MUNICIPAL ENGINEERING FOUNDATION VICTORIA

INTEGRATED WATER QUALITY MANAGEMENT STUDY TOUR 2005

Municipal Engineering Foundation Victoria

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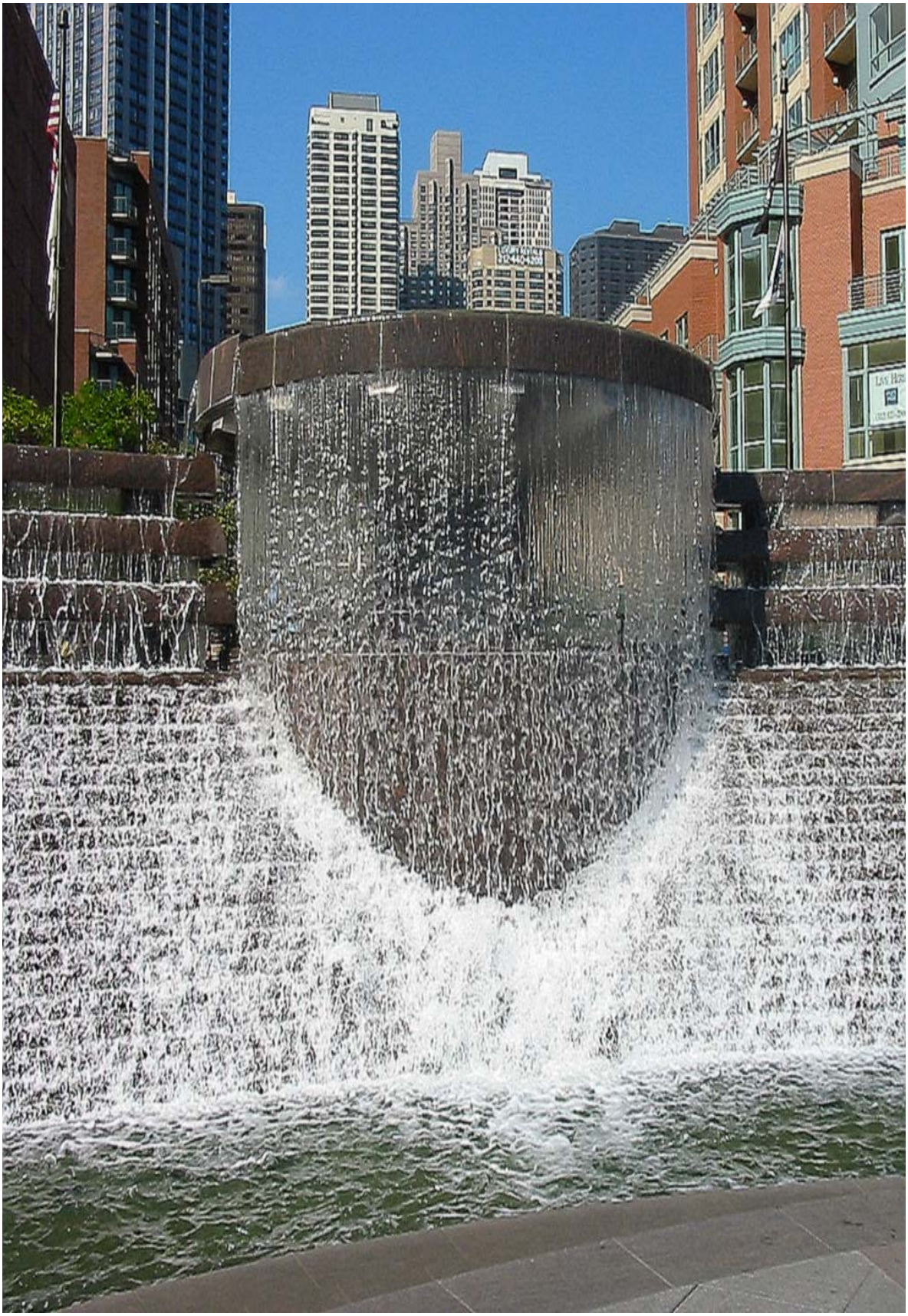
The views expressed in this report are those of the author and do not reflect Council policy or other study tour members.



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ACKNOWLEDGEMENTS

In September of 2005 a group of four Local Government Engineers and a Consulting Engineer from Victoria toured the United Sates of America to visit local authorities responsible for the management of storm water quality within their jurisdiction. This tour would not be possible without the support of the Municipal Engineering Foundation (MEF) of Victoria and I wish to thank the Foundation in being selected to participate in the 2005 study tour.

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Finally I would like to thank the other tour participants for their friendship and comradeship in making this study tour an enjoyable and valuable experience that will be of significant benefit my organisation and me personally.

EXECUTIVE SUMMARY

The traditional approach to managing stormwater in an urban environment has been to dispose of surface flows by means of piped solutions to nearby creeks and waterways. In some urban cities, creeks and waterways have also been paved or piped, discharging to larger water bodies such as lakes and bays.

In more recent times it has been recognised that piped solutions are not the answer as such discharge can have a detrimental impact on the environment including the aquatic life within our streams, creeks, lakes and other major water bodies. In addition, increased paved areas result in increases in stormwater flows resulting in high volume stormwater discharges causing significant flooding and erosion not to mention limiting infiltration into the natural environment.

Accordingly authorities responsible for stormwater discharges have recognised that there is a need to be more cognisant of the impacts of piped solutions and many have implemented strategies, policies and plans to improve the quality of stormwater discharging to our streams and waterways and ultimately major water bodies such as Port Phillip Bay.

A further development in particular in Australia has been the recognition that stormwater is a valuable resource and many authorities are investigating and implementing strategies and policies to harvest and reuse stormwater for various uses thereby limiting flooding but also limiting the impact on our environment.

The 2005 Municipal Engineering Foundation Study Tour with a focus on "Integrated Water Quality Management" was a timely topic having regard to the current changes that have occurred and the continuing changes that are taking place on managing stormwater.

This paper explores the USA experience and makes comparisons with the strategic approaches, the regulatory framework, funding and current practices taking place in Australia and whether some of these practices can be adopted in the Local Government in Victoria. The focus of this paper has been to research: -

- *Strategies, policies and funding mechanisms developed by stormwater authorities to manage stormwater runoff and flooding, stormwater quality and reuse and recycle of stormwater;*

- *Regulatory mechanisms to manage stormwater runoff, and stormwater quality improvements;*

- *Whether stormwater authorities responsible for the management of stormwater were implementing an integrated approach in the management of stormwater and finally;*

- *Whether these strategies and practices are a significant improvement to existing practices adopted in Australia (in particular Victoria) that can be adopted in the Victorian Local Government environment.*

In context the USA experience provided an insight on how stormwater is managed within the USA. The Government structures in the USA are not dissimilar to those in Australia where there are three tiers of Government, Federal, State and City and County Councils.

Unlike Australia however Local and County Councils have a greater responsibility for services, which are normally the domain of the State Government in Victoria. These include the police, the fire brigade, schools sewage and water supply systems. In addition unlike Victoria there is generally no demarcation of responsibility for managing stormwater systems, which are the responsibility of City and County Councils. To provide some transparency in the provision of stormwater services and the cost of these services, some Local Councils had established Stormwater Utilities whose sole responsibility was to manage the stormwater system.

Unlike Victoria flood management and water quality improvement measures in the USA operate in a highly regulatory environment. Most municipalities are required to establish flood maps and designate flood prone areas to protect private property and public safety.

Stormwater quality improvements are more regulated and commenced in 1972 at a Federal level with changes to the Federal Water Pollution Act that resulted in the enactment of the Clean Water Act (CWA) and the subsequent introduction of National Pollution Discharge Elimination System (NPDES). This scheme prohibits the discharge of any point sources of pollution to receiving waters unless the stormwater authority obtains a permit. The permit scheme in its current operation (NPDES Phase 11) requires owners and operators of stormwater systems to develop stormwater plans that address six minimum control measures. These include: -

1. *Public Education and Outreach;*
2. *Public Participation and Involvement;*
3. *Illicit Discharge Detection and Elimination;*
4. *Construction Site Runoff Control;*
5. *Post Construction Runoff Control;*
6. *Pollution Prevention and Good House Keeping.*

Whilst in Victoria there are some State regulatory controls in place to manage illicit discharges and pollution, regulation of stormwater quality is not as rigorous and there are no requirements on developments with the exception of green field sites to improve the quality of stormwater runoff. In established areas, the current practice of improving stormwater quality has been by means of encouragement through the development of municipal stormwater management plans. How effective the implementation of these plan have been has yet to be determined.

To manage flooding, illicit discharges, construction runoff and post construction runoff many local authorities in the USA have also introduced local ordinances, which are similar to local laws in Victoria that regulate development activity and manage stormwater quality runoff during construction and post construction.

In Victoria some progress has been made with the development of some local laws in managing construction stormwater runoff but very little progress on post construction runoff.

The funding mechanisms to implement flood management improvement works and stormwater quality improvements are not dissimilar to those applicable in Victoria. They include: -

- *Taxes (Property, Sales & Business Taxes). In Victoria Property Rates;*
- *Development Charges and Fees;*
- *Fees, Fines and Penalties;*
- *Special Assessment District Charges (Special Rates in Victoria);*
- *Loans;*
- *Federal and State Grants and Matching Funding.*

Some local USA authorities however have established separate Utilities and have the ability to charge a Utility rate for stormwater discharging from the property in addition to the other property taxes that can be applied to the property.

Details of the different government structures, legislative framework and funding mechanisms are documented in Section 4 of this report.

Many of the USA authorities visited on the tour had comprehensive strategies and policies in place to manage stormwater flooding and water quality improvements. Many of the strategies and policies were well develop. In some cases strategies were developed from necessity due to the regulatory framework, whilst others had taken a lead role and had recognised that successful stormwater management could only be achieved through the development of comprehensive plans and implementation of appropriate strategies and policies.

Some of the key elements of the comprehensive strategies and policies developed included: -

- *Master planning, catchment management or water management plans;*
- *Data collection, hydraulic modelling and identification of stormwater issues;*
- *Water quality monitoring;*
- *Development of appropriate source control measures for development and redevelopment projects;*
- *Development of appropriate retrofitting measures for existing facilities;*
- *Regulation and development of appropriate ordinances;*
- *Community education and participation.*

The development of comprehensive master plans or catchment management plans however provided a holistic and integrated framework for managing stormwater within these authorities.

There was limited evidence of any reuse and recycling practices within the authorities visited with the exception of some demonstration sites. This may be a reflection of the organisations visited where the cities were well resourced with good drinking water supply systems. Accordingly there were no significant strategies or policies in place for the reuse and recycling of stormwater.

Details of the strategies, policies, ordinances and funding mechanisms to implement integrated stormwater practices of the authorities visited are documented in Section 5 of this report.

In conclusion there were a number of authorities in the USA where stormwater practices in terms of flood management and water quality management were equivalent to those in Australia whilst in other areas, the USA was further advanced.

With respect to reuse and recycling of stormwater, Australia is further advanced, as there were no significant strategies or policies in place or significant examples, apart from some demonstration green roof projects, on the reuse and recycling of stormwater.

It should be recognised that the key driver for integrated stormwater management practices in the USA and in particular water quality improvements is the regulatory framework. The key question for Victorian Councils is whether there is a need for similar regulation to achieve a similar integrated approach to stormwater quality improvements.

Integrated water quality management is still in its infancy and whilst some regulation is necessary, I believe that integrated water quality management needs to be a mix of regulation, incentives, government and local government policy, capacity building, collaboration, education and improved technology.

The recommendations I have made reflect the above attributes and are documented in Section 7 of this report.

1. INTRODUCTION

The Municipal Engineering Foundation (MEF) each year sponsors and awards study tours to engineers employed in Local Government to study abroad on areas of interest that would be beneficial to Local Government in Victoria.

In 2005 the MEF sponsored four Local Government Engineers to tour the United States of America (USA) between the 7th September and 25th September 2005 to study Integrated Water Quality Management and attend the annual American Public Works Association (APWA) Engineering Conference in Minneapolis, which was held on the 11th to 14th September 2005.

The study tour participants included four Local Government Engineers sponsored by the MEF and a Consulting Engineer involved in the development industry with a special interest in stormwater quality management. The tour participants were: -

Mr Peter Aumann	Director Infrastructure Services City Of Monash;
Mr Michael McGlade	Manager Roads Development Wyndham City Council;
Mr Alan West	Team Leader Engineering Design Kingston City Council;
Mr Chris Sfetkidis	Client Services Engineer Manningham City Council; and
Graham Rule	Director WBCM Consulting Engineers.

The organisations visited during the study tour included: -

1. City Of Seattle – Public Utilities Department;
2. City Of Bellevue – Environmental Division Utilities Department;
3. Barr Engineering Company acting on behalf of the Ramsey – Washington Watershed District;
4. Short Elliot Hendrickson Inc acting on behalf of City of Maplewood, Minnesota;
5. Metropolitan Water Reclamation District of Greater Chicago;
6. City of Atlanta - Department of Watershed Management;
7. City of Griffin - Public Works and Utilities;
8. Low Impact Development Centre Inc, Maryland; and
9. Baltimore County - Department of Environmental Protection and Resource Management.

With the exception of Graham Rule who joined the group at the congress in Minneapolis, all the participants visited all the sites as a group.

2. STUDY TOUR TOPIC

The study tour topic chosen by the trustees of the MEF for the 2005 study tour to the United States was to study "*Integrated Water Quality Management*." The primary focus of the tour was to investigate and research best management practices associated with the management of stormwater in terms of water quality, quantity, reuse and recycling.

Whilst the participants toured as a group each tour participant had a specific area of interest in the topic. Some of the participants were more focused on detail design and construction standards associated with best management practices in managing stormwater quality in an existing urban environment and new developments including subdivisions, whilst others were interested in strategies policies and practices in the management of stormwater runoff from the perspective of flood control and improvements to the quality of stormwater runoff.

My specific area of interest was to investigate and research: -

- Strategies, policies and funding mechanisms developed by stormwater authorities to manage stormwater runoff and manage flooding;
- Strategies, policies and funding mechanisms developed by stormwater authorities to manage stormwater quality runoff;
- Strategies, policies and funding mechanisms developed by stormwater authorities on the reuse and recycling of stormwater;
- Regulatory mechanisms to manage stormwater runoff, and stormwater quality improvements;
- Whether stormwater authorities responsible for the management of stormwater were implementing an integrated approach in the management of stormwater; and finally
- Whether these strategies and practices are a significant improvement to existing practices adopted in Australia (in particular Victoria) that can be adopted in the Victorian Local Government environment.

This report details the findings and conclusions of the places visited and assesses whether authorities in the USA are implementing an integrated approach in the management of stormwater.

3. METHODOLOGY

Prior to leaving for the USA, the study tour group met and discussed the details of the tour, the tour objectives, the tour arrangements and requirements of obtaining information to produce a report on the findings of study tour.

The group met on several occasions to organise the tour. Tour participants were required to conduct preliminary research of cities and authorities in the USA that had implemented best management practices in the management of stormwater in the areas of interest of the group.

The group was also required to develop a brief overview of the study tour on the areas of interest of the group together with details of each of the participants for circulation to relevant cities and authorities within the USA.

Once these cities had been identified a preliminary itinerary was established with the view of visiting specific authorities within these cities relevant to the study tour. Each participant was then required to make contact with relevant staff at authorities within these cities and organise meeting times with relevant personal within these authorities that were prepared to host participants of the study tour.

The itinerary was subsequently finalised and final travel arrangements completed.

The study tour commenced on the 7th September 2005 visiting the Cities of Seattle and Bellevue in the State of Washington prior to attending the APWA annual conference held on the 11th to 14th September 2005 in the City of Minneapolis. The tour continued visiting authorities and sites in Minneapolis, then Chicago, Atlanta, Griffin, Baltimore and finally Washington.

4. CONTEXT

Any assessment of best management practices in the USA associated with the management of stormwater quantity, quality, reuse and recycling needs to be considered in the context of the environment in which authorities responsible for the management of stormwater operate. Accordingly before any comparisons can be made between authorities in the USA and those in Victoria, (Australia), and whether such practices can be adopted in Victoria, one needs to understand the structure of governments, the legislative framework in which authorities operate and the funding mechanisms and structures available to authorities to implement best management stormwater practices.

4.1 Government Structures

Similar to Australia there are three tiers of government in the USA as government structures are based on the British system. While there are many similarities there are also many differences.

The United States is a federation with the highest level of government being the Federal Government, which is responsible for issues that affect the national interests. In Australia the Federal Government is also the highest level of Government and is also responsible for major facilities and matters of national interest.

The second tier of government is the State Government, which is responsible for facilities and issues within State borders, in particular hospitals, freeways and the education system. Unlike Australia where there are only 6 States and two main territories, there are 52 States within the USA, which vary in size and population. Some States are quite small in comparison to Australia.

The third tier of Government in the USA is contained within State borders and includes County Councils and City Councils. Unlike Australia County Councils and City Councils are responsible for a wide range of services that include the police, fire brigades, libraries, roads, water supply, sewerage, schools, social services, drainage and transportation. In some County Councils and Local Councils, public Utilities have been formed. These Utilities are totally responsible for water supply, wastewater disposal and treatment including stormwater collection, discharge and treatment. Some of these Utilities have the ability to initiate separate charges for these services.

In Australia Local Governments are not responsible for the police, the fire brigade, water supply sewerage and major drainage systems, which are generally seen as the responsibility of the State.

City Councils within the USA can exist within the boundaries of County Councils and can be formed by a plebiscite of residents within the County. Accordingly whilst Counties and Local Councils may offer a wide range of services and have very large revenues to implement such services they can be very small in size and population. Some Counties and Local Councils in some circumstances depend on the State for the provision of some services.

By comparison Local Councils in the USA can serve a very small population by Australian standards but provide a wider range of services.

4.2 Legislative Framework

4.2.1 United States Of America

4.2.1.1 Flood Management

Flood management in the United States is generally the responsibility of the Local Government. Federal and State laws require Local Government to adopt regulations that restrict development in critical areas such as flood prone areas. Federal and State laws however can also influence local flood plain regulations enacted by Local and County Councils.

Whilst Local Government and County Councils are not necessarily the owners of waterways within their jurisdiction, these authorities are generally seen to have prime responsibility for the management of the waterways and catchments within their municipal district. These authorities also have prime responsibility to regulate development and implement flood management projects that protect public safety and property from flood damage.

Local authorities are not only responsibility for the management of the total drainage infrastructure within their municipal district within the public right of way (except State Highways), including waterways but also for managing and regulating development within designated flood prone areas. This is achieved through the development and application of ordinances adopted by the local authority and applied to any new development or redevelopment proposal within the boundaries of the local authority.

4.2.1.2 Water Quality Improvement

Stormwater quality improvements in the USA operate in a highly regulatory environment. Regulations were initially implemented in the early 1970's, in an attempt to improve water quality to receiving waters. The main drivers for these regulations was the recognition that a number of major water bodies and receiving waters within the USA were being highly polluted by discharges from industry, waste water treatment plants and stormwater drainage systems. Discharge of pollutants and nutrients to these major water bodies was degrading the health of these major water bodies and affecting the natural habitat within these waters. The major water bodies affected include: -

- The Great Lakes of Chicago;
- Chesapeake Bay in Baltimore; and
- The Pugent Sound in Seattle.

In 1972, in order to improve water quality to these receiving waters, amendments were made to the Federal Water Pollution Control Act that resulted in the enactment of the Clean Water Act (CWA). These amendments saw the introduction of the National Pollution Discharge Elimination System (NPDES), which prohibited the discharge of any pollutants to receiving waters within the USA from point sources unless a permit was obtained from the regulatory authority.

The United States Environmental Protection Agency (U.S. EPA) is the regulatory authority responsible for implementing the system and enforcement of the Act. The agency has the power to delegate some of its responsibilities to relevant environment protection agencies that exist within some States. The Act amongst other directives: -

- ”Requires permitting of point source discharges of pollutants into waters of the United States under the National Pollutant Discharge Elimination System (NPDES).
- Guides the development of effluent limitations to regulate wastewater treatment and management.
- Mandates that States set water quality standards, and require periodic listing of impaired waters.
- Mandates “total maximum daily load” analyses for impaired waters.
- Requires programs to encourage control of non point source pollution.
- Regulates discharges of dredged and fill material into navigable waters.
- Authorizes citizen enforcement actions.
- Prohibits oil and hazardous material discharges to waters.
- Requires certain spill response.”[1]

The initial focus of the legislation was to reduce pollutant discharges from industrial processes, wastewater and municipal treatment plants. There were limited requirements under the legislation to address stormwater runoff and discharges, which was limited to certain industrial categories.

It was recognised however that there was a need for a more comprehensive approach to NPDES and accordingly the CWA was amended in 1987 that resulted in the introduction of phased NPDES requirements for stormwater discharges.

Phase 1 requirements were initially introduced on the 16th November 1990 and applied to owners and operators of large and medium size separate storm sewer systems (MS4). It included municipalities with a population of 100,000 persons and more. The requirements did not only apply to industry and local municipalities but also owners and operators of stormwater systems under the jurisdiction of State departments of transportation, universities, local sewer districts, hospitals, military bases and prisons.

An MS4 is not necessarily a system of underground pipes but can also include roads, drainage systems, gutters and open ditches. The definition of an MS4 is detailed in the definitions and abbreviations. (Page 76)

Owners and operators of large and medium size MS4s were required to implement the requirements under Phase 1 in two parts. The first part required owners and operators of systems to document the conditions of their catchments and stormwater management activities and examine existing legal requirements and the means to enforce their stormwater management programs to control pollutants. Part one also required testing of major outfalls to determine the characteristics of stormwater discharges and detect illicit connections to the storm sewer system.

Part two of Phase 1 required owners and operators of medium and large MS4s to then document the data collected on the catchments and major outfalls and to establish a comprehensive stormwater management program that included legal authority to control pollutants to receiving waters.

[1] *City Of Seattle 2004 Comprehensive Drainage Plan,* Volume 1 Chapter 4 January 2005.

In order to extend the coverage of the NPDES stormwater program, the U.S. EPA on the 7th August 1995 announced the introduction of Phase 2 of the NPDES. Phase 2 would be applicable to all stormwater discharges from small MS4s to receiving waters. The Phase 2 requirements mainly apply to municipalities in urbanised areas not included in Phase 1 requirements. They apply to residential populations of at least 50,000 people with an overall population density of at least 1,000 people per square mile. Phase 2 requirements also apply to owners and operators of stormwater systems under the jurisdiction of State departments of transportation, universities, local sewer districts, hospitals, military bases and prisons not covered by Phase 1.

There are some exceptions where the requirements of Phase 2 can be waived and in particular in small communities less than 1,000 people and in circumstances where it can be demonstrated that discharges will not cause or have the potential to cause water quality impairment.

The rulings of Phase 2 regulations were published on the December 1999 and are more prescriptive than Phase 1 regulations. The ruling also outlined a different approach on how stormwater management programs are to be developed and implemented. To comply with the Phase 2 regulations.

"Operators of regulated small MS4s are required to design their programs to: -

- Reduce the discharge of pollutants to the "maximum extent practicable"(MEP);
- Protect water quality; and
- Satisfy the appropriate water quality requirements of the Clean Water Act."[2]

Phase 2 of the NPDES required the development of stormwater programs that addressed six minimum control measures and required the development and implementation best management practices (BMP's) and measurable goals for each of the control measures that when implemented together would result in significant reductions in pollution to receiving waters. The U.S. EPA has established guidelines and measurable goals in determining the most appropriate BMP's to be implemented for each of the six minimum control measures.

To satisfy each of the minimum control measure the owner or operator is required to implement the following requirements.

1. Public Education and Outreach

   Implement a public education program and distribute educational material to the community and or conduct outreach activities to inform citizens of the impact that polluted stormwater runoff discharges can have on water quality and local water bodies and the measures that can be taken to reduce stormwater pollution.

   BMP's include forming partnerships with other government departments and other organisations that may be involved in regional or State wide educational programs that perform outreach activities. Educational material could include brochures and fact sheets, educational displays and programs for school age children, storm drain stencilling and signage to increase public awareness.

[2] *United States Environmental Protection Agency EPA 833-F-00-002,* January 2000 Fact Sheet 2.0

2. Public Participation / Involvement

Actively engage the community and provide opportunities for citizens to participate in program development and implementation, including effectively publicising public hearings and or encouraging citizen representatives on a stormwater management panel. The owner and operator must also comply with State and local public notice requirements.

BMP's include public meetings and citizen panels that involve the public in the development of appropriate stormwater policies, volunteer water quality monitoring programs that involve citizens near local water bodies, speakers who conduct workshops, storm drain stencilling involving citizens, community clean ups along local waterways, citizen watch groups that aid enforcement and identification of pollution and encouraging citizens to keep storm drains free of debris and monitor local waterways.

3. Illicit Discharge Detection and Elimination Minimum Control Measure

Implement and enforce an illicit detection and elimination program. The program must include: -

- A storm sewer system map, showing the location of all outfalls and the names and location of all waters of the United States that receive discharges from those outfalls;

- The establishment of an ordinance, or other regulatory mechanism, to prohibit non-stormwater discharges into the MS4s, and appropriate enforcement procedures and actions;

- A plan to detect and address non-stormwater discharges, including illegal dumping, into the MS4. The plan may include identifying problem areas, then testing and determining sources of illicit discharge followed by notification and direction to rectify the problem including documentation and reporting;

- An education program informing public employees, businesses and the general public about the hazards associated with illegal discharges and improper disposal of waste.

Outreach to public employees, businesses, property owners, the general community, elected and public officials are an integral part of detecting and eliminating illicit discharges.

4. Construction Site Runoff Control Minimum Control Measures

Develop, implement and enforce a program to reduce erosion and control sediments and pollutants entering MS4s from construction activities associated with the disturbance of land of one or more acres. The program must include: -

- An ordinance or other regulatory mechanism requiring the implementation of proper erosion and sediment controls, and controls of other wastes on applicable construction sites;

- Procedures for reviewing site plans and construction plans that consider potential water quality impacts, including site inspection and enforcement of control measures;

- Site inspections and sanctions to ensure compliance; and

- Procedures for the receipt and consideration of information submitted by the public.

5. Post Construction Runoff Control Minimum Control Measures

Develop, implement and enforce a program to reduce pollutants from stormwater runoff post construction from new developments and redeveloped areas that result in the disturbance of land of one or more acres. The program must include:

- Strategies, which include a combination of structural and or nonstructural Best Management Practices (BMP's);

- An ordinance or other regulatory mechanism requiring the implementation of post construction runoff controls to the extent allowable under State or local laws;

- Measures that specify adequate long-term operation and maintenance controls.

BMP's of non structural measures would include planning controls through the development approval process and may include site based controls that include buffer strips or riparian zone preservations on master plans, comprehensive plans and zoning ordinances that promote water quality and the restriction of certain types of development.

BMP's of structural measures include storage basins such as wet ponds and detention basins, infiltration basins or trenches, porous pavements and vegetated practices such as grassed swales, artificial wetlands and rain gardens.

6. Pollution Prevention / Good Housekeeping Minimum Control Measures

Develop and implement a program with the view of reducing pollutant runoff associated with municipal operations. This would include an assessment of stormwater runoff from streets, parking lots, storage and vehicle maintenance areas including management and maintenance practices of storm sewer systems. The program must include: -

- An operation and maintenance program with the ultimate goal of preventing or reducing pollutant runoff from municipal operations into the storm sewer system;

- Employee training on how to incorporate pollution prevention measures and good housekeeping techniques into municipal operations.

BMP's include the development of maintenance schedules and inspection procedures for structural measures, controls that reduce or eliminate pollutants such as regular street sweeping, reduction in the use of pesticides or street salt, or frequent catch-basin cleaning, programs that promote recycling and reduce litter, procedures for the proper disposal of waste and ensuring new flood management practices assess impacts on water quality.

Owners and operators that implement BMP's under Phase 2 need to evaluate the effectiveness of their chosen BMP's to determine whether the BMP's are reducing the discharge of pollutants from their systems to the "maximum extent practicable"(MEP) and to determine if the BMP's are satisfying the water quality requirements of the Clean Water Act. The U.S. EPA recognizes that there will be site specific regional or national variability in the selection of the BMP's to be implemented. The measures chosen however need to satisfy the minimum control measures.

While water quality monitoring is not required under Phase 2 rule, the authority issuing the NPDES permit has the discretion to require monitoring if necessary. This may require owners and operators to improve controls and revise their mix of BMP's to achieve a more effective program.

4.2.2 Australia (Victoria)

4.2.2.1 Flood Management

Unlike the United States, there is a two tiered system and a demarcation of responsibility for the management of waterways and drainage in Victoria and in particular Melbourne. In the Melbourne Metropolitan area, Melbourne Water is the responsible authority for the management of waterways and the main drainage system whilst local Councils are responsible for the local drainage network. In the rural areas of Victoria, including the regional cities and towns, responsibility for the drainage networks generally rests with municipal Councils whereas the major waterways and flood management responsibility rests with the Catchment Management Authorities (CMA's).

For the Melbourne Metropolitan area, Melbourne Water is the regional drainage authority and "is responsible for maintaining the major drainage systems in stormwater catchments that cover areas exceeding 60 hectares. It is responsible for larger underground pipes, generally above a diameter of 1200mm, and open channels, creeks and rivers. Melbourne Water's area extends to the Yarra Ranges in the east, the Mornington Peninsula and Western Port in the south, Yan Yean in the north and Werribee to the west." [3]

"The Port Phillip and Westernport region covers an area of 12,346 square kilometres and the catchments of Dandenong, Westernport, Yarra, Werribee and Maribyrnong. Melbourne Water's responsibilities cover 7665 square kilometres or about 62% of this area. (See Figure 1)"[4]

Figure 1
Operating Area

Parts of the Port Phillip and Westernport region with varying arrangements for river management and related functions

Inside Melbourne Water area
- Yarra catchment, lower Maryibrynong catchment, and lower Werribee catchment
- Dandenong catchment and central Westernport catchment

Outside Melbourne Water area
- Upper Werribee catchment and upper Maryibrynong catchment
- Lower Mornington Peninsula in the Westernport catchment
- Bass sub-catchment in the Westernport catchment

The authority is responsible for managing 1340 kilometres of underground stormwater drains and open channels; some 5200 kilometres of rivers and creeks and more than 140 stormwater treatment systems, which include wetlands, sediment and litter traps.

[3] *Managing Stormwater Flooding Risks in Melbourne.* Auditor General Victoria July 2005.
[4] *Operating Charter For Waterways and Drainage 2005*. Melbourne Water.

As the regional drainage authority Melbourne Water has the obligation of providing a safe and effective system for managing stormwater runoff reducing the risk of flooding in priority areas and preventing inappropriate development in flood prone areas. The authority has the responsibility of providing a safe level of flood protection for the community.

"This is achieved by: -

- Limiting development in floodplains and overland flow paths to protect these areas for storage and conveyance of floodwaters;
- Ensuring new urban areas are planned to incorporate stormwater treatment and to accommodate overland flows of floodwaters without threat to property or public safety;
- Building and operating infrastructure such as drains, levees, retarding basins and wetlands to contain, detain, convey or treat stormwater or floodwater;
- Operating a flood warning network."[5]

Similarly Catchment Management Authorities have the obligations to develop regional flood plan management and waterway plans for the regions for which they are responsible and to coordinate and implement regional drainage plans and schemes.

Melbourne Water and other regional drainage authorities have specific powers conferred to them under various Victorian Acts of Parliament for the management of waterways, main drainage systems and the provision of flood protection. These include: -

a. The *Melbourne and Metropolitan Board Of Works Act 1958*, which provides Melbourne Water with the powers to manage waterways and drainage services. It includes drainage and river improvement works and defines the operational area of the authority;

b. *The Water Act 1989*, which further defines functions, conferred on Melbourne Water relating to drainage, waterways, flood plain management and diversions of drainage water;

c. The *Planning and Environment Act 1987,* which requires the referral of applications, related to subdivisions, zones and or overlays of interest to Melbourne Water.

Whilst there are a number of Acts that govern Catchment Management Authorities, it has been recognised with the recent publication of the Victorian Government's White paper "Securing Or Water Future Together" that the responsibilities and accountabilities of the CMA's are at times unclear. As part of the White Papers recommendations the Government proposes to develop a new legislative framework for CMA's to meet the Government's objectives outlined in the Governments White Paper policy statement.

[5] *Operating Charter For Waterways and Drainage 2005*, Melbourne Water.

Local Government however has no statutory powers or responsibility conferred to it for flood management. Local Government operates under the provisions of the *Local Government Act 1989* and under the Act Councils are required to provide services effectively and efficiently in accordance with the Best Value Principles to meet the needs of their communities.

Councils however play an important role in managing stormwater drainage systems. In the Melbourne Metropolitan area, Councils are responsible for the management of local area drainage networks that serve catchments less than 60 hectares and in total they "manage 25,000km of constructed drains servicing an area measuring 150,000 hectares. They are also responsible for land use planning and for drainage infrastructure in smaller catchments."[6]

Under the Local Government Act 1989, Councils obligations are to manage their drainage assets and ensure they operate effectively and efficiently. They also have powers under the same Act to require property owners that cause a nuisance to adjoining properties due to lack of proper drainage, to connect to the local network or undertake appropriate rectification works to alleviate the nuisance caused. Councils also have powers to initiate and implement drainage schemes to improve drainage within areas where drainage is deficient.

The only other powers conferred to Councils are those powers conferred to it under the Planning and Environment Act 1987, where a Council can require drainage requirements on development and redevelopment projects for the proper drainage of the development and or limit discharges from the development where it may impact on the existing drainage network and likely to cause local flooding.

"Under the *Emergency Management Act 1986*, Councils must prepare a municipal emergency management plan and appoint a municipal emergency officer. Responsibility for the emergency response to flooding rests with the Victorian State Emergency Services, but Councils coordinate recovery activities such as clean up of debris. When a more widespread municipal emergency is declared, the Council municipal emergency resource officer coordinates the immediate response."[7]

The Victorian Auditor General however in his recent report on "*Managing Stormwater Flooding Risks in Melbourne."* identified that Councils need to take greater responsibility for managing the risk of flooding within their municipal districts. In view of the current legislation there appears a legislative gap in the role and responsibilities of Councils with respect to flood management.

4.2.2.2 Water Quality Management

Water Quality Management in Victoria is not as regulated as it is in the USA In the State of Victoria; the Environmental Protection Authority (EPA) is the responsible authority for developing water quality objectives to protect rivers, creeks and the bay.

Similar to the USA, water quality improvements in Victoria initially focussed on the control of pollution from industrial discharges, waste disposal and unsewered urban areas. In more recent times while pollution from these sources has decreased it has become evident that pollution from urban stormwater runoff has increased.

[6] *Managing Stormwater Flooding Risks in Melbourne.* Auditor General Victoria July 2005.
[7] *Managing Stormwater Flooding Risks in Melbourne.* Auditor General Victoria July 2005.

The major driver for water quality improvements in Victoria is the deterioration in the ecological health of Port Phillip and Western Port Bays. This is mainly due to the high nitrogen loads, which have increased significantly due to the pollution runoff from the urban catchment. "Although urban areas make up less than 20% of the catchment, they are estimated to contribute around 40% of total annual catchment loads of nitrogen to the bay. Continuing urbanisation of the catchment is expected to further increase nitrogen loads if no efforts are made to manage stormwater quality." [8]

A survey undertaken by Melbourne Water in 2003 of the health of rivers within the Melbourne Metropolitan region indicates that only 28% of the rivers and creeks are in good to very good condition, 24% are in fair condition and 48% are in poor or very poor condition. These is mainly due to the many point discharges from Councils and Melbourne Water's drainage infrastructure that discharge stormwater directly to receiving waters without treatment and have contributed to the high nitrogen levels in Port Phillip and Western Port Bays.

The *Environmental Protection Act 1970* is the primary legislation that governs water quality improvements in Victoria and provides principles for environmental protection, State environment protection policies, industrial waste policies, scheduling premises, licensing and/or works approvals. This Act also provides the EPA, Melbourne Water and other relevant drainage authorities (with the exception of Local Government) the power to impose various conditions, objectives, improvement actions and monitoring for compliance that are relevant to waterway management including water quality and environmental flows.

Whilst the EPA is responsible for developing water quality objectives, in the Melbourne Metropolitan area, Melbourne Water together with many other agencies are seen to be responsible for meeting these objectives. Melbourne Water is recognised as the "Protection Agency" under the EPA Act. It is the lead agent in facilitating a collaborative approach between various stakeholders that includes Local Government to achieve water quality improvements in Victoria, unlike the USA where water quality improvements are regulated through the introduction of the NPDES and stormwater authorities responsible for urban stormwater discharges are required to develop stormwater programs and achieve the six minimum control measure (as detailed in section 4.2.1.2 of this report) before they can discharge stormwater runoff to designated waterways and major water bodies.

There have been a number of initiatives that have been implemented in Victoria to improve stormwater quality to meet State objectives. Many of these initiatives require a collaborative approach involving Melbourne Water as the lead agent and include: -

1. Capacity Building

   One of the key initiatives of Melbourne Water to deliver best practice in stormwater quality has been the development of the "Clearwater Capacity Building" program that has been managed by the Municipal Association of Victoria (MAV) and funded by EPA Victoria. Clearwater operates as an information exchange and develops and implements education and training for people in industry, local Councils and State government agencies. Melbourne Water has also been involved in the development of a technical manual known as *Water Sensitive Urban Design: Engineering Processes for Stormwater Management,* which will provide engineering standards and specifications for the design, construction and maintenance of water sensitive design technologies.

[8] *Operating Charter For Waterways and Drainage 2005*, Melbourne Water.

2. Municipal Stormwater Management Plans

A further key initiative involving Local Government has been the development of a memorandum of understanding between Melbourne Water, the EPA and the MAV where there has been an agreement to share responsibilities for the cost of improving stormwater run off through the development of Municipal Stormwater Management Plans.

This initiative commenced in 1999 where financial assistance was provided to local Councils through the EPA to develop and implement Municipal Stormwater Management plans for all of the municipal districts within the Melbourne Metropolitan area. Plans have now been developed for all 34 municipalities and progress has been made to implement these plans with the assistance of funding from the State Government.

The plans generally focused on the development of management practices to improve stormwater runoff from Councils own operations and to control and manage construction activities during the implementation phase of developments through the planning permit process. In addition the plans highlighted the need to install structural measures such as wetlands, sedimentation ponds, filtration systems, gross pollution traps and other measures at various locations within the municipal district to improve the quality of stormwater runoff before it discharged to receiving waters.

For most Councils, implementation of non structural measures has been relatively easy. Many Councils have reviewed their own operational arrangements to improve stormwater quality runoff from their own activities and introduced local laws and applied appropriate planning controls to control stormwater runoff from development sites.

The implementation of structural measures however has been more difficult particularly in more recent times where funding from the State for such measures has diminished with the abolition of the Victorian Stormwater Action Program (VSAP). Whilst the Government has introduced a new funding program for stormwater reuse and recycling initiatives it has neglected to allocate further funding to implement many of the structural measures identified by Councils in their Stormwater Management Plans to improve stormwater quality runoff.

Many local Councils have abandoned the implementation of structural measures to improve stormwater runoff due to the lack of matching funding which was seen as a joint responsibility between Councils and the State Government.

3. Water Quality Infrastructure

Water quality infrastructure facilities include wetlands, sedimentation ponds, filtration systems, and gross pollution / litter traps. In established urban areas may of these initiatives were implemented through the municipal Stormwater Management Plans developed for municipal Councils.

Melbourne Water assisted many Councils in the implementation of such works through their Stormwater Management Plan. There has been no indication that further funding will be available although Melbourne Water has indicated in it's charter that it will allocate a significant proportion of it's funding to water quality infrastructure works in established urban areas to reduce nitrogen loads.

As indicated previously many Councils are reluctant to install water quality infrastructure facilities without the financial support of the State, although some Councils are taking the opportunity with new infrastructure improvement works and road rehabilitation works to retrofit and incorporate urban sensitive design initiatives.

These initiatives however are few and far between due to the lack of knowledge on life cycle cost analysis of such treatments especially the long term maintenance costs and the lack of regulatory requirements to consider or install such initiatives where new works are proposed.

4. Regulatory Controls

Melbourne Water has powers as the referral authority under the Planning and Environment Act to require the installation of necessary infrastructure works within new developments to achieve “Best Practice” water quality objectives, especially greenfield sites where developments are proposed on sites greater than 5 hectares. For sites less than 5 hectares or greater than 0.4 hectares there are no statutory requirements to comply but water quality objectives are encouraged.

Water quality objectives for stormwater discharge in Victoria for greenfield sites was established in 1999 by the Victorian Stormwater Committee and is now recognised in the State Planning Policy Framework and forms part of the State’s Environmental Protection Policy (SEPP). The targets, which are detailed in the “Urban Stormwater Best Practice Environmental Management Guidelines”, require retention of 80% of suspended solids annual load, 45% of total phosphorus and 45% of total nitrogen annual load and are targets that need to be achieved for developments greater than 5 hectares.

Some Councils have encouraged water quality initiatives for small developments through the planing permit process including the imposition of water quality targets with limited success. This is mainly due to the lack of statutory powers in the Planning Scheme in particular the provision of Rescode, Clause 55 and Clause 56.

There are however changes proposed to the provisions of Clause 56, which applies to subdivisions and mainly greenfield sites, where developers will be required to comply with an integrated approach to the management of stormwater runoff. It is considered that whilst these powers are an improvement, it is questionable whether they will significantly improve water quality to receiving waters given that most of the development and redevelopment in the Melbourne Metropolitan area is likely to occur in the established areas where the provisions of Clause 55 of Rescode will apply and there is no requirements to apply an integrated stormwater management approach.

4. Education and Awareness.

In its operating charter Melbourne Water is generally seen as the lead agent in conducting education programs and engaging the community in changing community behavior to improve water quality of our rivers and waterways.

The authority’s activities include advertising campaigns, educational kits on litter, school and community activities associated with drain stenciling, Waterwatch and the Frog Census.

Waterwatch is a national program and Melbourne Water is the coordinator of the program that provides support to local catchment coordinators organizing training and development and fostering communication between schools and community groups involved in monitoring the health of rivers and creeks in the Melbourne Metropolitan area. The authority also coordinates funding applications and financial support from other sponsors mostly Councils to implement these programs.

Other than the Environmental Protection Act and to a lesser extent the Planning and Environment Act, there is no other significant legislative requirements imposed on drainage authorities that manage stormwater discharge to waterways and major water bodies to improve stormwater runoff from the catchments for which they are responsible, as is the case in the USA.

In so far as Local Government is concerned there are no legislative requirements to require Councils to improve stormwater runoff from their operations or to implement any program or initiative to improve the quality of stormwater discharge from their municipal district from the local drainage network to receiving waters. The implementation of Stormwater Plans developed by Councils will only be successful if funding is provided to support these plans, as there are no statutory requirements to comply.

In the Victoria there appears to be a legislative gap in the development approval process with development and redevelopment projects (other than greenfield sites) in requiring water quality improvements. In addition, there are no requirements for Councils to improve stormwater quality from their own operations that discharge from local drainage systems to receiving waters, to improve the water quality in rivers, creeks and ultimately Port Phillip and Western Port Bays.

The questions that need to be asked with the current legislative framework and collaborative approach, is will the State's water quality objectives be achieved and in particular will there be a reduction in nitrogen loads to the bay. In addition should there be legislative changes to Clause 55 of Rescode to support Councils in the development approval process and or legislative requirements on Councils to improve stormwater runoff from their own operations and stormwater systems that discharge to receiving waters.

4.3 Funding Mechanisms

4.3.1 United States of America

Local authorities in the USA have a number of funding options to fund stormwater programs and improvements. The funding options are dependent on 3 factors: -

- The type of the organisation that is required to deliver the drainage improvement program works, especially where local authorities have established a local Utility whose prime responsibility is to manage water and wastewater drainage services;
- The amount of revenue that can be raised from the various funding options; and
- The political feasibility of the options and the needs of the program.

Some of the funding options are similar to those available to authorities in Australia. They include: -

1. Development Impact Fees on Undeveloped Land

   These fees can be levied by local authorities on developers to fund the cost of infrastructure necessary to service new developments. This applies in particular to greenfield sites. Future property owners contained within the development will derive the benefit of the infrastructure works. Local authorities that charge development fees need to develop a capital improvement plan for greenfield areas to validate such fees.

2. Development Impact Fees on Developed Land

   A fee on developed land applies to properties that are subject to redevelopment and infill development within established areas. The fees can only legally be applied to expansion and enhancement of existing services necessary as a result of the redevelopment proposed. Such fees cannot be used to replace assets in disrepair or in need of an upgrade that is not related to the redevelopment.

3. Fees, Charges, Fines and Penalties

   These include fees associated with development approvals and activities regulating construction and construction runoff, charges for service connections, renewed connections, detection and repair of leaks, review of construction plans and fines and penalties associated with non compliance related to any enforcement program.

4. Taxes

   Unlike Australia, Local Governments in the USA may levy a variety of taxes to fund any program. They include sales tax, property tax, business tax and occupation tax. These revenue sources are also available to fund stormwater programs, however it should be recognised that it is very difficult to obtain political support to raise taxes where Councils have already exercised their legal authority to levy taxes in accordance with State powers.

   If taxes are to be raised, an analysis needs to be conducted on the community's ability to pay. Such taxes may also need to be quantified for specific purposes such as operational, asset replacement or new capital projects.

5. Utility Rates

Local authorities in the USA are able to form separate stormwater Utilities, which can then charge fees to users of the stormwater system. Funds generated by the Utility can be used to finance the operation of the Utility including capital improvements works with the exception of works that are required in greenfield sites or infill developments. The formation of a separate Utility and charging of fees to service the Utility is a very common practice in the USA. There are two types of rate revenue sources associated with Utilities and they include: -

a. Unit Charges

Unit charges are rates, which are calculated monthly or periodically on the quantity of product consumed. These are normally associated with water and electricity consumption and are very difficult to apply to stormwater programs, as it is difficult to measure the amount of stormwater discharged by each user.

b. Service Charges

Service charging is generally used where it is difficult to quantify the level of consumption on a unit basis and is the most common type of charging by stormwater Utilities. Service charges are generally fixed to minimise administrative costs and to ensure that the rate charged is generally in accordance with the benefit received by each property. There are three common methods of determining stormwater service charges, which are all based on the premise of disrupting the natural drainage system.

"The first is an approximation of the percent impervious surface. Percent impervious surface is a measure of the property that does not allow water to penetrate the ground. This includes roofs, parking lots and sidewalks.

A second method is a flat rate based on the number of residents in the community.

The third method assesses a service charge through a combination of percent impervious surface, type of business (SIC classification), and the size of the property. Each business type is assigned a runoff factor that reflects the potential discharge of pollutants from the property and a development factor that reflects the percent impervious surface. The product of these two factors is then multiplied by the size of the property in 500 square foot increments.

Once the rate is calculated a fixed fee is added to cover administration costs."[9]

6. Special Assessment Districts

A local authority can also create a special assessment district and levy a special rate on district members for the operation maintenance and infrastructure installations.

[9] *Guidance Manual For Implementing Municipal Stormwater Management Programs - Volume 1 Planning and Administration.* United States Environmental Protection Agency, September 1997.

7. Debt Financing

Debt financing is generally used to fund capital projects and has the major advantage of providing capital improvements to the community up front and allows repayments to be made over a period of time. The advantage to the community is the debt is generally borrowed at a fixed rate of interest and is repaid over years with dollars that are cumulatively deflating whilst the community enjoys the benefit of the capital improvement.

There are two primary methods of debt financing. They include the issue of bonds or loans. The issue of bonds can be either "*general obligation"* bonds or "*revenue"* bonds. "*General Obligation"* bonds are repaid via tax revenue paid to Local Government and have the full support of the local authority, whilst "*revenue'* bonds are repaid from a dedicated source of rate revenue. *"Revenue"* bonds have fewer statutory constraints and are more commonly used by established Utilities, as they do not affect an authority's credit rating. As these bonds are generally repaid from a fixed source of revenue, the interest rates are generally higher.

Most States within the USA have a "State Revolving Fund" (SRC) loan program, which is available to authorities for water pollution control works. These loans provide a source of low cost financing to authorities at very low interest rates. Recipients of the SRC loans are required under the CWA to provide a dedicated source of revenue to cover loan repayments.

8. Grants and Matching Programs.

States in the USA also provide grants to local authorities for stormwater quality programs. Grants can either be restricted with matching contributions or unrestricted in their use. Generally grants are issued for large capital projects to assist local authorities to finance water quality infrastructure works.

4.3.2 Australia (Victoria)

In the Victoria where there is a demarcation of responsibility for drainage and water quality improvements between Melbourne Water, Catchment Management Authorities and Local Government. There are also various sources of revenue available to these authorities to fund drainage improvement works and water quality initiatives.

4.3.2.1 Melbourne Water

Melbourne Water has several revenue sources to fund drainage and water quality improvement works. They include: -

1. Allocations from Government Taxes and Charges

Melbourne Water is a State Government statutory authority and accordingly funding for the operation of this authority is generally funded from State taxes and charges. An allocation is made annually to the authority to finance the operation of the authority and deliver many of the programs, which are the responsibility of the authority. The authority however does have some revenue raising powers to fund certain works.

2. Drainage Charge

Similar to some of the Utilities in the USA, Melbourne Water has the power to levy a drainage charge for drainage services. This charge is calculated on the Net Annual Value of the property and is generally in the order of $80.00 per property in the Melbourne Metropolitan area. Funds collected from the drainage charge are generally used to fund improvement works along rivers, creeks and the drainage system managed by Melbourne Water.

3. Drainage Schemes

Drainage schemes are being used by Melbourne Water to fund infrastructure and environmental improvement works associated with any new development. Schemes can be developed for greenfield sites and for urban areas where there is a significant level of redevelopment. The objective of these schemes is to ensure that appropriate infrastructure is installed to ensure that urban expansion does not adversely affect levels of flood protection, river or creek conditions or stormwater quality. The cost of these schemes is generally borne by developers undertaking any development within the scheme area.

Drainage schemes are generally strategic plans that identify appropriate works such as underground drains, overland flow paths, retarding basins, wetlands and gross pollution traps and specify the appropriate treatments necessary to protect rivers, creeks and any related sites of significance. Schemes need to be appropriately estimated in order that charges can be levied on developers.

4. Developer Contributions.

Developer contributions normally apply to small areas and once off developments where a requirement may be placed on the development as part of the planning permit process to fund specific infrastructure works.

4.3.2.2 Local Government.

Similar to Melbourne Water Local Government also has several revenue sources to fund drainage and water quality improvement works. They include: -

1. General Rate Revenue

The primary source of funding for many Councils for drainage improvement works to alleviate flooding is general rate revenue, which is a generally a property tax. Rate revenues are based on either the capital improved value or the net annual value of the property. Differential rates can be charged to different types of properties, however the rate charged is generally calculated having regard to the revenue required to fund the total operation of the municipality including any capital improvement works. Capital improvement works together with other Council programs are established during the budgetary process each financial year.

In Local Government very limited funding is provided for water quality improvement works, which are generally seen as a shared responsibility between the State and Local Government.

2. Developer Contributions

Revenues from developer contributions are normally collected from developers for the provision of improved drainage infrastructure associated with any development or redevelopment project. They are similar to drainage schemes implemented by Melbourne Water in that a strategic plan needs to be developed and the works costed such that appropriate contributions can be sought from developers for the improvement works. Developer contributions are not very common in Local Government particularly in well established urban areas due to the lengthy process involved in developing and implementing such schemes, which need to be undertaken through planning scheme amendment process.

Similar to Melbourne Water, Councils can require once off payments for drainage infrastructure for small developments that are site specific for the development.

Councils however have very limited powers however to require contributions for water quality improvement works to improve the quality of stormwater runoff from a development sites.

3. Special Rates And Charges

Councils have powers under the Local Government Act 1989 to charge for specific works that would be of special benefit to residents within its municipal district. Special rates and charges have generally been used to fund drainage schemes for properties where drainage is deficient or non existent and the works are necessary for the proper drainage of a specific area.

4. Government Grants

Federal Government grants are available to Councils for flood mitigation works. Generally these funds are provided to rural communities who lack funding resources to fund flood mitigation improvement works. Councils seeking grants need to meet established criteria to qualify for the grant.

State Government grants are also available to Local Government however these have primarily been for water quality improvement initiatives. Grants were previously available to Council on a dollar for dollar basis under the State Governments "*Stormwater Action Program"* to implement stormwater quality improvement projects. This program in Victoria has been replaced with the *"Urban Conservation Fund"* where grants are now predominantly being allocated for water conservation initiatives that include stormwater reuse and recycling.

As indicated previously many Councils relied on government grants to implement water quality initiatives associated with their stormwater management plans. Due to the lack of funding in this area many Councils are reluctant to implement these initiatives, which have generally been seen to be a joint responsibility of the State and Local Government.

5. Loans

Loans are also available to Councils to fund infrastructure improvement works. Loans are generally used to fund capital infrastructure improvements as in the USA. Councils in Victoria however have been very reluctant to initiate loan programs. Many Councils are very conscious of debt and generally maintain a high level of fiscal restraint when it comes to managing Councils financial position.

5. ORGANISATIONS VISITED

The study tour group visited a range of organisations in the USA. Most were local government authorities either City Councils or County Councils whose prime responsibility was to manage drainage infrastructure and water quality improvements. Other organisations included consultants acting on behalf of City or Councils and one research organisation. The places visited are as follows:

5.1 City Of Seattle - Public Utility Department

The City of Seattle is located on the north west coast of the United States in the State of Washington and is the largest City in this region. The City is located between two major water bodies of the Pugent Sound to the west and Lake Washington to the east.

The City comprises of 369.2 km^2 consisting of 217.2 km^2 of land and 152.0 km^2 of water. The population of the City is 573,672 residents with a population density of 2368/km^2. The metropolitan population, which includes the outer metropolitan area and other municipalities, is 3,769,267. The City is well known as a reasonable wet City due to the number of wet days, which is predominantly light drizzle. The City receives 35 to 38 inches (890 to 970 mm) of rainfall per year.

The City is governed by a nine member Council with members elected every four years. The City provides a significant number of services to the community and has an annual budget of $2.415Bil.

5.1.1 Responsibilities

Management responsibility for all drainage services, including drainage infrastructure to protect public safety and private property from flooding including water quality improvement works are the responsibility of the Seattle Public Utility. The Utility was formed in 1997 following the completion of a comprehensive drainage plan for the City. The Utility not only provides drainage services for the City but also wastewater management and solid waste management services. The Utility and the City do not own, nor is it responsible for, the creeks lakes and shoreline systems.

The Utility operates as a self supporting business of the City and a specific rating structure was established by the Utility to fund the administration; operation, maintenance and capital improvement works associated with drainage, wastewater and waste management systems that service the City.

The City of Seattle has a mix of drainage systems that have been developed over the last century. These include: -

- A combined sewerage and stormwater drainage system that terminates at one of the cities wastewater treatment plants;
- A partially separated system where wastewater discharges to the sewer and stormwater is directed to a separate stormwater drainage system. Roof runoff in a partially separated drainage system is directed to the sanitary sewer while street runoff is directed to the separate drainage system; and.
- An open ditch, swale and culvert system where one third of the City (70 miles) has no formal drainage with kerbs, gutters and underground drainage.

5.1.2 Strategies And Policies

The City of Seattle has developed a comprehensive drainage plan to manage stormwater surface flows from the City. The new comprehensive plan dated 2004 is an update and a review of the City's first drainage plan developed initially in 1995 and subsequently reviewed in 1998.

The City's new drainage plan consists of four major programs.

- Stormwater and Flood Control.
- Landslide Mitigation.
- Aquatic Resources Protection – Water Quality.
- Aquatic Resources Protection – Habitat.

In the development of the new plan, Seattle Public Utility (SPU) conducted a detail assessment of existing conditions of the City to determine the drainage needs for each of the four programs. The assessment consisted of a collation of existing scientific and environmental information including the conduct of hydraulic basin studies and condition assessments of all the major basins. The basin studies involved various community meetings where valuable information was collected from the community to determine the community's needs and expectations. The data was used to support the service levels determined for each program.

5.1.2.1 Flood Management.

The primary objectives of the City of Seattle's flood control program are to: -

a. "Manage surface water to protect public health and safety, minimise property damage and protect the environment.

b. Protect the value and function of public drainage infrastructure and extend its useful life."[10]

The basin studies and community information formed the basis of developing appropriate service levels of flood protection throughout the City. The focus of previous plans was primarily to convey stormwater via a piped system and the installation of detention facilities such as surface ponds and underground vaults to reduce peak flows.

The new plan adopts a new approach defining service levels to control flooding whilst integrating water quality, habitat protection and landslide mitigation works. The previous service levels were to provide a main drainage system for each of the basins to cater for a "25 year, 24 hour" storm event.

A cost assessment however of this service level revealed that the cost of implementing this service was cost prohibitive and beyond the capacity of the Utility to implement. The service level also did not address flooding problems that existed outside the main drainage system nor did it address flow control issues to mitigate stormwater runoff that could damage receiving waters and aquatic resources within receiving waters. Furthermore implementation of this strategy only benefited a low number of the City's population.

[10] *City Of Seattle 2004, Comprehensive Drainage Plan*, Volume 1 Chapter 5, January 2005.

Accordingly SPU developed new service levels that would provide a balanced approach that would provide a high level of protection to critical services such as hospitals, fire stations and police and lower levels of service in residential streets. The logic in this approach is that the cost of drainage improvements in the neighbourhoods would be less because runoff is not conveyed large distances to another location via a piped stormwater system. In addition receiving waters receive better protection because of the reduced quantity of runoff.

The new service levels for flood protection outlined in Seattle's Comprehensive Drainage Plan are detailed as follows: -

- "Manage stormwater runoff within the City right-of-way to protect public safety and buildings (e.g., residences and businesses) up to and including the "25 year, 24 hour" design storm event.

- Manage stormwater runoff within the City right-of-way to allow access to and functionality of critical services such as hospitals, fire stations, and schools up to and including the 100 year, 24 hour design storm event.

- Manage stormwater runoff within the City right-of-way to protect public safety and support mobility on major transportation routes (arterial roads) up to and including the "25 year, 24 hour" design storm event.

- Manage stormwater runoff within the City right-of-way to protect public safety and support mobility on residential roads (non arterials) up to and including the 5 year, "24 hour design storm event.

- Conduct flow control projects where appropriate and cost-effective to mitigate drainage impacts on creek ecosystems."[11]

In order to facilitate the implementation of the flood management program, the Utility developed a number of policies to guide the establishment of improvement work priorities in accordance with the levels of service. A detail list of policies is attached as Appendix A.

There has been a major shift in policies in the implementation of the new service levels. The major changes include: -

1. Expanding the services beyond the main drainage system

   The Utility had spent considerable sums of money implementing the previous drainage plans of upgrading the main drainage system and installing detention facilities. Most of the flooding problems associated with the main drainage system have now been resolved. Having defined new levels of service, the focus now has been on the implementation of drainage improvements works in areas that lack basic drainage improvements.

2. Varying the level of flood protection according to service area priorities

   The adoption of new service levels provides the Utility with a more responsive approach to the provision of funding where it is most required to maintain and improve access to critical services such as hospitals, fire stations and schools.

[11] *City Of Seattle 2004, Comprehensive Drainage Plan*, Volume 1 Chapter 5, January 2005.

3. Developing natural drainage system

SPU had previously installed detention systems to control flows to receiving waters however it was recognised that while peak flows were reduced, the volume of water entering the waterways remained the same and in many cases creating adverse affects on receiving waterways. Accordingly one of the significant changes in the management of stormwater flows has been the implementation of natural drainage systems (use of infiltration and detention) in localised areas, which are predominantly areas with ditches and culverts.

This approach was established following the success of a pilot project undertaken in 2000 where the Utility implemented the "SEA Street" project. It involved a redesign of residential streets using open vegetated swales, stormwater cascades and small wet ponds to mimic the natural environment. The project was undertaken in conjunction with the University of Washington's Centre for Urban Water Resources Management who conducted extensive monitoring of stormwater flows. The results indicated: -

- A reduction in discharge of 98% of the runoff from 2.3 acres.
- A 20% reduction in stormwater flow velocities discharging to the nearest creek.

This new approach has not only provided a significant reduction in stormwater flows but a high level of environmental protection and reduced pollutant loads. Whilst there are some transport safety issues associated with the open swale systems the approach has been very successful and the Utility proposes to continue the implementation of natural drainage systems in right of ways (streets), that do not have piped drainage systems, which is almost 30% (70 miles streets) of the municipality.

SEA Street and Broadview Green Grid Projects Seattle.

4. Protecting existing ditch drainage system

Historically the attitude with open ditches has been to replace them with a piped system. However it has been recognised that existing grassed ditches play an important role with flow control. These grassed ditches also, to a lesser extent, assist with the removal of pollutants.

Grassed ditch Pinehurst neighbourhood.

5.1.2.2 Water Quality Management

The primary objectives of the City of Seattle's water quality program are to: -

a. "Protect and seek opportunities to improve water, sediment, and physical aquatic habitat quality in priority environments associated with drainage and wastewater systems in Seattle.

b. Foster awareness and stewardship of water quality and aquatic ecosystems.

c. Coordinate City wide aquatic resource activities."[12]

There are a number of listed impaired water bodies within the Seattle area under the Clean Water Act that exceed current water quality standards. Accordingly apart from meeting NPDES requirements, the main focus of SPU's water quality program is to protect water quality in Seattle's lakes, streams, rivers and shoreline through improved drainage management and protect the fish habitat in the waterways particularly the salmon that have been in decline.

The water quality program in Seattle has evolved in response to the NPEDES regulatory requirements. The natural drainage system that has been used not only to control flow but also improve water quality is only a small part of the program. SPU have initiated a number of strategies to improve water quality improvements to receiving waterways. The key strategies include: -

1. Expanding Water Quality Monitoring

One of the challenging aspects of developing effective solutions to improving water quality is to understand the causes and effect of pollution not to mention identifying the sources. Accordingly, the collection of scientific data on the physical, chemical and biological condition of receiving water bodies, including the sources of contaminants impacting on water quality and the severity of urban pollutants on receiving waters is an important part of the program.

[12] *City Of Seattle 2004, Comprehensive Drainage Plan,* Volume 1 Chapter, 7 January 2005.

One of the key components of SPU's strategy is to expand water quality monitoring and develop a data management, evaluation and reporting process system such that information available can be provided to key personal in determining effective water quality solutions and priorities. Knowledge of the sources, pollutant types and the effectiveness of treatments improves the decision making process, not to mention the ultimate goal of improving water quality within receiving waters.

The monitoring program includes: -

- Long term monitoring to establish long term trends and an evaluation of the SPU's pollution prevention efforts;
- Compliance monitoring to assess whether businesses and particular projects or programs meet specific standards;
- Project and program monitoring to assess whether specific treatments meet the intended performance requirements.

2. Expanding Source Controls on Pollution Prevention and Engage Community

Reducing pollutants at the source before it reaches the waterway is a major focus of SPU's water quality program. Accordingly, another key strategy of the water quality program is to expand the enforcement and inspection program. This includes responding to complaints and inspecting drainage systems of businesses focussing on key problem areas that are likely to generate pollutants with the view of reducing pollutants to receiving waterways. Part of the inspection program also includes working with businesses to implement best management practices through on-site source controls to reduce pollutants leaving the site.

In addition the program includes public education, stewardship and incentive programs working with residents and businesses to change or modify behaviour to reduce pollutants to receiving waters. This includes, maintaining on-site drainage systems, reducing pollutants from routine home and maintenance activities as well as improving on-site water management.

3. Integrating Water Quality Objectives with Citywide Policy

The operations of a number of departments within Seattle can affect stormwater quality. Accordingly, the integration of water quality objectives into citywide policies, where consistent pollution prevention practices are implemented, would assist improvements to water quality objectives and also comply with NPDES requirements where they apply to Council's operations.

This would also apply to placing appropriate requirements on new developments and redevelopments to meet water quality standards and objectives.

4. Identifying High Priority Water Quality Problem Areas

A further strategy is to identify, evaluate and rank water quality problems within the City to determine appropriate solutions for specific pollution generating activities or high risk areas to improve water quality to receiving water bodies. This strategy is used to optimise resources and maximise the water quality benefits to receiving waters.

There are also a number of policies that drive the water quality program. These are detailed in Appendix B.

5.1.2.3 Reuse and Recycling

Seattle's comprehensive drainage program did not include any significant programs on the reuse and or recycling of stormwater. Recycling stormwater was mainly used on development or redevelopment projects, to maximise the size of the development on the site and obtain rating credits, by retaining stormwater in a detention system.

The tour group was able to inspect a demonstration building project at Seattle's City Hall building where rainwater from the entire site was collected and used for the rain garden on the roof of the building, toilet flushing throughout the building and reticulation for the water fountains and water features around the building surrounds.

Roof Garden, Cascade Water Features and Fountain – Seattle City Hall.

The only other reuse and recycling initiatives implemented by the City was the distribution of educational material on saving water and the use of rain barrels. Education material on good housekeeping practices on pollution prevention measures was circulated to the all residents three times per year.

5.1.3 Ordinances

The City of Seattle has two ordinances that regulate surface water management practices within the City. They include: -

- Stormwater, Grading and Drainage Control Code; and
- Side Sewer Code.

The *"Stormwater, Grading and Drainage Code"* is primarily used to regulate development projects during and post construction and regulate discharges from premises to the City's drainage system. The code sets out minimum standards and requirements on the extent of impervious surfaces for development and redevelopment projects including a review and inspection process of grading plans. Regulations on developments include flow control, source controls, water quality treatment, including erosion and sediment control practices during construction.

Stormwater quality runoff is regulated by prohibiting certain discharges to the public drainage system and requires owners and occupiers to implement operational and structural controls to reduce stormwater pollution. Operational controls include simple housekeeping such sweeping parking lots, maintaining existing drainage systems, training employees on pollution prevention and clean up spills. Structural controls are physical structural devices or facilities that prevent pollutant entering the stormwater system.

It should be noted that the rate of redevelopment within the City of Seattle is less than 1% and accordingly only a small proportion of these redevelopments play a role in controlling stormwater flow and water quality improvements within the City. The ordinance is mainly used to regulate existing premises to control the quality of stormwater runoff.

The code is enforceable by a number of departments and can include the issuance of a number of notices including stop work orders and penalties for non compliance.

The other ordinance in place is the *"Side Sewer Code"* which regulates activities related to privately owned and maintained pipe systems that carry sewerage and or stormwater from plumbing fixtures to the public sewer or approved outlet. The code prohibits the disposal of certain substances and regulates connections to the public system, pre-treatment requirements and permits for temporary connections and repair of inoperative systems.

5.1.4 Funding Mechanisms

Seattle Public Utility has the power as a Utility to charge a drainage rate charge to all property owners within its municipal district to raise revenue for the operation maintenance and capital improvement works conducted by the Utility. The primary source of revenue is from rates. The Utility also has some non rating revenues from permit fees but it represents less than 1% of the total revenue collected. Other revenue sources include capital grants and operating grants from other departments. The fees from drainage rates account for 99% of the operating revenue required by the Utility.

To simplify billing and administrative costs all single family homes and duplexes pay a flat fee of $110.36US per year. All other properties are assigned to one of six categories based on the percentage of impervious surface area of the site where an annual charge is calculated on the extent of imperious surface area of the site. The larger the impervious surface the greater the drainage rate. Impervious surfaces include roof areas, parking areas and any other hard paved areas on the site.

A 10% discount on the drainage rate applies to any commercial building development or redevelopment project where a rainwater harvesting system is installed. The system must utilise or infiltrate the amount of rainwater that would occur during a one year, 24 hour storm event to qualify for the discount.

The operating expenditure of the Utility over the next 5 years, on operation and maintenance on the four drainage programs outlined above is expected to average $16.5Mil per annum, whereas expenditure on capital improvement works is likely to average $19.5Mil of which more than half will be utilised to fund stormwater flood control measures.

5.2 City Of Bellevue – Environmental Division Utilities Department

The City of Bellevue is located in King County of the United States in the State of Washington across Lake Washington from Seattle and is the fifth largest City in the State. The City is located between Lake Washington to the west and Lake Sammamish to the east.

The City comprises of 87.28km^2 consisting of 79.6km^2 of land and 8.2km^2 of water. The population of the City is 115,000 residents with a population density of 1411/km^2. The rainfall is similar to Seattle, which is predominantly light drizzle. The annual rainfall is 35 to 38 inches (890 to 970 mm) per year. The City has seen significant growth and rapid development in the last 50 years growing from a population of approximately 3,000 in the early 50's to the current population of 115,000.

The City is governed by a seven member Council with members elected every four years. The City provides a significant number of services to the community and has an annual budget in the order of $982.4Mil.

5.2.1 Responsibilities

Similar to Seattle, management responsibility for all drainage services that includes drainage infrastructure to protect public safety and private property from flooding including water quality improvement works are the responsibility of the City of the Bellevue Utility. The Utility was established in 1974 under controversial circumstances when a rating charge was proposed for drainage improvement works. The proposal to form a utility materialised following concerns from the community that increased development between the early 1950s and 1973 had resulted in increased flooding and deterioration of the City's streams and waterways.

The City's population had increased rapidly from 7700 in 1950 to 68,000 by 1973. Although there was some controversy with the establishment of the Utility and a separate rating charge for drainage works, the community and the City recognised the formation of the Utility was necessary to preserve the City's rivers and lakes.

The Utility is not only responsible for drainage and surface water flows but also the City's drinking water supply and waste water systems. Unlike the City of Seattle the City has a separate stormwater and sewer system. The City is responsible for the management and maintenance of 26 watershed areas. This includes 60 miles of streams (70 streams), which form part of the drainage system, 800 acres of wetlands, 11 regional stormwater detention systems, 320 neighbourhood detention facilities, 373 miles of piped drainage lines and 93 miles of open ditches.

5.2.2 Strategies And Policies

Similar to the City of Seattle, Bellevue City developed a comprehensive Drainage Master Plan for the City to manage its drainage stormwater flows and water quality improvements. The first master plan was established in 1976 following the establishment of the Utility to address immediate issues of flooding and scouring.

In subsequent years the master plans were reviewed with a greater focus on water quality objectives. The City recognised very early that a comprehensive plan was necessary to manage flooding and water quality improvements. As part of the planning process, a number of studies were conducted of the various catchments to identify flooding and water quality issues within each of the catchments.

The Utility currently manages the municipal storm drainage system and open streams through programs of public education, maintenance, flood control, emergency response, comprehensive planning, capital improvements, water quality control and development regulation.

5.2.2.1 Flood Management

Prior to 1973, and the establishment of the drainage Utility, management of drainage works and response to flooding and run off problems within the City of Bellevue had been reactive. There was no planning or comprehensive plan to manage stormwater runoff on a basin to basin approach. The first Drainage Master Plan developed in 1976 had a 5 year focus on volume and erosion control.

Various options were investigated which included constructing large stormwater sewers using a combination of open streams, and high flow bypass pipelines, using on site flood controls (stormwater detention), constructing regional flood control dams and reservoirs and a combination of the latter two.

The approach and strategy selected was the use of a natural drainage system or “open stream” concept, which required on-site flood controls as well as regional facilities using the open streams as the main conveyance system. Flooding and stormwater runoff from new developments would be controlled with on-site controls (detention systems) and the impacts of past developments would be mitigated by the installation of regional facilities. The approach recognised that stream protection was paramount to protecting the stream’s ecosystem. It was also recognised that the implementation of a strategy based on the open stream concept was 4 to 10 times less costly than traditional stormwater sewer improvements.

The strategy plan to control flooding required the allocation of $15Mil over 10 years and was primarily used to build regional detention facilities. On-site detention facilities would be required through the establishment of ordinances and required through the development approval process.

Neighbourhood Detention Facility

Neighbourhood Detention Facility & Park

Most of the detention facilities that have been installed have proved to be very successful with controlling floods within the City.

The flood mitigation policies that were developed as part of the 1984 plan are generally still adhered to today and include: -

- "Retain existing open surface water systems in a natural State, except when necessary to protect public health and safety on an area wide basis.

- Restrict to the extent possible, surface water runoff to pre-development levels for all new construction and development (to the extent possible) using the best available technology.

- Preserve and maintain the 100-year floodplain in (a natural) an undeveloped State except when necessary for area-wide stormwater control projects."[13]

5.2.2.2 Water Quality Management

Bellevue City has been one of the leading authorities in the USA in the implementation of water quality improvements which began as early as 1976 with the development of their initial Drainage Master Plan and the development of their subsequent drainage plan in 1984. These plans have subsequently been reviewed in light of improved best management practices and pioneered to some extent the introduction of the NPDES permit scheme.

The City commenced its water quality program in the late 70's. Whilst the City has developed and implemented a number of initiatives since that time, the main strategy implemented by Bellevue to improve water quality has primarily been one of source controls and a strong focus on educational programs.

The City has a number of staff involved with monitoring probable pollution sources with the view of identification and elimination. Staff work with a wide variety of businesses to control pollution at the source. There is also a strong regulatory framework and enforcement program associated with water quality improvements. Those responsible for pollution events are liable to compensate the City for the efforts required to locate pollution sources including containment and disposal of pollutants. Fines may also be levied.

The regulatory program through the City's ordinance also includes the requirement to install the appropriate size, design and installation of on-site treatment facility to improve stormwater runoff prior to discharge off site to the drainage system or receiving waters. Many of these requirements are placed on developments as part of the development approval process in accordance with the Utility's Stormwater Surface Water Utility Code and the Utility's Surface Water Engineering Standards.

The Utility is also heavily involved in educational programs and engages the community in a variety of public education processes. The educational programs consist of printing and distributing various educational materials to residents and businesses and the conduct of various community workshops on stream protection preservation and enhancement. It also includes brochures on the proper disposal of hazardous substances, household products, chemicals herbicides and pesticides to ensure that such substances are not disposed of in storm drains, which subsequently impact on receiving waters. The program also involves community forums and environmental education meetings with the public and schools to promote methods of improving stormwater quality to receiving waters. The focus of some educational programs is on those groups that cause pollution and encourage businesses and the residential community to improve the management of on site runoff and pollution.

[13] *Bellevue Urban Runoff Program Summary Report.* Prepared by Robert Pitt Consulting Environmental Engineer and Pam Bissonnett Storm & Surface Utility Bellevue.

The City employs two staff full time within the organisation to facilitate the educational programs.

Source controls have predominately been used by the Utility to control pollutants for developments and redevelopments projects that have occurred since the establishment of the Utility. To improve water quality in areas where sources controls have not been implemented or prevalent, the Utility has implemented a number of retrofit technologies and regional treatment facilities to improve stormwater quality runoff. Retrofits include modification to existing detention systems by adding wet ponds, wetlands, bio-filtration swales and sand or soil filters. Regional facilities include the construction of large scale wetlands, chemical treatment facilities or sand filters.

Stormwater Regional Detention Facility (Water Quality & Flood Control)

The above facility has been constructed within the stream, which allows initial sedimentation to occur and also reduce water flow to the creek downstream. Nine facilities of this type have been constructed within the City.

Bio-filtration Swale With Kerb Openings Within Median of Main Road

The water quality policies that were developed as part of the 1984 plan are generally still adhered to today and include: -

- “Maintain good surface water quality and rehabilitate degraded surface water quality using the best available technology through appropriate controls on-site development.

- Preserve and maintain wetlands in a natural State except when necessary for area-wide flood control.
- Preserve aquatic and riparian habitats in a natural State and rehabilitate areas that have been degraded.
- Conserve ground water resources to the extent possible using the best available technology except when groundwater creates public safety problems."[14]

5.2.2.3 Reuse and Recycling

Similar to Seattle there were no significant programs in place to reuse and recycle water although the authority provided a rebate for people installing low water use appliances. In addition owners obtain a discount on their rate if they collect and reuse stormwater. The staff at Bellevue indicated that consideration needs to be given to water rights as it is naturally assumed that water collected belongs to the State.

There are no requirements on developers to reuse and recycle stormwater although there are some demonstration projects within the municipality.

5.2.3 Ordinances

The City of Bellevue has a Utility Code consisting of several parts that governs and regulates the Utility's activities associated with water, sewerage, storm and surface water.

The *"Storm And Surface Water Utility Code"* provides for the "the planning, security, design, construction, use, maintenance, repair and inspection of public and private storm and surface water systems, the establishment of programs and regulations to ensure the quality of water in such system, to preserve the integrity of such system, and to minimise the chance of flooding; and to provide for the enforcement of the provisions of the code."[15]

The code sets out the permit approval process and the engineering design requirements for on–site detention drainage systems as well as BMP source control quality improvement systems. The code applies to development and redevelopment projects. Development and redevelopment projects on land greater than 5,000 square feet (approx 465 square metres) are subject to the code requirements. Developers are required to design and install on-site detention and run off control systems, in accordance with the requirements of this code and the Utility's Surface Water Engineering Standards.

The code also sets out the responsibilities, installation and maintenance requirements for the detention and water quality improvement systems. For small systems, individual owners are required to maintain systems whereas for larger systems, the Utility will in many circumstances accept responsibility of the system. Accordingly the Utility has a very proactive program of inspection, maintenance and enforcement and employs three staff (2 full time and 1 part time) to inspect on-site detention and water quality systems to ensure these systems are adequately maintained and operate in accordance with the appropriate design standards.

[14] *Bellevue Urban Runoff Program Summary Report.* Prepared by Robert Pitt Consulting Environmental Engineer and Pam Bissonnett Storm & Surface Utility Bellevue.
[15] *Title 24 Utilities Code* – City of Bellevue Washington.

The code also details illegal discharges and the prohibition of these discharges to the public drainage system and receiving waters. It also prohibits pavement washing and sets out requirements on installing sources controls to control such discharges. Persons responsible for such illegal discharges and those who fail to comply with the requirements of the code can be made liable for the clean up of illegal discharges.

5.2.4 Funding Mechanisms

The funding mechanism to fund capital stormwater flood improvement works and water quality improvement works for the Bellevue Public Utility is similar to that of Seattle's. Funding is raised by means of a rating system based on the amount of stormwater runoff generated from impervious surfaces such as roofs, decks patios, driveways and the size of the property.

The rate is determined having regard to the extent of development and size of property where lightly developed smaller sites pay a lesser amount compared to larger heavily developed sites. There is no special water quality rate component included in the costs. The average cost per residential property of 10,000 to 12,000 square feet (930 to 1,100 square metres) is in the order of $153.00US per annum.

The Utility's operating budget is $27Mil of which $7.0 to $8.0Mil is allocated to drainage. One third of the drainage budget is allocated for capital improvement works, one third for maintenance works and one third for operational purposes. This includes the inspection and maintenance of on site detention and BMP water quality facilities.

5.3 The Ramsey – Washington Metro Watershed District

The Ramsay-Washington Metro Watershed District is a special purpose government organisation within the Ramsey County of Minnesota and is responsible for the protection of water resources within the watershed. The organisation was established on the 24th February 1975 under the Minnesota Watershed District Act. The Watershed Act of Minnesota recognised that water resources are best managed within the boundaries of catchments and rarely match political boundaries and accordingly Minnesota established watershed districts. The watershed districts are responsible for integrating water management activities between Cities, Counties and the State. There are 45 watershed districts in the State Of Minnesota of which 14 are located in the metropolitan area.

The Ramsay-Washington Metro Watershed District includes the eastern section of Ramsey County and western portion of Washington County. It covers an area of approximately 56 square miles and includes all or part of the 10 Cities of North St Paul, Little Canada, Maplewood, St. Paul, Vadnais Heights, White Bear Lake, Landfall, Oakdale, Woodbury and Gem Lake. The population of the district is 136,000 similar to a large metropolitan Council in Melbourne.

A five member Board of Managers governs the authority. Four members are appointed by the Ramsay County Board and one from the Washington County Board. Appointments are staggered and are for three year terms.

5.3.1 Responsibilities

The primary role of the authority is to manage waterways in the District including drainage. Its mission is to protect and improve the water resources and water related environment in the District. The authority is responsible for the management of 5 major creeks, 11 lakes and thousands of wetlands within the District. The District is involved in a number of programs that include: -

- Water Quality Protection;
- Stormwater Management;
- Flood Control;
- Lake Management;
- Lake Restoration;
- Wetland Management;
- Construction Permitting;
- Exotic Species Control;
- Native Landscaping and Habitat Restoration;
- Water Quality and Biological Monitoring;
- Watershed Education.

When the Board of Managers was formed, the Board adopted rules and regulations for the District. These rules and regulations detail the requirements for, permits for flood plain construction, potential soil erosion, wetland developments, plans for road and drainage construction, water related ordinances, water loss and withdrawal and sanitation and waste disposal.

5.3.2 Strategies And Policies

Similar to the Cities of Seattle and Bellevue, comprehensive planning forms the basis of preparing strategic plans and policies for the management of flood protection and water quality improvement measures.

The first watershed management plan for the District was developed in 1977 and subsequently reviewed in 1986. The focus of the initial plan was to address a number of significant flood and erosion control projects. The 1986 plan merged the District's watershed planning, regulation and construction activities with the related activities of the local Councils, Counties and Soil and Water Conservation Districts located within the District boundaries. The 1986 plan also commenced the process of focusing on preventative measures to improve water quantity and quality issues through careful planning rather than the traditional approach of responding to issues that involved repair type solutions. The major objectives of the 1986 plan were to: -

- "Provide for the management, protection and improvement of water and related land resources;
- Effectively and efficiently administer and manage the internal affairs of the District; and
- Foster a broader public understanding of the role and activities of the District and the need for water resource management."[16]

In 1994 the district commenced a review of its 1986 plan, which subsequently resulted in the development of the 1996 plan. In developing this plan the district recognized that there would be continued urban development over the next 20 years including redevelopment of some areas.

The 1996 plan is based on a strategic approach of "Integrated Resource Management" (IRM). The plan was developed following extensive consultation with numerous community groups where over 100 groups and individuals were involved in identifying issues within the District followed by the establishment of an Advisory Committee consisting of resident representatives and government representatives. The role of the Committee was to evaluate the issues, establish goals and objectives and develop policies and programs for implementation. The process was fairly lengthy extending over period of 16 months.

The IRM approach recognizes the need to manage natural resources including water resources to ensure that flooding is minimised, water quality is improved, fish, wild life and ecosystems are protected whilst maintaining a diverse range of vegetation and habitats and improving recreational opportunities. The IRM approach involves consideration and development of plans that includes all natural resources in the same geographic area.

The planning process in the development of the 1996 plan recognized that there were a number of existing and potential problems within the District. These include: -

- "Increased runoff volumes due to reduced infiltration;
- Erosion of soil and sedimentation of water bodies;
- Sediment and nutrient pollution of stormwater runoff;
- Potential hazardous-material pollution of groundwater resources;
- Inefficient management of resources and programs."[17]

Accordingly all the Districts policies are developed to reinforce the IRM approach. It includes the development of individual management plans for each major drainage area identifying the specific problems and solutions. The approach also requires: -

[16] *Ramsey-Washington Metro Watershed District 1997 Watershed Management Plan* - Section 1 Background Information.
[17] *Ramsey-Washington Metro Watershed District 1997 Watershed Management Plan* - Executive Summary

- Intergovernmental Coordination;
- Public Involvement and Education;
- Permit Process Streamlining; and
- Data Management and Collection.

5.3.2.1 Flood Management

The Watershed District is responsible for flood management throughout the District and must ensure that peak flows that enter the District's conveyance system (rivers and streams) storage facilities or lakes do not exceed the critical 100-year storm event. Flood levels are monitored regularly to check abnormal flows.

To manage the risk of flooding, Cities within the District, with a few exceptions are required to undertake flood studies and prepare flood maps. The District also conducts its own hydraulic modelling and updates these studies and maps. The modelling and maps form the basis for all maintenance, management, construction and development considerations to protect the Districts conveyance system and structures from flood damage.

The District has powers under its Rules and the Minnesota Watershed District Act to review and approve municipal planning zone changes that may increase runoff and effect exiting storage basins. Local Councils within the District are required to prepare and adopt "Local Water Management Plans" for their municipality, which need to be approved by the District. The Plans must clearly specify amongst other things any changes to the City zoning that may result in increased stormwater runoff.

The approach taken by the District to manage flooding has generally been to build detention basins and ponds throughout the watershed. Through the flood modelling studies, the District's approach has been to increase upstream storage facilities where possible by detaining water flow where possible either upstream within the catchments or sub catchments to minimize impacts on waterways and lakes downstream. For developments and redevelopments onsite detention systems are required through the municipalities "Local Water Management Plans" and ordinances. Most of the flood protection works were completed by mid 1990's.

Accordingly the District's policies on flood management are primarily focused on managing the District's conveyance system and storage facilities to ensure that the design of new facilities contain and limit future stormwater runoff from critical 1 in 100 year storm events and that there is no threat to human life, residential structures, commercial and industrial buildings or permanent public facilities.

A list of the District's policies on flood protection is detailed in Appendix C.

Battle Creek Erosion Control Project – 1.100 year pipe system below creek bed.

5.3.2.2 Water Quality Management

Similar to the City of Bellevue, the Ramsay Washington Watershed District has a very strong water quality monitoring program. Water quality monitoring commenced in 1977 to determine possible sources of water quality degradation and pollution. The water quality-monitoring program has been continuous since that time and has been used to identify short term trends and also establish a database to assess long term trends in water quality. The water quality program is also used to determine the effectiveness of current pollution control technologies.

The water quality program undertaken over the years indicates that the streams and waterways in the District are in good to excellent condition. The conditions of the lakes vary, however many display high levels of phosphorus and suspended solids. The District however realizes that at the current rate of urbanization, it must maintain or increase its water quality management practices to maintain its current level of water quality.

The main issues confronting the District are erosion control from developments and non point source pollution, which are increasing the levels of phosphorus and suspended solids in the lakes and streams. Phosphorus is the key nutrient influencing the quality of the Districts resources and measures to control this nutrient will assist with the control of other pollutants transported in stormwater runoff. Point sources of pollution are controlled by the State through the Minnesota Protection Control Agency (MPCA) whereas non point sources of pollution remain a problem for the District.

The District's strategy to address non point sources of pollution is to: -

- Promote the Minneapolis Protection Control Agency's BMP's;
- Target and encourage public participation in the implementation of BMP's and good house keeping principles;
- Require, through District permits the reduction of suspended solids by 50%-60%;
- Reduce phosphorus levels in detention ponds by 50%-60%;
- Require onsite detention ponds to be designed in accordance with the District's guidelines;
- Maintaining landscaping and vegetation standards;
- Requiring all cities within the District to collaborate and implement non point pollution control programs.

The water quality program also involves the use of an "Integrated Resource Management" approach to manage water quality within the District. This requires collaboration as much as possible with the Cities, Counties and the Minnesota Department of Natural Resources. The focus of this approach is to preserve, restore and manage aquatic systems, wetlands and upland habitats.

The approach includes: -

- The use of various techniques to increase infiltration to reduce runoff rates to improve water quality;
- Reducing impervious areas to decreases runoff and increasing the planting of native vegetation to stabilize erosion and provide wildlife habitat. The approach also requires landowners to be proactive to plant native vegetation to increase infiltration to reduce erosion and improve wildlife habitat;

- The use of experts to identify and assess key resources and relationships and the application of advances in ecological sciences;
- Involvement and education of key stake holders including local residents, businesses and local government representatives;
- Appropriately managing open spaces, corridors and buffers and integrating key land and water resource features; and
- Using demonstration projects.

Accordingly the District's policies on water quality management are primarily focused on managing the District's resources to increase infiltration, reduce erosion, increase natural vegetation and improve the natural habitat.

The Districts policies on water quality management are detailed in Appendix D.

A number of treatments have been used in the District to improve water quality. Some of the sites inspected by the group included: -

- A chemical treatment plant and use of alum at a detention pond to remove phosphorus;
- A filtration and infiltration system adjacent to a major highway:
- The establishment a rain garden within a local subdivision;
- Restoration of a major creek to control erosion; and
- The use of experimental surfaces such as porous pavements.

Tanners Lake Water Quality Improvement Project
Settling Pond with Alum Treatment Plant to Remove Phosphorus

Valley Creek Project – Infiltration / Filtration (Rain Garden) adjacent to Arterial Road.

Maplewood Mall Area – Rain garden in new subdivision.

Maplewood Mall Area – Disconnected down pipes discharging to garden

5.3.2.3 Reuse and Recycling

From our visit to the Ramsay Washington Watershed District there did not appear to be any significant programs in place on the reuse and recycle of stormwater, although there may be programs in place within some of the Councils and Counties within the District.

5.3.3 Ordinances

The District has Rules and Regulations that have been adopted under the Minnesota Watershed District Act, provide the District with powers to exercise control over developments and drainage plans of the Cities and Counties, to ensure that water resources are protection within the District.

The District recognises that land use planning and zoning is the responsibility of the Cities. However the Cities are required to prepare Local Water Management Plans (LWMP) that are consistent with strategies and policies of the District. The Cities and Counties are also required to submit their LWMP including any ordinances and zoning amendments to the District for approval to ensure they are consistent with the overall plan of the District. In addition the Cities and Counties are required to amend their LWMP to comply with the overall plan of the District.

The Rules and Regulations of the District require anyone undertaking any works that affect any activity on lands, marshes, lakes and watercourses within the District to apply for the necessary permit. This includes permits for the construction of any works within the flood plan areas of the District and a permit for any land development involving construction activity that disturbs one acre or more of ground cover that may result in potential soil erosion. The permit process also includes inspection and enforcement provisions to ensure the stormwater BMP's are implemented in accordance with approved plans.

The Rules and Regulations also require all plans for road construction, bridges, highways and drainage to be submitted to the District for approval and comment.

5.3.4 Funding Mechanisms

The District finances its administrative programs and capital improvement programs through annual property taxes levied against each property in the District under the powers provided to the District under the Watershed Act and the Metropolitan Water Management Act.

Irrespective of where the capital improvement works are located, the approach taken by the District is that all sub watersheds will benefit from projects within the District and accordingly, all properties are levied in accordance to property values.

The approximate levy charged is $35.00US per annum for a $100,000 market value property. Other sources of revenue include low interest loans offered through State and Federal programs, fees and charges from permit applications and State and Federal grants.

The total levy of the District annually in the last few years has generally been in the order of $2.0Mil to $3.0Mil US per annum. The District's budget for 2004 was $4.113Mil US of which $2.282Mil US was for capital improvement works.

5.4 The Metropolitan Water Reclamation District Of Greater Chicago

The City of Chicago is located in the Midwestern State of Illinois along the western shore of Lake Michigan. The central population of Chicago is 2.86Mil people and nearly 10.0Mil including the metropolitan area. The annual average rainfall is approximately 900mm per annum.

The Metropolitan Water Reclamation District of Greater Chicago is an independent government taxing agency. It encompasses 91% of the land area and 98% of the valuation area of Cook County, Illinois. The District is a separate legal entity sharing an overlapping tax base with the City of Chicago. The District serves an area of 2,258 square km that includes the City of Chicago and 125 suburban communities serving a population of 5.25Mil people of Cook County.

The District was originally formed as the Sanitary District of Chicago in 1889 in response to the typhoid and cholera epidemic, which killed thousands of residents in the City. The outbreak of the disease took place following the tremendous storm of 1885 where rainwater washed refuse and sewerage from the river far into Lake Michigan contaminating the intake water supplies areas for the City.

Following its formation, the District devised a plan to reverse the flow of the Chicago and the Calumet river system away from Lake Michigan where it could be diluted before it flowed to the Des Plaines River and eventually the Mississippi. Most of these channels were completed by 1922. Redirecting the river system however was only a short term solution and in 1919 the District commenced a program of constructing sewerage treatment plants to protect and preserve Lake Michigan.

Between 1955 and 1988 the District was called the Metropolitan Sanitary District of Chicago and in January 1989 it was renamed the Metropolitan Water Reclamation District of Greater Chicago.

The District is governed by a Board of 9 Commissioners that are elected and serve on a salaried part time basis. Three Commissioners are elected every two years for a six year term.

5.4.1 Responsibilities

The primary responsibility of the District is to ensure that sewage does not pollute Lake Michigan, which is the City of Chicago's primary source of drinking water. The other responsibilities are to properly treat sewage to avoid contamination of the Chicago, Des Plaines and Illinois rivers. This includes monitoring all kinds of waste that are deposited into the sewage system.

With the exception of outer metropolitan municipalities that have separate stormwater and sewage systems, the City of Chicago and 51 older municipalities have a combined sewage and stormwater system. The local municipalities own and operate their own sanitary and combined sewer systems however the District enforces the sewer permit program to ensure sewers are constructed to a high standard and discharge to the main system which is under the control of the District.

The District is responsible for 880km of sewers ranging in size from 300mm to 8.3 metres in diameter. The District owns and operates 7 water reclamation plants having a treatment capacity of 7.6 million cum/day. The District also owns and operates 23 pumping stations, 30 stormwater detention reservoirs and controls 132km of navigable waterways.

Beginning in 2005 the District was assigned responsibility for stormwater management for all of Cook County, including areas outside the District's corporate boundaries.

5.4.2 Strategies And Policies

The District's main strategy has been to protect the drinking water supply and aquatic life of Michigan Lake. Whilst the District had built a number of sewage treatment plants to treat normal flows, the District realised that the treatment plans were ineffective during extreme rain events. In the 1950's the City suffered two major rainstorms that caused major flooding and raw sewage to flow into Lake Michigan. Furthermore with increased development, runoff had increased by 250% and flood frequency and backflow into Lake Michigan was increasing with small rainfall events.

In the mid 1960's a Flood Control Coordinating Committee (FCCC) was formed consisting of engineers from the District, the City of Chicago, Cook County and State agencies to investigate and improve flood control and water pollution. After several years of studies, the FCCC identified 3 main water management objectives. They included: -

- Prevent all backflows to Lake Michigan;
- Alleviate combined sewer overflows and pollution of the inland waterway; and
- Provide an adequate outlet for floodwaters.

In 1970 the FCCC examined 23 initial alternative plans and developed some 51 proposals or combination of proposals finally focussing on 8 for detail analysis. The FCCC after analysing the 8 proposals against criteria such as capital costs, operating and maintenance costs, project benefits and other criteria finally selected the Tunnel And Reservoir Plan known as TARP. This option was seen to be the best option to address the District's flooding and water pollution problems. The project was refined from the original adopted plan with the enactment of the Clean Water Act to ensure compliance with the new water quality regulations and to maximise the opportunity for Federal and State grants.

The plan consists of the construction of 220 kilometres of large underground tunnels. During large storm events overflow sewage and stormwater is intercepted and conveyed and retained into 3 large storage reservoirs. After the storm events have subsided the overflow water is conveyed to the treatment plants by pumps for cleaning before it is conveyed back to the waterway. The TARP project will capture 971 square kilometres of combined sewage and stormwater that would otherwise discharge from 438 outfalls along 130km of waterway.

The TARP project commenced in 1972 and is divided into two phases. Phase 1 primarily targeted pollution control and will capture Combined Sewer Overflows (CSO) from all storms and all of the CSO from smaller and more frequent storms, which is approximately 84% of the pollution load. The Phase 1 plan consists of 176 kilometres of tunnels, 2.7 metres to 10metres in diameter and three dewatering pumping stations. Phase 1 of the TARP is scheduled for completion by March 2006.

Phase 2 of the project is primary aimed at flood control. Phase 2 will prevent all backflows to Lake Michigan and reduce basement flooding and capture CSO pollution not captured by phase 1. It consists of the construction of three surface reservoirs (O'Hare, Thornton and McCook) and an additional 34 kilometres of tunnels.

The O'Hare reservoir was completed in 1998. Part of the Thornton reservoir has been completed and the balance of this reservoir together with the McCook reservoir are currently under construction. The whole TARP project is scheduled for completion by 2022. The total estimated cost of the TARP project including the works completed to date is in the order of $3.345Bil.

Conceptual plans of the TARP project and status of works completed to date are attached as Appendix E and F.

5.4.2.1 Flood Management

The completion of the TARP project will significantly reduce the flooding problems in Cook County especially in the areas where there are combined sewage and stormwater systems in operation. In the outer areas of Chicago however there are many separate stormwater systems in operation and due to the flat topography of the surrounding areas of Chicago, stormwater does not readily drain away causing extensive flooding from time to time.

To address flooding in these areas the Metropolitan Water Reclamation District in cooperation with U.S Soil Conservation Service, the State and local municipalities has constructed 28 stormwater reservoirs (retarding basins) along tributaries along the Cook County area. Six additional reservoirs are planned for the County to retain stormwater to prevent flooding. When the water in the streams subsides, water from the reservoirs is pumped back into the streams. Many of these reservoirs act as community parks, playing fields and picnic areas in the dry season.

5.4.2.2. Water Quality Management.

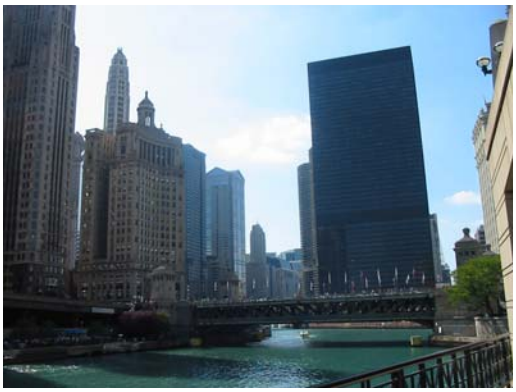
As indicated previously, Phase 1 of the TARP project was aimed at pollution control. A significant portion of the Phase 1 project has been competed and in operation. Some parts of the project have been in operation for some 15 years which has significantly improved pollution to receiving waters and in particular Lake Michigan. Since its operation water quality results indicate significant improvements to the quality of water in the Chicago and Calumet rivers resulting in increases in fish population and an increase in the number of other species. The improvement has been so dramatic that it has resulted in a real estate boom along the waterfront, where properties values have increased significantly, as has tourism. The river system is now seen as a major asset.

The TARP project has relieved the burden of many municipalities especially those with combined systems to build operate and treat combined sewage and stormwater flow to comply with Federal regulations and the NPDES scheme.

There is however still many outer areas within the District with separate stormwater systems. As indicated above, in 2005 the District was recently assigned responsibility for stormwater management for the whole of Cook County. The District is in the process of forming Watershed Planning Councils that will be responsible for major watersheds within the District with the view of implementing stormwater quality programs.

In addition many local Councils in the District are also in the process of establishing Utilities such as those that exist in Seattle and Bellevue with the view of improving stormwater quality. The Metropolitan Water Reclamation District will have specific powers over the Utilities that are established within the Cook County and the Utilities will be required to prepare stormwater management plans.

Lake Michigan



Chicago River

5.4.2.3 Reuse and Recycling

Due to the adequate supply of good quality drinking water from Lake Michigan there was little evidence or need for the District to reuse and recycling of stormwater. The District through their web site and other education material however encourages individuals and businesses to install rain barrels to collect stormwater for watering gardens and other non potable uses. The main focus of this strategy is to reduce CSO discharge to the main system.

5.4.3 Ordinances

The Metropolitan Water Reclamation District of Greater Chicago has adopted a *"Sewer Permit"* ordinance to enable the District to: -

- Effectively control and protect the authority's sewerage system and treatment plants;
- Control the nature and volume of discharges to the system;
- Maintain a stable operation of its system and plants;
- Protect the receiving waters within the District; and
- Preserve public health.

The ordinance applies to any municipality, corporation, sanitary district, township and individuals who seek permission to discharge sewage, stormwater and a combination of both, including industrial waste, or any other wastes into the District's sewerage and drainage system.

The ordinance sets out the minimum engineering design, construction and maintenance standards for any system or works that discharge to the District's system including the maximum permissible rates of discharge to the network. In addition the ordinance provides controls on other local authorities and municipalities within the District.

These authorities are required to control discharges from any developments within their jurisdiction and adopt stormwater detention or flood control ordinances acceptable to the District together with drainage plans to control the level of discharge to the District's system. The ordinance clearly specifies that discharge rates from all new developments shall not exceed stormwater runoff that would occur from the natural undeveloped state of the land.

Any municipality, corporation, sanitary district, township and individuals seeking permission to discharge to the District's system is required to obtain a permit and pay the prescribed fees detailed in the sewer ordinance. The sewer ordinance also sets out details on: -

- Exemption requirements;
- Requirements for the submission of plans and specifications for approval;
- The submission of bonds to ensure any new systems are adequately maintained; and
- The penalties for non compliance.

The sewer ordinance is supported by rules, regulations and a procedure manual that specifies design and submission requirements for permits and the construction and inspection requirements for any new system.

There are no requirements in the District's ordinance to improve stormwater quality or to control sedimentation and erosion from any new developments. It was indicated however that these new provisions are most likely to be adopted and prescribed when the District requires all municipalities to prepare stormwater management plans for their municipality.

5.4.4 Funding Mechanisms

The Metropolitan Water Reclamation District has a number of sources of revenue to fund the operations of the District, which include capital improvement works, operation and maintenance, stormwater management, research and development, staff services, bond redemptions and claims and judgements.

The Budget of the District for 2006 is in the order of $1,004.4Mil. Revenues include $259.6Mil (25.7%) from property taxes, $316.9Mil (31.5%) from State loans and bonds, $353.2Mil (35.0%) from appropriation of assets, $47.0Mil (4.7%) from user charges, $20.5Mil (2.0%) from investments, $6.5Mil (0.7%) from land rentals, $2.3Mil (0.2%) from sewer permits and $2.5Mil (0.2%) from miscellaneous sources.

Of the $1,004.4Mil in revenues $453.3 Mil (45.0%) is spent on the construction and design of capital improvements, $176.8Mil (17.5%) on maintenance and operation, $161.3Mil (16.0%) on redemption of bonds and loans, $98.4Mil (9.8%) on staff services, $26.4Mil (4.1%) on research and development, and $24.5Mil (2.4%) on stormwater management.

The TARP project consumes a majority of the District's capital budget. In the early stages of the project, 75% of the funding was allocated from Federal and State Grants. To date $1.4Bil has been allocated from State and Federal Grants.

5.5 The City of Atlanta - Department of Watershed Management

The City of Atlanta is located in the State of Georgia and predominately within the County of Fulton. The population of the City is in the order of 434,900 and a metropolitan area population of 4.7Mil. The City has a total area of 343 square kilometres and an annual average rainfall of 50.2 inches (1275mm).

The City is governed by an elected mayor and community representatives, which form the City Council. The Council consists of representatives from 12 districts as well as three representatives elected from across the City. The mayor can veto a bill passed by the Council however this can be overridden if there is a two third majority of the Council.

The Department of Watershed Management is one of 13 departments within the City of Atlanta. The Department is also supported by a number of other offices that report to the Mayor and include communications, intergovernmental affairs, human services, finance and law. The City previously operated separate water, wastewater and sewer agencies. However in 2002 the City recognised that that these functions are all related to overall water quality and management of water resources. Accordingly, the Department of Watershed Management was formed in September 2002 to administer all water related services and functions.

5.5.1 Responsibilities

The Department is responsible for the supply, treatment and distribution of the water supply system and the collection, treatment, management and operation of the City's wastewater treatment system. In addition the Department is responsible for the management of the City's water resource capital improvement program and the management of the NPDES permit program, which includes flood protection, stormwater management, erosion control and illegal discharges.

The Department of Watershed Management is headed by a full time commissioner appointed by the City and responsible for all functions of the Department. The department consists of a number Bureaus headed by Deputy Commissioners. They include Bureaus of: -

- Drinking Water;
- Wastewater Treatment and Collection;
- Engineering Services;
- Financial Administration;
- Program Performance;
- Management;
- Watershed Protection.

The District is responsible for 2,400 miles of water mains, 21,000 fire hydrants, 1900 miles of sewers, 6 combined sewer overflow treatment facilities, 4 wastewater treatment facilities, 15 pumping stations and numerous miles of stormwater drains and stormwater facilities.

Similar to Chicago the City has a combined sewer and stormwater system in particular the older areas of the City. Many of these systems were constructed in the late 1800's and early 1900's in many metropolitan areas. This practice has been discontinued in many of the newer areas, which have separate stormwater systems. Separate stormwater system comprise of 85% of the system whereas 15% is a combined system.

5.5.2 Strategies And Policies

Similar to Chicago the City of Atlanta relies on one of its natural water resources, the Chattahoochee River for its drinking supply for the City. The river also acts at the discharge point for most of the sewage treatment plants and stormwater drains. The City has recognised that there will be significant growth within the central area of Atlanta within the next 10 years which will further impact on the existing infrastructure and the combined sewer overflow systems.

Also similar to Chicago the combined sewer overflow systems have proved to be inadequate during high wet weather flows resulting in heavy pollution of the river systems. Accordingly the US EPA together with State Environmental Protection Department mandated the City to undertake the necessary steps to eliminate violations from the combined sewer overflow systems.

Accordingly the City's strategic approach and focus on improving stormwater quality has been on the clean up of these combined sewer overflow facilities. In July 2001 a 3 year study was commenced with input from residents from the City, US EPA and State Environmental Protection Department.

The study resulted in the development of a plan involving the construction of underground storage tunnels (similar to Chicago) to capture and store combined sewer overflow during heavy rain storms and treat the stored water after the storm and subsequently discharge the combined flows to the receiving waters. The plan proposes to reduce the number of overflows of 60+ per year at the existing 6 facilities to only 4 per year at 4 new facilities. The plan also involves the implementation of an improved operational and maintenance program of the existing system.

The plan is to be implemented in three stages. Stage one will involve a complete inventory of the existing system and inspection to identify the areas in need of repairs and replacement. The second stage will involve the reconstruction of assets that require replacement and the third stage will involve the construction of new works, which includes the tunnels.

The cost of the program is estimated at $3.2Bil and is scheduled for completion by 2014.

5.5.2.1 Flood and Water Quality Management

The City currently does not have any significant programs in place to manage flooding or stormwater quality, as has been the case in other cities within the United States. The City recognises that it does have flooding problems and stormwater quality issues to manage. The City with the formation of the new Department of Watershed Management is in the process of forming a stormwater Utility with the view of developing a master plan to address stormwater flooding and stormwater pollution. The City proposes to involve the public in the implementation of the Utility and the development of a master plan.

The Utility will have powers to charge fees from property owners to provide a dedicated revenue source to pay for the City's share of costs for stormwater pollution prevention and flood control projects. Stormwater pollution abatement projects are estimated to cost in excess of $300Mil over the next few years.

The City proposes to undertake significant improvements in both stormwater quality and flood controls. The City also proposes to initiate programs to monitor stormwater quality, the level of pollutants, improve stormwater system maintenance and provide educational material to individuals businesses and agencies that impact on the quality of stormwater.

In addition, the City proposes to adopt new Stormwater Ordinances, establish standards for keeping stormwater clean and establish and develop BMP's for residential, retail, industrial and construction activities to reduce stormwater pollution.

The services of the Stormwater Utility will include but not limited to: -

- NPDES Compliance;
- Erosion and Sediment Control;
- Street Sweeping;
- Stream Bank Stabilisation;
- Water Quality Improvements;
- Maintenance of Drainage Infrastructure;
- Flood Mitigation;
- Capital Improvements;
- Floodplain Management.

As part of the Department and Utilities functions the City proposes to conduct a long term Watershed Monitoring Program monitor water quality before, during and after improvements have been established. Currently several of the City's streams are listed for protection. The water quality monitoring program will identify sources of pollution, and assist with the development of water quality improvement programs and monitor the effects of these programs.

The only program currently in place of any significance within the City protecting the water quality of rivers and streams is the City's "Greenway Acquisition Project". Many of the rivers and streams within Atlanta abut private property. Accordingly the City has embarked on a $25Mil program to acquire and protect properties adjacent to selected rivers and streams within the City. The objective of the project is to encourage property owners to donate or sell a conservation easement (a minimum of 100ft wide) to the City adjacent the waterway. The easement will be set aside and protected from development, erosion, flood damage and clearing to ensure animal and plant habitat is protected whilst improving the water quality within the rivers and streams.

The City also has a community education program that is focused on projects and some water quality initiatives. The water quality initiatives primarily target soil erosion and improving the health of the waterways.

5.5.2.2 Reuse And Recycling

Similar to many cities within the USA there were no significant stormwater reuse projects in place. The City has a limited finite resource of water supply and recognises that with increased development there is a need to reduce water consumption. Similar to Melbourne there is a targeted public program to reduce water consumption although water within Atlanta is still relatively cheap ($1.50 US per cubic feet).

There is no State policy to reduce consumption. The approach taken is to treat any water taken from the river for the various uses and then discharge it back to the river system. There are no incentives to conserve water either because revenue is derived from those who use water from the water supply system.

The City however has undertaken a demonstration project where in December 2003 the City installed a roof top garden on the roof of City Hall called the "Green Roof" project. The objective was to demonstrate how stormwater runoff from a development could be significantly reduced, used and water pollution reduced.

City Of Atlanta (City Hall) – Roof Garden

5.5.3 Ordinances

Whilst the City of Atlanta does not have any integrated plans to manage flooding or stormwater quality, the City has adopted a number of ordinances to regulate surface water management practices within the City. They include: -

- Soil Erosion And Sedimentation Control;
- Flood Area Regulations;
- Post Development Stormwater Management;
- Illicit Discharges and Connections.

The intent of the *"Soil Erosion and Sedimentation Control"* ordinance is to control land disturbance activities and prevent soil erosion and sedimentation that may occur from such activities. The ordinance also provides controls for the conservation and protection of land, waterways, air and other resources of the City. It primarily applies to large development and redevelopment projects where a permit is required to conduct any land disturbance activity and applicants are required to submit plans for approval.

Applicants are also required to adopt BMP's in any land disturbing activity and failure to comply may result in stop work orders and penalties. There are exemptions which include minor activities associated with gardening, construction of single dwellings, agricultural, mining, construction and maintenance operations, forestry practices and any project involving disturbance of any land area less than 1 acre.

The intent of the *"Flood Area Regulations"* is to regulate and restrict the construction of any structures within any designated flood zone. Its purpose is to protect life and property, minimise hazards and damage that may arise following inundation and to reduce the public cost of rescue efforts and clean up operations that may arise as a result of a significant flood event.

Any person wishing to use land, construct a building or any other structure within the designated flood zone is required to obtain approval and a permit from the Commissioner responsible for flood zone areas. The primary focus is to ensure that the flood zone is free of obstruction and does not increase surface water elevations impacting on adjoining lands.

The intent of the *"Post Development Stormwater Management"* ordinance is to minimise the adverse impacts of stormwater runoff and non point pollution associated with new developments and redevelopments within the City of Atlanta. The prime objectives of the ordinance are to: -

- Improve decision making objectives associated with development and redevelopment, to protect the integrity of the watershed and preserve the health of water resources;
- Require new developments to maintain peak flow discharges to 70% of pre development peak discharge. It applies to the area of the site impacted by the development provided it is no greater than 35% of the total site area, otherwise if the impact is greater than 35%, it will apply to the total site area;
- Establish minimum standards of design for water quality and quantity runoff;
- Establish design criteria for the construction and use of structural stormwater control facilities to meet minimum post development stormwater management standards;
- Encourage the use of non structural stormwater management site design practices to preserve green space and use other conservation measures;
- Establish long term responsibility for the maintenance of structural and non-structural stormwater control facilities such they continue to function as designed and are regularly maintained;
- Establish administrative procedures for the submission and approval of stormwater management plans.

The ordinance is applicable to developments and redevelopments that increase impervious surfaces and involves land development activities greater than one acre. Single residential dwellings and additions to dwellings are exempt but multi unit developments and commercial developments are required to comply with the ordinance.

The ordinance requires applicants to submit a stormwater management plan for approval detailing how post development stormwater will be controlled to ensure that facilities comply with the appropriate design standards. The ordinance also requires applicants to enter into an inspection and maintenance agreement prior to the issue of the permit to ensure onsite detention facilities and other structural measures are regularly maintained. In addition the agreement needs to be registered on title such that it is applicable to any subsequent owners. It also specifies the payment of a maintenance bond that is payable by the applicant in the first instance and by the new owner prior to transfer of title to ensure on site stormwater facilities are appropriately maintained.

The City inspects such systems during implementation to ensure compliance with approved stormwater management plan and regularly inspects systems post development to ensure the systems are appropriately maintained. Enforcement proceedings and penalty notices are implemented in the event of non compliance.

Whilst the ordinance requires stormwater post development best practice, it is mainly targeted at controlling flow from the property, as the City has not established any stormwater quality improvement measures. Stormwater quality is encouraged but not mandatory.

The intent of the *"Illicit" Discharge and Illegal Connection"* ordinance is to regulate and prohibit the discharge of illegal substances and illegal connections to the stormwater system. Its intent is also to prevent non stormwater discharges generated from spills being disposed to the stormwater system and provides legal authority to authorised officers to undertake inspections, surveillance, monitoring and enforcement of illegal discharges and connections.

5.5.4 Funding Mechanisms

The budget of the City of Atlanta is in the order of $6.884Bil and the budget for the Department of Watershed Management is in the order $315.32Mil. The primary sources of revenue available to the City to implement the proposed capital improvements projects, such as the tunnel and reservoir projects and stormwater programs, are revenues from property taxes.

The City has introduced a new taxing structure to fund the new capital improvement initiatives. The City also raises revenue from sales taxes and has obtained a State loan of $50Mil for some of the major works.

In the long term the City proposes to establish a Utility and a rate charging system to fund all stormwater quantity and quality improvement works.

5.6 The City of Griffin Georgia – Public Works and Utilities

The City of Griffin was incorporated in 1843 and is located in Spalding County in the State of Georgia. The City currently has a population of 25,000 and occupies an area of 38 square kilometres (15.5 square miles).

The City is governed by a Board of 7 Commissioners who are elected on a non partisan basis and serve staggered terms where elections are held every two years. Three Commissioners are elected in one cycle and four commissioners are elected on the next cycle. The chairperson is elected by Board and serves one year only.

Although it is only a small municipality in terms of population, the City provides a full range of services including police, fire protection, construction and maintenance of streets and highways. It also provides other infrastructure such as water, wastewater, electricity, sanitation, stormwater, recreational and cultural activities and a municipal airport.

5.6.1 Responsibilities

The stormwater department of the City of Griffin is one of six major departments within the City. Similar to the Cities of Seattle and Bellevue the City established a stormwater Utility in 1996 to manage the construction and maintenance of stormwater facilities. It was the first Utility established in the State of Georgia.

The prime focus of the Utility is to address the growing concern of stormwater pollutants and stream water quality. In addition the Utility is concerned with increased runoff, which has resulted in the need for significant drainage and flood control measures and also resulted in increased operation and maintenance costs associated with managing it's infrastructure.

The Utility is responsible for 6 major drainage basins (watersheds), 39 sub basins covering an area of 16,400 acres and approximately 26 kilometres of streams. In addition the Utility is responsible for approximately 10,000 single items of drainage infrastructure of which some are 150 years old. The size of the system requires a large operating budget and accordingly the formation of the Utility was seen to be the best way to fund the organisation's stormwater program.

The department and the Utility are also responsible for all functions associated with wastewater and water supply. Funding for the various activities is separate but the Utility fees raised for stormwater is primarily used to manage and implement all the functions associated with the stormwater system.

5.6.2 Strategies And Policies

Similar to the Cities of Seattle and Bellevue, comprehensive planning forms the basis of preparing strategic plans and policies for the management of flood protection and water quality improvement measures.

The City has developed a Stormwater Master Plan to provide an integrated and holistic approach to stormwater management. It includes land use planning and zoning, flood plain management, habitat, recreational opportunities, water quality management and management of the City's infrastructure. The Master Plan was finalised in September 2000 and forms the basis of the City's flood control and water quality programs.

The Master Plan also details the City's response to the NPDES Phase 2 permit scheme introduced by the Federal Government for small municipalities. It includes an action plan on all 6 minimal control measures required under Phase 2 and details and progress made to date and the additional measures to be implemented in forthcoming years to meet the NPDES requirements.

In addition the Plan details the existing policies and proposed policies to be adopted by the City to guide the implementation of its Master Plan. There are numerous policies on flood plain and water quality management documented in the Plan and these can be sourced from the City of Griffin Stormwater Master Plan.

5.6.2.1 Flood Management

As part of the City's Stormwater Management Plan, the Utility completed a detail delineation and analysis of the 100 year flood plan for each of the major streams and the 6 major drainage basins within its municipal district to determine its own floodplain. The City also conducted an audit on the location and condition of all structures within the floodplain. The designated floodplain and structures have all been mapped on the City's GIS system. This information is used to manage those properties subject to inundation and assess building permit applications and development plans submitted for approval to ensure that developments comply with the City's floodplain management ordinance.

The flood mapping exercise has been useful in identifying flood hazard areas and the deficiencies in the existing drainage system with the view of prioritising capital improvement works to manage flooding. The flood plain mapping has also been used to identify the level of service for each stream crossing structure and prioritise those structures for capital improvement whether there is a high degree of flooding.

The primary focus of controlling flooding within the City is to complete several detention ponds and install larger stormwater drains. The City has constructed 5 large detention facilities and wetlands since the Utility was established.

North Griffin Regional Wetland Detention Facility.

5.6.2.2. Water Quality Management

As part of the master planning process the City of Griffin recognised that it was important to conduct watershed assessments of all 6 watersheds within it's municipal boundaries. The purpose of the assessments was to develop comprehensive watershed protection management plans for all of the watersheds to address the regulatory requirements of NPDES and TDML's on each of the waterways. The watershed assessments form part of the City's Stormwater Master Plan.

Water quality monitoring and water quality modelling have played a significant role in assessing the water quality of streams and waterways within the watershed districts. Extensive water quality monitoring was undertaken 4 times during wet weather and 4 times during dry weather flow over the last 3 years. The objective of the monitoring was to obtain accurate water quality records and base data of streams within each of the basins and assess the level of existing pollutants and TDML's within each of the waterways.

The City has recognised that establishing base line data is very important before proceeding with the implementation of stormwater BMP's (structural and non structural measures) within the watersheds to improve the quality of stormwater discharging to streams and waterways.

In addition, the City has conducted bacterial and chemical sampling, soil sampling, sediment sampling, including biological and habitat sampling within the watersheds to obtain a complete understanding of the pollutant loads and soil conditions within the watersheds and to determine the health of ecosystems and fish habitats.

The City is currently experimenting with a range of structural BMP's to improve stormwater quality. Some of the most significant projects have been the installation of detention facilities with sand filtration systems to remove sediments and pollutants. The City has also investigated the use of applied polymers within detention ponds to separate sediments and ionisation processes to separate heavy metals.

The City is also investigating the option of removing kerb and channels in urban areas and establishing bio retention systems at the front and rear of residential properties. Unfortunately many of these systems have not been in place long enough to assess their effectiveness.

The main focus of the Utility however has been to implement measures to comply with the NPDES phase two permit scheme. The City has implemented programs to address all 6 minimum control measures. These include: -

1. Public Education and Outreach

    - Implementation of "Water Wise" educational program in City schools;
    - Development of an educational video describing the establishment and need for the Utility;
    - Development and installation of stormwater stencilling program;
    - Development of a bulletin board/menu providing a list of stormwater do's and don'ts for use in schools and the general community;
    - Development of an educational booth that contains both printed material and video capabilities for use and distribution to general audiences;
    - Implementation of a neighbourhood park volunteer clean up program;
    - Development of additional outreach and educational programs.

2. Public Involvement And Participation

    - Developing public notice procedures for various stormwater related activities;
    - Establishing stakeholder groups for each 6 watersheds within the district to assist with the development of watershed management plans;
    - Establishing a citizen advisory group to represent minority interests within the municipality.

3. Illicit Discharge Detection and Elimination

    - Implementing an inventory of all components of its storm sewer system;
    - Developing ordinances to prohibit illicit discharges to stormwater system;
    - Implementing a program of detecting illicit discharges to stormwater (use of infra red photography);
    - Develop educational programs to inform community and businesses of illicit discharges and proper methods of disposal. (This includes educational material highlighting the correct practices of washing vehicles, grass cutting, leaf disposal, home repairs, pet care, septic system use and maintenance);
    - Evaluation of point source discharges and conducting audits of local businesses to ensure compliance with stormwater pollution prevention plans. (This includes car wash facilities which require 3 grid separators, automobile garages to record proper disposal of wastes, commercial and institutional kitchens on the removal of fats and greases, nurseries and garden supplies to ensure fertilisers are filtered before any water is discharged to drains).

4. Construction Site Stormwater Runoff Control

    - Amending current erosion and sedimentation control ordinance to comply with NPDES Phase 2 requirements.

5. Post Construction Stormwater Management on New Developments and Redevelopments

    - Development of a City ordinance that will ensure approved detention facilities are maintained in a functional state and an ordinance requiring retrofitting works to any redevelopment proposal to comply with existing stormwater requirements. (Currently there are no water quality requirements);
    - Implementation of stormwater training programs for developers contractors and builders;
    - Adopting a BMP manual for developments and redevelopment proposals.
    - Development and implementation of procedures for the annual inspection of stormwater facilities installed by owners to ensure facilities are appropriately maintained;
    - Development of land use plan that incorporates stormwater components.

6. Pollution Prevention and Good House Keeping

    - Implementation of a stormwater drain cleaning program;
    - Construction of new vehicle wash down racks at City facilities;
    - Development of a system to manage stormwater maintenance and complaints from citizens and resolution of complaints;
    - Development of an operations manual and training of staff on good house keeping with activities associated with stormwater activities;
    - Development of program of routine inspection and maintenance of stormwater system.

In addition to the above, the City is also investigating a number of additional programs to complement existing programs and comply with the Phase 2 NPDES requirements.

5.6.2.3 Reuse And Recycling

Similar to many other authorities we visited, there did not appear to be any stormwater reuse projects in place. The City however had utilised one of its large detention basins and used the stormwater for watering a nearby golf course.

The City and the State however, has experience drought conditions in recent years and the State has imposed water restriction on households similar to those imposed in Melbourne Victoria. The State and the City have a number of educational programs in place on ways to conserve water, which include water saving practices, repairing leaking facilities and installing water saving devices.

5.6.3 Ordinances

The City has adopted a number of ordinances to regulate surface water management practices within the City. They include: -

- Soil Erosion And Sedimentation Control;
- Flood;
- Development;
- Stormwater Management;
- Illicit Discharges and Connections.

The intent of the *"Soil Erosion and Sedimentation Control"* ordinance is to control land disturbance activities and prevent soil erosion. The ordinance sets out the minimum requirements and best management practices to be adopted for all land disturbance activities. The ordinance also details those activities that are exempt which include minor land disturbances, disturbances associated with single dwellings, agricultural operations, forestry and land management practices, projects less than 1.1 acres, public work projects and electrical system projects. In addition the ordinance details the permit approval processes for land disturbance activities, which includes the submission of plans, payment of fees, inspection and enforcement procedures and penalty provisions for non compliance.

The intent of the *"Flood"* ordinance is to control the construction of any structure within the designated special flood areas determined by the City. No structure shall be allowed within the flood hazard area without a permit. The ordinance details the permit procedure process, information required and the specific conditions and standards of approval. The standards specify that the lowest floor level allowable shall be 3 feet above the base flood elevation.

The intent of the *"Development"* ordinance is to regulate the standards of construction of developments and includes street design criteria, access requirements and stormwater drainage. The stormwater drainage component of the ordinance specifies the design criteria for drainage systems and the requirement to provide a stormwater detention facility if there is an increase in post development discharge compared with the pre-development discharge. Currently there are no requirements in the ordinance to provide BMP's water quality improvements.

The intent of the *"Stormwater Management"* ordinance is to regulate the functions of the stormwater Utility including the requirements for all developments that are likely to increase discharges to the City's public stormwater system to install an on-site detention system.

The ordinance also requires owners of such systems to adequately maintain such systems and provides powers to officers of the Utility to inspect such systems on a regular basis (twice a year). Officers may require owners to rectify, repair and upgrade any defective system and any owner that fails to comply may be prosecuted. The ordinance also specifies the powers of the Utility to effectively charge owners for the services provided by the Utility and provide credits to owners who install on site detention facilities that limit the impact of stormwater discharge on the City's stormwater system. The ordinance also specifies those properties that are exempt from the charge.

The intent of the *"Illicit" Discharge and Illegal Connection"* ordinance is similar to that for the City of Atlanta, which provides for the regulation and prohibition of discharges of illegal substances, pollutants, and controls illegal connections to the stormwater system. It's intent is to also prevent non stormwater discharges such as spills being disposed to the stormwater system and provides the legal authority to officers of the Utility to undertake inspections, surveillance, monitoring and enforcement procedures to ensure compliance with the ordinance.

5.6.4 Funding Mechanisms

Similar to the City of Seattle and the City of Bellevue, the City of Griffin raises most of its revenue by imposing a drainage rate charge to all property owners within its municipal district. The revenue raised is utilised for the operation, maintenance and capital improvement works conducted by the Utility.

The calculation of the stormwater charge is based on the impervious area of the property. The equivalent residential runoff unit is 2,200 square feet (approx 200m^2) and the charge per annum is in the order of $42.00US. The fees imposed generate in the order of $1.56Mil per year, which is used to manage all functions of the Utility.

The Utility can provide a credit on the drainage rate charged to property owners who install onsite detention facilities within their property under City's *"Stormwater"* ordinance. A range of credits is available and is dependent on the amount of discharge from the property. Properties that install a detention facility and demonstrate a reduction of peak stormwater discharge of 20% less than the peak pre-development stormwater discharge may be eligible for a 50% credit on their Utility charge. Credits are also available to school sites that teach water wise programs as part of their curriculum.

Currently no credits are provided for improving stormwater quality however the Utility is investigating criteria and means of providing credits of 15% on Utility charges for owners that improve stormwater quality.

Whilst the budget for the City of Griffin is in the order of $80Mil, the Utilities budget to manage stormwater is only $1.7Mil. The Utility also generates some revenues from various grant programs and user charges from the inspection of facilities and approval of permits.

5.7 Baltimore County - Department of Environmental Protection and Resource Management

The Baltimore County is located in the northern portion of the USA in the State of Maryland. The County occupies an area of 1,766 square kilometres (682 square miles) and has a population of approximately 754,300. It excludes the City of Baltimore, which is an independent City in its own right, which was annexed from the County in 1851. There are no other incorporated municipalities within the County.

The County performs all the local government functions within its jurisdiction. This includes education, police, fire protection, construction and maintenance of streets and highways, other infrastructure such as water, waste water, electricity, sanitation stormwater, recreational and cultural activities.

An elected County Executive and a seven member County Council govern the County. The seven members are elected every four years from the 7 Council districts each representing a population of approximately 107,000 residents. The County elects a chairperson annually to chair County meetings.

The Department of Environmental Protection and Resource Management is one of 11 departments that manage various functions of the County. The Department is supported by a number of other offices that report to the County Executive and include budget and finance, human resources, information technology, law, local management board, planning and community conservation.

5.7.1 Responsibilities

The Department of Environmental Protection and Resource Management is primarily responsible for the management of the County's natural environment programs. The Department's primary focus is to maintain the water quality of the rivers and streams within the County, to protect the County's three main water supply reservoirs and Chesapeake Bay, which has experienced declining fish populations over a number of years. The County contains some 2100 miles of non tidal streams and 1000 miles of streams that drain to the three drinking supply reservoirs.

Chesapeake Bay

The functions of the Department include environmental health, waterway capital improvement projects, waste management, watershed management and monitoring, land preservation, program coordination, research, and education. The Department is also responsible for a number of development review functions that include environmental impact reviews, development coordination, stormwater and ground water management, inspection, enforcement, food plans and recreational hygiene.

Whilst the Department is involved in the implementation of a number of stormwater capital improvement projects, the Department is not responsible for the management and maintenance of the stormwater drainage system, which includes some 715 miles of drains, 14,000 inlets and 900 stormwater management ponds. These are the responsibility of the Department of Public Works as are the water supply and sewerage systems.

5.7.2 Strategies And Policies

Similar to other cities mentioned previously, comprehensive planning forms the basis of preparing strategic plans and policies for the management of flood protection and water quality improvement measures for the County.

The Baltimore County Charter requires the County to develop a Master Plan for the County every 10 years. The purpose of the Master Plan is to guide the development of the County. The master planning process commenced in the 1960's and the since that time the County has developed 5 Master Plans. The current Master Plan was adopted by the County in 2000 and extends to the year 2010. It identifies the policies, issues and actions to be undertaken for all the functions of the County including the management of the natural environment, which is the responsibility of the Department of Environment and Natural Resources.

The first Master Plan developed for the County in the 1960's, recognised the need to separate the County into two distinct land management areas. Accordingly the County established a growth boundary (Urban Rural Demarcation Line) separating the urban area from the rural areas. The separation provides for the appropriate planning and management of the urban growth areas and the protection of the County's natural resources, in particular the drinking supply reservoirs that serve the County and the City of Baltimore.

Whilst proper planning is necessary in the urban areas, the Department's primary focus in the urban areas has been to protect the remaining natural resources and restore degraded ecosystems. This includes stream restoration, improvements to water quality to enhance aquatic habitat, reduction in erosion and the filtering of nutrients from stormwater runoff.

Accordingly the policies adopted by the County in the 2010 Master Plan for the urban and rural areas include: -

a) Urban areas.

- "Protect the remaining natural resources and promote conservation of biological diversity;
- Restore lost or degraded ecosystem functions, particularly those related to watersheds and reservoirs;
- Foster environmental stewardship among residents, and within the region.

b) Rural areas.

- Protect, conserve and restore all essential natural resources with particular attention to groundwater."[18]

[18] *Master Plan 2010,* Baltimore County Maryland

The 2010 Master Plan also identifies the issues and recommended actions that are required to manage the County's natural environment. The issues identified in the plan that specifically relate to flood control and stormwater quality include: -

- Managing Baltimore County's Watersheds;
- Protecting the Reservoirs;
- Protecting And Restoring Streams and Non Tidal Wetlands;
- Protecting Plant and Animal Habitat;
- Managing Ground Water.

5.7.2.1 Flood and Water Quality Management

Similar to the Ramsay – Washington Metro Water Watershed District and the City of Griffin, the preparation of detail watershed management plans for all of the watersheds within Baltimore County forms the framework for managing flood protection and water quality within the County. These plans also provide the framework for the County to comply with the NPDES permit system of managing point and non-point pollution sources associated with stormwater runoff.

The County's environmental programs commenced in 1987, which included the preparation of watershed management plans. The County has completed 10 watershed management plans to date of the 14 major watersheds within the County. The County is also in the process of developing watershed action plans for 24 small watersheds within the County.

The approach taken to manage flooding and water quality within the County is very similar to the approach taken by the City of Bellevue. It is based on the natural drainage and stream system concept. This approach requires the restoration of natural flows by requiring source controls, encouraging low impact development techniques, on-site flood controls as well as regional facilities.

Like most places in USA the County has establish a 100 year flood zone where development is restricted in flood prone areas to protect private property and improve public safety. Any works or developments proposed in the vicinity of any stream are prohibited within75 feet (approx 23 metres) of the stream.

There are approximately 2,685 approved stormwater facilities within the County of which 978 are publicly owned by the County. A majority of the publicly owned facilities are small detention ponds located upstream of many catchments.

Small Local Vegetated Detention Pond

Similar to many other USA cities, water quality monitoring is an integral part of the County's water management and watershed management program. It forms part of the County's strategy to enhance, restore and improve the water quality of the waterways within Baltimore County.

The County has developed an integrated water quality monitoring program to meet its regulatory and non regulatory program requirements. The County has undertaken extensive chemical, physical and biological testing of all its waterways. The results provide information on the existing condition of the waterways, trends in water quality and provide the basis of determining appropriate water quality treatment measures.

Similar to Bellevue, the County has been continuously implementing a number of water quality capital improvement projects in the last 15 years to improve the quality of waterways within the County. In the 70's and early 80's the focus was on erosion control due to the large storm event that occurred in 1972, which resulted in the transportation of significant sediments into Chesapeake Bay.

Between 1988 and 2005 the County has spent nearly $42Mil on water quality capital improvement works and proposes to allocate a further $32Mil in the next 5 years for water quality improvements.

The funding has generally been allocated for the following typical projects.

a) Stormwater Conversion Projects.

Typical works include conversion of existing stormwater detention (dry) ponds to extended detention or retention (wet) ponds to provide runoff quality in addition to volume control.

b) Stormwater Retrofits.

Typical works include BMP's such as extended detention water quality ponds, bio-retention systems, stormwater wetlands, end of pipe stormwater drain outfall plunge pools and water quality inlets. Retrofits are used in established urban areas that were developed prior to the application of the new stormwater requirements that currently apply to development and redevelopment proposals. No significant retrofits however have been established in urban areas. Some rain gardens and swales have been trialled in existing road reserves however many have resulted in muddy ditches. Kerbside parking is an issue with swales in local streets.

c) Stream Restoration Projects.

These projects are designed to restore degraded urban channels and enhance riparian ecosystems. Typical works include removing concrete channels and replacement with boulders and vegetated material to emulate natural streams that provide velocity controls and improvements to the natural habitat.

d) Shore Erosion Control Projects.

These projects are designed to stabilise eroding shorelines and create habitat and involve establishing shoreline vegetation and structural protection measures.

Similar to the City of Bellevue any new developments proposed in the County are required to design and install appropriate on-site treatment facilities to improve stormwater runoff prior to discharge off site to the County's drainage system or receiving waters. Many of these treatments are required as part of the development approval process to comply with the County's Stormwater ordinance. Systems also need to be designed in accordance with the 2000 Maryland Stormwater Design Manual.

Rain Garden in Local Street

Sedimentation Construction Pond

The Baltimore County also has an extensive maintenance program to ensure that existing structural facilities owned by the County are adequately maintained. The Department has a 4 man crew involved in maintaining the 978 publicly owned facilities within the County. In addition, inspections of the privately owned facilities are also undertaken to ensure they are adequately maintained and comply with current standards. Inspections are conducted every 3 years however the County's goal is to inspect once a year.

Other water quality initiatives include an extensive community educational program to highlight the awareness and impacts of urban stormwater runoff and pollution on the County's waterways, drinking supply reservoir and Chesapeake Bay. The County runs a multi media environmental education program that is offered to schools and citizen community groups. In addition citizens are encourage to be involved in watershed management plans and in stream restoration programs that involve stream clean ups, stream assessments, watershed assessments, tree planting and site sediment assessments.

5.7.2.2 Reuse and Recycling

Similar to many other cities we visited in the USA, there were no significant programs or projects in place within Baltimore County on the reuse and recycling of stormwater. There was no significant need to reuse recycled water due to the adequate drinking supply of water that serves the County. The County however encourages the installation of low flow energy efficient appliances.

5.7.3 Ordinances

The Baltimore County has adopted two primary ordinances to regulate surface water management practices within the County. These include: -

- Stormwater Management Ordinance;
- Excavation, Grading, Sediment Control and Forest Management Regulations.

The "*Stormwater Management*" ordinance sets out the minimum requirements to protect, maintain and enhance the water quality of waterways within the County and prescribes the minimum control measures to limit the adverse impacts of increased stormwater runoff from development and redevelopment projects. Certain development activities are exempt. These include agricultural land practices, additions and modifications to single dwelling, developments that do not disturb any area greater than 5,000 square feet and land activities regulated by State laws.

Applicants undertaking any development or redevelopment project, are required to submit a stormwater management plan for approval to the Department of Environmental Protection and Resource Management prior to undertaking any works on the site and prior to obtaining a grading permit.

The stormwater management plan needs to specify the site characteristics, computations, design standards and treatments to be implemented to limit the adverse impacts of increased stormwater runoff from the development or redevelopment project. The designs standards need to comply with the "2000 Maryland Design Manual".

For redevelopment sites, the impervious area needs to be reduced by 20% or an onsite detention system needs to be installed to cater for excess flows. In addition the redevelopment needs to meet water quality requirements and the installation of BMP's to meet the water quality standards. The Department may accept a fee in lieu of the requirements if the applicant can demonstrate hardship or difficulty in meeting the requirements. The fees are generally used to build larger public facilities.

The ordinance also specifies the construction inspection and continual maintenance responsibility requirements for any BMP's installed with any development.

The intent of *"Excavation, Grading, Sediment Control and Forest Management Regulations"* is to control land disturbance activities and prevent soil erosion. The regulations sets out the requirements for certain land disturbance activities and the requirements of obtaining the necessary grading permit prior to the commencement of works on site.

5.7.4 Funding Mechanisms

The budget of the Baltimore County is in the order of $1.45Bil. The annual operating budget in 2005 for the Department of Environmental Protection and Resource Management was $5.87Mil and the annual Capital Works budget was in the order of $5.16Mil.

The primary sources of revenue available to the County for its operation budget are revenue from property taxes, income taxes and service taxes. Property, income and service taxes represent 60% of the total budget of the County.

Other revenue sources include loan funds and funds from authorised general obligation bonds, which represent 27% of the total budget, and State and Federal grants, which represent 9% of the total budget. A majority of the revenue from these sources (57%) are primarily used to implement capital improvement projects. The bonds and loan funds are repaid from property taxes.

A further 4% of revenues are from miscellaneous sources.

6. CONCLUSIONS

The study tour provided an opportunity to investigate and research the approach taken by local authorities in the USA on “Integrated Water Management”. My conclusions from that tour and subsequent research indicate that there is variety of practices that are similar to those in Australia. Some authorities are well advanced with improvements to flood protection and water quality management whilst others are only just beginning to improve their practices.

In comparison with authorities in the USA, Councils in Victoria in some areas of integrated water quality management can further improve their practices whilst in other areas I found Victoria and Australia is further advanced than the USA. In particularly in the reuse and recycling of stormwater. My conclusions and recommendations on the areas of interest of the study tour topic are as follows: -

6.1. Strategies And Policies

With the exception of the City Of Atlanta, all of the authorities we visited had well defined strategies in place to manage flooding and water quality improvements. In addition many authorities had well defined policies to also manage flooding and water quality improvements.

Master planning, comprehensive drainage plans and watershed management plans provide the strategic framework to the strategies and policies adopted by authorities to manage flooding and water quality improvements. These plans also provide a holistic integrated approach to stormwater management within these authorities.

Whilst many municipalities in the Melbourne Metropolitan area have developed “Stormwater Management Plans” to guide water quality improvements and some have developed “Drainage Strategy Plans”, the idea of developing comprehensive master plans or “Catchment Management Plans” that integrates flood protection, water quality management and reuse and recycling is worthy of consideration. I believe that Councils should adopt the practice of developing Catchment Management Plans to guide an integrated approach to stormwater management.

In the policy area, some authorities had very simplistic policies whilst others had developed very detail policies on flood protection and water quality improvements. Most Councils in Victoria have policies on flood protection that would apply to their municipal district, however not many would have policies on water quality management, reuse and recycling and maintenance and management of private and publicly owned stormwater facilities. I believe that Councils should review and strengthen existing policies and develop new policies where appropriate to provide a holistic policy framework in the management of flood protection, water quality objectives and reuse and recycling of stormwater for their municipal district.

6.2. Flood Management

In the USA municipalities and local authorities are regulated to establish flood maps and flood prone zones to protect private property and public safety. All of the authorities we visited had undertaken flood mapping studies.

With the exception of the Ramsay - Washington Metro Watershed District there is no demarcation of responsibilities for flood protection unlike Victoria where Melbourne Water is the Flood Management Authority.

The Victorian Auditor General in his recent report on "*Managing Stormwater Flooding Risks in Melbourne."* recently highlighted the need for Councils to take greater responsibility for managing flooding risks within their municipal districts.

Under current legislation, Melbourne Water is the Flood Management Authority in the Melbourne Metropolitan area and Catchment Management authorities are the flood authority in rural areas. Melbourne Water however is only responsible for catchments greater than 60 hectares. Catchments less than 60 hectares in Melbourne are the responsibility of local Councils and many have experienced various degrees of flooding. There are currently no legislative powers conferred to Councils under the Local Government Act 1989 to manage flooding.

The Auditor General has suggested that Councils take greater responsibility for managing flooding within their municipal district. In view of the current legislative framework however there appears to be a legislative gap in the role and responsibilities of Councils in respect of flood management.

Most local authorities in the USA have conducted detail modelling studies to establish flood prone areas. Some had also undertaken a detail assessment and analysis of catchments to identify deficiencies in the network and developed programs for priority improvement works. Some authorities, in particular the City of Seattle had established different service standards for various parts of the City providing greater protection to public hospitals, schools and fire stations and a descending scale of service standards for other facilities.

In Victoria, as far I can ascertain, very few Councils have conducted detail modelling and flood mapping of their catchments. Many Councils do not see flood management as their responsibility given that they are not the flood management authority. In addition many Councils are concerned with the political ramifications of placing "a blight" on residential properties within flood prone areas within their district.

In order to provide good planning policy, I believe that it is appropriate that Councils take greater responsibility for flood protection and should prepare flood maps for their municipal district. In addition, Councils should advocate for greater financial assistance to prepare flood maps in collaboration with Melbourne Water.

The strategies adopted by most authorities in the U.S.A in managing flooding are not dissimilar to those adopted by some Councils and authorities in Victoria. These include a combination of source controls (on site detention systems placed on developments and redevelopments through the planning permit process) and major regional detention facilities such as detention basins and wetlands.

Some USA authorities had recognised very early in the high stage of development of their municipal district that source controls, infiltration methods and retaining the natural streams and overland flow paths were more effective than costly piped solutions that resulted in high levels of stream erosion. This was recognised in particular in Bellevue, Baltimore County and more recently in Seattle where 30% of the network had no formal drainage system. In other areas, the installation of detention ponds at more frequent locations upstream assisted in reducing the impact of flooding down stream within the catchment.

The City of Chicago was an exception where a large part of the system was a combined sewer and stormwater system and all stormwater discharged to the Great Lakes Of Chicago.

The City is unique in that the lakes are also the City's main drinking supply. In order to protect this asset the City embarked on a program of constructing large tunnels and reservoirs to collect high water flows and treat all water through treatment plants. Atlanta is proceeding to implement a similar strategy.

Most of the local authorities we visited in the U.S.A indicated that they had substantially implemented and completed flood control measures to control flooding within their districts with the exception of some localised areas.

In Victoria, in established areas, the strategy to control flooding has generally been to build large regional facilities such as detention basins and require source controls (onsite detention systems). These mainly apply to development and redevelopment projects as part of the planning approval process where existing infrastructure is deficient, similar to the USA.

In green field sites the practice has been to establish overland flow paths and build wetlands as well as regional detention facilities. In some outer metropolitan Councils overland flow paths have been established in the form of drainage reserves, however many of these reserves have not been managed effectively due to the lack of responsible ownership. Many reserves have remained in the name of the original subdivider and in many instances adjacent private property owners have fenced in the reserves with their property making the concept of the overland flow path ineffective.

I believe that Melbourne Water and local Councils need to take a more proactive approach to the management and maintenance of such reserves to ensure that these reserves remain open and free of obstructions and available as overland flow paths. The reserves need to be appropriately managed by a designated flood authority. The legislative framework of restricting fencing and claiming adverse possession of such land needs to be strengthened to ensure that such reserves remain open and free of obstructions.

In the Melbourne Metropolitan area there are still many areas that are subject to flooding. Whilst infiltration methods and on site detentions can be encouraged, I believe the main option to address flooding in existing urban areas is the allocation of an appropriate level of funding to upgrade existing drainage infrastructure. This includes the construction of additional regional detention storage facilities. In addition Councils and Melbourne Water need to take greater responsibility for the management and maintenance existing drainage reserves to maintain these reserves as overland flow paths.

This will require a coordinated strategic approach between Melbourne Water and Local Government and a greater level of investment by the State and Federal Governments on flood protection measures.

6.3. Water Quality Improvements

Water quality management in the U.S.A operates in a highly regulatory environment. The implementation of the Clean Water Act and the introduction of Phase 1 and more recently Phase 2 NPDES permit scheme requires local authorities to implement stormwater management plans to comply with 6 minimum control measures. Guidelines have also been developed by the U.S.E.P.A. to guide the development of stormwater management plans to meet the NPDES permit scheme requirements.

Most of the municipalities we visited with the exception of Atlanta had made significant progress in developing strategies to address the NPDES requirements and water quality improvements. Some municipalities had been actively involved in water quality improvements for a number of years in particular the City of Bellevue and to a lesser extent the Baltimore County. Bellevue had commenced some 30 years ago prior to the introduction of the NPDES permit scheme.

Detail planning, watershed management plans and water quality monitoring provide the framework for improving water quality within local authorities within the USA. Many authorities had completed or were in the process of completing a detail assessment of their watersheds (catchments). This included water quality assessments of streams and waterways and the status of existing vegetation and natural habitats.

Water quality monitoring in some local authorities was quite extensive where monitoring was used to assess pollution loads with a particular emphasis on the levels of phosphorus, nitrogen, and total suspended solids. In addition biological, chemical and habitat sampling had been undertaken to assess the ecological health of waterways. The water quality monitoring provided most municipalities with base line data to develop a structured approach to managing water quality initiatives. The data provided details of the: -

- Location and levels of existing sources of pollution;
- Trends in water quality over time;
- Standards to be applied;
- Effectiveness of current pollution control technologies.

In addition, authorities in the USA had developed definitive regulatory frameworks and public education programs as part of their strategic approach to improve water quality within their district. The strategies generally involved a combination of structural and non structural measures. They included: -

- Source controls predominately on development and redevelopment projects;
- Retrofits on existing stormwater system networks and facilities;
- Regulatory regimes to ensure compliance and detection of illicit discharges;
- Community educational, participation and involvement programs.

In Victoria most local Councils have adopted Stormwater Management Plans. Many of these plans recommend the implementation of both structural and non structural measures. Most of the structural measures generally relate to the implementation of point source pollution treatments and the construction of wetland facilities.

The Victorian State Government initially provided financial assistance under the VSAP to implement such treatments and facilities however this program has been disbanded. Some Councils are experimenting with retrofit measures mainly on existing drainage networks, however there effectiveness is yet to be assessed. In any event I believe that significant research is required on retrofitting existing facilities to ensure cost effective best management practices are adopted.

It was interesting to note that a number of authorities we visited employed a significant number of highly skilled personnel and maintained a high level of competency within their organisation to implement best practice stormwater management measures. In addition the authorities had developed and implemented extensive education and community participation programs within their municipal district.

I believe Victorian municipalities can significantly improve in this area and Councils need to develop strategies to develop their knowledge base to build capacity and develop and implement educational programs to improve the awareness and education of local residents on stormwater quality.

6.4. Reuse And Recycling

In the USA there was very little evidence of reuse and recycling practices. This may have been a reflection of the cities we visited where the cities were well resourced with good drinking water supply. There were some demonstration projects in place where roof gardens had been established where the primary objective was to retain stormwater flows and obtain rating credits on the discharge of impervious surfaces.

In Victoria, local Councils are further advanced and have been experimenting with a range of technologies to harvest and reuse stormwater. The most common practice is to collect roof runoff and retrofit toilets within municipal buildings. Other authorities have collected surface runoff and used the run off for various watering activities such as parks, reserves and golf courses. Some Councils are investigating a number of other innovative initiatives.

The regulatory framework on the reuse and recycling of stormwater, whether it is roof runoff or surface flow is unclear. I believe that State Government needs to develop an appropriate regulatory framework to manage the risk associated with using recycled water. In addition, guidelines need to be developed to clearly indicate the risks and appropriate uses of recycled stormwater.

6.5. Regulatory Regime.

Most authorities in the USA we visited had well developed ordinances to manage flood protection, soil erosion and water quality improvements. In particular ordinances had been developed for: -

- Soil Erosion, Grading and Sedimentation Control;
- Flood Area Protection;
- Stormwater Management;
- Illicit Discharges.

The “Stormwater Management” ordinances were of particular interest where authorities were able to require the submission of stormwater management plans for developments as part of the development approval process and the installation of on site detention facilities, including in some cases water quality improvement measures. The ordinances also gave powers to the authorities to inspect and require maintenance of such facilities for the life of the facility, to ensure they were operating satisfactorily. The ordinances applied to all development and redevelopment projects including green field sites.

In Victoria, most Council are able to require as a condition of a planning permit stormwater detention facilities and construction management plans to control erosion and sedimentation. In addition as part of planning approval process Councils may restrict developments within designated flood zones. Under the current legislative framework, unless the development is in a green field site, Councils are not able to require water quality improvements or require an integrated approach on stormwater management. In addition Councils have difficulty in ensuring facilities are properly maintained after installation, in particular on site detention systems.

The proposed changes to Clause 56 of ResCode will improve Councils ability to require water quality objectives to subdivisions in greenfield sites. However most redevelopments are likely to occur within the inner metropolitan area of Melbourne where the provisions of Clause 55 of Rescode would apply. Accordingly I am of the view that these provisions should also be reviewed to provide Councils the legislative framework to also apply water quality objectives on smaller developments.

Other alternatives include the introduction of planning scheme amendments that would provide Councils powers under the planning scheme to require water quality improvements for all developments, similar to that proposed by the "Bayside" Councils in Melbourne, which is currently the subject of a test case.

In addition to the above, I am of the view that Councils need to review their existing local laws to ensure that appropriate regulatory mechanisms are in place to manage soil erosion and sedimentation associated with construction activities. Councils also need to develop appropriate local laws to ensure that respective property owners adequately maintain privately owned stormwater detention or a water quality facilities within their property.

6.6. Funding

The sources of revenue that are available to most authorities in the USA are very similar to those that are available to Victorian municipalities, with the exception of those authorities that have established themselves as separate Utilities.

Property taxes, loans and grants were the most common sources of revenue. Those that had established Utilities charged a levy against each property based on the impervious area of the property discharging to the authorities stormwater system.

Establishing Utilities in Victoria would require significant structural changes and may not be supported by local Councils or residents. I don't believe that there are any advantages in establishing a separate Utility to manage stormwater and would only complicate existing governing arrangements.

In New South Wales (NSW) however, legislation was recently introduced in the NSW Local Government Act, which gave Councils the power to raise levies for stormwater quality improvement initiatives. Victorian Councils should further investigate this initiative to assess the practicalities of Victorian Councils having similar revenue raising powers.

7. RECOMMENDATIONS

These following recommendations are based on my experience of the study tour, the subsequent research undertaken on integrated water quality management and the conclusions reached from this course of study.

7.1 Strategies And Policies

1. That IPWEA Victoria, in collaboration with Councils and Melbourne Water, within the next 3 years, commence the development of detail Master Drainage Management Plans or detail Catchment Management Plans integrating existing stormwater management plans, drainage strategies and sustainable water management plans to provide an integrated holistic approach to the management of flooding, water quality improvements and reuse and recycling of stormwater.

2. That Councils in Victoria, as part of their Best Value or Council Plan review process, conduct a review of existing policies and or develop appropriate policies on flood management, water quality management, reuse and recycling. In addition Councils need to develop appropriate policies on the maintenance and management of privately and publicly owned stormwater facilities in accordance with strategic plans to guide flood management, water quality objectives and the reuse and recycling of stormwater.

7.2 Flood Management

3. That IPWEA Victoria through the MAV, within the next 12 months, seek clarification from the State Government on the role and responsibilities of Local Government on flood management and advocate for appropriate changes to the legislation that clearly defines Councils responsibility for flood management.

4. That Councils in Victoria, within the next 5 years develop flood maps for their municipal district to appropriately manage the risk of flooding and to appropriately manage development and redevelopment proposals within their municipal district.

5. That Councils in Victoria, as part of their Best Value or Council Plan review process, develop appropriate service standards and articulate these standards to their communities to provide a greater awareness on the standards provided by Councils in managing flooding within their municipal district.

6. That IPWEA Victoria through the MAV, within the next 12 months in consultation with Melbourne Water, develop appropriate strategies to manage and maintain existing overland flow paths that were established as drainage reserves in the Melbourne Metropolitan area.

7. That IPWEA Victoria through the MAV and the ALGA, within the next 12 months advocate for greater financial assistance to Councils from Federal and State Governments to develop flood maps for their municipal districts in collaboration with Melbourne Water.

7.3 Water Quality Management

8. That Councils in collaboration with Melbourne Water, in the next 24 months conduct a detail analysis of catchments within their municipal districts to locate and assess point sources of pollution, the standards of water quality of existing waterways and determine pollution loads and trends in water quality.

9. That IPWEA Victoria in collaboration with Melbourne Water, within the next 24 months, develop State wide standards and recommend appropriate technologies for implementation to achieve State water quality targets for Port Phillip Bay.

10. The IPWEA Victoria in collaboration with Melbourne Water, within the next 3 years, undertake appropriate research and development of best management practices that can be implemented to retrofit existing drainage systems in the Melbourne Metropolitan area.

11. The IPWEA Victoria in collaboration with Melbourne Water and other professional water industry associations, within the next 24 months develop appropriate strategies to build capacity within Local Government to improve the knowledge and skills of personal to implement water quality best management practices.

12. That Councils, as part of their Best Value or Council Plan review process, develop community and school educational programs to improve the awareness of good house keeping practices to improve source controls and water quality. This includes involving the community with catchment management planning to assess existing conditions of catchments and involving the community in the development of appropriate strategies to improve water quality.

7.4 Reuse and Recycling

13. That IPWEA Victoria through the MAV, within the next 12 months pursue the State Government on the development of a regulatory framework on the harvesting and reuse of stormwater and clearly define the rights of ownership of stormwater.

14. The IPWEA Victoria in collaboration with Sustainability Victoria and the EPA within the next 12 months, develop State wide guidelines on the harvesting reuse and recycling of stormwater including installation, operation and maintenance requirements.

15. That IPWEA Victoria in collaboration with Sustainability of Victoria within the next 24 months, document the research and development of new technologies on the reuse and recycling of storm water and develop a manual on best practice applications, having regard to the risks to the public on the various uses of recycled water.

7.5 Regulatory Regime

16. That IPWEA Victoria through the MAV, within the next 24 months, advocate for a review of the provisions of Clause 55 ResCode to include an integrated approach to water quality initiatives that would be applicable to multi unit developments similar to the current review of Clause 56 of ResCode.

17. That IPWEA Victoria through the MAV, within the next 24 months, advocate for changes to the Building Control Act and the Building Regulations that will require the installation of rain water tanks for appropriate uses in addition to solar hot water systems and other water quality initiatives applicable for single dwellings.

18. That Councils as part of their Best Value or Council Plan review process, conduct a review of current local laws and develop appropriate local laws to manage soil erosion and sedimentation from construction sites, and manage the maintenance of on-site stormwater detention facilities or water quality improvement facilities that are required as part of the planning permit approval process.

7.6 Funding

19. That IPWEA Victoria through the MAV and the ALGA, within the next 24 months advocate for a greater level of funding from the Federal and State Government to support the implementation of flood control measures and structural measures identified in Councils Stormwater Management Plans including funding for retrofitting of existing networks to improve the quality of stormwater discharging to the State's waterways.

20. That IPWEA Victoria through the MAV, within the next 24 months investigate the opportunities for Councils to increase their revenue sources by increasing Councils powers under the Local Government Act to charge a levy for water quality improvement and or flood management works similar to the changes to the Local Government Act in New South Wales.

DEFINTIONS AND ABBREVIATIONS

ALGA: Australian Local Government Association.

APWA: American Public Works Association.

BMP's: Best Management Practices.

CMA's: Catchment Management Authorities.

CSO: Combined Sewer Overflows.

CWA: Clean Water Act.

DSE: Department of Sustainability and Environment.

EPA: Environmental Protection Authority.

FCCC: Flood Control Coordinating Committee.

Illicit Discharges are defined as: -

"...any discharge to an MS4 that is not composed entirely of stormwater..." with some exceptions. These exceptions include discharges from NPDES-permitted industrial sources and discharges from fire-fighting activities. Illicit discharges (see Table 1) are considered "illicit" because MS4s are not designed to accept, process, or discharge such non-stormwater wastes.

Sources of Illicit Discharges
Sanitary wastewater. Effluent from septic tanks. Car wash wastewaters Improper oil disposal. Radiator flushing disposal. Laundry wastewaters. Spills from roadway accidents. Improper disposal of auto and. Household toxics.

Table 1[19]

IPWEA: Institute of Public Works Engineering Australia.

IRM: Integrated Resource Management.

LWMP: Local Water Management Plans.

MAV: Municipal Association Of Victoria.

MEF: Municipal Engineering Foundation.

[19] *United States Environmental Protection Agency EPA 833-F-00-007*, January 2000 Fact Sheet 2.5

MEP: Maximum Extent Practicable.

MPCA: Minnesota Protection Control Agency.

MS4: "***municipal separate storm sewer*** means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

(i) Owned or operated by a State, City, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law)...including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States.

(ii) Designed or used for collecting or conveying stormwater;

(iii) Which is not a combined sewer; and

(iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2."

NPDES: National Pollution Discharge Elimination System.

SEPP: States Environmental Protection Policy.

SPU: Seattle Public Utility.

SRC: State Revolving Fund.

TARP: Tunnel And Reservoir Plan.

TMDL's: ***Total Maximum Daily Loads*** "are water quality assessments that determine the source or sources of pollutants of concern for a particular water body, consider the maximum amount of pollutants the water body can assimilate, and then allocate to each source a set level of pollutants that it is allowed to discharge (i.e., a "waste load allocation")."[20]

USA: United States of America.

U.S.EPA: United States Environmental Protection Agency.

VSAP: Victorian Stormwater Action Program

[20] *United States Environmental Protection Agency EPA 833-F-00-003,* January 2000 Fact Sheet 2.1

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Appendix A: Seattle Public Utilities 2004 Stormwater and Flood Control Policies

"Stormwater Policy 1—SPU will manage the conveyance of stormwater in areas of Seattle that currently have constructed drainage infrastructure. SPU may develop drainage improvements in areas where established service levels have not been met, if the proposed improvement meets asset management criteria for cost-effectiveness.

Stormwater Policy 2—Property owners are responsible for building and maintaining stormwater systems on their private property, as directed by municipal code.

Stormwater Policy 3—SPU will size drainage facilities in the City right-of-way to meet multiple service levels that support community mobility, safety, and environmental goals.

Stormwater Policy 4—SPU will design projects in watersheds draining to creeks in a manner that seeks to mimic predevelopment hydrologic function for frequent storms (i.e., natural drainage systems).

Stormwater Policy 5—The applicability of natural drainage system design to help address stormwater flow control and water quality will be evaluated during project development.

Stormwater Policy 6—SPU will evaluate the purchase of private property as an option to solve a flooding problem or to meet another 2004 Comprehensive Drainage Plan objective.

Stormwater Policy 7—Within the street right-of-way, the City of Seattle will protect both natural and constructed ditches that drain to creeks, because of their critical function in stormwater quality and quantity management. Within the City right-of-way in creek watersheds, the City will not issue a permit to fill a ditch or replace a ditch with a culvert, with limited exceptions, such as development related street improvement requirements and driveway permits.

Stormwater Policy 8—SPU may fully fund or share costs of construction of stormwater management facilities to control excess runoff or to improve water quality resulting from development that predates adequate flow or water quality controls.

Stormwater Policy 9—The Comprehensive Drainage Plan defines solutions and sets implementation schedules to address flooding problems. Some of these solutions will not be accomplished for many years. To provide short-term relief to property owners, interim improvements may be built in certain areas. These improvements should be compatible with long-term solutions where possible.

Stormwater Policy 10—SPU may pay the drainage-related cost of street improvements associated with projects that are initiated by SPU to address a Comprehensive Drainage Plan objective.

Stormwater Policy 11—SPU will evaluate small-scale drainage improvements (i.e., spot drainage improvements) on a case-by-case basis to determine whether SPU drainage support is appropriate and whether a cost-effective solution can be implemented."[21]

[21] *City Of Seattle 2004 Comprehensive Drainage Plan,* Volume 1 Chapter 3 January 2005.

Appendix B: Seattle Public Utilities 2004 Water Quality Policies

"Water Quality Policy 1—SPU will conduct all operations, including construction and maintenance activities, in accordance, at a minimum, with regulatory requirements to protect water quality.

Water Quality Policy 2—SPU will investigate and assess water quality conditions, identify problems and pollutant sources, and develop solutions to improve water quality. SPU will develop a monitoring program to implement this policy.

Water Quality Policy 3—SPU will construct capital improvements that proactively retrofit existing drainage infrastructure, when physically feasible and cost-effective, to improve water quality in problem areas.

Water Quality Policy 4—SPU will provide technical assistance and leadership to other City departments for water quality and pollution prevention activities.

Water Quality Policy 5—SPU will participate with other agencies to investigate water quality issues of local and regional significance.

Water Quality Policy 6—SPU will aggressively pursue source control actions to reduce the amount of pollution discharged to the City system.

Water Quality Policy 7—SPU will coordinate City of Seattle compliance with NPDES permits for both stormwater and combined sewer systems. However, City departments are generally responsible for funding their own actions, enforcement, training, and capital improvement projects that meet the City's obligations under these Federally mandated permits."[22]

[22] City *Of Seattle 2004 Comprehensive Drainage Plan,* Volume 1 Chapter 3 January 2005.

Appendix C: Ramsay – Washington Metro Watershed District, Flood Control Policies

1. "Manage stormwater conveyance systems and storage facilities to eliminate flooding of structures that could be damaged by flood waters for events up to and including the critical 100-year storm.

2. Manage local floodplain areas to maintain critical 100-year flood storage volumes.

3. Prevent runoff from developed areas into new or existing detention basins to ensure that on-site or nearby detention basin water levels do not exceed the critical 100-year storm event flood level.

4. Require cities to update or adopt flood plain zoning regulations consistent with the District plan (and Minnesota DNR).

5. New buildings and filling activities must be above flood-prone areas to avoid causing an increase in the critical flood levels that could affect both the new construction and existing neighboring structures.

6. If increases or decreases in 100-year flood elevations are noted in the District hydrologic modelling or caused by any future District project, the District will alert DNR and prepare data for affected cities to use for revision of FEMA floodplain maps and studies. See Appendix I.

7. Maintain discharge rates and flood storage volumes to minimize pond overflow and reduce erosion.

8. Maintain maximum and average 100-year discharge rates and storage volume in regional detention areas.

9. Maintain an updated hydrologic model of stormwater system.

10. Design surface water conveyance systems and storage facilities, considering both the drainage area and the receiving waters downstream.

11. Maximize upstream storage.

12. Seek ways to increase infiltration by increasing vegetated areas and reducing impervious areas.

13. Prohibit filling lands within the established floodplain of ponds, lakes or streams without providing compensating replacement and mitigation and a permit from the District.

14. Maintain the proper function and performance of current stormwater conveyance systems and storage facilities.

15. Remove accumulated sediment from storage facilities in a timely fashion.

16. Monitor the lake levels within the District and modify predicted flood levels when necessary."[23]

[23] *Ramsey-Washington Metro Watershed District 1997 Watershed Management Plan* - Section 3.1

Appendix D: Ramsay – Washington Metro Watershed District, Surface Water Quality Management Strategy Policies

"Goal: Maintain current range of uses for District water resources.

Objective 1: To maintain or enhance water quality of lakes, wetlands, detention basins and watercourses.

Policies:

1. Establish and implement lake, wetland, and stream monitoring programs.

2. Evaluate the effectiveness of management activities on the affected water bodies.

Objective 2: To reduce non-point-source pollution loads to District water bodies through the use of District designed and managed regional stormwater treatment facilities and developer and City designed on-site treatment facilities.

Policies:

1. Construct regional detention basins to treat water when upstream facilities cannot effectively reduce sediment and nutrient loads to target levels.

2. Require on-site detention basins for all new developments in drainage areas where water quality cannot be effectively improved by regional basins.

3. Augment the benefit of water quality treatment basins with non point pollution reduction programs.

Non-point-source Pollution Control Strategy Policies

Goal: Strengthen construction-site permit compliance and reduce non-point-source pollution from other land use activities.

Objective 3: To increase local support of non-point-source pollution control.

Policy: Require all cities to adopt the Metropolitan Council Interim Strategy for Non-Point-Source Pollution Reduction.

Objective 4: To achieve 100% compliance with construction site erosion, sedimentation and runoff BMPs as defined by the *Ramsey Soil Erosion and Sediment Control Handbook*.

Policies:

1. Increase coordination with cities to ensure that all land disturbance activities and public works projects comply with the standards, criteria and methods of *Ramsey Soil Erosion and Sediment Control Handbook.*

2. Require permits and preparation of an erosion control plan for all public works projects and all land disturbances of one acre or more, to control bank, shore land and construction site erosion.

3. Require cities to provide erosion control regulation and enforcement for disturbed areas of less than one acre.

4. District permits will reinforce State shore land and stream bank setback requirements.

Objective 5: To reduce abuse of stormwater systems from direct disposal of refuse, debris and hazardous substances.

Policies:

1. Prohibit discharge of sediments, nutrients, natural debris, refuse and toxic chemicals to any water bodies, overflow areas, and storm sewers.

2. Reduce small non-point sources of pollution through community education, demonstration projects and various housekeeping practices and maintenance procedures.

Objective 6: To apply ecologically sensitive land use and landscape design principles to reduce urban pollution.

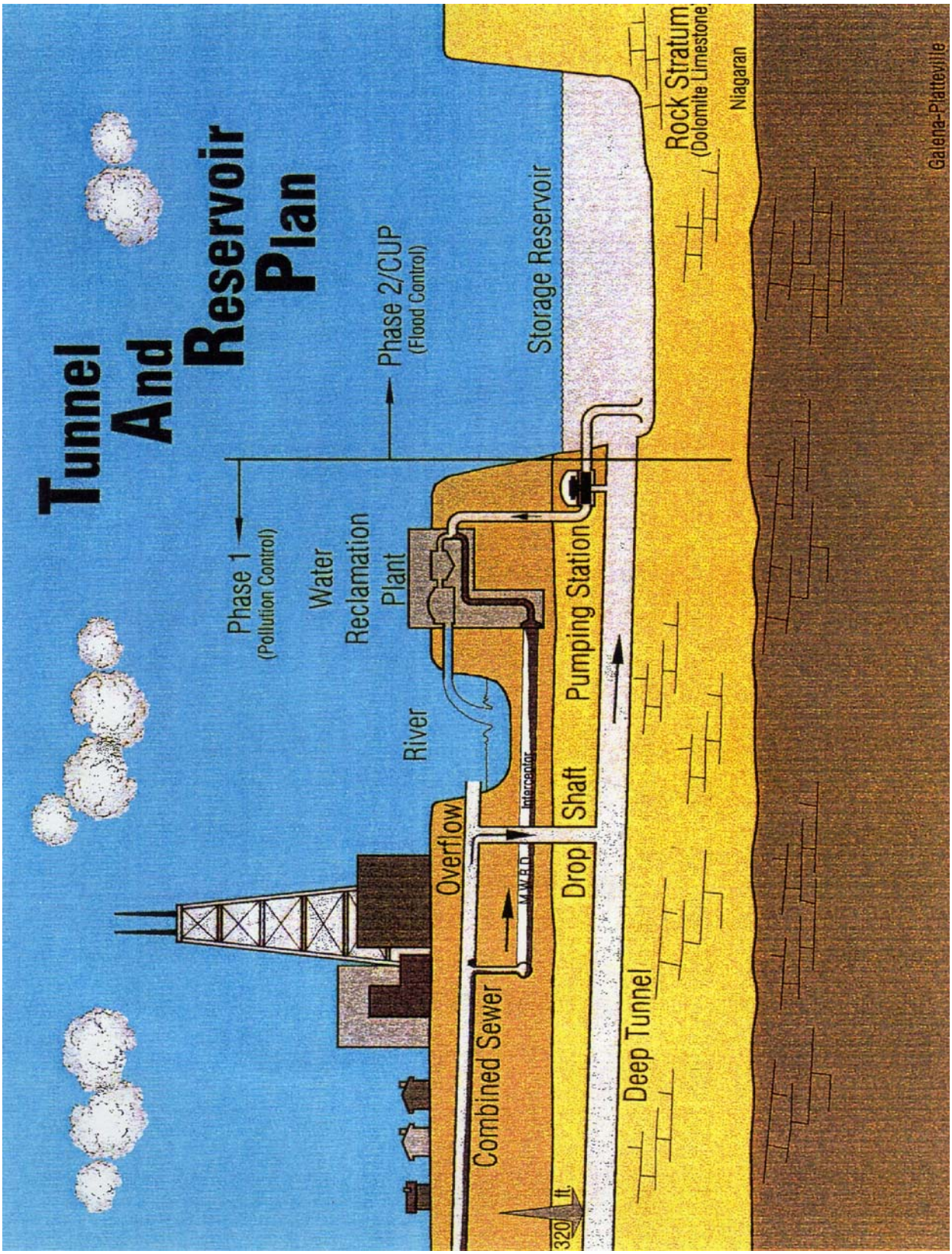
Policies:

1. Encourage project designs to use landscape design, preservation of natural resources and aesthetics and increasing natural vegetation along streams, lakes, wetlands and detention basins to reduce non-point-source pollution.

2. Encourage cities, developers and designers to consider site designs that reduce or postpone impervious-surface acreage."[24]

[24] *Ramsey-Washington Metro Watershed District 1997 Watershed Management Plan* - Section 3.2

Appendix E: Metropolitan Water Reclamation District of Greater Chicago, Concept Plan of TARP Project



Appendix F: Metropolitan Water Reclamation District of Greater Chicago, Status Of TARP Project