



Green Roofs and Walls Policy Implementation Plan

Green Roofs and Walls

Executive summary	2
Introduction	3
Benefits	5
International experience	6
City of Sydney	7
Policy objectives	8
Leadership	9
Addressing	10
Barriers	10
Collaboration & Engagement	11
Information & Education	12
Research	13
Council properties	15
Recognition in existing systems	16
Monitoring & evaluation	17
Appendix A Activities	18
Appendix B Local Sites	21
Appendix C Research Priorities	24

Images:

Unless stated, all images are by Lucy Sharman - Council's Senior Project Officer Green Roofs and Walls.

Published: Draft v.1. October 2013

Trim reference: 2013/381837

Executive summary



Wyldefel Gardens Potts Point – built 1936
Photo: J Poulton

Green Roofs and Walls have been part of the City landscape since the 1930's. Much has changed in the last eighty years as the City of Sydney has evolved into an urbanised and global city.

With the residential population set to increase by 40% by 2030 and as we continue to experience the effects of a changing climate, greater demands will be placed on the City's infrastructure and green spaces. With these demands comes the need to use our city spaces creatively, so we can continue to provide a welcoming, healthy and vibrant city.

The City of Sydney recognises the many benefits green roofs and walls can provide our city and is committed to supporting green roofs and walls to enhance climate change resilience and the adaptive capacity of the built environment.

Green Roofs and Walls Policy

A draft Green Roofs and Walls Policy has been created and will be considered by Council along with this Policy Implementation Plan. The primary aim of the Policy is for the City to work with residents, businesses and other stakeholders to support an increase in the number of green roofs and walls in the City of Sydney.

The Policy was developed after analysis of community and industry perceptions, reviewing international policies and programs and giving consideration to current development and industry drivers.

Policy Objectives

The City Of Sydney will support the installation of quality green roofs and walls through:

1. **Providing leadership in supporting the development of green roofs and walls;**
2. **Addressing barriers to the adoption of green roof and wall technology;**
3. **Collaborating with community, industry and other stakeholders;**
4. **Informing and educating the community about green roofs and walls;**
5. **Supporting local, practical research;**
6. **Supporting the recognition of green roofs and walls in existing planning systems and rating tools;**
7. **Installing green roofs and walls on Council properties; and**
8. **Monitoring, evaluating and reporting on progress.**

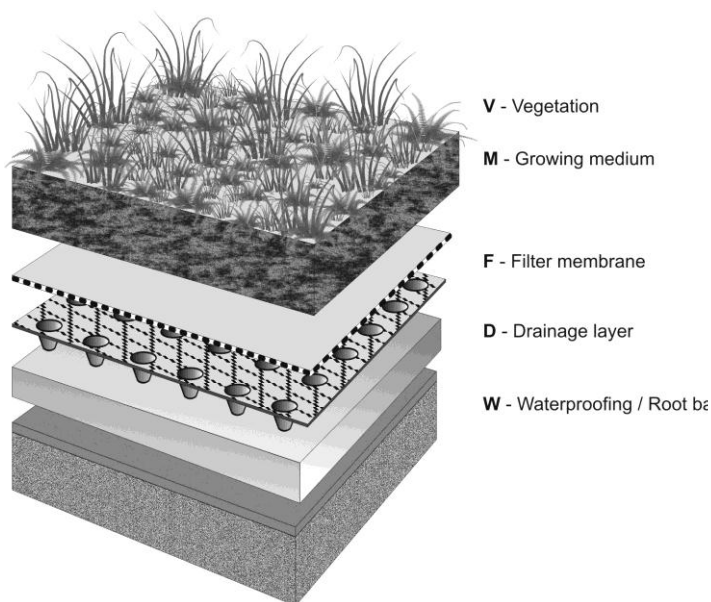
Taking Action

The Green Roofs and Walls Policy sets out the intention of the City. The Implementation Plan sets out the context and background for the Policy as well as the specific actions the City will take to ensure the Policy is effectively implemented. As well as broadly addressing each policy area, the Policy Implementation Plan also has a detailed list of actions and timeframes provided at Appendix A.

Introduction

Policy Implementation Plan

Incorporating plants into building design creates a city that is more beautiful, liveable and resilient to a changing climate. The Green Roofs and Walls Policy Implementation Plan provides information on the progress of green roofs and walls globally and in Sydney. It outlines how the City of Sydney intends to implement its Green Roofs and Walls Policy and work with partners and stakeholders to support an increase in the number of high quality green roofs and walls in our local government area.



Definitions

Green Roofs

There are many different types of green roofs. Typically they include layers of waterproofing, drainage, soil and plants. They can be constructed either in modules or in 'loose lay'. Modular designs have all the layers pre planted in light weight plastic boxes which clip together on the roof. A loose lay design is where the full available area of the roof is covered with layers of soil and plants.

Green roofs can be shallow (150mm or less) lighter weight constructions called 'extensive' green roofs. Green roofs with deeper soil (greater than 150mm) are called 'intensive' green roofs. These are typically more complex landscapes on roofs that are engineered to take heavier loads.

The City recognises that significant planter box landscaping on roofs and podiums can also provide benefits to the building and surrounding environment. In order to provide environmental benefit, the vegetation must cover a minimum 30% of the available roof space in order to be considered a 'green roof' by Council.

The majority of green roofs in Sydney are a mix of intensive (deep) and extensive (shallow) plantings. A good local example is M Central at Ultimo. Deep and shallow landscapes are combined with water features, barbecues and pathways to create open space for residents to meet, socialise, exercise and walk their pets.



M-Central – Green Roof - Ultimo

Green Walls

There are two main types of green walls – *green façades* and *living walls*.

i) Green façades

These are simple systems where the plants are grown directly into soil and trained up a frame or trellis system to cover the wall. Plants can be grown directly in the ground, or in containers or planter boxes installed on the ground or at intervals on the wall. A typical example is the Cumberland Street wall pictured below, which covers the access to the Sydney Harbour Bridge.



Cumberland Street – The Rocks

ii) Living walls

Living walls are more complex systems where panels or pockets are fixed directly to the wall and plants grown in the pockets. These systems often use very little soil to minimise the weight load on the walls. Instead plants are fed through nutrients in the irrigation water. One of the best local examples is the 1,100 square metre series of living wall panels on the Central Park development on Broadway, (pictured on the front cover). Similar systems are installed in the Patagonia store in Bathurst Street, (indoor) and the Pullman Hotel (outdoor).



Indoor green wall - Patagonia store



Pullman Hotel – College Street

On average the City of Sydney receives one new development application each week which includes a green roof or green wall.

Benefits

Green roofs and green walls are one of the few building technologies that provide multiple social, environmental and economic benefits. They are used around the world as an important climate change adaptation tool.

The City of Sydney recognises the significant benefits green roofs and walls can provide our city. Incorporating plants into building design creates a city that is more beautiful, liveable and resilient to a changing climate.



'Readers Digest' building – Surry Hills

Air quality	Greenery on roofs and walls helps remove harmful pollutants from the air, keeping city air cleaner and healthier. They can also improve air quality inside the building.
Beauty	Green roofs and walls are beautiful. They can turn a drab wall or bitumen roof into a striking building feature.
Biodiversity	Green roofs and walls provide space for insects, reptiles and bird life to find water, food and shelter. Biodiversity is vital for a healthy urban environment.
Health	The human need to be around living plants is called 'biophilia'. There are numerous studies showing the physical and mental health benefits human beings experience from being in and around growing plants.
Insulation	Green roofs and walls insulate buildings, reducing reliance on active heating and cooling and reducing energy consumption.
Noise	Green roofs and walls insulate the building from outside noise, creating a quieter, more peaceful indoor environment.
Space	With green roofs and walls, previously unused space can be turned into valuable space for recreation, growing food, gardening etc.
Roof life	Green roofs have been proven to extend the life of a roof by up to 40 years. The green roof limits the roofs exposure to sun and weather. It keeps roof temperatures more even and minimises expansion and contraction from temperature changes.
Solar panels	Green roofs improve the efficiency of solar panels by keeping the surrounding temperature at an optimum level for solar panel efficiency.
Urban Heat Island Effect	Heat from the sun is absorbed by the City's hard surfaces and re-radiated out into the environment, leading to higher city temperatures. Green roofs and walls lower this Urban Heat Island Effect, making the city a more comfortable place to be.
Water	Green roofs slow and clean the rainwater run-off from buildings, helping waterways by reducing run-off and water pollution.

International experience

Dozens of cities around the world actively support the installation of green roofs and walls through:

- Direct financial incentives such as grants and subsidies;
- Indirect financial incentives such as fee reductions and floor space density bonuses;
- Regulations and standards that encourage or mandate green roof installations; and
- Intangible incentives – by far the most common form of support. Examples include research, education and training, technical guidelines and awards programs.

Green roofs and walls are encouraged globally because they are one of the few technologies that combat a range of social, health and environmental issues. The most common reasons they are used is because they:

- Provide valuable open space in built up cities – Austria, New York
- Improve air quality – China, Singapore
- Prevent waterway pollution - Toronto, British Columbia, Germany; and
- Create a more climate change resilient city - Copenhagen, Switzerland.

The most effective programs internationally have included significant education and engagement programs. Cities that now enjoy high rates of green roof installations (greater than 20% of all roof space) have provided support over many years at national, regional and local levels.

International examples

Linz Austria Experienced rapid industrialisation in the late 70's which led to a loss of open space and air quality issues. City policies introduced in 1985 led to significant green roof installations. Linz now has more than 15% of all roofs as green roofs.

Germany First country to develop national green roof standards in the 1970's. Green roofs are supported at a national, regional and local level. More than 80 German cities offer green roof incentive programs. More than 15% of all roofs in Germany are green roofs (around 1 billion square metres).

New York South Bronx had asthma rates seven times the national average and high rates of diesel pollution. The city funded demonstration green roof projects, low interest and revolving loans to support green roofs in The Bronx.

Toronto Has supported green roofs with technical guidelines, workshops, demonstration sites, grants and subsidies. In 2009 Toronto City Council bought in a mandatory green roofs by law for all developments over 2,000 square metres. Prior to the by law Toronto had around 36,000 square metres of green roofs. In the few years since the bylaw was introduced, more than 170,000 square metres of green roofs are planned or under construction.

Copenhagen Copenhagen has set targets to be carbon neutral by 2050 and sees green roofs as a key tool to achieve this target. All new roofs of less than 30 degree pitch are required to be green roofs in Copenhagen.



Punggol Singapore – Public Housing Green Roof
Photo: A Lee, Elmich

City of Sydney

The City of Sydney local government area covers around 26 square kilometres. It is home to more than 180,000 residents, nearly 400,000 jobs and leading commercial, educational and cultural facilities. When the workforce and visitor numbers are combined with residents and hotel guests the local area hosts around one million people each week. Projected population increases to 252,000 residents by 2030 will place increasing demands on the City's buildings, infrastructure, open and green spaces.

Green Roofs and Walls in the City

By September 2013, the City of Sydney had recorded over 96,000m² of green roofs and walls installed in the local government area. Many of these sites are able to be viewed by the public. For a full listing see Appendix B.

Currently Council is receiving on average one new development application a week which includes a green roof or green wall. This is an impressive number, however whilst the number of installations is growing, there are still many opportunities to expand the use of green roofs and walls in Sydney.

Currently green roofs equate for less than 1% of the total roof space available in the City of Sydney. Analysis conducted by the University of New South Wales confirmed that around 18% of roofs in the central business district of Sydney may be able to be retrofitted to include a green roof.

Policy context

Sustainable Sydney 2030

The City of Sydney has consulted widely with the community in the development of Sustainable Sydney 2030. This comprehensive plan sets ambitious targets that confirm the City Of Sydney as a Green, Global and Connected City.

As part of the City's commitment to green Sydney, Council has developed a range of strategies to increase canopy cover in the City.

The Green Roofs and Walls Policy Implementation Plan not only supports the installation of green roofs and walls in Sydney, but also supports the objectives of the City's:

- Greening Sydney Plan;
- Urban Ecology Strategy;
- Urban Forest Strategy; and
- Decentralised Water Master Plan.

Green roofs and walls are listed in each of these plans and strategies as tools that support the objectives of Sustainable Sydney 2030. Green roofs and walls can be used to provide habitat for biodiversity, clean and slow stormwater and increase the City's canopy cover.



Sustainable Sydney 2030 and the strategies and plans listed above are all available on the City's website at www.cityofsydney.nsw.gov.au

Policy objectives

A more detailed list of actions and timeframes for implementing the Policy is provided at Appendix A.

Key objectives

The intention of the City of Sydney is to work with our community, industry, building owners and other stakeholders, to advance the use of green roofs and walls in the City Of Sydney. Council will support the installation of quality green roofs and walls through:

1. **Providing leadership in supporting the development of green roofs and walls;**
2. **Addressing barriers to the adoption of green roof and wall technology;**
3. **Collaborating with community, industry and other stakeholders;**
4. **Informing and educating the community about green roofs and walls;**
5. **Supporting local, practical research;**
6. **Supporting the recognition of green roofs and walls in existing planning systems and rating tools;**
7. **Installing green roofs and walls on Council properties; and**
8. **Monitoring, evaluating and reporting on progress.**

Listed below are the Policy objectives, with information on how the City will progress each policy area.



1 Central Park – Display green wall

Wisdom demands a new orientation of science and technology towards the organic, the gentle, the elegant and the beautiful.

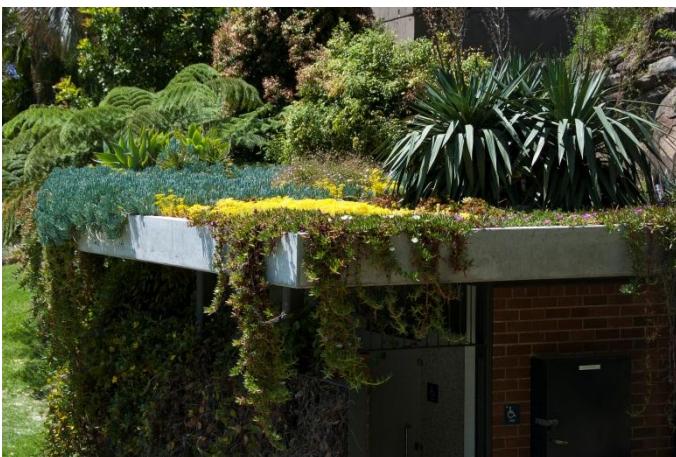
E. F. Schumacher

Leadership

The City Of Sydney Council has taken a leadership role in the development of green roofs and walls in the local government area. A table of the City's most recent achievements is provided below.

The City of Sydney has an ethos of not only supporting important environmental, cultural and social sustainability initiatives, but also in sharing our experience and information with others.

The City will continue to take an active leadership role in the development of green roofs and walls in Sydney and nationally through the development and adoption of a Green Roofs and Walls Policy and through the actions provided in this Implementation Plan.



Beare Park amenities block

Council has demonstrated its commitment to progressing green roofs and walls by:

Date	Action
2008	Installing green roof and walls in Beare Park
2010	Commissioned the Green Roof Design Resource Manual.
2011	Commissioned the University of New South Wales to conduct an inventory and audit of green roof and green wall sites in the City.
2012	Endorsed the Greening Sydney Plan which includes green roofs and walls as a tool for increasing urban greening.
2012	Unanimously adopted the Green Roofs and Wall Strategy.
2012	Conducted research to establish the hardiest combination of meadowland plants for the green roof at Prince Alfred Park.
2012	Established the Green Roofs and Walls Technical Advisory Panel to provide expert advice on advancing green roofs and walls in the City
2012	Commissioning the Green Roofs and Walls Perception Study which highlighted community support and the barriers to their installation.
2012	Commenced Green Wall trials on the Goulburn Street Car Park.
2013	Providing funding for Urban Rooftop Agriculture research at the University of Technology Sydney, Faculty of Design and Built Environment.
2013	Providing funding to the University of Technology Sydney, Institute for Sustainable Futures, to research the impacts of urban greening on indoor and outdoor air quality.
2013	Partnered with the Cooperative Research Centre for Low Carbon Living to investigate the benefits of green roofs and walls on minimising the Urban Heat Island Effect.
2013	Opened the 2,000 square metre green roof meadowland on the Prince Alfred Park Pool
2013	Developed a draft Green Roofs and Walls Policy.

Commenced and planned activities

Develop planning controls to support the establishment of green roofs and walls on new developments.

Support research into the social and environmental benefits of green roofs and walls

Continue to install green roofs and walls on appropriate Council facilities.

Investigate potential incentives to promote the advancement of green roofs and walls in the City Of Sydney

Conduct regular presentations, workshops and information sessions to residents and businesses to advance understanding and acceptance of green roof and green wall technology.

Advocate for national green roof and green wall standards

Establish a local council green roofs and walls networking forum

Help to establish a roof top agriculture network



Four Seasons Hotel – Pool side green wall

Addressing Barriers

In 2012 the City commissioned the *Green Roofs and Walls Perception Study*. The study detailed a number of factors which are acting as significant barriers to the adoption of green roof and wall technology in Australia. These were confirmed through discussions with the City's Technical Advisory Panel and industry representatives. Removing or minimising these barriers is an important focus for the City of Sydney.

Many of the existing barriers relate to gaps in technical and general information. The City will fill these gaps by working with industry and research bodies to better articulate the benefits and costs of green roofs and walls – as well as expand general knowledge of the technology through information sharing, skills training, education programs and technical support.

Cost Barriers

A key barrier to installing a green roof or wall is the lack of concise information about the costs associated with the design, installation and maintenance of green roofs and walls and the benefits they provide. The City will develop easy to use guides for industry and the community on different green roof and wall designs, as well as indicative costs for installation and maintenance.

Research being conducted (see below) will also help clarify the specific environmental, social and economic benefits of green roofs and walls as an important comparison to the overall costs.

Collaboration & Engagement

Technical issues

Waterproofing

Waterproofing is still a concern for some building owners. There is significant evidence that green roofs extend the life of a roof by reducing exposure of the water proofing layer to sun and weather. In order to counter the perception of water proofing issues, the City will develop technical guidelines and advice to support building owners with information on the optimum water proofing and installation techniques.

Species selection

Selecting the right plant species for a green roof or wall was an issue raised through the Perception Study. There is a large amount of local knowledge on how specific plants function on green roofs and walls, although this information is often difficult to find. The City will develop guides on plant species that are most suited to different green roof and wall systems as well as to different climatic conditions. This includes providing information on species that will provide specific benefits e.g. cooling buildings or providing habitat for biodiversity.

Commenced and planned activities

Publish the results of research to improve understanding of the social and environmental benefits of green roofs and walls compared to costs

Develop and publish a design guide series that provides information on different design specifications for green roofs and walls

Develop technical guidelines including best practice guide to waterproofing

Publish planting guidelines for different building environments and for different environmental outcomes

Develop detailed case studies on existing and planned green roof and wall installations

Develop a decision making tool to guide building owners through the process of designing, installing and maintaining a green roof or wall system

Develop price guides for different types of green roofs and walls

The City of Sydney has a proud history of providing opportunities for partnerships, collaboration and engagement. The core strategic document for the City (Sustainable Sydney 2030) is based on extensive consultation and engagement with our community and recognises the desire of our residents and businesses to be part of a Green, Global and Connected city.

The Green Roofs and Wall Policy was developed with valuable input from Council's Green Roofs and Walls Technical Advisory Panel made up of academics, architects, designers, installers and sustainability experts.

City staff also meet regularly with building owners, architects, academics, designers, green roof and wall suppliers and community members in order to understand issues, concerns and interest in green roofs and walls.

The Green Roofs and Walls Policy and Implementation Plan are designed to be living documents. As the industry changes and develops the documents will be reviewed and feedback from stakeholders integrated into the City's activities.

Information & Education

Presentations will also be provided to stakeholders such as the green roofs and walls suppliers and installers, building owners and architects as well as local businesses and residents groups. Just as importantly, presentations and information will be provided to City of Sydney staff across different divisions to ensure the Policy is understood and implemented across Council.

Commenced and planned activities

Host the Green Roofs and Walls Technical Advisory Panel to provide direction and monitor the implementation of the Green Roofs and Walls Policy

Meet regularly with key internal and external stakeholders to review progress and understand issues and opportunities

Develop an annual stakeholder consultation and engagement plan in conjunction with Council's City Engagement staff, business, industry and community stakeholders

Establish a rooftop agriculture networking group

Actively participate in the City of Sydney Greening Sydney meetings and activities

One of the issues with green roofs and walls is the difficulty in finding appropriate and reliable information. Council's objective is to ensure that relevant, high quality information is developed and made available to the City Of Sydney community and more widely.

The City's website is regularly updated with useful information and includes a map of green roofs and walls in the local government area, including information on publically accessible sites. The City has run green roof and green wall workshops and a large forum on green roofs and walls as part of the Sydney Design Festival. Feedback from these activities will help to improve future activities.

Information and education activities provided are designed to ensure that appropriate programs are being offered to improve understanding of, and skill in, green roof and wall installations. The planned activities will provide information at a range of levels, from the simple to more technical, for the merely curious to the aficionados.



Macdonaldtown rail bridge – green wall

Commenced and planned activities

Develop an annual program of green roof and green wall education programs including:

- Hold an annual forum on green roofs or walls
- Host regular workshops each year
- Produce step-by-step guide to planning and installing a green roof or green wall
- Publish fact sheet on green walls including a green roofs and walls growing food guide

Present regularly to community, business and government groups and organisations on the benefits of green roofs and walls

Publish and distribute new information on green roof and wall technology via the Green Village news and Council's website

Design and publish a self-guided tour of publically accessible local sites

Provide regular presentations to internal staff on the City's policy and strategies for green roofs and walls

Regularly review and update the City's green roofs and walls webpage with new information

Research

The environmental benefits of green roofs and walls and the way they function depends largely on the way they are designed and the specific environmental conditions of the site. For example a typically shallow green roof in Germany will not slow and clean stormwater in the same way that a deeply planted green roof will in Sydney.

If we are to develop a strong understanding of the benefits and costs of green roofs and walls, we need to understand how they function in Sydney's unique environment. What depths and types of soils retain stormwater? Which plant species thrive on shaded roofs? What foods can be grown on walls? Exactly how will a green roof or wall benefit a building and the surrounding environment? All of these questions and more are important to understand the full benefits green roofs and walls can provide a building as well as the broader city environment.

In late 2012 the City of Sydney investigated the gaps in local information on green roofs and walls. A Research Priority Plan was developed to direct the City's research efforts and address key gaps in our understanding of green roof and green wall technology. The Research Priority Plan is provided at Appendix C.

Consultation has also taken place with local universities and other potential research partners to develop relevant local and practical research.



Green roofs and walls forum Sydney Design Festival
Photo: Courtesy The Powerhouse Museum

The City has also already commissioned and completed green roofs and walls research. The most important of these is the *Green Roofs and Walls Perception Study*. Amongst other things, the study aimed to understand community recognition of green roofs and walls and their benefits, articulate the barriers to installing green roofs and walls and provide recommendations on the role the City of Sydney could play to advance use of green roofs and walls. Recommendations from this research have been integrated into the Green Roof and Walls Policy.

The City will continue to support research that meets the objectives set out in the Research Priorities Plan. Research results will be made available to the public and provided on our website in order to advance community understanding of the benefits of green roofs and walls.

Commenced and planned activities

Research Priorities Plan developed and reviewed annually

Collaborate with the University of Technology Research – Institute for Sustainable Futures on the effects of Urban Greenery on Indoor and Outdoor Air Quality

Collaborate with the University of Technology Research – Design and Built Environment on Urban Roof top Agriculture

Support green roof and wall research via the City's partnership with the Cooperative Research Centres – Low Carbon Living research program

Support the CRC for Low Carbon Living research on the impact of green roofs and walls on urban microclimates and the Urban Heat Island Effect

Work with local universities to establish GRW research sites in line with the Research Priority Plan

Review existing green roofs and walls installed by the City of Sydney and develop detailed case studies reviewing their cost and benefits

Publish results from the Goulburn Street Green Walls trial

Council properties

The City of Sydney has led the way by installing and maintaining green roofs and walls on its own properties and in the public domain.

Currently the City has seven green roofs and five green walls that are owned by or under the care and control of the City. The City has won architectural awards for two of its green roof developments at the Surry Hills Library and the Prince Alfred Park Pool.



Prince Alfred Park Pool – 2,000m² green roof
Photo: Brett Boardman

Draft

Green Walls	Address
Beare Park	13 Esplanade, Elizabeth Bay
Goulburn Street car park	101 Goulburn Street
Macdonaldtown railway bridge	Macdonaldtown
Waterloo Youth Family and Community Centre	Waterloo
William Street Overpass	William Street

Green Roof	Address
Beare Park	13 Esplanade, Elizabeth Bay
Embarkation Park	71 Cowper Wharf Road
Lawrence Hargrave Park	9 Elizabeth Bay Road
Paddington Reservoir Gardens	251 Oxford Street
Prince Alfred Park pool	Prince Alfred Park
Surry Hills Library	Chalmers Street Surry Hills
The Domain	Prince Albert Road

Commenced and planned activities

Develop and publish detailed case studies of existing City green roofs and walls including key design considerations, site information, plant species used, etc.

Develop criteria to assess additional Council properties to determine which properties could be retrofitted to include a green roof or wall.

Develop building and site criteria to assist building owners to assess their own properties and determine their potential to be retrofitted for a green roof or wall.

Investigate the potential for City owned sites to be the subject of future research programs in order to monitor and test their efficacy against a range of environmental outcomes such as stormwater and flood mitigation benefits, air quality, biodiversity etc.

Recognition in existing systems

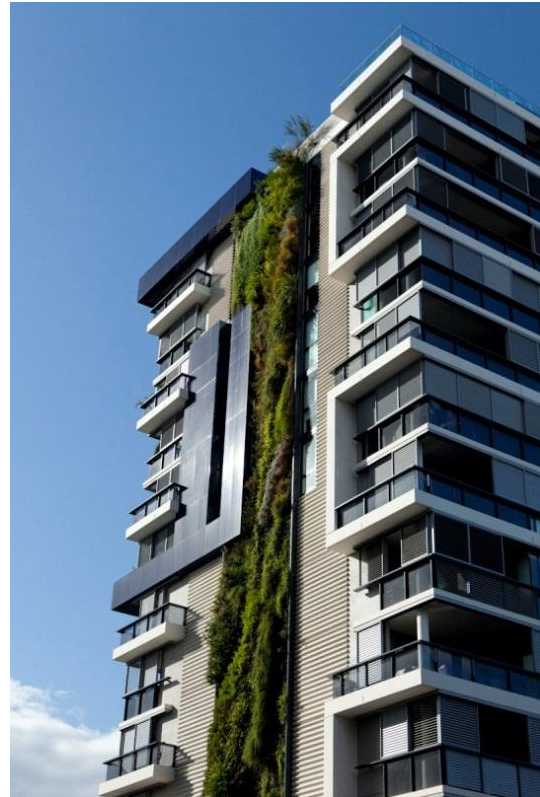
There are existing systems and processes that can be used more effectively to support the expansion of green roofs and walls in Sydney.

The City supports green roofs and walls by including them in important strategic documents as well as encouraging their use via Development Control Plans. The City has included green roofs and walls in the general provisions of the Sydney Development Control Plan 2012 (DCP) as well as in specific DCP's for Green Square Town Centre and the Harold Park Development.

Apart from planning controls, there are also sustainability rating and assessment tools used nationally that could also be used more effectively to support green roof and wall development. These tools include the Green Star rating tools from the Green Building Council of Australia as well as NABERS (National Australian Built Environment Rating System), NatHERS (Nationwide House Energy Rating Scheme) and BASIX (Building Sustainability Index).

More information could be provided to building owners and urban precinct designers to better understand these rating tools and how green roofs and walls might apply to improve a buildings sustainability rating.

Research proving the environmental benefits of green roofs and walls in Sydney will be important in advancing the recognition of green roofs and walls within planning controls and rating systems.



Trio Apartments - Camperdown

Commenced and planned activities

Review planned amendments to LEP and / or DCP or other planning controls to ensure green roofs and walls are appropriately recognised.

Review the development application process for green roofs and walls and remove potential barriers for the City and applicants

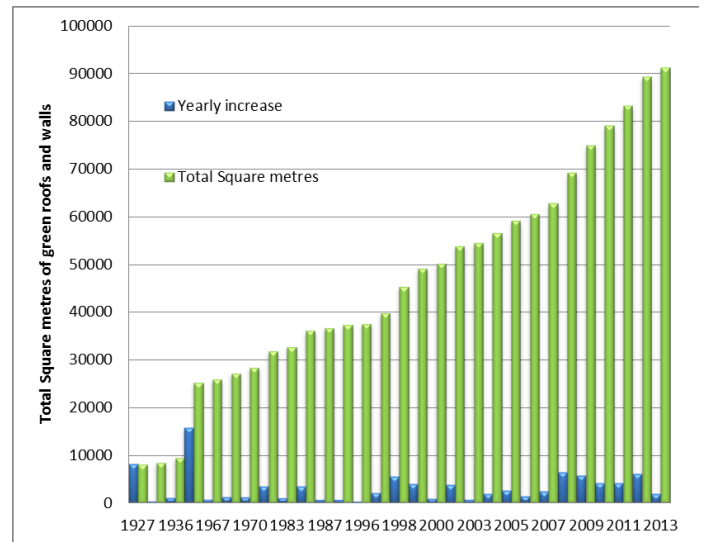
Develop information to assist building owners to achieve sustainability ratings with the use of green roofs and / or green walls

Investigate potential research that will provide data necessary to support the inclusion of green roofs and walls in sustainability rating tools

Work with rating tool agencies to support the inclusion of green roofs and walls in existing rating system assessments.

Monitoring & evaluation

Installation area of green roofs and walls 1927 - 2013



All the actions in this Policy Implementation Plan are designed to support the increase in quality green roofs and walls in the local government area. In order to assess whether our interventions have been effective the City will monitor the number and type of green roofs and walls that are being installed in the local government area.

Green roof and wall installations will be monitored through the Development Application process. All approved developments that have a green roof or wall included will be periodically reviewed to monitor the rate at which these developments are being built and the degree to which they are being maintained.

A base line inventory has already been established by Council and will be reviewed and reported on through the City's quarterly Green Report and annual State of the Environment Report.

Monitoring will also occur via regular site visits, consultation with local installers and through direct community and business engagement.

Establishing this monitoring and evaluation process may support the development of appropriate green roof and green wall targets in the future.

Commenced and planned activities

Maintain an inventory of green roof and green wall sites in the local government area

Periodically review the sites to ensure they are being maintained

Maintain and inventory of all development applications including a green roof or green wall

Survey building owners with approved green roof or wall developments to monitor installation rates and outcomes

Monitor and report on green roof and wall sites quarterly in the City's Green Report and annual State of the Environment Report

Appendix A Activities

The green roofs and walls industry is evolving rapidly in Sydney. These activities are designed to meet the aims and objectives set out in the Green Roofs and Walls Policy paper. They are part of a living document and will be reviewed annually as part of the Senior Project Officer Green Roofs and Walls annual performance review.

	Dec 2013	Feb 2014	April 2014	June 2014	Aug 2014	October	December	Feb 2015	April 2015	June 2015	August	October	December	Feb 2016	April 2016	June 2016	August	Sept 2016	
Leadership																			
. Install green roofs and walls on Council properties																			
. Review planning controls and DA process to remove barriers																			
. Support research into rooftop agriculture and air quality impacts of GRW																			
. Host a local government GRW networking event																			
. Expand the CoS website information and update monthly																			
. Investigate potential incentives programs																			
. Establish a rooftop agriculture working group																			

	Dec 2013	Feb 2014	April 2014	June 2014	Aug 2014	October	December	Feb 2015	April 2015	June 2015	August	October	December	Feb 2016	April 2016	June 2016	August	Sept 2016
Addressing Barriers																		
. Publish and communicate results from GRW research																		
. Publish design guide series e.g. designing GRW for biodiversity																		
. Develop waterproofing technical guidelines																		
. Publish Planting Guides for GRW																		
. Publish detailed case studies of GRW																		
. Publish a decision making tool to support building owners GRW choices																		
Collaboration and Engagement																		
. Host the GRW Technical Advisory Panel																		
. Participate in Greening Sydney meetings																		
. Host a rooftop urban agriculture networking forum																		
. Review and update stakeholder engagement plan annually																		
Information, education, skills training																		
. Publish a fact sheet on the benefits of green walls																		
. Present on GRW to stakeholder groups																		
. Publish and distribute GRW news through Village Green																		
. Hold an annual forum on GRW topic annually																		
. Publish GRW food growing guide																		
. Design and publish a self-guided tour of CoS GRW sites																		
. Produce a step-by-step on GRW installations																		
. Host minimum of 2 workshops a year on GRW																		
. Quarterly presentations on GRW to internal staff teams																		
. Present regularly to business and community groups on the benefits of GRW																		
. Update the CoS website GRW page																		
. Develop an annual workshop / education program for GRW																		

	Dec 2013	Feb 2014	April 2014	June 2014	Aug 2014	October	December	Feb 2015	April 2015	June 2015	August	October	December	Feb 2016	April 2016	June 2016	August	Sept 2016
Research																		
. Review and update the GRW Research priorities plan annually																		
. Support UTS / ISF research on urban air quality																		
. Support UTS / DAB research on Urban Rooftop Agriculture																		
. Support research projects on biodiversity (USYD), social and SW impacts (UTS)																		
. Investigate the potential for an urban demonstration site / research hub																		
. Participate as committee member on the CRC UHIE and GRW research																		
. Investigate new research opp's via CRC for low carbon living partnership																		
Recognition within existing systems																		
. Review existing planning controls for GRW provisions																		
. Review DA process and remove potential barriers																		
. Locality statements reviewed and amended where possible to include GRW																		
. GRW integrated into developer contribution plan reviews																		
. GRW Development applications assessed to standard																		
. Develop a guide to the integration of GRW into Green Star tool																		
. Review NABERS, BASIX and NatHERS capacity to integrate GRW																		
Council properties																		
. Develop criteria for assessing Council properties for GRW retrofit																		
. Conduct research / analysis on one existing site per year																		
. Create a CoS working group to assess the viability of demo site																		
. Review Council building upgrade program for GRW retrofit potential																		
. Monitor existing GRW for research and case study development																		
Monitoring and Evaluation																		
. Report on the verified numbers and m ² GRW via quarterly Green report																		
. Report on progress in annual State of the Environment Report																		
. Monitor GRW via Development Application process																		
. Analyse the number of GRW installed post DA consent																		

Appendix B

Local Sites

Legend:



Green coloured sites are owned by, or under the care and control of the City of Sydney

GREEN ROOFS			
Building	Address	Suburb	Publically accessible
ABC	700 Harris Street	Ultimo	No
Allianz Building	2 Market Street	Sydney	No
Atlas Apartments	Power Avenue	Alexandria	No
Barons Building	5-9 Roslyn Street	Potts Point	No
Beare Park	13 Esplanade	Elizabeth Bay	Visible
Belgrave Court	5-11 Boundary St	Darlinghurst	No
Bowman Street	66 Bowman Street	Pymont	No
Capita Centre	9 Castlereagh St	Sydney	No
Castlereagh Street	44 Castlereagh Street	Sydney	No
Channel 7	1 Central Avenue	Eveleigh	No
Chippendale Mews	92-96 Shepherd St	Chippendale	No
Common Ground	31 Pymont Bridge Road	Camperdown	By appointment
Darling Park	231-239 Sussex Street	Sydney	Yes
Eco1	11 Grandstand Parade	Zetland	No
Eco2	13 Grandstand Avenue	Zetland	No
Elan	1 Kings Cross Road	Darlinghurst	No
Elizabeth Bay Gardens	15-19 Onslow Avenue	Elizabeth Bay	No
Elizabeth Bay Road	17 Elizabeth Bay Road	Elizabeth Bay	Visible
Embarkation Park	71 Cowper Wharf Roadway	Potts Point	Yes
Forest Lodge	43 Foss St	Forest Lodge	No
Grandstand Parade	9 Grandstand Parade	Zetland	No
Holt & Hart Building	50 Holt Street	Surry Hills	No
Hudsons Apartments	240 Wyndham Street	Alexandria	No
KENS Site	271 Kent Street	Sydney	Yes
Lawrence Hargrave Park	9 Elizabeth Road	Elizabeth Bay	Yes

Building	Address	Suburb	Publically accessible
M Central	320 Harris Street	Pyrmont	No
Moore Park Gardens	780 Bourke Street	Surry Hills	No
Mount street walk	2-4 Mount Street	Pyrmont	No
Newhaven	278 Sussex St	Sydney	No
Nova Apartments	Victoria Park Parade	Zetland	No
Observatory Tower	168-170 Kent Street	Millers Point	No
Paddington Reservoir Gardens	251-255 Oxford Street	Paddington	Yes
Parliament of New South Wales	6 Macquarie Street	Sydney	By appointment
Prince Alfred Park Pool	Chalmers Street	Surry Hills	Yes
Prominence	1 Grandstand Avenue	Zetland	No
Readers Digest Building	71-111 Cooper Street	Surry Hills	No
Signature Apartments	21 Regent Street	Redfern	No
Springfield Mall	18 Springfield Avenue	Potts Point	No
St Martins Tower	31 Market St	Sydney	No
Surry Hills Library	405 Crown Street	Surry Hills	No
Surry Hills Reservoir	224A Riley Street	Surry Hills	Visible
The Bond	30 Hickson Road	Millers Point	No
Conservatorium of Music	1 Conservatorium Road	Sydney	Yes
The Domain	2 Prince Albert Road	Sydney	Yes
The Palladium	102 Miller Street	Pyrmont	No
Top of the Town Hotel	227 Victoria Street	Darlinghurst	No
UNSW CBD Campus	1 O'Connell Street	Sydney	No
Wayside Chapel	27 Hughes Road	Potts Point	By appointment
Westbury Apartments	221 Darlinghurst Rd	Darlinghurst	No
Westons Biscuit Factory	2-30 Lyons Road	Camperdown	No
Wharf Terraces	16 Lincoln Crescent	Woolloomooloo	Yes
Woolloomooloo Bunker	6 Lincoln Crescent	Woolloomooloo	Yes
Wyldefel Gardens	8aWylde Street	Potts Point	No
Wynyard Park	York Street	Sydney	Yes

GREEN WALLS

Building	Address	Suburb	Publically accessible
Beare Park (amenity block)	13 Esplanade	Elizabeth Bay	Yes
Bromeliad Wall	Botanic Gardens	Sydney	Yes
Burton Street Terrace	Burton Street	Darlinghurst	Visible
Central Park (under construction)	20 Broadway	Chippendale	Visible
City Central Display	Broadway	Chippendale	During opening hours
Four Seasons Hotel	199 George Street	The Rocks	No
Garden Life Terrace	373 Liverpool Street	Darlinghurst	Visible

Building	Address	Suburb	Publically accessible
Gazebo Wine Garden	2 Elizabeth Bay Road	Potts Point	During opening hours
Google Headquarters	5/48 Pirrama Rd	Pyrmont	No
Goulburn Street Car Park	101 Goulburn Street	Haymarket	Visible
Green Park Hotel	360 Victoria Street	Darlinghurst	During opening hours
Green Wall Stand	Botanic Gardens	Sydney	Yes
Hilton Hotel	488 George Street	Sydney	Visible
Ivy Hotel	330 George Street	Sydney	During opening hours
Ivy House	Art Gallery Road	Sydney	Yes
Ivy Terrace	22 Egan Street	Newtown	Visible
MacDonalddtown Rail	Leamington Lane	Newtown	Visible
NAB	255 George Street	Sydney	During opening hours
Norfolk hotel	305-309 Cleveland Street	Redfern	During opening hours
Patagonia Store	93 Bathurst Street	Sydney	Visible
Pullman Hotel	26-36 College Street	Sydney	Yes
Shelbourne Hotel	200 Sussex Street	Sydney	Yes
The Republic	46-50 Burton Street	Darlinghurst	No
Trio Building, City Quarter	1-5 Sterling Circuit	Camperdown	No
Waterloo youth, family and community centre	770 Elizabeth Streets	Waterloo	Yes
William Street Overpass	Darlinghurst Road	Kings Cross	Yes - September to June

Appendix C

Research Priorities

The City has already carried out a number of research projects detailed above. This proposed research program focuses on investigations that will continue to advance our knowledge of the environmental, social and economic benefits of green roofs and walls. The research will aim to strengthening our understanding of the costs versus benefits of green roofs and walls. It will also look at both the public and private contributions green roofs and walls make to the Sydney local government area.

Research may include new projects or may study existing green roofs and walls to assess their performance in relation to design, installation, maintenance and whole-of-life cycle costs.

All research projects will be developed in relation to existing City of Sydney targets and plans, with specific reference to Sustainable Sydney 2030, Green Roofs and Walls Policy, Greening Sydney Plan, Urban Ecology Strategic Plan, Decentralised Water Master Plan and Urban Forest Strategy. The proposed program will also prioritise research that builds on, and leverages off, existing knowledge and that helps remove barriers to green roof and wall installations in Sydney.

It is proposed that the research program will focus on the following:

Microclimates and Urban Heat Island Effect

On 27 June 2011, Council resolved to enter into an agreement to be part of the Cooperative Research Centre (CRC) for Low Carbon Living for the seven-year term of the program. Six priority research areas were submitted to the CRC board and include specific research into the impact of green roofs and walls on urban microclimates and the Urban Heat Island Effect.

Research on existing facilities

The City of Sydney own and have access to a number of green roof and wall sites. There may also be opportunities to conduct research on privately owned green roofs and walls.

One of the clear barriers to installation is the cost of installation versus the benefits green roofs and walls provide. Analysing existing systems will begin to fill a gap in our knowledge in this area, provide locally relevant information and provide a cost effective source of data.

Potential research on existing sites would include:

- Cost benefit analysis for example installation costs, maintenance and potential repairs.
- Design considerations – document design issues and lessons learnt from installations
- Species selection – which species on existing installation have been most resilient to local conditions.
- Stormwater analysis – analyse the stormwater retention benefits of the greening of sites such as the Conservatorium of Music and Domain car park.
- Social benefits – does having a green roof or wall provide positive benefits to those using the space? This research is likely to be better informed through a pre-construction and post-construction process, rather than attempting research on GRW already installed.

Demonstration project:***Retrofitting roof tops for urban food production, climate change adaptation and social benefits***

This is a more complex project and is intended as a demonstration site, where multiple hypotheses could be tested over time. The site would be set up in a high visibility area to test a number of soil depths and species types – including food producing areas. Testing social benefit would also be a key part of this project.

No budget is currently allocated for this project. A feasibility study, detailed project plan and research proposal would need to be developed in order to determine the costs and potential benefits of funding a research and demonstration site.

Stormwater management, retention, cleaning and flood mitigation benefits

This project will build on research already conducted in Melbourne, UK, Europe and the USA. The research will look at which roofs are able to be retrofitted for green roofs in the Sydney Central Business District and the impacts on stormwater of retrofitted green roofs. This research will support the City's Decentralised Water Master Plan and will contribute data to the proposed demonstration research project.

Research partnerships

The City is currently providing in-kind support to a number of research projects that will provide locally relevant green roof and wall data. At present these research proposals are proposals only and funding submissions are still being prepared or assessed.

Green roofs and biodiversity

The City is looking to partner with research institutes in Sydney to investigate the biodiversity impacts of green roofs. Sites are intended to be assessed before the green roof is built as well as at intervals after construction. Data on the migration of species onto green roofs will enhance our understanding of green roof designs and species selection that best enhance local biodiversity.

The impact of urban greening on indoor and outdoor air quality

The City of Sydney has provided funding to the University of Technology Sydney to investigate the potential air quality benefits of urban greening on indoor and outdoor air quality. Green roofs and walls have the potential to filter harmful pollutants from city air.

Roof top agriculture

The City is currently supporting research at the University of Technology Sydney looking at the particular design considerations and benefits of rooftop urban agriculture. Researchers will look at which food species do better in different rooftop site conditions as well as monitor water consumption and a number of other impacts on food growing.

Social benefits

A research partnership is currently being developed looking at the social impacts of workers having access to green roof space. This research will look at quantifying the economic benefit to an organisation of providing outdoor green space for office workers.

Other

There are a number of other possible research programs that would provide useful data on local green roofs and walls. Opportunities will continue to be explored to find projects that may assist in providing additional data in the following areas:

- To what extent do green roofs contribute to increasing solar panel efficiency;
- Carbon sequestration capacity of green roofs and walls; and
- Insulating effects of green roofs and walls on buildings and resultant energy savings.