Technical Research Paper 07

Water

Study Outline

This study outline summaries key points raised in one of the 10 technical papers in the pre-occupancy study series that investigates the City of Melbourne's world leading Council House 2 (CH_2) office building. Each technical paper has been developed by independent authors from Australian universities as part of the CH_2 Commercial Green Building Technology Demonstration Project. To obtain copies of the full technical papers visit www.ch2.com.au

This project forms a major part of the CH_2 Study and Outreach Program – a coordinated effort to consolidate the various opportunities for study, research, documentation and promotion generated by the CH_2 office building. The primary aim of this program is to raise awareness of sustainable design and technology throughout the commercial property sector and related industries.

The target audience for these papers is professionals involved in the design, engineering, construction and delivery of office buildings, which explains the technical detail, length and complexity of the studies. Although these papers may be of interest to a wider audience, readers who possess a limited knowledge of the subjects covered should obtain further information to ensure they understand the context, relevance and limitations of what they are reading.

Significant funding for the technical papers was provided through an AusIndustry Innovation Access Program grant and supported by cash and in-kind contributions from the City of Melbourne, Sustainable Energy Authority Victoria, the Building Commission of Victoria, the Green Building Council of Australia and the CH_2 Project, Design and Consulting Team. The Innovation Access Program is an initiative of the Commonwealth Government's Backing Australia's Ability action plan.

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Study Outline – Water

Australia is the driest inhabited continent in the world, yet its people have recorded the second highest per capita water consumption (ATSE, 2004). Melbourne currently uses approximately 500 GL of drinking (potable) water for many uses that do not require drinking quality water (Melbourne Water, 2005).

Where potable water quality is not necessary, recycled water sources should be considered including rainwater harvesting, stormwater, sewer mining, and the use of groundwater. The Victorian Government recognises the importance of water conservation measures and has set targets to reduce Melbourne's per capita drinking water consumption by 15 per cent and increase water recycling to 20 per cent by 2010.

In addition, Melbourne's demand due to population and economic growth is expected to increase by 34 per cent by 2050. In order to meet this increased demand and maintain a sustainable society, the Melbourne Water Resources Strategy recommended water recycling schemes in all new developments, with a target of substituting potable water use by 35 per cent, and the implementation of some form of water use substitution in existing developments by 2050.

The major objectives of this paper are to:

- document the sustainable water conservation measures adopted in the City of Melbourne's Council House 2 building (CH_2);
- provide an overview of international best practice of water conservation in commercial/office buildings;
- critically comment on the expected success and performance of the CH_2 building, and
- comment on the environmental, social and economic benefits of the building's ecologically sustainable development (ESD) features for reducing water consumption and use of mains supplied potable, which include:
  - increasing water efficiency by using water efficient fixtures and appliances;
  - rainwater harvesting and fire-sprinkler test water reuse; and
  - water recycling by sewer mining.

The City of Melbourne plans to reduce water consumption in the municipality by 12 per cent in 2020 (based on 1999 usage figures) despite forecasted residential population growth of 41 per cent during this period. This goal will require local households, businesses and industry to reduce mains supplied per capita water consumption by 40 per cent (Total Watermark, 2004). Case studies carried out by the Institute for Sustainable Futures in Sydney have confirmed water demand in commercial buildings could be reduced by up to 80 per cent and sewage discharge by 90 per cent if the full spectrum of water recycling measures were introduced into the design and operation of new buildings (Chanan et al., 2003).

Green Star Rating

The Green Building Council of Australia launched the first Green Star rating tool in 2003, which is similar to the USA's Leadership in Energy and Environmental Design (LEED[1]) system. These rating systems use a 'whole of building' protocol for assessing the environmental performance of buildings, based on satisfying specified criteria in different categories. These categories include, inter alia, water, energy, and indoor air quality. Within the rating tool, the assessment criteria for water include, water efficiency, water substitution, water metering, cooling towers and landscape irrigation (IISBE, 2004).

A study involving a 500 person office building in the US found the majority of its wastewater (40 kL/day out of a total waste flow of 45.4 kL/day) is blackwater, with greywater comprising only 4.5 kL/day (WSAA 1998). This means that 90 per cent of the building's water usage need not be of potable water standard.

Water management measures implemented by CH_2 fall primarily into four categories, namely (i) water efficiencies, (ii) water reuse (rainwater harvesting and sprinkle water), (iii) water recycling and (iv) innovative water saving initiatives (the shower towers, phase change materials, chilled water cooling system and the plant watering system which are not covered in this study).

1 The Plumbing Industry Commission of Victoria is currently conducting a review of relevant legislation and standards to identify ways to improve test regimes and reuse of water.

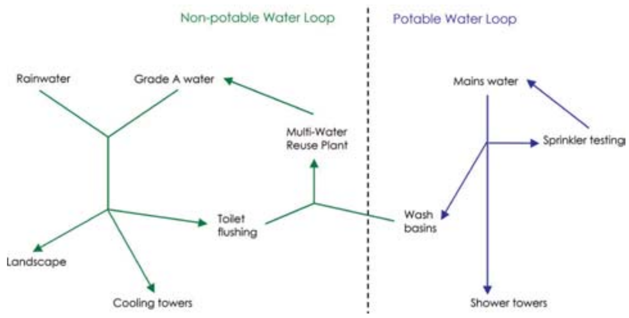

Figure 1: Water Cycle of CH_2 (AEC).

Operation of sprinkler water reuse, sewer water recycling and rainwater collection will reduce the demand for consumption of mains water by more than 70 per cent, resulting in a demand for mains water of about 8.4 litres per day per person.

The design features and innovative technology used in CH_2 are outlined below.

Water Efficiency

Installing efficient fixtures and fittings is one of the most cost effective ways of saving water in any development and could result in a saving of up to 30 per cent. Within CH_2, the following AAAA level fittings are being used:

- Showers – flow rate of 9L/min
- Taps – 4 L/min
- Toilets – 4.5 L flush (smart flush)
- Urinals – sensor triggered flushing

Where water efficient systems are not yet available, allowances are being made for their later addition. For example:

Provide concealed cisterns to all pans with the supply fed from the flushing system, the contractor to investigate the availability of four litre flushing cisterns when and if they become available.

Excerpt from Hydraulic Specification

Approximately 30 per cent savings in mains water supply are predicted from CH_2 fittings compared to conventional fittings. In addition, water loss via leakage usually accounts for 11 per cent of mains water supply both for cities and houses (ATSE, 2004). Therefore, water meters will be installed on the inputs and outputs to all water services in CH_2 to ensure early detection of leaks, and to allow immediate repair and better water management.

Fire Sprinkler Test Water Reuse and Rainwater Collection

The current Victorian Plumbing Regulations and Australian Standards related to fire systems[1] require the use of mains water to test the fire sprinkle system. It is estimated that CH_2 will require 10,000 litres per week for regular testing, which would usually be wasted to the sewer. In CH_2 the sprinkler test water will be collected, stored and used in conjunction with mains water for showers and bathroom basins.

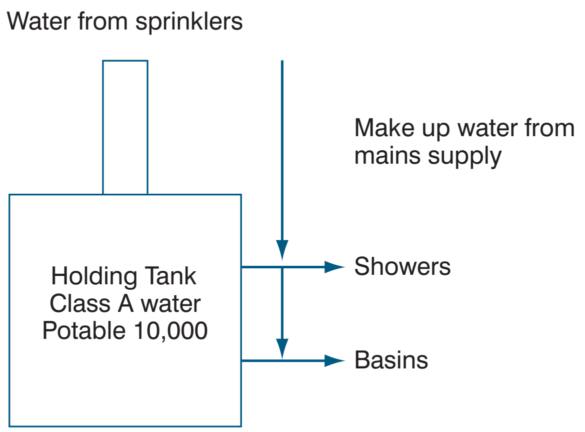

Figure 2: Water collection from sprinklers and its reuse.

Through collaboration with onsite contractors it was proposed that sprinkler water could be further reduced by carrying out testing less often. The Melbourne Fire Brigade is currently reviewing this proposal.

Another water reuse feature of CH_2 is rainwater capture, with its total roof area being used to collect rainwater. Both conventional and siphonic roof drainage were considered for the rainwater collection system. However, the siphonic system was not recommended due to insufficient roof area to produce a high enough water flow rate through the pipes. The roof area of CH_2 is 1500 m^2. Assuming 70 per cent capture, and rainfall of approximately 55 mm/month, a yield of 57 kL/month (0.7 ML/year) is expected. The rainwater collected will be used in conjunction with the treated wastewater for toilet flushing, landscape watering, cooling towers and wash down.

Water Recycling

When selecting a wastewater system for CH_2, careful consideration was given to quantity, quality and space as well as the end use of the water and the seasonal changes in demand for water. The system chosen was the Multi-Water-Reuse (MWR) plant, which comprises three stages of filtration. To run a cost effective treatment system and provide enough water to meet the needs of building users, sewer mining from a main city's sewer was incorporated in the design of the system.

The initial plan was for a capacity of 45 kL/day, but after further consideration, this was increased to 100 kL/day to meet the needs of CH_2, 200 Little Collins Street and the Council's water use requirements for the vicinity. Increasing the capacity of the system will have a positive effect on its viability and performance yet only cost an additional 20 per cent on the original capital cost.

A city's sewer usually contains 95 per cent water, which is a burden on the system and a waste of water. The sewage, along with any generated on site, will be put through a Multi-Water Reuse Treatment Plant that will filter out the water and send the solids back to the sewer. The water recovered will supply all CH_2's water-cooling, plant watering and toilet flushing needs while reducing the burden on Melbourne's treatment plant and supply system.

Chris Arms, CJ Arms and Associates, Hydraulic engineer

The MWT system is a three-stage filtration process: (i) a 200 micron pre-screen; (ii) a ceramic ultra-filtration process (UF); and a (iii) reverse osmosis (RO) process. A schematic diagram of the MWT plant is shown below.

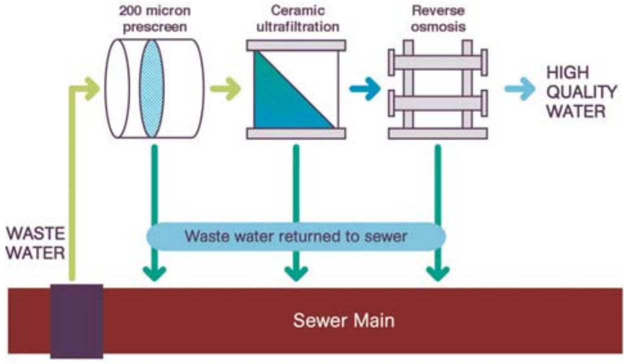

Figure 3: Schematic of the MWR "sewer mining" process.

The recycled water produced at CH_2 using the MWR plants meets all Class A water criteria with some parameters such as Total Dissolved Solids (TDS) levels at 12 mg/L and E.coli at <0.1/100 mL far exceeding the minimum standards set for potable water. Any incident of cross contamination is not possible due to the separation of water supply for human contact from non-human contact uses, such as flushing toilets, watering plants with subsurface flow and cooling tower system. The MWR process recently achieved Class A approval from the Department of Human Services and the EPA, which requires a minimum 6 log removal of bacteria and 7 log removal of viruses (Cooper 2005).

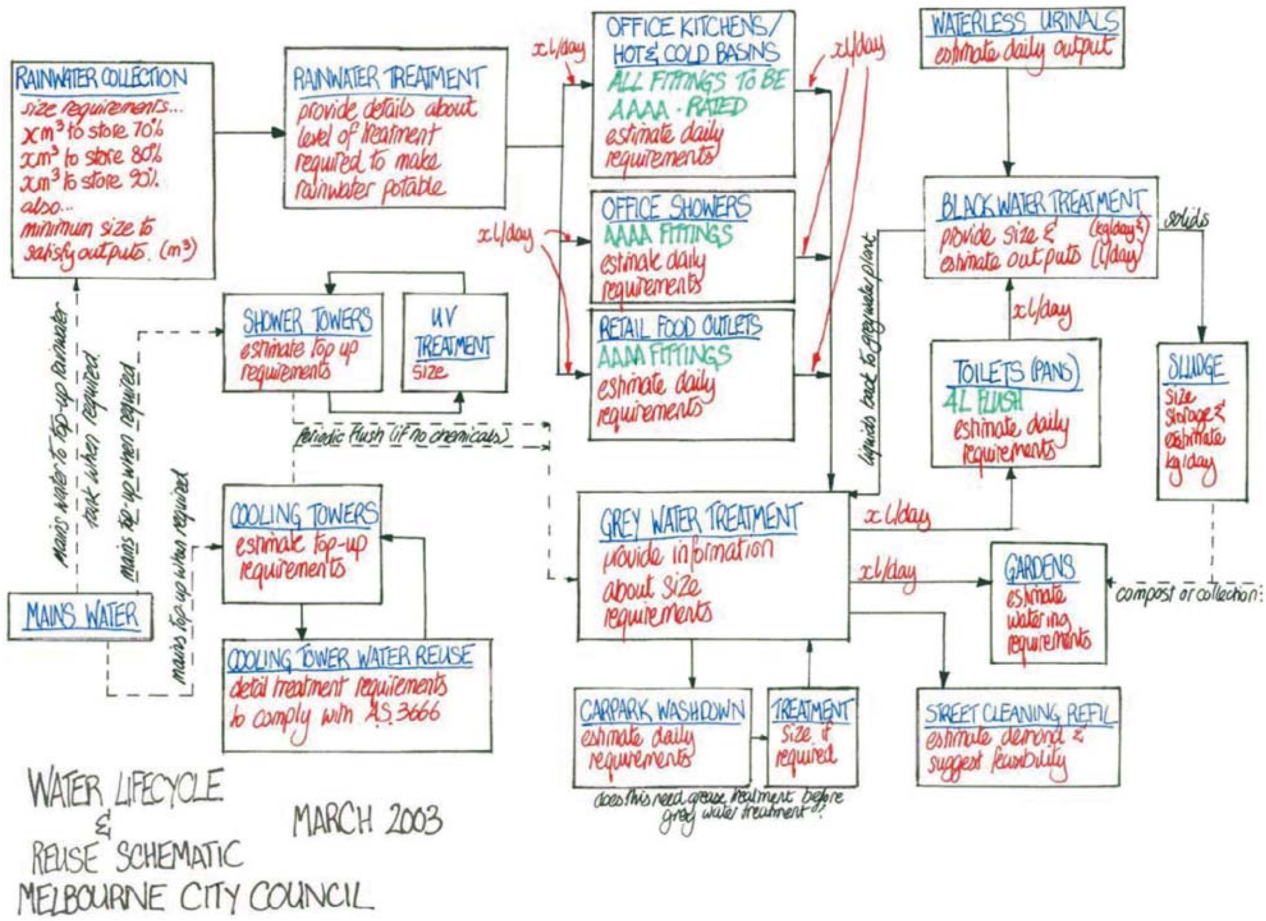

Figure 4: Schematic for CH_2's water lifecycle and reuse.

Other Studies in this Series:

1. **Nature and Aesthetics in the Sustainable City** – form, function, flora, fauna and art;
2. **Workplace Environment** – people, the built environment, technology, and processes;
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7. **Water** – reducing consumption and increasing harvesting;
8. **The Building Structure and the Process of Building** – engineering, transport, construction and structural elements;
9. **Materials** – selection based on an eco-audit that factors in embodied energy, process toxicity and off-gassing considerations;
10. **The Business Case for Sustainable Design** – economics, payback, productivity and efficiency.

For more information and access to a complete set of studies, visit the CH_2 Web site at:
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