2012 IPWEAvic Awards for Excellence

Category 2. Asset Management Award

Project Title:

Mordialloc Industrial Precinct
Managing Stormwater as an Asset

City of KINGSTON

2012 IPWEAvic Awards for Excellence

Category 2 : Asset Management

APPLICATION DETAILS:

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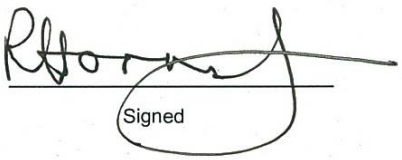


7/2/12
Date

Support Partners: Whilst the City of Kingston is the major contributor to this project (and the sole applicant for this award), we would like to recognise smaller contributions from:

* Melbourne Water
* Cardno Group
* AECOM; and
* Various contractors

Executive Summary

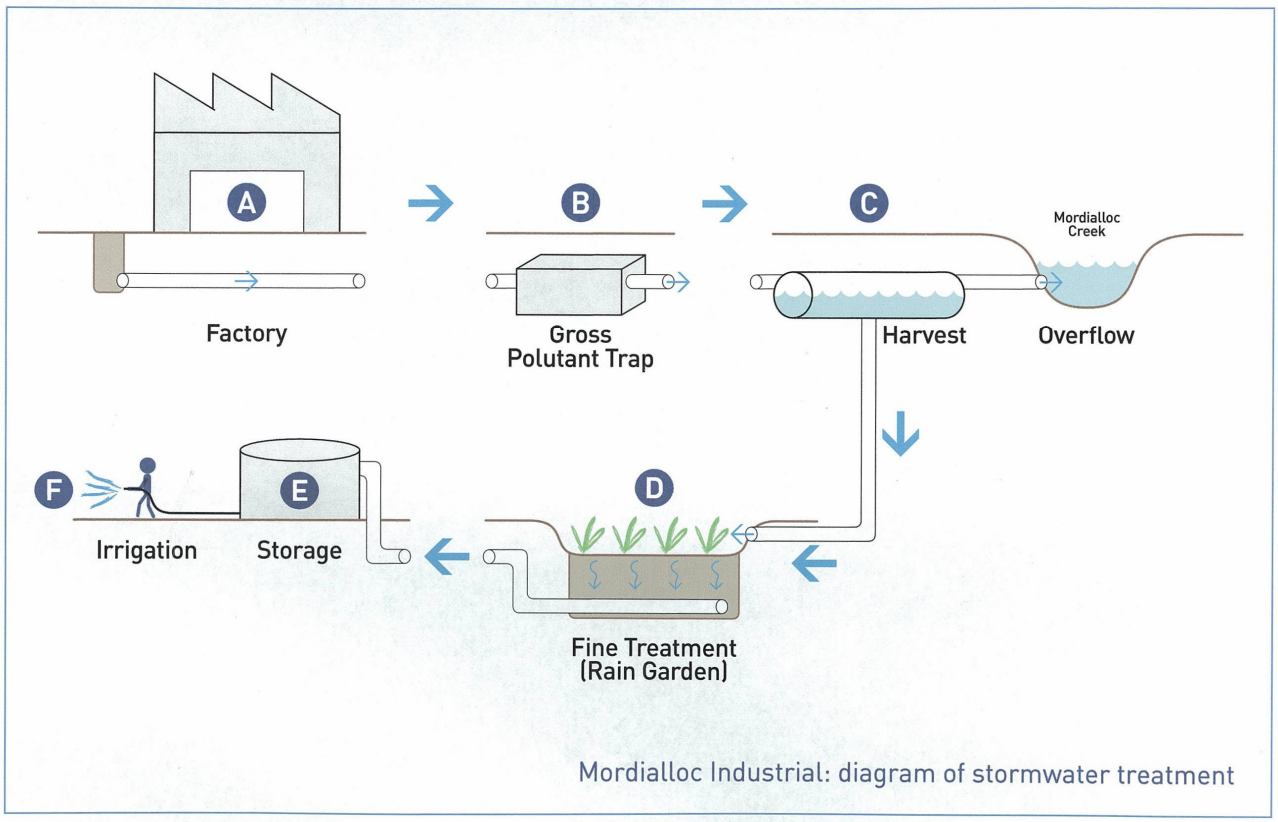
This project is the first time in Australia that public infrastructure, within an old industrial estate, has been renewed with the aim of using the harvested stormwater as a community asset.

Three industrial roads have been redesigned to harvest 4 mega litres (ML) of stormwater each year from factory roofs and road runoff to help protect Mordialloc Creek and irrigate adjacent park and street trees.

The major asset management outcomes from this $2.8M project involve:

- A major review of Stormwater Quality Treatment devices (e.g GPTs, pit inserts, and bioretention systems) to compare performance, durability, maintenance requirements, whole of life costs and overall suitability for industrial streetscapes.
- The development of a unique 'Project Scoring' system to help asset managers to compare competing Water Sensitive projects to aid business planning and funding decisions.

Additional investigation work, including the use of porous paving in an industrial environment, designing a new low cost silt trap and calculating green house gas emissions are other innovative aspects of this exciting project.



Mordialloc Industrial: diagram of stormwater treatment

Mordialloc Industrial Precinct
Managing Stormwater as an Asset

Table of Contents

1. Introduction

This project is the first time in Australia that public infrastructure, within an old industrial estate, has been renewed with the aim of using harvested stormwater as a community asset.

The $2.8M worth of innovative construction works could attract attention for an IPWEA award under category 1 (Capital Works Projects < $3M). However, in our opinion the real engineering merit is in the meticulous planning and research undertaken to ensure the long term success and sustainability of the public infrastructure involved. Our commitment to managing assets to ensure robust and practical maintenance outcomes within a harsh industrial streetscape is considered worthy of local and national recognition.

On this basis, we have decided to submit this project under Category 2 - Asset Management.

Figure 1. Aerial photograph of the Mordialloc Industrial Estate (illustrating the treatment train)

2. A Quick Snapshot

This project involves the reconstruction of three roads and associated drainage improvements within one of Mordialloc's busier older industrial estates. The new drainage pipes will capture 4 mega litres of stormwater each year from factory roofs and road runoff. The collected water will be treated via a series of unique pits, sediment traps and a large vegetated area located beside Mordialloc Creek.
The enclosed 'Public Display Plan' illustrates the stormwater treatment train and key elements.

Once completed, this project will significantly reduce the level of pollutants discharging into Mordialloc Creek, increase flood protection for surrounding properties and provide a valuable water resource for the adjacent park and supplement Council's street tree watering program.

2.1 Did we do any Planning ?

We believe the success of this project is due to the enormous amount of work devoted to research and project planning to ensure practical, cost-effective and sustainable outcomes including:

- **A Review of Existing WSUD Products**
  The Cardno Group was engaged by Council and Melbourne Water to review and compare available data on Stormwater Quality Treatment devices (e.g GPTs, pit inserts, bioretention system, etc). The purpose of the study was to compare performance, durability, maintenance requirements, whole of life costs and overall suitability for use within industrial streetscapes.
  Refer to section 5.1 for details

- **How can we Prioritise Projects ? - Strengthening the Business Case**

  In partnership with AECOM, Council officers developed a 'Project Scoring' system to help asset managers compare competing Water Sensitive projects to aid business planning and funding decisions. This 'Water Sensitive Cities' scorecard report is being presented as a stand alone project at this year's international WSUD conference to be held in Melbourne on the 23 February 2012.
  Refer to section 5.2 for details

- **Concept Development**
  Detailed MUSIC modelling was undertaken to confirm and size the various components within the stormwater treatment train. This project exceeds the recommended best practice pollution reduction targets.

- **Pavement Management Trial**
  Historically, Councils have been somewhat reluctant to install porous pavements as a water quality treatment due to concerns about durability and long term performance. As part of this project, the City of Kingston's engineers are trialling two types of porous materials - interlocking pavers and poured insitu paving - within a road subject to heavy semi-trailer and forklift traffic volumes. The results of the trial will be used to inform future asset management decisions.

- **Water Sampling**
  The City of Kingston teamed up with CESAR (a division of the University of Melbourne) to undertake stormwater sampling and testing. The aim is to evaluate the pollutant removal effectiveness at various locations within the treatment train before

and after construction.

- **Introducing an innovative treatment pit**
  As part of this project, the City of Kingston's engineers researched, designed and successfully implemented a unique stormwater treatment pit. The 'King Trap' (i.e Kingston Pollutant Trap) was developed as an alternative low cost, practical and effective pit that is extremely simple, robust and easy to maintain. It uses permeable pavers as a vertical wall to help separate silt and gross pollutant. This pit has been installed in 52 locations throughout the Mordialloc Industrial Precinct and is being trialled as a prototype for broader application.

- **How much Greenhouse Gas is emitted ?**
  One of Kingston's engineering students completed her final year research paper on our Mordialloc Industrial project. This invaluable report calculated that 1,200 tonnes of CO2e per km of industrial road was generated from construction activities. The report also provided recommendations on ways to reduce the environmental footprint of similar projects.

2.2 What have we Constructed ?

Stages 1 and 2 of this project involved the major road and drainage components. The works were designed in-house and construction commenced in January 2011 and is scheduled for completion by April 2012. The final stage involving the bio-retention system and pumps has been designed and will be implemented by June 2012.

The various components include:

- 1.1km of industrial road reconstruction;
- 1.2km of stormwater pipe upgrades to reduce flooding at low points and convey stormwater to the storage systems;
- 54 of Council's innovative 'King Trap' pits installed to capture silt and pollutants;
- 2 large capacity Gross Pollutant Traps (EcoSol) installed in Wells Rd;
- 330 sqm of interlocking porous pavers and porous paving;
- 180 sqm of bio-retention system consisting of 4 rain garden cells;
- 180 cubic metres of storage within a series of large underground 2.4m diameter pipes (after pre-treatment);
- pumps and rising main to transfer treated water to an aboveground 230 cubic metre tank; and
- two non-return valves (Tideflex) to prevent saline water from Mordialloc Creek flowing back up the twin 900mm diameter 'high flow' outlet pipes to avoid contaminating treated stormwater.

The size of the project is illustrated in the following construction photos:

Project Display Board

Reconstructed Industrial Roads (Beach Ave & Spray Ave)

Reconstructed Industrial Road (Wells Rd abutting Mordialloc Creek)

Interlock Porous Pavers (Asset Management trial on an industrial road)

Gross Pollutant Traps (EcoSol units)

2.4m diameter storage pipes for stormwater harvesting

Minor Storage tanks

Major 230KL tank to store harvested water for irrigation

Treated water that is surplus to storage needs overflows into Mordialloc Creek

3. When did it all Happen ?

A project of this size and complexity involves a number of years of planning, research, design, construction and monitoring.

In submitting a project of this nature for an IPWEA award, there is the difficult task of deciding the appropriate year to the make the submission, given that the very nature of asset management requires engineers to plan, implement and then monitor performance over many years.

Given that the bulk of the work occurred during 2011 and the interest in this project is growing, we feel that 2012 is the ideal year to share this project and our experience with IPWEA members.

Project Timeline Summary

2008	Initial planning and discussions with Melbourne Water
2009	Research existing Stormwater Quality Devices
2010	Develop the King Trap treatment pit (and implement in 2011)
2010	Model the concept using MUSIC software
2011	**Develop the 'project scoring system' to strength the business case and confirm project funding arrangements**
2011	**Prepare detailed design plans and specifications**
2011	**Commence water sampling and testing (pre-construction)**
2011	**Successful Federal Government funding application to enhance stormwater harvesting component ($150,000)**
2011	**Advertise tenders for construction**
2011	**Award contract for stage 1 ($1.1M) in Jan 2011**
2011	**Award contract for stage 2 ($1.5M) in Aug 2011**
2011	**90% of stage 1 & 2 works completed in Dec 2011**
2011	**Complete report into green house gas emissions**
2012	Seek quotes & complete the final stage 3
2012	Conclude water sampling and testing (post-construction)
2012	Monitor project and prepare asset management reports

4. Is our Community Interested ?

Are they interested in this project? Very much so!
Mordialloc Creek is a major waterway through Kingston and our local residents are very passionate about the quality of the creek and its surrounding environment. Council has devoted a lot of effort into consulting with our community on their 'vision' for improving the creek (2010) and developing an integrated water cycle strategy (2011) which identified our Mordialloc industrial project as a high priority.

Figure 4. Mordialloc Creek approx. 1 km downstream from project location

Closer to the works, the factory operators located in the epi-center of this project are strong supporters of the environmental benefits of our project. They also appreciate the economical benefits associated with the streetscape improvements including new footpaths, improved access and upgraded parking facilities.

Industrial areas contribute a disproportionately high concentration of pollutants, including heavy metals and hydrocarbons, which threaten the health of Mordialloc Creek and Port Philip Bay. As home to one of the most concentrated industrial sectors in Australia with about 4,200 businesses and 27,000 industrial jobs (representing 11% of Melbourne's total), this project is an important first step in a new approach to asset management.

Historically, engineers have found the implementation of stormwater treatment measures within busy older industrial estates to be very challenging due to the lack of space. This project aims to create a new standard and will provide invaluable asset management data that will be used to continue to improve the sustainability of our public infrastructure within industrial precincts.

Consultation on this project included information bulletins and 'door knocking' every factory, plus large information signs and project details on Council's website to engage with the broader community.

5. The Devil is in the Detail.

5.1 A Review of Existing Products

The Cardno Group was engaged by Melbourne Water and the City of Kingston to review various Stormwater Quality Improvement Devices and recommend those that would be best suited to this project. The review needed to consider Council's asset management requirements including:

- devices in roadways need to withstand semi-trailer vehicle loads;
- lids, grates and covers to be light weight and easily opened by one person;
- devices to be low-maintenance. Specifically, devices are not to require cleaning more than once every six months and shall not cause flooding if they are maintained less frequently;
- devices are to avoid expensive replacement filters or cartridges;
- annual maintenance cost shall be less than $1000 per unit, including materials;
- supply cost shall not be excessively expensive;
- dry sumps designed to capture gross pollutants and silts are preferable.
- due to shallow pit depths and a low Hydraulic Grade Line, devices that don't require hydraulic 'drops' are preferred.
- the treatment train to be modelled using MUSIC Version 3 to confirm pollutant loads through the catchment.

The findings from the study are summarised within the following two tables.

The full report (refer to the enclosed CD) provides an appreciation of the context of the findings which relate specifically to this project.

The information from this report, plus further investigations undertaken by Council engineers, was taken into consideration at the detailed design stage. Some of the products recommended were implemented and others substituted due to a range of factors including budgetary constraints and practicalities following consultation with maintenance supervisors.

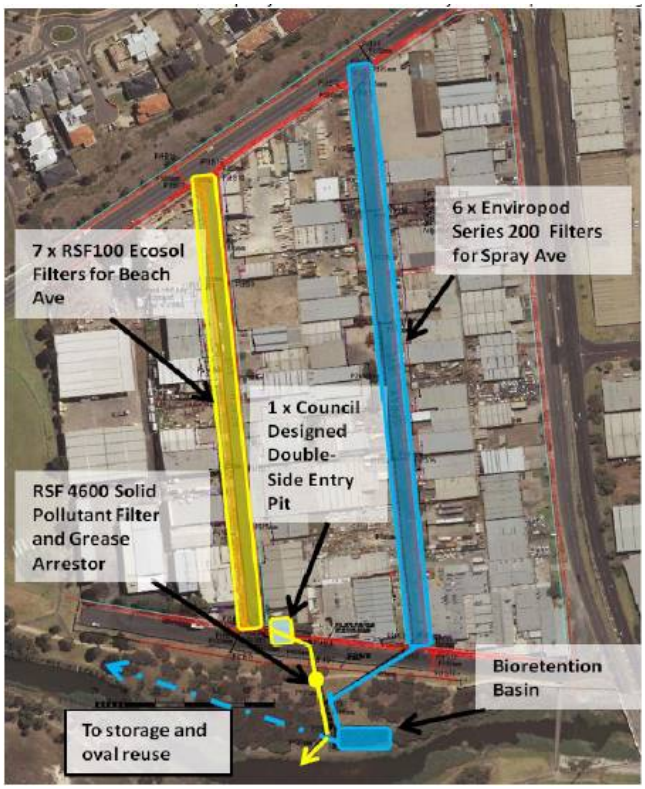


Figure 5. Recommended Stormwater Treatments

Treatment Device	Capital Cost ($)	Annual Maintenance Cost ($)	% TSS Reduced	% TP Reduced	% TN Reduced	Removes Oil and Grease?	Removal of GP	Footprint	Independent Verification	Comment
ECOSOL RSF100	$850 for supply and installation/unit	$86 cleaning cost per unit per annum $100 for replacemet of mesh liner (frequency not stated) $45 for replacement of by-pass flap (freq not stated) $290-350 for replacement of frame (freq not stated)	65%	40%	21%	No	Yes	Within Pits	RSF100 tested by SGS Food Environmental Laboratories	RSF100 cannot be installed through pits where there is less than 350mm cover.
ECOSOL 4600	Design and manufacture 29K installation and commissioning 49K	$2.5K cleaning cost per annum	91%	30%	13%	Yes	Yes	4,500mm x 1,950mm	RSF 4600 tested by Avocet Consulting	
CEMEX Humeguard	31K ex installation	1.6K cleaning cost per annum	50%	20%	20%	No	Yes	3,350mm x 2,500mm	Swinburne University (Victoria)	lacks capability to remove oil/grease.
CEMEX Humeceptor	60K ex installation	1.6K cleaning cost per annum	80%	30%	30%	Yes	Small pollutants such as cigarette butts only	4,200mm diameter	NJCAT	Large footprint, high capital cost when installation is included
CEMEX Hydrofilter	31K ex installation	3K cleaning cost per year plus additional $1K every 2 years	99%	90%	50%	Not stated	No	3,000mm x 2,500mm	University of Munster	250 mm headloss
Rocla CDS P1015	Approx $65K supply and installation 33K supply only	1.6K cleaning cost	TSS>0.1 mm 73% TSS>0.02mm 65%	39%	13%	Yes	Yes	1,950mm diam diversion chamber 1200 x 2700mm	Cooperative Research Centre for Catchment Hydrology	For large capacity systems, large excavation may be required
Rocla Filternator	Approx 80-90K for supply and installation 60K for supply only	$2,500/ year. Filter cartridges every 2-8 years @ $200/cartridge	80%	50-70%	0-13%	Removes hydrocarbons, oil/grease not stated	Pre treatment reqd	5,800 x 1,800mm	NJCAT	The Filternator requires 700mm of driving head through the device. Requires pretreatment for gross pollutants.

Treatment Device	Capital Cost ($)	Annual Maintenance Cost ($)	% TSS Reduced	% TP Reduced	% TN Reduced	Removes Oil and Grease?	Removal of GP	Footprint	Independent Verification	Comment
Rocla Up-Flo	Approx 40-45K for supply and installation 35K for supply only	2K per year cleaning filter media approx $1200 every 2-5 years	80%	72%	0-13%	Yes	Pre treatment reqd	1,200mm diameter	Morquecho et al, University of Alabama	The Up-Flo requires over 700mm of driving head through the device. This device is yet to be released in Australia - expected release date July 2009. Is currently on the market in NZ. Requires pretreatment for gross pollutants.
Enviss K409	2.7K per pit, supply only	Requires 2 cleans per year, cost of cleaning not stated. Replacement of sediment traps is $330 per pit (supply only) , per year. Replacement of filtration media cartridge is $560 per pit (supply only) frequency not stated.	95%	65%	76%	Removes hydrocarbons, oil/grease not stated	Yes	400 x 900mm located upstream of side entry pits	Monash University (Develop and test filter technology)	Designed to receive a catchment of up to 120m^2. Requires 650mm of depth from pit cover to obvert of pipe.
Enviss K809	4.7K per pit, supply only	Requires 2 cleans per year, cost of cleaning not stated. Replacement of sediment traps is $660 per pit (supply only) , per year. Replacement of filtration media cartridge is $1020 per pit (supply only) frequency not stated.	95%	65%	76%	Removes hydrocarbons, oil/grease not stated	Yes	800 x 900 mm	Monash University (Develop and test filter technology)	Designed to receive a catchment of up to 240m^2. Requires 650mm of depth from pit cover to obvert of pipe.
STORMWATER360 Enviropod Series 200	$450 for supply and installation/unit	$105 cleaning cost per unit per annum Costing for bag replacement etc not provided	Not specified in isolation of Stormfilter	Not specified in isolation of Stormfilter	Not specified in isolation of Stormfilter	Yes	Yes	In Pit	University of SA , James Cook University	Size of Enviropod mesh bag ranges from 200-1600 micron. Enviropods have the option of including a grease absorbant lining in the basket, this option should be included in the installation. Enviropod requires a minimum pit depth (to pipe obvert) of 300mm.
Stormwater 360 Vault Stormfilter ()	95K supply only	5K	79%	51%	32%	Yes	Yes	5700 x 2700mm	NJCAT	The Vault Stormfilter requires 700mm of driving head through the device. Requires pretreatment for gross pollutants.

5.2 The Business Case for Water Projects

Engineers are often faced with the challenges of how to justify the level of funding required. Our 'Mordialloc Industrial Precinct' project was no different.

While our project started as a basic road rehabilitation initiative, it became clear that with an innovative approach we could also achieve significant water quality and re-use outcomes.

At the same time, the City of Kingston was partnering with AECOM to develop an 'Integrated Water Cycle Strategy' with the aim of confirming water sensitive targets for our municipality, long term funding requirements and identifying the most cost effective types of water related solutions.

One of the questions investigated as part of this project was;
How can we supplement 'triple bottom line' decision making, so that the best 'all-round' water projects are more likely to receive funding approval?

From this work, Council and AECOM developed the idea of creating a 'Water Sensitive Cities Score' (WSCS). This score-card system helps to recognise projects with multiple benefits and ensures that future project selection is a true reflection of the principles of a Water Sensitive City[1].

The WSC Score evaluates projects against on the following categories:

- Water quality & natural asset protection
- Potable mains water reduction & alternative water supply
- Resource sustainability
- Providing amenity & protecting ecosystem services
- Building awareness & education

The scoring process outlined in the following table clearly highlights the water sensitive merits of competing projects (both structural and non-structural). It also highlights each project's effectiveness in providing multiple benefits to the broader community and the environment via the treatment and use of stormwater.

What was the criteria?

We decided that to be effective, the scoring system needed to:

- Be simple to use;
- Not require complex calculations and investigations as this would limit its uptake;
- Use information that was generally available at the concept design stage when funding decisions are made; and
- Be able to clearly communicate the effectiveness of competing water projects to non-technical decision makers.

[1] *A Water Sensitive City is a liveable city that has healthy ecosystems and waterways. It is place that uses rainwater, groundwater, surface water, wastewater, stormwater and potable mains water appropriately and where built and natural environments are in harmony.*

Water Sensitive Cities Score card

The following table summaries the minimum requirement for a project to achieve a certain 'score':

Water Quality	
Very High	Meets or exceeds best practice targets for TSS, TP and TN[2]
High	Is within 20% of best practice targets for TSS, TP and TN
Medium	Delivers some water quality improvement
No change	No change to water quality
Negative	Results in an increase in stormwater pollutants
Potable Mains Water Reduction & Alternative Water Supply	
Very High	Results in potable mains water savings, or an alternative water supply, of greater than 5 ML/yr
High	Results in potable mains water savings, or an alternative water supply, of 1-5 ML/yr
Medium	Results in potable mains water savings, or an alternative water supply, of up to 1 ML/yr
No change	No change to potable mains water demand or no alternative water supplied
Negative	Results in an increase in potable mains water demand
Energy Savings	
Very High	Surplus/positive energy generation over the life of the project
High	Zero net energy use over the life of the project
Medium	Some energy savings over current, ongoing energy resource requirements
No change	No change where there are already ongoing energy resource requirements
Negative	Increase in additional energy resources
Liveability and Environmental Protection	
Very High	On a regional scale, major improvement of amenity through provision of valuable/functional green spaces and/or provides significant protection for a regional natural asset
High	On a local scale, improvement of amenity through provision of valuable/functional green spaces and/or provides significant protection for a local natural asset
Medium	Delivers some improvement to local amenity
No change	No change in the local amenity
Negative	Is detrimental to the local amenity.
Building Awareness & Education	
Very High	High profile project that provides significant city-wide or national opportunities for interaction and education
High	Provides regional opportunities for interaction and education
Medium	Provides local opportunities for interaction and education
No change	Has no opportunity to influence behavioural change
Negative	Promotes poor behaviour in water sustainability

[2] Total Suspended solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN)

Case Study 1: 'Mordialloc Industrial Precinct Project'

The Mordialloc project was evaluated against the score with the following results. The project was designed to exceed best practice stormwater management, save around 4ML of potable water each year and its unique nature will generate major interest. For these reasons, the project was rated as a 'Very High' score for both 'Water Quality' and 'Building Awareness & Education'.

	Water Quality	Potable Mains Water Reduction & Alternative Water Supply	Energy Savings	Liveability	Building Awareness & Education
Kingston Industrial Stormwater project	V High	High	High	Medium	V High

Case Study 2 - Kingston Town Hall Waterless Urinals

This project involved the upgrade of 27 conventional urinals (flushed with potable mains water) to waterless urinals at the Kingston Town Hall. On average, this project saves around 1.2ML of potable water each year.

	Water Quality	Potable Mains Water Reduction & Alternative Water Supply	Energy Savings	Liveability	Building Awareness & Education
Kingston Town Hall Waterless Urinals	No Change	High	No Change	No Change	High

While the WSC score for this project demonstrates a limited scope for integrated water management, the score does reflect the importance of the Building Awareness & Education component of this project due to its high profile and the large number of people who visit the facility each year. In this case the tool clearly communicates the two key values of this project.

Case Study 3 – Kingston Warm Season Grass Conversion Program

The City of Kingston manages a program of warm season grass conversions at recreation reserves across the municipality. Cool season grasses typically have irrigation demands of up to 6 ML/year. However; once established, warm season grasses, only require ~ 2.5 ML/year.

	Water Quality	Potable Mains Water Reduction & Alternative Water Supply	Energy Savings	Liveability	Building Awareness & Education
Warm Season Grass Conversion Program	No Change	High	No Change	High	High

Warm season grass conversions are an excellent way for Council to maintain a large number of safe playing surfaces within allocated water targets. This project scores 'High' for Potable Mains Water Reduction given the anticipated reduction in demand after conversion. The project scores 'High' for Liveability as the program allows Council to increase the number of valuable (irrigated/safe/green) playing fields that can be irrigated given a limited supply of mains water for irrigation.

6. Conclusions

Our 'Mordialloc Industrial Precinct Stormwater Harvesting & Reuse Project' has been 4 years in the making with the bulk of the asset planning, design and implementation work undertaken during 2011.

This project has provided invaluable learning opportunities relating to challenges associated with successfully renewing and managing public assets within a busy industrial streetscape.

The main outcomes from this $2.8M project include:

(i) A major review of Stormwater Quality Treatment devices (e.g GPTs, pit inserts, and bioretention systems) to compare performance, durability, maintenance requirements, whole of life costs and overall suitability for industrial streetscapes.

(ii) The development of a unique 'Project Scoring' system to help asset managers to compare competing Water Sensitive projects to aid business planning and funding decisions. This system was used as a tool to support the business case for incorporating stormwater harvesting opportunities into this project.

(iii) A variety of other investigation work including the use of porous paving in an industrial environment, designing a new low cost silt trap and calculating green house gas emissions resulting from construction, maintenance and operational activities. All of these studies and trials have enhanced the outcomes from this innovative project.

(iv) Multiple community benefits including:
* Renewed road pavement and streetscape;
* Improved flood protection for factories;
* Improvements to the quality of stormwater draining into Mordialloc Creek; and
* Harvested water for irrigation

This project has demonstrated that stormwater can be harvested from industrial areas and used as a valuable community resource.

It has also demonstrated that a project of this nature can be used as a great opportunity to investigate the performance of public assets to support long term infrastructure planning and sustainability objectives.