

# Developing Maintenance Requirements and Standards to Prolong the Engineering Life of Piped Systems - The Kingston Case Study



**Project Outcome:** 

• August 2016 Silt Management Plan



- Centre Swamp Drain catchment in the City of Kingston.
- Area developed pre 1965.
- Flat, small diameter pipes that can only cater for low flow events.
- "Closed" catchment with the only outflow being via two MWC pump stations.





South Section

### Issues

- Localised flooding in roads.
- Ongoing Council work to upgrading the network.
- Performances of Council's proposed drainage improvements are heavily dependent upon the capacity of MWC's drainage system.
- Historically siltation within the MWC Centre Swamp Drain Low Flow pipeline has contributed to limiting the capacity in the upstream Council systems.



Centre Swamp Drain - Original pipe constructed in former swamp below sea level at extremely flat grades.



## **Catchment Delineation**

- 1731 ha contributes to the Browns Reserve Pumping Station
- 679 ha contributes to the Carrum Swamp Pumping Station
- Flooding problems concentrated in Catchment 1 but this is only 28% of Browns Reserve Catchment.
- Catchments 2a and 2b discharge directly to the existing Edithvale Seaford wetland system.



	Total Catchment	Land Use Breakdown (%)					
Catchment	Area (ha)	Residential	Industrial / Commercial	Major Roads / Freeway	Parks / Golf	Agricultural	
1	486	81%			19%		
2	223	58%	4%	9%	24%	5%	
2a and 2b	197	39%	17%	9%	35%		
3	824	9%		2%	2%	87%	
4	679	52%		5%	24%	19%	
TOTAL	2409						



# Estimated Silt Deposition Rates Based on Site Observations and Cleanouts Performed to Date



Observed Siltation within Existing Council Pipeline (Catchment 1, Site 9).

### Silt Observed as Deposited in Council Systems

Catchment	Approximate Silt observed/Collected over 20 years	Catchment Area	Approximate Silt/Sediment Load	Approximate Silt/Sediment Load	Approximate Silt/Sediment Volume
	(Tonne)	(Ha)	(Tonne/year)	(kg/ha/yr)	(m³/ha/yr)
1	4279	486	214	440	0.24
2	1488	223	74	333	0.19
3	3159	824	158	192	0.11

### Silt Observed as Deposited in Melbourne Water Systems

#### Silt Removed by MWC Since 2011

Date	Location	Description	Cost (\$)	Silt removed (Tonne)
Feb-12	Browns RB	Re-grade/re-profile basin	\$140,000	240
Feb-13	Chelsea Golf Club	Re-establish spoon drain adjacent to the club	\$60,000	80
Feb-13	Browns PS	Desilt PS pit well	\$60,000	30
Jul-15	DS of Thames Prm	Educted all low flow pipes	\$100,000	220
Dec-15	Browns RB	Desilt the silt trap	\$20,000	30

# **Estimate of Silt Loads using MUSIC**

### The MUSIC manual provides an approximation of how to calculate total sediment load

#### TOTAL SILT/SEDIMENT LOAD = TSS + GROSS POLLUTANTS + COURSE SEDIMENTS

#### **TSS CALCULATION**

Direct MUSIC Output Trapped TSS = Inflow Load - Outflow Load

Volume conversion factor =  $1,800 \text{ kg/m}^3$  for sediment

#### **Gross Pollutants**

Direct MUSIC Output Trapped TSS = Inflow Load - Outflow Load

Volume conversion factor of 260 kg/m<sup>3</sup> for gross pollutants =

#### **Course Sediment.**

For coarse sediment, it is known that in gross pollutant traps that capture nearly all c Coarse sediment and gross pollutants, approximately 29% of the volume is sediment (on average). Course sediment+GP = total "large particles" (1) Course sediment = 29% total "Large particles" (2) Solving simultaneous equations (1) and (2) Course sediment = 41% GP

Load of coarse sediment (kg/year) = GP load x 0.41

Catchment	Catchment Area	TSS Generated	Gross Pollutant Generated	Course Sediment Collected	Approximate Silt/Sediment Load	Approximate Silt/Sediment Load	Approximate Silt/Sediment Volume
	(Ha)	kg/yr	(kg/yr)	(kg/yr)	(tonne/year)	(kg/ha/yr)	(m³/ha/yr)
1	486	241000	54000	22140	317	652	0.36
2	223	112000	24800	10168	147	658	0.37
3	824	154000	19700	8077	182	221	0.12
3 (Residential)	109	67500	14500	5945	88	807	0.45
3 (Agricultural)	715	86400	5210	2136	94	131	0.07

# **Adopted Silt Load Generation Values**

- The MUSIC estimates are assumed to give a reasonable estimate of siltation rates as:
  - The MUSIC estimated siltation load (m<sup>3</sup>/ha/yr) is the same order of magnitude as observed siltation
  - Higher MUSIC values OK some silt must have been pumped directly to Mordialloc Creek.

For Catchments 1 and 2 (primarily residential catchments):

• Silt generation rate - 0.35 m<sup>3</sup>/ha/yr.

For Catchment 3 (agricultural):

- Silt generation rate 0.12 m<sup>3</sup>/ha/yr
- Catchment produces a lot of silt, it just is not transported as readily in storm events.

The above analysis was a starting point in regard to developing a silt management plan, particularly in regard to assessing:

- The impact and effectiveness in regard to silt capture of identified silt management, and
- Required cleanout frequencies.

# Silt Management Plan developed to:

- Provide clear & simple plans & checklist for field staff to undertake regular improved maintenance.
- Identify opportunities & location to install siltation sump pits.
- Clarify maintenance responsibilities & triggers between Council & MW.



Category 1:

• Melbourne Water Sumps & Pipes



### Category 2:

 Melbourne Water Open Channels/Sediment Basins



### Category 3:

Council Drainage Sumps & Pipes

### Plan separated into

- Asset type
- Existing and proposed assets
- Three maps formulated to clearly define all assets and responsibilities

### A.1 Melbourne Water Sumps & Pipes

Category 1: Melbourne Water Sumps & Pipes – Existing Asset Details (MAP 1)							
Asset Type	Asset Number	Asset Location and Access Provisions	Asset Description	Approximate Annual Silt Load (m <sup>3</sup> /year)	Maintenance Program <sup>1,2</sup>		
1A - Large sumps (15 m <sup>3</sup> sump) retrofitted within the existing Centre Swamp Drain Low Flow Pipeline (as part of the Council pump and pipeline works) or into existing DSS pipelines	1A-1	On Fraser Avenue Pipeline at intersection with MWC Centre Swamp Drain low flow pipeline, within Edithvale Public Golf Course, accessed via common reserve access road.	15 m <sup>3</sup> on line GPT/Silt Sump in MWC 1050 low flow pipe	81.4			
1B - Existing Centre Swamp Drain Low Flow Pipeline	1B-1	Pipe from Browns Reserve Pumping station to southern end of Rossdale Golf Club, accessed via common reserve access road.	1200 mm diameter low flow pipeline draining north	Varies			
	1B-2	Pipe from southern end of Rossdale Golf Club to Thames Promenade, accessed via common reserve access road.	1050 mm diameter low flow pipeline draining north	Varies	To be jetted and educted <sup>3.</sup> and tree roots removed as required from CCTV		
	1B-3	Pipe from Thames Promenade to Carrum Swamp Drain Pumping station.	1050 mm diameter low flow pipeline draining south	Varies			
1C - Existing MWC Development Services Scheme (DSS) pipelines	1C-1	MWC Pipelines as per Map 1, accessed via road reserves etc.	Variety of different sized Melbourne Water pipes	Varies	To be jetted and educted <sup>3.</sup> as required from CCTV		

Inspection notes:







# **Conclusions:**

Project demonstrates proactive cross agency cooperation to address and action known problem areas and to ensure adequate inspection and maintenance requirements in regard to existing and future assets.

Project Outcome: August 2016 Silt Management Plan.

The resultant cross agency management and maintenance procedures will now be used by Melbourne Water and Kingston City Council to maximise the life and performance of the piped asset.

