Bethnal Green Nature Reserve

Wetland Enhancement Report

2021-22

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This report is available on our websites and in print at the Bethnal Green Nature Reserve.

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Front cover: The Ecology Pond's first British water lily (Nymphaea alba) in flower on June 27th 2022. Photo: Michael Smythe.

The Bethnal Green Nature Reserve is a nature reserve and cultural institute in Tower Hamlets, East London. We host an annual residency for researchers working across the arts, architecture, science and humanities. Our public programme actively engages with the environmental and social complexities of the surrounding urban landscape.

The Wetland Enhancement project was directed by:

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Adelaide Bannerman, Curator in Residence
Andrea Cox, Careers Consultant
Ark Landscapes
The Bethnal Green Nature Reserve Volunteers and Residents
Daze Aghaji, Artist in Residence; Climate Activist
Dimuthu Meehitiya, Resident Ecologist and Environmental Educator
Forest Fridays' Ingrid Chen, Shilpi Choudhury and all the students
GoodGym Volunteers
Hayley Harrison, Artist in Residence
Isabella Johnston, Forager at Rights for Weeds
Jade and Sonny, Arborists and Tree Surgeons
Jane Laurie, Local Bird Ecologist
Joanna Pocock, Environmental Writer
John Archer, Biodiversity Officer at London Borough of Tower Hamlets
John Doe, Mini Digger Operator
Karolina Leszczynska, Site Manager at Camley Street Natural Park
Margaret Cox, Co-Founder of the Bethnal Green Nature Reserve Trust; Local Tenants & Resident Association Chair
Michael Smythe, Co-Founder of the Bethnal Green Nature Reserve Trust; Artist and Creative Director of Nomad Projects
Neil Davidson, Landscape Architect; Chair of the Bethnal Green Nature Reserve Trust
Nick Bridge, UK Foreign Secretary's Special Representative for Climate Change
Shumaisa Khan, Medicinal Garden Coordinator
Stephen Martin, Tower Hamlets Cemetery Park
Sylvia Myers, Ecologist at the Natural History Museum
Terry Lyle, Botanist and Environmental Educator
Tom McCarter, Head of Gardens at the Natural History Museum

A few of the many people involved. **Above (clockwise from top left):** Edward, Michael, Zoe, Tyra, Adelaide, Daze, Chiara, Charlie, Salih, Lauren, Mila, Dimuthu and Shumaisa. Photo: Michael Smythe.

Above: Forest Fridays. Photos: Shilpi Choudhury and Claire Chatelet.
Below: Volunteers, Residents and Ecology Interns. Photos: Michael Smythe.

Contents

Scope

This report is a summary of the Wetland Enhancement project at the Bethnal Green Nature Reserve, London, United Kingdom. The project began in September 2021 as part of a year-long upgrade of our pond network.

The many species reliant on this critical habitat are impossible to count. With a new wetland design, we aim to increase biodiversity across the site while improving pond access for amphibians, birds, insects and mammals (including humans).

The report begins with an introduction to wetland conservation and an overview of our wetland's history. We detail the ecological rationale for an upgrade, our project aims, and each phase of the pond redesign and refurbishment. In the following chapters, we share a planting list for the new Ecology Pond and an update from the wetland's first summer. Finally, we announce upcoming wetland ecology surveys and workshops, and share suggestions for how the wetland can be looked after over the next 30 years.

The report was written following an Ecology Internship at the Bethnal Green Nature Reserve, which ran alongside the pond refurbishment process in September to October 2021. We hope that it will be a useful resource for present and future site caretakers and friends of the nature reserve, and for anyone interested in wetland habitat creation or enhancement. It is not intended to be an expert guide, but an explanation of our thinking and experimental approaches, guided by insights from our residents and extended community in London.

Throughout the report, citations and additional notes are indicated by numbers in brackets. You can find a full list of references on pages 60 - 61. There is space for you to write notes on the inside back cover (page 62).

Introduction: Wetland Conservation

A wetland is an area of land that is covered by or saturated with water either permanently or seasonally, forming a distinct habitat and ecosystem. Whether inland or coastal, urban or rural, in a pond, swamp, marsh or fen, life flourishes wherever soil interacts with water.

Ponds are one of many types of wetland.

Why are wetlands important?

As habitats, wetlands are hotspots of **biodiversity**: the variability of life measured at different scales, from genes to species, ecosystems and more. Countless specialised amphibians, birds, invertebrates, microorganisms, plants and mammals rely on wetlands as homes, breeding grounds and critical water reservoirs.

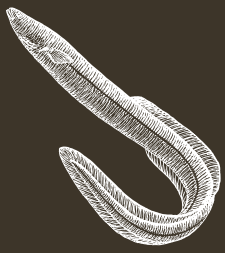
As complex and highly productive ecosystems, wetlands produce huge amounts of organic matter. They can absorb carbon from the atmosphere, slowing down climate change. They also act as buffer zones in extreme weather events, such as storms and floods, by storing water and and reducing air temperatures by up to 10 degrees Celsius [1]. In urban landscapes such as London, wetlands improve air quality by absorbing pollutants, and replenish and purify drinking water. They are also important to human societies, providing opportunities for livelihoods, education, leisure, and the improvement of human health and wellbeing.



Despite their value, wetlands are disappearing.

The UK has lost 35% of its wetlands since 1970 at a rate three times faster than the loss of forests [1]. In urban environments particularly, wetlands have been severely degraded, fragmented or built upon. 25% of wetland species globally are now at risk of extinction - from dragonflies and damselflies to water voles, toads, mosses, eels, and many more. In the UK currently, 128 inland wetland species are classified as Vulnerable, Endangered or Critically Endangered on the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species [2].

Fortunately, there is hope for conserving wetlands and the species that depend on them. Wetland conservation involves protecting and preserving wetland areas and species for current and future generations. Unlike ancient forests which can take centuries to regenerate, it is possible to create and restore wetland habitats in a matter of months or years [1]. Habitat-level conservation is more effective for protecting a wide range of species, rather than targeting conservation towards individual species. At the Bethnal Green Nature Reserve, this is why we're focusing on improving the quality of our wetland ecosystem as a whole, to provide crucial habitat and refuge for a range of species.


Clockwise from top left: water vole, dragonfly, moss, damselfly, eel, and toad.

Our Wetland History

The historic pond newtork

The Bethnal Green Nature Reserve's original wetland was founded 30 years ago under the guidance of Terry Lyle, a local botanist and environmental educator. In 2002, a larger pond network was installed with four interconnected modules, each lined with a synthetic butyl rubber. These ponds were populated predominantly with yellow flag iris (Iris pseudacorus). The wetland's first upgrade took place in 2016. This saw us install six smaller ponds around a larger pond to provide different habitat options (e.g., a bog pond, deep pond, shallow pond) for newts and toads.

Installation of modular ponds at the Bethnal Green Nature Reserve. Photo: Nomad Projects.

Ecological successes and challenges

Historically, the wetland has been particularly successful in supporting a smooth newt (Lissotriton vulgaris) population. Smooth newts are amphibians, and are legally protected in the UK from sale and trade [3]. Like other newts, they are negatively affected by habitat destruction, pollution, wetland fragmentation and the introduction of fish to ponds (which predate on newts). They live on land for most of the year, but reproduce in ponds between spring and summer.

Our ponds have, however, struggled to support toads. This may be because of the 'island effect'. Since the nature reserve is surrounded by a built environment where toads can't easily travel across (creating an 'island'), any populations here had a low level of genetic diversity, making them less resilient to diseases and environmental stressors. The historic wetland was also dominated by a few plant species, including yellow flag irises, common ivy (Hedera helix), and least duckweed (Lemna minuta): vast green 'mats' of tiny clover-like plants which can quickly overtake a pond and outcompete other plants. This was a huge problem for biodiversity.

Duckweeds and Azolla

Plants in the **duckweed** subfamily reproduce rapidly and can quickly spread across a pond surface unless regularly removed. This sample from a pond in Tower Hamlets Cemetery Park features a duckweed plants.

Azolla, a genus of aquatic ferns, is the main plant pictured here. It has a similar appearance to duckweed and can also dominate in ponds, affecting light and oxygen levels. It can be invasive and even more aggressive than duckweed, so should be avoided.

Yellow Flag Iris

The yellow flag iris (right), with its drooping, sunshine-yellow flowers and tall, sword-like leaves, is commonly found along pond margins and in reed beds. It can become invasive and dominate in wetlands, outcompeting other vegetation such as sedges and rushes. Once they have spread, yellow flag irises can gradually turn a pond into marshier wetland, altering the biological community structure through a process called ecological succession. Eventually, as open water is overtaken by vegetation and accumulated sediment, grasses and trees can become dominant, turning the pond into a forested swamp. Plants like these may be planted in baskets or cut back regularly to prevent their spread.

Pond health and invertebrate survey

On October 2nd 2021, we carried out a pond survey on the historic pond network using the Open Air Laboratories (OPAL) citizen science Water Survey kit [4]. We used nets to sweep invertebrates from the ponds and into plastic trays with samples of pond water. Using OPAL's Freshwater Invertebrate Identification Guide [5] and microscopes, we then identified the different types of invertebrates living in the water, the water's clarity, and its pH, which all indicate pond health.

Left: Identifying invertebrates in pond water samples with microscopes. Photo: Dimuthu Meehitiya.
Right: A pond water sample with a pH test strip.

Pond survey results

The invertebrates we identified indicated an overall low quality of water. We found invertebrates such as water snails, leeches and flatworms, which have the lowest pond health index scores (1/10) according to OPAL. While we found mayfly larvae, which have a medium pond health index score (5/10), bioindicator species of a high-quality pond (10/10) were missing, such as cased caddisfly larvae, dragonfly larvae, damselfly larvae and alderfly larvae.

The survey showed us that the historic wetland had a low level of biodiversity, which was likely related to poor pond health and a lack of suitable habitat for other invertebrates. We also found that the ponds were slightly acidic, with a pH level between 6.0 and 6.5. While this wasn't as acidic as we expected in an urban setting, the pond would ideally have a neutral pH of 7.

These results demonstrated a need to encourage a healthier wetland which could provide a suitable habitat for a wider range of species. The findings also coincided with the end of the lifespan of the pre-existing pond infrastructure, which naturally wears down over the course of a few decades.

A sample from the historic ponds.

Water slater

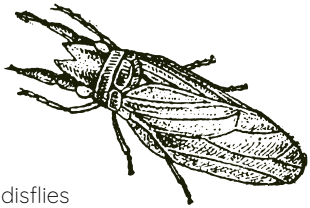
- Aquatic relatives of the garden woodlouse
- Often live in rotting leaves at the bottom of a pond
- Can live in nutrient-rich and low-oxygen conditions
- OPAL pond health index score: 1/10

Mayfly larva

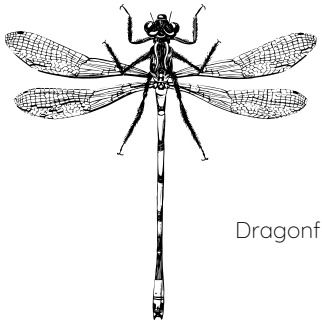
- Some mayflies can tolerate pollution.
- They are found in both high quality ponds, and ponds that are less healthy.
- OPAL pond health index score: 5/10

Invertebrates to attract with a healthy pond...

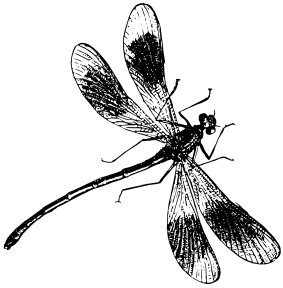
By improving the health of our ponds, we hope to provide suitable habitat for invertebrates such as caddisflies, dragonflies, damselflies and alderflies, which were absent from the historic ponds. Invertebrate diversity supports ecosystem functioning, e.g., through nutrient flow and cycling processes. These wetland invertebrates play important roles in food webs as primary consumers, predators, prey, and decomposers.



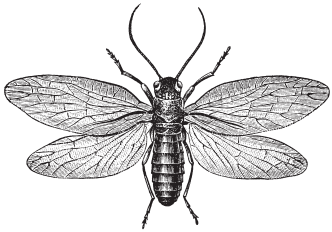
Caddisflies



Dragonflies



Damselflies



Alderflies

The Bethnal Green Nature Reserve

Wetland Enhancement Project (2021-22)

Wetland enhancement is the practice of rehabilitating or re-establishing degraded wetlands [6]. Our Wetland Enhancement project involves an ambitious upgrade of the Bethnal Green Nature Reserve's pond network by removing the pre-existing main pond network, and creating a new, larger pond with additional habitat features between 2021 and 2022.

Project Aims

1) Increase biodiversity at the Bethnal Green Nature Reserve

Biodiversity is the variability of life in an area, which can be measured at different scales, e.g., the variability of genes, species, and ecosystems. We hope that a larger, healthier pond populated with denser, more biodiverse vegetation will provide more food and habitat opportunities for wildlife. By attracting a greater diversity of invertebrate species, we hope that the wetland will support more types of amphibians, attract more birds, and consequently bring in more mammal predators.

In particular, we hope that the Wetland Enhancement project will support more newts such as the protected great crested newt (Triturus cristatus), toads, and dragonfly nymphs. Over time, we aim to attract birds such as reed warblers (Acrocephalus scirpaceus), sedge warblers (Acrocephalus schoenobaenus), water rails (Rallus aquaticus), black redstarts (Phoenicurus ochruros) and woodcocks (Scolopax rusticola) which may arrive onsite to nest, drink or rest. While our site is relatively small, it's possible that a grey heron (Ardea cinerea) may stopover if there is a suitable landing area.

Developments such as these will increase biodiversity throughout the nature reserve over time. Although we are initially focusing on species as an indicator of biodiversity, other dimensions of biodiversity are important and related. For example, greater species-level biodiversity can support functional diversity: the range of traits that organisms have which contribute to ecosystem functioning, influencing ecosystem dynamics, stability, productivity and nutrient balance.

2) Improve human engagement with wetland ecology by up-skilling local learning and confidence in pond care, and by providing educational use for schools and communities that access the site.

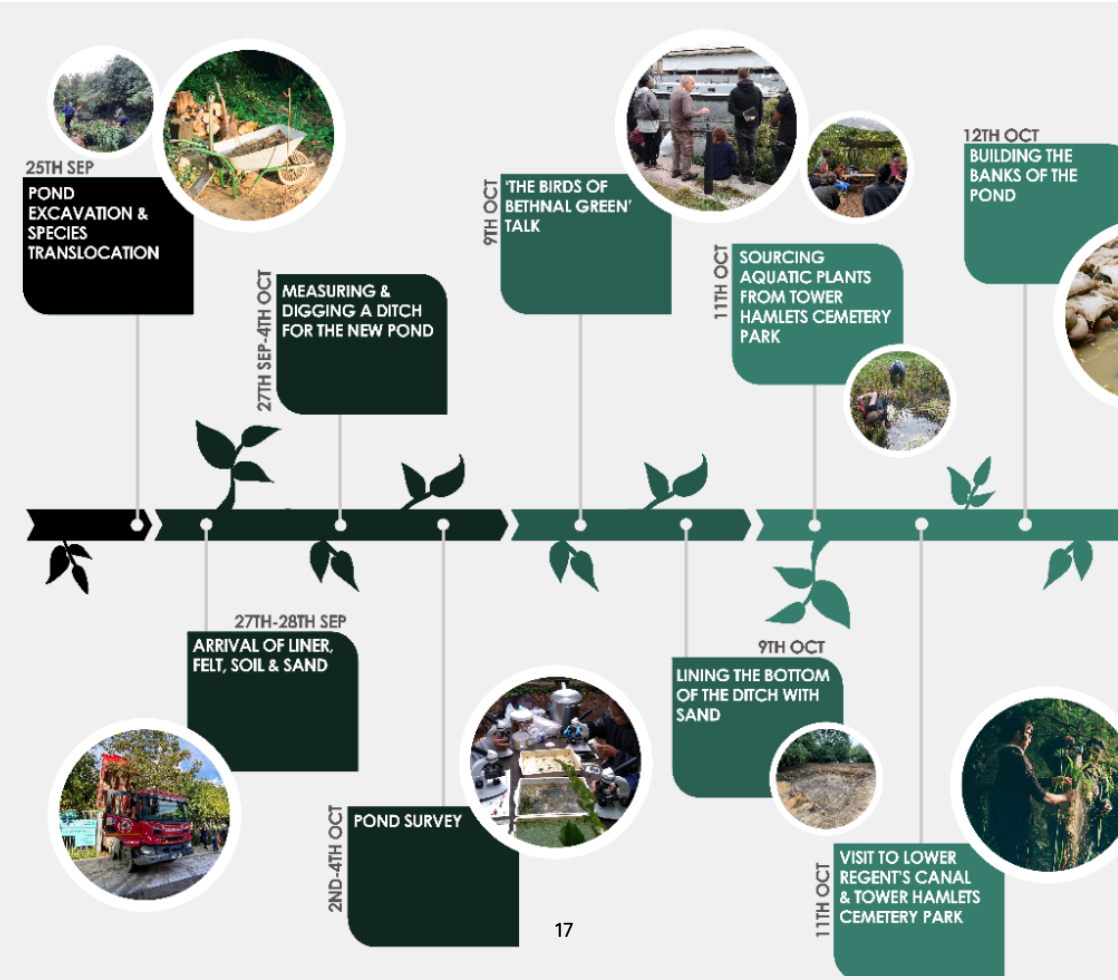
The Ecology Internship, through which our Urban Ecology team became involved with the Wetland Enhancement project, has already begun this. As young people from underrepresented groups in the conservation sector, we have gained valuable, transferable, and paid experience in urban wetland development and ecosystem management. We have also been able to nurture skills and connections to environmental workers and sites across London through enrichment activities led by professional ecologists, educators and artists, and through a community-led conservation project. The project will aim to continually centre the enrichment of human nature alongside non-human nature, and social resilience around wetland care, education and conservation alongside ecological resilience.

Project Timeline

The pond refurbishment process was carried out in three phases between September and October 2021. These are outlined in the timeline below and detailed in the following sections. However, please note that these phases were non-linear and often overlapped. For instance, consultations with local experts were interwoven with our design and planning processes, and building work was ongoing over the course of the 5 weeks this timeline covers. Beyond these initial phases, the work of the Wetland Enhancement project will continue throughout 2022 and beyond (see page 47).

Phase 1

Phase 2



Phase 3

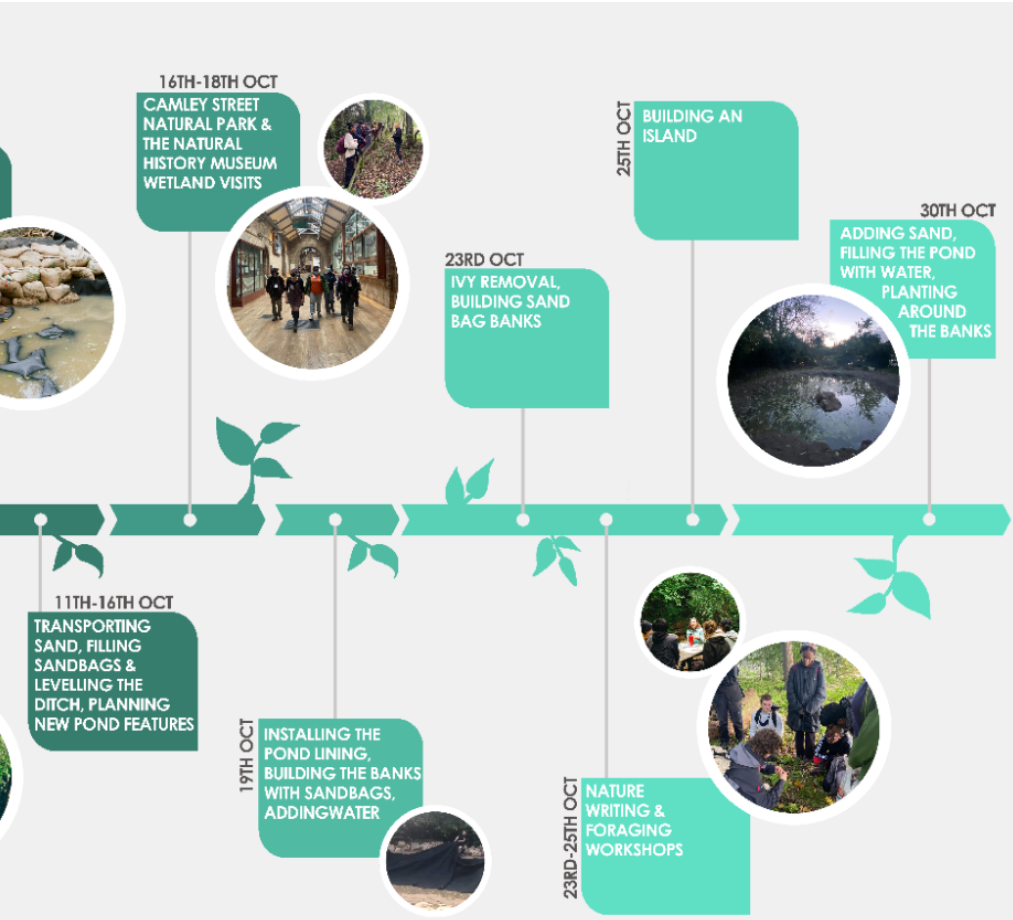


Image: Salih Abdurrahman

Phase 1

Pond Excavation

Since the pre-existing modular pond network had been in place for almost 20 years, we carefully removed its water, soil, pond liner, plants and invertebrates whilst aiming to cause the least disruption possible to the established ecosystem. We decided which plants would remain on site, how to keep these alive during the refurbishment, and which plants we would remove to encourage a net increase in biodiversity. Autumn is the best time to translocate species and excavate the pond as it's a quieter time for wetland life. We were thinking particularly of the newts, which hibernate from mid-October and no longer need to access the ponds for reproduction once summer is over.

The first step was to use buckets to manually move most of the water out of the modular pond network. We stored this water in three smaller ponds on the eastern side of the wetland site, which would remain a part of the pond network. We then translocated plants. There were many yellow flag irises to uproot using our hands and garden forks, and we kept some alive in a tub of water during the refurbishment for replanting later. We then used an elongated crowbar to puncture the pond liner and allow the remaining foot of water to drain into the earth underneath. This made it easier to remove debris and organic matter at the bottom of the pond with spades, shovels and wheelbarrows. We then unbolted the pond modules to remove them. These processes took several days over a three-weeks period.

Removing water from the pond with buckets. Photo: Michael Smythe.

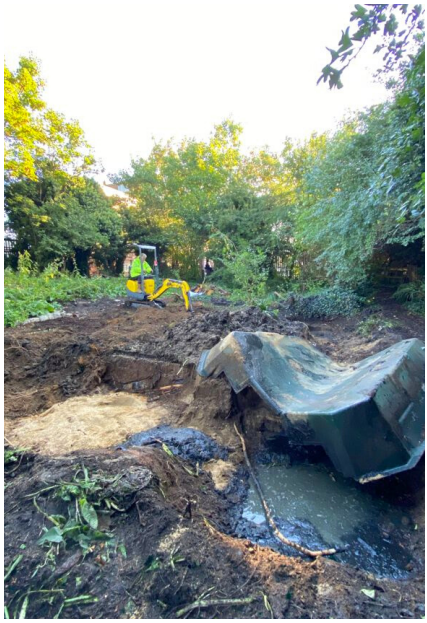
Piercing the module liner to drain water. Photo: Michael Smythe.

Removing sediment from the bottom of the pond. Photo: Zoe Opiah.

Unbolting modules. Photo: Dimuthu Meehitiya.

Excavating modules. Photo: Dimuthu Meehitiya.

We continued the excavation process with the help of volunteers and a mini digger. We removed the modular ponds and dug up surrounding earth to create a 9m length x 9m width x 1.8m deep ditch which could hold a new, bigger pond. Over the course of the refurbishment, we also removed plant species which were dominating the wetland area, including English ivy (Hedera helix) and alexanders (Smyrnium olusatrum). We combed the undergrowth to remove these plants while keeping less successful competitors such as violets. We also attempted to remove as many of the cherry tree saplings near the pond as possible, since their roots could easily grow through and damage the pond liner. We filled these areas with a soil and sand mixture to make it more difficult for dominant species to return, and give time to other plants to establish.



Digging and removing earth.
Photo: Michael Smythe.

The excavated wetland site. Photo: Michael Smythe.

Phase 2

Designing a New Wetland

Consulting local knowledge | Site visits

Before designing the new pond and habitat features, we had the opportunity to visit urban wetlands across London to enrich our understanding of wetland ecology, design and management, and tap into the rich ecological expertise of our wider community. We saw diverse wetland habitats and different types of ponds at Camley Street Natural Park [7], Tower Hamlets Cemetery Park [8] and the Natural History Museum [9]. We also visited a stretch of Regent's Canal maintained by the Lower Regent's Coalition [10]. Guided by ecologists, architects and environmental educators who kindly shared their insights, these visits informed our vision of what features our pond could integrate to encourage greater biodiversity.

Camley Street Natural Park, 18th October 2021

Camley Street Natural Park, a former coal yard near King's Cross, Central London, has been transformed into a 2-acre nature reserve featuring a wetland, meadow and woodland. Karolina Leszczynska, who manages the site, shared her 11-year journey from working as a London Wildlife Trust volunteer to becoming a site manager, and gave us a tour of the nature reserve.

The pond is fed by Regent's canal and is surrounded by marshlands and reedbeds. It's significantly larger than the wetland site at the Bethnal Green Nature Reserve, and useful to explore as an example of a developed urban wetland ecosystem. The site is biodiverse and frequently graced with kingfishers, dragonflies, grey herons, cormorants, damselflies, amphibians and warblers. However, management challenges arise in response to invasive species such as Japanese knotweed, red signal crayfish

Camley Street Natural Park's wetland.
Photo: Michael Smythe.

and terrapins - a small species of turtle known to eat bird eggs and disrupt vegetation. Karolina also showed us how dead wood is used around the wetland to create habitat for invertebrates, such as the endangered stag beetle. The site additionally integrates viewing platforms and low pond-dipping platforms, making the wetland more accessible and engaging for visitors. 35 floating islands in the neighbouring canal create valuable habitats for fish and invertebrates. The islands are made of three layers and constructed from pre-planted coir (coconut husk) mats that help to purify the water.

Karolina shows us around the extensive site, which includes a seating area designed to amplify sounds from the canal. Photo: Chiara Famengo.

Tower Hamlets Cemetery Park.

Tower Hamlets Cemetery Park,
11th October 2021

Tower Hamlets Cemetery Park is a nature reserve, heritage site, and London's most central urban woodland. Dimuthu Meehitiya led a tour of four of its ponds, which each had distinct architectures and characteristics. One pond (pictured right) had very straight, vertical edges, resulting in hardly any life. Dimuthu explained the need to build gently sloping banks to allow animals to easily enter and exit a pond. Sloping banks also allow different plants to root at their preferred water depth. Another pond was a seasonal pond, given its shallow depth and difficulty retaining water in drier months. The visit highlighted how influential design features are in determining the health and properties of a pond.

A pond with straight edges. The water was murky and there were few signs of wildlife. Photo: Michael Smythe.

Dimuthu leads a tour around Tower Hamlets Cemetery Park. Photos: Michael Smythe.

Lower Regent's Canal, 11th October 2021

We had the opportunity to talk with Terry Lyle during a tour of Lower Regent's Canal in East London. Terry holds an extensive knowledge of aquatic plants and wetland ecology, and an intimate understanding of the Bethnal Green Nature Reserve's wetland having overseen its original development. We learnt about the importance of introducing oxygenating plants, plants which provide habitat for birds, and invasive plant species to avoid planting. We also saw an example of a floating 'island' of plants, which provide food and shelter for birds, and a safe distance from terrestrial predators such as cats and foxes. Together, we considered introducing an island structure to our new pond to support and protect visiting birds.

Hornwort at Lower Regent's Canal. Photo: Michael Smythe.

Learning from Terry Lyle at Lower Regent's Canal. Photo: Salih Abdurrahman.

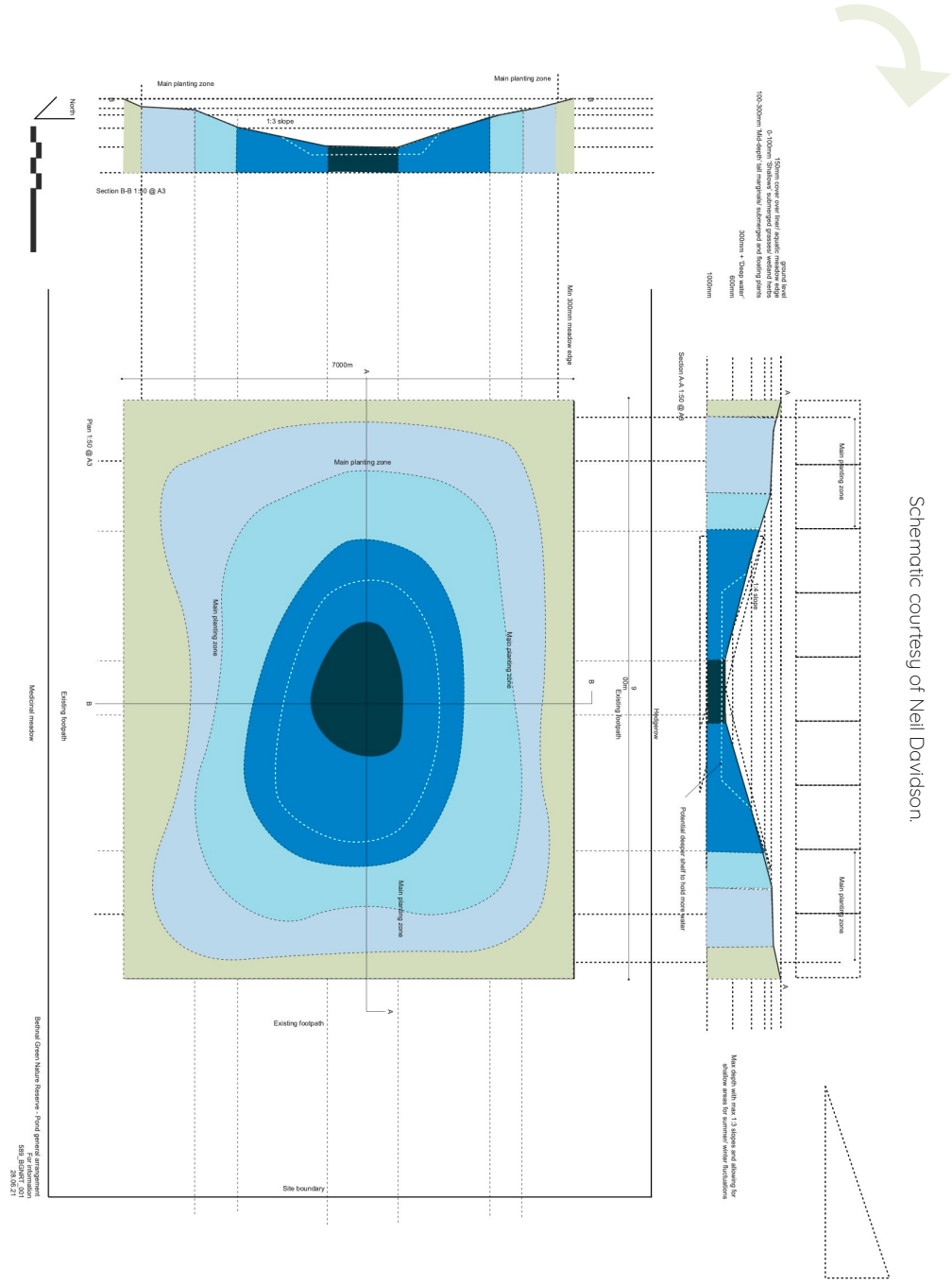
Visit to the Natural History Museum Wildlife Garden. Photo: Michael Smythe.

The Natural History Museum, 18th October 2021

We visited the Wildlife Garden at the Natural History Museum in South Kensington, West London. The tour was led by Tom McCarter, Head of Gardens at the Natural History Museum; Sylvia Myers, Ecologist at the Natural History Museum; and Neil Davidson, Landscape Architect from J&L Gibbons Landscape Architects and Design and Chair of the Bethnal Green Nature Reserve Trust. Neil is also currently overseeing the redesign of the extensive parkland surrounding the Natural History Museum.

As we explored the biodiverse garden and wetland, it was particularly helpful to hear their thoughts on the different depths we should build into our pond. We learnt that the majority of pondlife live in shallow depths of 10 - 15 cm, meaning that shallow shelves are more important to create than deep pools. Most pond-dwelling animals are also very mobile, which means that they can move around and between ponds when water levels fluctuate seasonally (i.e., if they overflow and dry out). Surprisingly, we learnt that designing a pond for an urban setting isn't too different from designing a pond in a rural environment like the British countryside. Our main concern in the city are foxes, which have a habit of digging into and puncturing exposed pond liners. This placed a time pressure on the building stage between inserting a pond liner into our ditch, and filling it with water.

Neil Davidson designed a schematic (opposite) for the new pond. We used this as a guide for designing a pond with gently sloping banks, allowing for different depths. The schematic shows that the centre of the pond will be its deepest point, and the pond will become more shallow with increasing proximity to the edges.



Schematic courtesy of Neil Davidson.

Visit to the Natural History Museum. Photo: Michael Smythe.

Consulting local knowledge | Talks at the Bethnal Green Nature Reserve

The Wetland Enhancement design process was informed by workshops, conversations and presentations held at the Bethnal Green Nature Reserve. These also formed part of our enrichment during the Ecology Internship. We greatly valued these opportunities to reflect on the impact of the project on the nature reserve as a community-led cultural institute for arts, ecology and education. Some of the wonderful people we learnt from included Hayley Harrison, a multidisciplinary artist in residence, and Joanna Pocock, an environmental writer, who both encouraged us to listen to and converse with the site in its urban context.

Above: Hayley Harrison's artwork displayed at the Bethnal Green Nature Reserve. A green kindling bag, embroidered with red text, reads: "how did we learn to let go".
Below: Environmental writer Joanna Pocock leads a nature writing workshop.

Spirits in the trees,
In their own Solitude,
A silence unbridled,
Can we still be friends?

An old memory walks by,
Cascading a redundant wind,
In a sacred grove uncharted,
Rustling leaves by the robins as they play,
When the branches pass away,
A life secret we have lost

Irredeemable as the abyss echoes
Fading in time
To it we return evermore...

Poem by Salih Abdurrahman. Written at the Bethnal Green Nature Reserve during Joanna Pocock's Nature Writing Workshop on 23rd October, 2021.

Above: Lauren, Chiara, Salih and Charlie at Joanna's nature writing workshop.
Below: Zoe reads a field guide book.

Career advisor, Andrea Cox, spoke with us the range of prospects within the environmental sector, and shared tools for developing our careers and aspirations. Isabella Johnston of Rights for Weeds guided us on a foraging walk through Wick Woodland and shared folk knowledge of plants and fungi. We were also privileged to hear Adelaide Bannerman, curator in residence, and Daze Aghaji, artist in residence, reflect on climate activism, finding our places in the world, and using our voices.

On 11th October 2021, we were grateful to talk with Nick Bridge, the UK Foreign Secretary's Special Representative for Climate Change, before the COP26 summit. Our conversation highlighted the importance of transparency and accountability amidst the climate and biodiversity crises, and raised questions around the effectiveness of sustainable development goals set at a national level. It was clear how important local initiatives are for building social and ecological resilience that are community-specific.

A conversation with Nick Bridge. Photo: Michael Smythe.

Together, these enrichment activities informed our collective language and praxis. We approached the redesign and building of the wetland experimentally and collaboratively, prioritising the needs of this biological ecosystem, yet also seeing the wetland as a social and cultural ecosystem of diverse communities, ideas and practices. We considered the project's potential as a tangible legacy of environmental action, responding to the environmental and social complexities of the urban landscape during a time of climate crisis and biodiversity crisis, both emerging from interconnected ecological and social histories.

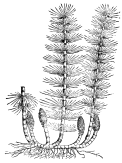
Medicinal Garden, 16th October 2021

Shumaisa Khan, coordinator of the Phytology Medicinal Garden [11], taught us about the usages of plant medicines situated opposite the wetland. Shumaisa also researched medicinal semi-aquatic plants that we could introduce between the pond and the Medicinal Garden. Excitingly, this would expand the range of medicines onsite by making use of the damp, marshy zone bridging the wetland and the Medicinal Garden.

"I was mostly thinking of plants for the [pond] edge, so things like marshmallow, meadowsweet, maybe calamus. I also like horsetail, but it needs to be contained and kept an eye on as it spreads by spores.

I also found this site [12] about medicinal aquatic plants, but again things like growth pattern, aggressiveness and size need to be considered for our context."

- Shumaisa Khan

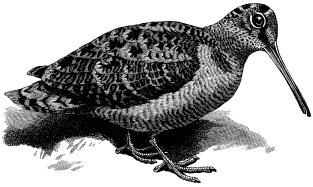


Clockwise from top left: marshmallow, meadowsweet, calamus and horsetail.

Shumaisa Khan leads a tour around the medicinal garden opposite the wetland. Photo: Michael Smythe.

Attracting bird diversity,
9th October 2021

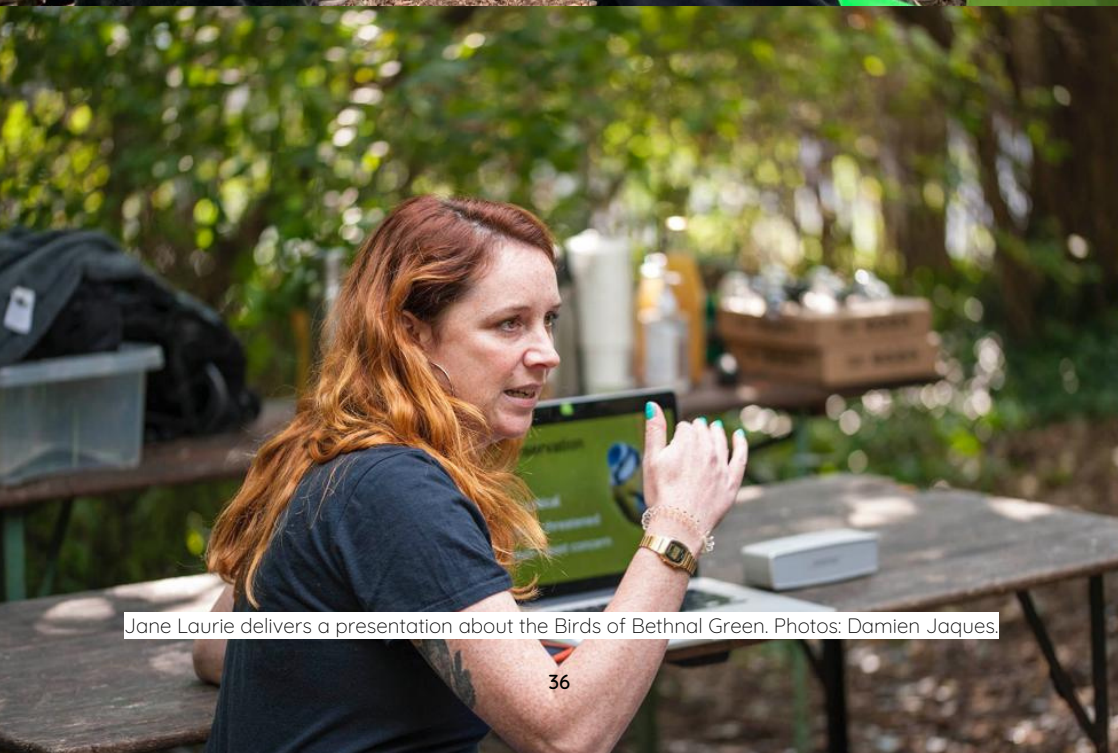
Local bird specialist Jane Laurie held a presentation about the birds which live in and visit the Bethnal Green Nature Reserve. These include species of the highest conservation concern in the UK according to the Royal Society for the Protection of Birds Red List, such as starlings, house sparrows, song thrushes and grey wagtails. Jane also suggested species we might be able to attract with new wetland features, including reed warblers, sedge warblers, water rails, grey herons, woodcocks and jacksnipes.



Woodcocks (Scolopax rusticola) are woodland species rare in cities, but Jane has seen them nearby in East London. They are a priority conservation species. Their long beaks are used to forage worms, beetles, spiders, caterpillars, fly larvae and snails.

To attract greater bird diversity, Jane recommended:

- Reeds around the pond edge. These create habitat for invertebrates, which birds can feed on. Birds can also hide from predators in dense vegetation.
- Fox monitoring. Foxes prey on birds and can deter them from visiting. We may be able to reduce their impact by ensuring there are places for birds where they can't reach, such as the pond island, nearby trees and roost boxes.
- Silver birch trees, which are great for caterpillars (eaten by birds such as the blue tit), and loved by reed warblers.
- Trees that purify air by capturing particulate matter, e.g. yew, conifers, silver birch and elder. Air pollution is a big problem in cities like London, and when air pollution is high, insects become scarce, which impacts bird populations.
- Encouraging insect diversity. The greater our invertebrate diversity, the more bird species we can support. We can attract and accommodate more invertebrates - e.g., worms, snails, aphids, beetles and flies - by introducing more flowering plants, adding to our dead hedge, and building log and rubble piles around the wetland. In
- Abundant food options. Climate change is leading to caterpillars emerging earlier, which can cause chicks hatching later in the season to go hungry [13]. Plenty of alternative food sources can help young birds that have missed the short peak in caterpillar abundance. Supplying bird feeders and mealworms is controversial as they can cause behavioural changes in birds and other unintended consequences, but we could look to maximising other food options such as plant buds, nectar and seeds, in addition to supporting insects and other invertebrates.
- Patience. It may take time for bird populations to establish or for individuals to visit, especially for larger species.



Jane Laurie delivers a presentation about the Birds of Bethnal Green. Photos: Damien Jaques.

Creating a new wetland design

Guided by the knowledge, expertise and reflections summarised in the previous sections, we designed a new wetland for the Bethnal Green Nature Reserve, including a new Ecology Pond with surrounding niche habitat features.

Diagram showing the new wetland design. Image: Zoe Opiah.

The wetland design features:

- An Ecology Pond with an approximate perimeter 6.3m x 5.9m.
    - A rectangular shape to maximise area. This will accommodate more wildlife and plants, while holding enough water to prevent the pond from freezing over in winter or drying out in summer. The edges are curved to create extra shallow pockets and microhabitats for specialist species [14].
    - Situated across semi-shade and sun. This increases habitat diversity by creating different microclimates around the pond, favouring greater biodiversity. Sun is important for wildlife, but by avoiding full sun exposure we avoid algae blooms and prevent the pond from drying out in the summer.

- Gently sloping banks from the deep western side and centre (90 - 100 cm) to the shallower ends (30 - 60cm). Slopes and shelves allow easy access for amphibians and small mammals, while maximising the range of planting opportunities at different depths. This will create a range of microhabitats where invertebrates can feed, shelter and lay eggs [14]. The deepest end functions as an anchor and temperature regulator. It holds the liner in place, and contains enough water to help prevent the pond from freezing or drying in temperature extremes. This protects pond-dwelling plants and animals from frost and drought.

- Walking paths to view each side of the pond. These paths will be wider than the pre-existing paths to improve accessibility for visitors.

- An island where birds can access the wetland without disturbance from predators to drink, feed, nest and roost. While birds often use undisturbed, sheltered areas to lay eggs and raise young, the island is relatively small at approximately 2m squared. We aimed to cultivate a natural feel by designing a circular, off-centre island whilst ensuring a minimum distance of 1m from the banks of the pond to protect its visitors from jumping foxes and cats. The island is closer to the pond's shallow regions to allow easier access for amphibians. It is in a sunny spot to encourage dense plant growth, which will provide cover for birds and amphibians.

- An overflow channel with raised banks leading from the main pond to the eastern ponds. This will encourage a gully to form in heavy rainfall, channelling water into the eastern ponds to prevent flooding on the paths and medicinal garden.

- Rubble piles made of scrap materials such as slate, corrugated iron and carpet. These will be built in sunny spots around the pond to create potential refuges for cold-blooded reptiles, such as slow worms and grass snakes, which need to warm up under cover. Reptiles and other animals could feed on invertebrates found lurking under these piles [14].

- Log and rock piles around the pond to provide protection for invertebrates and amphibians as they enter and exit the pond. Invertebrates such as beetles will shelter in the piles' nooks and crannies and reproduce in wet, rotting wood. Meanwhile, amphibians will appreciate damp spots within and underneath the piles. Insects and reptiles may also be seen basking on log piles placed in sunny spots. We will position piles in both sunny and shady areas to accommodate different species [14].

Phase 3

Building a New Pond

Levelling and shaping

After excavating the historic modular pond network in the centre of the wetland site, we worked to shape the bottom and sides of the ditch which would become the new Ecology Pond. The bulk of the manual work in this phase was carried out by Bethnal Green Nature Reserve volunteers and residents and GoodGym volunteers, with help from friends of the nature reserve, Forest Fridays students, and the Urban Ecology team. We removed earth and any sharp stones and debris which could puncture the incoming pond liner, but kept the earth we removed onsite nearby for backfilling. We then marked the dimensions of the new pond using metal stakes and rope.

Metal stakes and rope mark the dimensions of the new pond on the excavated wetland site. Photo: Dimuthu Meehitiya.

Next, we lined the ditch with recycled soft sand to create a layer of protection between the earth and the incoming pond liner.

Michael Smythe's idea was to repurpose used, locally sourced hessian coffee sacks as building blocks for shaping the pond by filling them with excavated earth and recycled soft sand. We filled hessian sacks with sand for building up the corners of the ditch before installing the pond liner. Given how heavy the sandbags became, the easiest and safest way to do this was to fill the ditch with sand first, fill sacks, and then pile the sandbags into each corner of the ditch.

Filling hessian sacks with recycled soft sand to make building blocks for the corners of the pond. Photo: Michael Smythe.

After roughly levelling the bottom and sides of the ditch, a precise laser level was used to make sure each side was level. This was important for preventing water from leaking from any of the sides, though this level of precision wasn't necessary for the bottom of the pond.

The levelled ditch layered with recycled soft sand and hessian sandbags. Photo: Michael Smythe.

Pond liner installation

On October 19th 2021, two professionals from Ark Landscapes helped us with the delicate process of lining the pond with a butyl (synthetic rubber) lining. This stage was critical: the liner was 1.5cm thick, expensive and extremely heavy. Any puncture in the liner would cause the pond to drain over time, compromising the entire project. There was also a risk of injuring ourselves if we handled the liner incorrectly.

Three large, thick layers of felt were first unrolled to cover the ditch, cut to size with approximately 50cm overhang at each edge.

Ark Landscapes cover the base of the ditch with felt. Photo: Mila G. Lawlor.

We then brought in the butyl lining. We thought it would be a challenge to carry this into the wetland site because of its weight and size, but Ark Landscapes managed to transport it in a wheelbarrow and roll it together toward the wetland. They then dropped it inside the middle of the ditch and unrolled it carefully as one walked barefoot along the material, gently tucking in the corners. They slowly, thoroughly ensured that there were no creases at the bottom.

Next, we filled the base of the lined pond with just enough on water to cover the bottom and anchor the liner in place. We monitored the water pressure as we needed just enough force to push the liner into the pond's edges, while too much would pull and tear at the liner in the long term. We could then cut the liner to size with at least 50cm overhang.

With the liner installed and partly anchored, we immediately used sandbags to line and secure the edges and corners of the pond with just enough tension to anchor the liner, but not so tightly that the liner stretch and become damaged over time. We then made a chicken wire fence to cover the pond at the end of the day to ensure that our resident fox, Sage, wouldn't try to dig into (and puncture) the liner.

Shaping the pond

Over the weeks, we shaped the terrain within and surrounding the pond. We used sand-filled hessian sacks, followed by earth-filled sacks, to line the corners and edges of the pond and build up its sloping banks. This was to ensure that no parts of the liner would be exposed to UV light, plant roots, tools or feet (when the time comes to remove overgrowth), which would all damage the liner over time.

The hessian sacks also help with keeping the banks' shape, particularly during the early stages of the pond's life. They protect the banks from soil erosion while they are most exposed and lack plant roots to hold them in place. In the coming years, the hessian (a natural material) will decompose, and mature plant root systems will begin to take over in securing the banks. Soil will gradually wash downward into the pond, creating gentler slopes over time.

We also created an oval perimeter of sandbags at the centre of the pond. This was to help reinforce the structural integrity of the pond over the years, while soil and organic matter wash down the sloping banks. The sandbags will push against the banks to prevent the pond collapsing inwards and levelling flat.

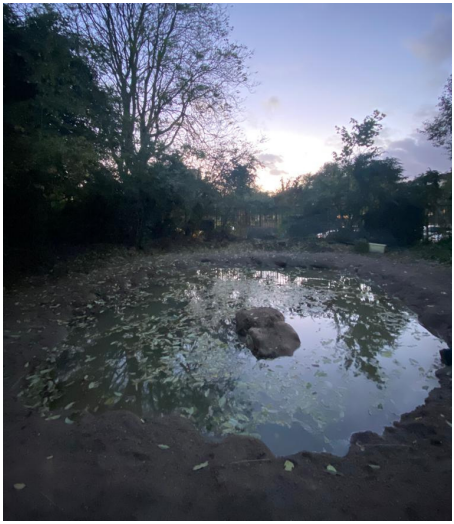
Creating sloping banks and shaping the pond with earth and sand-filled hessian sacks.


CAFÉS DO
CROP: 2020/2021
NET WEIGHT/LIQUIDO
GROSS WEIGHT/BRUTO
150 LBS

To make the centre of the pond and its western side deep, we lined these areas with the least bags. The shallow sides were built up with sandbags and earthbags on top of one another. We also used this method to create the raised edges of an overflow channel on the pond's eastern side. To build the island, we built a circular perimeter of sandbags and earthbags in position. We then built up the island with bags in alternating layers, each perpendicular to the next, until it reached a height above the anticipated water level. An extra ring of bags were placed at the island's foundation for structural support.

Completion of the pond's banks. Photo: Dimuthu Meehitiya.

Completion of the pond's internal structural support and island. Photo: Michael Smythe.



The filled pond. Photo: Michael Smythe.

On 30th October 2021, we finished filling the pond with water from a local fire hydrant. This step was important to secure the pond and protect the liner from exposure damage. It also represented the final stage of the pond refurbishment process. We used tap water containing chlorine, which can harm or kill wildlife and microorganisms, as well as additional nutrients that can upset the balance of an established pond. However, we anticipated that the chlorine would dissolve and the nutrient composition would rebalance over the course of winter, especially as the pond would be continually topped up with rain water.

The Ecology Pond, filled with water. Photo: Michael Smythe.

The Wetland Enhancement Project

2022 and beyond: next steps

After the Autumn refurbishment, volunteers and residents began work to build niche habitat features and improve wetland access for wildlife and people. From early 2022, this work included completing wider, levelled walking paths around the Ecology Pond, building log and rock piles, and paving the edges of the pond with rock slabs. From early spring, planting began. Details of what we planted start on page 49. An update from the wetland's first summer begins on page 53, and future management advice on page 57. There remains work throughout 2022 and beyond to continuously develop wetland ecology learning resources and engagement opportunities and monitor biodiversity. Information about our upcoming wetland surveys and workshops can be found on page 59.

Planting

Late Winter 2021 - Early Spring 2022

Ecosystems involve complex interrelations between species and their environment. The sudden introduction of a species to a new environment can make it difficult for the species, or for the entire system, to adapt. Risks include introducing new diseases and disturbing the food chain, which can both cause cascading changes across the ecosystem. These concerns are particularly relevant to the new wetland in its earliest stages, as the ecosystem has not yet had time to develop stability and resilience. To accommodate more amphibians, birds and mammals with different ecological niches, the wetland needs to provide enough food and shelter to support a stable and complex ecological community, with enough resilience to respond to changes.

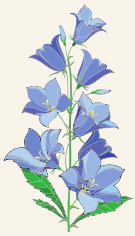
Wetland plug plants.

For example, even though we hope to see frogs in the new pond, bringing in adult frogs from another wetland would likely be unsuccessful. We expect that they would have difficulty establishing a successful population in a new environment. Similarly, introducing tadpoles to the pond would not necessarily lead to a self-sustaining population with successive generations. The wetland first needs to be able to accommodate them through an abundance of appropriate food throughout their lifespan (tadpoles eat algae, and small frogs eat invertebrates such as flies, moths, snails, slugs and worms), and appropriate environmental conditions (e.g., temperature and pH).

The most immediate step after the refurbishment was therefore to introduce plants to develop dense, biodiverse vegetative cover in and around the pond. From late winter to early spring 2022, we began planting. We hope that this preliminary arrangement of wetland plants will attract a diversity of invertebrates whose presence will, over time, support the diets of diverse amphibians and birds. We hope that wildlife will arrive to the wetland independently, increasing biodiversity over time.

The page opposite lists the plant species which were planted in and around the ponds. We expect that the plant community will change over time as some species may fail to establish again or become outcompeted, and as wild plants find their way to the site.

Pond edge plants provide vegetative cover along the shoreline to prevent soil erosion and maintain the structural integrity of the pond. These include: barren strawberry, betony, cow parsley, foxglove, fragrant agrimony, greater burnet-saxifrage, hedge bedstraw, lesser celandine, remote sedge, sanicle, stinking iris, wild strawberry, yellow pimpernel, angelica, brooklime, brookweed, cottongrass, cyperus sedge, gypsywort, lady's smock, marsh stitchwort, parsley water-dropwort, purple-loosestrife, ragged-robin, square-stalked St John's wort, water figwort, common dog-violet, enchanter's nightshade, greater burnet-saxifrage, ground ivy, oxlip, pale sedge, sanicle, wood avens, wood-sedge, woodrush, yellow archangel, yellow pimpernel, Autumn crocus, winter aconite, snowdrop, bluebells and daffodils.



Bluebell

Foxglove

Ragged-robin

Marsh-marigold

Hemp-agrimony

Marginal pond plants grow in the shallow edges of the pond, bringing shape to the water edge. These include: angelica, brooklime, gypsywort, greater bird's-foot-trefoil, hemp-agrimony, lesser spearwort, marsh-marigold, marsh stitchwort, meadowsweet, purple loosestrife, sneezewort, water forget-me-not and yellow flag iris.

Aquatic plants, both submerged and floating species, will live in the pond's main body of water. These include: reed mace, yellow flag iris, pendulous sedge, rushes, marsh bird's-foot-trefoil, hornwort, Canadian waterweed, water mint, water-plantain, British water lily and lady's smock.

Yellow flag iris

Bulrush

Sourcing plants

Before our visit to Tower Hamlets Cemetery Park on 11th October 2021, Dimuthu collated a list of plants that we could source from the ponds there to help populate our new wetland. Wearing waders, we extracted these plants from three of Tower Hamlets Cemetery Park's ponds to then translocate to the Bethnal Green Nature Reserve. When we returned to the Bethnal Green Nature Reserve, we washed the plants we collected to get rid of any residual duckweed and azolla. We then kept them in tub of water for the remainder of the refurbishment to keep them alive before planting. All other wetland plants were purchased online (see opposite).

Washing translocated plants.

Translocated from Tower Hamlets Cemetery Park

Aquatic plants

- Great reed mace
- Yellow flag iris
- Pendulous sedge
- Common rush
- Marsh bird's-foot-trefoil
- Hornwort
- Canadian waterweed
- Water mint
- British water lily
- Lady's smock

Pond edge plants (seed and bulbs)

- Purple loosestrife
- Yellow loosestrife
- Water avens
- Meadow crane's-bill
- Marjoram
- Hemp-agrimony
- Common knapweed
- Common agrimony

Extracting plants from Tower Hamlets Cemetery Park. Photo: Dimuthu Meehitiya.

Purchased online (wildflowers.uk)

- Autumn crocus
- Winter aconite
- Snowdrop
- Bluebells
- Daffodils

Selection for wet and boggy areas

- Angelica, brooklime, brookweed, cotton grass, cyperous sedge, gypsywort, lady's smock, marsh stitchwort, parsley leaved water dropwort, purple loosestrife, ragged-robin, square-stalked St. John's-wort, water figwort

Selection for semi-shade

- Barren strawberry, betony, cow parsley, foxglove, fragrant agrimony, greater burnet-saxifrage, hedge bedstraw, lesser celandine, remote sedge, sanicle, stinking iris, wild strawberry, yellow pimpernel

Selection for shaded site

- Bluebell, dog violet, enchanter's nightshade, greater burnet-saxifrage, ground ivy, oxlip, pale, wood sedge, sanicle, wood avens, woodrush, yellow archangel, yellow pimpernel

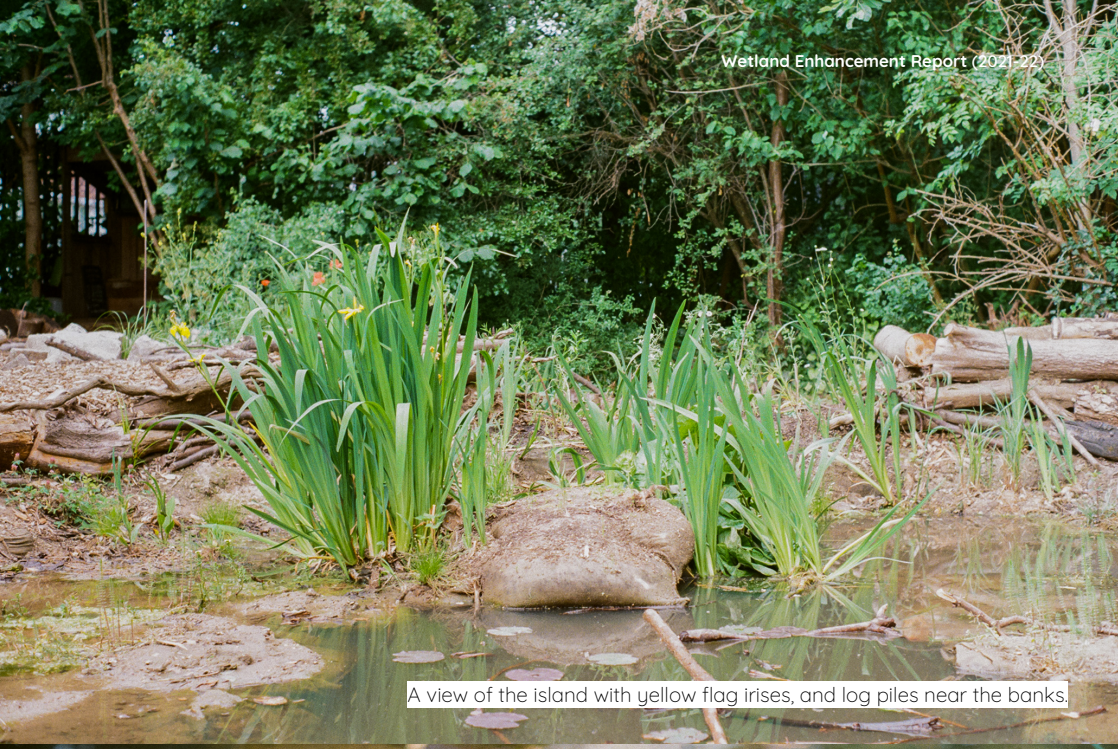
Selection for pond marginals

- Angelica, brooklime, gypsywort, greater bird's-foot-trefoil, hemp-agrimony, lesser spearwort, marsh-marigold, marsh-stitchwort, meadowsweet, purple loosestrife, sneezewort, water forget-me-not, yellow flag iris

Summer 2022 update

The wetland's first summer in pictures.

Mallards (Anas platyrhynchos) visit the Ecology Pond. Photo: Michael Smythe.



A view of the island with yellow flag irises, and log piles near the banks.

Mare's Tail (Hippuris vulgaris), an oxygenating aquatic perennial..

A close up of the pond water, algae, and decomposing hessian bags.

Side view of the damp medicinal garden-pond boundary. Wider walking paths have also been completed.

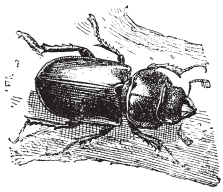
Clockwise from top left: Yellow flag iris, water-plantain (Alisma plantago aquaticum), cornflower (Centaurea cyanus) and foxglove (Digitalis purpurea). Photos: Michael Smythe.

Management Advice and Resources

We anticipate that the new Ecology Pond will last for approximately 30 years (until 2051), which is the typical lifespan of a butyl pond liner. As the liner degrades through natural wear and tear, the pond may start to drain and will need to be replaced.

We considered the ecological footprint of using a synthetic liner which has a limited usage lifespan. On balance, we felt this was outweighed by the enormous ecological benefits and educational opportunities of creating an urban, artificial wetland over the next crucial 30 years of global, regional and local climate and biodiversity change. The high quality, durability and impermeability of butyl also mean we can be relatively confident that the pond will last for these 30 years, giving us a timeline for managing the wetland as it develops.

The following page summarises key advice from our consultations across urban wetlands in London, and further resource suggestions for managing the Bethnal Green Nature Reserve's wetland going forward. These are not exhaustive, and we emphasise that the Wetland Enhancement project is an ongoing and experimental process. As we observe the wetland's development over the coming years, we hope to continually share progress on our aims, how biodiversity changes, and lessons learnt.



Stag beetle

When working to conserve wildlife and green spaces, over-managing can be worse than under-managing. Patience is key to allow ecosystems to develop and thrive. Still, getting the balance right is important; maintaining biodiverse spaces requires intentional management to prevent ecological succession - the natural process by which the structure of a biological community changes over time. In wetland habitats where a pond doesn't receive enough water each year, sedimentation builds up, allowing more and more vegetation to grow. This causes a positive feedback loop: the more plant matter in the pond, the more sediment can build, and the more plants grow in the following years. For instance, species such as great reedmace (Typha latifoli), commonly known as bulrush, can spread from a pond's edge and slowly take root further and further toward its centre. This changes the physical and biological composition of the pond, making it marshier. These changes in the environment make it increasingly harder for wetland species to thrive, but easier for woodland species to dominate.

Regular, ongoing management is therefore crucial for maintaining biodiversity and habitat diversity. Fortunately, ecological succession is a gradual and predictable process. This makes wetland conservation manageable through planning, observation and maintenance. For the wetland to thrive over the next 30 years, we suggest two key management approaches:

Regular removal of dominant species and organic sediment to prevent ecological succession.

- Continuous removal of duckweed and azolla can be carried out in weekly volunteer sessions. Manually rake or net the plants out. Learn more about duckweed management [15].
- Yellow flag iris numbers must be monitored annually and kept low.
- Reeds can be cut back to the pond's edges biannually to prevent them from spreading to the pond's centre.
- Remove leaves from the surface of the pond in autumn and winter to prevent organic sediment from building at the bottom of the pond.
- Learn more about invasive aquatic plants in the UK and management techniques [16, 17].

Monitor biodiversity and environmental conditions over time

- Examples of presence/absence surveys include botany, invertebrate, bird and protected species surveys. Environmental monitoring may include monthly checks of water pH, air and water temperature, and nitrate concentration.
- Observe ecological dynamics to evaluate which habitat features are successful or unsuccessful for improving biodiversity and wetland access. Adapt as needed.
- It may take years for some features to be used by a new species; patience is important.

Wetland Surveys and Workshops

Summer 2022 - Spring 2023

We are embarking on a site-wide experimental ecology survey, attempting to capture a snapshot of the many lifeforms that visit or live within the Bethnal Green Nature Reserve. Rather than simply recording the biodiversity of the site during a slice of time, the aim is to observe, connect and record the relationships between plants, insects, and mammal life that make up our many communities. We hope this project inspires slower and closer connections with this remarkable urban nature reserve, generating many new ways of understanding and caring for the land.

From Summer 2022 to Spring 2023, Tyra Enchill & Edward Simpson (a local resident, site caretaker and carpenter) are developing a series of wetland-focused ecology surveys and workshops in collaboration with friends and residents of the Bethnal Green Nature Reserve (both human and beyond). The surveys will track biodiversity in the new wetland to measure progress towards the Wetland Enhancement project's goals, and to establish a baseline for future monitoring over the coming years and decades. The experimental workshops will facilitate exploration of the wetland's ecology, as well as knowledge-sharing to upskill our community in species identification, biodiversity monitoring and wetland care.

For more information on our public events and to stay updated, please visit our websites and Instagram: @phytologyuk, or email: info@nomad.org.uk.

Edward collects a sample of water from the new Ecology Pond to measure its pH.

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Notes