Forgotten Landscapes:
Restoring our Rural Imagination

by
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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

As our world becomes increasingly interconnected through technology and global trade, urban populations are more and more detached from the realities of our consumption and the cultivated land that supports us. These food producing territories, vastly exceeding the space used for human habitation, are structured in such a way to displace environmental systems and human life, while simultaneously being degraded by the growing requirements of today's urban living. Advancements in industrial agricultural technology, alongside the subsequent migration towards urban centers, has played an important role in reinforcing these systemic changes and the growing disconnect between urban and rural. Despite this, urban populations retain a strong influence over land management and food production techniques, though often without an awareness of their impact. Thus, redeveloping human relationships with rural landscapes is a vital.

This thesis utilizes the existing remediation approaches to problems of dryland agriculture in Western Australia to address the disconnect between urban areas and their rural footprint. By examining and documenting site history, psychology of rural places, local wildlife habitats and ecological functions, the design of a new framework for social infrastructure in rural areas is developed. This design proposes an intervention that engages human and environmental dynamics to catalyze consciousness towards rural systems. It promotes a diversity of social and environmental conditions within farming landscapes, leveraging under utilized land, flexible implementation strategies, cultural vestiges and existing infrastructure. Through research and design methods, this thesis hopes to reveal how an improved understanding of rural landscapes – by engagement with human scale intervention – can create cross collaboration and heightened awareness between urban and rural to develop a new consciousness of farmlands and the larger environment, for the benefit of ecological and human systems.

Acknowledgments

Thank you to my committee, family and friends for your constant support and tolerance. This would not have been possible without you.

Dedicated to those who inspired this work.

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Broadacre Farming

A type of farming in Australia where land is used for large-scale crop operations, usually cereals and oilseeds.

Dryland Agriculture

A type of farming used all around the world in regions with little rainfall. This method relies on tilling and the selection of suitable crops.

Dryland Salinity

A type of land degradation that occurs when increased amount of salts concentrate in the soil of watercourses and unirrigated landscapes, causing damage to the environment. This process hinders plant growth, affects water quality and leaves behind salt deposits, known as scald.

Freshwater Flush

A period of high freshwater inflow into a regularly saline estuary. During extended dry periods estuaries can become hypersaline, damaging flora and fauna. Periodic freshwater flushes from rains are necessary to drain salt away.

Groundwater Recharge

Also known as deep percolation, groundwater recharge is the process of water moving down from the surface into the groundwater system. This can occur naturally or artificially.

Halophyte

A plant that either can tolerate or requires a saline environment in water or soil. Less than 2% of all plant species worldwide are halophitic, and many are endemic to Western Australia.

Paleodrainage Flat

An ancient watercourse no longer in use by the stream or river which cut its flow pattern into the land, but still active for drainage.

Productivity

The measurement of the consumable biomass produced per unit of land area. Productivity is often measured in weight per acre or hectare, but can also be a measured ratio of agricultural outputs to inputs.

Pyriscence

Seed release due to the environmental trigger of fire that some organisms develop in fire-prone environments. These organisms exist in much of Australia.

Saltgrow

A hybrid eucalypt tree that is fast growing and highly tolerant to waterlogged and saline soils.

Salinity, Primary

Salinity that develops naturally in areas where there is a high salt content in soils and water. This includes salt lakes, salt pans, salt marshes and salt flats.

Salinity, Secondary

Salinity that develops as a result of clearing or changed land use, usually caused by human activity, and is categorized as salinization of soil, surface water and/or groundwater.

Serotiny

When the seed of some plants release due to environmental trigger rather than maturity. A well known environmental trigger is fire. See pyriscence.

Yield

The measurement of the amount of a single crop that is harvested per unit of land area. Yield is often used for cereals, grains or legumes and is normally measured in weight per acre or hectare. It is only an effective measurement for the method of monocropping, and cannot take into account inputs or diversity of crops.

Introduction

The site of investigation is the southernmost corner of Western Australia, in a highly productive and economically important region called the Wheatbelt. The southern portion of Western Australia is currently experiencing high levels of secondary salinity, a condition associated with land clearing and altered land use. In the case of the Wheatbelt region, secondary salinity is due almost entirely to agricultural practices. Many of the problems experienced in this area are emblematic of dryland farming difficulties around the world.[0] Additionally, the Wheatbelt is recognized as one of the most unique and biodiverse regions worldwide, yet farming practices are having a significant and negative impact on its biodiversity.[1]

In Western Australia, the problem of increasing salinity has been evident since the late 1800s; but has not been until more recently that the ecological toll of farming has become recognized as a significant, nationwide problem.[2] However, rural communities are experiencing a number of other problems, including an aging workforce, labour shortages and a decreasing population which also have a negative impact on ecological systems as well as the farmers living there.[3] To address the core issues, responses must extend across a wide range of scientific, social and economic fields. The role of design in places not normally experienced by humans, yet greatly affected by us, is one being questioned already within the architectural field. Finding the value and function of design in these spaces is important, not only for learning how we experience and understand regions outside the periphery of human existence, but also for the future of the profession and its responsibility to cultivate meaningful relationships, human or otherwise. This thesis strives to find its significance in this realm by addressing the problems of scale, temporality and cultural networks in rural regions that are not necessarily apparent when viewed wholesale, yet are all part of the issues of rural communities in Western Australia and not necessarily addressed by methods of land remediation.

This proposal involves a light intervention on lands negatively impacted by agriculture. The intervention provides a social destination within a rural landscape that serves three users: the farmer, the visitor and the environment. The proposed physical infrastructure engages and operates as a visible part of a wider system; including elements of soil health and habitats for native flora and fauna, while also creating a platform for human interaction, education, and recreation. It also encourages initiative by the farmer with the potential to give an economic return. The design of the intervention is influenced by already established practices to reduce secondary salinization damage, as well as speculating on potential reciprocity between the three users. The farmer benefits from a secondary income and increased public awareness; the visitor is invited to participate in a system rarely seen and given an opportunity to learn and experience some part of food production as well as view local wildlife; and the ecosystem is given a place within the constructed landscape not normally habitable by the native plants and animals.

"*Our work in cultivated and urbanizing landscapes brings sharpness to things you can see, uncovers and reveals things you otherwise wouldn't, obscures things we choose to suppress in favor of those we foreground, and refers to things you may know about but could never see from one perspective. What you can see is the tangible, reduced, edited, straightforward reality we build. But it's never that easy, despite common observations to the contrary. What you don't see in a landscape relates to a telescoping interest that takes in many realms and scales that lend meaning to the work. It consists in varied proportions of what came before, what's beneath the surface, what's behind the shapes or patterns, below the horizon, past the view, beyond our capacity to see. It relates to practices and habits of mind that may be objective, subjective, rational, poetic, or just practical and obvious. And it is subject to adaptations that will unfold in time in a partly managed, partly random future*."

- Excerpts, Visible | Invisible [4]

This project explores both farm and territorial scales, current economic and social problems being experienced in the area, and the current state of dryland agriculture both in Western Australia and around the world so as to bridge the relationship between urban and rural landscapes. This is in hope of participating in the growing discourse on architecture, not just as a tool for design within urban areas in a conventional sense, but also as a way of reconnecting people to the living systems around them.

See footnotes on following page

The Rural Place

'But how could we be were it not for this planet that provided our very shape? Two conditions—gravity and a liveable temperature range between freezing and boiling—have given us fluids and flesh. The trees we climb and the ground we walk on have given us five fingers and toes. The "place" (from the toot plat, broad, spreading, flat) gave us far-seeing eyes, the streams and breezes gave us versatile tongues and whorly ears. The land gave us a stride, and the lake a dive. The amazement gave us our kind of mind.'

- The Place, The Regions, and The Commons [5]

It was my own experience that drew the thesis to this particular corner of Australia. I come from a place that has slowly been surrounded by the inescapable suburbs of Southern Ontario. I have never truly felt at home in these suburbs, and so I have moved around somewhat restlessly following opportunities as they came along. Finally, one day I found myself in the Southwestern-most corner of Australia; and there I found a new home.

The place we come from is an important part of who we are, but it does not always have a definitive impact in the way we understand our place in the world. I always felt lost in the suburbs: for me it was empty and soulless. That is not to say one could not find their home there or belong – but I didn't. When I found myself in Western Australia though, my little inner me jumped and sprung though the eucalypts, breathing in the fresh smell after rain and then the dryness that pervades the air soon after. The Banksia charmed me, as did the colourful birds that inhabited their branches, even before I discovered the beautiful temperatures all year round. The red interior desert looked scorched and uninhabitable, yet succulents and cacti bloomed, and grass trees sent up odd seed-holding arms, stretching high into the air, waiting for fire to burst the pods and scatter their offspring. Unknown animals, plants and the occasional fungi surprised me everywhere I went. The colours were bright and surreal, the smells fresh and unusual, and the sounds were strange and slightly hilarious. I felt I had found my home.

0 "FAOSTAT." Land Use Database. Food and Agriculture Organization of the United Nations, accessed April 15, 2015. http://faostat3.fao.org/browse/G1/*/E

1 "Gondwana Link." Greening Australia, accessed August 14, 2015. http://www.greeningaustralia.org.au/project/gondwana-link

2 "Salinity our silent Disaster." ABC, accessed August 14, 2015. http://www.abc.net.au/science/slab/salinity/

3 Fragar, L., A. Henderson, C. Morton and K. Pollock. "The Mental Health of people on Australian Farms, The Facts" Rural Industries Research and Development Corporation and Australian Centre for Agricultural Health and Safety, 2008: 7

4 Douglas Reed and Gary Hilderbrand, "Visible | Invisible," Excerpts, Harvard Design Magazine 36: 166.

5 Gary Snyder "The Place, The Region and The Commons." *The Practice of the Wild*. (Douglas & McIntyre, 1990), 29.

Fig 0.01 Grassy Pastures in winter, South Western Wheatbelt

I realized, however, there was also a sense of familiarity here. Acres and acres of dusty dry farmland stretched over nearly desert lands, and brick, stone, wood and metal homes clustered in small towns, feeling lost, empty, and very hot. In many ways, it looked like other dryland farming* regions. Yet there were certainly parts of this region that stood out to me as unique: it had a different vernacular of growth, cycles, flora and fauna from what I had seen before. The sense of familiarity alongside this left me with a feeling of discomfort. Although I had trouble identifying the source of this discomfort at first, I soon realized it was because the buildings and farming infrastructure had been imported from another land, with little or no thought to the local conditions. The impression they gave was not that of living in conjunction or even comfortably alongside the landscape, but of trying and failing to force it into submission.

Vacant homes and empty towns now litter the countryside, small reminders that a once extremely successful profession is dwindling in the time when food production is more important than ever. Although the Wheatbelt is located in the isolated southwest, it produces 80% of all grains consumed in Australia and exports another $4 billion Australian every year.[6]

There are many causes of population decline in rural regions, but a major one is the economic difficulties of farming. Government policies that once protected farmers have shifted over time to benefit industry and export costs. Labour has become scarce and many farms are also working with new expensive production technologies. While using machines to mono-crop fields requires less people, it also requires greater input in the form of fossil fuels, irrigation and seeds. The increased use and availability of artificial germinators, fertilizers, pesticides, fungicides and herbicides plays a role in economic feasibility as well. These products may increase the yield, but not necessarily the productivity* or value of the crop. The constant and endless growth that our society strives towards is impossible to maintain on any finite patch of land, often leading to resource exploitation and soil damage. All of these factors raise the cost of production for the farmer and lower the return.[7] Successive years of drought, land misuse and a changing climate have wreaked havoc on the farmlands in Western Australia, and because of this rural communities and the people in them suffer as well.

The resources available in urban areas are also a huge draw for younger generations born in rural areas, who have watched their parents struggle and sometimes fail to create a successful enterprise off the land. In addition, rural communities have generally been ignored and are not properly represented in governments and regulations.[8] The desire to have what many see as a successful contemporary lifestyle does not fit into the countryside either, and the stigma attached to rural upbringings pervades amongst the urban populations. This is despite the existence of advanced networking technology that can and does connect remote towns and farmsteads to the information and resources of the cities. Some communities have banded together to create their own distribution and sorting centres, trial new crops, develop better soil and water management practices, open new schools, or develop new methods of self-financing. Most farming families also now have dual incomes to support their farms as well. The farms survive; but still, the population shrinks.[9]

* See Index for definition

6 "Western Australian Grains Industry." Government of Western Australia Department of Agriculture and Food. https://www.agric.wa.gov.au/grains-research-development/western-australian-grains-industry. March 24, 2015. Accessed April 16, 2015.

7 Fragar, "The Mental Health of people on Australian Farms, The Facts," 9

8 Fragar, "The Mental Health of people on Australian Farms, The Facts," 13

9 Ibid 3

Fig 0.02 Sheep out to Pasture, Wheatbelt

This is not a problem unique to Australia. Farming communities are shrinking all around the world as the world's population shifts from rural to urban areas. The rift between urban populations and farmers is already enormous, and we see the disconnect in how we perceive the scale of our land use. This divide is becoming dangerous: 70% of the earth's arable surface area is already devoted to farming and only 3% to cities.[10] Matthew Skjonsberg calls this 70% the 'rural footprint.'[11] As the earth's population continues to grow and shift towards urban life, our rural footprint will also continue to grow likely at a rate exponential to urban growth – harming not only our planet's health but also our own – and likely without ever being seen.

Our focus on cities and urbanized areas distracts us from the greater implications of their design and associated lifestyles, and the impact at a systems scale. Urban communities are insatiable consumers of resources. Sustainability in architecture does not mean sustainability for our planet; it is merely a reduced impact. But these 'small impacts' from 8 billion members of a single species still amounts to a huge impact on the land itself – even if we can not see it in our own backyard. Since land consumption and rural life is so disparate and separated by the size and growth of urban areas, most of us will never see the impact of a growing urban population. Skjonsberg labels this as the 'rural blindspot.' Without thinking about the support system for the places architects design, the future of our profession may no longer have a space to design in. Through the design of urban spaces, we have in many cases perpetuated the loss of connection to those areas of the earth that sustain us.

10 Alder, Jacqueline, John Chilton, Erica Gaddis, Kevin Pietersen, and Christoph Zockler. "Global Environment Outlook 4." http://www.unep.org/geo/geo4/report/04_water.pdf. 2007. Accessed April 17, 2015.

11 Skjonsberg, Matthew and Adriaan Geuze. "Second Nature: New Territories for the Exiled." Counterpoint. 2011. Accessed April 17, 2015.

Fig 0.03 Canola and Wheat crops in the Central Wheatbelt

Fig 0.04 Aerial of a Farm in the Wheatbelt in the summer. An example of controlled tractor traffic is shown on the center and upper portions, important for runoff control and seeding.

Fig 0.05 Canola Crop in the Wheatbelt

Farming and Productivity

The myth of the greater productivity of larger farms stems in part from the confusing use of the term "yield" to measure productivity. Yield is how much of a single crop you can cultivate per unit area – for example, bushels of soy beans per acre.

That is a measure only relevant to monocultures. When you grow a single crop, you produce a large amount of one crop, but the ecological space - the land and water - is not being used very efficiently.

In our current system 1 calorie of food takes 10 calories of energy to produce. Most of this energy comes from fossil fuels and goes towards transportation, processing, packaging, storage & distribution.

The most common myth about agriculture is that to feed the world's expected 9 billion people we will need more land. The reality is, we can use less land if we use it better and reduce our food waste worldwide. Giving some farmed land back to native species can also affect productivity positively by creating a resilient feedback loop, reducing the need for artificial aids.[12] This can be done by introducing wildlife corridors or protected areas within a farm system, allowing some parts of the land to remain naturalized while others are farmed.

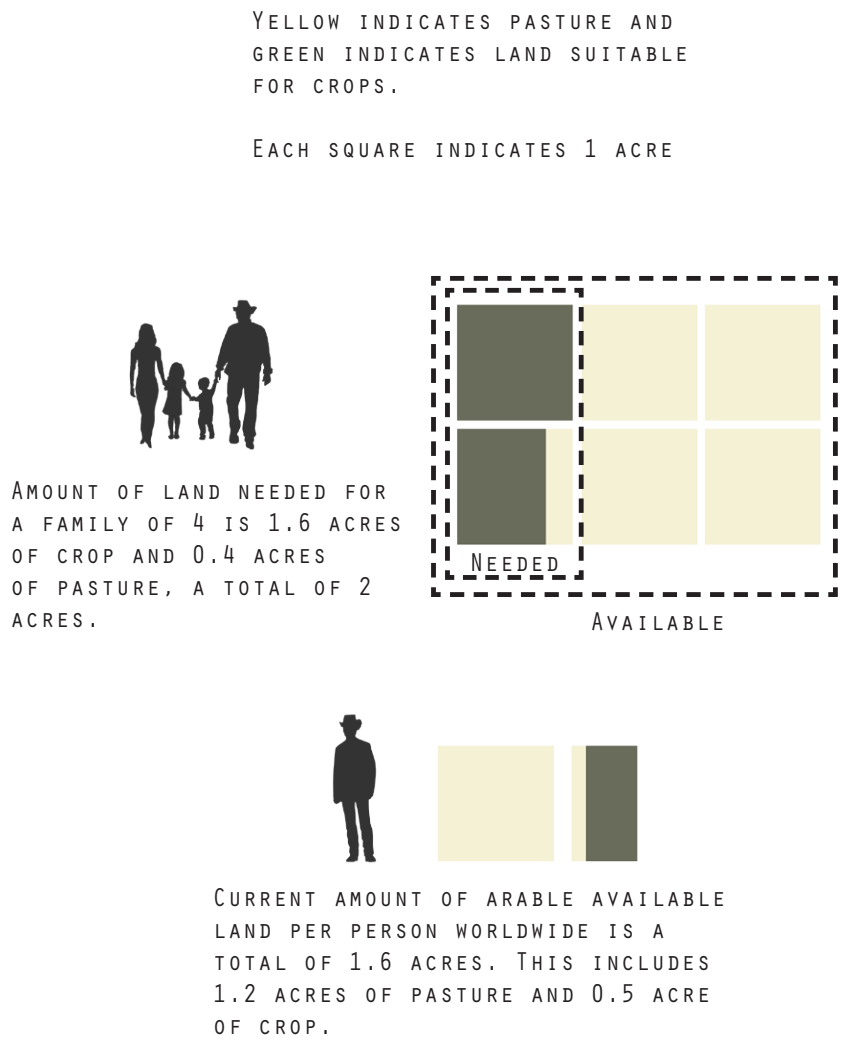


Fig 0.06 Diagram indicating amount of available farmland, what is needed, and what is available. There is already more than enough arable land to feed the world and the expected 9 Billion people, however distribution and waste greatly affect what reaches consumers[13]

12 Andrew Kimbrell & Douglas Tompkins, *The Fatal Harvest Reader* (Island Press: 2002), p. 3-28

13 "FAOSTAT"

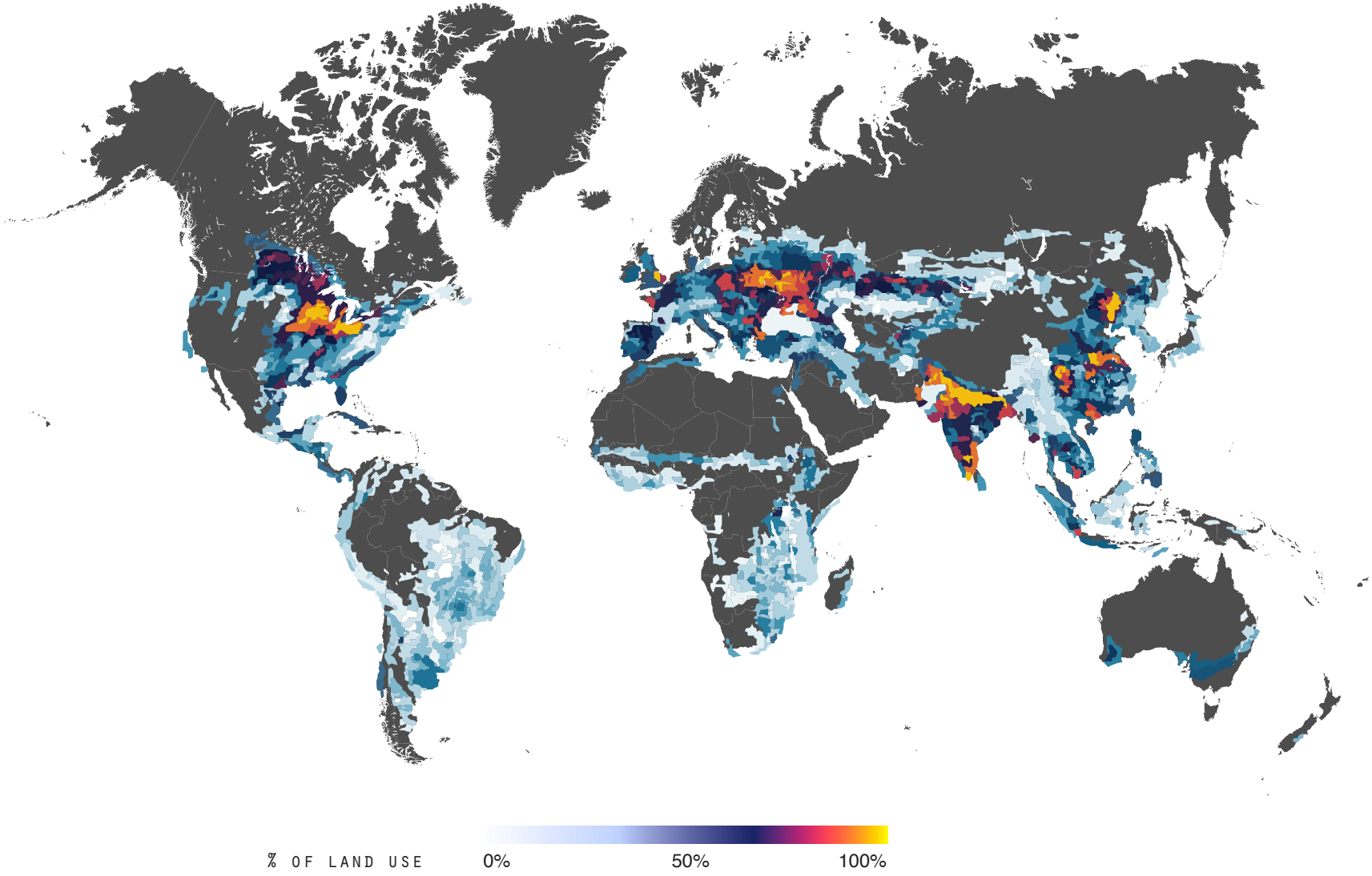


Fig 0.07 Crop Intensity Worldwide (indicates monoculture farming)

Much of the way the general public imagines farming is not accurate, with the truth often veiled by industry, marketing and the fact that increasing urbanization creates a widening physical separation. Human interaction with the natural world has been decreasing at a quickening pace. Due to the current industrial attitude by which we approach production, many no longer understand our impact on the planet that forms and maintains our way of existence. Human occupation of land is nearing half of the planet's surface area.[14] The bucolic image many have of the traditional farm, in most cases, no longer exists.

Agricultural communities are facing many challenges: competition from growing urban areas, population loss, an aging work force, and ecological and human health problems resulting from standard industry practices.[15] This thesis proposes that design can be used as a tool to help develop a synergistic approach to rehabilitating agricultural communities by aiding in the development of widespread understanding of our systems of food production. New types of interaction with rural landscape, realized at a more human scale than modern industrial agriculture, can become highly productive for community and ecological needs.

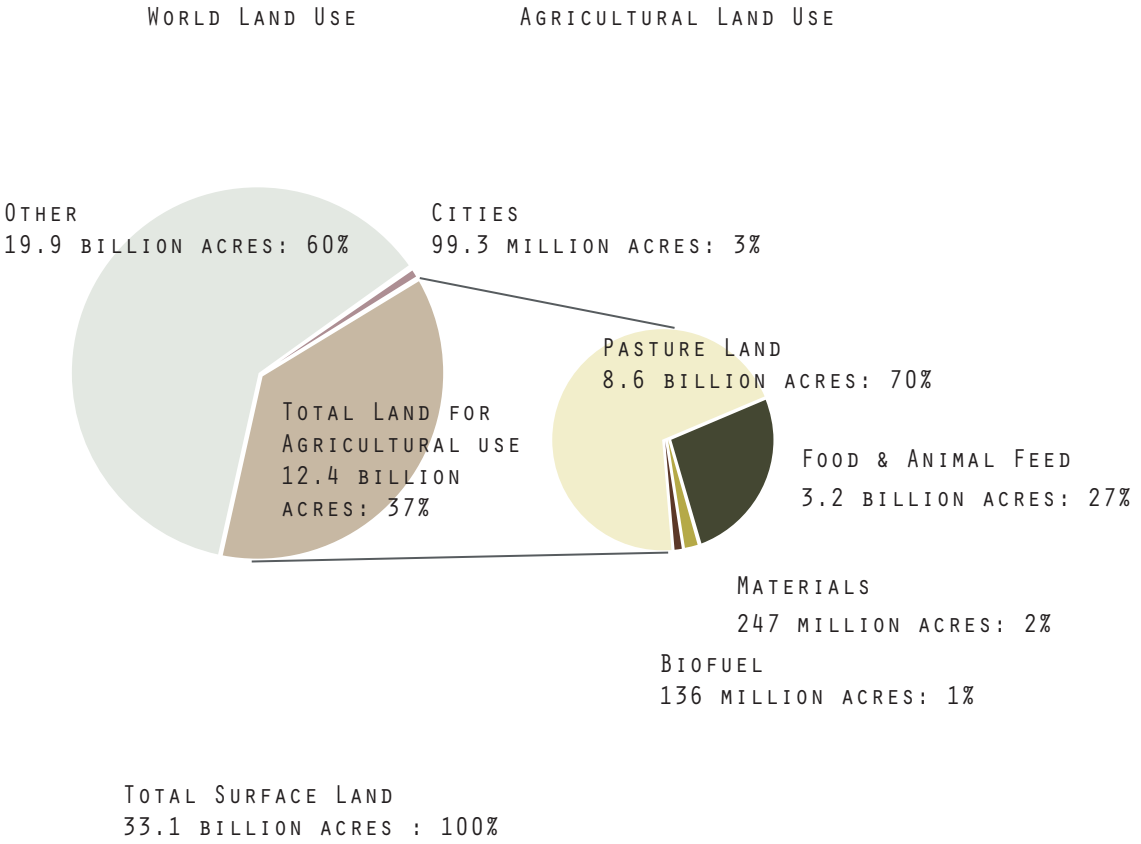


Fig 0.08 World Land Use and on the right: World Agricultural Land Use.
These diagrams show the disproportionate amount of land used for agriculture and the breakdown of land use within the agricultural regions.

14 "FAOSTAT"

15 "Wake Up Before it is too Late," last modified September 18, 2013, http://unctad.org/en/PublicationsLibrary/ditcted2012d3_en.pdf

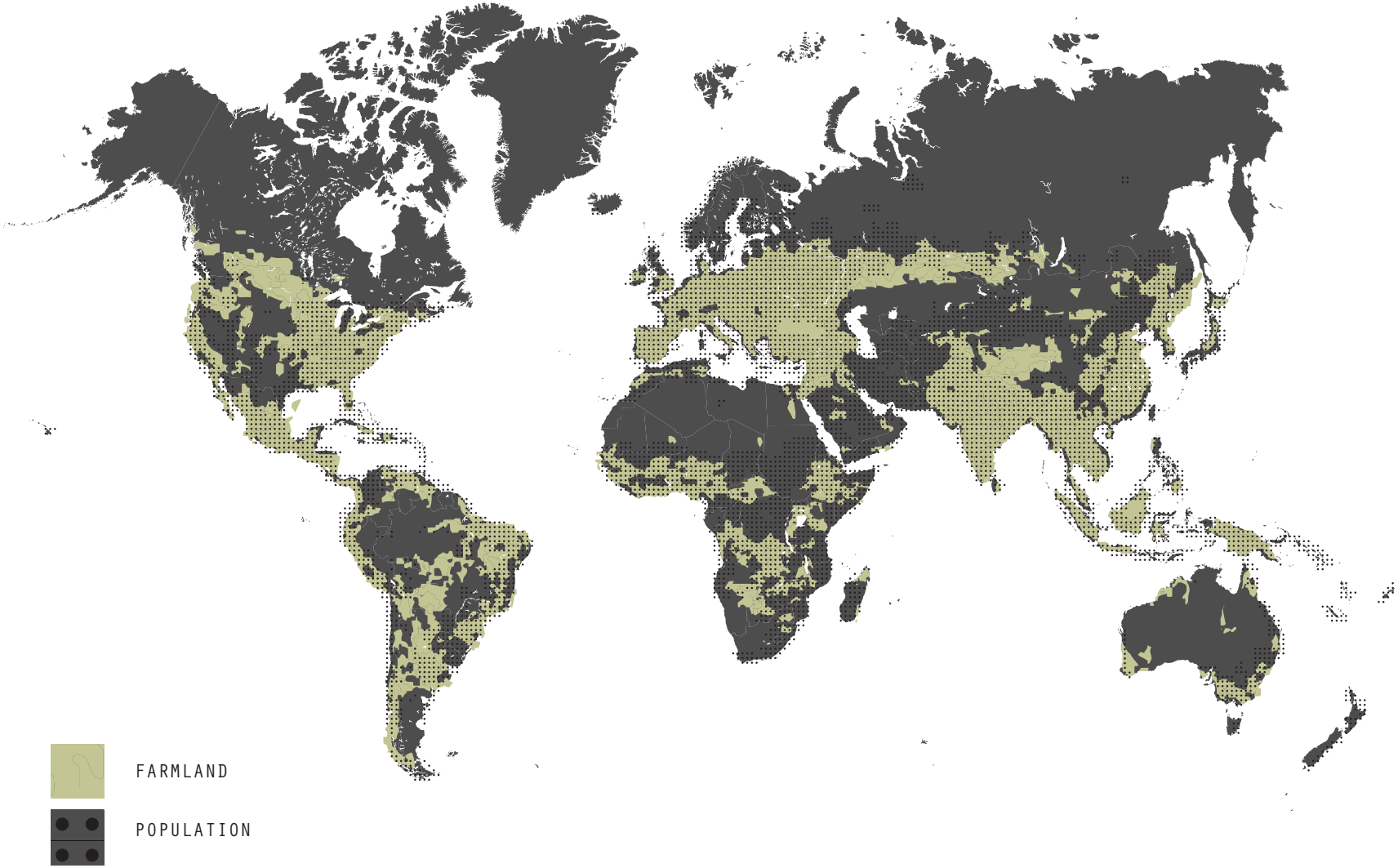


Fig 0.09 Urbanization & Agriculture. This map indicates that agriculture and urbanization are often quite close together and often competing for prime land.

Today, dryland agriculture exists across the planet in its industrial form despite existing knowledge of better practices that do not require petro-chemical fertilizers and other habitat-destructive practices. The Wheatbelt of Australia is at a critical moment for addressing hydrological issues, soil degradation and wildlife loss related to these farming techniques; but the region is also representative of widespread, global problems associated with modern agricultural practices and land development. The emerging movement of urban farming and interest in complex metropolitan organizations of food distribution has given rise to the possibility of operating more holistically within cities. However, this does not mean 'rural' issues are becoming irrelevant: urban farming still represents a small portion of overall food production.[16] Integration of sustainable practices and resources for reviving the land and rural communities must be done rurally and on a much wider scale to affect real change.

Soil health is the key for rehabilitating the land in rural areas. However, despite all of the current research focusing on life above the soil surface, life below is still barely known or recognized by the general public.[17] Soil studies and a rapidly developing understanding of the microbiota and organisms in the earth's soil are now showing that soil diversity is as important as the diverse microbiome in our own stomachs for our health.[18]

This thesis project will develop methods of fostering land stewardship and community development within rural areas through awareness of soil health. The intervention will act as a scaled down system to help create wider understanding of large-scale spatial problems and assist in creating an urban consciousness of farming. Australia's standing as a wealthy, developed nation, and its history as an adaptable and resilient place, situates the country as the perfect point for re-imagining and re-working concepts of agriculture. By examining rural Western Australia through the lens of its social and spatial complexity, the possibilities and value of design in remote and isolated areas –as a tool for wider consciousness operating alongside the ongoing technical aspects of remediation – will be better understood.

16 "Feeding the Cities, The Role of Urban Agriculture," FAO, accessed April 17, 2015, http://www.fao.org/docrep/x0262e/x0262e22.htm

17 "The Past, Present and Future of soils and human health studies," Soil Journal, accessed April 17 2015, http://www.soil-journal.net/1/35/2015/soil-1-35-2015.pdf, 40-41

18 "So, what is the link between soil health & human health?" Soils For Life, accessed April 17, 2015, http://www.soilsforlife.org.au/announcements/soil-health-human-health

19 "FAOSTAT"

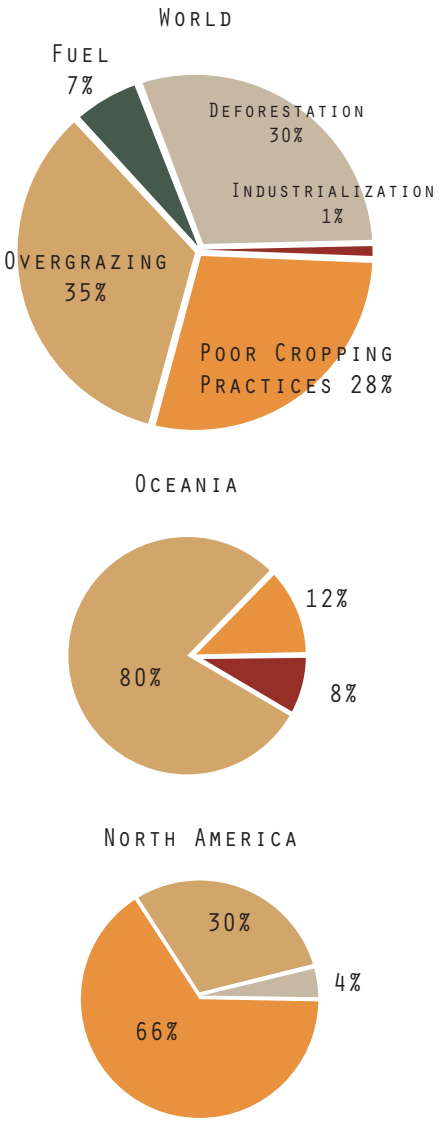


Fig 0.10 Soil Degredation Causes
Overgrazing worldwide is the largest cause of land degredation & crops a close second. It should be noted that the most significant cause of deforestation is agriculture. Combined they account for the most damage by far of soils worldwide. [19]

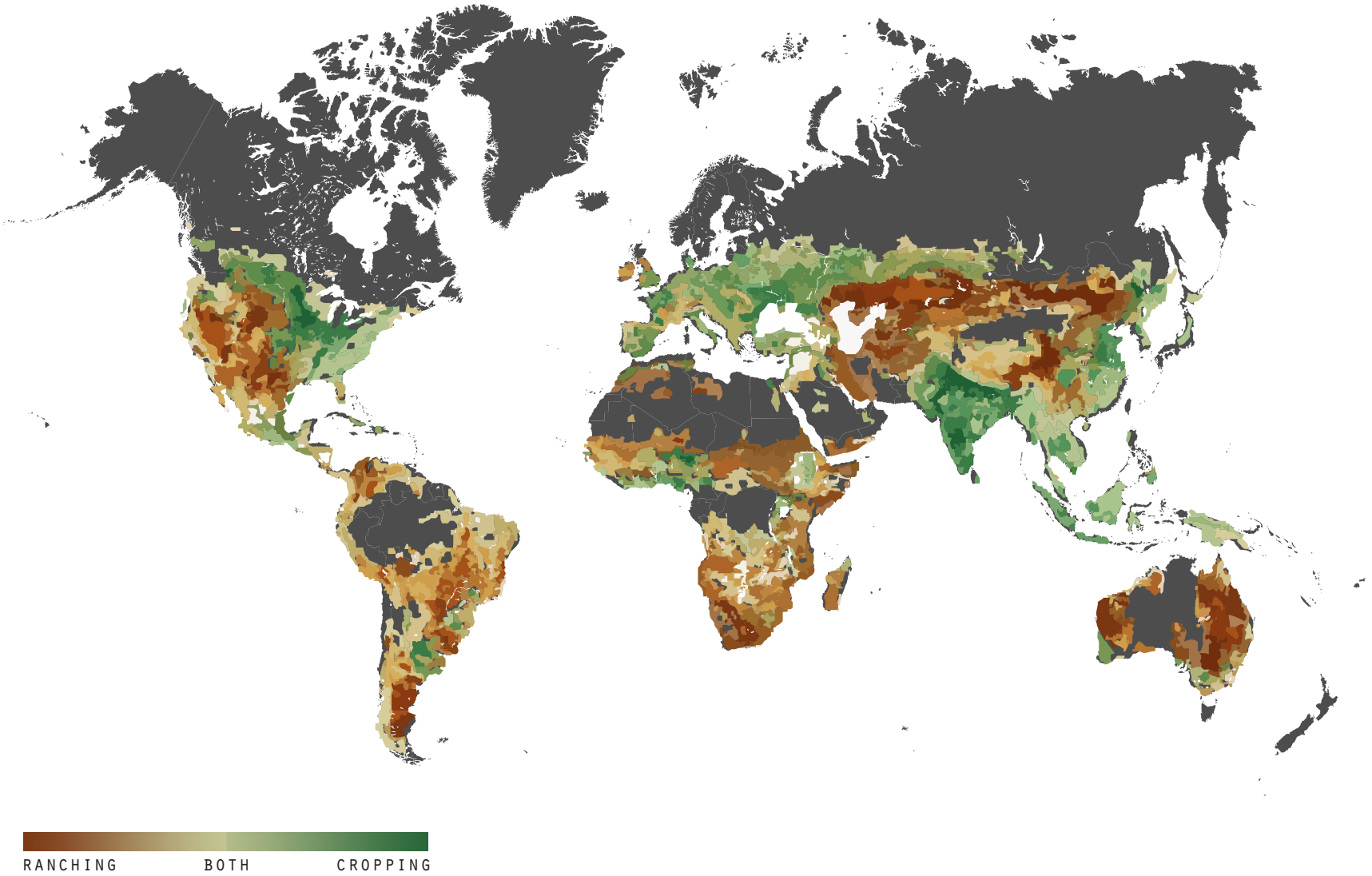


Fig 0.11 Agricultural Land Use worldwide. Red indications pastures and green indicates crop.

01 Site Analysis

Site

The following is an investigation into the regional site of Western Australia at a wide scale, in an attempt to develop an understanding of the broader conditions and relationships. This section looks at some of the more influential historical, economic and social aspects of farming in Western Australia. In order to address the territorial scale of farming in a sensitive and effective way, the role these relationships played must be understood. Western Australian landscape and rural culture continues to have a strong connection to its agricultural past, which has also strongly informed the shaping of ground conditions today.

Location

Western Australia is a unique and biodiverse region of Australia known for its mining and agriculture. The Wheatbelt sits in the southwestern corner of the state, bordered by eucalyptus forests, mallee scrubland and desert. It is Australia's largest wheat producer, and the primary grower of Canola. Sheep and cattle are also common, with ties to the United States, China and the Middle East for exports.[20]

The capitol city of Western Australia is Perth, which sits on the ocean coast and to the west of the Wheatbelt; it is more than 2000km to the closest major city, Adelaide, in South Australia. Just over 2.5 million people inhabit Western Australia, with close to 2 million in Perth and approximately 77 000 in the Wheatbelt in 2010.[21] The Wheatbelt region is massive, covering an area of 154,862 square kilometres, with a Gross Regional Product of $6.4 billion in 2013.[22]

Farming in Australia has traditionally been a major source of prosperity and a well-respected profession. Australia 'rode the sheep's back' into the 21st century, overcoming considerable ecological difficulties in its short history. New global food networks have irreversibly linked us in surprising and complicated ways to those who farm, but have not connected us to the land in a way that ensures the survival of farmers and farming communities we depend upon. This disconnect has created an opportunity for re-inhabiting rural regions in a more conscious way. The landscape of Western Australia must be re-inhabited in a socially-regenerative and environmentally-sustainable way.

Another issue in the Wheatbelt is soil condition. Farmland salinity has been rising as a direct result of broadacre agriculture* and the lack of native perennial flora that maintain salt levels by keeping the water table low. Currently, there are no widespread, cost-effective practices of soil management for the numerous terrains and habitats across the South West – each site requires individual consideration, testing and remediation in order to achieve stability and thrive.[23] Despite this, salinity is being addressed in a number of ways, and the remediation efforts – until now unseen by the urban public – can be used as a gateway for creating awareness of other problems experienced in the Wheatbelt.

These problems include a decreasing rural population, farmers that are struggling with psychological and environmental problems, which has consequently lowered productivity, and the lowest numbers and the oldest average age of farmers ever. Not only is salinity effecting yield, but as rainfall decreases and temperatures increase from the earth's changing climate, farmers have begun abandoning their land for more profitable ventures.[24] Labour shortages, due to competition from the mining sector, have only exacerbated these problems.

Fig 1.0 Image on right
Map of Australia
Areas in dark brown show the main agricultural regions & dotted lines indicate large vermin fences guarding farmland somewhat ineffectively from pests such as emus, wild dogs & rabbits. Only the largest fences are shown here.

The spread of invasive rabbits released by early settlers had a devastating effect on agriculture in the early 1900's and was the driving factor behind some of the longest infrastructure on the planet: Rabbit Proof Fences that stretch over 3000km. It is still a hotly contested subject today, blocking migratory routes in the most diverse parts of Australia.

There are four fences in Western Australia that border and cut through the Wheatbelt. This infrastructure is important because it shows the scale at which Australian agricultural intervention effects the land. Some of the fences are still maintained today. The main fence in Western Australia, shown in the diagram, is now known as the State Barrier Fence.

* See Index for definition

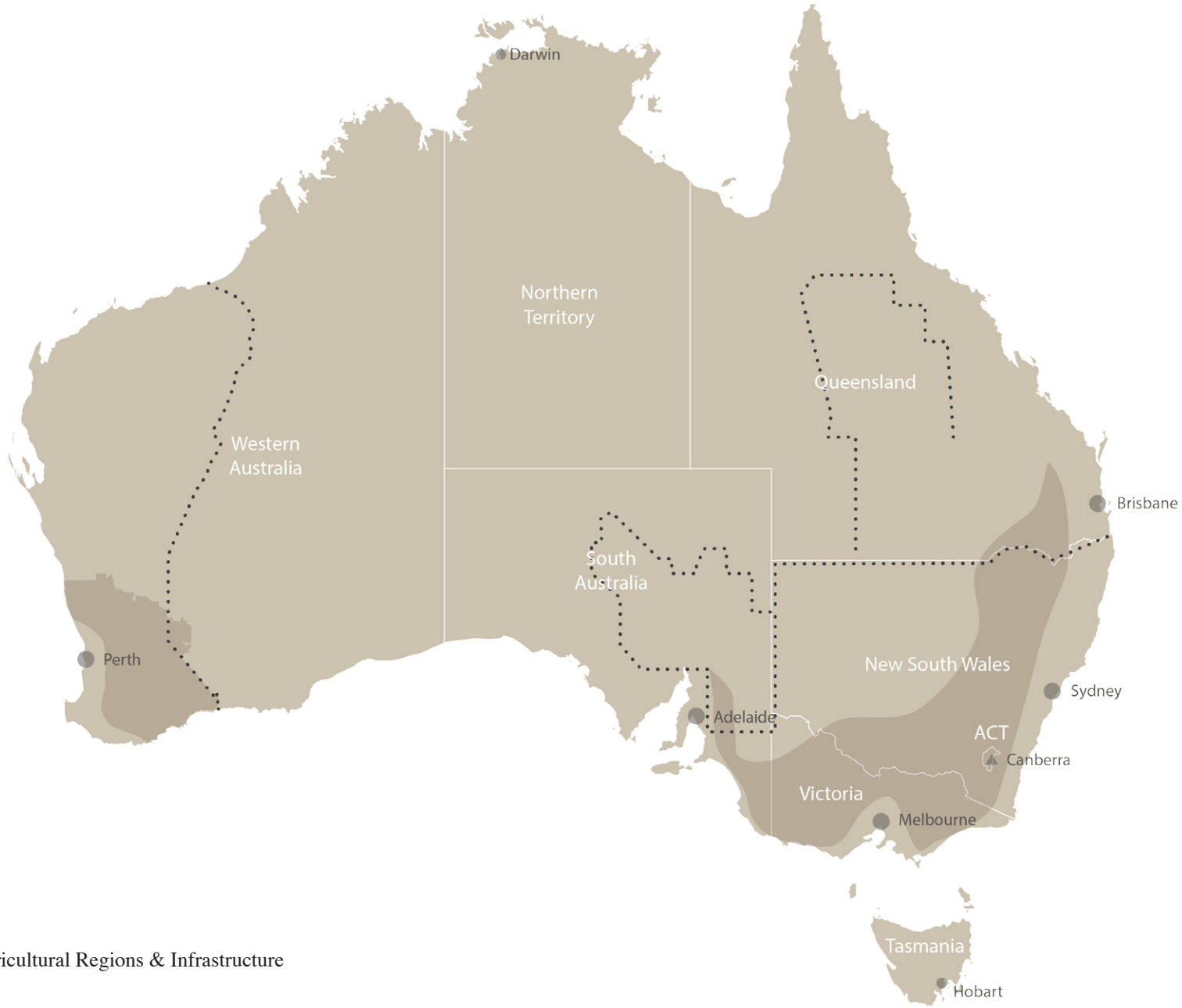
20 "NFF Farm Facts: 2012," National Farmers' Federation, 2012, accessed August 14, 2015, http://www.nff.org.au/farm-facts.html: 10, 31.

21 "Australian Demographic Statistics," modified June 25, 2015, accessed September 15, 2015, http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0

22 "Crops" & "Food, export & Investment," Department of Agriculture and Food, accessed April 17, 2015. https://www.agric.wa.gov.au

23 "Principles for Regenerative Landscape Management." Soils for Life 2012. Accessed August 14, 2015. http://www.soilsforlife.org.au/principles

24 Fragar, "The Mental Health of People on Australian Farms, The Facts." 5.



Australia's Agricultural Regions & Infrastructure

Western Australia Regions & Major Cities

Fig 1.01 Western Australia
Area in dark brown shows the focus area of the thesis research - the Wheatbelt

Western Australia was only truly developed after the discovery of gold, when the costs of constructing roadways and water infrastructure in such a remote location were more than recovered in the numerous mining operations that Australia is now known for.

The location of the Wheatbelt is telling of the conditions of Western Australia; the concentration of farming is precariously positioned in a small zone suitable for growing. With a changing climate and rising salinity damage, this zone has nowhere to go but to disappear. This is important because the precariousness of arable land is often misunderstood because the region seems so large at ground level. In reality, once this land is damaged there will be no more farmland.

Fig 1.02 Data

Sheep Farms

There are 15.5 million sheep produced each year in the wheat belt and approximately 5000 sheep farms.

The majority of live sheep exports are sent to U.A.E, Jordan and the U.S. Greasy wool exports are sent mainly to China.

The meat industry is worth $327 million each year, and the wool industry is worth $521 million each year to Australia's economy.[25]

However, grassy pastures like the ones sheep graze on will no longer be possible if salinity the soil continues to increase. Wheat, the third biggest export, will also not be able to withstand the saline soil.

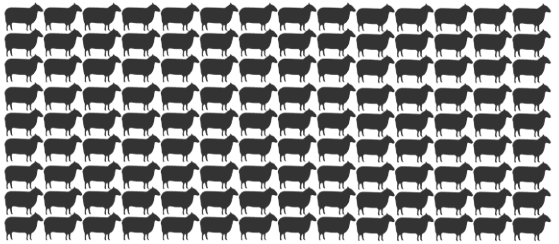
25 "Agricultural Production," ABS, last modified May 24, 2012, accessed April 17, 2015, http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Agricultural%20production~260

The Wheatbelt produces 70% of all grain in Australia, worth $3.4 billion in exports mostly sent to China.

Population 2010: 77 000

Area: 154 862km2

100 sheep per sq km



1 Person to every 126 Sheep

Average farmers age: 52

Last year Australia lost 18 000 farmers

Climate and Soil

The coast of Western Australia, including some parts of the Wheatbelt, sit at the convergence of three major ocean currents. The currents bring a wide diversity of life forms and nutrients from warm and cool parts of the surrounding oceans. Coastal life is greatly impacted by these currents. Air currents flowing north from the Antarctic closely match the path of the Antarctic ocean current, provide cooling and create a wet temperate climate along the coast. Australia's arid interior provides dry heat, and the mixing of these cool/wet and warm/dry zones creates a unique Mediterranean region in the middle. This is where the Wheatbelt is located.[26]

The soils found in the different regions of the Wheatbelt contribute greatly to the unique diversity found there. Many of the preferred agricultural soils are duplexes with a rich nutrient layer on the surface and a sandy layer beneath. These soils offer optimal conditions for growing as they provide excellent organic matter to grow in and a natural drainage layer below. However, many of the subsoils below the surface are naturally saline. This leaves the top layers susceptible to becoming sodic as well if water tables rise. Dry salt lakes and naturally saline drainage flats are a common feature of this landscape. Most surface soils remain non-saline due to perennial vegetation keeping water tables low.

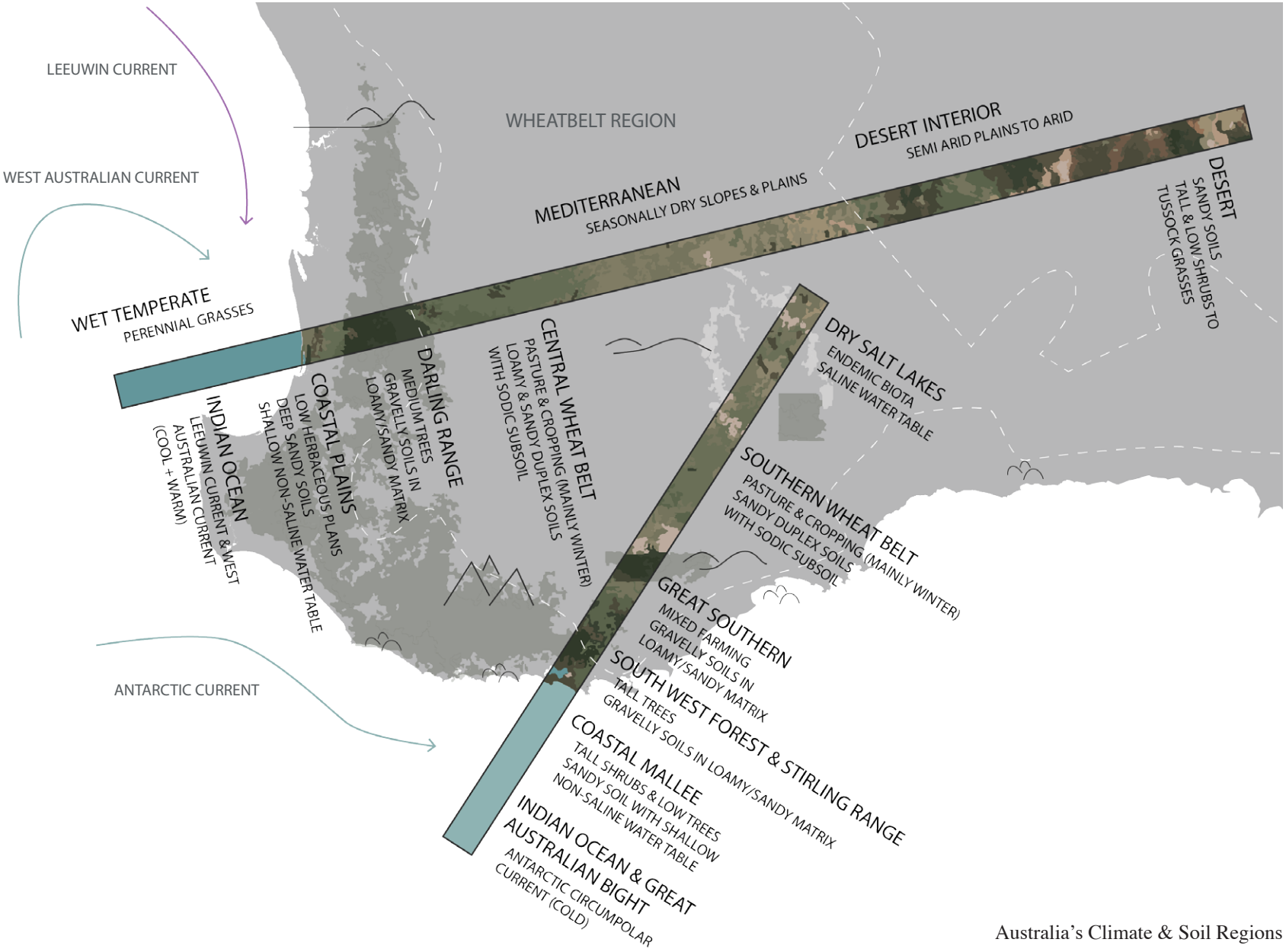
The wide array of soils and different levels of rainfall create numerous regions within the Wheatbelt which provide a wealth of agricultural products, but also a vast amount of different conditions to address when dealing with salinity.

Fig 1.03 Image on Right

Cross Sections through some of the many unique ecological & climatic regions that are found across the Wheatbelt

South Western Australia is home to a very unique set of conditions not found anywhere else on the planet. Warm and cold currents mix along the coast creating a Wet Temperate climate that enjoys hot dry summers and wet lush winters. The Mediterranean inland provides perfect conditions for agriculture, often without irrigation, and a very long growing season. The desert surrounding the Wheatbelt acts as a physical barrier, creating some of the most remote communities on the planet.

26 "Australian weather and seasons - A variety of climates," Australian Government, last accessed April 17, 2014, http://www.australia.gov.au/about-australia/australian-story/austn-weather-and-the-seasons



Australia's Climate & Soil Regions

Ground Conditions

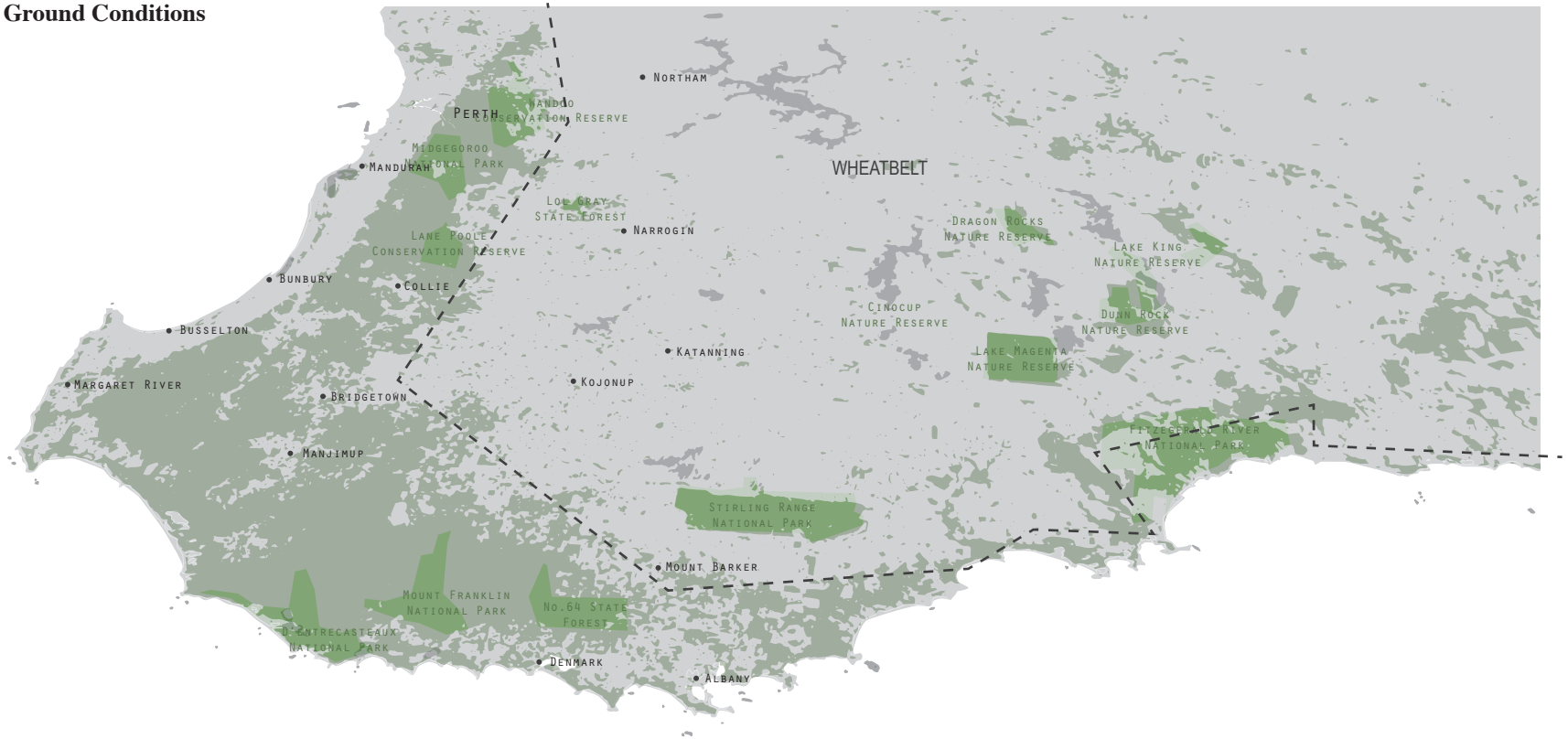
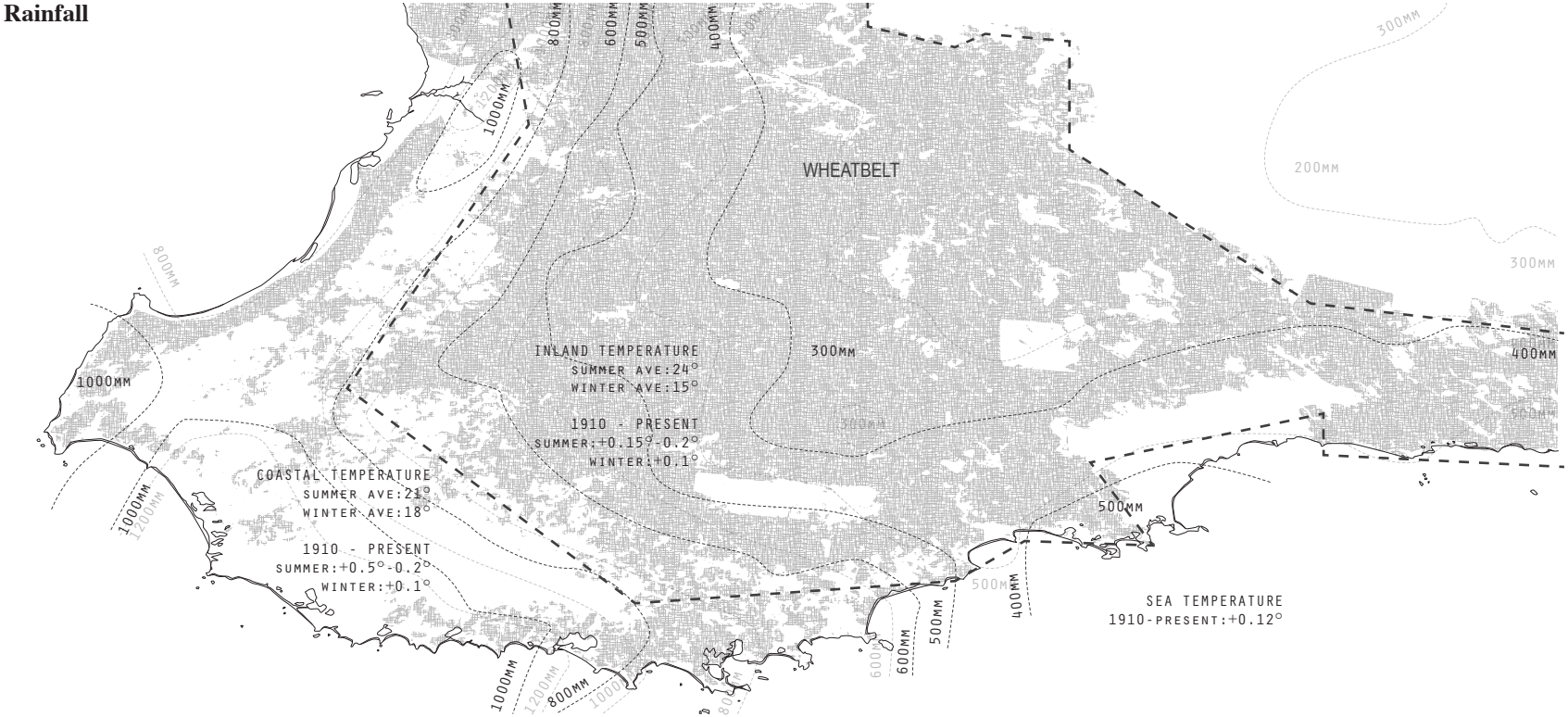


Fig 1.04 Above
South Western Australia ecological regions
Illustrating general regions of Western Australia

Fig 1.05 Image on the right
South Western Australia Rainfall Isohyets
Illustrating the change in rainfall patters from 1910 until Present day

Rainfall



FUTURE CONDITIONS OF THE WHEATBELT

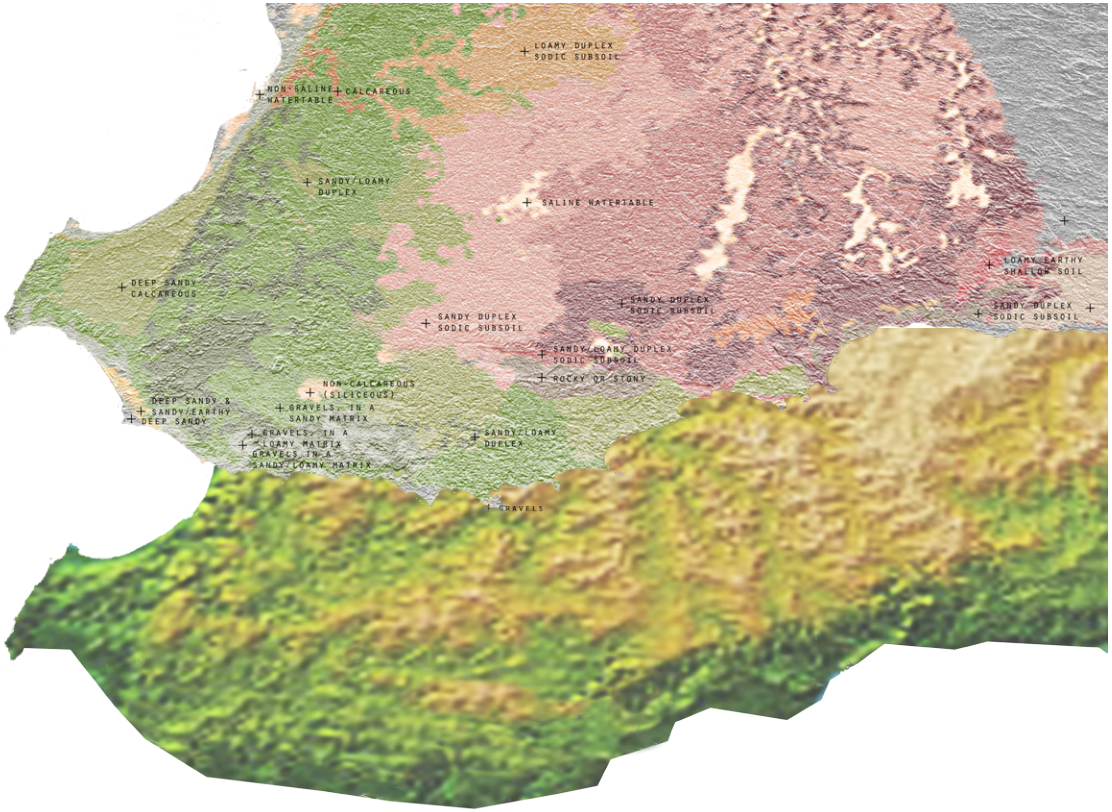
PROJECTION	YEAR	LIKELIHOOD
Rainfall:		
- 15%	2030	High
- 30%	2090	High
Temperature:		
+ 1.2°	2030	High
+ 2.7°- 4.2°	2090	High
Sea Level:		
+ 70-190mm	2030	Very High
+ 270-890mm	2090	High
Fire Frequency:		
+ Harshness	High	

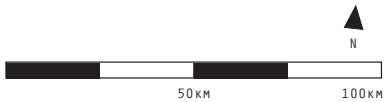
*Data for chart and map from bom.gov.au & climatechangeinaustralian.com.au.

Land Features of South Western Australia

Fig. 1.06
SOIL TYPES
Wide range of soil types even across Wheatbelt area.

Fig. 1.07
TOPOGRAPHY
Unique conditions created by wide array of Landforms ranging from mostly hilly to rocky ranges.





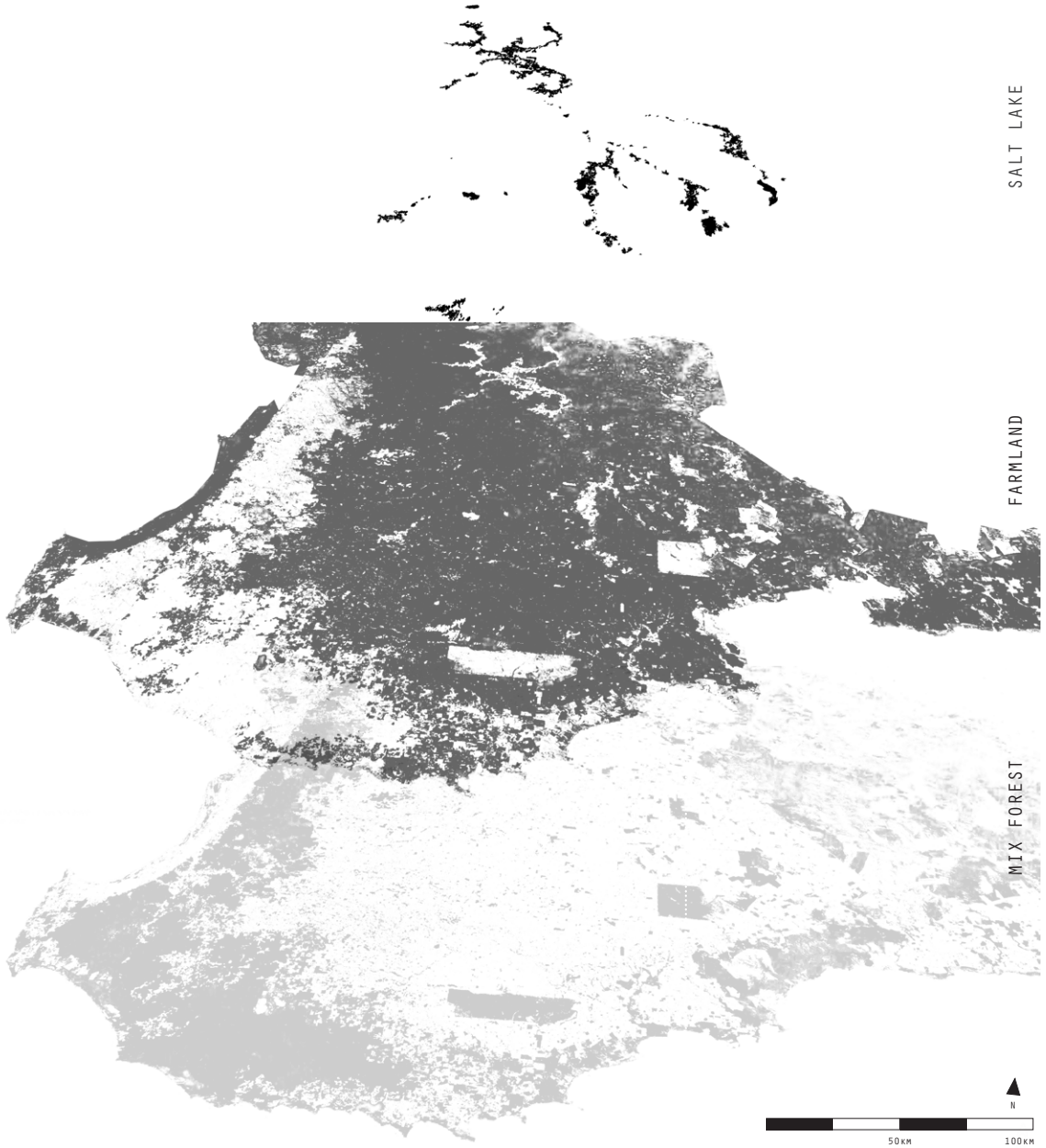
The conditions across the Wheatbelt, although very unique, are also suffering from problems that are very common to farmland around the world. Hilly landscapes, sodic subsoils and reduced old growth forests are common conditions of agricultural regions. Forests provide the rich soils that crops need to flourish, and are often burned or cut down to increase agricultural lands, as was done in the Wheatbelt, to the detriment of local wildlife and human populations. Hilly farmland, seen in the Wheatbelt and many other farming regions worldwide, is highly susceptible to soil degredation from erosion and waterlogging.

Understanding that these problems are not only inherent to Australia is important. Although Western Australia is at a critical point for farmland degredation, exacerbated by the unique climatic conditions and biology of the region, it is useful to address these problems here because Western Australia is a developed nation which has the research, educational and financial resources to support the changes needed. Finding solutions to problems in developed nations can also help address them faster and more effectively in weaker countries who depend on small farms to feed their populations and cannot necessarily use trial and error without alternate resources.

Fig. 1.08
EPHEMERAL SALT LAKES &
SALINE WATERTABLES
Importance:
Highly Unique Biota
Uses:
Salt Harvesting
Problems:
High saline water table
Solutions:
Native salt-tolerant vegetation that can also be used for grazing

Fig. 1.09
FARMLAND
Importance:
Fertile soils and pasture land + migration corridor
Uses:
Livestock + Crop, Mining
Problems:
High saline water table, arid treeless land
Solutions:
Native salt-tolerant vegetation that can also be used for grazing, small crop rotations and tree corridors to protect from erosion and salinization

Fig. 1.10
OLD GROWTH FORESTS
Importance:
Unique flora & fauna, Important Habitat
Uses:
Tree Farming, Mining, Tourism
Problems:
Some areas protected, some not, scattered laws and conservation efforts. Lacking regular burnoff for regeneration
Solutions:
Controlled burns/harvests + planting operations



Riding the Sheep's Back

The Wheatbelt of Australia is one of the most biodiverse regions in the world. Prior to colonization, the Aboriginal population used control burns to bring land in the region to a state of climax vegetation.[27]Today, control burning is regaining popularity due to better understanding of natural systems, as well as uncontrolled bush fires that have wreaked havoc on both populated and remote areas because of the excess of natural fuels built up from the long period of reduced burning after colonization. Fires play an important role in Western Australia because of the nature of its inhabitants; some of which are pyriscent* and others that rely on burning to create suitable habitats. Of the 8000 species living in Western Australia, over three quarters are endemic only to the Southwestern corner, the home of the Wheatbelt region.[28] Many are now listed under the IUCN database as threatened or endangered due to human disruption of natural systems, such as burning. More than 1000 non-native 'weed' species have also been identified as inhabiting the area. This not only endangers local flora and fauna, but is also contributing to the destruction of valuable farmland and decreasing land productivity.[29]

The Southwest is a highly-productive grain and sheep producer, accounting for nearly 80% of Australia's grain and $2 billion Australian in sheep exports every year.[30] The value of the Wheatbelt to the economy is substantial. Farming communities are rapidly declining as the cost of farming rises and public infrastructure to support these communities disappears. Yet Australia's prosperity has come from its difficult agricultural beginnings. It is often said that Australia has 'rode the sheep's back' to becoming a developed country, which is a local idiom referencing the country's wool industry that was traditionally the nation's main export. Today, it also often references the importance that has been placed on the agricultural industry for national wealth. Yet the economic success of the Wheatbelt has hinged on resource availability: water, healthy soils and vibrant ecosystems, all of which are now in decline.

The following timeline and historical section demonstrates the adaptability of the Australian people, their mobility and some lessons learned from a difficult past. This section is important for understanding the changes and development of agriculture within Western Australia, but it also illustrates Australia's ability to overcome such obstacles as extreme soil degradation and severe water crises, the cultural heritage of the Wheatbelt and importance of farming communities. From the perspective of an outsider, this research imparts a valuable lesson about the economic, social and physical relationships of the rural populations to the land, and their importance historically and currently to a wider Australian society. Understanding the history and evolution of the Wheatbelt creates the opportunity to design an intervention that addresses not only the current state of the Wheatbelt, but the region as a whole.

* See Index for definition

27 "State of the Environment Report Western Australia 2007," Environmental Protection Agency Western Australia http://www.epa.wa.gov.au/AbouttheEPA/SOE/Documents/5_WA_SOE2007_BIODIVERSITY.pdf: 127

28 "Threatened Species," IUCN Redlist, accessed April 17, 2015. http://www.iucnredlist.org

29 "Australian Farming and Agriculture - grazing and cropping," Australian Government, accessed April 17, 2015.http://www.australia.gov.au/about-australia/australian-story/austn-farming-and-agriculture

30 "Agricultural Production."

31 E.C. Rolls, "Land of Grass: Loss of Australia's Grasslands" Institute of Australian Geographers, 1999, accessed August 14, 2015, http://www.serratedtussock.com/sites/default/files/Land%20of%20Grass%20-%20the%20Loss%20of%20Australia%27s%20Grasslands_Rolls.pdf: 197-199.

Timeline

WATER

Groundwater Source

Mixed Source

Surfacewater Source

Dam / Weir

INFRASTRUCTURE

Dirt Road

Paved Road

Railway

Shire Region

State No.1 Rabbit Proof Fence

No.2 Rabbit Proof Fence

Water Mains

LAND

Regions

Approximate Area Clearing Occuring

Approximate Area Cleared Land

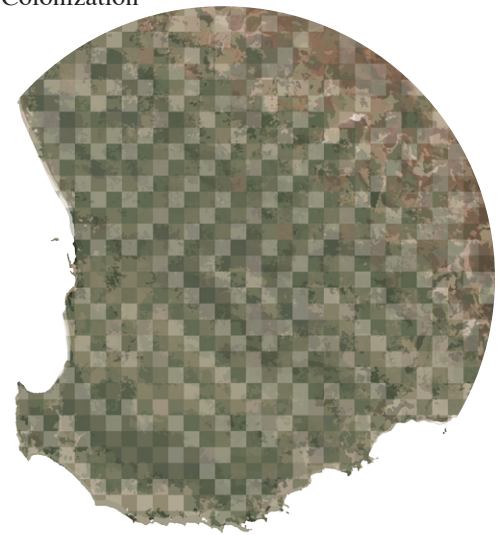
Rangelands Leaseholding

Wheatbelt

Group Settlement

Fig 1.11 Legend
Legend for following pages in 'Timeline' section

Pre- Colonization



Today

Pre-Colonization: Mixed Land Mosaic

Fig 1.12 Pre 1829
Controlled burning by aboriginals created a mixture of types of vegetation at different stages of growth.

This reduced large natural bush fires, created favourable habitats for many flora and fauna and diversified food sources for the aboriginals. Today in all of Australia, less than 5% of the grassy woodlands that characterized the Wheatbelt region remain.[31]

ECOLOGICAL REGION

Soil Degradation

Grassy Woodlands

Woody Shrubland / Farmland

Dryland Plains

Salt Lakes

Desert Borderlands

Central Desert

Forested

Heavily Forested

Legend for maps on right

Fig 1.13 Present Day Conditions
White areas show soil under threat or already affected by erosion & salinity. Most of the wheatbelt is already under threat, and damage is apparent throughout the entire region.

1829 - 1879 Colonization

Fig 1.14 Map & Timeline 1829 - 1879
Fremantle and Albany were the first two ports of access. Early settlers arranged themselves on coastal areas near rivers. These riparian communities were the first food producing settlements, yet still relied heavily on European imports.[32]

Early Transportation
Bulls were often used for transportation of goods, and it wasn't until the late 1800's that enough horses were brought over to be used as pack horses. [33]

Methods for Transportation of Goods and Labourers

32 "A Brief History of the Avon River Basin," Wheatbelt Natural Resource Management, accessed August 14, 2015, http://www.wheatbeltnrm.org.au/sites/default/files/basic_page/files/Brief%20History%20of%20the%20ARB.pdf: 1-2.

33 "Bullocks, Camels and Horses," Western Perspectives on a Nation, accessed August 14, 2015, http://slwa.wa.gov.au/wepon/transport/html/camels.html

34 "A Brief History of the Avon River Basin." 3-4.

35 "Bullocks, Camels and Horses."

36 "A Brief History of the Avon River Basin." 5-6.

37 "Australian farming and agriculture - grazing and cropping."

Fig 1.20 Centre Map & Timeline 1880 - 1889
The 1885 gold rush and subsequent mineral finds in Western Australia nearly quadrupled the population in 20 years and provided the push to increase infrastructure. Land clearing began around the main arterial roads and new towns appeared in its wake.[34]

Afghan migrants brough the first camels with them and they quickly became the preferred form of transportation due to their ability to survive in the desert and travel long distances. Camels are responsible for much of the construction and maintenance of rabbit proof fences, as well as transportation of agricultural products during this period.[35]

Fig. 1.21 Far Right Map & Timeline 1900 - 1919
Group Settlement Schemes began shortly after the war, bringing more British settlers to Western Australia. They were intended to clear land to start wheat and dairy farms. At this time, foxes and rabbits begin to have serious affects on agricultural land and native ecosystems, leading the construction of the Rabbit Proof Fence.[36]

The train network is now more accessible than many roads, and camels are phased out in favour of coal powered trains for the transportation of goods, although some camel use remains. This increases the clearing capacity as enormous amounts of timber can be carried away on the trains.[37]

Photos in Timeline from Left to Right

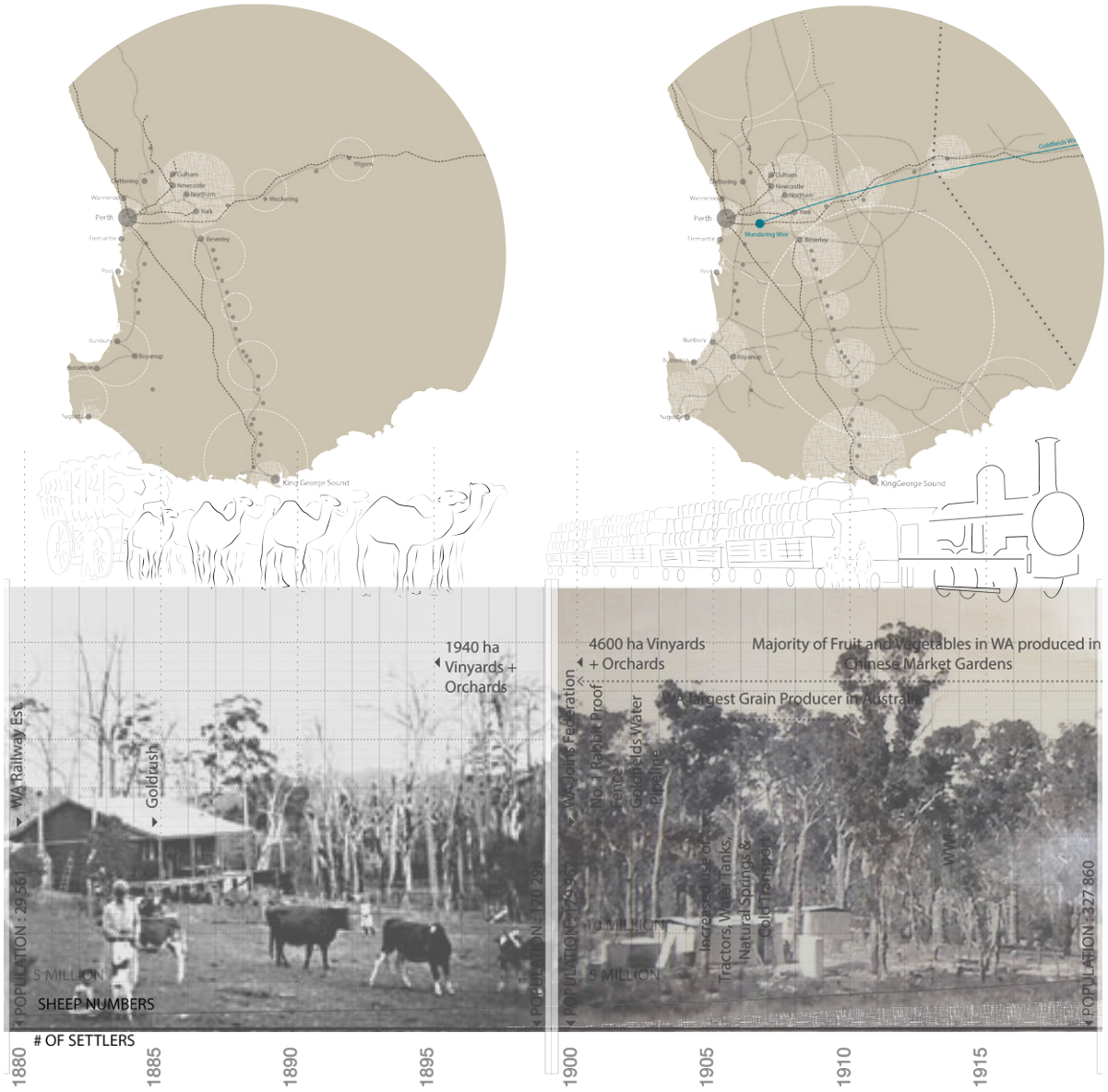
Fig 1.15 Watercolour Painting of Fremantle (Swan River Colony) from the journal of an early settler

Fig 1.16 Photo of an early settler and her tent in a sawmill village.

Fig 1.17 Photo of early construction method using whatever could be found.

Fig 1.18 Photo of Dairy in the Southwest Wheatbelt

Fig 1.19 Photo of the unsuccessful group settlement 95, now known as Northcliffe



1880 - 1899 Forward Move

1900 - 1919 Exploitation & Land Clearing

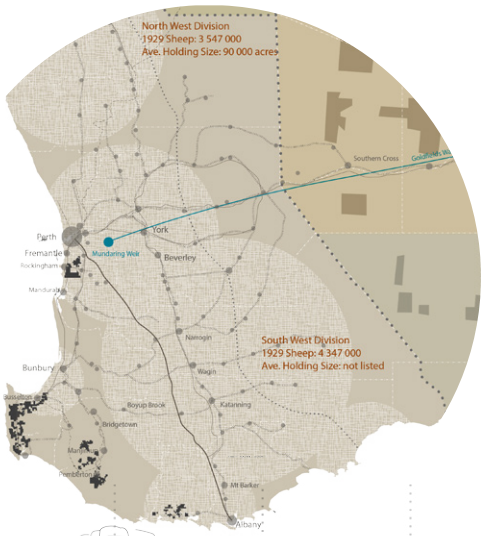


Fig 1.22 & Fig. 1.23 Maps & Timelines 1920 - 1969

Although the war caused economic difficulty and a labour shortages in Western Australia, technology from both world wars brought innovations in irrigation, transportation, cold storage and energy to agriculture. It also brought an abundance of chemical fertilizers and products that allowed for a huge increase in productivity on the same amount of land.[38] Widespread clearing greatly increased the amount of farmland and a wave of immigrant labourers from Italy and then China brought labour, new techniques and viable cultivars.[39]

The arrival of cars in Western Australia improved accessibility to areas not connected to the extensive railroad network, further expanding cleared areas.[40]

38 “A Brief History of the Avon River Basin.” 6-7.

39 “Australian farming and agriculture - grazing and cropping.”

40 “Motor Vehicles,” Western Perspectives on a Nation, accessed August 14, 2015, http://slwa.wa.gov.au/wepon/transport/html/motors.html

1920 - 1949 Conservation, War & Depression

1950 - 1969 Postwar Boom

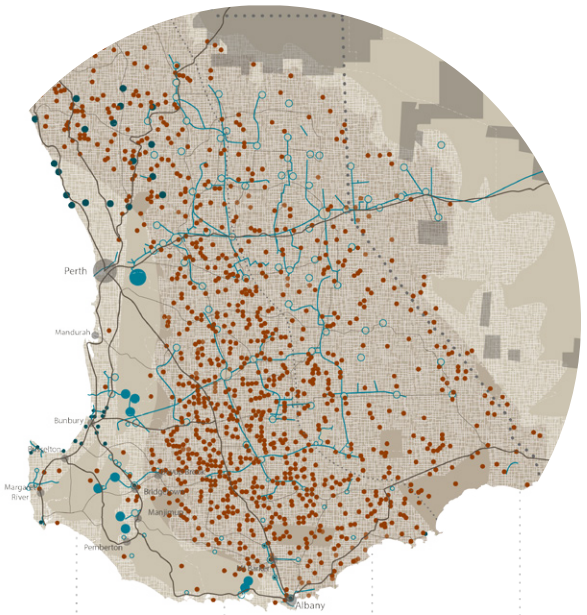
Photos in Timeline from Left to Right

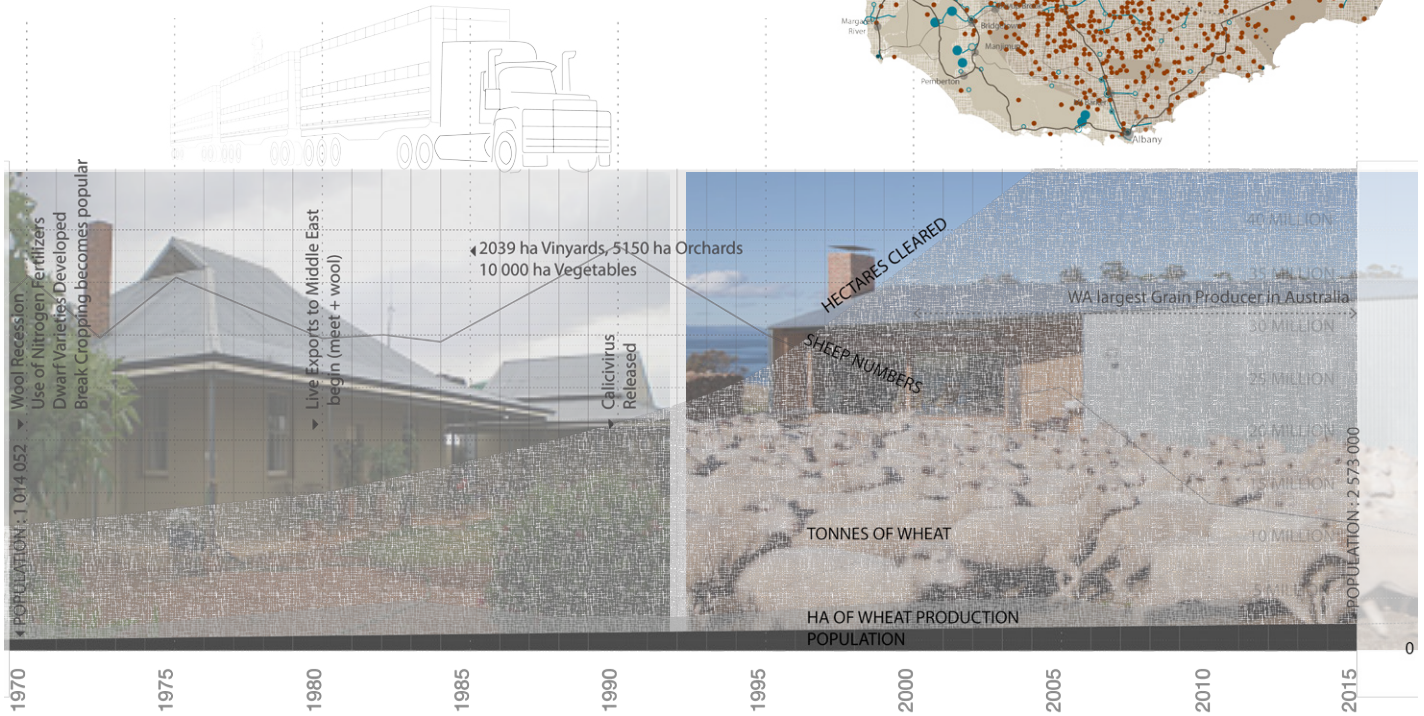
Fig 1.24 Early Failed Group Settlement near Denmark & tree clearing
Fig 1.25 Photo of an asbestos farmhouse and car
Fig 1.26 An old farmhouse from the 1950's constructed of wood and stone
Fig 1.27 A 1980's fibre-cement sheet house, replacing the asbestos construction.
Fig 1.28 Modern farmhouse constructed out of native Karri, brick and corrugated metal.

Fig 1.29 Map & Timeline 1970 - Present
Release of the calicivirus, post-war technology and improved infrastructure brought the biggest wheat boom Western Australia has seen. Since then production has dropped and salinity has increased due to the region's lack of planning and clearing constraints, as well as environmental degredation and poor understanding of soils.

Economic upheaval is regularly apparent in the history of Western Australia, as well as major leaps in innovation. At this time, the population of Western Australia drastically increased, creating further pressure on water infrastructure and planning needs.[41]

41 "A Brief History of the Avon River Basin." 7-9.





1970 - 2010 Market Regulations & Industrialization

Present Conditions

Evolution of the Western Australian Farm

This section is a brief look at the construction methods, materials and size of rural dwellings in Western Australia, as well as the evolution of the family farm in terms out outputs versus land sizes. Infrastructure and artifacts influencing or relating to scale and territorial inhabitation are also noted.

Agriculture has played a major role in the development of the southwest, providing the economic foothold to emerge into the 21st century as a rich and developed nation. Western Australia has changed immensely since colonization, usually through quick bursts of activity stimulated by environmental and economic crises. Traditionally, local resourcefulness and adaptability has created a resilience within the agricultural community in a climate and land that is often unforgiving. Before the 1970's, Australian agriculture relied on many home-grown techniques, despite the prevalence of European foods that were cultivated. Immigration and difficult climatic conditions played a large role in developing innovation in the agricultural industry. Since the 1970's, industralization and new policies have had a significant impact on the scale of farming and techniques used.

The implications of the growth and changes of Australian farms is also an important and necessary study in understanding scale when addressing problems in the Wheatbelt. The following section illustrates the evolution not only of the farm, but helps to anchor the thesis within the vernacular of the region and ways of inhabitation in this particular landscape.

Fig 1.30 An itinerant worker with a swag

Transient Workers

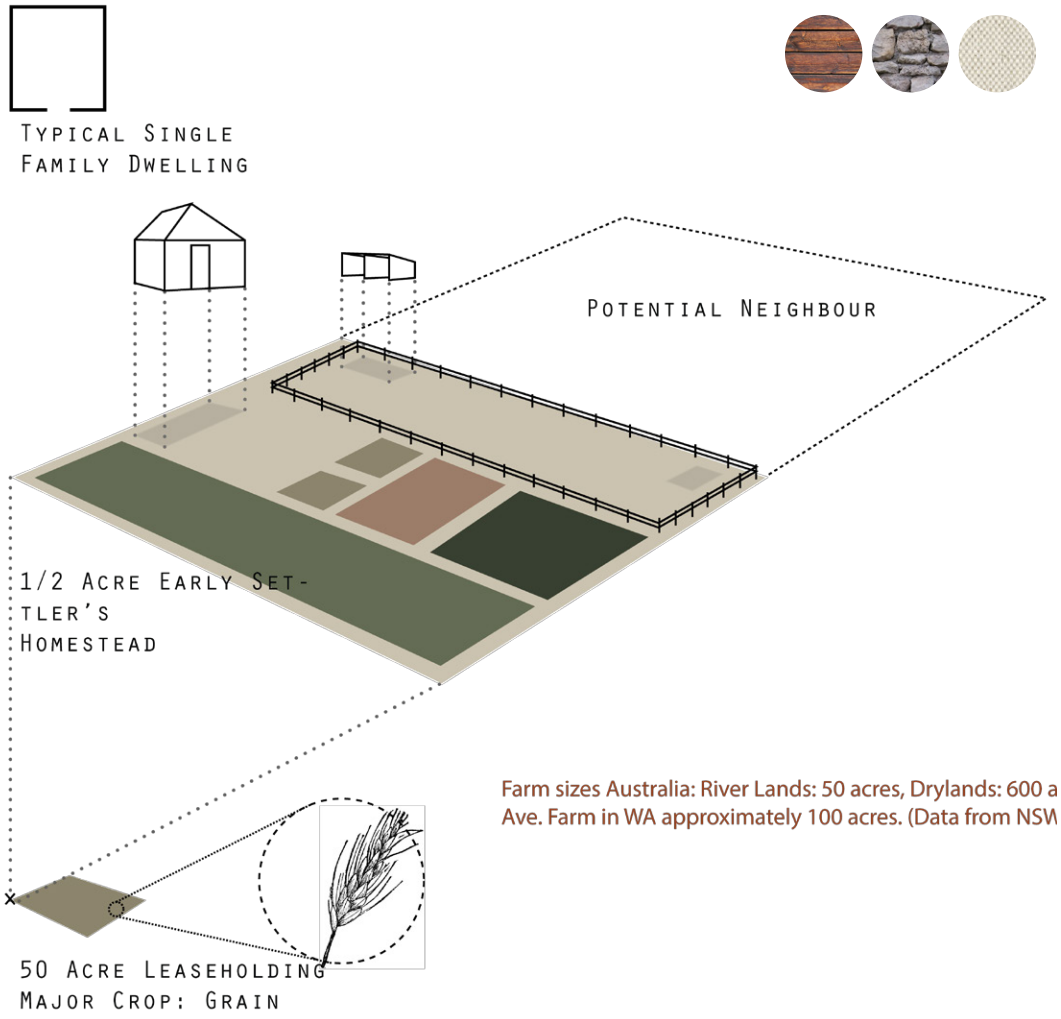
Short term labourer's and unemployed men would walk the countryside looking for work. They carried with them all their belongings in their bedroll, known as a swag. The transient workers were an important part of farms across the country, and often were essential for shearing and harvesting before motor vehicles. Swags are still commonly used today, and are also an icon of Australian culture and mobility. [42]

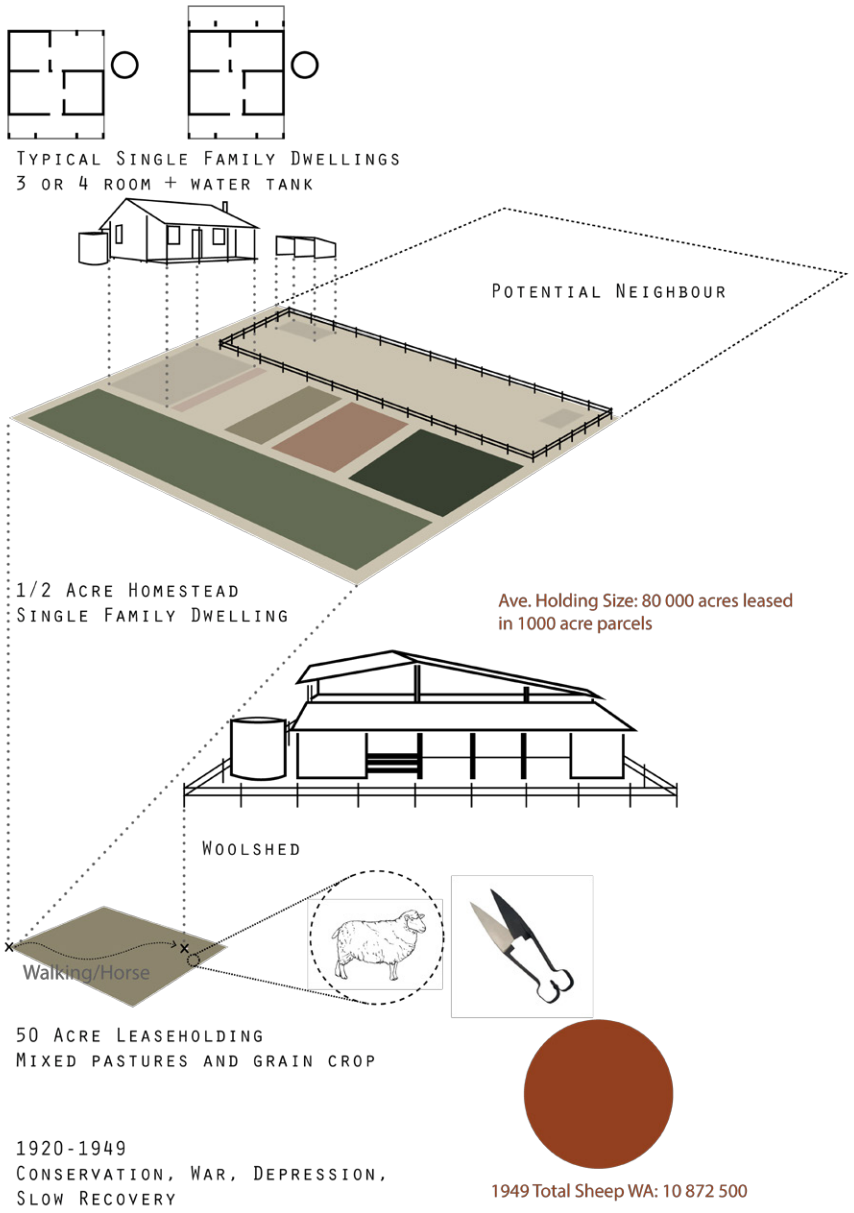
42 "Rural Workers on the Road," Encyclopedia of New Zealand, accessed April 17, 2015, http://www.teara.govt.nz/en/rural-workers/page-4

Fig 1.31 Material Legend for following section

Fig 1.32 Early Settlers 1900 - 1910
A wide variety of crops were grown in the early years of settlement and provided nearly all of the food for the colony. Unfortunately, many of which were unsuccessful around Australia.[43]

43 "Year Book Australia, 2001: Agriculture, the Early Years," Australian Bureau of Statistics, last modified January 25, 2001, http://www.abs.gov.au/ausstats/abs@.nsf/90a12181d877a6a6ca2568b5007b861c/d89985a9f2286efaca2569de0026c597!OpenDocum





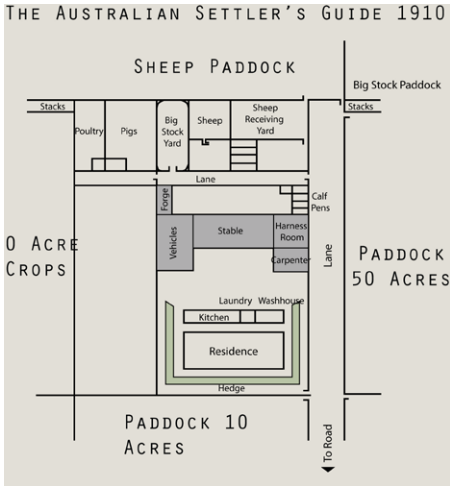


Fig 1.33 Early Settler's Handbook for farmstead planning in Australia

Fig 1.34 Single Family 1920 - 1949

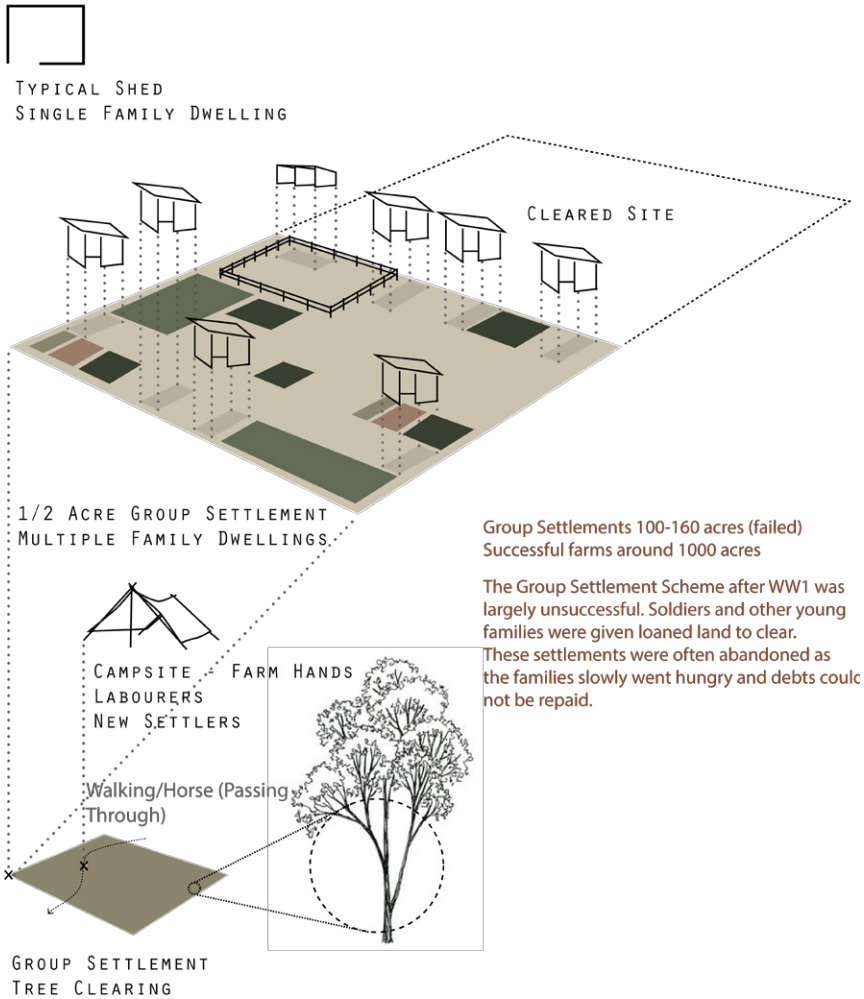
As the population grew, more farmers were needed and the government began creating licensed leaseholdings. Prior to this, squatters roamed and used land freely in the more remote areas. Land could also be bought for 3£ per 40 acre parcel.[44]

44 "A Brief History of the Avon River Basin," 1.

Fig 1.35 Multi-family 1920 - 1949

Land clearing was done by new settlers, often British soldiers after the war, who were settled in camps with their families. Unfortunately, this was largely unsuccessful: families suffered in isolation and farmer debt rose, resulting in many farmers leaving the land.[45]

45 “A Brief History of the Avon River Basin,” 2.



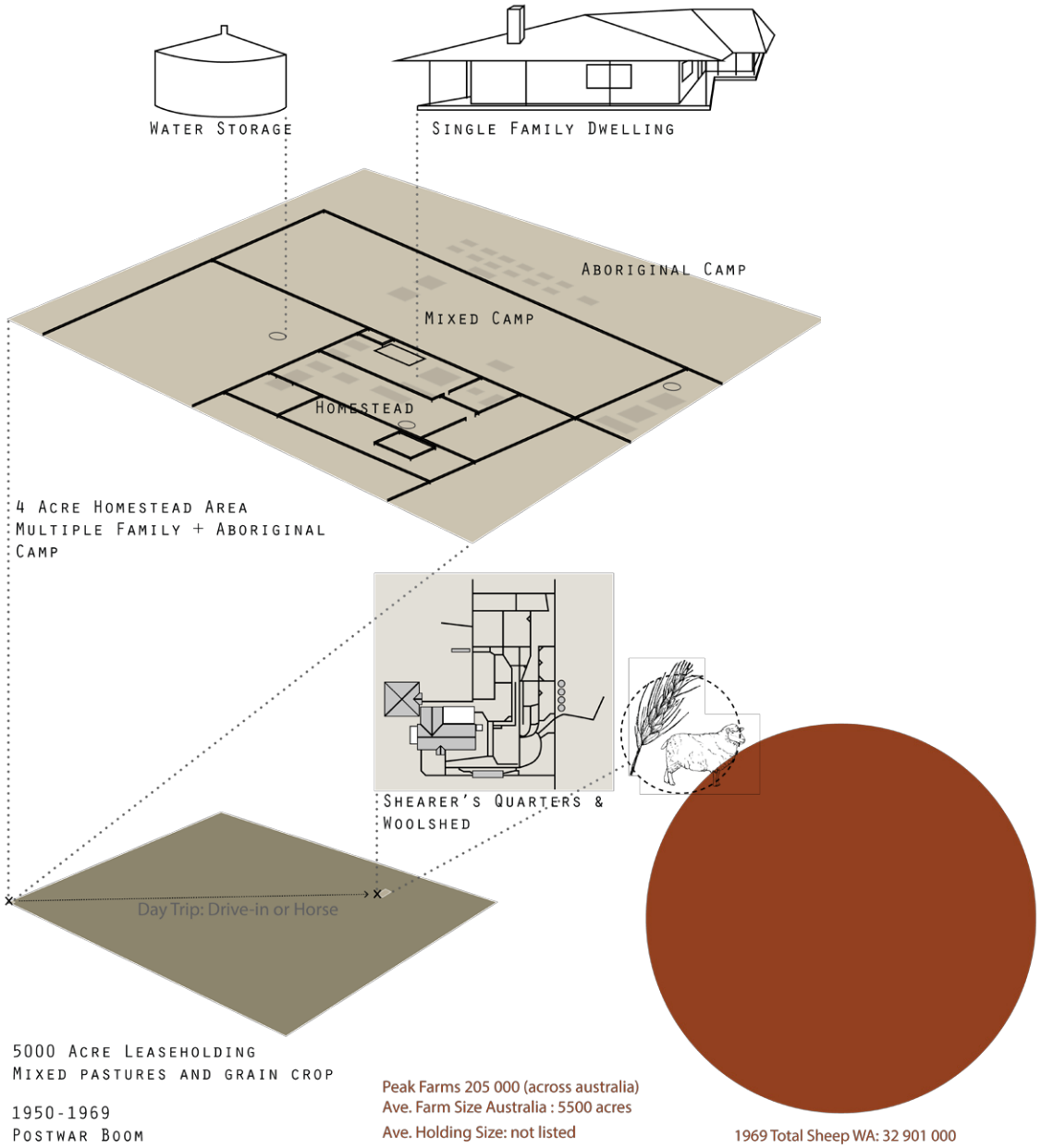


Fig 1.36 Regions serviced by the Royal Flying Doctors in dark brown. Medium Brown shows Wheatbelt area.

Regional Homesteads & Flying

The size of rural properties is still growing despite productivity peaking in the 1970's - 80's. Technology developed from both world wars has helped propel property size upwards as mobility becomes quicker and more easily accessible. This has also led to farms further away from urban areas in remote areas requiring access by plane.

Flying technology from WWI helped lead to the creation of the Royal Flying Doctors, who since the 1930s have operated in Western Australia as a remote regional first air response service. In 1950's, the School of the Air, broadcast over shortwave radio, was also facilitated by the use of plane. Both services are still in use today, and the School of the Air is now broadcast live in a two-way stream over the internet. This allows Australians in remote areas to access education and medical services available in urban areas.[46] Flying in rural areas is now popular, not only for services but also for recreation.

Fig 1.37 Multiple Dwelling Types 1950 - 1969
As property size grew, more labourer's were required and the market boom allowed farmers to build and grow the size of their property.

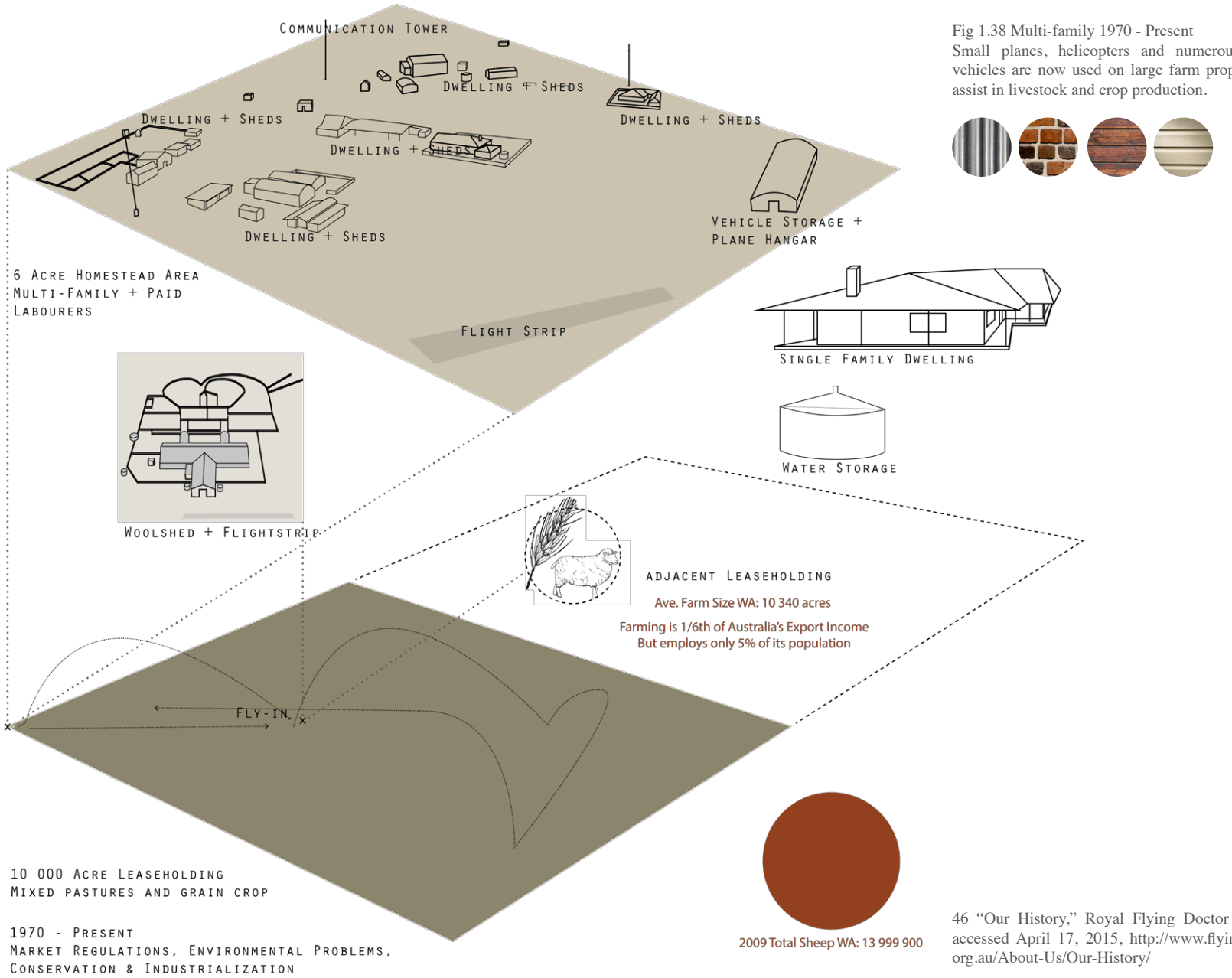


Fig 1.38 Multi-family 1970 - Present
Small planes, helicopters and numerous motor vehicles are now used on large farm properties to assist in livestock and crop production.

46 "Our History," Royal Flying Doctor Service, accessed April 17, 2015, http://www.flyingdoctor.org.au/About-Us/Our-History/

02 Land

Ecological Unconscious

The following section first explores the perception of place and identity in remote areas, and the role of design in spaces that are not normally seen. In the second part, it seeks to understand the environmental degradation currently experienced in Western Australia, as well as some of the remediation efforts and why they have been largely unsuccessful at creating lasting change.

Uncovering Soliphilia

It is easy to see the problems of the rift between human and nature from an ecological point of view, but perhaps harder to understand the detriment from the psychological side – and its wider implications that hinder our ability to address problems at the source – furthering the importance of a designed connection to the land.

Daniel Smith describes our 'ecological unconscious' as our behavioural and cognitive reactions to our surrounding environments.[47] For example, change perceived as 'positive' in our environment may create positive change in us, while 'negative' change may in turn cause negative psychological affects. It is also a way of understanding the importance of our inner relationship with the land, whether or not we see it in our everyday lives.

Gary Snyder alludes to something similar in his essay *The Place, the Region, and the Commons*, in which he explains how we experience and understand spaces in urban, rural or wild settings all equally as a 'place'. According to Snyder, we understand such places as the 'home' not only as the dwelling in which we live in, but as a landscape in the mind, defined by an urban neighbourhood, a rural property or even an entire bioregion. Our sense of belonging to these spaces is important because of the connection it establishes between our place and us.[48] This is the beginning of our own ecological unconscious. Social habits of the people within the territories we inhabit begin to shape our understanding of boundaries, carrying capacity, limits and controls for exploitation. A term coined by Australian philosopher Glenn Albrecht describes this feeling or understanding as soliphilia; 'the love of and responsibility for a place, bioregion, planet and the unity of interrelated interests within it.'[49]

Many of the problems currently experienced in the farmland of Western Australia can be traced back to a lack of soliphilia for Australian lands from its colonizers. Before settlers arrived in 1830, the Southwest was a rich and diverse land. The first settlers arrived seeing what they described as a well-kept English garden.[50] For 30, 000 years, Indigenous Australians practiced burning and harvesting techniques to encourage certain species, climates or habitats to thrive, ones that favoured the Indigenous people's own survival. Although there is only sparse evidence from surviving writings and paintings, it is suspected that at the time of settling, Western Australia was at climax vegetation. This meant the indigenous population was not only surviving, but thriving in an area rich in vegetation and fauna. This region is only now recognized as one of the most biodiverse and unique regions on the planet. The Indigenous Australians cultivated the land in a way that provided rich food supplies not only to them, but also to the many species they lived alongside. Yet this was a relationship that had grown over thousands of years – and not without its own losses. But for the most part, new settlers could not see or understand this, and brought with them their own idea of home and cultivation, which they applied extensively over the landscape. They did not understand the land they had arrived in, and did not feel a sense of love or responsibility for it.

47 Daniel B. Smith, "Is There an Ecological Unconscious?" The New York Times, January 31, 2010.

48 Snyder, Gary. "The Place, The Region and The Commons." In The Practice of the Wild. Douglas & McIntyre, 1990.

49 Smith, "Is There an Ecological Unconscious?" January 31, 2010.

50 Rolls, "Land of Grass: Loss of Australia's Grasslands," 1.

Although the term soliphilia is unique, the feeling is not. While Snyder does not use this specific terminology, he also describes something very similar. When your community does not respect or care for their land, he says, the land suffers. The suffering of the land inevitably has an effect on the emotions of people within it. Albrecht describes the emotional response to surrounding environmental degradation as solastalgia. His visits to communities in Eastern Australia that have been devastated by the impact of mining showed that the people within the communities were psychologically hurt by the damage to the land.[51] A similar problem occurs in rural communities who see the damage to their land visually and through their loss of income; often, they are given no choice but to sell and leave, or use bigger machinery and more chemicals. The high prevalence of depression, self harm and suicide of those who remain are symptoms of their unhappiness with the system, but also symptoms of a sick land.[52]

Snyder notes that, in a place such as a small community, visual cues such as dying trees and plants – or even garbage – may signal solastalgia, and it is thus easy to see and take steps to correct. But with a growing urban population who do not see their rural footprint outside of the city, the problem is distant and in many cases completely unknown. We no longer have a sense of stewardship for our lands because hardly anyone lives there, and it is hurting the people and communities who do.

Today, Australia's unique and already extreme environment is feeling the effects of a changing climate more acutely than most other nations. Rainfall along the coastal regions (the Wheatbelt included) is decreasing rapidly, while monsoons in the north and rain in the interior are increasing.[53] In the past 200 years since European settling, land clearing for farming, invasive species and poor water management practices have exacerbated the problem. The Bureau of Meteorology in Australia predicts that in the next 55 years, temperatures along the Southwestern corner may rise anywhere between 2.2 and 5 degrees Celsius, with many areas becoming non-viable for agriculture.[54] Despite this, no better widespread practices have evolved. This may be because soil degradation and water management have only recently become high priorities, or because of the economic upheavals in Australian farming and the exodus from the countryside have brought awareness to the issue. However, it may also be a lack of soliphilia from designers and policy makers who could initiate change.

'It is worth noting that by now every institution offering degrees in architecture or planning has established an "institute of urban design" of some kind. By comparison, we would be hard pressed to find any institution offering programs with comparable emphasis on rural design: correlating technical and research data with sensory and experiential ones, as well as meaningfully and imaginatively deriving formal and procedural implications for projects of diverse scales, and strategically considering their implementation. The mass abandonment of rural regions for urban ones by populations worldwide and the subsequent industrial exploitation of the natural resources left behind potentially threaten society's ability to respond to either crisis or opportunity.'

- Second Nature: New Territories for the Exiled[55]

51 Smith, "Is There an Ecological Unconscious?" January 31, 2010.

52 Fragar, "The Mental Health of people on Australian Farms, The Facts," 14-19

53 "Climate Change Impacts in Western Australia." Australian Government Department of the Evironment. http://www.environment.gov.au/climate-change/climate-science/impacts/wa. 2015. Accessed April 16, 2015.

54 "Climate Change and Variability." Government of Western Australia Bureau of Meteorology. http://www.bom.gov.au/climate/change/. 2015. Accessed April 16, 2015.

55 Skjonsberg"Second Nature: New Territories for the Exiled."

As Geuze and Skjonsberg note, the design community has all but left rural areas for dead. This may be part of the greater epidemic of our urbanizing society: within the city, we see and hear no evil of the countryside. The idea of city and country is so ingrained and segregated within our mind that often we forget the 'rural' no longer exists alongside wilderness, but is rather a heavily industrialized, man-made landscape. Yet the city cannot survive without the rural, and the rural cannot survive without maintaining natural ecologies. We now know that biodiversity is the key to all life – including our own – and that monocropped landscapes do not benefit soil health and the highly complex systems of nature.[56] In The World Without Us, Alan Weisman writes, "Without us, Earth will abide and endure; without her, however, we could not even be."[57] As designers, we need to consider this carefully – the way we design, create and grow has profound implications for our species' survival. Cultivating soliphilia within the design community may be a good first step. Understanding the greater relationship between our natural systems, food production, and us will help reveal many of the false assumptions we often live by.

Architecture augments the way people interact with each other within cities; this is a well-documented and popular belief,[58] but I believe architecture can also do the same with land, and how we use and consume our planet. By consciously planning and designing for our rural communities and the lands they sow, a redefinition and re-imagination of country landscapes might occur. Designing contemporary rural communities to engender a sense of identity for place, like we often do for cities, and cultivating an inherent belonging to the land, its ecologies and natural cycles, could help to heal the rift between the rural and the urban. The possibility of 'liveable' country towns could encourage some counter-urbanization and inspire sustainable farming habits. This might in turn influence economies to be based on stewardship rather than ownership, and help develop secondary purposes for rural towns to ensure their survival. Designing for soliphilia, and with the ecological unconscious in mind, may help move the rural blindspot into focus and start to heal some of the larger problems of rapid urbanization and population growth from the land up.

Redefining the Second Nature

'…we sow cereals and plant trees; we irrigate our lands to fertilize them. We fortify river-banks, and straighten or divert the courses of rivers. In short, by the work of our hands we strive to create a sort of second nature within the world of nature.'

- De Natura Deorum[59]

The 'second nature', as described by Cicero nearly two thousand years ago, is the land we impose our ideal of nature upon, or what we define as a 'productive' landscape.[60] But the growing imbalance of the 'second nature' with respect to the first has reached a point where there is no longer space for the Earth's 'first nature' to reside. A shift in thinking towards designing land as performative as opposed to productive may help. Productive land is something that produces a product or yield that we encourage, whereas a performative land is a space that may accomplish multiple functions and still provide a usable product or edible species during its cycle, while still enduring and carrying on its own function as a home to other

56 Brian Tunstall "Global Implications of Soil Organic Matter." ERIC Resource Applications. Last modified 2008, accessed August 14, 2015. http://www.eric.com.au/docs/news/eric_soil_OM.pdf

57 Alan Weisman, "The World Without Us," New York: Thomas Dunne Books/St. Martin's Press, 2007: 287.

58 Dan Lockton, "Architecture, Urbanism, Design and Behaviour: a brief review," accessed April 17, 2014. http://architectures.danlockton.co.uk/2011/09/12/architecture-urbanism-design-and-behaviour-a-brief-review/

59 Cicero, Marcus Tullius, and H. Rackham. De Natura Deorum; Academica. Cambridge: Harvard University Press, 1961: 102

60 Ibid

species. In other words, performative land encourages the differing degrees of nature to exist harmoniously amongst one another, as opposed to the segregated way we use now.

Today, our growing biological knowledge and understanding of complex 'natural' relationships allows us to understand the reciprocity of nature better than ever before – not only in the chemical Nitrogen Phosphorus Potassium formula, but also within smaller and wider dynamic cycles of interconnectivity. As Robin Kimmerer tells through interconnected narratives in her book *Braiding Sweetgrass*, we need to rebuild not only the relationships between species living within or upon the soil, but also our relationships with them.[61] Kimmerer describes the land not only as the soil beneath our feet, but as a living organism that we are a part of. We must find ways to design this awareness and thoughtfulness into architecture. Biomimicry, the emulation of natural systems in man-made innovation, may be an obvious one; but there are simpler ways to recreate the functions and adaptability present in nature through our own designs.

'Biocultural restoration raises the bar for environmental quality of the reference ecosystem, so that as we care for the land, it can once again care for us. Restoring land without restoring relationship is an empty exercise. It is relationship that will endure and relationship that will sustain the restored land. Therefore, reconnecting people and the landscape is as essential as re-establishing proper hydrology or cleaning up contaminants. It is medicine for the earth.'

- Braiding Sweetgrass[62]

Where Kimmerer talks about relationship building and biocultural restoration, architects should consider the literal and implied relationships that buildings and structures might promote with the help of thoughtful design. However, in order to recreate a state of climax vegetation and a truly healthy world, we need to take these practices one step further. One way might be through what is called 'bioarchitectural restoration': the beyond-sustainable practices of restoration, or 'giving back' to nature through design and buildings. Architecture can be part of the cycle of reciprocity. Daniel Smith outlines how the way we think about 'nature' changes the environment, but also how our experience of nature changes us.[63] Architects could use a similar principle in the Southwest of Australia, specifically by designing a vernacular system of living and growing that will change the land and our inhabitation of rural spaces. If that system promotes awareness, responsibility and reciprocity, it may also change us as well.

61 Robin Kimmerer, "Braiding Sweetgrass," New York: Milkweed Editions, 2013:

62 Ibid, 338.

63 Smith, "Is There an Ecological Unconscious?"

Designing a new Rural Community for the Wheatbelt

The ‘home’ is a reflection of ourselves. In Australia, it is easy to see the pride and uniqueness of Australian identity and the way it is expressed through the places they live. The homes, towns and cities are an extension of the inhabitants’ way of life.

A similar type of anthropomorphism in architecture is discussed in Suzanne Preston Blier’s *Houses are Human*, in which Blier uses the example of the Tamberma homes in Africa and their meaning for local culture.[64] In Tamberma, the home literally represents the body through the rooms and structure of the home. It is also common practice to destroy and rebuild homes with deaths, marriages and births of its inhabitants, and to alter the structure to help fix the personal problems of those living inside. Peoples’ physical and psychological selves are expressed within the flesh, blood and bones of their houses. What if we understood ourselves not as independent from the natural world, but a part of it? And our homes and communities embodied not only ourselves, but also the natural systems around us? Could a community die and be reborn within the cycle of its environment?

Cultivating a strong sense of community and identity in urban areas has almost always been central to the discourse of spatial design. It is a topic with thousands of years of building experience and research. But now our neglected rural communities desperately need attention and rethinking to create habitable landscapes, that are not only good for the environment but for those living within them. In order to achieve this, a new approach must be taken that is very different from the way we design in urban areas. Architects, designers and planners all need to develop a careful consideration of our own ecological unconscious so we can design these places with the reciprocity and relationships of humans and other inhabitants in mind.

The rural lands of Southwestern Australia are a series of complex, interconnected spaces, with traces of a distinctive history and many multifaceted populations – human and otherwise. But the farmlands blanketing them conceal nearly all of this rich diversity, and rapid growth and industrialization has disturbed and destroyed many of the communities existing on the land and in the soil. Considering a way to develop new identity for these agricultural lands, with a design perspective that understands the relationships, environments and immersive psychology of the land, alongside a new idea of performative landscapes and rural habitation, is now essential.

64 Suzanne Preston Blier ”Houses are Human: Architectural Self-images of Africa’s Tamberma,” Columbia University: JSAH, XLII:4. December 1983: 373.

Salt & Water

Identity may not always come from positive identifiers; it can also be cultivated from what is normally perceived as 'negative' aspects of agricultural land, which may in fact be inherent to the land. For example, Western Australia is a naturally saline landscape, home to many species that have evolved from and require specific niches in the environment, geography and climate, including salinity. Appreciation of salinity never existed for the colonizers and contemporary farmers of the Wheatbelt. But designing a connection to the land requires creating an interface that makes the wider population aware of how their consumption impacts the land and those living there, including qualities that are rarely seen. To re-frame the way farming is perceived in the region, it is important to understand the natural soil conditions and the other physical characteristics of the Wheatbelt landscape.

Salt

Soil quality and composition is a big topic in the Australian agricultural world. Million year-old salts sit beneath the fertile ground soils found in the two main agricultural regions in Australia. As salinity has always been a natural feature of Australia, the flora and fauna there grew to tolerate the primary salinity* of the land, in some cases even thrived off it, becoming halophytic. In other places, native perennial vegetation provided shade that slowed surface evaporation and encouraged evapotranspiration. The deep-reaching roots of these perennials kept the water table well away from the surface, leaving most of the salt dry underground.

Land clearing and planting of annual crops, often grasses or short-rooted varieties, made it possible for the water table to rise to the new root level, changing the overall saline composition of the soil. The salt and other minerals, now in wet soils, dissolved in the rising ground water. As the water table continues to rise towards lowland surface areas, the hot Australian sun quickly evaporates the water and salts are left behind and deposited on the surface, causing salt scald. This is the process known as secondary salinity, and because of the nature of water tables and the beautiful rolling hills inherent to the Wheatbelt, salt scald is now a feature of many low-lying areas. In 1996, 18 000 square kilometres of land was affected by salt scald in Western Australia alone, and in 2000 that number had more than doubled to 43 630 square kilometres, which was approximately 10% of the land in the Wheatbelt. By 2050 an estimated 88 000 square kilometers will be damaged by salt.[65]

* See Index for definition

65 Hugh Middlemis, "Dryland Salinity, A Position Paper," National Committee on Water Engineering. Last modified September 6, 2006: 3-4

Fig 2.00
Salt damage in a wheatfield in WA, also known as salt scald. Wheat cannot germinate in a sodic environment. Waterlogging is also apparent on the upper right side of the field. Salt residue can be seen on the surface of the soil.

Water

Water has long been a problem for settlers in Australia. Although some parts of the country experience nearly four distinct seasons, many experience something closer to two: wet and dry. This is the case for the Wheatbelt, and for most crops, the wet season is also the growing season. Growing in the dry season poses a problem for farmers who must rely on the arid and hot conditions to produce food in a place where irrigation is seldom used.[66] In years of normal climatic conditions, wet season rains refill water sources, filling dams and replenishing groundwater before the season of growing, prepping the soil for the next year of plantings.

But at the time of settling, this was not fully understood and water problems were often exacerbated in years of drought. The colonizers were desperate: when found, groundwater occasionally came up saline, and transporting water into the Australian interior required a depth of knowledge the first arrivals did not have. Aboriginal peoples passed down knowledge orally, and knew of groundwater oases, watering holes and billabongs hidden away in the unmapped territory. Many Aboriginals were used and sometimes exploited by new settlers for this knowledge.[67] Now, technology and infrastructure exploits the land to reroute water sources, dam up freshwater streams and create easier access for municipal water supplies. But as non-saline groundwater is increasingly used up faster than it can be replenished by the diminishing winter rains, wells, dams and streams are increasingly turning saline. At the same time, rainfall continues to decrease and droughts destroy dryland crops and livelihoods in the Wheatbelt where the vast majority of farms do not use irrigation. Traditionally, droughts occurred on average every 11-14 years in Western Australia; and yet in 2010 they experienced the driest year on record, and then again in 2013, severely reducing productivity.[68] The Australian Bureau of Meteorology predicts the frequency and harshness of droughts will be rising in coming years.

Building water infrastructure in Western Australia is costly, and thus traditionally controversial. This controversy goes back as early as 1902, when the Engineer in Chief, C.Y. O'Connor, committed suicide after criticism he faced for his pipeline proposal to bring water to the Goldfields, 530km east of Perth – at that time, the longest water main ever constructed to bring water uphill.[69] It also cut through aboriginal lands and important native sites. Despite this, the pipeline was ultimately deemed successful and led to the development and much improved conditions in the extremely profitable gold rush at Kalgoorlie. O'Connor would never see this success, though. This pipeline is still in use today, and supports a community that could not survive otherwise.

In the past 10 years, the city of Perth has commissioned two desalinization plants, and now relies on desalinized ocean water to supply nearly half of its water needs. Prior to this, the city relied almost entirely on dams and groundwater.[70] Another recent scheme has been implemented to pump wastewater back into groundwater aquifers to replenish water sources, which has been met with surprisingly little controversy.[71] Still, despite this future planning, wastewater schemes and massive investments in water infrastructure, most of the water and drought problems for agricultural lands remain. Both of these methods also have

Fig 2.01
Extreme salt damage on a farmer's field near Perth. This soil is now completely unusable for crops and pastures.

66 "Salinity and Land management on Western Australian Farms," Australian Bureau of Statistics, Western Australian Statistical Indicators 1367.5, June 2003: 26.

67 "The Canning Stock Route," Government of Australian, accessed August 14, 2015, http://www.australia.gov.au/about-australia/australian-story/canning-stock-route

68 "A Hundred Years of Agriculture," ABS, accessed August 14, 2015, http://www.abs.gov.au/ausstats

69 "O'Connor, Charles Yelverton (1843-1902)," Australian Dictionary of Biography, accessed August 14, 2015. http://adb.anu.edu.au/biography/oconnor-charles-yelverton-7874

70 "Desalination," Water Corporation Australia, accessed August 14, 2015http://www.watercorporation.com.au/water-supply-and-services/solutions-to-perths-water-supply/desalination

Images clockwise from top left

Fig 2.02
Passing over a running stream in winter, some amount of salt damage can be seen on right hand side - appears shiny white.

Fig 2.03
Passing over a dry stream with salt damage. Pastures cannot grow in the centre portion where damage is worst. Water from stream is also too saline for drinking when it does flow.

Fig 2.04
Controlled traffic farming.

Fig 2.05
A sample of the Wheatbelt landscape in the winter growing season.

their own drawbacks for expansion. Desalinizing water is extremely energy intensive and expensive, and hypersalinated discharges from the process are drained into the ocean, creating new problems for marine and coastal wildlife. Replacing groundwater with wastewater may work for a while, but is not a long-term solution – at some point the water will still run out, or be too polluted to use. Instead, farmland itself needs to be well-designed to become resilient against drought for farming to continue to be profitable and viable in the Southwest.

Addressing Salinity & Waterlogging

Salt and water issues have long plagued farmers in Western Australia, and efforts to address salinity are ongoing. Reducing salt scald and other environmental problems associated with dryland agriculture in the Southwest has become the priority of a number of governmental and independent organizations, and has received billions of dollars of funding.[72] But salinity will always be a problem in Wheatbelt soils, one that will never be solved entirely. Similarly, droughts are a fact of life in Australia, and are becoming more frequent. Both issues are equally pervasive: you cannot flush millions of years of salt out of a country no more than you can stop a drought. However, with the increasingly in-depth and thorough research done on secondary salinity and remediation, it is possible to design a system that interacts with the ground conditions rather than fighting against them.

Salinity is often addressed in a four part resolution.[73] The first step is prevention: stop further clearing of land, and allow native vegetation to play its role in keeping water tables low. The second is the adaptation of known better practices: this includes reducing groundwater recharge* – which is only possible by reducing irrigation and thus not an option in many parts of the Wheatbelt, since very little farmland uses irrigation – and intercropping perennial and native plants as a way to increase soil health and increase resiliency. The third action required is remediation by planting saline and water-tolerant species to lower water tables and remediate soil. This can be done through tree planting, re-vegetating with native deep-rooting perennials, or planting perennial crops rather than annuals.[71] Both the second and third steps are similar, but difficult to persuade farmers to do because the return on investment is often not as profitable as annual crops and often occurring outside the aging farmer's own lifetime. Another option for remediation is deep or shallow drainage, pumping and the use of sacrificial dumping ponds, all of which are highly controversial. These methods are energy-intensive and require large-scale land surface alterations that have not been proven to actually reduce secondary salinization. In many cases, deep drainage and dumping ponds have even exacerbated environmental problems.[74]

The fourth, and possibly most important, action to combat salinity is awareness and social change. Although salinity has long been a known problem in Australia and is being addressed across the Wheatbelt, the general public has not been actively included in the discussion or made to understand the long-reaching effects of salinization.[75] There is little public awareness or opinion on many issues affecting rural communities, and because of this the government's role in funding alternative opportunities for farmers and tree planting

71 "'Drought-proofing' Perth: the long view of Western Australian water," The Conversation, last modified February 15, 2015, accessed August 14, 2015, http://theconversation.com/drought-proofing-perth-the-long-view-of-western-australian-water-36349

72 Mark Altus, David Morrison and Rasmus Moerch, "An Economic Analysis of Investment in the National Dryland Salinity Program." Department of Treasury and Finance, Government of Western Australia. October 2011.

73 Laura Kuginis and Joanne Daly, "Plant Based Solutions for Dryland Salinity Management." Department of Land and Water Conservation. Presented at the Salinity Economics Workshop, Orange, New South Wales, Australia, August 22-23, 2001.

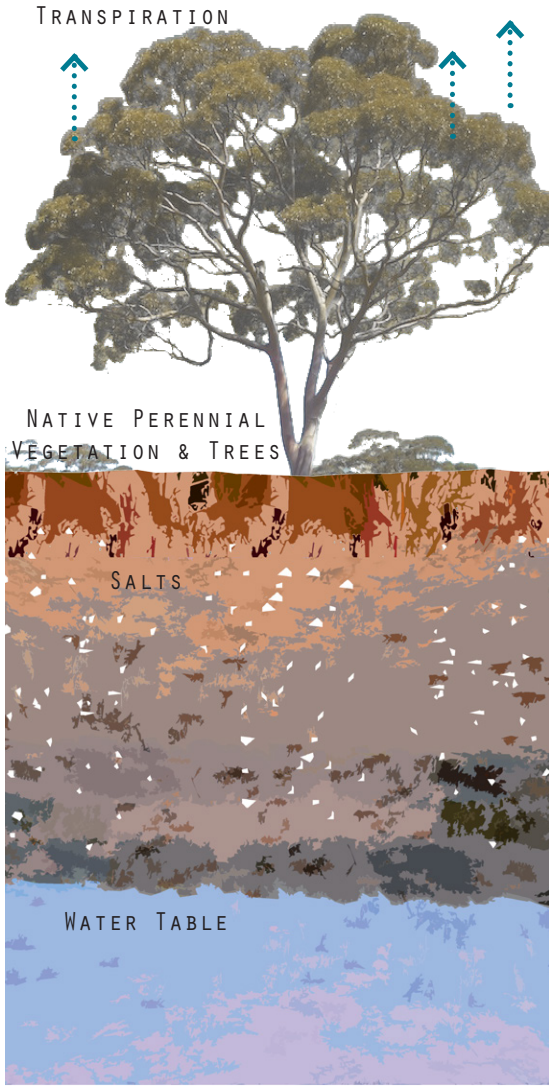
74 "Media Reports," Money Down the Drain, accessed August 14, 2015, http://www.usedrains.org.au/media_reports.htm

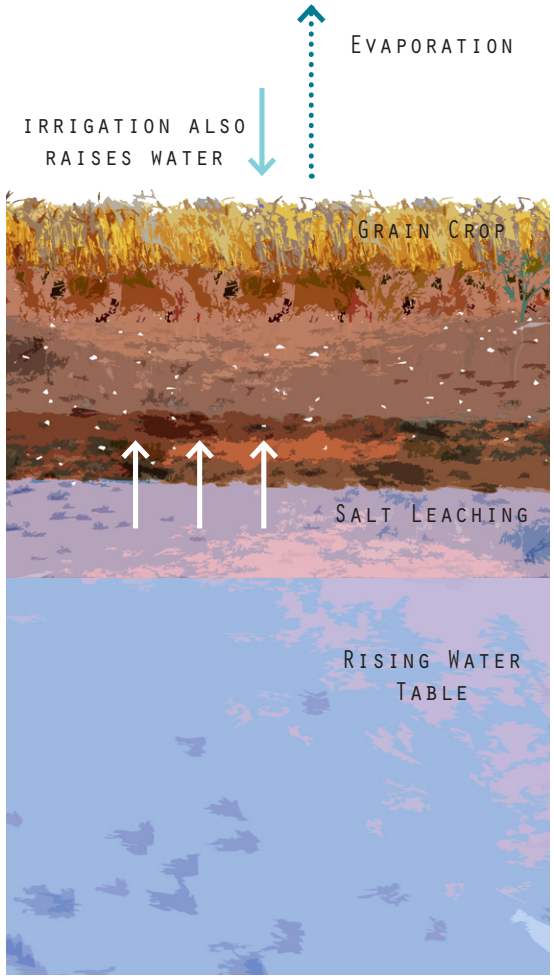
75 Lumb, "Land Degradation," 5.

*See Index for definition

Fig 2.06 Left
Previous condition of soil prior to colonization
Water table sits at depth of tree roots. Water is transpired through the tree, never passing through the soil or disturbing the dry salts.

Fig 2.07 Right
Enlarged current soil conditions
Water table is significantly closer to ground level allowing direct evaporation from the soil. This deposits salts and other minerals on the surface.





schemes has been largely unsuccessful compared to the economic and social toll. Although estimates vary, the cost of agriculture to the Australian government in 2002 alone was an estimated $287 million, an amount that has been increasing every year since.[76] Between 2001 and 2008, the government spent approximately $1.4 billion in public money on fighting salinity, with matched investments from the private sector.[77] But the cost is not only economic. In Western Australia, approximately 30% of animals and 1500 plant species suffer from excessive dryland salinity, and 450 of them are now on the verge of extinction.[78]

The benefits of addressing salinity are also well documented: less waste of public resources and public money, improved productivity, and an increase in biodiversity through better practices that can further increase productivity and provide resilience against drought or other environmental hazards.[79] Benefits also include increased social ties and shared responsibility between urban populations and farmers, including the psychological benefit to the farming community from the improved state of the land.

The social benefit of remediating land and improving the economic viability of farming and land care management is known as 'social capital.' This is a relationship that is developed within and around a community that brings about economic development and innovation through strong social ties. Building social capital relies on availability of external resources to help the community with problems, such as salinity, and visibility of solutions and affordability to address these problems.[80] Organizations such as Landcare Australia support farmers and farming communities by connecting people and groups within small pockets. However, building long lasting social capital is not possible without external support as well.[81] Creating a system to improve problems related to salinity and also reconnect farmers and the general public will not only address environmental issues associated with dryland farming; it has the ability to address many of the social problems farming communities face, like being disconnected from external opportunities. It may also help improve long-term sustainability of agriculture through continued progress, innovation and development.[82] However, this is fully reliant on a system where the greater public, who is part of the network of producers, distributers and most importantly consumers, know full well how their choices play an essential part in the agricultural system.

Despite knowledge that social change is necessary, only the first three methods to combat salinity – prevention, adaptation and remediation – have been funded or addressed by most organizations. And while most efforts to utilize only these methods have proven successful on a large scale, the opportunities offered by the fourth to create widespread social change continues to be overlooked. This is key for also addressing the human issues of farming communities, including an ageing workforce, depopulation and labour shortages. Without urban populations caring for rural stewards of the land, farmers, the response to land management and environmental issues will be hindered and slowed by the other conditions they face.

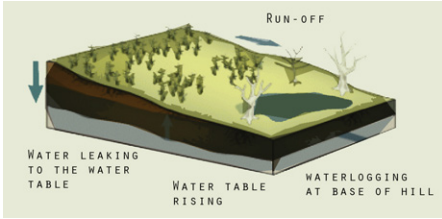


Fig 2.08
Illustration of how waterlogging occurs.

76 Altus, "An Economic Analysis of Investment in the National Dryland Salinity Program," 11.

77 "Salinity and Land management on Western Australian Farms," ABS, 30.

78 Altus, "An Economic Analysis of Investment in the National Dryland Salinity Program," 11.

79 Ibid, 10-19.

80 Thomas S. Lyonas, "Building Social Capital for Sustainable Enterprise Development in Country Towns and Regions: Successful Practices from the United States," The Regional Institute Online Publishing, (Paper presented for the First National Conference on the Future of Australia's Country Towns, La Trobe University, Bendigo, Victoria, Australia, June 30, 2000) http://www.regional.org.au/au/countrytowns/keynote/lyons.htm

81 Landcare "About," http://www.landcareonline.com.au/?page_id=2

82 Thomas S. Lyonas, "Building Social Capital"

Fig 2.09 Left
Normal summer pastures on a farm in the Southern Wheatbelt

Fig 2.10 Right
Normal winter pastures on the same farm in the Southern Wheatbelt

Climate change is having a devastating impact on winter rains in the Wheatbelt, increasing the length of the dry season, stopping growth and killing crops and pastures. As visible in the summer pastures photo, grass and vegetation goes dormant during summer, meaning an extended dry seasons reduces the amount of food available for livestock and crops.

Hilly pastures such as these are also susceptible to waterlogging at the base of the hills, as illustrated in the diagram above.

Soil Awareness

The problems of salinity and water come down to a single, vital issue: soil health. Knowledge of the underlying chemistry, and recognition of the importance of soil rebuilding and diversity, has come a long way in recent years. Methods developed in the last two centuries, including the use of nitrogen, phosphorus and potassium as fertilizer, are recognized today as lacking the true abundance required to promote life. These techniques and the imported farming methods do much more to harm to Australian soil than good.[83] This method of farming is still the dominant image of farming today. Changing the public image of farming is a big step towards creating a more resilient communities and a wider consciousness of problems of rural areas.

By creating a public platform for monitoring and indexing the issue of soil health within rural communities as a gateway, increased visibility and awareness of other problems will become more possible. Developing a new habitable infrastructure for urban visitors inside the agricultural landscape could also help establish a network that provides assistance from outside of the community, a powerful tool in creating long term viability in rural areas.[84] This is possible if urban populations have the opportunity to visit rural landscapes, establishing a visual and physical connection, and experiencing the contemporary reality of agricultural land use. Awareness also affects consumer choices made in urban areas by reflecting the knowledge and experiences learned in a rural context. This type of system is already in use by peri-urban farmers, to influence buyers' product choices, develop brand recognition, and protect farm lands from urban development, but is dependent on an unprocessed or lightly processed food product.[85]

Agritourism is becoming a big business, but today it mainly profits from leisure activities, not necessarily by promoting awareness and consciousness of rural problems. An example of this is a typical rural homestay, which encourages visitors to visit an often peri-urban farm to try their hand at some farm task or experience the 'lifestyle' aspect of farming. Another type of profitable venture using consumer-producer interaction is the reforming of food systems. Examples of these modified consumer to producer configurations are Community Supported Agriculture (CSA) and Alternative Food Networks (AFN), which are opportunities to buy into a local farm to support planting, seeding and harvesting in anticipation of receiving an end food product (CSA), or shortening the supply chain by offering consumers a more direct link to the farmer (CSA & AFN). Yet this is not necessarily exposing urban populations to the difficulties farming communities face, even though farmers are profiting from the increased networking, social capital, rural cultural appreciation and sustainability.[86]

Although both these systems have great rewards and often encourage organic and more sustainable practices on both the producer and consumer side, these systems still only focus on niche products and markets. Neither can fully address problems of increased land use for farming or the obstacles faced by remote farming communities and large-scale grain and sheep production. Ways to connect urban populations to this type of farming does not exist yet – at least not in a way that is beneficial to the farmer, consumer

83 Lumb, "Land Degradation," 5, 6.

84 Fiona Haslam McKenzie and Daniela Stehlik, "Futures for the Wheatbelt - Is 2030 already here?" Australian Journal of Agricultural Research, 2005: 549.

85 Valeria Paul, Fiona Haslam McKenzie, Noelia Araujo and Xiano Rodil, "Alternative Food Networks or Agritourism? The 'Vegetable Tourism' Experience in the Barcelona Peri-Urban Area," The Commission on the Sustainability of Rural Systems:122-124.

86 Trevor Budge and Christine Slade, "Integrated Land Use Planning and Community Food Security," Victorian Local Governance Association, October 2009: 50-51.

Fig 2.11
Highland cows on a tourist farm in the Southern end of the Wheatbelt. Farmer's are beginning to look for alternate income crops and livestock. The meat from highland cows is low fat and fetches a much higher price than beef, yet still requires a great deal of land and water to produce. However, when used appropriately, livestock can be used to improve soil health. Currently these cows are only for tourism purposes.

and the land. Remote and massive farming operations are still inaccessible and relatively unseen, and the majority of rural problems goes unnoticed. In agriculture, this consumer-product disconnect is especially true for such things as wheat, canola, and sheep, which traditionally don't attract much agritourism, nor are they available locally as they are not considered consumer end-products. Still, they are certainly economic staples for the region, and represent the majority of food commodities the Wheatbelt produces; they also contribute significantly to salinity in the region.

Western Australia is no stranger to local and international tourism. Although the Wheatbelt experiences no tourism, the entire Southwest coastal area is a string of tourist attractions that bring in over 7 million visitors every year, and the industry is worth around $6 billion Australian, roughly the same as the gross value of agricultural commodities in Western Australia 2014, which was $5.8 billion.[87] Visiting wineries and bee farms, camping in national parks, animal farms and numerous other outdoor activities are already popular. It may be possible to find a way to bring together tourism outside of the Wheatbelt, in the nearby South West, into the broadacre agricultural region for the benefit of remote farming communities, environmental health and rural awareness.

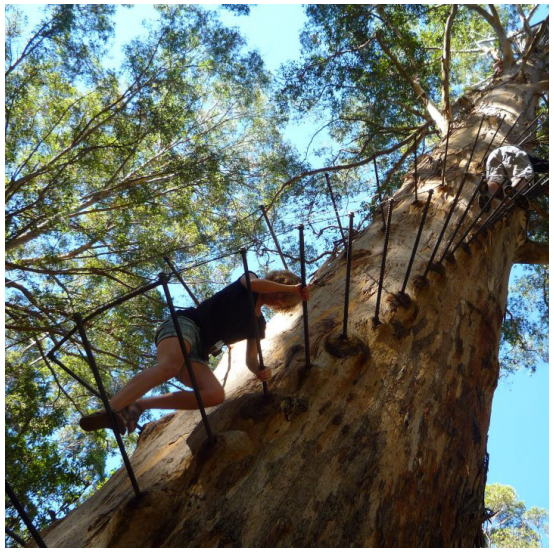
Despite the remoteness of most agricultural land in the Wheatbelt, many areas have infrastructure that make them in some ways accessible. This includes a still-developing network of regional roads and air traffic. Regional farms outside the Wheatbelt now use small planes and helicopters to access their properties, or have been made flight-accessible for the School of the Air and Royal Flying Doctors; this means some farms already have a landing strip. This type of infrastructure could be implemented as well in the Wheatbelt. The remoteness of these areas can be taken advantage of to create a new type of tourism and recreation in these seldom-visited places, something that is appealing to the younger more mobile generations. To promote future agritourism in the Wheatbelt, a desirable destination for tourists to visit is a good start.

Using existing remediation knowledge and tourism is key to developing a viable economic human-soil interface. But to design for long-term reciprocity between humans and agricultural lands, we also need to develop a new ecological methodology. Although in urban areas our connection to the land may seem tenuous, part of our psyche still responds and relates to our surrounding landscapes, whether built or natural. It is important to understand that land degradation hurts not only our physical health – and the physical health of other species – but continues to affect us emotionally, even though awareness to our own emotional responses may be diminished. Healing the land requires we re-establish this diminished connection. Restoration is not only about land remediation, but also about building identity, awareness and bringing together technical knowledge with our own ecological unconscious.

87 "Value of Agricultural Commodities Produced," Australian Bureau of Statistics, last modified May 29, 2015, accessed April 17, 2015, http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/7503.0

Fig 2.12 Image on left
Outside of the Wheatbelt, climbing trees were once used as fire lookout posts, but are now just a way to get a good view over the forests in the south.

Fig 2.13 Image on right
Valley of the Giants Tree Top Walk in the Great Southern region south of the Wheatbelt. Tree climbing and elevated pathways are popular tourist destinations, drawing in tourists from all over the world and creating revenue for locals.



03 Design Elements

Catalogue

The project leverages three main processes, but which are now largely missing from the site of the intervention, to help re-establish resilience and equilibrium. The absence of soil disturbances, perennial vegetation and fires from the landscape become apparent when contrasting rural landscape to the existing native conditions. Although the intervention cannot fully replace the importance and function of any original element or system in its natural environment, simulating their properties to begin the process of recovery can lead to a developed awareness of their importance for farmers and urban populations.

Soil Disturbances

The bilby, is a small omnivorous marsupial once prolific on the grassy forests in the Western Australia, and is now listed as vulnerable by the IUCN. There originally were two distinct types of bilby which were found in 70% of Australia. The Lesser Bilby is now extinct, but efforts to reintroduce some greater bilbies into Western Australia have been successful. The bilby is dependent on fire for its habitat, and is threatened mainly by introduced species such as rabbits, foxes and livestock. Agricultural machinery also damages their burrows and destroys the grasslands they live in.

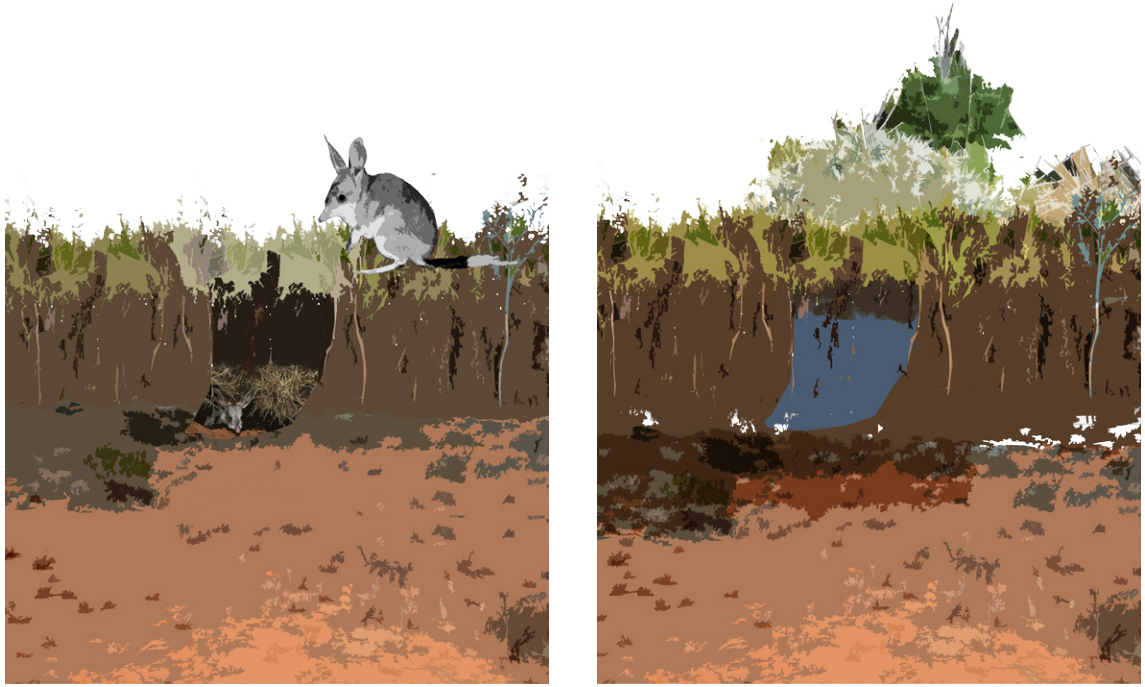
The bilby played an important role in creating fertilility in the soil. Empty nests and tunnels would fill with water during rainy periods, and wind would blow seeds and plant matter into them, creating a tiny fertile oasis during dry periods. This regenerated soil and provided other animals niche habitats. Bilbies were prolific diggers with extensive tunnel networks within their territory. They provided aeration for the soil and were a key species for landscape health in Western Australia. [88]

Fig 3.00 A Greater Bilby, or Rabbit-Bandicoot

88 “Macrotis Lagotis,” IUCN Red List, last accessed April 17, 2015, http://www.iucnredlist.org/details/12650/0

Fig 3.01 Image on left
Previous Conditions
Bilby nest with collected seeds, nuts and bits of organic matter

Fig 3.02 Image on right
Oasis Building
Each year the nest would be abandoned, and the empty burrow would fill with water after rainstorms, germinating seeds and creating small pockets of fertility in an otherwise dry and harsh landscape.



Native Vegetation

Grassy woodlands like the one pictured were once a feature of the Wheatbelt region. These woodlands were carefully cultivated by aboriginal people who control burned to encourage certain types of growth for food and resources, yet older trees were quite resistant to fires, and quickly regrew leaves after burning. Trees once played a vital role in the Wheatbelt, providing shade for seed germination and reducing direct evaporation of water from the soil by using groundwater and transpiring excess moisture. These deep rooted trees kept the water table low and the salts dry within the soil. Grassy woodlands and hummock grasslands provided habitats for a wide variety of species, including the bilby. Tree canopies also play an important role in biodiversity and bird life, providing fertilizer and food.

Covering a paddock with grassy woodlands is not an option for most farmers, as the return time outweighs the cost. Too much salinity in the soil and severe waterlogging can also kill planted trees. However, a new hybrid eucalypt known as Saltgrow was developed in early 2000. Saltgrow is very drought and water tolerant, as well as having the ability to live with high levels of salinity. It produces a hardwood that can be used for furniture or construction. At 10 to 12 years thinning occurs which produces small saw logs, and a final full harvest at 20 to 25 years for full size lumber.[89] This is much faster than commercially grown hardwoods, which can take between 50 and 80 years to be at harvesting size. Another timber with moderate salt tolerance and native to Australia is the Blackwood Acacia. This tree takes between 15 and 50 years, depending on conditions, to produce suitable timber, but is much more valuable and is often compared to walnut in terms of value.[90]

Both of these trees create beautiful forests, planted or natural, and are interesting to visit. Trees play an incredibly important role in soil and water health and their value cannot only be calculated economically. Without trees, soil quickly becomes overly dry and desert-like, and quickly erodes from wind and rain, as well as waterlogged in low-lying areas creating highly sodic regions unusable by any species.

Fig 3.03 Karri tree in a grassy plain, typically how native trees would grow

89 “Planning for Success with Hybrid Eucalypts,” Dragon Horticulture Pty Ltd, accessed April 17, 2015, http://www.saltgrow.com/#!technical-information/c2162

90 “Acacia Trees,” LoveToKnowCorp., accessed April 17, 2015, http://www.2020site.org/trees/acacia.html

Fig 3.04 Image on left
Saltgrow Eucalypt plantation for lumber

Fig 3.05 Image on right
Acacia wood for furniture production

Burning Cycles

The Wheatbelt region of Western Australia was once a continually changing landscape, with cycles in nature that were prone to peaks and declines as different species matured, died and were reborn through their seeds. This cycle was also reinforced by aboriginal people before colonization. The burning done by Aboriginals controlled sections of forest and grasslands to rejuvenate and encourage certain edible species to grow that were beneficial for their own survival, but also for the survival of many species. Burning encouraged certain species to re-sprout or seed, as some plants in Western Australia can only proliferate when burned, known as pyriscence. Many trees in Australia can also withstand fires and quickly regrow after intense burns.

Certain types of microbes in the soil also benefit from burning, creating healthy communities underground that encourage new growth and proliferation of many species. There are also many animal species in Western Australia that require land to be burned to be able to survive, including the bilby.[91]

Controlled burning happens with much less frequency since colonization. Burning and brush fires were seen as dangerous and out of control. Yet small regular burning reduces the amount of fire prone bush. Dry brush and an excess of vegetation leads to uncontrollable wildfires and destruction of homes and infrastructure. But increasing the frequency of small burns can actually reduce the harshness and frequency of wildfires, as well as increasing productivity and soil health. Ash provides valuable fertilizer to soils and clears out weaker growth. Burned soil provides the perfect breeding ground for biodiversity and is an important part of Western Australia's natural cycles and serotinous plants. However, it should be noted that the use of burning cycles also requires a much more researched comprehensive approach than that used within this thesis.[92]

91 "Macrotis Lagotis."

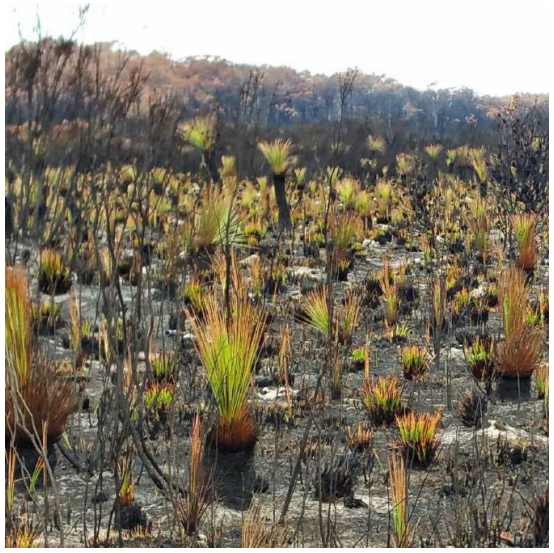
92 Sarah Barrett, Sarah Comer, Nathan McQuoid, Meghan Porter, Cameron Tiller, and Deon Utber.,"Identification and Conservation of Fire Sensitive Ecosystems and species of the South Coast Natural Resource Management Region," Department of Environment and Conservation, 2009: 25-28.

Left Page Images clockwise from top left
Fig 3.06
Bushfire and a grass tree in foreground with seed arms shown sticking out of the grass.

Fig 3.07
Aftermath of a bushfire near Perth, WA.

Fig 3.08
A few weeks after the fire near Perth, WA the eucalyptus trees are already sprouting new growth.

Fig 3.09
Grass trees a few days after a forest fire in WA, already recovering from the fire.



Components

The design is composed of a series of parts that can be assembled by a single person. There are four distinct assemblies: the pavillion, the water catcher, the greenhouse and the treeclimber.

The pavillion and water catcher are constructed from the same components, and can be used in conjunction with one another. Both the pavillion and water catcher's forms are influenced by the ecological roles of trees and the bilby. Their main purpose is to catch and control water while providing a suitable breeding ground for native vegetation, like an oasis. The greenhouse and treeclimber, while having similar components to the pavillion and water catcher, but are scaled up to twice the size in order to accommodate their intended functions. The form of the tree climber is influenced by an already established tourist attraction in the Southwest, the Climbing Trees, and the greenhouse is influenced by requirements and conditions for growing trees from saplings to harvesting size.

All four interventions are intended for visitor use and each marks a clear 'place' for human interaction within a large landscape. Additionally, elements of soil transformation and rehabilitation are shown by the interventions through contrast between its immediate surroundings and the larger rural landscape to illustrate the importance of soil health to human visitors.

The design proposal considers the implications of tourism, agricultural production and environmental impact. The intent is to create a lightweight, simple structure requiring little to no maintenance that will change slowly over time, and can perform a variety of functions while positively influencing the soil around it. The design also considers the history, character and mindset of Western Australians, the predilection towards rapid bursts of advancement and change, their past and current wide scale interactions with a unique landscape and the past role of the agricultural profession as a stepping stone for advancement.

The intervention is designed to be light on the land, requiring as little or as much land as the farmer is willing to devote to visitor purposes. Economic and spatial 'flexibility' is therefore a central characteristic. The small footprint also has as little impact on the ground surface as possible, leaving almost no evidence after it is removed – except for a hole and small patch of fertile soil. The flexibility of form also gives farmers the opportunity to create a unique experience by customizing its configuration to such factors as land form, or the farmers' specific preferences and needs. This helps develop a sense of personalized identity across different farms, a secondary purpose of the intervention. Although the elements themselves would be standardized – creating a sense of similarity or familiarity – no two locations would have the same configuration, giving users a sense of recognition that this is a unique place to inhabit. It would not become boring by overt repetition or standardization.

The intervention is also cyclical; parts can decay or are control-burned to mimic cycles in Western Australian landscapes. Unlike the typical tourist site, which over time can create long-lasting damage to the land, the intervention is never static. This cyclical nature also provides the possibility of new experiences for return visitors, who might visit every few years as the intervention changes, decays, rejuvenates or even disappears. The design seeks to provide a more comfortable environment for human use (such as shelter from rain and sun) while creating a more suitable environment for native species to colonize. This is done by reducing surface evaporation and giving some protection from sunlight, similar to how mature trees function in native grassy woodlands.

The shape of the intervention not only helps to provide a desirable environment for visitors, but also frames specific features of the land, particularly those related to soil health. It fosters maximum visibility and interaction between visitors and the concept of soil remediation. The hexagonal shape of the shade cloth and the drip lines beneath the ground surface encourages a radial pattern of native plant growth outwards from the structure's foundation, producing unique hexagonal progress patterns in the soil facilitated by the seeded concrete. Visually, this growth pattern suggests life itself stems outwards from the intervention, like the roots of a tree. Even after burning or the removal of the foundation, hexagonal patterns of growth would pervade through self-seeding in the healthy soil, encouraging future growth in a similar pattern.

The spaces for camping or other recreational uses could be rented out at a small fee by farmers to cover the cost of implementation. Conversely, if the farmer is more interested in developing customer relations for CSA or AFNs, then they could offer the site for free by integrating the interventions in a system of their choosing as advertisement for their own products.

TYPE 1A
PAVILLION
Total Expected Lifespan: 5 - 15 years
Foundation, Supports & Platform disassembled
when no longer required / used.

Wheatbelt winter daily high rainfall
between 50mm to 70mm amounts
to 620L to 865L per day

TYPE 1B
WATER CATCHER
Total Expected Lifespan: 5 - 15 years
Foundation & Supports disassembled
when no longer required / used.

Rainfall in
Winter (April - September)
average between
300mm - 400mm amounts to app.
12 000L - 16 000L potential rainfall
within 23.1m² catchment

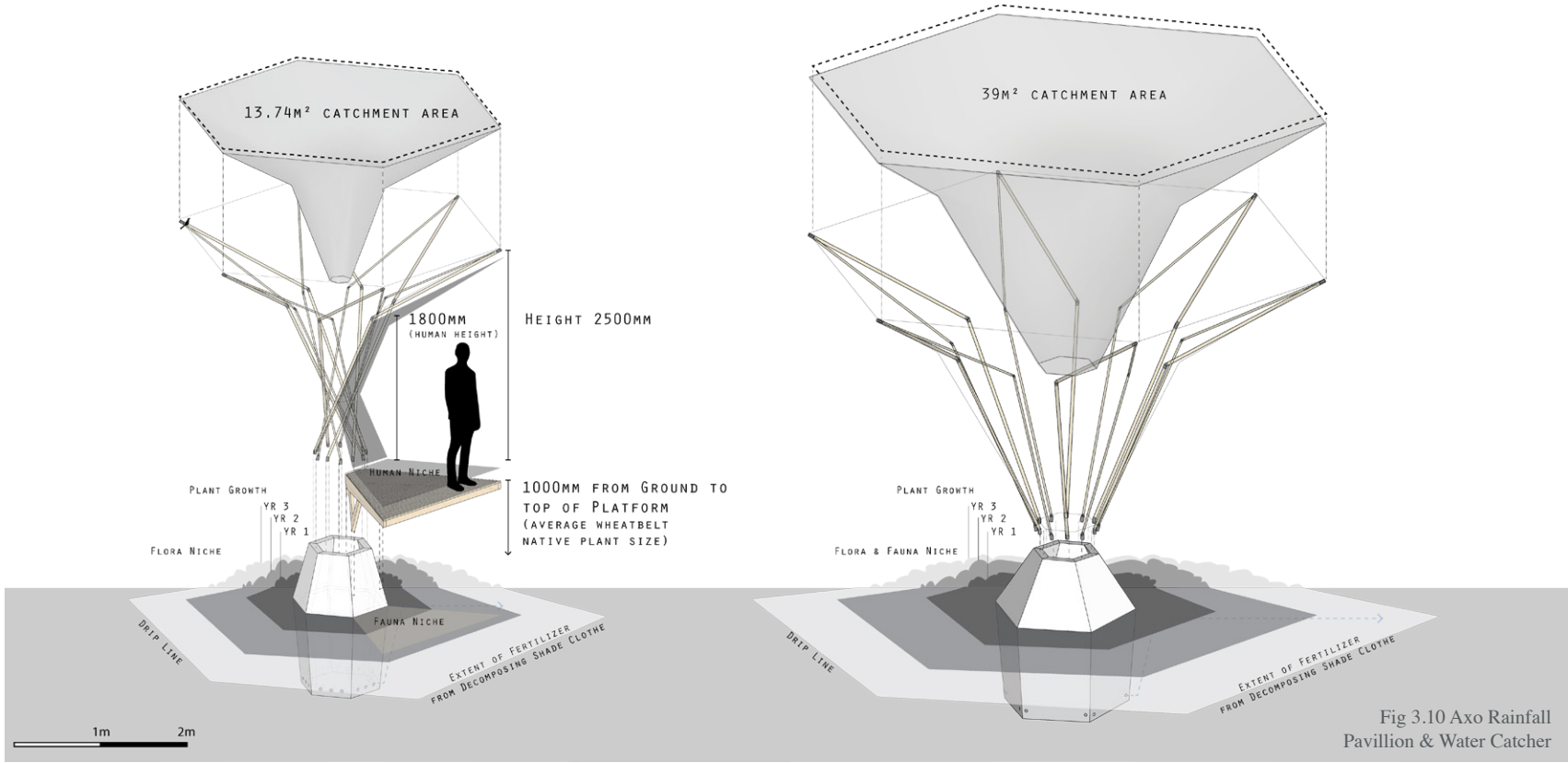


Fig 3.10 Axo Rainfall
Pavillion & Water Catcher

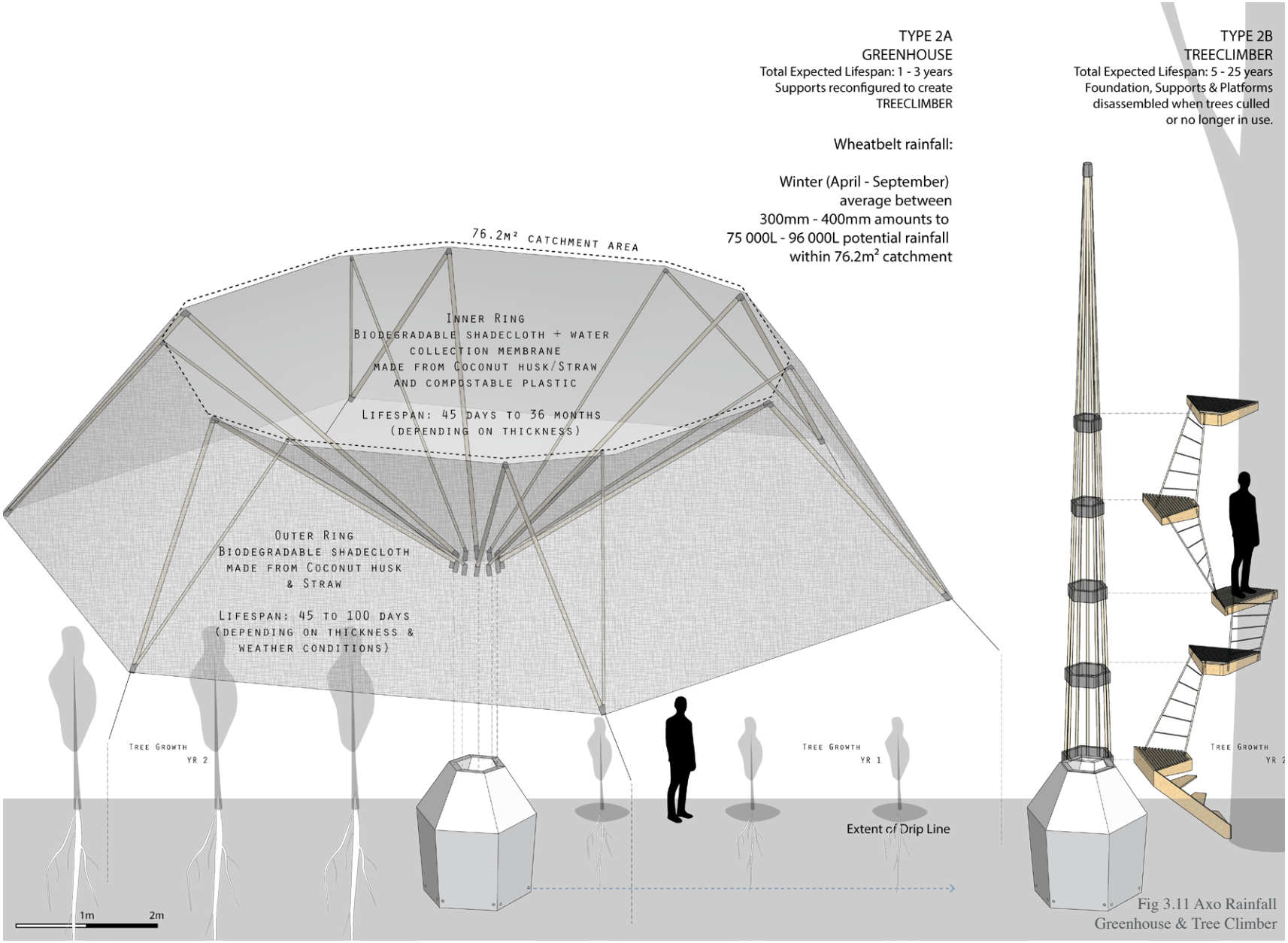


Fig 3.11 Axo Rainfall
Greenhouse & Tree Climber

Both the pavillion and water catcher function as a temporary tree. The shade they provide to the ground acts to reduce surface evaporation and slow the flow of water into the water table. The pavillion and water catcher's foundation is removed when no longer needed, and leaves a small hole behind. This hole, if not filled, can provide the opportunity for water and seed collection after the lifecycle of the intervention is complete, similar to the nests of bilbies.

The pavillion and the water catcher provide a niche for native vegetation to return the Wheatbelt farm landscapes that was removed when the Wheatbelt was cleared.

Pavillion

The proportions of the pavillion and water catcher were determined by the size of the waterbladder within the foundation in relation to how much rainwater could be collected by the membrane above. The size of the components are developed to be light enough for construction by hand, and transportable with small vehicles. The pavillion collects water and promotes seed growth by creating a less harsh environment for germination like a tree. The water can also be used for human consumption. The height is determined by a comfortable enclosure for the average person, and the width is determined by the space needed for two people passing one another or walking side by side. Although it is not spacious, the staggering of the structures provides a feeling of enclosure and frames the connection to the landscape.

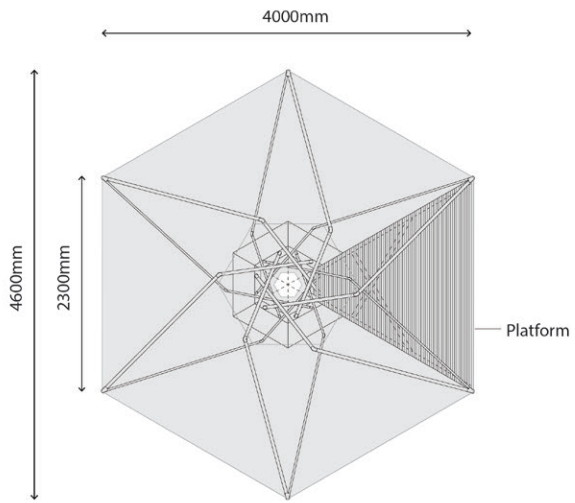
Water Catcher

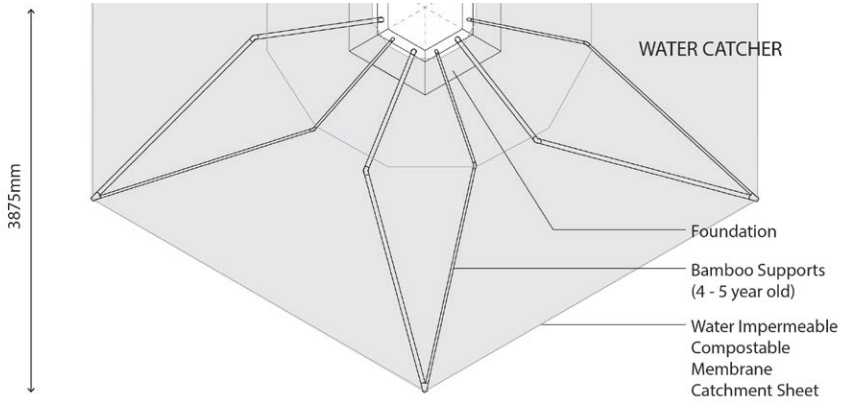
The water catcher's primary focus is on retaining enough water through dry periods. Depending on the size of the foundations (either 900L or 3300L) and the amount of rainfall, the catcher can hold up to three months worth of winter rain and slowly release over the drier summer months. This can either be done through constant slow drip, or an electronic drip line system that automatically releases water according to programming.

Fig 3.12 on Right
Sections - Pavillion & Water Catcher

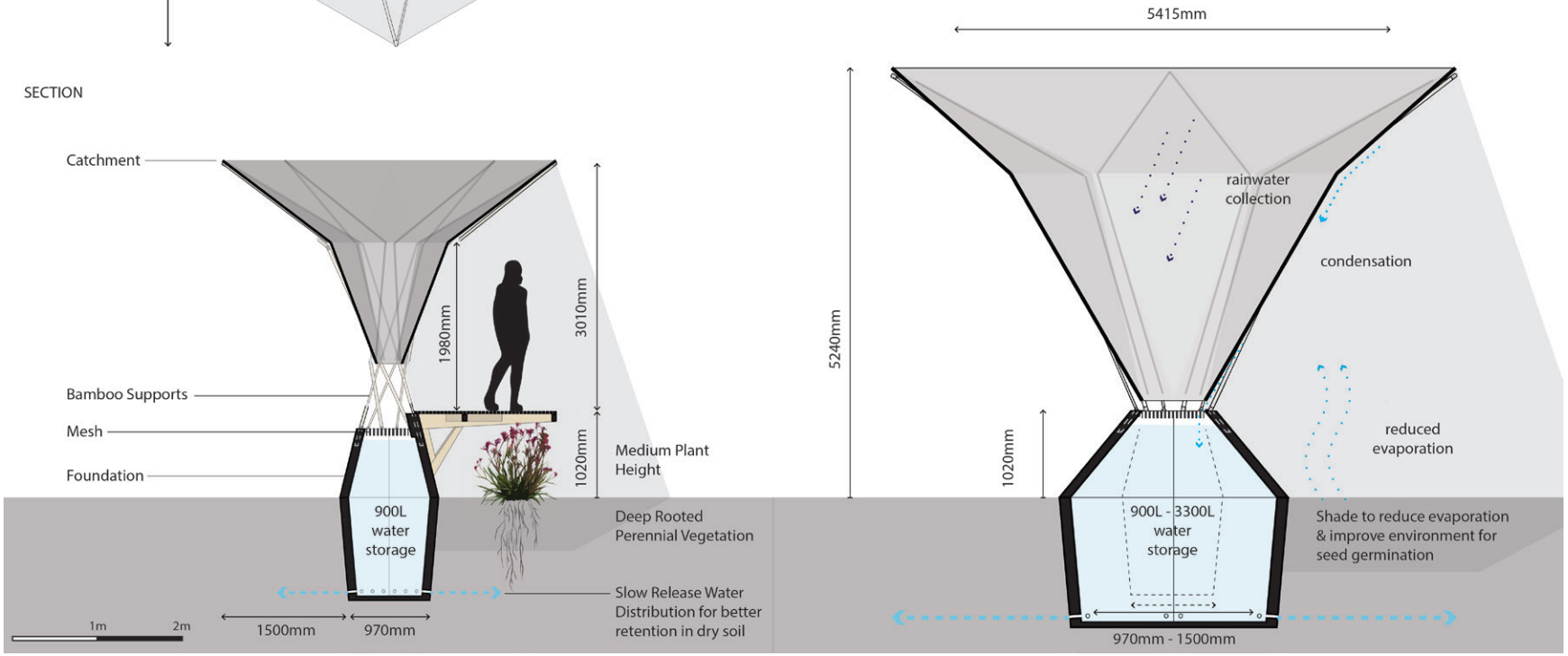
PLAN

PAVILLION





SECTION



Greenhouse

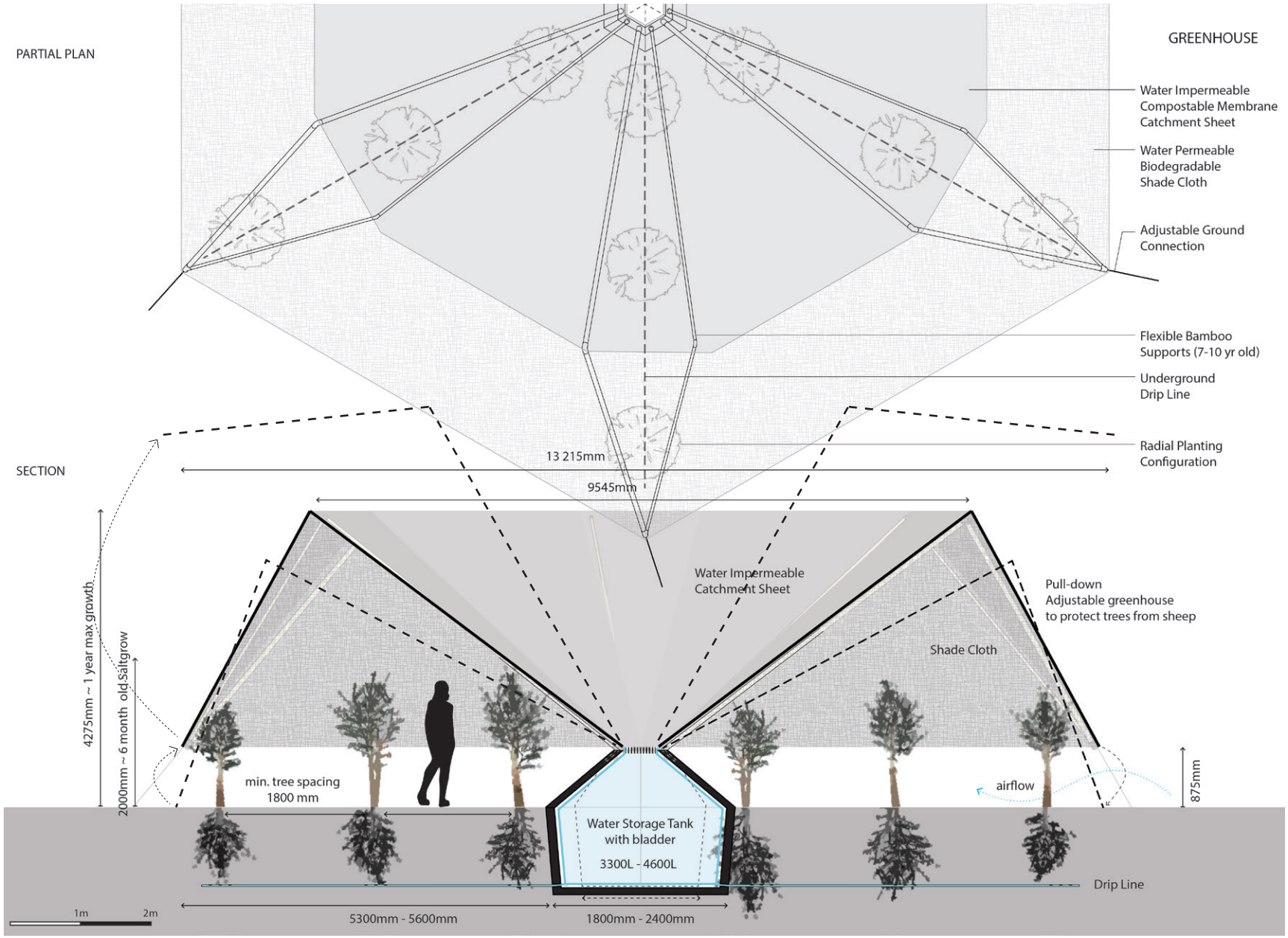
The diameter of the greenhouse is determined by the spacing of planted trees for cultivation. Each tree requires a minimum of 1800mm radius. Depending on soil conditions and types of trees, these may need to be spaced further apart, requiring the greenhouse span to be larger. Shown is the average spacing for Saltgrow Eucalypts. The flexibility of the bamboo construction would allow the greenhouse to be made larger or smaller depending on need. After four years, unsuccessful or damaged planted trees would be culled to increase spacing between the mature trees. Around ten to fifteen years another round of harvesting would be done to further increase space. At this point the trees could be sold for lumber production.

During the first few months of planting, the greenhouse edges would be pulled fully to the ground to protect the trees from pests and livestock, such as sheep, which will destroy saplings. As the trees mature the greenhouse is pushed upwards to increase airflow and allow space for the trees to grow. Water is collected only from the inner portion of the shadecloth, collecting up to 3 months of stored rainwater. A drip line system below the greenhouse would deliver water directly to the roots of the trees. This system could be used in conjunction with an electronic timer or constant drip release.

When the trees begin to push up against the underside of the greenhouse cloth, the structure would be pushed upwards and reconfigured to create the Tree Climber structure. After the culling of trees around the Tree Climber, the greenhouse could be pulled back down into place and used for harvesting and cutting lumber, as well as shelter for workers. The greenhouse would also provide an interesting place for visitors to view young trees and relax in a shaded and cool environment. As the greenhouse is pushed upwards it continues to shade and collect water, and creates a more open and accessible environment below for visitors to enter.

Alternatives uses for the greenhouse include germinating seeds, propagating delicate plants, winter vegetable growing, teaching and educational space, temporary shelter or storage, and small farmers markets.

Fig 3.13 on Right
Sections - Greenhouse


PARTIAL PLAN
GREENHOUSE
Water Impermeable
Compostable Membrane
Catchment Sheet
Water Permeable
Biodegradable
Shade Cloth
Adjustable Ground
Connection
Flexible Bamboo
Supports (7-10 yr old)
Underground
Drip Line
Radial Planting
Configuration
SECTION
13 215mm
9545mm
Water Impermeable
Catchment Sheet
Pull-down
Adjustable greenhouse
to protect trees from sheep
Shade Cloth
4275mm ~ 1 year max growth
2000mm ~ 6 month old Saltgrow
min. tree spacing
1800 mm
airflow
875mm
Water Storage Tank
with bladder
3300L - 4600L
Drip Line
1m
2m
5300mm - 5600mm
1800mm - 2400mm

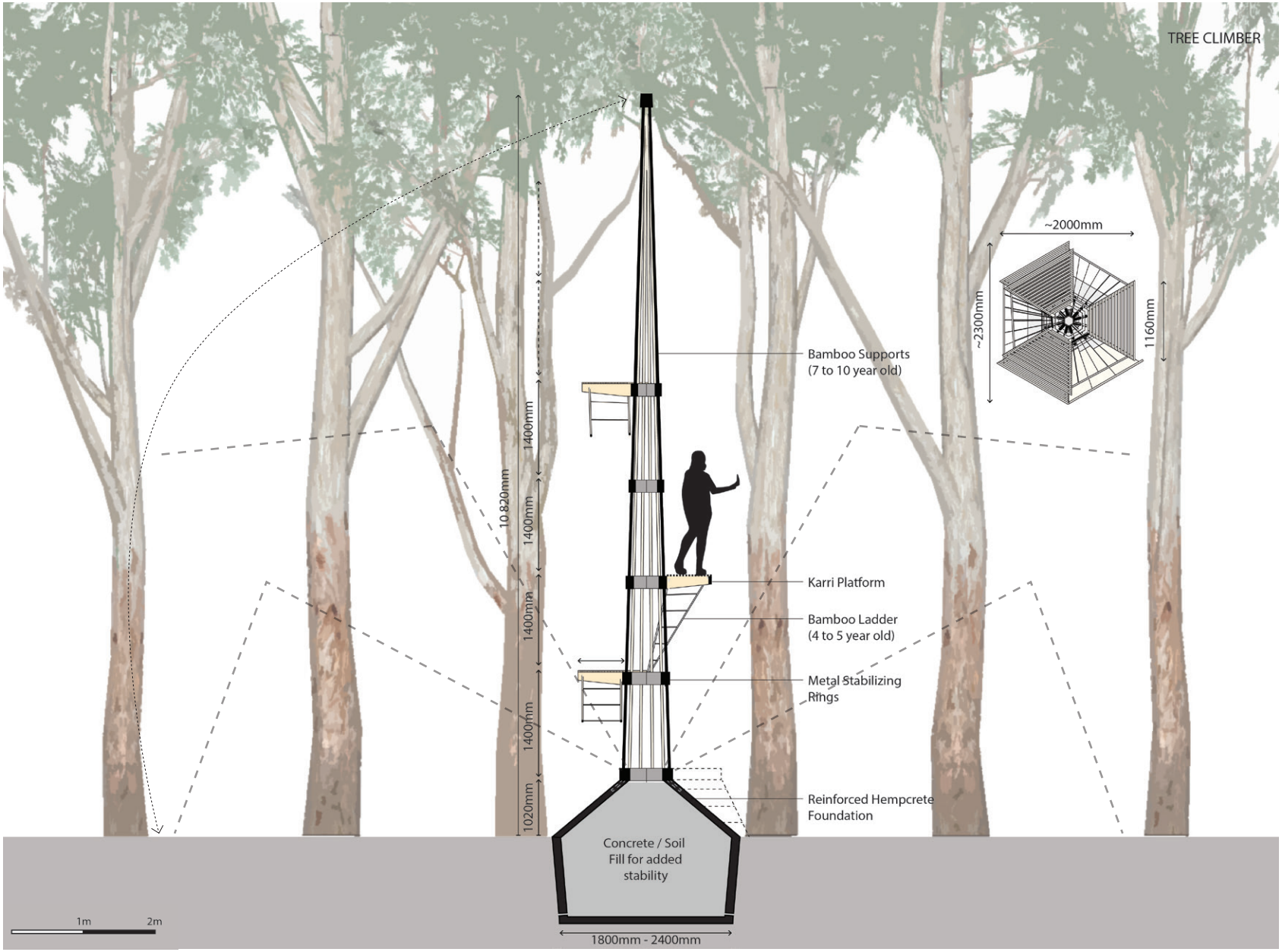
Tree Climber

The height of the treeclimber reaches the average height of a 10 to 15 year old eucalyptus tree. The Tree Climber would be configured when the plantation trees are between 1 and 5 years old. As the trees grow, the trunks would become closer to the tree climber, allowing for close interaction with a part of a tree rarely experienced.

The tree climber is primarily used for tourism purposes, but could also be used to inspect tree canopies for insect and bird life, as well as monitor for pests. As the trees grow, bird life will return to the foliage, and the tree climber will become an excellent place for bird watching. Insect life on the bark and branches would also be much closer and observable from the platforms. This offers an interesting perspective for education and research.

Because of the requirements for growing timber to sell, trees are regularly pruned and maintained in order to keep wood knot free and straight. This also ensures that the area around the Tree Climber would not be overgrown or inaccessible. After the trees are harvested, the Tree Climber structure can be reverted back to the greenhouse form for shelter or space to process lumber. If the structure is no longer needed the foundation could be removed and used elsewhere.

Fig 3.14 on Right
Sections - Tree Climber


TREE CLIMBER
~2000mm
~2300mm
1160mm
Bamboo Supports
(7 to 10 year old)
10 820mm
1400mm
1400mm
1400mm
1400mm
1020mm
Karri Platform
Bamboo Ladder
(4 to 5 year old)
Metal Stabilizing
Rings
Reinforced Hempcrete
Foundation
Concrete / Soil
Fill for added
stability
1m
2m
1800mm - 2400mm

Materials

The kit of parts approach is used in order to simplify the construction, transportation and removal process. All parts of the design are chosen for either their biodegradable nature or their environmentally conscious processing and production footprint. The intent of the construction is not to limit a farmer or builder to a narrow range of materials and configurations, but to provide a flexible system that can be customized based on need, available resources, machinery types and available funding. Farmers are resourceful and use creative solutions everyday. The simplicity and flexibility of the material palette as well as the structure is to encourage innovation and alterations to ensure the intervention is effective and controlled by the farmer.

The materials chosen are based on available sustainable or plant based products grown, or with the potential of growing, on Australian farms. Depending on soil type and climate of individual farms, farmers could potentially cultivate, assemble and construct the majority of the intervention with their own resources and skills. There is also the opportunity for farmers to create a network amongst themselves to provide materials and build the parts, creating a closed loop system. For example, farms that cannot implement the intervention could provide the materials and assembly required, and thereby profiting from soil remediation elsewhere.

Hempcrete Foundation & Water Bladder

Hempcrete is an extremely durable lightweight concrete product that uses only hemp, lime and water. Although not considered a structural material, with some additional reinforcing it can support the weight of the bamboo supports and karri platform. Hempcrete has an extremely long lifespan and is fire & termite resistant. Hempcrete also sequesters CO_2 and requires very little energy or water to make.

The foundation also serves a secondary purpose of a holding tank for the water bladder. A custom shaped bladder would be inserted into the hollow centre of the foundation, with a drip line connection through the holes at the base of the foundation to allow a slow drip of water. This would slow the recharge of the ground and allow direct watering at the roots of the plants. Hemp is a very economic and sustainable crop, requiring no irrigation, fertilizer or pesticides, and maturing within 16 weeks. Hempcrete is already available in Australia.[93]

Seeded Hempcrete

The seeded hempcrete would be applied to the outside of the foundation at the base of the structure. A mixture of local plant & grass seeds would be used. The seeded layer is very fragile and allows seeds to germinate then break off and continue growing in the soil. This would be the first step in re-vegetating the area at the base of the foundation. As the seeded concrete fulfills its purposes, it will wear away and leave only the hempcrete foundation. Seeded concrete is not yet a commercial product, but has been tested in the USA.[94]

93 “Products,” Hempcrete Australia PTY Ltd., accessed August 14, 2015, http://www.hempcrete.com.au

94 “Seeded Concrete,” Cargo Collective, last modified July 2013, http://cargocollective.com/williamleesurfacedesign

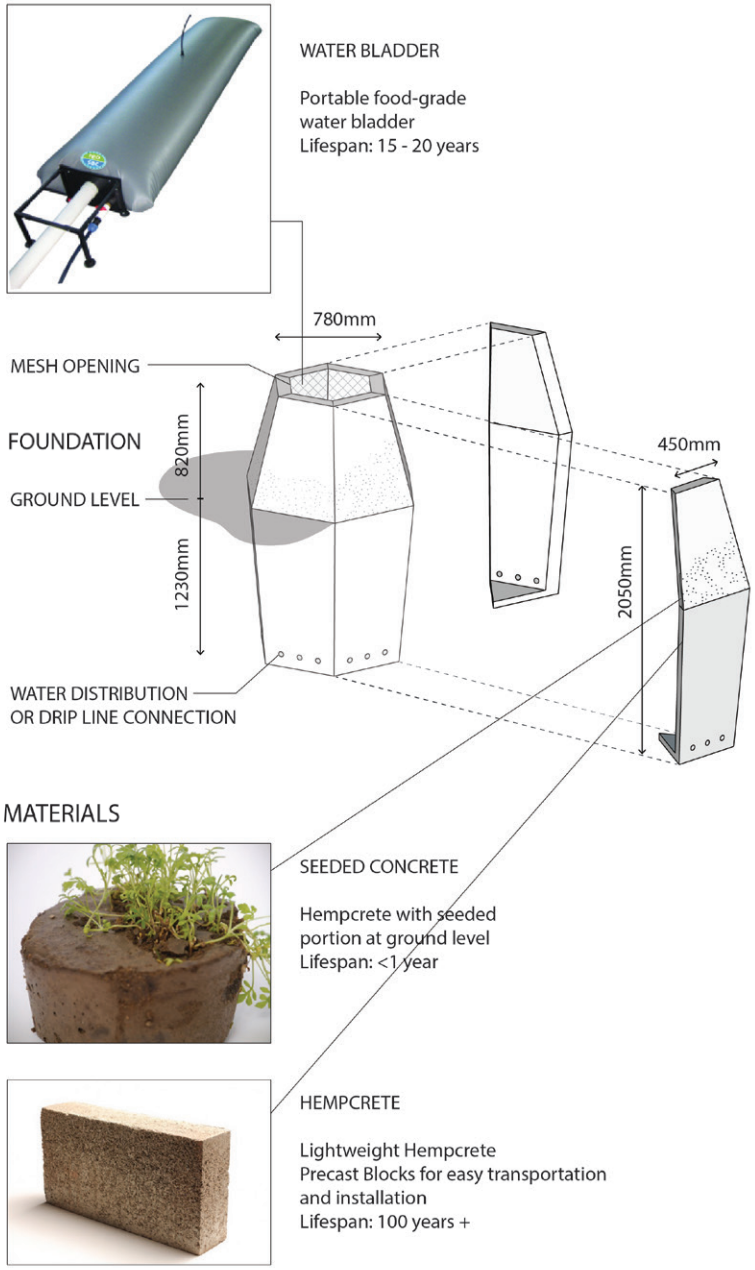


Fig 3.15 on Right
Construction - Foundation

Bamboo Supports

The bamboo supports can be easily made in any size. Two to three inch diameter bamboo would be used to provide flexibility in case of high winds, while also being thick enough for structural stability. At the end of its lifecycle the bamboo could be reused or burned during the clearing process. The bamboo supports would also act like tree limbs, providing places for birds to rest. Bamboo can be grown in many parts of Australia and is quick to mature.[95] With proper harvesting and drying, bamboo is also pest resistant.[96]

Biodegradable Shade Cloth & Water Collection Membrane

The biodegradable shade cloth and membrane is a lightweight 'cloth' material made from a mixture of coconut husk or straw fibres pressed together with a biodegradable shrimp plastic and mesh. The straw fibres are lightly spaced to allow some light to permeate the cloth, and the biodegradable plastic collects water towards the foundation and into the bladder. As the straw fibres decompose and fall apart, the bioplastic is exposed to sun and air and quickly degrades, providing rich nutrients and fertilizer for the plants below from the proteins in the shrimp plastic.[97] Shrimp plastic was developed by the Harvard University as a solution to plastic packaging and is not yet sold. Biodegradable cloth products are already sold in Australia and around the world.

95 "Bamboo Poles," Bamboo Australia, accessed April 17, 2015, http://www.bambooaustralia.com.au

96 "The Eleven Basic Principles," Bamboo Building Essentials, accessed April 17, 2015, http://bamboobuildingessentials.com

97 Wyss Institute, "Promising solution to Plastic Pollution," Harvard Gazette, May 5, 2014, accessed August 14, 2015 http://news.harvard.edu/gazette/story/2014/05/promising-solution-to-plastic-pollution/

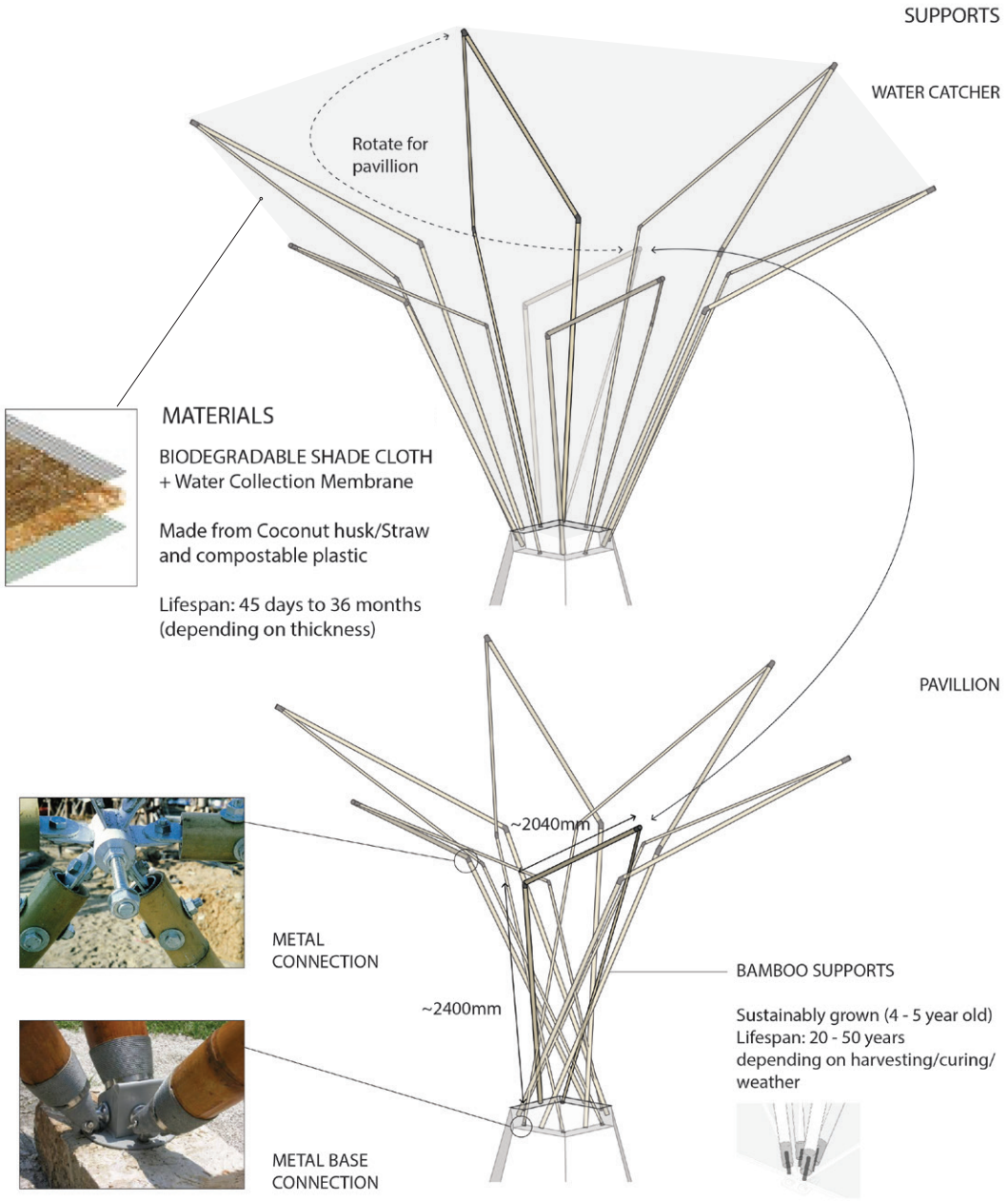


Fig 3.16 on Right
Construction - Supports

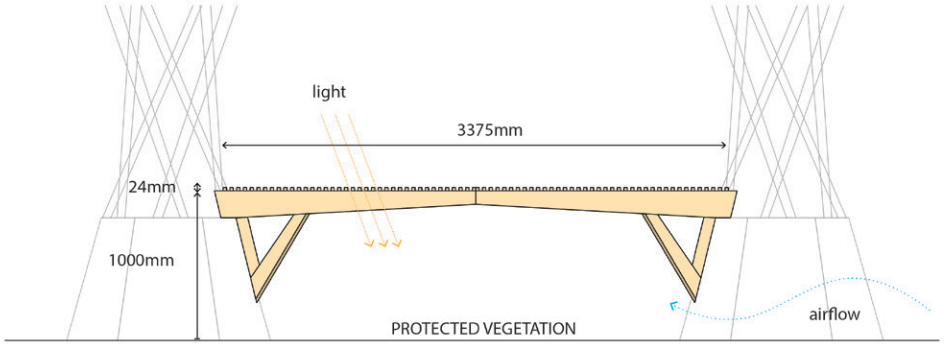
Platforms

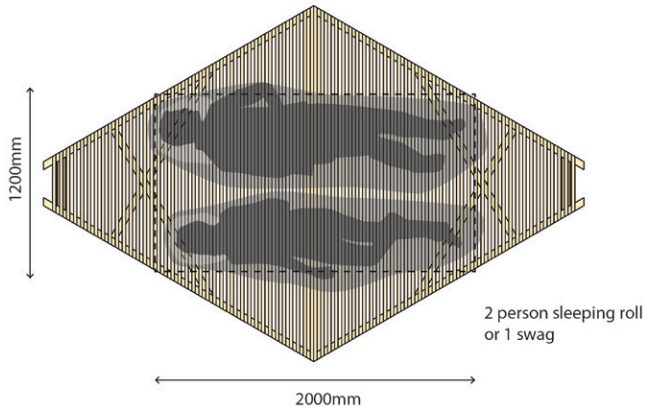
The platform is designed for human proportions and comfort. Each platform consists of a single triangular deck piece with cross bracing and support arms. The platform is made entirely from karri; a hardwood eucalypt and naturally rot resistant that grows in the South West. The platform is raised off the ground to ensure minimal human disturbance on the ground plane.

There are four suggested types of platforms that can be arranged in different patterns for custom configurations. The typical platform is the boardwalk type, used as a place for walking or camping; the seating platform is used for viewing and meeting places; the access platform is required to climb to the height of the other platforms; and the viewing platform is used to create a blocked off area or opening between platforms for looking into or protecting a specific place on the ground.

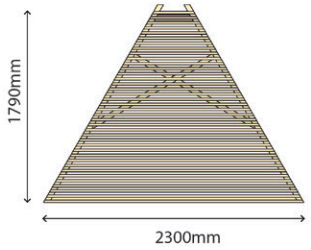
The platforms are sized to be lightweight and easy to transport and disassemble. They also allow rainwater and light to pass between the slats encouraging plant growth below them, creating a protected niche for small animals and insects. At the end of the lifecycle of the intervention, the platforms could be removed and reassembled elsewhere, or if damaged, burned during the clearing process. The distance from the ground to the platform is determined by the height of short to medium sized perennials. Taller plants could come up through the slats or be surrounded by viewing platforms to protect from trampling.

Fig 3.17 on Right
Construction - Platform Types

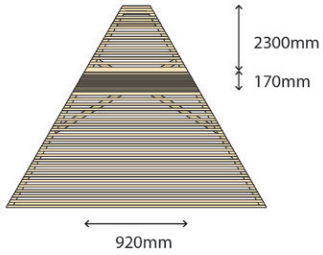




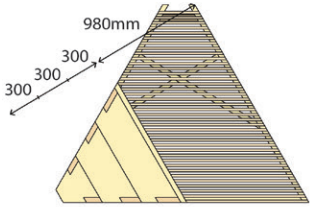
BOARDWALK



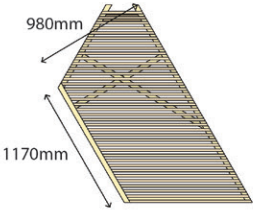
SEATING

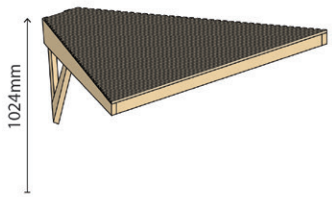


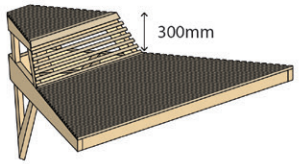
ACCESS

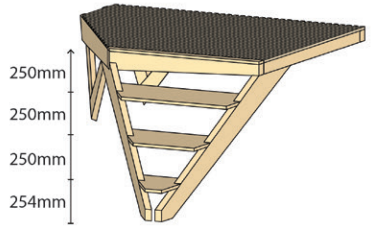


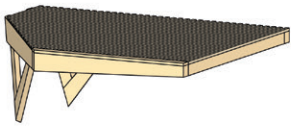
VIEWING











Configurations of the Pavillion

01 Campsite

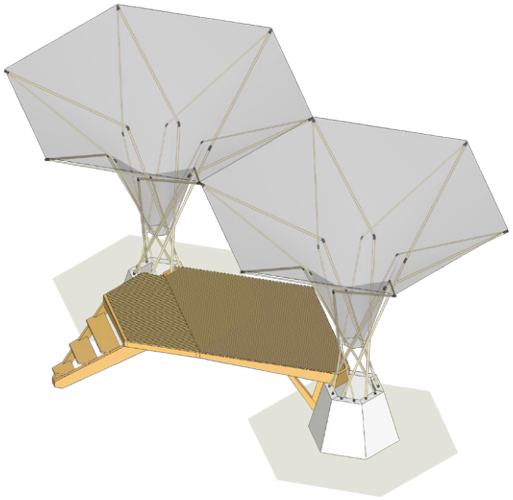
The campsite configuration requires two boardwalk platforms and one access platform, and is large enough for a double swag or a single small tent. The biodegradable cloths provide shelter. Additional platforms could be added to create cooking or resting areas. Campsites could be a source of income for a farmer if needed, or provide shelter for temporary labourers.

02 Water / Waste

This configuration requires the seating platform on the ground with minor modifications.

The configuration shown is a human and organic waste disposal area. A small tent structure made of bamboo would be constructed on the ground using a less transparent straw and bioplastic cloth for privacy. The foundation at this configuration does not have drip holes, and water in the catchment does not go into the ground, but stays within the tank for human use. A small foot-pump is used to pump water out for human washing and consumption. The seating platform has a covered opening for use as a composting toilet, which can be used with agricultural scraps (grain husks, saw dust, dried stalks, etc.). The sealed waste disposal storage below grade does not come in contact with the foundation at any point. It is covered when not in use to prevent animals and water contamination.

This structure would be located in proximity to the campsite for camper and day use to ensure human waste does not come in contact with food cultivation. The composting toilet, with proper use, will not smell or leak. One year after last use, the remains in the composting toilet are safe for use as organic fertilizer on crops.



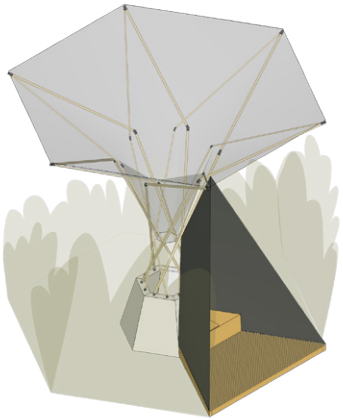
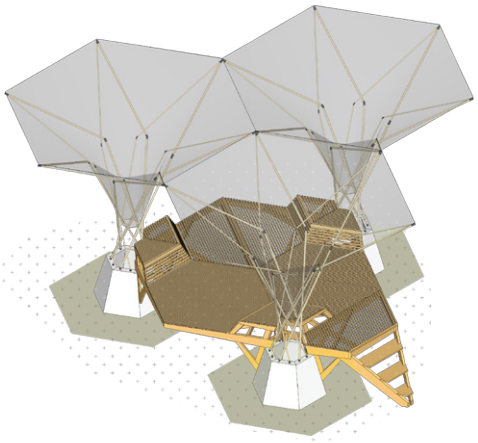


Fig 3.18 on top
Configuration - Campsite

Fig 3.19 on bottom
Configuration - Waste Disposal



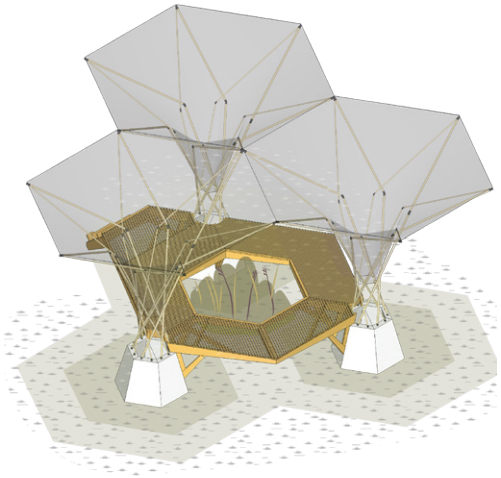


Fig 3.20 on top
Configuration - Meeting Place

Fig 3.21 on bottom
Configuration - Protected Viewing

03 Meeting Place

This configuration requires 6 seating platforms and one access platform.

The form of the meeting place structure is configured to prescribe equal importance to all sides with no front or back. Similar to many native practices of sitting in circles for storytelling or group meetings, this is an arrangement that suggests equality. This place could be used as an outdoor classroom, resting area, research pavillion or meeting place. This configuration provides a unique type of classroom encouraging equality for all participants on and around through its form. Outdoor learning environments stimulate increased brain activity and are excellent places for learning.

This configuration could also be used with 6 boardwalk platforms to create a larger campsite or more seating platforms to create a larger meeting place.

04 Conservation

This configuration requires 6 viewing platforms and one access platform.

The conservation configuration is intended for taller plant life or protecting an area of special importance. Viewing platforms could be placed over interesting geologic and soil conditions, wetlands, small streams or tall flowering plants. This configuration would also signify to viewers an important or interesting location to view. It's form also encourages participation and equality.

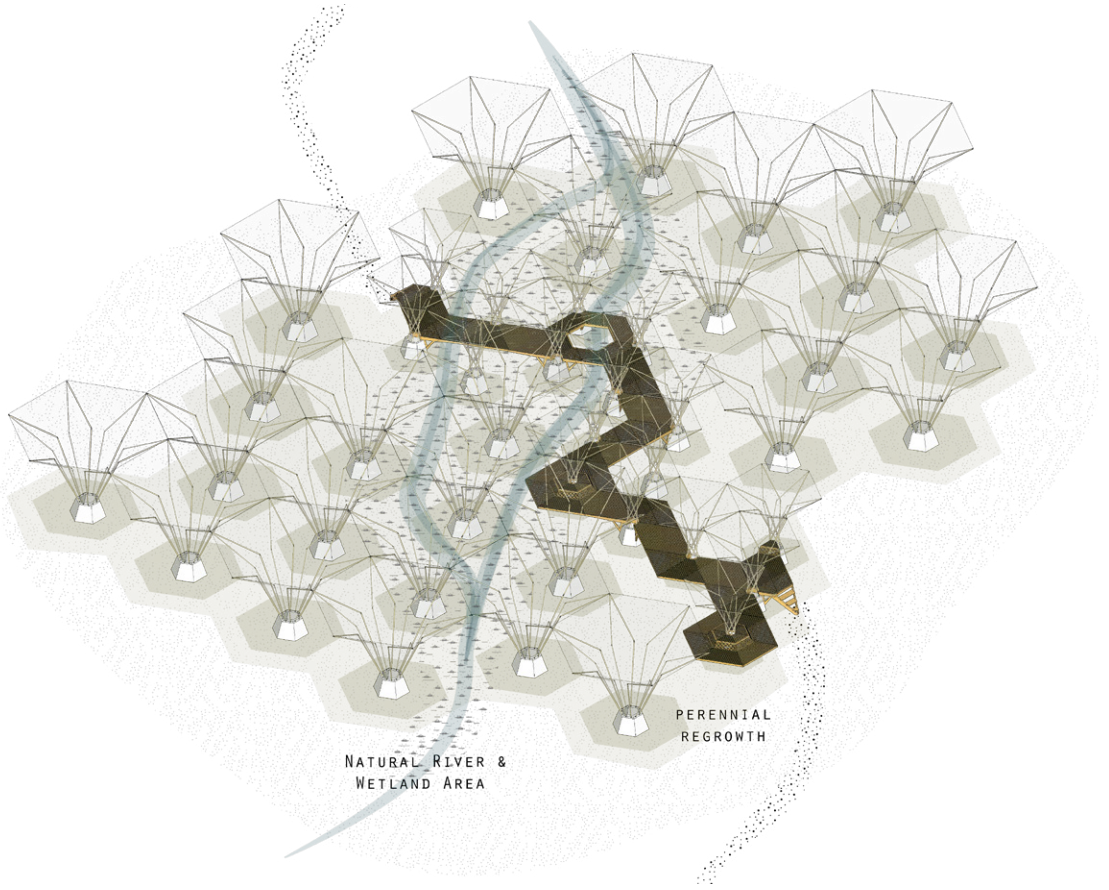
This configuration could also be used with 3 seating platforms and 3 viewing platforms to create a place for repose on one side and a viewing hole on the other.

05 Trail

Any configuration or mixture of platforms could be used to create the trail aggregation. In this instance, 26 boardwalk, 14 seating, 6 viewing and 2 access platforms are used to pass through a wetland area undergoing regrowth. The trail offers passage through an area mostly covered by waterlogged soil and a small stream.

The trail configuration could be used as a means of crossing a protected area that needs to remain undisturbed, or function similar to a bridge over wetland and marshy areas. It could also be used as a way to indicate trailheads, pass through dense undergrowth or provide navigational assistance.

As each site would be different, the trail could also be used as a way to create identity or bring tourists to specific places on a farm. Trails could be reconfigured as conditions change or removed as vegetation takes over.



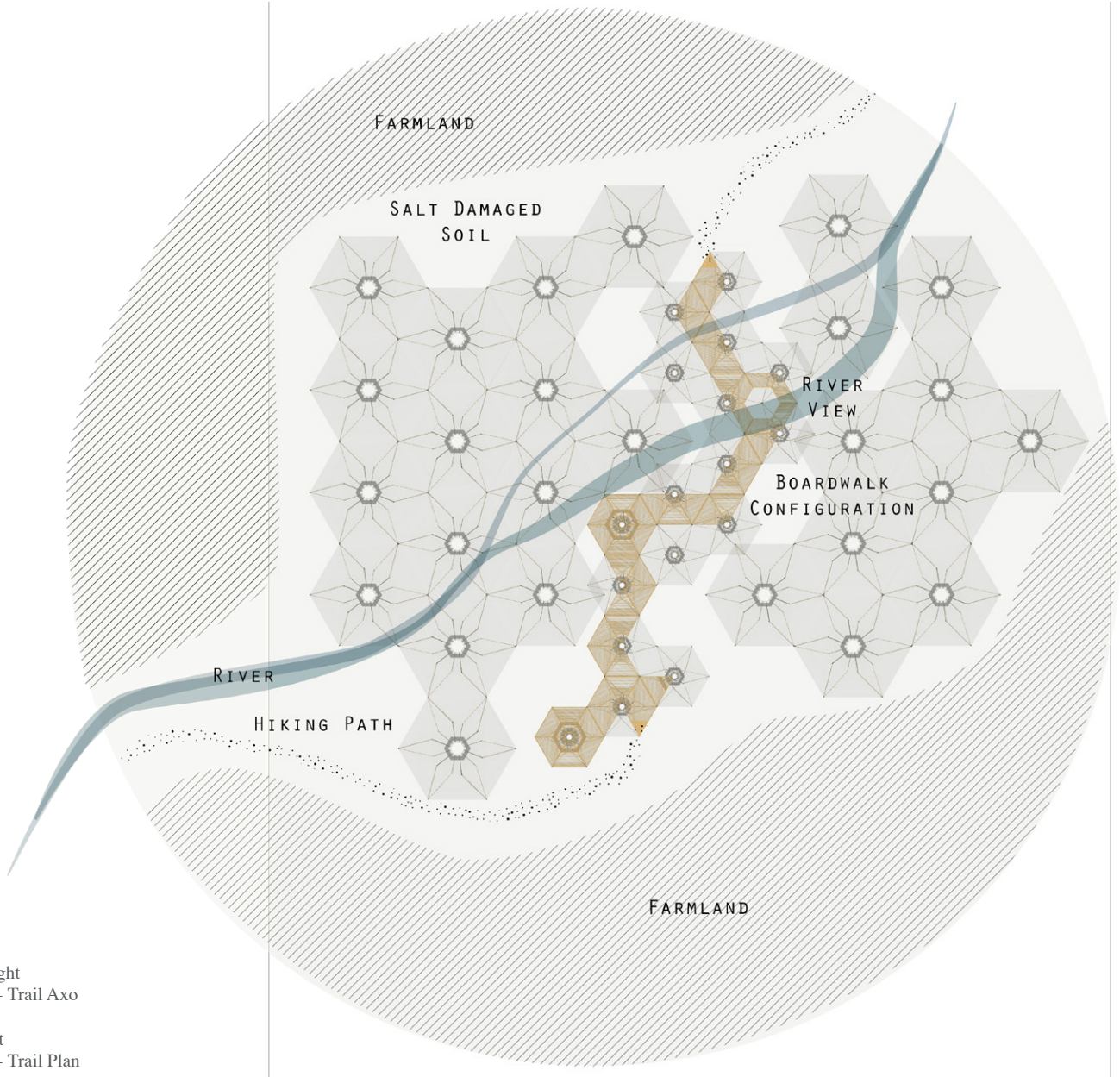


Fig 3.22 on Right
Configuration - Trail Axo

Fig 3.23 on left
Configuration - Trail Plan

04 Application

Implementation

The following is a temporal exploration of a fabricated site. The exploration seeks to understand how the intervention can appear, disappear, aggregate and trigger changes within a farm system as required by the site conditions. This section expresses how design can be part of a dynamic system and also be used as an interface to promote visitor and consumer interaction with rural landscapes.

Re-Imagining Rural

At first, architecture and design may not seem like a viable approach for addressing social and environmental problems in the Wheatbelt. However, existing approaches, such as those of Australian government agencies, the National Action Plan and Water Quality (NAP), various Wheatbelt National Resource Management groups (NRMs) and environmental campaigns by scientific and private organizations, although affective at addressing environmental problems, have not yet addressed the wide spectrum and interconnected social disconnect in the Wheatbelt. Yet salinity can be used as a gateway into exploring some of the other environmental and social problems of the region because it can be experienced and seen by visitors, as opposed to social problems which are harder to turn into qualitative aspects.

In 2003, 80% of farms in the Wheatbelt reported lands showing signs of salinity, and 63% of that salinized land was unusable.[98] This does not mean farmers are not aware of the problem; the same study showed that 82% of farmers had changed land management practices in an effort to manage or prevent salinity. However, a lack of financial resources, lack of time, insufficient or inadequate information and doubts about being able to actually control and manage salinity were all cited by farmers as limiting factors for the amount of land actively under remediation or new forms of management. While resources and funding have been made available to farmers, this has not had a significant impact on their ability to address salinity in an appropriate time frame, change overall land care practices, or believe in their own abilities to make a difference.[99]

Interestingly, the development of digital tools for addressing land salinity is already well underway. The results of these programmes have provided sophisticated tools that are used by farmers in an increasingly connected way. For example, in New South Wales the Department of Land and Water Conservation developed a GIS program called CATSALT to identify water and salt movement across the landscape. Using this program, a farmer or researcher can analyze the impact of different volumes of tree planting by getting instant feedback on the impact of remediation through a reading of waterlogging and salt load. These kinds of programs make planning for remediation easy, because a farmer can instantly see and measure their own success rate. This is done by assessing the area a farmer wishes to plant trees in, focusing on current waterlogging and salinity levels, and comparing different amounts of tree cover. The GIS program then identifies the time required for waterlogging and salinity damage to be remediated using different schemes.[100] These farming techniques and land remediation tools are connecting farmers and increasing the availability of knowledge, support and communication networks. This allows farmers to interface with soil and land in a way not possible before, yet still excludes the general urban public from participation, and this is where the role of architecture as a mediator has the greatest potential.

Architects often coordinate a complex group of clients, consultants and builders, but are also responsible for the design choices influenced by such things as environmental and site conditions, financial requirements of the client, building code and policy, as well as their own concepts of public and private space in creating

98 "Salinity and Land management on Western Australian Farms," 25, 29.

99 Ibid, 30.

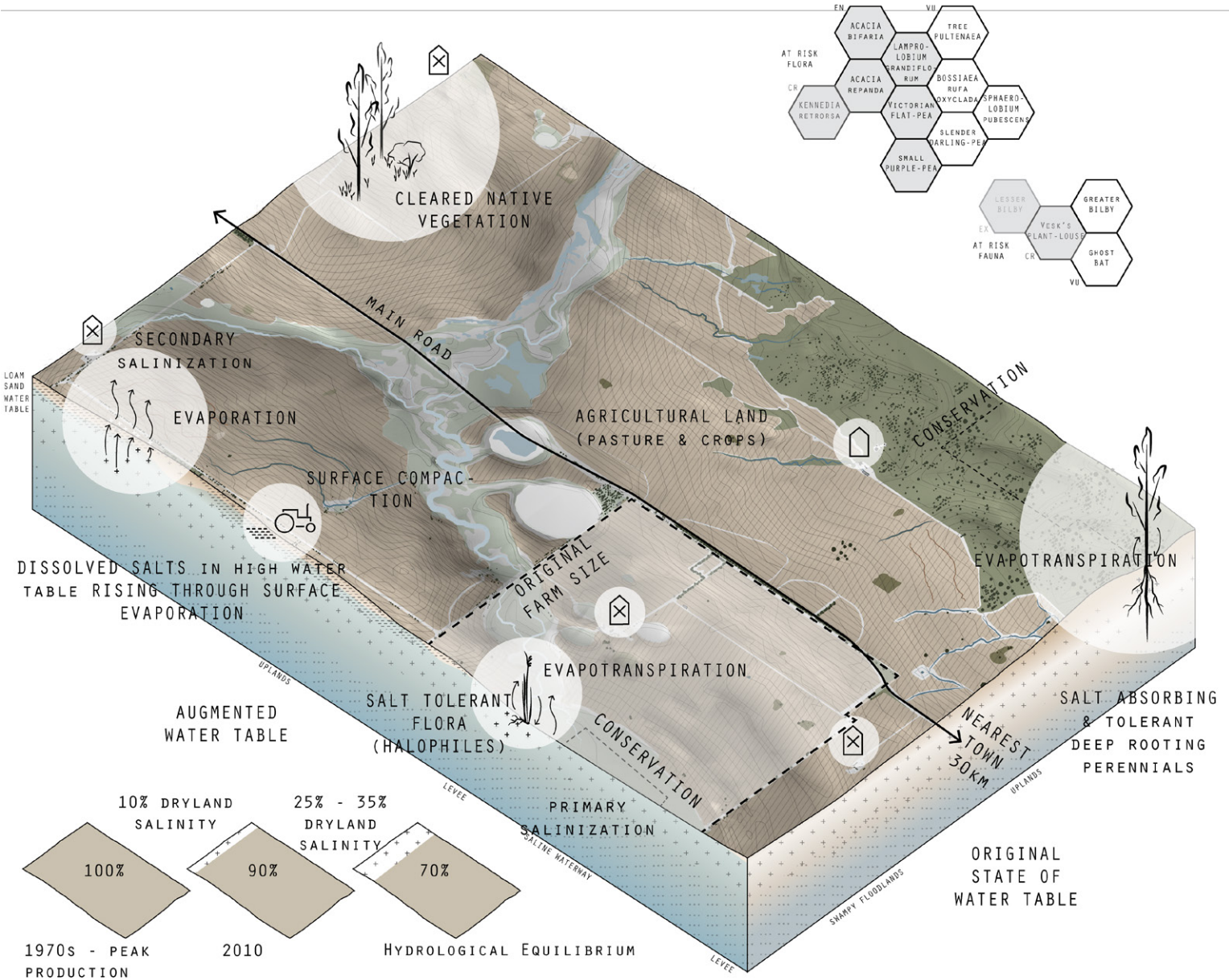
100 Laura Kuginis, and Joanne Daly, "Plant Based Solutions for Dryland Salinity Management," Department of Land and Water Conservation, (presented at the Salinity Economics Workshop, Orange, New South Wales, Australia, August 22-23, 2001): 27.

an enhanced social experience. Incorporating architects into the design of rural spaces could help frame interrelated yet diverse problems in a way that could not be done by any single organization or program, and would help to ensure those issues are addressed formally in the public realm. By conceiving of a new public place that provides a recognizable identity to the salinity remediation efforts that are ongoing – while at the same time addressing a wide range of stakeholders and factors – hidden social and environmental issues could become clearer to those usually outside of rural issues. In the Wheatbelt, awareness and wider public responsiveness to social and environmental problems is already recognized as important step to addressing them on a wider scale. Creating a 'face' for the problem, as a place that is both recognizable and inhabitable, could bring together the often-missing consumer element of salinity management and remediation by creating a place to monitor and index changes. It also connects the variety of stakeholders required for rural community longevity and resilience for the benefit of the farmer.

This project seeks to emphasize the role multiple participants might play in the process of rural awareness, by encouraging a wide range of interaction. This is largely done by assigning unique, participant roles to each part of the proposed intervention: the water catcher, pavilion, greenhouse, and tree climber.

The water catcher invites interaction from what are called 'environmental' participants – natural elements such as sunlight, water, flora and fauna – which are visible from the viewing platforms of the human pavilion. The pavilion, on the other hand, encourages the participation of visitors by providing a public platform of occupation, inviting tourists, educators and their classes, as well as researchers to use the designed space. The platform of the pavilion also allows human interaction to occur without disruption to the natural surroundings, freeing up the ground plane and allowing small animals and plants to activate the spaces below, while birds and water collection use the space above. The farmer is the main participant of the greenhouse, which provides the opportunity for tree planting in a controlled environment and can also be used to collect water. When the greenhouse's lifecycle is complete, it is transformed into the tree climber and can then be used by both visitors and bird life. When a tree climber is no longer needed, it is can be converted back to greenhouse form, to be used by the farmer or hired workers to process lumber from felled trees.

Proximity and visual connection between each part of the intervention fosters interaction of different participants, human and otherwise. Visitors can wander freely, and experience different activities across the site. While the system derives very little from soil remediation, it is the intervention's potential as an educational and relationship-building tool that holds the greatest value. The project reconnects stakeholders to the natural cycles of the land, and to other disappearing important networks in the environment. At the same time, it links land care directly to rural life.



TYPICAL 10 000 ACRE AGRICULTURAL SWATCH
(PARTIAL FARM PROPERTY)

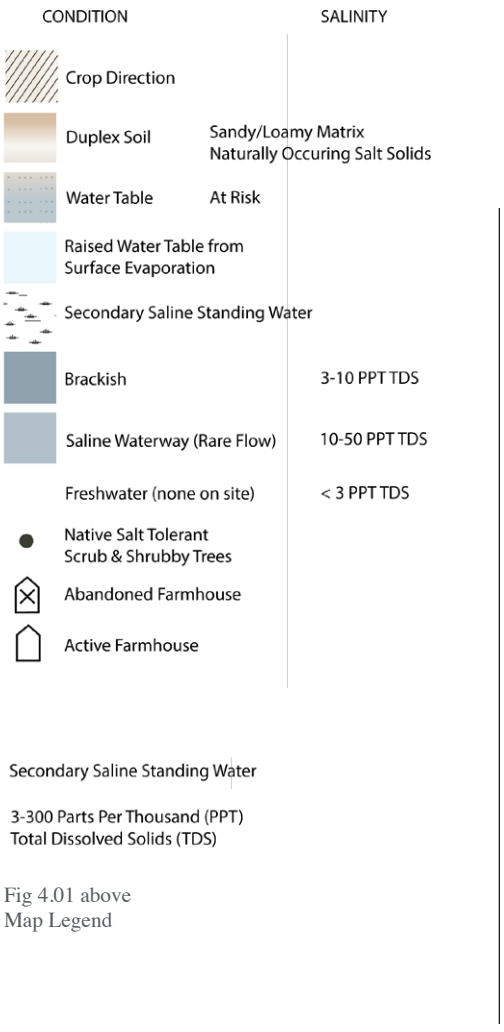


Fig 4.01 above
Map Legend

Fig 4.00 on Left
Typical 10 000 sq ac broadacre farm with highland bush and a saline drainage flat conservation areas bordering.

Implementation & Cycles

The following documentation shows the implementation of the intervention over a period of 50 years. This system is only supplementary to sustainable choices made by the farmer. This intervention is meant to be part of a larger system to help create awareness, and is not a stand-alone solution.

Case Study Site

The chosen site is located 200km east of Perth in the central wheatbelt region. Although the site is partially fabricated, it exemplifies many of the problems experienced by farms all over the wheatbelt. Soil in hilltop areas is affected by compaction from uncontrolled traffic from farm vehicles, and in lowland areas salt deposits from waterlogging and a high water table. Lack of perennial vegetation also creates more runoff from high areas and increases erosion on slopes.

There are two conservation areas bordering the site. The conservation area on the south-eastern side of the site is mainly made up of low brush and small trees. On all sides the conservation area is slowly being cut into and eroded by tractor traffic and increased cropping area. On the southwest corner of the site is a second conservation area protecting a naturally saline drainage plain. The drainage plain remains dry most of the year until midwinter when freshwater rains flush the area. In recent years rainfall has significantly decreased causing less freshwater to flush the drainage flat. Increased salinity from the high water table has reduced the amount of arable land around the flats and created standing brackish areas where only halophytic species can survive. Although these can tolerate the sodic and wet soil, as salt content increases the plants will no longer be able to survive.

The 10 000 square acre farm was once four separate properties which were slowly amalgamated into one as the cost of farming increased, profits decreased, soils worsened and an increasing extreme climate reduced the reliability of good yields.

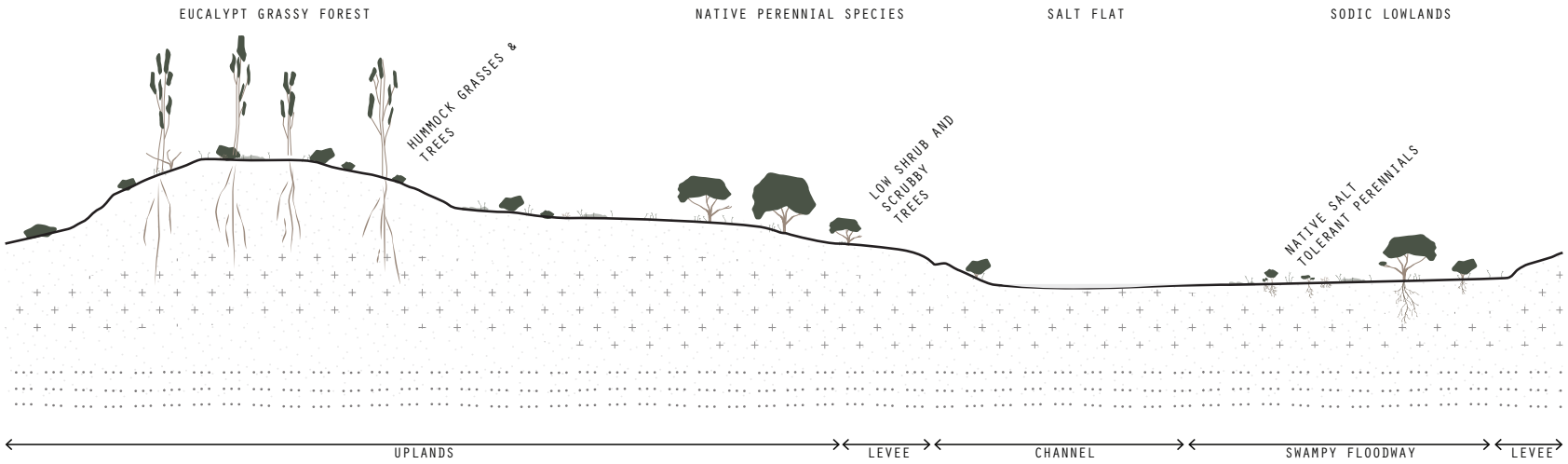


Fig 4.02 Diagram of Previous conditions on site.

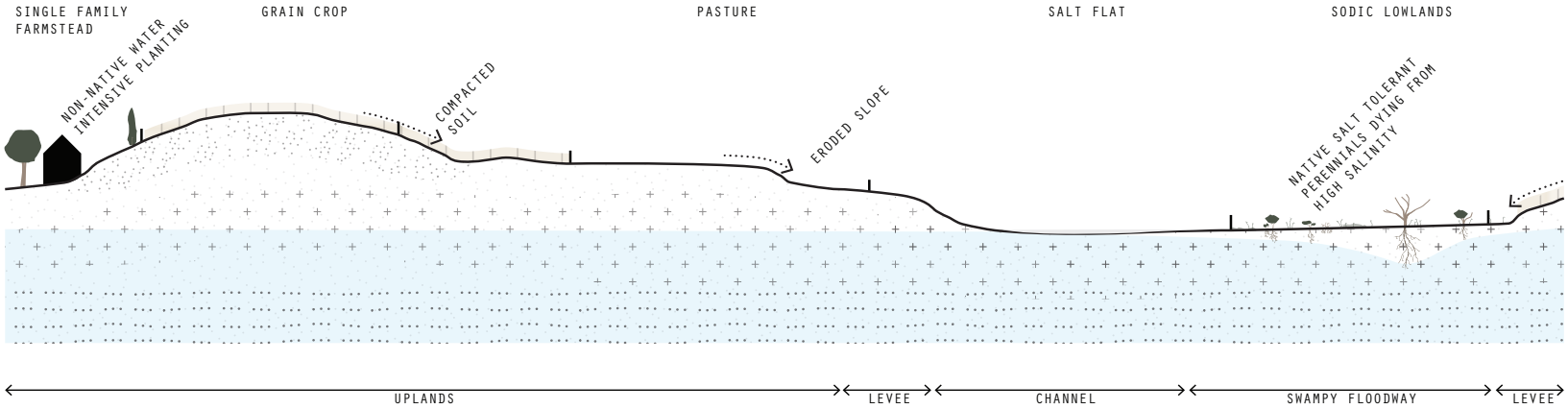


Fig 4.03 Diagram of Current conditions on site.

System Participants

The position of each stakeholder and their role in the system is important in order to understand the value of creating an architectural intervention in a remote area. Systemic change is only possible when the different parts of the system are aware of each other and can act symbiotically. The participants in the system are also stakeholders who are either active on the site of the intervention or a direct beneficiary of increased participation in soil health and remediation.

Farmers

Of the population of Australia, less than 2% of all Australians are employed in the agricultural sector. In the Central Wheatbelt region the Agriculture, Fishing and Forestry occupations account for more than twice as many people employed than any other single industry.[101] However, the distance between farms and the lack of a centralized meeting place discourages the Wheatbelt from acting as a single community rather than individual parts. The nature of land management also requires each individual farmer to assess and enact his own remediation efforts. This creates a barrier between communal sharing of information and efforts towards land care management, as no two sites are the same or accessible to one another.

Creating a network of visible and inhabitable structures that could be used by tourists and farmers can help open up communication between individual farms. Implementing an intervention that connects farmers, educators, researchers and visitors can help create a platform for interaction between all parties. Once locations of the intervention are known and open to visitors, farmers can also take part by visiting nearby farms to see what changes are taking place around them and learn from their widespread community. Farmers can then create their own social connections and learn from one another, generating confidence in their ability to make changes on their own land and seeing positive results elsewhere.

Farmer

101 “2011 Census of Population and Housing - Central Wheatbelt Basic Community Profile,” Australian Bureau of Statistics: B43a.

Fig 4.04 Legend of Participants (continued 99-102)

Urban Population

Organization

Urban Populations

It is difficult as an outsider to engage or understand the realities of an industry like agriculture that is heavily community and family based, as well dispersed outside the normal concentrations of people. Yet 93% of domestic food is grown in Australia, meaning agriculture is touching the lives of those living in cities every day.[102] With the rising popularity of local food movements and new consumer interest in where and how food is grown, there is a growing public interest in some types of farming. This is illustrated with the vegetable tourism model that informs consumers about local food and seasonal availability, and is reciprocated by increased sales of local seasonal produce.[103]

The same food-based opportunity is not possible for broadacre farmers in the Wheatbelt. The intervention of habitable structures on rural lands provides a new type of infrastructure to support a tangible connection. Giving mobile visitors a place to visit sheep or wheat farms and linking it into the existing tourist routes outside the Wheatbelt will connect the urban public physically and psychologically with rural lands.

Funding & Organizations

Organizations offering funding and resources often understand problems of farming in terms of dollar value, land care, policy, management and environmental damage, but sometimes lack the human connection to the problem. Farmer's and their families rely on the viability of their crop or livestock, and although may understand that there is a solution to salinity, the changes required often do not take into account the risk taken by the farmer and the actual amount of time and labour required to make those changes.

Using the interventions as part of an income-generating scheme activates the farmers role and responsibility to the system, and can address some of the issues of taking partially damaged land out of production by providing direct return on salinity management investments. This changes the function of funding and land care resources available to farmers by enabling them to become a secondary support system for providing education, resources and financial backing for their families. This puts less onus on outside organizations to be the sole caretakers of the land, and more power into the hands of farmers, which in turn benefit directly from social and cultural capital.

102 "NFF Farm Facts: 2012," 5.

103 "Alternative Food Networks or Agritourism? The 'Vegetable Tourism' Experience in the Barcelona in the Peri-Urban Area," 123-124.

Researchers & Educators

Many researchers of salinity are not actually living or working on or near farms and farming communities. Educators similarly are focused in classrooms, and children living in rural areas, who have a higher likelihood of working in the agricultural industry, are not necessarily exposed to more sustainable practices at a young age.

Developing a common platform for research and education, or a sort of 'corridor', for studying salinity and wildlife in a number of different conditions, could help with implementing a more generic model for salinity management. Using the platforms as meeting places or outdoor classrooms would create a location that could be visited each year to see the changes in a site, and possibly become part of the curriculum for children in agricultural regions. Outdoor environments provide excellent places for learning, and hands on observation of natural systems provides future generations with an innate ability to understand and interact with the network in a reciprocal relationship. The platforms could also be a place for farmers to talk about what changes they are implementing and focus groups to meet. Day trips for classes in nearby cities could be used to learn about where and how food is grown, the relationship between soil and human health, and be teach contemporary problems and realities of farming. This again enables farmers to become the most active participants, while also creating outside cultural capital by bringing new ideas and people to their land.

Research & Education

Environment

Although the environment is more of a passive stakeholder, it still stands to benefit or suffer losses from land management. The intervention seeks to work alongside natural systems as a mini boost before true vegetation can return or more holistic farming methods can be used, rather than augmenting the natural system to fit in with the current approach to farming. The intervention also provides shelter and habitat regeneration, creating small wildlife corridors through otherwise uninhabitable landscapes. Although the intervention would never be able to truly replicate a natural system, it does attempt to give back to the environment through soil remediation and niche creation. By mimicking and re-introducing natural cycles into the system, the intervention also helps to create resiliency against planet wide environmental changes and long-term sustainability for ecosystems alongside humans.

Flora

Environment

Fauna

Industry

Agricultural Industry

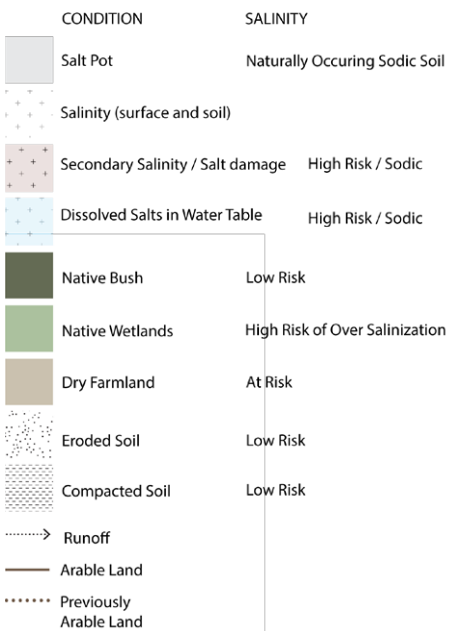
Since industrialization, the agricultural industry has benefited from a great deal of technology, but has not necessarily progressed in terms of learning from the land. Most machinery and technology today attempts to force soil to behave in a way that is only beneficial to humans, but little technology has become responsive to environmental conditions, soil building, regeneration, remediation or preservation of complex and supportive local conditions.

By increasing human traffic to agricultural areas with the use of the intervention, increased interest in farming and farming techniques may result in new innovation in the field of agriculture. Developing Western Australia specific farming technology and systems can only happen when a diverse range of expertise is able to understand and see problems associated with agriculture today. Engagement with a system that clearly has its own struggles will create opportunities for those who enjoy solving problems to help find new solutions to old problems. The platforms for visitors not only serves to bring tourists out to the land, but also potentially develop the next generation of farming practices. The intervention helps to develop interest from outside the community, bringing new knowledge and ideas, which in turn will help create social capital. Supporting the agricultural industry through constant innovation is especially important in creating long-term resilience and adaptability in an industry that has become sluggish in its response to environmental problems.

Providing habitable structures also creates a space for short term labourers, introducing a new type of affordable temporary dwelling that can be grown, assembled and constructed on the farm by those living and working there.

Year 0 Early September

The site in its current state is planted with canola during winter and pasture in the summer. Damage from continuous crop/pasture cycles and removal of native vegetation has contributed to waterlogging and salinization in low lying areas. Much of the site has either salt damage, compaction from traffic or erosion from increased runoff from lack of native vegetation. The drainage flats between canola fields suffer from high salinity which is visible in a white residue around the edges of the stream. The high water table leaves the surface waterlogged at low areas. This prevents germination of seeds from most plants. Some halophytic species survive but are slowly dying. Every year the width of unusable land increases, reducing the amount of arable land.



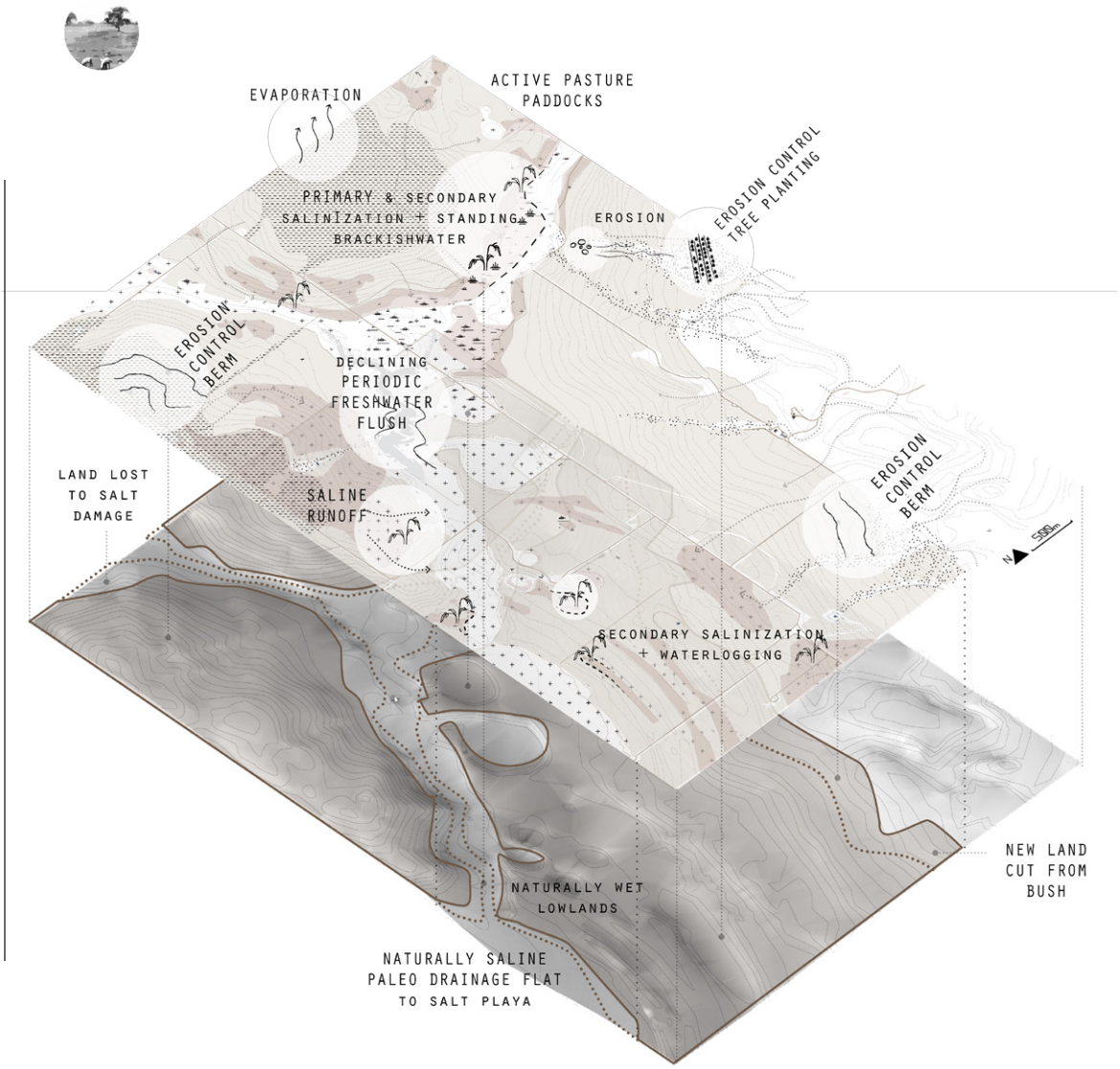


Fig 4.05 Image on left -Map Legend for following section

Fig 4.06 Image above -Year 0 Plan

Fig 4.07 Year 0 Render

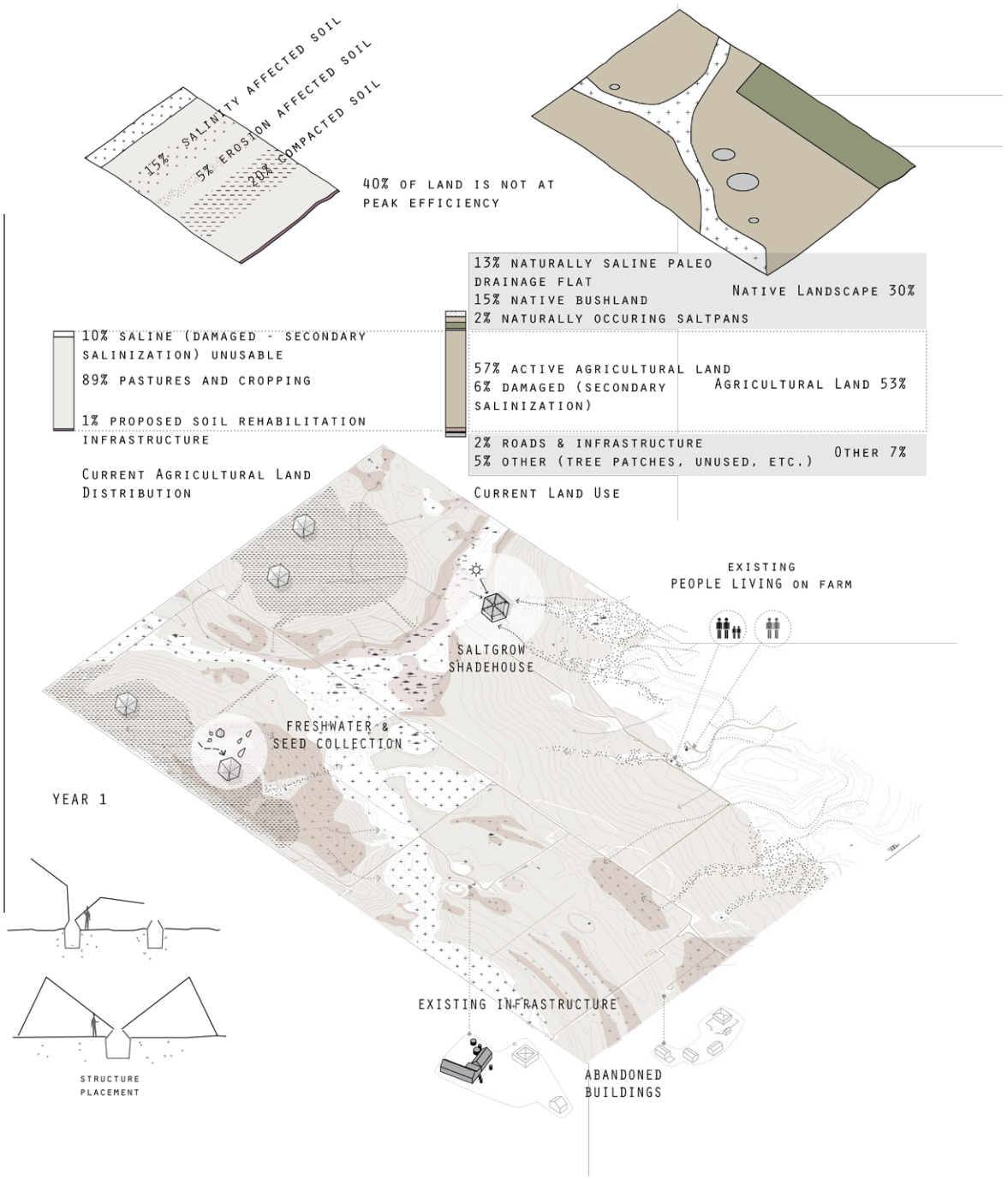
Year 1 Spring Build

In year one, the farm operates as normal with a small amount of land allocated to the interventions, mostly in areas that cannot grow crops due to salt damage. As in Year 0, a young family of four and two grandparents live on the property. Only two adults work full time on the farm. Structures are erected in three main places. One area suffering from compacted soil, another from waterlogging and a third from erosion. All three areas have some degree of salinity damage.

Construction of the structures would likely begin between September and November, as rains become less frequent but the ground remains moist and soft for digging. During this period an extremely high water table is visible, creating wet areas on the surface. In the background, building and planting of the greenhouses is visible in the wettest area. Soil would be mounded up around seedlings to allow some drainage around the root area. To build the structures, materials would be transported to site using any means available. The light weight and small size of building materials would mean that even by ATV materials could be fairly easily transported. The construction would begin by digging holes and placing precast foundation pieces, followed by the water bladder. After, the bamboo supports would be erected and cloth attached to the supports.

Fig 4.08 Image top left - Year 1 Land Use Breakdown

Fig 4.09 Image bottom left - Year 1 Plan



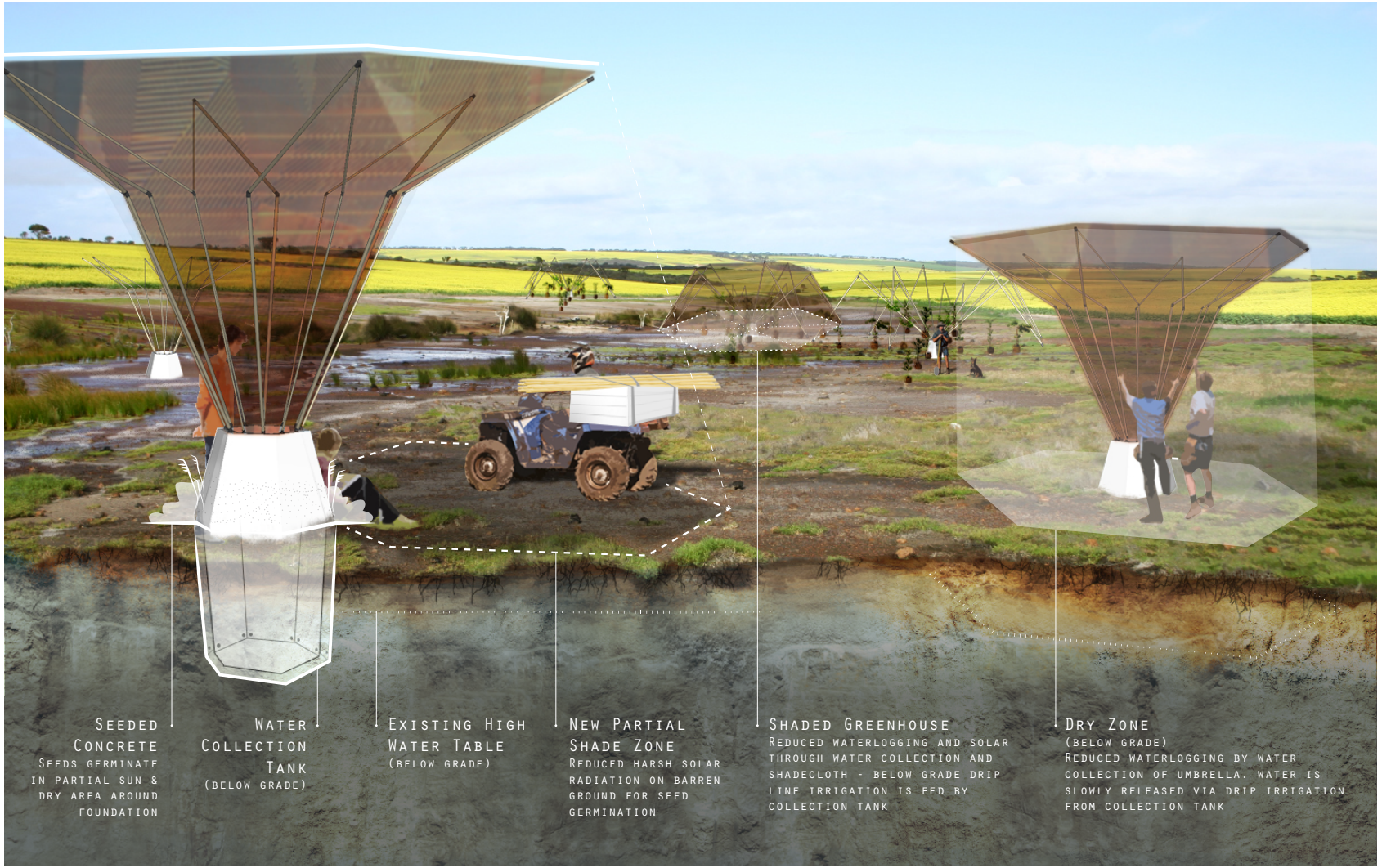


Fig 4.10 Year 1 Render

Year 5 Winter Camping

During the first five years, the intervention would continue to be placed around site in problem areas, and original structures would become well established. Some new growth would be apparent as well as a reduction in wetness in some areas. Educational or tourist groups could begin to take advantage of the platforms.

The original greenhouses would be turned into tree climbers to accommodate the growth of the trees. More trees could be planted in areas where erosion continues to be a problem or in extremely wet areas. Future planning for how to continue to develop the site would be needed at this stage.

At this point 3 adults are working full time on the farm and the children are beginning to help out. Additional labour for more tree planting may be needed and interventions could be repurposed for labourers or volunteers.

Perennial vegetation is now well established around the base of the intervention, and spreading outwards as surface soil becomes less waterlogged. The deep roots of perennial plants soak up more water than annual crops, dropping the water table to the depth of their roots.

Fig 4.11 Image top right - Year 5 Land Use Breakdown

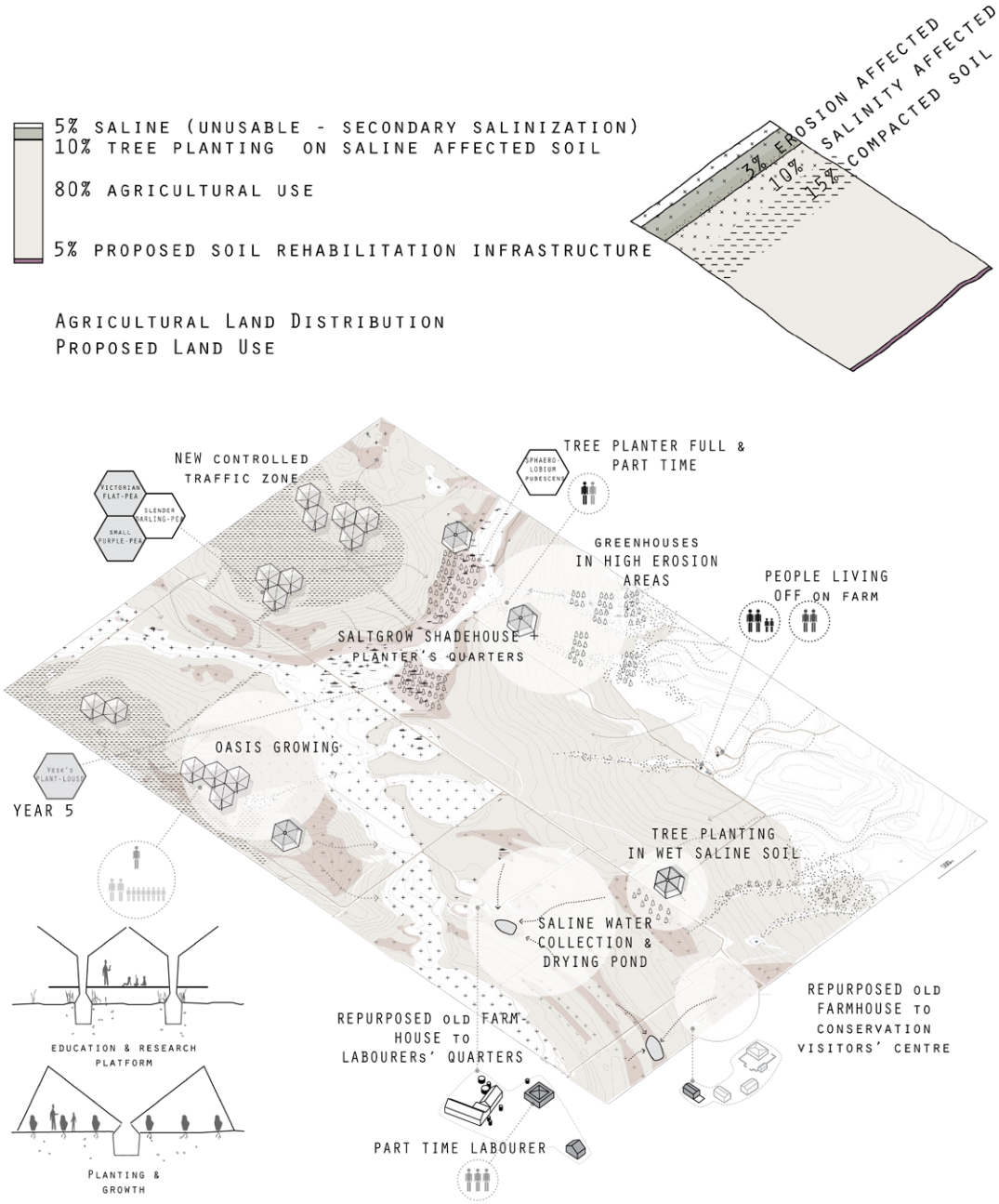


Fig 4.12 Image bottom right - Year 5 Plan

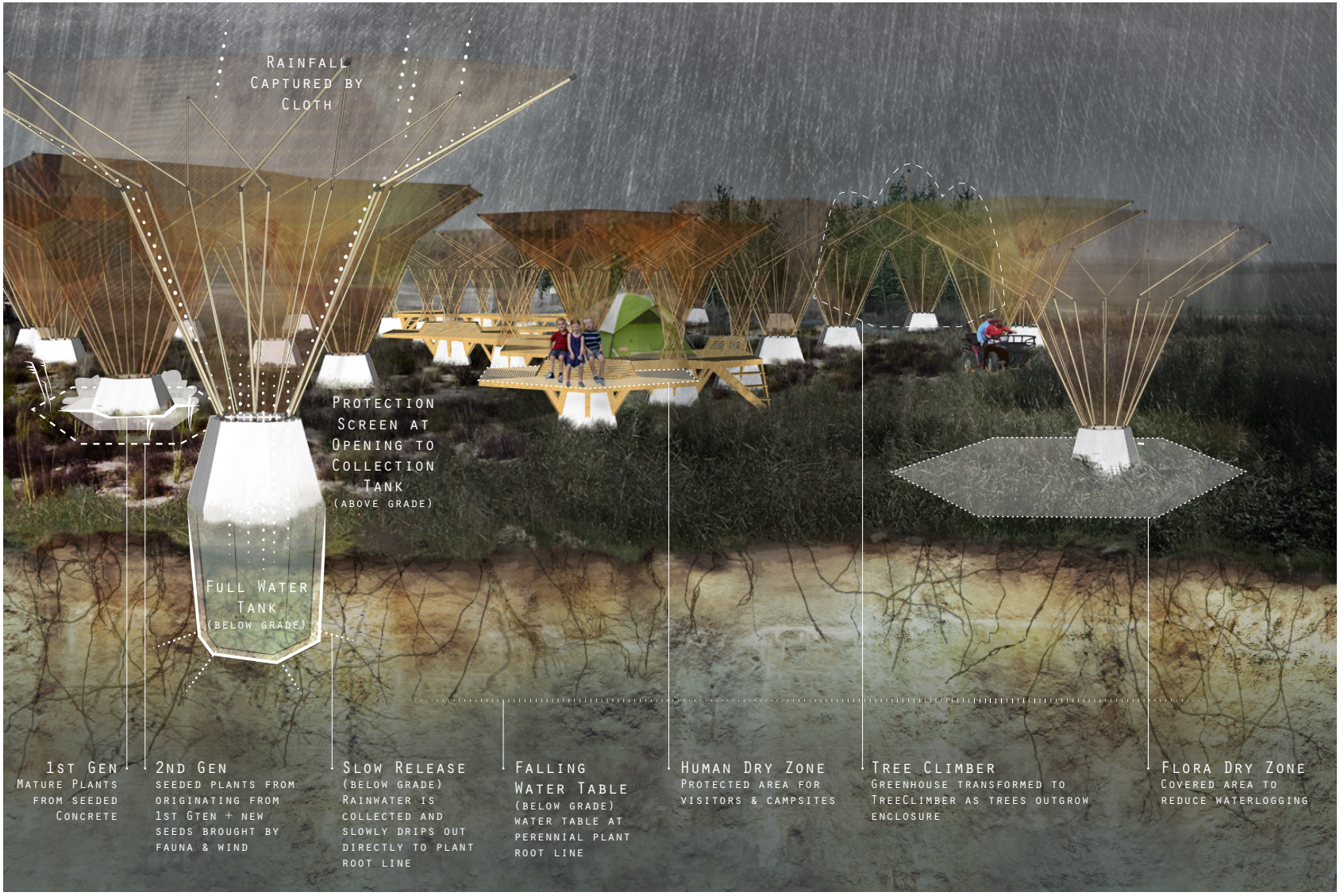


Fig 4.13 Year 5 Render

Year 15 Wildflowers

At year 15 some of the Saltgrow trees would be harvested and sold. Vegetation around pavillions and water catchers would be well established and self seeding. The cloth fabric and membrane at this point would be entirely degraded, allowing full sun and water to the ground plane. Vegetation would keep groundwater levels low and water tanks could be filled with soil or left to fill with water that percolates out the bottom. New structures could be added as needed.

The platforms would still be in use, although in some cases vegetation may cover them. The bamboo supports would still be structurally sound, although showing signs of weathering. These would now act as 'limbs' for nesting and resting birds. The campsites and visitor areas would now be well established. Educational and research use would increase traffic to the farm. Income from early tree harvesting could be used to repurpose old farm buildings for farmstay tourism or other alternative income generating use. At this point, fewer people would be living on the farm as older farmers retire. Some additional help may be hired.

Salt damage is visibly reduced, and a controlled traffic scheme has reduced the amount of compaction in some areas. Erosion is also reduced from carefully placed tree planting. Some species are beginning to return to the site.

Fig 4.14 Image top right - Year 15 Land Use Breakdown

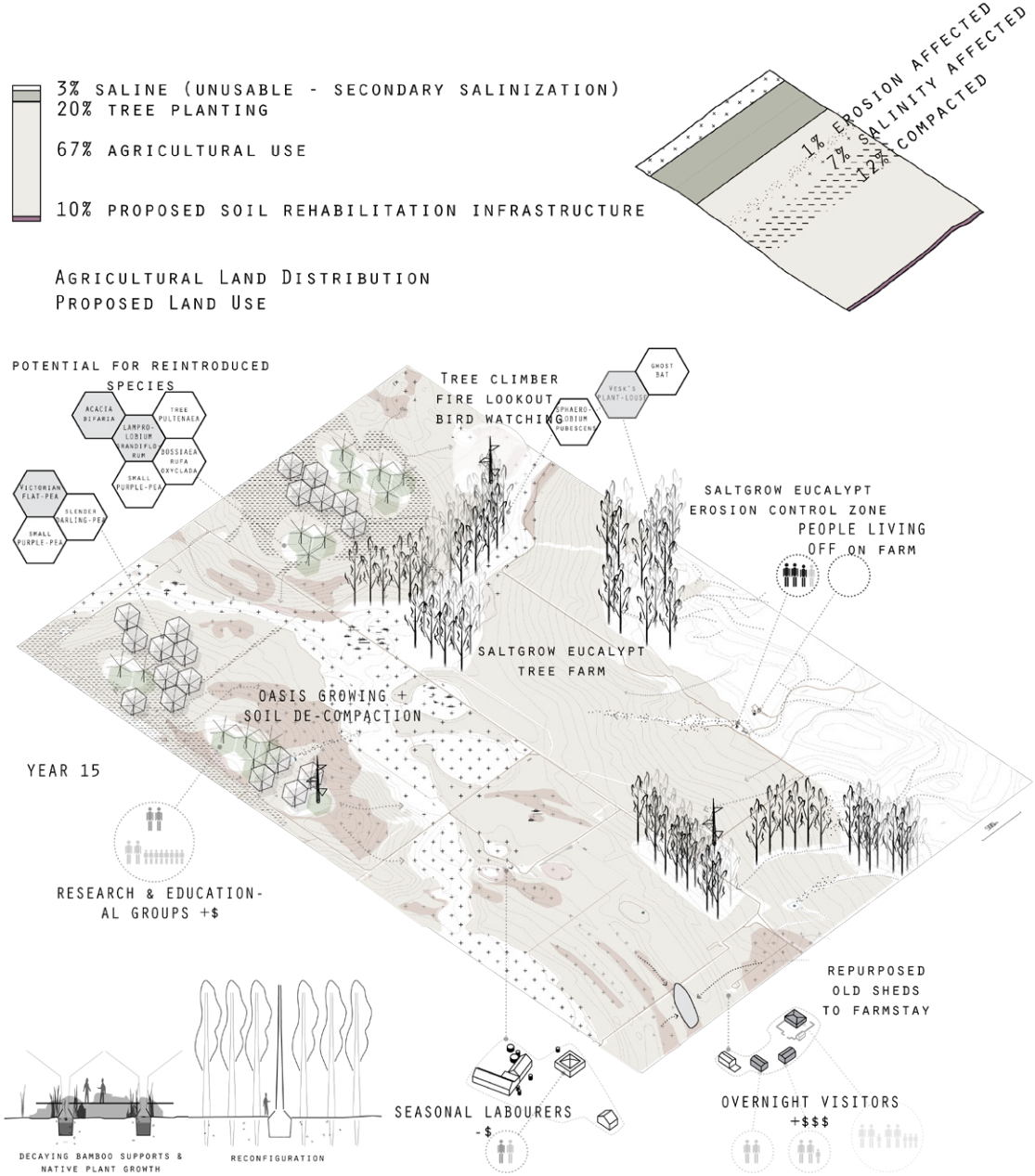


Fig 4.15 Image bottom right - Year 15 Plan

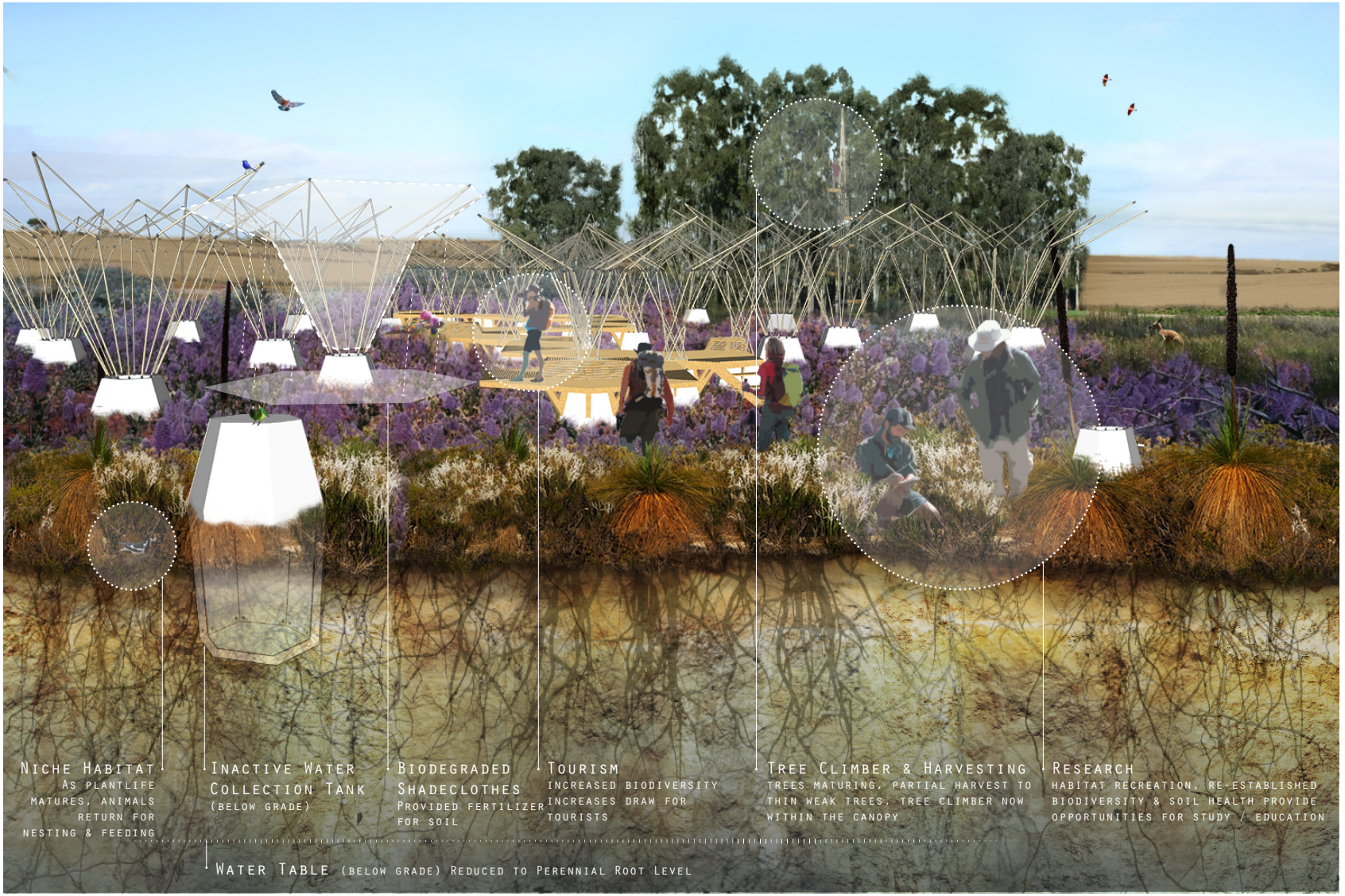


Fig 4.16 Year 15 Render

Year 30 Winter Burn

Before the burn off, the planted Saltgrow trees would be harvested and sold as furniture grade hardwood lumber. Trees providing erosion control or in extremely wet areas would remain and could survive the burnoff. These remaining trees would also act as wildlife corridors between the conservation areas.

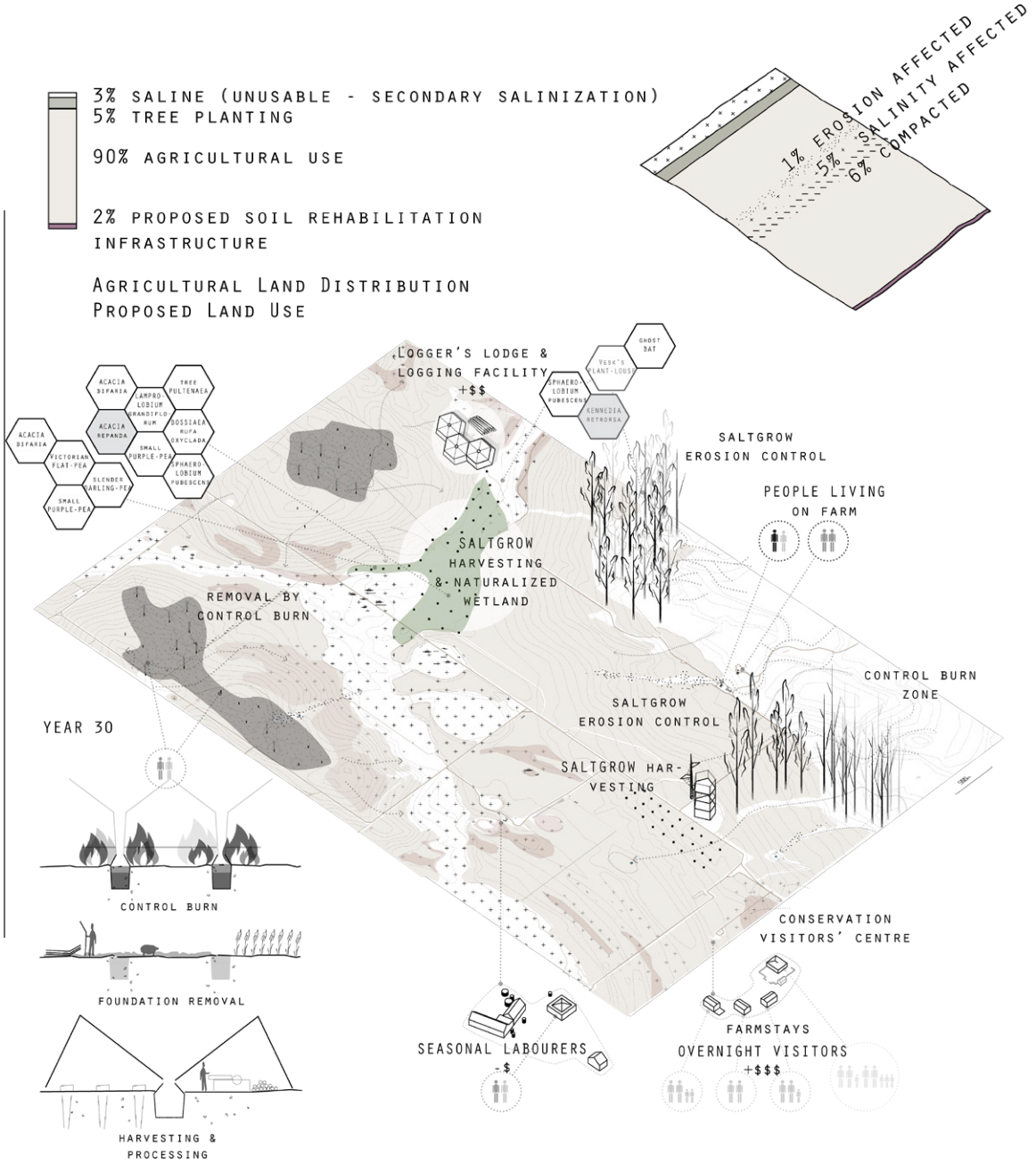
After the burn, some areas could remain native perennial vegetation while others return to being cropped or used as native pastures depending on needs of the farmer. Burning vegetation would fertilize the soil and allow some plants to seed themselves. This also helps moderate wildlife populations and encourage diversity.

After burning, the soil would be in peak condition to trial native edibles such as bush tomatoes or bush peaches. Watertable conditions would be at an optimal level and the lack of competition would provide them with a good opportunity to become established. The native edibles would also help to retain some of the remediation work and keep water tables low, while also providing habitat for wildlife.

At this point alternative income generation from tree culling, tourism and potential farm stays would support the parents, now aging, and one or both of the children as well as potential partners.

Fig 4.17 Image top right - Year 30 Land Use Breakdown

Fig 418 Image bottom right - Year 30 Plan



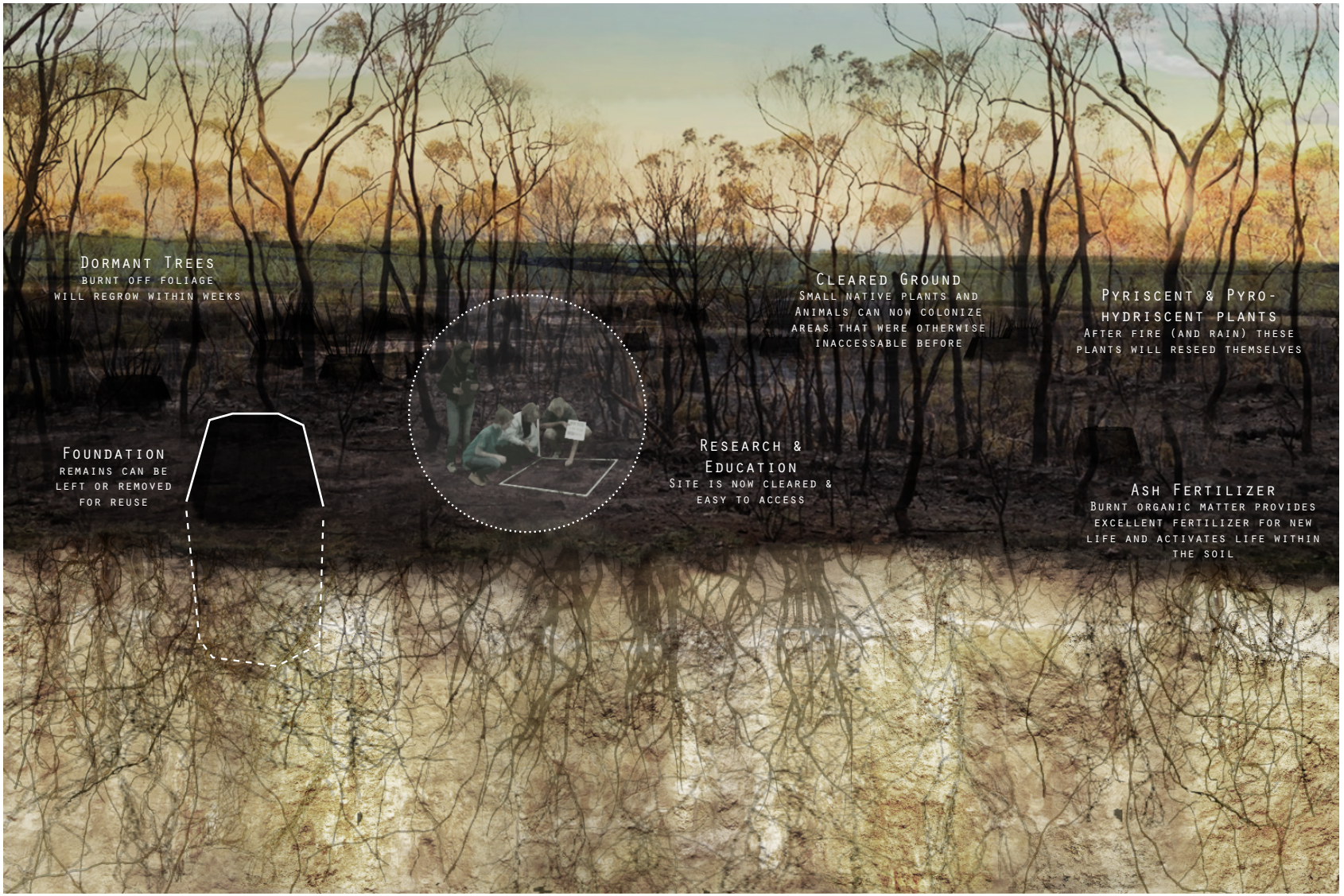


Fig 4.19 Year 30 Render

Year 50 Canola

In the future, after the site has been fully remediated and local plant life has been allowed to flourish for a number of years, re-cropping of the area could resume.

Shown in this render is a class visiting the canola field, learning about planting, harvesting and landcare management. Some of the original trees planted in the greenhouses remain to maintain a low water table in the wetter areas of the drainage flat. Newer trees are seen on the left planted in areas that returned to being too wet after the removal of the installations.

Although annual cropping could continue, to preserve remediation efforts more sustainable land management practices must occur alongside native permaculture in order to ensure water table remains low and soil damage is limited. Intercropping native perennials as well as trees and planning for animal corridors will improve resiliency and maintain ideal site conditions.

Fig 4.20 Year 50 Plan

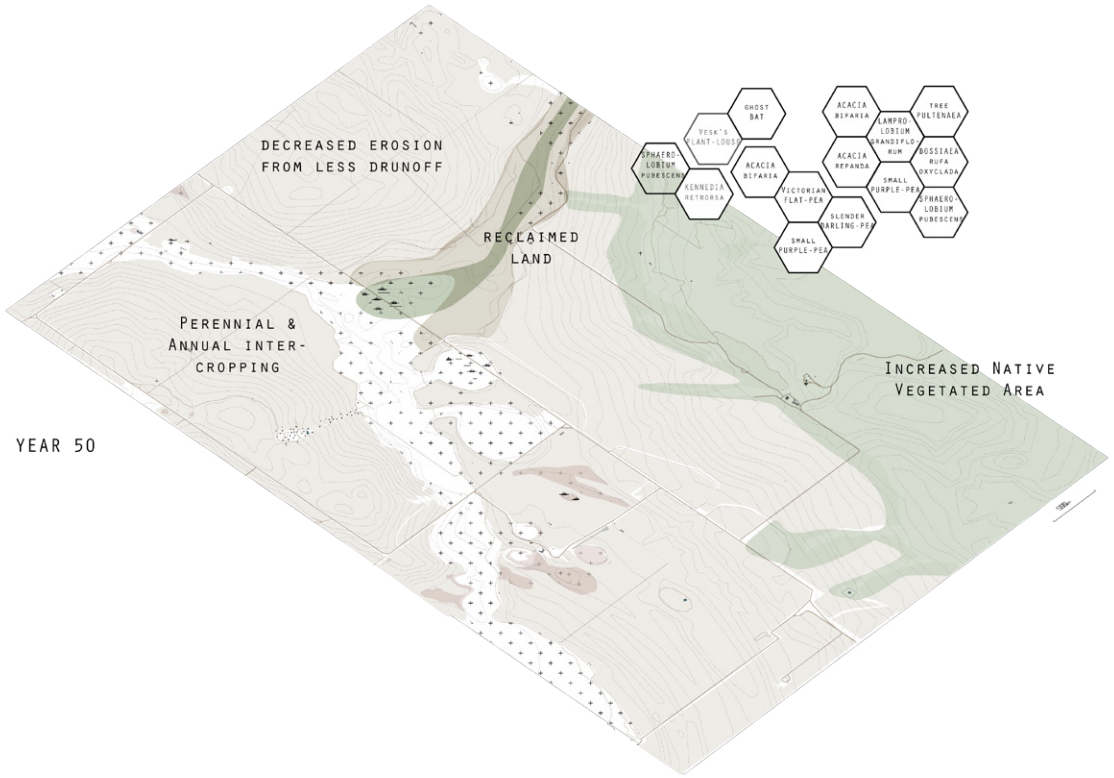


Fig 4.21 Image on right - Year 50 Plan

Fig 4.22 Year 50 Render

Potential Sites

Although actual site locations would be dependent on implementation by farmers, this map proposes three main locations to integrate into the tourist circuit of the Great South West region by providing a variety of new ecological conditions. This ensures the widest set of data for research and education, and a unique experience at each site for tourists. Although the Wheatbelt currently has no tourism, it is surrounded by the coastal tourism circuit of the South West. The proposal aims to integrate and use existing tourism as a departure point for establishing tourism in the Wheatbelt.

The first site is not within the Wheatbelt, but part of the farmland around Denmark, a popular tourist destination on the coastal highway circumnavigating Australia. This area does suffer from some salinity, but is bordered by rich forests and ocean, as well as different soil types, which mitigate many of the more extreme effects seen in Central Wheatbelt farms. Erosion is of some concern because of the extremely hilly landscape, as well as waterlogging. This site is an excellent entranceway into the circuit as it connects into existing tourism in the South West. Site 2 is located in the Southern part of the Wheatbelt, close to the Stirling Ranges. Its close proximity to Albany also provides easy access to this region. Farms in the region have a wide range of products including dairy and vegetables due to the slightly cooler more temperate climate than the central Wheatbelt. The furthest point, Site 3, is located on the very edge of the Wheatbelt along the vermin fence. It is close to the arid interior and has much more desert-like conditions. This area is known for pastures, used for grazing sheep and cattle, due to the low quality of the soil and lack of rainfall needed for crops.

Two other suggested sites include the Stirling Range, an interesting and small mountain range bordered by farmland with unique wildlife and park reserves, and a central northern point close to the Kondinin Salt Marsh Nature reserve. Both are easily accessed by the Great Southern Highway, which also acts as a link to Perth. The Stirling Range is now completely cut off from all other nature reserves, with erosion and soil damage around it is increasing. The farms around Kondinin suffer from high levels of dryland salinity due to the proximity of the marsh.

The variety in sites allows tourists to visit places suffering from extreme salinity to very little, and also experience landscape ranging from wet coastal to extremely dry and desert-like. There is also an opportunity for sites to latch onto existing infrastructure, like the rabbit proof fence and dams, and become part of land infrastructure.

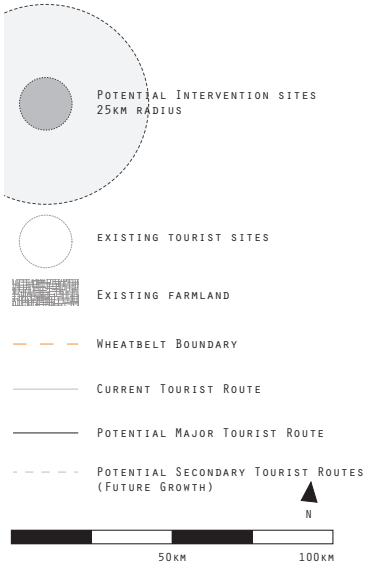
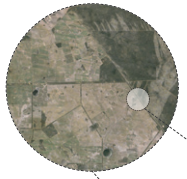


Fig 4.22 Directly Above
Legend

Fig 4.23 on right
Site Network

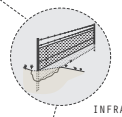
SITE 1
POINTS OF INTEREST
+ SEASONAL SEAFOOD & MALLEE SCRUB
+ FISHING HUT
+ DAIRY FARMS
+ BEEKEEPING

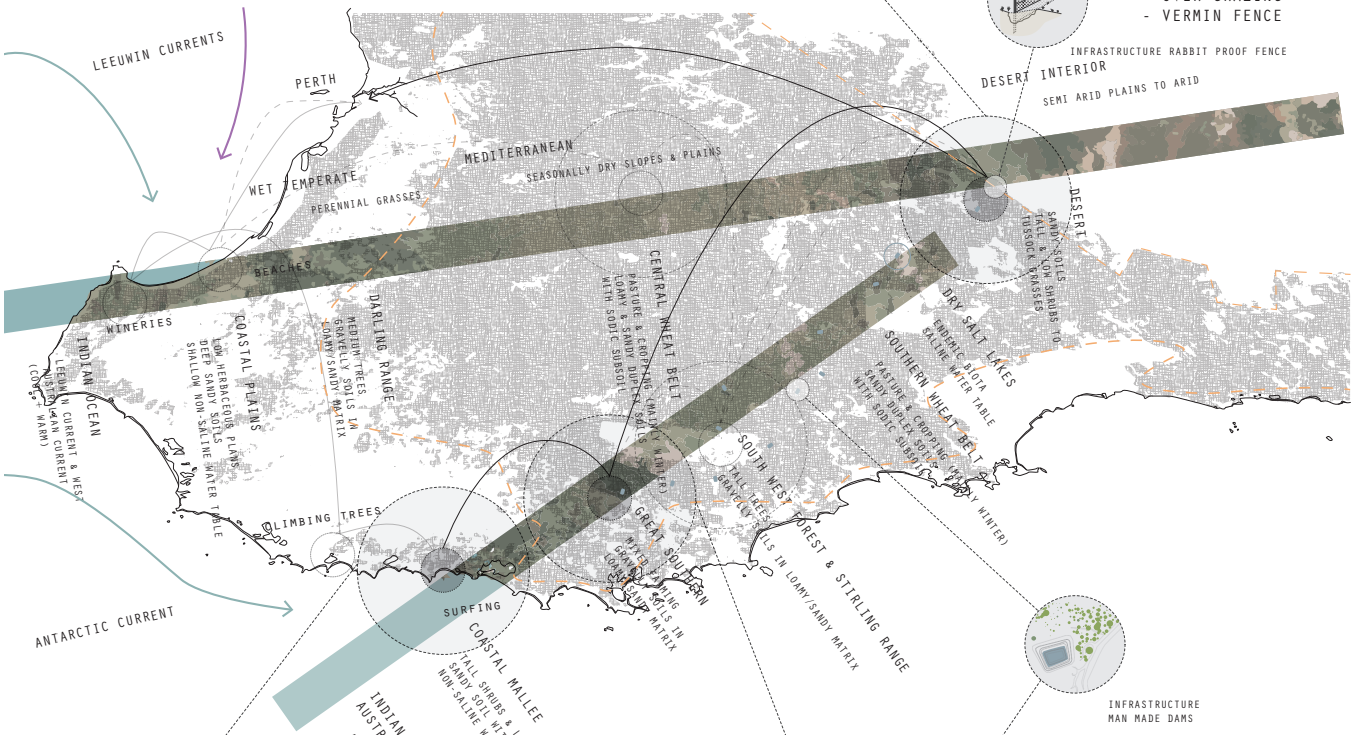
PROBLEMS
- PESTICIDE RUNOFF NEARBY FARMS
- OVERFISHING



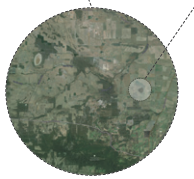
SITE 3
POINTS OF INTEREST
+ SALT COLLECTION
+ RABBIT TRAPPING
+ HUNTING
+ SHEARING
+ MUSTER

PROBLEMS
- OVERWATERING & SOIL SALINATION
- OVER GRAZING
- VERMIN FENCE





SITE 1



SITE 3
POINTS OF INTEREST
+ SALT COLLECTION
+ RABBIT TRAPPING
+ HUNTING
+ SHEARING
+ MUSTER

PROBLEMS
- OVERWATERING & SOIL SALINATION
- OVER GRAZING
- VERMIN FENCE

Identity

The ability to reconfigure and arrange the interventions in different patterns and places creates the opportunity for personalization of each site by the farmer or builder. This would allow different locations to focus on attributes of soil and site specific factors that the farmer knows best. This could be done in any number of ways. For example, using a solar panel on one of the water catchers to power a light inside, attracting insects to the shade cloth and providing a nighttime viewing opportunity of moths and bug life. Increasing the frequency of pavillions could provide an array of campsites, generating income and bringing increased traffic to a farm. Multiple boardwalk platforms could also provide space to hold a small raised market in areas closer to towns or cities. Larger greenhouses could grow multiple tree species for commercial purposes, or even be outfitted with benches for potted plants and be used as a nursery. The ability to personalize or make decisions even within a controlled set of parameters allows farmers to take control of the portrayal of their farm and the type of visitors they wish to encourage.

Climate, geography, crops and livestock all play a part in creating this experience. Creating a network of these places for tourists to visit could support a rural tourism corridor, connecting farms with similar goals and values. Current tourism focuses on south western tip of Western Australia, and not the Wheatbelt. However linking a network of rural destinations into the already existing framework of coastal ones would benefit travelers who are looking to do a circuit down the coast and back up through the central region. This would also help to reactivate shops and restaurants by increasing traffic through areas that often do not see visitors.

With multiple farms using this intervention, there would be opportunities for researchers and educators to use the network to view and study successful or unsuccessful attempts at remediation, learn about a variety of ecologies, farming techniques and systems, and view remediation in a variety of different stages. This connection and ability to control the intervention empowers farmers to act on their own for the good of their livelihood and the benefit of the land.

Fig 4.24 Image of intervention with nighttime lights addition, a potential way for farmers to add on or change the intervention to suite their requirements or preferences.

Index

The index is the most important outcome of the project's life cycle, from which the human participants can actively see changes that have occurred, and understand the role of each component in the system. Using a phased intervention – in which components are added over different stages – the age of water catchers, greenhouses and tree climbers will vary, creating a spectrum of new to old. These interventions would also vary site to site, creating a dynamic network of parts. As each individual part is implemented in different phases, and decays slowly at its own unique rate, different components or parts of the index will be activated.

For the water catcher and pavilion, this change occurs mostly through passive means, without need for the farmer to change components. Early on in their life cycle, the shade cloth and foundations become the most dynamic component of these two systems, collecting rainwater for reducing waterlogging, and germinating seeds within the outer foundation wall to generate a hexagonal pattern of growth and dry land around the intervention. The shade clothe creates an inhabitable niche for human activities by sheltering from rain and sunlight, and also encloses the platforms at this stage. The height of this platform provides maximum protection for new growth and fauna returning, but also allows for views down into the water-storing foundation and the seed germination on the ground.

Within a few months or years, depending on weather conditions, the shade cloth will complete its life cycle: this means it will decay, and leave behind not only the bamboo arms of the support structure – which now act as branches for bird life – but also the naturally-occurring fertilizer of the shrimp bioplastic. Life on the ground will radiate steadily outwards from the structure, maintaining the hexagonal pattern that is now dictated by the fall of the decayed bioplastic. The ground plane will be fully activated and dense with life. The platforms will appear overgrown, creating a new experience for visitors who pass through the blooms and the reaching tips of plant life growing up through the deck surface. Human life will no longer be enclosed within the structure, but balance just above life on the ground. Views open up to the sky, towards bird life on the bamboo arms.

Some years later, the lush environment surrounding the pavilion and water-catchers will be control-burned. Shortly after, burnt trees will regrow leaves and the hempcrete foundations, which are naturally fire-resistant, will resemble blackened stumps. Before seeds germinate, the blackened clearing will be accessible to humans, allowing first-time access to the ground plane in a seemingly desolate zone. In a few weeks, life will return; once again, the previously-barren area will transform into a completely different environment.

Fig 4.25 Image of decaying intervention with a farmhouse in the background. Because most of the intervention is biodegradable, there is no true need to remove it once it is has fulfilled its purpose. In the future, this site could have new shade clothes put up or be burned to remove wooden components.

Whereas transformation of the pavilion and water-catcher area relies primarily on growth and regrowth, the activation of the greenhouse and tree climbing components requires greater human intervention. In its early stages, visitors to the greenhouse will be within a controlled atmosphere, surrounded by the shade cloth and water collection membrane. This will protect the interior from wind, rain and sun. The ground surface within the greenhouse will quickly dry out from the thirsty roots of new trees, thus creating a dry zone within an otherwise waterlogged landscape. As the trees within the greenhouse begin to outgrow their enclosure, the shade cloth will decay, again acting as fertilizer for the trees below. At this point, the greenhouse support arms will be reconfigured by the farmer to an upwards position. Once transformed to the shape of the tree climber, views from above the young trees will open up, allowing visitors to watch them grow from a unique angle. At this stage, the tree climber will emerge well above the tree line, appearing as a tower in a field and as a beacon for visitors. The tower will also act as a reverse index or predictor for the future height of the trees. As the trees grow, they will become thicker and the inner ring of trees will grow closer to the tree climber platforms, allowing visitor interaction to the leaves and arms of the surrounding trees. Slowly, the tree climber will disappear as the surrounding trees mature, and surround its perimeter. As they grow higher, these trees will eventually fully enclose the climber, providing a direct opportunity for interaction with limbs and upper trunks, hiding the climber completely from view. Now the tower sits hidden inside a forest. The soil area defined by the limit of the trees' canopy, mirroring its roots below ground, will be fully dry, revealing the direct relationship between the trees and the soil.

The index of these interventions will develop an identifiable contrast to the surrounding rural conditions. Salinity damage that remains outside the perimeter of the intervention will be observable from the platforms and tree climber; by contrast, the dry and fertile ground, within the limits of the intervention, will be perceptible in close proximity. The interventions provide not only a deeper understanding of the systems at work, but also their impact on the environment and their immediate reach. The contrast between farmland, salt damage and remediated land would be an important part of creating awareness and eliciting an emotional response from visitors.

Fig 4.26 Image of tourist visiting cows on a dairy farm with wildflowers growing in the center. The intervention could be used to protect rare species from livestock and humans, but also to showcase special features of on a farm.

Limitations

Many limitations exist in the scope and implementation of this project. The first and foremost is that of testing. Although a great deal of research and effort to mimic existing natural systems has been included in the design, as well as through developing the role of each part of the intervention, all of the proposed processes, materials and structure have been idealized, and lack rigorous, scientific verification. Value of the proposal therefore needs to be challenged, and considered alongside the work of consultants and specialists to ensure they are capable of producing the type of change imagined here. The work in this thesis is a preliminary step in understanding the relationships and stakeholders surrounding Western Australian soils and the Wheatbelt. It is a conceptual project that hopes to bring awareness to an overlooked opportunity with regards to soil remediation. It is not meant to solve soil damage and salinity in the Wheatbelt, but to act as a stepping-stone between disciplinary realms.

Another limitation is the economical efficiency of the system. The scale of the individual interventions, compared to the scale of secondary salinity damage, makes implementing the proposed intervention on every farm in the Wheatbelt expensive, inefficient, and impractical. Thus, it is not intended for every farm in the region. Instead, locations of the intervention would be strategically chosen to encourage maximum diversity and interest for visitors across the region, and also to encourage a wide variety of research and education opportunities, as well as interaction between farmers. The spacing of the interventions would have to be carefully analyzed to ensure the market for visitors is not oversaturated by too many opportunities to visit broadacre farms. The scope of the thesis lacks general research into this realm; as of now, the interventions are implemented on a partially-fabricated site, and use somewhat random spacing between different ecological regions throughout the Wheatbelt.

Fig 4.27 Image of farmers planting young trees beneath the greenhouse in a sheep paddock. The greenhouse is fully pulled down to the ground to protect the saplings from hungry sheep.

The most significant limitation of the current design is its inability to develop systemic change to farming practices. Although potentially useful for remediating small plots of land and transforming attitudes towards farming, this intervention does not address the core issues of secondary salinity: inadequate farming practices. This is not to place blame on farmers alone, but to understand the way current farming methods were developed was with a much smaller population in mind than what exists today. These practices were also intended for a populace that did not rely on enormous amounts of energy to transport fertilizer, water and food across the planet. Modern agriculture has not yet found a way to be continuously viable – economically, environmentally, and socially – on Australian soil or elsewhere. If current practices continue, eventually salinity and other damages will be irreversible, and will cover most of the arable land on the continent. Today, there are known ways to farm and produce food that does not cause secondary salinity, erosion, waterlogging or compaction. But currently these practices are irreconcilable with the industrial food complex and food distribution systems around the world. A complete restructuring of agriculture and food systems is needed to work in full reciprocity with the land to ensure a resilient food supply, ecological diversity and both environmental and human wellbeing.

Fig 4.28 Image of hikers climbing and bird watching in a naturalized area on a farm. Trees could eventually be harvested and the tree climber removed or returned to the greenhouse form.

Towards an Ecological Consciousness

In order to better address problems in rural areas to develop long term health and inherent resilience, we must consider how design in rural areas could play an important role in fostering an 'ecological consciousness' for both urban populations and farmers.

If an 'ecological unconsciousness' develops our soliphilia for the land, and introduces us to the environmental boundaries and capacities of the places we actually live, then an 'ecological consciousness' is a deliberate, learned experience that can help us recognize reciprocity in nature and develop a new type of relationship with places outside our immediate, day-to-day lives. This new type of soliphilia – for lands beyond our place of residence, or normal scope of interaction – must be designed with the complex systems that compress space between distant places, such as contemporary distribution networks, in mind. Agricultural landscape is just one notable example of 'place' affected by these networks.

As early as the 1880s, theories of soil degradation as a by-product of social networks that disconnect humans from natural systems was already being developed, and was even theorized by Karl Marx because of his concern over 'soil exhaustion.'[104] However, such ideas were not made popular until the late 1990's, when John Bellamy Foster coined the term 'metabolic rift.'[105] This rift was first defined by Marx as a problem of excess waste and broken nutrient cycles between city and farm, but has since expanded into the realm environmental sociology and used as an argument against the constructed mentality that human systems are separate from natural systems, a concept that has become increasingly prevalent today.[106] In fact, the term 'nature' itself is a fairly recent notion that perpetuates the belief that human life – especially inside the city – is distinctly separate from the environment outside it. Yet in reality, 'nature' is a human construct. Natural systems are part of and deeply affected by our political, social, economic and demographic systems, which can have enormous and negative impacts when not fully considered.

This is becoming increasingly evident in Western Australian agricultural regions. As farmers are more and more isolated socially and physically from the population they support in urban areas – due especially to increasing farm sizes and a decreasing rural population – and their response to land degradation is slower and less effective. The health of the land also directly impacts the health of farmers and their families, just as general environmental health can and does affect overall human health. The Farm Health & Safety 2008 report 'The Mental Health of People on Australian Farms' indicated pressures on the shrinking number of farming families included climate stressors like increasing droughts; difficulties meeting government requirements; declining public infrastructure; succession issues in a difficult economy; an aging farmer population; the information and biotech revolution; and increased market pressure due to globalization. All of this contributed towards a growing sense of uncertainty and loss of control for farmers.[107]

104 John Foster, "Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology," AJS Volume 105 Number 2, September 1999: 375.

105 Ibid, 366-401.

106 Jason W. Moore, "Metabolic Rift of Metabolic Shift? From Dualism to Dialectics in the Capitalist World-Ecology" University of California Press, 2011, accessed August 14, 2015. http://www.jasonwmoore.com/uploads/Moore__Metabolic_Rift_or_Metabolic_Shift__for_website.pdf

107 The Mental Health of people on Australian Farms, The Facts," 14.

"*The major restructuring of Australian farming over recent decades has contributed to a decline in populations of most small rural communities in which farmers derive social interaction and dependency.*"
- The Mental Health of People on Australian Farms[108]

Despite similar rates of psychological problems in urban and rural areas, suicide rates are much higher among farming communities. The report also notes that unrecognized mental conditions in farmers also 'significantly impact[s] loss of productivity,' in turn further affecting income, output and ability for remediation.[109] The suggestions from the report to address these farmers' mental health include programs to increase business, family and personal resilience, local community programs for social networking, professional networking opportunities, and generating a positive view of farming from a city perspective.[110] The dual nature of farming, as both an occupation and a way of life, means that it requires a type of change enabled not just through land care, but also through human care.

Soil degradation can be addressed in rural areas through environmental remediation schemes, but without the cultural mindset to create long-lasting change, soil degradation will continue. The popular belief that cities are independent and separate from the 'natural' world needs to be reversed.

The suggestion of ecological unconscious, as described by Snyder, acknowledges the emotional response humans develop to their environment, and reveals how this in turn impacts our choices and actions. However, developing emotional responsiveness to lands that support us through unconscious means is hindered in today's world, as the direct, physical relationships between humans and these supporting environments often no longer exist. Due to such widespread processes as urbanization, industrialization, and globalization, these relationships are made increasingly complex. Although consumer choices within this system maintain a large impact on rural landscapes and on those who live there, this relationship is often incomprehensible to urban dwellers.

In rural areas, on the other hand, emotional responsiveness is often hindered by physical, financial and social barriers, allowing (even encouraging) poor practices for soil and local human health to continue despite the efforts of some governments, scientists, researchers and farmers. Creating a place and a designed experience for deliberate learning of a new 'rural consciousness' will help urban populations and farmers experience and develop a more innate understanding of the causes, issues and interconnected systems at stake in remediation efforts. It will also provide a platform for farmers to develop their own social networks, and increase access to external networking and business opportunities. These places could create the conditions needed for new emotional responsiveness, enhanced connectivity, and soil remediation in a long term and inherently-resilient way.

108 Ibid, 14.

109 Ibid, ##

110 Ibid, 22.

System Awareness

In addressing and eradicating cultural notions on the separation between the 'natural' and 'human' spheres, design plays an important role. In particular, designed spaces must be carefully curated for maximum interaction with our 'external' environments. Design has always been used as a tool for shaping human interaction with built space, and increasingly is used as a tool for interaction with ecological systems. Despite this, these interactions usually occur in urban or peri-urban regions; our lack of attention towards food production landscapes is evident in the general absence of social infrastructures in rural built environments.

Using an approach that favours lightness on the land, with a system and scale that is implementable by individual farmers, can help empower and give back a sense of control to rural inhabitants, who have little control over such issues as increasing droughts or poor crop yields. This approach is already used by Rural Studio, an undergraduate program at Auburn University, Alabama, whose student projects are often inexpensive and community-oriented in order to enable residents to affect change in their own impoverished rural communities of west Alabama. The design-build studio shows an understanding of the more systemic problems associated with rural communities, and seeks to address financial, environmental and social problems with the seemingly-simple construction of a house.[111]

This notion of addressing these systemic problems through design is not only being applied to housing, but is also currently imagined at a much larger scale. Alan Berger coined the term 'systemic design', which describes the interaction of economic, social and environmental stressors of territories beyond an immediate site that can be integrated into design.[112] This systemic design thinking is especially important in rural areas, which are greatly impacted by variables outside their immediate boundaries – such as Western Australia's soil degradation. Another architect addressing similar systemic problems but in a more environmentally-responsive way is Vincente Guallart. Guallart developed a series called GeoLogics which seeks 'to redefine the modes of construction on the Earth so as to ensure that the fact of inhabiting it does not transform the basic parameters of the environment.'[113] This booklet asserts through a series of projects, as well as a written and drawn analysis, that architecture must go beyond the singularity of insertion, and instead become a part of a landscape, situating itself amongst the existing processes and conditions of its site. In the Wheatbelt, inserting human habitation on a naturally-saline landscape has had some very negative and detrimental effects on the environment, and on the human population attempting to cultivate it. Designing a new model of human interaction and agriculture that becomes part of the salinity, drought and ecological systems, as well as reactive towards social, economic and environmental problems, will help develop resiliency. As we have seen, it can also help build awareness on the identity of rural, Western Australian landscapes.

To achieve true resiliency and identity, the system must become responsive to its natural environment. Developing ecological consciousness through design must also carefully consider the cyclical variation, diversity and adaptability of landscapes. These types of strategies are just starting to be employed in landscape architecture, but again, often these experiments are located within urban parks.

111 "Rural Studio," Rural Studio Website, accessed August 14, 2015, http://www.ruralstudio.org

112 Alan Berger, "Systemic Design can Change the World," SUN Publishers, 2009.

113 Vincente Guallart, "Geologics - Geography, Information, Architecture," Actar, February 1, 2009: 4.

Fresh Kills in New York by Field Operations is one example of a project that employs this strategy by designing a framework for the transformation of a park, as opposed to a fixed plan that is implemented as a final product.[114] Interestingly, this is similar to the water catching and pavilion intervention elements proposed here, which are conceived as seeding mechanisms that provoke transformation of the land over a period of up to 30 years, rather than as fixed objects. Provoking human interaction in this way, for the purpose of ecological restoration and land remediation, demonstrates how our own actions inevitably shape what we consider to be 'nature', and how our understanding of ourselves and our environments might be brought closer together. It is not meant as a stand-alone system, but to act as part of a larger series of discussions and efforts towards the remediation of farmland and rural awareness. The intervention acts as a lens to understanding our participation in a complex system – but in a far-simplified way – by placing an interconnected and changing landscape (one that is reactive to human actions) at a scale perceivable to the human eye.

Human Scale

Land remediation often happens at a scale so wide it is hard for human interaction to take place, or for distinguishing characteristics to become evident. The long-term nature of land and soil remediation also makes many changes imperceptible within the human lifetime. Social problems in Wheatbelt communities are also difficult to engage in from outside the community. This intervention seeks to address land and social remediation at a scale that distinguishes itself from other efforts. In doing this, human interaction and participation becomes far more possible.

Visibility and accessibility are two important benefits to using a 'human' scale. This small, simplified representation of a larger, more complicated system can have a much greater impact on human participants, especially those not trained to understand the complex networks that define contemporary life. This method is not all that different from principles used by food-activist and New York chef Dan Barber, who uses simple stories to encourage more sustainable food choices. His stories have modest actors; the fish, the duck, the farmer, as well as a compelling narrative of his quest for the best food products. This works particularly well in the story of foie gras, which allows him to reach an audience who might otherwise have no idea what the impact of this particular food choice is, despite being a widely published and sensitive topic. Barber's story of foie gras is the tale of a farmer who purposefully allows his farm to act as a natural system would, as an illustration of how natural systems can produce better, tastier products. For example, the farmer willingly loses his eggs to eagles, his ducks are not fenced in, forage freely on his more lucrative crops, and, perhaps most importantly, his ducks are not force fed as foie gras ducks are 'meant' to be.[115] Of course, the foie gras tastes like no other, yet his story makes another important point as well: by using narrative representation that scales down the greater function of a natural system, he develops an effective device to teach consumers where their food comes from. Consumers listen, perhaps in part because they are morally affected, but also because it is clear how natural systems can affect such things as quality or taste as well.

114 "Fresh Kills Park," Field Operations, accessed April 15, 2015, http://www.fieldoperations.net/project-details/project/freshkills-park.html

115 Dan Barber, "The Third Plate," Penguin Books; Reprint edition, May 2014: 103-104

Using a similar device to Barber's stories, this thesis relays information and awareness on natural systems in a comprehensible way, through visual and interactive elements over a shorter time period. It tells the story of salinity, water management and food production from the point of view of farmers and consumers. It provides a compelling reason to better understand our agricultural industry by re-establishing our relationship with it. It is not just the physical intervention itself that is placed at a human scale, but its narrative as well.

Being small and intermittent, the physical scale of the project has value in its ability to be erected with spontaneity and flexibility, and is mobile and easy to disassemble and relocate elsewhere. The intervention does not try to function at the enormous scale of the system, or at the scale of the organization. By existing at the scale of a single farmer, there is autonomy given to the farmer, and the project is easily translated into alternate income generation and localized remediation. In this way, the intervention is empowering for farmers and consumers by addressing this missing human link in rural long term viability. Already, this type of adaptation is known to have stronger effects than large-scale, top-down strategies. Peter Senge outlined this type of effect in another compelling story, told at the Aalto Systems Forum in 2014, about clam divers in La Paz, Mexico.[116]

In the story, Senge describes how the local clam fishery is in a state of imminent collapse due to a dwindling clam population, and is under extreme pressure from a lack of alternative income sources, and from the general poverty surrounding the area. Interestingly, the first step in remediation was not to address the clams, but to build a soccer field for the children of the clam divers. The new field acted as a networking site: the children came to play soccer, and their parents came to watch. Scientists and researchers used this opportunity to meet and talk to local clam divers about reviving the clam fisheries. This was not done by suggesting the clam divers immediately stop all clam fishing; but by suggesting they implement small, organic farms as alternative income and food sources. The resources and training were provided for the organic farming operations, which in turn provided alternative income and food sources. As the organic farms became successful, clam fishing was slowly replaced by selling vegetables and other locally-produced food products. The clam population has since rebounded, yet the clam divers wait, understanding the seeds of the system must be cultivated as carefully as those of their vegetable farms. Senge calls this practice 'innate systems intelligence,' which means addressing the core issues of environmental, or other, problems to solve a wider problem.[117]

The scope of this thesis addresses some of the systemic problems of salinity and land remediation; it must be made clear, however, this work does not cover the full scale of the system, nor the complete systemic framework from which problems in rural communities are caused. It would be impractical to believe this work alone could address everything that needs to be addressed. Thus, this project operates at a tiny scale in relation to the wider environment – similar to the scale of the soccer field in La Paz, Mexico. This is the reference point in which architectural design has a place for encouraging interaction between urban populations, farmer and landscape, three key actors needed to keep rural communities viable and

116 Peter Senge, "Systems Thinking for a Better World," Aalto Systems Forum, 2014. https://www.youtube.com/watch?v=0QtQqZ6Q5-o

117 Ibid.

productive. The intervention seeks to reduce problems to manageable proportions, at a scale conducive to public understanding; it is intended to act as an aid alongside system-wide changes needed for larger change.

We are all part of natural systems that are sometimes only visible outside our limits of understanding, or caring. The uncontrolled and unplanned growth of networks and those connected human populations has inhibited our reaction to most environmental crises, such as that currently experienced in the Wheatbelt. Design has a role to play in reviving our connection to and understanding of nature, in order to develop a more responsive and intentional ecological consciousness. To do this, design must be placed in a constant state of flux with the systems around it. Nature is not stable, and neither are the systems that support us. Better care-taking of the environment and our food systems will come when we rediscover our role as active participants in it. As Peter Senge states in the Aalto Systems Forum: all life exists in a niche, and if humans cannot exist in a niche then we will cease to exist.[118]

Developing an ecological consciousness that is responsive to complex systems can create mindfulness and cognizance of our place in the world, even if we are not fully aware of the intricate webs we have become a part of. This design attempts to address our own social networks as embedded with nature, rather than treating the 'human' and the 'natural' as autonomous, separate objects: we are nature, we participate in nature, and we have to understand mindfully our growing impact on nature.

The intervention seeks to create a niche for a new type of rural occupation at the intersection of food production and the environment, one that can be experienced by multiple participants. The multiplicity of use and user participation encourages resilience through dynamism, which is further enhanced by the reciprocity between participants and individual components of the intervention. This is in hopes of creating a new type of social system that fundamentally supports and connection between rural life, food production and natural systems.

118 Ibid.

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