MUSEUM OF CONTEMPORARY ART

ESD PROJECT APPLICATION REPORT

STEENSEN VARMING

BRISBANE CANBERRA MELBOURNE SYDNEY

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1.1 GENERAL

This report has been prepared for submission with the Project Application for MCA redevelopment project. In response to the Director General Requirements for ESD this report outlines how the development will incorporate ESD principles in the design, construction and ongoing development of the project.

In the development of the ESD brief for this project the design team has use the Green Building Council of Australia (GBCA), Green Star Education tool as a guide to provide a framework from which ESD initiatives can be reviewed and adopted for the project. This ensures the ESD principles are sound and based on an industry standard that encompasses sustainability items across a broad range of disciplines.

It should be noted that the GBCA Education Rating Tool does not directly apply the MCA which is a public building. As yet there is no tool for public buildings so where the application is deemed suitable the intent of the Education Rating Tool will be used to guide and inform the design.

The matrix below provides a comprehensive summary of the Green Star credits that have been adopted for the project an ensure ESD outcomes for the project from design, construction through to ongoing operation of the building and its services.

1.2 ESD MATRIX

Green Star ID	Task Name	Design Team Responsibility	Credits Available	Credits Targeted	Prelim. Order of probable cost $*	Comment	Adopted
	Management						
MAN-1	Sustainability Advice from Green Star accredited Professional	Steensen Varming	2	2	Included		P
MAN-2	Commissioning - Clauses	All	2	2	Included	Normal Practice	P
MAN-3	Commissioning - Building Tuning	All	1	1	Included	Included in MAN-4 cost.	P
MAN-4	Commissioning - Commissioning Agent	MCA/Steensen Varming	1	1	~$60 – 100K	MCA to discuss with SHFA. Steensen Varming proposed to undertake pending discussions with SHFA	**Pending**
MAN-5	Building Users Guide	All	1	1	Included	Included in MAN-4 cost.	P
MAN-6	Environmental Management	Construction Manager	2	2	Included	Normal Practice	P
MAN-7	Waste Management	Construction Manager	2	2	Included	Waste management in exhibition spaces very difficult to achieve. Office and cafe area waste management achievable.	P
MAN-8	Learning Resource - Optional	AM/GAO /MCA	1	1	Included	At least 3 displaying building environmental attributes. Included in existing MCA PR.	P
MAN-9	Maintainability	MCA	1	1	Included	SHFA facilities management should be present throughout the project – Paul to cover elec/power/lighting.	P
	Indoor Environmental Quality						
IEQ-1	Ventilation Rates	Steensen Varming	2	1	-	Applicable for office, cafe, meeting and education areas. Agreed 50% improvement to AS1668.2 requirements	P
IEQ-3	CO_2 Monitoring	Steensen Varming	1	1	~$60K	To be applied high occupancy areas only. Eg cafe, meeting and education areas. Galleries to have fixed outside air	P
IEQ-4	Daylight	AM/HR	4	2	Included	30-60% UFA Difficult to achieve – galleries no natural light. Achievable in areas such as cafe, office, meeting and education areas.	P
IEQ-5	Daylight Glare Control - Possible design elements	AM/HR	1	1	Included	A fully glazed solution and any fixed shading that appears on the current plans has been costed ($631,000). For areas such as the cafe, office and meeting facilities and education spaces blinds/internal shading devices are recommended. Blinds have been allowed	P

Green Star ID	Task Name	Design Team Responsibility	Credits Available	Credits Targeted	Prelim. Order of probable cost $*	Comment	Adopted
						for offices ($1000) and function spaces ($13,500), any additional areas are design dependant.	
IEQ-6	High Frequency Ballasts	HR	1	1	$25K	To be identified as a tender option	**Pending**
IEQ-7	Electric Lighting Levels	HR	1	1	Included		**P**
IEQ-8	External Views	AM	1	1	Included	60% UFA has direct line of sight through glazing. Not achievable in gallery areas, however, achievable in the cafe, office, meeting and education areas.	**P**
IEQ-9	Thermal Comfort	Steensen Varming	3	1	Included	Areas that require close control such as galleries will have a very high degree of thermal comfort. Areas such as offices will be mixed mode so will still maintain a relatively high degree of thermal comfort. Areas such as foyers that are transient in nature and have significant external air movement will be considered tempered air spaces. The thermal comfort in the spaces will, under certain conditions, not be as high as in the other spaces.	**P**
IEQ-11	Internal Noise Levels	AM/Acoustic Consultant	2	2	Included	Achievable in new building but problematic in existing building.	**P**
IEQ-12	Volatile Organic Compounds	AM	4	2	Included	Generally achievable – paint, carpet, adhesives and furniture.	**P**
IEQ-13	Formaldehyde Minimisation	AM	1	1	TBA	Low formaldehyde composite timber products to be specified	**P**
IEQ-14	Mould Prevention - Possible design elements	AM/ Steensen Varming	1	1	Included		**P**
	Energy						
ENE-1	Energy Reduction	AM/ Steensen Varming/HR	15	6 + 3	$200K Allowance	Sea Water system adopted	**P**
ENE-2	Electrical Sub Metering	HR/ WSP	1	1	$10,000		**P**
ENE-4	Stairs	AM	1	1	Included	Major public stair included in schematic design.	**P**
ENE-5	Unoccupied Areas	Steensen Varming / HR	1	1	Included		**P**
ENE-6	Lighting Zoning and Control	HR	1	1	Included	Dynalight solution allowed in brief.	**P**
ENE-7	Efficient External Lighting	HR	1	1	Included	Dependant on client brief.	**P**
ENE-8	Car Park Ventilation - Possible design elements	Steensen Varming	TBA	TBA	Included	Possible natural ventilation/Mechanical exhaust – design dependant.	**P**
	Transport						
TRA-1	Provision of Car Parking - Possible design elements	AM/MCA			Included	Achievable-check no. Against GHD.	**P**

Green Star ID	Task Name	Design Team Responsibility	Credits Available	Credits Targeted	Prelim. Order of probable cost $*	Comment	Adopted
TRA-2	Fuel Efficient Transport - Possible design elements	AM/MCA			Included	Achievable.	P
TRA-3	Cyclist Facilities	AM/MCA	4	2 +2	Included	Staff bicycle storage already allowed for – possible provision for public use.	P
TRA-4	Commuting Mass Transport	MCA	5	4	TBA		P
TRA-5	Pedestrian Routes	AM/MCA	1	1	Included	Achievable.	P
	Water						
WAT-1	Occupant Amenity Portable Water	AM/ WSP	5	3	Included	Water restrictors, waterless urinals etc. fixtures and fittings will be water efficient type.	P
WAT-2	Water Meters	AM/WSP	1	1	Included	Water meters are included for installation on all water supplies to comply with the point.	P
WAT-3	Landscape Irrigation Water Efficiency	AM/WSP	3	3	Included	It is proposed to install a rainwater reuse tank utilising the new roof area catchment only and fire sprinkler test water, with this water being used for irrigation only.	P
WAT-4	Heat Rejection Water Consumption	MCA/ AM / Steensen Varming	4	4	Included	Sea Water system – mechanical only.	P
WAT-5	Fire System Water Consumption	WSP	1	1	$26,000 ext GST	The current design scheme is proposed to include, if possible, for full test, commissioning and drain down water sprinkler system usage to be put back to the rainwater reuse tank. The only problem we might encounter with achieving this is getting the water across to the proposed tank location but final comment can only be made once more thought has gone into the tank location. Applicable for new building only.	**Pending**
	Materials						
MAT-1	Recycling Water Storage	AM/MCA	1	1	Included	Area for separation, collection, recycling has been provided.	P
MAT-2	Re Use of Façade - Possible design elements	AM	1	1	N/A	Re-use of building.	P
MAT-3	Re Use of Structure - Possible design elements	AM/ Simpson	1	1	N/A	Re-use of building.	P
MAT-4	Recycled Content of Concrete	Construction Manager	3	1 +1	20% Premium	Tender price option.	**Pending**
MAT-6	PVC Minimisation - Optional Design Elements	All	2	1	Elec $50K	Linoleum over vinyl floor. Electrical cabling. Tender price option.	**Pending**

Green Star ID	Task Name	Design Team Responsibility	Credits Available	Credits Targeted	Prelim. Order of probable cost $*	Comment	Adopted
MAT-7	Sustainable Timber	AM/ Construction Manager	2	2	Included	Achievable in theory– joinery, floors, lining, framing. If cost <0.1%. Difficult to achieve in practice.	P
MAT-10	Loose Furniture - Optional Design Elements	AM/MCA	3	3	Design Dependant - TBA	Achievable but loose furniture not in current budget. Cost depends on design.	P
MAT-11	Recycled Content & Reused products and Materials - Optional	AM	1	1	N/A	Existing building retained.	P
MAT-12	Disassembly / Deconstruction	AM	1	0	N/A	N/A	P
	Land Use and Ecology						
ECO-1	Ecological Value of Site - Conditional Requirement					Site previously built on.	
ECO-5	Topsoil and Fill removed from Site	AM/ Construction Manager	1	1	N/A	Minimal soil removed.	P
	Emissions						
EMI-1	Ozone Depletion Potential	Steensen Varming	1	1	Included	Included in mechanical design.	P
EMI-3	Refrigerant leak Detection and Recovery -possible Design elements	Steensen Varming	1	1	$30K	To be included in mechanical design	P
EMI-5	Reduced Flow to Sewer - Possible design elements	AM/WSP	2	2	Included	Included in current hydraulic design.	P
EMI-6	Light Pollution	HR	1	1	Included.	To BCA requirement.	P
EMI-7	Legionella	Steensen Varming/ WSP	1	1	Included in WAT-4	N/A	P
	Additional Items						
	Sea Water Cooling (excluding structure and earth works. Mechanical components only.)	Steensen Varming			$480K (Total)		P
	Green Roof (light weight Elmich system) Terrace 3 & 4 (220m2)	AM			$50K	Tender option	**Pending**
	Mixed Mode Ventilation (cafe, office, seminar)	AM/Steensen Varming			Included	Included in mechanical.	P
	Building Construction – Thermal Mass	AM/Simpson			Included		P
	Insulation Infill Panels to Existing Gallery Windows	AM			$60K		P
	Natural Ventilation (transfer plenum for cross vent)	AM/Steensen Varming			Included	Included in mechanical.	P
	Grey Water Flushing	WSP			N/A	Grey water flushing proposed instead.	
	Ultra Sonic Humidification	Steensen Varming			Included	Included in mechanical	P

* Allowances only at preliminary stage of design.

1.3 SEA WATER HEAT EXCHANGER

A key ESD inclusion for the project is the adoption of a sea water heat exchange system for the building.

The use of harbour for air conditioning is a key feature which saves both water and energy. In respect to energy, it allows the air conditioning chillers to operate at equal or better efficiencies in cooling mode. Additionally it offers the opportunity to operate the reverse cycle heat pump made for heating demands, where it has a much higher efficiency than direct heating methods of either using gas or electricity as the heat source.

The option for cooling and heating plant would consist of heat recovery chillers located in the plant room. Theses chillers will supply both chilled and heating water via pipework reticulated to air handling unit coils. For heat rejection from the chiller plant, the system will utilise the Harbour as a heat sink. Heat rejection is fundamental to all air conditioning systems. Refrigeration systems produce a cooling effect that is used to cool buildings. At the same time waste heat is produced by the refrigeration system. Unsightly roof mounted air cooled condensers / chillers and cooling towers are by far the most commonly used method for rejecting heat from a building. Access to the Harbour provides a large heat sink to which we can use to heat or cool due to its relatively stable temperature. The chiller plant coupled via a heat exchanger to the sea water enables the waste heat to be rejected to the Harbour. Water is pumped from the Harbour to the plant room.

This means that cooling towers and air cooled condensers are no longer required, providing the additional advantage of a clean roof form. As the Harbour temperature is relatively stable we are also able to operate the chiller plant as a heat pump. The reverse cycle operation means that waste heat from the refrigeration plant can be used to heat the Museum without the need for a separate boiler plant.

The use of river or sea water for cooling in air conditioning systems is a tried and proven technology. In fact, power stations have been using this method long before building services systems. There are many successful and long time applications around the world and in Australia. There are also feed back and experience that will inform the design to ensure that this building's system will be reliable and expandable should it be deemed appropriate to include the MCA into the system.

With the introduction of the sea water system, it enhances the opportunity of cogeneration and/or tri-generation. Whilst it may be too ambitious to implement a completely standalone on site generation system, the clever application of the standby generator with a waste heat recovery for either absorption cooling or heating would be worthy of considering for peak lopping of power demand, better use of the capital investment in the standby system and reduction in Greenhouse Gas emission.

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2 INTRODUCTION

2.1 GENERAL

This report has been prepared for submission with the Project Application for MCA redevelopment project. In response to the Director General Requirements for ESD this report outlines how the development will incorporate ESD principles in the design, construction and ongoing development of the project.

In the development of the ESD brief for this project the design team has use the Green Building Council of Australia (GBCA), Green Star Education tool as a guide to provide a framework from which ESD initiatives can be reviewed and adopted for the project. This ensures the ESD principles are sound and based on an industry standard that encompasses sustainability items across a broad range of disciplines.

To best meet the requirements to embrace environmental responsibility within a high profile project such as the MCA Redevelopment, this document recommends an integrated building design process, which considers all aspect of a building, its environment and life cycle, by a team which includes all relevant professionals and stakeholders working together throughout the process, rather than sequentially and independently.

Potential benefits of integrated design include:

- Addressing the needs of clients, occupants and the environment
- A better designed product (design teams can explore a wider range of solutions)
- More efficient design and construction (consultants can identify design opportunities and constraints early on)
- Increased building performance and customer satisfaction (promotes better understanding of building use and performance by all concerned)
- The most holistic, sustainable and appropriate environmental solutions

The early involvement of stakeholders in project design can lead to significantly better quality capital investment decisions in construction generally.

Although most construction professionals would agree that a well designed building cannot be produced without teamwork, a range of factors conspire to reduce the level of integration.

Thus it is recommended that a completely integrated and environmentally conscious approach will be appropriate for this project.

2.2 TARGET AUDIENCE

All of the project professions need to be prepared to share knowledge and responsibility, particularly during the important early stages of design. All those involved also need to think more globally and not regard the tasks they have been given as immutable requirements or constraints, but to question them and consider whether more environmentally friendly alternatives could be offered.

The client, design professionals, Authorities, quantity surveyors, contractors and MCA staff all have different priorities and perspectives and all need different kinds of advice and reference information. All can contribute in an important way to reducing the environmental impact of a building.

The client
By investigating, identifying and clearly instructing the design team with regard to the real needs, requirement and priorities of the users. By being prepared to move away from the syndrome of lowest price in pursuit of quality and by supporting, as far as possible, design selection and plant procurement on the basis of lifecycle costs and environmental impact. Much can be achieved by establishing the right priorities at an early stage, in order to achieve the right kind of building in the right place.

The design team
By responding to, challenging and influencing if necessary the client's requirements in order to produce the best result. Designers must think through issues leading to over-design and inefficiencies; pay attention to detail and give forethought to maintenance and manageability; integrate the architecture, structure and service strategies and take account of lifecycle costs and environmental impact in product selection.

Quantity surveyors
By considering waste minimisation and the requirements for materials and costs over the whole lifecycle, reflecting on appropriate benchmarks rather than inappropriate historic data.

Contractors, manufacturers and suppliers
By meeting the requirements in an environmentally sound way; by minimising and wastage, pollution, hazards and risk associated with their products, services and working practices; and by providing occupiers with better training, information and support.

Occupiers and facilities managers
By occupying, managing and altering buildings in an environmentally sound way, making improvements where practicable and recognising and pursuing quality.

2.3 ENVIRONMENTAL POLICY / SUSTAINABILITY CHARTER

To ensure that the necessary consideration is given to environmental issues it is recommended that an environmental policy is developed for not only this project but the general MCA operations and an environmental management system established to implement it. This should focus not only on environmental, but also social and economic impacts, and should aim to make the building sustainable. A stated environmental policy, which is reviewed throughout the design and construction phases, will help to ensure a well designed building with low running costs and resource consumption (in the form of energy, water and materials), which is appropriate for the use intended, and is flexible enough to accommodate changes in use which can be reasonably expected. All of these features are consistent with a more sustainable building.

The existence of an environmental policy and an environmental management system, through which it can be implemented, is equally important for minimising the adverse environmental impact of buildings in use.

Whilst the concept of sustainability is to some extent embodied in the way a Public body does business, expansion and formalising of objectives will require thought as to how far the organisation wishes to push the boundaries.

If the MCA is keen to pursue greater sustainability, it might be prudent to announce a 'headline initiative'. (See separate document for more details).

Headline initiatives will generate short term interest in the community, but sustaining a leadership position will require something more substantial. We suggest that a leadership position would be reinforced through the development of 'showcase' initiatives. Such initiatives would not necessarily involve cutting edge technology or the like, but it would be necessary for the MCA to innovate.

We suggest that some of the options listed below might be appropriate.

- Co-generation/ Trigeneration (possibly coupled to the City of Sydney initiative)
- Water Capture and Re-use
- Renewable Power Generation
- Seawater Cooling
- Biosequestration
- Greenpower
- Community Education
- Waste minimisation/ Recycling
- Site Ecology Improvement
- Cradle to Cradle Approach
- Buying Green

From an initial discussion perspective, and looking in particular at the greenhouse impact of the building, we suggest there may be three possible levels be reviewed.

Simple – Be carbon neutral in your building operations by a particular date. This is not a 'stretch' target, indeed MCA could be carbon neutral from the outset simply through the purchase of accredited Greenpower. However, this would make MCA short term leader

Semi aspirational – Be carbon neutral in your operations and in the property related operations of your staff etc. This is a more challenging target. Firstly you will need to better eMCAge with your

staff, not least because you will need to understand their power consumption patterns. You should then aim to help them reduce consumption, as well as generate/purchase carbon credits on their behalf. This is more of a stretch target that would certainly establish the MCA as a leader.

Aspirational – Be carbon negative (capture/offset more carbon than the building and staff produce) by a particular date. This is a stretch target. To the best of our knowledge no institution has committed to this level of carbon reduction.

With regard to the new building project, the intention is to achieve energy efficiency and reduce greenhouse gas emissions and water use that are historically limited for this type of building. As well as these we shall be utilising the Green Building Council main categories to provide guidance on a range of issues including Management (Construction techniques, recycling, commissioning etc), Indoor Environmental Quality, Energy, Transport, Water, Materials, Ecology, Emissions and Innovation.

The potential for kudos from taking a leadership role is as great as the potential political fall-out if the targets and commitment are seen as insufficient.

3 BENCHMARKING

It is difficult to benchmark MCA's energy consumption against other buildings and even existing solutions against proposed solutions when benchmarking against energy intensity (MJ/m^2). Historically this has been simply an addition of the electricity used annually (MJ) and the gas used annually in (MJ). With gas having as much as four times lower carbon emissions per mega joule as electricity due to the inefficiencies and carbon intensity of grid electricity generation. The primary energy required at the power plant must be considered to give a true comparison of 'energy intensity'. If this is not considered it will make green technologies such as cogeneration, where a building will use more gas and less electricity appear to be more energy intensive.

Industry has found it relatively difficult to provide benchmarking for even commercial buildings for a range of climatic and micro-climatic conditions with a plethora of examples to draw on, therefore, care must be taken in determining appropriate benchmarks for a specialist building such as this where there are only a handful of similar facilities in the country.

3.1 BUILDING CODE OF AUSTRALIA REQUIREMENTS ON ENERGY PERFORMANCE

In a media release on 25 November 2005, the Australian Building Codes Board (ABCB) decided to include energy efficiency measures for buildings (Class 5-9) in BCA2006, this has subsequently been revised with the 2008 version being current.

Part J of the BCA is a "new" section that relates to the energy performance of buildings (Class 5-9). The section covers energy performance, building fabric, external glazing, building sealing, air movement, A/C ventilation systems, lighting and power and hot water supply as well as suitable access for maintenance.

The underlying goal of the "new" section J is to reduce greenhouse gas emissions by efficiently using energy. Reference to energy efficiency alone could be construed as regulating for the sake of saving fuel or operating costs, which may not be an appropriate goal for regulations. Such an approach could also discourage innovation in alternative energy technologies. A goal of greenhouse gas reduction could infer measures that go beyond building control powers such as power generation and reticulation.

It should also be noted that the goal is not occupant comfort. The measures are based on achieving an internal environment in which occupants may not be comfortable, but the conditions are sufficiently tolerable for occupants to minimise their use of artificial heating, cooling or lighting.

The energy used over the life of a building has an operational energy component and an embodied energy component. Operational energy is the focus of the ABCB at this time; broader environmental sustainability measures are being considered under a separate work program.

The minimum benchmarks listed in the BCA with regard to equipment efficiencies are intended to prohibit the installation and use of inefficient equipment. It must be noted that it is not necessarily an indication of equipment having good energy performance if it meets the requirements of the standard.

It is noted that the new BCA also has minimum requirements for lighting loads and any new work or energy savings projects need to consider these 'minimum' benchmarks.

3.2 GREEN BUILDING COUNCIL OF AUSTRALIA – GREEN STAR RATING

Green Star is a complex rating tool that covers not only energy but also management practices, Indoor Environmental Quality (IEQ), transport, water use, material selection, site ecology and waste emissions. Rather than being strictly a performance based tool it can be more readily used as a design tool as it states that a certain building feature will be specified (or is already installed). Similar to ABGR, Green Star is a voluntary scheme.

Green Star was established by the Green Building Council of Australia and can also be applied to either a base building or just a tenancy by asking different questions in each instance. The total environmental performance of the building is benchmarked by giving it a star rating from 1-6. Ratings below 3 star are not officially recognised. A 4 star rating represents best practice while a 5 star rating represents Australian Excellence and a 6 star represents World Leader.

The Green Building Council of Australia now offers several Green Star rating tools. The tool most applicable for the MCA may be the Green Star – Public Building tool. This tool however has not yet been developed but it is possible to be so prior to the project being fully realised and is therefore still seen as pertinent. To move forward we suggest utilising a slightly modified Education Tool as being most appropriate.

As ABGR has been developed for commercial office space, it is more appropriate to utilise an Energy Calculator which normalises operational energy based upon the following factors:

- Building size;
- Hours of operation;
- Occupant behaviour;
- Yearly weather; and
- Car park spaces etc.

The Greenstar rating method may be chosen as a form of sustainable design analysis for the proposed building regardless that the rating tools do not cover specifically, similar building categories. It offers a holistic approach to the construction of the building over a wide range of issues, from water to energy, materials to indoor environmental quality and site considerations to emissions.

The Greenstar rating is achieved by demonstrating compliance with ‘Points‘ that are organised into 9 categories, these being:

- Management,
- Indoor Environmental Quality,
- Energy,
- Transport,
- Water,
- Materials,
- Land use and Ecology and
- Emissions.

The categories are weighted according to the importance of environmental issues and geographical location within Australia. For instance, potable water has a greater significance in South Australia than the Northern Territory, and therefore the Water category has a higher weighting in South Australia. The ninth category is Innovation and up to 5 points are set aside to reward projects that utilise 'innovative' technology or practices. The weighted points are added together to give an overall score which corresponds to the final Greenstar rating, as follows:

Rating	*Total Weighted Points*
1 Star	10 - 19 pts
2 Star	20 - 29 pts
3 Star	30 - 44 pts
4 Star	45 - 59 pts Best Practice
5 Star	60 - 74 pts Australian Excellence
6 Star	75+ pts World Leader

Only ratings of 4 star and above are recognised and marketed by the Green Building Council since they represent better than average environmental credentials.

It is suggested that this project should begin by targeting a category of Australian Excellence and preferably be a World Leader if possible within the project funding limitations.

Whilst the brief alludes to a Green Star rating we note that this is not an appropriate tool. With this and the fact that no formal assessment is to be undertaken at this stage, the MCA and wider team should be aware that they are unable to make any claims as to the buildings likely performance in relation to Green Star Tools (for further information see GBC website) as these are viewed as trademark infringements.

4 GREENSTAR CATEGORIES

This section provides a brief summary of point compliance in each of the 9 categories. The detailed point information and compliance shall be developed during the initial and subsequent design stages.

4.1.1 Management

The intent in this section is to improve services performance and environmental impact. Points awarded relate to improved services performance and energy efficiency through commissioning and hand-over to the building maintenance personnel. Points are also awarded for documentation which will also assist in the optimum performance in the operation of the building.

4.1.2 Indoor environment quality

Indoor Environment Quality (IEQ) relates to the internal services, conditions and finishes that contribute to a healthy environment.

Poor IEQ is the principal cause of sick building syndrome and according to scientific research can cost millions of dollars each year in lost productivity and health sector costs.

4.1.3 Energy

The aim of this section is to minimise energy consumption within the development with a view to reducing greenhouse gas emissions. Large operational energy requirements for developments can create the potential for substantial environmental benefits in energy savings.

Energy efficiency is an item of high importance to the design team and the developments of mechanical, electrical and hydraulic services shall be designed to minimise energy consumption.

4.1.4 Transport

Motor vehicles and private car use are responsible for many forms of pollution. Global warming is directly affected by motor car use including the high amounts of energy required to build cars and produce fuels that lead to greenhouse gas emissions from car exhausts.

Transport during construction can also be targeted with initiatives such as pre-assembly etc being addressed.

4.1.5 Water

Water conservation is an increasingly pressing issue worldwide and especially in Australia and various water conservation initiatives are being used to combat water availability problems.

This category scores the project in terms of the water efficiency of the fixtures/fittings. It also rates projects with rainwater collection and those without cooling towers very highly.

4.1.6 Materials

Material selection is an important aspect of environmental design in that every material consumes natural resources during its manufacture and transportation to site.

4.1.7 Land use & ecology

The design intent of the proposed development should be to minimise the ecological impact of the

building and maximise the enhancement of the site.

4.1.8 Emissions

This section addresses the waste output of the building during operation and the potential for long term damage to the Earth's stratospheric ozone layer.

Pollution of the atmosphere must be minimised during construction and in normal operation of the building as it can negatively impact both the local and global environment.

The design intent should be to utilise minimum ODP and GWP refrigerants, minimum ODP insulants as well as minimising watercourse pollution, light pollution and the use of cooling towers.

4.1.9 Innovation

This is an area to achieve additional points for 'innovative' design, strategies and technologies, exceeding Green Star Benchmarks and Environmental design Initiatives. The project should target at a minimum one key initiatives that it can "market" and be recognised for.

5 GREENSTAR TASK DESCRIPTIONS

5.1 SUGGESTED GREENSTAR BASE DESIGN INCLUSIONS

5.1.1 MANAGEMENT

5.1.1.1 Green Star Accredited Professional

To encourage and recognise the adoption of environmentally sustainable principles from the earliest project stages throughout design and construction.

Two points are awarded where it is demonstrated that at least one principal participant in the design team is a Green Star Accredited Professional and is engaged to provide sustainability advice throughout the design and delivery period, and commencing prior to schematic design.

5.1.1.2 Commissioning – Clauses

To encourage and recognise improved building services performance and energy efficiency due to adequate commissioning and hand-over to the building owner.

One point is awarded where it is demonstrated that comprehensive pre-commissioning, commissioning, and quality monitoring are contractually required to be performed by the appropriate contractors and subcontractors on site (in accordance with ASHRAE Guideline 1 or the CIBSE Commissioning Codes).

An additional point is awarded where the point above is achieved AND the design team and contractor are required to transfer information and documentation to the building owner/manager regarding:
• design intent;
• as-installed details;
• commissioning report; and
• training of building management staff.

5.1.1.3 Commissioning – Building Tuning

To encourage and recognise improved energy efficiency and comfort within the building in all seasons due to adequate commissioning.

One point is awarded where it is demonstrated that there is a client commitment to a firm 12-month commissioning building tuning period after handover. This requires minimum quarterly reviews and a final recommissioning after 12 months of operation.

5.1.1.4 Commissioning – Commissioning Agent

To encourage and recognise the appointment of an independent commissioning agent from design through to handover.

One point is awarded where it can be demonstrated that an independent commissioning agent has been appointed to provide commissioning advice to the client and the design team and to monitor and verify the commissioning of HVAC and building control systems.

5.1.1.5 Building Users' Guide

To encourage and recognise the provision of guidance material to enable building users to achieve the environmental performance envisaged by the design team, and to manage future changes that promote efficiency and environmental quality.

One point is awarded where it can be demonstrated that there is provision of a simple Building Users' Guide, including information relevant to the building users and staff and made available to the Client.

The Building Users' Guide should include an environmental health and mission statement prepared by the Design team, for use by the facility's management to complement the facility's functional design program. This statement shall be retained by the facility with the other design data to ensure that future alterations, additions, and program changes are consistent with the intent of the environmental health and mission statement.

The Building Maintenance Plan created by the design team for the Building Owner or Manager, that provides detailed guidance on accessing and maintaining the building's external building fabric and mechanical, electrical and hydraulic services (copies of equipment sheets are not equivalent to the BMP).

The reference section for staff outlining the basic design intent of the facility, including principles surrounding waste management, recycling, energy and water efficiency, and should provide basic guidance and training to assist part-time and temporary employees to become familiar with the facility. Signage and information should be provided in high visibility staff areas.

5.1.1.6 Environmental Management

To encourage and recognise the adoption of a formal environmental management system in line with established guidelines during construction.

Up to two points are awarded as follows:

• One point is awarded where it can be demonstrated that the contractor is required to provide and implement a comprehensive, site-specific Environmental Management Plan (EMP) for the works in accordance with Section 4 of the Environmental Management System guidelines;
• One point is awarded where it can be demonstrated that the contractor is required to have ISO 14001 Environmental Management System accreditation applicable to the construction of this building.

5.1.1.7 Waste Management

To encourage and recognise management systems that facilitates the reduction of construction waste going to landfill.

Up to two points are awarded where it is demonstrated that the contractor will provide and implement a comprehensive waste management plan AND contract provisions require the contractor to reuse and/or recycle construction waste, as follows:

1 point where 60% of waste by weight is reused or recycled;

2 points where 90% of waste by weight is reused or recycled.

Records must be kept by the contractor to demonstrate the actual percentage of waste recycled by weight and these must be reported to the client quarterly.

5.1.1.8 Maintainability

To encourage and recognise building design that both readily enables and minimises the need for ongoing building maintenance.

One point is awarded where it is demonstrated that a representative of the organisational unit responsible for the management and maintenance of the building has been included on the design team, and has performed and submitted a design review at both the preliminary and final design stages. This review must cover building services, external building features and cleaning and maintenance.

5.1.2 INDOOR ENVIRONMENTAL QUALITY

Definition: Usable Floor Area (UFA)

The sum of the floor areas measured at floor level from the general INSIDE face of walls of all spaces related to the Primary Function of the building. This will normally be computed by calculating the Fully Enclosed Covered Area (FECA) and deducting common use areas, service areas, and non-habitable areas. Note: in some cases the Useable Floor Area may include some external covered areas which relate to the Primary Function of the building.

5.1.2.1 Ventilation Rates

To encourage and recognise the provision of increased outside air rates, in order to promote a healthy indoor environment.

Up to three points are awarded if the minimum outside air is provided at rates better than the requirements of AS 1668.2-1991 or if natural ventilation is provided, as follows:

Mechanically Ventilated Buildings
- 1 point is awarded for a 50% improvement on AS 1668.2-1991
- 2 points are awarded for a 100% improvement on AS 1668.2-1991;
- 3 points are awarded for a 150% improvement on AS 1668.2-1991.

Naturally Ventilated Buildings
Three points are awarded where it is demonstrated that 90% of the UFA is naturally ventilated in accordance with AS 1668.2-2002.

Mixed-Mode Ventilated Buildings
Both modes of operation must satisfy the relevant mechanical and natural ventilation criteria. The points awarded will be limited to the maximum points awarded under the mechanical ventilation criteria.

5.1.2.2 Daylight

To encourage and recognise designs that provide good levels of daylight.

Up to three points are awarded where it is demonstrated that a nominated percentage of the UFA (excluding atrium and corridor spaces) has a 2.5% daylight factor as measured at the floor level under a uniform design sky, as follows:

1 point = 30% of the UFA;
2 points = 60% of the UFA;
3 points = 90% of the UFA.

If a Daylight Factor of 2.5% is achieved for 90% of the UFA, an additional point is available where it is demonstrated that 50% of functional spaces achieve a Daylight Factor of not less than 4.0% for 95% of the area of the fuctional space, measured at the finished floor level under a uniform design sky.

5.1.2.3 High Frequency Ballasts

To encourage and recognise the increase in occupant comfort by avoiding low frequency flicker that may be associated with fluorescent lighting.

One point is awarded where it is demonstrated that high frequency ballasts are installed in fluorescent luminaires over a minimum of 95% of the UFA.

5.1.2.4 Electric Lighting Levels

To encourage and recognise education facility lighting that is not over designed.

One point is awarded where it is demonstrated that the facility lighting design provides a maintenance illuminance of no more than 25% above those recommended in Table E1 of AS1680.2.3 for 95% of the UFA as measured at the working plane (or as required by AS1680.2.3).

5.1.2.5 External Views

To encourage and recognise reduced eyestrain for building occupants by allowing long distance views and the provision of visual connection to the outdoors.

One point is awarded where it is demonstrated that 60% of the UFA (excluding atrium and corridor space) has a direct line of sight through vision glazing, either externally, or to an adequately sized and naturally lit internal atrium.

The distance to the nearest vision glazing is to be no more than eight metres for all spaces except possibly courtrooms where views shall be any distance within a 45 degree arc from the normal seated front view line.

5.1.2.6 Thermal Comfort

To encourage and recognise the use of thermal comfort assessments to guide design options.

Up to two points are awarded where it is demonstrated that the thermal comfort levels for the as-built design of the UFA have been made and used to evaluate appropriate servicing options. The following Predicted Mean Vote (PMV) levels, calculated in accordance with ISO7730 (or equivalent using Draft ASHRAE Comfort Standard 55 and "Developing an Adaptive Model of Thermal Comfort and Preference - Final Report on ASHRAE RP884") must be achieved during Standard Hours of Occupancy and using standard clothing, metabolic rate and air velocity values for 98% of the year:

- 1 point = PMV levels are between -1 and +1;
- 2 points = PMV levels are between -0.5 and 0.5.

An additional point is available where is it demonstrated that every enclosed office with no more than four workstations is provided with control of air supply rates, air temperature or radiant

temperature, and all office areas with more than four workstations must have individual control of air supply rates, air temperature or radiant temperature.

For buildings without dedicated office areas, this point is 'Not Applicable' - type "na" in the 'No. Points Achieved' column.

5.1.2.7 Internal Noise Levels

To encourage and recognise buildings that are designed to maintain internal noise levels at an appropriate level.

Up to two points are awarded where it is demonstrated that for 95% of the building's UFA, the design achieves ambient internal noise levels in accordance with AS/NZS 2107:2000, as follows:

Building Services Design
One point is awarded where the building services noise meets the recommended design sound levels provided in Table 1 of AS/NZS 2107:2000.

Overall Building
One point is awarded where it is demonstrated that:
- The UFA design sound levels measured in LAeq and reverberation times, for each functional space are provided in accordance with the lower values in Table 1 of AS/NZS 2107:2000; and
- All partitioning between adjoining academic offices or courtrooms etcis constructed to achieve a Sound Transmission Class (STC) rating of at least 45 between spaces in order to minimise cross talk.

5.1.2.8 Formaldehyde Minimisation

To encourage and recognise projects that reduce the use of formaldehyde composite wood products in order to promote a healthy indoor environment.

One point is awarded where it is demonstrated that:
• All composite wood product used, including joinery and loose furniture, is low emission formaldehyde (rated E0); OR
• No composite wood product is used.

5.1.2.9 Carbon Dioxide and VOC Monitoring and Control

To encourage and recognise the provision of response monitoring of carbon dioxide (CO2) and Volatile Organic Compounds (VOC) levels to ensure delivery of minimum outside air requirements and tracking of VOC pollutants.

One point is awarded where it is demonstrated that:

• A combined CO2/VOC (Carbon Dioxide/Volatile Organic Compounds) monitoring system is linked to the Building Management System (BMS), and a minimum of one sensor per return duct is provided to facilitate continuous monitoring and adjustment of outside air ventilation rates in response to CO2 levels to at least 95% of the total UFA, excluding corridors. The VOC monitor is to provide for monitoring and alarm for VOC pollutants and should not be linked to the adjustment of outside air rates. OR
• Where systems provide 100% outside air with no recirculated component; OR Where 100% of UFA is naturally ventilated and ventilation rates are directly controlled by occupants.

5.1.2.10 Volatile Organic Compounds

To encourage and recognise projects that reduce the detrimental impact on occupant health from finishes emitting internal air pollutants.

Up to four points are awarded where it is demonstrated that various finishes and coverings meet the benchmarks for low Volatile Organic Compound (VOC) content or emissions. One point is awarded for each criterion below that is achieved:

- 95% of all paint are low-VOC emitting (per EN 13419);
- 95% of all carpets and other floor finishes are low-VOC (carpet - US Carpet and Rug Institute Green Label; other floor finishes - EN 13419) OR no carpet and floor finishes are installed;
- 95% of all adhesives and sealants are low-VOC (per EN 13419) OR no adhesives/sealants are used; and
- 95% of all tables, chairs, and desks are low-VOC (per US EPA's Environmental Technology Verification test method or California specification 01350 15 July 2004. Refer to the Submission Guidelines for emissions standards.)

5.1.3 ENERGY

5.1.3.1 Ene-Conditional Requirement

To encourage and recognise designs that achieve no less than best-practice reduction in Greenhouse Gas emissions associated with operational energy consumption.

It is expected that a Conditional Requirement for obtaining a Green Star – Public Building Certified Rating that the building meets the minimum energy benchmark. This may be determined by a future Energy Calculator.

5.1.3.2 Energy Improvement

To encourage and recognise projects that contain design features that help to minimise operational energy consumption and greenhouse gas emissions of the base building as calculated by the Energy Calculator.

Up to fifteen points are awarded where it is demonstrated that the design provides a reduction in the energy consumption and greenhouse gas emissions of the base building on those from a comparable conventional base building.

The points are determined using the Energy Calculator to assess the predictive computer model. The computer energy modelling must be conducted according to the Energy Calculator Guide, which is available on the GBCA website.

5.1.3.3 Electrical Sub-metering

To encourage and recognise the provision of energy sub-metering to facilitate energy monitoring.
One point is awarded where it is demonstrated that sub-metering is provided for substantive energy uses within the building (greater than 100kVa).

Sub-meters must also be provided to monitor both lighting and general power consumption for primary functional areas (per floor) as defined in the technical manual, these areas include:
- Primary Functional areas;
- Office/administration space; and
- Tenancies etc.

Where a functional area is less than 200m2, they may be grouped with an adjacent functional area providing the total area being metered does not exceed 1000m2.

The sub-meters must be connected to a BMS or dedicated electronic energy monitoring and reporting system and continually demonstrate actual performance against energy benchmarks.

5.1.3.4 Stairs

To encourage and recognise buildings that provide attractive stairs as a viable alternative to vertical transportation by lift.

One point is awarded where it is demonstrated that internal stairs are provided and meet the following criteria:

- Are available for use by the public;
- Are highly visible (i.e., not visully blocked or behind doors); and
- Are located within 5m of the primary set of lifts OR in a central location (e.g., within 20m of a main entrance); and
- Are fully open to the interior on at least one side over the entire span of the stairwell, OR 25% of the stairwell wall area is exterior glazing OR each level within the stairwell has a Daylight Factor of at least 3.5 at FFL.

If the building is single storey or does not have a passenger or goods-passenger lift (dedicated disabled persons lift is excluded), then the credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.1.3.5 Unoccupied Areas

To encourage and recognise designs that minimise or eliminate energy use when unoccupied.

One point is awarded where it is demonstrated that each separate enclosed space within the UFA is designed to be automatically shut down or the temperature set-back (air-conditioning) when not in use; OR
Where it is demonstrated that the building is naturally ventilated

5.1.3.6 Lighting Zoning and Control

To encourage and recognise lighting design practices that offer greater flexibility for light switching and automated control, making it easier to light only occupied areas.

One point is awarded where it can be demonstrated that:

- All individual or enclosed spaces have individual switches;
- The size of individually switched zones does not exceed 100m2;
- Switching is clearly labelled and easily accessible by building occupants; and
- An automated lighting control, including occupant detection and daylight adjustment, is provided.

5.1.3.7 Efficient External Lighting

To encourage and recognise designs that facilitate reduction in energy consumption by external lighting.

One point is awarded where the following is demonstrated:

- External lighting and outbuilding lighting has an efficacy of at least 50 lumens/watt (examples include high- and low-pressure sodium, metal halide, induction lighting, tubular and compact

fluorescent);
- 95% of outdoor spaces do not exceed the minimum requirements of AS 1158 for illuminance levels by more than 50%; and
- 95% of external lights have daylight sensors (daylight sensors can be combined with a time switch).

If the externally lit area requires less than 10kW total lighting, then the credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.1.4 TRANSPORT

5.1.4.1 Cyclist Facilities

To encourage and recognise building design that promotes the use of bicycles by staff, students and visitors by ensuring adequate cyclist facilities are provided.

Up to four points are awarded where it is demonstrated that the building design includes provision of cycling facilities. "Secure" bicycle storage is defined as dedicated, undercover and specifically by the following:

• bike storage must be either within 100m of the building front entrance or as per the office design technical manual.

Public Bicycle Storage

• One point is awarded where a minimum of 5% of the peak number of students using the building at any one time (with 75% occupancy) are provided with a secure bicycle storage space. Two points are awarded where a minimum of 10% of the peak number of occupants using the building at any one time (with 75% occupancy) are provided with a secure bicycle storage space.

Staff Bicycle Storage

One point is awarded where there is adequate provision of cycling facilities, as follows:
• secure bicycle storage space for 5% of building staff; PLUS
• accessible showers (one per 10 bicycle spaces provided or part thereof); PLUS
• changing facilities (with secure lockers or equivalent – one for each bicycle space) adjacent to the accessible showers.

Two points are awarded where there is good provision of cycling facilities, as follows:
• secure bicycle storage space for 10% of building staff; PLUS
• accessible showers (one per 10 bicycle spaces provided or part thereof); PLUS
• changing facilities (with secure lockers or equivalent – 1 for each bicycle space)

5.1.4.2 Commuting Mass Transport

To encourage and recognise developments with proximity and good access to mass transport networks which have frequent services.

Up to five points are awarded based on the proximity of the building to public transport, the number of routes served, and the average frequency of service during the weekday two-hour morning peak commuting period and the two-hour afternoon peak commuting period.

The points are determined using the Public Transport Calculator.

5.1.4.3 Pedestrian Routes

To encourage and recognise the provision of safe and secure pedestrian routes

One point is awarded where it is demonstrated that there is at least one dedicated pedestrian route onto and off the site, linking the site to public transport nodes and other nearby amenities. Routes must be signposted and provide safe night-time lighting.

5.1.5 WATER

5.1.5.1 Occupant Amenity Potable Water Efficiency

To encourage and recognise systems which have the potential to reduce the potable water consumption of building occupants.

Up to five points are awarded where it is demonstrated that the predicted potable water consumption for sanitary use within the building has been reduced.

Points are to be determined using the Potable Water Calculator. The points awarded are based on the type and potable water efficiency of fixtures/fittings, less any reduction in potable water demand through the use of rainwater or recycled (e.g., grey- or blackwater).

5.1.5.2 Water Meters

To encourage and recognise the design of systems that monitors and manage water consumption.

One point is awarded where it is demonstrated that water meters are installed for all major water uses (e.g., laboratories, cooling towers, irrigation, sub-tenant use, rainwater, bathrooms, and hot water). Meters must be electronic and/or linked to a Building Management System to provide a leak detection system.

5.1.5.3 Landscape Irrigation Water Efficiency

To encourage and recognise the design of systems that aim to reduce the consumption of potable water for landscape irrigation.

Two points are awarded where it is demonstrated that:
• 90% of the water requirement for landscape irrigation is sourced from non-potable water (e.g., rainwater or recycled water collected on site); OR
• A water efficient irrigation system comprising subsoil drip systems and automatic timers with rainwater or soil moisture sensor control override is installed; OR
• A xeriscape (no applied water) garden has been installed.

An additional point is available to projects where over 30% of the site area is vegetated and the above criteria are met.

If landscaping represents less than 1% of the total site project area then the credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.1.5.4 Heat Rejection Water Consumption

To encourage and recognise design that reduces potable water consumption from heat rejection systems.

Up to four points are awarded where it is demonstrated that potable water consumption is reduced through efficient use, or avoidance, of water-based heat rejection systems, as follows:

• Two points are awarded where it is demonstrated that water-based heat rejection systems reduce potable water consumption by at least 50% (from a comparable typical application).
• Four points are awarded where it is demonstrated that water-based heat rejection systems reduce potable water consumption by at least 90% (from a comparable typical application); OR
• No water-based heat rejection system is provided.

5.1.5.5 Fire System Water Consumption

To encourage and recognise building design that reduces potable water consumption of the building's fire protection and essential water storage systems.

One point is awarded where it is demonstrated that:

• There is sufficient temporary storage for a minimum of 80% of all fire protection system test water (sprinkler water may be excluded) and maintenance drain-downs for reuse on-site; OR
• Where a facility exists for the pump out and recovery of water for use off-site; OR
• The fire system does not expel water for testing.

5.1.6 MATERIALS

5.1.6.1 Recycling Waste Storage

To encourage and recognise the inclusion of storage space that facilitates the recycling of resources used within buildings to reduce waste going to landfill.

One point is awarded where it is demonstrated that a dedicated storage area is provided for the separation, collection and recycling of office consumables with good access for all building occupants and for collection by recycling companies. The storage area shall be adequately sized to allow for recycling of, as a minimum, paper, glass, plastics, metals, and organic (compost) materials.

5.1.6.2 Recycled Content of Concrete

To encourage and recognise the reduction of embodied energy and resource depletion due to the use of concrete.

Up to three points are awarded where it is demonstrated that the concrete to be used in the building construction or refurbishment has a significant recycled content.

One point is awarded where 20% of all aggregate used is recycled aggregate. Up to two points are also awarded, as follows:

• 1 point = 30% of cement used for in-situ concrete, 15% of cement used for pre-cast concrete and 10% used for stressed concrete is replaced with an industrial waste product;
• 2 points = 60% of cement used for in-situ concrete, 30% of cement used for pre-cast concrete and 20% used for stressed concrete is replaced with industrial waste product.
The industrial waste product must not come from industrial facilities co-fired with hazardous waste.

If the material cost of new concrete represents less than 1% of the project's contract value, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.1.6.3 Recycled Content of Steel

To encourage and recognise the reduction in embodied energy and resource depletion due to the use of recycled steel.

Up to two points are awarded where it can be demonstrated that the percentage of all steel in the design has a post-consumer recycled content greater than 50%, as follows:

- 1 point = 60% by mass; and
- 2 points = 90% by mass.

If the material cost of steel represents less than 1% of the project's total contract value, this credit is

'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.1.6.4 Sustainable Timber

To encourage and recognise the specification of reused timber products or timber that has certified environmentally responsible forest management practices.

Two points are awarded where it is demonstrated that all timber and composite timber products used in the building and construction works are required to be sourced from either or a combination of the following:

- Post-consumer reused timber; or
- Forest Stewardship Council (FSC) certified Timber.

If the material cost of timber represents less than 0.1% to the project's total contract value then this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.1.7 LAND USE AND ECOLOGY

5.1.7.1 Ecological Value of Site

To encourage wherever possible development on land that already has a limited ecological value and discourage the development of ecologically valuable sites.

It may be a Conditional Requirement for obtaining a Green Star – Public Building Certified Rating that the development site is a refurbished building OR is not on land of high ecological value. To fulfil this requirement none of the following criteria must be applicable to the site:

- prime agricultural land;
- land on or within 100m of a wetland listed in either the Convention on Wetlands of International Importance (Ramsar Convention) or in the Directory of Important Wetlands in Australia.

This is a Conditional Requirement

5.1.7.2 Topsoil and Fill Removal from Site

To encourage and recognise practices that reduce the amount of topsoil and fill removed from development sites.

One point is awarded where it is demonstrated that cut and fill requirements are balanced on-site and where there is no exportation of fill or topsoil from the site or in the case of a campus development, from the campus.

5.1.8 EMISSIONS

5.1.8.1 Ozone Depletion Potential

To encourage and recognise the reduction of potential long-term damage to the Earth's stratospheric ozone layer through the use of ozone depleting substances in refrigeration and the manufacture and use of insulation.

One point is awarded where it is demonstrated that:

- 95% of all HVAC refrigerants in use have an Ozone Depletion Potential (ODP) of zero OR where

no refrigerants are used; AND
• The specified thermal insulation avoids the use of ozone depleting substances in both manufacture and composition.

5.1.8.2 Watercourse Pollution

To encourage and recognise project design that reduces the potential of pollution in water running off from buildings and hard surfaces to natural watercourses.

Two points are awarded where it is demonstrated that all stormwater leaving the site, at any time up to a 1-in-20 year storm event, is treated/filtered in accordance with:

- The Australian and New Zealand Environment Conservation Council (ANZECC)'s Guidelines for Urban Stormwater Management.

To obtain points it must also be demonstrated that the development does not increase peak stormwater flows for rainfall events of up to a 1-in-2 year storm.

An additional point is awarded if the development site includes any section of a watercourse or is adjacent to a watercourse and it is demonstrated that vegetated riparian buffer zones are established, as follows:

- Where there is no existing established vegetation, where soils are identified as of low to medium erodibility, and average slope is less than 10 degrees - buffer zone of 10 metres width;
- Where there is existing established vegetation and soils are identified as of medium to high erodibility and/or average slope exceeds 10 degrees - buffer zone of 20 metres width; and
- Where there is existing established vegetation and soils are identified as of high erodibility and/or the average slope exceeds 15 degrees - buffer zone of 30 metres width.

If the development site does not include any section of a watercourse, this point is 'Not Applicable' - type "na" in the 'Number of Points Achieved' column.

5.1.8.3 Light Pollution

To encourage and recognise lighting design that reduces pollution from the unnecessary dispersion of light into the night sky and onto neighbouring property.

One point is awarded where it is demonstrated that no light beam is directed beyond the site boundaries or upwards without falling directly on a surface with the explicit purpose of illuminating that surface and where the design complies with AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting.

5.1.8.4 Legionella

To encourage and recognise building systems design that eliminates the risk of Legionnaires' Disease.

One point is awarded where it is demonstrated that there are no evaporative heat rejection systems within the project.

5.2 GREENSTAR OPTIONAL DESIGN INCLUSIONS

5.2.1 MANAGEMENT

5.2.1.1 Learning Resource

To encourage and recognise designs of buildings and grounds that enable them to serve as an intrinsic learning resource in raising the environmental awareness of the building users.

One point is awarded where at least three of the building's environmental attributes are displayed in a manner that can be readily understood by building users, and meet the following criteria:

- Each attribute must reflect an environmental initiative rewarded within a Green Star credit;
- One attribute must be related to energy use and one attribute must be related to water use; and
- Each display must measurably identify the environmental and economic benefits of the initiative.

Please refer to the Submission Guidelines for examples of demonstrable environmental attributes

5.2.2 MATERIALS

5.2.2.1 PVC Minimisation

To encourage and recognise the reduction of Poly Vinyl Chloride (PVC) products in Australian buildings.

Up to two points are awarded where it is demonstrated that the total PVC content cost for major services elements (pipes, conduits, wire and cable sheathing, and flooring) is reduced by replacing with alternative materials, as follows:

- 1 point = 30% reduction by cost; and
- 2 points = 60% reduction by cost.

5.2.2.2 Flooring

To encourage and recognise the selection of flooring that has a reduced environmental impact relative to available alternatives.

Up to three points are awarded where it is demonstrated that the flooring used in the project has a reduced environmental impact as determined by the Flooring Calculator.

5.2.2.3 Joinery

To encourage and recognise the installation of reused joinery or joinery designed for reuse.

Up to two points are awarded as follows:

- 1 point = where 95% of the joinery (by area) used in the project is new and has been designed to be modular AND easily disassembled for future reuse; and
- 2 points = where the 95% joinery (by area) used in the project is made from salvaged, refurbished, or reused materials.

If the material cost of joinery represents less than 0.1% of the project's contract value, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.2.2.4 Loose Furniture

To encourage and recognise the selection of loose furniture that has a reduced environmental impact relative to available alternatives.

Up to three points are awarded where it is demonstrated that the loose furniture (defined as chairs, tables and storage only) used in the project has a reduced environmental impact as determined by the Loose Furniture Calculator. All chair, table and storage items must be listed in the Calculator and complete documentation must be provided for at least 80% of entries to make the project eligible for full points.

5.2.2.5 Recycled-Content & Reused Products and Materials

To encourage and recognise design initiatives that increase the market demand for building materials with recycled content and for reused building materials.

One point is awarded where it is demonstrated that materials selected for building construction representing at least 2% of the project's total contract value meet the following criteria:

- have a post-consumer recycled content of at least 20%; OR
- are reused (from the existing building or any other building).

Examples of reused materials may include flooring, furniture and doors, but must exclude those materials covered in Mat-2 through Mat-11. Examples of recycled-content materials may include carpet and underlay, ceiling tiles and grids, and vehicle stops, but must exclude those materials in Mat-2 through Mat-5.

5.2.2.6 Disassembly / Deconstruction

To encourage and recognise designs that minimise the loss of embodied energy and resources associated with demolition.

One point is awarded where it is demonstrated that 50% (by area) of the structural framing, roofing, and façade cladding systems are designed for disassembly:

- Connections allow for disassembly;
- Elements to be recovered are clearly marked with their inherent properties and date of manufacture to enable reuse; and
- A comprehensive Disassembly Plan (provided separately or as a part of the Operations & Maintenance Manual) illustrates how the elements should be recovered.

If the material cost of the structural framing, roofing, and façade cladding systems represent less than 1% of the project's total contract value, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column

5.3 GREENSTAR POSSIBLE DESIGN INCLUSIONS

5.3.1 INDOOR ENVIRONMENTAL QUALITY

5.3.1.1 Air Change Effectiveness

To encourage and recognise systems that provide for the effective delivery of clean air through reduced mixing with indoor pollutants in order to promote a healthy indoor environment.
Two points are awarded where it is demonstrated that the Air Change Effectiveness (ACE) meets the following criteria for at least 90% of the UFA:

Naturally Ventilated Buildings
Demonstrate a distribution and laminar flow pattern for at least 90% of each space in the direction of air flow for not less than 95% of standard hours of occupancy.

Mechanically Ventilated Buildings
The ventilation systems are designed to achieve an ACE of >0.95 when measured in accordance with ASHRAE F25-1997. ACE is to be measured in the breathing zone (nominally 1m from the finished floor level).

Mixed-Mode Ventilated Buildings
Both criteria above apply except the naturally ventilated requirement is reduced to 95% of hours of predicted natural ventilation operation.

5.3.1.2 Daylight Glare Control

To encourage and recognise buildings that are designed to reduce the discomfort of glare from natural light.

One point is awarded where it is demonstrated that glare is reduced across the UFA (excluding atrium and corridor space) as follows:

• Where, for each typical glazing configuration on each facade, fixed shading devices shade the working plane 1.5m in from the centre of the glazing, from 80% of direct sun; OR
• Where occupant controlled automated blinds/screens with a Visual Light Transmittance (VLT) of <10% are fitted as a base building commitment to reduce glare associated with natural lighting and eliminate all direct sun penetration.

5.3.1.3 Hazardous Materials

To encourage and recognise actions taken to reduce health risks to occupants from the presence of hazardous materials.

One point is awarded where it is demonstrated that a comprehensive hazardous material survey has been carried out for the project site, as defined by the relevant environmental and Occupational Health and Safety (OH&S) legislation, and whenever asbestos, lead or Polychlorinated Biphenyls (PCBs) were found, they were removed in accordance with the standards listed under Additional Guidance.

For Greenfield developments or developments in which none of the above hazardous materials were found, this credit is 'Not Applicable' - type "NA" in the 'No. of Points Achieved' column.

5.3.1.4 Mould Prevention

To encourage and recognise the design of systems which reduce the risk of mould growth and its associated detrimental impact on occupant health.

One point is awarded where it is demonstrated that:

- The building is fully naturally ventilated; OR
- The mechanical ventilation system is designed to actively control humidity to be no more than 60% relative humidity in the space and no more than 80% relative humidity in the supply ductwork.

5.3.2 ENERGY

5.3.2.1 Peak Energy Demand Reduction

To encourage and recognise projects that implement systems to reduce peak demand on energy supply infrastructure.

Two points are awarded where it can be demonstrated that energy demand reduction systems are installed to reduce peak demand on electricity infrastructure by 40% when compared to the minimum base load profile when air-conditioning is not operating. OR
Two points are awarded where is demonstrated that the difference between the average and peak load is less than 20%.

This may be achieved by on-site generation or by thermal/energy storage systems, but not by load lopping using the Building Management System (BMS).

5.3.2.2 Car Park Ventilation

To encourage and recognise designs that facilitate reduction of energy consumption by car park ventilation.

Up to two points are awarded where it is demonstrated that the design incorporates the use of passive ventilation and energy-saving features for car parks, as follows:

One point is awarded where 50% of the car park area is naturally ventilated or where 100% of the car park area has either passive supply or exhaust. All mechanical ventilation fans include Variable Speed Drives controlled by CO monitoring.

Two points are awarded where there is no mechanical car park ventilation.

If there is no car park, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.
If there is less than 1 parking space per 200m2, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column; in this case, car park energy consumption must be included in calculations for Ene-1.

5.3.2.3 Centralised Energy Systems

To encourage and recognise the use of centralised energy stations that minimise maintenance, energy and resource consumption.

One point is awarded where it is demonstrated that the project is served by a central energy station that provides reticulated chilled water from a plant room shared by at least two buildings.

If the building(s) is naturally ventilated, the campus contains less than two buildings, or no two buildings are within 200m of each other (for refurbishment projects only), this credit is 'Not Applicable' – type "na" in the 'Number of Points Achieved' column.

5.3.3 TRANSPORT

5.3.3.1 Provision of Car Parking

To encourage and recognise building design that promotes the utilisation of alternative modes of transport by limiting available car park spaces.

Up to two points are awarded where it is demonstrated that the number of car parking spaces to be provided on the site is reduced, as follows:
• 1 point = at least 25% less than the maximum local government requirements or equivalent or within 10% of the minimum local government requirements or equivalent if only a minimum is stipulated;
• 2 points = at least 50% less than the maximum local government requirements or equivalent, or no more than the minimum local government requirements or equivalent if only a minimum is stipulated.

Where there is no new car parking associated with the project this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

Where there is a nett reduction in car parking on a campus as part of the new development then this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.3.3.2 Fuel Efficient Transport

To encourage and recognise building design that supports the use of fuel efficient transport.

One point is awarded where it is demonstrated that:

• 25% of the total parking spaces on the site are designed and labelled for small cars in accordance with AS/NZS 2890.1:2004 (i.e., 2.3m wide x 5.0m long) and/or mopeds/motorbikes. The greater of 10 parking spaces or 10% of the total parking spaces must be for small cars. For less than 10 total parking spaces, all must be for small cars; AND
• A minimum of 10% of the total preferred parking spaces (i.e., located near the facility entrance) are dedicated solely for use by carpool participants, hybrid or other alternative fuel vehicles. These car spots must be clearly signposted and marked with a separate colour from other spots. Carpool participants must be registered as part of a documented carpooling program.

Car parking spaces dedicated for disabled users can be excluded from the total number of car parking spaces.

Where there is no new car parking associated with the project, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.3.4 WATER

5.3.4.1 Potable Water Use in Laboratories

To encourage and recognise reduced demand on potable water supplies due to equipment cooling.

Two points are awarded where it is demonstrated that:

• 95% of the water requirement for once-through cooling is sourced from non-potable water; OR
• There is no once-through cooling for any equipment (excluding water for cooling tower makeup or other evaporative systems).

If less than 10% of the UFA is devoted to laboratories, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.3.5 MATERIALS

5.3.5.1 Re-use of Façade

To encourage and recognise the reuse of existing façades to reduce new material consumption.

Two points are awarded where it is demonstrated that at least 50% of the total façade of the building by area comprises reused building façades.

If the site is a greenfield site OR the total floor area of existing buildings demolished on-site is less than 30% of the NLA of the new building then the credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.3.5.2 Re-use of Structure

To encourage and recognise the reuse of existing structures to reduce new material consumption.

Up to three points are awarded where it is demonstrated that a design allows for the reuse of a significant proportion of an existing major structure by gross building volume and where the reused structure comprises at least 50% of the total final structure by building volume. Points are awarded as follows:

- 1 point = 30% reuse of existing structure;
- 2 points = 60% reuse of existing structure; and
- 3 points = 90% reuse of existing structure.

If the site is a greenfield site OR the total floor area of existing buildings demolished on-site is less than 30% of NLA of the new building then the credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.3.6 LAND USE AND ECOLOGY

5.3.6.1 Re-use of Land

To encourage and recognise the reuse of land that has previously been developed.

One point is awarded where it is demonstrated that the site has been previously built on. For the point to be awarded over 75% of the site must comply with the criteria.

5.3.6.2 Reclaimed Contaminated Land

To encourage and recognise positive actions to use contaminated land that otherwise would not have been developed.

Two points are awarded where it is demonstrated that the land prior to development was defined as contaminated and where adequate remedial steps have been taken by the developer to decontaminate or safely encapsulate the site prior to construction.

This credit is 'Not Applicable' for refurbished buildings - type "na" in the 'No. of Points Achieved' column.

5.3.6.3 Change of Ecological Value

To encourage and recognise the minimisation of ecological impact from a development and maximise the enhancement of a site for both new and existing buildings.

Up to four points are awarded where it is demonstrated that the ecological value of a development site is either not diminished, or is enhanced beyond its previously existing state. No points are available for sites which contain rare, threatened or vulnerable flora and fauna. The points are calculated using the Change in Ecology Calculator that compares the relative ecological value of land use before and after development.

5.3.7 EMISSIONS

5.3.7.1 Refrigerant GWP

To encourage and recognise the selection of refrigerants that reduce the potential for increased global warming arising from the emission of refrigerants to the Earth's atmosphere in the event of accidental release of intensive greenhouse gases to the atmosphere.

Two points are awarded where it is demonstrated that all refrigerants have a Global Warming Potential (GWP) of less than 10 OR where no refrigerants are used.

5.3.7.2 Refrigerant Leak Detection and Recovery

To encourage and recognise systems that reduce and prevent unnecessary loss of refrigerants in the event of a leak.

One point is awarded where it is demonstrated that a refrigerant leak detection system with a manually triggered automated pump down system is installed. The refrigerant must be directed to the heat exchanger or to or dedicated storage tanks with isolation valves.

If there are no refrigerants are used OR if all points in Emi-1 and Emi-2 are achieved, this credit is 'Not Applicable' - type "na" in the 'No. of Points Achieved' column.

5.3.7.3 Reduced Flow to Sewer

To encourage and recognise building design that reduces water flows to the municipal sewerage systems for treatment.

Up to two points are awarded where it is demonstrated that the outflows to the sewerage system due to building occupants' usage have been reduced through the use of greywater or blackwater reuse systems. The number of points are determined using the Sewage Calculator.

5.4 INNOVATION

5.4.1 INNOVATIVE STRATEGIES AND TECHNOLOGIES

To encourage and recognise the spread of innovative initiatives for building applications that improve a development's environmental impact

Up to five Innovation points are awarded at the discretion of the Green Building Council of Australia (GBCA) where it is demonstrated that an innovative strategy or technology is eligible for AusIndustry Research and Development tax concessions and has a significant environmental benefit. The application will be assessed by the GBCA against the following criteria:

- Does the application comply with AusIndustry Research and Development tax concessions requirements?
- What is the environmental benefit of the innovation?
- More than one innovation can be submitted, however, the maximum points available for any one building assessment under Inn-1, Inn-2 and Inn-3 is five (total).

5.4.2 EXCEEDING GREEN STAR BENCHMARKS

To encourage and recognise design initiatives that demonstrate additional environmental benefit by exceeding the current benchmarks in Green Star - Education.

Up to five Innovation points are awarded at the discretion of the Green Building Council of Australia (GBCA) where it is demonstrated that the building exceeds, by a measurable margin, one or more existing Green Star – Education credit category criteria. The application will be assessed by the GBCA against the following criteria:

- How has the building initiative exceeded the benchmarks in the Green Star – Public Building rating tool?
- What is the measurable environmental benefit of the innovation?
- More than one innovation can be submitted, however, the maximum points available for any one building assessment under Inn-1, Inn-2 and Inn-3 is five (total).

5.4.3 ENVIRONMENTAL DESIGN INITIATIVES

To encourage and recognise design initiatives that have a significant measurable environmental benefit and that are not awarded points by Green Star – Public Building.

Up to five Innovation points are awarded at the discretion of the Green Building Council of Australia (GBCA) where it is demonstrated that a design feature provides a significant environmental benefit but is not awarded points under the Green Star – Public Building rating tool criteria.

The application will be assessed by the GBCA against the following criteria:

- What is the measurable environmental benefit of the innovation?
- Which significant environmental benefits of the innovation have been addressed by Green Star – Public Building credits?
- More than one innovation can be submitted but the maximum points available for any one building assessment under Inn-1, Inn-2 and Inn-3 is five (total).