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OPERATING AND MAINTENANCE COST ESTIMATING GUIDELINE

This Guideline was developed by Hunter Water to be used for the estimation of operating and maintenance costs associated with water and/or sewerage works that are, or are to become, the property of Hunter Water. It is intended that this Guideline be used in conjunction with various other standards, codes, guidelines and design requirements as defined by Hunter Water for each particular project.

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Changes to Revision 1.2 - March 2012

Old Clause	New Clause	Amendment
3	3	Sentence added re: sites with consumption greater than 1GWh/a Table 4 - Year column deleted, FY 2011/2012 and 2012/2103 rows deleted and tariffs updated, source updated 20 replaced with 2031/2032 in last paragraph
Cost Estimating Examples	6	Examples now Section 6 Examples updated to reflect new tariffs.
		Formatting

Changes to Revision 1.1 - September 2011

Old Clause	New Clause	Amendment
2.1	2.1	Network operating cost formulas reformatted and pump station energy calculation clarified
3	3	Energy tariffs updated
4	4	Greenhouse gas section removed, carbon tax requirements added
Cost Estimating Example	Cost Estimating Example	New example added

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1 Scope

This guide has been developed to assist designers in estimating operating and maintenance costs, including environmental considerations through greenhouse gas abatement costs, for water and sewer designs. All water and sewer designs, upgrades, renewals or operational changes require an assessment of life-cycle costs, capital and operating, for all proposed options.

This document details values and formulas for network operation and maintenance requirements. It also includes values and tables for incorporating environmental considerations and outlines the process for assigning value to emissions.

Hunter Water should be consulted in determining the operating and maintenance requirements for non-standard networks, such as pressure sewerage.

2 Annual Network Operation and Maintenance Costs

The following generic annual operation and maintenance cost formulas and tables are to be used to estimate costs associated with network operations. Alternate data may be used with prior Hunter Water approval where site/project specific information is available.

2.1 Sewer

Gravity Mains	$2872 - 1.13 x DN + 0.00024 x DN2 x L
Rising Mains	$700 + 0.0005 x DN2 x L
Sewage Pumping Stations	$4000 + 2000 x No. of Pumps

DN – pipe nominal diameter (mm)

L – pipeline length (km)

Determine pumping station energy usage from an annual flow of 1.2 x ADWF for all catchments contributing to the system. Pump efficiency determined from the current performance for existing systems or the duty point determined from the manufacturers pump curve.

2.2 Water

Table 1 Water Network Maintenance Costs

Watermain	
Diameter (mm)	**Cost ($/km)**
80-100	800
150-600	520

Table 2 Water Pump Station Maintenance Cost

Power	Maintenance Costs	
Consumption	**Fixed Speed**	**Variable Speed**
(kWh/year)	**($/MWh/year)**	**($/MWh/year)**
1,000	1,000	1,380

2,000	720	1,100
3,000	550	910
4,000	440	800
5,000	380	660
10,000	200	500
15,000	120	380
20,000	100	280
> 25,000	85	170

Table 3 Water Pump Station Operational Cost

Electricity	**Demand Proportion**	
Tariff	**Average Day**	**Peak Day**
As below	80%	20%

3 Electricity

The price of electrical supply to an asset includes feed and network tariffs, and connection costs – all of which are dependent on the site's annual power usage.

The Electricity Prices (¢/kWh) listed in Table 4 are to be used to determine the annual cost of electricity over the life time of the asset. A small site is defined as one where the metered connection to the electricity grid supplies less than 160 MWhpa. Sites that have annual power consumption greater than 160 MWh are considered large.

More precise pricing information should be sought for sites with consumption greater than 1 GWhpa through consultation with the HWC Energy Efficiency group energy.efficiency@hunterwater.com.au.

Table 4 Electricity Prices

Financial Year	HWC Electricity Prices (¢/kWh) (2013/14 dollars)	
	Small sites (<160 MWh/yr)	Large sites (≥ 160 MWh/yr)
2013/14	27.8	16.5
2014/15	29.6	17.6
2015/16	30.6	18.2
2016/17	33.0	19.6
2017/18	35.0	20.8
2018/19	37.0	22.0
2019/20	37.1	22.0
2020/21	38.0	22.6
2021/22	38.8	23.0
2022/23	39.2	23.3
2023/24	39.6	23.5
2024/25	39.8	23.6
2025/26	40.9	24.3
2026/27	40.4	24.0
2027/28	41.0	24.3
2028/29	40.9	24.3
2029/30	40.4	23.9
2030/31	40.1	23.8
2031/32	40.3	23.9

Source: Energy Price Forecasts 2013 to 2032 for WSAA by SKM.MMA (Revision 1.0, 13 Nov 2012)

If assessment of life-cycle costs beyond 2031/32 is relevant, a constant electricity price may be projected beyond 2031/32.

4 Carbon Tax

Accounting for the cost of abating greenhouse gas (GHG) emissions from Hunter Water's electricity consumption is now incorporated in the electricity price projections above. These include the expected pass-on of the legislated price on carbon that electricity providers will be liable to pay, commencing July 1, 2012.

In addition, Hunter Water may be liable to pay a carbon tax on direct GHG emissions, known as "Scope 1" emissions, depending whether Hunter Water's total Scope 1 emissions meet a determined threshold. Scope 1 emissions constitute GHGs released as a direct result of activities within a corporation's facility. In Hunter Water's case the majority of Scope 1 emissions are fugitive gases released during the treatment of waste water. This includes the production of methane and nitrous oxide from treatment and biosolid processing.

For all wastewater treatment plant projects that will impact on Scope 1 emissions, consult the HWC Energy Efficiency group energy.efficiency@hunterwater.com.au.

5 Further Information

Any questions regarding this guideline should be directed to standards@hunterwater.com.au.

6 Cost Estimating Examples

The following examples of Options Analysis – Cost Effectiveness Analysis have been included as guides to incorporating operating and maintenance costs into options assessments. Economic analysis for all projects should follow the NSW Treasury Guidelines (http://www.treasury.nsw.gov.au/Publications_Page) and Hunter Water guidelines or directions relevant to the project.

6.1 Infrastructure Operating and Maintenance Cost Formulas

Determine infrastructure operating and maintenance costs the formulas provided in this guideline.

Determine annual pumping costs from tariffs above, pump characteristics and usage determined during planning/system design and the following energy consumption formula:

$$kWh / Year = \frac{0.0098QHt}{eff}$$

Where

Q	=	pumping rate (L/s)
H	=	total pumping head (m)
t	=	duration of pumping per year (hrs)
eff	=	pump efficiency

Determine future costs from:

$$PV = Cx\frac{1}{(1+r)^n}$$

Where:

PV	=	present value
C	=	cost in current dollars
r	=	discount rate
n	=	years from current year

Include the residual value of assets where they have not fully depreciated in the analysis period.

6.2 Example 1 – Pump Selection

6.2.1 Scenario:

As part of a renewal strategy pumps at a WWPS require replacement. In this system the rising main is common to a separate pump station for a portion of the length and a preliminary assessment has identified that the two stations will be pumping at same time for approximately 15% of the time. A preliminary assessment has identified 2 pumps types as being suitable and a Cost Effectiveness Analysis is required to determine the most suitable pump.

6.2.2 Factors considered

- Existing system, with little growth anticipated over the analysis period.
- Both pumps selected have a design life of 15 years.
- Pump station and rising mains maintenance costs are the same for both options
- 20 yr life cycle cost period with a 7% discount rate.
- Sensitivity analysis required at discount rates of 4% and 10%.

6.2.3 System Data

Base Year	2013/2014	
Pumping Station Structure Capital / Maintenance	Constant for both options – omitted	
Rising Main Capital / Maintenance	Constant for both options – omitted	
ADWF	2.1	
Design Flow	14.1 l/s	
	Option 1	Option 2
Pump Type	Brand X	Brand Y
Pump Cost	$25,500	$19,500
Single Duty Flowrate (L/s)	21.9	22.5
Single Duty Head (m)	27.9	28.3
Single Duty Efficiency	56.6%	40.0%
Common Duty Flowrate (L/s)	15.6	16.0
Common Duty Head (m)	29.7	29.4
Common Duty Efficiency	47.6%	33.0%
Common pumping	15%	15%
Pump Replacement	15 years	15 years

6.2.4 Present value Analysis

	Discounted Cashflow (NPV) (20 year Period)	
	Option 1 ($,000)	**Option 2($,000)**
Lifecycle costs(7% discount rate)	75	88
Discounted Cashflow Sensitivity @ 4%	88	106
Discounted Cashflow Sensitivity @ 10%	65	75

The Cost Effectiveness Analysis indicates that Option 1 represents the lower life cycle cost. In this case the improved efficiency of the pumps selected for Option 1 offsets the higher capital cost. Sensitivity analysis indicated that Option 1 remained the lower life cycle cost with both an increase and decrease in future Discount Rate.

6.3 Example 2 – Pump Station Selection

6.3.1 Scenario:

As part of a servicing strategy, a new pump station is required to service a new development area. The most suitable location of the new station would allow an existing station to be decommissioned and flows diverted to the new station. A Cost Effectiveness Analysis is required to determine the most suitable network configuration.

6.3.2 Factors considered are:

- Growth in the new area is expected to occur in 2 stages over 5 year periods
- Growth in the existing system is not expected to change over the analysis period
- All pump station infrastructure at the new station is consistent for both options.
- $50,000 decommissioning costs are incurred to abandon the current station.
- An additional $20,000 incremental gravity main upsize costs are incurred to abandon the current station
- 20 yr life cycle cost period with a 7% discount rate.
- Sensitivity analysis required at discount rates of 4% and 10%.

6.3.3 System Data

Table 5: Option A: Retain No1 WWPS + Construct No 2 WWPS

	Initial	Stage 1 (by 2019)	Ultimate (by 2024)
No1 WWPS			
Pump Duty (L/s)	11	11	11
Eff (@h and Q)	0.59	0.59	0.59
ADWF (L/s)	0.31	0.31	1.21
Pump Head (m)	8	8	8
RM Length (m)	1,000	1,000	1,000
RM Nominal Diameter (mm)	150	150	150
No2 WWPS			
Pump Duty (L/s)	90	90	90
Eff (@h and Q)	0.65	0.65	0.65
ADWF (L/s)	0	2.1	11.5
Pump Head (m)	40	40	40
RM Length (m)	1,500	1,500	1,500
RM Nominal Diameter (mm)	250	250	250

Table 6: Option B: Decommission No 1 WWPS divert flows to No 2 WWPS

	Initial	Stage 1 (by 2019)	Ultimate (by 2024)
No2 WWPS			
Pump Duty (L/s)	90	90	90
Eff (@h and Q)	0.65	0.65	0.65
ADWF (L/s)	0.31	2.41	12.71
Pump Head (m)	40	40	40
RM Length (m)	1,500	1,500	1,500
RM Nominal Diameter (mm)	300	300	300

6.3.4 Present value Analysis

	Discounted Cashflow (NPV) (20 year Period)	
	Option A ($,000)	**Option B ($,000)**
Lifecycle costs(7% discount rate)	329	307
Discounted Cashflow Sensitivity @ 4%	434	389
Discounted Cashflow Sensitivity @ 10%	258	252

Option B is determined to be the most cost effective due to the savings achieved through the reduced maintenance costs of one site over two.

6.4 Example 2a

6.4.1 Scenario

A hydraulic review of the Example 2 catchments has identified that the majority of flows from the proposed No 2 WWPS catchment can be designed to gravitate to the No 1 WWPS. This option however would require an upgrade of the No 1 WWPS. A Cost Effectiveness Analysis is required to determine the most suitable option.

6.4.2 Factors considered are:

- Growth in the new area is expected to occur in 2 stages over 5 year periods.
- Growth in the existing system is not expected to change over the analysis period.
- An additional $75,000 capital upgrade costs are required to enable flow diversion to No 1 WWPS (difference between downsizing No2 WWPS and No 1 WWPS upgrade).
- RM can be directed to No 1 WWPS catchment, decreasing length and lift required.
- 20 yr life cycle cost period with a 7% discount rate.
- Sensitivity analysis required at discount rates of 4% and 10%.

6.4.3 System Data

Table 7: Option C: Retain No1 WWPS and Upgrade + Construct smaller No 2 WWPS

	Initial	Stage 1 (by 2019)	Ultimate (by 2024)
No1 WWPS			
Pump Duty (L/s)	11	90	90
Eff (@h and Q)	0.59	0.71	0.71
ADWF (L/s)	0.31	2.41	12.71
Pump Head (m)	11.4	13.7	13.7
RM Length (m)	1,000	1,000	1,000
RM Nominal Diameter (mm)	150	300	300
No2 WWPS			
Pump Duty (L/s)	3.5	3.5	3.5
Eff (@h and Q)	0.62	0.62	0.62
ADWF (L/s)	0	0.21	0.81
Pump Head (m)	21	21	21
RM Length (m)	300	300	300
RM Nominal Diameter (mm)	100	100	100

Table 8: Option C: Retain No1 WWPS and Upgrade + Construct smaller No 2 WWPS

	Initial	Stage 1 (by 2019)	Ultimate (by 2024)
No1 WWPS			
Pump Duty (L/s)	11	90	90
Eff (@h and Q)	0.59	0.71	0.71
ADWF (L/s)	0.31	2.41	12.71
Pump Head (m)	11.4	13.7	13.7
RM Length (m)	1,000	1,000	1,000
RM Nominal Diameter (mm)	150	300	300
No2 WWPS			
Pump Duty (L/s)	3.5	3.5	3.5
Eff (@h and Q)	0.62	0.62	0.62
ADWF (L/s)	0	0.21	0.81
Pump Head (m)	21	21	21
RM Length (m)	300	300	300
RM Nominal Diameter (mm)	100	100	100

6.4.4 Present Value Analysis

	Discounted Cashflow (NPV) (20 year Period)
	Option C ($,000)
Lifecycle costs(7% Discount Rate)	296
Discounted Cashflow Sensitivity @ 4%	353
Discounted Cashflow Sensitivity @ 10%	255

The assessment of the options indicates that Option C has the lowest lifecycle costs. This is due to the deferral of capital costs; upgrade staged with development, and reduced energy costs with improved system hydraulics. It should be noted that Option B has the lowest lifecycle cost at 10% Discount Rate.