The protection of our environment is an important global and local responsibility. Council wants to help lead the transformation in how we live and use our resources in the future.

Today, buildings produce 20% of Australia’s greenhouse gas emissions through the use of energy during operation. What’s more, the construction of buildings, including demolition waste, contributes 40% of all the materials sent to landfill. And in operation, buildings use large amounts of potable water for non-drinking purposes.

For environmental, economic and social reasons, Council supports you in creating a more sustainable lifestyle. Therefore, Council’s planning application process includes sustainable design considerations.

This fact sheet explains what this means for applicants and what resources and assistance are available.

What is sustainable design?

Sustainable design is a key priority in the development of today’s built environment. Sustainable design protects our environment, secures today’s living standards and future-proofs our community against rising energy, water and waste disposal costs.

Several Victorian Councils have developed a consistent and transparent sustainable design assessment process. This process offers a high level of planning certainty relevant to sustainable design, and ensures that it has been considered during the early project phase – when it achieves the greatest benefits at the lowest cost.

Sustainable design in your planning application

The chart overleaf explains whether your planning application falls into the ‘Small’, ‘Medium’ or ‘Large’ category and whether sustainable design–related information needs to be submitted with your application.

What is the SDAPP program?

The SDAPP (Sustainable Design Assessment in the Planning Process) program refers to the inclusion of key environmental performance considerations into the planning permit approvals process in order to achieve more sustainable building outcomes for the long-term benefit of the wider community.

SDAPP is:

• Your guide to achieving more sustainable building outcomes.

• A practical approach to assessing sustainable development matters during the planning permit approval process.

• The consistent inclusion of key environmental performance standards into the planning permit approvals process.

SDAPP is an excellent tool to foster collaborative design at a project’s early design stage. In my experience, the planning approval process is the key stage to lock in best practice sustainable design outcomes.

Tim Angus, Sustainable Design Architect
Submitting sustainable design information

All applicants are encouraged to consider the 10 Key Sustainable Building Categories within their design. However, Council will request certain applications (based on size) to specifically address these criteria. On the back page of this fact sheet you will find an overview of these categories and relevant design considerations. Council has also developed detailed fact sheets for each of these categories, highlighting the key benefits and strategies to implementing them.

Sustainable Design Assessment (SDA)

When is an SDA requested?
An SDA is required for medium developments, comprising of 5 or more residential dwellings, multi storey buildings, and new industrial or commercial developments.

What is an SDA?
An SDA is a simple sustainability assessment of a proposed design at the planning stage. The assessment will support your planning application by showing how you intend to address the 10 Key Sustainable Building Categories.

Regardless of the formal requirements of the planning scheme, we encourage you to strive for excellence, creativity and innovation. By using free web–based tools, such as BESS, combined with a brief cover report of how the project responds to the above categories, you can easily demonstrate that your project meets Council’s best practice standards for sustainable design. Generally, an SDA can be prepared by the applicant, but we encourage most projects to engage a sustainability professional.

Please also refer to the SDA guidelines and resources on our website for further information.

Sustainable Management Plan (SMP)

When is an SMP required?
An SMP is required for all larger developments, comprising of 60 or more residential dwellings or requests for planning scheme amendments.

What is an SMP?
An SMP is a detailed sustainability assessment of a proposed design at the planning stage. An SMP identifies beneficial, easy to implement and best practice sustainability initiatives. It addresses the 10 Key Sustainable Building Categories and demonstrates that a holistic sustainable design review has been undertaken during a project’s early design stage.

In relation to these categories, an SMP must:
• identify relevant sustainability targets or performance standards
• document the means by which the appropriate target or performance will be achieved.

The nature of larger developments provides the opportunity for increased environmental benefits and the opportunity for major resource savings. Hence, greater rigour in investigation is justified. It may be necessary to engage a sustainability professional to prepare an SMP.

Please also refer to the SMP guidelines and resources on our website for further information.
The 10 Key Sustainable Building Categories

1.0 Indoor Environment Quality

Objective: to achieve a healthy indoor environment quality for the wellbeing of building occupants.
Examples of design decisions:
- daylight
- thermal comfort
- natural ventilation.

2.0 Energy Efficiency

2.1 Sunshading

Objective: to ensure the efficient use of energy, to reduce total operating greenhouse emissions and to reduce energy peak demand.
Examples of design decisions:
- effective shading
- building fabric enhanced above the minimum Building Code of Australia (BCA) requirements
- efficient heating and cooling services.

3.0 Water Efficiency

Objective: to ensure the efficient use of water, to reduce total operating potable water use and to encourage the appropriate use of alternative water sources.
Examples of design decisions:
- use efficient fixtures and fittings
- avoid the use of mains water for landscape irrigation
- re-use water (e.g. greywater).

4.0 Stormwater Management

4.1 Site Permeability

Objective: to reduce the impact of stormwater run-off, to improve the water quality of stormwater run-off, to achieve best practice stormwater quality outcomes and to incorporate the use of water sensitive urban design, including rainwater re–use.
Examples of design decisions:
- minimise watercourse pollution
- maximise stormwater capture
- maximise onsite rainwater re-use (e.g. for flushing toilets and irrigation).

5.0 Building Materials

Objective: to minimise the environmental impacts of materials used by encouraging the use of materials with a favourable lifecycle assessment.
Examples of design decisions:
- embodied energy of materials
- use of materials with recycled content
- future recyclability of materials.

6.0 Transport

Objective: to minimise car dependency and to ensure that the built environment is designed to promote the use of public transport, walking and cycling.
Examples of design decisions:
- providing convenient and secure bike storage
- providing access to showers and lockers at work
- Green Travel Plan for residents, visitors and staff.

7.0 Waste Management

Objective: to ensure waste avoidance reuse and recycling during the construction and operation stages of development.
Examples of design decisions:
- preparation of a construction Waste Management Plan
- adoption of a demolition and construction material recycling target

8.0 Urban Ecology

8.1 GreenRoofs, Walls and Facades

Objective: to protect and enhance biodiversity and to encourage the planting of indigenous vegetation.
Examples of design decisions:
- maintaining / enhancing the site’s ecological value
- creating resident amenity
- encourage biodiversity areas.

9.0 Innovation

9.1 Melbourne Climate

Objective: to encourage innovative technology, design and processes in all development, so as to positively influence the sustainability of buildings.
Examples of design decisions:
- significant enhancements of best practice sustainable design standards
- introduction of new technology
- good passive design approach.

10.0 Construction and Building Management

Objective: to encourage a holistic and integrated design and construction process and ongoing high performance.
Examples of design decisions:
- Building Users Guide that explains a building’s sustainable design principles
- preparation of operation Environmental Management Plan
- contractor has valid ISO14001 (environmental management) accreditation.

ESD Tools

What are ESD Tools?
Why use them?
Voluntary or mandatory?
Which tool for SDAPP?
An overview of the following tools:
- BESS
- STORM
- MUSIC
- Green Star
- NatHERS
- NABERS
Council’s sustainability resources

On Council’s website, you will also find reference documents that demonstrate how an SDAPP submission can be prepared. You may wish to adopt these documents for use in your planning application. To make sure that your project realises its full sustainable design potential, we encourage you to discuss your design approach and environmental targets with our Statutory Planning staff or Council’s sustainable design experts.

Please also see clause 21.06 of the Maribyrnong planning scheme. Note that BESS has now replaced the SDS and STEPS ESD tools.

Where can I find out more?

10 Key Sustainable Building Categories Fact Sheets
Make sure you download your fact sheets on the 10 Key Sustainable Categories from Council’s website.
www.maribyrnong.vic.gov.au

BESS
Built Environment Sustainability Scorecard. Developed by local government members of CASBE (Council Alliance for a Sustainable Built Environment), BESS is a free and simple online assessment rating tool for most types of development. BESS has been tailored to suit the SDAPP program and help applicants demonstrate ‘best practice’ in the following categories:

• Indoor Environment Quality
• Energy Efficiency
• Water Efficiency
• Stormwater Management
• Transport
• Waste
• Urban Ecology
• Management
www.bess.net.au

FirstRate
A software tool developed under the Nationwide House Energy Rating Scheme (NatHERS). FirstRate estimates your home’s future energy demands for heating and cooling. The calculations consider your building’s orientation, thermal insulation and other major design attributes. The higher the rating the less demand the building will have on mechanical heating and cooling therefore reducing operational energy demand. An energy rating may be required to apply for a residential building permit but we recommend confirming your rating in advance to ensure compliance with both planning and building standards.

Please note that FirstRate is only one of the accredited energy rating tools, alternative tools such as BERS Pro or AccuRate can also be used to confirm compliance.

Refer to the following websites for more information about Victoria’s 6 Star Standard.
www.makeyourhomegreen.vic.gov.au
www.buildingcommission.com.au

NABERS
NABERS rates the operational impacts of non-residential buildings on the environment. It can be used during building’s operations as well as during the design phase to predict base building ratings and establish benchmarks and likely outcomes. NABERS distinguishes between the tenancy and base building and therefore can identify and detail areas for improvement.

NABERS applies to offices, hotels and retail buildings. The areas of sustainability considered are:

• Energy Efficiency
• Water
• Indoor Environment Quality
• Waste
www.nabers.com.au

Green Star
Green building rating tools from the Green Building Council Australia (GBCA). These tools for large scale building projects represent a comprehensive national environmental rating scheme. The tools evaluate the design and achievements of buildings in all sustainable design categories.
www.gbca.org.au

Mandatory Requirements and Council’s Best Practice Standard

Mandatory Requirements:
Meeting minimum sustainability standards as outlined by the National Construction Code of Australia and the relevant Planning Scheme clauses.

Best Practice Standard:
In order to claim that your development has met Council’s best practice standard, the development must:

• Meet or exceed best practice standards as described in each of the 10 Key Sustainable Building Categories.
Balancing Indoor Environment Quality

Designing for a high indoor environment quality can be challenging as all criteria need to be addressed while some may even contradict each other. Indoor quality in particular need to be carefully designed — they influence access to daylight and ventilation, create heat gains in summer and losses in winter and provide a visual and acoustic connection to our immediate environment.

Another example is the choice of internal finishes. They not only impact on internal sound quality but also influence a room’s thermal comfort, light reflectivity and air quality.

It is therefore important to understand and carefully balance individual design and product choices upon the benefits and disadvantages of different indoor environment quality criteria. If in doubt, we recommend talking to a sustainability expert and focusing on a project’s key indoor environment quality goals.

Mandatory Requirements and Council’s Best Practice Standards

Mandatory Requirements
You must meet the National Construction Code (NCC) requirements for ventilation, daylight, energy efficiency, and.

The objectives and standards of the local planning scheme.

Council’s Best Practice Standards

- Habitable rooms of single-aspect apartments should be limited in depth to 8 metres from a window.
- Achieve a minimum daylight factor of 1% for 90% of the floor area in each living area including kitchens, and a minimum daylight factor of 0.5% for 80% of the floor area for each bedroom. A daylight modelling report for large scale developments may be required.
- For non-residential developments, achieve a daylight factor of at least 2% for at least 30% of the floor area on regularly occupied primary spaces.
- Design living areas and private open spaces so that at least 70% of apartments in a development receive a minimum of three hours direct sunlight between 9am and 3pm in mid-winter.
- Limit the number of apartments with internal egress to a maximum of 10% of the total apartments proposed.
- Design all dwellings to be effectively naturally ventilated, either via cross ventilation, single-sided ventilation or a combination.

Where can I find out more?

Technical Manual Passive Design
Your Home
www.yourhome.gov.au

Apartment Design Guide
New South Wales Department of Planning and Infrastructure
http://www.planning.nsw.gov.au

Toolbox and other info
Sustainability Victoria
www.sustainability.vic.gov.au

LJ Hooker Sustainability
www.sweably.com.au

Healthy Product Database
Ecospecifier
www.ecospecifier.com.au

GEDA (Good Environmental Choice Australia)
www.geca.org.au

Best Practice IEQ Guidelines
Green Building Council of Australia
Download the applicable rating tool: www.gbca.org.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Indoor Environment Quality, consider the Fact Sheets entitled:

- Energy Efficiency
- Building Materials
- Urban Ecology
- Sun Shading

What’s included in this fact sheet:

- Why is good Indoor Environment Quality so important?
- What defines Indoor Environment Quality?
- Design criteria for improved Indoor Environment Quality:
  - Daylight
  - Ventilation
  - Thermal comfort
  - External views
  - Product choice
  - Internal noise levels
- Balancing Indoor Environment Qualities
- Where can I find out more?
- Mandatory Requirements
- Council’s Best Practice Standard.

What defines Indoor Environment Quality?

The quality of an indoor environment (e.g. a room) is commonly defined through the following main factors:

- Ventilation – can the room be sufficiently ventilated (preferably naturally but where this is impractical, mechanically) and provide occupants with quality fresh air?
- Thermal comfort – is the room sufficiently insulated, shaded and conditioned to ensure comfortable temperatures throughout the year?
- Noise – is the room sufficiently insulated from external noise sources and does it minimise internal reverberation and noise levels?
- Air quality – does indoor air contain sufficient levels of oxygen and acceptable levels of pollutants from internal or external sources?
- Energy Efficiency
- Building Materials
- Urban Ecology
- Sun Shading

Where can I find out more?

Why is good Indoor Environment Quality so important?

Australians spend on average 90 percent of their time indoors. And with indoor environments having a direct impact on our wellbeing and our health, it is important to strive for enhanced indoor environment quality in both our homes and offices. In fact, the CSIRO has estimated that the cost of poor internal air quality in Australia may be as high as $12 billion dollars per year due to mental and physical ill-health and lost production.

Those most at risk are people with weak immune systems, including children and the elderly. While most will only ever experience medium health effects such as headaches or tiredness, others may suffer more serious health effects due to “sick” buildings. On the other hand, studies also show that an enhanced indoor environment quality in offices can be linked to staff’s improved work performance and reduced sick-leave.

Council’s experience shows that good indoor environment quality has become an important criteria for not only those who are developing their own homes but also for savvy developers, who understand today’s market demands.

Improving the indoor environment quality at home and in the workplace will generally enhance well-being and reduce the likelihood of Ill-health. Through the implementation of passive design principles, good indoor environment quality also leads to energy savings due to reduced energy demands for heating, cooling and artificial lighting.

This fact sheet recommends ways to improve indoor environment qualities through informed building design and product and materials choices.

STRADBROOK and VERS (known as SDAPP)

Sustainable Design Assessment in the Planning Process
10 Key Sustainable Building Categories

Building design for a sustainable future

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Design criteria for improved Indoor Environment Quality

Council recommends carefully considering all aspects of good indoor environment quality during a project's early design stage. Experience shows that early design decisions make the greatest impact on future occupant's wellbeing and only expensive technologies and product choices can recoup early mistakes.

**Ventilation**
- Whether via natural or mechanical means, Council recommends substantially exceeding minimum requirements for window opening sizes and air exchange rates under the Building Code of Australia.
- In homes, the most effective ventilation is achieved through natural cross ventilation. The ideal layout features operable windows located in opposite walls, which creates a breeze path to let in fresh air and flush out stale air. Note that cross ventilation can be achieved through various façade openings, be it standard windows, operable skylights or even small solid doors.
- In office buildings, air change effectiveness is important to ensure good quality air. Carbon dioxide levels should be regularly controlled to ensure a healthy and productive work environment. In smaller offices, natural ventilation is also a great way to save energy and cater for individual’s differing comfort needs.

**Thermal comfort**
- Thermal comfort describes the temperature and humidity range in which humans feel comfortable. This range can fluctuate by many degrees and percentages, depending on activity levels, clothing, annual seasons and personal preferences.
- Environmentally sustainable buildings provide thermal comfort levels with little reliance on mechanical heating and cooling systems. This is commonly achieved through sensitive orientation, good insulation, effective ventilation and flexible external shading. In order to respond to changing weather conditions throughout the year and different user patterns, occupant should be provided with sensible controls of both active and passive systems to ensure good thermal comfort.

**Daylight**
- In order to achieve high quality daylight levels, Council recommends substantially exceeding minimum requirements for daylight under the Building Code of Australia.
- Good access to natural light is essential to occupant wellbeing and employee performance. Daylight is vital for body functions, gives us a sense of time and place and connects us to our environment. Therefore, habitable rooms with 'borrowed light' should be avoided.
- Daylight is the combination of direct and indirect (reflected) sunlight. Therefore, on an overcast day, south facing windows will receive just as much daylight as north facing windows. High level windows will throw daylight deep into rooms, that's why they are particularly useful for deep floor plans.
- In office environments, daylight has to be carefully balanced with possible glare as this strains our eyes.

**Product choice**
- Many materials used in the fit-out and construction of homes and commercial buildings contain Volatile Organic Compounds (VOC) which pose serious health risks to building occupants. VOC’s are found in many common construction materials however alternative low / no VOC products are available on the market including: paints, coatings, sealants, carpets and pressed wood products (e.g. cabinetry and furniture). Council recommends the early commitment to low / no VOC construction materials.

**External views**
- The provision of long distance views and a visual connection to the outdoors commonly increases wellbeing for building occupants. In office buildings, views can reduce eyestrain for computer workers; in residential buildings views provide a sense of connectivity. Due to statutory planning provisions, the balance between sufficient external views and limiting the overlooking into neighbouring properties needs to be carefully considered.

**Internal noise levels**
- Excessive noise generated by neighbours, traffic and hard surfaces that reflect internal sounds (echo) can impact occupant’s amenity and employee’s productivity. In order to ensure comfortable noise levels, Council recommends considering the inclusion of acoustic insulation to internal and external walls, double-glazing to windows, landscaping that buffers traffic noise and a good balance of internal hard and soft finishes.

**SDAPP 1.0 INDOOR ENVIRONMENT QUALITY**

11/15 page 2 of 4 www.maribyrnong.vic.gov.au
This fact sheet explains how energy efficient design and specification principles can be incorporated into your next building project and the benefits that can be shared not only by you, but all Victorians.

Why do our buildings need to change?

Around 40% of the world’s energy resources are used in our buildings – both residential and commercial. Estimates show that the use of electricity contributes approximately 70% of Victoria’s total greenhouse gas emissions due to our reliance on brown coal. Passive design principles including thermal mass, external shading, building orientation, cross ventilation and better insulation in buildings lead to less reliance on energy hungry mechanical systems to maintain comfortable internal temperatures. Using renewable energy further reduces a building’s environmental impact. Good building design decreases power consumption, saves money and reduces the effects of climate change. On the other hand, poor building design is uneconomical and contributes to greenhouse gas emissions.

How will improved Energy Efficiency benefit me?

As an owner/occupier you can expect:
- lower energy bills due to less reliance on active heating and cooling systems
- improved living comfort
- future proofing of your building asset.

Developers and builders can take advantage of:
- enhanced market appeal to prospective purchasers
- higher investment returns
- a development that meets best practice standards and more importantly, community expectations.

What’s included in this fact sheet:

Why do our buildings need to change?

How will improved Energy Efficiency benefit me?

What should I consider to enhance Energy Efficiency?

- Building envelope
- Building compliance for residential and commercial buildings
- Internal layout and orientation
- Heating and cooling systems
- Lighting
- Renewable energy generation
- Water heaters
- Clothes drying facility
- Peak demand

Where can I find out more?

Mandatory Requirements

Council’s Best Practice Standard.

Typical energy consumption in homes
What can I do to enhance Energy Efficiency?

For both home owners planning a renovation to an existing dwelling and developers planning to construct multi-storey buildings, it is important to ensure that ESD is considered during the initial scoping stages of a project. In fact, it is more costly to incorporate sustainability measures after the design process is complete. The following information in this fact sheet will help you to identify and address the key areas of energy efficient building design.

Building envelope

The exterior of a building is often referred to as the ‘building envelope’. The building envelope ensures that occupants are protected from the elements such as heat, cold, wind and rain.

To maximise the building envelope’s thermal protective capabilities:

• Insulate walls, floors and ceilings, exceeding current standards.
• Draft-proof any gaps around doors, windows and vents including any opening between the interior and exterior of the building.
• Consider the use of exposed ‘thermal mass’ of a building to balance a building’s internal temperatures through heat storage and release.
• Specify high performance windows.

Internal layout and orientation

To minimise your reliance on mechanical heating and cooling systems, consider the following design principles:

• Orient living areas to a northerly aspect or as close to as possible, to take advantage of passive solar gains during colder months.
• The positioning and size of windows impacts on the amount of artificial lighting required during daylight hours. To maximize light ingress, it is preferable to use clear glazing. You can use highlight or roof windows to increase lighting levels in buildings with deep floor plans.
• Carefully study the location of your project. Is there the chance of overshadowing from neighbouring buildings? If so, consider how you might overcome any potential problems through clever window placement or reorienting your building.
• Try to cluster heated rooms together. Separate rooms with doors and apply internal insulation to walls adjacent to non-heated rooms. For example, adjoining garages and storage areas can be just as cold as the temperature outside.

Building compliance for residential and commercial buildings

How can you be certain that your building envelope meets best practice energy efficiency standards?

Before commencing a major renovation or new construction, a building permit will be required, confirming compliance with the National Construction Code of Australia (NCC). Residential buildings receive an energy efficiency rating which is calculated through tools such as:

- FirstRate
- Building Energy Rating Scheme (BERS) Pro
- Accurate

The rating reflects a dwelling’s energy efficiency and is measured on a scale of 1 to 10 Stars. A 1 Star rating means that the dwelling is extremely inefficient and ‘energy hungry’. While a 10 Star rated building is extremely energy efficient and requires very little or no energy for heating and cooling due to the passive design principles incorporated during the building’s early design stages. Similarly, non-residential buildings must also meet the NCCs energy efficiency standards. However, this is determined using different modelling tools that rate the relative energy efficiencies of a building.

It’s important to be aware that the NCC only describes minimum standards that must be met and not what is considered best practice. To ensure you future proof your asset, it is strongly recommended that you exceed today’s minimum standards.

Energy efficient office buildings are generally rated above 4 Stars under the National Australian Built Environment Rating System (NABERS). This also makes sure your property will remain a ‘good performer’ as the standards will be raised over time and that you are ready for the recently introduced mandatory disclosure scheme.

"Thermal mass (e.g. exposed concrete floor) can store and release heat in winter when exposed to direct sun. In summer, thermal mass can assist with passive cooling by releasing the stored heat at night through effective means of ventilation (night purging)."
### Heating and cooling systems

Choosing the correct heating and/or cooling system for your project can have a big impact on your energy consumption and greenhouse gas emissions.

Smart buildings and renovations will incorporate passive solar design in their construction. This may include above standard insulation, external shading that can be adjusted to changing climate conditions, good cross ventilation and the best possible building orientation.

When all of these are combined, buildings will have significantly lower heating requirements in winter and you may be able to avoid the need for active cooling systems in summer.

When choosing an active heating and cooling system (reliant on energy to power), be aware that each has its pros and cons. Some general rules apply:

- Gas fuelled systems create considerably less carbon emissions than electricity fuelled systems.
- The efficiency of a heating and cooling system is rated in stars. The higher the star rating, the more efficient the unit.
- Hydronic heating systems (run by hot water) can utilise the sun’s renewable energy in the form of a ‘solar-boosted’ heating system, that works just like the solar hot water system on your roof.
- Central systems in larger commercial developments are generally more energy efficient. However, individual systems are more flexible and can be easily modified to suit a building’s changing occupancy.
- Some systems are inherently more efficient than others. A ceiling fan, for example, will always consume less energy than an efficient air-conditioner.

<table>
<thead>
<tr>
<th>Building Services</th>
<th>Low Efficiency</th>
<th>High Efficiency</th>
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<tbody>
<tr>
<td>Space Heating</td>
<td>Electric Heating Panels</td>
<td>Gas Boosted Solar Hydronic Heating</td>
</tr>
<tr>
<td>Space Cooling</td>
<td>Electric Air Conditioning</td>
<td>Ceiling Fan</td>
</tr>
<tr>
<td>Water Heating</td>
<td>Electric Storage Heater</td>
<td>Gas Boosted Solar Hot Water (Solar contribution &gt;80%)</td>
</tr>
<tr>
<td>Artificial Lighting</td>
<td>Halogen Light Bulb</td>
<td>Light-Emitting Diode (LED), Compact Fluorescent</td>
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### Lighting

When considering artificial lighting design, weigh up these design options:

- Ensure living areas, including kitchen and bedrooms, do not require any artificial lighting throughout the day.
- Familiarise yourself with appropriate lighting requirements (how bright is bright enough?) for different living and working spaces.
- Choose energy efficient lights and lamps.
- Install efficient lighting controls such as motion, sound and daylight sensors and time switches, or a ‘master switch’ that controls several lights, and possibly appliances, at once.

### Renewable energy generation

In addition to good “green” design and performance, many buildings are now being designed to generate their own energy to supplement or meet everyday’s energy consumption. Council supports these initiatives and recommends exploring onsite renewable energy production. Renewable energy options include photovoltaic solar panels and small wind turbines for electricity production, solar hot-water heating systems, and geothermal systems for space heating and cooling.

Solar hot water systems are the most common systems that work with renewable energy - free energy from the sun.

While we weren’t able to provide renewable energy for all 150 apartments, we at least covered all common area electricity demand (lighting and ventilation for entrance lobby, corridors and basement) through onsite electricity generation with photovoltaic panels. That way we not only reduce the development’s environmental footprint but also reduce the body corporate fees.

“...”
**Water heaters**
On average, hot water heating contributes 20 per cent of a household’s energy bill. Choosing a highly efficient system reduces energy costs and a building’s environmental footprint.

Water heaters follow similar guidelines to heating and cooling devices:
- Gas fuelled systems are commonly more efficient than electricity fuelled systems.
- The efficiency of a hot water system is rated in stars. The more the better.
- A solar hot water system provides a large proportion of the energy required to heat water by directly using the sun’s energy. Where possible, supplement outstanding energy requirements using a gas booster, known as a gas boosted solar hot water system.
- Instantaneous systems are generally more efficient than storage systems as there is no water being stored and constantly reheated. However, this can vary, depending on the fuel source, be it renewable energy, electricity or gas.

**Reducing peak demand**
Peak energy demand refers to the use of electricity, caused by extreme weather events such as heat waves and cold snaps. For example, on a hot summers day, the Victorian electricity grid carries an additional load of up to 20% due to the additional use of air conditioners. Extreme conditions occur on a relatively few number of days per year however this peak demand is enough to increase demand for the construction of new power stations.

The impact on consumers is additional costs for the entire year as Victoria’s energy grid is 20% larger than it would need to be without peak demand. However, we can all take steps to help reduce peak demand on our electricity supplies by:
- installing efficient shading
- providing good insulation
- only using high efficiency heating and cooling systems, which means that specified systems should be within 1 Star of the highest rating available
- installing photovoltaic panels that produce energy when it is needed most - on a hot summers day.

**Clothes drying facility**
A well designed residential dwelling should incorporate natural clothes drying facilities. External drying spaces give the occupant the opportunity to use sun and wind to dry clothes rather than electrical appliances. Apartment buildings could provide retractable drying racks on individual balconies or a common clothes line on the building’s roof terrace.

**Where can I find out more?**
6 Star Energy Efficiency Requirements
Victorian Building Authority
www.vba.vic.gov.au

Find an accredited Thermal Performance Assessor
Association of Building Sustainability Assessors
www.absa.net.au

Building Designers Association Victoria
www bdav.org.au

National Australian Built Environment Rating System (NABERS)
www.nabers.gov.au

Choose an Energy Efficient Appliance
Department of Climate Change and Energy Efficiency
www.energysaving.gov.au

Sustainability Victoria

Energy Use Technical Manual
Your Home
www.yourhome.gov.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Energy Efficiency, see the Fact Sheets entitled:
- Indoor Environment Quality
- Urban Ecology
- Building Materials
- Sun Shading
- Melbourne’s Climate

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**Mandatory Requirements and Council’s Best Practice Standards**

**Mandatory Requirements**
You must meet:
- The National Construction Code (NCC) requirements for energy efficiency, and;
- The objectives and standards of the local planning scheme.

**Council’s Best Practice Standards**
- Achieve an energy efficiency standard at least 10% above minimum NCC compliance.
- Install energy efficient lighting to achieve an improvement of at least 10% above NCC compliance for lighting power density.
- Provide daylight and occupancy sensors for external lighting.
- Provide on-site renewable energy generation.
- Provide external natural clothes drying facilities.
- Install energy efficient hot water, heating and cooling systems within one energy star rating of the best available.
- Ensure basement carparks are either fully naturally ventilated, or use Carbon Monoxide monitoring to control the speed and operation of ventilation fans.

Developments, which seek to vary from these best practice standards, must demonstrate how energy efficiency can be satisfactorily achieved.
What’s included in this fact sheet:

What is sunshading?
Sun angles
Comparing different external shading devices
• Integrated or ‘built in’ devices
• Fixed horizontal projection
• Fixed horizontal battens
• Adjustable horizontal projection(s)
• Fixed vertical fins
• Adjustable vertical fins or battens
• Fixed perforated screens

Where can I find out more?
Mandatory Requirements
Best Practice Standards
Show on Planning Application Drawings

Sunshading
Building design for a sustainable future

This Fact Sheet explains the different types of sun shading and the impact it will have on the indoor environment quality and energy demand of a building. It also details the type of shading that is best suited to the different orientations and facades of the building.

What is sunshading?

Historical architecture relied on passive design approaches, such as the inclusion of sun shading to provide comfortable indoor conditions. Since the second half of the 20th century, when technology became affordable and readily available, building design was able to rely on energy hungry devices, such as air conditioning and artificial lighting to provide the desired comfort. With energy becoming more expensive and showing the effects on our environment, Council encourages you to design buildings that thrive on passive design, rather than active appliances.

Appropriately designed sun shading will not only support comfortable building temperatures but will help you save energy and money on cooling and heating systems. Melbourne’s climate requires building facade design that responds to changing summer and winter temperatures and changing sun angles throughout the year. Fixed or flexible external shading should protect your windows from unwanted heat gain in summer and allow for desired heat gain in winter.

The effectiveness of different shading devices is expressed as the Fc value, also called the shading factor. It is measured in the proportion of solar energy entering a window. A low figure means the shading device is very effective, most of the solar energy is excluded. A high figure means the shading device is not very effective, a lot of heat enters the room. A figure of 1 means no shading device is applied. Refer to the example of internal and external louvres below.

Unwanted solar energy trapped inside

Typical shading factor for internal devices: 0.6-0.9

Comparison of solar heat gains through different window treatments in summer

Solar radiation reflected

Typical shading factor for external devices: 0.2-0.4

Melbourne’s climate requires building facade design that responds to changing summer and winter temperatures and changing sun angles throughout the year. Fixed or flexible external shading should protect your windows from unwanted heat gain in summer and allow for desired heat gain in winter.
The graphic to the right shows how sun angles change, depending on the season, the orientation, and time of the day. Generally speaking, summer sun angles are high (up to 75°) and winter angles are considerably lower (up to 29°). Furthermore, midday sun in the North is higher than morning or evening sun in the East and West.

**North:**
Due to the sun’s high angle in summer, shading can be horizontal and fixed. To provide full shading from late October to late February in Melbourne, the depth of the horizontal overhang should be approximately 45% of the vertical height to be shaded, measured from the window sill to the underside of the shading device. This depth represents a good compromise between shading in summer and winter solar gain. Fixed horizontal shading can be provided through structures, such as eaves, awnings, pergolas and verandas. Adjustable external shading devices are also an option for north facing glazing, however they rely on the occupier understanding when to operate them for maximum benefit.

**East and West:**
Even in summer, eastern and western facades are exposed to relatively low sun angles. On 21 December (mid-summer), eastern and western sun angles remain below 60°. Due to those low sun angles, normal fixed horizontal sun shading becomes ineffective. Therefore adjustable shading devices are recommended. These include (horizontal or vertical) canvas blinds, conventional or roller shutters, angled metal or timber slats and shade cloth over pergolas. The flexibility will allow occupants to respond to different seasons and individual comfort levels. Furthermore, well designed flexible shading will contribute to a building’s architectural appearance and meet occupant’s privacy requirements.

**South:**
In Australia, southern facades receive very little direct sunlight. Only in mid-summer will some low angled sun hit a southern facade, in the morning and evening. Therefore it is not required to provide external shading devices. However, when a building has an overheating problem, a flexible shading installation on the southwest can be an valuable addition. Nevertheless, internal glare protection should be provided, especially for working environments.

---

### Rule of thumb for sizing north facing window overhangs

- **29° winter solstice**
  - 450mm (16% of H)
- **52° equinox (spring/autumn)**
  - 1215mm (45% of H)
- **75° summer solstice**
  - 2800mm

### Example of not enough overhang on north facing window

- **29° winter solstice**
  - 450mm (16% of H)
### Sunshading Description

<table>
<thead>
<tr>
<th>Description</th>
<th>Benefits and limitations</th>
</tr>
</thead>
</table>
| **No Shading device**  
Relies solely on the thermal performance of the window and glazing system to prevent heat transfer which is usually the building’s weakest point. Internal blinds will be minimally effective. | • Not effective  
• North:  
  Good during winter  
  Not good during summer  
• East/West:  
  Good during winter  
  Not good during summer |
| **Integrated or ‘built in’ sunshading**  
The sunshading is usually integrated into the design of the building such as an eave, overhang or balcony which cannot be easily removed and is considered within the overall design of the building. | • Moderately to very effective  
• North:  
  Ideal if designed at 45% rule  
• East/West:  
  Will have some impact but is not optimal |
| **Fixed horizontal projection**  
The sunshading is commonly fixed above the glazing to the building’s facade. If designed to the 45% rule for Melbourne it will effectively shade the glazing during summer and allow for the sun to penetrate through the building envelope in winter. | • Moderately to very effective  
• North:  
  Ideal if designed to 45% rule  
• East/West:  
  Will have some impact but is not sufficient |
| **Fixed horizontal battens**  
Timber, aluminium or other material battens are placed at carefully considered spacings across the glazing and fixed to the façade. This can be very effective if designed to the 45% rule for the battens and spacing. | • Moderately to very effective  
• Can prevent overlooking  
• Will reduce daylight penetration  
• North:  
  Ideal if designed to 45% rule  
• East/West:  
  Will have some impact but is not sufficient |
| **Adjustable devices**  
Adjustable shading devices are typically roller blinds, sliding screens or shutters which commonly are constructed in timber, aluminium or shading fabric and are either integrated into the building fabric or are fixed to the external façade. These can be manually operated or automated and allow for the occupant to easily control their thermal comfort. | • Very effective  
• North:  
  Good option if the user operates the shading device at the right times, i.e. closing shutters on summer days to reduce heat gains and having shutters open on winter days to capture wanted solar energy  
• East/West:  
  Ideal to control eastern and western solar gains. However, as per north orientation, it relies on occupant awareness to function as intended |
| **Fixed vertical fins or battens**  
Vertical elements cover the glazing and are fixed to the building’s façade. These elements typically provide shading for one direction. Installed on west facing glazing, they block most western sun. However, spacings and angles are important as protection will be at its least when the sun is parallel to the device’s angle. | • Moderately to very effective  
• Can prevent overlooking  
• North:  
  Moderately effective as is will not protect glazing at optimal times. Midday sun will strike the glass which is good in winter but undesirable in summer  
• East/West:  
  Very effective |
### Sunshading Description

<table>
<thead>
<tr>
<th>Benefits and limitations</th>
<th>Adjustable vertical fins/battens</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Very effective</td>
<td>Adjustable vertical elements, such as sliding shutters or rotating fins which are placed across the glazing. These can be manually or automatically operated to protect the glazing at optimal times.</td>
</tr>
<tr>
<td>• North, East &amp; West: Very effective if adjusted according to the changing seasons and sun angles</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits and limitations</th>
<th>Fixed perforated screens</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Moderately effective</td>
<td>Perforated screens or meshes will provide varying levels of shading to the glazing, depending on their percentage of transparency. Patterns can be generic or custom designed to suit different applications.</td>
</tr>
<tr>
<td>• Can prevent overlooking</td>
<td>North, East &amp; West: Moderately effective as commonly too little heat gain is prevented in summer and too little heat gain is possible in winter</td>
</tr>
<tr>
<td>• Will reduce daylight penetration</td>
<td></td>
</tr>
</tbody>
</table>

### Where can I find out more?

- **How to shade windows for summer**
  - Sustainability Victoria
- **Shading Your Home**
- **External shading devices**
  - Ecospecifier
  - [www.ecospecifier.org](http://www.ecospecifier.org)

### Where can I find out more?

- **Mandatory Requirements and Council’s Design Advice**
  - **Mandatory requirements**
    - NCC Part 3.12 and Section J shading to walls and windows.
    - Overlooking in clauses 54 and 55 of the Victorian Planning Provisions (VPP), 54.04-6 and 55.04-6 Overlooking Objective.
    - Confirm these requirements before lodging your planning permit.
  - **Council’s Design Advice**
    - A window and shading design that balances undesired heat gains in summer and desired heat gains in winter and also maximises daylight penetration throughout the year.
    - **Show on Planning Application Drawings**
      - External fixed and flexible shading devices.

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This fact sheet explains what you can do to conserve Victoria’s precious water resources by using it more efficiently and in certain circumstances substituting drinking water with other sources of recycled water such as rainwater. Even minor changes and installations can save you money, future proof your property investment and increase the amount of water available on your property.

Why do we need to adjust our water usage?

The average Melbourne household of four people uses approximately 240,000 litres of drinking water each year. That’s equivalent to 3000 bathtubs or 10% of an Olympic size swimming pool. In fact, up to 90% of that water consumption is used for toilet flushing, garden irrigation and other uses that don’t require water of drinking quality.

Looking at it another way, the average household flushes fresh drinking water equivalent to 80 litres of milk or nine slabs of beer down the toilet every day.

With our population growing and weather patterns shifting, we need to rethink the availability of fresh water and prepare for a more efficient use of available resources.
How will improved Water Efficiency benefit me?

There are many benefits to using water more efficiently. By using water wisely, you can:

- reduce the costly demand on infrastructure upgrades (e.g. desalination plants)
- lower your water bills
- future proof your property investment
- secure a water supply that is not subject to water restrictions
- maintain your garden through low periods of rain
- discharge less sewage to rivers and the ocean.

With households becoming more aware of our water security issues, properties that are designed to use water more efficiently are becoming highly regarded by tenants and homebuyers. So when renovating or building new, it is wise to integrate water saving measures, such as water efficient fittings and fixtures (taps, shower heads etc.) and rainwater tanks connected to toilets and irrigation from day one to avoid the increased cost of retrofitting at a later stage.

What can I do to use water more efficiently?

Water can be saved through the combination of three important measures:

Firstly, overall water use can be reduced through the installation of highly efficient fixtures, appliances and systems, throughout your property.

Secondly, rainwater and / or greywater should be used in preference to drinking water for purposes such as toilet flushing, laundry and irrigation where appropriate.

Thirdly, minimise the volume of external water features and pools. Reuse water in water features and utilise pool covers.

Water efficient fixtures and appliances.

Installing water efficient fixtures, appliances and systems in your property is the first, and probably the easiest step in reducing water consumption. The following products are readily available:

- taps and shower roses that use water more efficiently
- dual flush toilets and waterless urinals that use less water than traditional models
- dishwashers and washing machines that use water more efficiently
- garden irrigation systems that use available water with maximum efficiency, eliminating unnecessary waste and evaporation.

Look out for WELS rated products. Having compared the water efficiency of many taps, showerheads, toilets and also white goods made us realise how easy it is to save water and money at the same time. The WELS website provided us with a great overview of the many rated products available.

Some basic guidelines to reduce water consumption

- 4,000L Polyethylene tank
- 10,000L Corrugated Steel tank
- 3,500L Concrete tank
- 4,000L Slimline polyethylene tank
- 2,000L Extra slimline poly tank along fences or to form walls of courtyards and between terraces.
- 4,000L Bladder tank
- 3,000L Slimline corrugated steel tank.
Some basic guidelines to reduce water consumption

Rainwater reuse
Drinking water supplied through the mains system has been treated to a very high standard to ensure that it is safe to drink. This process includes the use of chemicals, disinfectants and a lot of energy. That is why it is so important to conserve and substitute its use in applications where high quality water is not needed and alternatives such as rainwater can be used.

Rainwater tanks help us conserve our precious potable water resources, by allowing us to substitute mains drinking water for uses such as toilet flushing, garden irrigation and hot water throughout homes. Additionally, by keeping rainwater on site, we reduce the volume of stormwater and quantity of pollutants entering our local streams.

Tanks come in many different designs and materials. They can be installed above ground, underground, below outdoor decks or even hidden within planter boxes (graphic previous page).

In Victoria, most new homes and renovations are required to install (as a minimum) a 2,000L rainwater tank, connected to 50 square meters of roof space for toilet flushing. Often these variables (area of roof and tank size) are not enough to ensure rainwater availability throughout the year.

Therefore, we recommend carefully assessing your rainwater availability and demand taking the following factors into account:

- What will the rainwater be used for (toilet flushing, laundry and irrigation)?
- How big is the roof and any other catchment areas that can feed the tank?
- How many people live in the household?
- How big is the garden and how often does it need watering?
- What size tank should I get to match the demand and where can the tank be located?

Various free online tools, including Tankulator from the Alternative Technology Association and STORM calculator from Melbourne Water, will give you an early indication of the best sized rainwater tank. Nevertheless, you should always seek advice from a licensed green plumber or rainwater tank retailer.

I was surprised how easy recycling water actually is. Once you understand the different sources, usages and quantities, it just makes common sense.

Greywater reuse
Greywater is the waste water discharged from washing machines, showers and laundry sinks. Water discharged from the kitchen and toilets is by law not permitted to enter a greywater system. Greywater is not permitted to be used for drinking purposes however, it can replace mains water for toilet flushing and garden watering. Greywater can only be used on your property. Additionally, if the untreated greywater is not used within 24 hours it should be discharged to the sewer.

There are a number of greywater systems available on the market that range from manual to mechanical systems.

The most common way to use greywater on a single dwelling property is to install a diverter that diverts water directly from your washing machine, shower or bath to the garden or tank via a hose. The mechanical systems on the market do all greywater diversions automatically and do not rely on manual operation although the systems do require some maintenance.

Prior to planning a greywater treatment system, you need to obtain advice from a licensed plumber, the Department of Health and the Environment Protection Authority. A permit from Council is required.
Some basic guidelines to reduce water consumption

Applying rainwater and greywater

Using rainwater and greywater around your property is an effective way to reduce your mains-water use and bills. However, it is important to carefully consider where it is appropriate and safe to apply rainwater and greywater. To give you an indication for appropriate reuse, we have highlighted common household uses in the table below.

<table>
<thead>
<tr>
<th>Water end use</th>
<th>Rainwater</th>
<th>Greywater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least Sensitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape irrigation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Toilet flushing</td>
<td>Yes</td>
<td>Yes, but treated</td>
</tr>
<tr>
<td>Edible garden irrigation</td>
<td>Yes</td>
<td>Yes, but treated</td>
</tr>
<tr>
<td>Car washing</td>
<td>Yes</td>
<td>Yes, but treated</td>
</tr>
<tr>
<td>Washing machine</td>
<td>Yes</td>
<td>Yes, but treated</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Swimming pool</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Showers</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Drinking and cooking</td>
<td>Yes, however only recommended where no reticulated drinking water is available.</td>
<td>No</td>
</tr>
</tbody>
</table>

Most Sensitive

<table>
<thead>
<tr>
<th>Water end use</th>
<th>Rainwater</th>
<th>Greywater</th>
</tr>
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<tbody>
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</tr>
<tr>
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<td>Yes</td>
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<tr>
<td>Swimming pool</td>
<td>Yes</td>
<td>No</td>
</tr>
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<td>Drinking and cooking</td>
<td>Yes, however only recommended where no reticulated drinking water is available.</td>
<td>No</td>
</tr>
</tbody>
</table>

Where can I find out more?

Sustainable Rebuilding Ideas, Water Fact Sheets
Sustainability Victoria

Water Efficient Labelling and Standards Scheme (WELS)
Australian Government
www.waterrating.gov.au

Tankulator
Alternative Technology Association
www.tankulator.ata.org.au

Water Rebate Program
Department of Environment, Land, Water and Planning, Victoria
www.depi.vic.gov.au

STORM calculator
Melbourne Water
www.storm.melbournewater.com.au

Practical Water Saving Tips
Savewater
www.savewater.com.au

Information on Licensed Green Plumbers
Master Plumber and Mechanical Services Association Australia
www.plumber.com.au

Information on Annual Rainwater Fall
Bureau of Meteorology
www.bom.gov.au

Greywater Use around the Home, and Code of Practice - Onsite Wastewater Management
Environment Protection Authority (EPA Victoria)
www.epa.vic.gov.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Water Efficiency, see the Fact Sheets entitled:

- Stormwater Management
- Site Permeability
- Melbourne’s Climate
- Urban Ecology
Building design for a sustainable future

What’s included in this fact sheet:

- Why do we need to change our Stormwater Management practices?
- How will best practice Stormwater Management benefit me?
- How does my choice of Stormwater Management strategies impact on the environment?
- Some basic guidelines to manage stormwater:
  - Rainwater tanks
  - Porous paving
  - Raingardens
  - Drought tolerant landscaping

Measuring Stormwater Management performance

Where can I find out more?

Mandatory Requirements

Council’s Best Practice Standard.

This fact sheet will assist you in making informed decisions about Stormwater Management practices to minimise negative impacts on the environment.

**Why do we need to change our Stormwater Management practices?**

Melbourne’s continued urbanisation and expansion has resulted in a dramatic increase in areas of hard and impervious surfaces, such as buildings, roads and car parks. Consequently, the majority of the rain that falls in urban areas is converted into run off, or stormwater.

Traditional stormwater management practices direct stormwater into urban waterways, which carries pollutants that ultimately enter our rivers and Port Phillip Bay.

The increase in stormwater negatively affects the health and amenity of our waterways for people, plants and animals. Additionally, the large volumes of stormwater entering our waterways can cause flooding that damages both natural and built environments.
How will best practice Stormwater Management benefit me?

Water Sensitive Urban Design (WSUD) can capture, treat and reuse stormwater onsite to dramatically improve the quality and quantity of water entering our waterways. Integrating WSUD into your development will minimise its downstream impacts and also enables you to conserve potable (drinking) water by substituting it with rainwater. WSUD strategies allow you to achieve the following outcomes and helps Melbourne transition to a water sensitive city:

- improve water quality in streams and in groundwater
- protect stream and riparian habitats for native plants and animals
- prevent erosion of banks along our waterways
- reduce flooding risk
- protect the scenic and recreational values of streams
- conserve potable water by providing an alternative water source for uses such as, irrigation and toilet flushing.

How does my choice of Stormwater Management strategies impact on the environment?

There is enormous scope for creativity when building or renovating to incorporate a variety of WSUD strategies into your design. Some simple measures to eliminate the negative impacts of stormwater and conserve potable water are outlined below:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Stormwater Quality</th>
<th>Stormwater Quantity</th>
<th>Potable Water Substitution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainwater tanks</td>
<td>Highly Applicable</td>
<td>Highly Applicable</td>
<td>Highly Applicable</td>
</tr>
<tr>
<td>Raingardens &amp; swales</td>
<td>Highly Applicable</td>
<td>Highly Applicable</td>
<td>Moderately Applicable</td>
</tr>
<tr>
<td>Porous pavers</td>
<td>Moderately Applicable</td>
<td>Moderately Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Drought tolerant landscaping</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Highly Applicable</td>
</tr>
</tbody>
</table>

Rainwater tanks

Rainwater tanks are perhaps the easiest way to reduce the amount of stormwater leaving your property. They also have the added benefit of providing a water source that can replace drinking (potable) water in certain uses such as outdoor use, toilet flushing and clothes washing. By using stormwater to replace drinking water, savings of up to 90% can be achieved.

Tanks come in many different colours, materials and designs. They can be installed above ground, under ground, below outdoor decks, under buildings (if space allows), or even hidden within planter boxes.

Sizing rainwater tanks is contingent on a number of variables namely, rainfall, roof catchment area and proposed uses. There are now a number of free tools, such as Tankulator and STORM, available to assist people in sizing their tanks and delivering best practice WSUD outcomes. For more information on water tanks, see the resources section of this fact sheet and refer to fact sheet 3.0 Water Efficiency.
Porous paving

Porous paving allows rainwater to pass through the pavers and soak into the ground, unlike standard concrete or block pavers. By using porous pavers you can:

• reduce the amount of ‘impervious’ surfaces on your block
• increase groundwater recharge by allowing the water to soak through the soil
• improve stormwater quality by filtering stormwater and reducing pollutant loads
• reduce high flows during peak rain events entering the waterway from urban areas causing stream erosion and habitat scouring.

Porous paving is installed in the same way as traditional paving and is available in many forms. They can be used to replace asphalt, concrete or other impervious pavers.

Drought tolerant landscaping

The average Victorian family uses almost twenty percent of their drinking water in the garden. You can not only reduce your water consumption by reusing household water or rainwater, but also by maintaining a water-efficient garden. This can be done through simple measures, such as using mulch, maintaining healthy soil or installing a more efficient watering system.

Drought tolerant plants are also an excellent way to save water in the garden. They are better suited to our dry environment and create an attractive and low-maintenance garden.

Raingardens

Installing a raingarden on your property is an easy way to reduce pollutant loads in stormwater while providing attractive landscaping. Raingardens are designed to capture, filter and reduce the flow rate of stormwater from roofs or hard surfaces.

For more information on raingardens, see the resources section of this fact sheet.

Raingarden sizing chart

<table>
<thead>
<tr>
<th>Area of run-off (m²)</th>
<th>Raingarden size (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td>250</td>
<td>5</td>
</tr>
<tr>
<td>300</td>
<td>6</td>
</tr>
<tr>
<td>350</td>
<td>7</td>
</tr>
<tr>
<td>400</td>
<td>8</td>
</tr>
<tr>
<td>450</td>
<td>9</td>
</tr>
</tbody>
</table>

“Generally, the size of the raingarden should be approximately two percent of the run-off area. One square meter of raingarden commonly treats 50 square meters of hard surface.”
Measuring Stormwater Management performance

To address and measure stormwater quality outcomes, the Best Practice Environmental Guidelines (BPEG) were developed and published by the Victorian Stormwater Committee. These guidelines establish specific stormwater quality objectives, to assist in determining the level of stormwater management necessary to meet the State Environment Protection Policy (SEPP) requirements. These guidelines are now a referenced document in the State Planning Policy Framework. The best practice performance objectives from the BPEG aim to remove:

- 80% of suspended solids
- 45% of total Nitrogen
- 45% of total Phosphorus
- 70% of typical urban annual litter load.

When applying for a planning permit, you may be required to demonstrate that your development proposal will meet these performance targets. This can be done through the use of different tools.

For small and medium sized developments, Melbourne Water developed STORM, a free and simple online stormwater calculator that helps you assess and improve your design’s stormwater performance. Exceeding the 100% benchmark in the STORM tool confirms that your building design will meet Council’s performance targets.

For large sized developments, we recommend using proprietary tools such as MUSIC and Urban Developer to simulate urban stormwater systems and their performance. These tools require a sound knowledge of urban stormwater management principles and practices.

Mandatory Requirements and Council’s Best Practice Standards

Mandatory Requirements
You must meet:

The National Construction Code (NCC) requirements for water efficiency.

New developments may be required to install a rainwater tank. For a single dwelling, a rainwater tank must:

- have a storage capacity of at least 2,000 litres
- be connected to a roof catchment of at least 50 square meters
- be connected to all internal toilets.

Meet the objectives and standards of the local planning scheme including permeability, site coverage, stormwater management and water sensitive urban design (as applicable).

Council’s Best Practice Standards

- Exceed Victoria’s best practice stormwater performance targets, set out in the Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG) and local integrated water management plans. These targets may be demonstrated by a STORM rating of at least 100% or equivalent modelling results (MUSIC, Urban Developer).

- Note: rainwater tanks sized for retention are in addition to any required for detention in storm events.

Developments, which seek to vary from these best practice standards, must demonstrate how best practice stormwater management can be satisfactorily achieved.
Building design for a sustainable future

Site Permeability

What’s included in this fact sheet:
- What is Site Permeability?
- How will consideration of site permeability benefit me?
- How can I increase site permeability?
- Permeable paving
- Design Considerations
- Where can I find out more?
- Mandatory Requirements
- Council’s Design Advice

This fact sheet examines the increasing densities in our urban environments which have led to a dramatic reduction in permeable surfaces, through the construction of impervious roads, buildings and car parks. Council encourages you to consider permeable design solutions in your building project to help prevent stormwater run-off, which in turn has capacity implications for drainage infrastructure and can degrade the water quality of Melbourne’s rivers, creeks and ultimately Port Phillip Bay.

What is Site Permeability?
Permeable sites minimise stormwater run-off by permitting rain water to be absorbed into the soil. A lack of permeability increases flooding in urban areas during storm events affecting not only infrastructure, but our homes as well. Many simple measures can be taken to counter-act this, and good building design should always consider ways in which site permeability can be enhanced or maintained.
Providing a contribution to your overall Water Sensitive Urban Design (WSUD) aims, enhancing or maintaining permeability on site can also:

- Reduce the volume of stormwater runoff which can cause localised flooding. Localised flooding can damage homes and property and greatly increase insurance premiums in certain areas
- Reduce pollution of waterways and habitats
- Reduce the need for expensive upgrades to local stormwater infrastructure
- Increase infiltration to sub-soil and allow groundwater recharge. This will not only help maintain groundwater supplies, but also aid local site ecology by ensuring sufficient water reaches tree root zones
- Reduce downstream flooding and stream-bank erosion

How will site permeability benefit me?

How can I increase site permeability?

The simplest way to increase your site permeability is to maximise areas where natural drainage can occur. These will include garden beds and lawn areas.

However, where areas such as paving or driveways are required, the type of surface or sub-surface construction can greatly affect the overall permeability outcome. The diagram below lists the most permeable surfaces to the least. Keep it in mind when selecting building materials for your project.

“Through the design process we realised how easy it was to improve our site’s permeability with readily available cost effective measures.”
How to increase site permeability?

Permeable paving

Whilst most increases in site permeability can be achieved without specialist treatment, in some situations measures such as porous/permeable paving may be required. For example, where paving is required to carry a certain load capacity with a high frequency of use, such as a car park.

Porous or permeable pavements supporting load bearing structures are comprised of a pervious base and sub-base. These allow infiltration of water, and in some cases, retain polluting particles.

Porous or permeable pavements supporting load bearing structures are comprised of a pervious base and sub-base. These allow infiltration of water, and in some cases, retain polluting particles.

**Design Considerations**

Whilst use of permeable paving can have many beneficial outcomes, not all sites are suitable for its installation. In addition, lack of maintenance can lead to clogging which in turn reduces infiltration levels. Therefore, to ensure effectiveness of permeable paving, the following site conditions must be considered:

- What is the primary design purpose? Flood mitigation, water quality improvement, water conservation
- Depth to groundwater table
- Soil type
- Soil depth
- Type of traffic (weight and volume)
- Slope
- Design life
- Maintenance and clogging
- Local regulations
- Adjacent infrastructure

It is advisable to seek specialist advice when selecting and installing permeable paving to ensure efficacy. Contact your local council for further guidance.

**4. Permeable paving**

Typically used where pavement is required to have a load bearing capacity such as:
- Car parks
- Driveways
- Streets with low traffic volumes
- Public squares

**5. Concrete or brick pavers**

Spacing to allow drainage. If not possible, slope paving to drain to garden beds, swales etc.

**6. Non-porous concrete, tarmac etc.**

Where porous/permeable paving cannot be applied, slope hardstand drainage towards swales and grassed buffer zones to reduce stormwater run-off.
Mandatory Requirements and Council’s Design Advice

Mandatory requirements
Council WSUD Policies, Site permeability requirements in local planning schemes. Confirm these requirements before lodging your planning application.

Council’s Design Advice
Landscape design that maintains or enhances infiltration of stormwater on site. Show on planning application drawings:
- Percentage site permeability
- Location of garden beds/lawns
- Location and extent of paving/hardstand areas
- Type of paving and hardstand areas
- Cross-sections for stormwater treatment type, e.g. permeable paving, raingardens etc.
- Slope/direction of run-off from hardstand areas to garden beds, swales or buffers

Information in reports – SDA/SMP:
- Type of paving proposed
- Suitability for site conditions
- Indicative maintenance regime

Further design options

Garden Beds and Swales
To improve permeability of semi and non-porous surfaces consider sloping small area surfaces to a garden bed. For larger sites such as car parks, an engineered swale with a drainage component can be utilised to reduce and treat discharge to the stormwater system.

Alternative design options
In situations where it is not possible to improve your site’s ground level permeability, there are other options available to reduce stormwater quality and flow. This may include inner urban sites which have been built on boundary to boundary.

Such measures may include raingardens, rainwater tanks, green walls and roofs. The latter may provide additional benefits such as open space amenity to building occupants, an increased ecological contribution, increased insulation and reduction in urban heat island effect.

Where can I find out more?

Resources and Tools:
- Water Sensitive Urban Design: www.melbournewater.com.au
- Sustainable Gardening in the City of Melbourne guide: City of Melbourne www.melbourne.vic.gov.au
- Sustainable Landscaping and a list of water saver garden centres: Department of Sustainability and Environment www.ourwater.vic.gov.au
- Stormwater Management Education Programmes: Clearwater www.clearwater.asn.au
- Maintaining Water Sensitive Urban Design Elements: Environmental Protection Authority www.epa.vic.gov.au
- Permeable Paving Design tools: LockPave and PermPave software www.cmaa.com.au
- Selection of WSUD materials: Ecospecifier www.ecospecifier.org
- Green Roofs and Walls Design Guide: www.growinggreenguide.org

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on site permeability, consider the Fact Sheets entitled:
- Stormwater Management
- Green Roofs, Walls and Facades

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Building design for a sustainable future

What’s included in this fact sheet:

- Why do we need to carefully consider our choice of Building Materials?
- How will my choice of Building Materials benefit me?
- How does my choice of Building Materials impact on the environment?
  - Embodied energy
  - Retaining and re-using existing materials
  - Specifying recycled materials
  - Sustainably sourced timber
  - Third party certification
  - Ecospecifier
  - GECA (Good Environment Choice Australia)
  - Life Cycle Assessment (LCA)
- Where can I find out more?
- Mandatory Requirements
- Council’s Best Practice Standard.

This fact sheet will assist you in making informed decisions about the materials you select for a project to help minimise their impact on the environment.

Why do we need to carefully consider our choice of Building Materials?

Building construction currently consumes between 30-50% of raw materials worldwide. With significant growth taking place in the building sector, the burden being placed on limited resources is increasing – resources that one day will run out.

What’s more, ongoing fitouts, extensions and / or refurbishments increase the environmental impact during a building’s life cycle.

As a result, we need to make more informed choices with regard to the impact that material sourcing will have on the environment. These impacts will accumulate through:
- harvesting of raw materials
- a material’s high embodied energy
- on-going maintenance requirements
- inability of materials to be recycled.

How will my choice of Building Materials benefit me?

By making informed choices about the materials you use in the construction and fitout of buildings, you can:
- assess the viability of reusing what you already have
- save on construction, refurbishment and maintenance costs
- design buildings that have a longer life span, by nominating durable materials such as brickwork, stone, and post consumer steel.

FSC Certified timber; locally sourced
Tilt panel concrete with recycled content; durable material
Re-used bricks from original dwelling
Recycled aggregate from grinded concrete rubble from existing dwelling
Recycled Porous Pavers

Mandatory Requirements
Council’s Best Practice Standard.
Many natural resources and building materials require mining, processing, refining and ultimately manufacturing, transport and delivery before they are utilised in construction. The energy used during these processes is commonly known as embodied energy.

The embodied energy of building products varies dramatically. For example, new or virgin aluminium window frames require up to 90 times more energy than timber window frames to produce. Generally, non recycled metals contain the highest embodied energy, followed by plastics and other materials with a high chemical content. Natural construction materials such as timber, brick and render contain the least embodied energy.

To reduce the embodied energy of a typical building structure, specify:

• metal produced from post consumer waste
• concrete blends that include a percentage (e.g. 30 percent) of recycled content (cement extender including fly ash or blast furnace slag)
• concrete that incorporates recycled aggregate wherever possible.

The sourcing of locally produced materials and products which are lower in embodied energy will also help in minimising their impact through reduced transport requirements.

Embodied energy can be minimised by retaining and re-using existing building structures and materials, particularly if demolition of existing structures is required.

Therefore, consideration should be made to re-use the existing materials within a new development in either their existing state or in a revised/renewed state. For example, crushed hard materials such as bricks and concrete may be re-used as aggregate. But also when building new, future recyclability through easy disassembly should be considered.

Consideration should be given to composite materials which are more difficult to recycle than raw materials. For example, facade and roof structures that are easily disassembled, are more likely to be reused than those that would be damaged when taken apart.

If none of these options are possible, then ensuring that most existing materials are recycled and re-used off site should be the next option.

Where practical, specifying recycled materials is a more sustainable practice than compared to specifying new materials. Not only will the material’s life span be extended and in turn reduce the amount of waste going to landfill, it can also be used as a key design feature of your project. For example, recycled timber can often be reused as new flooring and decking.

The high demand for wood products worldwide has led to large-scale illegal and unsustainable logging practices in some countries. With this in mind, we should all ensure that the timber products specified for a building development are sourced from renewable resources.

When specifying timber, ensure that it is certified through an accredited forest certification scheme such as the Forest Stewardship Council (FSC), or the Australian Forest Certification Scheme (AFCS).
How does my choice of Building Materials impact on the environment?

Third party certification

Many materials and products that claim to be “environmentally friendly”, “green” or “sustainable” often do not live up to their claim. The most effective way to choose a sustainable product or material is to check for certification under a recognised standard such as ISO (International Organisation for Standardization) 14000 Environmental Management and ISO 9000 Quality Management. Choosing a material or product with either certification will ensure that production processes have been conducted to satisfy the requirements set out in the standard. In the case of ISO 9000, the quality and management systems of the supplier has been conducted independently by a third party to ensure that the standards have been met.

When specific information about a material is not available you should investigate the base materials to get an understanding of their production processes.

The recommended hierarchy in selecting materials for a project should be based on the following order:

- re-use existing materials where practical
- re-use recycled materials
- nominate materials that have minimal processes involved in producing them from their natural state
- nominate locally sourced materials
- select materials that are durable, long lasting and require minimal maintenance throughout their life cycle
- select materials that can be recycled.

Ecospecifier

Ecospecifier is a web based resource that provides a list of recognised third party endorsed eco-products and materials, technologies and resources. The website has recently been made accessible to the public at no cost and is a leading global supporter of sustainable development and life-cycle assessed green product information.

GECA (Good Environment Choice Australia)

Promotes the production and consumption of environmentally preferable products and services, thereby reducing environmental harm.

Life Cycle Assessment

Life Cycle Assessment is an emerging methodology that assesses the environmental impact of building materials by measuring the amount of resources required at the development, transport and disposal phases of their lifecycle. In other words, a cradle to grave analysis. Whilst Life Cycle Assessment is the most accurate methodology for assessing the environmental impacts of buildings, it is not currently a viable option for small scale individual buildings.

Have you considered the resources consumed by the products you are using?

“Taking your time when choosing construction materials will allow you to tick as many boxes as possible: aesthetics, durability, insulation, low toxicity, low embodied energy and easy recyclable.”
How does my choice of Building Materials impact on the environment?

Mandatory Requirements and Council’s Best Practice Standards

Mandatory Requirements
You must meet:
• The National Construction Code (NCC) requirements and;
• The objectives and standards of the local planning scheme.

Council’s Best Practice Standards
• Substitute some cement content of concrete with recycled content.
• Select low embodied energy materials. Limit or do not use aluminium, zinc and other high embodied energy materials.
• Source all timber from sustainably managed sources that hold third party verification.
• Select recycled or re-usable materials.
• Avoid materials which are toxic in manufacture and use.
• Select low maintenance and highly durable materials.
• Dematerialise project through reduction in the quantity of materials required.

Developments, which seek to vary from these best practice standards, must demonstrate how their sustainable building materials have been selected.

Where can I find out more?

Technical Manual Materials
Your Home
www.yourhome.gov.au

Healthy Product Database
Moreland Greenlist
www.sustainablesteps.com.au

Ecospecifier
www.ecospecifier.com.au

Good Environment Choice Australia
www.geca.org.au

Green Building Council Australia
Design Tools Material Credits
www.gbc.org.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Building Materials, consider the Fact Sheets entitled:
• Waste Management
• Construction and Building Management
Transport
Building design for a sustainable future

What’s included in this fact sheet:

6.0

In Australia, cars account for approximately 50 percent of our total transport greenhouse gas emissions. The other half includes emissions from trucks, buses, aviation, railways and shipping. In addition to contributing to global warming, car exhaust contains toxic pollutants that are dangerous to our health. As the population of cities increases so does traffic congestion, further multiplying the amount of exhaust pollutants and greenhouse gas emissions in our air.

It is Council’s aim to reduce the dependency on cars by its residents. Research has shown that approximately 80% of Australian adults rely on their car to commute to work. It is our aim to substantially reduce this figure. And while governments are working on the provision of sustainable transport modes (i.e. public transport services and bicycle lanes), we also rely on collaboration with private developers to encourage the use of these services. By reducing the reliance on private car trips, you can:

• reduce overall building construction costs
• reduce expenditure on petrol and car maintenance
• improve air quality and reduce the incidence of respiratory illness, especially in the young and very old
• improve occupant’s health and fitness
• reduce greenhouse gas emissions to support our community’s environmental targets.

Why do we need to change our Transport patterns?

In Australia, cars account for approximately 50 percent of our total transport greenhouse gas emissions. The other half includes emissions from trucks, buses, aviation, railways and shipping. In addition to contributing to global warming, car exhaust contains toxic pollutants that are dangerous to our health. As the population of cities increases so does traffic congestion, further multiplying the amount of exhaust pollutants and greenhouse gas emissions in our air.

Why do we need to change our Transport patterns?

• Reducing onsite car parking
• Fuel efficient transport
• Public transport
• Car share
• Bicycle facilities
• Showers and lockers
• Bicycle parking
• Walking

What is a Green Travel Plan?
Where can I find out more?
Mandatory Requirements
Council’s Best Practice Standard.
Reducing onsite car parking

Reducing onsite car parking can save construction costs as either less space is required, or more space can be used for other purposes (i.e. bicycle parking and storage). In areas with readily accessible public transport and bike routes, Council will consider reducing the minimum number of car parking spaces required.

This is provided that a Green Travel Plan is in place and that sufficient provision for alternative transport modes, such as bike parking and car sharing facilities, has been provided. Contact Council to discuss further details and refer to section ‘What is a Green Travel Plan?’ on the last page of this fact sheet.

Fuel efficient transport

In addition to promoting public transport, cycling and walking, allocating onsite car spaces for smaller sized vehicles will assist in reducing greenhouse gas emissions. This is because smaller cars generally generate less greenhouse gas emissions than larger cars.

The same applies for the provision of parking spaces for scooters and / or motorbikes. According to relevant Australian Standards, a parking space for small cars is commonly 2.3m by 5m in size.

Encouraging the use of electric vehicles, powered by renewable energy charging stations, will also support development applications as it assists in achieving Council’s sustainable transport goals.

Public transport

Developments should encourage the use of public transport (tram, train, bus, ferries) by providing annual public transport tickets and informing residents, staff and visitors about nearby public transport links. You can do this by making available signs, maps and public transport information in common areas. What’s more, the inclusion of Green Travel Plans in Building Users Guides is an excellent way of making residents and staff aware of their public transport options.

Car share

An emerging low-cost alternative to car ownership, car sharing is available in 600 cities world wide. Generally, the cars are owned by a company who leases them out to a user for a minimum of 1 hour or for a whole day.

With at least 3 car share companies operating in Melbourne, covering most urban areas, it is a viable option for many residential and non-residential building occupiers.

The car share vehicles are commonly found in a designated parking bay on the street for access by a range of potential users who live or work nearby. A Car share vehicles may also be located on site in multi-residential or large commercial developments. The space should be located on the site to maximise accessibility on a 24/7 basis to members of the relevant car share scheme (not just the residents or workers within the building). Council recommends confirming the feasibility of an onsite scheme with a car share company before a planning permit application is lodged.

Every car share space takes about 7-10 cars off the road, reducing transport greenhouse gas emissions. For people who drive less than 15,000kms per year, research indicates that car sharing will save money as opposed to owning a vehicle. And, car sharing encourages more sustainable travel patterns for users who already rely on public transport, cycling and walking. Provision of a car share system within or near a large development, can form an important part of a Green Travel Plan and reduce onsite car parking requirements. Contact Council and local car share companies to discuss further details.

Bicycle facilities

Bicycle use is growing in popularity, so it’s important to offer residents, workers and visitors convenient and secure bicycle parking facilities.

Whilst the Planning Scheme defines the allocation of required bicycle spaces for each building type, these figures represent absolute minimum requirements. Meeting these requirements does not represent a sustainable transport solution. Exceeding the minimum requirement will encourage the use of sustainable transport modes and therefore reduce a development’s overall greenhouse gas emissions.

As a rule of thumb, at least one bicycle space should be provided per dwelling for residential buildings. Non-residential buildings should provide spaces for at least 10% of building occupants. To complement this, incorporate appropriate signage to guide bike riders from the entry point to the bike parking area.

Further to bicycle parking for residents and staff, a development should provide visitor bike parking. Residential developments should provide 0.25 visitor spaces per dwelling, offices should provide 1 visitor space per 500m² net lettable area. Visitor spaces are best located in an accessible location, sign posted and close to a major building entrance.

Showers and lockers for staff

In addition to secure bicycle parking facilities, building staff will appreciate the availability of showers and lockers when either using their bicycle to commute to work or walking to work. Office buildings and other workplaces should offer one shower per 10 bicycle spaces and one secure locker for each bicycle space provided.
Bicycle parking

When designing bicycle parking facilities, it is important to consider their space efficiency, accessibility, security and convenience. Below, we have summarised key design considerations:

- Which style of rails suits the need of the development’s users?
- Is there an opportunity to install different types of rails that cater for different user’s heights and strength? Children and the elderly, for example, wouldn’t be able to use hanging style rails.
- Do the selected rails comply with Australian Standard AS 2890.3?
- Is there enough room to park and remove a bike without bumping into other bikes?
- Is there sufficient access for riders to lock and unlock their bike?
- Is there an opportunity to provide different parking facilities for short term visits and long term storage?
- Are rails securely fixed to floor or wall?
- Can the bike be supported securely and both wheels and the frame be locked to the rail?

In recent years, the bicycle industry has developed a wide range of parking solutions addressing product selection criteria, such as space availability, user preferences and security requirements. The table below provides an overview of the most common bicycle parking systems. For further details, we recommend referring to the ‘Bicycle Parking Handbook’ from Bicycle Network Victoria and talking to their ‘Bike Parking Experts’ division.

<table>
<thead>
<tr>
<th>Parking rail</th>
<th>Spatial requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ned Kelly</td>
<td>wall mounted or free standing on framing</td>
</tr>
<tr>
<td></td>
<td>recommended rail spacing 0.4-0.5m</td>
</tr>
<tr>
<td></td>
<td>rails alternate in height; 1.75m and 2.05m (top of rail)</td>
</tr>
<tr>
<td></td>
<td>minimum ceiling height is 2.2m</td>
</tr>
<tr>
<td></td>
<td>bicycles will extend up to 1.2m from the wall</td>
</tr>
<tr>
<td></td>
<td>minimum access corridor width 1.5m</td>
</tr>
<tr>
<td>Mona Lisa</td>
<td>wall mounted</td>
</tr>
<tr>
<td></td>
<td>above a passenger car space, mount top of bar at 1.8m from floor; for a 4WD allow 2.05m</td>
</tr>
<tr>
<td></td>
<td>minimum ceiling height above a passenger car space is 2.3m, above a 4WD space 2.55m</td>
</tr>
<tr>
<td></td>
<td>from the wall, one bicycle extends 0.6m, two bicycles extend 0.8m</td>
</tr>
<tr>
<td>Flat Top</td>
<td>free standing</td>
</tr>
<tr>
<td></td>
<td>allow 1.7m in length for parking spaces</td>
</tr>
<tr>
<td></td>
<td>mount rails at least 0.4m off a wall or kerb</td>
</tr>
<tr>
<td></td>
<td>allow for 1m minimum spacing between rails</td>
</tr>
<tr>
<td></td>
<td>allow for 0.7m parking space at the start and end of each row of rails</td>
</tr>
<tr>
<td></td>
<td>minimum access corridor width 1.5m</td>
</tr>
<tr>
<td>Anaconda</td>
<td>Same as ‘Flat Top’ parking rail.</td>
</tr>
<tr>
<td></td>
<td>10 bicycles require a parking space of 1.7 x 5.4m, plus a 1.5m access corridor</td>
</tr>
<tr>
<td>Towel Rail</td>
<td>wall mounted</td>
</tr>
<tr>
<td></td>
<td>recommended rail spacing centre to centre 1.8-2m.</td>
</tr>
<tr>
<td></td>
<td>mount approximately 0.7m above the floor</td>
</tr>
<tr>
<td></td>
<td>bicycles will extend the width of a handlebar (up to 0.7m) from the wall</td>
</tr>
</tbody>
</table>

One car space can usually be converted to 10 to 14 bike parking spaces.
Walking

Traditionally, the urban design of our cities has been based on car usage. Important amenities including public transport, parks and open spaces, schools and other services, were often located in areas that are not easily accessible by foot.

An important concept in sustainable urban design, walkability is a measure of how good an area or particular site is for walking. Whilst the location of a site is often pre-determined at the planning stage, it is a worthwhile exercise to determine what amenities are accessible within walking distance of your site to help support your application.

Walkscore is an online tool based in the United States which can also be used for sites in Australia. The Walkscore algorithm provides a site with points that are based on the number of amenities located nearby.

What is a Green Travel Plan?

A Green Travel Plan is a suite of onsite initiatives and offsite services to encourage residents and staff of large developments to use sustainable transport options. Depending on the development type, a Green Travel Plan should highlight:

- parking facilities for bicycles, motorbikes, small cars, electric cars and onsite and nearby car share systems
- end of trip facilities for staff, including the location of showers and the availability of personal lockers
- bicycle and walking maps
- nearby public transport stops
- timetables for public transport services
- availability of free or substituted public transport tickets through the employer or relevant Owners Corporation
- nearby recreation areas (e.g. parks)
- an organisation’s car-pooling scheme. A Green Travel Plan is highly valued by future residents and staff. It provides a valuable resource when choosing sustainable transport options such as walking, cycling, car-sharing and public transport.

Mandatory Requirements and Council’s Best Practice Standards

Mandatory Requirements

The objectives and standards of the local planning scheme.

Council’s Best Practice Standards

- For residential developments, provide at least one secure bicycle parking space per dwelling and one visitor bicycle parking space per 4 dwellings.
- For non-residential developments, provide at least one secure bicycle parking space for 10% of building occupants and sufficient end of trip facilities (showers and lockers).
- For large developments, commit to the development of a Green Travel Plan.
- Incorporate electric vehicle charging infrastructure into the development.
- Allocate 5% or at least 5 parking spaces for motorbikes and/or small vehicles.

Developments, which seek to vary from these best practice standards, must demonstrate how sustainable transport modes will be satisfactorily promoted.
Waste Management
Building design for a sustainable future

This fact sheet explains how simple design decisions can influence the amount of construction waste being produced and operational waste streams being separated. Considering waste requirements during a project’s early design stage can help you save money and reduce negative impacts on the environment. It will explain how the 3R waste minimisation concept – Reduce, Reuse and Recycle – can be applied to your building project.

Why do we need to change our view of Waste Management?

Up to 40 per cent of the waste going to Australia’s landfills is related to the construction and demolition of buildings. Even more waste is produced during the occupancy of buildings and the production of goods that we consume every day. Poor waste practices and treatment of the environment in the past have not only lead to a degradation of our water, air and land resources but also represent a big financial burden to current and future generations.

Therefore, it is becoming increasingly important to minimise, separate and recycle waste. This will lead to significant social, economic and environmental benefits. By reducing, recycling and reusing waste you can:

• reduce the amount of waste going to landfill
• reduce emissions, pollution and contamination
• protect scarce resources
• reduce overall construction costs
• reduce tipping fees
• sell salvaged resources
• contribute towards Council’s waste reduction targets for your community.
Construction Waste Management in practice

The biggest impact on construction waste volume can be made at the early design stage. Determining what extent of an existing building is to be demolished or partially retained. They decide on the materials being used and the construction methods to be employed.

Think about additional financial incentives for exceeding minimum waste recycling targets. Consider selecting a contractor that has proven experience with sustainable waste management practices. Discuss a monitoring process to ensure your waste management expectations have been met.

The construction stage is where all waste management strategies are implemented. To ensure that contractors are able to meet described process and targets, we recommend the following:

- Allow for sufficient space on site to accommodate not only new materials, but also different skips for different waste and recycling streams.
- Clearly label individual skips and bins and protect them from contamination, rain and wind.
- Organise regular pick up of skips and bins to avoid overloading or false use of containers.
- Ensure sub-contractors are fully aware of the site’s waste management practices.
- Make sure written contracts with trades include waste minimisations practices.
- Provide separate bins for household waste.
- Ask suppliers to collect/recycle packaging.

Construction Waste Management in practice

The most effective waste minimisation strategies are those that have been developed throughout a project’s design stages and have been agreed to by all parties involved.

Building designers make the key waste minimisation decisions, including whether an existing building will be completely demolished or partially retained. They decide on the materials being used and the construction methods to be employed.

The table to the left demonstrates what quantities of materials are commonly disposed during a building’s construction.

**It’s time we realise that waste is an asset, and not a problem. Through informed design, alternative waste treatment and effective resource recovery, money can be saved at every stage of building development.**

At the specifications stage, further decisions about materials and their handling are to be made. Which materials contain recycled contents and can be recycled in the future? Are materials and finishes durable and can they be easily maintained? And, can cut-offs and packaging be recycled?

At the contract documentation and tendering stage, it is time to develop a waste management plan that describes clear key performance indicators (e.g. total minimum recycling rate). This is important so that all tenderers factor best practice waste management into their price.

**Common composite of a building site’s construction waste.**

<table>
<thead>
<tr>
<th>Waste Description</th>
<th>Percentage of total waste (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>36</td>
</tr>
<tr>
<td>Concrete-based masonry</td>
<td>16</td>
</tr>
<tr>
<td>Bricks and tiles</td>
<td>16</td>
</tr>
<tr>
<td>Timber</td>
<td>10</td>
</tr>
<tr>
<td>Vegetation</td>
<td>3</td>
</tr>
<tr>
<td>Metals</td>
<td>2</td>
</tr>
<tr>
<td>Plasterboard</td>
<td>2</td>
</tr>
<tr>
<td>Hard plastic</td>
<td>1</td>
</tr>
<tr>
<td>Paper</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>13</td>
</tr>
<tr>
<td>Total construction waste</td>
<td>100</td>
</tr>
</tbody>
</table>

Think about additional financial incentives for exceeding minimum waste recycling targets. Consider selecting a contractor that has proven experience with sustainable waste management practices. Discuss a monitoring process to ensure your waste management expectations have been met.

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- Provide separate bins for household waste.
- Ask suppliers to collect/recycle packaging.

**What is construction and demolition waste?**

The biggest impact on construction waste volume can be made at the early design stage. Determining what extent of an existing building is to be demolished or reused is often a key design decision. Consideration should be given to a total life cycle assessment of an existing material or product. Of course, retaining or reusing as much as practically possible, should be the aim.

Developing a Waste Management Plan that describes what materials will be reused on site or separated for off-site recycling is a very effective way of reducing waste going to landfill.

As a rule of thumb, a minimum of 70% of waste (by mass) of all demolition and construction waste should be recycled or reused. The table to the left demonstrates what quantities of materials are commonly disposed during a building’s construction.
**Stormwater management during construction**

Construction sites can represent a great burden on local waterways. Site litter, paint, solvents, bricks, cleaning substances and clean-fill can all contaminate stormwater runoff. It is an offence under the Environment Protection Act to discharge contaminated water into the stormwater system. To avoid contamination, ensure that a drainage system is installed before construction activities commence and storm water is diverted from areas where soil is exposed.

**Operational waste**

Dedicated storage spaces should be allocated for the collection and sorting of waste. These spaces should be easily accessible to all building occupants and be in close proximity to waste collection points.

Bins or storage containers should be allocated to accommodate different waste streams including recyclable waste, rubbish (non-recyclable waste), oversized household items, green waste, composting and small containers for hazardous waste, such as batteries and fluorescent light bulbs.

It is important that storage areas are conveniently located within a development and have been designed to accommodate space for signs and education material. Furthermore, simple design decisions, such as the provision of in-built kitchen bins for different waste streams and separate waste chutes (general waste and recyclable waste) in apartment buildings can make a big difference.

Recycling bins should be sized and located to accommodate paper, cardboard, glass, plastics and metals. Rubbish bins should only accommodate common waste that cannot be recycled or composted and will go to landfill.

**What can be recycled and should be reused?**

Most construction and demolition materials can be recycled. Often, it is just a matter of separating waste, either on-, or off-site and sending it to the relevant waste stream. Many waste contractors are specialised in this area and will be able to provide you with detailed advice. Below is an overview of common materials and the relevant recycling/reuse opportunities:

- Steel can be melted and reused within new steel products. Using recycled steel reduces the embodied energy by 72%.
- Aluminium can be 100% recycled. Using recycled aluminium reduces the embodied energy by 95%.
- Gypsum plasterboard can and should be recycled as when it is disposed to landfill, it produces poisonous hydrogen sulphide.
- Timber can either be directly reused or turned into horticultural mulch. If not recycled, always specify sustainably sourced timber.
- Concrete can be crushed and recycled as aggregate for new concrete or road base and fill. Specify concrete with recycled aggregate in all viable applications.
- Glass can be reused as aggregate for concrete.
- Bricks and tiles can either be directly reused or crushed for backfill, aggregate and gravel.
- Plastics can often be granulated and reused to make new plastic products.

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Green waste and composting

Green waste includes garden waste, such as branches, prunings and grass clippings. Composting includes largely food waste and should, like green waste, be separated from common waste. Wherever possible, provisions should be made for onsite composting of food and green waste at a project’s early design stage. Alternatively, contact your Council for detailed advice on green waste and composting services.

Bear in mind that different composting systems have different spatial requirements. So when designing a new home or multi-unit residence, ensure that composting of food scraps and possibly garden waste can be accommodated within the site.

Composting options

- Open Compost: food and garden waste
- Bokashi System: food waste only
- 200 Litre Aerobic Compost System: food and garden waste
- Tumbler Compost Bin: food and garden waste
- Worm Farm: food waste only

Operational Waste Management in practice

Composting options

- Open Compost: food and garden waste
- Bokashi System: food waste only
- 200 Litre Aerobic Compost System: food and garden waste
- Tumbler Compost Bin: food and garden waste
- Worm Farm: food waste only

Where can I find out more?

Waste Minimisation Technical Manual
Your Home
www.yourhome.gov.au

Guide to Best Practice for Waste Management in Multi-unit Developments
Sustainability Victoria
www.sustainability.vic.gov.au

Download waste separation wall posters and bin lid stickers
Sustainability Victoria
www.sustainability.vic.gov.au

Towards Zero Waste Strategy
Sustainability Victoria
www.sustainability.vic.gov.au

Reducing Stormwater Pollution from Construction Sites, publication 981
Environmental Protection Authority Victoria
www.epa.vic.gov.au

Also refer to Council’s website for details on recycling, green waste and composting services.

Mandatory Requirements and Council’s Best Practice Standards

Mandatory Requirements
Construction Waste – to the satisfaction of the relevant local authority.
Operational Waste – to the satisfaction of the relevant local authority.

Council’s Best Practice Standards
• Adopt a recycling target of at least 70% for all demolition and construction waste (by mass).
• Provide recycling facilities that are at least as convenient for building occupants as general waste facilities.
• Provide on-site management of food and garden waste.

Developments, which seek to vary from these best practice standards, must demonstrate how sustainable waste management can be satisfactorily achieved.

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Waste Management, consider the Fact Sheets entitled:
• Building Materials
• Stormwater Management
• Construction & Building Management

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Urban Ecology
Building design for a sustainable future

What’s included in this fact sheet:

Why do we need to change our thinking regarding Urban Ecology?
How will improved Urban Ecology benefit me?
• Economic
• Health and wellbeing
• Environmental
• Communal
What can I do to improve urban ecology?
• Landscaping for seasonal heat control
• Landscaping to reduce glare and ground temperature
• Landscaping to reduce wind penetration and capture summer breezes
• Landscaping to increase habitat.
Where can I find out more?
Mandatory Requirements
Council’s best practice standard.

In highly urbanised environments, such as metropolitan Melbourne, it is important to recognise the importance of maintaining and increasing the health of our urban ecosystems to improve living conditions not only for the fauna but also ourselves.

This fact sheet will explain ways to improve our urban ecosystem through the incorporation of vegetation through landscaping for both new and existing developments.

Why do we need to change our thinking regarding Urban Ecology?

Urbanisation in cities and suburbs has altered natural environments and processes such as soil drainage, overland and waterway flows, light availability and the habitat for birds and other wildlife.

For example, removing areas of vegetation and replacing this with hard surfaces including roads, driveways and paving increases stormwater runoff and contributes to flash flooding. This damages our landscapes, waterways and buildings.

There is much we can do in our metropolitan areas to overcome the loss of natural processes and improve liveability for people, flora and fauna.

One of the easiest actions involves decreasing the areas of hard or impervious surfaces and at the same time increasing vegetation and landscaping.

In fact, research indicates that landscaping in metropolitan environments can reduce air conditioning costs by up to 50 percent, by shading the windows and walls of a home. Just one healthy tree can be the equivalent of ten room-size air conditioners operating 20 hours a day.

The benefits to our urban ecology include reducing overall temperature and noise, increasing air purification and providing habitat for local fauna.
Economic
The economic benefits of having trees in the proximity to buildings can be both direct and indirect:
• Air-conditioning costs for cooling can be up to 50 percent lower in a tree-shaded home as the home is provided with effective shading of windows and walls.
• Trees increase in value from the time they are planted until they mature. The housing market acknowledges that landscaped homes are more valuable than non-landscaped homes.

The savings in energy costs and the increase in property value directly benefit each home buyer.

Health and wellbeing
Studies show that green spaces (plants, trees, parks etc.) are good for human health and wellbeing. What’s more, green spaces in cities have been closely linked with improved physical, social, and mental well-being. Studies have found that hospital patients with a view of green space from their window, compared with a wall, needed less pain medication and recovered faster from surgery.

Environmental
Vegetation in cities assists in moderating ambient temperatures. This reduces the urban heat island effect which is caused by pavements and buildings absorbing heat. For example, effective shading of a window or home can negate the need to have air-conditioning.

Trees and shrubs can also be carefully selected to:
• reduce glare
• reduce penetrating winds
• control airflow
• improve air quality
• sustain a viable ecosystem for birds, small animals, and insects.

Communal
Metropolitan vegetation and landscaping often provides the following communal benefits:
• providing privacy
• emphasizing or screening out views
• reducing glare and reflection
• directing pedestrian traffic
• complementing and softening the built environment.

Incorporating vegetation and landscaping into urban developments provides many benefits to residents, developers and the community.

Make sure you carefully consider the selection and location of vegetation around your house to balance internal temperatures throughout the year.

Evergreen trees are kept well back from the north (at least three times the trees’ height).

Deciduous trees & shrubs shade the east walls and windows.

Deciduous trees & vines to the north.

Use ground covers in front of north facing windows. Avoid paving.

Dense planting as wind breaks to the south & south west.

Deciduous trees & shrubs to shade west walls & windows.
Green roofs and walls are a great way to not only enhance the local urban ecology but also to improve the insulation of a building. This will keep internal spaces warmer in winter and cooler in summer. In urban areas, green roofs also help reducing the heat island effect, which describes the fact that metropolitan areas are generally warmer than rural areas. This is due to the extensive use of materials, such as concrete and bitumen, that retain heat.

There are three types of green roofs:

• Intensive roofs, which have a deeper substrate and can support a wider variety of plants but are heavier and require more maintenance.
• Extensive roofs, which have a shallower substrate, supporting a lighter layer of vegetation.
• Planter boxes on roofs, which can be installed on most accessible flat roofs and often represent a simple alternative to intensive and extensive green roofs.

There are two main types of green walls:

• Green facades, where a wall or structure is designed to allow for climbing plants to grow onto.
• Living walls, where modular systems of growing media are integrated into, or fixed onto, a wall.

The first step to improving local urban ecology is to conduct a site analysis. From there, a landscape design can be developed that will assist in determining the best location for vegetation and the greatest contribution it can make.

Landscaping to reduce glare and ground temperature

Glare occurs when intense sun reflects from surfaces such as paving, roofs and walls. Glare can be reduced by increasing ground cover, low growing shrubs, lawns and vegetated roofs and walls.

Ground cover planting not only reduces glare, it also decreases surface temperatures. For example, a vegetated courtyard can be 6°C cooler than a paved courtyard.

In addition, a vegetated surface allows stormwater runoff to be absorbed into the soil which reduces stormwater runoff, improves stormwater quality and increases soil moisture.

Green roofs are known to help lower urban air temperatures (heat island effect), provide building insulation and create a habitat for wildlife.

Landscaping for seasonal heat control

- It is best to protect north, east and west facing windows as this will help protect against hot summer sun.
- Deciduous vegetation will provide summer shade but allows winter sun to penetrate the building.
- Trees with dense foliage create more shade and therefore have greater cooling abilities.
- As space is often limited in urban developments, vegetating courtyards as much as possible is an effective way to reduce temperatures in your courtyard and internal living spaces.
- Vertical shading is most appropriate for east and west walls and windows to protect from hot summer sun at lower angles e.g. trees, shrubs and vines supported on a frame.
- Utilising plants that grow on walls (such as ivy) can act as thermal insulation for a building.
- Horizontal shading is best for north facing windows e.g. deciduous vines grown over a pergola.
- Tall evergreen trees should not be planted too close to north-facing windows as they create too much overshadowing in winter.

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Tall evergreen trees should not be planted too close to north-facing windows as they create too much overshadowing in winter.
What can I do to improve Urban Ecology?

Landscaping to reduce wind penetration and capture summer breezes

Vegetation can be selected and positioned to control the chilling effects of winter winds and also assist in capturing and harnessing cooling summer breezes.

Things to consider when landscaping to influence winds:

• Windbreaks are most effective when located at 90° to the direction of the wind.
• A windbreak with 50–60% density is generally more effective than a solid one, as a solid wall can create turbulence.

• Large dense shrubs can be used as windbreaks to the south-west to counter cold winter winds and channel cooling summer breezes.
• Medium to large-sized shrubs or trees clipped to form a hedge can provide useful still air insulation and shading when grown close to a wall.
• Careful positioning of windbreak planting can encourage the entry of desirable summer breezes through the building.
• Low shrubs, lawn and ponds to the north will help cool hot summer winds.

Landscaping to increase habitat

In addition to creating larger areas of habitat in local parks and reserves, sustainable gardening around dwellings and buildings can contribute to increasing habitat value and urban ecology.

Points to consider to achieve a sustainable habitat garden include:

• It is possible to have contemporary gardens, e.g. cottage or formal gardens, and still utilise indigenous plants.
• Select plants that are indigenous as they will best suit your local climate and soil. Research what plants will attract native birds and insects.
• Complete a site analysis focusing on soil quality, sun, shade and privacy before you choose your native plants.
• Get a copy of Council’s local plant guide.
• Avoid using plants that are known environmental weeds.

Where can I find out more?

Save Energy Through Landscape Design
Sustainability Victoria
www.sustainability.vic.gov.au

Urban Ecology Information
Urban Ecology Australia
www.urbanecology.org.au

Technical Manual Green Roofs
Your Home
www.yourhome.gov.au

Sustainable Gardening Information
Sustainable Gardening Australia
www.sgaonline.org.au

Green Building Council Australia
Change in Ecology Calculator
www.gbca.org.au

Green Roofs, Walls and Facades
City of Melbourne
www.melbourne.vic.gov.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Urban Ecology consider the Fact Sheets entitled:

• Green Roofs, Walls and Facades
• Stormwater Management
• Water Efficiency
• Energy Efficiency
Green Roofs, Walls and Facades
Building design for a sustainable future

This fact sheet provides information about green roofs, walls and facades that can be designed to cool a building, help reduce stormwater runoff, increase biodiversity and provide more greenery in the city - which is known to reduce people’s stress levels and improve mental health. Incorporating vegetated roofs and vertical surfaces into existing and new developments can increase the appeal and marketability of properties. This fact sheet has been developed from the Growing Green Guide: A guide to green roofs, walls and facades in Melbourne and Victoria, Australia.

What are green roofs, walls and facades?
A green roof is a vegetated landscape that is installed on a roof surface, and is built up from a series of either loose-laid layers, or modules made of pre-prepared layers in trays. Vegetation on green roofs is planted in a growing substrate that can range from 50mm to over 1 metre in depth, depending on the weight-bearing capacity of the building’s roof and the design objectives.

Green facades are created by growing plants up and across the face of a building. Plants are either rooted in the ground or grown from containers installed at different levels on the face of the building.

Climbing plants can attach directly to the surface of a building or be supported on a structure independent of the building.

Green walls are plants grown in vertical systems that are usually attached to internal or external walls. Green walls differ from green facades in that plantings are made across the entire vertical structure, as opposed to planting at the base of the structure to enable vertical and horizontal growth. In a green wall, plants, growing medium, irrigation and drainage are incorporated into the system.
A well designed and maintained green roof, wall or facade can provide:

- aesthetic improvements in highly visible locations
- protection of building materials leading to an increased lifespan of those materials
- reduced building heating and cooling costs due to increased insulation
- green spaces (and sometimes usable recreation spaces) in densely built environments
- increased property value
- food production areas for residents or commercial tenants
- rain water run-off management and water filtering/pollution reduction
- habitat creation and increased biodiversity
- cooling effect for the city – where there is a high density of green roofs, walls, facades and other types of greenery such as street trees
- cleaner air, with less pollutants.

The three key areas of development

**Design**
Well considered design is vital to realise the potential benefits of a green roof, wall or facade installation. If a green roof is intended to increase the permeable surface on a site, and to decrease stormwater run-off, a deep layer of growing substrate should be used. Design considerations also include understanding the site’s aspect and exposure so that suitable plants are selected. One of the most important design considerations lies in understanding the structural load that the wall or roof can take to determine what can be installed. If structural capacity is limited it may be possible to reinforce the walls or roofs to increase the weight loading capacity. Design must also take into account the project budget and a realistic assessment of the resources available for ongoing maintenance.

For shallower designed green roofs, also known as extensive green roofs, the benefits of reduced stormwater run-off is less in comparison to the deeper intensive green roofs.

**Installation**
Roofs, walls and facades can be installed on existing buildings, or built into new structures. In new builds it is important that the green roof, wall or facade installer is involved in discussions with the project team during the design phase, and not just brought in later to work around the existing conditions. Care must be taken where multiple contractors are involved in an installation that no damage is made to earlier work, for instance to the water proofing membrane, and that warranties and insurance liabilities are clear.

Access for builders can be difficult and consideration must be given to OH&S requirements for working at heights. Irrigation systems are usually incorporated into green roof, wall and facade installations, and thought should be given to water collection and storage, and in some cases water re-use through the system.

**Maintenance**
Maintenance is critical to the success of a green roof, wall or facade. Maintenance will depend on:

- irrigation in particular must be maintained to ensure proper operation
- the vigour of the vegetation
- use of the roof or facade (e.g. if growing food versus creating a biodiversity space)
- aesthetic preferences for the roof, wall or facade
- number of likely weed seed sources around the site.
We know the city can be 4 to 7 degrees hotter than surrounding suburbs due to the urban heat island effect. Green walls, facades and rooftops not only look good but help cool our city and retain stormwater which can help reduce flash flooding.

Design goals and considerations

The following tables provide some examples of different considerations for different design goals. This is not an exhaustive list, and is intended only to illustrate that different goals will require different inputs and system set ups. Discussions with professional green roof, wall and facade installers, landscape architects, structural engineers and a review of relevant research will be needed to make final decisions about the most appropriate approach.

Green roofs

<table>
<thead>
<tr>
<th>Design goals</th>
<th>Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced stormwater run-off</td>
<td>Increase depth and water-holding capacity of substrate, and include plants that can adapt their water use</td>
</tr>
<tr>
<td>Recreation and amenity use</td>
<td>Increase weight loading, ensure safe roof access, planning and safety requirements</td>
</tr>
<tr>
<td>Maximise thermal insulation</td>
<td>Increase substrate depth, provide irrigation, select species for leafy plant cover in summer (passive heat gain in winter may be increased if the roof is bare in winter but this strategy increases maintenance and reduces aesthetic benefit)</td>
</tr>
<tr>
<td>Provide biodiversity outcomes</td>
<td>Include habitat plants and features (such as water, food and shelter), and consider including small changes in topography and variation in substrates</td>
</tr>
</tbody>
</table>

Green walls

<table>
<thead>
<tr>
<th>Design goals</th>
<th>Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A multi-storey green wall</td>
<td>Ensure access for maintenance is possible, consider a lightweight growing system if structural loading capacity is limited. Ensure species selection is appropriate for specific light and wind exposures at different heights</td>
</tr>
<tr>
<td>Low cost and easy to install on a residential building</td>
<td>Consider DIY installations, the size of the green wall systems that can recirculate irrigation runoff water, systems that can be easily maintained</td>
</tr>
<tr>
<td>Internal green wall</td>
<td>Ensure adequate light is available to support plant growth. This can also be achieved by installing a specialised artificial lighting system</td>
</tr>
<tr>
<td>Aesthetics and a design statement</td>
<td>Include a variety of species with extensive and different flowering times; consider planting in patterns and including different textures and colours or foliage</td>
</tr>
</tbody>
</table>
Design goals and considerations

Green facades

<table>
<thead>
<tr>
<th>Design goals</th>
<th>Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low cost and easy to install</td>
<td>Use a climbing plant species that attach directly to the wall, grown in a planting bed at ground level. Seek advice to ensure the best selection of plant types for your building structure.</td>
</tr>
<tr>
<td>A multi storey facade greening</td>
<td>Include containers at different heights, include cabling or lattice support structures for twining plants, ensure access for maintenance, provide irrigation, consider secondary protection of plants against stem damage (e.g. wind protection trellis)</td>
</tr>
<tr>
<td>Screening of an unsightly view</td>
<td>Use evergreen species to ensure year round screening, create a structure for the plants to grow on as the screen. Usually this is mesh or cabling, and twining species of plants are used.</td>
</tr>
<tr>
<td>Maximise thermal benefits</td>
<td>Use deciduous species if heat gain is desired in winter; ensure very leafy plants, covering the entire wall for providing best shade in summer, particularly on north and west facing walls; provide a structure at least 100mm off the wall of a building for the plants to grow on, leaving an air gap between the building and green plants to maximise cooling effect.</td>
</tr>
</tbody>
</table>

Where can I find out more?

The Growing Green Guide provides advice on how to design, construct and maintain green roofs, walls and facades in Victoria, Australia. Growing Green Guide www.growinggreenguide.org

Your Home Technical Manual

Landscaping Victoria
Ten things to consider www.liav.com.au

Green Roofs Australasia greenvroofsaustralasia.com.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further relevant information, consider the Fact Sheets entitled:

• Urban Ecology
• Stormwater Management
• Water Efficiency
• Energy Efficiency

Mandatory Requirements and Council’s Design Advice

Environmental Sustainable Design (ESD) Principles
There are two levels of compliance when it comes to ESD principles – mandatory and best practice.

Mandatory Requirements
The design, construction and installation of green roofs, walls and facades is subject to the normal planning and building permits, approvals and consenting processes. Specific information should therefore be obtained from planning authorities prior to the commencement of any such projects.

Council’s Design Advice
• Design the system to provide the maximum number of benefits
• Use non-potable water to supply any irrigation systems
• Enhance the ecological value of your site through inclusion of habitat features and plants
• Cover as much area as possible with vegetation to maximise thermal benefits; for green roofs, maximise the planting area for greatest stormwater benefits.

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This fact sheet aims to explore the notion of innovation with respect to the design of both our residential and commercial buildings. Council encourages you to explore innovative design solutions in your building project. We hope we can provide you with the inspiration to begin thinking outside the box that will in turn, let you reap the rewards.

**It’s time to innovate!**

Innovative ideas and their implementation led us to the economical and social revolutions that we experienced throughout the last centuries. Most innovative ideas result from defining a problem or need. The invention of the motor car was born out of the need to travel between places faster. Later, it was the problem of congested cities that led to the development and construction of underground trains. Similarly, it was the need to communicate more efficiently that led to the invention of the internet.

Today, we face the problem of an increasingly polluted environment that will have an ever increasing impact on our quality of life. Many innovations, such as systems for renewable energy production or the growing efficiency of building technologies, have made a contribution to lessen our environmental footprint.

And while we have made huge leaps forward in the efficiency of our buildings, they still consume too much energy, water and other resources. It is now our challenge to take the next step by developing truly sustainable building solutions. Individual examples all over the world have shown that innovative design solutions can lead to outstanding results, including buildings that produce more energy than they use.

It is also important to highlight that innovative design solutions not only lead to highly efficient buildings, but that they are often combined with very high living and working qualities and award winning architectural design.

“...We can’t solve problems by using the same kind of thinking we used when we created them.”

Albert Einstein
Humans have been living in shelters, and later houses, for thousands of years. Ever since the first settlements, our living amenities and quality of life has improved.

Innovative engineering led to unlimited drinking water and electricity in our homes, to thermally improved building shells and easy to handle heating and cooling devices. But not only have our living standards improved, appliances and construction standards have also become increasingly efficient.

There’s no doubt that what is described as ‘best practice’ construction standards today will be overhauled in the very near future. Council therefore encourages you to explore opportunities to exceed current industry standards, not only to lessen your impact on the environment now, but also to future-proof your asset and living amenities in the years to come.

Buildings have a lot in common with humans; in winter they get cold and in summer they get hot. While we respond to a changing climate in the way we dress, buildings are much more inert to these changes. Modern technical solutions seemed to deliver a solution to that problem.

The introduction of air-conditioning and artificial light allowed us to construct buildings in any climate zone with an arbitrary shape and facade and still maintain comfortable temperatures and light levels throughout the year. But only quite recently have we become aware that the use of excessive energy has come at a price.

The use of ‘passive’ design is as old as human settlement. In the days before active building services, building designers had to design buildings that provided adequate living conditions through passive means.

The size and location of windows balanced access to daylight, heat losses and gains. The provision of external shading allowed occupants to protect themselves from the harsh summer sun while letting in warm winter rays. Ventilation openings were strategically placed to quickly cool a home and building materials were carefully selected based upon attributes for good indoor environment qualities. Small ponds were placed to make the most of summer breezes across their cool surface and living rooms were located adjacent to kitchens to make use of waste heat.

It is the reinterpretation of these old building traditions that will provide us with the ability to cut back on our energy consumption and to condition our homes and work places through passive means.

Passive Design describes a building design approach that focuses on the provision of maximum indoor comfort with minimum reliance on energy and building services. That’s good for you, the environment and the wider community.
Understanding your building site’s climate conditions

In order to maximise the effects of passive design, it is vital to understand your building site’s climate conditions. Finding answers to the following key questions will provide you with a good starting point for your environmentally sustainable design:

**What are the different sun angles for each façade throughout the year?**
Knowing the highest sun angles in summer, the minimum sun angles in winter and those for the shoulder seasons in between, allows you to optimise a building’s orientation, to strategically place window openings and sun protection (external shading) and to accurately position solar energy devices.

**What are the different temperatures throughout the year?**
Understanding the different temperatures (minimum, average and maximum) throughout the year will enable you to quantify the benefits of different passive design responses.

**What are the different temperatures throughout the day?**
Understanding the different temperatures (minimum and maximum) throughout a 24 hour cycle will determine whether passive design strategies, such as night purging (natural ventilation at night), will contribute to comfortable indoor temperatures throughout the year.

**What is the prevailing wind direction in summer?**
Understanding a site’s prevailing wind direction in summer will allow you to place window openings that make the most of cooling summer breezes.

**What are humidity levels in summer?**
Understanding a location’s humidity levels in summer is necessary to making informed decisions on both, passive cooling strategies and active cooling systems.

**Identifying synergies**
Through the identification of synergies, today’s mobile phones for example, are able to provide us with a vast array of applications, functions and services. Similarly, our supermarkets offer a wide selection of groceries and consumables, as has never been seen before. Synergies have not only provided us with new products and services, but have helped us use them in more efficient and cheaper ways.

Buildings also provide the opportunity for synergies that will lead to major resource and financial savings:

- **External shading elements can replace decorative paints and finishes as they are contributing to the appearance of a façade.**
- **Solar panels can be installed as roof panels, façade elements or shading devices and therefore replace other building materials while providing renewable electricity.**
- **Slimline water tanks can act as a garden fence or building wall while providing reusable water to garden and toilets.**
- **Exposed concrete ceilings not only serve as structural elements but function as thermal mass (storage and release of heat).**
- **Use common building materials in a new way to improve a building’s performance and environmental footprint.**

With resources becoming increasingly scarce and our population constantly growing, building designers face the challenge of creating more by using less – most likely by defining successful synergies.

“Synergy is when “the whole is greater than the sum of the parts.””

Aristotle
Redefining the Australian Dream

The ‘Australian Dream’ is commonly perceived to be a detached house on a quarter acre block, surrounded by a garden and providing plenty of space for the extended family. While this was a lifestyle we were able to enjoy in the past, recent social and economical changes now require us to redefine the Australian Dream for the 21st century.

The sprawl of our cities has placed both economic and physical strain on the infrastructure that is needed to service them. The long travel distances between work, home and school by car and public transport requires a heavy reliance on the burning of fossil fuels which expands our carbon footprint. Therefore, it’s time to ‘densify’.

Historic examples in both European and Asian cities and recent projects in Australia have shown that the quality of living space is not determined by its quantity. Council therefore recommends building designers and their clients to carefully reconsider spatial needs.

Many examples have demonstrated, how living needs can be comfortably met within little space by combining different uses:

- Cupboards under stairs, in podiums and overhead, can substitute separate storage rooms.
- An efficient and concealed kitchen allows combining cooking, dining, playing and resting in one single room.
- Through the use of flexible wall panels, several rooms can be turned into one large space if required.
- Retractable beds save precious space in kid’s and guest rooms.
- Hand basins, combined with toilets not only save water but also space.
- A sub basement allows for additional living space without exceeding statutory setback and height limits.

Where can I find out more?

Passive Design Technical Manual
Your Home
www.yourhome.gov.au

Sustainable building ideas
Sustainability Victoria
www.sustainability.vic.gov.au

Climate data for your location
Bureau of Meteorology
www.bom.gov.au

Finding an architect and design inspiration
Australian Institute of Architecture
www.architecture.com.au

The voice of professional designers
Design Institute of Australia
www.dia.org.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Innovation, consider the Fact Sheets entitled:

- Melbourne’s Climate
- Indoor Environment Quality
- Energy Efficiency
- Water Efficiency
- Stormwater Management
- Building Materials
- Transport
- Waste Management
- Urban Ecology
- Construction & Building Management

Mandatory Requirements and Council’s Best Practice Standards

Mandatory Requirements
None.

Council’s Best Practice Standards
In order to claim a truly innovative sustainable design solution, your development should meet at least one of the following criteria:

- Exceed best practice standards in one or more of the other key sustainable building categories.
- Eliminate the need for mechanical heating and cooling through passive design.
- Incorporate technologies or design strategies that deliver environmental and/or social benefits and are new to Victoria.

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DISCLAIMER: This Fact Sheet has been created for general information purposes only. While the Fact Sheet has been created with all due care, no warranty is given as to its suitability for any particular purpose and users should obtain their own advice relevant to their situation and specific needs. IMAP or any party authorised by IMAP to reproduce the Fact Sheet is not responsible for the accuracy, currency or reliability of the Fact Sheet and accepts no liability for any damage, losses whether direct or indirect, claims or expenses howsoever arising from any party who may rely on its contents.
This fact sheet examines Melbourne’s climate and the impact it has on the design and construction of residential and commercial buildings.

Melbourne’s climate significantly changes with the seasons and often is referred to as having four seasons in one day. But how do you design buildings for a climate such as this?

Designing for the local environment means acknowledging Melbourne’s climatic patterns including the changing angles of the sun, temperature variations, rainfall patterns and prevailing winds. It means orientating your building correctly, applying different types of external sun shading, locating heavy weight materials or ‘thermal mass’ where it can trap winter warmth and selecting rainwater tanks of the appropriate size to optimise rainwater collection and use - even in the drier months.

Best practice building design should not only account for these climate variations, but use them to its advantage. Just as your wardrobe responds to different seasons so should the buildings we inhabit.

Climate responsive design

A totally climate responsive building is one which requires no active heating or cooling but remains comfortable all year round. There are many benefits to climate responsive design:

- **Indoor Environment Quality** – Living or working in a building that stays cool in summer, warm in winter and provides good levels of daylight and natural ventilation throughout the year is what every occupant desires. Good building design achieves this by responding to its local climate.

- **Energy cost savings** – 34% of an average home’s energy use is in heating and cooling. A further 11% is used for lighting. So designing buildings that naturally provide comfortable temperatures and plenty of natural light can really pay off.

- **Investment in the future** – Developers and residents are increasingly starting to recognise the benefits of lower ongoing costs and the health and comfort a well designed building can provide. All of these attributes are increasingly factored into their up-front decision making.

- **Environmental Impact** – Climate responsive building design is not only good for its occupants but also for the environment. Through the reduced need for energy hungry services we can minimise our reliance on non-renewable resources and therefore reduce our overall greenhouse gas emissions.
Melbourne’s Sun Angels and Sun Path

Understanding a location’s changing sun angle (altitude) and direction (azimuth) throughout the year and day are probably the two most vital aspects when designing energy efficient buildings with high indoor environment qualities. The tables below explain these changes and should always be considered when designing a building’s floor plan, windows and sun shading.

During summer, northern sun angles reach their highest point at 75.5°. Eastern and western sun angles are relatively lower throughout the year.

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*Data for Daylight Saving Time is shown.

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*The table shows data for 21 Sept. Figures for the 21 March vary very slightly and must add one hour for daylight saving.

### Melbourne sun path

The transparent sun path diagram in this fact sheet can be used to determine the sun’s impact on a window throughout the day and year. The diagram’s circles represent the sun’s altitude. The radial lines represent the sun’s azimuth. Both are drawn at 15° intervals. The small circles indicate those different sun angles (altitude) for different times and seasons.

- Align the centre of the diagram with the centre of the window to be assessed.
- Rotate the diagram until its orientation matches the one of your drawing.
- Now you see at what times of the day and year the window is exposed to the sun.
- Furthermore, the diagram demonstrates the different sun angles (altitude) for those different times and seasons.
- In the example to the left, the north-east facing window is exposed to summer sun from 9am to 2:30pm (area shaded purple in diagram).

*Data for Daylight Saving Time is shown.

During winter, the northern facade is the main source for passive solar heat gains. It is therefore important to design windows and shading that allow for maximum solar access into a home during this time. Non-residential buildings, however, may be better to shade throughout the year.
Melbourne’s Climate Data

Melbourne’s temperatures and rain

The chart to the right shows Melbourne’s temperature distribution throughout the year.

The monthly ‘Highest’ temperature shows the past highest daily maximum for the month. The monthly ‘Mean maximum’ temperature shows the average daily maximum for the month. The monthly ‘Mean minimum’ temperature shows the average daily minimum for the month. The monthly ‘Lowest’ temperature shows the past lowest minimum for the month. Maximum temperatures are usually measured in the afternoon; minimum temperatures just before sunrise.

The shaded area indicates typical day and night time temperatures throughout the year.

The hatched area between ‘Indoor Max’ and ‘Indoor Min’ indicates what occupants perceive as a comfortable indoor temperature, depending on the season and what clothing they wear. When overlaying the different areas you can see that Melbourne’s climate actually provides us with comfortable temperatures for most of the year. A sensibly designed building should require mechanical heating and cooling for only a short period.

When designing for Melbourne’s climate, it is important to not only consider the mean temperatures but also the extreme temperatures that dramatically impact on our indoor environment quality.

Thermal mass and night purging

(1) During a hot summer’s day, building structures absorb heat build-up from solar gain, electronic equipment and user occupancy. The more thermal mass (i.e. concrete floors or brick walls) that is exposed to the interior, the more heat can be stored.

(2) But just as a sponge that is absorbing water, at some point it cannot take any more. It needs to be ‘wrung out’. In the evening, when temperatures have dropped, its time to open windows so the building structure can be cooled.

(3 & 4) By exposing thermal mass to direct solar energy in winter, it can also be used as a ‘heat bank’ to store warmth when internal temperatures drop.

This method is often referred to as ‘night-purging’. Given that heat rises, high level windows, skylights and thermal chimneys work best to release excess heat from a building.

It should also be noted that there are significantly more rain days in winter than in summer, meaning our summer rain generally comes in bigger bursts.

These monthly and yearly variations should be considered when:

- sizing rainwater tanks to reduce demand on potable water, and
- designing site permeability to help control drainage in peak rainfall events.

Rainfall

The chart to the right shows Melbourne’s annual rainfall data for the last 150 years. It shows that on average, we experience an annual rainfall of 650mm relatively evenly spread over the year. However, this can change dramatically from year to year. During the El Niño-Southern Oscillations, the climate in south-eastern Australia is much drier and monthly rainfall can be very low. Whereas during La Niña, it is considerably wetter and we can experience extremely high rainfalls.
Melbourne’s Wind & Adaptive Design

Melbourne’s wind
Despite Melbourne’s reputation for erratic weather, prevailing wind patterns can be identified for the various seasons. Warm northerly winds prevail in winter, resulting in occasional warmer days. Wind direction varies during summer mornings but tends to be southerly during the afternoon, providing a cool change. Therefore the installation of openable high level windows in southern facades provide the best opportunity for passive cooling. The wind roses below indicate Melbourne’s morning and afternoon wind direction and intensity during summer and winter.

Climate adaptive design
The impact of climate change will directly affect the performance of our existing buildings. Given the lifetime of a building is generally 50 years or more, this has a significant impact on the way we design now. Localised direct impacts are likely to include:
• Increased land and sea temperatures (Australia has already experienced an increase of 0.9° since 1950)
• Further sea level rises (20mm per decade over last 5 decades)
• An increased number of extreme weather events (more heatwaves, bushfires, peak rainfall and storm events)
• A reduction in annual rainfall across south-eastern Australia
Buildings which are designed sensibly for the local climate respond much better to temperature extremes. It has become vital to respond to higher expected temperatures through external shading, natural ventilation, thermal mass, thermal insulation and landscaping for seasonal heat control.
Buildings which consider permeability and incorporate water reuse will prove more adaptable to flooding and respond better to future constraints on potable water.

Where can I find out more?
Historic climate data and statistics
Bureau of Meteorology
www.bom.gov.au
Sun Movement App - SunCalc
www.suncalc.net
Passive design advice
Your Home
www.yourhome.gov.au
Understanding climate change
State Government Victoria
www.climatechange.vic.gov.au
For further information on our climate and sustainable building design, consider the other Fact Sheets in this series entitled:
• Indoor Environment Quality
• Energy Efficiency
• Stormwater Management
• Urban Ecology
• Innovation
• Permeability
• Sun Shading
• Green Roofs, Walls and Facades

Mandatory Requirements and Council’s Design Advice
Mandatory Requirements
Your building design in Melbourne must consider NCC requirements for the relevant climate zone depending on location.
Council’s Design Advice
A building design that not only accommodates but utilises Melbourne’s diverse climate.
Consider showing on Planning Permit Application Drawings:
• External shading provisions, including landscaping
• Schematic sections that demonstrate efficient shading
• Schematic sections that demonstrate natural ventilation strategy
• Location of significant internal mass
• Site permeability and stormwater treatment and detention systems

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Melbourne Sun Path

Sunrise Summer, 21. Dec.**
Sunset Spring/Autumn

*The graphic shows data for the 21 September. Figures for the 21 March vary slightly and must add one hour for daylight saving.
**Data for Daylight Saving Time is shown.
Construction and Building Management
Building design for a sustainable future

This fact sheet will assist you in making informed decisions about Construction and Building Management to help minimise building’s impact on the environment.

Why is best practice Construction and Building Management so important?

In recent years the number of green buildings being constructed in Melbourne has steadily grown. Using environmentally sustainable design principles, these buildings have the potential to lessen their impact on the environment. However, practising sustainable site management and ensuring that green buildings actually operate as efficiently as their design intended, is vital for a complete project success.

Poor construction management, an ill-informed handover process, lack of effective and timely maintenance and lack of understanding of building services can lead to disappointing results. Higher than expected energy and water consumption and unforseen construction waste generation can add to a building’s environmental footprint.

In essence, environmental building design will only lead to a truly sustainable building if the project includes a sensible and well conceived construction management approach and an ongoing building management allowance, including:

• an early commitment to environmental targets
• a demolition and construction waste minimisation strategy
• an operation waste separation strategy
• regular tuning of building services
• sensible use of building services, such as heating and cooling devices
• preparation of a Building Users Guide.

Some basic guidelines to Construction and Building Management:

• How will best practice Construction and Building Management benefit me and those around me?
• Sensible Construction Management
• Professional’s Green Accreditation Schemes
• Building Users Guide
• Ongoing Building Management

Where can I find out more?
Mandatory Requirements
Council’s Best Practice Standard.
Construction and demolition can lead to significant impacts on neighbours and the environment. These arise from construction waste, energy and water use, traffic flow, air pollution and noise disturbance. In order to minimise these impacts, Council recommends committing to best practice environmental construction standards as early as possible. This may include the preparation of a project-specific Environmental Management Plan for large developments or the engagement of a building contractor with valid ISO14001 Environmental Management System accreditation.

It’s worth noting that not only large-scale projects can lesson their environmental impact during the construction process, but smaller ones as well. Council encourages all planning permit applicants to adopt a recycling target for demolition and construction waste. A best practice target should be a minimum of 70% (by mass).

Construction and demolition can lead to significant impacts on neighbours and the environment. These arise from construction waste, energy and water use, traffic flow, air pollution and noise disturbance. In order to minimise these impacts, Council recommends committing to best practice environmental construction standards as early as possible. This may include the preparation of a project-specific Environmental Management Plan for large developments or the engagement of a building contractor with valid ISO14001 Environmental Management System accreditation.

Another important consideration during the construction phase is the prevention of stormwater pollution from construction sites which can cause significant harm to our creeks, rivers and Port Phillip Bay.

When stormwater runoff moves across exposed soil and surfaces, it picks up rubbish, debris and pollutants such as sediment, oil, pesticides and other toxins. Once they enter our waterways and Port Phillip Bay, these pollutants can be detrimental to aquatic life, wildlife, and human health.

Common stormwater pollution prevention strategies are either of structural or non-structural nature. Structural strategies include silt fences, sedimentation ponds, erosion control blankets, and temporary or permanent seeding, while non-structural strategies include picking up rubbish and debris, sweeping up nearby footpaths and streets, maintaining equipment and training site staff on erosion and sediment control practises.
Some basic guidelines to Construction and Building Management

### Professional’s Green Accreditation Schemes

When choosing a designer, builder or specialised contractor, we recommend considering their green credentials. You may ask for past project experience, their view on individual sustainability initiatives and whether they have any green accreditations. Below is a list of common sustainability accreditation schemes.

**Green Living Builders** are accredited by the Master Builders Association. They provide competencies in designing, building, installing and maintaining environmental building solutions with a focus on small to medium sized residential buildings. Green Living Builders not only help their clients to meet Building Code of Australia (BCA) energy efficiency standards, but to set new benchmarks for sustainable design.

**GreenSmart Builders** are accredited through the Housing Industry Association (HIA) and are supposed to enhance residential projects through their environmental awareness and recognised skills for more sustainable building design and construction.

**Green Plumbers** have been trained in home water-efficiency products, heating and cooling appliances, hot water heating, solar hot water, water conservation strategies and other emerging products and technologies. They are able to advise on initial investment and long term running costs of different appliances. Not sure where to start when renovating? Green Plumbers offer an environmental household inspection report that will assist in working out where best to start saving.

**EcoSmart Electricians** have been trained to advice on energy management, lighting strategies, solar systems and heating and cooling devices. Accredited through the National Electrical and Communications Association (NECA), EcoSmart Electricians can identify financial savings, reduce energy consumption and minimise occupant’s overall impact on the environment.

### Building Users Guide

As is the case with any technical product, a users guide or instruction manual should be provided with it. A building is no different. A ‘Building Users Guide’ (BUG) should be provided, especially in large commercial and residential developments. It can be provided in the form of a booklet, even in combination with up to date information on a website, or on digital screens in a building’s entrance area. The provision of a BUG can substantially improve the building’s environmental performance. It will assist:

- property managers in operating the building asset efficiently
- contractors to understand how to service and maintain particular building systems
- occupants to understand their ability to influence a building’s internal amenities without minimising its overall environmental performance.

A BUG should be written in a non-technical style and outline a development’s:

- key environmental strategies and targets
- concept and implementation of passive design strategies (e.g. use of flexible shading and night ventilation)
- building services controls (e.g. heating, cooling and hot water systems)
- potable and non-potable water supply
- onsite energy generation
- sustainable material choices
- pro-active maintenance regime
- fine-tuning strategy, especially for complex HVAC systems
- sustainable transport opportunities (including bicycle parking provisions, end of trip facilities and availability of public transport)

- waste minimisation and separation policies
- provision of sub-metering and the interpretation of the metering data
- environmental monitoring or participation in environmental reporting schemes
- building management and other building supply contacts.

Smaller developments should consider operational needs when including building services such as solar hot water or photo-voltaic panels and flexible shading elements or automated windows. While these installations will drastically improve the performance of a building, only regular maintenance will ensure long and efficient service.

> Working with contractors that have environmental skills and experience makes it much easier for us and our architect to implement our sustainable building design."

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**Thermal Performance Assessors** are either accredited through the Association of Sustainable Building Assessors (ABSA) or the Building Designers Association Victoria (BDAV). Accredited assessors have completed a short course in building thermal performance assessment through a registered training provider. Make sure you not only obtain a final rating for your permit application but use the modelling results in order to interpret an improved building design.

**Green Star Accredited Professionals** are accredited by the Green Building Council Australia (GBCA). They are recognised for their advanced knowledge, experience and competency with the Green Star environmental rating system.
Ongoing Building Management

Ongoing Building Management, including regular maintenance and tuning of building services, and providing a Building Users Guide is just like regularly servicing a car and driving it in accordance with road regulations. In both cases, the car and the building will deliver their best performance.

For developments that include considerable amounts of mechanical, electrical and hydraulic building services this is particularly the case. It is recommended to consider building tuning requirements and commitments at the early design stage of such a building.

It’s important to note that inefficiently performing services, such as HVAC plants, may not only impact on indoor environment qualities but may also increase running costs, greenhouse gas emissions and disturb neighbouring properties.

Where can I find out more?

Green Living Builders
Master Builders Association
www.mbabv.com.au

GreenSmart Builders
Housing Industry Association
www.tradebuild.com.au

Green Plumbers
www.greenplumbers.com.au

EcoSmart Electricians
National Electrical and Communications Association
www.ecosmartelectricians.com.au

Thermal Performers Assessors
Association of Sustainable Building Assessors
www.absa.net.au

Building Designers Association Victoria
www.bdav.org.au

Green Star Accredited Professionals
Green Building Council Australia
www.gbca.org.au

The resource efficient builder booklet
Master Builders Association
www.mbabv.com.au

Guidelines for the Preparation of Environmental Management Plans
Department of Infrastructure, Planning and Natural Resources, NSW
www.nla.gov.au

Technical Manual Waste Minimisation
Your Home
www.yourhome.gov.au

Keeping our Stormwater Clean – A Builder’s Guide
Melbourne Water
www.melbourne-water.com.au

Reducing Stormwater Pollution from Construction Sites
Environment Protection Authority (EPA) Victoria
www.epa.vic.gov.au

1200 Buildings Program
City of Melbourne
www.melbourne.vic.gov.au

Other Fact Sheets in this series are also available to provide guidance on the 10 Key Sustainable Building Categories. For further information on Construction and Building Management, consider the Fact Sheets entitled:

- Energy Efficiency
- Building Materials
- Waste Minimisation
- Stormwater Management

Mandatory Requirements and Council’s Best Practice Standards

Mandatory Requirements
You may be required to prepare an Environmental Management Plan and / or Construction and Operational Waste Management Plan as part of your planning permit application.

Ensure ongoing health, safety and amenity levels for equipment and safety installations in accordance with National Construction Code (NCC) requirements.

Council’s Best Practice Standards

• Adopt a recycling target of at least 70% for all demolition and construction waste.

• Prepare a stormwater pollution reduction strategy for the building construction works.

• Commit to the preparation and availability of a Building Users Guide (BUG) and/or Building Operations Manual for large developments.

• Provide individual utility meters for all dwellings / non-residential areas.

• Provide sub-metering for all major common area services.

• For larger developments, engage ESD professional(s) on the project design team to provide advice from preliminary design through to construction.

• For large developments, commit to regular fine-tuning of building services and their ongoing maintenance to ensure a building’s maximum environmental performance.

• Undertake preliminary building energy ratings (e.g. NatHERS, JV3 etc)

Developments, which seek to vary from these best practice standards, must demonstrate how sustainable Construction and Building Management principles will be addressed.
What are ESD Tools? Why use them? Voluntary or mandatory? Which tool for SDAPP?

An overview of the following tools:
- BESS
- STORM
- MUSIC
- Green Star
- NatHERS
- NABERS

What are they and why use them?
Environmentally Sustainable Design (ESD) tools are an effective way of measuring a proposed building design or actual performance. Benchmarks allow proposed designs and/or actual buildings to compare their performance with buildings of the same type. In most cases they provide instant and reliable feedback on various measurements including energy use, greenhouse gas emissions, potable water saving, treatment of stormwater, embodied energy emissions, daylight and ventilation.

As the Sustainable Design Assessment in the Planning Process (SDAPP) framework is implemented at the design stage, the most common tools that are recommended to demonstrate ‘best practice’ are design rating tools, including:
- Built Environment Sustainability Scorecard (BESS)
- Sustainable Tools for Environmental Performance Strategy (STEPS)
- Sustainable Design Scorecard (SDS)
- Green Star
- NatHERS tools including Firstrate, Accurate and Building Energy Ratings Scheme (BERS)
- Stormwater Treatment Objective Relative Measure (STORM)
- Model for Urban Stormwater Improvement Conceptualisation (MUSIC).

Voluntary or Mandatory?
In most cases ESD tools are not mandated, however there are exceptions to this:
- The NatHERS* tools are most commonly used to demonstrate compliance with energy standards in Part 3.12 of Volume 2 of the National Construction Code (NCC) for single residential houses and multi-residential housing.
- The NABERS* tool is enacted through Commercial Building Mandatory Disclosure Scheme, which requires any commercial office space of 2000m² or more offered for sale or lease provide information in regards to its operational energy performance.

The other ESD tools listed are generally not mandated within Australia and are generally used voluntarily. The Green Building Council Australia released their first Green Star rating tool in 2003 and have been successful with transforming the top end of the commercial building sector through their rating scheme. There has been a healthy level of competition from various business owners to design and build their offices with the highest Green Star ratings.

Which tool for SDAPP?
The most commonly used tools at the planning stage in Victoria are STEPS for residential developments and the SDS for non-residential developments. These two tools have been recently integrated into the new Built Environment Sustainability Scorecard (BESS). BESS differs from other tools as it is free for applicants to use and is focused on improving designs and buildings to a ‘best practice’ level of the SDAPP program. BESS provides flexibility for the property owners to decide which solutions are appropriate for their budget and their desired level of performance.

*Refer to last page
Table 1: Tool applicability overview

<table>
<thead>
<tr>
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<th>Residential</th>
<th>Non-residential</th>
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<td>NABERS</td>
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<td>Requirement depends on Responsible Authority</td>
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<td>BESS</td>
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<td>Green Star</td>
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BESS
(Built Environment Sustainability Scorecard)
www.bess.net.au

Administrator: Council Alliance for a Sustainable Built Environment (CASBE)
Applicability: Residential, non-residential and mixed use – Building Classes 1-10

Measure of performance
Free and simple online assessment rating tool for most types of development.

Pros
- Free to use online
- Simple interface and easy to use
- Provides benchmarks and measures the percentage improvement of a development compared to a conventional design
- Adopted by councils across Victoria
- Caters to residential, non-residential and mixed-use development of various sizes
- Specifically formulated for assessment in the planning process
- Interactive with scoring generated immediately, allowing user to improve their score by upgrading design features

Cons
- Requires an understanding of the NatHERS energy rating scheme
- Limited applicability to rural areas/areas without reticulated services, i.e. gas & water

STORM
(Stormwater Treatment Objective - Relative Measure)
www.storm.melbournewater.com.au

Administrator: Melbourne Water
Applicability: Stormwater impact of all development types up to ~1 hectare

Measure of performance
The elements of a development that affect or treat stormwater are assessed and given a score from 0% to 100%+. 100% STORM rating = 45% reduction in the typical annual load of total nitrogen and achievement of best practice water quality objectives.

Pros
- Free to use online
- Simple interface and easy to use
- Interactive scoring
- Perfect for smaller developments of 10 dwellings or less

Cons
- Doesn’t allow sequential treatment trains
- Restricted to sites up to 1 hectare
- Assumes rainwater tanks are connected to toilets for flushing
- Several buildings on a large site may require more treatment than a single large building, depending on the site coverage and other aspects
Table 2: What do the tools cover?

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**MUSIC**  
(Model For Urban Stormwater Improvement Conceptualisation)  

**Measure of performance**  
MUSIC models stormwater treatment elements and provides the litres of stormwater treated or stored for reuse and pollution reduction.

**Pros**  
- Designed to simulate more complex urban stormwater systems, multiple treatment types and treatment trains  
- Better for larger developments

**Cons**  
- Requires a sound knowledge of urban stormwater management principles and practices  
- Licensed software  
- Cost

**Green Star**  
-www.gbca.org.au

**Measure of performance**  
4 Star Green Star (score 45-59): ‘Australian Best Practice’  
5 Star Green Star (score 60-74): ‘Australian Excellence’  
6 Star Green Star (score 75-100): ‘World Leadership’  
Certification is required for claiming a particular star rating.  
Reviews environmental sustainability in the following categories:  
- Management  
- Indoor Environment Quality  
- Energy

**Pros**  
- Transport  
- Water  
- Materials  
- Land Use & Ecology  
- Emissions  
- Innovation

**Cons**  
- Detailed analysis that is suited to larger developments aiming for the top of the property market  
- Independent verification of rating  
- National/International marketing through GBCA

**Green Building Council of Australia (GBCA)**  
**Applicability:** Office, office interiors, retail, healthcare, multi-residential, education, industrial and convention centre buildings, residential neighbourhoods

**Pros**  
- Members can download tool components from the website www.gbca.org.au  
- Provides benchmarks and scores a development  
- Adopted and endorsed by CASBE

**Cons**  
- Green Star Certification requires an accredited professional  
- Not suited to all types of developments  
- Relatively high cost of assessment  
- Tradable points scoring system may encourage adoption of non-optimal measures
### NatHERS
(Nationwide House Energy Rating Scheme) www.nathers.gov.au

NatHERS provides a framework that allows various computer software tools to rate the potential energy efficiency of Australian homes. NatHERS is referenced by the National Construction Code (NCC) Part 3.12 for Class 1 - Section J for Class 2. A dwelling can be rated before or after it is built. The rating depends on:
1. Layout of the home
2. Construction of its roof, walls, windows and floor
3. Orientation of windows and shading to the sun’s path and local breezes
4. How well these suit the local climate.

NatHERS includes the following tools:
1. AccuRate
2. BERS Professional
3. FirstRate 5

#### Measure of performance
- NatHERS uses computer simulations to assess the potential thermal comfort on a scale of zero to 10 stars
- 0 stars means the building shell has extremely poor thermal performance
- 6 stars indicates good, but not outstanding, thermal performance
- Occupants of a 10 star home are unlikely to need any artificial cooling or heating
- Some builders are currently designing homes with 7 and up to 8 star ratings
- Minimum requirement for NCC is currently 6 Star for single dwelling, or 6 Star for Class 1, or a 6 Star average (5 Star Minimum) for Class 2

#### Pros
- Allows for different elements in a building to be interchanged to improve thermal performance
- Encourages going beyond minimum compliance by defining star bands up to 10 stars

#### Cons
- Training is required for each of the NatHERS software interfaces
- Requires licensed specialists to complete
- Limited to residential only
- Only addresses thermal efficiency of the building fabric or ‘envelope’
- Does not measure actual performance
- Only considers a predicted energy of heating and cooling

### NABERS
(National Australian Built Environment Rating Scheme) www.nabers.com.au

NABERS rates a building on the basis of its measured operational impacts on the environment according to the following categories:
- Energy
- Water
- Waste (Office only)
- Indoor Environment (Office only)

Ratings are awarded in a scale of 0 to 5 Stars, including half Star increments. NABERS applies to offices, residential, retail and hotels. Official ratings are only obtained after occupation of a building, based on actual performance.

NABERS normally requires accredited assessors to conduct reviews, however, NABERS Home (online tool) can be used by anyone. NABERS can be used to inform projects during the design phase in order to establish benchmarks and likely outcomes.

NABERS is currently used by the mandatory Commercial Buildings Disclosure scheme for office buildings.

#### Pros
- Predictive energy modelling can be undertaken to ascertain a ‘NABERS base building rating’

#### Cons
- Official ratings can only be achieved for buildings more than 12 months old
- Not all categories are available for all building types (e.g. Waste and Indoor Environment)

### Where can I find out more?

- **BESS**
  www.bess.net.au
- **Green Star**
  www.gbca.org.au
- **NatHERS**
  www.nathers.gov.au
- **NABERS**
  www.nabers.com.au
- **STORM**
  www.storm.melbournewater.com.au
- **MUSIC**
  toolkit.ewater.com.au/tools/MUSIC

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