Warrnambool City Council

Warrnambool Drainage Strategy

Volume 1 Report

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WARRNAMBOOL CITY COUNCIL

Hyder Consulting

Warrnambool City Council

Warrnambool Drainage Strategy

Volume 1 Report

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1 Introduction and Study Objectives

1.1 Intoduction

This report presents the results of the Warrnambool Drainage Strategy and advice to Council on a range of issues relevant to drainage in the municipality.

The project has been undertaken by Hyder Consulting for the City of Warrnambool, as described in Council's brief Contract No. 2001066 and Hyder's submission VCX1846/Vb00e752 dated June 2001.

The outputs for the Final Drainage strategy consist of:

- Volume 1 (this report).
- Volume 2 (Colour A3 plans plus detailed catchment reports)
- A1 colour plans of the municipality.

1.2 Study Objectives

The objectives of this study are to:

1 Identify deficiencies in the Council drainage system, based on the Council existing design guidelines and proposed objectives for the performance of the drainage system.

2 Identify areas of the Council drainage system that may be subject to overland flow and provide guidelines on controls on development in these areas.

3 Provide a cost estimate for drainage upgrade works and rate works as high low or medium priority.

4 Investigate the feasibility of diverting flows from the Simpson St tunnel to an artificial wetland at the Warrnambool Racecourse.

5 Consider and advise on the viability of continued use of Soak Pits within the municipality.

6 Investigate stormwater reduction methods

7 Investigate alternative funding through contribution schemes for the drainage strategy.

2 Drainage System Objectives

Drainage objectives provide the policy framework for Council's drainage design standards (and for setting drainage requirements on developments). Drainage system objectives similar to those listed below have been agreed upon between Hyder Consulting and a number of Council's as well as Melbourne Water.

Drainage system performance objectives are a way of specifying the "risk management" approach to urban drainage issues. There are a range of risks and consequences associated with the choices made in designing a drainage system. The design approach proposed is to consider all of the risks and to choose appropriate levels of protection.

Discussion regarding each of the proposed drainage system performance objectives is also included for your information.

2.1 Objectives

In developing the following proposed drainage system objectives for Warrnambool Hyder have reviewed Council's Design Guidelines (July 2001). A number of the objectives are covered by Warrnambool Council's existing guidelines.

The proposed objectives for the City of Warrnambool's drainage system are:

Objective 1 To minimise the effects on natural waterways from changes to natural flow regimes (such as flood frequency, run-off volume and flow velocity).

Objective 2 Preserve and restore (if necessary) existing natural features of the stormwater drainage system, such as natural channels, wetlands and riparian vegetation.

Objective 3 To protect all waterways from pollution.

Objective 4 To encourage integration of drainage systems into the urban landscape to maximise the visual and recreational amenity of developments.

Objective 5 To ensure that when drainage and flood protection works are constructed that existing habitable buildings are protected from flooding in major storms.

Objective 6 To ensure that flood waters do not present an unacceptable risk to the community.

Objective 7 To ensure that piped drains have sufficient capacity to ensure that flooding is not a regular nuisance in minor storms.

Other objectives for the City of Warrnambool's drainage system, which should be taken into consideration for assessment of future development areas, are:

Objective 8 To ensure that all new habitable buildings have floor levels at least 300mm above the 100 year ARI flood level.

Objective 9 To ensure that in new subdivisions no overland flow is directed onto the building envelope of any new allotment from roadways or upstream properties during major flood events.

Objective 10 To ensure that new developments shall not have an adverse impact on downstream properties and environments in terms of :

a. Major flooding.

b. Minor flooding.

c. Water quality.

It should be noted that the current investigation and report has not considered these objectives.

3 Catchment Studies

This section of the report summarises the results of the study of Council drains in the City of Warrnambool. This includes recommended drainage improvement works to improve protection from flooding where potential problems have been identified.

Hyder's study of each catchment in the City of Warrnambool has been undertaken in accordance with risk management principles aimed to identify and analyse locations where the following problems may occur in the Council drainage system.

1 Overland flow entering private property (usually downstream of low points in the road network) during major storm events in valleys. Valleys that may be subject to overland flow in a major storm events where the overland flow may enter private property.

2 Runoff in excess of the pipe capacity in larger Council drains (typically 900 mm diameter or greater), particularly during;

- **a** minor storms where the extent of nuisance flow is greater than permissible (eg. Flow along a kerb and gutter which may be a nuisance to pedestrians or a hazard to vehicles travelling at normal speeds)
- **b** major storms where the amount of overland flow may exceed safety criteria for pedestrians or vehicles (even if no private property is flooded).

3 Greater than permissible flow along the kerb and gutter for a minor storm in streets where there are no drains for a substantial length may require properties to discharge to kerb and channel .

Hyder has visited each street in the municipality, studied maps and undertaken calculations to identify drainage problem locations, assess potential hazards, calculate flow rates and recommend drainage works for 201 identified locations.

3.1 Catchments

The municipality was divided up into 10 catchment areas to aid with drainage analysis. The locations and boundaries of the catchments are shown on the plans in Volume 2. The low points that fall outside of the 10 designated catchments have been grouped together as an eleventh catchment under the heading of Outlying catchment.

The catchments were based on main drains, waterways and outlying areas. Boundaries were determined based on topography, Council drainage plans and site observations. The main function of these designated catchments was to help analyse the cost distribution across the City of Warrnambool.

The catchments are listed below:

Table 3.1 Catchment Reference

Label Reference	Catchment Name
SIMP	Simpson Street Catchment
RUSC	Russell Creek Catchment
WATC	Watson Street Catchment
LPER	Lake Pertobe Catchment
RACE	Warrnambool Racecourse Catchment
MERR	Merri River Catchment
MORT	Mortlake Road Catchment
GREY	Warrnambool Greyhounds Catchment
HOPK	Hopkins River Catchment
JAPA	Japan Street Catchment
OUTL	Outlying Catchment

Many of the catchments can be further broken down into sub-catchments but have been left to enable easier analysis of the works required. Only the Japan and Simpson Street catchments have one major outlet, the other catchments have many different outlets within the catchments.

3.2 Methodology

The aim of the catchment studies was to identify locations where the Drainage Performance Objectives may not be achieved under existing conditions. Contour maps of each catchment were studied and likely drainage problem locations were systematically identified.

With regard to likely drainage problems, each catchment was studied as detailed in the following sections.

3.2.1 Site Assessments

Every street was visited, including all low points, locations of large Council drains and undrained streets. At each location the existing conditions data was recorded, including:

a number and type of drain inlets.

b likely overland flow path from the low point.

c location and level of houses and other buildings which may be at some risk of being flooded.

d possible works to relieve drainage problems.

It should be noted that all site assessments were made from public property and that there may be assets on private property which could not be viewed or assessed during this study.

Photographs were taken at each low point location and are available to Council in digital format.

3.2.2 Hydrologic / Hydraulic Analysis

Peak flow rates were calculated using the Rational method.

Peak flow rates were determined for a 5 year, 10 year and 100 year Average Recurrence Interval (ARI). The residential catchments were assumed to be developed for 2 scenarios:

- "Existing" peak flow rates: calculated using a fraction impervious that was assumed to be 0.3.
- "Maximum future" flow rates: calculated using a fraction impervious of 0.65 to allow for future urban consolidation.

Other parameters used in the analysis included;

a minimum time of concentration of 6 minutes

b 5, 10 and 100 year ARI rainfall data was used from the Warrnambool data obtained by Hyder from the Bureau of Meteorology.

c hydraulic calculations used the Manning's equation with a value of Manning's n of 0.013.

The pipe capacities were estimated assuming pipe on grade capacity given the pipe size shown on Council base plans and the slope of the natural surface level. Where pipe grades were obtained from engineering drawings the pipe grade was used in preference to the slope from the contour plans and the pipe grade has been included on the Drainage Feature Plans. Where pipes were laid in flat areas and no other information was available it was conservatively assumed that the grade was equal to the pipe diameter (i.e. for a 300 mm pipe it was assumed the grade was 1 in 300).

4 Recommended Drainage Improvement Works in the City of Warrnambool

The efficient resolution of problems within existing built-up urban areas invariably involves a combination of various options for works and activities, which are dependent on site-specific conditions over the catchment under investigation.

From a catchment area perspective, it is rarely appropriate to consider any single option as a “stand alone” measure.

In deciding on the need for remedial works at a given location, it is necessary to assess and test the situation for compliance with defined performance objectives.

In designing remedial works it is also essential for a whole catchment approach to be maintained. Resolution of a problem at one location can easily lead to creation of a new problem or exacerbation of an existing problem at points downstream.

4.1 Flooding Hazard

The recommended drainage improvement works for each catchment have been grouped into categories according to the risk and potential consequences of flooding at each location. Some effort was also made to better define the differences between the three categories of flooding hazard, although the application of a specific rating still relies on judgement. The three broad categories are:

- High Hazard
- Medium Hazard
- Low Hazard

Details regarding each of these hazard ratings are provided below.

4.1.1 High Hazard

Where there is a risk of the floor levels of habitable buildings being flooded on a frequent basis and / or there is a serious risk to the personal safety of people in private property or in streets.

4.1.2 Medium Hazard

Where there is a risk of the floor levels of habitable buildings being flooded on an infrequent basis and /or there is some risk to the personal safety of people in private property or in streets.

4.1.3 Low Hazard

Where there is little if any chance of the floor levels of habitable buildings being flooded, and where there is little or no risk to the personal safety of people in private property or in streets.

Generally the risk of flooding of the floors of habitable buildings is not a problem in low hazard areas. However, the drainage design objectives may still not be met if the street, private property or non habitable buildings are flooded on a relatively frequent basis.

4.2 Recommended Works

In determining the recommended drainage improvement works at each location a number of options were considered, including:

- Replacement of existing pipeline(s).
- Construction of an additional pipeline.
- Construction of a flood storage.
- Construction of an overland flow path, along a road or public lands.
- Diversion of overland flows along existing roads and/or public lands.
- Land acquisition for flow paths or retarding basins.

Generally the preference was to manage flood flows above ground along overland flow paths and/or by constructing flood storage. Very few additional sites suitable for flood storage were identified and therefore flood storages were rarely viable. Land acquisition was least favoured due to the high cost and lengthy procedures required to acquire properties.

4.3 Cost Estimates

4.3.1 Drainage Problems

The total estimated value of recommended drainage works is **$10.2 Million** as detailed in Table 5.1. The recommended works are all based on future rates of runoff to ensure that new drains will not have to be replaced in the future to provide additional capacity.

Table 5.1 Cost for Recommended Drainage Works by Catchment – Future Conditions

Catchment	Low Priority	Medium Priority	High Priority	Total Cost of Recommended Works
RUSC	$1,390,000	$680,000	$1,060,000	$3,130,000
MORT	$322,000	$1,250,000	$65,000	$1,637,000
HOPK	$1,030,000	$200,000	-	$1,230,000
WATC	$435,000	$640,000	-	$1,075,000
OUTL	$220,000	$210,000	$245,000	$675,000
SIMP	$445,000	$205,000	-	$650,000
MERR	$510,000	$90,000	$50,000	$650,000
JAPA	$230,000	$40,000	$165,000	$435,000*
RACE	$125,000	$30,000	$25,000	$180,000
GREY	-	$165,000	-	$165,000
LPER	$20,000	$85,000	-	$105,000
Total	**$4,772,000**	**$3,845,000**	**$1,610,000**	**$10,227,000**

* Excludes cost of tunnel upgrade

The Russell Creek Catchment has the highest total cost and highest average cost associated with drainage upgrade works. The catchment is the largest of the designated 10, with 35 identified low points. A list of catchments, their number of low points identified and average cost per low point has been included in Table 5.2 below.

Table 5.2 Average Upgrade Cost Per Low Point

Catchment	Number of Low Points	Average Cost Per Low Point
RUSC	35	$89,000
GREY	2	$83,000*
HOPK	16	$77,000
MORT	27	$61,000
WATC	19	$57,000

Table 5.2 Average Upgrade Cost Per Low Point (cont.)

Catchment	Number of Low Points	Average Cost Per Low Point
LPER	3	$35,000*
JAPA	13	$33,000
OUTL	24	$28,000
SIMP	26	$25,000
MERR	26	$25,000
RACE	10	$18,000

* Less than 10 low points in catchment

The cost of drainage works was also estimated for "existing conditions" rate of runoff. These estimates enable quantification of the additional cost of drainage works due to urban consolidation. The cost of drainage works for "existing conditions" rates of runoff are tabulated below (Table 5.3).

Table 5.3 Cost for Recommended Drainage Works by Catchment – Existing Conditions

Catchment	Low Priority	Medium Priority	High Priority	Cost of Recommended Works
RUSC	$710,000	$220,000	$780,000	$1,170,000
MORT	$180,000	$710,000	$55,000	$945,000
WATC	$263,000	$365,000	-	$628,000
HOPK	$380,000	$135,000	-	$515,000
OUTL	$195,000	$105,000	$200,000	$500,000
MERR	$270,000	$80,000	$50,000	$400,000
JAPA	$165,000	$35,000	$125,000	$325,000
SIMP	$135,000	$75,000	-	$210,000
GREY	-	$140,000	-	$140,000
LPER	$20,000	$30,000	-	$50,000
RACE	$20,000	$25,000	-	$45,000
Total	**$2,375,000**	**$2,120,000**	**$1,210,000**	**$5,705,000**

4.3.2 Major Works

Upgrade works consisting of costs greater than $100,000 for a single location have been identified as major works. Table 5.4 lists the catchments and the number of major works required within that catchment.

Table 5.4 Major Works Required – Future Conditions

Catchment	Number of Major Works	Highest Single Upgrade Cost	Low Point	Location
RUSC	11	$670,000	124	78 Laverock Rd.
HOPK	5	$370,000	38	91 Bostock St.
MORT	3	$550,000	89	Intersection of Couch St & Whites Rd.
SIMP	2	$115,000	42	Between 7 & 9 Thompson St.
WATC	2	$230,000	154	8 Fitzroy St.
MERR	1	$175,000	185	Opposite 52 Younger St.
OUTL	1	$190,000	6	14 Dorson Way
LPER	0	($85,000)	65	1 Worland Gr.
RACE	0	($95,000)	82	End of Netherfield Ct.
GREY	0	($90,000)	66	Between 5 & 7 Redford St.
JAPA	2*	$245,000	62	Intersection of Japan & Latrobe St.

* Excludes cost of tunnel upgrade

From the information provided in Tables 5.1 to 5.4 it can be seen that the Russell Creek Catchment requires the most drainage works. The catchment has the highest number of identified low points, the highest average cost per low point, the highest total upgrade costs and the highest number of major works (single upgrade of $100,000 or more).

The Mortlake Road Catchment the second highest number of identified low points and hence the second highest total upgrade costs. The catchment also has the third highest average cost per low point and third highest number of major works required.

The Hopkins River Catchment also appears high in the Tables for the amount and cost of works required. The catchment has the third highest total upgrade costs and average cost per low point as well as the third highest number of major works required.

The above three mentioned catchments require the most upgrades followed by the Watson Street Catchment. The remaining eight catchments have lesser costs involved with upgrade works.

The figures representing the Japan Street Catchment do not reflect the major works required to upgrade the capacity of the tunnel. At present the tunnel does not have the capacity to cater for the present 5 year flows. To increase its capacity to cater for ultimate development 100 year flows (proposed design standard) a 2700 mm pipe is required. It is recommended that Warrnambool City Council investigate this problem further, possibly with an options investigation for the upgrade works. This may find an alternative to piping these flows, which will be a very expensive exercise with a cost likely to be in excess of $1 million.

5 Soak Pits

5.1 Summary

This section aims to identify the benefits and limitations of 'soak pits' as part of a drainage network in view of the Warrnambool Drainage Strategy. This section draws on information regarding the existing 'soak pits' in Warrnambool, current research on on-site stormwater detention systems and also on experiences of other Councils in their design, use and maintenance.

Generally, 'soak pits' are a viable drainage asset providing the soil conditions and 'soak pit' design are taken into consideration for correct operation.

5.2 Background

Warrnambool City Council (WCC) already has over 80 soak pits installed in a variety of locations in Warrnambool. The existing pits are of various designs. The individual pits are also constructed of different materials. The more standard soak pits are constructed of concrete or asbestos cement pipes stacked on end with a pervious base.

Currently there is no regular maintenance of the soak pits, consequently there have been blockages and flooding caused by sediment, organic matter and litter build up in the pits. One noted agent causing many blockages has been pine needles.

WCC has informed Hyder Consulting that some of the pits in central Warrnambool, indicated on the drawings as 'pengo wells', have previously flooded and are constructed in stratified sandstones. The cause of flooding is unknown but speculation indicates that either general blockages or inadequate design capacity may be one of the causes.

From the base drainage drawings supplied by WCC it is evident that the installed soak pits have been documented at different times with inconsistent naming conventions and graphical representations. It is our first recommendation that a stock take of the existing soak pit structures be documented consistently before further action can be taken based on the findings in this report.

5.3 Technical Overview

5.3.1 Definition

'Soak pits' are an On-site Stormwater Retention (OSR) system that allows for infiltration of the retained water into the ground. The water is collected by way of kerb drains, swales or spoon drains and transported into a permeable pit for infiltration into the soil.

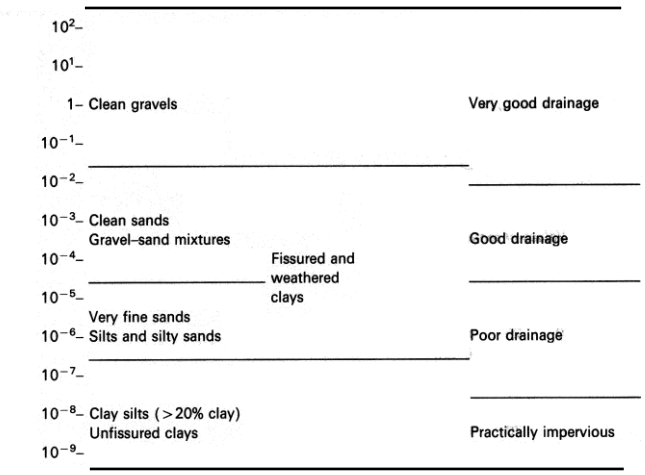
'Soak pits' are also identified by a number of other names that refer to the same structure depending on :

- Soakage pits
- Soak wells
- Leaky wells
- Soakers

Soak pits should not be confused with sub-surface **soakaways**, which are stormwater storage basins often defined as On-site Stormwater Detention (OSD) systems constructed either of crushed rock or a proprietary cellular system such as the Atlantis Matrix cells wrapped in geofabric. The main differences are that 'soak pits' always retain the stormwater in an open storage zone that can be easily accessed and maintained similar to a traditional stormwater pit. Soak pits are always designed for stormwater infiltration into the surrounding soil whereas some soakaways do not allow infiltration but are drained by traditional pipe networks.

5.3.2 Storm Capacity

Soak pits require the right soil conditions for effective operation. It is important that the soil permeability is high enough that a practical number of pits per hectare can be designed to contain the design storm flows.



(Table indicating the permeability coefficient, k (m/s), for various soil types)

As shown in the table, the rate of infiltration quickly drops off for less permeable soils. This rapid decrease in capacity would also apply for soak pits that have been blocked with silt.

5.3.3 Limitations

Soil Types

Soil type is the most important limitation with the capacity of the pits being greatly reduced in less favourable soils. Not only is the infiltration rate reduced but the soil fines also quickly clog up the geofabric from within and from without after stormwater subsidence.

Litter and Pollution

Not only is siltation a cause of blockages but gross pollutants also reduce the pit capacities and can block the larger perforations in the pit structure. Chemical pollutants may also be washed into 'soak pits' and can have a harmful effect on groundwater, especially where artesian bores are used for domestic water supplies. Many soak pits can be used in conjunction with a range of pollution control devices from simple trash racks to more complex pollutant filters such as the CDS Technologies screening units.

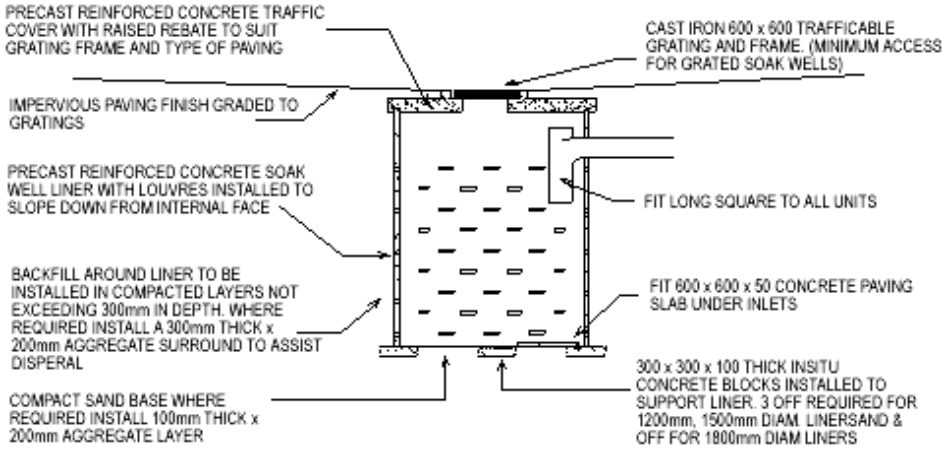
Location

Soak pits may be an effective surface drainage solution in a particular location but if the groundwater is raised too high it may resurface elsewhere causing waterlogging in downstream areas. Waterlogging or ground subsidence may also be a problem if soak pits are placed too near building foundations. Any settling or migration of the soil can cause instability of large structures.

5.3.4 Design

Traditionally, soak pits for areas less than 100 m^2 have been built as square or circular pits. The pits can be built as either stand-alone structures or combined with a soakaway to increase the capacity in low permeability soils.

In Australia soak pits currently on the market are mostly circular in shape and range between 900 and 1800 mm in diameter and up to 1800 mm deep with perforated walls. The soak pit base is filled with a synthetic filtration matrix layer or a crushed rock layer wrapped in geofabric. The entire pit is also wrapped in geofabric to prevent soil migrating into the pit. A typical soak pit installation is shown below.



(Typical 'soak pit' installation, Anthony Serek, On-site Stormwater Disposal Systems)

The pits can be installed in a number of ways depending upon the soil type, location and stormwater quality. Where soak pits are the main form of stormwater drainage in an area they are usually installed as regular side entry pits or grated pits. The pits can also be connected by pipes in a network to allow for minor flooding if they become clogged with silt and litter. If the topography does easily permit free drainage of stormwater, the use of a soakaway may also be considered.

Some sizing methods currently in use by local authorities developing land are as follows:

- Ca / 60 = Effective Volume (m^3)
- Ca x 0.0122 = Effective Volume (m^3)
- Ca / 80 = Effective Volume (m^3)

(Provided by Anthony Serek, On-site Stormwater Disposal Systems)

Where Ca, is the catchment area and the criterion approximate pit volumes for a 1 in 20 yr storm and 5 minute duration storm. These methods will vary depending on the area and what soil types exist. It should also be noted that sizing for commercial projects will also differ to accommodate a 1 in 100 yr storm.

The Australian Standards do not as yet have a section specifically applying to soak pits (referred to as 'soakers' by Standards Australia clause 3.8, AS3500.3.2) although they have formulated a section on On-site Stormwater Detention (OSD) systems. The standards do not cover the calculation methods for working out capacities and tend to apply more to soakaways. Though some of the more general considerations are accounted for here and can be compared with current or future 'soak pit' designs.

5.3.5 Existing Usage

Because soak pits require favourable soil conditions the number of Councils that can utilise them is limited. The limited use is also due to accepted traditional drainage practices, which rely on a piped drainage network transporting water away as quickly as possible.

Currently in Australia the largest number of soak pits installed are in Western Australia. Many areas have clean sandy soils with exceptional permeability rates. Soak pits also have a significant effect on the water supply of many towns in Western Australia where bore water is a common source of supply and the recharging of groundwater is important in maintaining the groundwater levels.

Of the West Australian Councils contacted regarding their soak pits, Kwinana City Council has installed over 6000 pits in the last 10 years, being one of the more experienced Councils in their use and maintenance. They have standard sized soak pits 1800 mm in diameter by 1800 mm deep.

Kwinana City Council have also developed a consistent maintenance schedule whereby the pits are vacuumed twice a year. Once in April and once in October, which corresponds with just before the wet season and just after. They have been happy with the performance of their 'soak pits' and currently some have been in continuous operation without upgrade since 1992.

An important aspect that permits the system to work with reduced risk of flooding is the provision of a 225 mm pipe network interconnecting the 'soak pits'. During periods of heavy rain and clogged pits the minimum cover pipes give adequate protection against flooding without requiring an entire network to be designed

Perth City Council has a large number of soak pits in operation although many are older than in Kwinana and there is no regular maintenance organised. On average they have 73 pits per hectare and also provide an overflow pipe network.

Melville City Council provide every residential and commercial block with a soak pit. Roads, carparks and other public land is drained separately to soak wells or retention basins. Cleaning of soak pits is the responsibility of landowners and due to the large number of soak pits in Melville and surrounding areas, cleaning services are offered as cheap as a flat rate of $24 per pit for an inspection and cleaning with a $14 per cubic metre dumping charge. From Council experience this averages out at about $27 per soak pit.

Due to the suitable soil conditions in the coastal plains areas in Western Australia, many Councils prohibit private landholders from discharging stormwater into the Council drainage network and instead require that all excess run-off must be retained in on-site retention systems.

Mornington Peninsula Shire Council also uses soakage pits extensively, and have developed and updated the design and sizing criteria for such pits based on their experience.

A copy of the Council Standard Drawings MP221 Sheets 1 and 2, issued in July 2002, are included in this section for reference.

5.3.6 Maintenance and Cleaning

The maintenance and cleaning of soak pits is consistently the one factor that stands out when considering the cost of using 'soak pits' versus traditional drainage. It has been established that for effective operation of the 'soak pits' they must be cleaned annually at least twice and possibly more times if sedimentation and litter cause further blockages.

Cleaning is done using eduction trucks that vacuum sediment and litter from within the well. Currently Councils that have a regular maintenance schedule for their soak pits, use a contractor to periodically go through and clean every pit. It may also be economical to use street sweeping trucks with a vacuum tube fitted to carry out the same job when not being used on the street. As long as the pits have been designed to provide easy access and they use a gross pollutant trap, cleaning can be reduced to half an hour per pit.

As many of the more modern pits have not been in service beyond their lifespan there is limited experience in upgrading of soak pits. Generally all that is required is replacement of the permeable base and the geofabric used to enclose the gravel or other permeable base material. In areas with higher silt levels, hence less permeable soils, it may also be necessary to replace the geofabric used to wrap the pit. It is important to maintain all percolation channels or risk losing capacity in the soak pit.

The cost of maintenance and upgrading of pits needs to be allowed for in Council budgets, to ensure ongoing effective operation of the soakage pit system.

5.4 Conclusion and Recommendations

5.4.1 General

From the research carried out in this report it has been shown that 'soak pits' are a viable drainage asset providing the soil conditions and 'soak pit' design are taken into consideration for correct operation.

It is important that the soak pits are managed as a part of the whole drainage network and maintained accordingly. 'Soak pits' require more frequent but less expensive cleaning provided they have been designed with easy access and easily maintained impervious bases.

5.4.2 Recommendations

In view of the Warrnambool Drainage Strategy and the existing soak pits, it is generally recommended that they be retained as part of the drainage network to provide necessary capacity where the pipe network cannot due to existing topography or the cost of upgrading to a larger underground pipe network. A number of more detailed recommendations that will help enable the Council to retain their soak pits have been identified below.

Due to the topography of Warrnambool, it would be expensive to replace the soak pits with a continuous drainage network.

Our first recommendation, which should be carried before any others, is that a stock-take be made of all existing soak pit structures and documented consistently to clearly identify how the following recommendations impact Warrnambool as a whole.

Further detailed recommendations in order of consideration:

1 Carry out soil tests to determine suitability and capacity of pits. It may not be necessary to test every soak pit to determine its capacity. Testing may be able to be limited to 5 or 6 locations so that a representative sample can be obtained. Testing of soak pit where failure may cause property damage should also be evaluated.

2 Confirm that existing soak pit locations are suitable in regards to the effect on downstream groundwater tables and possible flooding.

3 Upgrade of poorly designed and under capacity 'soak pits' or those that have been found to be in unsuitable locations.

4 Planning and implementation of a regular maintenance and cleaning program for the soak pits. This should take into consideration the likes of soil types, local pollutants, flood risk analysis and cleaning costs.

5 Closer monitoring of litter and sedimentation in the soak pits and considering how the impact may be reduced through use of silt/litter traps or other screening devices.

6 Develop a standard method of sizing and construction for soakage pits most suitable for the Council area for future adoption.

6 Wetlands

6.1 Introduction

As part of the investigations associated with the preparation of the Drainage Strategy, Hyder Consulting Pty Limited (Hyder) has been engaged by Warrnambool City Council (WCC) to provide a technical feasibility study into the possibility of providing a retarding basin and wetland system in the Racecourse area. Such a facility would allow water to be harvested and used for irrigation of the Racecourse.

In terms of stormwater management, the wetland and retarding basin system would support the Councils commitment to the adoption of Water Sensitive Urban Design (WSUD) with the following benefits:

- Protect and enhance natural water systems within urban developments
- Integrate stormwater as part of the landscape by creating visual and recreational amenities such as wetlands.
- Improve the quality of stormwater on the receiving environment.
- Reduction of peak flows by local detention measures
- Minimisation of drainage infrastructure costs, especially the upgrading of existing infrastructure and maintenance of “end of pipe” stormwater control

The following sections review the current stormwater system in the vicinity of the Racecourse, present options for use of the Racecourse site, the impact of proposed works on the downstream drainage systems and the cost of proposed works.

6.2 Racecourse Site

As described on the Warrnambool racing Club web site, the Racecourse is situated on the eastern outskirts of the city and is “set in a valley surrounded by low hills”.

The Racecourse occupies about 40 hectares including the Brierley and Granters Paddocks that are used during steeplechases. The site is generally bounded by Moore Street, Tozer Road, McGregors Road and Grafton Road.

The use of the site and extent of development, including grandstands, carparks, marquee areas and the steeplechase course, means that the only available area for construction of a retarding basin and wetland system would be in the centre of the race track area.

The available area for construction of works could be as much as 10 to 12 hectares approximately, depending on the Racing Club's future development requirements for this site in the centre of their racecourse.

The benefits to the Racing Club would include the availability of water from the wetland to be used for irrigation and the beautification of the centre of the course. The course currently uses about $50,000 worth of potable water annually for irrigation purposes.

6.3 Drainage System and Catchments

The existing Council stormwater system to the south of the Racecourse generally drains away from the Site and south to the Simpson Street tunnel that leads to a discharge location in the Hopkins River.

The catchment to the east of the Racecourse drains to an existing open channel along the western side of Tozer Road. This drain heads north along Tozer Road then along the south side of Moore Street to a 1200mm dia. culvert under Moore Street and thence to Russell Creek.

To the west of the Racecourse, Council drains in Grafton Road head along Park Street into the site and the open drains which currently cross the site and outlet to the north into the Russell Creek catchment.

The levels and locations of the existing drains in this area mean that there are only two sub-catchments to the east, plus the existing drainage from the Grafton Road area which could be directed to a wetlands on the site for treatment and storage. These catchments are shown on the Wetland Concept Plan drawing WSK001 included in Volume 2 of this Report.

Catchment A, which is currently part of the Simpson Street catchment, has an area of approximately 14.7 hectares and would require the construction of a new connecting drain to transfer the stormwater to the Racecourse site. This pipe could be constructed in the existing reserve that is the extension of Tozer Road and would be at least a 900mm dia in size.

The second catchment (Catchment B) currently discharges to the top end of the existing open drain in the Russell Creek catchment along the western side of Tozer Road and has an area of approximately 17.6 hectares. The discharge location is at the eastern corner of the Racecourse site and would allow the combining of the two catchments for direction into a Wetlands facility in the centre of the track.

This would provide a total catchment area for treatment and water harvesting of 32.3 hectares, excluding any discharge from the Grafton Street drainage system.

There are two areas to the north (19.7 ha) and north east (20.8 ha) of Catchment B that have been identified by Council for future development. The flows from these two developments would be directed to the proposed wetland. The existing 750 mm dia. pipe at the north end of Catchment B

has sufficient capacity to take the flows from the 19.7 ha catchment to the north under existing conditions. For future conditions it is recommended that the developer of the land be required to install a retarding basin to maintain the flow rate from the development so as to not cause downstream flooding. The 20.8 ha area to the north east of Catchment B currently has no outlet. This area would require a 750 mm dia. outlet. The outlet pipe would be brought down the eastern edge of Catchments A and B and brought into the wetland via the proposed diversion pipe for Catchment A. This would avoid upgrading existing pipes through the backyard of residential lots. The two proposed development sites would add an additional 770 litres per second and 850 litres per second to the flows going to the wetland.

Based on a mean annual rainfall for Warrnambool of 740mm and a coefficient of runoff of 0.40, the average annual flow into the wetlands from these two catchments (excluding the future development areas) would be approximately 95 megalitres, and the inflow rate would be about 2,800 litres per second for 5 year ARI rainfall intensities.

The total flow to the wetland including the future development sites (providing flows are retarded) would be 4,400 litres per second for 5 year ARI rainfall intensities. The preliminary wetland design has been based on the existing drainage network, an allowance for future development may need to be incorporated at detailed design stage.

The drainage system downstream of the Racecourse is to the Russell Creek catchment and the controlling feature is currently the existing 1200mm dia culvert across Moore Street. The invert level of this culvert, from Council information, is approximately RL 8.29m.

The invert level of the discharge pipe from Catchment B is RL 13.5m approximately and from Catchment A is RL 12.93m. The existing surface level in the centre of the tracks is approximately RL 12m.

These levels indicate that it should be possible hydraulically to construct a Wetlands facility in the centre of the tracks. This will need to be confirmed by a detailed investigation and design, so that such factors as pipe size and grade, existing surface and track levels and downstream capacity can be properly considered.

It should be noted that, on the basis of the assessment carried out by Hyder Consulting in this report, there will not be any cost benefits arising from the diversion of some of the drainage flows from the Simpson Street catchment, as the system is generally adequate. Depending on the detention storage adopted as part of the Wetlands, there should not be any adverse effects on the Russell Creek catchment.

6.4 Wetlands Design

With the drainage catchments described above, a preliminary sizing for the possible Wetlands has been undertaken, based on current Melbourne Water design guidelines.

From the Melbourne Water Design Guidelines, a surface area for the Wetlands of approximately 2% of the total contributing catchment area would provide treatment to achieve the Stormwater Treatment Objectives relating to reductions in suspended solids, total phosphorous and total nitrogen.

For the total catchment area of 32.3 hectares, a Wetlands facility with a surface area of about 6,500 square metres (0.65 hectares) would be necessary. A larger surface area will provide increasing pollution retention.

The surface area adopted will depend on the detention time for stormwater flows, depth of ephemeral storage above normal top water level, the amount of storage required to meet the Racecourse irrigation requirements and detention requirements to prevent adverse effects on the Russell Creek Catchment.

The normal top water level for the Wetlands would need to be approximately RL 11.0, to allow for a 450mm depth of ephemeral storage and some freeboard.

Also required, as part of the treatment train associated with the Wetlands, will be a primary sedimentation pond and a carbon and litter trap.

In view of the possible limitations and unresolved issues concerning the proposal for a Wetlands at this site, it is recommended that a detailed investigation, including preparation of concept design options and costings be undertaken to confirm the scope of works and costs.

These issues include the site levels, existing and proposed use and development of the site, unknown ground conditions, Racecourse water requirements, extent of catchments to be directed to the Wetlands, pipe size and grading and restrictions on the outlet to the Russell Creek Catchment.

Such an investigation should also consider the future operation and maintenance of the Wetlands.

7 Stormwater Reduction Methods

7.1 Water Sensitive Urban Design

With the limited supply of water resources, many local authorities are becoming increasingly aware of the need for sustainable urban drainage. One method of adapting sustainable urban drainage is to implement Water Sensitive Urban Design (WSUD).

The application of WSUD aims to achieve sustainability by conserving, protecting and recharging waterway systems. Not only does the WSUD hope to protect those waterways receiving stormwater discharge, but encourages the recycling or reuse of stormwater.

According to the Senate Inquiry into Urban Water Management, only 3% of stormwater is directly reused (Hunt, 2002). By applying some of the WSUD strategies, this volume can further be increased. In terms of stormwater management, the WSUD seeks the following:

- Protect and enhance natural water systems within urban developments
- Integrate stormwater as part of the landscape by creating visual and recreational amenities such as wetlands.
- Improve the quality of stormwater on the receiving environment.
- Minimising impervious areas and reduction of peak flows by local detention measures
- Minimisation of drainage infrastructure costs, especially the maintenance of “end of pipe” stormwater controls.

WSUD Techniques

WSUD techniques can be adapted to existing urban settings as well as for future developments. The techniques can be adapted by the local government as well as by the community.

Encouraging community participation may help assist in alleviating costs incurred by the local authority. For example, if residents were encouraged to purchase rainwater tanks, not only would there be a decrease of stormwater run off entering the system (alleviating the need for capital works on current drainage systems), but provide a saving on water supply. This stormwater could be used for garden irrigation, toilet flushing etc. Such an approach would benefit the local authority as well as the ratepayer, as water consumption costs would be reduced.

Community based programs such as Waterwatch, which is a nationally based water quality monitoring program, may provide helpful information in assisting the local authorities with information such as the condition of a water course.

Implementing detention systems (such as wetlands) not only reduce the capital works costs on the drainage system but are also aesthetically pleasing.

A range of WSUD techniques which may be applied include (but are not limited to):

- Grassed or vegetated swales – to provide primary treatment and secondary treatment benefits
- Filtration tanks - to provide primary treatment, detention, retention and secondary treatment benefits
- Bio-retention systems – to provide secondary treatment, detention and retention (through infiltration) as well as tertiary treatment benefits
- Wetlands- to provide tertiary treatment, storage and detention. In addition, it may provide possible reuse of the stormwater.
- Rainwater tanks - this technique not only provides retention and detention, but may be suitable for stormwater reuse in garden irrigation, car washing etc.
- Urban forests, rooftop greening and rain gardens – provide filtration of stormwater as well and aesthetic value.

7.2 Technology & Techniques

Technology and techniques play a vital part in stormwater management, and the right technological tool applied today, can reduce future capital work costs. Stormwater management should consider impervious areas, and the effectiveness to collect stormwater from these areas.

Stormwater reuse can be beneficial in various ways. Not only does it encourage water preservation it also reduces the volume of water entering the stormwater system. As a result, there would be a decrease in localised flooding.

Recent studies (depending on catchment characteristics) indicate that up to 65% of potable water supply can be saved per annum by the installation of rainwater tanks on houses and urban developments (*Coombes, Kuczera, University of Newcastle*). Most of the rainwater collected is relatively clean, as it is collected prior to running off in the kerbside. This water may be used for toilet flushing, laundry, garden irrigation and hotwater systems.

Over a 20 year time frame, the peak flow of stormwater in catchments can be reduced by 20% with the provision of rainwater tanks. In some catchments this is reduced by 40% (*Coombes, Kuczera, University of Newcastle*). The proposal of compulsory detention tanks on new and existing residents (of say over a 5 year period) could prove to be beneficial.

WCC may be able to implement a strategy of offering home owners to purchase rainwater tanks. Currently Barwon Water is offering their

customers to purchase rainwater tanks ranging from 6500-4,500 L. Prices start at $650.00 and installation is included. Currently, the Barwon Water region estimates that 120,000 L of rainwater runoff is discharged directly into the stormwater system (Barwon Water website).

New technological approaches should aim to minimise the impacts of development on the water cycle and maximise the benefits of the stormwater system. These approaches should ensure a minimum practical net increase in adverse materials such as sediments, nutrients, bacteria, and rubbish to local waterways and receiving waters. The approaches will also reduce the risk of algal blooms and increase biodiversity within waterways.

Some approaches, which may be implemented, include:

- The evaluation, design and construction of gross pollutant traps, wetlands and ponds, bioretention systems, and grassed swales to alleviate the intensity and peak flow.
- Establish standard design guides and standard drawings. These could include standards for infiltration systems, bioretention systems, grassed swales, rainwater tanks and road treatments (eg. flush kerbs)
- Establish policy drivers and legislation to encourage WSUD
- Evaluate the performance and economics of stormwater recycling
- In conjunction with developers/Council purchasers to implement examples of stormwater recycling at lot, estate and medium density scale.
- Incorporating WSUD best practices on medium density and high density estates
- Incorporating WSUD best practices in car parks such as incorporating porous paving
- Incorporating WSUD best practices on new subdivisions including water reuse, natural linkages, water efficient fixtures and settings.
- Review Council's policies and suggest amendments to create strong drivers for stormwater recycling.
- Regulatory review eg. imposing restrictions and licensing

Any new policy or design implemented should be monitored to check its effectiveness. In some cases such as the introduction of wetlands and grass swales, it not may be feasible, as sufficient land is required for their construction. Optimum design and management strategies need to be investigated.

7.3 Implementation

The implementation of best stormwater management practices requires education, liaison with various groups and access to funding.

7.3.1 Education

Educating the community and local industries is an important step to implementing a successful stormwater management strategy. Often, community members are ill-informed on projects and sometimes the media can 'kill-off' a project.

In the past, stormwater has been addressed as a hindrance rather than a valuable resource. Stormwater should be viewed as part of the dynamics of the water cycle and be treated as one grade of water available to the community.

It is important that the community is made aware of how stormwater reuse and recycling can not only benefit the community but the household. Education campaigns should encourage community awareness and be informative of the benefits of water sensitive and sustainable practices.

Education should not only be extended to members of the community, but should be addressed to developers, thus encouraging new initiative designs beneficial to stormwater management.

Education hopes to achieve the following goals:

- Increase public awareness of maintaining indigenous vegetation, and improvement of water quality on receiving water-courses and on detention systems (such as wetland).
- Encourage community participation on stormwater management such as community water monitoring programs.
- Foster a new attitude that values stormwater as a resource and commodity.
- Encourage stormwater recycling and reuse at the lot eg by implementing rainwater tanks and encouraging households to maintain these practices.

With the emphasis of viewing stormwater as a resource and a better understanding of stormwater management, the implementation of drainage contribution schemes may possibly be achieved.

Education can be achieved by the following implementations:

- Provide newsletters, seminars, brochures and educational tool kits within the community.
- Organise workshops and conferences with major developers, industry group leaders, influential stakeholders and planners.
- Provide information through websites and media such as local newspapers and television.
- Provide conferences between members of the community, developers, Council members and local conservation groups.

- Publicise case studies focusing on practices implemented by other local authorities including drainage contribution techniques and examples of stormwater recycling.
- Establish a WSUD design award to encourage members of the community and developers to provide strategic stormwater measures.
- Consult households about the acceptability of stormwater reuse and contribution.
- Gather social and economic information on local consumers needs and wants with respect to WSUD techniques.
- Investigate opportunities for new fee structure and positive publicity.
- Provide surveys to ratepayers. Topics which may be addressed, include the importance of stormwater management and the willingness to contribute to a drainage levy.
- Provide financial incentives to invest in reuse opportunities. This should not stop at large user level, but be available to household schemes.

7.3.2 Liaising Parties

Assistance from other government and private bodies may also assist in stormwater management practices. External assistance may provide an insight to current design and standards implemented elsewhere, as well as providing financial assistance.

Conjunction with Water Authority

If WCC aims to perceive stormwater as a valuable resource, it needs to work in conjunction with Warrnambool's major water resource provider, ie South West Water (SWW). Together, both parties may be able to design and implement a WSUD strategy for perhaps new subdivisions or incorporate new techniques on existing estates.

One example where both the local authority and water resource provider worked in conjunction with each other is the Lynbrook Estate project (LEP). Located 35 km south-east of Melbourne, the LEP was a result of collaboration between the City of Casey (local authority), Melbourne Water, the Urban and Regional Land Corporation (developer) and their sub-consultants as well as the Cooperative Research Centre for Catchment Hydrology for performance monitoring.

The project consisted of water sensitive urban design features implemented to curtail the impact on the receiving waters from the new development. The project aimed to reduce the pollutant loads of nitrogen, suspended solids, heavy metals and phosphorus entering Port Phillip Bay and local waterways.

The estate features runoff collection from roof and roads, which is captured into vegetated buffer strips above gravel-filled conveyance trenches at the local streetscape level. A central boulevard connected to the local street swales discharges stormwater into a landscape medium strip, which further treats the stormwater. This forms part of the bioretention system and is incorporated into a standard road width of 16m with a one-way cross fall. This alleviates the need for kerbs, gutters or side entry-pits.

Wetlands constructed downstream of the bioretention system provide final tertiary treatment. The stormwater is then discharged into an ornamental lake before entering a local waterway. A 7.5-hectare Town Park and remnant River Red Gums are irrigated from treated stormwater harvested from the lake via a gravity-fed infiltration trench.

The results of this sensitive urban design has reduced stormwater pollutant loads by 80% for total phosphorous (TP), 90% for total suspended solids (TSS) and 60% for total nitrogen (TN).

Melbourne Water is currently assisting 32 local governments in developing Municipal Stormwater Management Plans. Such a system could be implemented between WCC and SWW.

As previously mentioned in section 3.2, Barwon Water is currently offering their customers to purchase rainwater tanks for stormwater reuse. WCC may encourage SWW to devise a similar scheme between the Council and water authority. Both parties may be able to provide incentives for ratepayers to encourage purchases.

Government Bodies and Universities

State and Federal governments may offer great assistance with not only funding, but can help reform current legislation. Legislation may include the implementation of drainage contribution from rate payers as well as implement new reforms to current drainage design practices.

Government agencies such as Department of Natural Resources (DNRE), CSIRO and universities can provide research, evaluation, performance and economics of stormwater management practices and reuse. These parties may be able to research items such as market acceptance, stormwater recycling at lot scale, design costs, construction costs, maintenance needs, views of residents etc.

Developers

High profile developers such as Delfin and the Urban and Regional Land Corporation are showing interest in working in conjunction with local authorities incorporating WSUD techniques. Not only can developers assist in funding, but can assist in drainage scheme designs. Developers can also provide positive media on projects through their websites, television, articles etc.

Although developers may be able to contribute on drainage schemes, their assistance is limited. Developers may only assist on new land developments and subdivisions, as the incentives on these projects are greater than that on existing estates.

8 Drainage Contribution Strategy Study

8.1 Introduction

Hyder Consulting Pty Limited (Hyder) has been engaged by Warrnambool City Council (WCC) to provide an appraisal with current industry thinking and practices in regards to stormwater contribution. It is understood that WCC wish to introduce a drainage levy within its municipality and require the substantiation of a model to current stormwater industry practices.

This section will also look at some case study examples including strategies implemented by City of Maribyrnong (VIC), Hornsby Shire Council (NSW), and City of Glen Eira (VIC).

The importance of stormwater management is becoming quite significant with the increase of urbanisation. Not only does WCC have to consider current development growth, but additionally must consider the cost of upgrading existing stormwater systems. At present, current funding of such systems has been raised from the Council's budget via the assistance of ratepayers.

It is not always feasible for WCC to fund stormwater management systems, as revenue raised may fall short of infrastructure costs. WCC wish to propose the introduction of a drainage contribution scheme, which would allow ratepayers to contribute to stormwater management.

Before any scheme can be implemented it is important to investigate current practises executed by local authorities within Australia. It must be noted that although some of the local authorities have different environmental and climatic conditions (resulting in different stormwater practices), the basic principles can still be applied.

8.1.1 Funding

Funding is the most important element of implementing a project, as without finances, projects cannot proceed. Independent revenue should be considered to ensure that on-going funding will always be available eliminating the uncertainty of politically driven grant schemes.

Funding may be obtainable from various sources including:

- The private sector – for land development projects provided there is significant benefit from a proposed initiative such as a high profile WSUD scheme.
- Government subsidies – both state and federal
- Assistance from the water authority
- Introduction of a drainage contribution or "stormwater levy" scheme.

Drainage Contribution

Introduction of Drainage Contributions or a “stormwater levy” by rate payers may be the way into future stormwater management funding for WCC. Currently, this is quite a sensitive topic amongst ratepayers but one that needs addressing.

Local authorities such as the City of Maribyrnong (VIC), Hornsby Shire Council (NSW) and the City of Glen Eira (VIC) are investigating ways in which to incorporate this type of funding into their Councils.

From the case studies investigated, each local authority had to justify the need to charge a levy. In most cases, a levy was charged for a particular project, such as capital works on a wetland development or drainage infrastructure. In some cases the levy has a sun-set period, in other cases it is on-going.

To implement the strategy, one must address the need for such a scheme. It may be the case where an upgrade of a drainage network is required in order to prevent further flooding on a particular catchment. It could also be the case where water pollution on a particular water course (caused by stormwater discharge) may need attention. An environmental or drainage levy may be introduced in this case.

It would be unfair to ratepayers to charge a levy simply as a way to gain more revenue. WCC would need to address to ratepayers the cause or reason for such a scheme. An adequate case should be put forward by the Council and should be supported by evidence such as recent studies, extracts from findings as well as the importance for the works required.

In order for a drainage contribution scheme to be successful, the system must be fair and cater to the community needs in terms of stormwater management. It would be unfair for example, to charge a flat rate so that a pensioner is paying the same contribution as an industrial property. Community consultation is also required to ensure that any contribution levy implemented will solely fund stormwater projects and not be re-directed on other projects such as roads or streetscape. It is also important to charge a levy only on those community members who will benefit from the capital works. For example, consider catchment areas X and Y. If catchment X has a deficient drainage problem and catchment Y has none, then only catchment area X should be charged the levy as this is the only catchment area that will benefit from the works.

One system, which may prove to be fair, is by making the levy proportional to impervious surfaces per lot . For example lots which have multi-dwellings, such as a unit development, and therefore more impervious area, should pay a higher portion of the levy then those lots with a greater pervious area.

The municipality may implement impervious surface maps in order to determine which catchment area/s causes the greatest concern. This may be achieved by using specialised GIS programs and digital aerial photography.

Similarly if a wetland is implemented in a particular area which may perhaps be aesthetically pleasing to a particular estate, then only those members of the community should be charged a higher portion of the levy. The idea of constructing or beautifying existing wetlands would prove to be greatly beneficial. The wetlands may effectively prevent or decrease flooding, and perhaps increase the property value of surrounding properties.

In order to implement the strategy, the community must be fully aware of the Council's intentions. Positive media and articles will assist in informing community members and gaining their support. This can be achieved by posting newsletters, reports, broad sheets etc to those households that will be affected. It is important to include extracts from legislation, maps of the areas affected, diagrams or photos (as they are proven to be effective in getting the point across) and a easily understandable description of the proposed project when informing households . It is also important to have the text printed in more than one language to assist those of non-English speaking backgrounds.

It is also important to obtain feed back from the community, so they may offer their own opinions and suggestions. Public meetings are vital, and would assist in gaining community acceptance. Other parties may also be invited to attend meetings such as local environmental groups (eg Landcare Australia), members of building and infrastructure associations (eg Master Builders Association) etc. These parties may be able to offer support and assistance in informing community members as well as providing feedback and suggestions to the Council.

The introduction of a levy may or may not necessarily have a sunset period. It is recommended that the levy be introduced to fund a particular project and reviewed at a pro-rata basis (eg every 3 years). If the project is complete and further funding is not required, it is suggested to reduce or extinguish the levy.

8.2 Case Studies

Drainage contribution schemes and/or techniques have been implemented through various municipalities throughout Australia. This section will provide an insight on how the City of Maribyrnong, Hornsby Shire Council and City of Glen Eira implemented their projects.

8.2.1 City of Maribyrnong

The City of Maribyrnong is located a few kilometres west of Melbourne's central business district and covers a range of suburbs including, Braybrook, Footscray, Kingsville, Maribyrnong, Maidstone, Seddon, Tottenham, West Footscray and Yarraville.

In 1998, Hyder Consulting was engaged to conduct a drainage strategy of the entire municipality. The study included identifying the deficiencies in their drainage system and developing a capital works program to alleviate the problem.

The study found that the two regions with the most drainage problems were Braybrook and Maidstone. To help assist in funding for works, a drainage contribution levy was implemented to ratepayers of these two suburbs. Residents are charged the additional levy in portion to the works carried out within their boundary.

The drainage levy was prepared and introduced in accordance with Part 3B of the Planning and Environment Act 1987. The Council implemented Development Contribution Plans (DCP) which incorporates municipal planning for each component of infrastructure including drainage, traffic etc. The drainage levy was introduced as part of the Drainage DCP and is reviewed every 3 years. In accordance to legislation, the levy is only implemented on those catchments that require works.

The project initially targeted community members by posting A3 broad sheets and copies of the Council's strategic report. These were posted to all residents and commercial and industrial occupiers effected by the levy. Community members such as environmental groups and bodies like the MBA were also informed of the project.

The Council's report included the planning scheme documentation and addressed the problems with the current stormwater infrastructure. The report outlined the proposed capital works and its costs. Diagrams, photos and maps of the areas effected were also presented.

The A3 broad sheet was also distributed with the Council report. This consisted of the following:

- Extracts from the current legislation and its amendments.
- Map of areas within the municipality that have drainage deficiencies
- Descriptions of the proposed projects
- The project descriptions were set in different languages to assist those of non-English speaking backgrounds.

The community as well as environmental groups and various corporate bodies, were invited to attend a panel hearing. The hearing addressed all issues and concerns including the ramifications of implementing the levy due to the urgency of improving the current drainage system.

All parties, including those community members effected by the levy, accepted the proposal and were willing to contribute. The drainage contribution levy is currently implemented within the suburbs of Braybrook and Maidstone.

8.2.2 Hornsby Shire Council

Hornsby Shire Council (HSC) is situated north of Sydney and encompasses land from Epping in the south to Wisemans Ferry and Brooklyn in the north. HSC boasts to be the second largest local government within the Sydney region at 510 square kilometres in area.

Due to environmental degradation on receiving waterways from stormwater discharge, a Catchment Remediation Program was introduced to the Shire. These strategic measures were put in place between 1994-95.

The aim of the strategy was to implement catchment management, research and complete remedial environmental works including the design and construction of:

- Wetlands
- Gross Pollutant Devices
- Leachate control from old landfill sites
- Sediment basins and creek stabilisation / rehabilitation

A Catchment Remediation Rate (CRR) was introduced to help raise funds which identifies specific water quality improvement works, annual maintenance and lifecycle costs for these assets.

The Shire Council required external funding to support the project. The levy was introduced in accordance with section 495 of the NSW Local Government Act, 1993. The revision of the Act entitled HSC to charge ratepayers a specialised rate to be allocated for a specific purpose eg environmental degradation.

The levy initially charged 1.97% of the ordinary rate with was further increased to 5% in 1997. On average, the levy rate amounts to an additional $40.00 per annum from each ratepayer. It is estimated that this will generate approximately an additional $2 million dollars for the 2002/03 financial year (*HSC website:* www.hornsby.nsw.gov.au).

Using various forms of print media, ratepayers were made aware of the catastrophic conditions in local watercourses due to pollution sourced from stormwater discharge.

The print media emphasised the following:

- The decrease of native fish population
- The effects that polluted watercourses have on the community eg recreational (swimming or other water activities)
- The impact on native flora and fauna
- The spread of weeds into bushland areas
- The need to protect the environment for future generations.

The nature of media used to promote the CRR included media coverage, press releases, posting on the HSC website and advertising campaigns. A copy of a typical brochure used by HSC can be found in Appendix A.

Two public meetings were held to address the proposal and any issues concerning the project. Environmental groups were invited to attend the meetings and talk to the community about the importance of environmental remediation. They also assisted in answering any queries that the community had in regards to the project.

The community was made aware that all contribution money would be accounted for and would solely fund the remediation program.

As the Shire is situated in a semi-rural setting, most community members accepted the contribution levy. The ratepayers were willing to contribute to the scheme as they appreciate the importance of conserving the waterways and their surroundings.

The levy was implemented in 1994 and the works are monitored on a regular basis. Professionals such as accountants and engineers have been employed to review the expenditure and monitor its efficiency.

8.2.3 City of Glen Eira

The City of Glen Eira (CGE) is located in Melbourne's inner south-eastern suburbs. Approximately 53,000 households are situated within the municipality that includes the suburbs of Bentleigh, Bentleigh East, Carnegie, Caulfield, Caulfield South, Caulfield North, Caulfield East, Elsternwick, Gardenvale, Glen Huntly, McKinnon, Murrumbeena, Ormond and part of St Kilda East.

The Drainage DCP overlay was introduced to CGE in 1997. This was implemented under the State Planning Policy Framework and the Local Planning Policy Framework, including the Municipal Strategic Statement and local planning policies.

The DCP was applied within the boundaries of the municipality and was divided into 9 development areas. Each development area was formed under the various drainage catchments within the municipality and as such, those areas prone to more drainage problems were charged a higher portion of the levy.

The development areas were divided as such, (1) Elsternwick (ELS); (2) Moorabbin (MOO); (3) Byron Street (BYR); (4) Elster Creek (ECK); (5) Bentleigh (BEN); (6) Murrumbeena (MUR); (7) Grange Road (GRA); (8) Heatherton (HEA); and (9) Shakespeare Grove (SHA).

Those residents exempt from the DCP are :

- Developments which do not require a planning permit ; and
- Single dwellings per lot

Residents who contribute to the DCP are those who live on multi dwelling lots including unit developments and townhouses. The levy is charged per lot for each additional square metre of impervious area, generated by development. This rate is similarly charged for non-residential dwellings.

The contribution levy is adjusted annually at the beginning of the financial year to cover inflation. The current portion charged by the CGE for each development area can be referred to in Appendix B.

It should be noted that the development contributions levied under this policy are only applicable to new developments and not a general levy on all ratepayers.

8.2.4 Impervious Surface Maps

Impervious Surface Maps may be employed by the Council to provide a fair levy system that charges ratepayers in accordance to the impervious area on their lot. Impervious Surface Maps have been developed by Auckland City Council (ACC) (New Zealand) to assist on utility planning, marketing and financial contribution plans.

The technique requires digital aerial photos taken within the municipality. The photos are then loaded into Arcview GIS using remote sensing or heads-up digitising techniques to capture the impervious surface.

Surface analysis can be achieved at different levels between the stormwater catchment area and property. The percentage of impervious surface coverage may therefore be calculated. By using the GIS package and current Council drainage records, properties may be analysed to determine if they are in deficit or excess of their impervious surface allocation.

Site inspections may be undertaken to ensure that the GIS results are accurate. From previous experience at ACC, the inspections revealed that the digital impervious measurements were within 1% accuracy of the site measured results.

The results may be presented graphically on maps or on excel spreadsheets. The output may analyse both the property and catchment area.

8.3 Drainage Contribution Scheme for Warrnambool

The techniques described in Sections 8.1 and 8.2 of this report can be used by WCC to develop and implement a drainage contribution scheme.

The assessment identified that the only two catchments that have major outfall drains are the Japan St and Simpson St catchments. These two catchments are possibly the easiest for which to implement a levy, as the major outfall drains affects all the properties in these two catchments.

Other catchments, such as the Russell Creek catchment, are broken into many sub-catchments, which creates difficulty in implementing an overall levy.

It is therefore recommended that the levy initially be implemented on the Simpson St and Japan St catchments, as it is easiest to execute the strategy on these two catchments. This strategy could provide a basis for a model on implementing levies in the other 9 remaining catchments.

In the case of Warrnambool's drainage infrastructure, many of the catchments, such as the Russell Creek catchment, consist of many sub-catchments. It would not be feasible to charge a levy per sub-catchment, as to identify each individual sub-catchment and implement the levy would be a costly exercise. It is recommended that WCC review these sub-catchments and come up with a strategic plan that would allow ratepayers within these sub-catchments to be charged a levy. In these cases, the Council may wish to charge a levy on multi-dwelling lots, or charge a fee based on impervious area per lot.

Any levy implemented by the Council should be demonstrated to be non-biased and charged fairly. It would be unreasonable to charge a ratepayer who has relatively no drainage problems the same portion of levy as someone with significant drainage issues.

Similarly it would be unjust if a household fitted with a rainwater tank is charged the same portion of the levy as a household without one. The levy should be introduced to fund the works recommended in Hyder's Drainage Strategy report. The Council may provide incentives to encourage households to implement rainwater tanks. WCC may choose to work in conjunction with SWW to offer a reduction on the levy for those dwellings with the tanks.

A levy introduced to the ratepayer should be charged as a percentage increase of the current ordinary Council rate. For example, the Council may wish to provide a rate increase of say between 2-5%. This fee should be charged at the discretion of the Council, depending on budget and feasibility. The levy should only be introduced to those ratepayers who will benefit from the project. If for example the Council decided to upgrade or duplicate the Japan St tunnel as part of the initial drainage works, then only the Japan St catchment ratepayers should be initially charged the levy. Similarly once the project is complete and the works paid for the levy should be reduced or extinguished.

Any levy that will be introduced by the Council will need to be addressed to the ratepayer. It is recommended that an initial letter be sent to each household affected by the levy. The letter should address issues such as valuing stormwater as a resource rather than a hindrance. The letter should also state the current stormwater infrastructure problems and include relevant excerpts from Hyder's report concerning items that need to be adopted, such as proposed works, project stages and costs associated. The letter should also invite the ratepayer to a general meeting where Council members may resolve any queries and concerns.

The letter should be positive and encouraging so as to gain support from the community. The more issues addressed and the more information provided in the letter will help the ratepayer gain a better understanding of the project. A copy of the final Drainage Strategy Report should be accessible to the public, located either at the Council office and/or at the library.

The general meeting is an important step in gaining public support and acceptance. The meeting should emphasise the importance of introducing the levy and provide details of the Council's budget as to why there must be a rate increase. It is recommended to invite members of SWW and other governing bodies to provide support on the project. If it is possible, case studies of other Victorian local governments should be provided to indicate that the scheme has been implemented elsewhere. An invitation to the meeting may be posted on the WCC website as well as in local newspapers.

Media plays an important role in gaining community acceptance. Once the initial letters have been posted, A3 size information sheets and media prints should be sent to all those residents affected by the levy. This could include maps of the catchment including the drainage network with a description of the work required. For example, for those residents in the Japan St catchment, a diagram of the catchment similar to that shown in Volume 2 of this report may be included on the information sheet, illustrating the drainage system and indicating the drains that require works. Extracts from current legislation may be emphasised, particularly with reference to sections from Part 3B of the Planning and Environment Act 1987.

Educational tool kits should also be provided encouraging stormwater reuse in the household. This includes providing information on rainwater tanks and ways in which stormwater discharge can be reduced. This could be included in the A3 blurb or provided as additional information.

Media plays a vital role in "getting the message across" and could prove to be informative and influence ratepayers to gain a positive perspective on the contribution scheme. WCC may advertise or provide interviews for local newspapers as well as posting information on their website. The website and articles should include facts and figures of the proposed drainage projects. The WCC website may invite the community to provide feedback and offer any further suggestions that will initiate the scheme.

As soon as the community is made aware of the proposed drainage contribution scheme, a second meeting between Council members and ratepayers should follow. The purpose of this meeting should allow the community to provide their own comments, opinions and feedback. The more public support gained for the project will allow the introduction of the scheme much easier.

Once the levy has been implemented, it is recommended that the scheme be reviewed annually. Annual reports may be posted on the WCC website, so that the ratepayers are given an indication on the project's status. A copy of the report should also be made available at the Council office and library so that it is accessible to those without Internet access.

The levy should be reviewed annually. If a particular project is coming to a completion (eg upgrade of Japan St tunnel) then the Council may wish to reduce the levy, extinguish it or perhaps use the funds to upgrade another part of the catchment. It must be noted that if the funds are used to upgrade another part of the catchment, then only the ratepayers that will benefit from that upgrade should be charged the levy.

8.4 Recommendations

To summarise, the key steps needed to ensure the successful implementation of a drainage contribution scheme include:

1 Define the stormwater drainage problem. This may be achieved through drainage studies.

2 Define the works required including estimated costs and duration of project.

3 Put the case forward to community members stating the reason for the introduction of the levy. Provide details of the project and ways in which the levy will be introduced.

4 Implement the levy and only introduce it to those members of the community who will benefit from the project.

5 Review the project on a pro-rata basis. The review should consider reducing or extinguishing the levy once the project is complete.

Incorporating some of the WSUD techniques described in Section 7 of this report will assist in reducing environmental degradation and limit the upgrade cost of "pipe-work" infrastructure. Integrating new technologies such as porous paving on car parks will further reduce the volume of stormwater entering the system.

Educating the community is a key step in adopting the levy. The approach to education must be one that will be effective in "getting the message across". This in the long term will prove beneficial, as ratepayer will be more willing to accept the levy.

Liaising with other parties such as the State Government, the local water authority or developers may assist in funding and/or develop new design schemes as well as provide sponsorship for various projects

9 Conclusions and Recommendations

9.1 Recommended Actions

It is recommended that Warrnambool City Council adopts the criteria and recommendations discussed in this report.

9.1.1 Drainage Design Criteria

It is suggested that Council develops or confirms standard drainage criteria that can be applied to all future development and used for the design of new infrastructure to treat existing drainage problems. Setting criteria will involve determining a minimum level of service that is expected from the drainage network and developing criteria to meet that standard.

Setting standard criteria will also ensure that uniform drainage standards are achieved across the city over time.

9.1.2 Prioritised Drainage Works

We suggest that the City of Warrnambool adopt the Recommended Drainage Improvement Works as detailed in Section 4 of this Report to prioritise future drainage works, in conjunction with the other measures listed in Section 7 of this report.

9.1.3 Overall Drainage Funding Arrangements

We recommend that the Warrnambool City Council implement the following drainage funding arrangements. Separate arrangements are proposed for the following categories of drainage works:

- Capital works to reduce flooding based on existing rates of runoff through a drainage levy. Details to be determined by undertaking the preparation of a Development Contributions Plan.
- Drainage works to cater for the increased runoff from developments through developer contributions.
- Drains to provide legal points of discharge for properties that do not have an adjacent piped drain.
- Drains to service Greenfield developments.
- Capital and recurrent expenditure on stormwater quality improvement measures.

9.1.4 Maintenance Program

It is recommended that Council reviews or develops an updated maintenance program to ensure that the existing drainage network is operating as efficiently as is possible. The maintenance program should include:

- Regular pit inspections and cleaning where pits are blocked or filled with leaves or rubbish.
- Upgrading and maintenance of existing Soak Pits
- Street sweeping as a preventative measure

9.1.5 Community Awareness and Consultation

We recommend that Warrnambool City Council adopts the stormwater reduction methods described in Section 7 of this Report, including Water Sensitive Urban Design guidelines, and creates a Community Awareness Program. The program should include a means by which to ensure the public understands the importance of drainage and the variables that impact upon its performance.

9.1.6 Wetlands Facility at Warrnambool Racecourse

While it is considered feasible for a Wetlands facility to be constructed at this site, in view of the possible limitations and unresolved issues concerning the proposal it is recommended that Warrnambool City Council undertake a detailed investigation of the proposal. The investigation should include preparation of concept design options and costings to confirm the scope of works and range of costs, as well as future operation and maintenance of the facility.

9.2 Measuring Success

In managing most public infrastructure assets, success would often be measured by noticeable decreases in recorded failures or a reduction in complaints or requests for maintenance from the public. However this may not be a suitable method of measuring success for Warrnambool's drainage network for the following reasons:

- Success or failure of a drainage network is somewhat random because of the random nature of the rainfall events that may lead to flooding
- Warrnambool's drainage network has significant areas where the network is under capacity and success may be difficult to measure in the early years of an ongoing improvement strategy.

- Local networks that may have minor consequences of failure may be rectified while known significant problem areas may remain. Rectifying drainage problems resulting from community feedback may not necessarily result in the most critical sections being addressed.

It is therefore recommended that success be measured by the progress that is being made to rectify drainage inadequacies identified in the Warrnambool Drainage Capacity Analysis. An additional measure of success would be the extent to which new drainage problems are reduced, through improved development practices.

Measuring success in this way will allow known drainage problems to be prioritised based on their calculated effect on the network and consequence of failure and will assist in ensuring that long term drainage strategy goals are met.

9.3 Monitoring and Review

It is recommended that Warrnambool City Council improve their existing or generate a comprehensive G.I.S database containing all relevant drainage infrastructure information.

The G.I.S should be used to deal with all community consultation issues, as a tool to monitor and update remedial works, to assist town planners with the programming of both development and other works on other infrastructure and to assist maintenance crews where possible. The database should be kept up to date at all times.

As part of the implementation of such a database, it is imperative that an adequate training program is also provided. The training should be provided to all parties using the database and cover not only how to use it but also the broad spectrum of facilities that it offers.

10 References

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