Grow Up Guide

An Introduction to DIY Laneway Greening
PARTNERS

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Community-University-Engagement

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Contents

01 Introduction
02 Vertical Greening Systems (VGS)
06 DIY friendliness
09 Selecting your Green Wall Site
11 Site Access
13 Checklist for Appraising the Suitability of an Existing Wall Structure for Green Wall Retrofit
16 Budget
20 Installation
23 Weight loading and External forces
25 Waterproofing
28 Maintenance
34 Drainage and Irrigation
39 Professional Consultants and Advice
43 Plant Considerations
48 Achievable DIY Designs
51 Design Ratings
61 References
63 Disclaimers and Acknowledgments
In urban environments, where space is costly, an innovative approach to increasing the abundance of plants in cities is to grow them vertically as 'green walls', rather than horizontally. Whether growing on independent self-supporting structures or directly on buildings, plants can use largely underexploited vertical space allowing an additional type of urban greening to be incorporated into the urban environment. This is especially true for urban laneways that can undergo revitalisation, activation and engagement through greening.

Large-scale green wall projects are growing in size, number and popularity. There is, however, a disconnection between these large commercially oriented projects and local communities. It is becoming clear that to bring city people closer to the ecosystem services that urban green infrastructure provides, it is important to incorporate urban greening into small-scale projects in local, residentially oriented communities.

By increasing green spaces and other nature-based solutions through methods such as laneway greening including low cost green wall systems, individuals will be provided with valuable opportunities to engage with the positive outcomes of urban greening and support a sustainable movement. While there is a vast and growing literature on both the benefits of volunteering and value of urban green space, the social impact of community gardening remains largely overlooked.

To ensure the longevity of green wall projects, their benefits to society must be investigated, promoted and realised to encourage community involvement. Research in the space suggests that urban, low-income individuals can have limited connections between themselves and nature, restricting potential social interactions, health, wellbeing and recreation.

The objective of this guide is to establish an enabling environment to facilitate the uptake of vertical greening systems, more commonly known as ‘Green Walls’, within urban environments at a community level.

To achieve this, a coherent framework will be provided, that will provide guidance on planning, designing and managing a green wall within community space. This project is a collaborative enterprise that unites academia, government and community know-how to produce a complete, practical and inclusive means of enabling the expansion of urban greening.
Overall, the terms ‘vertical greening systems (VGS)’, or ‘vertical gardens’, can be seen as overarching umbrella terms used to describe all forms of vegetated wall surfaces.

These can be further sub-categorized, as explored in the next few pages. Green facades are traditional VGSs which utilise hanging or climbing plants as vegetation cover. A common characteristic of these systems are plants rooted at the base of walls or in planter boxes attached to a wall at a particular height or at the base.
Green Facades

Green facades can be further separated into direct or indirect green facades, according to the location of the vegetation, either directly attached to the wall or supported by structures to climb and spread. Direct green facades utilise vegetation in the form of climbing plants, which grow directly on the wall and attach by natural means. Therefore, they do not require any structural support.

Alternatively, indirect green facades require a support structure to assist the growth of the plants. These structures are often quite basic, and could be in the form of cables, mesh or trellis systems commonly made from steel or wood.

Because of their simplicity in design and lack of structural requirements, green facades are relatively low cost and easy to maintain compared to living walls. They are also simple to implement, relatively lightweight and materials can be easy to source. However, the aesthetics of these systems are dependent on the vegetation used, as some species may take longer to grow and spread than others.
Living Walls

Living walls are generally considered a more modern form of vertical greening, and usually utilise more intricate designs. However, this complexity allows these systems to be more effective at providing benefits such as improved thermal performance, acoustic insulation and increased biodiversity.

Living walls can be classified based on their application, as either continuous, modular and linear living walls. These different designs relate to the support structure used; thus continuous living walls require a larger single support structure, modular systems utilise several modular elements, and linear living wall structures are attached in a linear format.
It’s time to...

Connect with nature
A DIY-friendly VGS is one where a system can be designed, developed and constructed without the support of an expert or professional.
Irrespective of your skill level, a sensible first step when developing a green wall system is to seek out inspiration, information and guidance to guide the initial design concept.

It is also essential at the initial stage of the project to set some guidelines and develop some realistic expectations. Identifying a realistic construction time duration and budget are crucial to DIY projects. Evaluating the skills and knowledge required to undertake the task will assist greatly in delivering a successful project.

Familiarising oneself with the overall project goals, as well as the tools, materials and safety involved, will ensure the activity runs smoothly and the product comes out according to plan.

For those who do not want to build a vertical garden from scratch or purchase a comparatively expensive customised VGS, DIY vertical garden kits may be the best option. Unfortunately, there is not a large variety of these products currently available on the market.
If contemplating a DIY vertical garden, consider the following:

01 Utilising resources (magazines, gardening and DIY television shows, online DIY forums and blogs) is a great way to get inspired, develop ideas and learn skills.

02 Be aware of your skills and resources, ensure the project is achievable.

03 Identify your parameters: budget, size, resources, skills, time etc.

04 Identify your motivation: why do you want to do this and what do you aim to gain from the experience (e.g. to be creative)?

05 Be realistic and set realistic expectations.
Selecting your green wall site

Look for a site within your neighbourhood that does not compromise the existing activities and accessibility of the proximal laneway. Ideally, if it is a community facing project, it should be potentially on a community centre, park building or other area where greening takes place or could take place.
01
A nearby structure provides shade for community participants.
Is your site close enough to existing restrooms, or will a portable toilet need to be provided?

02
Don’t rule out sites that are not parkland or contiguous to a park.
Look to partner with your city or a private individual to assess buildings that have vacant and bare walls, if necessary. Be cautious, however, since these arrangements can sometimes be temporary. Plan and design your VGS development appropriately for the timeframe and look for a permanent arrangement with your city or within your district.

03
Look for a site that can be easily accessed by you, our volunteers; and the community throughout the day and evening.
Maintenance, watering and supervision will be needed. Direct maintenance access for a car or ute is also helpful, but not critical.

04
Look for a structurally robust wall that receives adequate light throughout the day (6 to 8 hours of sun).

05
Look for a site that is capable of handling excess irrigation and potential water runoff from irrigation.
Observe your site after a rain storm and take note of where water settles and how long it takes for the water on the ground to drain.

06
Look for a wall that has access to or is adjacent to a water source such as a water tap on the building or nearby water main.
Other water sources like the collected water from the runoff of the building can also be used to irrigate your VGS with proper permission. Ideally, the collected water from roofs directly plumbed into the VGS or collected in rain water tanks could be used for irrigation.
Access to the green wall is important to consider when placing and integrating a VGS. The VGS needs to be accessible throughout the lifetime of the system, especially during the construction and ongoing maintenance of the VGS.

If a system is placed too high on a façade, the safety of personnel (for installation and maintenance) needs to be considered, and equipment such as ladders and specific machinery (e.g. cranes, elevated work platforms etc.) are required to undertaking regular maintenance, such as pruning and weeding.

It is also notable to consider the width of the space, specifically when installing in smaller narrow places such as laneways and alleyways. This is dependent on the type of VGS and the positioning of plants. In modular greening systems, vegetation is placed and grown sidewards (perpendicular to the façade wall) causing plants to grow slightly outwards onto the laneway, rather than upwards like those grown in planter pots. If not properly maintained, larger plants may obtrude the laneways space and block access for people passing by.
It’s time to...

Improve wellbeing
Checklist for appraising the suitability of an existing wall structure for green wall retrofit

Please review the following aspects and take them into account in green wall implementation decision-making.
01 Position of the wall
What is the position of the wall within the settlement? Is it overshadowed by other adjoining buildings which may affect access to sunlight and the growth of plants?

02 Location of the building
What is the prevailing climatic condition? For example, is the building in a hot arid climate zone or a maritime zone? Each has different characteristics which favour different types of green wall solutions.

03 Orientation of the wall
In the southern hemisphere, north facing walls receive more sunlight than walls oriented towards other directions, whereas south facing walls are oriented towards the sun in the northern hemisphere.

04 Height above ground
In some locations high buildings are subject to high winds and/or fierce heat, which can make growing plants challenging, and create safety challenges in construction.

05 Existing wall construction
What is the existing structural form of the wall?
A) Timber
B) Concrete
C) Brick
D) Structural steel

06 Load limitations of the wall
What is the dead load-bearing capacity of the existing wall?
What is the live load-bearing capacity of the existing wall?
Preferred planting options
- Is the choice of plants suitable for the level of maintenance available?
- Is there a water supply on site?
- Is there a power supply on site?
- Are there any potential environmental hazards?
- Cross check against Council’s list of prohibited and recommended plants.
- Assess microclimate (sun, wind etc.) and ensure proposed plants are suitable for the microclimate (see above).

Are there any windows or air conditioning that may affect the wall to be retrofitted?

Access for construction and installation of the wall
What is the access like for construction and installation?

Levels of maintenance
What is the access like for maintenance to the plants?

Costs
How much money has been sourced to pay for a green wall and its potential council approval?

Activation
Is the proposed green wall located in such a way that public space is activated eg. space nearby for seating, lighting etc.
Cost can be a significant influence on the design of a greening system. Multiple studies have examined the economics of VGSs and identified the installation (specifically capital costs) and maintenance of these systems as the fundamental costs involved throughout the life cycle of a VGS. This section illustrates how VGSs can be viable for everyone’s budget and indicates factors which should be considered when evaluating the cost of a VGS throughout its lifetime.
VGS costs

Design factors which can potentially influence the cost of a VGS include:

- Height and size of system.
- Location (climate, likelihood and impact of weathering).
- Materials involved (can also impact the durability of the system).
- Maintenance required (including nutrient and watering system).
- Support and attachment method to building wall.
- Design complexity and integration of components.

Consider the following to reduce VGS costs:

**Simplify the design:**
Using less and simple components results in fewer and cheaper items to buy, replace and dispose.

Re-circulated irrigation system cuts on water costs but materials to install this may be high.

**Consider the materials:**
Look for materials which are durable and weather resistant as they are less likely to need replacing.

Use cheaper materials such as old unwanted materials, but don’t compromise on durability, safety and strength of the material.

**Carefully select your plants:**
Consider local endemic plants, plants that require less water and ensure plants selected are suitable and able to thrive in the environment of the VGS.
## Potential DIY green wall costs

### Green facades

<table>
<thead>
<tr>
<th>Cost Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$100–$150/m²</td>
<td>Substrate, plants and irrigation in planter box.</td>
</tr>
<tr>
<td>$400/m² and up</td>
<td>Professionally supplied and installed.</td>
</tr>
<tr>
<td>$30–$300/m²</td>
<td>Support structure only: 2400 x 900 x 65 mm treated pine trellis.</td>
</tr>
</tbody>
</table>

### Living walls

<table>
<thead>
<tr>
<th>Cost Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1100–$2800/m²</td>
<td>Professionally supplied and installed: often includes 12 months maintenance visits.</td>
</tr>
<tr>
<td>$80</td>
<td>VGS Modular Pot Kit: four panel (16 pots) structure with a built in irrigation system.</td>
</tr>
<tr>
<td>$100</td>
<td>VGS Modular Planter Kit: five module structure only (1 m²).</td>
</tr>
<tr>
<td>$100</td>
<td>Planter pot VGS individual components: mesh support grid, wall anchors, hooks and 4 x planter boxes.</td>
</tr>
<tr>
<td>$10–$80</td>
<td>Small irrigation drip kit: five branches across three pot layout.</td>
</tr>
</tbody>
</table>
Potential DIY components

Initialisation - Off-site, acquirement of materials and construction.

**Materials:**
Structure, plants, pots, panels, growing media, irrigation system, drainage system, fertilizer.

**Personnel:**
Are salaried staff required? e.g. for caring for plants, construction or preparing system components.

**Utilities:**
Electricity, water.

Installation - On-site

**Utilities:**
Electricity, water

**Equipment:**
Tools to install system.

**Personnel:**
Are salaried staff required? e.g. workers transporting and installing the system on-site.

**Material:**
Transportation of materials.

Operation and maintenance

**Material:**
Replacement cost of materials (generally plants, irrigation system parts and fertilizer).

**Personnel:**
Are salaried staff required? e.g. system maintenance; pruning, monitoring, watering.

**Utilities:**
Electricity, water.

**Equipment:**
Tools for maintenance work (ladders, pruning tools, etc.).
Installation

Green walls can be attached to a façade structure or be freestanding. Commonly a green walls is installed onto a wall structure to gains its vertical arrangement. This is often in the form of screws and wall anchors to attach the VGS structure or support structure to the wall, which can be completed yourself or professionally by an installer.
A support structure may be used as a middle material preventing direct contact of the growing material, irrigation and plants from the wall. This has potential to protect the wall from damage from water and salts as well as making it easier to attach components such as planter pots. But the installation of a VGS will vary depending on the material of the wall structure (e.g. brick, steel or wood), the type of VGS and its support structure of one is used.

**Direct Greening Façade:**
No external material required, specific plant species latch directly onto wall.

**Indirect Greening Façade:**
Support structure (e.g. wooden trellis, wires, cables, mesh) mounted directly on wall or mounted on the ground and freestanding in front of wall.

**Living Wall:**
Growing structure (such as planter boxes, pots, modules, guttering etc.) can be directly mounted on wall using screws or use a support structure to separate wall surface from the green wall. More complex systems with numerous components are more difficult to adapt to a wall structure as it requires more support (due to its weight).
It is also important to know which tools to use, and be aware of how to appropriately use the tool installing a VGS. In urban areas for example, there is a high chance the VGS will be attached onto a brick or masonry wall. When drilling a hole into a brick wall, a masonry drill bit should be used, likewise a wood drill bit is recommended when drilling into a wood support structure. This is because each drill driver are made of different materials and are of different shapes to drive through the material and create a clean hole. A masonry drill bit for examples is made of stronger metals to drive through brick and stone. Moreover, the screw which is being used to attach the VGS or its support structure to the wall needs to strong, wide and deep enough to ensure security and stability of the structure. Materials such as a masonry screws or anchors can be used.

It is highly recommended to do some research before installing your VGS. This can be done by researching online, talking to a DIY enthusiast you know or consult a knowledgeable employee at your local hardware store. Additionally, nearly all pre-fabricated VGS kit will come with a guide on how to install the unit. If you are worried about the safety and security of your installed VGS, speak to a vertical greening professional and/or structural engineer for advice.

“When drilling a hole into a brick wall, a masonry drill bit should be used, likewise a wood drill bit is recommended when drilling into a wood support structure.”
Before installing and retrofitting a VGS on an existing wall, it is essential to ensure the wall is capable to withstand the additional total weight of the system. This is recognised as the ‘load bearing capacity’ of the structure and is particularly important for large systems or those placing systems on retaining walls and similar structures.

For those unsure or concerned about the weight capacity of the wall, it is recommend to seek professional advices such as a structural engineer. This safeguards the strength of the wall structure as it may require additional reinforcement to support the VGS. If the wall is not structurally capable, freestanding VGS systems are also popular, positioned and supported on the ground in front of a wall structure.

In addition to the strength of the structure, the total weight of the system should also be considered. It is important to consider the accumulative weight of the plants at maturity (fully grown) and soil substrate at saturation as they are often overlooked. During irrigation, the water accumulation adds weight to the system. This is also why an appropriate drainage system and regular drainage maintenance is important, ensuring excess water and thus excess weight is removed from the system.
It’s time to...

Improve air quality
Waterproofing

Depending on the project, waterproofing and weatherproofing the façade wall is an essential installation task to be considered as it protects the wall structure and assists to maintain the aesthetics. This is to ensure the wall surface is protected, to prevent damage from water and vegetation.
Waterproofing Prevents:

- Microbial growth on wall due to water and dissolved salt build up from irrigation and fertilisers.
- Increase maintenance and upkeep to clean the façade.
- Damage to the wall from plant growth, moisture and weathering.
- Reduction of aesthetic appeal.

Waterproofing the façade is recommended and required if the VGS is placed directly on the wall. The wall is considered waterproof and doesn’t need waterproofing if:

1. The wall is made of thick preformed concrete wall.
2. Wall is constructed from marine grade plywood.
3. There is a sufficient air gap between the back of the system and the wall. The air space between the back of the VGS and the wall façade prevents growth of mould as well as contact of plant, plant roots and water with the wall.
4. A Green Façade VGSs is used. Although waterproofing is not required, plant growth (stem and roots) may damage the façade. Using a support structure to assist plant growth (indirect green facades) will prevent damage.

To waterproof a wall surface, liquid waterproofing treatments or waterproofing membranes can be applied. Nevertheless, it is recommended to seek professional advice from waterproofing consultant to ensure the treatment is suitable for the façade. If waterproofing membranes are used, they need to comply with specific Australian Standards regarding waterproofing the exterior of buildings (AS 4654.2-2012).

The integration of a VGS on or in front of a wall structure is a process which involves the consideration of multiple factors.
When installing a VGS consider the following:

- Ensure the existing structure is structural capable and has a sufficient load bearing capacity.
- Ensure the VGS does not obstruct the flow and usability of the space.
- Placement of the VGS is accessible to adequate sunlight and a water source.
- There is sufficient façade surface area as well as the size and configuration of the VGS.
- Quality of the surface façade, including waterproofing, aesthetics and longevity.
- Support structure is suitable for the type of VGS and supports growth of vegetation.
- Ensure the VGS is accessible for construction and regular maintenance.
- For DIY projects, be aware of how you are going to install the VGS on the wall or on the ground and what tools and materials you are going to use.
The maintenance of a green wall is a fundamental consideration that can influence the overall design of the system. A well-established VGS with an appropriate maintenance plan will ensure the success and longevity of the system.

Selecting plants which need regular monitoring, pruning, watering and to thrive in the VGS, will require more maintenance.

Maintenance tasks and their frequency is also dependent on the type of system and will differ accordingly. Complex systems such as hydroponic systems are more difficult to maintain due to its integrated fertigation system and inorganic substrate material, requiring more monitoring to ensure plant growth.

Because maintenance is conducted throughout the operational stage of a VGS lifecycle, it is essential that the maintenance required for upkeep of the system is achievable.
When evaluating the maintenance required for a greening system, consider the following:

- Develop a maintenance plan: this outlines all maintenance tasks which need to be completed, including the frequency and who is responsible for each task. This should be reviewed regularly as needed.
- Identify the resources needed to maintain the system. This includes the materials, skills, tools, time and financial cost.
- Understand the ongoing maintenance costs required to take care of the system and its surroundings (including irrigation water, fertiliser, replacing plants etc.).
- Consider the ongoing renewal of the system (including replanting of vegetation, restore and/or replacing structural materials etc.) as well as the eventual removal of the VGS at the end of its lifetime.
- Select plants which will thrive in the climate and VGS. These plants will not need to be replaced as frequently, require less watering and pruning as well as monitoring of pests and nutrients.
“Because maintenance is conducted throughout the operational stage of a VGS lifecycle, it is essential that the maintenance required for upkeep of the system is achievable.”

Overall, it is important to understand your maintenance objectives and capacity to undertake the maintenance of the VGS. It is crucial to ensure the maintenance of the VGS does not exceed the skills and resources of those responsible for its upkeep. If you and/or the community is unable to complete the maintenance requirements, consider your choice of plants and its suitability to the climate, automation, downsizing and/or a third party option.

For those implementing a larger vertical greening projects and using a company to design, supply and/or install VGS. Depending on the scale of the project, these companies may include a maintenance service with the installation of the system, but it is important to check this with the company first.
Potential maintenance operations

01 Weed Control
Weeding (minimize weeds) and mulching.

02 Maintain planting design
Plant replacement and infill plantings.

03 Pest and disease management
Inspect plant health, coverage and for pests or disease and treat if required. Dependent on the local climate, plant species, location and environment.

04 Maintain plant growth
Pruning (seasonal to promote growth or remove over-growth). Remove waste plant material (leaf litter and weeds) to reduce fire risk from build-up of dry vegetation. Maintain substrate (top up organic substrate if required).

05 Irrigation/watering
Ensure to water vegetation as required, depending on plant species, location and climate of the VGS.

06 Fertilisation
Ensure to monitor and fertilise vegetation as required. This is dependent on the plant species used, specifically if fertilisation is completed manually (VGS does not have an integrated fertilisation system), specifically important for hydroponic systems.
**07** Maintain irrigation and/or fertilisation systems
Monitor, test and inspect the system for faults and leakage. Adjust volume and frequency of the system according to seasons.
Monitor plant nutrition: Record and inspect fertilisation and pH of plants to ensure good health.

**08** Maintain drainage system
Inspect and ensure drains are clear and functional. Remove dirt and litter from drains to confirm clear drainage.

**09** Maintain non-vegetated zones
Remove vegetation from surrounding area and around other equipment and fixtures. Particularly around windows, guttering, pipes, drains etc.

**10** Maintain safety systems
Check the support system for loose attachments or fittings.
Ensure anchor points are secure and access to the system is clear.
Examine any connected electrical and/or irrigation systems if required.

**11** Maintain facade and waterproofing
Inspect wall and surroundings for damage from water, fertiliser and plants.
Clean façade from plant, moss and/or algae growth if required.
It’s time to...

Increase thermal performance
Drainage and irrigation is a primary component of the maintenance and operations of a VGS as it promotes and supports plant growth. A well-developed irrigation and drainage system is key to the successful operation of a VGS as it can alleviate maintenance work and increases aesthetics.
The suitability of an irrigation system is highly dependent on the type of VGS installed and the user’s needs. For example, simple systems such as green faces and planter box/pot VGSs can be manually watered by hand periodically as required. This may be more suitable within a community setting as it promotes community involvement and engagement. The variability of ones irrigation requirements are based on the following external and VGS design specific factors listed below:

- **Location of VGS**
- **Light exposure**
- **Climate: Temperature and humidity**
- **Function of VGS (active vs. passive, ornamental vs edible)**
- **Vegetation used Substrate used**

Drainage goes hand in hand with irrigation as it involves the movement of water through the system once it is released from the irrigation. Excess water which is not consumed by the plants or trapped within the substrate must go somewhere as the accumulation of water in the growing medium (‘waterlogging’) can affect plant growth and adds weight to the system, eventually compromising the structural integrity of the system causing it to become too heavy, unstable and/or break.

Like the irrigation network, drainage is dependent on the type of VGS and its set up. A common example of drainage within a VGS is the drainage holes located at the bottom and sides of the growing structure (where the plants and growing medium sits) such as planters/pots and permeable cloth textile. From there, runoff water can:

- Free fall onto the ground.
- Fall into vegetation below (e.g. on ground planter unit or VGS layer below).
- Run into a drainage pipe.
- Drain into a drip tray or container unit, which must be emptied periodically either manually or through piping.
- Recirculated back into the irrigation system.

When designing living walls, specifically textile based systems, consider the drainage capability of the substrate and cloth material. The material must have a base permeable enough for water to pass through or have drainage holes for water to pass. For hydroponic systems, substrate must be able to retain water to feed roots but also prevent saturation (so roots can be oxygenated). Thus excess water runoff should be able to seep to the bottom of the system.
The following outlines some considerations for your drainage and irrigation system:

- **Ensure there is accessibility to a water source.**
- **Recirculation of water and using recycled water:** irrigation systems which use recycled water have to be filtered and maintained. This requires sufficient skills and knowledge to install and labour to regularly monitor and maintain the system.
- **Water supply: where is the water coming from?**
  A) Inbuilt water tank
  B) Directly from the mains
  C) Manual watering
- **Drainage: how is this implemented** (e.g., drip free, removable tray which needs to be emptied, to a tank to be reused)? Where is the excess water going?
- **Distribution and movement of water:** manual movement, piping and/or drip irrigation
- **Height of the system**

“Drainage goes hand in hand with irrigation as it involves the movement of water through the system once it is released from the irrigation.”
Types of Irrigation Systems

01 Drip irrigation

This can be a surface or subsurface system which uses perforate pipes or emitters to slowly release water into the growing medium.

**Advantages:** Low initial cost
Even delivery of water.
Moderately efficient.
Less labour intensive.

**Disadvantages:** Requires basic technical knowledge and installation.
Moderate water losses.

02 Manual watering

Most basic but effective form of irrigation using equipment such as watering can or hose when required.

**Advantages:** No technical equipment or installation required.
Very low initial cost.

**Disadvantages:** Labour intensive.
Relatively high water losses from runoff.
Uneven distribution of water.

03 Spray/Sprinkler irrigation

Similar to the drip irrigation, sprinkler or mist emitters are used to release water. These are connected by a pipe to form network.

**Advantages:** Low initial cost.
Reliable.
Less labour intensive.

**Disadvantages:** Requires basic technical knowledge and installation.
Relatively high water loses from sprinkler effect.
Uneven distribution of water.
Sensitive to wind.

04 Hydroponics

A method of growing plants without a soil growing medium using only water and a nutrient solution (fertigation system).

**Advantages:** Highly efficient
Requires less space.
Saves water.
No weeds, pests or pesticides.

**Disadvantages:** Relatively complex and requires some technical knowledge and skill to install.
Expensive to install and maintain.
Monitor and control of fertiliser and irrigation required.

05 Wicking bed

Uses a built-in reservoir below soil to supply water. Water climbs upwards to plant roots using wicks (e.g. wool, cotton, soil, gravel).

**Advantages:** Low water losses.
Highly efficient.
Less labour intensive.

**Disadvantages:** Relatively complex and requires some technical knowledge and skill to install.
Expensive to install.
Heavy for a vertical system.
It’s time to...

Increase biodiversity
Above all else, it is crucial to ensure that your VGS project complies with legal regulations. A VGS or community vertical garden has the potential to become a safety hazard to the general public, and thus needs to comply with laws and regulations of the local council. This may include responsibilities such as obtaining permission from the owner of the space (local council if public property), ensuring safety of the volunteers and general public, and ensuring the VGS is not a fire hazard.
When planning a community-based vertical garden in public space, such as in a laneway, it is essential to contact the local council to obtain a permit or approval before construction starts. The difficulty obtaining approval may depend on the location, size, supporting structure (such as heritage status if a building is used) and space requested.

Even if your VGS is to be installed on private property, it is important to determine where the property boundary is, and to ensure that the VGS does not extend beyond this border. Different councils will have their own individual processes regarding approval of community gardens and greening projects.

Whilst processes for community gardens are common, currently there are few specific processes for the implementation of community vertical gardens, although it is likely that the processes would be similar if not the same. For laneways, the approval process may be slightly different, as considerations including safety of pedestrians and environmental concerns need also to be considered. Local councils are often very supportive of greening projects, and some are willing to assist with resources once the initiative is approved. Additionally, it is important to be aware of the services, or lack thereof, your local council provides to community-based initiatives. For example, obtaining insurance for community group volunteers and visitors can present problems in some areas, but not in others.

It is important to be aware that VGSs that are incorrectly installed or poorly maintained are a potential fire hazard. Dead and dried vegetation will promote the spread of a fire, and materials such as textiles and plastic can be highly flammable. To reduce this risk, effective irrigation and a good maintenance schedule is highly recommended to ensure healthy plant growth at all times.

If there are genuine concerns regarding the safety of the VGS, it is recommended that the advice of a professional consultant is sought. Especially for larger and more complex projects, professional advice will ensure that the VGS is compliant with legal regulations and standards as well as being safe.
Some legal considerations which may occur during the building and maintenance of a VGS might include:

- Avoiding obstructions to public access and emergency services (e.g. obstrusion onto footpaths or accessibility to buildings and public spaces).
- Ensuring adequate waterproofing and drainage is used so as to ensure building structural integrity and the surrounding environment are not compromised.
- Ensuring the safety of the general public, both passers by and those maintaining the system (e.g. secure integration onto wall, no loose components, and secure elevated working platforms if required).
- Obstruction of signage and lighting in public spaces (i.e. traffic signs, street lights).
- Obstruction of public drainage.
- Ensuring correct disposal of waste, especially vegetation.
- Ensuring the load-bearing capacity of the supporting structure (e.g. building wall, fence) and the structural integrity of the system.
- Avoiding fire hazards, particularly from lack of vegetation maintenance.

The following professionals may assist in the development of VGSs

- **Landscape Architects**: for vegetation layout, design and selection.
- **Architects**: for design of VGS and its integration onto building façades.
- **Horticulturists**: for appropriate plant selection.
- **Structural Engineers**: for advice on wall structure load bearing capacity and integration of VGS on the building façade.
- **Hydraulic Engineers**: for advice on the integration of drainage and irrigation.
“In situations where the VGS is established on your wall, but the system protrudes onto public space, a regulatory grey area exists, and it is best to consult with the owner of the space as well as surrounding neighbors, to ensure all parties are happy with your planned structure.”

Summary:

- If in doubt, contact your local council: approval for the project and location may be required.
- If you are concerned, seek professional advice to ensure the VGS meets legal regulations and is safe for the public.
- Especially for DIY projects, ensure your construction meets legal regulations (e.g. correct disposal of waste products, public disruption, safety of volunteers and workers).
- Ensure regular vegetation maintenance and removal of vegetation litter to minimize fire hazards.
Plant Considerations

The use of evergreen plants is recommended in living wall systems, especially as evergreen plants contribute to visual appeal with year-round foliage. The selection of plants should be based on the desired outcome, whether it is for thermal insulation, aesthetic appeal or food production.
The first step for plant selection is to consider the climate. Databases like Gardening Australia can be referred to for detailed plant selections based on different climate zones. It is also important to consider that most productive plants require light to grow, otherwise the plants will become undernourished and their health and visual appeal, such as leaf size, will be compromised.

Implementation of vegetation in buildings is affected by variables including the space available and plants’ weight, foliage, and shape. Parameters such as the façade orientation, environmental effect, and climatic factors are considered during the selection of plant species for VGS installation. Most plants in successful long-term VGS setups are shallow rooting and drought tolerant, which enable the plants to thrive in a shallow soil environment. Further, soil depth impacts on the irrigation requirements and the mixture of growing media directly relates to plant moisture and watering needs.

Sandy soil with low water storage capacity and high infiltration rate can be used for plants that require well-drained growth media. Selecting Australian native plants are preferred, especially with respect to the living wall’s water efficiency, as these plants are more likely to be accustomed to the local climate and precipitation patterns.

Be sure to use plants that do not pose a threat to the Australian native environment. It is advised to avoid plants that are present on The National Environmental Alert List, which contains a number of non-native plant species that have established naturalised populations in the wild. If in doubt, when planting something new check with your local authorities regarding the weed potential of plants for your particular area.

If a green façades is used, climbing plants that are rooted into the ground, or into the wall itself are required. These plants can further be supported by cables or trellis. Climbers planted on the base of the building provide a relatively inexpensive façade greening. Climbers, however, often give rise to increased maintenance of the façade. When planning a green façade, it is important to consider that some climbing plants can grow 5 or 6 m high, others around 10 m and some species at least 25 m. Available plant choices for a living wall can be categorized into the following considerations edible/non-edible, perennial/seasonal, and endogenous/global, native/invasive.

For more details on plant selection with respect to both an urban and Australian context, please see The Which Plant Where program (https://www.whichplantwhere.com.au). This project communicates the factors that influence your decisions for plant selection, the top species choices for urban areas, what tools and resources do you use for species selection, and notable planting success and failures within your urban environment. The plant considerations and selections listed should be used as a general guide.

For exact recommendations on plant selection, the local nursery should be visited explaining the direction the vertical garden with respect to the cardinal direction of the sun. Plant selection not only ensures that the plants can survive in the specific conditions present within the confines of the living wall and the local climate, the selection also influences the wall’s maintenance level and appearance.
If the VGS is designed for food production; different living wall systems were better suited to grow different plant categories. Climbing vegetable plant species grow best in the cable and wire netting system, and the Trellis and Container system. Plants like, choko squash, grapes, peas, tomatoes, and beans. Leaf vegetables and brassicas can be successfully grown in the modular systems. Because root vegetables could only be grown horizontally (or almost horizontally), only modular systems with large substrate volumes can facilitate their growth. Fruit vegetables and legumes also require large root volumes to reach a productive size, and thus modular systems are preferential. Edible living walls need to be easily accessible (no higher than 1.7m) to enable maintenance and harvesting. Replanting is required, if root based plants are harvested.

Native plants should be prioritized, and pests and weeds need to be managed regularly. Choosing plants that have many flowers and nectar will encourage wildlife to interact with the VGS. The practice of integrating the human environment into the natural environment to encourage ecosystem services is termed ‘ecological engineering, so in this context, introducing VGS could enable animals to bridge the gap between their fragmented urban habitats. Additionally, plants that offer large and dense foliage offer refuge and shelter for roosting animals.

If the VGS is intended as an artistic piece focusing on their aesthetic appeal, ornamental plants should be prioritized. The use of VGS for aesthetic purposes can be used as building features, especially to hide unattractive areas of the building. Both private enterprise and community groups have been known to use VGS to portray a message of environmental sustainability. However, ornamental VGS tend to involve the most amount of maintenance, in order to preserve their appeal and attractiveness. It is possible, with extensive thought and planning, to create patterns, signs, and even logos with a detailed planting arrangement that takes plant colours into account.
Internationally, the most prominent living wall module plants species that grow well in the vertical alignment that VGS modules as seen in Junglefy’s modular setup use are:

- Chlorophytum orchidastrum (Fire Flash)
- Ficus lyrata (Fiddleleaf Fig)
- Nematanthus glabra (Goldfish Plant)
- Schefflera arboricola (Dwarf Umbrella Tree)
- Nephropelis exaltata bostoniensis (Boston Fern)
- Schefflera amate (Umbrella Tree)
- Philodendron hederaceum (Heart Leaf)
- Epipremnum aureum (Devils Ivy)
- Raphidophora tetrasperma (Baby Monstera)
- Neomarica northiana (Waling Iris)

The top climbing plants used for green wall façades are:

- Vitis vinifera (Grape vine)
- Parthenocissus tricuspidata (Boston Ivy)
- Pandorea pandorana (Wonga Wonga Vine)
- Billardiera scandens (Apple Berry)
- Jasminum officinale (Clotted Cream)
- Hedera helix (English Ivy)
- Trachelospermum jasminoides (Star Jasmine)
- Clematis montana (Virgins Bower)
- Hydrangea petiolaris (Climbing Hydrangea)
- Ficus pumila (Creeping fig)

Australian native plants for modular systems (sourced from Junglefy)

- Lomandra longifolia (Basket Grass)
- Viola hederacea (Monga Magic)
- Westringia fruticosa (coastal rosemary)
- Dianella sp. (Blueberry Lily)
- Correa alba (White Correa)
- Blechnum gibbum (silver lady)
- Calistemon citrinus (Crimson Bottlebrush)
## Substrates used in green walls and their characteristics

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| **Organic materials**  
(eg. compost, soil, coco coir) | **Inert mediums**  
(e.g. Rockwool) | **Crushed brick**
| **Benefits:** Retains water, coco and soil filter nutrients, coco does not compact easily  
**Limitations:** Water should not be recirculated, soil can compact over time  
**Typical weight:** 930-1100kg/m³ | **Benefits:** Can be used in hydroponics, retains water and aerates  
**Limitations:** Not recommended to reuse, pH can be too high  
**Typical weight:** 90-270kg/m³ | **Benefits:** Recycled  
**Limitations:** Will need to be supplemented with organic material  
**Typical weight:** 1090-1300kg/m³ |
| 04 | 05 | 06 |
| **Inert mediums**  
(e.g. sand) | **Gravel** | **Perlite**
| **Benefits:** Drains well, can recirculate water  
**Limitations:** Too heavy for most green walls  
**Typical weight:** 1800-2200kg/m³ | **Benefits:** High drainage and aeration  
**Limitations:** Needs monitoring of nutrients as no buffering  
**Typical weight:** 1700kg/m³ | **Benefits:** High drainage, water can be recycled, lightweight  
**Limitations:** Not to be used on its own without soil or coco coir  
**Typical weight:** 500-800kg/m³ |
This section presents eight VGS designs which are DIY-focused and achievable for many communities. Whilst there are an almost infinite variety of DIY designs, experience indicates that these designs are the most achievable designs under normal circumstances.

The aim of this section is to provide ideas and inspiration, as well as to demonstrate the different design principals and practicalities of green wall construction. It is nonetheless essential to note that these designs are just a guide, and all of the designs will not be perfect for every situation.
The following details apply to all designs:

01. If there are concerns regarding the design of your VGS, it is recommended that you consult a vertical greening professional for advice. Please refer to the ‘Legal Regulations and Professional Advice’.

02. Drawings of all designs are not to scale and intended as a conceptual guide only.

03. The maintenance process for all designs will be largely reliant on the climate, type of plants and the irrigation or fertigation method.

04. Materials and components of each design can be modified according to the user’s preference, DIY know-how, budget, space, needs, and accessibility.
It’s time to...

Add acoustic insulation
This rating system is an evaluation tool to help determine the best VGS design for individual or community groups. It is important to note that this rating system is general, and specific applications may have their own criteria that favour a VGS that is not necessarily the one indicated from our rating system.
The rating system is based on the following criteria:

**DIY friendly:**
How easy is the VGS to DIY?
One star (not DIY friendly) to five star (very DIY friendly)

**Cost effective:**
How budget friendly is the VGS?
One star (least cost effective) to five star (most cost effective)

**Integration:**
How easy is the VGS to implement onto a vertical surface?
One star (may be challenging to integrate) to five star (easy to integrate)

**Maintenance:**
How easy is the VGS to maintain?
One star (operation and maintenance intensive) to five star (easy to operate and maintain)

**Drainage and Irrigation:**
How simple are drainage and irrigation systems to implement and operate?
One star (complex drainage and irrigation) to five star (simple drainage and irrigation)

**Others:**
Additional comments and factors which are important to consider regarding the design
This design involves in-ground plantings which grow upwards along the façade structure.

**Pros**
- Easy to construct
- Requires the least materials
- Budget friendly
- Very easy to integrate

**Cons**
- Low aesthetic appeal
- Limited plant selection
- Slow and uneven plant growth

**Design 1: Direct Greening Facade**

The primary requirement for this design is that the vegetation selected includes self-attaching climber plants. These are plants which utilise adhesive pads or clinging roots to attach to, and spread across a vertical surface. This design is easy to construct and requires the least materials and components, making it the most DIY and budget friendly choice. Anyone can install a direct greening façade as long as the location permits, and these systems are very easy to integrate as the vegetation does most of the work.

The level of maintenance is generally very low, but will depend on the type of plant/s used and the location (climate and placement).

It is still important to maintain these systems, specifically regarding regular pruning, as an unkempt direct greening façade can detract significantly from the system’s aesthetic appeal. Furthermore, overgrowth of vegetation can disrupt building services like vents and windows.

The main disadvantages of this design is its comparative lack of aesthetic appeal from the uneven and slow growth of plants. It is also the least effective VGS for providing benefits such as noise and air quality reduction.
Design 2: Indirect Greening Facade

This design utilises a support structure to assist plant growth by providing an anchor for plants to attach to.

### Pros
- Easy to construct
- Lightweight support structure
- Budget friendly
- Very easy to integrate

### Cons
- Low aesthetic appeal
- Limited plant selection
- Slow and uneven plant growth

### DIY Friendly

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### Drainage & irrigation

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### Maintenance

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Indirect greening façades are similar to design one but use a support structure. This assists and directs plant growth by providing an anchor for plants to attach to. Supports include trellises, meshes, nets, wires or cables running either or both horizontally or vertically. They can be made of a variety of materials such as bamboo, wood, steel, aluminium or HDPE. Integration onto a façade wall is usually very simple.

Wall anchors, from your local hardware store, can be drilled into the façade to secure the structure. Talk to someone at your local hardware store to determine the best wall anchor for you. This will depend on your VGS’ wall material and weight.

Another significant component of this design is the above ground planter box in which the growing medium is contained. This can be constructed DIY style out of wood or purchased from a local garden or hardware store. Plantings can also be grown directly in ground, as for design one. The simplicity of this design makes it incredibly DIY and budget friendly. Recycled or upcycled materials can be used and trellises or planter boxes can be easily constructed by hand.

This design lends itself to manual irrigation. But other systems such as a drip, sprinkler or wicking irrigation can be installed. Maintenance will primarily relate to ongoing tasks such as pruning and watering. Regular maintenance will affect aesthetics as overgrowth and undergrowth of plants may become visually unappealing.

This design is a common form of VGS. Disadvantages relate to limited aesthetic appeal due to the restricted vegetation choices. Plants which thrive in this design are generally climbers with tendrils and twiners. A support structure will increase the range of suitable plants over design one.
The modular panel VGS is based on commercial style modular systems. This type of VGS is characterised by use of modular box panels which are often filled with an inorganic substrate (e.g. mineral wool, felt or perlite), wrapped in geotextile so it doesn’t fall out, supplied by a fertigation.

Because of this, most applications of these systems are supplied by companies which specialise in vertical greening. Whilst design 3 is not the most budget or DIY friendly VGS, the cost of this style of system will differ depending on factors including the supplier and manufacturer of the VGS, installation requirements and the size of the system. The supplier may also install the vertical garden for you, enabling easy integration, but also at a higher cost. As the modules are usually integrated very close to the wall, it is also important to ensure the wall façade is waterproofed in some way before installation.

Maintenance for this system is relatively simple and hands off, as regular tasks such as watering and fertilisation are highly suited to automation. Upkeep of the vegetation and surrounds, including replacing plants and clearing fallen debris, will need to be conducted occasionally. Furthermore, the modular design allows for versatility, as it is easy to scale up and expand the greening system, or vice-versa. The modular design can also simplify maintenance, as the modules can usually be removed independently and replaced as required.

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Design 4: Textile Bag System

This design thrives off the use of textile materials to create the system.

Pros
- Easy to integrate and maintain
- Lightweight
- Preferable for edible plants
- Can be made from recycled materials

Cons
- Limited irrigation options
- Frequent fertigation required

The structure is made of a textile material such as felt, geotextile, old burlap, tarpaulin, or a suitable cloth. Whichever textile is chosen, the material must be strong enough to withstand water and weathering, as well as the weight of the system.

This style of VGS can be directly integrated onto a wall structure using wall anchors which can be purchased at your local hardware store. A support structure such as a horizontal steel rod or trellis system can also be utilised to separate the VGS from the façade surface, from which the textile system can hang. A significant advantage of this design is its light weight, making it relatively easy to construct and integrate onto a range of wall types.

Pockets in the textile provide a space to house the growing medium. A range of growing media can be used apart from soil, including fibrous substrate materials such as felt or mineral wool which will produce a hydroponic or hydroculture system (which will then require a fertigation system).

Dependent on the growing medium a suitable irrigation system will be required. If a textile substrate is incorporated, a wicking or subirrigation system would be ideal, whereas surface drip irrigation or manual watering may be more appropriate if soil is used. Particularly for soil, the best way to ensure sufficient drainage is to poke holes near the base of each pocket for water to flow through.

The main disadvantage of this design is the lack of volume the pockets provide, as the structure of these systems is invariably reasonably flat. It is thus important with these systems to consider the size of the pockets relative to the growth habit of the plants selected, as they need to be deep enough for plant roots to develop.
Planter boxes are the main element in this design, and are attached to a support structure.

**Pros**
- Versatility allows for unique designs
- Preferable for edible plants
- Can use recycled materials

**Cons**
- Limited irrigation options
- Frequent fertigation required
- Requires some technical skills

This simple VGS utilises planter boxes or pots attached to a support structure. Like the previous designs, the support structure can be attached to the wall using wall anchors, and steel hooks can be used to attach the planter units to the trellis or mesh support structure.

These materials are relatively common, and may be found at your local garden center or hardware store. An on-ground planter box can optionally be placed beneath the VGS, making a simple solution to catching excess water.

Other than a mesh or trellis support structure, different materials can be used depending on the user’s creativity, available materials and desire for sustainable practice. Upcycled materials such as used cans and old curtain rods would make a functional and interesting planter VGS. In some cases, the support structure can be done away with entirely, with the planters directly attached to the wall surface.

In regards to irrigation, this design lends itself to manual irrigation, but the utility of this will depend on the user as well as the size and arrangement of the planters along the support or wall. If planter pots are spread far apart, a piped irrigation network may not be practical due to the spacing. However, if larger planter boxes or pots are placed close together, a drip line can be easily be placed along the top row.

Overall, the design is a relatively simple vertical greening solution that is easy to assemble and can be adapted in multiple ways to fit highly varied applications. It is this design flexibility that makes these systems so appealing, and aesthetically unique designs can be easily thought up.
Design 6: Guttering System

This design upcycles old guttering which becomes the primary structure.

Pros
- Fun design
- Easiest to irrigate
- Made from upcycled materials

Cons
- Substrate depth may restrict plant choice.
- Requires some technical skills

This is a fun and reasonably cost-effective DIY VGS which makes use of old guttering as the primary structure, thus upcycling durable materials. This design is based on the guttering system at the Coal Loader Community Garden).

To integrate this system as a façade, wood planks can be installed using wall anchors to separate the VGS from the wall surface, with the guttering structure then simply screwed to the wood supports. If preferred, the guttering can also be directly attached to the wall.

A drip irrigation network can be installed along the surface of the soil to ensure even watering of the plant roots. Irrigation flow can be supported by gravity if guttering is placed on a slight angle, allowing excess water to flow down the guttering to the unit beneath.

The major disadvantage of this system is its restricted substrate depth and volume, which limits plant growth and species selection. Despite this, the design is an eye-catching showpiece with potential to be highly sustainable.
Design 7: Piping System

Similarly to the previous design, old pipes like PVC piping are key components of the system.

**Pros**
- Fun design
- Easiest to irrigate
- Made from upcycled materials

**Cons**
- Substrate depth may restrict plant choice.
- Requires some technical skills

Design 7 is a unique DIY-friendly and cost effective approach to vertical greening. The piping VGS takes advantage of old pipes, such as PVC piping, as the key component of the system.

These can be directly attached to the wall using masonry screws and pipe saddle clips, or if preferred, a support structure can also be used to separate the VGS from the wall façade.

The linear structure allows a drip irrigation line to be placed along each level, allowing for easy watering. Sprinkler irrigation networks or manual watering also work well with these systems. It is recommended to drill drainage holes along the base of the horizontal pipes for excess water to seep through.

A modification which can be added to this design is adding planter pots into large holes along the piping, cut with a hole saw. This confines the soil, making the system cleaner and easier to maintain, as pots can be pulled out and replace when needed. A drip irrigation line can still be placed along the vessels.

Although some basic DIY skills and tools are required to assemble and construct the system, it makes a challenging but fun project for many applications.
Design 8: Wood-Based System

Wooden boxes are stacked and screwed to create holdings and support structures.

**Pros**
- Made from upcycled materials
- Large depth for root growth
- Potentially freestanding

**Cons**
- Wood may deteriorate
- Weight loading may be an issue

**Design 8 is a system based on stacked wooden boxes. The wooden boxes can be constructed from wood slats, or upcycled crates can be used. These are stacked and screwed together, using longer wooden planks as a support structure, allowing the unit to be free standing.**

It is essential to monitor the weight of these systems. Anchoring the top of the system to a wall can also assist in preventing the system from falling.

With any system that uses timber, over time, wood is subject to decay. There are a few ways to prevent this, a common solution being to use an exterior wood treatment such as a stain or paint. This will weatherproof the wood and protect it from UV. To irrigate the system, a drip irrigation network is ideal. A wicking irrigation system in each box is also an effective system for this design, depending on the size of the boxes.

A key advantage of this design is the boxed system allowing for more depth and volume of soil. This broadens the selection of plants which will thrive in the system, as long as system weight, stability and safety are well thought out. System, it makes a challenging but fun project for many applications.
References

Standards and Legislation and Guides


C3.2 Protection of openings in external walls – NCC


Websites


Which Plant Where Project
Disclaimers

The information in this guide is provided to help disseminate information regarding community greening projects pertaining to the social aspects of green walls and facades. It is not a complete guide and is not a substitute for professional advice.

The design, construction and installation of green walls and façades is subject to the relevant authorities granting the required permits, approvals and consents. Specific information should be obtained from relevant authorities prior to the commencement of any project.

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Acknowledgment


This project has been funded by Horticulture Innovation Frontiers Funding - Green Cities with co-investment from the University of Technology Sydney Shopfront Community Program.

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This e-book was developed in collaboration with UTS Shopfront at the Centre of Social Justice and Inclusion and the student Visual Communication team from the Faculty Design Architecture and Building at the University of Technology Sydney. Aaron Davis, Beth Sacco, Emma Lai, Leeanne Nguyen, and Lucy Ward were supervised by Claudia Leigh.