Appendix C

ESD Report

Sydney Water

Sydney Water, Potts Hill

EA Sustainability Report

ISSUE 1

Sydney Water

Sydney Water, Potts Hill

EA Sustainability Report

June 2008

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Job number 205424-00

Job title	Sydney Water, Potts Hill	Job number 205424-00	
Document title	EA Sustainability Report	File reference	
Document ref			

Revision	Date	Filename	0003EA Issue 1 Report.doc		
Draft 1	25/06/08	Description	First draft		
			Prepared by	Checked by	Approved by
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Issue 1	25/06/08	Filename	0003EA Issue 1 Report.doc		
		Description			
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		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

Contents

1 Introduction

On the 28th of May 2008, a workshop was carried out to gather initiatives and guidelines for the proposed project to fulfil the needs of the Sydney Water Potts Hill development, consisting mainly of office spaces.

One of the main objectives is ensuring the environmental performance of the building. It is also fundamental to provide improved working environment in an energy efficient and cost effective manner. Water efficiency was also considered an essential feature of the building, and this issue was agreed to be clearly reflected in design and technological strategies proposed for the building.

The purpose of this document is to discuss the master planning strategies and ESD opportunities that will guarantee high levels of environmental performance and an increment on occupant's health, productivity, comfort and satisfaction.

The following areas were the main focus of the design team:

- Energy –reduce energy use and greenhouse gas emissions. The building envelope and services have been integrated to ensure the building is controlled to maintain the desired conditions whilst optimising the energy efficiency of the complex.
- Indoor Environmental Quality – design the building to maximize occupant comfort addressing issues of thermal and visual comfort and indoor air quality.
- Water –minimize potable water consumption and optimise the water efficiency of the development.
- Material – minimize waste, encourage reuse and recycling of materials and use low environmental impact materials.
- Transport – encourage more energy efficient and less polluting forms of transport to and from the site
- Benchmarking – The building is to be designed to achieve a 5 star ABGR and 5 star Green Star rating for the office areas.

Benchmarking the building against current best practice has been done from the beginning of the design process. For that reason, a minimum rating of 5 (five) stars under the Green Star rating tool is targeted.

The proposed ESD initiatives will be developed during future design stages by the design team to lead to a minimum Green Star Office Design rating of five (5) Stars. By aiming at some of the highest environmental performance standards, the building is intended to be an Australian landmark in sustainable design. Projects rewarded with Five (5) Star rating under the Green Star tool are considered sustainability landmarks and are recognized as "Australian Excellence". It is however important to state that the process focuses on good and creative sustainable design solutions, not on 'points collection'.

Future scenarios such as predictions of climate change and peak oil should also be considered in any new building. The building should be developed to current best practice but be flexible enough to accommodate the impacts of these scenarios. Climate change and peak oil scenarios indicate that energy prices may rise significantly as we shift from an oil-based economy to a more varied economy that uses renewable and low carbon emmiting forms of energy.

As buildings are responsible for 40% of CO_2 emissions there is need to further reduce their environmental impact in the coming years. This involves incorporating the flexibility required to accommodate mechanical systems and fit-outs that feature energy efficient technologies and the ability to adapt to multiple uses. As façade and structural systems are not easily modified these have been developed to allow for flexibility of use. In addition the building needs to be flexible to respond to future work practises.

2 Background

This section introduces a background on environmental, social and financial benefits that sustainable initiatives can deliver to a building and its occupants.

Arup recognizes and emphasises the importance of green buildings in terms of environmental preservation, occupant's health, safety and well being, as well as in terms of greenhouse gases emissions reduction. Moreover, based on experience, Arup also identifies the high potential for green buildings to reduce operational costs, representing models of environmental and economic sustainability.

Many green initiatives have medium to long term financial paybacks. These initiatives are often ignored unless an extended payback lifetime is considered. When the building is to be occupied by the client (which is the case of the new Sydney Water Potts Hill building) these long term benefits are usually considered. This long term time scale is often identified as reasonable for the assessment of green initiatives.

The following are some common design technologies that along with simple design inclusions have been considered and will typically improve the environmental performance of a building, delivering long term financial benefits:

- Right Sizing of the mechanical plant can ensure the plant is working at its peak efficiency and will typically reduce the capital cost of the plant;
- Variable Speed Drives (VSD) controls the speed of pumps, fans and other mechanical plant to ensure that they only using as much power as it is needed;
- Building Management System (BMS) commissioning involves the commissioning of all building systems to ensure their correct operation;
- Having high efficiency lighting and air conditioning equipment will reduce the energy consumption of the building;
- A high performance façade will limit the heat entering the building, reducing required plant sizes and the energy use over the year
- A mixed mode approach allowing the building to be naturally ventilated when outdoor conditions are suitable allowing significant energy reduction by not requiring the air conditioning system to operate at all times.

The building industry accounts nowadays for more than 40% of total greenhouse gas emissions (The Department of the Environment and Heritage, Australian Greenhouse Office Design, 2005) partially due to the manufacture of high embodied energy materials and building components, and mainly as a result of poor passive design that usually doesn't consider natural elements as the sun and winds to promote higher levels of energy efficiency.

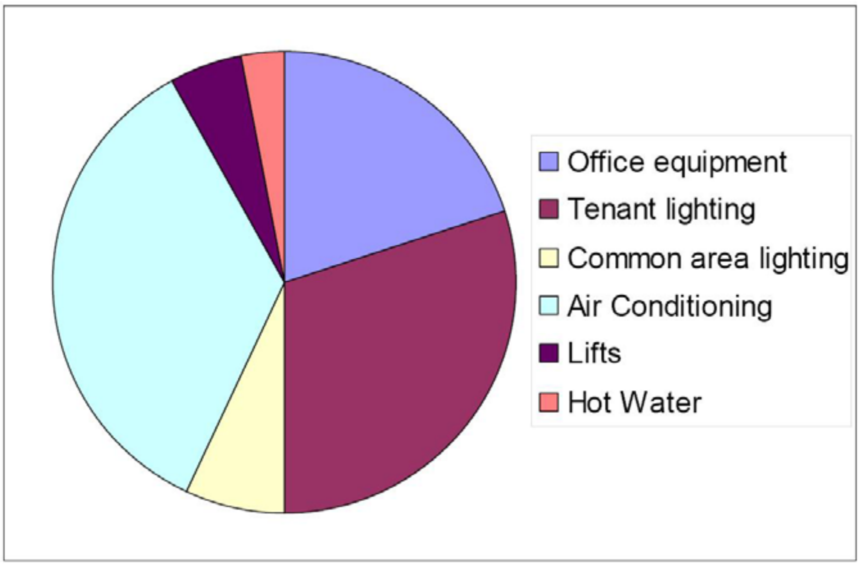


Figure 2.1: Typical energy usage breakdown for office buildings

Conventional buildings are therefore likely to waste and spend more energy on artificial cooling and heating to restore thermal comfort to their occupants. In that sense, operational costs are increased, and not only environmental, but economic sustainability goals are not achieved. This scenario ultimately represents wastage of economic resources in the long term.

A typical energy usage breakdown for office buildings, shown on Figure 2.1 re-enforces the importance of incorporating passive design strategies in accordance with the local climate. Air Conditioning represents the largest slice of the chart.

Passive design strategies that could improve efficiency of Heating Ventilation and Air Conditioning (HVAC) systems are therefore key aspects of a green building design.

Office lighting is also a major consumer of energy. Again passive design combined with good control and commissioning can have a major impact on energy consumption.

Many research studies indicate that green buildings provide healthier, thermally comfortable and safer indoor environments ultimately leading to an increment in occupant's productivity and reduction in absenteeism.

Giving the occupants of a building the ability to control their ventilation, temperature, lighting levels and access to daylight has been shown to provide increased productivity.

Figure 2.2 shows various case studies relating Indoor Environmental Quality and individual control to an increment in productivity levels among office buildings occupants.

A conservative value of one (1) to one point five (1.5) percent gain in occupant productivity has been reported through the combination of these measures.

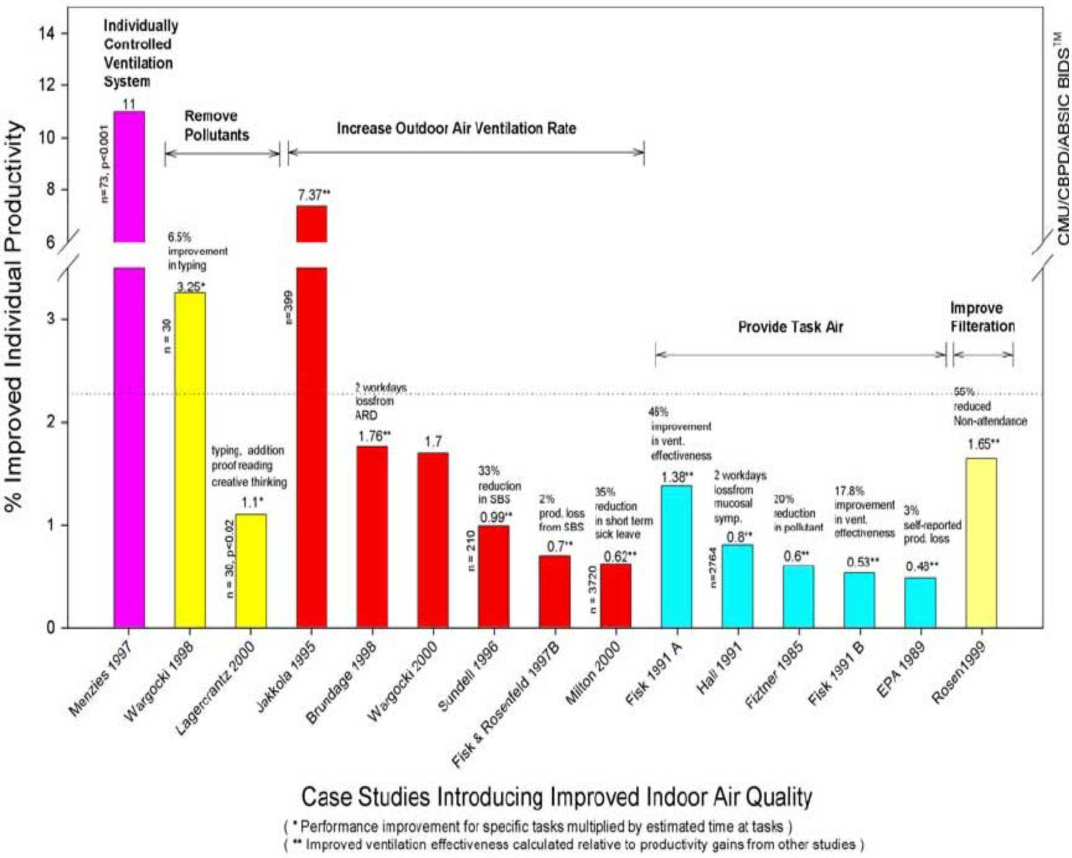


Figure 2.2: Impact of Indoor Environmental Quality and Individual Control on the improvement in productivity levels

Combining the areas of energy efficiency and productivity gains, the draft report by The Department of the Environment and Heritage *"Incorporating Energy Efficiency and ESD into Australian Government Owned and Occupied Buildings: Guidelines for Briefing of Design Consultants"* indicates that if a 20 year payback period is considered it might be possible to attribute a NPV to the design of green buildings. The following table demonstrates savings from energy and potential productivity improvements in performance[1]:

Initiative	**Indicative Yield**	**20 Year Net Present Value of Benefit (at 8%)**
Setting leading practice energy targets	50% energy reduction (100 kWh/sqm/yr) over standard commercial design	**$88 per sqm**
Setting leading practice targets for lighting, air quality, visual amenity, individual comfort control, etc (ESD Targets)	1% improvement in workforce productivity on $100,000 per 20 sqm leased area	**$491 per sqm**
	Total	**$579 per sqm**

Table 2.1: Estimated NPV from ESD leading practice

[1] Source: Engineers Australia Task Force on Sustainable Energy in Buildings and Construction, 2000 (Available at **Incorporating Energy Efficiency and ESD into Australian Government Owned and Occupied Buildings: Guidelines for Briefing of Design Consultants** - Draft report by The Department of the Environment and Heritage, Australian Greenhouse Office Design, July 2005)

A similar study was conducted by Gregory H. Kats[2] (2003) considering LEED[3] certified buildings. The author suggests that a NPV benefit of between $700 and $920 (in Australian Dollars) per square meter when considering resources (water and energy), maintenance and emissions (cost of carbon) long term (20 years) savings, productivity and health improvements, and an average extra cost of green buildings based on the US market, as demonstrated next:

Saving Category	**20 year NPV per sqm**
Energy	$A82.15
Emissions	$A17.00
Water	$A7.08
Operations & maintenance	$A120.40
Productivity and health improvements	$A522.62 to $A783.22
SUBTOTAL	$A749.00 to $A912.00 (rounded down)
Average extra cost of building “green”	$A43.00 to $A71.00 (rounded up)
TOTAL 20 year NET BENEFIT	**$A706.00 to $A841.00**

Table 2.2: Benefits reported from LEED certified buildings in the USA (Original source: KATS, 2003). Figures converted from per sq ft to sqm and US$ at exchange rate of A$1.00 = US$0.76)

In addition, Green Buildings certified by nationally recognized organizations, such as the Green Building Council of Australia (GBCA) usually improved its image and visibility within the industry.

This means that within a medium to long term period, green buildings are profitable and economically sustainable if the sustainability approach is adopted in the early stages of the design process and through integrated design.

“Integrated design is a critical and consistent component in the design and construction of green buildings” (LUCUIK et al, 2005, p. 6).

[2] KATS, 2003. **Green Building Cost and Benefits**, Massachusetts Technology Collaborative

[3] LEED: Lleadership in Energy and Environmental Design is the design based environmental rating tool largely used in the United States, created by the US Green Building Council.

3 ESD Initiaves

Aiming at leading practice in energy and environmental targets, the design team focused on the following strategies for the proposed building:

- Energy efficiency
- Improved Indoor Environmental Quality for building occupants
- Water strategies to minimize potable water consumption and address stormwater management
- Use of reused or recycled materials to reduce embodied energy
- Effective transport strategies to reduce vehicular emissions
- Environmental benchmarking – a minimum Green Star Office Design rating of 5 stars and a minimum ABGR rating of 5 stars.

These issues have been addressed by the design team through the following initiatives:

- High performance building envelope to improve energy efficiency and address indoor environmental quality (visual, acoustic and thermal comfort).
- Highly efficient mechanical system.
- Rainwater harvesting to cater for toilet flushing and irrigation within the site
- Management of stormwater on site before discharging into the public infrastructure
- Selection of reused /recycled materials where possible.

The design concepts incorporated in the report are discussed in detail in the following sections:

3.1 Building Envelope

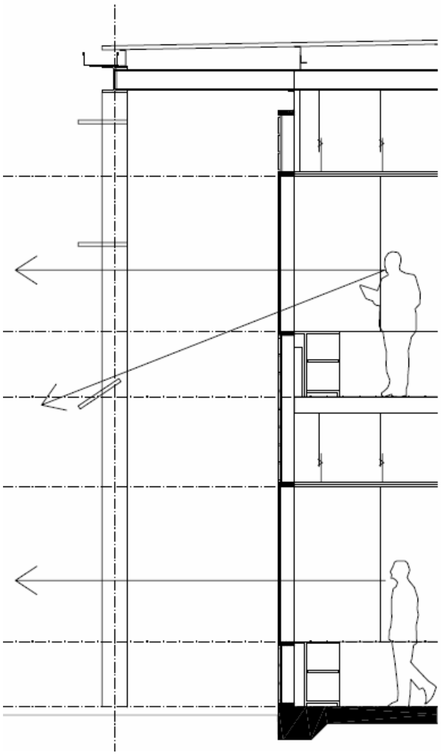
The building envelope is essential in the design to guarantee the delivery of an appropriate environment to respond to the brief requirements. The role of the envelope is to block solar gains from penetrating the building fabric in summer while optimising daylight and minimizing glare. The glazing performance and shading configuration for each orientation will be optimised to ensure that thermal comfort is achieved and solar gains are adequate for the efficient operation of the mechanical system.

The proposed building is intended to be a mixed mode building, being capable of operating on the naturally ventilated mode during off peak temperatures periods, and on a mechanical cooling mode during the hottest half of the year. The building envelope will be designed to achieve maximum benefits from both operation modes.

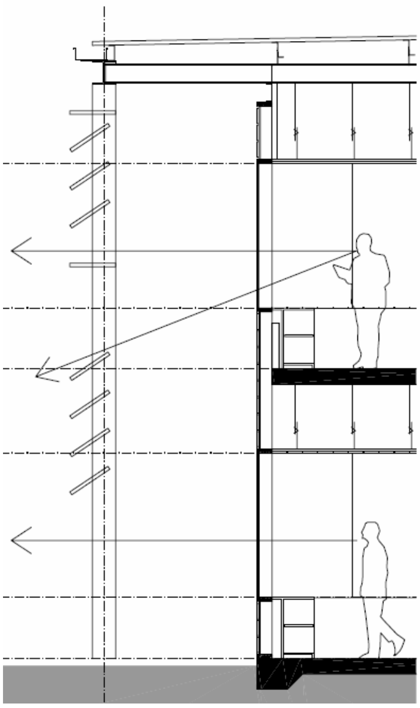
The facade for the office building is proposed as high performance facade with operable elements strategically placed to allow natural ventilation. Externally, facades are being designed with shading devices to protect the building against direct solar radiation along the north, west and east aspects of the building. The façade is also responsible for optimising thermal comfort and minimizing solar heat gains to minimize the required hours of operation of the proposed mechanical system.

This type of facade configuration shall be effective in minimizing direct solar loads whilst maximizing daylight penetration and access to views. Glazing properties were specified in conjunction with the shading arrangement on each orientation to control solar loads imposed on the mechanical systems, ensuring thermal comfort, optimising daylight penetration and preventing glare.

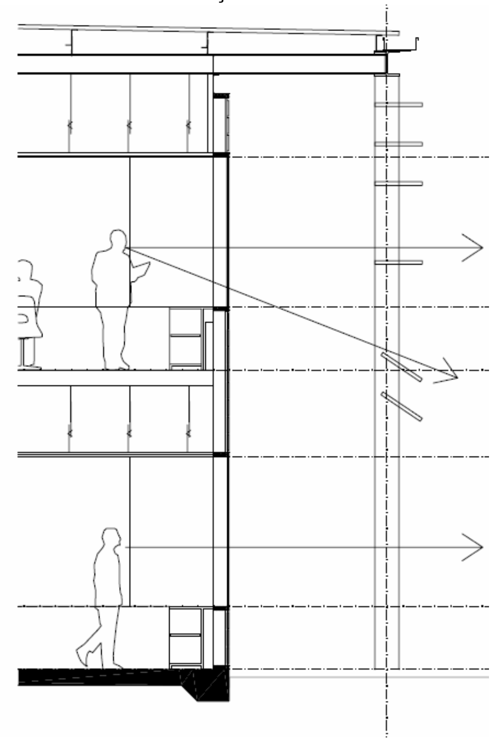
3.1.1 North Facade



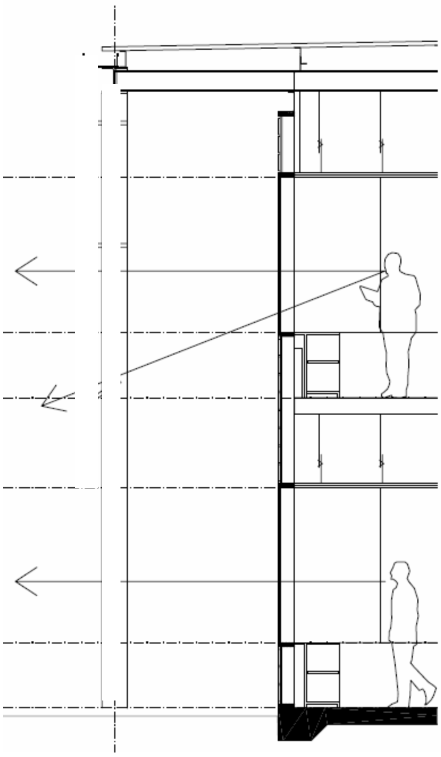
3.1.2 West Facade



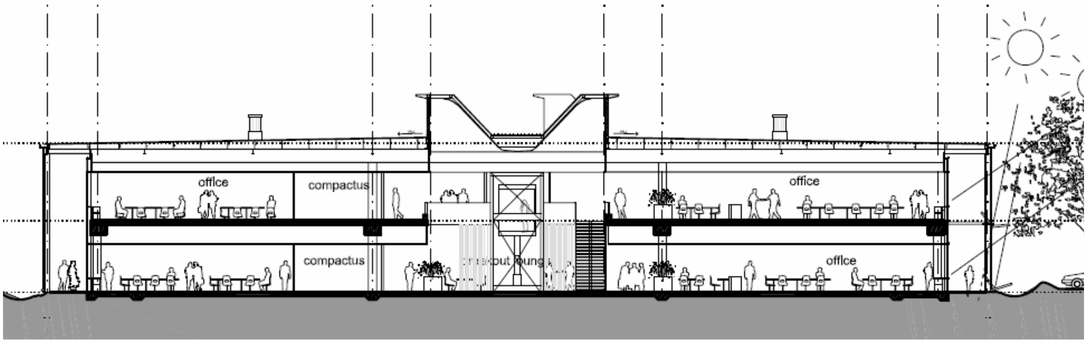
3.1.3 East Façade

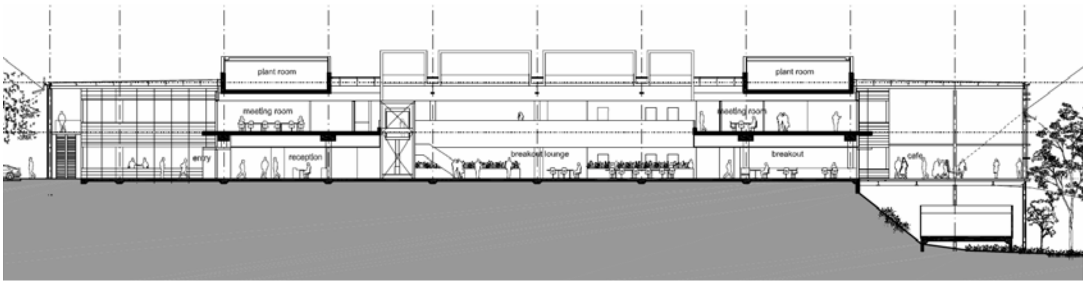


3.1.4 South Facade



The roof design was developed to optimise daylight penetration into the central atrium, and office areas adjacent to it, whilst ensuring thermal comfort is maintained. Strategically dimensioned and positioned daylight openings on the atrium roof shall ensure visual and thermal comfort whilst delivering abundant daylight to occupied spaces creating pleasant and well lit areas and allowing warm air to be naturally exhausted.





3.2 Mechanical System Mode

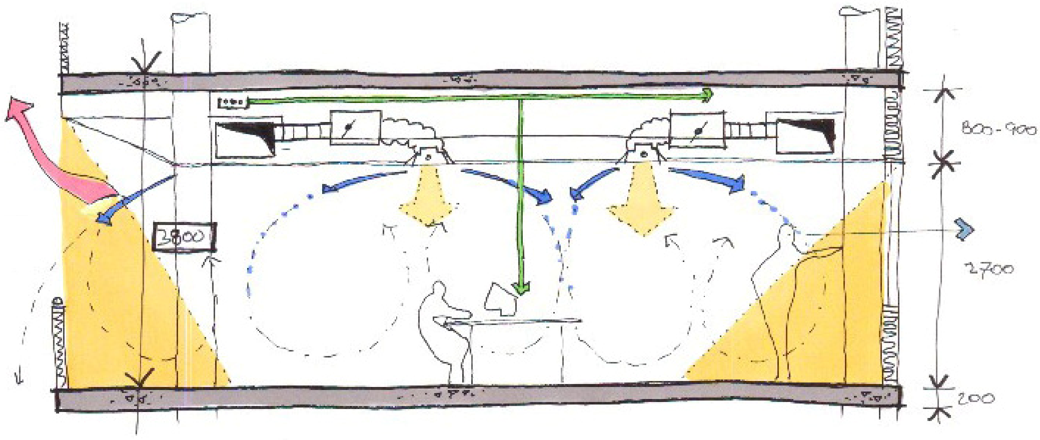
In design, emphasis will be placed on providing an appropriate level of system resilience and quality to ensure efficient operation of the building. The integration between the selected mechanical system and the façade performance play a fundamental role on delivering high levels of thermal comfort to occupants whilst optimizing energy consumption through building operation.

Two options for mechanical systems were considered for the proposed building. The building is being designed to accommodate a VAV system but the façade has been developed to provide the flexibility to also cater for a displacement system. The final selection shall be based on further performance, design and life cycle cost studies. This section presents an analysis of both selected systems and their impacts on building design and performance.

3.2.1 Variable Volume Control System (VAV)

The main advantage of this system is that it can efficiently provide individual cooling requirements for multiple zones, as cooling requirements vary among facades and also due to a concentration of internal heat sources, such as people and equipments.

From a central plant, air at constant temperature is provided to VAV units in each zone. A damper inside the unit is thermostatically controlled, and regulates the amount of cooling delivered to the zone.



Some advantages of this system are:

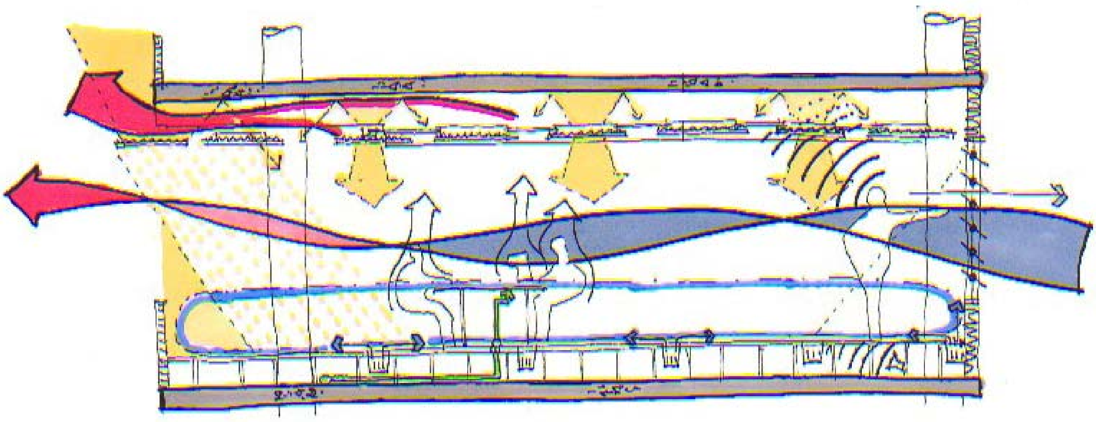
- It is a simple and well understood system;
- Requires low capital cost;
- Good acoustic performance;
- Good energy efficiency

3.2.2 Underfloor Displacement System

This main advantage of this system is that it can combine good indoor air quality and thermal comfort with relatively low energy consumption.

Cool air is provided to occupied spaces from underneath a raised floor system. The temperature to which the air is cooled is not as low as in a VAV system, as it is provided at occupants level. This means that less energy is consumed in the cooling process. Natural convection is promoted by internal heat sources like people and equipment, making the cool air to move across the space until it gets warm enough and is extracted by exhaust system.

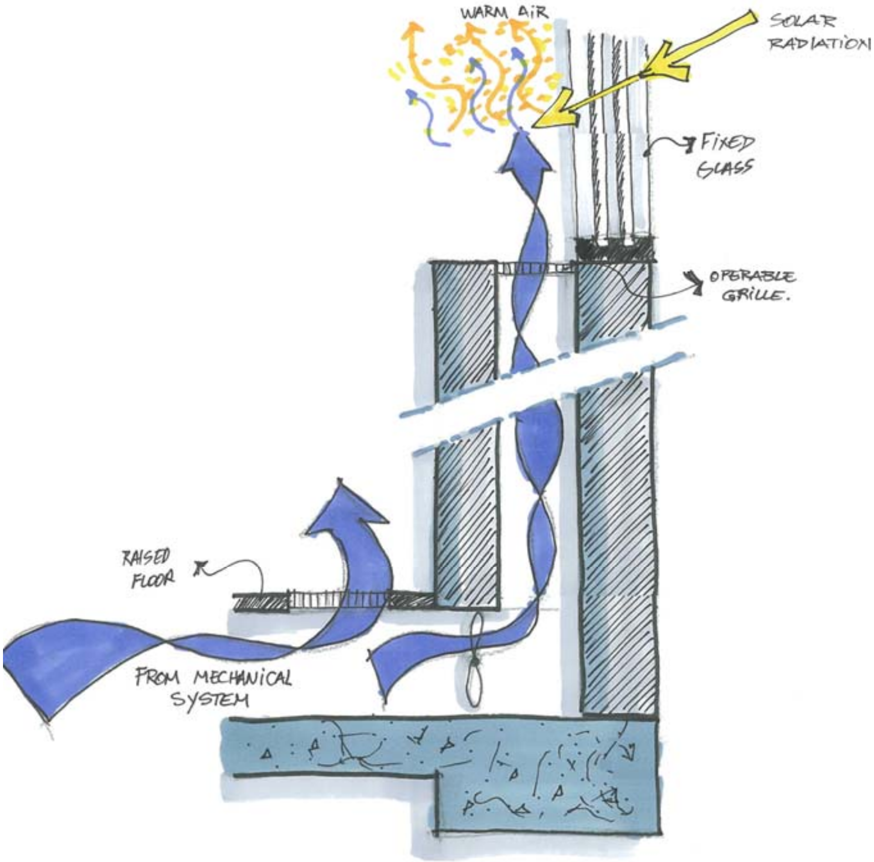
The figure bellow demonstrates the basic functioning of an underfloor displacement system combined with natural ventilation through the façade, suggested to the proposed mixed mode building.



Some advantages of this system are:

- Goof flexibility for cable access and Fitout;
- Potential to achieve high score on energy section of the Green Star rating tool (higher than a VAV system)
- Improved indoor air quality
- Individual control
- Good affinity with open atriums
- Good affinity with natural ventilation
- Reduced maintenance as there are no moving parts such as dampers

As part of the integration scheme between the underfloor displacement system and the façade design, a spandrel area would incorporate high level diffuser to provide air to the façade at lower temperatures at higher levels. This is intended to deal with heat loads from radiation and conduction through the glass at perimeter zones, avoiding discomfort to occupants and ensuring temperatures are controlled effectively within the building.



3.2.3 Central Plant and System Distribution

Air cooled chillers will form part of the central plant. Chillers and heat rejection system are to be combined into a single packaged chiller unit to be located outside. This system does not require cooling towers, as heat will be rejected by the chillers. This is extremely beneficial to occupant's health as it eliminates the risk of legionnaires disease. Also, the inexistence of cooling towers improves water efficiency, which was considered one of the main environmental targets of the proposed building. The avoidance of cooling towers can reduce the use of potable water in the building by up to 80%.

Chillers will be organised in a plant room located outdoors, making easier access for maintenance, whilst the AHU's (Air Handling Units) will be placed on the roof to minimize duct runs and sizes. This configuration will allow the roof form to be streamlined and free of large protruding elements as intended by the design team.

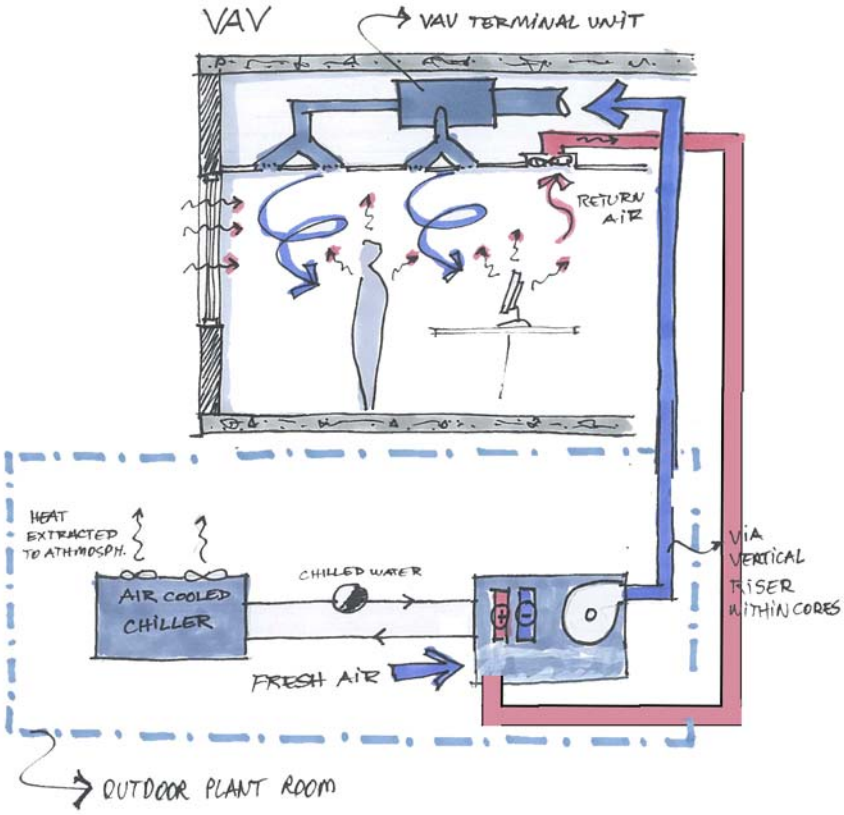
Primary chilled air is to be provided for each zone from the respective air handling unit located on the roof plant room via vertical risers. For the VAV system air would be distributed to the various areas via diffusers located in the false ceiling. If the displacement option were to be adopted air would be reticulated via a raised floor system.

Heating will be provided by reverse cycle. This system works well in mild climates where winter temperatures are usually above zero when the peak heat loss occurs.

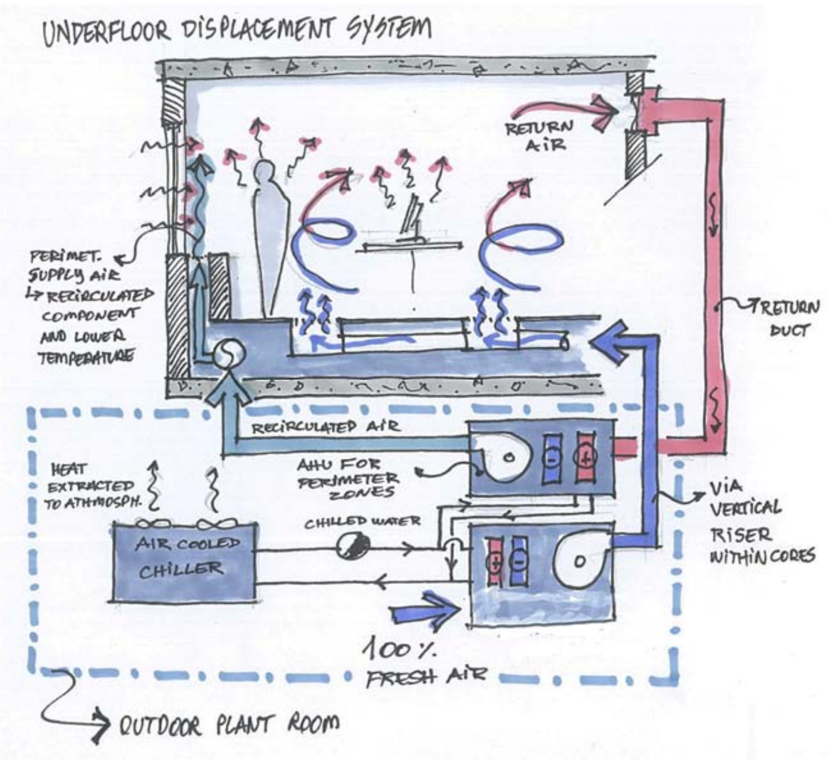
3.2.4 Air Conditioning to Offices

The following figures demonstrate the air conditioning system scheme for office spaces.

For a VAV system, chilled air would be provided to VAV terminal units for each zone, and to ducts and diffusers in between the slab and a suspended ceiling.



The drawing is based on an underfloor displacement system.



3.3 Natural Ventilation Mode

The Natural Ventilation mode is a fundamental aspect of the energy and the indoor environmental strategies. It is intended to be triggered when climatic conditions don't require mechanical cooling (usually mid seasons and winter).

The proposed building design reflects this intention by a series of design decisions taken so far. They are presented in this section.

3.3.1 Narrow Floor Plan

The building was designed to have a relatively narrow floor plan, ideal for an effective naturally ventilated building. Besides increasing the effectiveness of natural cross ventilation, these are some of the benefits from the proposed narrow floor plan:

- Night flush;
- Lower pollutant levels through high ventilation rates;
- Energy use reduction;
- Higher façade performance;
- Daylight penetration;
- External views;
- More effective passive cooling in summer;
- Increased levels of occupant's productivity, due to a healthier indoor air quality

By adopting the narrow floor plan approach, the building could be split into separate units linked to each other by a naturally lit and ventilated atrium. East- West axis is elongated, as ideal for Sydney's latitude. As mentioned previously, to improve the overall energy efficiency of the building, these facades shall receive highly performance double skin glazing.

3.3.2 Automated ventilation openings

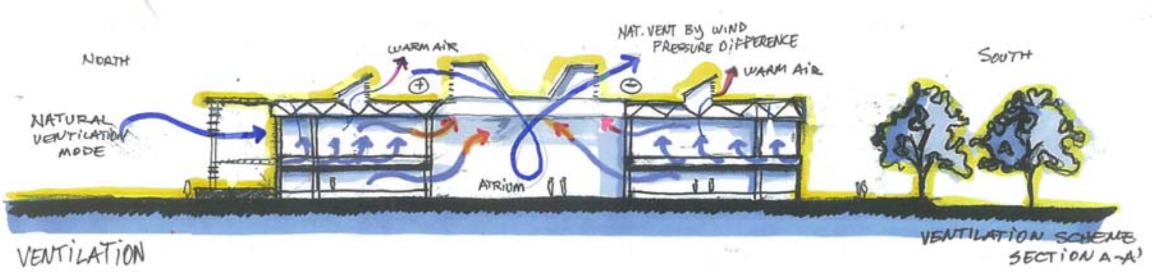
These components of the building design represent respectively the inlet and the outlet of the natural ventilation scheme

Operable windows are located along the building perimeter allowing outside air to be introduced into the envelope for natural ventilation. The atrium skylights and exhaust areas located above the Level 1 floor plates work as exhaust air path for the air.

This approach promotes the stack ventilation effect. Fresh cool air penetrates the building through automated louvers on the façade, cooling the inside air. The warm air is then redirected through convection and wind negative presuures to the exhaust openings on the roof, and then finally extracted.

Atrium skylights are also expected to capture prevailing winds and circulating it within central spaces to promote passive cooling.

The basic functioning of the system is demonstrated next:



3.4 Water

Water recycling is a key component of the total water cycle management and integrated water resource management. Water recycling is fundamental to manage and balance all of the components of hydrological cycle (rainwater, stormwater, wastewater, groundwater, surface water and recycled water) to secure a range of social, economic and environmental benefits. The effective and safe implementation of water recycling strategies can help to reduce inputs of nutrients and other contaminants to surface water, conserve potable water and provide economic and social benefits to local communities.

Water related strategies have been considered since the beginning of the design process as key environmental ones for the proposed building.

3.4.1 Building Water Strategy

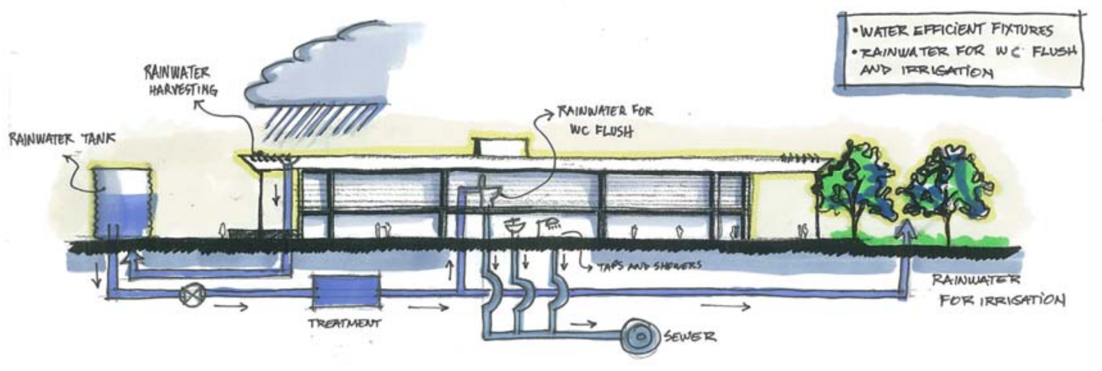
To ensure water resources are maximized within the building Rainwater will be harvested through the roof and tanks sized to provide enough water for all WC flushing and irrigation. The following initiaves have been incorporated:

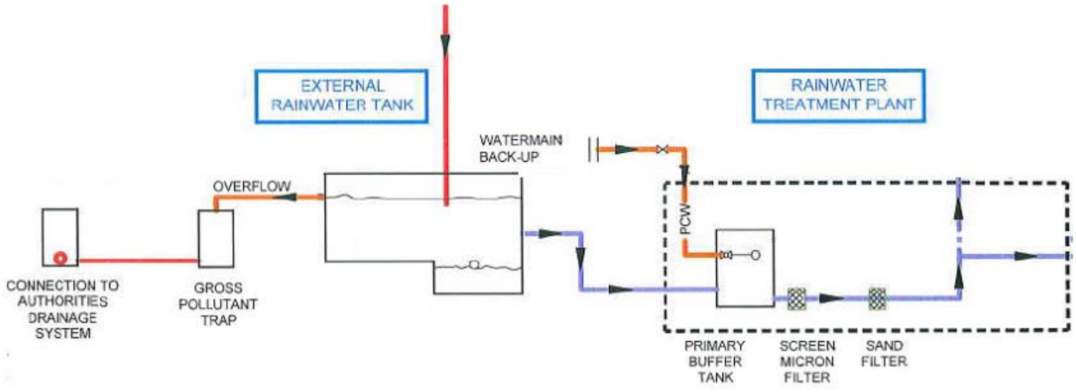
- Water efficient fixtures - 4A rated taps and 3A rated shower heads
- Low flow urinals or waterless urinals
- 3 / 4.5 Litre dual flush toilets
- Water efficient landscape requiring minimum amounts of irrigation;
- Large roof catchment area and rainwater tanks sized to provide 100% of water required for toilet flushing , urinal flushing (if non waterless urinals are selected) and irrigation.
- Treatment: Filtration and Chlorination

Water savings from the system can achieve all available points on the water section of Green Star Office Design rating tool.

These strategies provide a 40% reduction in water consumption when compared a building with no recycling water strategies but that incorporates water efficient fixtures. It reduces potable water consumption by 70% when compared a conventional office building.

The figure bellow demonstrates the basic scheme of the system.





3.4.2 Water Sensitive Urban Design

Water Sensistive Stormwater management strategies have been implemented where possible as the site presented challenges to the design team. The soil consists mostly of clay which is impervious to water. This limits the amount of WSUD strategies that can be adopted and as a result the development of a stormwater line and detention tank solution was required. In all areas where the soil and site configuration permitted, an extensive WSUD philosophy was integrated into the design.

WSUD principles are intrinsically linked to Ecological Sustainable Development (ESD), specifically the interactions between the urban built form and the urban water cycle. The WSUD approach will manage surface water runoff generated from areas of hard impervious surfacing on site such as the internal Transit-ways (i.e. circulation roads, cycleways, bus-lanes), car parks, pedestrian pathways and gathering areas, building structures and roof drainage systems. In addition, WSUD systems can provide the required degree of protection to the local water environment whilst promoting a more sustainable and integrated process of water management on the site.

The design of the water drainage system has encompassed the philosophy to:

- Identify and maximise available storage across the site.
- Reuse, recycle and reduce the amount of water being utilised as part of the development.
- Make use of infiltration to ground via the installation of permeable conveyance systems where possible.

The design philosophy includes the attenuation of peak flows throughout the system and the use of temporary surface storage in designated areas where appropriate, so that the risk of surface ponding could be alleviated as far as practicable.

WSUD systems have aimed to achieve the following key objectives where feasible:

- Control the quantity of surface water runoff, and thereby reduce flood risk
- Improve the quality of surface water runoff
- Add amenity and environmental features to the development concept
- Recycle natural resources (rainwater harvesting)

An integral component of stormwater management has been to encourage infiltration and natural drainage through the adoption of WSUD systems where possible. The following elements have been integrated into the overall scheme:

- The use of hard standing areas has been minimised by limiting these to internal roads, industrial component of the site and building envelopes.

- Permeable surfacing has been employed to enable rainwater and stormwater runoff to infiltrate to ground via porous pavements in areas where tree planting is required such as the office car park. These porous surfaces are connected to underground stormwater line that stores the runoff water in OSD (on site detention) tank.
- The use of grass-lined swale systems will reduce the need for kerb and guttering and concrete lined drainage systems. Swale systems retard and filter runoff and pollutants, and in particularly remove coarse to medium-sized pollutants.. The use of small swales has been applied to the areas in between opposite car parking bays as a way of providing some water retention surface.

The following figure illustrates the overall stormwater management scheme developed for the Sydney Water site.

The adoption of this type of drainage design will promote a source control approach and, therefore, will reduce the potential volume and velocity of surface water runoff generated across the site. It will also permit additional storage during periods of intense and prolonged rainfall.

1.1 Energy

It is essential to ensure the building is designed and built to minimize energy consumption and reduce or eliminate greenhouse gas emission to the atmosphere. Energy performance is considered by the design team as a crucial issue and the following measures were targeted in the proposed design for the office component of the base building:

- A minimum ABGR rating of 5 stars

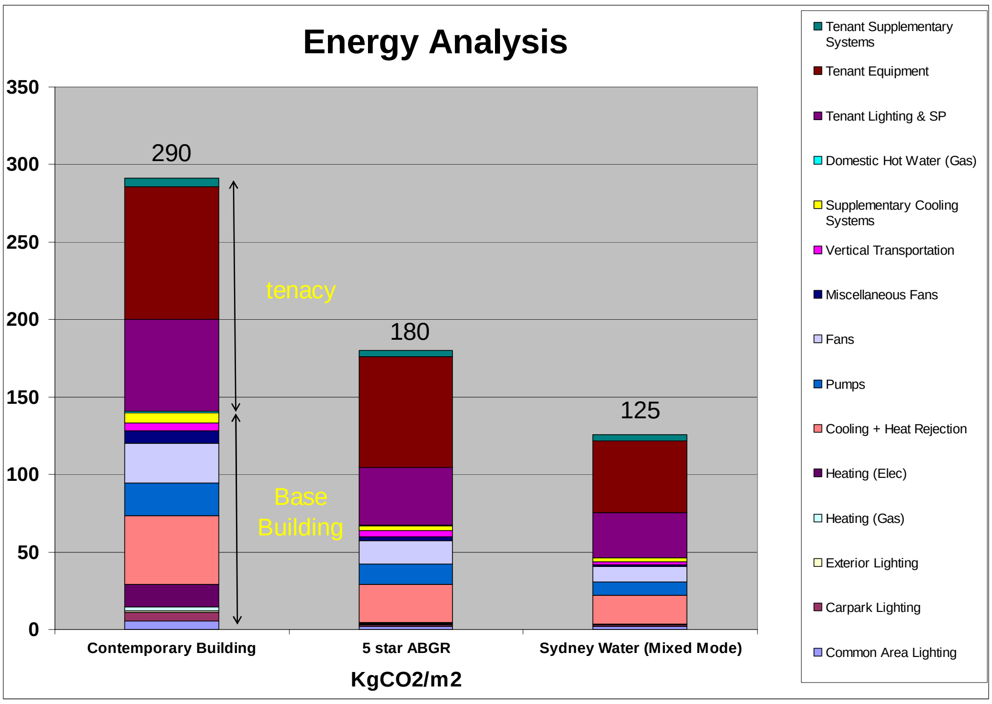
The contemporary typical Sydney office building achieves between 2 and 4 star ABGR energy performance. Typical buildings have high tenant lighting use and out of hours equipment use. Peak loads associated with façade loads and low efficiency equipment are significant. A typical Sydney office building would generally produce around 290 kg/CO2/ m²/ annum.

A 5 star ABGR building will perform 40% better when compared to a conventional office building. Initial calculations demonstrate that the design has the potential to perform 60% better than a conventional office building interms of energy use.

This level of performance is attributed mainly to:

- **Mixed Mode Strategy:** It is expected that not having to use the HVAC system at all times will reduce energy associated with cooling, heating, AHU's and pump energy use by of 30-40%;
- **100% Naturally Ventilated and Day lit Car Park:** The proposed building was designed to have external car parks only, eliminating therefore the need for mechanical ventilation and pollutants exhaust system. Also, there is no need for car park lighting during daylight hours.
- **Reduction on tenant lighting:** Due to increase natural daylight quality, and integration between natural and artificial lighting systems, it is expected that up to 25% reduction on artificial lighting energy consumption can be achieved for this building when compared to a standard design.

The proposed building preliminary estimated energy use for the office component is above the 5 Star + ABGR minimum benchmark. This is an improvement of up to 55% in relation to a typical Sydney office building energy use.



1.2 IEQ – Indoor Environmental Quality

Indoor Air Quality is proposed to be addressed through the design of a high performance facade; highly efficient mechanical system and carefully sized and orientated floor plate configuration. The following IEQ aspects have been considered:

- **Indoor Air Quality** – For the mechanical ventilation/ cooling mode, 100% fresh air would be provided with no recirculated component. Swirl diffusers ensure air mixing and distribution is effective eliminating stagnant areas and hot or cold air dumping zones. When the natural ventilation mode is in operation, operable portions of the facade provide fresh cool air to occupied spaces, whilst warm air is exhausted through skylight openings on the roof.
- **Daylight and Glare** – daylight levels and glare are proposed to be managed by the design of external shading devices. The facade will be designed to maximize access to view by reducing glare from the diffuse sky brightness and reducing reliability on blinds. Improved daylight levels can be expected on the upper level and perimeter of the atrium on both levels, due to skylights on the roof.
- **Thermal Comfort** – To improve thermal comfort a series of strategies have been considered to enable facade performance and the mechanical systems to work as an integrated system and allow for high ratio of air change inside the space, minimization of direct solar radiation and that air velocity and humidity are within adequate conditions. This would be achieved by the integration of a high performance facade and robust mechanical system.
- **Materials** – low VOC and low formaldehyde materials such as carpets, paints and sealants have been considered to reduce gas emissions and ensure indoor air quality is optimised.

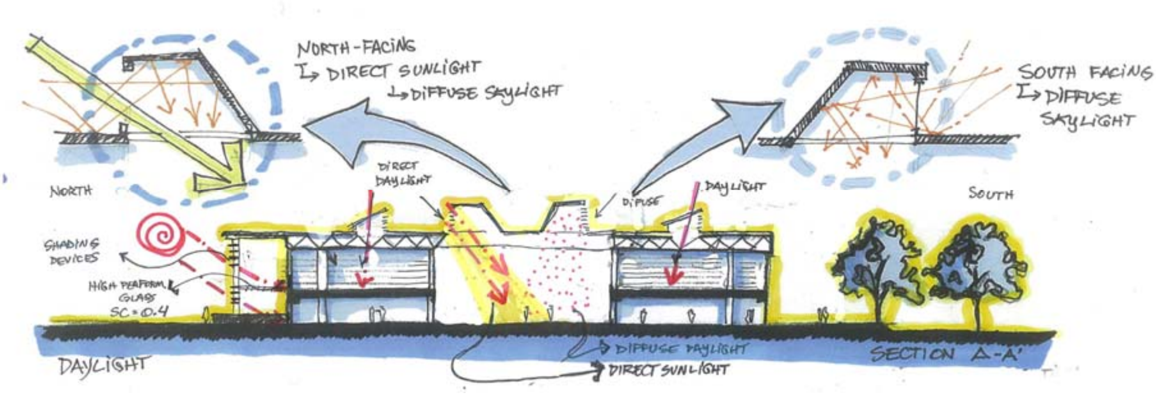
1.3 Daylight

One of the main considerations given to the design was the importance of treating daylight in particular ways as to respond to needs of different areas in the building. Natural light offers benefits such as improving indoor environmental quality, having impact on the health, well being and productivity of occupants, and reduction in energy consumption and green house gas emissions by reducing dependency on artificial lighting systems when integrated with lighting controls.

Lighting is one of the main factors contributing to energy consumption in commercial buildings, thus making daylight availability is one of the key elements of addressing sustainability in a building in the current and future market contexts.

The following elements in the building have been considered to optimise daylight performance:

- Selection of appropriate glass capable of reducing solar loads while allowing generous amount of daylight to penetrate the building envelope. Where glazed portions of the façade were proven not to be exposed to any direct solar radiation the glass visual light transmittance can be increased;
- Utilization of horizontal roof overhangs and shading devices on the north, west and east aspects of the building, reducing exposure to direct solar radiation during the hottest half of the year, minimizing glare associated problems as well as solar gains;
- Utilization of high performance glazing to optimise daylight penetration and thermal comfort on the floor plate;
- Inclusion of skylights above the atrium and upper level office spaces, to increase daylight penetration inside the core atrium and perimeter zones adjacent to the atrium. .



1.4 Materials

The way we as a society have traditionally 'viewed' waste should be modified. The world's resources must be in contiguous circulation and materials should be re-used or recycled. For optimum efficiency, all waste should be treated, redirected or re-used as close to the point of creation as possible to minimize environmental impact of building construction.

The following measures have been considered:

- The mandate for contractors to re-use or recycle surplus material on site
- A waste management program to effectively collect, sort and re-use waste where appropriate to avoid land fill.
- An appropriate waste management strategy in operation to maximize recycling potential and continually improve recycling targets.
- Use of low embodied energy materials (whenever possible) in the construction of the building giving preference to light weight materials
- Maximize the use recycled material in the construction of the building.
- Design construction systems for disassembly making recycling and reuse of components more effective at the of building's life cycle;
- Promote full integration between base building construction and tenancy Fitout works to avoid material waste and replacement.

1.5 Transport

The use of transport (both private and commercial) has been a major contribution to environmental pollution and the excessive consumption of natural resources.

The development has the opportunity to create an environment where pedestrian access is crucial and the use of fuel efficient private car is stimulated by:

- Encouraging walking and cycling by ensuring provision of bicycle facilities for building users;
- Provision of preferred parking spaces dedicated for use by car- pool participants, small and hybrid cars, or any other alternative fuel vehicles to encourage the reduction on petrol consumption, therefore minimizing pollutants emission and fossil fuels consumption.

1.6 Green Star

The building has been designed to achieve a minimum 5 star Green Star rating. The following table summarizes the credits that can be achieved by the proposed design, with a worse case scenario for mechanical system (VAV).

Category	Title	Credit No.	Points Available	BASE Scheme	Weighted Points Achieved
Management					
	Green Star Accredited Professional	Man-1	2	2	1.50
	Commissioning Clauses	Man-2	2	2	1.50
	Building Tuning	Man-3	2	2	1.50
	Independent Commissioning Agent	Man-4	1	1	0.75
	Building Users' Guide	Man-5	1	1	0.75
	Environmental Management	Man-6	2	2	1.50
	Waste Management	Man-7	2	2	1.50
		TOTAL	12	12	9.00
Indoor Environmental Quality					
	Ventilation Rates	IEQ - 1	3	1	0.77
	Air Change Effectiveness	IEQ - 2	2	2	1.54
	Carbon Dioxide Monitoring and Control	IEQ - 3	1	1	0.77
	Daylight	IEQ - 4	3	2	1.54
	Daylight Glare Control	IEQ - 5	1	1	0.77
	High Frequency Ballasts	IEQ - 6	1	1	0.77
	Electric Lighting Levels	IEQ - 7	1	1	0.77
	External Views	IEQ - 8	2	1	0.77
	Thermal Comfort	IEQ - 9	2	1	0.77
	Individual Comfort Control	IEQ - 10	2	0	0.00
	Hazardous Materials	IEQ - 11	0	0	0.00
	Internal Noise Levels	IEQ - 12	2	2	1.54
	Volatile Organic Compounds	IEQ - 13	3	3	2.31
	Formaldehyde Minimisation	IEQ - 14	1	1	0.77
	Mould Prevention	IEQ - 15	1	0	0.00
	Tenant Exhaust Riser	IEQ - 16	1	1	0.77
		TOTAL	26	18	13.85
Energy					
	Conditional Requirement	Ene -	NA	yes	0.00
	Greenhouse Gas Emissions	Ene - 1	20	11	9.48
	Energy Sub-metering	Ene - 2	2	2	1.72
	Lighting Power Density	Ene - 3	3	3	2.59
	Lighting Zoning	Ene - 4	2	2	1.72
	Peak Energy Demand Reduction	Ene - 5	2	0	0.00
		TOTAL	29	18	15.52
Transport					
	Provision of Car Parking	Tra - 1	2	0	0.00
	Fuel-Efficient Transport	Tra - 2	1	1	0.73
	Cyclist Facilities	Tra - 3	3	3	2.18
	Commuting Mass Transport	Tra - 4	5	1	0.73
		TOTAL	11	5	3.64

Water					
	Occupant Amenity Water	Wat - 1	5	5	5.00
	Water Meters	Wat - 2	1	1	1.00
	Landscape Irrigation	Wat - 3	1	1	1.00
	Heat Rejection Water	Wat - 4	4	4	4.00
	Fire System Water Consumption	Wat - 5	1	1	1.00
		TOTAL	**12**	**12**	**12.00**
Materials					
	Recycling Waste Storage	Mat - 1	2	2	1.75
	Building Reuse	Mat - 2	0	0	0.00
	Reused Materials	Mat - 3	1	0	0.00
	Shell and Core or Integrated Fit-out	Mat - 4	2	2	1.75
	Concrete	Mat - 5	3	1	0.88
	Steel	Mat - 6	2	0	0.00
	PVC Minimisation	Mat - 7	2	1	0.88
	Sustainable Timber	Mat - 8	2	2	1.75
	Design for Disassembly	Mat - 9	1	0	0.00
	Dematerialisation	Mat - 10	1	1	0.88
		TOTAL	**16**	**9**	**7.88**
Land Use & Ecology					
	Conditional Requirement	Eco -	0	yes	0.00
	Topsoil	Eco - 1	0	0	0.00
	Reuse of Land	Eco - 2	1	0	0.00
	Reclaimed Contaminated Land	Eco - 3	2	2	1.71
	Change of Ecological Value	Eco - 4	4	1	0.86
		TOTAL	**7**	**3**	**2.57**
Emissions					
	Refrigerant ODP	Emi - 1	1	1	0.40
	Refrigerant GWP	Emi - 2	2	0	0.00
	Refrigerant Leaks	Emi - 3	2	0	0.00
	Insulant ODP	Emi - 4	1	1	0.40
	Watercourse Pollution	Emi - 5	3	0	0.00
	Discharge to Sewer	Emi - 6	4	3	1.20
	Light Pollution	Emi - 7	1	1	0.40
	Legionella	Emi - 8	1	1	0.40
		TOTAL	**15**	**7**	**2.80**
					BASE Scheme
	Sub-total weighted points:			84	**67**

Innovation					
	Innovative Strategies & Technologies	Inn-1	2	0	0.00
	Exceeding Green Star Benchmarks	Inn-2	2	0	0.00
	Environmental Design Initiatives	Inn-3	1	0	0.00
		TOTAL	**5**	**0**	**0.00**

The proposed design has the potential to achieve an overall weighted score of 67 points based on a VAV system, as it has the potential to reach 69 points with an underfloor displacement system. By achieving 67 points, the building is reaching beyond the minimum 60 points required to achieve 5 star Green Star rating. These extra points demonstrate that the design is capable of exceeding the minimum brief requirements and provide a risk margin that guarantee that the building will be able to achieve the Green Star targets. The design will target a minimum of 64 points to ensure a safety margin is provided above the minimum 60 points required for 5 star rating.

Appendix D

Contamination Summary for Eastern Precinct and Bagdad Street

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26 June 2008

Nigel Macdonald
Director
National Project Consultants
PO Box 1060
Crows Nest NSW 1585

E: nigel.macdonald@npc.com.au

Dear Nigel,

Re: Potts Hill Reservoir Facility, Contamination Summary for Planning Application for Eastern Precincts & Bagdad Street

1.0 Introduction

ENSR Australia Pty Ltd (ENSR) was engaged by National Project Consultants (NPC) on behalf of Landcom to complete Supplementary Contamination Assessments (SCAs) of portions of the Potts Hill Reservoir Facility (the Facility). The portions of the Facility investigated by ENSR include Zones 1, 3, 4, 5 and 6.

This letter presents a brief summary of contamination assessment works undertaken at relevant Zones at the Facility, and remediation works that may be required. ENSR understands that the relevant zones for the Project Application are:

- The Eastern Precincts, identified as Zone 5 and Zone 6;
- Zone 4, fronting Brunker Road; and
- A single lot identified as the Bagdad Street property.

The Potts Hill Reservoir facility is owned by Sydney Water Corporation (SWC). NPC has been appointed by Landcom as project manager for the Potts Hill Redevelopment project. NPC on behalf of Landcom has engaged a NSW EPA accredited (Land Contamination) Auditor, Mr Graeme Nyland of Environ Pty Ltd, to provide Audit services associated with the redevelopment project.

ENSR understands that the Zones will be developed by Landcom for commercial/industrial land use, except Bagdad Street, which will be developed for residential with garden accessible soil land-use.

2.0 Background Information

A Phase I Environmental Site Assessment (ESA) of the facility was completed by SWC's Environment & Innovation Division in July 2003. Subsequent to the Phase I ESA, intrusive investigations and sample analysis programs (or Phase II ESAs), were completed by URS Corporation Pty Ltd (URS) and Coffey Environments Pty Ltd (Coffey). The Auditor has reviewed the data obtained from these investigations.

ENSR's Supplementary Contamination Assessments have subsequently been undertaken to gain a better understanding of the extent of some identified soil contamination, and also to enable the formulation of Remediation Action Plans (RAPs) that may be required to ensure suitability of the relevant Zones for the proposed land-uses.

The contamination investigations have been undertaken with reference to relevant NSW Department of Climate Change (DECC) and Environment Protection Authority (EPA) published guidelines. RAPs, where and if required, will be completed in accordance with the requirements of DECC/EPA guidelines and State Environmental Planning Policy (SEPP) 55.

The Auditor will review ENSR's investigation reports and any subsequent RAPs. ENSR notes that residual soil contamination (if any) may potentially be suitable to remain at the relevant Zones, as long as it is managed according an Environmental Management Plan (EMP). The EMP, if required, would also require Auditor review and approval.

3.0 Contamination Overview

The URS and Coffey investigations comprised the collection of fill and soil samples for subsequent laboratory analysis to evaluate concentrations of contaminants of potential concern (COPC). The URS investigations included an analysis regime, for various COPC, including petroleum hydrocarbons (i.e. TPH and BTEX compounds), organo-chlorine and organo-phosphorus pesticides, polychlorinated biphenyls, asbestos, herbicides, 'solvents', polycyclic aromatic hydrocarbons (PAH) and a suite of eight heavy metals. On the basis of the URS results, the Coffey and ENSR investigations were undertaken on a more targeted basis.

In summary, the investigations have identified the following:

- **Bagdad Street**: the site is covered in variable fill material to an approximate average depth of 0.3 m. Some asbestos contamination was identified within the fill material. The identified contamination can be excavated and disposed to landfill, and the Site can be made suitable for the proposed residential land-use. Remediation would be undertaken in accordance with a RAP;
- **Zone 4**: no soil contamination identified at concentrations above current commercial/industrial land-use assessment criteria currently endorsed by DECC. Any contamination identified during re-development could be managed appropriately according to the EMP;
- **Zones 5 and 6**: these areas are extensively filled with materials excavated from the reservoirs. Some areas of metal and PAH contamination were identified in the fill material. The contamination would either be retained in-situ (capped by future

buildings and roads etc) and managed according to the EMP, or remediated (i.e. selectively excavated and disposed to landfill) according to the RAPs. Remediation could be undertaken as part of the site re-development process.

4.0 Conclusions

Based on the available soil contamination data, ENSR considers that the relevant Zones are either suitable or can be rendered suitable for the proposed re-development.

The NSW EPA accredited Auditor appointed to the project will provide an independent review and final 'sign-off' on the land-use suitability.

Yours sincerely,

ENSR Australia Pty Ltd (ENSR)

Alex Latham
Associate Environmental Scientist

Paul McCabe
Principal Environmental Scientist