Alien vegetation must be removed under the guidance of a competent botanist.

### 2. Planting concept

(see diagram, right)

### 3. Suggested species lists

#### Trees

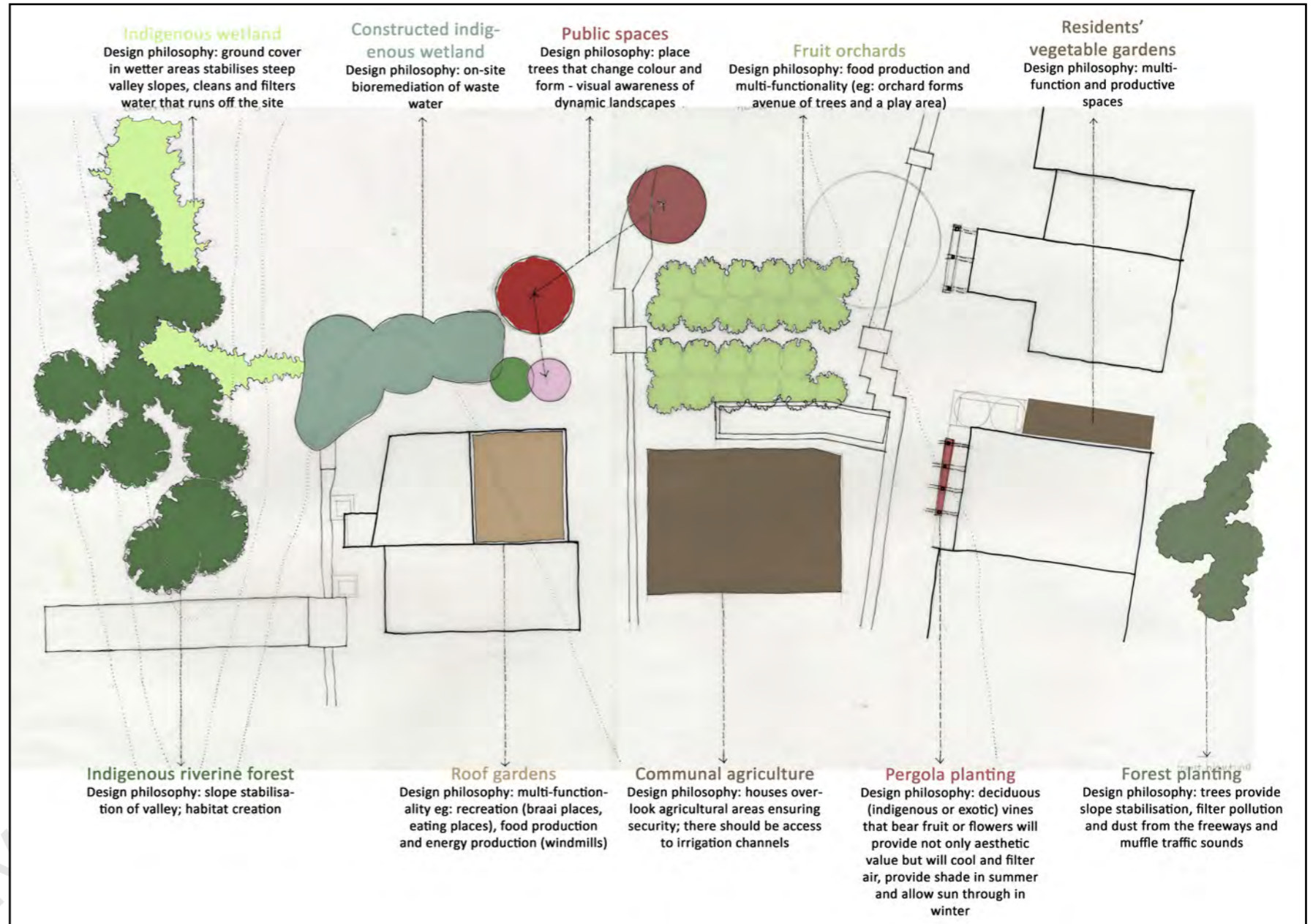
- Acacia xanthophloea* (riverine, striking green of bark)
- Albizia adianthifolia* (coastal tree)
- Anastrebe integririma* (ravine forest)
- Brachylaena discolor* (coastal tree, silvery colour of underside of leaves)
- Bridelia micrantha* (riverine, edible fruit)
- Calodendrum capense* (coastal, pink flowers in summer)
- Clusia pulchella* (red/orange colour in autumn)
- Dais cotinifolia* (sweetly scented mauvish flowers in early summer)
- Erythrina lysistemon* (scarlet flowers, deciduous)
- Ficus natalensis* (shade tree/indaba tree)
- Loxostylis alata* (red panicles)
- Syzigium cordatum* (riverine)

- Tibouchina granulosa* (Exotic: but pink and purple in spring and autumn and is a well known tree in Durban)
- Trichilia emetica* (good shade tree)

#### Fruit trees

These are all exotic but they are suited to Durban's tropical climate and produce fruit.

- Anacardium occidentale* (cashew nut)
- Carica papaya* (papaw)
- Carya illinoensis* (pecan nut)
- Cyphomandra betacea* (tree tomato)
- Litchi chinensis* (litchi)
- Musa x paradisiaca* (banana)
- Persea americana* (avocado)
- Macadamia ternifolia* (macadamia)
- Mangifera indica* (mango)
- Prunus persica* (nectarine)
- Psidium guajava* (guava)
- Pyrus communis* (pear)



#### Shrubs/hedges

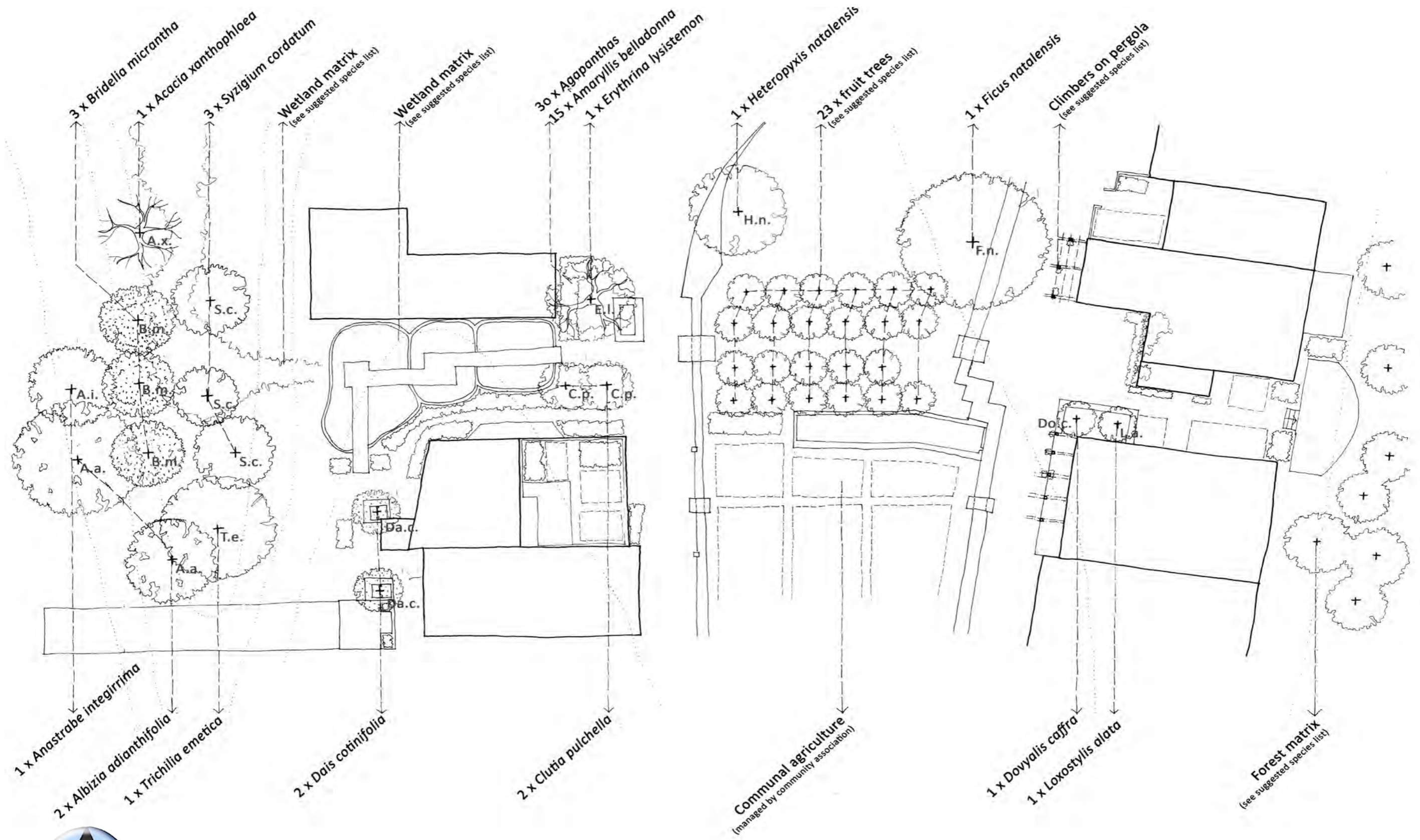
- Agapanthas*
- Dovyalis caffra* (good hedge plant, edible fruit)
- Hibiscus pedunculatus*
- Morus nigra* (Exotic, mulberry)
- Physalis peruviana* (Exotic, gooseberry)
- Plumbago auriculata* (evergreen hedge, flowers in summer)
- Strelitzia nicolai*

#### Climbers

- Actinidia deliciosa* (Exotic, kiwi fruit)
- Bougainvillea x buttiana* (Exotic but colourful)
- Jasminum multipartitum* (indigenous evergreen)
- Passiflora edulis* (granadilla)
- Podranea brycei* (Zimbabwe, trumpet-shaped pink flowers)
- Senecio tamoides* (canary creeper, cascades of bright yellow daisy-like flowers)

#### Wetland species

- Clivia miniata*
- Crinum campanulatum*
- Cyperus proflifer*
- Iris laevigata*
- Schizostylis coccinea*
- Salix mucronata*
- Wachendorfia thyrsiflora*
- Watsonia aletroides*
- Zantedeschia aethiopica*



# Planting plan

Scale: 1:200



Cape Town



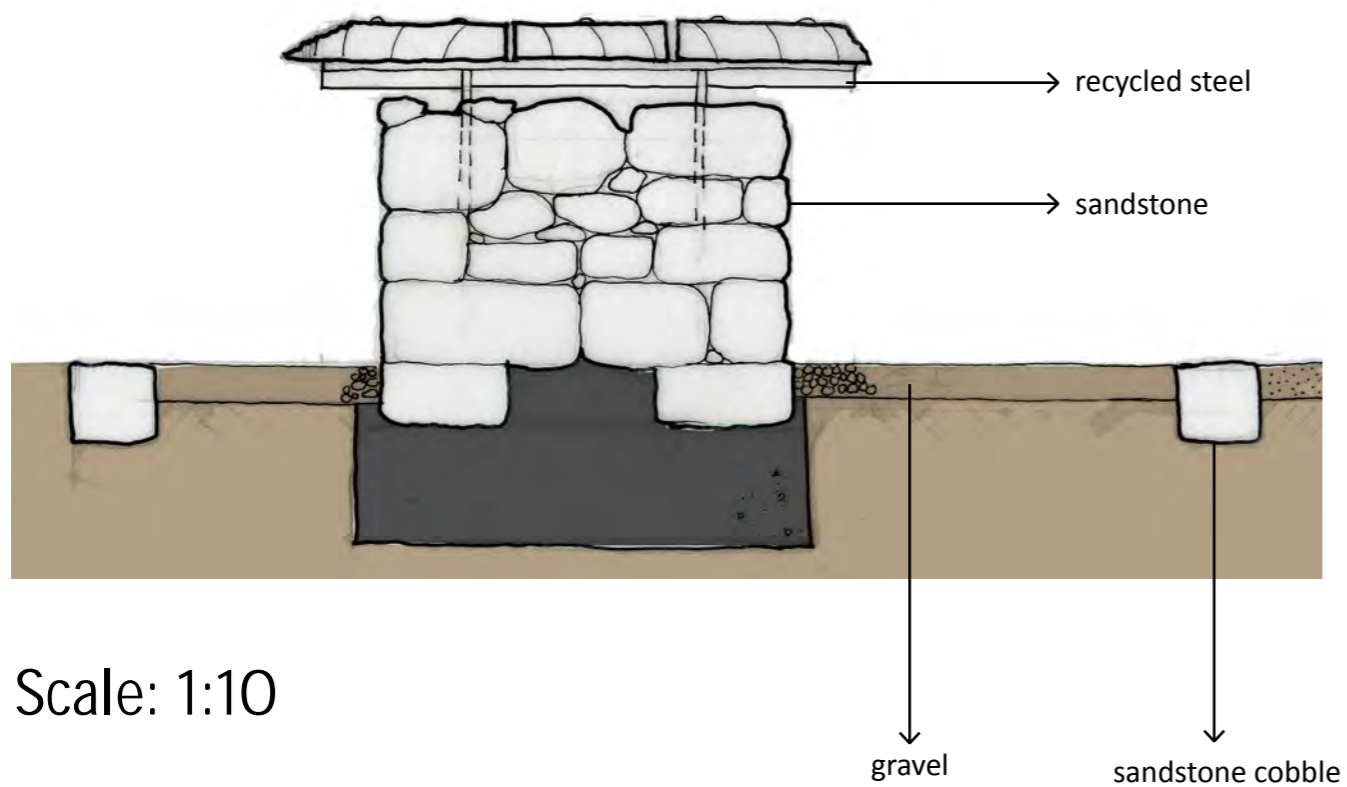
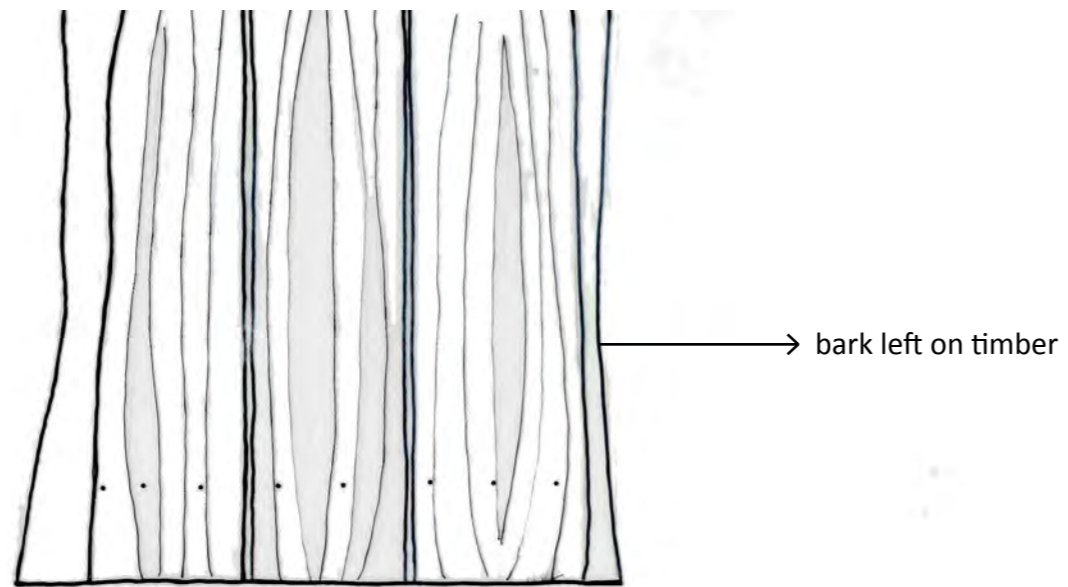
light air shadow lines  
floating recycled steel timber

**heavy grounded**  
**stone baked clay**

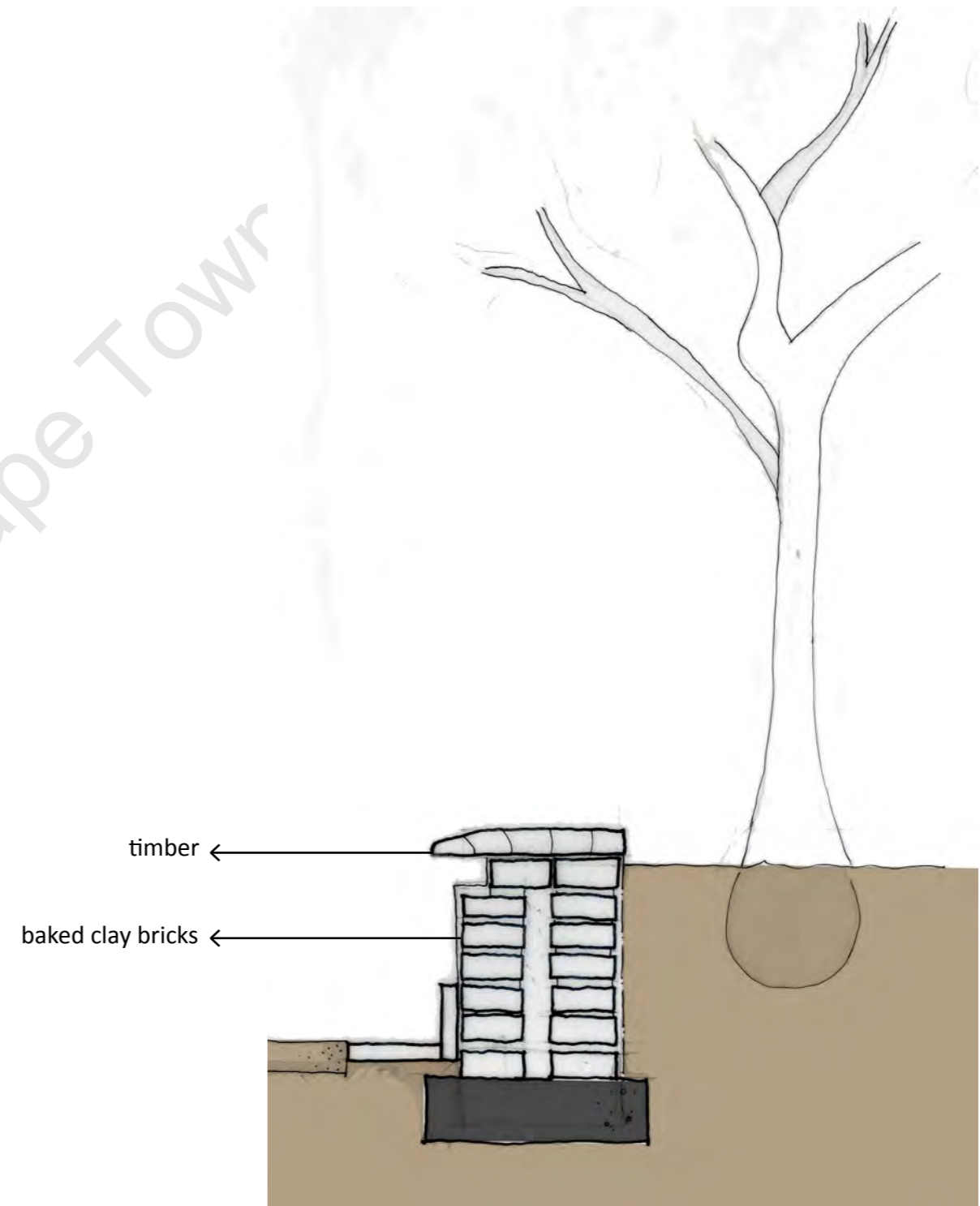
SOIL MICROBES EARTHWORMS NUTRIENTS WATER

seasons  
landscapes  
dynamic  
life  
spring plants  
growth

# Seating details

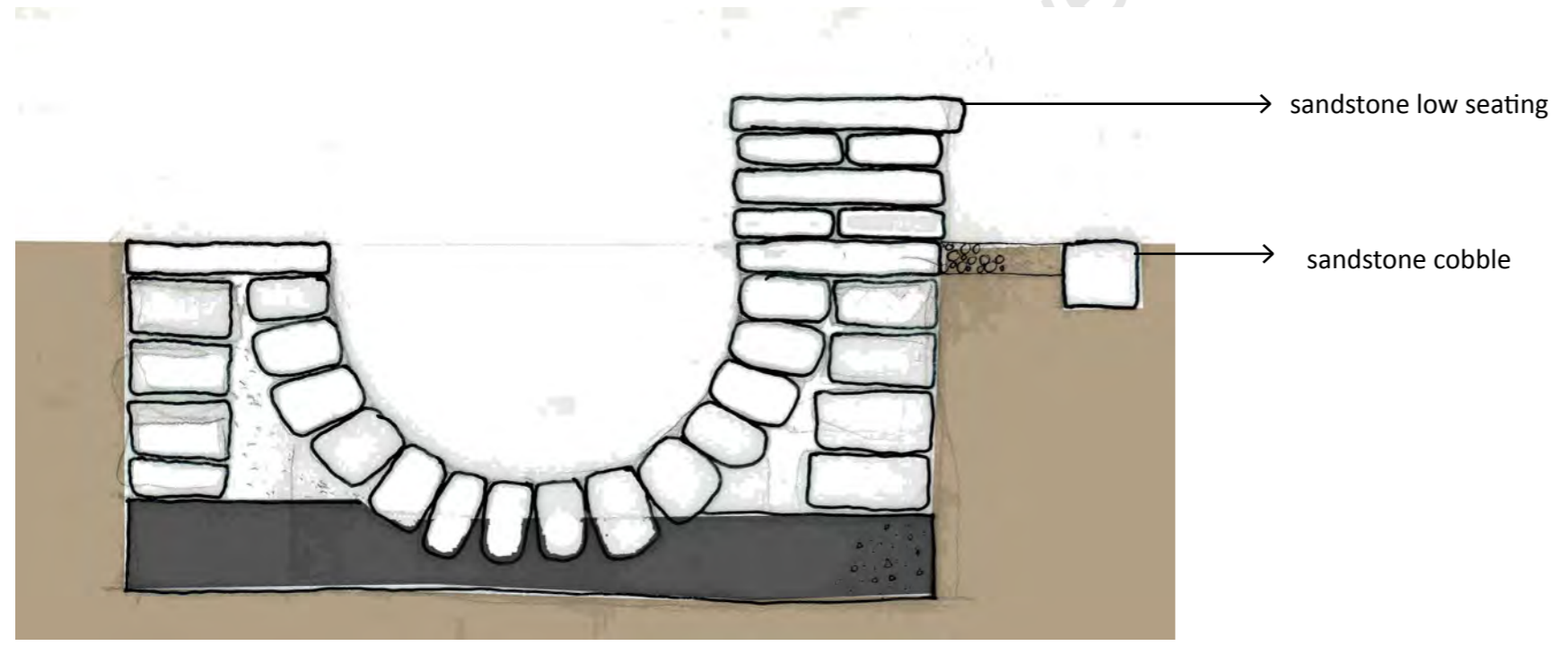
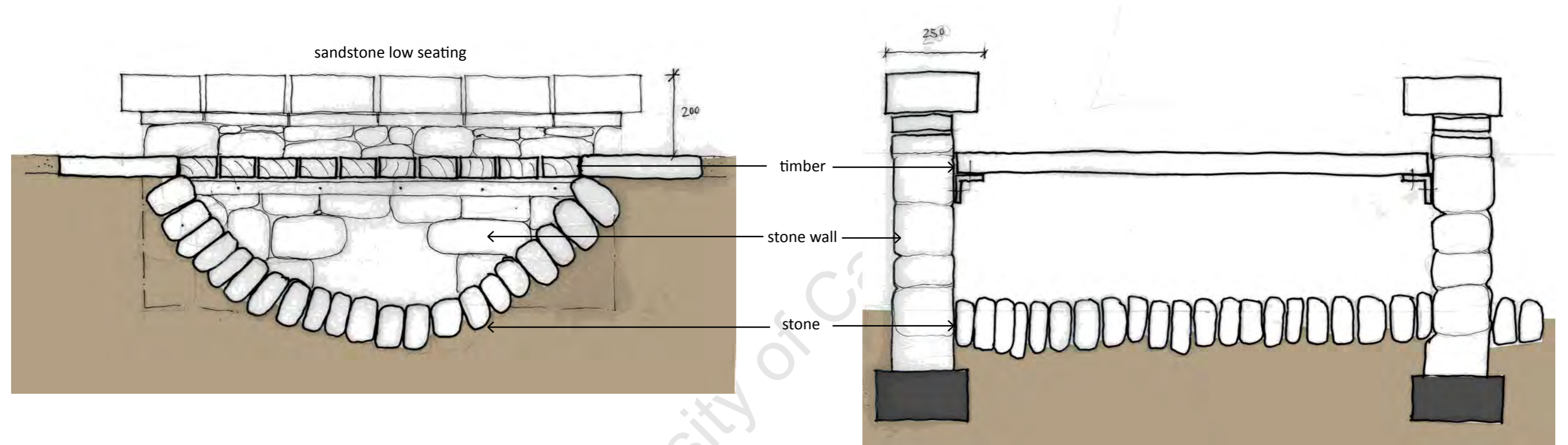


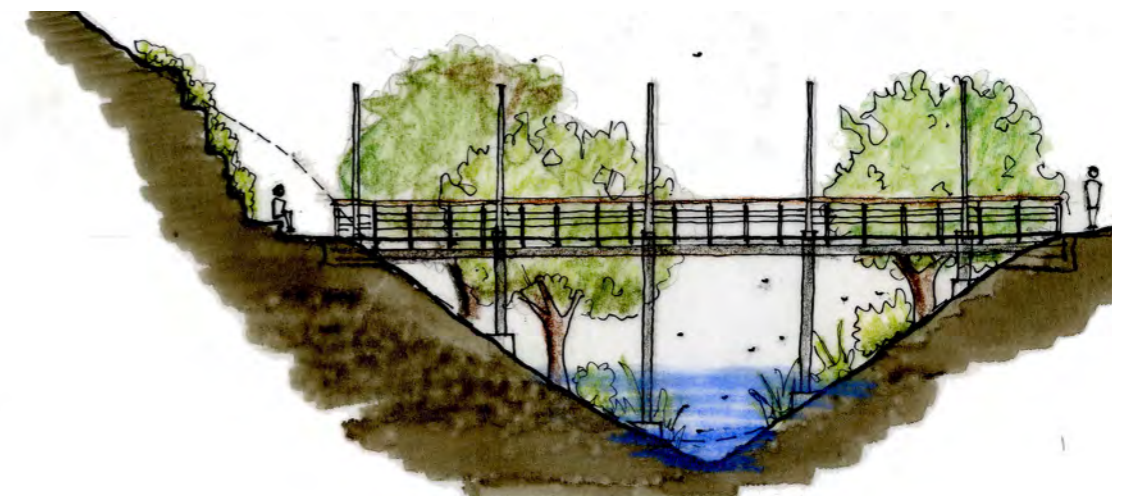
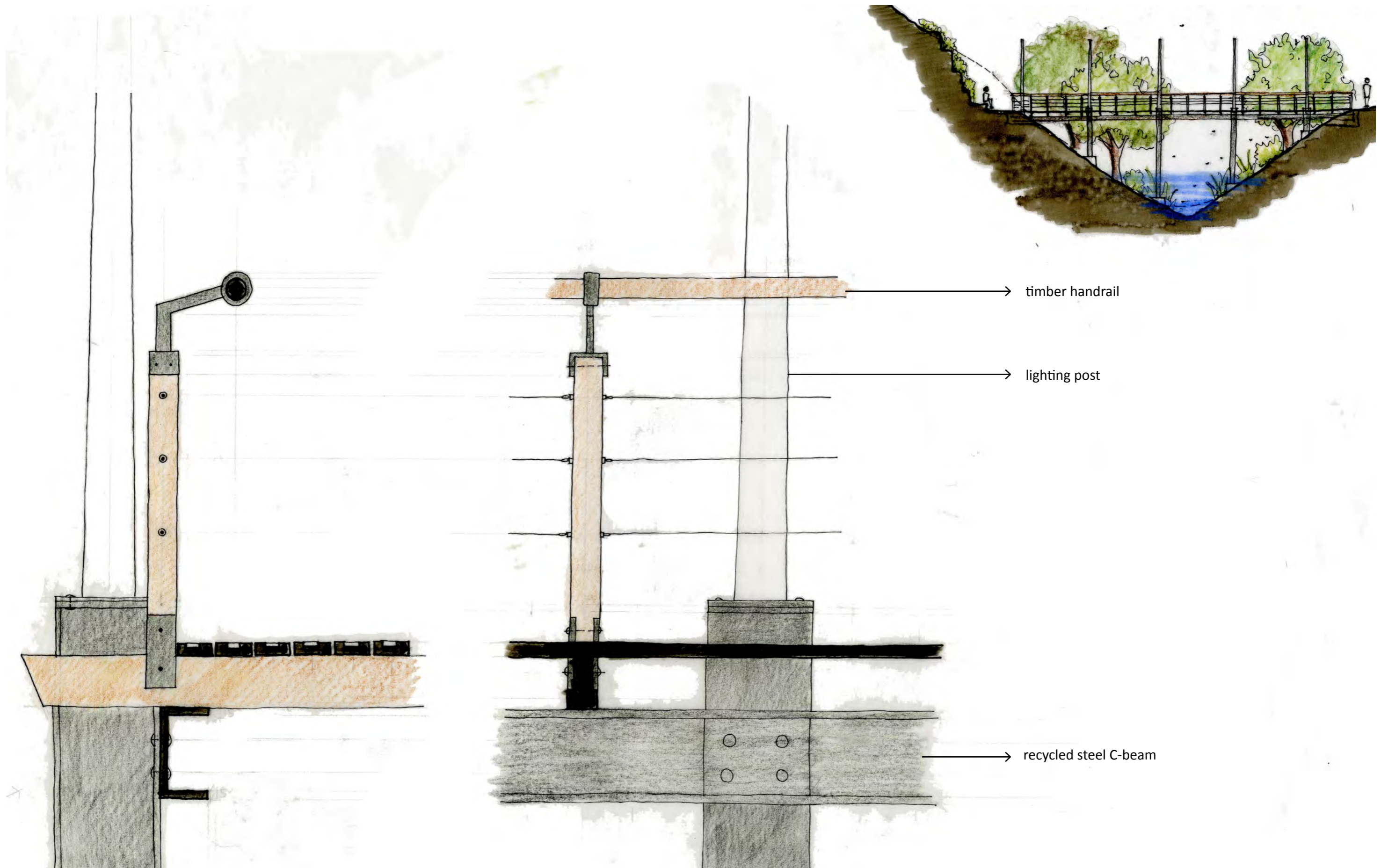
Of Cape Town



# Water details

Scale: 1:10



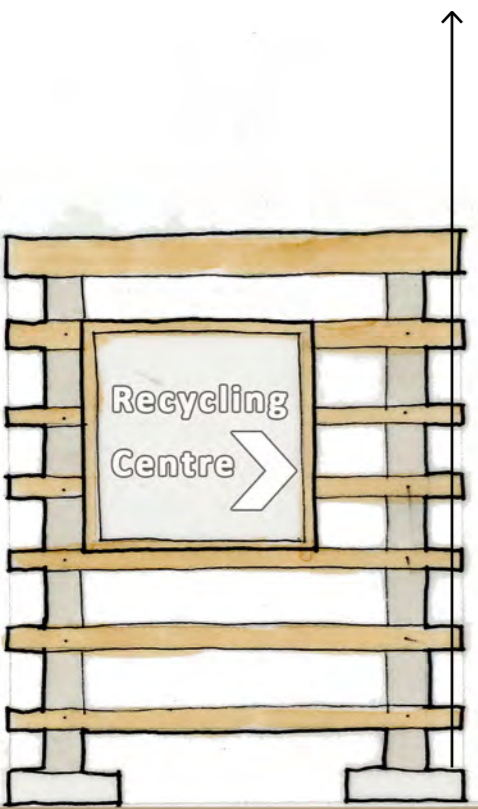


# Signage

Scale: 1:10

Cape Town

stone footing



timber struts



signage box protrudes beyond plant

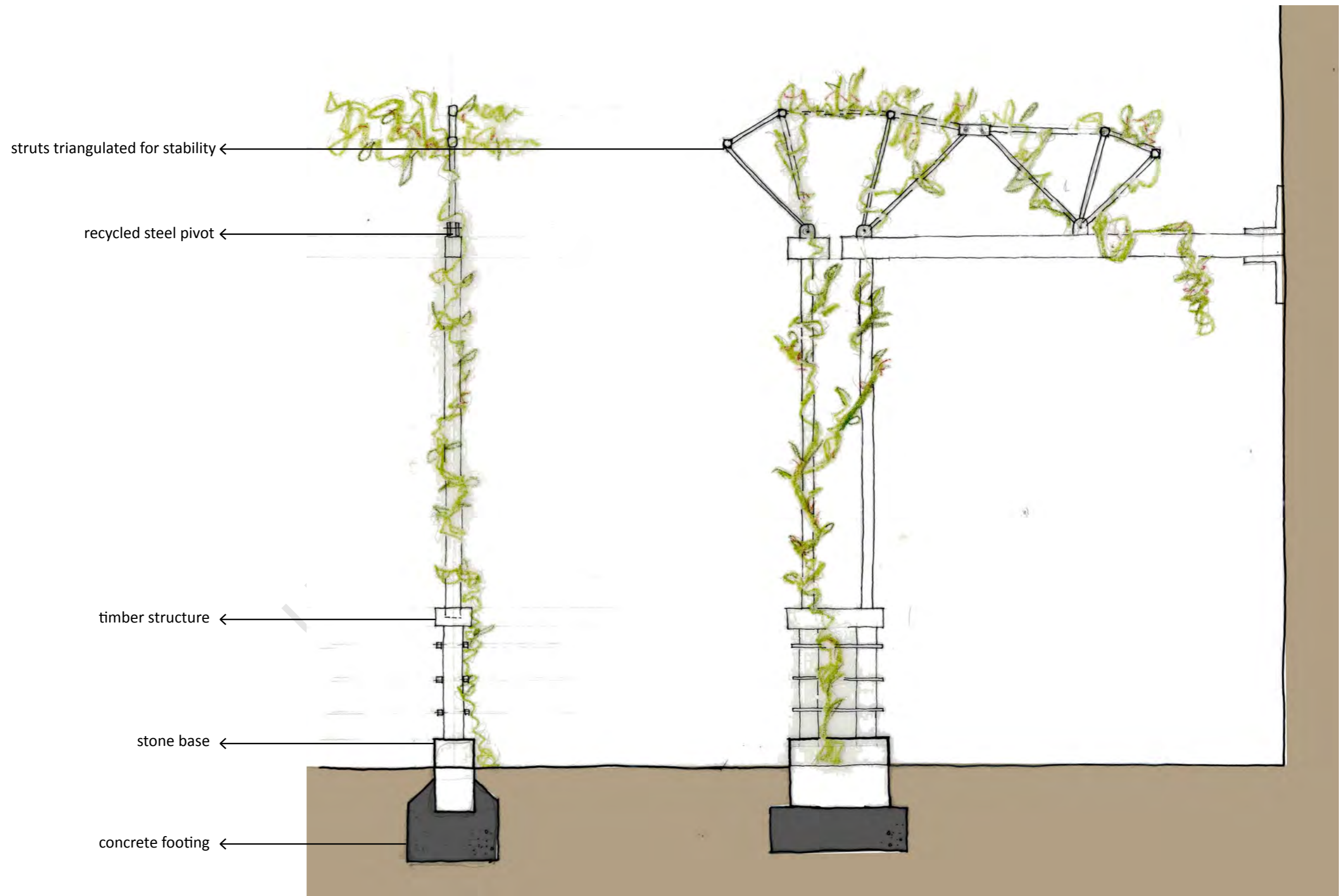


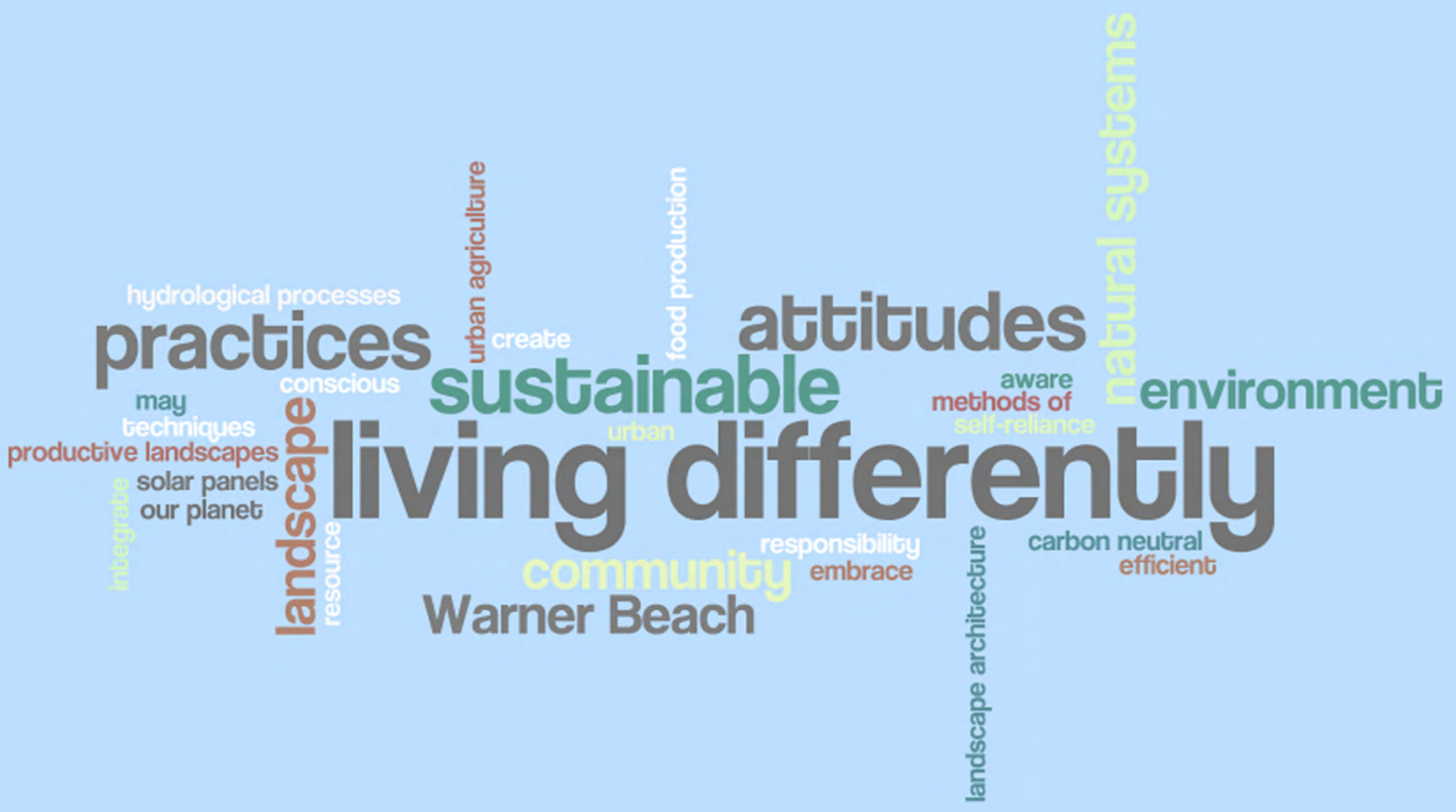
flowers



# Pergola

Scale: 1:10





# Contents

Topic and introduction

Literature review

Design principles

River basin analysis

Site selection

Site design

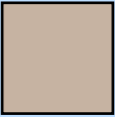
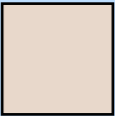
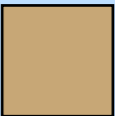
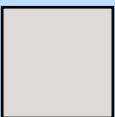
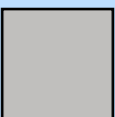
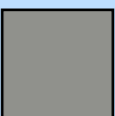
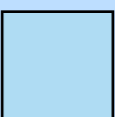
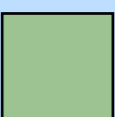
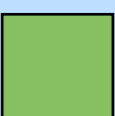
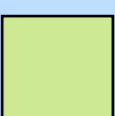
Precinct design

Construction details

 Conclusion



## Legend

	Paving
	Paving
	Timber decking
	Laterite
	Stone chips
	Seating surfaces
	Water
	Agriculture
	Hedges and groundcover
	Grass (lawn)

## Conclusion

This thesis first investigated a body of knowledge about the way in which current lifestyles are unsustainable: we are a resource-consuming, waste-producing, consumer-driven species with no regard to our effect on our planet. We give no thought to taking resources that rightly belong to current and future generations. We have painted ourselves into a corner and we have fallen into convenient unsustainable habits.

Yet we are creative beings capable of breaking outside this box that we have constructed. All we need is at our fingertips: Nature provides us with free resources as well as systems that will provide us with energy and filter our wastes. We need to change our lifestyles to be more aware of the environmental processes around us and to learn to work in tune with them, learning the lore and living in the land.

Profit is not a driving motive towards lifestyle change, and while this thesis has not attempted to explore economic sustainability, it is recognised that self-sufficiency and self-sustaining communities can be economically viable. Whether self-sustaining urban villages will become the norm is uncertain - in a world where money drives decision-making processes, changing lifestyle habits is not a priority. It would be disappointing for sustainable living to be enforced only out of desperation and necessity, instead of living differently as an attitude towards our valuable landscapes.

Through the literature review, a series of design principles was developed that could guide future development. Urban villages could become more aware of their landscape and could merge into natural systems instead of acting as unrelated urban systems.

The spatial exploration of these design principles on an existing site provided an understanding of the elements needed in urban areas to create sustainable systems, eg: urban areas that celebrate and depend on the patterns and flow of water while ensuring that these systems are not polluted or degraded.

The lessons learnt in the design principles can be carried through at any scale, from a large settlement, to a precinct design of 10 families and even in the way in which street furniture is constructed: grounded elements that blend into the landscape but allow natural processes (such as planting) to become part of the element itself.

I have learnt a lot through the research and design of this dissertation about how we should not be living, how we should be living and what living different could look like. This is an important investigation because while there is ample theory on the concepts of sustainable living, there are still huge gaps in the actual implementation of these ideas. We need to question our current way of living and if need be, find a way to live differently.

## References: Literature review

Birkeland, J., ed. (2004). *Design for sustainability: A source book on integrated eco-logical solutions*. London: Earthscan.

Bosjolie, J (2008). *Ecovillage at Ithaca: A virtual tour*. [Online] Ecovillage at Ithaca Available at: <http://www.ecovillage.ithaca.ny.us/default.html> (accessed 6 August 2008)

Boyle, C. (2005). Sustainable Buildings. *Engineering Sustainability* (ES1), p. 41-48.

Desai, P. (2007). An ecological footprint to fit our planet. *Building Design*, [Online] Fri., 16 Feb. Available at: <http://www.bdonline.co.uk/> (accessed 9 July 2008)

du Plessis, C., Lundy, J., & Swanepool, P. (2000). *Manual for Sustainable Neighbourhood Development*. Pretoria: Department of Environmental Affairs and Tourism.

Ede, B. (1998). Beyond the Dome. *Landscape Design*, May 270, p. 26-30.

Goodland, R., & Daly, H. (1996). Environmental Sustainability: Universal and Non-negotiable. *Ecological Applications*, [Online] Nov. 6 (4). Available at: <http://links.jstor.org/sici?sici=1051-0761%28199611%296%3A4%3C1002%3AESUAN%3E2.0.CO%3B2-8> (accessed 9 July 2008)

Jacobs, J. (2004). *The Greening of the City*. [Online] Wired – New York Forum 16 May Available at: <http://wirednewyork.com/forum/showthread.php?t=4857> (accessed 30 July 2008)

Landman, K. (2007). *Sustainable "Urban Village" Concept: Mandate, Matrix or Myth*. [Online] CSIR Building and Construction Technology. Available at: [http://www.buildnet.co.za/akani/2003/jul/07\\_landman.pdf](http://www.buildnet.co.za/akani/2003/jul/07_landman.pdf) (accessed on 8 July 2008)

Li, F., Wang, R., Paulussen, J., & Liu, X. (2005). Comprehensive concept planning of urban greening based on ecological principles: a case study in Beijing, China. *Landscape and Urban Planning*, [Online] 15 May 72 (4), p. 325-336. Available at: <http://www.sciencedirect.com.ezproxy.uct.ac.za/science> (accessed 9 July 2008)

Linehan, J. R., & Gross, M. (1998). Back to the future, back to basics: the social ecology of landscapes and the future of landscape planning, *Landscape and Urban Planning* [Online] 7 December 42 (2-4), p. 207-223. Available at: <http://www.sciencedirect.com.ezproxy.uct.ac.za/> (accessed 10 July 2008)

Mazmanian, D. A., & Kraft, M. E. (1999). *Towards Sustainable Communities: Transition and Transformations in Environmental Policy*. Cambridge, Massachusetts: The MIT Press.

Reader, J. (2004). *Cities*. New York: Grove Press.

Roseland, M. (2000). Sustainable community development: integrating environmental, economic and social objectives. *Progress in Planning* [Online] 54 (2), p. 73-132. Available at: <http://www.sciencedirect.com.ezproxy.uct.ac.za/science?> (accessed 7 July 2008)

Roseland, M., Connelly, S., & Hendrikson, D. C. (2005). *Towards Sustainable Communities: Resources for Citizens and Their Governments* (Revised, 3rd ed.). Gabriola Island, B.C.: New Society Publishers.

Sale, K. (2000). *Dwellers in the land: The Bioregional Vision*. Athens: The University of Georgia Press.

Shannon, K., & Manawadu, S. (2007). Indigenous landscape urbanism: Sri Lanka's reservoir and tank system. *Journal of Landscape Architecture* (Autumn 2007 Issue).

Warburton, D., ed. (1998). *Community and Sustainable Development*. London: Earthscan.

Wikipedia. (n.d.). *Automobile dependency*. [Online] Available at: [http://en.wikipedia.org/wiki/Automobile\\_dependency](http://en.wikipedia.org/wiki/Automobile_dependency) (accessed on 15 July 2008)

[www.flickr.com](http://www.flickr.com)

Zeihner, L. (1996). *The Ecology of Architecture: A Complete Guide to Creating the Environmentally Conscious Building*, Whitney Library of Design, New York: Watson-Guption Publications.

## References: River Basin Analysis

Meitner M. J. (1994). *A History of Amanzimtoti*, South Africa: Rapid Results College.

Mucina, L., & Rutherford, M. C. eds., (2006). *The vegetation of South Africa, Lesotho and Swaziland*. Pretoria: Strelitzia 19, South African National Biodiversity Institute, p. 570-578, 750.

Herman, K. (2004). Environmental Assessment of the Proposed Region Shopping Centre at Kingsburgh, KwaZulu/Natal: Environmental Scoping and Development Facilitation Act Report EIA/5225 7 December 2004 p. 82-92, 172-179, 294, 297.

Heshula, U. (nd) Evaluation of impacts on *Falconia intermedia* (Hemiptera: Miridae) on *Lantana camara* (Verbenaceae) in the Eastern Cape, South Africa [Online] Department of Zoology and Entomology, Rhodes University, Grahamstown Available at: <http://www.ru.ac.za/academic/departments/zooento/STUDENTS/Heshula/unathiMSc.html> (accessed on 4 September 2008)

IUCN/SSC Invasive Species Specialist Group (2006) [Online] Available at: <http://www.issg.org/database/species/ecology.asp?si=209&fr=1&sts> (accessed 4 September 2008) Reviewed by Dr Terry Olckers, ARC – Plant Protection Research Institute, South Africa

National Biological Information Infrastructure & IUCN/SSC Invasive Species Specialist Group (2006) *Melia azedarach*. Available at: <http://www.issg.org/database/species/ecology.asp?si=636&fr=1&sts=sss> (accessed on 4 September 2008)

South African Weather Services, Durban climatic data, accessed from <http://www.weathersa.co.za/Climat/Climstats/DurbanStats.jsp> on 11 July 2008

Wikipedia. *Chromolaena odorata* [Online]. Available at: [http://en.wikipedia.org/wiki/Chromolaena\\_odorata](http://en.wikipedia.org/wiki/Chromolaena_odorata) (accessed on 4 September 2008)

Wikipedia. *Kaapvaal* [Online]. Available at: [http://en.wikipedia.org/wiki/Kaapvaal\\_craton](http://en.wikipedia.org/wiki/Kaapvaal_craton) (accessed on 1 July 2008)

Wikipedia. *Köppen climate classification* [Online]. Available at: [http://en.wikipedia.org/wiki/K%C3%B6ppen\\_climate\\_classification](http://en.wikipedia.org/wiki/K%C3%B6ppen_climate_classification) (accessed on 11 July 2008)

Wikipedia. *Lantana camara* [Online]. Available at: [http://en.wikipedia.org/wiki/Lantana\\_camara](http://en.wikipedia.org/wiki/Lantana_camara) (accessed on 4 September 2008)

Wikipedia. *Melia azedarach* [Online]. Available at: <http://en.wikipedia.org/wiki/Chinaberry> (accessed on 4 September 2008)

Wikipedia. *Pangea* [Online]. Available at: <http://en.wikipedia.org/wiki/Pangaea> (accessed on 11 July 2008)

Wikipedia. *Solanum mauritianum* [Online]. Available at: [http://en.wikipedia.org/wiki/Solanum\\_mauritianum](http://en.wikipedia.org/wiki/Solanum_mauritianum) (accessed on 4 September 2008)

Wikipedia. *Tropical climate* [Online]. Available at: [http://en.wikipedia.org/wiki/Tropical\\_climate](http://en.wikipedia.org/wiki/Tropical_climate) (accessed on 11 July 2008)

Wikipedia. *Vaalbara* [Online]. Available at: <http://en.wikipedia.org/wiki/Vaalbara> (accessed on 1 July 2008)

[en.wikipedia.org/wiki/Vaalbara](http://en.wikipedia.org/wiki/Vaalbara) (accessed on 1 July 2008)

## References: Site Selection

Alexander, C. (1997) *A pattern language*. New York: Oxford University Press.

Gehl, J. (2001) *Life between buildings: using public space* (4th edition). Bogtrykkeriet, Skive: Arkitektens Forlag, The Danish Architectural Press.

Lynch, K., & Hack, G. (1985) *Site Planning* (3rd edition), Cambridge: The MIT Press.

Mazmanian, Daniel A. and Kraft, Michael E. (Eds) (1999) *Toward Sustainable Communities: Transition and Transformations in Environmental Policy*, Cambridge, Massachusetts: The MIT Press.

McHarg, I. L. (1992). *Design with nature*, Garden City, NY : John Wiley & Sons.

Rogers in Landman:

Rogers Richard (1999) *Cities for a small planet*. London: Faber and Faber.

Landman, Karina (2007) *Sustainable "Urban Village" Concept: Mandate, Matrix or Myth*, CSIR Building and Construction Technology.

Roseland, Mark (2000) Sustainable community development: integrating environmental, economic, and social objectives. *Progress in Planning Volume 54* (2) 2000, pp 73-132.

Sutcliffe, Mike (2006) "2016 - The future of SA's cities questioned", *Urban Green File*, 11 (1) April 2006 pp 45.

## References: Site Design

Lynch, K., & Hack, G. (1984). *Site planning*. Cambridge, Massachusetts: The MIT Press.

chusetts: The MIT Press.

MacCormac, R. (2007) Sustainable Suburbia. *Planning in London*, 61 (April-June) 2007

Marsh, W. M. (1998). *Landscape Planning: Environmental Applications*. (3rd ed.) New York: John Wiley+Sons, Inc.

## Bibliography

Breines, S., & Dean, W. (1974) *The pedestrian revolution: streets without cars*. New York: Vintage Books.

Brussard, P. F., Reed, M. J., & Tracy, C. R. (1998). Ecosystem management: what it is really? *Landscape and Urban Planning*, [Online] March 40 (1-3), p. 9-20.

Available at: <http://www.sciencedirect.com.ezproxy.uct.ac.za/serid=635696&md5=b53a5f3f9cd5ce5383014dc5c6ec7a61> (accessed on 9 July 2008)

\*Camp 1999 In Rutherford & Mucina 2006:

Camp (1999) *The Bioresource Groups of KwaZulu-Natal Coast and Hinterland*. Cedara Report No. N/A/99/12, Cedara: KwaZulu-Natal Department of Agriculture.

Dewar, N., & Gasson, B. (2006). *The Industrial and Urban Metabolism: Analysing Processes and Problems for Sustainable Practices* [Online] NIE-SEAGA Conference 2006: Sustainability and Southeast Asia.

Available at: [http://www.hsse.nie.edu.sg/staff/changch/seaga/seaga2006/proceedings/Full%20Papers/day1\\_fullpaper/session1\\_Neildewar.pdf](http://www.hsse.nie.edu.sg/staff/changch/seaga/seaga2006/proceedings/Full%20Papers/day1_fullpaper/session1_Neildewar.pdf) (accessed 16 July 2008)

Dreiseitl, H., Grau, D., & Ludwid, K. (eds) (no date) *Water-scapes: planning, building and designing with water*. Basel: Birkhäuser.

Grant, J. (2006). *Planning the Good Community: New Urbanism in Theory and Practice*. London: Routledge.

Haughton, G. & Hunter, C. (1996). *Sustainable Cities*. Gateshead: Athenaeum Press.

Hunt D.V.L., Jefferson I. & Hunot K. (2006). Sustainable energy? A feasible study for Eastside, Birmingham, UK. *Engineering Sustainability*, Dec. 159 (ES4) p. 155-168.

Jenkins, J.C. (1999). *Alternative Grey Water Systems* [Online] Chapter 9, The Humanure Handbook, Jenkins Publishing,

Grove City PA16127

Available at: <http://weblife.org/humanure/chapter9.html> (accessed on 8 July 2008)

Jolicoeur, S., & O'Carroll, S. (2007). Sandy barriers, climate change and long-term planning of strategic coastal infrastructures, Îles-de-la-Madeleine, Gulf of St. Lawrence (Québec, Canada). *Landscape and Urban Planning*, [Online] 5 July 81 (4) 5 July p. 287-298.

Available at: <http://www.sciencedirect.com.ezproxy.uct.ac.za/science?> (accessed on 9 July 2008)

Landman, K. (2007). *Sustainable "Urban Village" Concept: Mandate, Matrix or Myth*. [Online] CSIR Building and Construction Technology.

Available at: [http://www.buildnet.co.za/akani/2003/jul/07\\_landman.pdf](http://www.buildnet.co.za/akani/2003/jul/07_landman.pdf) (accessed on 8 July 2008)

Margolis, L., & Robinson, A. (2007). *Living systems: innovative materials and technologies for landscape architecture*. Basel: Birkhäuser.

Massey, H. (2002). Urban Farm, *Landscape Design*, July, 312, p. 39-40.

Norman, N., & Whitfield, G. (2006). *Geological Journeys: A traveller's guide to South Africa's rocks and landforms*. Cape Town: Struik Publishers & Council for Geoscience.

Nuttall, Bonita (2008). *Green Alchemy* [Online] Carte Blanche, 6 July 2008

Available at : <http://www.mnet.co.za/Mnet/Shows/carte-blanche/story.asp?Id=3534> (accessed 8 July 2008)

Oberholzer, B. (2007b). *Landscape Design*. Version 1.0. [Class notes prepared for the Landscape Architecture Programme] Cape Town, UCT.

One Planet Living (2008). *BioRegional solutions for sustainability*. [Online] One Planet Living.

Available at: [http://www.bioregional.com/programme\\_projects/opl\\_prog/principles.htm](http://www.bioregional.com/programme_projects/opl_prog/principles.htm) (accessed 21 July 2008)

Sowman, M., & Urquhart, P. (1998). *A Place Called Home: Environmental issues and low-cost housing*. Cape Town: University of Cape Town Press.

Thayer cited in Linehan and Gross:

Thayer, R. (1989) The experience of sustainable landscapes. *Landscape J*, 8, p. 101-110.

Tweed, C., & Sutherland, M. (2007). Built cultural heritage and sustainable urban development, *Landscape and Urban Planning*, [Online]. 12 Nov., 83 (1) p. 62-69.

Available at: <http://www.sciencedirect.com.ezproxy.uct.ac.za/science?> (accessed 9 July 2008)

## Image credits

Page 2 -www.wordle.org

Page 4

Image 1: www.flickr.com

Page 5

Images 1 - 4: www.flickr.com

Page 9

Images 1 + 2: www.flickr.com

Page 12: Ithaca Ecovillage Precedent

Image 1: Cornell University (1999) *Ecotecture*. [Online]

Department of Design and Environmental Analysis, Cornell University Available at: [http://ergo.human.cornell.edu/ecotecture/Case%20Studies/Eco-Village/eco-vill\\_ext.html](http://ergo.human.cornell.edu/ecotecture/Case%20Studies/Eco-Village/eco-vill_ext.html) (accessed 6 August 2008)

Images 2-10: Bosjolie, J (2008) *Ecovillage at Ithaca: A virtual tour*. [Online] Ecovillage at Ithaca Available at: <http://www.ecovillage.ithaca.ny.us/default.html> (accessed 6 August 2008)

Page 13

Images 1 + 2: www.flickr.com

Image 3: Li, F., Wang, R., Paulussen, J., & Liu, X. (2005). Comprehensive concept planning of urban greening based on ecological principles: a case study in Beijing, China. *Landscape and Urban Planning*, [Online] 15 May 72 (4), p. 325-336. Available at: <http://www.sciencedirect.com.ezproxy.uct.ac.za/science> (accessed 9 July 2008)

Page 14

Image 1: www.flickr.com

Page 15: Greenwich Peninsula Precedent

Image 1 + 5: Ede, B. (1998) Beyond the Dome. *Landscape Design*, May 270, p26-30.

Image 2, 3 + 4: www.flickr.com

Page 22 & 23: Geological sequence

Images 1, 2, 5, 7 + 8 are credited to the School of Geological Sciences, University of KZN website. (Whitmore G., Meth D., & Uken, R. 2006)

Available at: <http://www.geology.ukzn.ac.za/GEM/kzngeol/> (accessed 23 July 2008)

But their images are derived from 1:1 000 000 scale geology map sheets (Geological Survey, 1984, Pretoria, Government Printer, NE + SE Sheets)

Image 3 + 4- Wikipedia

Image 6 - UKZN website but adapted from: the Story of Earth and Life (T. McCarthy & B. Rubidge)

Image 9 - UKZN website but accredited to Dr P. Ramsay, Council for Geoscience

Page 24: Geology

Map: 1:50 000 map, data also from Durban GIS

Inset map: credited to the School of Geological Sciences, University of KZN website. (Whitmore G., Meth D., & Uken, R. 2006)

Available at: <http://www.geology.ukzn.ac.za/GEM/kzngeol/> (accessed 23 July 2008)

Images are derived from 1:1 000 000 scale geology map sheets (Geological Survey, 1984, Pretoria, Government Printer, NE + SE Sheets)

Page 30: Climate

Image: Wikipedia. *Köppen climate classification* [Online].

Available at: [http://en.wikipedia.org/wiki/K%C3%B6ppen\\_climate\\_classification](http://en.wikipedia.org/wiki/K%C3%B6ppen_climate_classification) (accessed on 11 July 2008)

Page 32: Vegetation and Habitats

Image 1 + 2 - Mucina, L., & Rutherford, M. C. eds., (2006). *The vegetation of South Africa, Lesotho and Swaziland*. Pretoria: Strelitzia 19, South African National Biodiversity Institute, p.750.

Image 3 - Derived from Mucina, L., & Rutherford, M. C. eds., (2006). *The vegetation of South Africa, Lesotho and Swaziland*. Pretoria: Strelitzia 19, South African National Biodiversity

Institute, p.750.

Page 34&35: Human settlements

Image 1: wikipedia

Image 2: www.lib.umich.edu

Image 3, 4 + 5: www.flickr.com

Image 6: www.south-africa-tours-and-travel.com (accessed 4 August 2008)

Page 36&37:

[Durban GIS] <http://citymaps.durban.gov.za>

Page 45

Photo taken by Annerie Whiting, June 2008

Page 68

Photos taken by the author, June 2008

Page 77

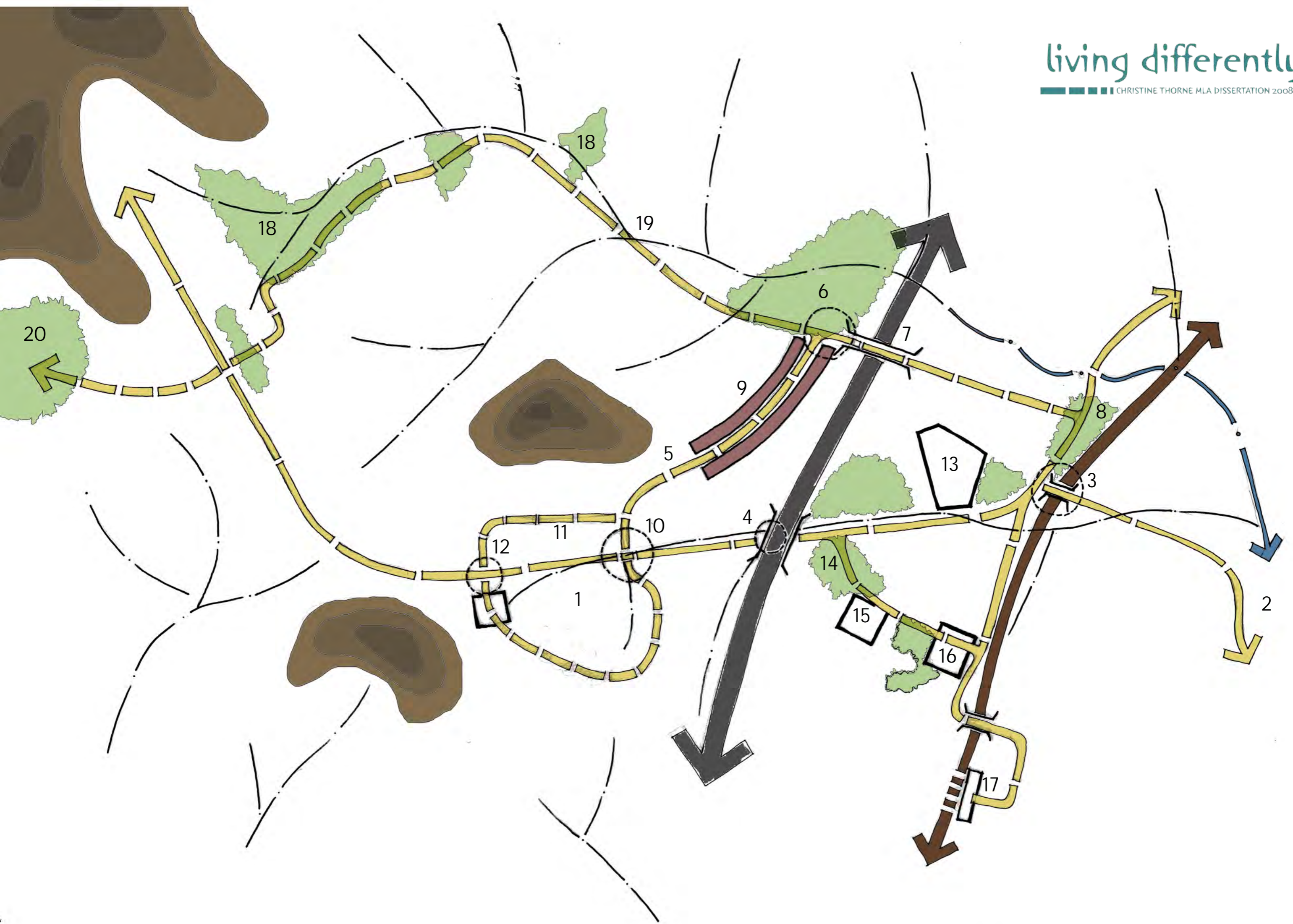
Image 5: MacCormac, R. (2007) Sustainable Suburbia. *Planning in London*, 61 (April-June) 2007

Page 98

Photo taken by the author, September 2008

[1:10 000 orthophoto map] 3030 BB 7 and 3030 BB 8

1:50 000 map Published by the Chief Directorate: Surveys and Land Information, Mowbray. Third Edition 1992

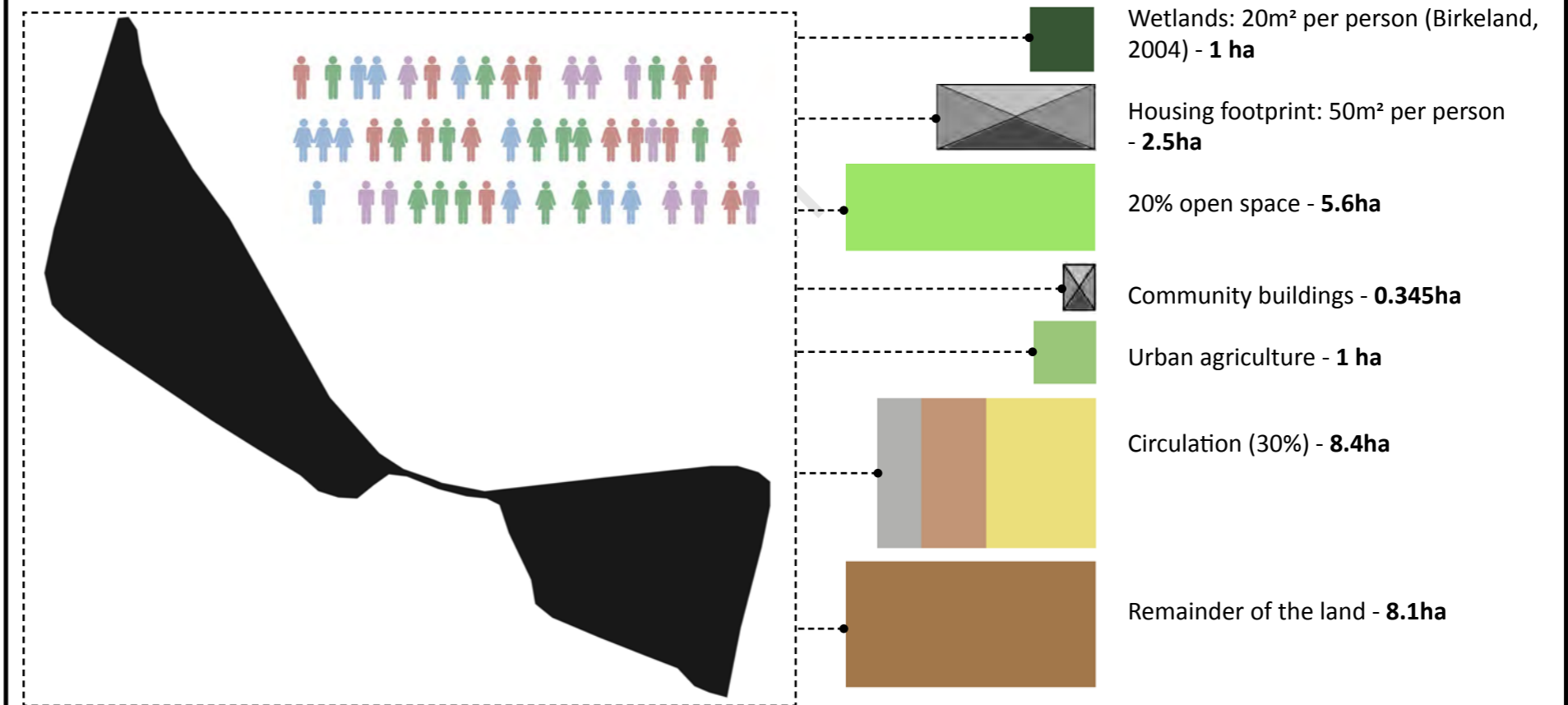


## Calculating area of the land



	Number of blocks	Size of block	Total
	13	1ha	13ha
	28	¼ha	7ha
	114	¼ha	7ha
			<b>27ha</b>

## Calculating the area of the programme for the site



## Calculating roofwater supply

Water storage tanks - CBN Archives (2000) calculated the average monthly water consumption per person at 6 kilolitres. This value is excessive for this site considering irrigation water comes from another source and there will be greywater reuse. Therefore, reasonable water consumption is 3 kilolitres per person per month.

36m<sup>2</sup> roof per person and 1000ml of rainfall per year means 3.6 kilolitres if water per year and (3 kilolitres a month). \* 1mm rainfallx1m<sup>2</sup> roof = 1 litre of water

References:

CBN (2000) "How much is a right to water? [Online] CBN Archive Available online: <http://www.cbn.co.za/archive/2000-apr/RIGHT.HTM?PHPSESSID=10c55c519901cf0a089ec0a1473894cc> (accessed 13 August 2008)

## Calculating dam capacity

Assuming there is a 4 hour storm (intensity = 100mm/hour) over 12000m<sup>2</sup> land where 1mmX1hour of rainfall = 1 litre of water

Therefore 400x1200 = 48000000 litres of rain over 4 hours = 4800m<sup>3</sup>

Assuming 50% infiltration of water (based on permeable surfaces and vegetation to slow runoff) the dam will need to store 2400m<sup>3</sup>

Therefore the dimensions of the dam must be 4x15x40m

## BIOGAS GENERATORS

### The Principle:

Biogas is a renewable resource that uses organic waste to produce low cost energy. Since the 1950s, China and Nepal have been using this technology to produce electricity, clean sewerage and produce a liquid fertiliser that enriches the soil.

“Biogas digesters are airtight containers in which water, organic wastes, animal wastes and/or faeces are acted upon by anaerobic bacteria i.e. those bacteria that thrive in the absence of oxygen. Biogas is formed by bacterial action on the organic matter, with three primary sets of bacteria being involved in the biological breakdown. The final stage of this process is the production of methane and carbon dioxide, which make up 2/3 and 1/3 of the total gas produced, respectively. Small amounts of nitrogen, hydrogen and hydrogen sulphide also occur. One cubic metre of biogas will provide a cooking time of at least 2 hours, or 1.5 kWh electrical output.” [AGAMA, 2007:1]

About 90 to 99% of the pathogens from this organic waste are eliminated in the process of biogas digestion and by filtering the products of the digester through a series of polishing ponds or wetland cells, a water quality could be produced that is suitable for irrigation or flushing toilets.

There is great potential for use of this technology in South Africa, given that Minister of Education Kader Asmal told Parliament in 2001 that 45% of schools in South Africa have no electricity, 27% lack clean water, 66% have inadequate sanitation, and 12% have no sanitation at all. [AGAMA, 2007:5]

References:AGAMA, 2007: Biogas Technology: delivering Ecological Sanitation and Renewable Energy

**Precedent**

Domestic biogas digesters range in size from six to 10m<sup>3</sup> and are buried underground to minimise their impact on your garden. If you know what you're doing, they should take about six weeks to build.

around the quality and volume of the available feedstock, as well as its intended purpose. So if you're only interested in producing gas, and have no interest in gardening, it's possible to direct the out-flow directly into the sewage system. Although digesters produce a volatile gas, says Parker, they are completely safe. He explains: "These are self-venting systems. If, for whatever reason, excess pressure builds up in the dome, it just forces the water level down and vents into the expansion chamber to prevent any untreated waste from escaping."

However, he has a word of warning for interested homebuilders and DIY enthusiasts: although the technology involved is simple, you have to get it right. If the digester is incorrectly built, or you don't stick to the design, it simply won't work.

● For more information visit AGAMA Energy's website [www.agama.co.za](http://www.agama.co.za) PM

Biogas at a domestic scale Source: Popular Mechanics January 2008

## ON-SITE SEWERAGE REMEDIATION

Current methods of sewerage treatment is based on a centralised system, are highly energy dependant and use vast tracts of land that are mainly mono-functional.

Bio/phytoremediation of this sewerage is on-site, highly energy efficient (because it does not require huge electrical inputs) and not only absorbs and processes harmful chemicals but its processes encourage new habitats.

This form of sewerage treatment produces less sludge than conventional methods although it takes more time and uses more land area .

In the presence of oxygen, bacteria convert ammonium into nitrates which can then be metabolised by the plants in the wetland cells. Micro-organisms on the gravel break down the contaminants.

Sewerage water does not occur at the surface of these wetland cells so it is safe for limited recreational activities to occur in the wetlands.

The output quality of water is suitable for flushing toilets and reuse as irrigation water.

**Precedent**

Inside a living machine

Instead of relying on chemicals to treat wastewater, a Living Machine lets nature do the dirty work. Wastewater is screened for solids and then enters a series of tidal-flow wetland cells, which alternately fill and drain to move water through the system. As each cell empties, and water is pumped to the next cell, incoming air helps bacteria oxidise ammonia, forming nitrate. As a cell begins to refill, other microbes break the nitrate into carbon dioxide and nitrogen gas. At the end of the one-day process, 60 per cent of the water is recirculated; the rest is disinfected for toilet flushing, irrigation and other uses.

Each watertight cell holds 1,5 to 2 m of gravel-like media engineered to harbour bacteria. Vegetation grows on top, and roots create pathways in the gravel to help distribute water throughout the cell. Micro-organisms living on the plant roots keep the bacteria population in check. In indoor systems, a 10 to 15 cm layer of mulch caps the gravel to help scrub odours from wastewater.

At Sidwell Friends School in Washington DC they treated 11 000 litres of waste water per day producing water that was 100% suitable for flushing toilets. Source: Margolis and Robinson (2007) "Living Systems: Innovative Materials and Technologies for Landscape Architecture", Birkhauser, Basel.

Treasure Island Source: Popular Mechanics February 2008

## *Chromolaena odorata*

**Family:** Asteraceae

**Common names:** Siam weed, Christmas bush

**Origin:** Native to North America, from Florida and Texas to Mexico and the West Indies (Wikipedia)

## *Lantana camara*

**Family:** Verbenaceae

**Common names:** Spanish flag

**Origin:** Central and South America

**Invasive stats:** Declared a weed in South Africa in 1954 and is one of South Africa's top ten most alien invasive plants.

**Control:** Chemical and mechanical methods have proven to be expensive and time-consuming and are often mixed amongst indigenous plant species. Projects for its biological control have been launched, by releasing a bug, *Falconia intermedia* but it has not been conclusive. (Heshula) (Wikipedia)

## *Melia azedarach*

**Family:** Meliaceae (Mahogany family)

**Common name:** Syringa (in South Africa, despite the fact that this is not a Syringa tree which is of the lilac genus)

**Origin:** native to India, southern China and Australia

**Description:** Deciduous or semi-evergreen, grows between 7 and 12 metres with small, purple, fragrant flowers, fruit are highly poisonous (except not to birds)

**Invasive stats:** Produces a lot of fruit, the seeds of which are dispersed by birds. It also reproduces vegetatively by forming root suckers which spread and form dense thickets.

**Control:** Chemical basal bark and cut-surface treatments are most effective, followed by chemical foliage spray. Mechanical injury or fire only appears to induce prolific resprouting (ISSG 2006)

## *Solanum mauritianum*

**Family:** Solanaceae

**Common names:** Woolly nightshade, tobacco weed

**Origin:** South America

**Description:** Small tree/shrub, grows up to 10m tall, grey-green leaves covered in felt-like hairs, purple flowers, green berries that ripen to a dull yellow

**Invasive stats:** Is poisonous. In South Africa, the plant invades riparian zones, forestry plantations, natural forest, agricultural lands, urban open space and any other disturbed areas, particularly in the eastern, higher rainfall regions of the country (Henderson, 2001). Also provides winter food for KwaZulu-Natal fruit flies which are horticultural pests

**Control:** Easily killed with chemical herbicides, ring-barking or removing seedlings by hand are also effective methods of removal. Biological control has been introduced in South Africa in the lace bug *Gargaphia decoris* but has not yet proven to be 100% effective, permission for the use of the flowerbud weevil, *Anthonomus santacruzi*, has yet to be granted. (T. Olckers, pers. Comm..)

