May 2014

Leeds Edible Campus

Edible Wetland Research Project

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BRIEF

There have been many developments over the last decade or so with regards to sustainable drainage. Sustainable drainage techniques are becoming increasingly important throughout the country, as the effects of climate change see more extreme rainfall events. Climate change is also causing society to re-evaluate the ways in which food is produced and supplied. The costs to the environment of current food production are unsustainable and new techniques to develop food production in our ever-expanding urban areas are needed.

This research project aims to link both the need for sustainable drainage and sustainable food production to create a new form of truly multifunctional green infrastructure. It will do this by investigating the potential to create an edible wetland within, or close to, the existing phase 1 boundary of the Leeds Edible Campus. This will offer multiple benefits including flood/surface water management, food growing, aesthetic improvements, educational opportunities and ecological enhancements in the form of new habitats.

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Leeds Edible Campus

The Leeds Edible Campus is a project bringing together different urban food growers in and around the Leeds University campuses and the Woodhouse area of the city centre. The Edible Campus is a partnership of both Leeds and Leeds Metropolitan Universities, along with the organisations that make up Feed Leeds, inspired by the Incredible Edible Todmorden movement.

The aim of the Edible Campus is "to create an inspirational demonstration of how Leeds could become more healthy and more sustainable through the creative growing of edible plants".

Edible Campus Area

The first phase of the Leeds Edible Campus area stretches from Millennium Square in the Civic Quarter, up through the university district and on to Woodhouse Moor. It includes projects such as edible flower bed planting outside the Civic Hall and the permaculture community orchard and forest garden at Bedford Fields. The phase I area is largely urbanised, as can be expected with it beginning in the city centre; it does however contain large areas of key green Infrastructure, in the form of Woodhouse Moor and smaller areas such as St George's Field.

There are proposed extensions to the Edible Campus boundary: anticipated areas 2a and 2b extend over considerably larger areas to the north of Leeds city centre towards more suburban and rural areas. The

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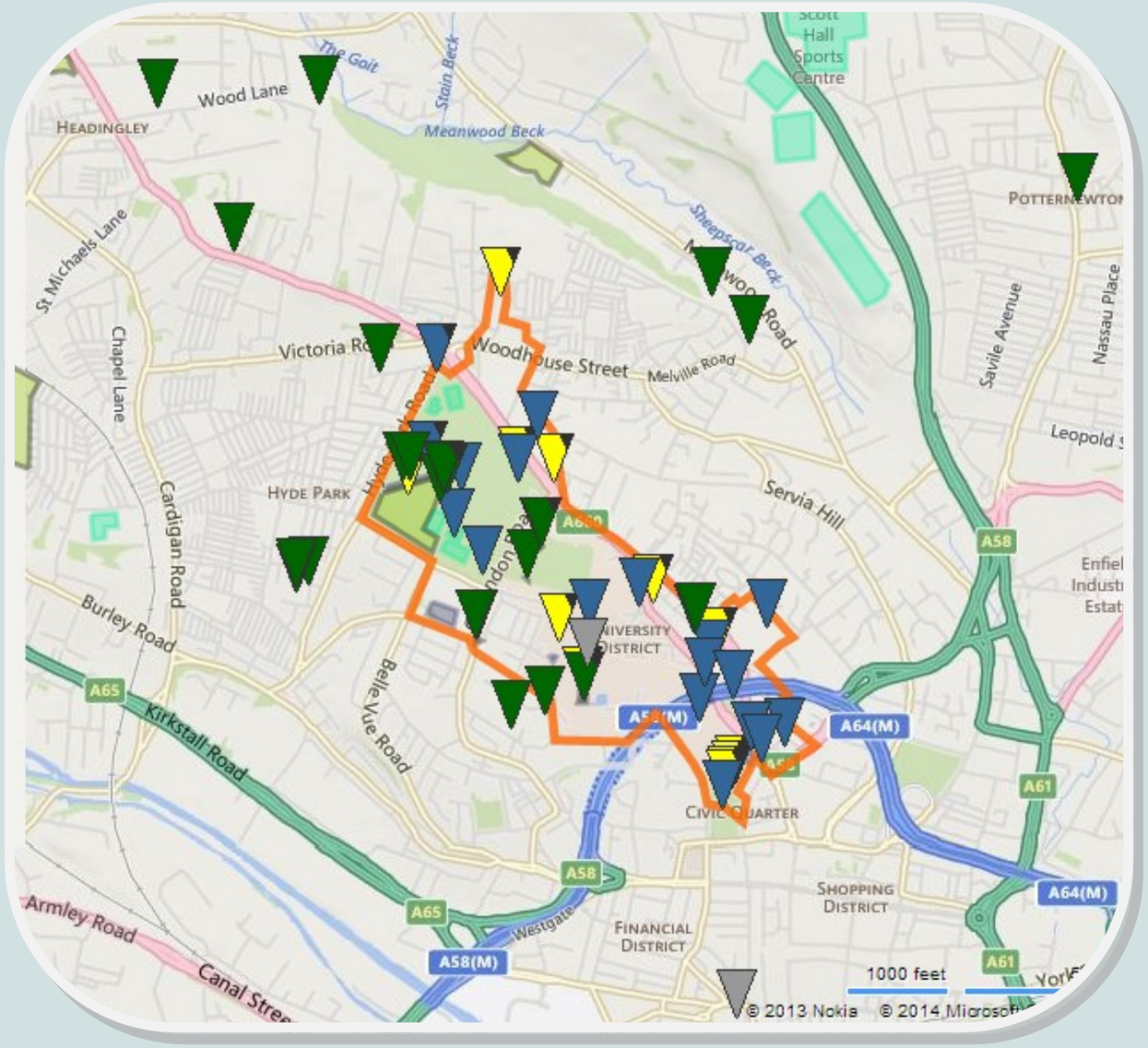
benefits to these extended areas are that they offer further opportunities for food growing and create green infrastructure links between the city centre and more rural areas.

The current Leeds Edible Campus area and the project locations within it are shown on the right.

www.leedsediblecampus.co.uk



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Continuous Productive Urban Landscapes

A Continuous Productive Urban Landscape or CPUL is a design concept which aims to provide and link productive landscape areas within our cities and towns. There is a growing belief that in the future our cities will have to be as productive as our countryside areas, particularly as importing food long distances becomes more costly and unsustainable. The Edible Campus area is in effect a CPUL and with further coordination and delivery of projects, the area (and further boundary extensions) will be able to start producing food and developing food growing techniques for the future population of the area.

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Sustainable Drainage Systems (SuDS)

Sustainable drainage systems are designed to reduce the impact of existing and proposed development, with respect to their surface water run-off. The UK floods of 2007 are highlighted as a changing point in terms of government policy towards flooding. The floods were incredibly damaging and some of the most serious flooding was caused by surface water. The Pitt Review, which followed in 2008, recommended a number of changes to flood management and planning within the UK, many of which strengthened the need for sustainable drainage to mitigate the effects of new development.

The UK is now seeing these changes take place with sustainable drainage features becoming the norm in new housing developments and retrospective schemes being added to areas where existing problems have been identified. Sustainable drainage systems cover a number of techniques, which can be hard engineering, soft engineering or a combination of the two. All have the ultimate aim of reducing the flow or surface water run-off from development into existing water courses or sewers and can often be found coupled with low water-using technologies, particularly in new housing or industrial development.

There are now numerous examples of where sustainable drainage systems have been integrated into new and existing development to deliver multiple benefits. Although all deliver the same core principle of reducing surface water run-off, many are designed in such a way that they deliver multiple benefits, such as ecological and aesthetic improvements.

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Case Study: Hollickwood Primary School

As well as solving water quality and flooding issues, this project also aimed to enhance the natural environment of the school, whilst also providing various educational opportunities.

SuDS were designed by stakeholders and retrofitted into the school grounds. The quality of the surface water run -off from the school, which enters a nearby brook, has been improved. It also enriched the school grounds by reducing flooding and water logging on the school playing fields and all weather pitch.

The scheme involved detention and retention areas, as well as swales. This included a bio-retention bog garden and detention areas, accompanied by bridges planted with native species. The scheme has been specially designed to allow easy access for students and teachers to the newly-formed wetland areas for learning opportunities.

In summary, the scheme achieved its principle benefits of reducing flood risk and improving water quality and has greatly enhanced the natural environment.

Bio-retention bog garden.

Detention area with bridges, planted with native species.

Case Study: Hopwood Motorway Service Area

The motorway service area is located at Junction 2 of the M42. The service area itself lies next to a 34 ha wildlife reserve and is split into two sub-catchments by the A441 road.

The concept for the SuDS scheme was to incorporate a variety of different components in an overall system, with aims to improve the flow and quality of water run-off from the site, before being discharged into an adjacent watercourse.

For example, the scheme includes different treatment techniques and stages depending on where the run-off originates. Water from the roof of the main building runs into a pond feature, which improves the landscape of the site. In areas of car parking, filters are used to separate oil, grit and fuel from the water before it continues its journey.

The design has created multiple benefits for the site and adjacent water course. These include: reducing the flow and improving the quality of run-off through the site into the adjacent water course, whilst improving the ecological value of the site and creating a more aesthetically-pleasing landscape around the service area.

Spillage basin newly constructed (Bob Bray)

Constructed wetland (Bob Bray)

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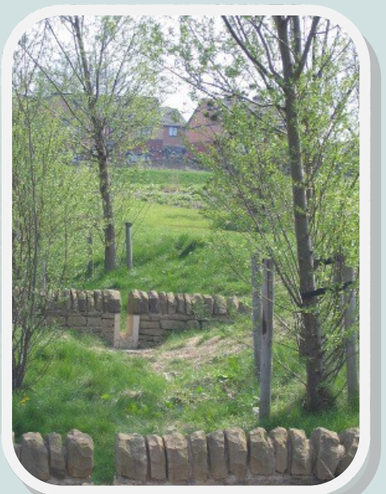
Case Study: Manor Ponds, Sheffield

This scheme was retrofitted adjacent to the Manor Estate in Sheffield, when it underwent major regeneration. The SuDS were located on council-owned public open space contiguous to the estate. Through the regeneration proposals and development of new housing, it was discovered that existing surface water drainage was insufficient and that hard engineering options to alleviate the problem would be too costly.

The decision was therefore taken to incorporate a SuDS scheme into the adjacent land, which was also proposed to be developed into a park. The SuDS would treat and store surface water run off from the estate but also enhance the park area for local residents.

The scheme comprises a number of ponds and detention basins throughout the park. These are all fed from one point and the surface water is untreated before reaching the park. The ponds and basins act as different management tools: filtering silt, cleaning and controlling flow. The ponds are all fed by swales, which run through the park.

Manor Ponds has delivered multiple benefits, including; reclaiming brownfield land and improving amenity value; enhancing opportunities for nature; reducing flood risk and providing enhanced funding for the new park.



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Case Study: Nottingham Green Streets – Retrofit Rain Garden Project

This was a pilot retrofit scheme to create rain gardens within a highway setting, as a way of enhancing surface water interception, attenuation and infiltration. The project was also used to test and evaluate the effectiveness of the scheme, with regards to surface water run-off from the public highway.

A partnership of interested stakeholders, including: Nottingham City Council; The Environment Agency; Groundwork and Severn Trent Water worked together with local residents to design, implement and monitor the effectiveness of the scheme with a view to retrofitting the design into other public highways.

21 linear rain gardens were constructed within the grass verge of a residential street, with the aim of storing and treating surface water run-off from the road. Planting was specially designed for the scheme to ensure it could withstand the large variance in water levels; create delineation of the street; improve the street scene and be low maintenance (evergreen plants to reduce blockages from leaf fall). The rain gardens have also acted as a way of educating local residents, with regards to surface water flooding. Evaluation of the effectiveness of the scheme is ongoing; however, initial feedback from residents on the street has been positive.

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Case Study: Hockerton Housing Project – Reed Beds

Hockerton Housing Project is a self-sufficient co-housing development located in Nottinghamshire.

The housing uses a low cost integrated approach to water treatment and use, including rainwater harvesting, sustainable hot water production and reed beds for waste water treatment.

All waste water from the housing on site is collected and treated in a reed bed. Waste water first enters a septic tank, where solid matter is settled out, before flowing into a floating reed bed. The waste water takes three months to pass through the reed bed, which treats and filters the water to such an extent that it can be released into the main lake of the development. Water entering the lake from the reedbed is regularly monitored to ensure that it reaches EU standards in terms of bathing quality.

This method of sustainable drainage and waste water treatment delivers a number of benefits, such as: low maintenance and low cost; no need for power supply; an aesthetically-pleasing backdrop for the development and ecological enhancements for local wildlife.

Www.hocertonhousingproject.org.uk

Www.hertslink.org

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SuDS Case Studies – Summary

The previous case studies show a range of different SuDS solutions that have been designed and implemented into new developments or retrofitted into existing developments. Each has delivered multiple benefits for both the developments and local people.

Water quality is obviously a major issue when considering using SuDS for food production and all have delivered water quality improvements as part of their outcomes; in particular, the Hockerton Housing Project shows that even the dirtiest waste water can be treated by sustainable means to such an extent that it is clean enough to bathe in.

This shows that the possibility of including edible wetland species within a sustainable drainage system is not completely out of the question.

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Edible wetland plants

There are a number of wetland plants that have edible properties. Many exist naturally in the wild and are native to the UK, others have been naturalised over many years and others are native to other countries but may be suitable, under the right conditions, for use in this country.

Edible plants that are suitable for use in pond or wetland vary in terms of the conditions which they prefer; some prefer marginal marshy and boggy areas, whereas others grow fully submerged below the water line. The following list is a mixture of these plants with instructions as to how they can be used as food. The majority of the information is from the organisation Plants for a Future (pfaf.org), which maintains a database of productive plants, including those which are edible or medicinal.

The list of plants is not exhaustive; many more exist that have the potential to be grown in this country under the right conditions. The plants that have been selected have varying levels of edibility but all could be used in the right design and mix to create a wetland with edible plants and also provide amenity/landscape enhancements and habitat improvements.

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.*Acorus calamus*—Sweet Flag

Europe, Asia and N. America. Naturalized in Britain

Acorus calamus is a PERENNIAL growing to 1 m by 1 m at a medium rate. Prefers wet soil and can grow in water.

The rhizome is candied and made into a sweetmeat. It can be peeled and washed to remove the bitterness and then eaten raw like a fruit. It makes a palatable vegetable when roasted and can also be used as a flavouring. Rich in starch, the root contains about 1% of an essential oil that is used as a food flavouring. The dried and powdered rhizome has a spicy flavour and is used as a substitute for ginger, cinnamon and nutmeg. A pinch of the powdered rhizome is used as a flavouring in tea. The young and tender inflorescence is often eaten by children for its sweetness. Young leaves - cooked. The leaves can be used to flavour custards in the same way as vanilla pods). The inner portion of young stems is eaten raw. It makes a very palatable salad.

http://commons.wikimedia.org/wiki/User:Jeffdelonge

http://www.pfaf.org/user/plant.aspx?latinname=Acorus+calamus

.*Apium graveolens*—Wild Celery

Central and southern Europe, including Britain, to temperate areas of Africa and Asia.

Apium graveolens is a BIENNIAL growing to 0.6 m by 0.3m. It is in flower from Jun to August, and the seeds ripen from Aug to September. The flowers are hermaphrodite and are pollinated by flies, self. The plant is self-fertile.

Wild celery has a long history of medicinal and food use. it is an aromatic bitter tonic herb that reduces blood pressure, relieves indigestion, stimulates the uterus and is anti-inflammatory. The ripe seeds, herb and root are aperient, carminative, diuretic, emmenagogue, galactogogue, nervine, stimulant and tonic. Wild celery is said to be useful in cases of hysteria, promoting restfulness and sleep and diffusing through the system a mild sustaining influence. The herb should not be prescribed for pregnant women. Seeds purchased for cultivation purposes are often dressed with a fungicide, they should not be used for medicinal purposes. The root is harvested in the autumn and can be used fresh or dried. The whole plant is harvested when fruiting and is usually liquidized to extract the juice. The seeds are harvested as they ripen and are dried for later use. An essential oil obtained from the plant has a calming effect on the central nervous system. Some of its constituents have antispasmodic, sedative and anticonvulsant actions. It has been shown to be of value in treating high blood pressure. A homeopathic remedy is made from the herb. It is used in treating rheumatism and kidney complaints.

http://commons.wikimedia.org/wiki/File:Illustration_Apium_graveolens0.jpg

http://www.pfaf.org/user/Plant.aspx?LatinName=Apium+graveolens

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Aponogeton distachyos—Water Hawthorn, Cape pondweed

S. Africa. Occasionally naturalized in Britain

Aponogeton distachyos is a PERENNIAL. It is in flower from Apr to October. The flowers are hermaphrodite.

Tuber - roasted. Considered to be a great delicacy. Flowering spike - pickled or used as a spinach or asparagus substitute. The young shoots are used as an flavouring.

http://www.pfaf.org/user/plant.aspx?latinname=Aponogeton+distachyos

http://commons.wikimedia.org/wiki/User:Jeffdelonge

Butomus umbellatus—Flowering Rush

Most of Europe, including Britain, and temperate Asia.

Butomus umbellatus is a PERENNIAL growing to 1 m by 0.5 m. It is in flower from Jul to September, and the seeds ripen from Aug to September. The flowers are hermaphrodite and are pollinated by Bees, flies, lepidoptera.

Tuber - cooked. It should be peeled and the rootlets removed. The root can also be dried and ground into a powder, it can then be used as a thickener in soups etc., or be added to cereal flours when making bread. It contains more than 50% starch.

http://www.pfaf.org/user/plant.aspx?latinname=Butomus+umbellatus

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http://commons.wikimedia.org/wiki/User:Taka

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Chrysosplenium alternifolium –Golden Saxifrage

Europe, including Britain, from Scandinavia south to C. France, east to C. Asia and the Himalayas.

Chrysosplenium alternifolium is a PERENNIAL growing to 0.3 m by 0.5 m. It is in flower from Apr to July. The flowers are hermaphrodite and are pollinated by beetles, flies, self. The plant is self-fertile.

Leaves - raw. Added to salads. The leaves are rather small, and there is a distinct bitterness in the flavour, especially during hot weather .

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http://commons.wikimedia.org/wiki/User:BotBln

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Cornus Canadensis—Creeping Dogwood

N. America - Newfoundland to Alaska, south to Virginia and California.

Cornus canadensis is a PERENNIAL growing to 0.3 m by 1 m at a fast rate. It is in flower in June. The flowers are hermaphrodite and are pollinated by Insects.

Fruit - raw or cooked. Pleasant but without much flavour. The fruits are rather dry, a bit gummy and rather mealy but they have a pleasant slightly sweet flavour. They can be added to breakfast cereals or used for making jams, pies, puddings etc. An excellent ingredient for steamed plum puddings. High in pectin, so it can be used with pectin-low fruits when making jam.

http://www.pfaf.org/user/plant.aspx?latinname=Cornus+canadensis

(c) 2010 Ken Fern & Plants For A Future

(c) 2010 Ken Fern & Plants For A Future

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Cyperus longus—Galingale

Britain and the Mediterranean region north to Lake Geneva.

Cyperus longus is an evergreen Perennial growing to 1.2 m by 2 m at a fast rate. It is in flower from Aug to September. The flowers are hermaphrodite.

Tuber - used as a spice in soups, pies and sweets

http://www.pfaf.org/user/plant.aspx?latinname=Cyperus+longus

http://commons.wikimedia.org/wiki/File:Cyperaceae_spp_Sturm3.jpg

Glyceria fluitans—Floating Manna Grass

Europe, including Britain, temperate Asia the Caucasus and N. America.

Glyceria fluitans is a PERENNIAL growing to 0.5 m by 0.5 m. It is in flower from May to August. The flowers are hermaphrodite and are pollinated by Wind.
Seed - raw or cooked. A sweetish taste, the seed was considered a delicacy in some parts of Europe and was an article of commerce until well into the 20th century. A flour from the seed is said to make a bread little inferior to wheat bread, the flour can also be used as a thickener in soups etc. when it imparts a sweet delicate flavour. Unfortunately, the seed is very small and therefore the plant is relatively unproductive.

http://www.pfaf.org/user/plant.aspx?LatinName=Glyceria+fluitans

commons.wikimedia.org/wiki/File:450_Glyceria_fluitans.jpg

http://www.commanster.eu/commanster.html

Nasturtium officinale—Watercress

Europe, including Britain, from Sweden and Denmark south and east to N. Africa and W. Asia.

Nasturtium officinale is a PERENNIAL growing to 0.5 m by 1 m. It is in flower from May to October, and the seeds ripen from Jul to October. The flowers are hermaphrodite and are pollinated by bees, flies, self. The plant is self-fertile. It is noted for attracting wildlife.

Leaves - raw or cooked. Water cress is mainly used as a garnish or as an addition to salads, the flavour is strong with a characteristic hotness. It has a reputation as a spring tonic, and this is its main season of use, though it can be harvested for most of the year and can give 10 pickings annually. Some caution is advised if gathering the plant from the wild, see the notes above on toxicity. The leaves are exceptionally rich in vitamins and minerals, especially iron. The seed can be sprouted and eaten in salads. A hot mustardy flavour. The seed is ground into a powder and used as a mustard. The pungency of mustard develops when cold water is added to the ground-up seed - an enzyme (myrosin) acts on a glycoside (sinigrin) to produce a sulphur compound. The reaction takes 10 - 15 minutes. Mixing with hot water or vinegar, or adding salt, inhibits the enzyme and produces a mild but bitter mustard.

In the UK the watercress growing industry is heavily regulated due to risks associated with the liver fluke parasite. For this reason it is not recommend to be eaten raw when grown in the wild.

http://www.pfaf.org/user/plant.aspx?LatinName=Glyceria+fluitans

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Nuphar lutea—Common Spatterdock

Southeastern N. America - Labrador and Nova Scotia, south to Florida, Texas and Utah.

Nuphar lutea is a PERENNIAL.
It is in flower from Jul to August. The flowers are hermaphrodite and are pollinated by flies, beetles.

Root - raw or cooked. The root can be soaked in water in order to remove a bitter taste. After long boiling, it has a taste like sheep's liver. The root can also be dried and ground into a powder then used as a thickener in soups, or can be added to cereal flours when making bread, cakes etc. Seed - raw or cooked. It can be roasted, then ground into a powder and eaten raw or used to thicken soups etc. The seed can also be toasted like popcorn.

http://www.pfaf.org/user/plant.aspx?latinname=Nuphar+lutea

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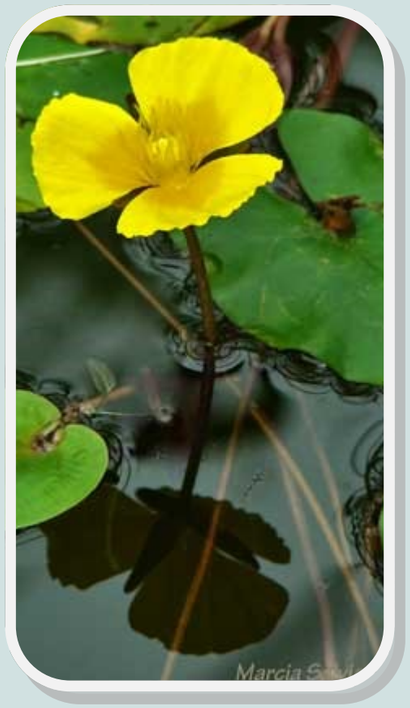

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Phragmites australis—Common Reed

Cosmopolitan, in most regions of the world, including Britain, but absent from the Amazon Basin.

Phragmites australis is a PERENNIAL growing to 3.6 m by 3 m at a fast rate. It is in flower from Jul to September, and the seeds ripen from Aug to October. The flowers are hermaphrodite and are pollinated by Wind.

Root - raw or cooked like potatoes. It contains up to 5% sugar. The flavour and texture are best when the root is young and still growing. It can be dried, ground coarsely and used as a porridge. In Russia they are harvested and processed into starch. Young shoots - raw or cooked. They are best if used before the leaves form, when they are really delicious. They can be used like bamboo shoots. The partly unfolded leaves can be used as a potherb and the Japanese dry young leaves, grind them into a powder and mix them with cereal flour when making dumplings. The stems are reported to contain 4.8 g protein, 0.8 g fat, 90.0 g total carbohydrate, 41.2 g fibre, and 4.4 g ash. Seed - raw or cooked. It can be ground into a powder and used as a flour. The seed is rather small and difficult to remove from the husk but it is said to be very nutritious. A sugar is extracted from the stalks or wounded stems. A sweet liquorice-like taste, it can be eaten raw or cooked. The stems can be boiled in water and then the water boiled off in order to obtain the sugar. A sugary gum that exudes from the stems can be rolled into balls and eaten as sweets. A powder extracted from the dried stems can be moistened and roasted like marshmallow.

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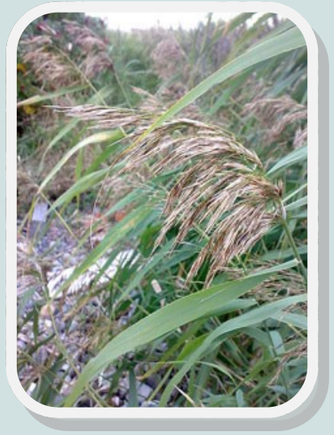

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Sagittaria sagittifolia—Arrow Head

Most of Europe, including Britain, temperate Asia and N. America. Sagittaria sagittifolia is a PERENNIAL growing to 1 m by 0.5 m. It is in flower from Jul to August, and the seeds ripen from Aug to September. The flowers are monoecious and are pollinated by Insects.

Root - cooked. Excellent when roasted, the taste is somewhat like potatoes. The tubers are starchy with a distinct flavour. The tubers should not be eaten raw. The skin is rather bitter and is best removed after the tubers have been cooked. Tubers can also be dried and ground into a powder, this powder can be used as a gruel etc. or be added to cereal flours and used in making bread. The roots (tubers really) are borne on the ends of slender roots, often 30cm deep in the soil and some distance from the parent plant. The tubers of wild plants are about 15cm in diameter and are best harvested in the late summer as the leaves die down. The dried root contains (per 100g) 364 calories, 17g protein, 1g fat, 76.2g carbohydrate, 3.1g fibre, 5.8g ash, 44mg calcium, 561mg phosphorus, 8.8mg iron, 2,480mg potassium, 0.54mg thiamine, 0.14mg riboflavin, 4.76mg niacin and 17mg ascorbic acid. They contain no carotene.

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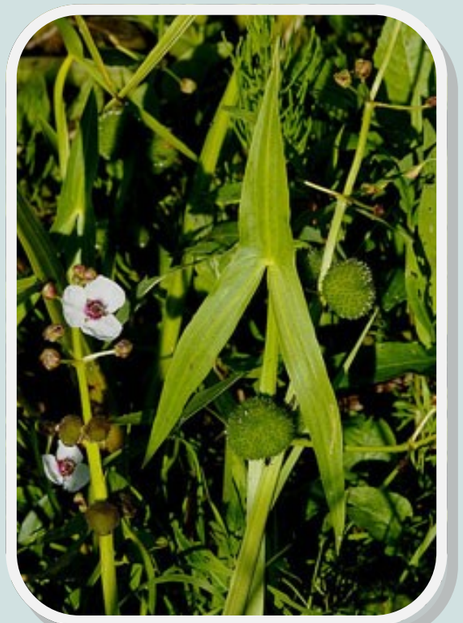

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Scirpus lacustris - Bulrush

Europe, incl Britain, south and east from Lapland to Africa and Asia. N. and C. America, Polynesia.

Scirpus lacustris is a PERENNIAL growing to 2.5 m. It is in flower from Jun to August, and the seeds ripen from Aug to September. The flowers are hermaphrodite and are pollinated by Wind.

Root - raw or cooked. Rich in starch, it can be dried and ground into a powder or made into a syrup. The buds at the end of the rhizomes are crisp and sweet, making excellent eating raw. Young shoots - raw or cooked. Used in spring. Seed - ground up into a powder and mixed with flour for use in making cakes etc. The seed is small and rather fiddly to harvest and utilize. Base of mature stems - raw or cooked. Somewhat tough. Pollen - raw or cooked. Rich in pollen, it is mixed with flour and used in making cakes etc.

http://www.pfaf.org/user/plant.aspx?latinname=Scirpus+lacustris

http://commons.wikimedia.org/wiki/User:OldMuzzle

commons.wikimedia.org/wiki/File:360_Scirpus_lacustris_L._S._setaceus_L.jpg

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Trapa natans - Water Chestnut

Europe to W. Asia and N. Africa.

Trapa natans is a PERENNIAL. It is in flower from Jun to July. The flowers are hermaphrodite.

Seed - raw, cooked or dried and ground into a powder. A sweet floury and agreeable flavour, similar to sweet chestnuts (Castanea spp). The seed contains up to 50% starch according to one report, 16% starch, 3% protein in another report and 15% protein, 7.5% fat in a third.

http://www.pfaf.org/user/plant.aspx?latinname=Trapa+natans

commons.wikimedia.org/wiki/File:Illustration_Trapa_natans1.jpg

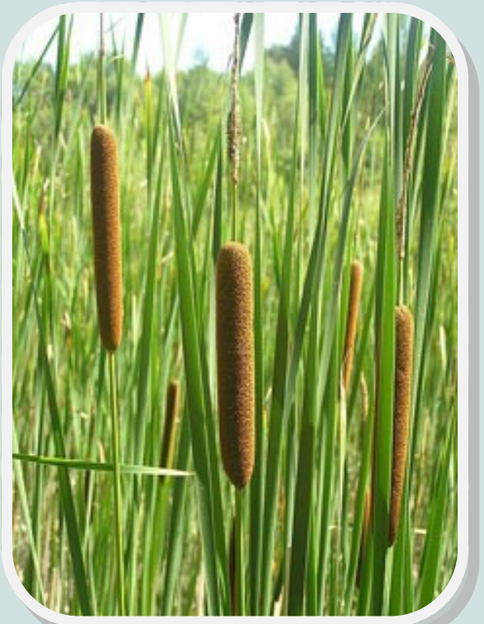
biolib.de

Typha angustifolia - Small Reed Mace

Throughout the world from the Arctic to latitude 30° S, including Britain but absent from Africa.

Typha angustifolia is a PERENNIAL growing to 3 m by 3 m. It is in flower from Jun to July. The flowers are monoecious and are pollinated by Wind. It is noted for attracting wildlife.

Roots - raw or cooked. They can be boiled and eaten like potatoes or macerated and then boiled to yield a sweet syrup. The roots can also be dried, ground into a powder and then used as a thickener in soups etc. or added to cereal flours. Rich in protein, this powder is used to make biscuits etc. Young shoots in spring - raw or cooked. An asparagus substitute. Base of mature stem - raw or cooked. It is best to remove the outer part of the stem. Young flowering stem - raw, cooked or made into a soup. It tastes like sweet corn. Seed - cooked. The seed is very small and fiddly to harvest, but it has a pleasant nutty taste when roasted. An edible oil is obtained from the seed. Due to the small size of the seed this is probably not a very worthwhile crop. Pollen - raw or cooked. A protein rich additive to flour used in making bread, porridge etc. It can also be eaten with the young flowers, which makes it considerably easier to utilize. The pollen can be harvested by placing the flowering stem over a wide but shallow container and then gently tapping the stem and brushing the pollen off with a fine brush. This will help to pollinate the plant and thereby ensure that both pollen and seeds can be harvested.



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Vaccinium macrocarpon - American Cranberry

Eastern N. America. Occasionally naturalized in Britain. Vaccinium macrocarpon is an evergreen Shrub growing to 0.2 m by 2 m at a medium rate.
It is in leaf 12-Jan It is in flower from Jun to August, and the seeds ripen from Aug to October. The flowers are hermaphrodite and are pollinated by Insects, self. The plant is self-fertile.
Fruit - raw or cooked. It can also be dried for winter use. Rich in vitamin C, the fruit is too acid for most peoples tastes to be eaten raw, so it is mainly used in pies, preserves etc. It is said that a teaspoon of salt added to the cooking fruit can take the place of half the sugar normally used. The fruit is between 1 and 2cm in diameter.

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Zizania latifolia - Manchurian Wild Rice

E. Asia - China, Japan, Manchuria

Zizania latifolia is a PERENNIAL growing to 3.5 m. It is in flower from Jul to September, and the seeds ripen from July to September. The flowers are hermaphrodite.

The swollen stem bases, infected with the smut fungus Ustilago esculenta, are eaten as a vegetable by the Chinese. They must be harvested before the fungus starts to produce spores since the flesh deteriorates at this time. They are parboiled then sautéed with other vegetables and have a nutty flavour reminiscent of coconut. The wild forms of this species have developed resistance to the smut, so specially disease-susceptible cultivars are grown. Seed – cooked. It can be used like rice in sweet or savoury dishes. The seed can also be ground into a flour and used in making cakes, biscuits etc. The seed contains about 13.7% protein, 0.9% fat, 72.7% carbohydrate, 0.7% ash. Young inflorescences - cooked and used as a vegetable). Young shoots - raw or cooked. A pleasant sweet taste. The shoots contain about 1% protein, 0.3% fat, 4.7% carbohydrate, 0.7% ash.

http://www.pfaf.org/user/plant.aspx?latinname=Zizania+latifolia

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Case Study – Edible Floating Wetland, Florida, USA

This project has seen the design and installation of a floating wetland into an existing SuDS detention pond, adjacent to a high school in Florida. The floating wetland is designed to remove excess nutrients from the detention pond and is a well-used method, which has also been employed within the UK. In this case, however, the project has been taken a step further by the inclusion of edible plant species within the mat.

The edible species chosen should thrive within the pond, removing excess nutrients as they are harvested. The mat can then be repeatedly reused and replanted, continuing the process. The bare root plants are rolled in coconut coir pads that are inoculated with elm oyster (Hypsizygus ulmarus) mushroom mycelium, which filters the water and helps the plants grow. The mats are created by an American company; www.beemats.com and are made using recycled gym/children's play mats.

The majority of the aquatic vegetables selected for this project would not be suitable for use in UK conditions, but it does include some of the species previously mentioned, such as: Sagittaria sagittifolia (Arrow Head) and Nasturtium officinale (Watercress). This is a design that could be easily replicated and adapted for use in UK conditions, not only in SuDS ponds and basins but also potentially in smaller ponds, lakes and canals.

www.mushroomkatie.tumblr.com/tagged/Edible-Floating-Wetland

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Leeds Edible Campus - Potential site analysis

It is clear when looking at the first phase of the edible campus that it has little in the way of blue infrastructure. There are no water courses or ponds within the area; although there is evidence that there used to be a pond within St Georges Fields, this looks to have dried up a number of years ago. Leeds is a city that suffers from serious flooding problems, mostly fluvial, related to the River Aire and its tributaries.

Although the first phase of the Edible Campus area does not suffer from fluvial flooding problems, there is an increasing awareness of the problems created in heavily urbanised areas and city centres by surface water. It is also anticipated that surface water will become an increasing problem in the future, as average rainfall amounts increase through the effects of climate change and severe rainfall events become more frequent. There is a real opportunity to link the objectives of the Edible Campus with new water management techniques to create a truly multi-functional green space.

St Georges Fields

Within the Leeds University campus, to the south of Woodhouse Moor, is St Georges Field (also known as the former Woodhouse Cemetery). Since becoming part of the Leeds University campus, the area has been landscaped and many monuments have been removed to

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create a green space for use by students and members of the public.

Within St Georges Fields, to the south of the remaining Grade II listed chapel, is a depression that used to be a pond (see photo on previous page). The pond has since dried up; however, there is still evidence of it in the form of some large Weeping Willows that likely once grew around its edge.

Creation of an edible wetland in this location would provide an extra reason for people to visit the site, meaning the area is better utilised. The pond that may have existed in the past would provide an ideal area to create the wetland; other areas within the site would likely be unusable due to the presence of graves. The proximity of large mature trees in and around where the pond used to be may cause problems in terms of shading and this may mean that some of the trees would need to be removed in order to facilitate the development of a wetland. In terms of topography, the site is not ideal; St Georges Field is located at a high point (Woodhouse Moor), which would therefore make the collection of any surface water to create the wetland difficult.

Woodhouse Moor/Hyde Park Bowling Greens

Within the formal park area of Woodhouse Moor (also known as Hyde Park) are 3 bowling greens. As a result of the decline in the popularity of crown green bowling,

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the greens are underused. Leeds City Council, who maintain the bowling greens, have accepted that two of the greens may no longer be maintained in the future. due to the expense of doing so and their under use.

Unlike other similar Victorian parks of this size, there are no existing water features within Woodhouse Moor. Creation of an edible wetland to replace one or both of the redundant bowling greens would provide multiple benefits to the park and the area as a whole. The topography of the area is similar to St Georges Fields in that the park occupies a high point (hence Moor), therefore accumulating enough surface water to create a wetland will be difficult.

Meanwood Valley Urban Farm

The Meanwood Valley Urban Farm is a charity, which began operation in 1980 in order to provide environmental and educational services to inner city Leeds communities. It occupies an area of around 10 hectares in the Meanwood Valley. The farm contains

many of the facilities that one would expect to find at any farm but with an ethos of sustainability, environmental education and community involvement.

By definition, the Meanwood Valley Urban Farm is already a productive landscape. It lies just outside the current phase 1 boundary of the Edible Campus, although it is close enough to link in to the existing campus projects. The farm suffers from flooding problems caused by its location and proximity of Meanwood Beck

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to some of its buildings. The café area in particular is prone to flooding from the Beck and evidence from the farms management team suggests that flooding is becoming a more regular problem over the last 10 years.

The Farm already has a number of sustainable drainage initiatives designed to reduce the impact of flooding and also reduce its water consumption. The main farm building and visitor centre is not connected to the mains sewer; all waste water from the building's toilets is treated by a small reed bed just outside the building. This is a small example of a technique that is now being used at much larger scales. Waste water is cleaned naturally by the reed bed and then released into the nearby Beck. Regular checks take place to ensure the water reaches minimum standards of cleanliness.

The Farm's management team have also created a wetland area adjacent to the Beck. This is fed by a drain, which travels down the side of the valley and into the Beck, close to the entrance of the farm. This drain was previously culverted where it met the Beck, which caused problems with flooding during heavy rainfall events. Through the removal of this culvert and creation of wetland adjacent to the Beck, the flow of water is slowed before it is released into the watercourse. This has reduced flooding problems at this point and helps to reduce flooding downstream. The wetland created is also an important habitat for plants, birds and insects.

Meanwood Valley

There are a number of potential edible wetland projects that could be undertaken within the Meanwood Valley Urban Farm, or adjacent to it, that could be of benefit to the farm. As has been highlighted, the Meanwood Valley already suffers from flooding problems and due to its location with respect to the edible campus, the productive landscapes already there and the knowledge and know how from the Farm, makes it the ideal test location for an edible wetland.

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Meanwood Valley Urban Farm– Site Analysis

There are a number of potential sites within and around the Farm that could possibly support different types of constructed wetlands.

The first site is adjacent to the Farm and local housing. This would be ideal for testing a waste water or surface water treatment and edible wetland system. Waste water would first be treated in a reed bed, before continuing into a large pond and eventually being discharged into Meanwood Beck.

The area is currently underused, and currently only contains a small football pitch. There is a lack of biodiversity due to the large amount of amenity grassland.

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The second site is located on the opposite side of Meanwood Beck. This is again an underused area of amenity grassland adjacent to the main road, with trees on it boundaries.

The proposal for this site would involve a partial diversion of some of the flow from the Beck to create a wetland, before releasing it back into the Beck a little further downstream. There would be considerable engineering problems to deliver this proposal; the level of the site is well above that of Meanwood Beck and therefore considerable earth moving would be required. This would potentially create a very deep wetland due to the difference in levels and therefore may not be suited to use for growing edible plants.

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The third site is located downstream of Meanwood Valley Urban Farm at a meander in Meanwood Beck. This proposal would see a small diversion of the Beck into a natural glade area that regularly floods before being released back into the Beck on the other side of the meander.

There are potential problems with this option. A number of mature trees may need to be removed to provide adequate light to the wetland. The area also regularly floods; in extreme cases it may be that any wetland constructed in this area would be come damaged and edible planting lost.

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Meanwood Valley Urban Farm– Site Analysis

The fourth and final potential site lies to the north east of the farm boundary on the steep valley side. Due to the steepness of the land in this area, the only viable option would be to create a terraced wetland, such as those found in Asia in rice production.

This would be a technically difficult proposal to implement due to its location. There would also be concerns with collecting enough water sustainably in this location to create a wetland suitable for supporting edible plants.

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Edible Wetland Research Project—Sketch Designs

Short rotation Willow coppice

Main Wetland

Waste water reedbed

Inlet

Drain

Path

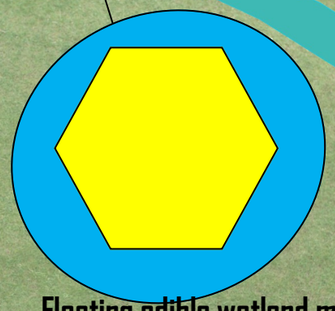
Reedbeds and sub-mergent plant species

Common Reed

Meanwood Beck

Outlet

American Cranberry to southern margin



Floating edible wetland mat, containing: Galingale, Wild Celery and Watercress.

Native woodland buffer

Boardwalk through site

40.0m

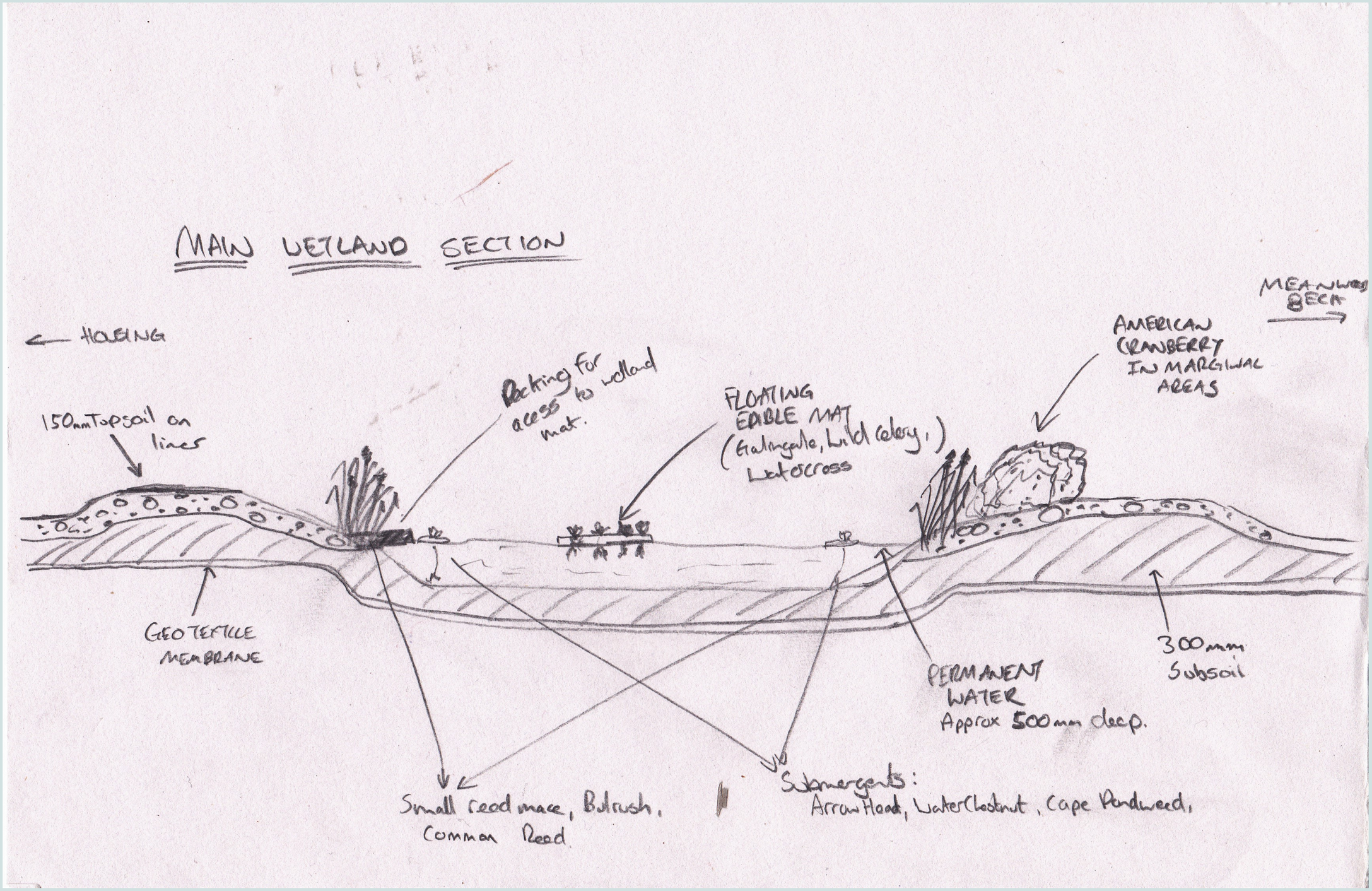
Scale 1:500

0 5 10 15 20 25 30 35 40 45 50 m

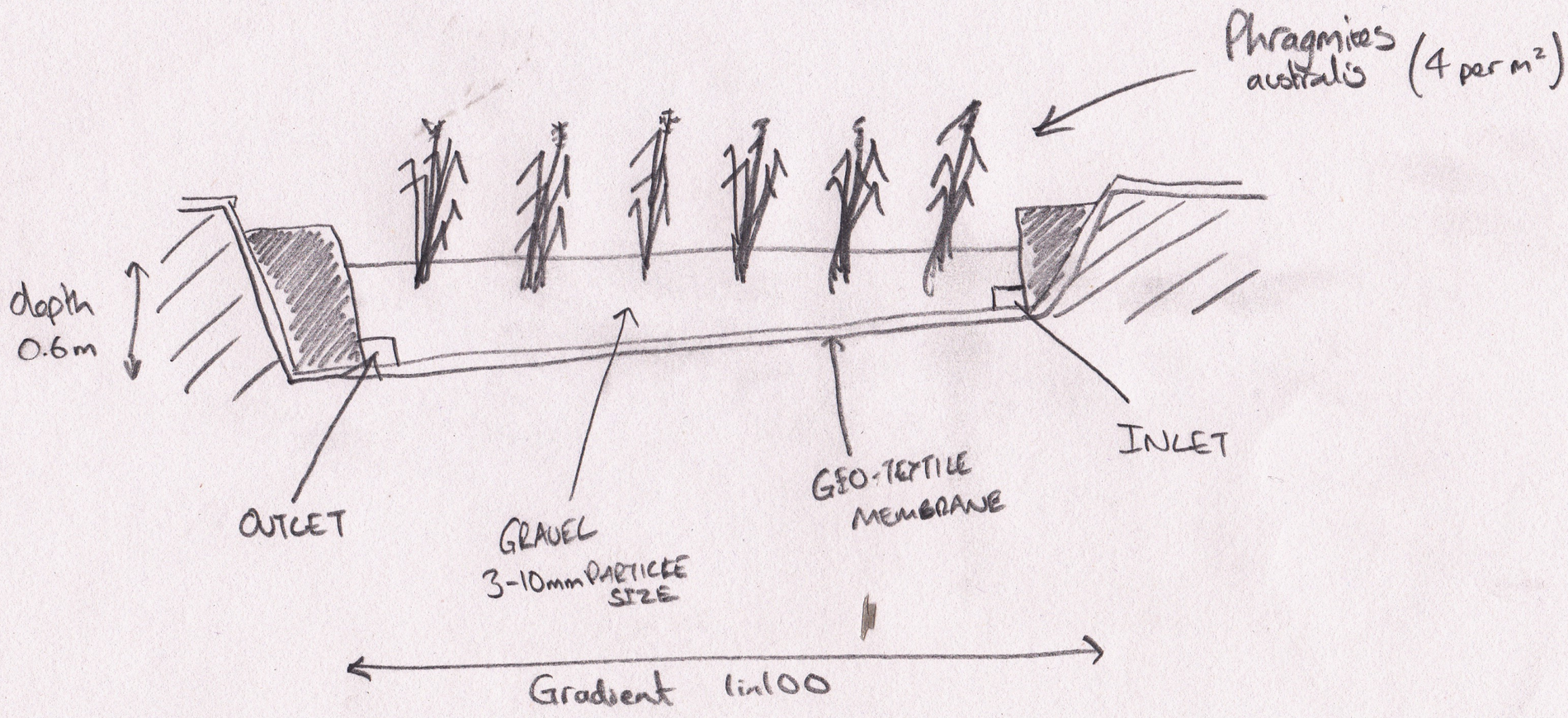
Digimap®

Mapping sourced from Ordnance Survey®

Christopher Leather
Leeds Metropolitan


MAIN WETLAND SECTION
← HOSING
MEANWOOD BECK →
AMERICAN CRANBERRY IN MARGINAL AREAS
Decking for access to wetland mat.
FLOATING EDIBLE MAT (Galingale, Wild celery, Watercress
150mm Topsoil on liners
GEOTEXTILE MEMBRANE
PERMANENT WATER Approx 500mm deep.
300mm Subsoil
Small reedmace, Bulrush, Common Reed
Submergents: Arrowhead, WaterChestnut, Cape Pondweed,

REEDBED SECTION



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Analysis

The proposed design solution has a number of strengths; however, it needs to be acknowledged that this is purely a proposal for further research. The included sketch plan shows a waste water treatment option with a reed bed of approximately 700m^2. The size of this reedbed is based on an assumption that it would serve around 100 houses or 400 people, requiring an average size of between 6.6m^2 and 10m^2 of reed bed per house based on average sewerage levels.

The use of a waste water reed bed obviously makes the project more complicated when the water further down the system will be used for producing edible plants. Therefore there are alternatives, for instance: creating a reedbed that accepts grey water (none sewage) or surface water only from the nearby houses. Grey water would mean that the reed bed could be reduced in size by 30% and a surface water reed bed would be even smaller. These options would also allay any fears regarding public health and the use of the water for producing edible plants.

Edible floating wetland mat

The proposed floating wetland mat is based on the American case study. However, this would definitely require further testing within UK conditions to establish the best species mix and locations for these floating mats. There are not currently any suppliers of these mats within the UK but there are other specialists who have knowledge and experience of implementing floating reed beds, which are very similar in construction.

A floating wetland mat is also very transferable; smaller versions could even be used in garden ponds. The species chosen in this example are all native to the UK and therefore should thrive in the right conditions. However, non native species may also be suitable for further testing, providing they are properly managed.

In this case, the mats would be anchored to points along the boardwalk where they could be pulled in for harvesting, maintenance etc.

Main wetland planting

The main wetland contains a variety of different edible and productive elements within its design. This includes

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short rotation willow coppice; marginal areas planted with American Cranberry bushes; edible reedbeds; edible submergent plants and the edible floating wetland mats**.** The chosen plant species are not all native but have been chosen, as they should be able to survive in UK conditions.

Two reed species and one rush have been chosen for the main wetland. All have considerable edible qualities but are currently not considered as a food source. This is surprising due to their abundance within the UK. This project could therefore act as a stimulus to educate the public about edible wetland species, particularly as it would be managed by the Meanwood Valley Urban Farm.

Green Infrastructure Benefits

As well as producing edible aquatic plants, this project also delivers many more benefits. These include; ecological enhancements, aesthetic improvements, leisure opportunities, educational opportunities and flood risk/water quality development.

In particular, the project would deliver significant habitat improvements for the Meanwood Valley. The site would act as another important wetland in what is already an important wetland corridor running into the centre of Leeds.

Future Challenge

If this project or something similar is realised in the future, the main challenge will be educating the public as to the uses of edible aquatic plants. There is an abundance of wetlands within this country that could support edible aquatic plants, and in the future the use of SuDS will become more and more important to protect existing and future development from the impacts of climate change. An edible wetland as part of a sustainable drainage system is therefore an ideal method of creating a Continuous Productive Urban Landscape and a project in some form would enhance the Leeds Edible Campus area significantly.