

Climate Change & its Impacts on Council's Infrastructure

MEFVIC Study Tour 2011



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- City of Burnaby, British Columbia, Canada
- City of Vancouver, British Columbia, Canada
- City of Seattle, Washington, USA
- Urban Drainage & Flood Control District – Denver, Colorado USA
- City of New York, New York, USA
- Reigate & Banstead Borough Council, Surrey, UK
- Birmingham City Council, Birmingham, UK
- Kent County Council, Kent, UK
- Oxfordshire County Council & Royal Borough of Windsor, Oxford, UK

Executive Summary

The Municipal Engineering Foundation Victoria Overseas Study Tour is a wonderful opportunity for engineers within local government to develop their knowledge and understanding in an international arena. It provides an experience for personal growth where you can meet and network with people from Canada, United States of America & United Kingdom, as well as being able to attend the International Public Works Congress.

Participating in the congress in Denver Colorado this year, I was able to learn and research international responses to climate change and flood control management. I met people from varied backgrounds and interacted with experts showcasing their products at the expo.

Through visiting councils I was able to gather details on water conservation, storm water harvesting programmes and sustainable design techniques to compare with current local practices and find ways to improve our flood mitigation strategies.

The sharing of knowledge with our site contacts showed that other people face similar issues and concerns when it comes to climate change, it is still a relatively unknown quantity, however there are plans and strategies that can be put in place to minimise its impact in the future.

Climate change is likely to affect our environment in many ways from more severe unpredictable weather events or drops in crop production to rising sea levels. This report specifically focuses on how to deal with the increased intensity of rain events and the subsequent issues of flooding that they cause. This is a setback for urbanised areas where many permeable surfaces have made way for development.

We need to broaden our thinking and enter into partnerships with universities and developers to attain greater designs of public space that integrate water sensitive urban design, and increase liveability of our urbanised environments.

Aim

The aim is to consider the influences climate change is having on our weather patterns and investigate innovative methods to harvest storm water run-off to reduce its impacts on urbanised environments.

The purpose of my study tour was to;

- Investigate the impacts climate change and the increasing severity of storms with the subsequent effect these may have on urban areas where development has not always allowed for overland water flow of storms with greater intensity and run-off.
- Analysis of public works initiatives for storm water harvesting that may have been applied to reduce the impact of the unpredictable weather patterns, namely in areas where the influence of significant weather events leads to the inability of Council's existing infrastructure to cope.
- Identify strategies to increase water conservation in existing Council buildings with limited land availability, thus reducing the reliance on present drinking water resources.

Introduction

In February 2011 I was fortunate to be awarded a scholarship from the Municipal Engineering Foundation Victoria to travel to Canada, United States of America & United Kingdom to research international initiatives in the area of environmental sustainability and to attend the American Public Works Association's Annual Congress.

During the tour we visited several Councils throughout Canada, USA and the United Kingdom as well as associated government agencies. From the onset it was obvious that local governments around the world may have a similar purpose, to provide services such as stormwater and sewer management to their residents. What was interesting was how each location set the priorities with regards to the environment, management of water, flooding and stormwater.

This report will provide my observations of how each organisation provides for flooding and if they have any water sustainable initiatives in place. It will also look at how they are managing climate change and compare it to Victoria's readiness to cope with this change.

Council Visits

1. City of Burnaby

1.1 Overview

City of Burnaby has a population of 205,000 people covering an area of 98.6 km². It is home to British Columbia's largest shopping centre and it prides itself on being part of the Liveable Action Plan that prioritises the environment in all programs and policy making.



1.2 Water Initiatives, Flooding & Climate Change

1.2.1 Water Initiatives

City of Burnaby has developed Integrated Stormwater Management Plans that require stormwater management be coupled with land use planning. In the construction of the SFU UniverCity the idea was to determine the pre-development stormwater runoff and use these existing conditions to ensure the post construction runoff mimicked them. Therefore negating any adverse affects on the aquatic life in the river system. This was achieved using a network of water sensitive designs such as bio-swales, open watercourses, detention ponds, pervious pavers and underground infiltration chambers.

Another initiative was their Southpoint Rain garden. Stormwater run-off from a downhill road was causing issues with drainage system. A plan was devised to daylight the stormwater runoff and separate it from the sewer. The stormwater run-off could then continue down the hill through series of infiltration raingardens. To measure the effectiveness of the project a flow monitoring station was installed and interactive learning posts were strategically set up along the new walking tracks so the public and local schools could gain a better understanding of how raingardens work.

1.2.2 Flood Management

The main area of concern for Burnaby, when it comes to flooding, is the Fraser River. Most of the low lying areas along the river are protected by dykes. There are a couple of areas that have been identified as deficient and a program is in place to make upgrade them over the next 5 years. Temporary measures, such as sand bagging will be in place until permanent works are completed. The maintenance program sets out regular inspections of the dykes to assess any degradation.

1.3 General Site Observations & Comments

After learning about the City of Burnaby and the engineering department we visited sites including the university raingardens, incineration plant and a gas flare off station.

Interestingly the city incinerator generates its own power from burning the rubbish and even provides enough power to deliver energy to the paper mill next door. Regular testing of the area surrounding the site is still carried out as a precaution to ensure that the plant is fully contained and no particulates are entering the atmosphere.

2 City of Vancouver

2.1 Overview

Vancouver is the capital of British Columbia and the city covers 114.7 km² with a population of 578,000. City of Vancouver Council has approved their Greenest City Action Plan and is aiming to be the greenest city in the world by 2020.



2.2 Water Initiatives, Flooding & Climate Change

City of Vancouver engineering department has for several years been developing sustainable streetscapes to integrate new ideas into their street design and assist with the management of stormwater. Vancouver has a system of combined sewer and storm water pipework throughout the city so to alleviate pressure on the system they are trying to manage stormwater by providing permeable areas wherever possible.

2.2.1 Crown Street Project

One such project was their Crown Street – Sustainable Streetscape & Fish Habitat Enhancement Project completed in 2006. This development had four main issues to address:

- a. Stormwater management
- b. Traffic calming
- c. Aesthetics; and
- d. Maintenance.

Salmon habitats in the urbanized area of Vancouver had been uncertain and prior to this road reconstruction a project to preserve and restore salmon bearing streams had been developed. As the stormwater runoff from Crown Street entered two of Vancouver's last remaining salmon producing streams, the Musquean and Cutthroat Creeks this was an area where improvement had to be made and typical road reconstruction techniques could not be employed.

To encapsulate stormwater management, traffic calming, aesthetics and maintenance the final design featured a narrow, meandering single lanes fringed by vegetated swales and retention ponds. Stormwater from the road runs into the swales where it is absorbed into the soil covered in native plants and grasses, overflows bigger than a 10-year storm flow into the detention ponds in the adjacent park. Culverts for both the rivers were also upgraded to allow for better stream movement. Monitoring was undertaken for 5 years after completion to test water quality and infiltration volumes. To maintain the amenity for resident's visitors, parking bays were maintained but structural soil was placed in square and hexagon plastic grass paver modules for grass to grow through and water to penetrate.



2.2.2 Country Lanes Project

The Country Lane treatments used by City of Vancouver was another way to reduce the amount of surface water entering the combined storm/sewer system from concreted or asphalted surfaces. This was an effective initiative because in Vancouver vehicular access to properties is from the rear lanes, not the street frontages. The benefits of upgrading these lanes were to reduce dust, improve the environment by

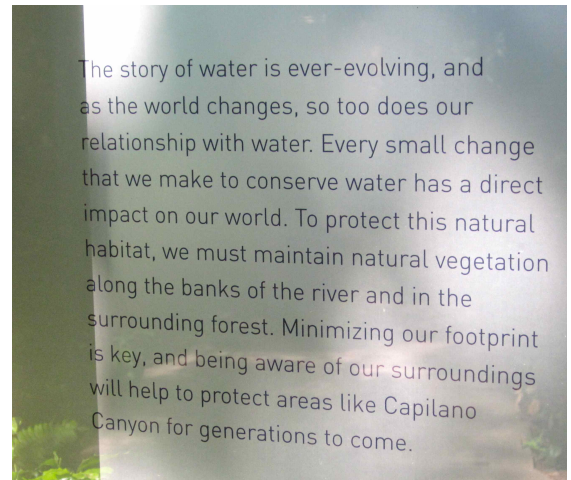


minimizing water sent to the combined storm/sewer system, provide a rural appearance and retain the green verges. There were several techniques used to create these lanes such as integrated concrete stripes, porous paving, honeycombed plastic mats and grassed areas. These provided the functionality and access to properties while allowing permeable areas to absorb the surface water runoff in the lanes.

2.3 General Site Observations & Comments

During our site visit we also stumbled across a City Farmer project. This was an organisation that grew all kinds of fruits and vegetables and ran workshops for people to learn how to compost and grow things in their own backyard, no matter the size. This endeavour from committed people may be beneficial to minimising flooding in the future, as residents may be enthused not to pave their little bit of open space but instead grow plants and vegetables allowing stormwater to be absorbed into the ground as every little bit helps.

The picture opposite really describes how important water is in our everyday lives. It is the small things we do that will make a difference and every little bit helps. I think that sometimes, especially in urbanised environments, people forget the impact their actions have. I am glad I found this sign early in the study tour as it reminded me time and time again that we all can make a difference.



2.3.1 Crown Street Project

Our study group visited the Crown Street site 5 years after its completion and it was observed that although maintenance had been listed as a design priority prior to construction that when it came to the economic crunch this was the first thing to deteriorate. Our guide indicated that budgetary constraints meant maintenance crews were not carrying out routine maintenance, this coupled with the ban on spraying of weeds meant the area was not groomed as well as our



group would have expected. It was obvious during the site inspection that many residents had enjoyed the improvements made to the streetscape and provided maintenance to the area adjacent to their property boundary, however those who had been opposed to the changes took it upon themselves to cover swales near their home with gravel. This clearly shows that for the total success of an innovative streetscape well into the future that all affected parties must be consulted and involved in the decision making process.

2.3.2 Country Lanes Project

In the two country lanes we observe some of the different techniques used to create them. Each lane appeared to be in good condition and it was obvious that the houses abutting the country lanes made an effort to keep the lanes clear of rubbish and tend the grass. This may be due to the monetary contributions that residents made prior to the construction works, they have willingly taken ownership for the areas, which in turn assists Council by minimizing their maintenance regime.

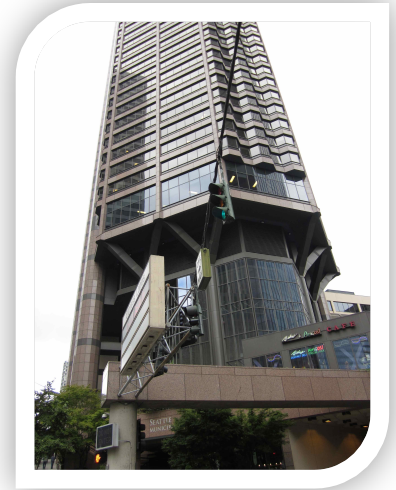


3 City of Seattle

3.1 Overview

City of Seattle has a population of 608,660 people and covers a land area of 217 square km, of which 150 square km is water sources meaning 41% of the water is within the city limits.

A leader in Street Edge Alternative (SEA) designs City of Seattle has been perfecting their designs for the last 10 years.



3.2 Water Initiatives, Flooding & Climate Change

3.2.1 Water Initiatives

The City of Seattle has many examples of SEA designs, ranging from simple swales to fully integrated and monitored raingardens. SEA has been used to improve drainage in areas of the city where no storm water drainage existed, open ditches provided a path for water run-off.

To reduce the impact of flooding Seattle is separating all its combined storm/sewers and are on track to complete this within the set timeframes.

The High Point project was the biggest achievement to date by instigating the housing development to install SEA designs. In every street there are swales, porous pavements, and even a waterfall that moves water from one level of the development into a lower detention lake. This incorporated landscape has added amenity to the estate and improved the value of the housing.



3.2.2 Flood Management

Seattle is committed to improving areas where it has the greatest flooding concerns and one project was the Madison Valley Stormwater Project. It upgraded stormwater pipes and their capacity, then bought several blocks of land to form a detention pond for heavy falls. Creative thinking was used for the detention area as the Council did not want it to become an eye sore and saw the potential to create an open space with native plants that can handle inundation, a dry creek bed for low or no flow times and safe attractive walking paths for use by the public. Ultimately this water will then flow to the next stage of the works where a large water tank is set into the public space and will be used as a viewing platform for the adjacent sporting fields and park.



3.2.3 Climate Change

Seattle's main issue when it comes to climate change is sea level rise as many parts of the city are located at current sea level, so even a small increase can have devastating effects. The main objectives regarding climate change are to learn more about it, engage the science behind it and then assess the impact it may have on Seattle and ultimately try to enhance the city's resilience.

3.3 General Site Observations & Comments

Seattle was an amazing city to visit there was such a variety of SEA designs to see and the departments involved in the design and construction were more than willing to share the successes as well as show how sometimes change takes time and residents are not always on board with such change, therefore consultation is paramount.

4 New York City Environmental Protection

4.1 Overview

The City of New York is made up of five boroughs, Manhattan, The Bronx, Brooklyn, Queens and Staten Island with an overall population of 8.4 million people. It covers an area of 786 square km and was by far the most densely populated area we visited on the study tour.

4.2 Water Initiatives, Flooding & Climate Change

New York City's (NYC) Environmental Protection department is focused on improving its waterways and has developed a Green Infrastructure Plan. This plan looks at ways to incorporate rain gardens, swales, green roofs and other methods to reduce the amount of stormwater that enters the combined sewer/storm water system that makes up most of New York's drainage.

When it comes to climate change NYC Department of Environmental Protection has been working on an assessment and action plan for the last 7 years. It is committed to reducing greenhouse gas emissions as a way of mitigating the effects of climate change.

4.3 General Site Observations & Comments

As a visitor to the great city of New York I was rather surprised to hear regular flood warnings for the Manhattan area. New Yorkers were observed on more than one occasion wearing gumboots, a practice we tend to keep on the farm or for gardening. Our visit to the NYC Department of Environmental Protection answered my concerns, as it was discovered this area has a limited stormwater system or more commonly a combined storm/sewer system, which leads to overloading on a regular basis.

5 Reigate & Banstead Borough Council

5.1 Overview

The Reigate and Banstead Borough Council covers an area of 129 square km of the Surrey countryside. It has a population of 138,600. This area has a chalky geology that allows water to permeate through the soil.



5.2 Water Initiatives, Flooding & Climate Change

The Council harvests water from their depot building for washing trucks and watering gardens. Although this is relatively small scale it all assists to conserve water. They also have a large recycling scheme in place for resident collections and a drop off centre at the Council offices.

The use of swales and porous paving in residential developments is a method for collecting stormwater run-off while maintaining the country environment.

5.3 General Site Observations & Comments

Our site visit centred on a broad acre development where Council had been instrumental in having porous paving installed in the residential streets as well as using swales to capture stormwater run-off from roads and other impermeable areas.

6 City of Birmingham

6.1 Overview

City of Birmingham with its population of 992,100 is the second largest city in United Kingdom. It covers an area of 267.77km² and is approximately 2 hours north of London.

Birmingham Council is committed to going green and has reaffirmed its commitment to climate change with the Birmingham Declaration.

6.2 Water Initiatives, Flooding & Climate Change

Birmingham City Council is a member of SWITCH programme that looks at ways to manage water sustainably. Its main focus was concerned with increased risk of flooding due to climate change and the impact that reduced water consumption from industry is causing, rising groundwater.

Birmingham City Council is proactively trying to influence a cultural change with its residents by committing to provide alternatives in its everyday business to be less of a burden on the environment.

Some of the initiatives Council has committed to implement by 2015 are:

- 50% of electricity used by the Council should be generated from renewable sources.
- 10% of Birmingham home will have retrofit insulation.
- All cars procured by the Council should be electrically powered or run on liquefied petroleum gas.

6.3 General Site Observations & Comments

Our party visited 2 sites to observe how Birmingham is improving the environment and incorporating improvements to water quality and heating of public housing in major developments. The first was Selly Oak where major works have taken place to provide new road access the Queen Elizabeth Hospital and reconstruct the Harborne Reservoir.



The second location was the Manton & Reynolds Tower Block where the Council was upgrading the insulation on the building and installing double-glazing to all external windows to reduce heating costs. In addition to these works a new boiler to run the bio-mass heating system was being completed. This building is part of an upgrade of the entire area to encourage growth and provide increased amenity to those residents.

I found that City of Birmingham was extremely progressive in its approach to improving the environment and making the city a better place for its residents. This I believe is due to having Councillors committed to implementing change for the betterment of the environment.

7 Kent County Council

7.1 Overview

Kent County Council is made up of three tiers of government, the County Council, the District Council, of which there are 12 and more than 300 Towns or Parish Councils. The population for all of Kent County is 1,427,400 and it covers an area of 192.03km². Our site visit was centred on the picturesque countryside of Ashford Borough.

7.2 Water Initiatives, Flooding & Climate Change

7.2.1 Water Initiatives

Many of the commercial and residential developments in the Ashford area have incorporated Sustainable Urban Drainage System (SUDS) schemes. The main aim of SUDS is to reduce pollutants entering the rivers and can be used as a way of harvesting water.

The following list of treatments are ways of installing SUDS into an area:

- a. Permeable surfaces;
- b. Filter strips;
- c. Filter and infiltration trenches;
- d. Swales;
- e. Detention basins
- f. Underground storage
- g. Wetlands; and
- h. Ponds



Ashford uses rain gardens to separate a ring road and public space where pedestrians & cyclists can safely travel. The rain garden uses the slope of the natural surface to assist with water flow and vegetation uses the water, therefore reducing the amount of collected run-off in the conventional drainage system.

7.2.2 Flood Management

The town of Ashford has grown through the ages around the Great Stour River and contains many low-lying areas that are vulnerable to flooding. In the early 1990's a clay embankment dam was built forming the Hothfield Flood Storage Reservoir. Its purpose was to stop the flow of the river and cause it to backup and flood up to 250 acres of farmland, further downstream, minimising the impact on the town of Ashford. If this level of protection was exceeded the water can flow over a purpose built spillway. Earlier this year improvements were made to increase the spillway by 30m to make the reinforced clay, grassed covered embankment from eroding in extreme flood events.

In the city of Canterbury sluice gates built in 1829 have been maintained to manage river levels, balance flood risk and promote recreation. The original sluice gates were as part of Abbott's Mill

which unfortunately burnt down in 1933, their function however has not changed in this time and are still active today. New technology has been added to make the opening of the gates less strenuous.

7.2.3 Climate Change

It was interesting to find that in January 2007 the Ashford Borough signed up to the Nottingham Declaration on Climate Change. This declaration acknowledges that climate change is occurring and that these changes will affect people, socially and economically. In signing the declaration Ashford Borough has set short-term aims, such as extending recycling schemes and reducing CO₂ emissions in Housing run by the Council. These are just a couple of the ways that it is proactively assisting to minimising the effects Council has on the climate.

7.3 General Site Observations & Comments

During our site visits in Kent County we observed a Commercial installation of SUDS at the Eureka Park, Bockhanger, Ashford. The SUDS was built to control the development surface run-off, flood storage and flow attenuation by using large scale balancing ponds. These ponds in turn provided an area for recreation and wildlife. One issue with SUDS is that continued construction in the area does not always take into consideration SUDS purpose and as a result unapproved works blocked one of the balancing ponds. As a consequence remediation works will have to be undertaken to reinstate the balancing ponds function.

8 Oxfordshire County Council (including Royal Borough of Windsor)

8.1 Overview

Oxfordshire County Council is a rural county in the South East of the United Kingdom and has a population of 635,500. It covers a large area of 2,605 km² with many small villages dotting the landscape. Oxfordshire have utilised Sustainable Urban Drainage Systems (SUDS) for approximately 15 years as a way of providing a more sustainable approach to stormwater runoff than just sending it into a pit through a pipe and out into the nearest water course.

8.2 Water Initiatives, Flooding & Climate Change

8.2.1 Water Initiatives

As a way of improving the stormwater discharge from roadways in Oxfordshire all side road improvements must include porous paving and drainage to aid in cleaning the water through filtration prior to it reaching the stormwater system. This is a method of SUDS.

8.2.2 Flood Management

The changes to the Flood and Water Management Act 2010 in the United Kingdom has seen Oxfordshire's responsibilities change regarding the management of water.

The county council's role is to look after local issues and has a duty to:

- a. Promote 'Sustainable Drainage Systems' (SUDS) on all developments
- b. Adopt all SUDs which drain two properties and above
- c. Investigate all flooding in Oxfordshire
- d. Designate flooding structures in Oxfordshire
- e. Maintain a public register of adopted SUDs
- f. Maintain a public register of designated flood structures noticed by the county council as well as the district council and Environment Agency
- g. Consent to the piping of watercourses

Under the Flood and Water Management Act 2010 the Environment Agency has been given the task of setting national strategic policy and is responsible for the maintenance of major water channels that are registered with the department.

8.2.3 Climate Change

Oxfordshire recognises that climate change, even if only slight rises in temperature may have devastating effects on their region. The changes that they may see include:

- a. warmer, drier summers
- b. milder, wetter winters
- c. more frequent extremes of temperature and rainfall
- d. changes that could lead to reduced air quality and higher levels of ozone.

To combat these issues Oxfordshire has an Adaption Action Plan that has been established to allow the area to 'be better prepared to deal with the effects of the weather in the future, and save money.' The main priorities are:

- a. Ensure the necessary measures are in place to address their priority impacts: flood and increased summer heat;
- b. Include current weather and climate risks in their risk assessment processes;
- c. Identify and prepare for longer term climate impacts within the council and within organizations across Oxfordshire.

8.3 General Site Observations & Comments

The site visits were centred on areas around Oxford where we observed a few housing developments and side street reconstructions where large areas of porous paving had been installed. Our guide indicated that by providing large areas where water could filter into the substrate in heavy storms water may still cause pooling, but only for short periods of time. As this is a rural council it also relies heavily on soak-aways (ditches) and swales on the sides of highways to allow for overland flow of water from the roads.

APWA Congress

The study tour was arranged around attending the International Public Works Congress and Exposition at the Colorado Convention Centre in Denver. This is the annual American Public Works Association (APWA) Congress where for four days delegates can attend specialised sessions including stormwater, flood control, emergency management, parks and grounds, roads and bridges as well as personal and career development talks. People come from all over the United States as well as Canada, New Zealand and of course Australia.

During the conference I participated in many sessions and enjoyed attending Colorado's Green Jobs Pipeline for Women breakfast. I met members of the APWA committee and women from many different sectors of the public works fraternity.

The Stormwater summit was very interesting and hosted by members of the Urban Drainage & Flood Control District. This district was established by the legislature after the June 1965 floods that inundated 250,000 acres of farmland, creating a damage bill of over half billion dollars. The purpose of the Urban Drainage & Flood Control District is to assist local government in the Denver metropolitan area with multi-jurisdictional drainage and flood control efforts.

Keynote speakers each day shared their knowledge and expertise with the attendees and each session was inspiring and I wanted to hear more. The first keynote speaker Michael Hayden, a retired United States Air Force Four-Star General; Former Director, Central Intelligence Agency; Former Director, National Security Agency, gave his insight into crisis management and was amazing.

However my favourite speaker was from Gregg Steinberg a sports psychologist and Professor of Human Performance who provided an inspiring argument as to how human behaviour is important and by learning how to control your emotions, can provide you with great rewards.

Comparisons

Climate change is impacting all parts of Australia and from the study tour this is also true for other parts of the world. It may be more intense rainfall, or longer warmer days, whatever the change Councils are looking into ways to minimise its impact by setting policy.

I found that stormwater harvesting of water from building roofs is not widely used, however many places use infiltration through raingardens or swales as a popular way of gathering the water and in turn reducing high flows in storm events. I also observed the use of detention ponds or retarding basins that also integrate public open space as smart land use. This is a great idea as long as the area is properly signed to ensure people do not risk their lives during flood times.

It was also observed that Councils use the partnerships they form with universities in their municipalities to assist with the gathering of data. Collecting information such as flows from raingardens to give an accurate measurement of how well these schemes work. I believe that this is an area where improvements could be made in Victoria.

Victorian Councils and their associates overseas all appear committed to minimising flooding issues, whether it is creating barriers between flood waters and buildings, upgrading infrastructure to diminish the issue or changing the flooded land to open space for all to use.

Recommendations

Recommendations that have been identified from the tour are outlined below:

- Council should continue to study the effects of climate change and put policy in place to implement improvements to the drainage systems before issues worsen.
- Further develop and promote the use of water sensitive urban design in our public spaces. Make better use of paved areas by swapping conventional pavers for porous/permeable alternatives to allow for infiltration of water into the soil.
- Encourage programs that provide information on water sensitive urban design for residents to provide a better understanding of the benefits of their use in an urbanised environment. Ensure that where new water sensitive urban designs are to be installed that consultation is carried out with residents and the scheme is explained to reduce negativity by the public.
- Continue to implement improvements to flooding and drainage but where possible use alternative methods such as detention systems and create attractive public areas.
- Contact universities in the area to collaborate with data collection and review, to improve our understanding of best practice for water sensitive urban design.
- Where Councils are implementing green strategies into its policies, retrofitting buildings and reducing water usage it should heavily promote this to the residents and the general public. If there are no such measures in place then Council's should commence developing and applying changes to minimise the impact on climate change.
- Setup or encourage programs for residents that reduce their impact on climate change. Provide information on Council websites of how to implement water sensitive urban designs into their private open spaces and explain the benefits of using these techniques and the effect it will have on the environment around the residents.

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Kent County Council

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