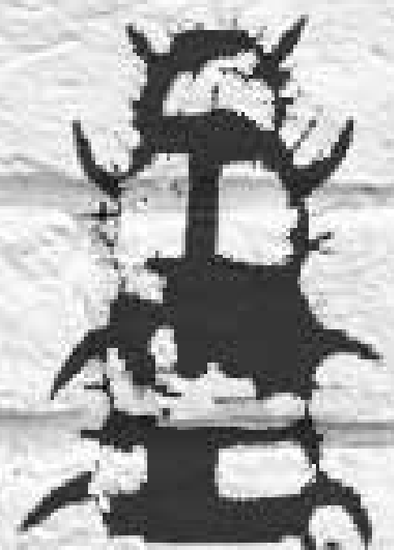
GRUBBIES

Save the World, Eat the Insects!



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CONTENTS

INTRODUCTION

Here at Grubbies our aim is to create a future of sustainable food in urban spaces.

This document outlines a proposal and plans for Grubbies; our brand focused on insect farming, urban agriculture and public space. In addition to this instruction, this book documents research regarding the sustainability of insect farming.

As a result, this document can be divided into two parts: the first section is a collection of research regarding sustainable farming; with the second an explanation of Grubbies - our project.

In our research, we consider climate change, the rising human population and the implications that these have on food security. We also look at food production methods, their sustainability and how these affect climate change. We have considered case studies of sustainable agriculture and technical food production systems that we feel can assist us to achieve food security and to ensure a low impact on the planet.

In addition, we have also taken into account the practice of eating insects, the perception of this, and introduce some current methods of farming, eating and selling insects for food.

The second half of this book documents Grubbies' strategy of linking together methods of sustainable urban agriculture, technical food systems, insect farming and eating into a farming system of our own.

GRUBBIES


GRUBBIES

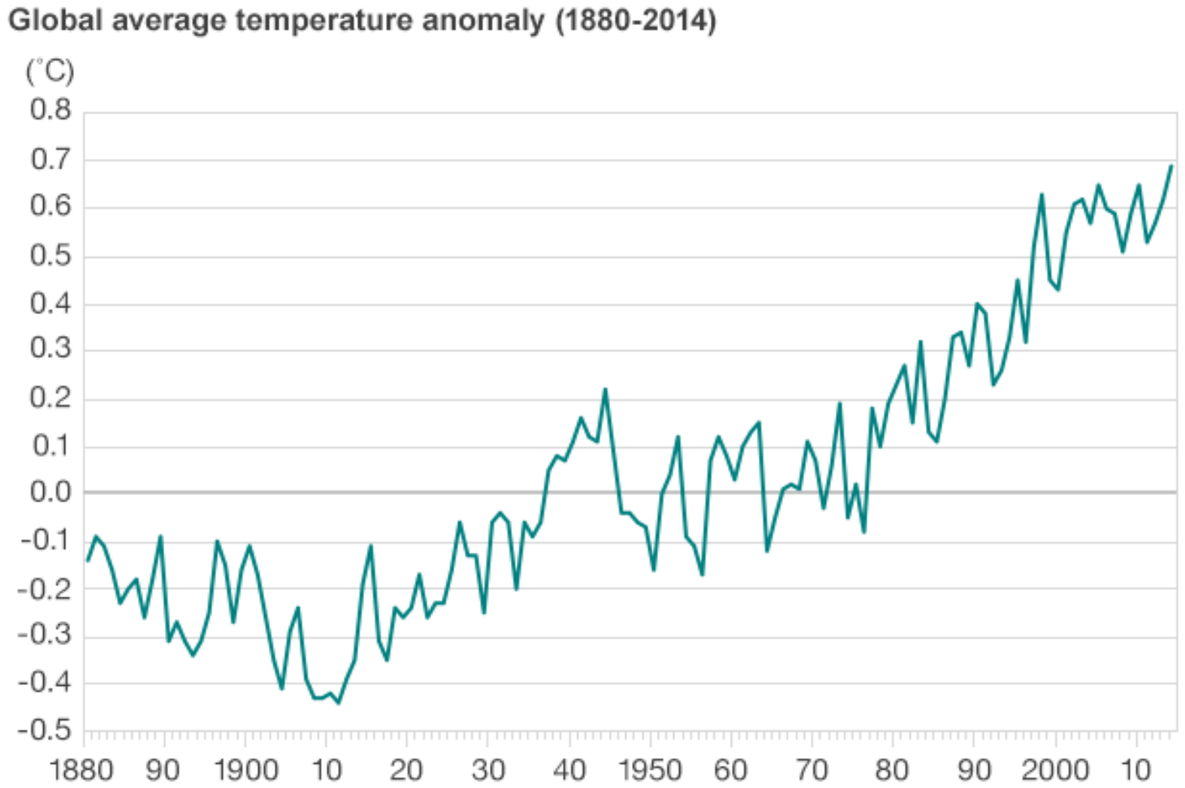
CLIMATE CHANGE & FOOD

2

Earth *is* Warming

Climate change poses a very serious threat to humanity. Over the last twenty years, scientists have accumulated a vast body of research demonstrating that the world is warming and that the rise in temperature is very strongly linked to human activity. [1]

These changes are occurring as a result of greenhouse gases – most prominently carbon dioxide, but also more powerful gases like methane and nitrous oxides – which are being released into the atmosphere as a result of burning fossil fuels, deforestation and agriculture. [2] Carbon dioxide levels in the atmosphere are higher now than at any time over the last 800,000 years. They may be at their highest level for the last 20 million years.[3] In the last 100 years we have seen a global rise in temperature of 0.74ºC. 14 of the 15 warmest years on record have occurred since the turn of the century with 2014 being the warmest since records began. [4] We are also experiencing a rise in ocean temperatures, rising sea levels, faster than average warming in the Arctic, ocean acidification, an increase in the intensity of extreme weather events and shifts in the life cycles of plant and animal species. [5] Scientists and politicians have agreed that we need to limit warming to two degrees above preindustrial levels in order to avoid the worst effects. This would mean dramatically reducing the greenhouse gases we release into the atmosphere over the next 5 to 10 years. [6] If we fail to achieve this target and global average surface temperatures become increasingly warmer, the resulting effect on natural and managed habitats, could have disastrous consequences around the world for agriculture and the global food supply chain. [7]



“Warming of the climate system is unequivocal”

IPCC, 2007

The Role Of Food

It is estimated that agriculture contributes 10-12% of the total global green house gas emissions. [9] Some estimate this figure to be much higher at between 17–32% if you include emissions associated with agriculturally induced land use change – that is, the release of carbon into the atmosphere resulting from deforestation or the conversion of savannah or pasture to arable land, or from overgrazing and subsequent soil erosion. [10] 70% of agricultural land use worldwide (30% of the Earth's land surface) is devoted to raising livestock and more than half of the greenhouse gas emissions attributable to agriculture. Reducing livestock production would reduce emissions directly through reductions in methane from ruminants and waste management, and nitrous oxide from forage and feed production. [11] Agriculture is also a major source of methane, which is 23 times more powerful than carbon dioxide at warming the atmosphere, and nitrous oxide, which is 296 times more powerful. [12] The production and consumption of food, known as the supply chain, also contributes to global GHG emissions through its transport, the process of farming itself, the energy used in food processing and retail, and from food waste. The supply chain in the UK is estimated to account for almost a fifth of our overall greenhouse gas emissions. [13]

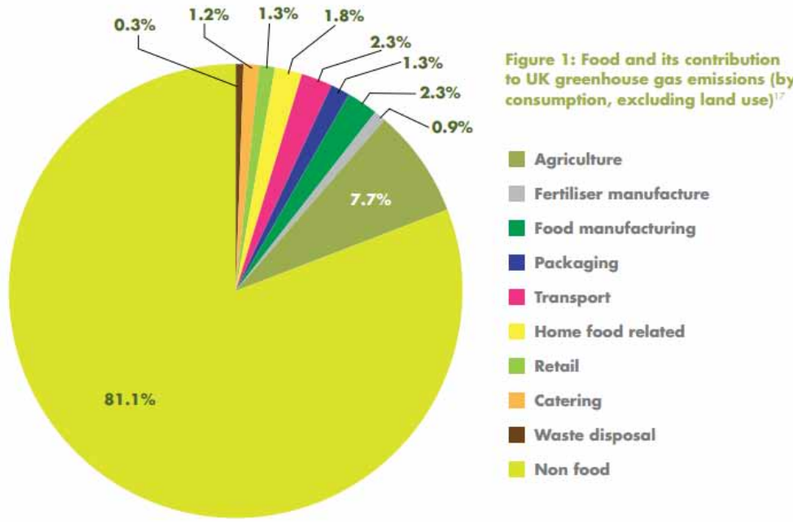
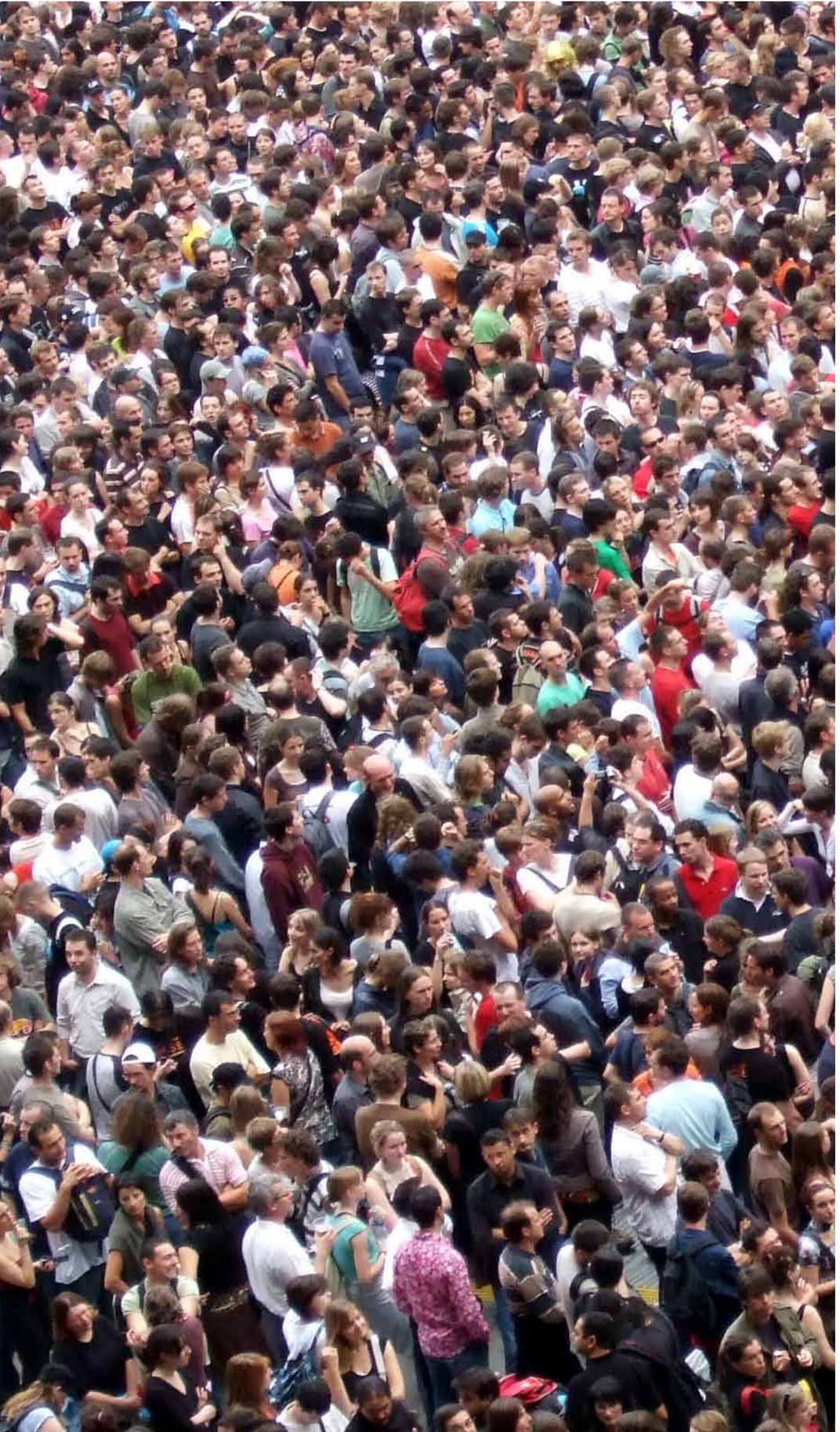


Figure 1: Food and its contribution to UK greenhouse gas emissions (by consumption, excluding land use)[17]

Intensive Agriculture, Brazil

30% **of the Earth's land surface is devoted to raising livestock and more than half of the greenhouse gas emissions attributable to agriculture.** [11]

Intensive Livestock Farming, California

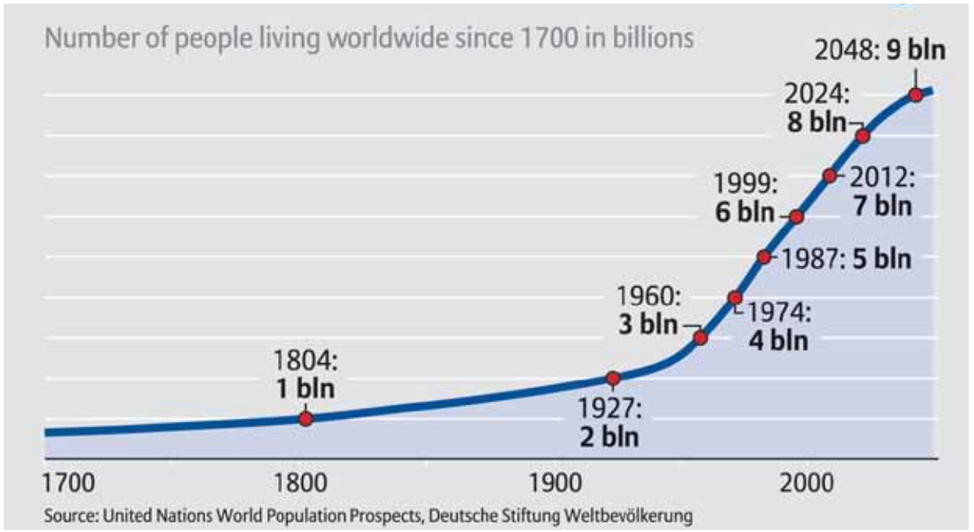


Rising Human Population

Greenhouse gas emissions are rising dangerously. The global population is also increasing and it is thought 9 billion people will be living on the planet by 2050, all of whom will need to eat. The numbers of people in absolute poverty and those who are very wealthy are increasing. Climate change will affect poor people first and worst. If action isn't taken now, it may be too late and very much more expensive to act later. [14]

Food contributes to a significant proportion of global GHG emissions- possibly around a third - and all stages in its life cycle play their part, with agriculture taking the largest individual share. Globally speaking, our pattern of food production and consumption is moving in more greenhouse gas intensive directions. [15]

Ultimately, land is the real challenge. There is only so much to go round. In the context of nine billion people on the planet by 2050, policy makers need to consider what the best use of land might be, such that we are all fed adequately and at minimum GHG cost; stored carbon is not released; and biodiversity is protected. [16]



Urban sprawl, India

The rise of the human population is causing the demand for food to rise at a higher rate than the rise of population as people get richer. This is meaning more 'natural' land, such as the rain forests, is being cleared for agriculture. [17]

Landfill, Devon UK

Food Crisis - Food Resilience

The current global food security situation is a cause for deep concern. Every day on Earth there are over 200 000 more people to feed. There are increasing and competing pressures for land and water resources. Carbon emissions continue to rise and some experts say we're only one poor harvest away from a global food crisis. [18] Food is an urgent issue of our time, how we produce it, eat it, transport it and how we deal with waste. Demand for food will grow by 38% by 2030 and 60% by 2050. [19] At the same time we are an increasingly urban society. By the end of the century, 4 out of 5 people will live in the city. It is in cities that the food crisis must be tackled and solved. [20] Globally, we grow enough food to feed about 10 billion people, while nearly 1 billion of today's 7 billion people are chronically undernourished and well over 1 billion suffer from significant malnutrition. [21] 33% of all food produced is wasted at a cost of around £500 billion a year. 28% of farmland grows food that will be thrown away. 6-10 % of greenhouse gases come from waste food. [22] The food security challenge is to meet the rising demand for food in ways that are environmentally, socially and economically sustainable.

10 actions to help deliver sustainable, sufficient and secure supplies of food for everyone in the future

1. The farmers, landowners and food producers creating and maintaining a high quality natural environment need to be properly rewarded for the provision of 'public goods'

2. Government policies must ensure that food production in the UK is environmentally sustainable and must not promote increases in production where this damages or degrades the environment, human well-being or animal welfare

3. Agri-tech solutions to increasing food production, including genetic modification (GM), should not be promoted at the expense of developing and implementing agro-ecological approaches

4. Taking land out of production for conservation or flooding should be recognised as providing important environmental benefits

5. The EU should lead the way in developing and implementing sustainable responses to climate change in agriculture

6. The common agricultural policy (CAP) should be reformed to create a European Sustainable Land management Policy that supports the delivery of environmental public goods across Europe.

7. Steps should be taken by the EU and the Government to prevent biofuel production damaging the environment and contributing to increases in the price of food

8. Introducing measures to reduce food waste should be made a priority

9. Steps should be taken to encourage more sustainable diets to address the environmental issues arising from food consumption.

10. The benefits of extensive grazing systems should be given greater recognition and support by policy makers and the food industry

Wildlife & Countryside Link [23]

Food Security

Consumers having access at all times to sufficient, safe and nutritious food for an active and healthy life at affordable prices.
World Health Organisation

Farmers protesting the rising cost of raising livestock, Paris 2013

Tunisian Food Riots, 2011

Time to Move Forward

We have shown that a rapidly growing world population and the depletion of our resources had led to an urgent rethinking of our food patterns and habits, particularly those relating to meat consumption. Climate change is forcing civilization to adapt .

Our food supply must be reliable and resilient to shocks and crises. Food must also be produced in a way that is environmentally sustainable or we will set up problems for the longer term.

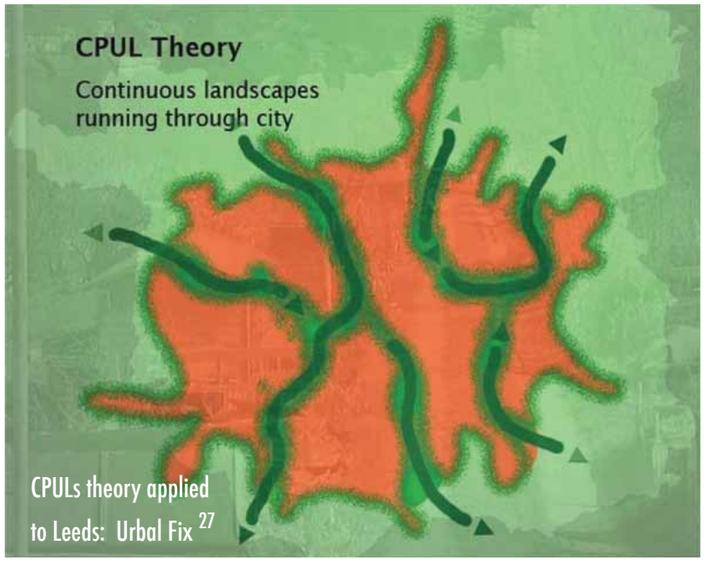
We will now concentrate on projects that are trying to address these issues, with particular focus on sustainable urban agriculture, the need to reduce waste and reduction in ‘food miles’.

3 CASE STUDIES: SUSTAINABLE AGRICULTURE & TECHNICAL FOOD SYSTEMS

Sustainable Agriculture

CPULs - Continuous Productive Urban Landscapes

Both: Urban agriculture, Sole Food Farm, Vancouver



CPULs theory applied to Leeds: Urbal Fix [27]

The driver behind the CPULs concept is to create a coherently planned and designed combination of continuous landscape and productive urban landscapes. A continuous landscape refers to an unobstructed landscape route all the way through the city, which connects pedestrians and wildlife to rural landscapes. [24] By definition, this concept aims to thread the rural landscape through urban environments and help to enable biophilic cities. Scientific research on the well-being benefits of contact with nature has revealed that encounters with the natural environment are very likely to have a significant positive effect both physiologically and psychologically on human health and well-being.[25] Urban landscapes can be productive in a number of ways; Environmental, social and economic. By increasing the amount of linear green routes and connections between them; the opportunities for productivity will also increase. The theory argues that continuous productive urban landscapes should be recognised by policy makers as essential infrastructure, in the same way as energy and water infrastructures are. [24] Urban agriculture is viewed as a major spatial and occupational component of CPULs, with a core philosophy of reconnecting people to the food growing process. By applying CPULs to cities, the opportunities to preserve biodiversity, improve waste management and reduce the amount of energy used to produce and distribute food are increased. [24]

There are also sociocultural benefits, such as communities 'coming together' through urban regeneration; Crime reduction as community activities can offer alternatives to drug use and prevent other criminal activities; Reducing discrimination by providing a means of involving groups who are often discriminated against, such as women, ethnic minorities and the elderly, in sociable, productive activity.[24] Producing food where one wants to eat it, or consuming food where it has just grown, establishes a healthy and sustainable balance of production and consumption. It is an effective and practical, but at the same time self-beneficial way of reducing the energy embodied in contemporary western food production. [24]

“We confirmed our calculations several times. If you use just the existing open space in a contemporary British city, then you can feed about **30%** of the population their fruit and vegetable requirements” [26]

By encouraging the development of food growing projects into the urban fabric....richer, more diverse townscape will emerge [24]

Incredible Edible - Todmorden

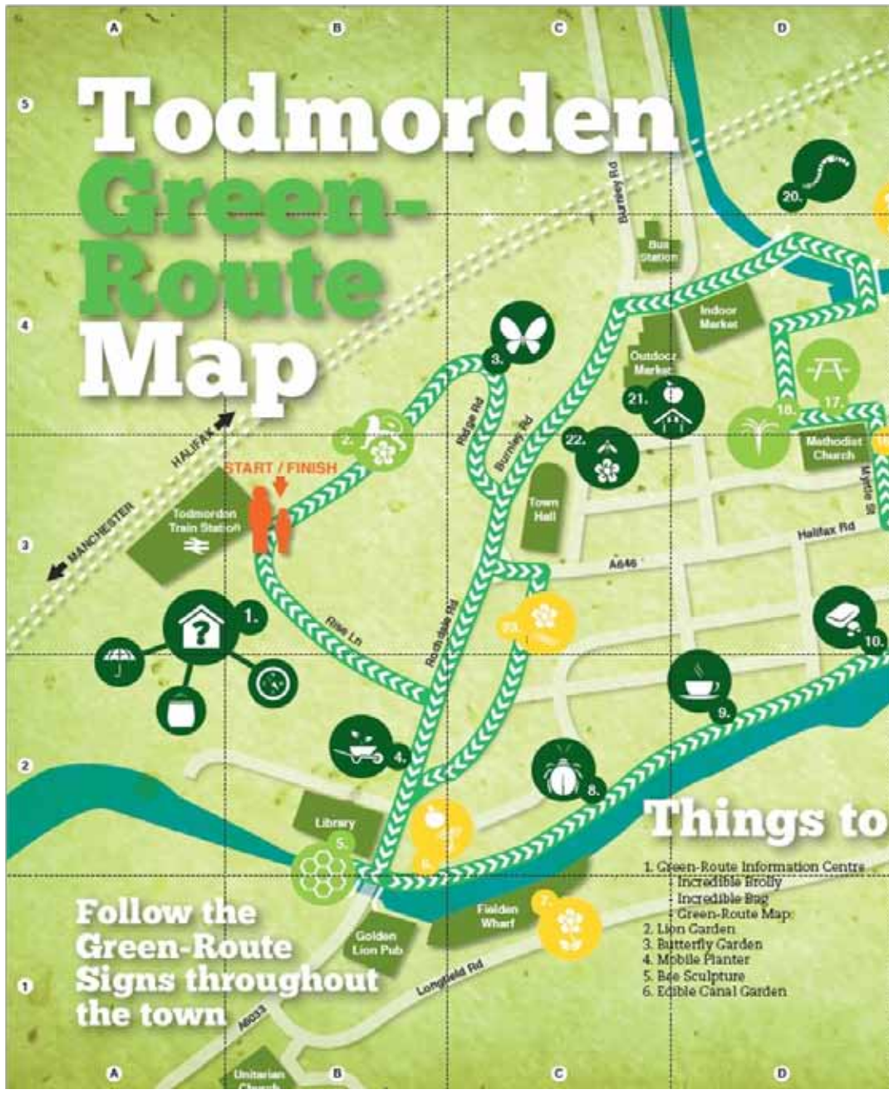
Todmorden, a small market town in between Leeds and Manchester, has become a worldwide tourist attraction thanks to urban agriculture and an effective marketing campaign. The grassroots project utilises any vacant or available plot of land to grow fruit and vegetables, which can be harvested by anyone for free. It started with propaganda planting or guerilla gardening; Without seeking approval from local authorities, a few residents decided to plant vegetables on public land, and the initiative grew from there.

"The old health centre has plenty of land in front, so it was ideal. I didn't ask anyone's permission: I just went there with my spade and my seeds and I planted cabbages and rhubarb." Nick Green . [28]

Productive crops can be found in a variety of spaces, such as the railway station, the police station, alongside busy roads and even within graveyards.

"Our aim is to make our town entirely self-sufficient in food production by 2018 – and if we can carry on at the same rate as we've done over the past 18 months since we had our first meeting and set this initiative up, we're going to make it." Pam Warhurst [28]

This project can be seen as a blueprint to enable other towns and cities to adopt CPULs principles. Since the initiative began in 2007, a third more townspeople now grow their own vegetables; almost 7 in 10 now buy local produce regularly, and 15 times as many people are keeping chickens. Other projects include a 50m-long poly tunnel being set up to grow larger amounts of food and vegetables on a site just outside the town, a drop-in jam-making centre, a woodwork shop to supply chicken huts and greenhouses, and a vegetable garden at an elderly people's care home, which will be designed to enable residents to garden and pick vegetables from their wheelchairs. Another recent addition to the food supply chain is an experimental aquaponics farm, which will produce salad crops and fish by utilising a closed loop system for water and nutrient recycling.



“ It’s all about involving people, giving them ownership, letting them realise it can be fun and interesting and that the food is delicious, and giving them space to set up their own ideas and run with them.” [28]

Urban Bee Keeping


Productive Graveyard


Gorilla gardening outside the police station

Help yourself

Community Veg Box

Local CSA farmers' market

Community Supported Agriculture

The principals of community supported agriculture (CSA) respond to global environmental issues on a local level. It is a means for a community to benefit from sharing in the production of food, fuel or fibre whilst ensuring sustainable, low impact, land management. Individuals work together by providing physical labour, financial investment or ownership of land or tools. This community benefit from consuming fresh, locally produced food whilst feeling a connection with it source. The local farmers share their skills and are subsequently supported in achieving a stable income. [29] The most common produce for CSAs is vegetables, but they can also include eggs, poultry, bread, fruit, pork, lamb, beef and dairy produce. CSAs are also developing around woodlands for firewood and also more recently fish. [29] CSA initiatives provide a high proportion of their members' food needs: initiatives supplying vegetables provide 62% of their members with all or nearly all of their requirements and a further 27% with about half.[29] The current rate of growth, even greater growth in other countries and the high latent appeal of CSA (despite a lack of public awareness), all point to potential for further and accelerating growth for the movement as a whole. [29]

"CSA is powerful on many levels. It is a proactive response to concerns around resilience and transparency in the food system and provides a logical step for consumers towards reclaiming sovereignty over the way their food is grown, processed and traded."

Bonnie Hewson, CSA Project Manager at the Soil Association

CSA. Waltham, Massachusetts

CSA. School farm, Devon

Benefits to Environment

·Effecting change through awareness raising and encouraging sustainable behaviour
·Providing food of low environmental impact
·Improving the local environment through land management

Benefits to Community

·Fresh food from a known source
·Reduction in 'food miles' and less packaging
·Enhanced local economy through employment and 'local spend'
·Education about food and it's production methods
·Influence over the local landscape
·Encouraging sustainable farming

Benefits to Farmers

·Stable income
·Products sold directly for good return
·Community involvement and direct communication with consumers
·Provision of labour and business planning for the future

Growing Underground – Zero Carbon Food, London

This project uses hydroponic systems and LED lighting technology to grow various salad leaves and micro greens in a disused WWII air raid shelter 33 meters below the busy streets of Clapham in London. The project claims to use 70% less water than conventional farming methods as well as no artificial fertilizers or pesticides. Currently, renewable electricity is bought in from a supplier, but the team have ambitions to start generating their own energy on site through solar and wind technologies situated above ground level. The project has attracted a lot of media attention, with thanks to celebrity chef endorsements, which can only be beneficial to the plight of sustainable urban agriculture. [39]

High quality marketed product

WWII Shelter utilised for growing crops

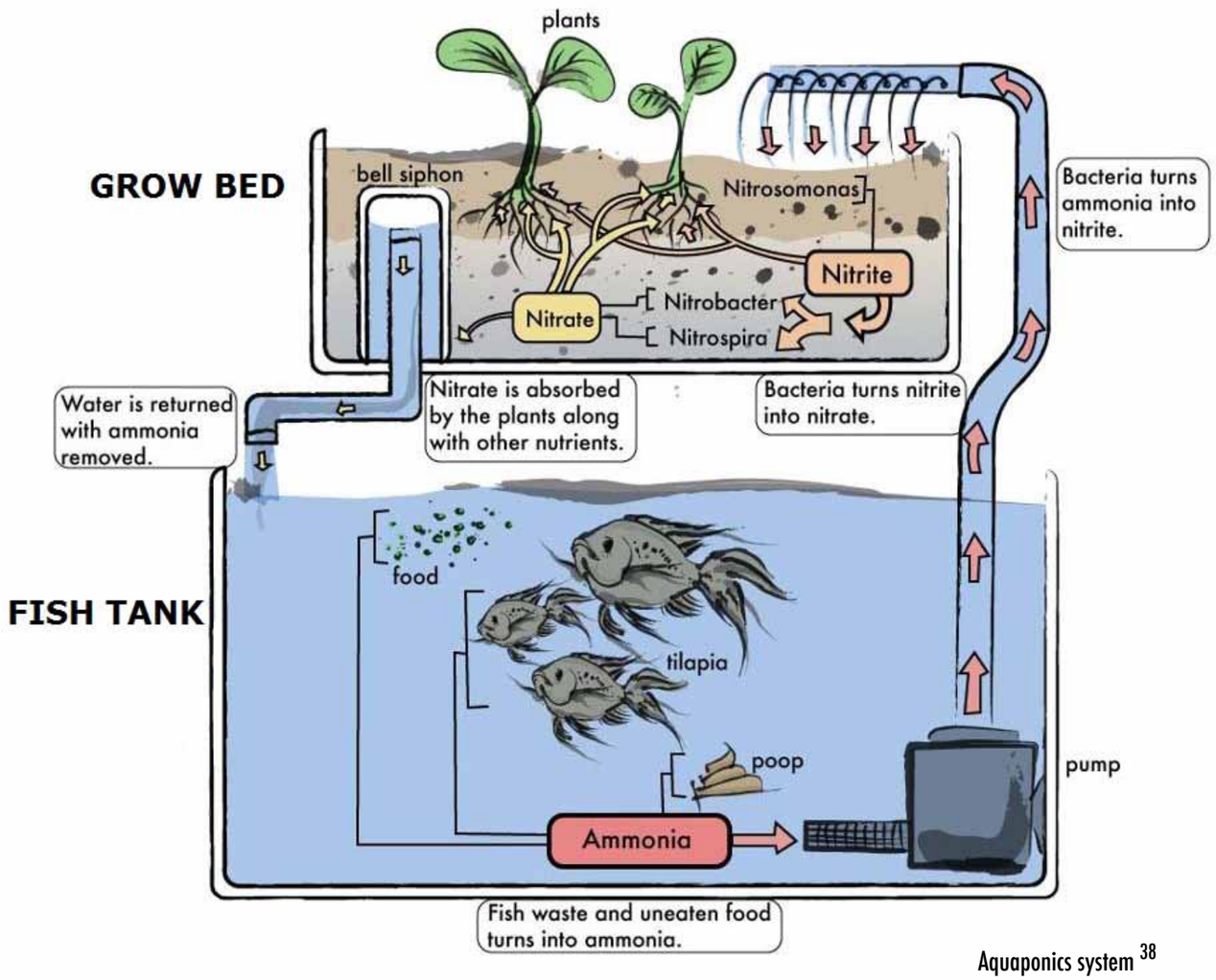
Harvest

CERES Aquaponics- Melbourne

Aquaponics is an environmentally sustainable food producing technology that is very adaptable to urban environments. It is a hybrid system that links recirculating aquaculture (fish farming) and hydroponics (growing plants in water without soil). This system has several advantages: fish waste is absorbed by plants as food; plants can purify the systems water; and together both processes eliminate the need for expensive bio-filters, fertilizers and contaminated waste water disposal and recharge. It is also more productive and less energy intensive when compared with traditional agriculture production. Community based urban aquaponics enterprises represent a new model for how local business can be blended with scientific innovation to increase the food security of cities, re-engaging urban communities in their food production, while minimising the stress placed on the natural environment caused by rapid urban expansion.

The CERES Aquaponics system was designed and built by Steve Mushin and is part of a well-known eco/ sustainability hub in inner city Melbourne, with 400 volunteers and 100 part time members of staff. The aquaponics system itself is an 80m2 floating raft deep bed system, with two re purposed 1000 litre tanks for the fish. The fish tanks sit higher than the plant pools, and are housed in a shipping container that has one side cut out of it so that it opens into the greenhouse. The system at CERES was designed as a 'sub-optimised commercial system that has low energy use, robust and is easy to use', with the production capacity to support a single wage. The system is completely self-sufficient in energy and water and produces enough produce to support the farmer who maintains it. The farmer's income wage depends on how much he produces with all produce being sold directly to the CERES Fair Food organic box delivery enterprise in the neighbouring building. [37]


Steve Mushin - Founder

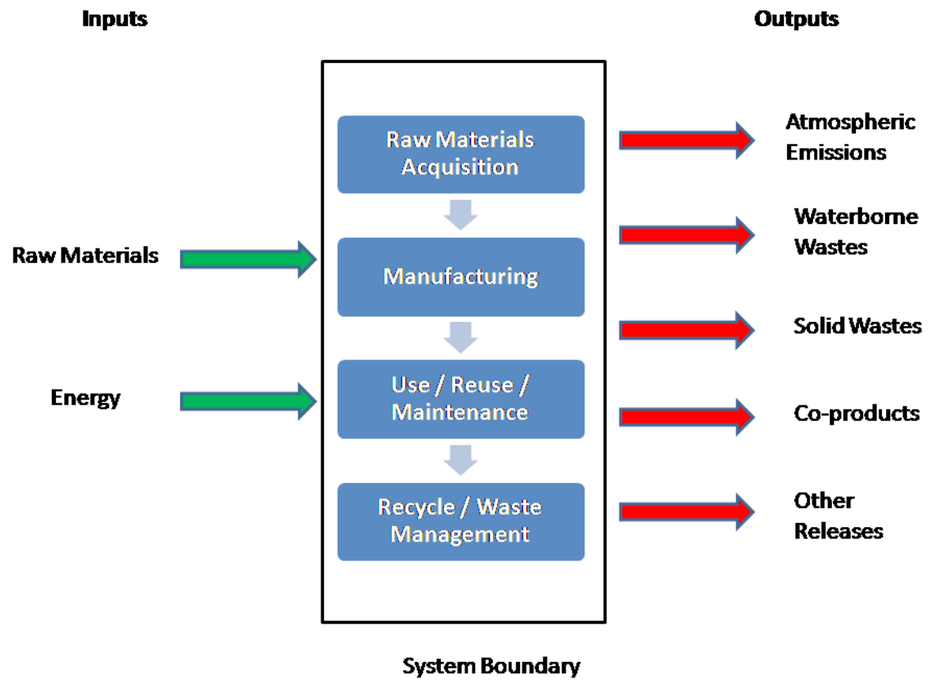


Aquaponics system [38]

Systems Thinking - Closed Loop Systems

Closed Loop System

A closed loop system emulates a natural ecosystem; each component feeds into the next; nothing is wasted and there is no excess



Man made - linear system [32]

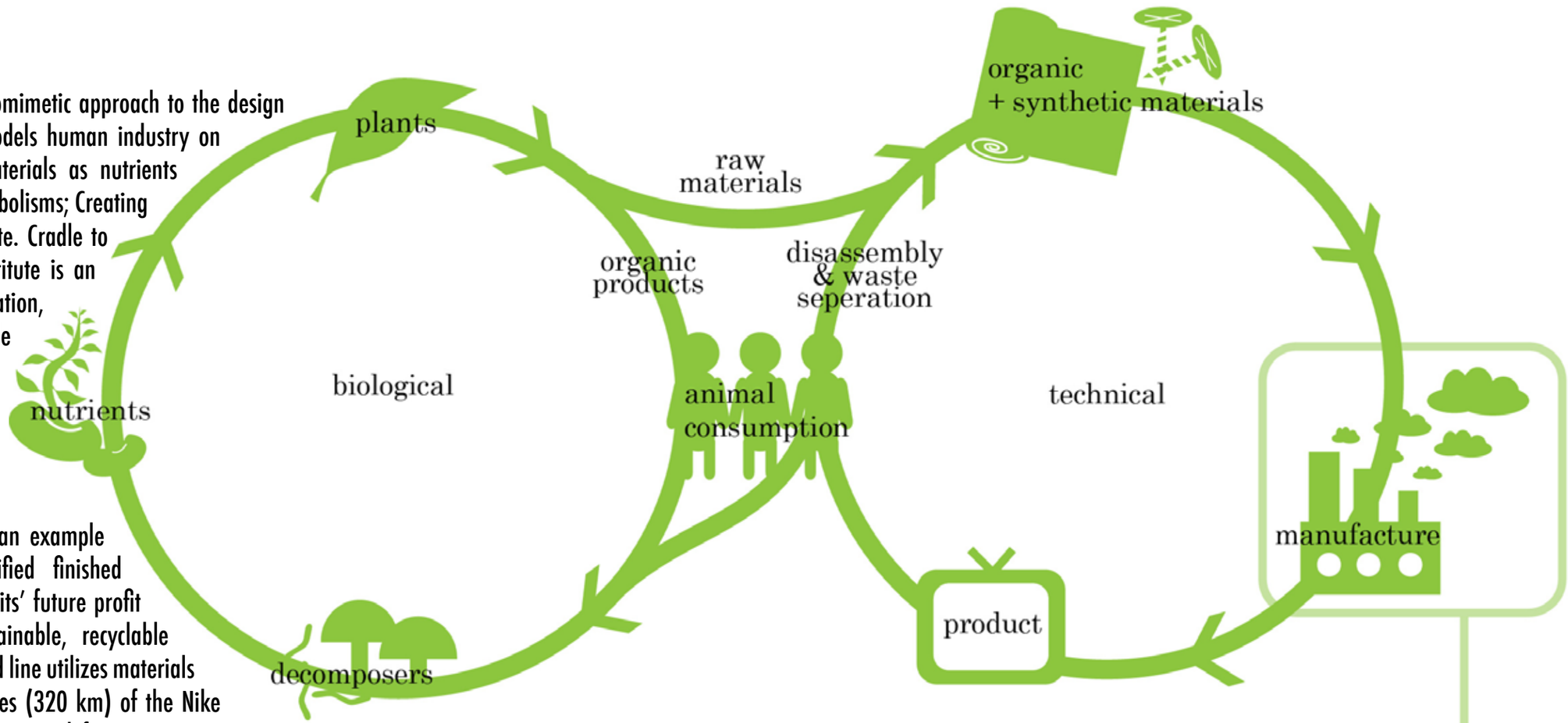
It is possible to describe the way in which we use resources (such as food and energy) as a linear system. We extract them, we turn them into short-life products and then dispose of them. In economics, this process is known as the materials economy, which is fuelled by consumerism and the desire for growth. [30] We Can not run a linear system on a finite planet indefinitely. In natural ecosystems, the waste from one organism becomes the nutrient for another. In other words, everything is recycled and these self sufficient systems can (in theory) continue indefinitely. Applying these principles to business models within urban environments and reducing waste, suggests a huge opportunity to radically reduce a major contributor to climate change. [31]

In order to determine a true closed loop system, a life cycle analysis (LCA) must be completed to assess its sustainability value. [32] LCA is a methodology used to appraise the resource inputs, throughputs, outputs and associated environmental impacts of all stages of a product or process. The "life cycle" refers to all individual steps surrounding the subject under assessment. The LCA process allows its users to identify opportunities, within the life cycle of a product, to turn waste into nutrients; From a linear system (cradle to grave), to a circular system (cradle to cradle). [33]

Cradle to Cradle

Cradle to Cradle design is a biomimetic approach to the design of products and systems. It models human industry on nature's processes viewing materials as nutrients circulating in healthy, safe metabolisms; Creating efficient systems with zero waste. Cradle to Cradle Products Innovation Institute is an independent non profit organisation, which administers the cradle to cradle certified product standard to companies using sustainable, closed loop principles. [33]

The Nike 'Considered' boot is an example of a Cradle to Cradle certified finished product,which aims to increase its' future profit margins by using more sustainable, recyclable materials. [34] The Nike Considered line utilizes materials found primarily within 200 miles (320 km) of the Nike factory which reduces the energy used for transportation, diminishing the resulting climate change impact. The manufacturing process reduces solvent use by more than 80% compared with Nike's typical products. The leather comes from a tannery that recycles wastewater to ensure toxins are kept out of the environment, and it is colored using vegetable-based dyes. Hemp and polyester are used to make the shoe's woven upper and shoelaces. The mid-sole is cut to lock into the outer sole, reducing the need for toxic adhesives. The shoe's outer sole includes rubber made from recycled factory rubber waste [35]

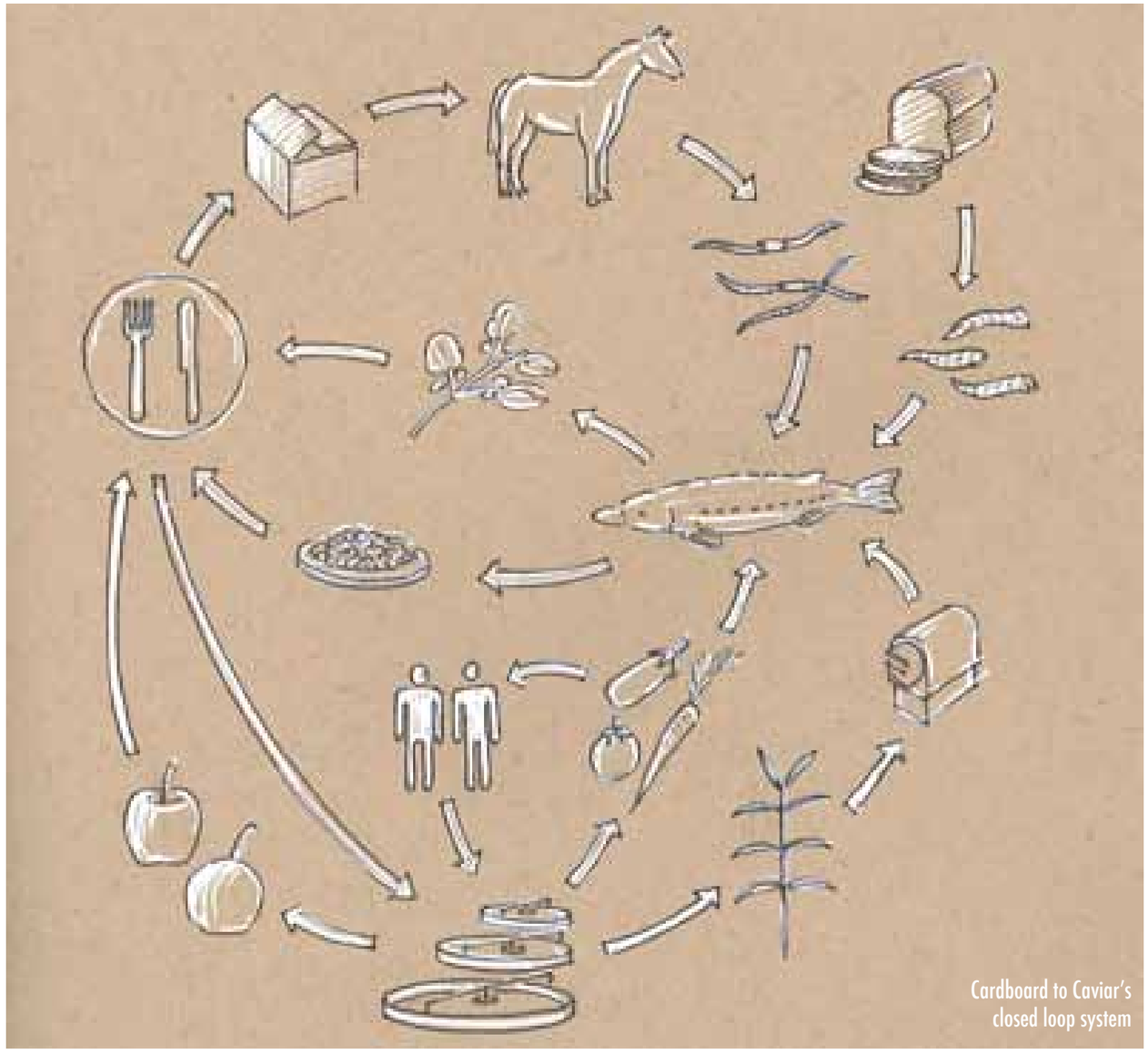


Cradle to Cradle - circular system [33]

The ABLE Project - Cardboard to Caviar

The ABLE project (nicknamed 'cardboard to caviar') was set up in Wakefield by Graham Wiles in 2003. He has developed a closed loop system to turn waste streams into a scheme that creates a valuable product, caviar . The cycle begins with the removal of waste cardboard boxes from a local restaurant, these are shredded and sold to the local stables as horse bedding, the old bedding is then used to feed worms and the worms feed Sturgeons. The Sturgeons produce caviar which the restaurant purchases as well as paying for the removal of it's cardboard boxes. The project is successful from an economics perspective by generating revenue from waste derived products whilst also saving money for local businesses. It also benefits local society; through new employment opportunities for disadvantaged people. [36]

Volunteer with Sturgeon



Cardboard to Caviar's closed loop system

The Mobius Project - Exploration Architecture

The Mobius Project is by biomimicry experts Exploration Architecture. This conceptual design is a system designed to be applied to existing urban areas and new masterplans.

The concept of The Mobius Project is to provide a space that produces a range of outputs through closed loop systems. These include

- A productive greenhouse including community allotments
- A restaurant serving food grown in the greenhouse
- A fish farm rearing edible fish
- A food market
- A wormery composting system
- Mushroom cultivation on waste coffee grains
- An anaerobic digester and biomass combined heat and power (CHP)
- A water treatment system
- Artificial limestone creation from waste CO_2

As a scheme this project would create a community space for people to reconnect with their food source and raise awareness and education of sustainable living. This multiple level, closed loop system is a futuristic farming concept that could revolutionise the way food is created in urban areas.

EATING INSECTS

4

entomophagy

(Mass Noun)
The practice of eating insects, especially by people.[11]

Dish from Danish restaurant, Noma

Why Eat Insects?

Eating insects is not only an alternative foodstuff, it is also an alternative method of farming. Currently around 50% of the worlds land is used for agriculture,[1] and 70% of that is used for meat production, this includes the land we use to farm the crops to feed the animals and the land used to farm the animals themselves. This high land use is growing: the combination of the rising population and an ever wealthier population is increasing the demand for meat, the demand is expected to double by 2020. [2]

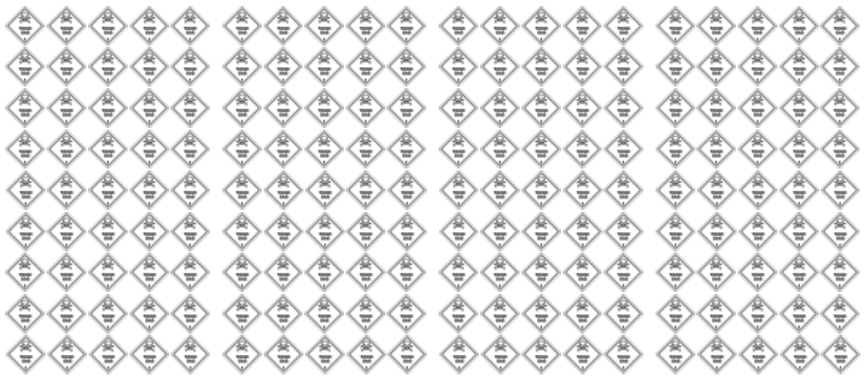
Whilst demand for food is increasing, but there is not much spare land or sustainable resources available to produce it. One of the ways to cope with this pressure on land use, without losing more rainforest or other natural space, is to switch from eating traditional meats such as beef to eating insects. Farming insects uses a huge amount less land than farming cattle due to the insects efficiency of turning the food they eat into the food we eat. Because both cattle and insects are fed very similar foods the amount they eat can be compared to the amount of land they use. For every 10 kilograms of food a cow eats, you get 1 kilogram of beef, but for every 10 kilograms an insect eats you get 9 kilograms of insect meat.[4]
They are also more efficient with water. It takes approximately 4800 gallons of water to produce 1 kilogram of beef, yet to produce 1 kilogram of insects would use under 500 . [5]

When comparing insect farming's ecological advantage to livestock their minimal land use and water use is not the only benefit, they

The Cost of 1kg of Beef

10kg of animal feed

Just under 5000 gallons of water



2800g of greenhouse gasses

OR

The Cost of 1kg of Insects

1kg of animal feed (produces 0.9kg of insects)

OR

Just under 500 gallons of water

OR

100g of greenhouse gases

are also more friendly to the atmosphere. Green house gases (GHG) produced per kilogram of mass gain for beef is around 2800g of GHG, whereas insects produce around 100g. [6]

Switching to eating insects is not only good for the environment, it is also healthy. Insects are high in protein, vitamins, and minerals, including iron and calcium. They are also low in fat, yet contain the good fats our bodies need. Their nutritional benefit is said to be equivalent or higher than traditional meats and fish. They are also said to be disease free compared to meats such as pork, which can carry animal - human transmittable disease such as swine flu. [7]

With the rising demand on the planets land and resources, and our desire to eat healthily, it makes sense to eat insects , so why don't we?

Who Eats Insects?

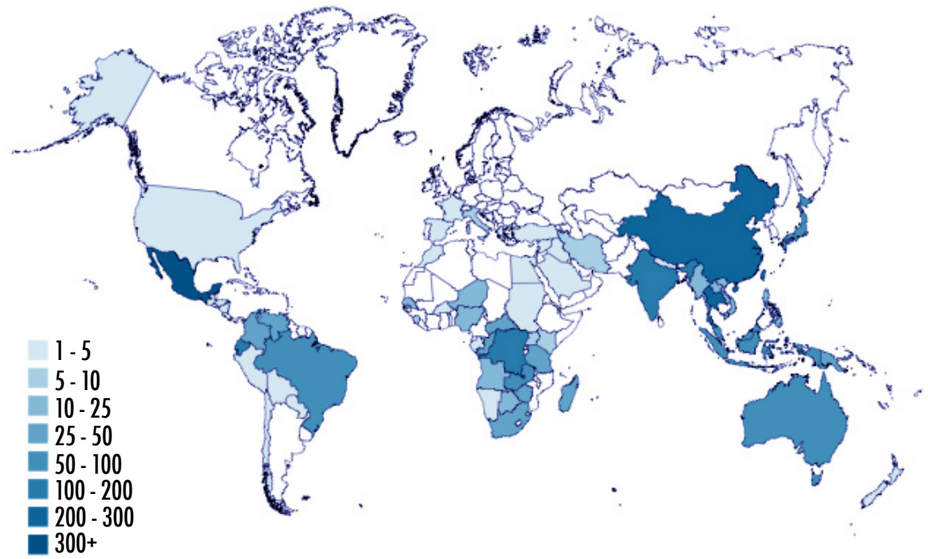
Currently around 2 billion people eat insects as a day to day source of animal protein. In Asia, Latin America and Africa insects are a common food.

In Africa insects are eaten during the rainy season, when other forms of hunting and fishing becomes harder. One of the most common insect eaten here is the caterpillar, it is used to supplement the diet when other food sources are not as widely available. This demonstrates a basic method of hunting and eating sustainably, to eat only what is in season. In some areas the caterpillars are dried and stored for times of food shortage.[8]

In Asia insects are consumed in a more celebrated way. Some species, such as Red Palm weevils, are a delicacy across the continent. Whereas in Africa insects are eaten seasonally, in Asia they are enjoyed year round. Different varieties are caught from a range of different habits and eaten season to season.[9] Across Asia and Central America lay the largest range of edible insects on the planet (figure 1).

Throughout Latin America insects are eaten by the indigenous people. In much the same way as Africa wild foods are caught year round and a part of that is insects. Maize and corn are grown, but during the growing season when these crops are less widely available, insects are more plentiful, and so become a more important source of food. But more similar to Asia there is a huge range of insects eaten in Latin America, and they are eaten year round.[10] The indigenous peoples taste for insects has influenced into the mainstream diet across much of Latin America, insects can be found in food markets across the southern half of this continent.

Fig. 1: Number of edible insects species by country



From: Centre for Geo Information, Wageningen University, 2012


Edible insects in the UK

While insects are eaten intentionally across much of the planet, in the western world we eat hundreds every year by accident and hidden within our food such as food dyes. Due to insects being everywhere, living off crops, fruit and vegetables, a certain amount of them will get caught up in the food production process and we will happily eat them without realising. Almost all red food dye is produced from the cochineal insect, a small bug that lives on cacti in South America. So if you eat tomato soup, crabsticks or anything with 'natural red 4' dye in it you are eating insects. In the west, without realising, we each eat 500g of insects every year. [12]

Why Don't We Eat Insects?

So with people across the globe enjoying insects, why are they not eaten in the west? To understand this we have to look back to the beginning of agriculture. Agriculture is believed to have first developed in The Fertile Crescent: fertile lands ranging across western Asia, and the Nile Valley and Nile Delta in northern Africa. The agriculture spread from there into Europe.[13] As agriculture developed then began the domestication of animals for livestock. Across the planet there are only 14 domesticated mammals over 45kg, and of these 13 exist in Europe, the only other is the Llama from the Americas. Due to having all these large animals in Europe there was not a need to eat insects, all of the meat and nutrients needed was available from eating mammals.[14] Other countries simply did not have this range of mammals as a food source and so insects and small animals were consumed instead.

But now in this global world, where everything across the planet is available, insects have still not caught on in the west and Europe. We have do not see them as an acceptable food source. Other food types previously thought as unacceptable have crept in to our diet and become the norm. Sushi is the famous example: in the west it used to be thought of as unhygienic to eat raw fish. These thoughts began to change around the 1950's and 60's when the first few sushi restaurants opened up in the UK and US, and it became popular in the 1990's. It is now a common item seen in supermarkets and restaurants worldwide. It is hard to understand what dramatically changed peoples opinions, but at some point the western culture accepted sushi as a normal food.

The acceptance and rejection of food is influenced by a multitude of effects; genetic inheritance, maternal diet, child raising practises, learning, cognition and culture. [14] Looking at these factors, eating insects does not fit in to any of them for most of the people growing up in the western world. Without growing up eating insects, and not seeing anyone eat insects, we are unlikely to start eating them in later life, unless our general culture towards eating them changes.

The difference between sushi and edible insects could lie in the perceptions of the animals themselves. Fish was already previously eaten in the west commonly, the only change was that with was sushi it was now served raw. Insects are generally perceived with disgust, we give them nasty sounding names when we are children, we call them creepy crawlies and are told nursery rhymes about spiders to scare us. The perception is encouraged in later life by television programs such as 'I'm a Celebrity...Get Me Out of Here!', where contestants are challenged to eat insects. Growing up with these influences does not encourage us to eat them. But besides this our culture is beginning to change.

Edible insects in Asia

Edible Insects: Creeping into Our Culture?

As people are becoming more aware of climate change and the realisation for the need to live sustainably is beginning to grow, people are beginning to eat less meat and are looking for alternatives. The normal alternative is vegetarianism, but a few restaurants and shops in Europe and North America are beginning to serve insects as food.

Noma, Copenhagen

Rated the top restaurant in the world by the San Pellegrino Worlds Best Restaurants awards 2014, this establishment pushes boundaries in cuisine and has began serving insects as a part of that. Live ants were on the menu at a £200 a head tasting meal the restaurant hosted in London this year, and currently on the restaurants menu is 'Beef tartare and ants'. Whilst serving the insects with beef may remove the sustainability side of entomophagy, by serving insects and such an influential restaurant will without doubt put insects on the menu across the world. Here the insects are not hidden away into recipes, they are boldly placed in plain sight so there is no hiding from them. This portrays a powerful message of here are the insects, eat them!

Here; live ant salad, and left; beef tartare and ants

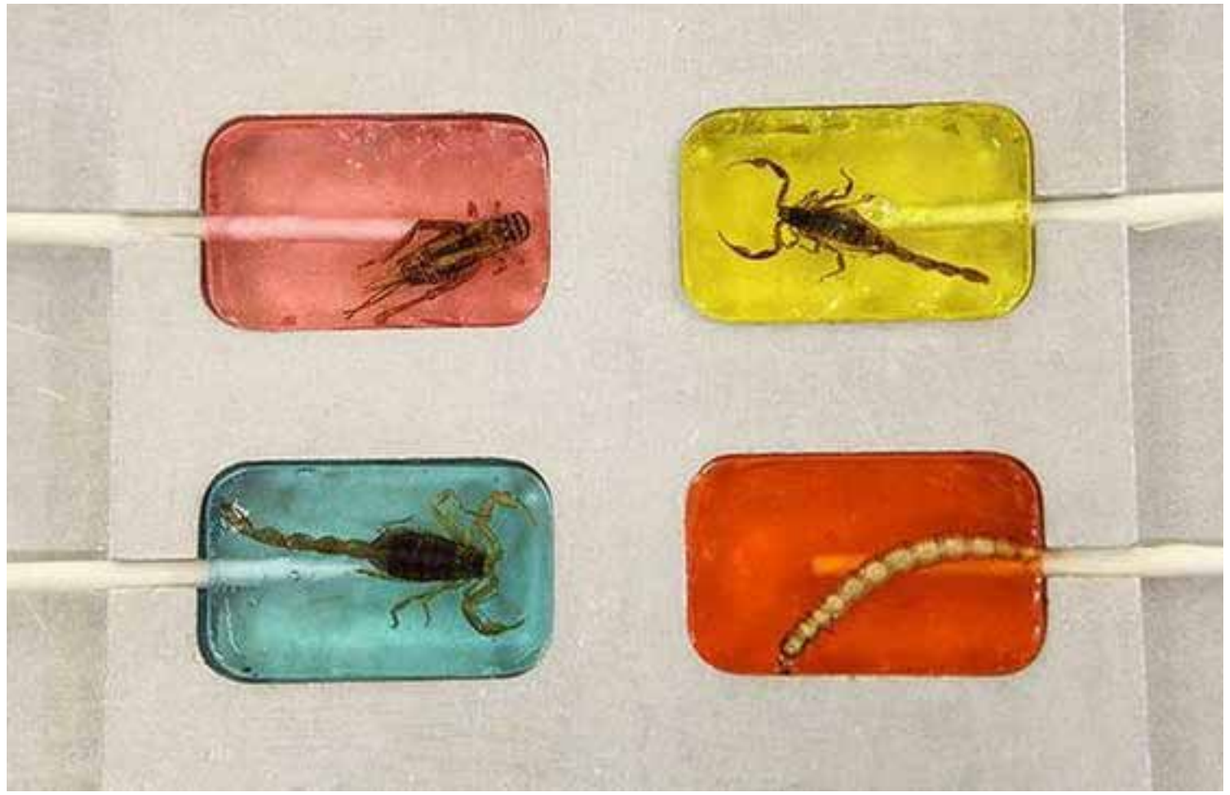
Ento, London

Ento is a small start up business based in London aimed at promoting eating insects as healthy, sustainable food. Ento put on events around the country to push their ideas and operate as a business. One of their recent events was a tasting menu evening put on at a pop up restaurant. The evening sold out at £75 a head. Ento also market insects in well packaged, ordinary looking forms that people recognise as good food and can easily accept.

Noma & Ento both show how entomophagy has the potential to become a trendy food, in the way sushi has. Once a few more places like these begin serving insects in a presentable way we can accept and enjoy, then maybe a culture shift will begin and they will become a common sight on supermarket shelves.

Here; Ento caterpillar cubes, and left; grasshopper pate

Harvey Nichols, UK



Sexy Foods, France

These two examples of edible insects show the gimmicky side of entomophagy. Both of these retailers sell insects in an accessible form, but keep the insects wholly visible for the consumer. Harvey Nichols mainly sells these sweets pictured above with insects incased in sugar, alongside other sweet treats such as chocolate covered mealworms and crickets. Sexy Foods sell small tins of beautifully packaged cooked whole insects. Their snazzy website and high prices put these bugs across in a 'try me' sort of way. The Harvey Nichols lollipops are priced at £5.95 a go, and the Sexy Foods option is a similar price for the small tin. These expensive gimmicks may almost reinforce the 'I'm a Celebrity' take on insect eating. They retain entomophagy as a bit of a joke idea to have a go at.

Insects as Protein Food

In the US (and in the UK online) insects are being ground into 'flour' to replace ordinary flour to produce protein supplements and snacks. There is currently a trend for high protein, low carbohydrate diets for weight loss and muscle gain and these products fit perfectly into that market. As many protein supplements are made form dairy products, and as mentioned earlier the cow is not a sustainable form of livestock, Exo's protein bars made from insects is a perfect replacement. Six foods have taken the route of creating cookies and crisps form insect flour, again if people are using these as an alternative protein snack to ordinary meat then this is a highly sustainable product.

The difference to these two companies and the previous examples is that these are ordinary products that everybody recognises yet they are made with insects. They are not high end as with Noma or Ento's tasting menus* nor are they a gimmick product like Harvey Nichols or Sexy Foods, they are normal food for anyone to buy. This allows them to become an instant success and a flagship for entomophagy in the west.

*Ento's packaged food may be as accessible as these protein focused products, but their tasting menus are priced out of most peoples everyday food.

Edible Insects: Farming For the New Demand

If the western world is beginning to accept insects as a new food source then there will need to be farms to cope with the demand. We will need insects farms in the countries we are eating the insects, if not the food miles will begin to remove from their sustainable appeal. These examples show current insect farming methods around the world.

Cricket Farming, Thailand

Up until the 1990's insects were all caught in the wild for food throughout Thailand but since then people have been farming them on a commercial scale. Farmers have been switching from rearing pigs to crickets as it is more profitable and reliable. It is also a simple skill that anybody can easily learn and or start up a business with little money behind them. This has led to around 20,000 cricket farms currently operating in the Isaan region (the nations 'rice bowl'). [16] Farming methods are basic, crickets are fed chicken feed in concrete pens with cardboard trays for cover, the insects mature and are ready for harvest after four short weeks. This industry is a stable income for the farmers of Isaan and is estimated to bring $30 million a year in profit for the region. [17]

Here; the end product, and left; insects being farmed in cardboard trays

Insect Farming for Animal Feed, UK

Here; mini mealworms, and right: a speciality of live foods, a silent cricket

Currently in the UK no one farms insects for human consumption, they are only farmed for animal or wild bird feed. Of this, the largest farmers are Live Foods Direct who produce a range of insets including mealworms, wax worms, locusts and crickets. Live Foods Direct supply most of the main insect based animal feed suppliers in the country and directly supply individuals looking for food for their pets or garden. Producing tons of insects weekly they are big business in the insect world but do not produce them for human consumption, we asked Dean Jackson head of live foods, why not we were told that it was due to regulations on what animals can be fed if they are for human consumption. If rearing insects for humans the process would have to become more technical, but it is possible.

Insect Farming for Human Consumption, Netherlands

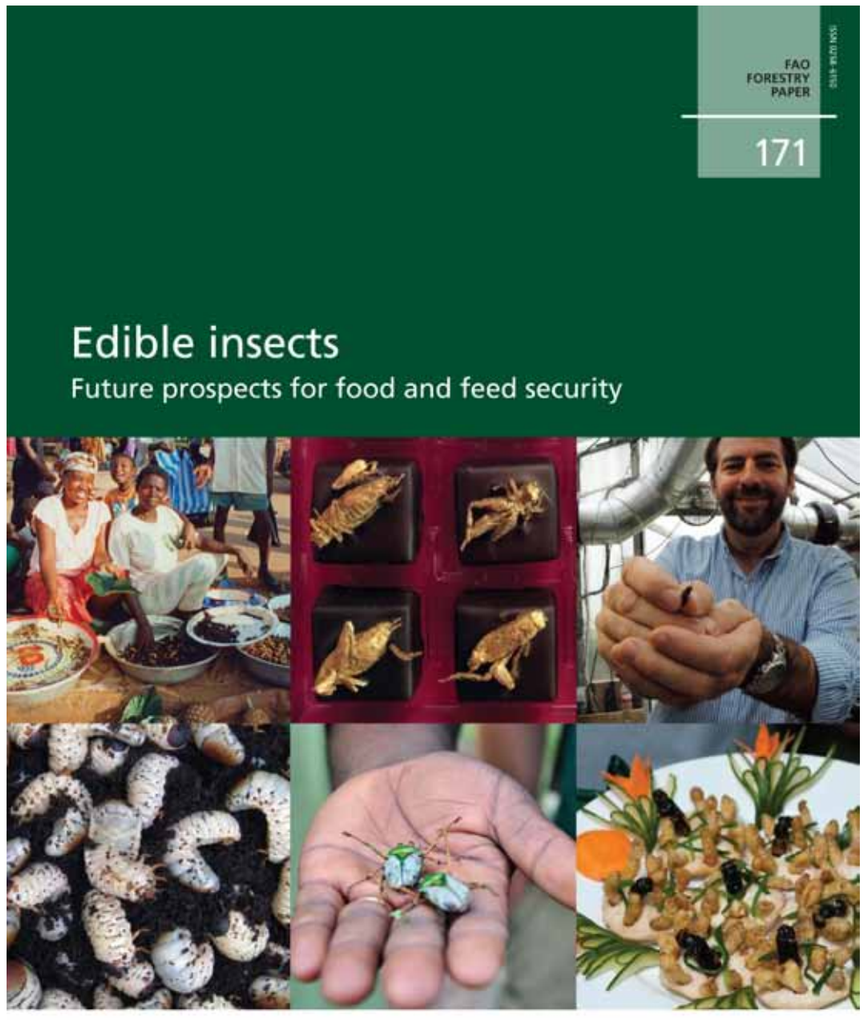
Insect Europe;
producing Cricket Meal
from their own crickets.


Here & Above; New
Generation Nutrition;
farming & producing
cooked insects

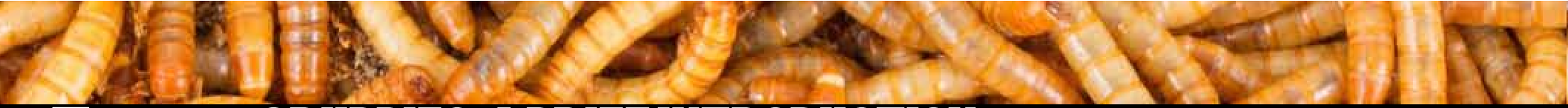
Currently the Netherlands is at the forefront of insect farming for entomophagy. There are 3 organisations with licenses to breed insects for humans: Insect Europe, Kreca and New Generation Nutrition. All three of these companies are new to the entomophagy world but all have products for pre-order and are based heavily in research alongside selling their products.

In many cases government legislation is holding insect farms back but despite this in Europe there are a lot of universities and organisations putting research into entomophagy and as often is the case the Netherlands are pushing ahead at the front of this, in particular Wageningen University. The Food and Agriculture Organization of the United Nations (FAO) is also putting a lot of research into how entomophagy can help us tackle climate change by living sustainably using this very new method of agriculture. The FAO are compiling this research into easy to read documents, and are linking together leading researchers and businesses in the field, in particular their document ‘Edible Insects Future Prospects for food and feed security’. This document is the currently the top source of knowledge and research on the subject and should be consulted for any further reading and information the subject. The FAO and Wageningen University are producing and compiling the latest and best knowledge allowing the edible insect industry to grow quickly and efficiently.

Kreca's large scale insect farm & the mealworms they produce



Right: The FAO's edible insect bible of the subject.



5 GRUBBIES: A BRIEF INTRODUCTION

This next half of the book explains our take on insect farming, sustainable agriculture, green infrastructure and public space.

We are producing these elements as a brand. Our brand is Grubbies.

GRUBBIES

Grubbies has currently has two elements to it; Grubbies Leeds and Grubbies at Home.

Grubbies Leeds will use brownfield sites in Leeds to create public space, farm insects (and other crops) in a closed loop system, and sell this food as a product to the public. We will also be able to use this space to educate people on farming this future food in a sustainable way.

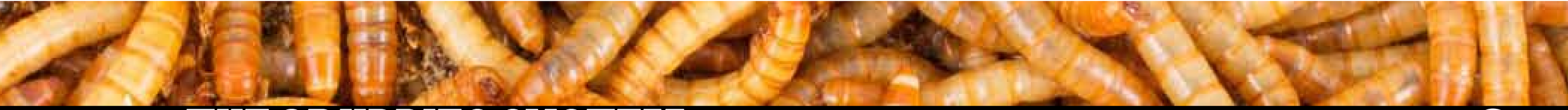
Grubbies at Home is a small scale closed loop insect farm that people can implement at home. Grubbies will produce a leaflet for people to use as a guide for insect farming at home. This will allow people to produce their own readily available sustainable protein source.

To implement these elements we have developed the Grubbies Loop. This is our farming system. This system has been designed to apply at any scale, so it is used in Grubbies Leeds and in Grubbies at Home.

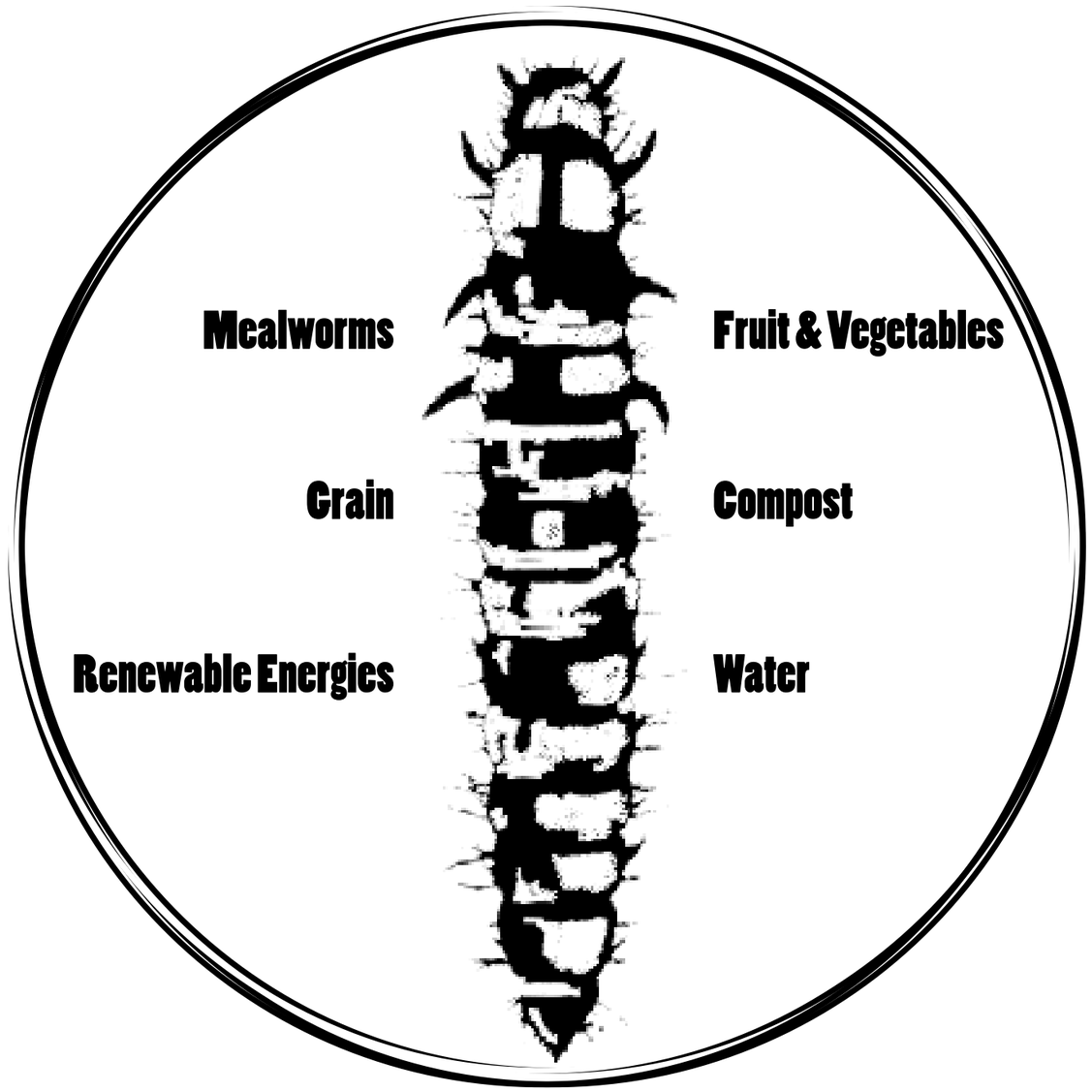
The system runs on six key elements; mealworms for us to eat, the grains the mealworms need, the fruit and vegetables us and the insects need, renewable energy for electricity for us and the insects again, compost for the crops and lastly water to sustain the crops, us and the insects.

These six elements will interlock to produce a closed loop system. This will mimick a natural ecosystem where there are no waste products, just a cycle of use.

All of these elements will be produced on site, reducing food miles down to zero. This will also allow Grubbies to be run carbon neutral, and if other planting is incorporated and surplus renewable energy is produced Grubbies will run carbon negative. Grubbies will be running this system in the urban environment, as to be able to produce food where it is most needed in densely populated areas.

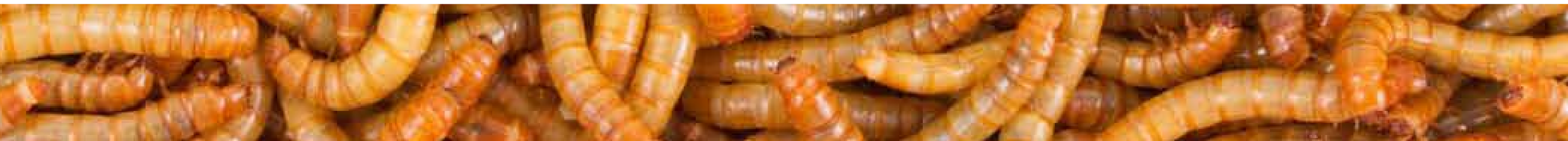


THE GRUBBIES SYSTEM



This section of the book will explain our closed loop system and the main six elements it is composed of.

We will begin by introducing these elements; mealworms, grain, renewable energies, fruit and vegetables, compost and water.



Mealworms

Mealworm Dusted
Sainte-Maure Touraine
Goats Cheese

At Grubbies yellow mealworms will be farmed as the test, or example product to kick things off.

The yellow mealworm *(Tenebrio molitor),* larvae of the mealworm beetle, naturally lives by burrowing amongst it's food, this may be in the leaf litter of a woodland, in animal burrows or in grain stores, and relatively, they will eat dead leaves, animal faeces or grain. Due to these habits they are very easy to farm, they can simply be left in a tray with their food as bedding and will grow very quickly over a three month cycle.

Mealworms are an ethically sound insect to farm, to understand why you have to look their main contender in insect farming options: the cricket. The cricket naturally lives in open space with long grass and pray to catch, and so may be yearning to be amongst this when farmed in a commercial scale tray. Crickets are also known to fight and eat each other (to the point they are bet on to fight in Asia), for this reason they do not seem like a natural choice to keep together in a cramped space. When farming a mealworm the conditions it lives in are not that different to it's natural habitat, so hopefully this results in happy mealworms! The ease and ethics of farming mealworms is why here at Grubbies we are beginning our insect rearing with them.

As a food source mealworms are nutritionally high in the entomophagy world, and are high when compared to beef:

- A mealworm is almost 62% protein, whereas beef is 52%. [1]
- Fat content of the mealworm is 35% and beef is 41%.
- Mealworms contain higher levels of some essential and non essential amino acids, and so does beef. These numbers roughly equate.

(Percentages shown are dry weight of both beef and mealworm).

To enjoy these nutritional benefits the mealworms have to be cooked, and there are plenty of recipes and options available. Mealworms can be enjoyed whole in dishes, used easily if imagined as substitutes for other proteins such as prawns or bacon. Or they can easily be dried and ground down for more refined dishes such as the dusted goats cheese (pictured left).

But before cooking can even be thought about the mealworms need to be farmed. Grubbies has looked at the different elements needed to be able to produce them and the following pages will explain these.

Other things that need to be thought about when farming insects include hygiene and slaughter. Although it is very unlikely to catch any diseases from mealworms from eating them, it is possible when farming them on a mass scale. To avoid this masks should be worn inside the farm itself and a cleaning room for people coming in and out if the farm should be set up so that people can change clothes and shower after being in the farm building. As with any large groups of single species in close proximity, diseases can easily spread amongst the mealworms if not taken care of. To avoid this they need to be regularly monitored and their containers need to be cleaned thoroughly between harvests. For slaughtering the mealworms freezing them is thought to be the most humane method possible. This also keeps the mealworms fresh during storage.

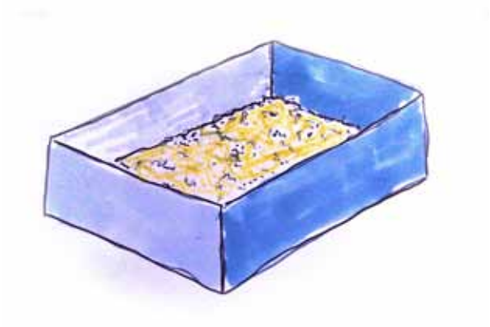
The Mealworm Farm

At Grubbies Leeds mealworms will be farmed in upcycled shipping containers such as this. This will allow the farms to be easily scaled up or down by altering the amount and size of shipping containers put on site, alongside providing for simple design and construction with upcycled materials. Containers could be pre fabricated and transported to sites as farms are developed.

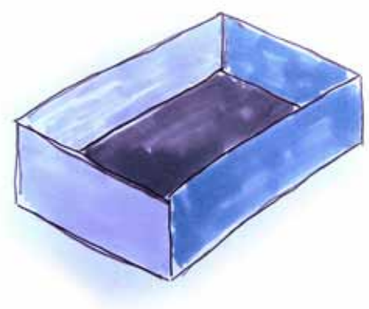
Mealworms in their
larvae stage

How the Mealworms Are Farmed

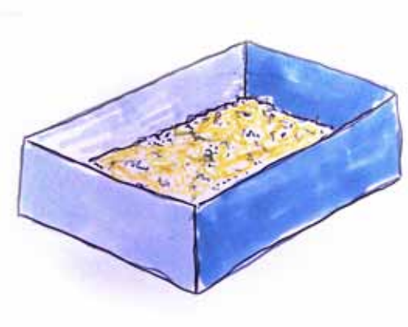
Larvae



Pupae



Beetle



To Begin You will Need:

3 trays, each measuring 41cm x 26cm x 13cm.

A mixture of feed, containing:

- 10 parts oat or wheat kernels
- 10 parts rolled oats or whole wheat flour
- 1 part wheat germ
- 1 part yeast

A few bits of fruit or veg, such as apples or carrots.

Around 50 larvae mealworms.

Method:

Firstly fill one of the trays to around 2.5cm depth with the grain mixture, this should take around 4.4kg per tray, also add some pieces of the fruit or vegetables, this will provide moisture for the mealworms and should be replaced when it becomes mouldy. Then add the mealworm larvae and stir the mixture every day or two to observe the mealworms' stage in their lifecycle.

As the pupae appear transfer them to the second empty tray, this is a non feeding stage in the mealworms lifecycle.

These pupae will develop into beetles (darkling beetle), once this happens transfer them to the third tray with the same mixture of grain and fruit or vegetables. Once again, regularly monitor and stir to replace rotten fruit and veg and to check on the life cycle. The beetles will mate after 2-5 days and produce 40 eggs a day, hatching after 12 days. This will produce mealworms for harvest and for beginning new cycles. As the adults live around 2 months prepare appropriately to have a constant supply of mealworms.

This whole process takes 3-6 months and uses 8.8kg of grain mixture, plus the fresh ingredients, and can be scaled up or down very easily. The mealworm farms should be kept warm at a temperature of around 18-25^{0}C, but will generate some of its own heat. The farms need to be out of direct sunlight and need constant ventilation. [3]

Grains

As described previously, the mealworms live mainly off a mixture of grains, these grains can be either all from oat or from wheat, or as Grubbies has decided to use, a mixture of both. The grains Grubbies will produce are Avena sativa (winter oat) and Triticum aestivum (wheat). These have been chosen as they are common cereal crops grown in the UK, are known to do well in our climate and there is in-depth growth and yield knowledge readily available. Here at Grubbies we also (helpfully) had a farming friend who recommended these as easy to grow reliable crops.

Yields from these crops average at 7 tonnes per ha for winter oats, and 6.5 tonnes per ha for wheat, although these figures are reduced down by 35% if farming organically. This reduces yields down to 4.6 tonnes per ha and 4.2 tonnes per ha respectively. Despite this lower yield all Grubbies food crops will be organically grown to maintain ecological and health benefits.

From wheat we can develop another element the mealworms need in their diet, yeast. Yeast is a live culture

Avena sativa - winter oat

and produced from a small amount of the wheat crop, once this culture has been made it can be separated and grown to larger quantities. As the culture is a wet product it will need to be dried and ground before use in the mealworm feed.

Where field size allows agroforestry methods will be applied using productive trees such as Juglans regia (common walnut), and to avoid using fossil fuel fuelled machinery fields will be worked by hand, or if needed animals such as horses can be utilised to plow, this would mean growing extra crop to sustain the working farm animals, which although not ideal is a better compromise to using machinery.

Crops will be grown in rotation with biomass to avoid pests and disease and help maintain good soil conditions.

Triticum aestivum
(wheat)

Case Study: Agroforestry

Agroforestry is the application of planting productive trees amongst productive crops. The incentives for this range from increased profit, which comes with the increased productivity, through to increased ecology and soil conditions. It makes better use of the land by producing two or three crops with one plot; the land is being used for the ground crop, as per usual, and then the trees can be used as a fruit or nut crop, or as a timber crop, or as both. They also help fertilise the soil by drawing nitrogen from the air and fixing it in the soil. The leaf litter dropped will also aid the soil as a fertiliser and reduce surface runoff and processes of desertification by increasing the soil's organic matter and water holding capacity. Ecologically the trees create habitat for the micro organisms such as fungi and bacteria, and for larger animals such as insects, birds and small mammals. This allows a crop field to become an beneficial ecosystem within the surrounding area.

For Agroforestry to work the right trees have to be selected for the right place and for the right crop and after researching the matter, at Grubbies we will use the common walnut for its benefit of producing a high value food product we can sell alongside our insect crop. Not all walnuts will be harvested immediately to provide a food source for the local wildlife.

Case Studies: Wheatfield - A Confrontation, Agnes Denes


Agnes Denes in the field

Agnes Denes brought wheat to New York city in her 1982 installation Wheatfield - A Confrontation. This two acre plot of landfill in lower Manhattan was hand dug, seeded, weeded and maintained over four months and was harvested to produce almost 500 kilograms of wheat just two blocks away from, at the time, the Twin Towers. The field was planted as a art installation, rather than as a farm project. The land the wheat was grown on was worth $4.5 billion at the time, and the artist used it for wheat to question our values and links between commerce, world trade, food, world hunger and ecological concerns. To use such valuable for land for growing wheat would seem a waste of the space to many due to the money that could be made there, but by placing a food crop on this building plot causes question to which we care more about; money or food.

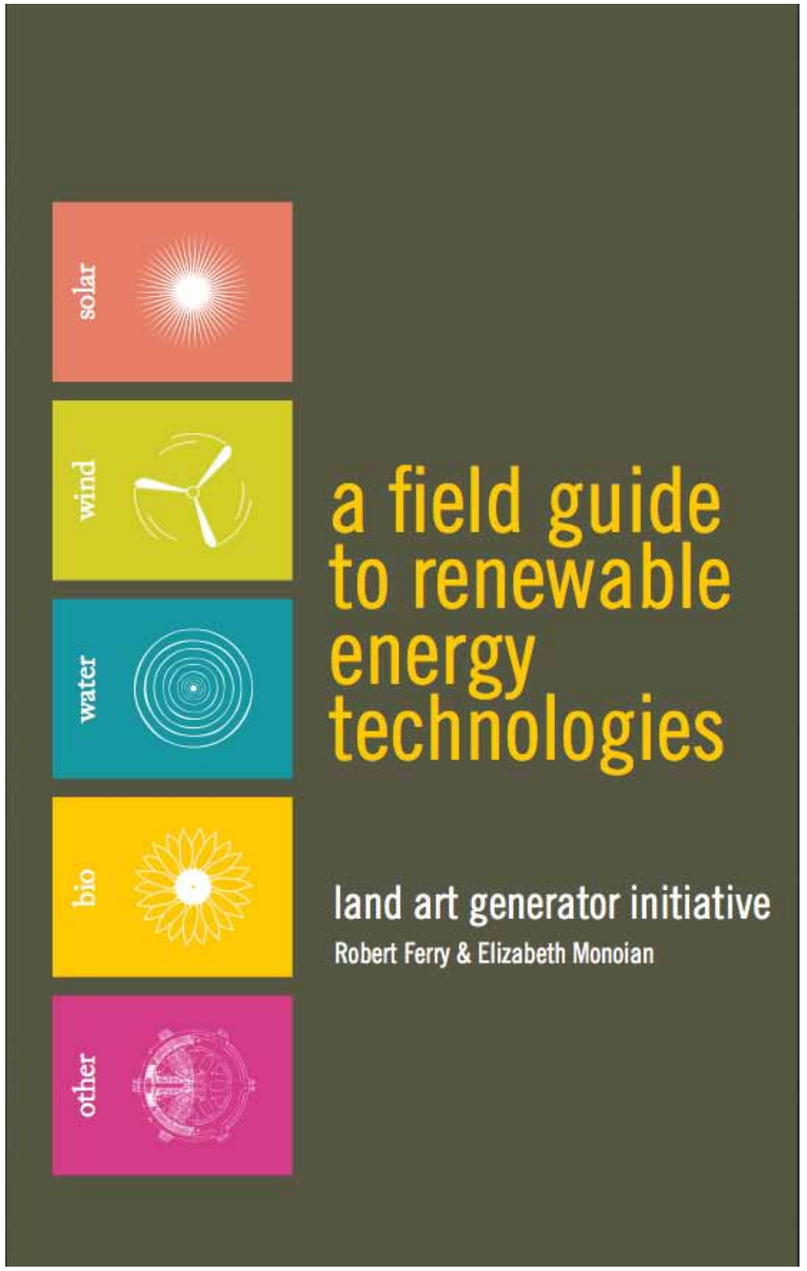
Seeds from the wheat were harvested and planted around the planet and the grain was exhibited around the world by the Minnesota Museum of Art as part of 'The International Art Show for the End of World Hunger' exhibition (1987-90). [4]

By growing wheat crops in the urban environment Grubbies will also question peoples value of land, space, food and money. As explained later in this book our farm sites are in the city centre, on probable development land. Using urban land for growing cereal crops will also bring a scene from the rural environment into the urban, creating a space of contrast to the city around.

Renewable Energies

At Grubbies we aim to be self sufficient within our closed loop, to achieve this we need to create our own electricity. To do this on site we will use renewables. Renewable energy is energy, generally in the form of electricity, that has been produced from either a replenishable or infante source. There are many forms of renewable energy available, but largely they fit into four main categories; solar, wind, water and biological.

To chose which form of energy to use you have to think carefully about your site and your electricity use. The options to chose from are huge, within the four main categories there are specific possibilities that fit specific purposes and sites. To get an understanding of options and possibilities available there is a publication from The Land Art Generator Initiative by Robert Ferry & Elizabeth Monoian. This booklet (pictured) showcases new and old forms of renewable energy and explains their energy producing capacity and potential.



Biomass crop testing

Solar roof panels

For Grubbies the main options we would consider for our electricity generation are solar, wind and most principally biomass.

Solar works as an option for us but only on a small scale. Solar farms that generate large amounts of power take up large amounts of land, and as we are based in the north of England, for us using solar as our main electricity source would not be worthwhile. Solar panels will be used wherever possible on roofs of buildings and on our shipping containers to make use of the defunct space and generate extra power. On a home scale solar power becomes the best option to use as the roof is an unused available space.

The Grubbies sites are currently urban, and although wind is often tunnelled between buildings at high speed in the city, it is not as constant or reliable as needed to generate our full power needs. Wind turbines will be considered on sites with some height and space, and vertical wind turbines (pictured) are our best option as they catch the wind from any direction at all times, this is useful in the gusty conditions experienced in the city.

Due to the fact that biomass is the most reliable and constant source of electricity available, we believe that it would be the most appropriate option for Grubbies. Despite Biomass requiring potential agricultural space to grow, we believe that it will allow Grubbies to be entirely self-sufficient for our electricity.

The crop we have selected to use for generating our power is giant Miscanthus, or elephant grass. This plant has been developed to be fast growing, high yield and low maintenance. As it has an annual growing cycle the crop will not need replanting each year: the crop begins growth in the spring and reaches up to 3m in height in the summer, this is then left over winter in the field to dry and allow nutrients to sink back into the rhizome, in early spring it is ready to harvest. [2] The crop can produce yields of around 22 tonnes per acre [3] and 1 tonne will produce 18mw of power. [4] This allows for high amounts of energy to be produced on small sites.

Our crops will be taken to a local biomass generator, and to avoid using fossil fuels to get there, this will have to be done once a year either by pedal power, by hand, or possibly by making use of a horse and cart.

Vertical wind
turbine

Miscanthus
biomass

Fruit & Vegetables

Herbs growing in a permaculture garden

Fruit and vegetables need to be grown to help sustain the mealworms by providing them moisture, but they will also be needed as something to go with our mealworms on the plate.

Apples, pears, carrots and potatoes will be suitable for feeding the mealworms as they store well, are reasonably reliable crops and have good moisture content. After harvesting these fruit and vegetables a proportionate amount can be put aside in a dry space to store for mealworm food throughout the year.

A range of other fruit and veg will be grown for human consumption, and these will be chosen with recipes in mind to keep food waste to a minimum.

These crops will be grown organically and by permaculture methods, the majority of them in forest edge style edible beds. This allows for maximum and sustainable use of the land and soils. Alongside the fruit and vegetables herbs and mushrooms will be grown, and above them nuts and hard fruit will be growing on trees.

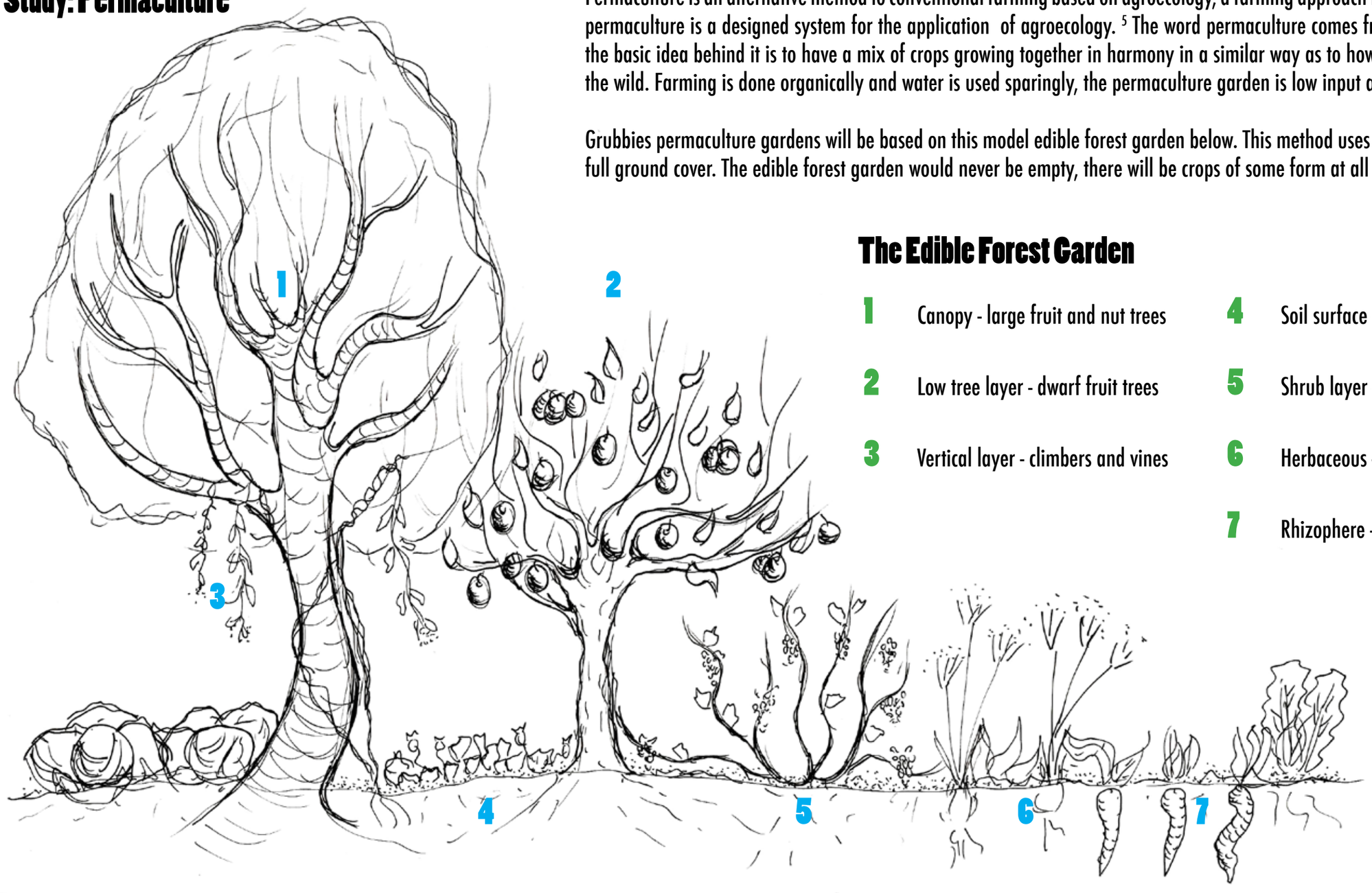
The local community will be encouraged to visit our edible planting areas to allow the public to be involved in food growing, helping people engage with their food.

Apples & carrots:
Good options for
mealworm food

Case Study: Permaculture

Permaculture is an alternative method to conventional farming based on agroecology, a farming approach that mimics natural ecosystems, permaculture is a designed system for the application of agroecology. [5] The word permaculture comes from permanent agriculture and the basic idea behind it is to have a mix of crops growing together in harmony in a similar way as to how a mix of plants would grow in the wild. Farming is done organically and water is used sparingly, the permaculture garden is low input and biodiverse. [6]

Grubbies permaculture gardens will be based on this model edible forest garden below. This method uses the height of the space and the full ground cover. The edible forest garden would never be empty, there will be crops of some form at all times.



The Edible Forest Garden

1. Canopy - large fruit and nut trees
2. Low tree layer - dwarf fruit trees
3. Vertical layer - climbers and vines
4. Soil surface - ground cover eg strawberries
5. Shrub layer - currents and berries
6. Herbaceous - comfreys and herbs
7. Rhizophere - root vegetables

A young example of a permaculture garden

Compost

Steaming hot: regular farm compost heap

Creating compost is the process of gathering all of your organic waste together and allowing it to break down and decompose, resulting in a beneficial product created from waste. It saves rubbish going into landfill and can be used to fertilise and grow plants. It is the same process as what would naturally occur in nature when any plant, fungi or animal dies, they will be broken down by the environment around them and their nutrients will be put back into the ecosystem. At Grubbies we wish to be as sustainable as possible and this can often be done by mimicking nature, and so a part of doing this is by composting our waste.

We will be producing organic waste from the mealworm bedding and food, trimmings from vegetables and fruit, and from any plants we cut back (any tree waste will be left to rot on the floor in plant beds as it provides habitat for wild insects and can be to much for a compost heap to deal with). Any materials we use for packaging the mealworms will be biodegradable, so that we can compost that too. If space is available on our sites we will collect and compost food waste from local homes and businesses.

This range of materials will provide a good varied mix to produce a rich compost. To understand why you need a mix of materials for your compost you have to think of compost as a recipe that you are cooking, and you are feeding it to the bacteria and organisms that break it down. For these organisms to break it down and return you a good compost they need a good varied diet just like we do. One of the keys to creating this varied diet is to have the correct mix of ‘brown’ and ‘green’ waste, 4 parts brown to 1 green. The brown waste in our case will be the bedding, packaging and any waste from the cereal crops, the green will be fruit and veg trimmings and fresh plant waste.

Hot or Cold?

There are two main categories in composting; hot and cold.

Hot, or aerobic, composting allows lots of air into the compost mix and will heat up to very high temperature. This causes the micro organisms that break down the materials to become more active. It is a quick process that needs regular turning to stop the heat becoming trapped in the middle and to mix air, water and materials evenly. This is a speeded up version of the natural process that occur in ordinary composting.

Cold composting is the natural way matter is broken down, it is what happens in the woods in the leaf litter below the trees. To cold compost you simply put all of your materials into a container or pile and allow nature to do the work. Although easier it is a slow method that can take years to fully break down the waste. If cold composting, the process can be made quicker using worms to aid the decomposition process, this is known as vermiculture. In hot composting the mixture becomes too hot for worms to be in.

Grubbies compost

At Grubbies we will use the hot method of composting due to its speed and efficiency of breaking down organic matter. For this we will need a composter.

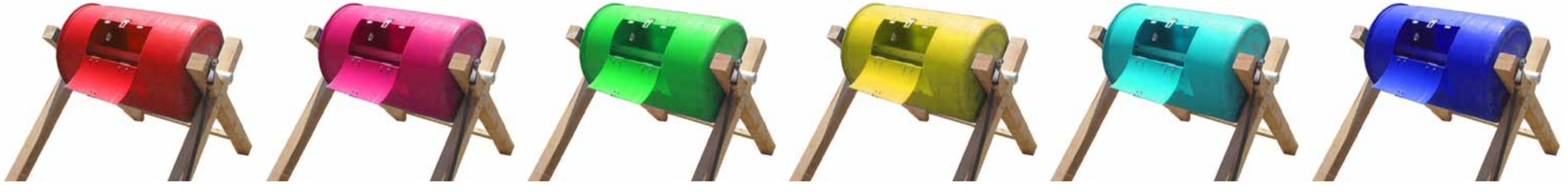
To create our hot composter Grubbies will use recycled water tubs set on an axles, such as the example pictured. These allow the compost to be turned easily and regally by simply spinning the tub. They will also keep the compost contained, and can be painted to make a visually pleasing compost bin.

By having these small drums we can keep many composters running at the same time, all in different stages of decomposition, and the composting systems can be scaled up by simply adding more containers. These turning containers should produce compost from raw materials in a few weeks.

In compost terms this has been a very brief description, there is a huge wealth of information on the subject out there! Links to many great resources on the subject can be found at http://www.beginningfarmers.org/information-about-composting/

The rotating recycled compost bin

Multi coloured and multi scaled: the recycled water tubs can be painted for colour and more can simply be added for the size of the scheme



Water

Water at Grubbies will play a part in two systems:

- Firstly water for our use; for drinking, cooking, washing, for toilet facilities and for any irrigation.
- Secondly, but as important, within our sites we will need to slow and catch water for sustainable drainage systems (SuDS). This has to be done to help minimise flooding through reducing surface runoff. The SuDS do not play a part in our closed loop system - they are separate system designed to mange water around the sites and allow it to soak into the ground naturally.

Water for Us

Storage & Harvesting

To have enough water to meet our needs we will need to harvest as much as possible. This can be done by collecting every drop that falls on any shelter or roof within our Grubbies sites and then containing it in vessels large enough that they will not overflow in even the heaviest of downpours.

These vessels will then emptied in a large water tank within in another shipping container. As with other Grubbies systems this can be scaled up easily, and to scale down for home use water can be harvested in exactly the same way but retained in the vessels rather than moving it to a larger tank in order to save space.

Within the container simple charcoal filters can be set up on the outflow for initial purification before the water enters our plumbing systems. Although it is rain water, the drinking water will have to run through a more complex natural filter for hygiene safety.

Use & Recycling

Water use will be kept to a minimum to save this valuable resource and will be recycled wherever possible.

To keep water use down, low water taps and toilets can be installed and any washing can be done in sinks and containers. Efficient water use will be achieved by Grubbies simply being conscious of how much water is being used every time we turn the taps on.

Water can be recycled by introducing grey water systems into our site. A greywater system would collect water from our sinks, showers and any washing appliances we have, it then stores the water and re-uses it in our toilets and plumbs in for outdoor use. Unfortunately grey water can not be used on our edible crops but can be used on anything ornamental.

By recycling our water and being aware of use we can easily have harvest enough for our use at Grubbies.

Irrigation

To keep our crops healthy some we will need irrigation systems set up for periods of drought and for more water heavy plants such as salad crops.

By using permaculture methods irrigation can be kept to a minimum on our edible beds as all ground is covered, having bare soil exposed causes it to rapidly dry out in any heat and wind.

Generally the UK has a wet enough climate for irrigation to not be needed for cereal crops and the same applies for our biomass. These crops are so densely planted the soil is not exposed. We have been told by our farming friend that 'irrigation is a waste of money!', and we will take this information on board for these more ordinary farm crops.

The irrigation we do use will be done with a drip pipe system laid out on the ground around the plants that need it.

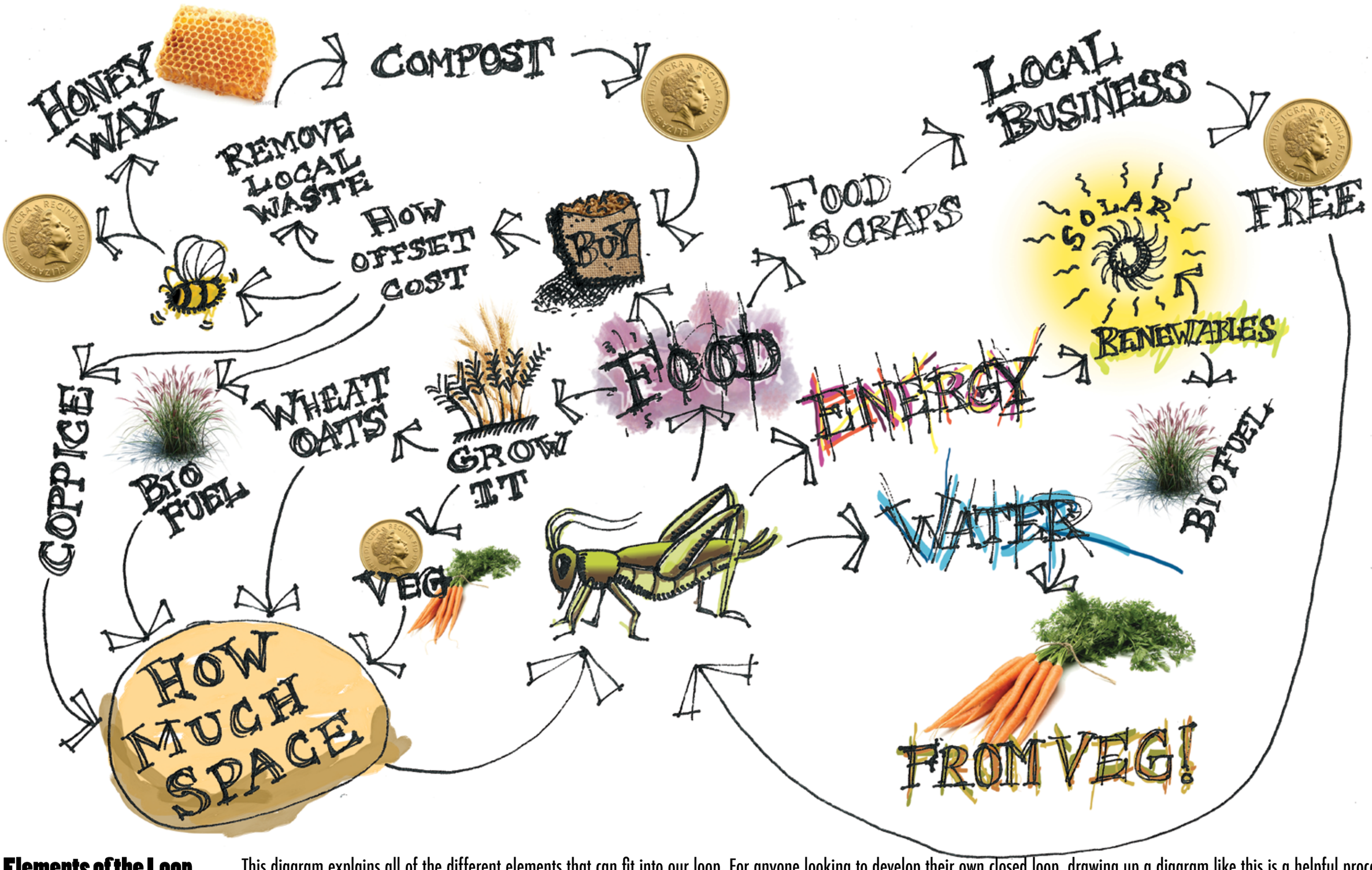
Drip system
irrigation pipe

The Grubbies Loop

The Closed Loop Solution

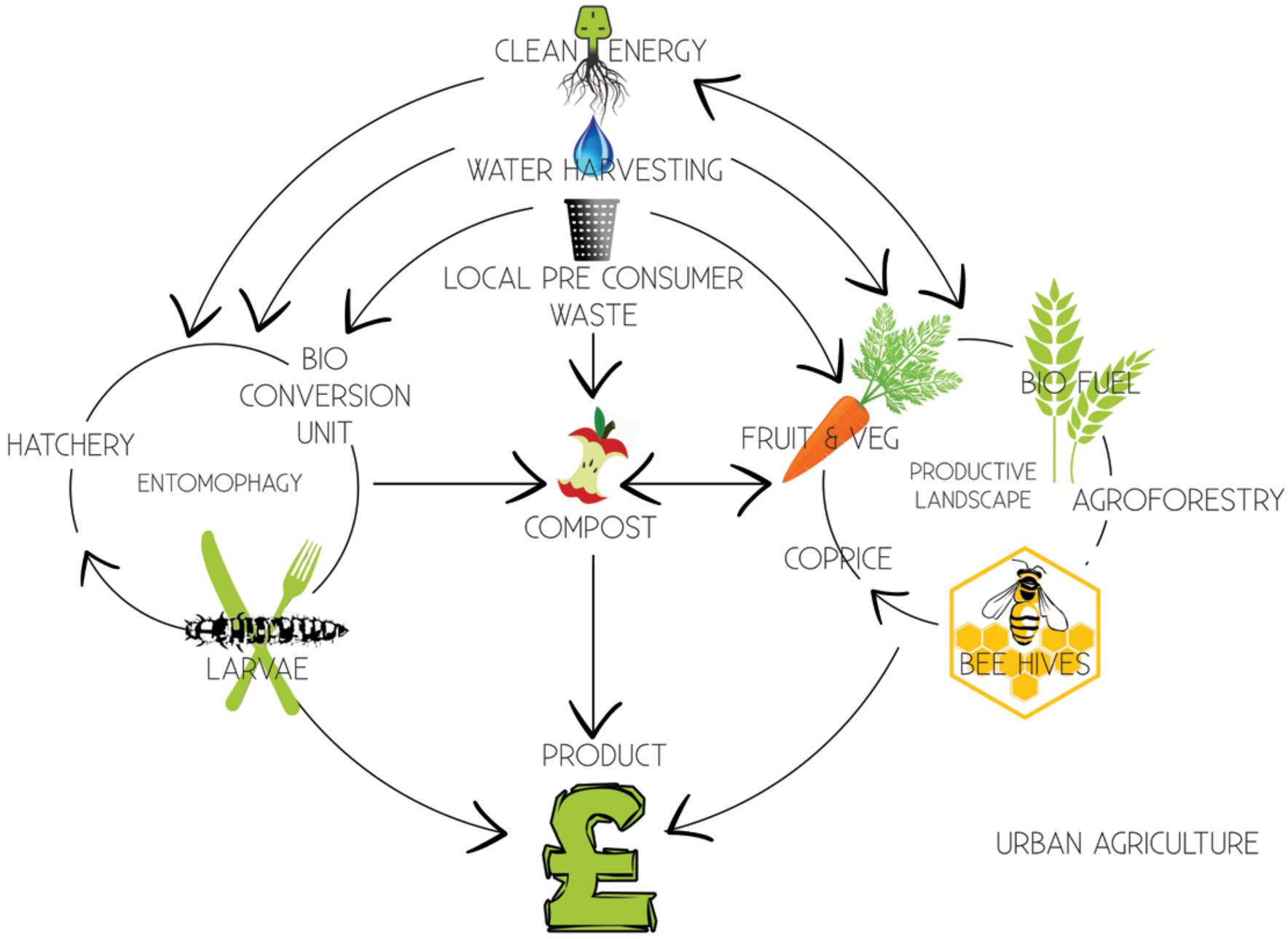
"The way we tend to use resources is we extract them, we turn them into short-life products and then dispose of them. Nature works very differently. In ecosystems, the waste from one organism becomes the nutrient for something else in that system."

(Michael Pawlyn, 2010) [2]



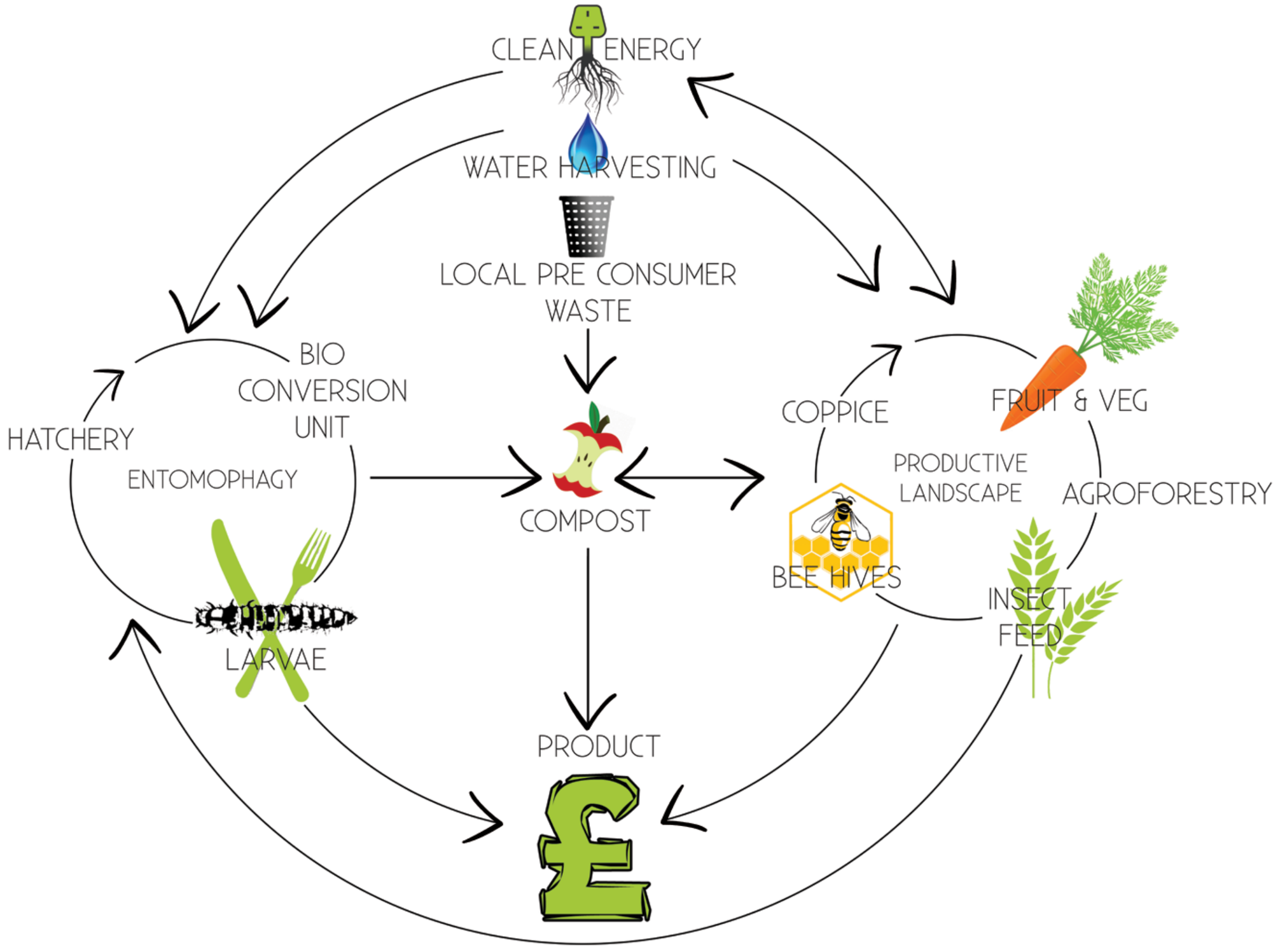
Elements of the Loop

This diagram explains all of the different elements that can fit into our loop. For anyone looking to develop their own closed loop, drawing up a diagram like this is a helpful process. Being able to see all the elements together on one page allows you to understand the connections and orders between each piece of the puzzle.



Closed Loop Insect Farming for Animal Feed

This is an option we considered early on in the project, but did not go for. The benefit of farming insects for animal feed is that you can rear them on food waste. This would have allowed us to take waste from local businesses and feed this to our insects, helping make our local area more sustainable. This can still be done when farming insects for human consumption as we can simply compost the local food waste and use this to grow our vegetables in. The downside of this loop is that we would not get a protein crop out of it, as we did not wish to farm conventional farm animals. By farming the insects for human consumption we can create full meat and veg meals to serve on site.


CLEAN ENERGY
WATER HARVESTING
LOCAL PRE CONSUMER WASTE
BIO CONVERSION UNIT
HATCHERY
ENTOMOPHAGY
COMPOST
COPPICE
FRUIT & VEG
PRODUCTIVE LANDSCAPE
AGROFORESTRY
BEE HIVES
INSECT FEED
LARVAE
PRODUCT

Closed Loop Insect Farming for Human Consumption : The Grubbies Closed Loop

This loop has the combinations and results that we want for Grubbies. By linking the elements together in this order Grubbies can produce food in the form of fruit, veg and mealworm protein for human consumption. This will allow us to cook and sell food from on-site cafes or restaurants.

This loop is similar to the previous animal feed loop, but if you look closely at the arrows connecting the different elements you can see the subtle differences. Farming insects for human consumption means they are to raised on grain and fresh produce.

This loop would need testing in practice in order to discover the real life interactions between each element. Although this loop works in theory, you can never tell with closed loops until they are up and running. For example 'Cardboard to Caviar' (mentioned earlier in the book) is still in development after being set up in 2003 due to issues between interactions of the elements. To perfect a closed loop system will take years of development.

In theory this loop would be waste negative, carbon negative and produce a reliable local food source. This system could be set up anywhere at any scale and would help create local food resilience and promote sustainable living and food production.

Component Breakdown

- The mealworms get their food from the grain which is grown on site
- The mealworms get their moisture from the fruit and vegetables which are grown on site
- The frass (waste) from the mealworms feeds into the compost system
- The temperature for the mealworms is regulated by electricity from on-site renewable energy source
- Fruit and vegetables are also grown for human consumption
- Water is collected and stored on site for growing crops, cleaning facilities (for the insects) and waste water mangement
- Compost is made on site and is fed from mealworm frass, local pre consumer waste, fruit and veg trimmings and any other plant material.
- Money can be made from the sale of insect protein, fruit and vegetables, compost, education programs and food tourism.

Externalities (Add on Extras)

- Bees will pollinate our crops and provide honey and beeswax for our cafe
- Potential for coppiced Corylus, Salix and Fraxinus to be sold / used on site
- Potential for agroforestry to be introduced on larger sites with a product of nuts and timber

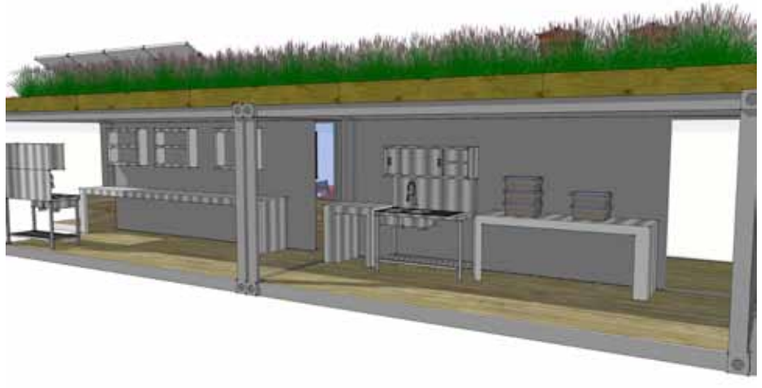
Farm Buildings

Grubbies Leeds will use this scalable set up of upcycled shipping containers as a model for our farm buildings. The buildings will contain the mealworm farm, the kitchen and cleaning area and the cafe / restaurant space for serving and cooking the product.

The design of these buildings is presented as a rough and ready yet sleek style, intended to showcase the upcycled materials such as the shipping containers, palettes and recycled timber deck, yet look crisp enough for people to see the buildings as a place they want to eat, relax and enjoy the space.

Front view: Glass fronted cafe / restaurant
with planted outdoor seating

Rear view: Kitchen and cleaning area



Side view: Entrance into cafe / restaurant

Green roof with solar panels and bee hives

The mealworm farm
(wall shown open for display purposes only)

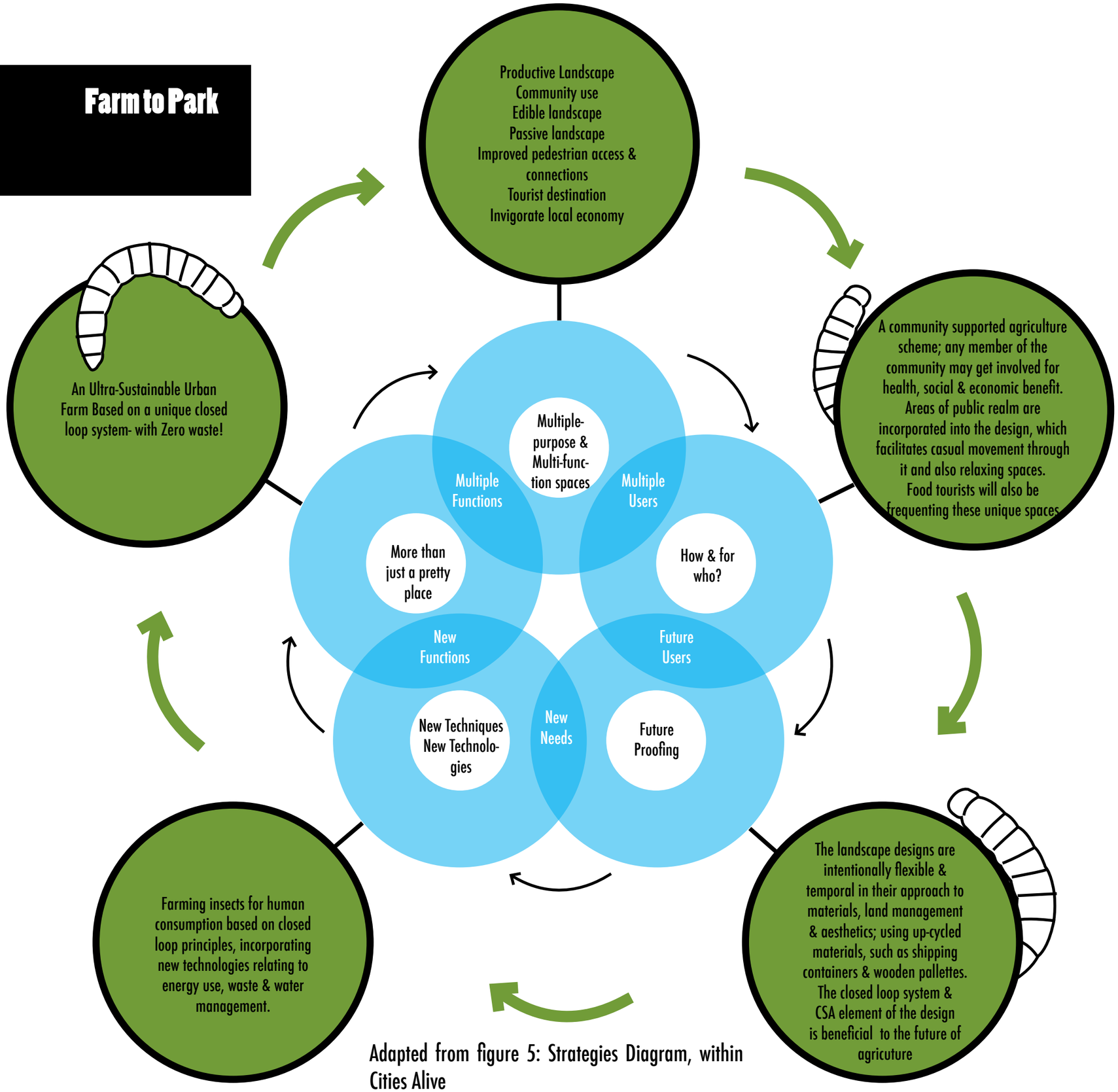
Kitchen area and cleaning facilities

Cafe / restaurant area with indoor &
outdoor seating

Ornamental planting and informal seating,
raised on recycled palettes

Farm to Park

Arup have produced a very comprehensive booklet, entitled 'Cities Alive - Rethinking Green Infrastructure',which discusses the origins, methods, policies and implementation of green infrastructure within current and future cities. We have refered to this booklet as a design tool throughout the Grubbies design process to ensure that this project has the greatest potential to suceed. The following diagram and table display how Grubbies have responded to Arups green infrastructure interrogation toolkit.



Adapted from figure 5: Strategies Diagram, within Cities Alive

LANDSCAPE CONTEXT AND ASSETS	Grubbies Response
Acknowledge geographic setting and landscape characteristics	Full survey & analysis completed and responded to for all Grubbies site interventions
Take account of water catchment/supply	SuDs incorporated in all sites; Water collection & storage vital part of Grubbies system
Note current land uses and design responses to locality	Full survey & analysis completed and responded to for all Grubbies site interventions
Consider ecosystem services and implications for biodiversity	Improve green infrastructure & local biodiversity a key principle within Grubbies system
Review history of area and any heritage implications	Full survey & analysis completed and responded to for all Grubbies site interventions
Note social and economic factors influencing landscape	Full survey & analysis completed and responded to for all Grubbies site interventions
Review implications of climate change, energy needs, population growth	Key drivers for Grubbies systems
Consider plans and any design proposals to date	Full survey & analysis completed and responded to for all Grubbies site interventions
Review similar projects/case studies and project approaches	Production of Grubbies Documentation
SUSTAINABLE MASTERPLANNING	**Grubbies Response**
Conserve historic landscape, built form and significant aesthetic features	Key features conserved include; cast iron railings, building, chimneys
Prioritize development on disturbed land wherever possible	All Grubbies sites are based on previously developed/ abandoned sites
Protect natural heritage and enhance biodiversity of site	Pollinator species & wildlife corridors a key element of Grubbies design
Reuse redundant structures and adapt existing landscapes for new uses	Significant buildings rennovated on Grubbies sites such as a new agricultural college
Design for socially inclusive community and neighbourhood safety	Grubbies is a community based project. Safe by design consulted
Plan compact development to optimize land development potential	n/a
Cater for wide spectrum of users and communities	Grubbies is a community based project; disabled access integrated within all sites
Site buildings to minimize energy use	Grubbies aims to be a carbon negative scheme
Ensure site is part of green and blue infrastructure	A key driver for design
Develop design rooted in local context	Urban agriculture. Local artist interventions incorporated
Encourage local use through ease of access	Desire lines, permeability & disabled access considered
Design networks for walking and cycling and permeable space	Desire lines, permeability & disabled access considered
Ensure connections to public transport	All sites chosen for good transport links
Respond to the ecology of the place	n/a at this stage
Design social gathering spaces and active frontages	A key driver for design
Integrate overall vision with detail design	n/a at this stage
Engage local community	Plans for Grubbies events in the future
Enhance biodiversity	A key driver for design
Incorporate productive landscapes	A key driver for design
Create unique, comprehensible and memorable places	A unique project; attractive food tourism potential
Plan for the inclusion of public art	Local artist interventions
Encourage local business opportunities	A key driver for design
Design for multiuse and range of uses	Flexible/ temporal public realm design
Design for health of all ages	Community agriculture scheme; excersize for all ages
Connect people to places/destinations	Creating unique destinations
Include information and interpretative facilities	Education a key element of Grubbies design
Provide for flexible space for future change of uses	Temporary landscape approach

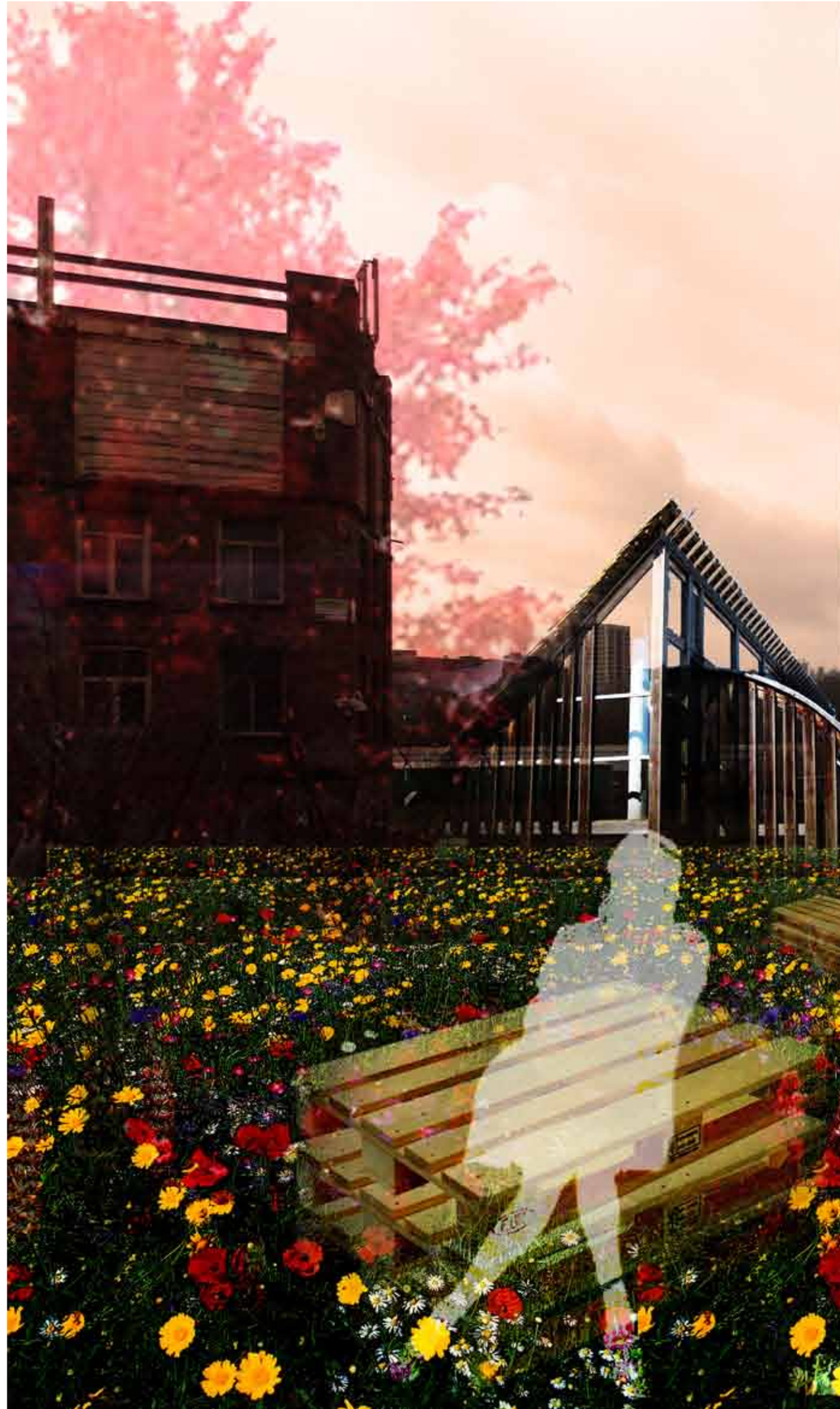
ECOLOGICAL SITE DESIGN	Grubbies Response
Generate green energy on-site	A key driver for design
Use indigenous and/or non-invasive plant species	A key driver for design
Minimise night light pollution	Smart lighting incorporated
Incorporate homes for wildlife	Insect hotels, native hedgerows
Extend local plant communities	where applicable
Balance cut and fill of soil on-site	A key driver for design
Minimise floodplain development	n/a
Use water-sensitive urban design	A key driver for design
Maximize water retention on-site	A key driver for design
Restore and create wetlands	where applicable - Buslingthorpe Lane site
Reduce impervious surfaces	A key driver for design
Take measures to reduce air pollution	Carbon negative scheme
GREEN TECHNOLOGIES	**Grubbies Response**
Use recycled materials	A key driver for design
Green structures/buildings	Shipping containers retrofitted with green roofs
Use timber from sustainable sources	n/a
Use durable products	n/a
Minimize mowing/use of machinery	Permaculture approach to landscape design & management
Use organic compost, fertilizers and mulches	A key part of Grubbies system
Decompose waste on-site	A key part of Grubbies system
Use phytoremediation on contaminated sites	n/a
Use porous paving	On all sites
Procure local construction products	where applicable; wooden palletts
LANDSCAPE MANAGEMENT	**Grubbies Response**
Facilitate education for sustainability	A key driver for design
Establish a landscape management plan	A key part of Grubbies system
Incorporate site nursery and composting	Food growing & composting key element of Grubbies design
Ecological monitoring to inform change	A key part of Grubbies system - crop rotation
Ongoing design and conservation	Flexible/ temporal community spaces facilitate ongoing design potential
Minimize use of pest/herbicides	A key approach to Grubbies system
Site-based maintenance/park manager	Community supported agriculture

Adapted from appendix 1: checklist for landscape architects

GRUBBIES LEEDS DESIGN AIMS

Design will be presented in a rough and ready yet sleek style, using upcycled materials with a contemporary approach. The design aims to create a temporary feel to allow the local community to feel a sense of ownership to the space, as opposed to a modern high end landscape design approach, which could have the opposite effect.

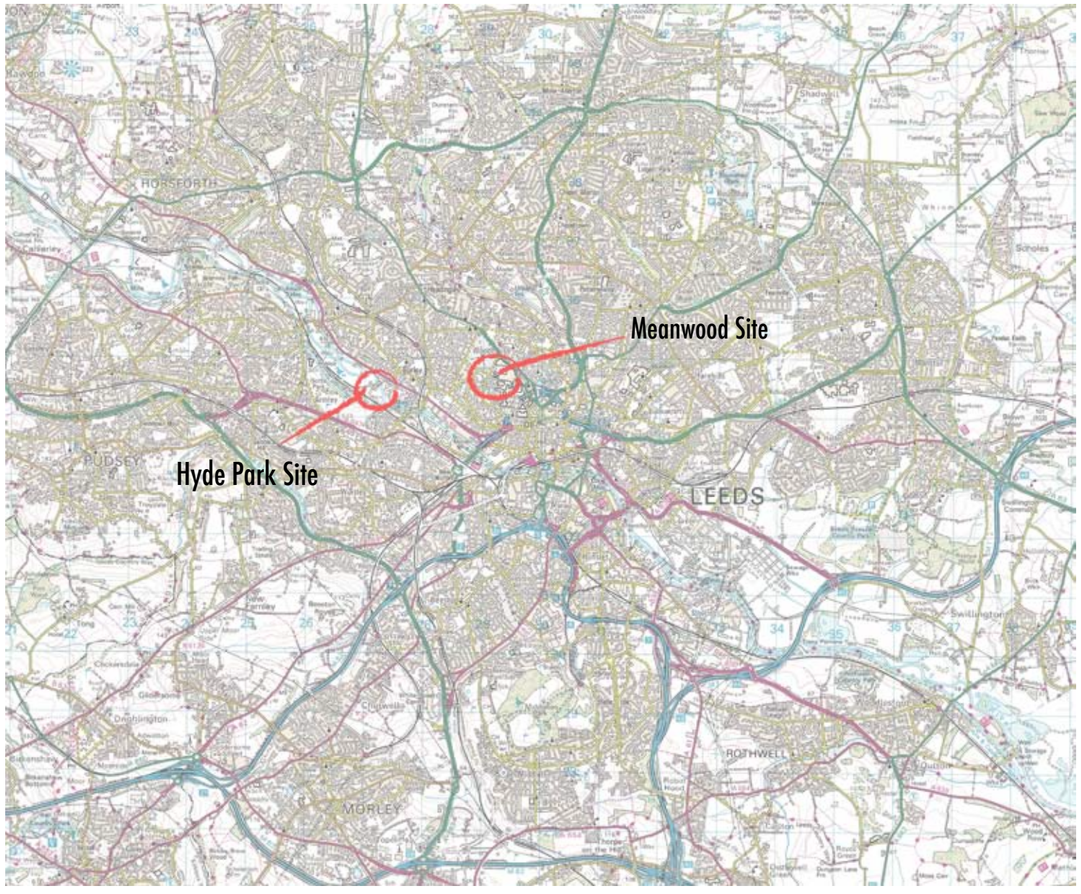
Our design will pay homage to Asian street food (the epicentre of entomorphagy), the form of insects and a permaculture approach to the productive landscape.



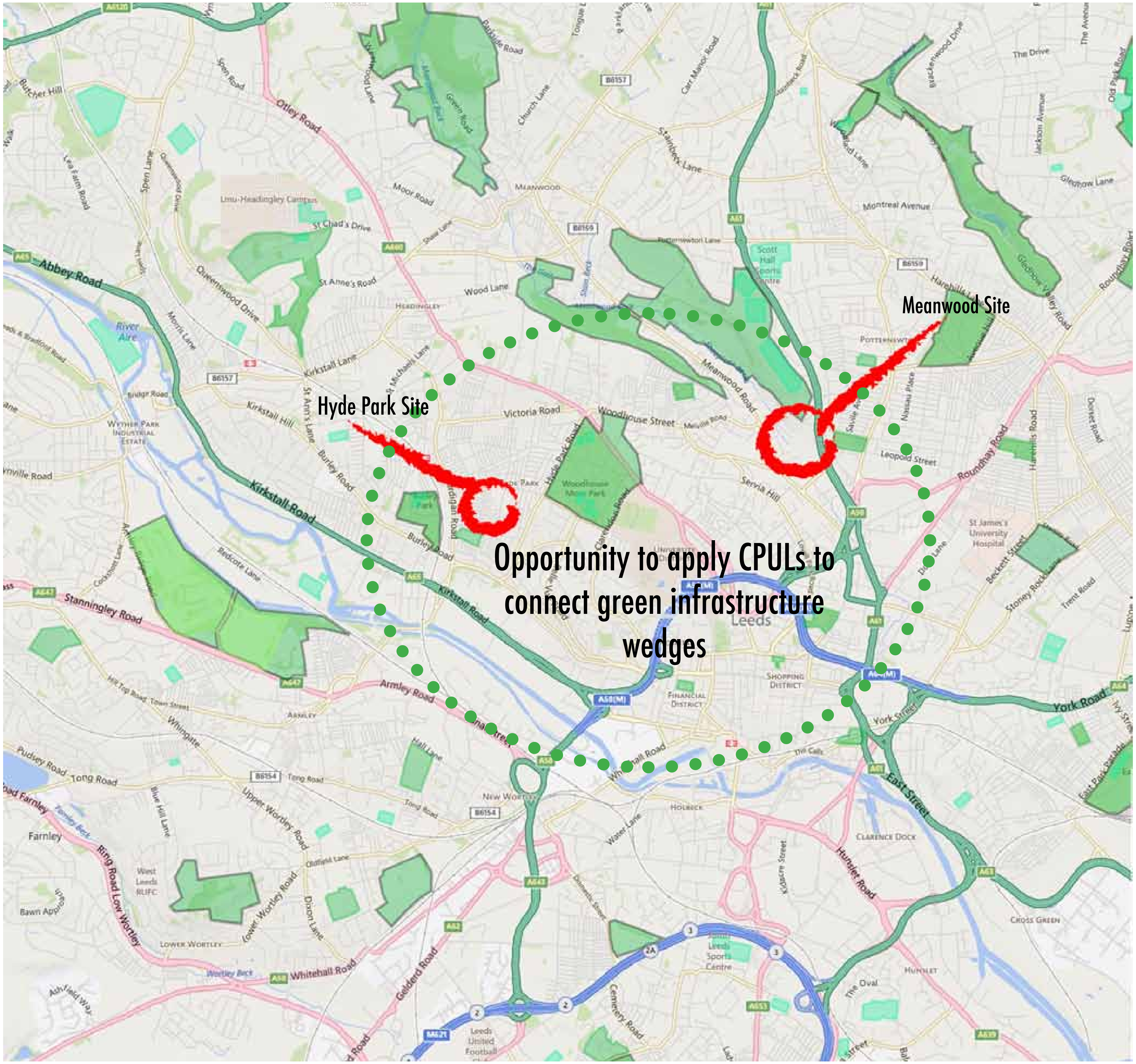
Site Location & Context

UK

Leeds

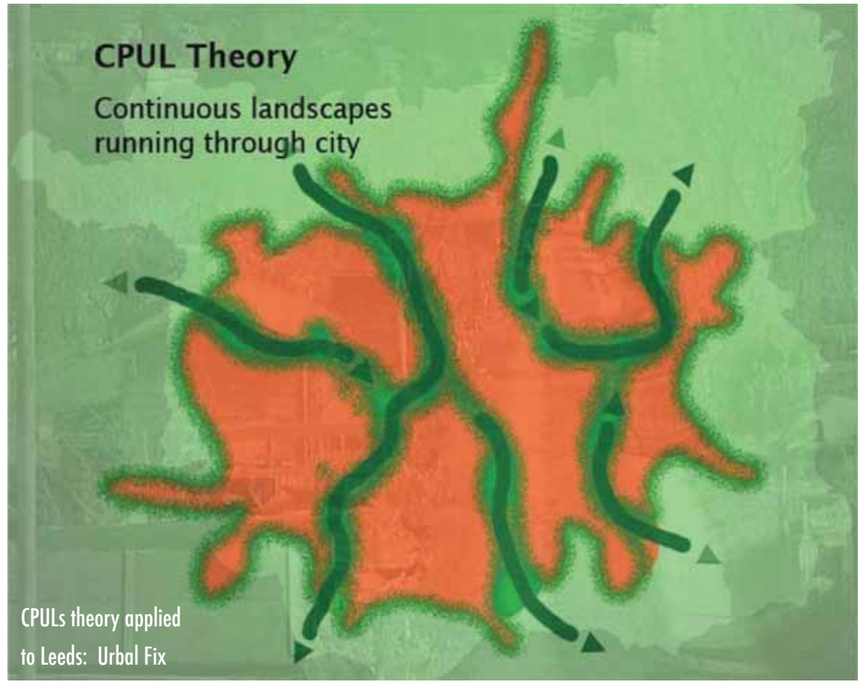


Grubbies Sites & Green Infrastructure Analysis

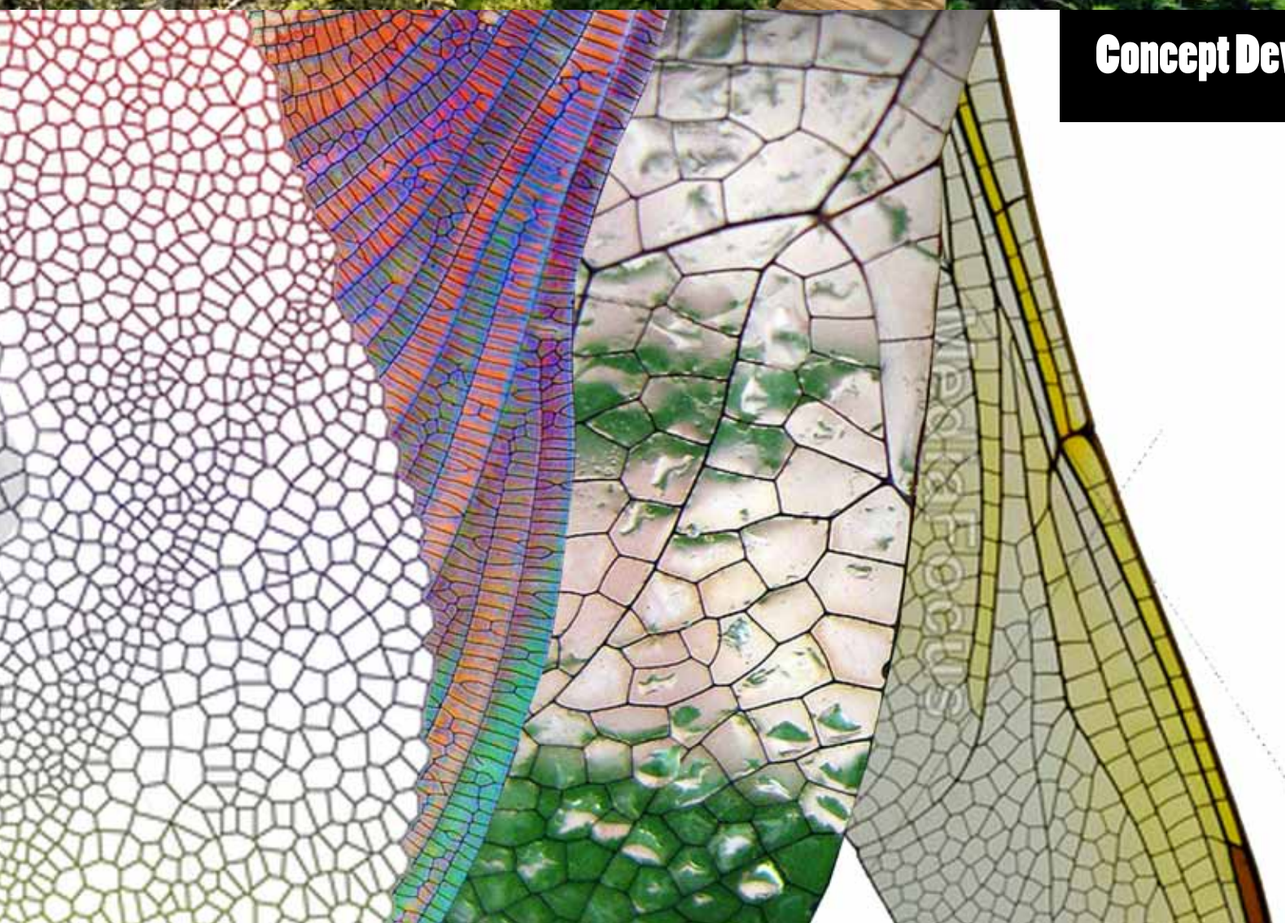


Integrated Green Infrastructure

- Urban agriculture can be a very positive contribution to the green infrastructure in cities
- It can help make good use of underused land, create a fine grain of peopled places, build comunity and contribute to a range of social and economic benefits
- The Grubbies Leeds model allows for redundent sites to be transformed into green oasis at a relativly low cost with potentional economic benefits to local comunities
- This allows for multiple sites be integrated easily into the existing urban fabric improving green infrastructure
- Each site will be benificial for wildlife, water mangement and humans



CPULs theory applied
to Leeds: Urbal Fix



Concept Development

Insects are central to our Grubbies system.

We believe to create an effective design that reflects our theme of farming insects, we will create a public space that reflects the culture that eat insects. For cultures in south east Asia (the epicentre of entomorphagy), street food is a vital part of everyday life.

With more people travelling and developing a taste to more exotic food, coupled with the trend in pop up restaurants, creating a street food market feel would appease these trends, as well as fitting into the food tourism scene.

As much as possible we want to take influence from insects, this is developed in the form. By using insects as a design influence we hope to subconscoinusly influnce peoples perception towards the value of insects in modern life, thus encouraging positive thoughts to their edible potential.

The elegant form of the insect anatomy, such as cricket wings, is directly influencing the form of the sites layouts.

Concept Development / Re-Use, Re-Cycle

Grubbies Leeds believes in up-cycling and re-useing materials. This can play an important role in the design process. There are a lot of materials such as palettes that can be gathered and used in our sites. Hyde park has a high turnover of students therefore there's often furniture and other interesting objects that could add character to the landscape. This is important as it allows unskilled members of the comunity to have the confidence to implement a Grubbies project of their own.

Grubbies Leeds - Hyde Park

Hyde Park is an inner-city area of Leeds, situated between the University of Leeds and Headingley. Hyde Park is predominately a student area but also has many families and a large Muslim community.

Full to the brim with independent cafes, decked out with chilled out pubs and even a music venue that promotes underground and upcoming music acts, as well vintage and antique shops and a beautiful park for the rarity that is a sunny day in Leeds, Hyde Park really isn't lacking in any department.

Hyde Park is a vibrant area with many social gathering spaces, interesting and boutique shops and good transport connections. The area sufferes from the student exodus in the summer months leaving the place with a feeling of abondenment. Local permenant residents feel the need for more comunity space, but as an economically disadvanteged area it has struggled in recent years to achieve this.

Hyde Park Survey and Site Photos

Our initial reaction to the site was that is has high potential and a strong sense of character.

The site is a pleasant green space in a bustling area, but is fenced off from the public. The site itself was a formal shool which was demolished in 2014, there have been numerous attempts to save the building with community groups set up to activly seek benifical use of the site, with no current success.

The surrounding houses have very little private open space and so would benifit greatly from local public space. The site has the added value of natural surveilance from these surrounding houses, making it safe.

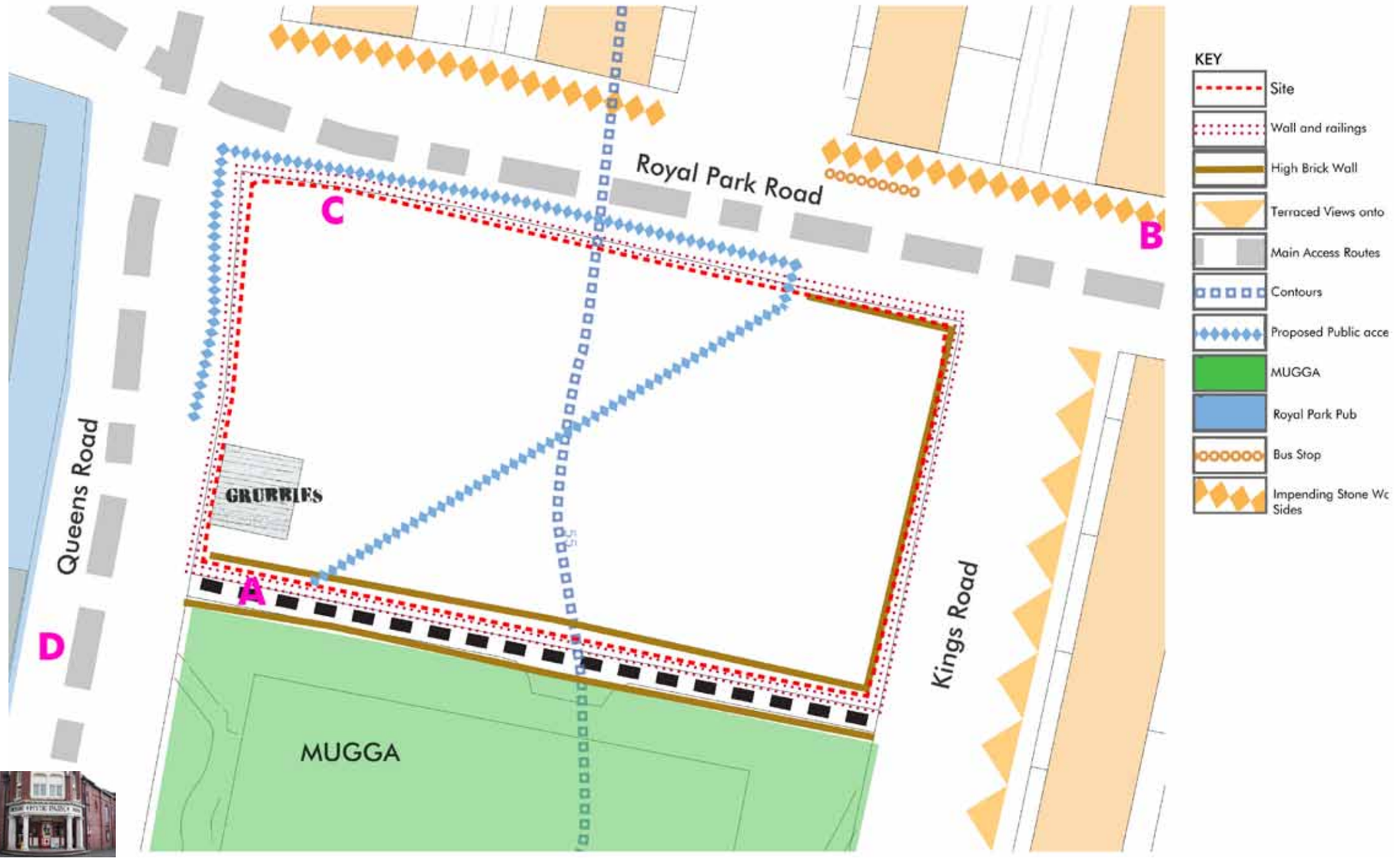
There is a sense of character to the site through the local architecture and public art in the form of graffiti. These are qualities we can emphise and utilise within design.

STRENGTHS

- The site is Westerly facing, therefore good growing conditions.
- The location, has a high footfall and is on a main road with other shops and busineses.
- Character of the area: up and coming with good restaurant scene as well as community groups and community style bars
- Political hot potato, any new development with be heavily advertised.
- Strong links to the Woodhouse Moor
- Strong sense of identity
- Multicultural society great for diverse foods
- Student area, they like something new and exciting
- Walled in part to create microclimate
- Gentle slope to assist drainage.

OPPORTUNITIES

- Vastly improve a site that's been neglected by the council and turn it into a successful business venture
- Regenerate the whole area with increased investment
- Create an important green route through the Hyde Park area
- Increase biodiversity
- Increase public awareness of the world food crisis
- Create an area that local producers can showcase their foods
- Create an hub of excitement in a diverse area
- Use the existing site buildings as a base as well as utilise the character of the painted stone wall



Community that's unable to afford to be part of 'the big society'

An inner city Leeds community has been campaigning for years to take ownership and turn a neglected school building into a community hub but find a lack of cash has left their bid in a critical condition

8 Sept 2011: the Guardian

History

23rd December 1968. Looking east along Royal Park Road across Queens Road towards Woodhouse Moor. People can be seen getting on a number 56 bus. R.H. Williams newsagent is on the left, and Queen's Road school can be seen on the right (image courtesy of Leed's Photographic Archive)

This is an outside shot of the former Royal Park primary school. It closed it's doors to pupils 5 years ago in 2004 and was abandoned by Leeds City Council. It was lived in by a group of squatter who planed to do up the building and grounds, showing that the Grubbies philosophy is well suited to this site.

The school was demolished in 2014. After a ten year long campaign to turn the school into a culture or community hub. For the site to of been saved it would of needed a strong business investment. From this we can see there is a strong need for something in it's place that would regenerate the area

Community Benifits

Case Study: London's small food enterprises to receive funding and business advice to benefit their communities

Over 30 small food enterprises across London are to receive funding and business advice from Urban Food Routes, an initiative to support a variety of London's small food enterprises to gain expert advice and funding to enable them to thrive and benefit their local communities.
From Waltham Forest to Westminster, over 80 social enterprises and privately-run businesses applied for funding and support from Urban Food Routes, a programme funded by the Mayor of London and Seeds of Change®, and co-ordinated by the Plunkett Foundation, Growing Communities and London Food Link.. This makes it clear that people in the government are seeing the benifits local food produces and the benifit they have on urban communities as a whole.
The Plunkett Foundation

Food Tourism Could be Big Business in Leeds

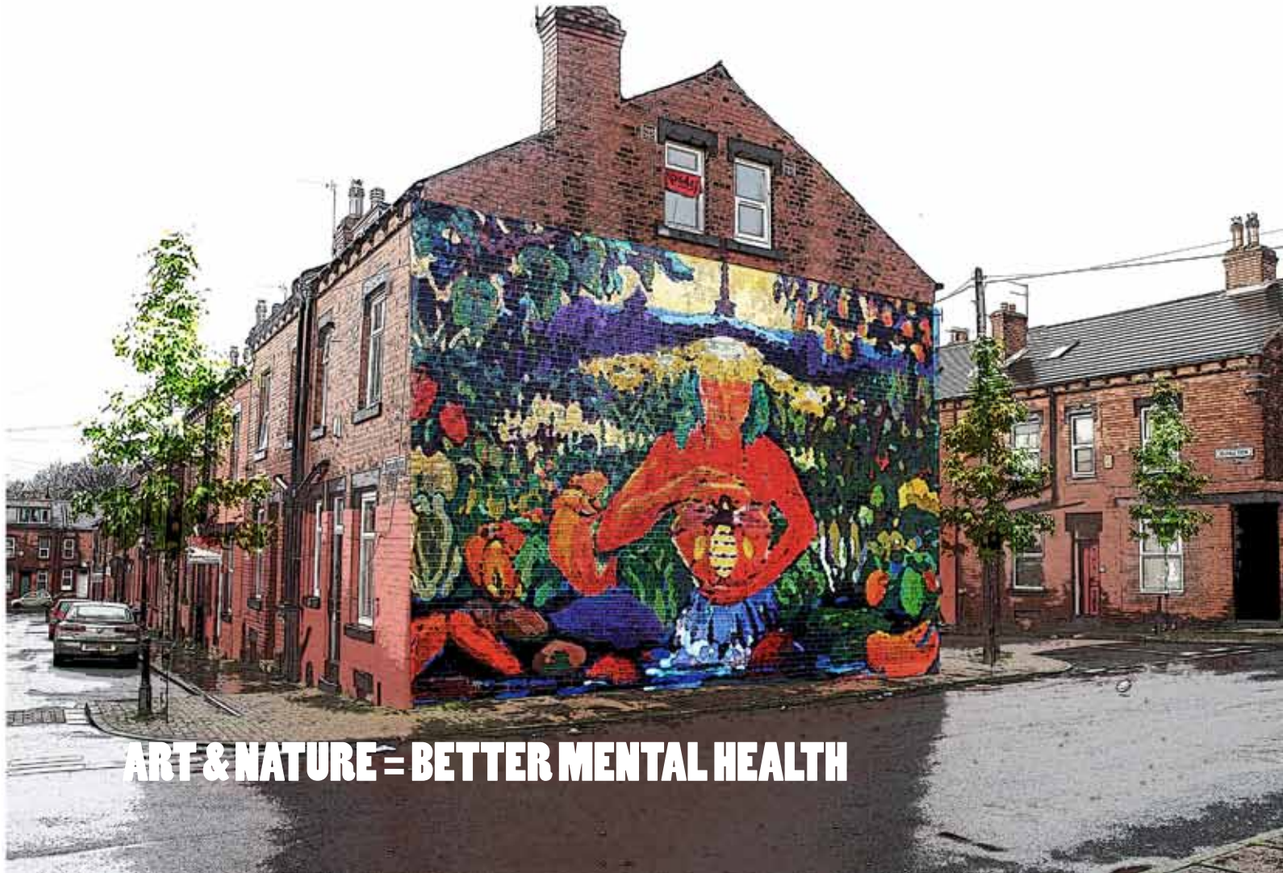
Food Tourism is a big market in the UK. People visit destinations on the reputation of the food and restaurant scene. Hyde Park has a high percentage of good quality cheap family run places to eat with a wide range of cuisine from Arabic to American. Grubbies Leeds can bring a unique experiance for food tourists.

Art and Nature

Hyde Park has a diverse range of public art, from painted buses to street art to graffiti sprayed frontages, impressive churches and the park itself. It is important to play on this from a design perspective as research shows being near nature improves mental health and the financial and social benifits are huge. (Kaplan, S. 1995)

There is growing evidence to suggest that exposure to green space can be associated with mental health benefits:

'Proximity to greenspace has been associated with lower levels of stress (Thompson et al., 2012) and reduced symptomology for depression and anxiety (Beyer et al., 2014), while interacting with nature can improve cognition for children with attention deficits (Taylor and Kuo, 2009) and individuals with depression (Berman et al., 2012). A recent epidemiological study has shown that people who move to greener urban areas benefit from sustained improvements in their mental health (Alcock et al., 2014).




Permaculture


Upcycle


Innovative architecture


Urban agriculture


Temporary landscape

Concept Visual

Community

Ownership

Art

Concept Visual -Queens Road

Grubbies Crop

Grubbies shipping container.
-Used for the farming of meal worms
-Dug into the level change providing insulation and reduce power costs

Grubbies HQ.
-Renervated school building
-Grubbies cafe and the face of the business

Bee Keeping.
-Provides income to the business and increases pollination

Wild Flower Meadow
-Low maintenance
-Increaes biodiversity

Concept Visual

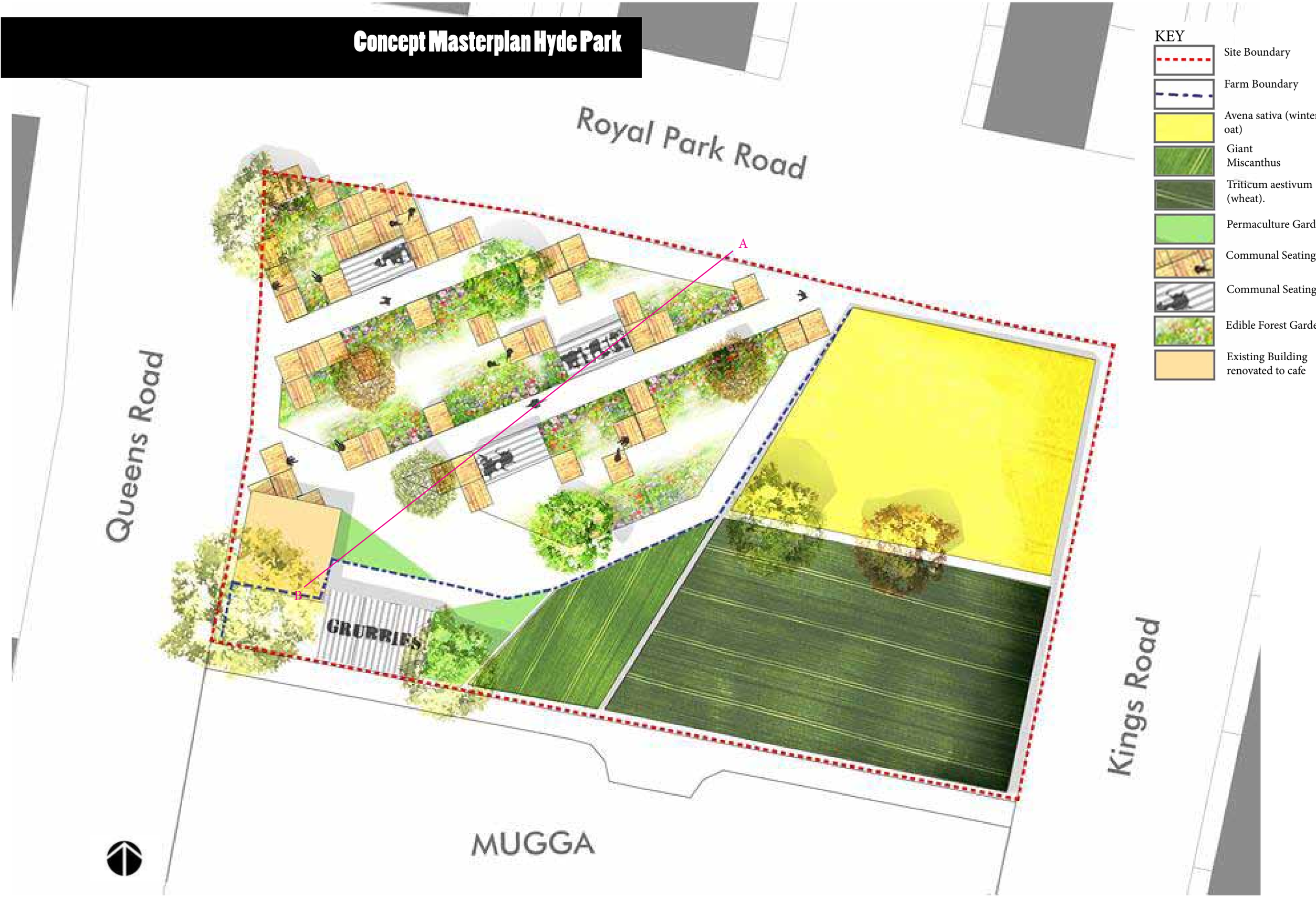
ible Forest Garden
rt of the public realm
sers of the park can pick vegtables like
ddishes and tomato's to use at home

Movement through the site
-Residents will use the park as a route to town or university
-High footfall area.

Relaxed open space
-Residents will feel secure and safe
-Presents of the Grubbies business will create a safe enviroment

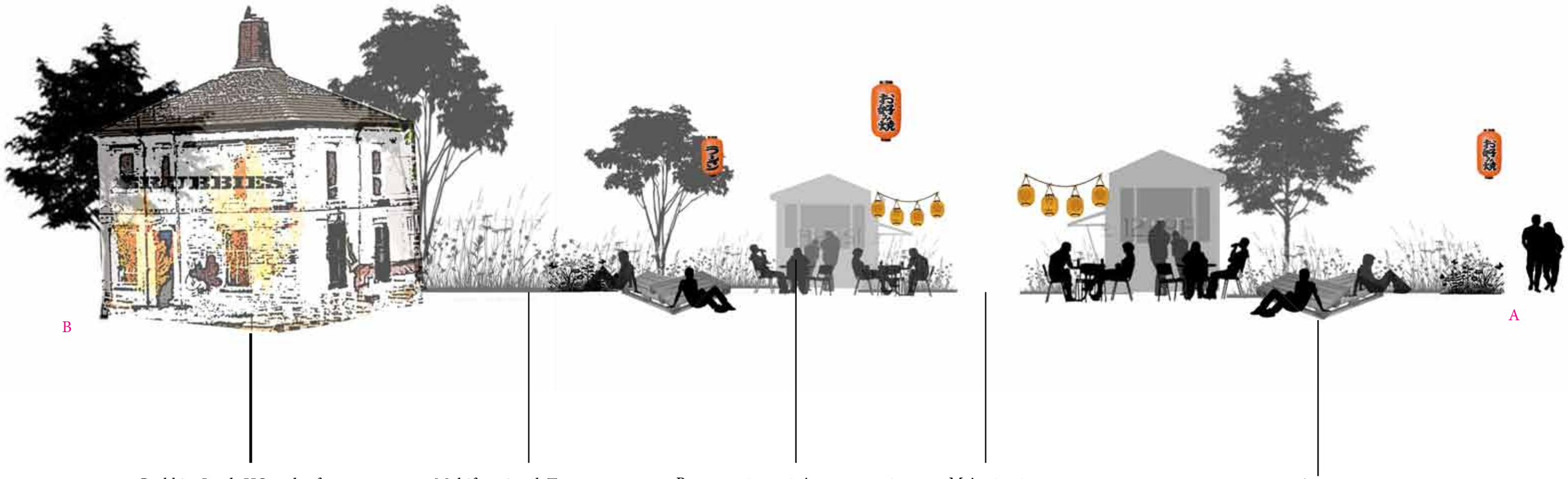
Art
-Artist that currently uses the wall for grafiti will be able to paint the walls everywhere
-Sense of ownership created

Concept Masterplan Hyde Park



NIGHTTIME- EXCITING-BRIGHT-FUN-GOOD SMELLS-SAFE

TIME-PEACEFUL-RELAXED-PRODUCTIVE



B

A

Grubbies Leeds HQ and cafe

Multifunctional, Temporary space for events

Pop up restaurants in permanent shipping containers.

Main street in food market

Forest garden seating area

Cross section not to scale

Grubbies Leeds - Meanwood

The site in Meanwood is substantially larger than the Hyde Park site and will accommodate an Urban Agriculture College. The main purpose of looking into this site is to use the principles from the Hyde Park Site at a much larger scale. We wanted to look into how the public space retains the same identity of the other site as well as creating an exciting new public park.


Bustlingthorpe
Chy
Liby
Woodhouse Carr
Sch
Sch
A58(M)
35
Sheepscar
Coll
Bagby Fields
Sch
A660
Sch
Little London

Urban Agricultural College

Sub-Station

Meanwood - Initial Concept Visual

The Grubbies mentality is to work with the existing conditions without unnessercary intervention. The sites existing sloping landform lends itself to two initial themes: Asian terraced paddy fields and the classical English lanscape, inspired by Capability Brown.

The terraced paddy fields of upland Asia are an efficient method of agriculture in challenging sloping conditions.

Asian Paddy Fields

Blenheim Palace Park, by Capability Brown

MEANWOOD-SURVEY AND SITE PHOTOS

Meanwood Site-Site ananlyse

Key

- Site
- Residential
- Existing Green infractstucture
- Commerical
- Main roads
- Meanwood Way
- Topographical Feature
- Importantant Green Infrastructure Hyde Park/Meanwood Ridge
- University area
- Visual Receptors Leeds Beckitt/University steps
- Meanwood Urban Farm

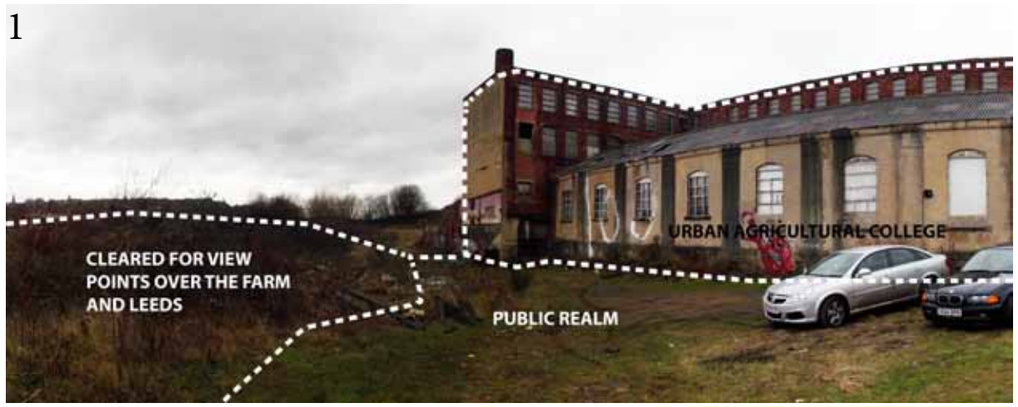
STRENGTHS

- Strong view from site to city and city to site
- Strong topography
- Sheepscar Beck interesting landform feature
- South facing providing ideal growing conditions
- Good natural drainage
- Links with Meanwood Valley Way
- Possible regeneration land to the south of the site.
- Has potential for extension of key wedge of green infrastructure running into the city.
- Heritage architecture

OPPORTUNITIES

- Expansion of green infrastructure wedge
- Create new footpath and cycle links towards the centre of the city
- Utilise landform for productive crops
- Expansion of urban green space to the south of the park
- Create a tourist destination

1



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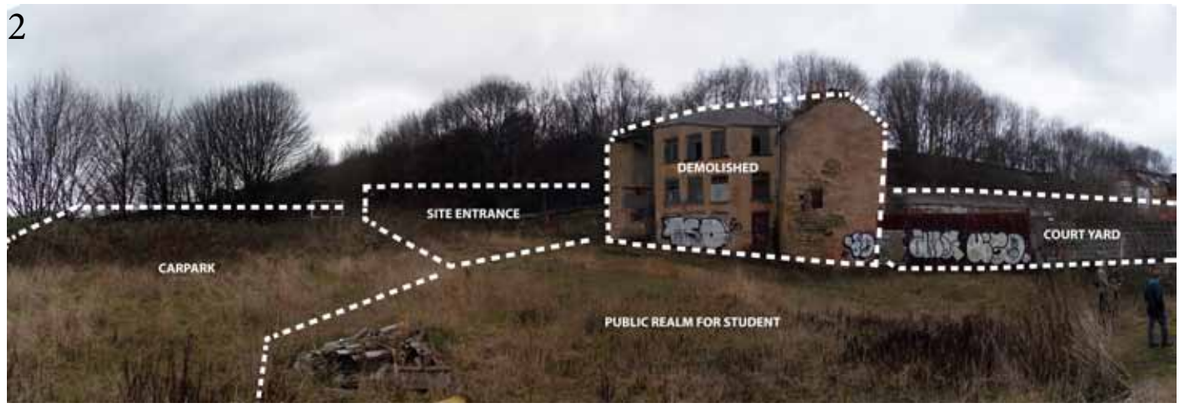


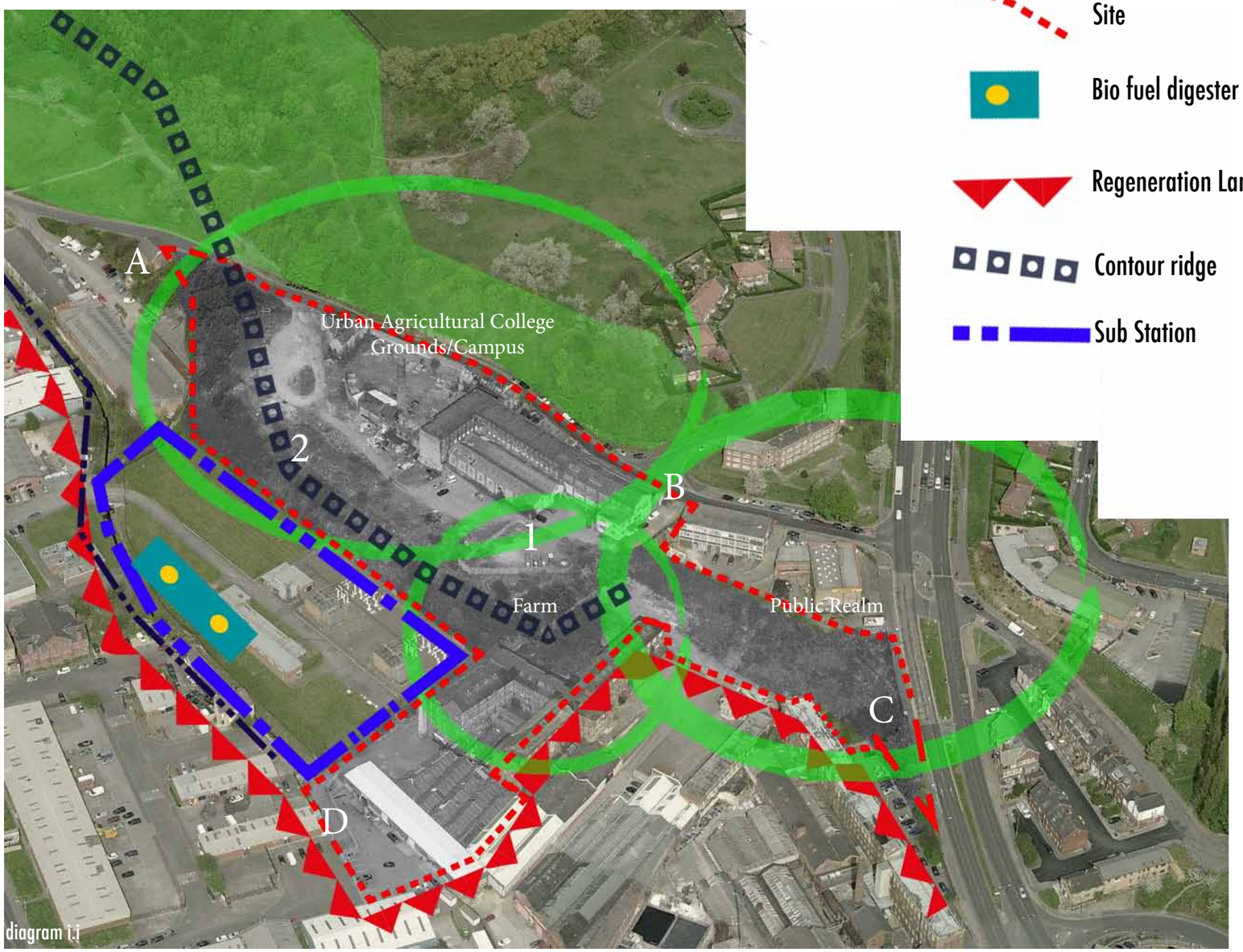


diagram i.i

Key Design Points

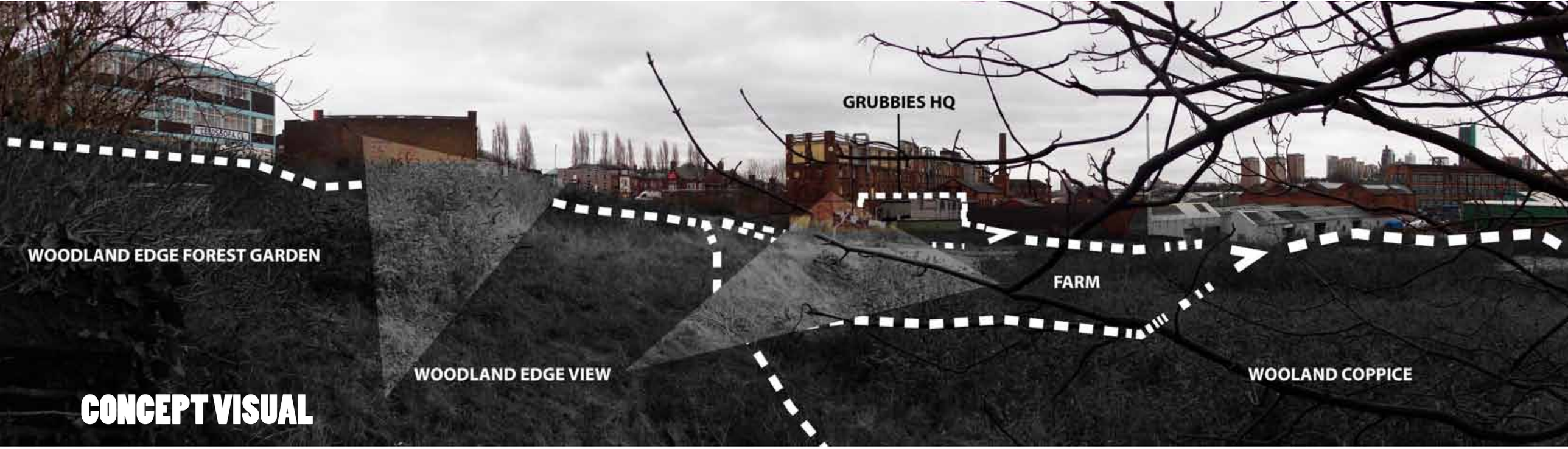
The sites success relies on creating successful public routes through the site.

Entrance A will be predominately used by students and for staff parking but will also connect to the Meanwood Way which is used by walkers.

Entrance B will be a pedestrian entrance for loal residents and commuters to the city. The entrance will open up on to exceptional views over the park.

Entrance C will be used by Grubbies staff.

Entrance D will cross Sheepscar Beck, which will be turned into one of the key aesthetic public spaces on the site. The Meanwood Road industrial estate is prime regeneration land with a high volume of abandoned buildings. A future green corridor could be created here.



CONCEPT VISUAL

Sense of Place, Immersive Qualities

Naturalistic inspired design

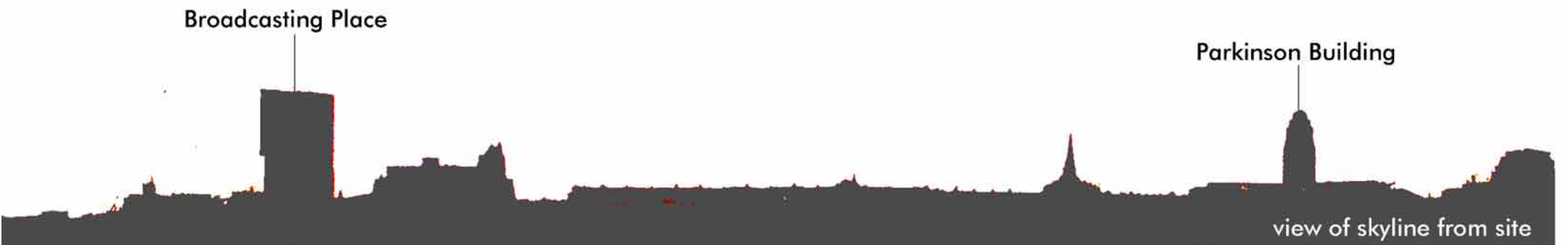
Improved personal conections to nature and wildlife

Woodland areas for play, private reflection and seclusion

Paths through wooded areas design to create excitment and to intregue

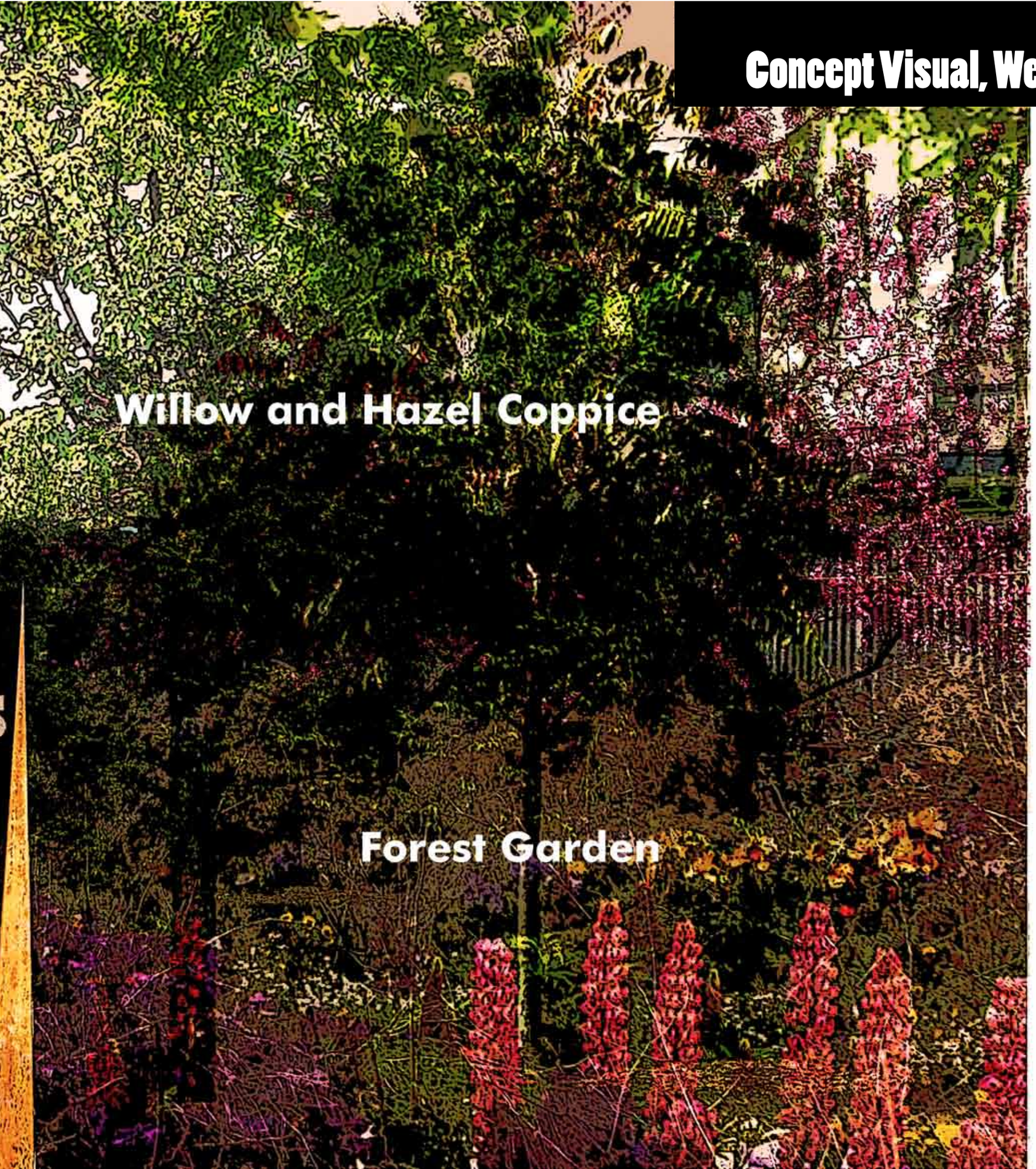
Views

The site is one of the few places in Leeds the complete unique city skyline can be observed from. These impressive views will be retained and borrowed in.




Urban Agricultural College
Grubbies Crop
GRUBBI
Wild Flower Meadow

Concept Visual, Western Entrance



Movement through the site will take people on a journey through the Grubbis crop fields and naturalistic woodland edges.

This will create a unique sensation of being in space that food is produced and grown, yet the public are welcome and encourged.

Passive exposure to urban agriculture in this way will increase public awareness of global issues of food sercuity.

By growing wheat crops in the urban environment Grubbies will question peoples value of land, space, food and money.

Concept Masterplan, Meanwood

KEY

- Site boundary
- Sheepscar Beck
- Attractive naturalistic planting
- Recycled timber decking
- Agroforestry crop fields
- Permaculture gardens
- Agroforestry crop fields
- Riverside public realm
- Grubbies farm buildings
- Coppiced woodland and edible woodland edge

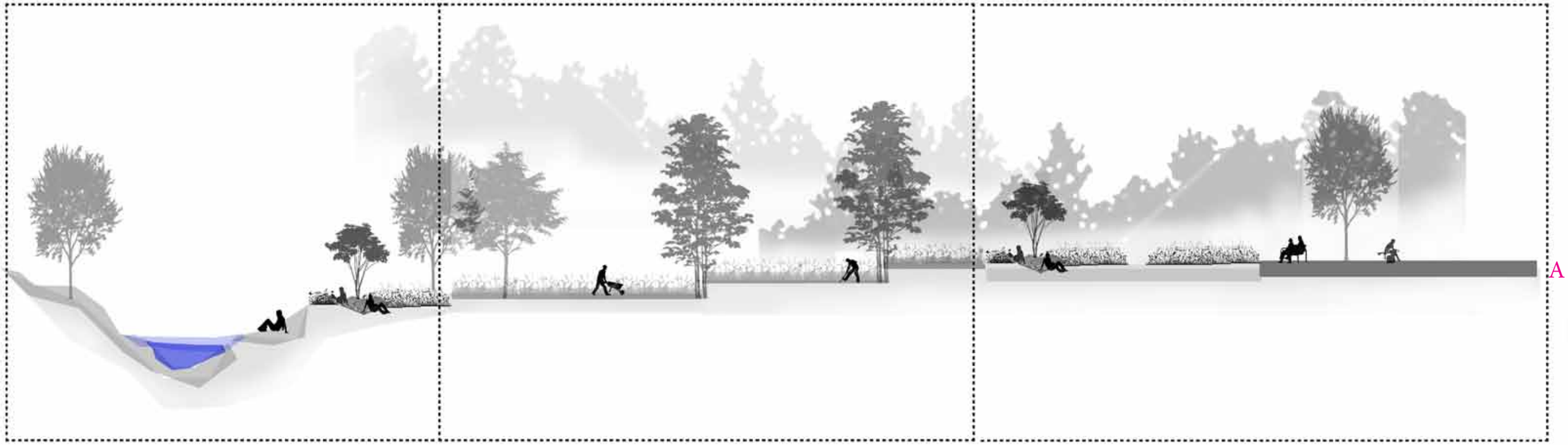
- Existing surrounding green infrastructure
- Potential surrounding development oppertunity
- Existing surrounding residential area





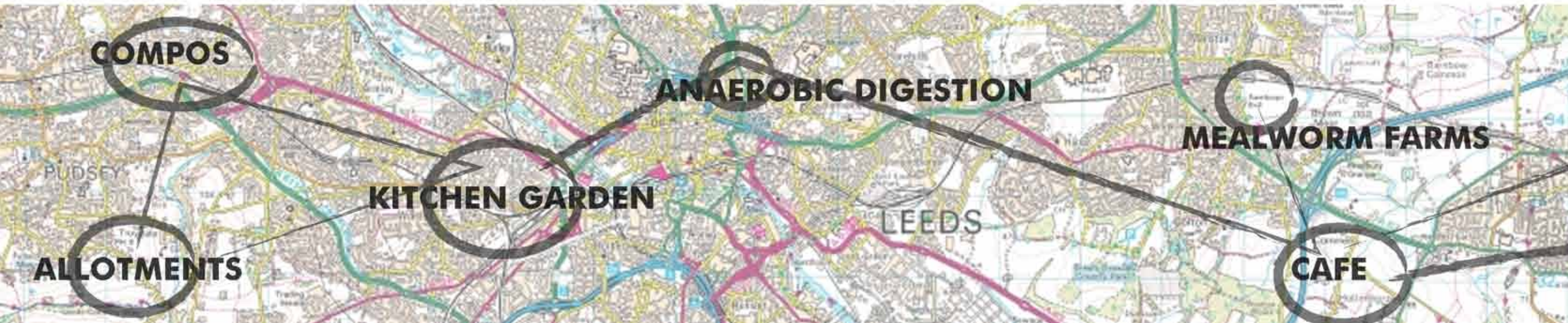
A WALK THROUGH THE ENGLISH COUNTRYSIDE-VIBRANT RIVERSIDE-MULTI LAYERED LANDSCAPES-MEADOWS-FOREST-AGRICULTURE

Cross Section



RIVERSIDE POCKET PARK **AGRICULTURE** **NATURALISTIC PUBLIC REALM**

Cross section not to scale

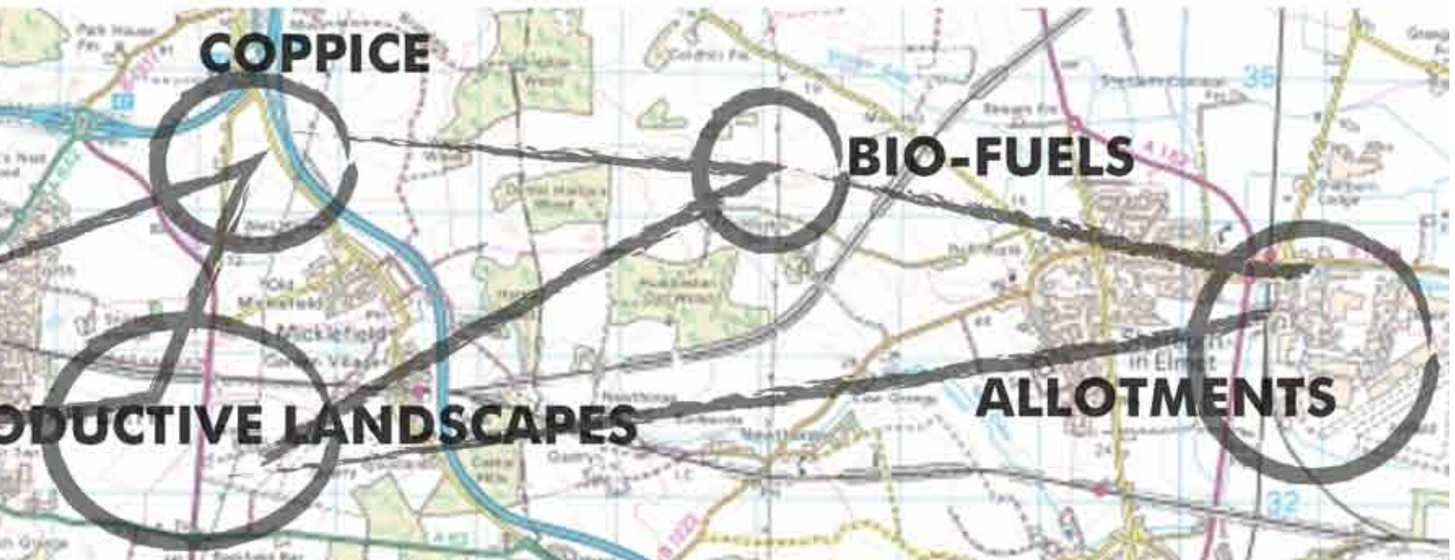

COMPOS
ANAEROBIC DIGESTION
MEALWORM FARMS
PUDSEY
KITCHEN GARDEN
LEEDS
ALLOTMENTS
CAFE

Can the Idea be Adapted to Work Anywhere?

An alternative approach to the Grubbies System is to utilise multiple sites across the city to create a single working urban farm. Sites which are not suitable for certain aspects of the system, such as growing a crop, have the potential effective at producing an alternative element of the system, such as composting.

The diagram below demonstrates in theory how this dispirsed farm could function. An important consideration for working model is effective green connection between the sites, which could make use of existing transportation and pedestrian routes.

This method also has the oppertunity to imporve social cohesion by connecting comunities through shared food production.

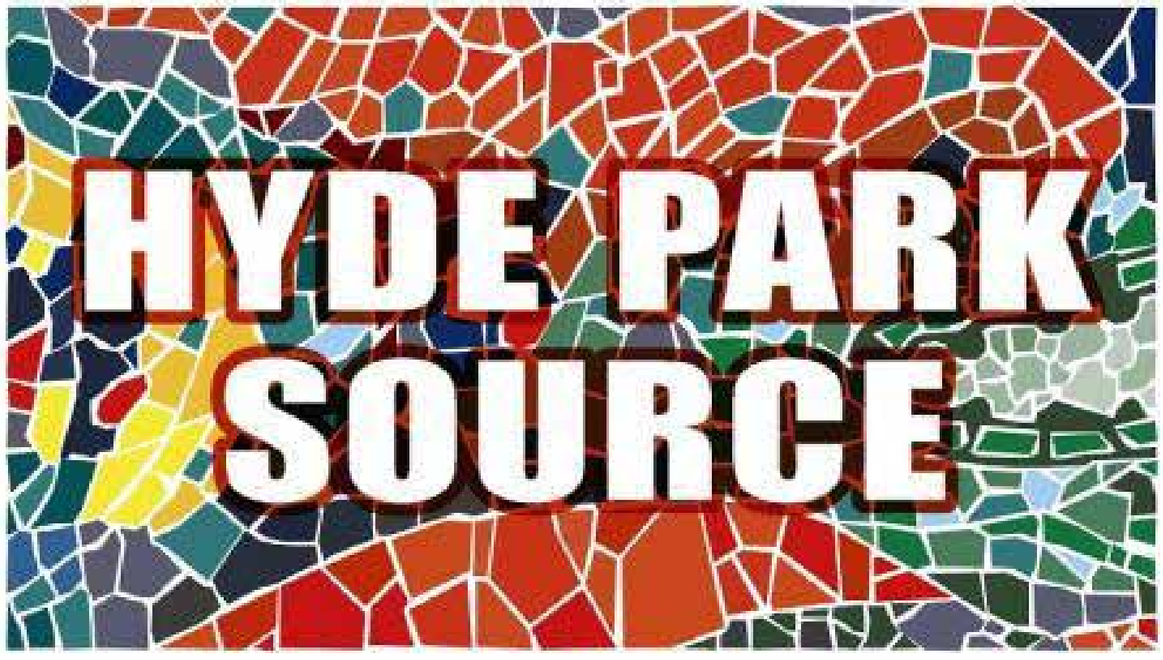


GRUBBIES AT HOME

The Grubbies system is highly adaptable. We will explore how it can be applied at a micro scale; by transforming small spaces, such as front gardens, into ultra sustainable domestic farms. Grubbies at home is intended to excite, inform and generate enthusiasm within communities to get involved. It has 'grass roots' potential to reduce the impact of agriculture on climate change and improve food security. Over time, we hope to see Grubbies streets, Grubbies towns and even Grubbies cities. This project has the capacity to work in collaboration with other local food and community based schemes. One of the many benefits of a collaboration is the sharing of knowledge and resources. There are 2 current projects within Leeds, which we believe could work well in partnership with Grubbies at Home; Back to Front and Hyde Park Source.

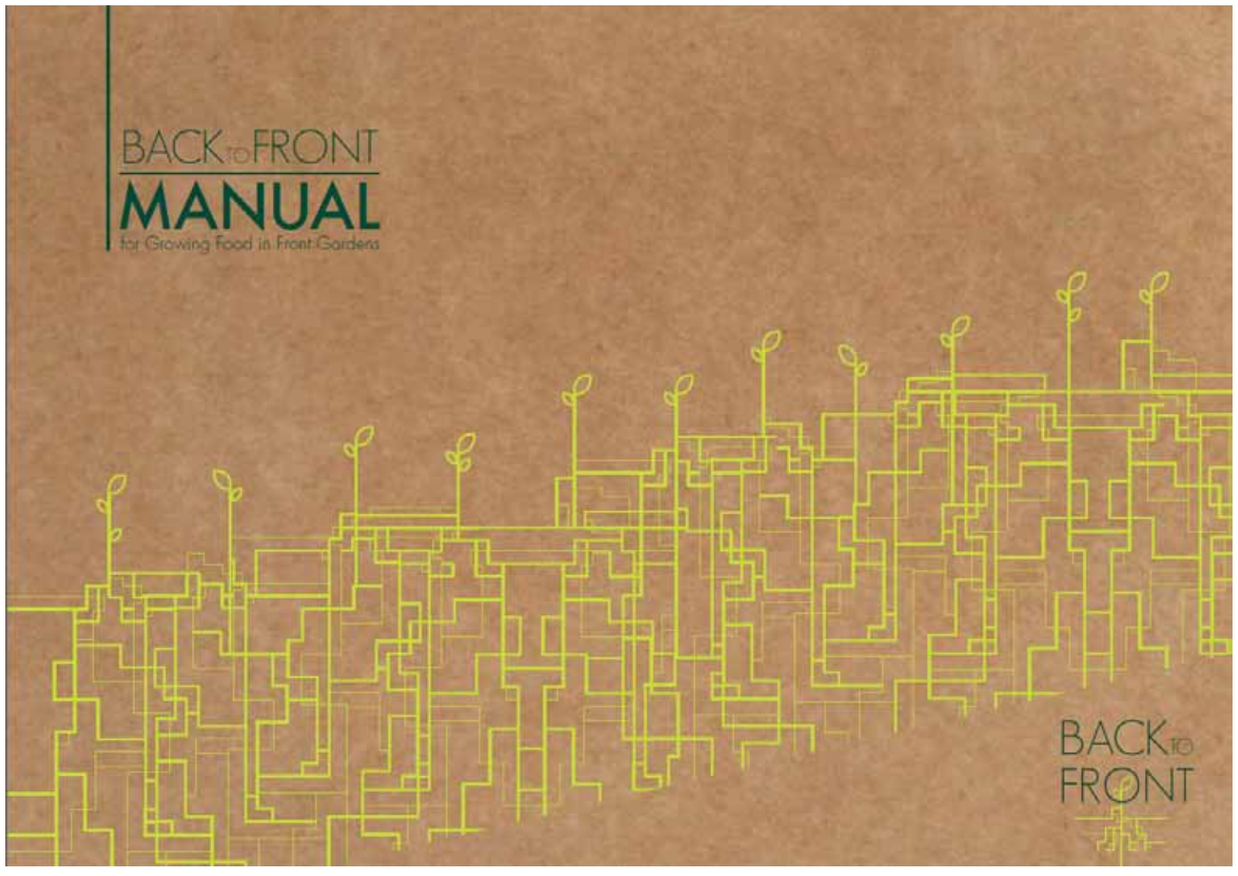
Back to Front

Back to Front is a community food growing scheme currently active in East Leeds. Instigated by NHS Leeds, their aim is to inspire and encourage community members to grow and eat home grown produce with support from local authorities, including the landscape architecture department at Leeds Beckett university. Sharing resources and knowledge is fundamental to the future success of the project. The landscape architecture department have developed a manual in collaboration with various members of the communities involved in the project; the manual aims to inspire and inform with the use of illustrative designs for maximising production in small spaces. Grubbies at Home can be interpreted as an alternative evolution of the Back to Front model, which could both operate in collaboration to improve the food growing potential, health and green infrastructure of communities and cities.



“ We think the Grubbies project is really interesting and innovative and could provide the area with an amazing example of future food systems.”

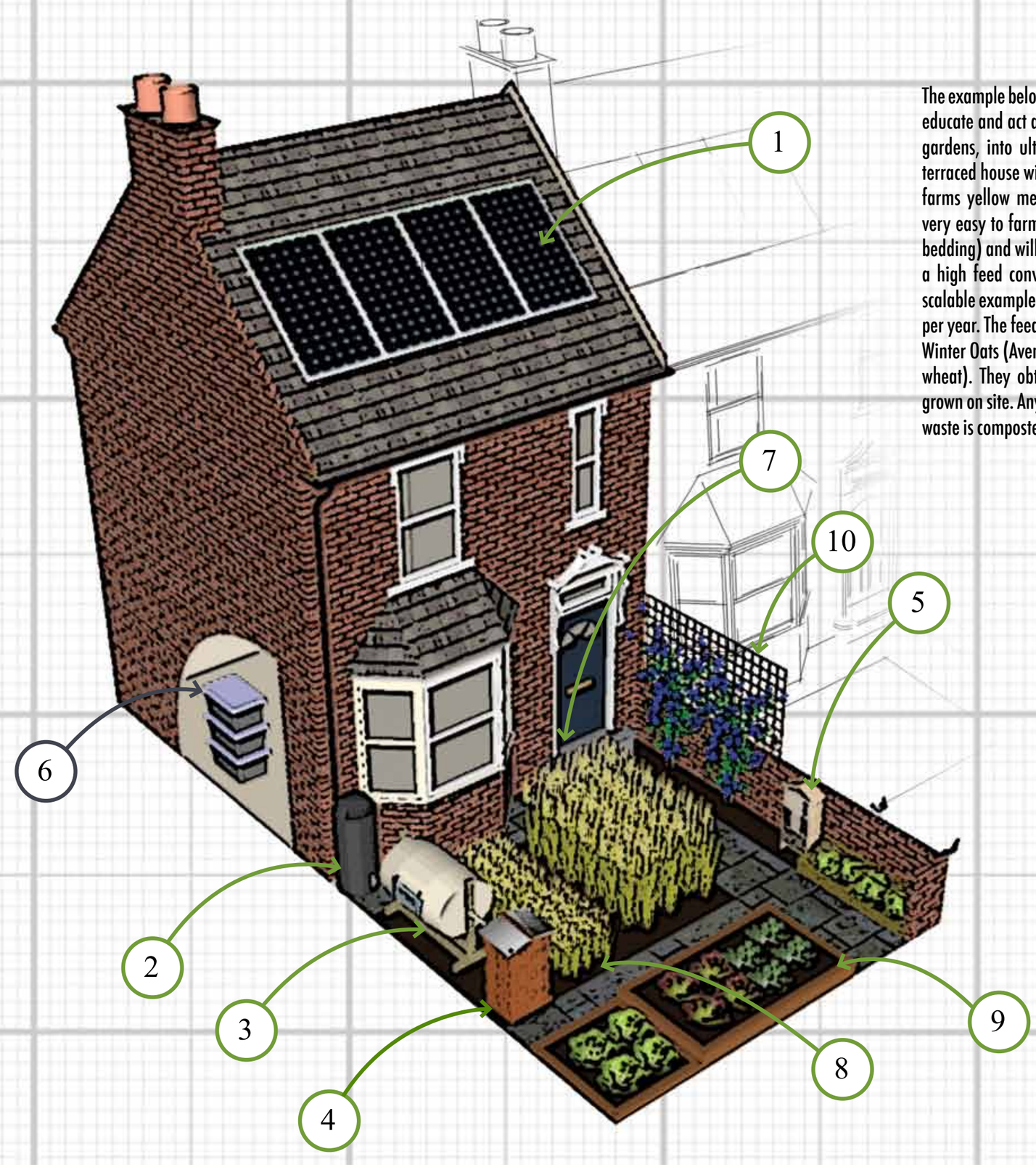
Pete Tatham - Hyde Park Source



Hyde Park Source

Hyde Park Source is an environmental community organisation based in Hyde Park but operating throughout Leeds. They work with disadvantaged communities to improve health and well being through improving local environments, designing and creating attractive, exciting, safe and useful places for people to live, work and play. Examples of projects include designing forest gardens for local schools, adventure ‘junk’ playgrounds and community food growing schemes. They are now also a permaculture (LAND) learning and distribution centre, acting as a hub for permaculture education and training within Leeds. Hyde Park Source would be an ideal platform to help launch Grubbies at Home within Leeds, which has the foundations already in place to provide the skills and support needed to ensure the success of the project. The Grubbies team had a meeting with the manager of Hyde Park Source, Pete Tatham, who was very impressed with our projects’ aims and ambitions within Leeds.

GRUBBIES at HOME



The example below has been extracted from a leaflet, designed to spark interest, educate and act as a design guide for transforming small spaces, such as front gardens, into ultra sustainable domestic farms. It shows a typical Victorian terraced house with a 20 m^2 garden (excluding paths) or 5m x 5m. This system farms yellow mealworms (Tenebrio molitor), which are ethically sound and very easy to farm, they can simply be left in a tray with their food (also their bedding) and will grow very quickly over a three month cycle. Mealworms have a high feed conversion rate (2:1) in comparision with beef (10:1) and this scalable example will yield at least 200g of animal protien per month or 2.35kg per year. The feed for the mealworms will be grown on site; their diet consists of Winter Oats (Avena sativa), wheat (Triticum aestivum) and yeast (derived from wheat). They obtain water from scraps of vegetables (carrots, potato), also grown on site. Any waste from the mealworms, vegetables or organic household waste is composted on site, which in turn acts as a nutrient source for the plants.

1

Renewable Energy

Closed loop = Renewables
Reduce carbon footprint

2

Water Collector

Used to water the crops
Reduce harm to urban

3

Composter

Organic household waste
Mealworm Frass

4

Bee Hive

Provides additional produce
Honey, Bees Wax
Pollinator conservation

5

Insect Hotel

Enhance local biodiversity
Natural pest control

6

Mealworm Farm

Keep indoors to simplify temperature control
See below

7

Summer Crop

Wheat (*Triticum aestivum*)
6m^2

8

Winter Crop

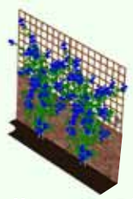
Winter Oats (*Avena sativa*)
6m^2

9

Vegetable Beds

Raised beds & cold frame
7m^2

10



Pollinator Plants

Use of vertical surfaces
Enhamce local biodiversity
Aesthetic value

DIY Instructions

A.

B.

C.

A. Upcycle/Recycle a sealable plastic container
B. Carefully cut ventilation holes in sides and lid
C. Secure mesh to prevent escapees

You will Need:

3 sealable containers, each measuring approx 40cm x 25cm x 15cm.

A mixture of feed, containing:

- 10 parts oat or wheat kernels
- 10 parts rolled oats or whole wheat flour
- 1 part wheat germ
- 1 part yeast

A few pieces of fruit or vegetables, such as apples or carrots.

Method

Firstly fill one of the trays to around 2.5cm depth with the grain mixture, this should take around 4.4kg per tray, also add some pieces of the fruit or vegatables, this will provide moisture for the mealworms and should be replaced when it beomes mouldy. Then add the mealworm larvae and stir the mixture every day or two to observe the mealworms' stage in their lifecycle.

As the pupae appear transfer them to the second empty tray, this is a non feeding stage in the mealworms lifecycle.

These pupae will develop into beetles (darkling beetle), once this happens transfer them to the third tray with the same mixture of grain and fruit or vegtables. Once again, regulary moniter and stir to replace rotten fruit and veg and to check on the life cycle. The beetles will mate after 2-5 days and produce 40 eggs a day, hatching after 12 days. This will produce mealworms for harvest and for begining new cycles. As the adults live around 2 months prepare appropriatly to have a constant supply of mealworms.

This whole process takes 3-6 months and uses 8.8kg of grain mixture, plus the fresh ingredients, and can be scaled up or down very easily. The mealworm farms should be kept warm at a temperature of around 18-250C, but will generate some of its own heat. The farms need to be out of direct sunlight and need constant ventilation.

GROW INSECTS TO EAT

GRUBBIES at HOME

CONCLUSIONS

9

This document has shown that an urgent rethinking of the agricultural system is required, not only in the rural landscape but in the our cities also. Food has an enormous role in the production of greenhouse gases, a major contributor to global warming, therefore the food production cycle has to change in order to reduce the harmful effects of climate change on the human population.

This document has also shown that entomorphagy is a possible solution to meet growing demand in animal protein and therefore reduce the harmful effects of raising livestock on the planet.

This has also shown there are severe barriers to entomorphagy in the western world and these need to be addressed. We have shown examples of people who are currently working on solutions to these problems.

Currently nobody is farming insects for human consumption in the UK, and there is substantial primary research needed to be done in this field to begin this pioneer industry. However there are universities and people performing good research throughout the world, especially in the Netherlands.

The book has also documented various sustainable agriculture projects and innovative technical food growing systems, including the concept of farming within a closed loop method. We have taken influence from these systems and developed our own closed loop model for farming Tenebrio molitor, the mealworm. In theory our closed loop system will work, but it would need to be subjected to rigorous testing and analysis in order to determine the true interaction between each element of the loop.

We have shown how this farming concept can be adapted and taken by communities, homes or businesses and applied to a variety of sites and scales to generate food security and an income.

We have shown the best way of integrating these farms may be to introduce them alongside public space. This will encourage people to the idea of eating insects.

Further work would need to be done in considering detail design of sites, and methods of cooking, serving and selling the mealworms as food. To realise this system in practice more research would be needed to be done in the constraints and practicalities of farming mealworms.

APPENDICES 10

a Insect Recipes

b Grubbies First Entomophagy Attempts & Reviews

a.

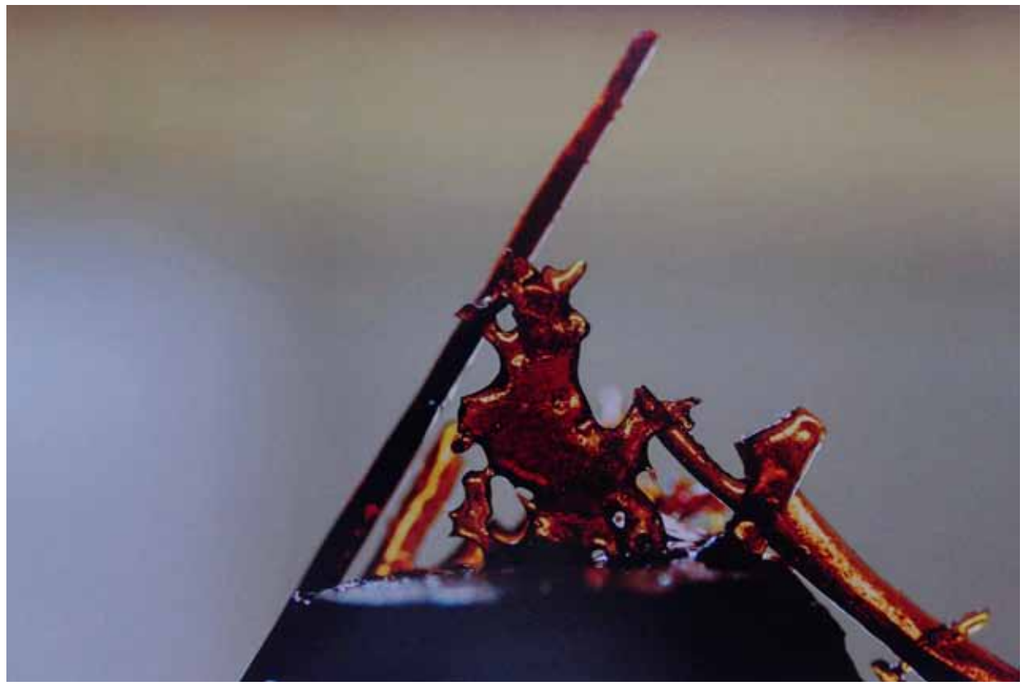
Insect Recipes

The following recipes and images are sourced from Accept or Reject by photographer, chef & friend of Grubbies, Naomi Moores. This recipe book is a one off private publication.

Mealworm Dusted Sainte-Maure Touraine Goats Cheese

Ingredients

Sainte-Maure Touraine goats cheese, sliced
175g mealworms
2 tsp cayenne pepper
1/2 tsp chilli powder
Ground mustard seeds



Locust Mouse au Chocolat

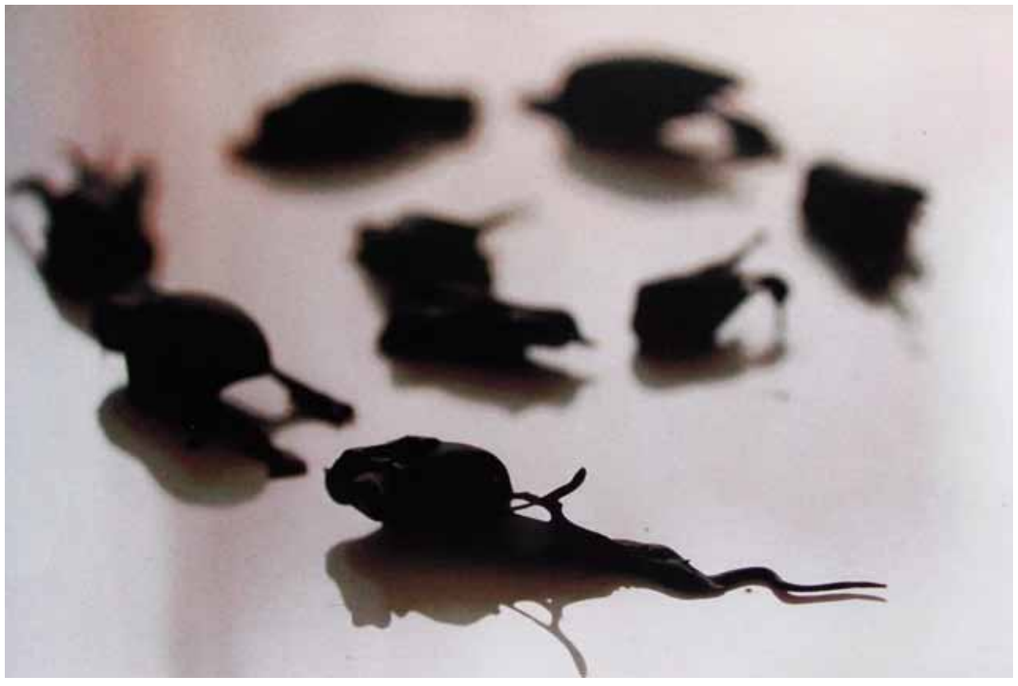
Ingredients

200g dark/bittersweet chocolate
30 locusts
3 eggs, separated
250ml double/whipping cream
35g caster sugar
100g granulated sugar for caramelising

Butternut Squash, Star Anise & Locust Risotto

Ingredients

1 large butternut squash
20 large locusts
2 cloves garlic, peeled
2 tbsp olive oil, plus extra for drizzling
15 sage leaves
2 star anise, toasted and ground
3 large knobs butter
1 large onion chopped
400g arborio rice
200ml white wine
1 ltr hot chicken/vegetable stock
Salt and pepper to taste
Handful grated Parmesan cheese, plus extra to serve
75g pinenuts to serve



Cricket Couverte de Chocolate

Ingredients

30g crickets
500g dark chocolate
2 tbsp butter

Cricket, Cinnamon & Vanilla Ice Cream

Ingredients

285ml double cream
300ml full fat milk
115g golden caster sugar
1 vanilla pod
1 tsp ground cinnamon
25 black crickets
3 large free range egg yolks
Ice cubes

b.

At Grubbies we decided we needed to try cooking insects for ourselves to begin the project, instead of buying ready made ones we wanted to cook some crickets ourselves. Crickets were sourced from our local Thai supermarket in Leeds.

Grubbies First Entomophagy Attempts & Reviews

Hot Battered Crickets

Salted Chocolate Covered Crickets

Reviews

"Happy to try them, tasted a bit weird. Great that your working on the future of food!"
Little Stu

"They take on the taste of what they are cooked with but because they are so small you don't get a strong flavour of the meat. So depends what they are cooked with, take the legs off and make them look different and they would be like prawns... "
Joey Cook

"They could have tasted better, I'd want a gourmet bug!"
Stewart Macaye

"I enjoyed the crunch!"
Harry Baker

"They were ok didn't like the batter, the legs and the look of them put me off but they tasted ok"
Nikki Camp

Some room for improvement...

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