CHAPTER THREE - CRAFTING WATER SENSITIVE CITIES

3.1 Water sensitive urban design and integrated water cycle management

We have been on a trajectory to water-waste-reduction with the drought-driven uptake of water sensitive urban design.

A plethora of water sensitive urban design projects (too many to mention), predicated on early work often instituted as a result of the requirement to develop and implement stormwater plans, illustrate the present level of highly localised commitment.\(^{147}\)

Local government has been an innovator and early adopter of demonstration sites. Local government has also geared up for change in respect of the policy options in which it has immediate control.

Nillumbik Shire Council water cycle management plan reflects the interest in stormwater management, comprehensively reviewing its Stormwater Management Plan of 2002 to examine ways to reduce water consumption and secure long term potable water supply.

City of Kingston has been ingraining water sensitive design, advancing projects such as the construction of 130 rain gardens.\(^{148}\)

Like the City of Melbourne,\(^{149}\) the City of Port Phillip is thinking of itself as a catchment, telegraphing a sense of itself as situated in a water cycle and system.\(^{150}\)

The City of Melbourne is institutionalising change and seeking to proactively implement climate change adaptation through its urban forests project which is not just about tree planting but also about amenity, water retention and the co-benefit of thermal comfort.\(^{151}\)

Over time the City of Melbourne has developed three major stormwater harvesting projects using a range of techniques. In the Fitzroy Gardens gravity feed is used, Birrarung Marr integrates with the Fitzroy scheme, irrigating street and river trees, and at the Alexandra Gardens and Queen Victoria Market existing ponds and underground tanks are used to produce fit-for-purpose recycled water to replace 119ML/yr of potable water historically used for irrigation in Melbourne.\(^{152}\) It is also continuing to roll out funding for water and energy and other initiatives which meet sustainability criteria through the Sustainable Melbourne Fund and the Environmental Upgrade Fund.\(^{153}\)
Regional local government is also committed to water sensitivity and conservation.

Shepparton Boulevard development.

Over 5000 rain gardens have also been registered with the Melbourne Water Raingardens Program.

In East Gippsland the *Urban Waterway Strategy* is being developed to turn existing drainage lines into community assets.

Wodonga City Council is working on installing a water capture and storage system with tanks, pumps and integrated pipe systems for the *Bonegilla Migrant Experience*.

Yarriambiak Shire Council is working on the installation of rainwater tanks.

The major water management agencies are also proffering potential changes. For instance Melbourne Water is thinking through the institutional issues, developing its *Stormwater Strategy (2012)* and considering planning policy and the issue of integrated water cycle management in city contexts.\(^{154}\)

Over 5000 rain gardens have also been registered with the *Melbourne Water Raingardens Program*.

Figure 14: Raingarden. Source *Melbourne Water*.

A raingarden is a water saving garden that is similar to a regular garden bed, but is designed specifically to capture stormwater from hard surfaces such as driveways, patios and roofs via downpipes after it rains. These gardens are water efficient and improve the health of local creeks. Melbourne Water has set itself the target of promoting the establishment of 10,000 raingardens.\(^{155}\)

We have shown we can address the issues but we now need to consolidate and embed sweeping change.
Adoption of this design strategy gathered pace as we felt our way through the big dry – crisis drove change. This is what we now want to avoid: design of this type needs to become the new normal and it needs to expand its reach and influence moving from a design feature to an operational water cycle integration ethic.

The practice of Water Sensitive Urban Design will almost invariably encapsulate the principles of Integrated Water Cycle Management so our baseline is good.

Urban Design is the planning and architectural design of urban environments, otherwise disconnected with water practice but interactive with environmental effects on land and water.

*Water Sensitive Urban Design* introduces ‘sensitivity to water’ into urban design.

‘Water Sensitivity’ represents the starting point for a *new paradigm* in integrated urban water cycle management, and integrating the social and physical sciences and the disciplines of engineering, environmental sciences and protection of aquatic environments in urban areas.

Community values and aspirations for urban places impact urban design decisions and water management practices.

Taking a holistic view, and including the public in the conversation, it is the blend of Water Sensitive Urban design and Integrated Water Cycle Management that will give us Water Sensitive Cities. These are the sort of cities we will need to adapt to climate change and insulate us from the next droughts.

Water Sensitive Urban Design reinforces the view that is possible to develop cities as sustainable ecosystems, or biophilic cities and build green infrastructure.

Sensitive Urban Design reinforces the view that is possible to develop cities as sustainable ecosystems, or biophilic cities and build green infrastructure.
Considering our level of knowledge it would appear that water sensitive cities are now within our imaginative, theoretical and organisational grasp.\textsuperscript{164} For instance, the Australian Government’s Our Cities, Our Future - A National Urban Policy for a productive, sustainable and liveable future (May 2011)\textsuperscript{165} consolidates the various elements of productive, sustainable and liveable cities into a vision for Australian cities. To ensure cities and their people enjoy the advantage of the ‘services’ that the natural environment provides, avoiding the imposition of unnecessary costs to future generations, Our Cities Our Future promotes the protection and enhancement of natural ecosystems, waterways and biodiversity by incorporating quality green space, micro-climate and water sensitive design into urban systems.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{ Carlton Housing redevelopment.jpg}
\caption{Gardens at Carlton Housing redevelopment. \textit{Image courtesy of Department of Human Services.}}
\end{figure}

In the well designed city of the 21\textsuperscript{st} century the city and the environment are brought together and work together.\textsuperscript{166}
The shift from natural balance to water sensitive urban design can be shown in this way.

Water Sensitive Cities, in which urban water cycles are designed and managed as integrated systems enmeshed with urban design and communities will be the ‘cities of the future’.

Figure 15: Water Balance Scenarios.
National Water Commission.\textsuperscript{167} CfES modified.

Shepparton.
3.2 International movement, local action, community interest in participation

At a national level, water sensitive urban design is being explained and promoted[^168] but we should consider whether there is adequate administrative, legislative, and institutional support for the step change we require. To effect change, we will require enabling policies and water pricing measures that are conducive to change and which provide policy stability. The creation of the new ‘normalised’ water sensitive city will also need to actively cultivate the public.

The rate of adoption of water saving efforts by the community, notwithstanding incentives offered, suggests enthusiasm for the practical work.

Rainwater tank data (ABS 2011) shows the rate of change:

- 706,900 Victorian homes – one in three, an 18% increase in two years - now have rainwater tanks
- Melbourne has seen a 9% increase (22% - 27%) (2009)
- Mornington Peninsula SR (Statistical Region) had the highest proportion of take-up - 40% (50,600)
- Loddon Mallee SR, had the highest take up across the balance of Victoria with 64% (68,800)
- two-thirds of people with a rainwater tank and a swimming pool used the tank to fill the pool.[^169]

Figure 16: Rainwater Tanks Victoria 2011.
Does incremental local and community change lead to a paradigm shift?

Whilst all of this work builds critical mass the overarching question continues to be whether a plethora of individual, somewhat circumscribed water sensitive urban design projects is actually delivering integrated and systemic change.  

Plainly, reforms to the whole water cycle will not be driven by local government and community efforts alone. Local government does not have the water and sewerage management capacity or responsibility to progress Water Sensitive Urban Design to the same level as do water corporations or higher tiers of government. For this reason state government intervention, through the Office of Living Victoria is welcome. All of these efforts can be seen as prongs of systemic and necessary erosion of the old centralisation paradigm. They should not be seen as ancillary to, and paradoxically supportive of, its continuation.
3.3 Beyond just water – sophisticated and entrepreneurial cities

Professors Tony Wong and Rebekah Brown have outlined three fundamental principles of practice for the attainment of a water sensitive city:

- **Cities will be comprised of water sensitive communities**, asserting the existence of socio-political capital for sustainability and enabling citizens' decision-making and behaviour to encourage urban water sensitivity.  

- **Cities will align themselves with the provision of ecosystem services**, allowing us to understand the city as a built environment which actually functions to supplement and support the natural environment.

- **Cities will see themselves as water supply catchments**, promoting access to a portfolio of alternative water sources through a diversity of supply scales, in a catchment.

In the last few years many city planners, water corporations, practitioners and researchers throughout Australia have participated in dialogue envisioning water management in the liveable Australian city of the future. Brisbane City Council's *Watersmart City Strategy* shows the level of the water-city-people intersections and complexity.  

How do we transition to a WaterSmart city?

![Diagram of water smart city strategies]

**Figure 17: WaterSmart Strategy.**
Source Brisbane City Council.
Defining the attributes of the liveable city is complex, potentially quite subjective, and predicated upon social and cultural norms. These attributes will involve many considerations well beyond a narrow conception of what constitutes urban water management. Nevertheless, the role and contribution of water, its management, use and interaction with the environment, in determining the liveability of cities should come to be seen as intrinsic to the 21st century cityscape.

The creation of water sensitive cities will require significant departures from our conventional urban water management approaches and involve a major socio-technical overhaul of business-as-usual. We will have to shift our focus from water supply and wastewater disposal (the ‘taps and toilets’ water utilities) to more complex, flexible systems.

New systems will:
- integrate various sources of water
- operate through a combination of centralised and decentralised systems
- deliver a wider range of services to communities such as ecosystem services and urban heat mitigation
- be actively, subtly and pointedly, integrated into urban design.

A water sensitive management regime will produce a system that is more resilient to major system ‘disturbances’ such as floods, droughts, heat waves and waterway health degradation.

It appears that we can continue to rely upon bolt-on engineering solutions but this mindset will not equip us to address anticipated difficulties. Identifying our most vulnerable urban areas and our greenfield sites, and considering their design, may serve as a starting point.

Systems configured on new modes of planning and design will have adaptive capacity, explore the potential and create opportunities out of these disturbances, generate innovation, and promote new urban water and liveability regimes.

They will not only be adaptive and resilient, as we suggested they need to be, but they will also be highly interactive with the environment and, at their very best, entrepreneurial and well positioned to take advantage of opportunities which present in times of change.

**Entrepreneurial cities: doing more with less – efficient, decentralised, biophilic**

A combination of water conservation efforts produced by water efficiency measures and potable water substitution mechanisms will provide some of the conditions for the step change required to actively reduce water consumption. Future, resilient cities will secure their water supplies through investment in a diversity of water sources, underpinned by a range of centralised and decentralised (inherently entrepreneurial) infrastructure.

Future-focused urban water supply schemes will have the flexibility to access a ‘portfolio’ of water sources at optimal value and with least impact on rural and environmental water needs - a key consideration in the Living Melbourne Living Victoria program.
Self reliance will be a core value.

Decentralisation, to optimise liveability, and the active search for novel non-centralised approaches will, through integrated planning, be delivered within timeframes that synchronise with the rate of urban development. Costs will be significantly lower than some traditional water supply alternatives. Planning for growth or other eventualities will be long term and proactive, not reactive.

The environmental co-benefits are significant. Stormwater harvesting in all new greenfield and brownfield developments in Melbourne will prevent as much as 150 tonnes/year of nitrogen entering Port Phillip Bay. This figure represents up to 30% of the current target for nitrogen abatement. Sewage recycling will reduce discharge of treated effluent from sewage treatment plants, significantly reducing pollution in Port Phillip Bay and Bass Strait.

It is important to recognise that these sort of environmental benefits, attributed to the management of stormwater and sewage as resources, can be realised in all Victorian cities and towns.

The integrated water sensitive city and town of the future will better understand the whole water cycle and better use water as a scarce resource. Future sewage treatment plants will be facilities for recovery of resources including energy, water and nutrients.
Planning for the use of fit-for-purpose water and the clever and sustainable recycling of stormwater will help to address the water needs of Melbourne’s population, which is projected to double from 4m to 8m by 2056 (ABS).

The most obvious effect of urbanisation on catchment hydrology is the increase in the magnitude of stormwater flow events in urban streams. Climate change scenarios suggest an increase in extreme events and it is projected that this will include rainfall events.

As a result of the confluence of these factors we will need to deal much more effectively with impacts of flooding, stream erosion and loss of aquatic habitats, and threats to public safety.

The past

Stormwater management has traditionally focused on stormwater drainage. The principal technical challenge promoting hard engineering solutions, and often the primary objective has been to convey this runoff away quickly and safely to ‘receiving’ waters.

Traditional modern (19th and 20th century), engineered approaches involve increasing the hydraulic capacity of urban waterways by a combination of channelisation and partial, or complete, impervious concrete surfaces.

The Moonee Ponds Creek was treated in this way fifty years ago.

Royal Park wetlands – a similar view into Melbourne but a very different way to see water management.

Image courtesy of City of Melbourne.
Contrast the Moonee Ponds Creek drainage system with a more recent understanding of waterway treatment as an ecosystem with ponds, wetlands, currents, rockfalls and riparian zones which need to be nurtured, as habitat zones and as having social and cultural meaning.

The present
Melbourne Water tells us that wetlands are good for stormwater in creeks because they slow down the flow of water and help reduce the amount of sediment in stormwater runoff. They also allow natural processes to clean the water.\(^{182}\)

The Merri Creek, once a neglected, but never a concreted drain, is now a community project and meeting place. It provides valuable social and recreational ecosystem services across cultures and generations. Its management enables the development of wetlands. Urban Landcare brings people to the environment and bed and bank protection works to promote enjoyment and thermal comfort. Waste reduction, which might have been a principal driver for change is evident but not the most important attribute of the creek’s care and management.
Traditional or settled approaches in ‘efficiently’ conveying stormwater and its pollutants as they are flushed from urban areas into receiving waterways has a double negative impact. The potential for reusing the stormwater is wasted, but this sort of management also produces a waste product - as the outflow causes the deterioration of the water quality in the receiving water environment.

Watercourses as neglected and rubbished sites will hopefully become a thing of the past if we think of them as significant to our health in integrated ways.183

---

Storm water drains along Yarra River.

*Image courtesy of Yarra Riverkeepers Association and CfES.*
The potential

We should consider the potential for other, water sensitive options in the riverine design and in water cycle integration work taking a lead from imaginative applications found in places as diverse as Seoul and New York.

In these places, imagination, confident and thoughtful design and collaborative interdisciplinarity have been married to address water and amenity issues in ways which contribute to climate change adaptation efforts.

New infrastructure investments in greenfield developments which draw the pollutants out of stormwater and which also reduce run off allow us to redefine stormwater management services, reflecting the many attributes associated with water sensitive urban design.
Co-benefits – thermal comfort

Integrated stormwater planning will also have co-benefits such as mitigating the urban heat island effect.

Providing urban (and rural) thermal comfort will be an increasing challenge under climate change scenarios, as has been recognised by the Victorian Centre for Climate Change Adaptation and Research (VCCCAR) in its project responding to the urban heat island: optimising the implementation of green infrastructure.\textsuperscript{184}

Thermal image of Melbourne showing the urban heat island effect, where built-up zones are often warmer than rural areas, particularly after dark. On a hot day, the city can be up to seven degrees warmer than the surrounding countryside. The Urban Forest cools the city and mitigates the urban heat island effect. The red and orange areas in this image illustrate the hotter parts of the city.

Figure 19: Source City of Melbourne Fact Sheet http://www.melbourne.vic.gov.au/Sustainability/URBANFOREST/Pages/Why.aspx
Heatwaves are projected to increase in frequency, duration and intensity in Victoria. ‘Hot’ days will increase as will hot nights. Mortality-heat thresholds (variable across cityscapes) are expected to rise, with increasingly tragic consequences as has recently occurred in the USA. Melbourne’s maximum temperature of 45.1°C on 30 January 2009 was the second-highest on record. We also know that both these temperatures were surpassed on Saturday 7 February 2009, when the gauge reached 46.4°C.

Compounding the simple issue of warming days and nights, urban development modifies the hydrological cycle and it changes the radiative and turbulent heat transfer producing warmer urban environments. Contemporary urban design strategies are already aiming to retain water in the landscape and promote well-irrigated spatially distributed green landscapes which are supported by access to an abundance of water.

These strategic responses to rising heat have a symbiotic relationship with the work we do to reduce the waste of stormwater runoff. Such strategies will limit human exposure to extreme heat and improve urban climates, as variability in temperatures in urban landscape is primarily driven by differences in urban land surface characteristics.

Contemporary integrated approaches involving vegetated landscape design will detain and treat stormwater on site.

Stormwater filtration will be undertaken. Water contained in this way will be managed to preserve key hydrological and water quality characteristics which will in turn support the ecosystem health of urban rivers and creeks.

Systems can be small and fit for purpose, reducing pollution and litter and such highly localised systems may also produce economic co-benefits by reducing the expense required in planning and installing new concrete infrastructures and in repairing the old.

In these new configurations stormwater runoff will be generated across distributed areas, and given its ubiquitousness it has real and meaningful potential for generating green infrastructure in urban areas, as has been shown by proactive, entrepreneurial local governments.

Integrated stormwater management can effectively realise multiple beneficial outcomes in a landscape where we value urban liveability.

And, even as, technically, stormwater treatment is a fundamental pre-cursor to its management, managed in this way, stormwater can be deployed in many fit-for-purpose ways, all short of provision of potable water.

Multiple possibilities also appeal to and reflect community values.
Case studies

The value of public interest in water planning.

A good example of empowerment and community participation is found in the Bronte Catchment Project (BCP, NSW). A community-based participatory process was used to enhance stormwater quality. There business, non-resident stakeholders and traditional owners were the focus of targeted strategies. The work was supported by the Stormwater Trust and the NSW Environment Protection Agency. The citizen jury process produced more than fifty recommendations. The ‘value’ of stormwater came to be clearly recognised across a wide and varied group of interests with lasting implications.

Figure 20: Value of Stormwater. Source Waverley Council NSW.
Systems which address these issues may be small [and] community focused. They may be wide ranging, they may be large and situated in green, grey and brown field sites. They will be found in capital cities and towns. Every demonstration site is valuable and every mainstreamed planning effort is a powerful indication of the fact that we can make the changes we need to make.

On a large scale Yarra Valley water shows what can be done.

**Integrated stormwater management - Yarra Valley Water’s Kalkallo project**

We are already seeing large scale integrated water planning in the Yarra Valley Water Corporation’s Kalkallo project where big engineering works will produce water management integration in a greenfield site.

By the middle of 2013 Yarra Valley Water will be harvesting stormwater from a 160ha industrial development site at Kalkallo 30 kilometres north of Melbourne. The project is a new development and it covers a total area of 1200ha. Kalkallo is situated on the basalt plain to the north of Melbourne. It lacks tree cover and water storage has been an issue for the farming communities which have operated in the area. Much of the old residential development has been rain water tank dependent for generations. Melbourne is however expanding up the Hume Highway and the area will see expansion in the future. Yarra Valley Water’s plan for the site is farsighted and shows leadership in integrated water technologies.

Yarra Valley Water is promoting the sustainable generation and use of water, and preparing for and acting on assessments of climate change.

Yarra Valley Water has researched the issues and possibilities, obtained best practice advice and carefully analysed and multi-criteria tested possibilities. The analysis conducted by Yarra Valley Water has demonstrated that its project for harvesting and treating stormwater at the site improves on other potential options.
Water from that dam will be pumped to a treatment plant which has been proactively planned to have the capability of producing water to a drinking water specification. Kalkallo precinct road rainfall runoff will be directed to a series of wetlands and treatment ponds, filtering pollutants. A second, and much larger, wetlands will further purify the precinct’s stormwater before it filters into a large open storage dam. Water from that dam will be pumped to a treatment plant which has been proactively planned to have the capability of producing water to a drinking water specification. Storage and testing-in-tank will provide scrupulous quality control before the water is released into the water supply.

Figure 21: Water purification.
Source Yarra Valley Water.
CrES modified.
Corridors will filter urban stormwater through vegetated treatment systems, detain and convey flood waters, and provide potentially productive landscapes intrinsically linked to soft and hard infrastructure.

Technical outcomes and public health requirements are met. Economic issues are addressed.

Kalkallo will reduce the use of reticulated potable water use by up to 90%.
Stormwater discharge will be reduced by 45% and nutrient discharge will also be reduced by 70%.
Demonstrating whole of system benefits, the plant will reduce pumping energy needs by 75%.

Engineering solutions, underscored by analysis which shows an understanding of the benefits of sensitive water design have a significant place in addressing future water supply and demand but this project also illustrates the outcomes which can be achieved by integrated planning and multidisciplinary collaborations.

The work has the potential to feed in a very different conceptualisation of the terrain around the site. A network of ‘green and blue corridors’ of open spaces, places for walkability and of amenity is a longer term possibility for the installation and its surrounds. Corridors will filter urban stormwater through vegetated treatment systems, detain and convey flood waters, and provide potentially productive landscapes intrinsically linked to soft and hard infrastructure. Human thermal comfort in local communities will be improved and water spaces and canopy and grassed areas will promote biodiversity in the urban environment.
3.5 Regional possibilities – greenfields in the country

Research which contrasts Darwin and the Mallee, two very different environmental water regimes, has demonstrated that context matters in respect of water conservation commitments. Behaviour and attitudes are influenced by exposure to water scarcity.\(^{195}\)

In developing our new water city templates we should actively consider the role which regional centres can play as demonstration sites, in capturing the imagination of regional communities, and in providing 21st century outcomes ahead of need.

A new, entrepreneurial city water-scape is not only a vision for the centre. Why would it be? – particularly when we consider that the physical and philosophical attributes of an integrated water cycle management system are inherently decentralised.

In regional cities and towns water issues are also felt with a degree of intensity. Coliban Water, which services the needs of the growing Bendigo community, a town essentially dependent upon pipelines, felt the drought years acutely. Water prices were contested ground. Users are expected to pay. During the drought smaller towns like Broadford and Euroa, amongst others, had water trucked in as supply evaporated.

**Swan Hill, Tower Hill and the eco house**

Swan Hill, built upon the banks of the Murray River, supplied with drinking water from water tower technology which is relatively inexpensive, is not a town where we might expect to see interest in novel ways of using water, but we do.
The development of Tower Hill subdivision provides an example of better and achievable water technologies. VicUrban drove the initiative in tandem with the local council. The site was a greenfield and leant itself to innovative design. Growing housing demand promoted the proposal.

Figure 22: Tower Hill site map.
Source Places Victoria.
Sited to the east of the development is a wetlands, providing thermal comfort but also an ecosystem for native bird life.

Swan Hill.
*Image CfES, 2012.*

Water used on playing fields is ‘recycled’ and signage records the fact. Road scapes are used to catch and retard stormwater, drought tolerant plants have been installed.

Swan Hill.
*Image CfES, 2012.*

Pocket parks dot the development. Solar panels produce hot water and a number of houses have solar arrays for power generation.

The nearby SUNI TAFE complex is also involved in the water catchment and tanks are a visible reminder of the need to capture water, sited as they are at the entrance of the campus. The campus itself is a drought-tolerant plant demonstration site and its building fabric is committed to energy and water efficiencies.
But beyond landscaping and water management techniques, the TAFE site provides a demonstration site of an eco-friendly house and demountable nursing station. Whilst this housing design has clearly not been adopted in the housing development, it does provide training in green building for local apprentices, mainstreams the message that housing can be attractive and serviceable in a changing climate, and is a community resource centre for better, climate sensitive design. Situated proximate to the wetlands and other water sensitive urban design features it is a reminder of what can be effected if a holistic approach is adopted.
The house of the future for Victoria’s climate

Swan Hill SUNI TAFE has established a green building course. **Ecohouse** was built by students who have become both adherents to and the outliers for the sustainable building practices they have learnt on the project.

New skills acquired include designing buildings for water conservation and energy efficiency and the incorporation of water-wise native species and a drought tolerant garden.

The house faces north, taking advantage of natural sunlight whilst avoiding late afternoon western sun. Windows are shaded where necessary. A verandah supports the solar features of the house. Windows and doors are double glazed.

The house is thermally comfortable during Swan Hill’s icy winter days and its oppressively hot summer days. Energy consumption is low and air-conditioning and heating is barely used. The house has attained a 9 star rating.

Landscape gardening is a feature of the work. Garden paths are comprised of porous crushed rock, promoting surface water runoff, a materials consideration augmented by site selection which utilises the gentle slope of the land.

All water fittings are 6 star rating to the Water Efficient Labelling Standard (WELS).195

The kitchen mixer tap delivers 4.1 litres per minute and the bathroom taps 3.8 litres per minute (cf 15-18 litres).

Toilets are 4.5 lt full flush and 3 lt half flush producing 22% of water savings.

Efficiencies add up: replacement of a typical single flush toilet with a dual flush toilet saves 51lt per person per day and over a year upwards of 30000–40000 lt will be saved in the typical household.

Three star showerheads will save up to 14500lt per year.

Externally **Ecohouse** delivers 56kl roof water runoff per year.

Stored in tanks under the house this water is used for toilets and gardens.

Extrapolating this data to the contiguous Tower Hill/Steggall Park residential estate, tank water collection and reuse of fit for purpose water would equate to the effective delivery of 67.200kl or 67.2mglt per year.

 Provision of this amount or water would be **free** after tank installation depending on the need for any pumping.197

Not only would it be free it would reduce the call for water from the Swan Hill water reserve system.
Shepparton – a ‘river city’

Shepparton has always been a city between rivers. The Broken and the Goulburn Rivers bisect and service the city. They have also impacted the city on occasion by flooding.

Taking water, culture, sociality and sensible, thermally comfortable development as its motif, and responding to the recent protracted drought and concerns about climate change, the Shepparton City Council has made a commitment to the city becoming a ‘river city’. It has signed the ICLEI Water Campaign and is embarked upon reconstituting itself around its river systems, describing the Goulburn and the Broken Rivers as the city’s ‘life and soul’.

Parks on the Goulburn River show the extent of change taking place. An old roadside park at Archer Street in Mooroopna is a drive in facility which provides a pleasant view. The Cudgee Park on the Boulevard in Shepparton is complete with interpretation about the types of trees which grow along the river and it includes representative totems and a chair for contemplation.

The river and wetlands are being re-entered into the cultural understandings of the place by clever and purposeful planning which will stand the city in good stead for the dry and hot times ahead.

This change is being effected in partnership with others, notably the Goulburn Broken CMA, but it is not just about the rivers and their frontages.

Integrated water management demonstration sites and water sensitive urban designs are appearing across the city.
The river and wetlands are being re-entered into the cultural understandings of the place by clever and purposeful planning which will stand the city in good stead for the dry and hot times ahead.

The redevelopment of the Showgrounds presented as an opportunity to redevelop differently. Swale drains and 43000 litre water tanks have been installed to harvest water which previously simply ran off. Funding was provided by the Australian Government water Fund – Community Water Grants program.

The redevelopment of the Shepparton Lake also provided potential to think about this artificial water feature as a wetlands, part of an ecosystem, with the Goulburn River metres to the west and the Broken a further distance to the south.

A European-type lake has been turned into an Australian permanent wetlands. The transformation tells the visitor a great deal about what an Australian wetlands looks and feels like.

It differs from the Gemmell’s Swamp Wetlands across the river in Mooroopna but it strives for a certain authenticity which is pleasant and informative.

Developments across the city have also become demonstration sites for changing ways of thinking about and valuing water. At Kialla Lakes a wetlands, roadside swale drains, drought tolerant plantings have turned a dry and hot plain into a cool and comfortable residential development.

At The Boulevard development pocket parks, a wetlands and dry creek water retention area has produced a sandy environment which has water sensitive features across its whole expanse. Residents have taken up the challenge, installing solar arrays and drought tolerant gardens. At Parkside Gardens houses are 5 and 6 star energy efficient and the commitment to open space extends to 50%.
Greyfields in the city – WestWyck

WestWyck in Brunswick is a private medium density housing complex which both retrofitted an old school site in Brunswick and developed new housing as if on a greenfield site.

It is an example of water sensitive design and integrates water needs (demand) and conservation (sustainability).

Reduction of potable mains-supplied water was a key objective and reduction of the discharge of used water - stormwater and sewer outflow – was subsidiary. Multiple, integrated methodologies have been adopted.

Water saving devices including flow restrictors, efficient appliances and efficient fittings are installed and harvested roof water works as a supply source for the solar hot water system.

The greywater treatment plant receives bathroom and laundry water and subjects it to bacterial, membrane and UV treatment to create ‘Class A’ water for reuse in toilet flushing and gardens and, subject to approval, the laundries.

The blackwater plant treats human waste and food scraps on site in two 3,500-litre vermiculture pits situated under the car park. Worms process solids. Liquid waste is pumped through to three evapo-transpiration beds, being absorbed and processed by woolly ti-trees, locally provenanced grasses and river mints.

Once the residual liquid has been filtered in this way it is pumped to the sewer.

WestWyck landscaping is an advanced example of water sensitive urban design: native plants are chosen because they have work to do.198

Demonstrating the savings to be made, a generous concessional local water business charging arrangement acknowledges reductions in, and the enhanced, pre-treated, quality of the discharge.

Less stormwater is discharged from WestWyck by both passive collecting and active harvesting of roofwater and as a function of the removal or reduction of impermeable bitumen and concrete surfaces. Additionally a system has been designed to retard the passage of storm water through the site. Swale drains, planted out in local native reeds are both attractive and a key landscape feature. They partially retard, but also absorb and clean the storm water before it is released to local drainage infrastructure and waterways.

WestWyck as a functioning, reasoned and comfortable medium density suburban habitation is a greyfields redevelopment exhibition site which is broadly educational.

Open days with Museum Victoria’s Water Smart Homes, the Australian Open Gardens Scheme and ANZSES Sustainable House Day, and development industry, professional associations, local government and environmental conference site visits, have become routine.
3.6 One ethic across a variety of sites

Future-focused water sensitive cities are constituted when many water sensitive precincts of varying urban densities involving Integrated Water Cycle Management and Water Sensitive Urban Design are realised. In these precincts, opportunities and constraints need to be recognised. Innovative water management initiatives will be highly responsive to dynamic conditions. One size will not fit all but one ethic will underpin each effort: integration, imagination, entrepreneurial thinking.

Every attribute of a site - geographic, geomorphic, and human-centred - will be explored and understood within the new integrated water cycle management paradigm. Greywater and potable water will be recognised as producing outcomes within and across a range of possibilities. Harvesting rain, producing clean water, and anticipating future extremes will all be elevated as foundational considerations in the new planning and management paradigm.

Medium to high density development projects which hold enormous promise for local wastewater recycling, will have their potential exploited sensitively. We know that the very density of such a development can reduce potable mains water demand in a typical household by up to 50%. Simply adopting current permissible uses of recycled water, an excess of locally recycled water may be provided and this could be used to promote productive landscapes, a greener public realm and green building façade.

A brownfield site also has great potential. Brownfield redevelopment projects will present the potential to harvest alternative water from stormwater or sewers from across a catchment which will be larger than the physical footprint of the development. Redevelopment of this character may promote a 40-50% increase in the percentage of potable water substitution as a function of on-site wastewater treatment and recycling.

An abundance of available alternative water sources means that development can feature significant extensive greenscapes, potentially limiting exposure to extreme heat. Brownfield development provides clear prospects of this given their increased impervious surfaces. This will become a resource and used to support passive watering of vegetated features. The availability of locally generated grey water or treated wastewater from such sites can be used to support vegetated systems in extended periods of dry weather conditions.

Greyfield sites clearly also have enormous potential, as is illustrated by the Westwyck example. Such sites are unlikely to require decontamination. As places where services and public transport have built up over years, these sites provide access to facilities in ways which have to be generated in greenfield sites and which may not exist in older formerly industrial sites.

As the needs of the residents change and their desire for changes in residential attributes shifts over time these sort of sites, particularly at a precinct scale, should be sought out for development potential. At the precinct scale greyfield sites plainly lend themselves to organised and orderly redevelopment possibilities which incorporate integrated water cycle design and management.
As we build water sensitive cities *greenfield sites* will not compete to the detriment of their less attractive predecessors.

Each type of site will be chosen and developed to exploit its particular resources.

The proximity of *greenfield sites* to centralised sewage treatment and recycling plants and recycled water trunk mains, often the main determinant on the quantum of alternative water sources accessible to *greenfield developments*, will be one of many attributes to be mined. Such possibilities, already well understood, will be, as we build our new, water integrated cities, exploited thoughtfully and purposefully.

External stormwater catchments are often small in *greenfield developments*. However, stormwater harvesting at the precinct scale, showing us its value beyond water sensitive urban design as a feature of integrated water cycle management, can be supported by the availability of open space which then provides a landscape envelope which lends itself to the construction of storage ponds and lakes, ensuring credible water yield reliability.

Subdivisions and *greenfield* sites are a subset of the larger catchment and catchment planning is necessary for stormwater harvesting to work. Effective stormwater harvesting is difficult to achieve with ‘piecemeal’ approaches at the subdivision level. And, highly effective stormwater harvesting will expand upon our already recognised management of the resource in water sensitive urban design.

The protection of the ecological values of urban streams is arguably highest in *greenfield developments* where we generally expect to find the natural waterways either in good ecological condition or only marginally degraded.

Investment in preserving creekside current ecological condition can be significantly lower than the cost of restoration of an already degraded waterway in built up catchments. We already see the use of waterways in contributing the greater amenity in some of the Growth Area Precinct Plans, and in the regions in places like Swan Hill and Shepparton, but the condition of creeks and wetlands will vary across these precincts. The Plenty River region differs from the Werribee River catchment (where biolinks are being developed).

Development proposals which explore terrain, catchments, contours, history of use and community aspirations will be the ones we seek and need to deal with future challenges. Instead of in-filling an ephemera watercourse we will make provision for it, recognising its ecosystem benefits to biodiversity and humanity.

A network of green/blue corridors – which we will describe otherwise than ‘drainage corridors’ – will in the water sensitive city, convey, detain or manage flood waters protecting downstream communities. *Greenfield developments* will provide great scope for such approaches.

Imagining other changes, the advent of real-time control technologies, which could link advances in weather forecasting to infrastructure operation, will enable the supplementary use of stormwater infrastructure as flood mitigation systems in high density developments.
3.7 A water sensitive city will look like…

Figure 23: Water sensitive city. CIES developed infographic.
...for a water sensitive city specifics could include –

**Higher density mixed-used housing** generating innovative investment in:
- localised sewage treatment and recycling
- stormwater treatment
- harvesting from roofs, streets and urban drains
- optimising exploitation of localised storm events across all seasons.

Collectively additional water sources will support a **bio-diverse vegetative environment** independent of Melbourne catchment water supply conditions.

A **portfolio** of water sources serving the precinct with **centralised** drinking water and **recycled water** from stormwater harvesting and local wastewater.

**Substantially built-up areas** producing broad scale stormwater harvesting across a larger catchment so that centralised potable water services need to provide less than 10% of water supply.

**Development density** promoting use of **low carbon district-level gas fired power**.

**Waste generation heat will filter stormwater** which will then be used for reticulated hot water.

**Sewage treatment will be localised and this ‘waste’ water will be reused** in toilets, green space irrigation and a productive garden landscape.

**Design configuration of the precinct will promote green corridors and pocket parks** which will serve as flood detention and dispersal points during extreme storms.

**Active engagement and strong community feeling** will become the norm. **Public art** will be used to augment relationships with water and water’s intrinsic value. Participation will be encouraged noting that social cities are important for capacity building.200

People will be part of the solution. They will be **better informed** about water as an ecosystem service in all its guises. The community will be interested in water conservation, water’s ecological and other attributes and they will be more resilient in the face of climate change.

This new conceptualisation of water in our everyday environments: as it comes out of our taps, and as we bicycle, walk and drive around the perimeters of wetlands and along meandering pathways, as we collect and filter the water we use, familiarising ourselves with purple pipes and ephemeral and dry watercourses, will need to be nurtured and it will only be sustained with supports. These supports will include the sort of self-referential changes found in interdisciplinary research and across different and differing communities. We will need to line up the planets to be able to ‘wheel stacked water’.