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S9045 Moore College

Masterplan – ESD Strategies

Prepared for

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The success and realisation of the proposed initiatives will be dependent upon the commitment of the design team, the development of the initiatives through the life of the design and also the implementation into the operation of the building. Without this undertaking the proposed targets may not be achieved.

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Contents

1 Introduction

This report details the ESD strategies that are being considered for inclusion as part of the master planning redevelopment of Moore Theological College. A broad range of initiatives are considered and discussed and recommendations given as to which are the most suitable for this development. The items covered include:

- Indoor environment quality
- Energy Conservation
- Renewable Energy
- Materials
- Waste Management
- Water Conservation

For each category the principles of sustainable design are discussed and then recommendations put forward as to which are best applied to this development. Inclusion of ESD principles within a design can have multiple benefits, including:

- Reduced operational costs for energy and water and future proofing the development against rising utility costs
- Reduced impact on the environment through emissions reduction, resource depletion and waste to landfill
- Improved indoor environment to make the buildings a better place to work, study and live in

With a mixed use development such as this, there are multiple opportunities to include site wide strategies which can benefit the whole site and take advantage of the varying demands of the different building types throughout the day. Strategies such as cogeneration, solar hot water and water recycling should be given strong consideration when putting together the masterplan of this development.

Where possible allowances should be made for the staged nature of the site and provisions made for the inclusion of future ESD strategies at a later date. This can include space provisions for future items of plant and infrastructure connections for future stages.

2 Sustainability Context

Legislation changes, increasing energy prices and market demand have brought the need for sustainable buildings to the forefront. There are minimum targets which are required for specific building types as part of local planning requirements as well as numerous voluntary schemes which benchmark a buildings sustainable credentials. Additionally there are targets and aspirations being set both at a local level and nationally with regards to environmental sustainability.

Whilst many of these may not be directly applicable to the Moore College development and the specific building types, it is important to understand the context in which these guidelines and targets are set.

2.1 Planning Requirements

Local planning requirements for NSW state the following:

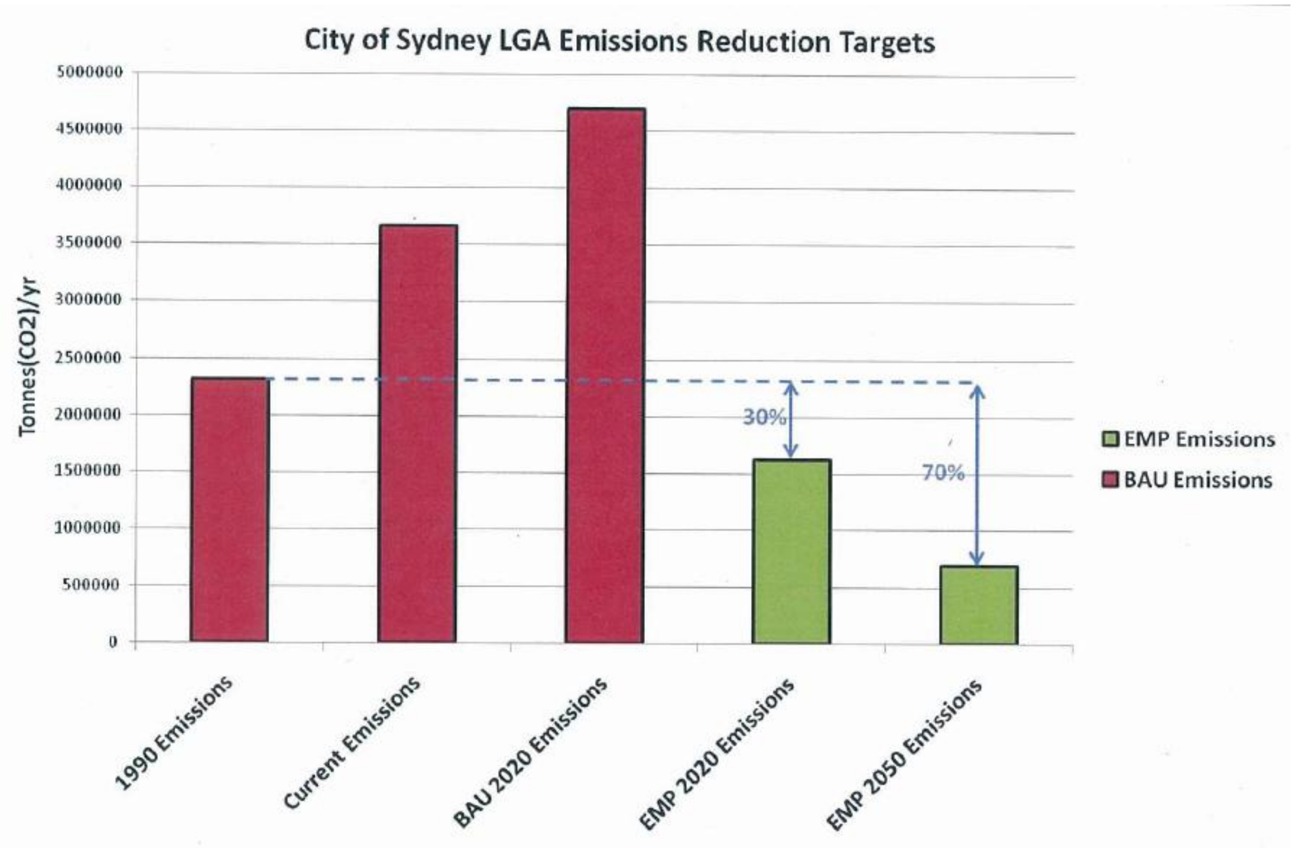
- All new residential buildings and all residential alternations and additions with estimated cost of works over $50,000 in NSW are required to comply with the Building Sustainability Index (BASIX). BASIX sets minimum targets for energy, water and thermal comfort. Targets for energy are a 20-40% reduction compared to a standard dwelling and targets for water are a 40% reduction compared to a standard dwelling.

- All other developments are required to comply with minimum BCA Section J Energy efficiency requirements. BCA Section J sets minimum performances for both building fabric and services.

- City of Sydney local planning requirements state that any commercial building with a floor area exceeding 1000m^2 must be designed to achieve a 4.5 Star NABERS (National Australian Built Environment Rating System) Energy rating.

2.2 Local Targets

The City of Sydney has set ambitious targets with regards to reducing greenhouse gas (GHG) emissions. City of Sydney's Environmental Management Plan (EMP) is a recently released guideline document which proposes 70% reductions from 1990 greenhouse gas emissions (GHGE) levels across the whole Local Government Area (LGA), by 2050. This target sits within the range of emissions reduction identified in the 2006 "Stern Review Report on the Economics of Climate Change", a widely accepted report advocating GHGE reductions by developed countries of at least 60-80% by 2050, based on 1990 emissions levels. The chart opposite shows the targets for the City of Sydney LGA for 2020 and 2050.



2.3 Voluntary Schemes

The two main schemes which exist in Australia for benchmarking the environmental credentials of a building are the NABERS and the Green Star schemes.

NABERS is a national scheme managed by the NSW Department for Environment and Climate Change (DECC) which benchmarks the operational performance of a building based on 12 months of data. NABERS rates Energy, Water, Waste and Indoor Environment Quality (IEQ), and ratings can currently be performed for Offices, Hotels and Homes.

Green Star is also a national tool which assesses the environmental performance of a building across a number of categories including IEQ, Management, Materials, Energy and Emissions. Within the Green Star suite there are tools for Offices, Multi-Unit Residential, Retail and Healthcare amongst others.

3 Indoor Environment Quality (IEQ)

3.1 Concept

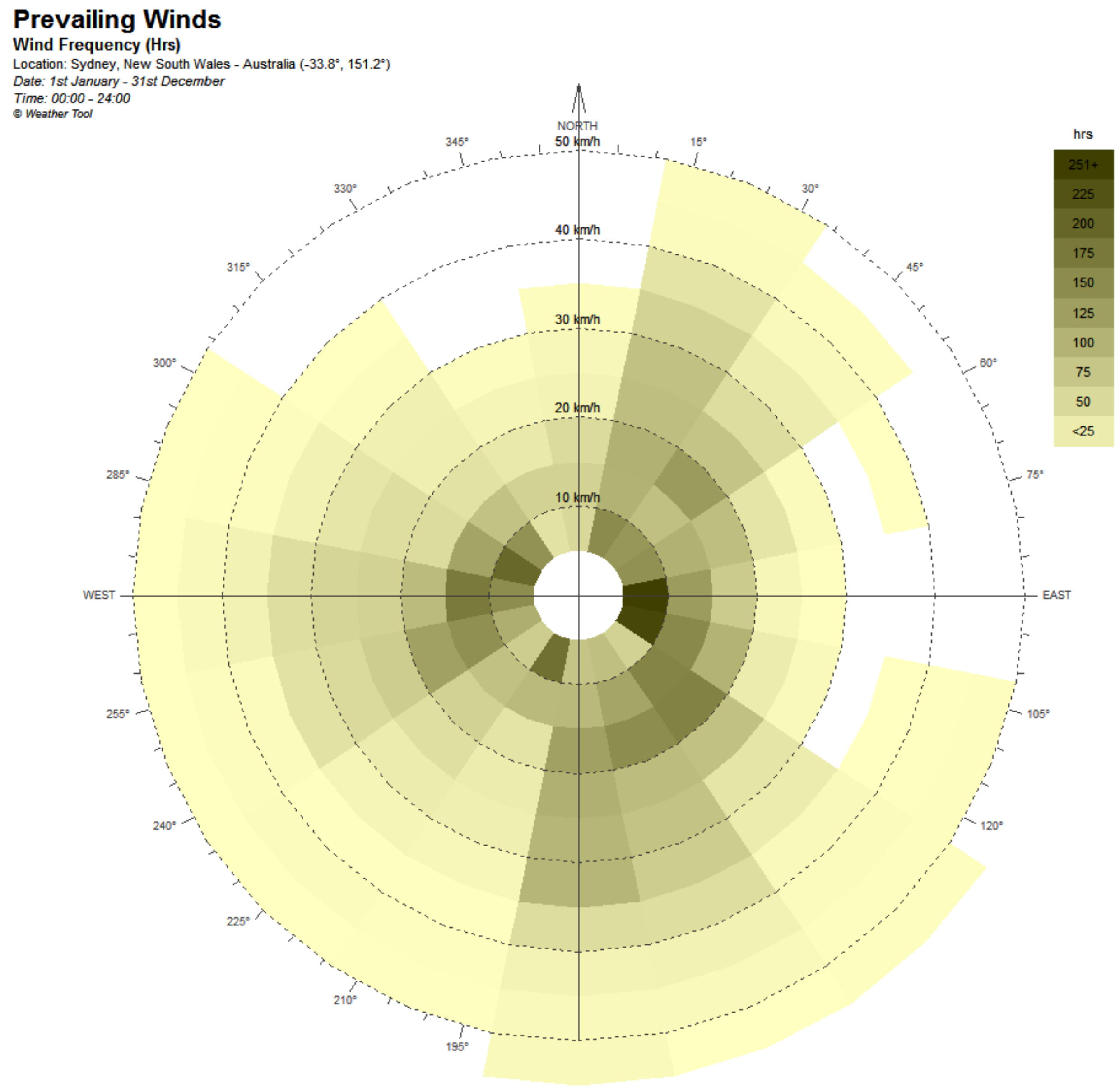
Indoor environment quality (IEQ) is crucial to human comfort and health and is a significant issue given that the average Australian spends 90% of their time indoors. It is important to make the indoor environment both a healthy and inviting place to work, study and live in. The principles of good IEQ apply to all building types and usages. In academic terms a good indoor environment quality provides a better space for learning and can contribute towards improved concentration and productivity.

The table below outlines the principles of IEQ and how these can be incorporated into the Moore College development. These principles apply to both the academic and the residential areas of the site.

	Ventilation	Daylight	Thermal comfort	Pollutant minimisation
Principles	 Increasing evidence is showing that learning ability is significantly improved when indoor air quality is maximised. Occupant control of ventilation is also desirable as this gives occupants more control over their indoor environment.	 Studies in the U.S. have shown a positive correlation in pupils' examination abilities and daylight exposure when able to sit in naturally lit spaces to carry out tests. The use of electric lighting can hinder learning abilities and can be the source of irritation if light selection is incorrect for the intended application. Good daylight levels in residential buildings are also important in providing a comfortable environment to live in.	 Thermal comfort can be improved by using insulation in external walls, selecting appropriate glass and providing a mixed mode ventilation system.	ENVIRONMENTAL CHOICE AUSTRALIA Indoor air is contaminated by emissions from occupants, furnishings and building materials. Careful selection of materials can reduce the adverse effects of these contaminants on human health.
Considerations	• Natural ventilation or mixed mode ventilation where possible • Increased fresh air rates above minimum standards • Ensure cleaning of all reused mechanical ductwork to minimise the dust in the ventilation supply	• Facade optimisation to ensure good daylight potential whilst balancing thermal comfort and energy efficiency requirements • Consideration of roof glazing and / or clerestory glazing for academic buildings to maximise daylight potential into the larger spaces • Consideration of orientation of residential buildings to ensure daylight potential matches room type.	• Buildings to be well insulated to ensure good levels of thermal comfort can be achieved. • Optimised building design to ensure solar gain is minimised in summer and best utilised in winter	• Selection of environmentally responsible materials to ensure minimisation of volatile organic compounds (VOCs) and formaldehyde within the spaces • Ensure removal of all toxic substances such as asbestos and lead from all refurbished buildings.

3.2 Wind Analysis

An important aspect to consider when assessing the suitability of natural ventilation is the likely wind speed and direction. This can have a significant impact on the successful integration of natural ventilation. The image below shows the annual wind conditions for Sydney.



Predominant wind directions on site

As the wind analysis above indicates the predominant wind directions in Sydney are from the South East and North East. The strongest winds are most likely to come from either a Southerly or North Easterly direction. There is also a significant percentage of wind directions from the West, however these tend to be at lower speeds. The South East and North East wind directions are coastal wind which tend to be cooler breezes, and the Westerly direction is the warmer inland wind. The North East breeze is the dominant summer season wind and would be most beneficial for providing a cooling effect in summer.

The predominant wind directions are likely to be beneficial to the buildings on site as they cut across the two main streets bounding the site, King Street and Carillon Avenue. This means that the prevailing winds are likely to provide benefits for natural ventilation purposes.

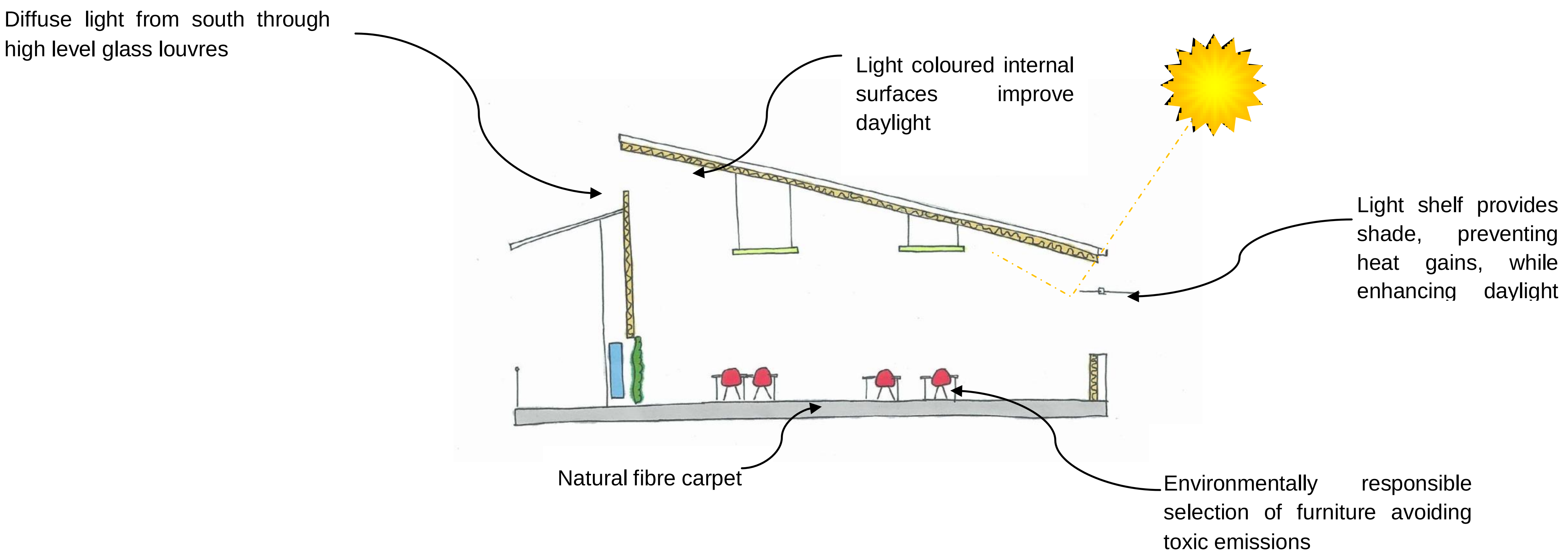
Direct wind from the east or west could result in some funnelling of wind down Carillon avenue which runs almost due East-West, however the prevailing wind speeds from these directions are likely to be low.

3.3 Recommendations

The following outlines the recommendations for IEQ strategies to be incorporated as part of the Moore College development. The strategies are broken down into three areas: those applicable to academic buildings, those applicable to residential buildings and those strategies which will be beneficial to be incorporated into all building types.

3.3.1 Academic and teaching buildings

- Cross ventilation offers beneficial effects where possible with the ideal maximum depth of buildings being around 14m. If acoustics are an issue and cross ventilation is not possible, single sided natural ventilation should be considered with maximum room depths of room 6-8m.
- Internal blinds be installed on all windows to provide glare control
- Reed switches are used to disable air conditioning when windows/doors are ajar – this allows an effective mixed mode ventilation strategy to be put into operation.
- Daylight should be optimised in lecture rooms and common areas by careful façade design. Internal surfaces should be light in colour to reflect daylight.
- Lightshelves should be considered as a dual purpose shading device and to redirect light further into the deeper academic areas.
- Effective shading should be installed on all windows facing north, east or west.



3.3.2 Residential buildings

- The floor plate layouts should be designed to enable cross ventilation of apartments where possible.
- External views should be prioritised for the living spaces.
- Where possible any common areas and core spaces should be naturally lit and naturally ventilated to improve the amenity of these spaces.
- Windows should be sized to minimize heat gains and losses while allowing sufficient daylight in.

3.3.3 All buildings and site wide strategies

Some common good practice IEQ strategies can be applied to all building types, including the following:

- The emission of indoor pollutants can be mitigated by selecting appropriate low-emission, low-toxin paints, furnishings, insulation materials, floor coverings and cleaning products.
- Materials should be chosen which are moisture-resistant to inhibit biological contamination, and do not require toxic maintenance products.
- Indoor plants can also help to further improve internal air quality.
- Good levels of insulation in all roofs and external walls to prevent heat losses and make spaces more thermally comfortable
- Higher outdoor air supply rates and filtration efficiencies for mechanical systems serving buildings which cannot be provided with natural ventilation. Outdoor air supply rates should be balanced against overall energy consumption targets.

4 Energy Reduction

4.1 Concept

Energy conservation should be an important consideration for any new or refurbished development. Conservation of energy helps to reduce greenhouse gas emissions associated with the site and to reduce the operational running costs. As society is becoming more climate change aware both of these are extremely important, firstly to limit the impact a development has on the environment and secondly to future proof and protect against rising energy costs.

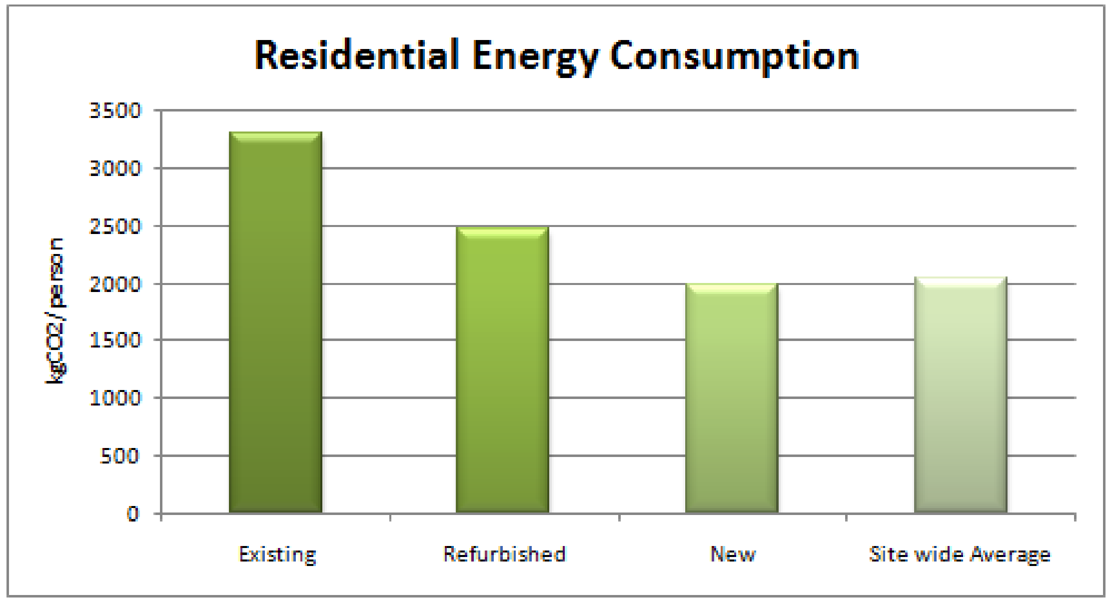
The table below outlines the energy reduction strategies which should be considered for this development. The primary energy consumers are identified and the strategies for reducing each of these identified.

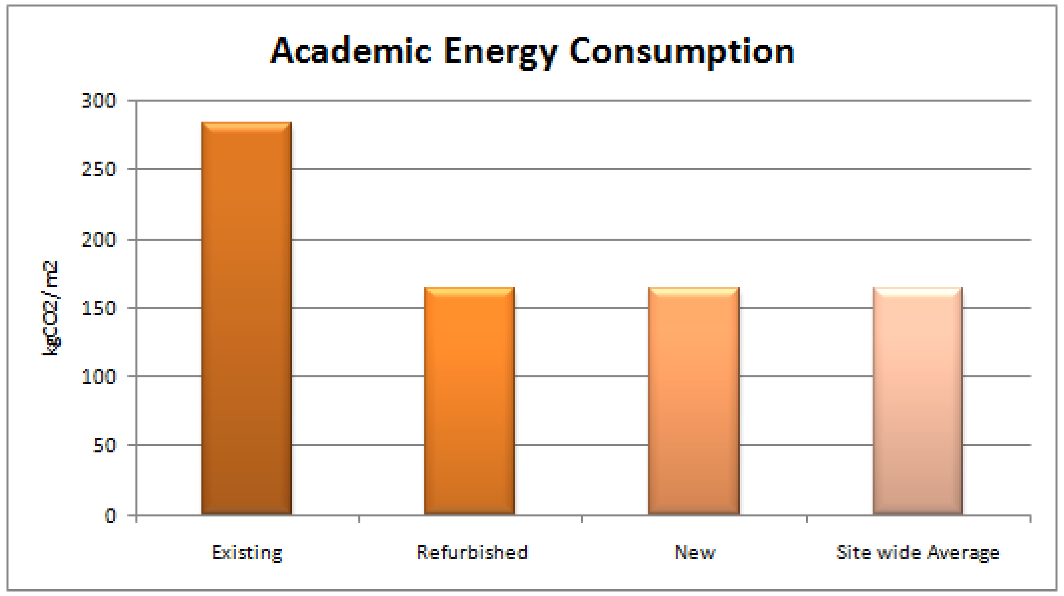
	Air Conditioning	Lighting	Equipment & Small Power
Principles	 In academic buildings the air conditioning can contribute to a significant amount. In existing buildings particularly this air conditioning can be very inefficient resulting in a large energy consumption. More and more residential buildings are now being air conditioned; however the reliance on this air conditioning can be reduced through building design and utilising natural ventilation when possible. The Sydney climate makes it possible to use natural ventilation for a large portion of the year.	 Lighting loads can account for a significant percentage of total energy consumption in both academic buildings and residential buildings and ineffective zoning and control strategies can often mean that lights are on in areas and at times when they are not required.	 In office areas overnight equipment loads can be as much as 50% of daytime loads due to equipment being left on and consuming power when not in use.
Considerations	• The first step in reducing air conditioning loads is to reduce the need for air conditioning through efficient building design and facade selection • Control and metering strategies are important to ensure that the energy consumption is being monitored and is tracking as expected • Selection of efficient plant to ensure that when air conditioning is being used it is consuming the minimum amounts of energy	• Efficient light fittings can significantly reduce the energy consumption associated with artificial lighting and has the additional benefit of reducing the heat load in the space and thus the contribution to air conditioning. • Lighting zoning and controls should be selected to ensure that lights can be controlled and only used where and when they are required • Consideration should be giving to occupancy sensors and daylight sensors where applicable to reduce the energy consumption	• Selection of energy efficient appliances in all areas • Use of high efficient computer and audio visual equipment • Control strategies for computer equipment to ensure that it is turned off when not in use

4.2 Recommendations

The opportunities for energy reduction are different between new buildings and existing buildings, therefore the list of recommendations have been divided to reflect this. It is recommended that targets be set in order to determine what are the appropriate energy reduction strategies to be used. Preliminary modelling has been undertaken in order to understand what the potential is for energy reduction on site and what are the realistic energy targets.

The two graphs below indicate the energy breakdown for the two main types of buildings on site, residential and academic. The residential figures have been taken from BASIX guidelines which gives figures for typical residential emissions on a per person basis and sets targets for minimum standards. The academic figures have been assumed to be NABERS whole building equivalent figures. Although NABERS figures are for commercial buildings the relative improvements and reductions possible will be similar for academic buildings. Using actual site energy bills will mean that more accurate predictions can be made of specific site strategies.





Each graph contains 4 figures as explained in the table below, detailing the proposed figures for existing, refurbished and new buildings. There is obviously a greater potential to reduce energy consumption in the new buildings therefore higher targets have been set for these. The final figures are for site wide averages, reflecting the mix of existing and new buildings proposed for the Moor College development.

	Existing	Refurbished	New	Site wide average
Residential	BASIX figures for existing residential	25% improvement to meet minimum BASIX standards	BASIX Minimum +20% improvement	Equivalent to 38% reduction against existing consumption
Academic	2.5 Star NABERS Equivalent	4 Star NABERS Equivalent	4.5 Star NABERS Equivalent	Equivalent to 42% reduction against existing consumption

As the analysis has shown, setting minimum BASIX targets for all refurbished buildings and an improvement of 20% over BASIX targets for new buildings, has the potential to reduce site wide energy consumption associated with the residential buildings by 38%.

As the majority of academic buildings will be new buildings, the potential for energy reduction is greater. Setting minimum 4 Star NABERS equivalents for refurbished buildings and 4.5 Star equivalents for new buildings has the potential to reduce site wide energy consumption associated with academic buildings by 42%.

Whilst these targets are ambitious, they are realistic in the current market place given that many new buildings are now constructed to BASIX + 40% and 4.5 Star NABERS standards.

4.2.1 Existing Buildings

The existing energy bills from the site will be used to determine which are the biggest consumers and what opportunities there are for energy reduction across the site. The current energy usage will be used to set targets for realistic energy reduction across the site.

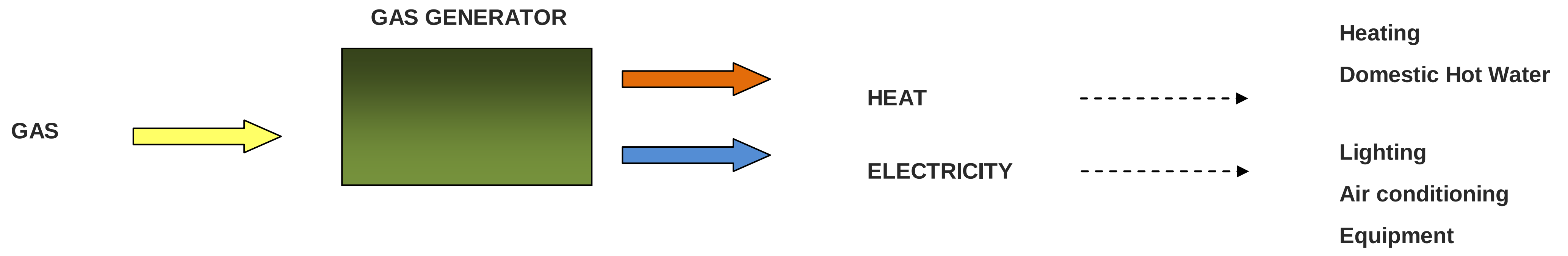
- Where required replace existing air conditioning with new efficient plant
- Reconfigure and / or recommission existing cooling and heating systems
- Review of existing control and supply strategies
- Replacement of inefficient lights in existing academic buildings with new energy efficient lights.
- Implementation of control strategies for overnight equipment loads in academic areas
- Good practice guidelines to ensure computer equipment is shut down when not in use

4.2.2 New Buildings

- Facade selection to ensure solar gains are minimised in summer and utilised in winter where required
- Mixed mode ventilation where possible
- Efficient light fittings
- Zoning and control of lights to ensure lights are only used when and where required
- Occupancy and / or daylight sensors for common areas in residential blocks
- Natural ventilation where possible for the residential buildings
- Selection of energy efficient appliances for the new residential areas
- Energy efficient cooling and heating systems

4.2.3 Site Wide Strategies

- Consideration of a central plant strategy to capitalise on differing requirements of the site and reduce the peak plant sizes
- Onsite energy generation via cogeneration or trigeneration to provide a less carbon intensive means of providing electricity. Cogeneration/trigeneration is the simultaneous generation of two or three useful energy sources from one fuel input. In this particular instance the application would be electricity produced via an onsite gas generator. As a by product of this heat will be generated which can be used for space heating and domestic hot water generation. A separate co/trigernation feasibility analysis for the site will confirm the viability of this strategy and the most suitable system type and capacity.



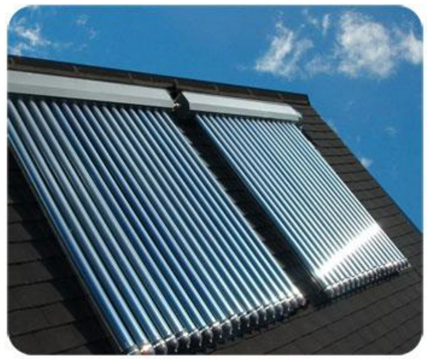
5 Renewable Energy

5.1 Concept

The primary focus in any site energy strategy should always be to reduce the energy consumption as discussed in the previous section. Following on from this alternative means of supply from low or zero carbon sources should be considered as a means of reducing the carbon emissions attributed to the site. The following options for renewable energy have been considered for this site:

- Solar Thermal for Hot Water
- Photovoltaics (PVs) for Electricity
- Wind turbines for Electricity

The table below details the renewable energy options that are available to the site:

	Solar Thermal	Photovoltaics	Wind Turbines
Principles	 Solar water heating utilises solar radiation to heat water for use in water heating of a building. The radiation is converted using a solar collector, of which there are two main types available: Flat Plate and Evacuated Tube collectors.	 Photovoltaic (PV) panels are devices that convert sunlight directly into electricity. This electricity can be harnessed and used to power any number of devices. The photovoltaic modules can be mounted on rooftops where they will be out of sight and produce the optimum energy output. Alternatively different styles of photovoltaic modules can be incorporated into the building fabric where they can be showcased and offset the cost of building materials.	 The kinetic energy in the wind can be harnessed to generate electricity or other forms of energy. Wind energy converters are generally located in regional areas, or in the ocean where the wind is predominantly strong and unobstructed by buildings or other structures. There are wind turbines available for the urban environments which are able to harness the wind's energy even at low wind speeds.
Considerations	• Low cost to produce effective energy savings • Not suitable for applications when the demand will be low for extended periods	• No moving parts therefore minimal maintenance • Long lifetimes of up to 25 years • Modular design and variety of sizes allows flexibility • Large areas required to produce significant electricity • Long payback periods	• Generally a cheaper form of renewable energy production • Completely dependent on wind profile of site – generally more suited to offsite locations in windy environments • Cut in speeds are generally high

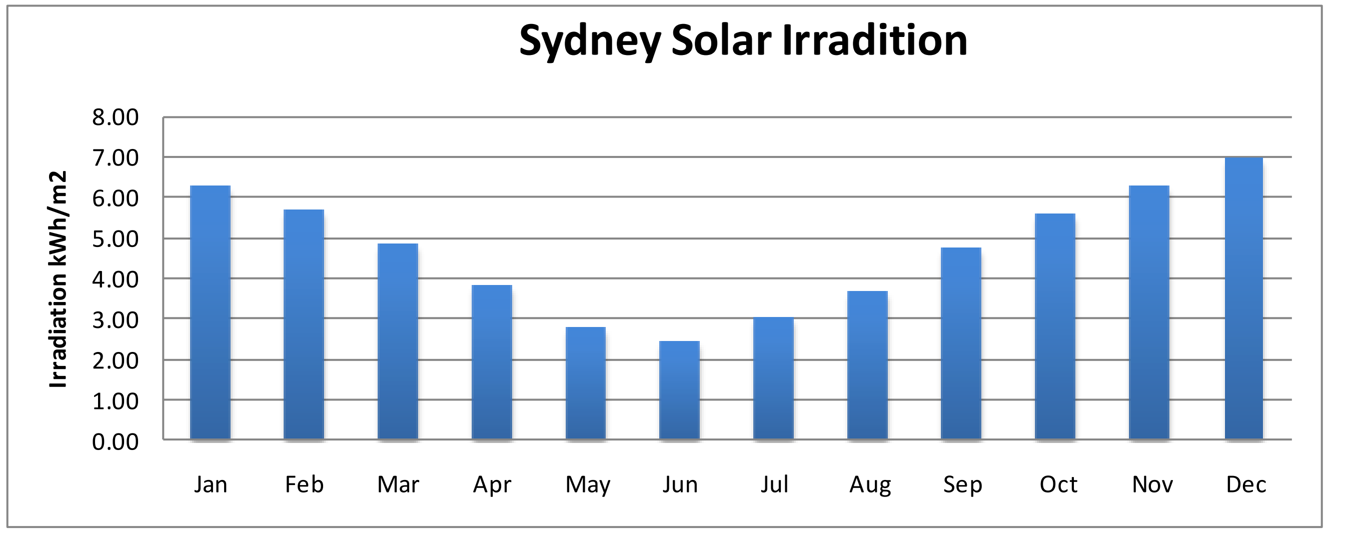
5.2 Recommendations

The following sections detail the preliminary calculations into the above technologies and how these can be incorporated in the Moore College development.

5.2.1 Photovoltaics

The table and chart below show the preliminary results of the PV analysis for the Moore College development.

PV Panels	
Typical system efficiency	11.6%
Area per panel	1.3m^2
Annual Output	220 kWh/m^2
CO2 saving	303 kgC02/panel/year
1 panel equivalent consumption	8% annual domestic electricity per person
Costs	\$1000 - \$1100 /m^2



The optimum orientation for a photovoltaic panel in and around Sydney is a North facing surface, tilted at an angle of 33º from the horizontal. However, orientation is not critical and azimuths +/-30º from North and tilts +/-20º from 33º still achieve reasonable outputs.

The results from the PV analysis indicate that a typical panel can provide the equivalent of 8% of the annual domestic electricity load for 1 person. Therefore 1 panel per dwelling has the potential to reduce the electrical demand significantly.

5.2.2 Solar Hot Water

Similar to PVs the optimum orientation in Sydney is a North facing surface. Solar irradiation is low in winter, therefore in order to size the plant effectively; manufacturers' recommendations are that 60% of the domestic hot water demand should be met by the panels.

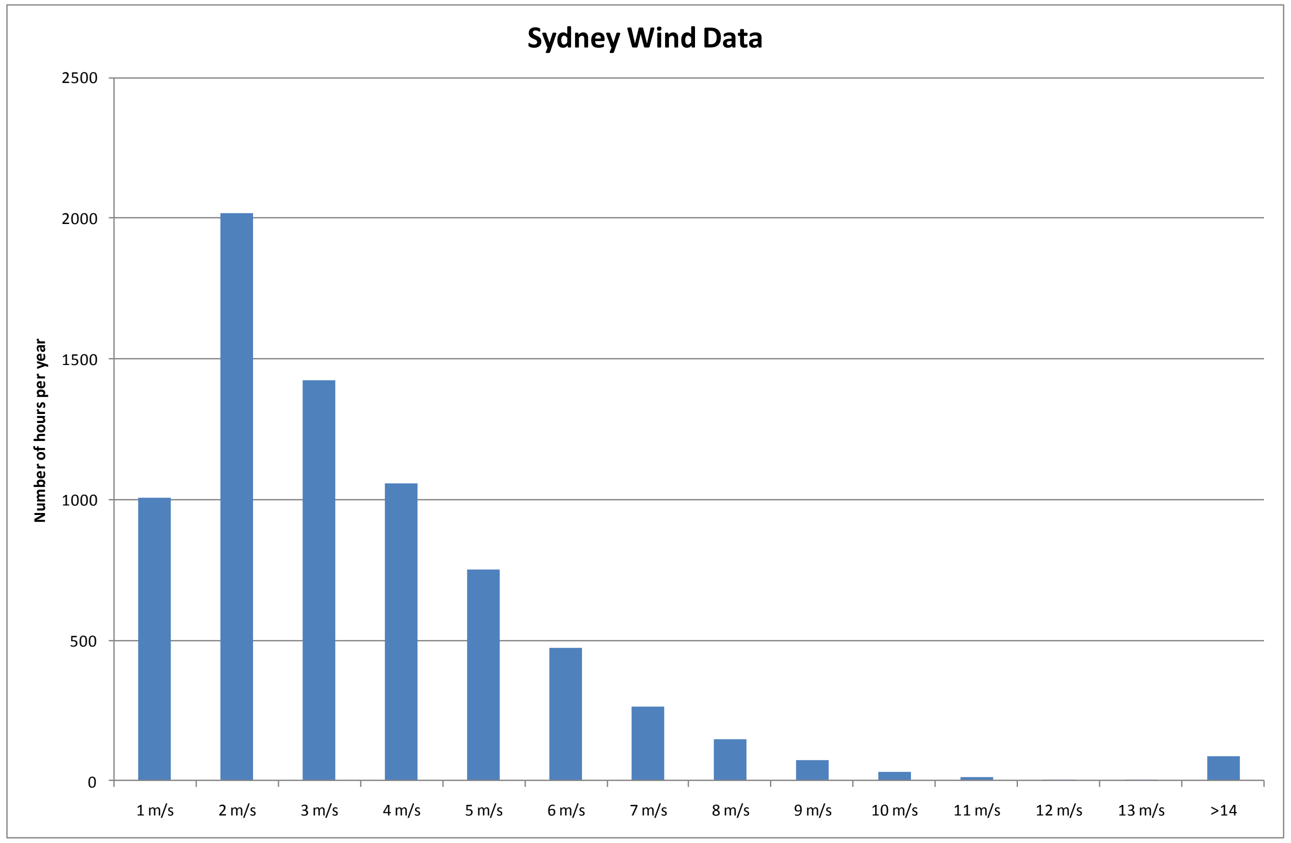
Flat Plate Collectors	
Annual Output	925 kWh/year
Area	4m^2 North facing
CO2 saving	222 kgC02/year
Cost	\$3,750

Evacuated Tube Collectors	
Annual Output	462 kWh/year
Area	2m^2 North facing
CO2 saving	111 kgC02/year
Cost	\$4,150

The results from the solar hot water analysis have shown that this could be a very effective means of reducing the emissions associated with the site, particularly for the residential areas. Therefore the recommendation is to consider the inclusion of solar hot water panels in order to provide domestic hot water for the residential areas.

5.2.3 Wind Turbines

The Wind Turbine analysis has considered two different types of wind turbines. The Ropatec wind turbine cuts in at 3m/s wind speed and will only start producing electricity at wind speeds of 3m/s and above. The qr5 turbine cuts in at 4m/s. Using the wind data for Sydney (as shown in the graph below) indicates that for a large proportion of the year the wind turbines will not be producing electricity. On a cost basis the wind turbines cost significantly more per kgC02 avoided than the other renewable energy technologies discussed. Therefore the recommendations are to utilise the other technologies in preference to wind turbines.



Ropatec 3kW Wind Turbine	
Annual Output	935 kWh/year
CO2 saving	991 kgC02/year
Cost	$28,000
Equivalent consumption	25% annual domestic electricity per person

Qr5 Quiet Revolution Wind Turbine	
Annual Output	1620 kWh/year
CO2 saving	1717 kgC02/year
Cost	$82,000
Equivalent consumption	45% annual domestic electricity per person

Wind Turbines are a viable option for offsite renewable energy generation and if located at a windy site have the potential to produce significant amounts of electricity. Therefore it is recommended to consider an offsite renewable component to further help in the emissions reduction associated with the site.

6 Water Conservation

6.1 Concept

Increasingly water is becoming one of the major environmental issues required to be addressed in the Sydney environment and indeed throughout Australia. Sydney and the surrounding areas currently consume around 630,000 ML of water per year, which averages out to around 1.7ML per day. In light of the past 50 years, due to climate change and population growth, this water consumption is unsustainable.

Water use within the buildings will be assessed and the provision of water efficient appliances and fittings used to minimise the impact on the town water supply.

The table below highlights the water conservation strategies that should be considered for this site.

	Water efficiency	Rainwater/stormwater reuse	Greywater/blackwater recycling
Principles	 The simplest method to reduce potable water use in all building types and applications is to install water efficient fixtures and fittings.	 Opportunities exist for the collection of stormwater and rainwater from the roofs. This collected water can be used for landscape irrigation, further reducing the demand on the potable water supply.	 A greywater or blackwater recycling system would enable water used on site to be recycled for use in toilet flushing and sub-surface irrigation.
Considerations	• Replacing all existing fittings could be costly, however fitting flow restrictors to existing fittings could achieve a similar result • Cost premiums are generally not significant for 4 and 5 Star fittings	• Rainwater collection tanks will need to be sized based on predicted rainfall, roof type and water demand. • On a domestic scale rainwater can often provide all of the non-potable requirements • For mixed use sites the demands will have to be considered carefully to ensure that the rainwater collection is suitable	• Retro-fitting a recycled water system to existing areas could be difficult • Rainwater and stormwater could provide sufficient reused water removing the need for greywater / blackwater

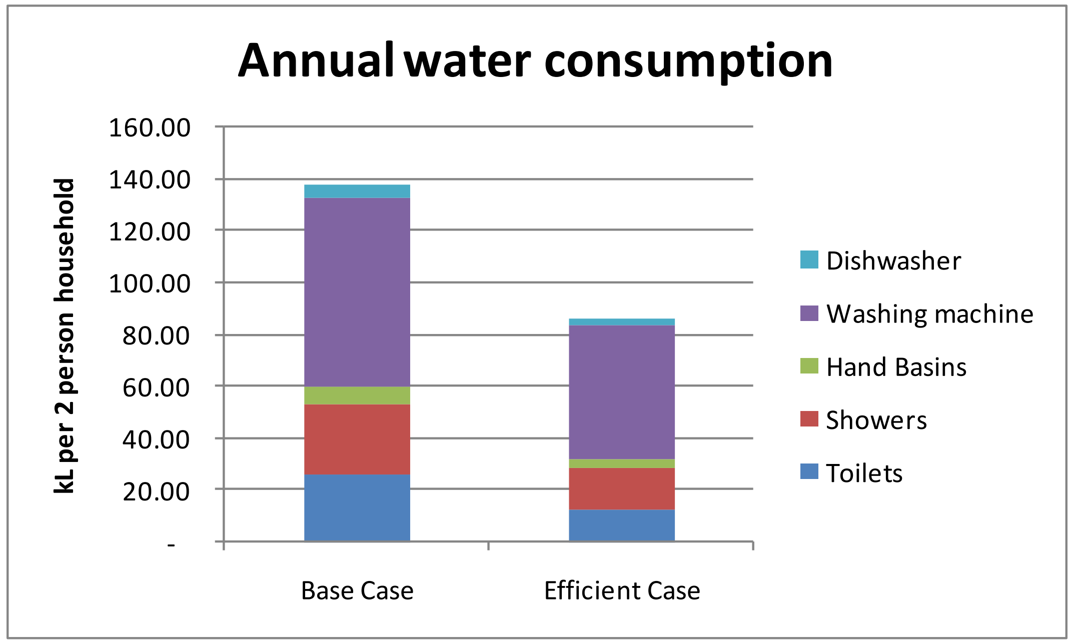
6.2 Recommendations

The following outlines the recommendations for the Moore College development in terms of water reduction.

6.2.1 Water Efficient Fixtures & Fittings

The table below indicates the recommendations for water fitting efficiencies. The chart illustrates how these water efficiencies can reduce the annual potable water consumption (figures displayed for a typical 2 person household). The preliminary analysis has shown that for a typical 2 person household, efficient water fittings can reduce the annual potable water consumption by over 35% compared to using standard water fittings. It is therefore recommended that a minimum 4 Star WELS (Water Efficiency Labelling & Standards Scheme) fittings be provided to all new and refurbished buildings.

Fixture / Fitting	Typical Consumption	Proposed Consumption
Basins	8 litres/minute	4 litres/minute
Toilets	7.5 litres/flush	3.5 litres/flush
Shower	12 litres/minute	7.5 litres/minute
Washing Machine	100 litres/wash	70 litres/wash
Dishwasher	1.5 litres/place setting	0.8 litres/place setting



6.2.2 Rainwater and/or Greywater / Blackwater Recycling

Preliminary calculations indicate that for the residential areas, rainwater will be a better strategy than greywater / blackwater as the irrigation requirements are minimal therefore meaning that the rainwater collected can be used for toilet flushing. Greywater and blackwater on a domestic scale can prove to be costly due to the additional pipework requirements, whereas rainwater is a more cost effective strategy. The annual rainfall for the Sydney area is approximately 1250mm, therefore for a typical residential building a small installation could provide the majority of water for toilet flushing, reducing the potable water consumption.

On the larger residential buildings where the ratio of roof area to apartment area is smaller, larger tanks will need to be investigated to meet demand.

For the academic buildings, storage volumes will need to be sized based on specific demands.

6.2.3 Site wide strategies

The nature of the development lends itself to site wide strategies for reducing potable water consumption, as the varying demand profiles can be matched across the site. Therefore it is recommended that a site wide recycled water strategy be further investigated.

Additionally the use of borewater on site should be investigated further as this could provide a significant volume of water which could be used for landscape irrigation, toilet flushing and in any water based cooling systems.

7 Materials

7.1 Concept

A sustainable materials strategy should be an important part of any developments ESD aspirations. Careful selection of materials can have multiple benefits including preventing the depletion of natural resources, reducing the energy loads of the buildings and improving the indoor environment for building occupants.

The table below outlines the considerations that should be made when selecting materials for the development.

Walls	Paints and finishes	Insulation	Cupboards, Shelves, Doors	Construction
Principles	 The oil-based solvents used in traditional wall paints and finishes release harmful volatile organic compounds (VOCs) for up to five years after exposure to air. Many synthetic paints also contain other harmful elements, including cadmium and mercury.	 Wall and roof insulation is required to improve thermal comfort and reduce the dependency on air conditioning.	 Wood products from renewable plantations with low VOC phenol formaldehyde rather than urea formaldehyde are available. Finished carcasses must be sealed using paint and/or a water-based sealant.	 The embodied energy of external walls should be considered as well as the finishes and maintenance required.
Considerations	• Products should be selected which have low VOC contents to minimise impact on occupant health	• Zero ozone depletion potential (ODP) insulants should be specified. • Retro-fitting of insulation in existing buildings can be extremely beneficial, particular in residential applications	• Low formaldehyde wood products should be selected where possible • Timber should be sourced from sustainable sources or be FSC certified	• Recycled material content for concrete and steel should be specified for new buildings.

7.2 Recommendations

Good material strategies can apply across the site to all building types and applications. Generally, preference should be given to environmentally responsible materials during the materials selection process, according to the following principles:

- Sustainable & Renewable – Material selections such as FSC certified timber
- Low Emission – Reducing the released pollutants in the indoor environment
- Low Embodied Energy – Reducing the impact the development has on global emissions
- PVC Minimisation – PVC has high environmental and human health impacts, both in manufacture and from disposal.

Consideration should be given to materials which are recognised for their environmental credentials. One scheme which certifies products that are considered to be environmentally responsive is Good Environmental Choice Australia (GECA) which has an expanding database of certified products.

Preference should be given to products which can demonstrate the following qualities:

- Reduction in natural resources – through durability and environmental content (i.e. FSC timber, recycled materials)
- Manufacturer's management strategies – Manufacturers to have an Environmental Management System (EMS) and to have an agreement in place to take back the product at the end of its useful life and reuse or recycle.
- Reusability – Products which are modular to allow multiple applications and products which are designed to disassemble easily to reduce material wastage.

8 Waste Management

8.1 Concept

Waste management is a strategy that should be implemented from the earliest demolition and construction phases and carried right through until operation. The large volumes of waste currently going to landfill in Australia is unsustainable.

	Topsoil	Demolition & Construction waste	General waste
Description	 Topsoil is a valuable and diminishing natural resource in Australia. The most meaningful indicator for the health of the land is whether topsoil is being formed or lost. If soil is being lost, so too is the economic and ecological foundation on which production and conservation are based.	 Setting targets for the recycling/reuse of demolition and construction waste helps to facilitate the diversion of resources from landfill. Studies have shown that despite an already high recycling rate of construction and demolition waste, 50% of that going to landfill still has the potential to be recycled.	 Operational waste can amount to a significant volume if not sorted correctly and this waste will then go to landfill
Considerations	• Provide a location onsite to store topsoil during construction and enable the reuse of that topsoil around the site.	• Provision of an on site separation and storage facilities for recycling different waste streams • Minimising waste associated with packaging • Specifications and ordering materials in standard sizes where possible in order to reduce wastage • Reuse of construction/demolition waste on site • Selection of materials that are easily deconstructable, allowing reuse	• Provide a suitable recycling area for waste products such as paper, metal, glass, plastic and organic waste. • Allow for suitable collection of the waste products and ongoing implementation and monitoring of the process. • Ensure appropriate staff members are trained and college policy ensures adherence to the waste management process.

8.2 Recommendations

Good waste management strategies can be applied throughout the site and are applicable to all building types. The recommended strategies are listed below and are separated according to the design, construction and ongoing operation phases of the development:

8.2.1 Design

- As per the materials strategies, selection of materials which are modular and suitable for easy disassembly will help to reduce the waste associated with materials use

8.2.2 Construction

- Appointment of a contractor who is ISO 14001 certified and implements an Environmental Management Plan to ensure waste management principles are applied on site
- Target a recycling / reuse rate of 90% of construction and demolition waste to limit waste going to landfill

8.2.3 Ongoing Operation

- Recycling facilities available, both on a local basis and site wide. Facilities need to be easily accessible both by building users and waste management companies.
- Education of staff and students regarding waste management principles
- Reuse strategies promoted on site i.e. reuse of scrap paper