DESIGN & INSTALLATION OF LIVING LAB NBS IGNITION PH2 SALFORD UNIVERSITY

Sel Environmental
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3.2 NBS Innovation

Stormwater Design

SEL have devised an innovative stormwater management system for IGNITION Phase 2. We have considered the four lots as one integrated NBS system. By utilising innovative attenuation products, smart water management technology and clever engineering, we are able to replicate the natural environment and water cycle by creating a zero-input-zero-discharge water management system.

SEL have analysed Met Office weather data to establish the average monthly rainfall and sunshine hours for the Salford area. We have combined this information with water usage data collected from our other existing green infrastructure installations. By combining this information, we are able to predict how much rainwater we can expect to capture from the lot areas, and how much water will be required for irrigating all lots combined. Our calculations showed that excess water can be captured and stored during winter months, then used to supplement shortages in rainfall during summer months, without the need for topping up the system with fresh water.

We have utilised innovative rainwater attenuation techniques across all lots. For Lot B – Green/Blue Roof we have utilised a shallow irrigation pad with the ability to attenuate up to 80% of its volume in rainwater and passively release water at an on-demand basis. In depth studies with STRI Group suggest this material makes it possible to establish healthy vegetation with significantly reduced soil depths (as low as 50mm). By utilising this material to gain reduced soil depths, we can achieve a very lightweight blue roof system and maximise the roof level rainwater attenuation capacity within the loading constraints.

For Lot C – Tree Pits we have utilised a shallow and modular tree pit design with integrated attenuation volume and passive irrigation. This innovative technology allows the SuDS tree it to be almost self-sufficient, with a negligible water discharge and no mains water top up irrigation. Lot A – Living Wall will also have a small amount of integrated attenuation volume within the planting mechanism.

The remainder of the attenuation volume will be created with a very innovative shallow overlay attenuation tank. By utilising high strength attenuation units no deeper than 150mm. we can create a shallow overlay attenuation tank across a large area without the need for any excavation. This also offers further opportunity to become part of the living lab enhancement and public realm.

Captured rainwater will be automatically recirculated at an on-demand basis to the various lots. By utilising our Cloud Water Control remote monitoring and control platform, we can set parameters such that soil moisture levels do not drop below a predetermined value. When set parameters are triggered the Cloud Water Control system will automatically batch irrigate the required lots. This method of batch irrigating and allowing soils to wet and dry replicates the natural ecosystem and water cycle.

To summarise, by calculating the required attenuation volume, seamlessly integrating it within the lots and utilising smart technologies for irrigation, we believe under expected weather conditions it is possible to create an NBS intervention that is zero-input-zero-discharge all year round. See **APPENDIX 2.**

Heat Mitigation

We have gathered data from existing blue roof projects that show the introduction of green infrastructure significantly reduces the temperature inside a building during warm summer months. Water managed blue roofs and living walls do not conduct heat, they have the ability to absorb excess heat and maintain lower internal

temperatures. Additionally, green infrastructure is a terrific insulator and can keep heat inside a building during winter months.

Product selection can also have a significant effect on the heat mitigation of green infrastructure. For example, the irrigation pad we have utilised within Lot – B Green/Blue Roof is made of highly compressed mineral fibres, which is also used in products such as insulation and brake pads due to its insulating and fire resistant characteristics. As such, this material can for the basis of a blue roof system with superior insulation and fire resistance. The same material can also be integrated with living wall systems.

Healthy green infrastructure also has a cooling effect on the surrounding atmosphere. During evaporation, heat energy is absorbed and used to convert liquid to gas, thus having a cooling effect on the surrounding atmosphere. Lots A, B and C will work in conjunction to cool the air temperature on campus. On a warm day, this cooling effect will be noticeable particularly on the blue roof, near the living wall and on grassed areas.

Lot C – Tree pits and other trees not only have evaporative cooling benefits as mentioned above, but they also prove shade which creates a convenient cool spot to escape from the direct heat.

Biodiversity Net Gain/Ecology Enhancements

The project provides a real opportunity to deliver ecological enhancements through the interventions (and beyond) to increase opportunities for wildlife with increased GI and appropriate planting to deliver a biodiversity net gain. Our ecologist from Urban Green would firstly undertake a Preliminary Ecological Appraisal on the site in accordance with the latest guidance. The appraisal would comprise a desk study and field survey to identify features of ecological interest at a landscape scale. This will provide the baseline to measure the potential and actual enhancements of the interventions. The Biodiversity Metric 2.0 from DEFRA will be utilised to undertake the calculation based the site's Phase 1 Habitat map and the detailed Gi and landscape proposals.

The Biodiversity Metric 2.0 uses habitat features as a proxy measure for capturing the value and importance of nature. It uses a simple calculation that takes into account the importance of these features for nature: their size, ecological condition, location and proximity to nearby 'connecting' features. The metric enables assessments to be made of the present and forecast future biodiversity value of a site.

The Urban Green ecologists and landscape architects will coordinate with the SEL design team to make recommendations and planting specifications to maximise biodiversity net gain on site on all of the components:

Lot A – Living wall, utilising the green wall infrastructure to introduce species rich vegetation to an existing bare wall, which will encourage and showcase research into planting, bio-filtration and water quality improvements.

Lot B - Green/Blue Roof, offers the opportunity for a large area of species rich vegetation to an area that was previously completely bare. The introduction of fully water managed fertile soils can encourage colonisation of native species and provide well established vegetation as well as opportunities for habitat creation for birds, insects, invertebrates and reptiles. The introduction of water managed green infrastructure at roof level has proven to provide biodiversity net gain as shown in our recent KTP with Coventry University. See **APPENDIX 3.**

Lot C – SuDS trees - the relocation of three existing trees and planting three new trees will increase the GI and provide a biodiversity net gain with an increase in habitat for wildlife.

The team will seek the most appropriate plant species to achieve the optimum impact for the specific environment, climate resilience and to encourage a variety of wildlife. We will also seek opportunities to provide integrated bat boxes and bat roosting opportunities as well as encourage birds particularly to the green roof.

Financial Benefits

By introducing green infrastructure and the innovative nature-based solutions mentioned above, there is greater potential for generating income from advertising. Our vibrant, interactive and attractive NBS solutions will attract tourism, footfall and create a user-friendly space and experience for students to congregate, socialise and relax, which is also the ideal environment for offering advertising space for local and national organisations.

The water management philosophy SEL have implemented for this project will capture, store and utilise rainwater meaning there can be reduced water usage and discharge rates which can reduce the costs associated with water use and disposal. This same philosophy can be applied to other NBS interventions to generate return on investment.

There is an abundance of data (including our own) to suggest the introduction of green infrastructure can significantly reduce the temperature inside a building during warm summer months. Additionally, green infrastructure is a terrific insulator and can keep heat inside a building during winter months. Therefore, it can be assumed that there will be a reduction in energy bills by utilising green infrastructure. It is our intention to support and facilitate the IGNITION project to generate further data from this project to support the aforementioned return on investment.

Implementing green infrastructure and NBS solutions in the urban environment has proven human health and well-being benefits both physically and mentally. Therefore, it is not inconceivable to believe health insurers may have a vested interest in reducing the likelihood/chance of ill health by investing in beneficial human health and well-being measures such as the green infrastructure and NBS solutions displayed at the Living Lab.

There have been many instances reported to suggest that the addition of green infrastructure to a building and its vicinity has notably increased its value and the value of surrounding property. It would be interesting to investigate how the value of university buildings have been affected following the implementation of this project.

There is the opportunity to create an edible garden as part of the scheme (which could be expanded), offering opportunities for local produce to university kitchens or Salford Museum, this could also reach to the introduction of beehives with multiple benefits as pollinators but also the production of honey.

Diversity in Planting

The different nature of lots A, B and C showcase different methods of planting and different types of planting within each lot. Each lot has been innovatively divided to showcase different types and methods of planting, for comparison and monitoring purposes. By utilising a range of appropriate species rich planting, we will monitor and assess plant establishment and performance and how they increase biodiversity to achieve a net gain, as well as monitoring how the students and public interact.

Lot A – Living wall is split into two sections, a vertical living wall and horizontal living wall. We have suggested a further split the wall into four sections, showcasing different types of planting for comparison purposes. The living wall will include and edible wall, pollinating wall, seasonal wall and biodiversity wall.

Lot B – Green/Blue Roof will have varying soil depths that will allow us to experiment with different types of planting. Additionally, the movable test beds will provide further opportunity to incorporate a diverse range of species rich planting. The varying soil depths and test beds will allow us to experiment with a combination of extensive, intensive and edible planting.

Lot C – Tree Pit provides the opportunity to plant three different appropriate tree species to assess their performance. Additionally, our raised tree planter provides the opportunity to incorporate additional shade

tolerant plants including perennials at the base of the trees, creating further diversity in planting and increasing biodiversity.

Aesthetic Appearance

The introduction of the living wall, blue roof, tree pit and showcasing area will no doubt dramatically improve the appearance of the campus. The green infrastructure will introduce vibrant colours and greenery all year round with water managed NBS and planting increasing the aesthetic appeal. Yet there is a real opportunity to create the 'living lab' as part of the public realm, reinventing the space between Lady Hale, Cockcroft and down to the library, creating a different look and feel so that you are entering a green oasis …'welcome to the living lab'… more than just interpretation boards.

Creating a space that brings together the interventions in a green, useable and productive environment within the campus that provides water treatment and reuse, increased biodiversity and wildlife, planting with urban cooling functions and even food production. An aesthetically pleasing space where people can stop, rest, meet, eat and contemplate, as well as interact, study and research with the interventions and planting, which encourage and showcase research into planting, bio-filtration and water quality improvements.

An integral space within the Campus Masterplan that promotes health and wellbeing. This integrated and innovative approach to the public realm between the Newton, Cockroft and Lady Hale buildings will not only provide the showcase for lot D, it will create a visual connection between all of the lots, emphasise the space as a 'living lab' with an improved environment for people to use and enjoy. See **APPENDIX 2.**

All systems utilised in this project are quality products with emphasis on attention to detail. It is important that careful consideration is taken when selecting finishes, trims and the like. It is also important that consider how well the selected systems integrate with the existing infrastructure and appearance.

Human Health, Wellbeing and Social Value

The innovative NBS interventions showcased in this project have both physical and mental health benefits. Green space promotes physical activity and purifies city air. Green space also provides psychological relaxation, stress alleviation and stimulates social cohesion.

Our design for each lot has emphasis on the integration and connection with users, to create social value. Each lot is designed to be attractive and enticing to users, encouraging them to use and enjoy the space. By incorporating seating in innovative ways such as raised tree pit wall, we are able to create social spaces where people can meet, socialise, eat and relax.

Rather than simply fulfilling the basic brief we have gone the extra mile to create greater interaction with users. For example, we have proposing extending the vertical living wall into the space at ground level with additional seating and planters, becoming part of the public realm and becoming part of the living lab garden beyond the building.

Monitorable Solutions and Raising Awareness

All of the products and systems we have specified in our design are carefully selected based on their compatibility with the Cloud Water Control monitoring and control platform. It is important to us that we can monitor inputs and outputs from every operation in each lot. Data collected from this project is an essential tool

for proving return on investment and demonstrating how NBS can be integrated across Greater Manchester and beyond.

Lot D is essential for showcasing the data harvested from the monitoring. Lot D will also provide a great platform for raising awareness of the details and real time performance of the installed technologies, through visual representations.

Throughout the installed lots, we can incorporate QR codes that can be scanned and display information on the installed technology, such as the habitats and animal species that reside there. QR codes can also be directly linked to the Cloud Water Control portal, where real time data will be displayed such as water levels, water usage, energy usage, temperatures and more.

Connection Between Lots

Lot D will showcase visualisations and graphics showing how the lots are physically connected. Logic drawings can be displayed to show how the water management cycle operates; this can be backed up with real time system data displayed on monitors. All lots will be physically connected by one central water management system. Lots will be visually connected by creating visual connections where possible and adopting a holistic integrated approach to the space and incorporating information boards within each lot.

We understand the University has a campus masterplan to create a green space for all. We would be keen to learn more and explore the opportunities to integrate the lots within this tender with the campus masterplan.

Ecology Enhancements

Bats

- Integrated bat roosting opportunities within the proposed wall garden structure - gaps between cladding and the existing wall
- Bat boxes on the proposed roof garden/wall
- The project should consider lighting impacts on the proposed green areas:
  - Keep the roof and wall as dark zones
  - Existing lighting on ground level which will need to be in line with BS standards/cannot be altered.

Birds

Green roof:

- Identify notable birds in the local area and target design of towards these species.
- Example could be Black Redstart:
  - The implementation of green roofs for biodiversity in London was initiated to help support the population of black redstart. They are known to be in the Manchester area and are red Listed on BoCC and listed as a Schedule 1 species.
  - https://www.blackredstarts.org.uk/pages/greenroof.html - leads to how to target roof design for Black redstart.
- Need to consider who can access the roof and minimise disturbance.
- Bird species known to use green roofs in Europe – goldfinches, starlings and wagtails.

Invertebrates

- Use industry best practice - https://livingroofs.org/bees-green-roofs/ - provides a good list of plant species used by bees which were planted on green roofs, showing success rates of use.
- Integrated insect bricks or boxes on the roof.

Monitoring approach for biodiversity:

- Ecology/conservation department of Salford University as well as local group engagement
- Monitor levels of bat activity – Use static bat detectors and could be situated on the roof.
- Opportunities for research for students.

PEA / Biodiversity Net Gain Calculation

Assessment of current value of habitats and set a target for the project

APPENDIX 2

Design Summary

Overall Stormwater Design

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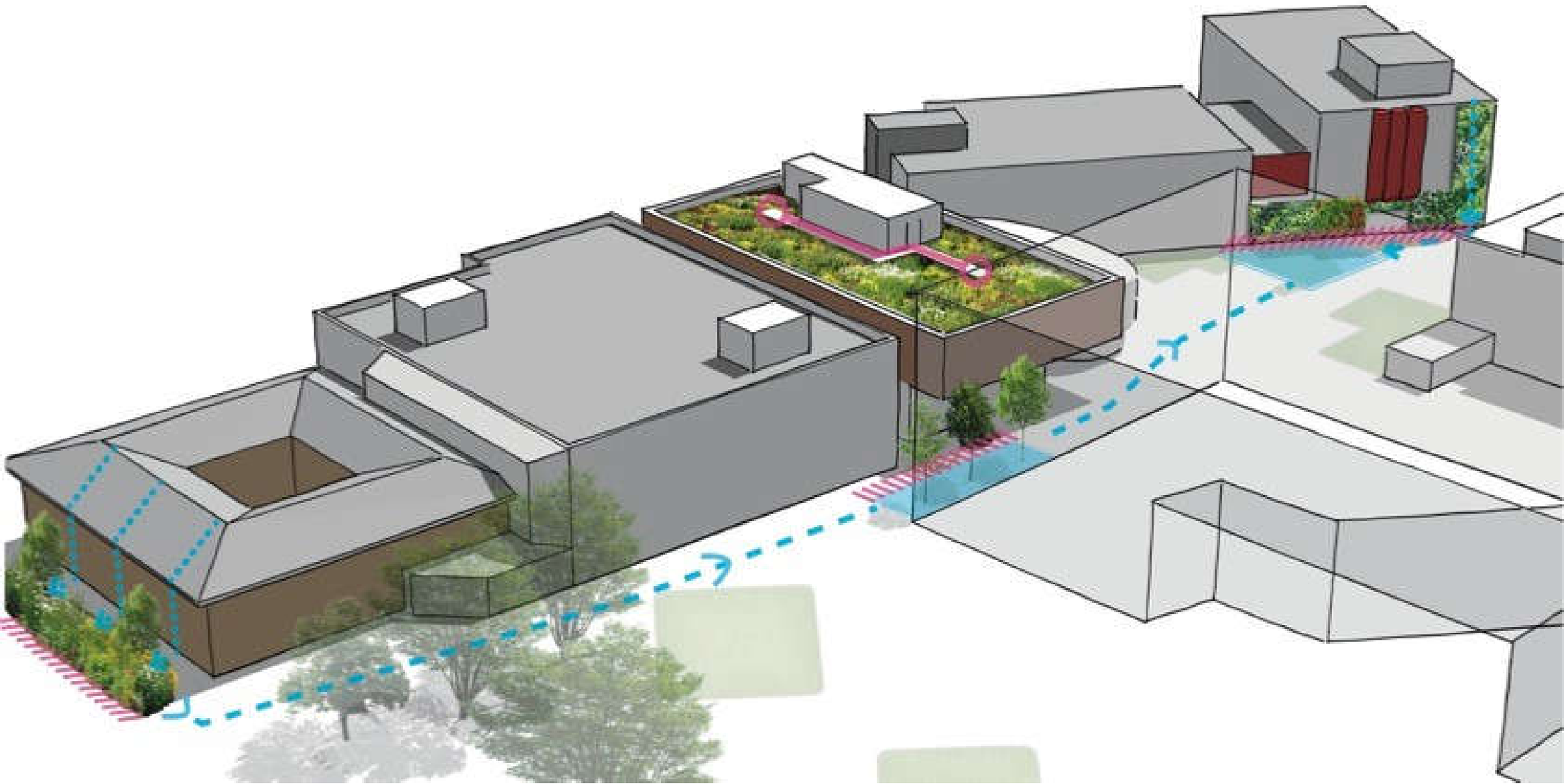

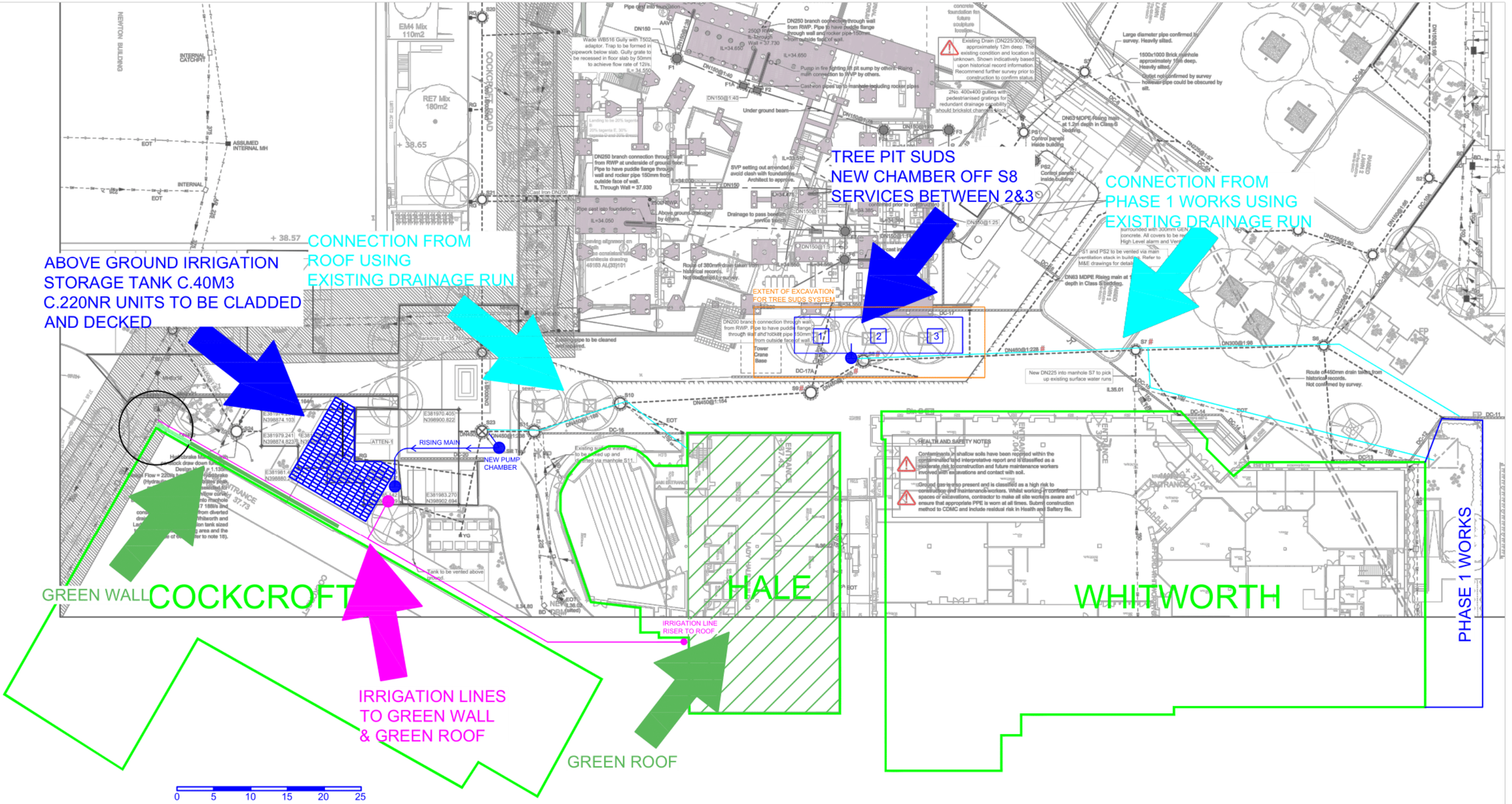

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Project: Living Lab NBS Innovation Phase 2
Description: Overall Water Management Philosophy

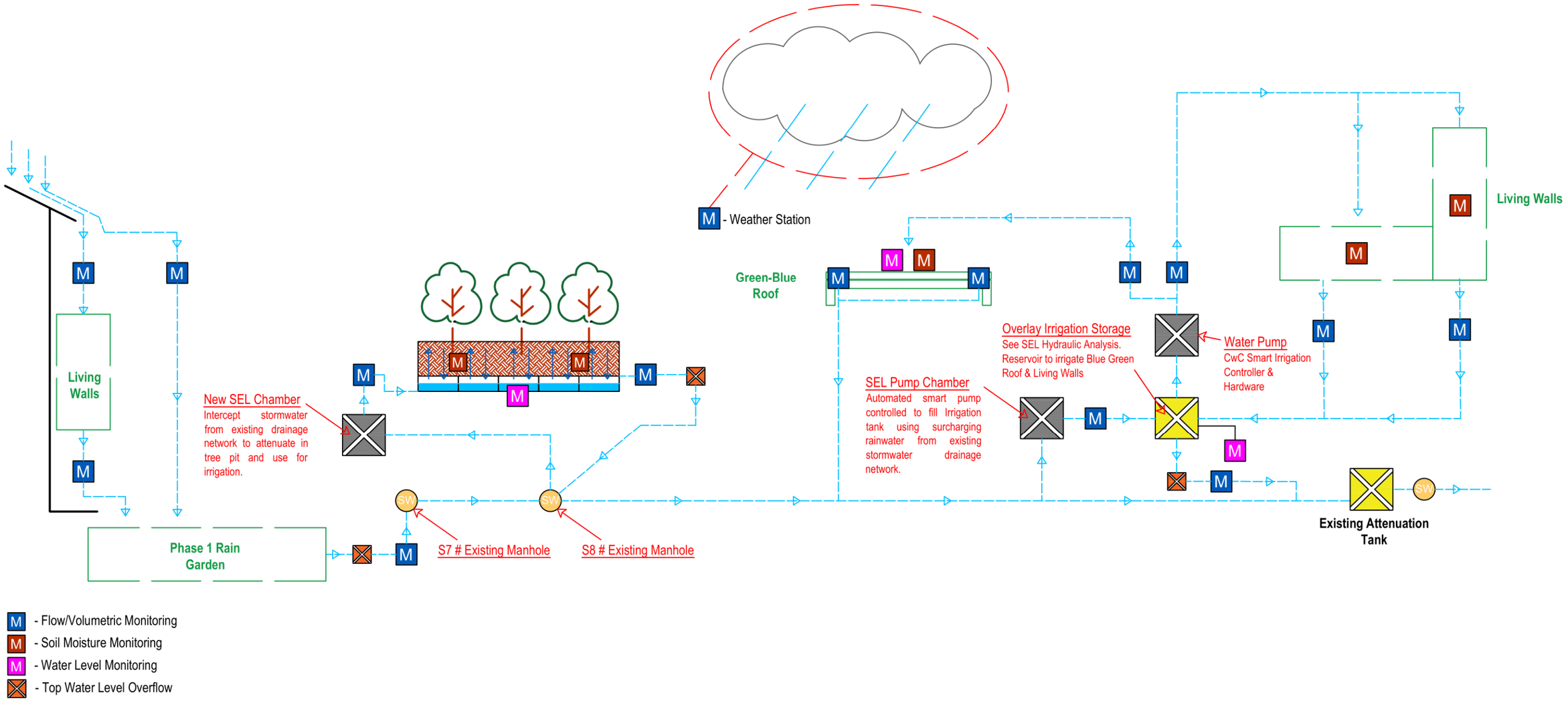
Client: Salford University

Status: TENDER

Rev	Date	Description	By	Chk
A	12/04/20	Initial issue	MG	BS

Scale	not to scale	**Paper Size**	A4
Drawing Number		2200409/006	

Client Ref: ITT IGNITION Phase 2



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Drawing Title: Site Wide Connectivity layout

Description: Indicative Hydraulic Connectivity Logic Diagram

Client: Salford University

Status: COMMENT

Rev	Date	Description	By	Chk
A	21/04/20	Initial issue	BS	ECA

Scale	n/a	**Paper Size**	A3
Drawing Number	2200408/003		

Client Ref: ITT IGNITION Phase 2

Lot A – Living Wall

For Lot A we are looking to utilise an innovative living wall system with reduced wall loading. By incorporating a bespoke steel frame designed specifically for the location, we can transfer a large proportion of the load through the frame to the ground, rather than relying on a strong wall fixing. The frame will be lightly fixed to the wall simply to hold it in place, not to support significant load.

The injection moulded modular wall planters have integrated water reservoirs and passive irrigation capabilities. Produced by a business local to Manchester.

We have also utilised a range of planting methods to promote biodiversity, social interaction and improve the aesthetic appearance of the campus. This green wall infrastructure will showcase research into plantings, bio-filtration and water quality, encouraging participation with the system and enabling monitoring and research. Habitats are further encouraged with the inclusion of bird houses and pollinator nests. State of the art lighting designed to minimise lighting impacts of wildlife will be used to illuminate the living wall in the evenings.

1. Edible Wall

Herbs
Strawberrys
Salads

2. Polinating Wall

Include plants to attract Bee's and Butterflies

3. Seasonal Wall

High colour impact seasonal planting

4. Biodiversity Wall

Evergreen planting perfect for birds and insects to nest, with additional bird and insect houses

The living wall will self-irrigate to a degree as a result of the small integrated attenuation volume. Additional irrigation will be achieved by utilising a drip line method with water supplied from the above ground storage tank and a small blue roof located on the exposed roof area of the Cockroft Building ground floor.

Living Wall Example 1

Living Wall Example 2

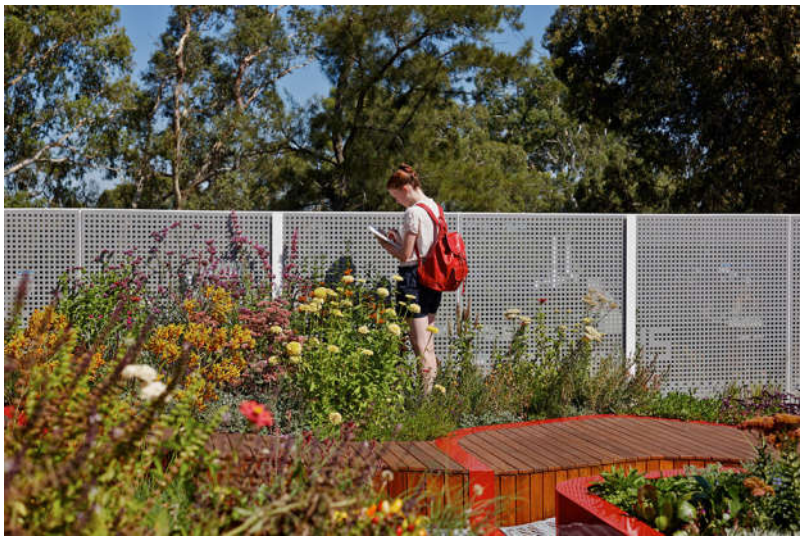
Potential Added Value

Living Lab Garden – opportunity to utilise the above ground attenuation tank and Lot D – Interpretation to extend the Living Lab through the surrounding public realm and planting to recreate the space.

The space to the frontage of the Living Wall at Cockcroft building offers further opportunity that we would welcome further dialogue with the Ignition team on. Our ambition is to make the space part of a 'Living Lab Garden', designed with our Landscape Architects that not only showcases Lots A and C and integrates Lot D the interpretation it brings them all together, this could include:

- Extended SuDS system / paving
- Incorporation of existing planting and grass areas with addition further species rich planting
- Above ground attenuation tank – incorporating raised seating and biodiversity / wildflower / indigenous planting

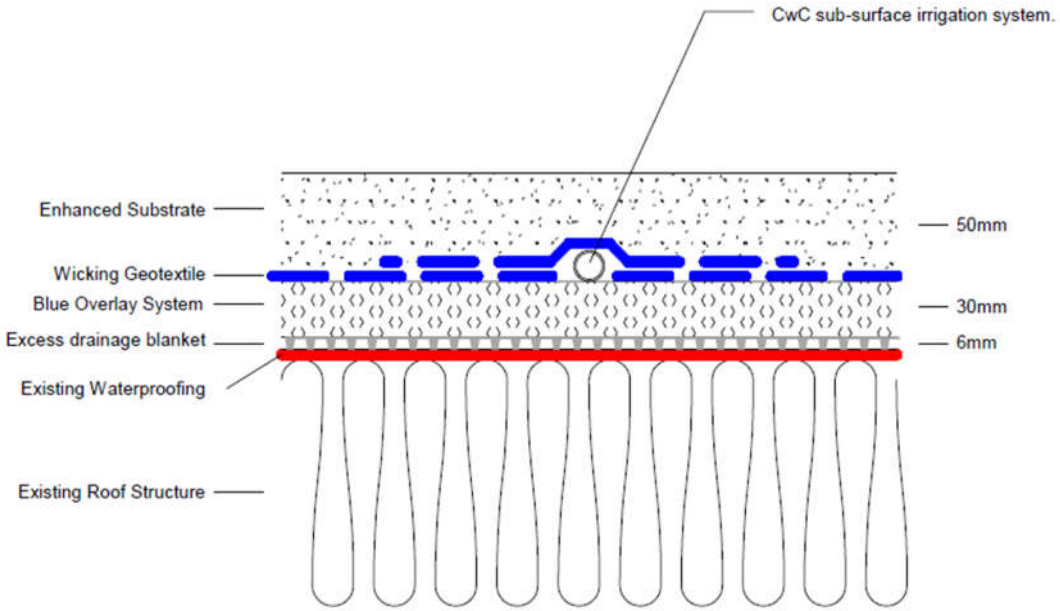
The opportunity is to create a space that users feel part of – a green oasis at the heart of the campus to meet, relax, socialise, engage and learn… the potential to add to the appearance and create bigger impact, flexibly extending the principles of the Living Lab through the public realm.



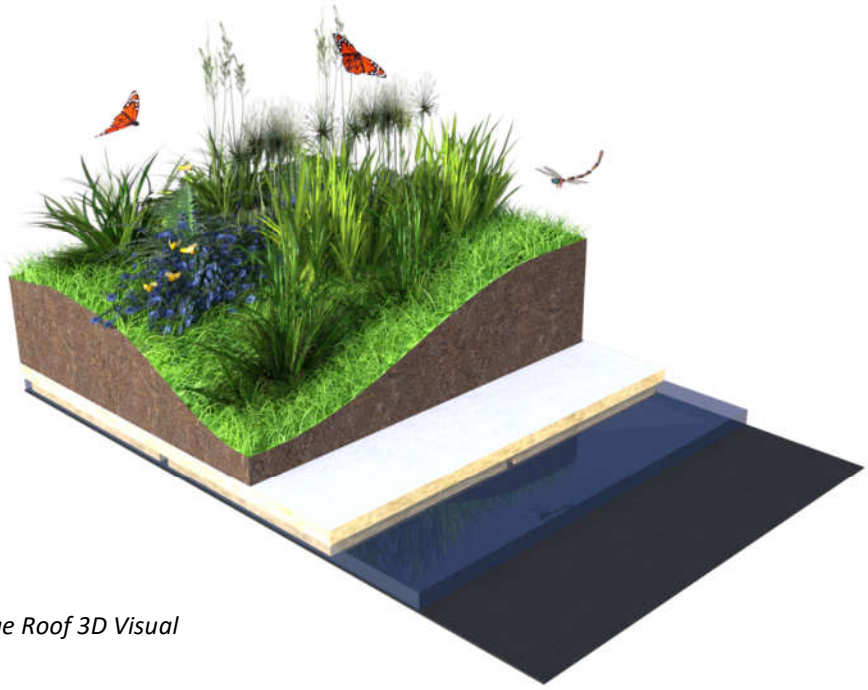
Example of space at the base of Lot A.

Lot B – Green/Blue Roof

For lot B we will utilise a lightweight system to optimise roof level water storage volume within the design constraints. The lightweight Blue Overlay system has the ability to absorb water like a sponge and release it at an on-demand basis. Studies have shown that this characteristic can facilitate and maintain healthy vegetation with reduced soil depths (as low as 50mm).



Lightweight Blue Roof Build Up



Lightweight Blue Roof 3D Visual

There is also potential to incorporate a living wall on all sides of the plant room to create better integration with the green/blue roof. We will also incorporate lightweight modular walkways made from recycled plastic.

The introduction of a fully water managed fertile growing medium can encourage colonisation of native species and provide well established vegetation of mosses, grasses, herbs and shrubs, as well as opportunities for habitat creation for birds, insects, invertebrates and reptiles. We envisage aspects of the planting beds to allow for trial research plots as well as natural colonisation and promotion of indigenous species to increase biodiversity with minimal human intervention, that can offer a protected space for experimentation with native plants as urban habitat that encourages colonisation and support biodiversity. Through installation of natural and recycled elements including logs, sticks, roof tiles and different aggregate types it can further create bird, insect and reptile habitat. The anticipated colonisation of these animals will be monitored and observed over time as part of the net gain.

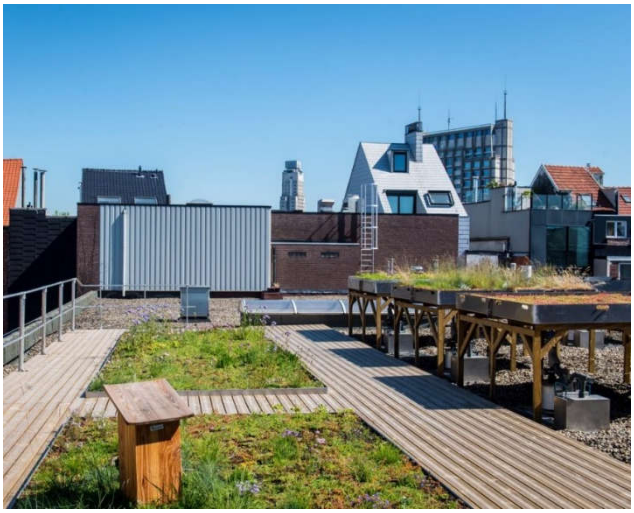
- Wildlife enhancements - target local wildlife known to be in the area and are conservation concern in Greater Manchester such as house sparrows and starlings… And of course, bats!
- Climate resilience – selection of most appropriate species demonstrating tolerance and adaptation to predicted increases in global temperatures and climatic extremes.

The raised beds will offer opportunity for different plant species and approaches including growing areas / edible aspects, there may also be opportunity to introduce beehive depending….

Example Wildflower Meadow with Log Pile

Example Water Managed Raised Beds

Example Water Managed Raised Bed Technology
Movable, Modular, Lightweight, Prefabricated



Example Alternative/Additional Raised Beds

Lot C – Tree Pit

Removal and relocation of existing trees:
Subject to an in depth structural survey of the Lady Hale Building roof and investigation of the tree species, we would like to relocate the some or all of the existing trees to the green/blue roof atop the Lady Hale Building. To do this, we would need to ensure the tree species has sufficient hardiness and wind tolerance. We believe it could be possible to utilise strong parts of the roof to support raised soil levels and trees. If the in-depth survey suggests this is not feasible, we will incorporate the trees within the lot D space. We will utilise our innovative prefabricated modular SuDS tree pit as the planting method for this option.

The new SuDS tree pit system we have incorporated brings together multiple innovative products and techniques. The tree pit system is partially submerged, giving multiple benefits. Firstly, this tree pit system is shallow meaning it does not require a deep excavation and will sit above most services. This makes installation easier and possible in difficult areas. Secondly, the raised planter element of the tree pit above can add further opportunity for outdoor seating under the tree canopy and additional species rich understorey planting as an added value feature. Cladding of the raised planters could be from sustainably sourced timber to add to the aesthetic but soften the urban aspect of large areas of hard paving. These could also incorporate matching timber seating to the surround of the raised planter.

Tree species will be selected from an aesthetic, biodiversity and performance / resilience criteria, such as:

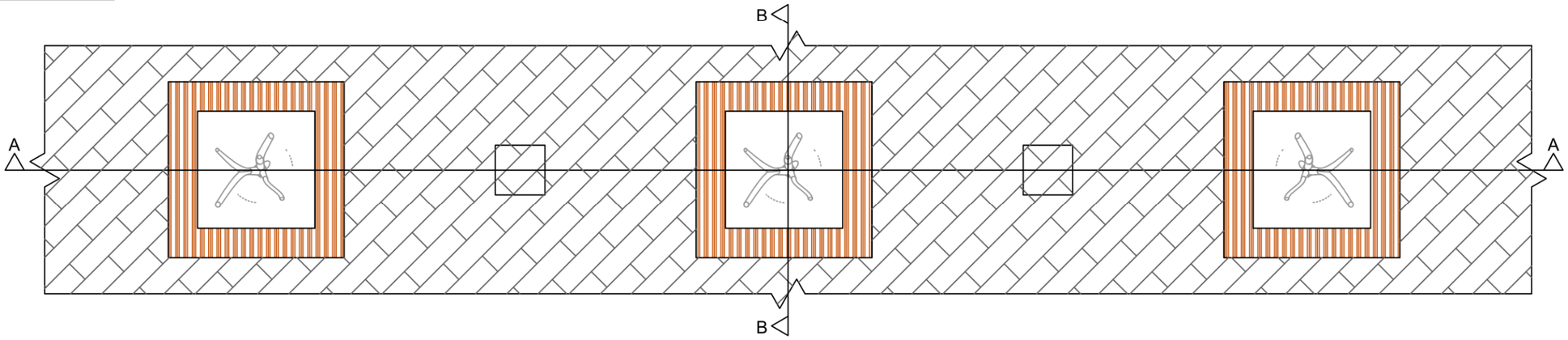
- Liquidambar styraciflua 'Lane Roberts'
- Ulmus New Horizon
- Acer campestre 'Red Shine'
- Pyrus calleryana 'Redspire'
- Gleditsia triacanthos 'Skyline'
- Liriodendron tulipifera

The structural Permavoid raft at the base of the tree pit provides integrated attenuation volume with passive irrigation capabilities. The Permavoid raft directly beneath the permeable paving surface spreads load to protect tree roots, and simultaneously provides oxygen and prevents uprooting of the paving. This Permavoid raft is also filled with nutrient enhanced soils such that during rain events, nutrients are washed into the soils beneath. The raised Permavoid walls provide the structure of the above ground portion and the tree pit and create an air gap to reduce soil compaction.

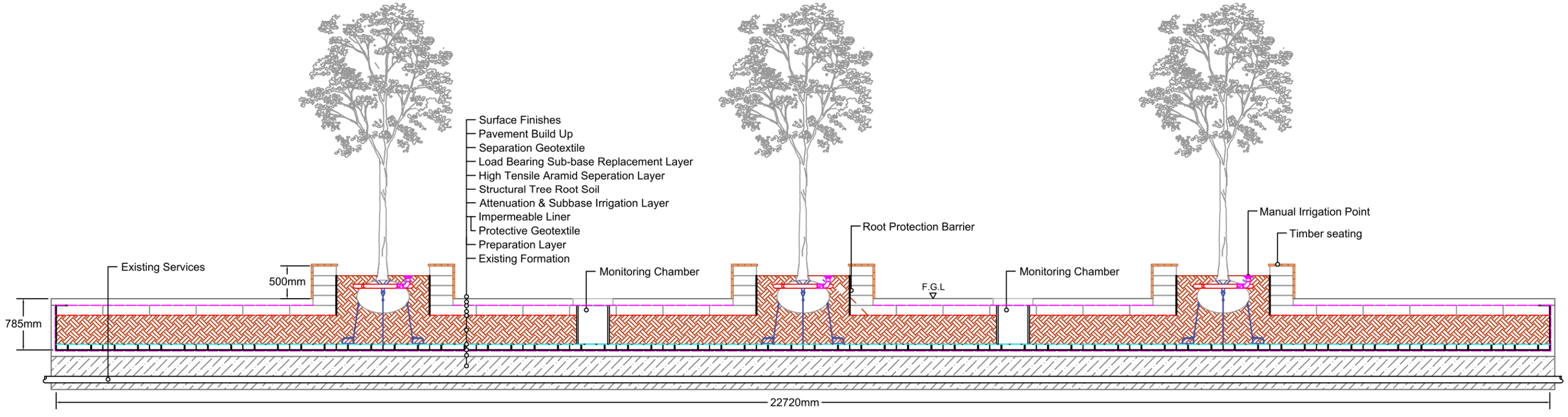
This system encourages tree roots to grow down initially, then allows the roots to exploit adjacent soils in a controlled manner.

Example Raised Tree Pit Arrangement & Seating

Plan (Without Tree Canopy)



Section A-A



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Project: Living Lab NBS Innovation Phase 2
Drawing Description: Lot C SuDS Trees Plan & Section Detail

Client: Salford University

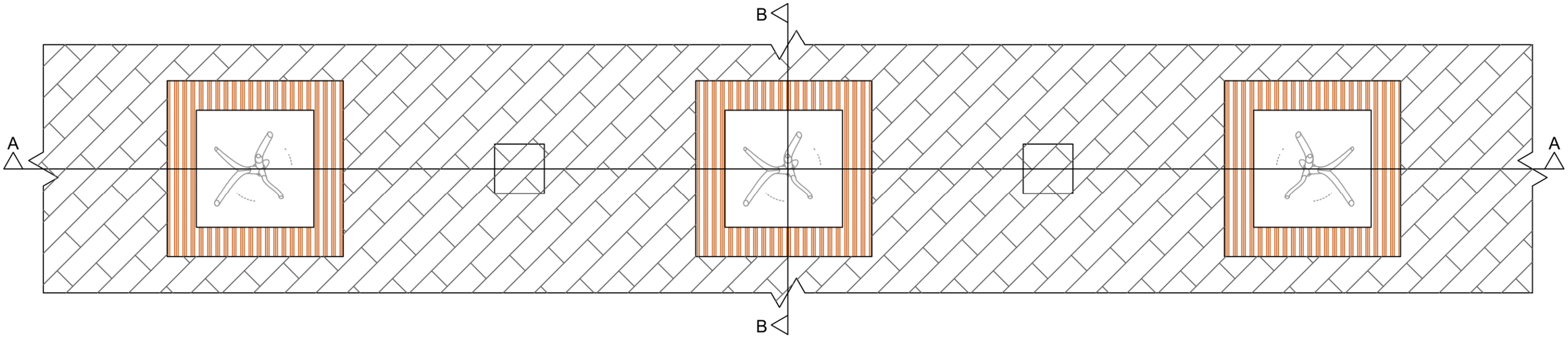
Status: FOR COMMENT

Rev	Date	Description	By	Chk
B	06/05/20	Revised Issue	BS	ECA
A	01/05/20	Initial issue	BS	ECA

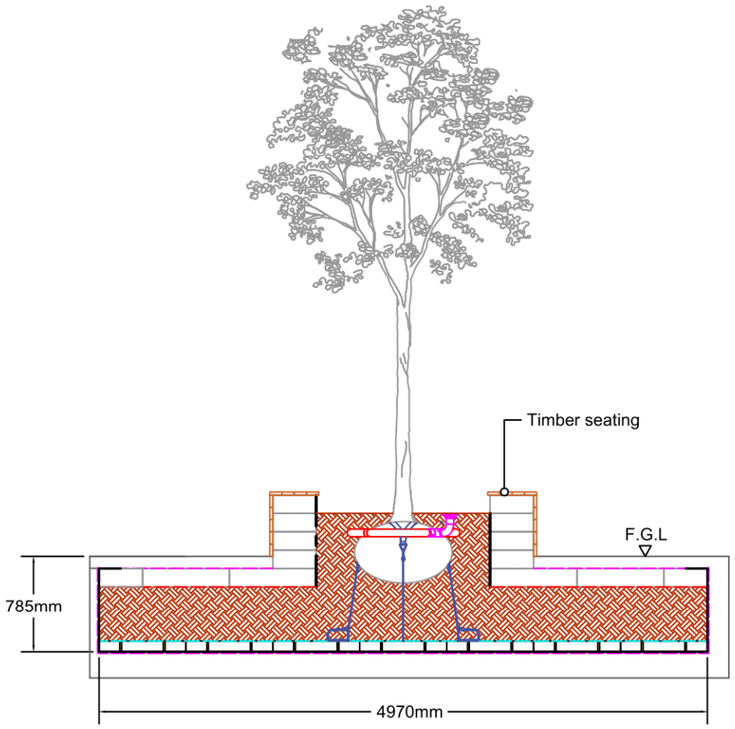
Scale	1:60	**Paper Size**	A3
Drawing Number		2200408/004	

Client Ref: ITT IGNITION Phase 2

Plan (Without Tree Canopy)



Section B-B



SEL Environmental SuDS Tree Design Features

- **Shallow** - 785mm total depth. This includes the attenuation structure, root zone & pavement build up. Shallow constructions means the new tree pit can be installed above formation as to not interfere with any existing services.
- **Stormwater Attenuation Volume** - constructing a tree pit area of 115m2, we can look to look to achieve a maximum attenuation volume of 9.3m3
- **Passive Sub-surface Irrigation** - tree irrigation is achieved using patented sub-surface passive irrigation technologies. Wicking cones within the storage layer draw water upwards from the reservoir into the substrate via capillary action. Providing trees with water as and when it is required.
- **Modular** - Structure formed using a modular plastic void forming unit 710x710x85mm. Units clipped together to form a tensile raft capable of withstanding 70 tonnes per sq.m. Modular nature enables structure to work around any unforeseen, or known, obstacles without affecting existing without compromising the integrity of the tree pit.
- **Root Protection Barriers** - Tree pit contains strategic root protection barriers to promote the growth of tree roots into the main substrate body. System includes an air gap to prevent the upward growth of roots and therefore eliminating any disturbances to the ground level finished surfaces.
- **Monitoring** - Tree pit to include 2 dedicated monitoring points to allow for monitoring of conditions within the tree pit. Lot C to include Cloud Water Control (CwC) smart monitoring & control system. System to remotely monitor, water quality (pH, salinity, temperature), water level, soil moiture, temperature & electrical conductivity and flow metering
- **Raised Sections** - Tree pit to include partially raised planters containing the root ball. Raised section helps to facilitate a shallow subsurface construction, but also becomes a usable feature for seating.

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Project: Living Lab NBS Innovation Phase 2
Drawing Description: Lot C SuDS Trees Plan & Section Detail
Client: Salford University
Status: FOR COMMENT

Rev	Date	Description	By	Chk
A	01/05/20	Initial issue	BS	ECA

Scale	1:50	**Paper Size**	A3
Drawing Number		2200408/005	

Client Ref: ITT IGNITION Phase 2

Lot D – Showcasing Interpretation

We believe this lot requires visualisations, information and real time data. By using a combination of educational information boards and monitors displaying real time system data, we believe this space can show the purpose and connectivity of the IGNITION project.

For this lot we would like to utilise the Student Engagement Opportunities scheme to offer students the opportunity to have design input on the appearance of information boards.

Our monitoring platform allows us to display real time system data including water levels, water flow rates, soil moisture levels, building temperatures, tree water uptake/usage via sap velocity monitoring etc.

This element could also be integral to the 'Living Lab Garden', the potential recreation of the space to provide a destination for all users, to feel like they are entering a green oasis, a place where they can meet and socialise but importantly engage and interact in a number of ways using a variety of media. The real time system data can be integrated within the space on boards and screens to provide constant information on performance and environmental benefits.

QR codes could be added to various elements of planting, drainage and intervention to provide users with further detailed information and images on each element see **APPENDIX 5.**

Example Freestanding Touchscreen Display

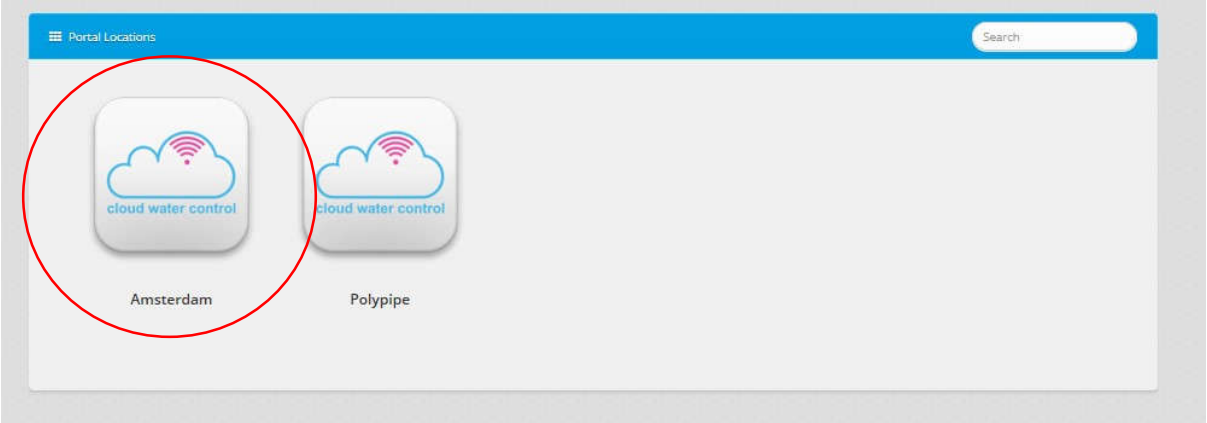
Example 4G Solar Webcam

Potential “Living Lab Garden” Inspiration

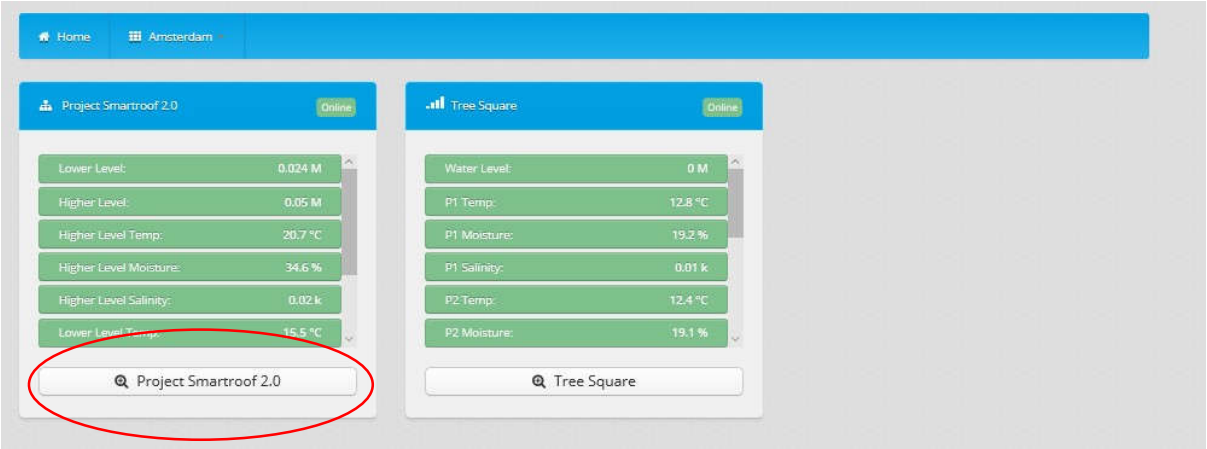
APPENDIX 4

Cloud Water Control

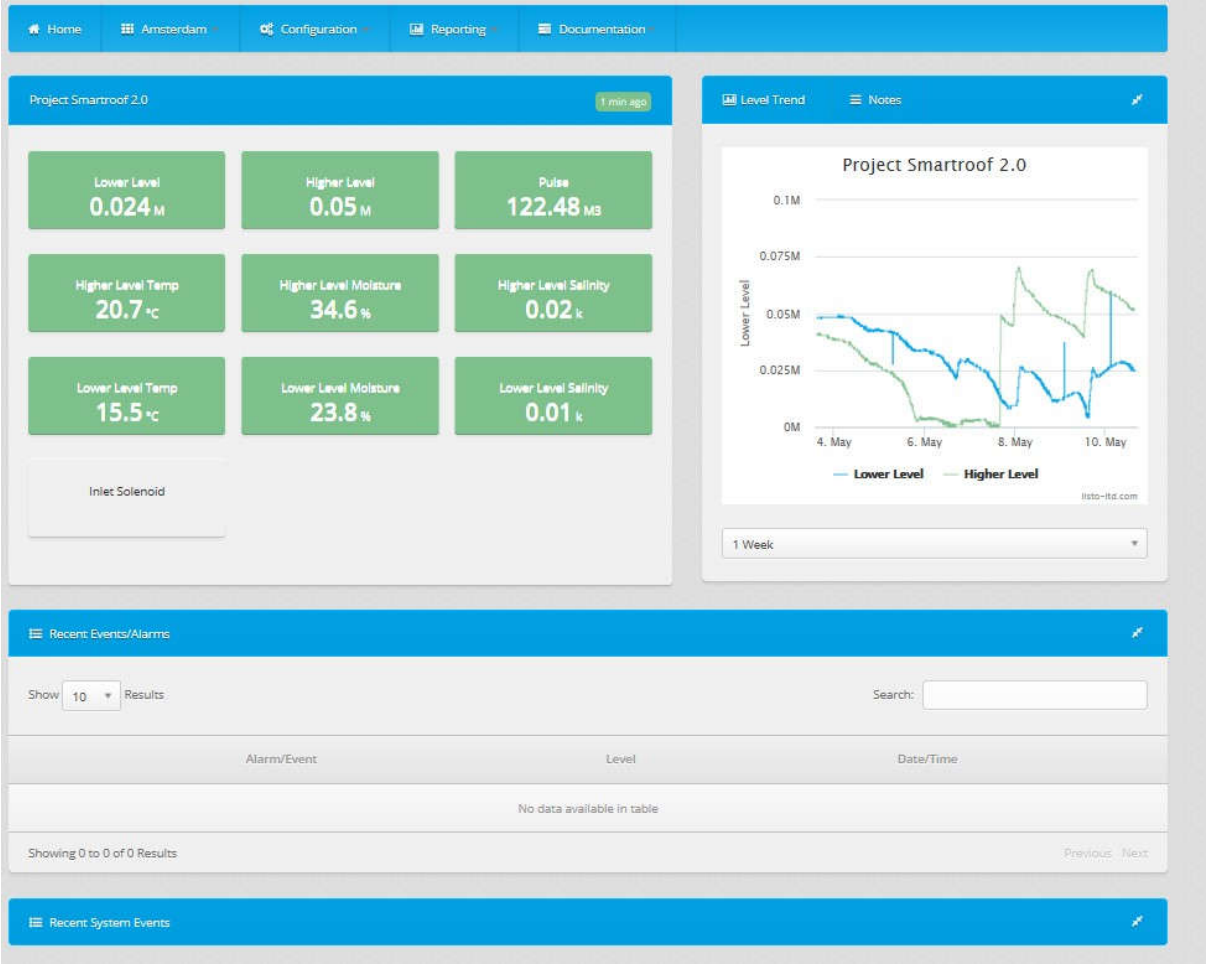
Cloud Water Control Demo Visit – www.cwc-portal.com
Username: **Demo**
Password: **Password1**



*Click Amsterdam for live CwC green infrastructure installations in the Netherlands. Click Polypipe for UK based installations***.**



Click the highlighted button to view the completely bespoke and customisable live project dashboard.



Live CwC project dashboard.

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Cloud Water Control

cloud water control

Cloud water control offers a remote green infrastructure management solution that combines monitoring sensors, remote control management technologies, and cloud computing to deliver and maintain optimum growing conditions.

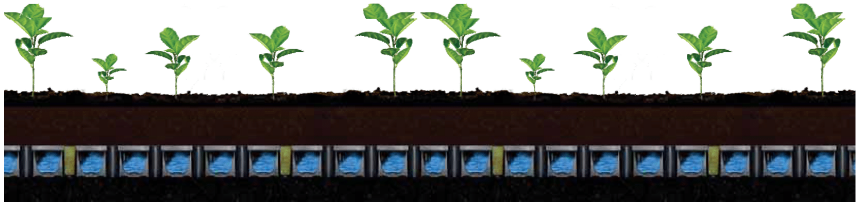
Cloud Water Control systems (CWC) are smart water management solutions that remotely monitor and control, soil and water conditions on podium decks and rooftops. In fact, anywhere where soil conditions require close management.

All systems are built to specification based on site specific requirements and are designed to provide and maintain a healthy growing environment for plants, grasses and trees.

CWC systems comprise a series of interconnected sensors, valves and pumps. The sensors are directly in contact with soils. The valves and pumps are housed in CWCPODs on-site. All hardware is hardwired to a central communication control panel which has an integrated wireless modem to provide a wireless link to the CWCPortal.

The CWCPortal is the cloud-based interface where users can remotely monitor and control their installation. Using the CWCPortal, users can log in on any web enabled device and are able to do the following:

- Monitor real time system performance from remote locations
- Remotely control systems to manage growing conditions
- View historical data
- Receive automated system updates and alarms
- Download data for reporting
- Access and manage multiple sites from one user login



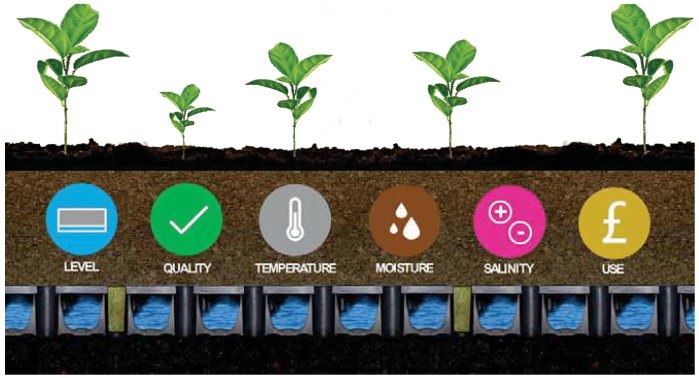
Remote Monitoring

cloud water control

Our temporary and permanant systems use research grade sensors and flow meters to provide users with real-time remote datalogging which feeds back to the CWCPortal. The CWCPortal allows users to view live soil and water conditions and download historical data captured by the system.

CWC systems can be set to take readings up to every minute, providing a detailed analysis of the growing environment conditions. CWC systems are used to remotely monitor:

- level of available irrigation water (mm, or % of available storage volume)
- Soil moisture content (0-100% Saturation)
- Soil electrical conductivity (0.01-1.5 S/m)
- Soil Temperature (-10oC-+55oC)
- Water usage (m3)
- Irrigation water quality – pH, Salinity, Turbidity and more



Remote Management

CWC systems are built to specification making them flexible, adaptable and scalable in their design. This allows for the integration of other irrigation and turf management systems with CWC to provide users with a complete green infrastructure management platform.

A selection of standard connectivity options are available allowing Cloud Water Control to be further integrated with existing or new building management systems.

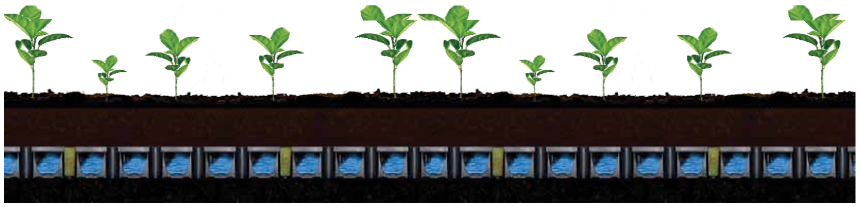
Remote Control

cloud water control

CWC systems process data captured by onsite firmware, to remotely control valves and pumps to manage and maintain an optimum growing environment. Using the CWCPortal, users can login and remotely control CWC systems by adjusting the default settings to fully maximise water use efficiency and effectiveness.

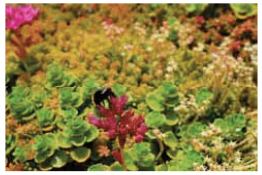
Using the CWCPortal, users can remotely control their systems to:

- Control water supplies to irrigation systems to ensure soil moisture content is optimal
- Control water levels within Permavoid rafts to maximise storm water attenuation and re-use
- Manage water levels in storage tanks to maintain water levels in back-up and re-use tanks
- Control water use by moving water between zones to promote sustainable water use
- Maintain soil pH and Salinity
- Control water quality such as maintain suitable optimum pH and salinity to ensure re-use is safe for plants



cloud water control

Smartroof 2.0, Netherlands



Blue-Green Roofs - Taking Green Space to New Heights

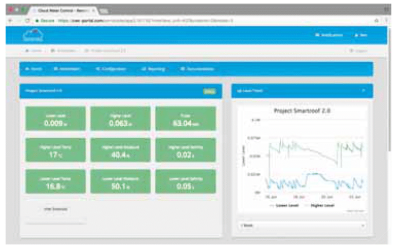
Blue-Green schemes combine the flood water management techniques of both blue and green roofs to alleviate urban rainwater issues, but also provide fresh healthy spaces that can be enjoyed.

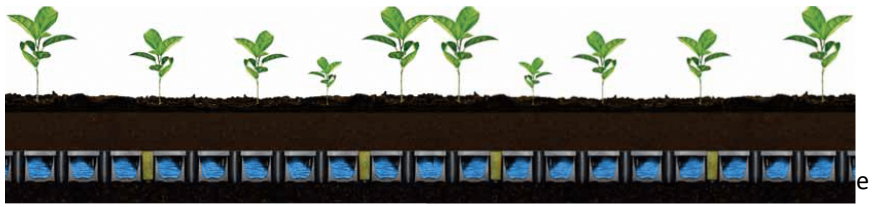
Blue-green spaces are growing in popularity because of their ability to manage water to provide green spaces that have enhanced biodiversity and urban cooling properties.

Cloud Water Control designed, supplied and installed a smart water management system on a blue-green rooftop in the heart of Amsterdam. The system is responsible for managing water levels on the rooftop to minimise roof loading, but maximise attenuation and optimise irrigation. This retrofit system remotely monitors water level, soil moisture and remotely controls valves to distribute water across multiple roof levels.

The system works in sympathy with the original building construction, but also maintains a healthy green space!

- Control water storage levels
- Monitor water use
- Monitor soil moisture
- Monitor soil salinity
- Monitor soil temperature





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cloud water control

Treesquare, Netherlands

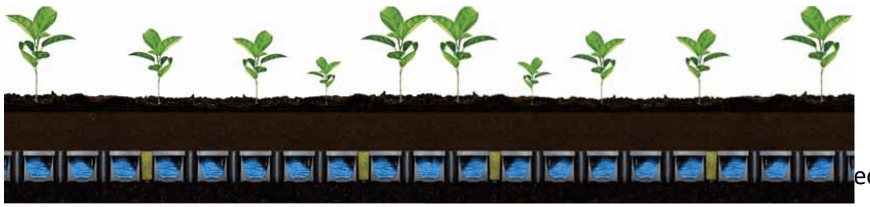
Resilient Cities - Building for the Future

To accommodate the growth in popularity and combat the effects of climate change, the the City of Amsterdam are future proofing new city developments by installing more green infrastructure and constructing on elevated ground to avoid flood damage. These new developments risk green infrastructure failing due to little or no natural ground water for trees.

To achieve successful tree growth, Cloud Water Control was selected to manage water an innovative new development site in Ijburg, Amsterdam.

At Ijburg, a 50m x 50m square was constructed on top of a man-made water table. The CwC solar powered system remotely monitors soil conditions, controls water inlet irrigation supplies and controls evacuation valves to manage water levels within the water table. The CwC system is vital for the survival of these trees during the early establishment stages and ensuring ground conditions are maintained long term.

- Control irrigation water supply
- Monitor water use
- Monitor soil moisture
- Monitor soil salinity
- Monitor soil temperature
- Solar powered



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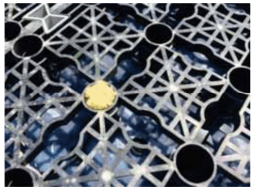
cloud water control

Natural Grass Irrigation, Middle East



Healthy Natural Grass in the Desert

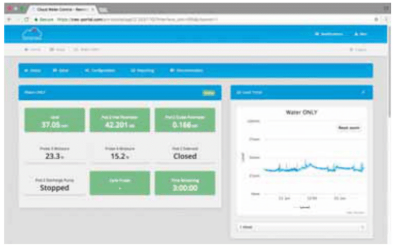
Cloud Water Control are at the forefront of a pioneering scheme to enable the healthy growth of natural grass in the desert.

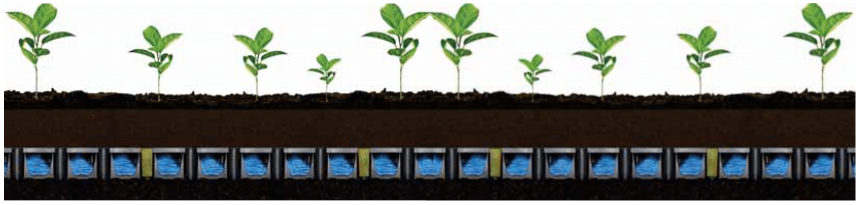
Desert climates make for challenging environments to grow non-drought resistant plant species. Without CwC, the hot climate would result in huge water losses due to high evaporation and transpiration rates. It is essential to maximise irrigation efficiency, but minimise water wastage.

Cloud Water Control designed, supplied and installed an innovative system which allows the client to view real time data. The CwC system uses sensors, valves and cloud based software to remotely control soil conditions and promote sustainable water use.

CwC supplies only what the grass requires, not too much - not too little!

- Control irrigation levels
- Monitor water use
- Control soil moisture
- Monitor soil salinity
- Monitor soil temperature





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