BMT JFA Consultants

Newport Waterways Long Term Maintenance Plan - 2016

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Moreton Bay Regional Council
PO Box 159
CABOOLTURE QLD 4510
Email: mbrc@moretonbay.qld.gov.au
Phone: (07) 3205 0555

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BMT JFA Consultants Pty Ltd
Level 8, 200 Creek Street
Brisbane Qld 4000
Australia
PO Box 203, Spring Hill 4004

Tel: +61 7 3831 6744
Fax: + 61 7 3832 3627

ABN 74 109 191 764

www.bmtjfaconsultants.com

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Title:	Newport Waterways Long Term Maintenance Plan - 2016
Project Manager:	J. Stewart
Author:	J. Stewart / J. Visser
Client:	Moreton Bay Regional Council
Client Contact:	A. Stuer
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Limitations statement

The purpose of this report and the associated services performed by BMT JFA Consultants (BMT JFA) is to provide an updated Long-term Maintenance Plan and associated Maintenance Model for Newport Waterways in accordance with the scope of services set out in the contract between BMT JFA and Moreton Bay Regional Council ('the Client'). That scope of services was defined by the requests of the Client, and by the time and budgetary constraints imposed by the Client.

In preparing this report, BMT JFA has relied upon and presumed accurate certain information (or absence thereof) relative to the site, provided by the Client and others identified herein. Except as otherwise stated in the report, BMT JFA has not attempted to verify the accuracy or completeness of such information.

No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon site conditions and information supplied by the Client in existence at the time of the study.

This Long-term Maintenance Plan has been prepared for the exclusive use of Moreton Bay Regional Council and is subject to and issued in connection with the provisions of the contract between BMT JFA Consultants and Moreton Bay Regional Council. BMT JFA excludes to the fullest extent lawfully permitted all liability whatsoever for any loss or damage howsoever arising from reliance on the contents of this report by any third party.

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1 Introduction

1.1 Background

Newport Waterways is a residential canal estate and marina located in Newport, Queensland. The canal waterways and 2.4 km dredged entrance channel provide access to Deception Bay and the wider Moreton Bay. The canal estate has been progressively developed in stages following original construction commenced in the 1970's. The canal estate currently has approximately 620 waterfront residential properties and a Marina with a total of approximately 205 berths. An adjacent residential canal development to the west of Newport Waterways, the *Isles of Newport*, is planned for future development.

Moreton Bay Regional Council (MBRC) undertake regular maintenance works within the canal estate. These works include maintenance dredging within the canals and entrance channel, maintenance of canal batters, navigation aids and signage, and removal of marine plants and litter. Funding to support the delivery of these maintenance activities is generated through a special levy, paid by waterfront residential properties and commercial entities, together with a contribution from MBRC's general maintenance budget. The levy amount is calculated in consideration of forecast long-term maintenance costs, which are estimated based on a Long-term Maintenance Plan, and associated Maintenance Model.

The Long-term Maintenance Plan provides a high-level plan for forecast maintenance activities, and provides key inputs into the Maintenance Model. The Maintenance Model is a financial calculation tool which essentially comprises a list of maintenance activities, associated unit cost rates, and a forecast program of maintenance activities over the specified planning period. The estimated long-term maintenance costs are calculated in the Model based on the forecast program and estimated unit cost rates. The Long-term Maintenance Plan, including Maintenance Model, is subject to periodic review in order to ensure that the maintenance activities, unit cost rates, and program remain appropriate and up-to-date.

The initial Long-term Maintenance Plan, *Newport Waterways Long Term Maintenance Study* was developed in 2003-04 (KBR 2004, in KBR 2013a), and formally adopted by MBRC (then Redcliffe City Council) on 1 July 2004. Subsequent studies and assessments, which largely focused on the canal dredging and dredged material management, were consolidated into an updated Long-term Maintenance Plan and associated Maintenance Model in 2013 (KBR 2013a). In line with the planned 3-5 year review cycle, MBRC commissioned a review and update of the existing Long-term Maintenance Plan for 2015-16.

1.2 Scope

1.2.1 Scope of services

BMT JFA Consultants Pty Ltd (BMT) were commissioned by MBRC in late 2015 to review and update the Newport Waterways Long-term Maintenance Plan and associated Maintenance Model.

Given that a significant proportion of the maintenance costs are attributed to maintenance dredging and dredged material disposal (KBR 2013a), the review focussed on siltation rates, dredging and material disposal strategies, and included an overall review and update of all unit cost rates in the

Maintenance Model. Subsequently, BMT's proposal (Ref. *Q-P15.74-1 Rev.0*) incorporated the following scope of services:

- Review of siltation rates
- Assessment of dredging and material disposal options
- Development of a recommended dredging and material disposal strategy
- Development of a proposed dredging schedule for the purposes of informing the Maintenance Model
- Review and update of maintenance costs/rates
- Provision of updated:
  - Dredging schedule
  - Maintenance Model
  - Long-term Maintenance Plan

This Long-term Maintenance Plan (LTMP) documents the outcomes of the completed work, and provides a high-level plan for forecast maintenance activities, together with key inputs into the Maintenance Model. The document is structured as follows:

- Site description – brief description of the site including historical development of the canal estate, and summary of the maintenance activities.
- Canal maintenance dredging – summary of past dredging and disposal works, review of siltation rates, review of dredging and material disposal options, the recommended dredging and material disposal strategy, and discussion of environmental approval requirements.
- Entrance channel maintenance dredging – summary of past dredging and disposal works, review of siltation rates, the recommended dredging and material disposal strategy, and discussion of environmental approval requirements.
- Other maintenance activities – discussion of the broad scope of general maintenance activities and forecast maintenance requirements.
- Maintenance costs – presentation of the estimated long-term maintenance costs, and discussion of key assumptions and sensitivities in the model, together with the accuracy of estimates.
- Conclusions – concise summary of the outcomes of the completed work and the estimated long-term maintenance costs.
- Recommendations – discussion of recommended additional studies and investigations identified during the review and update of the LTMP.

1.2.2 Scope of LTMP

The maintenance activities undertaken by MBRC, and subsequently considered in the LTMP, are limited to the canal waterways and entrance channel, and exclude works within private properties. As outlined in the Project Brief (Ref. *RFQ VP0000000031743*) the following areas and maintenance activities are not included in the scope of the LTMP:

- All concrete revetment walls or flush kerbs. These are the responsibility of the associated property owner.
- Bridges and retaining walls at causeway-type road crossings are part of the road network and therefore are not part of the LTMP.
- Pontoons. All pontoons are the responsibility of the associated property owner.
- Drainage outlets and associated infrastructure. These are part of the drainage network and therefore are not part of the LTMP.
- Parkland abutting the canals is part of the park network. Maintenance of these areas is therefore not part of the LTMP.
- The planned adjacent development, the *Isles of Newport*, is not included within the scope of the LTMP.

Additionally, the upstream end of the canal system terminates at the boundary of Walkers Creek Canal and Talobilla Park (Lot 2 SP208907), and the seaward end terminates at the end of the entrance channel (i.e. design chainage 2454 m).

1.2.3 Limitations

The following limitations apply to the LTMP, including the associated work completed by BMT:

- The LTMP is a high-level planning tool and should not be used for the detailed planning and execution of maintenance activities.
- No site-based condition inspections have been completed by BMT in completing this work. The condition of existing structures shall be assessed by others as part of regular inspections and maintenance activities.
- The contracted scope of services was limited to the review and update of the existing LTMP. As such, additional maintenance activities, beyond those included in the existing LTMP and specified in the Project Brief, have not been considered.
- The work completed by BMT has been largely based upon information provided by MBRC, including hydrographic surveys and costing information. While all care has been taken to apply the information appropriately, BMT have not independently verified the accuracy of the supplied information and shall not be liable for any errors in the supplied information including any subsequent calculations or assessments completed by BMT.

- All dollar amounts are presented in 2016 dollars and exclude the Goods and Services Tax (GST). Further, the time value of money and inflation is not taken into account, and therefore, financial modelling is required to be completed by others in order to determine appropriate levy amounts.

This LTMP, including the associated Maintenance Model, has been prepared for MBRC to assist in the long-term planning and funding of maintenance activities in the Newport Waterways canal estate. While considerable detail is included within the LTMP, it is highlighted that it has been developed as a high-level, long-term planning and costing tool. As such, the LTMP should not be used for the detailed planning and execution of maintenance activities, which will generally require separate detailed planning and design. Further, the LTMP should be reviewed and updated periodically, notionally every 3-5 years, to ensure that the underlying assumptions and cost rates remain appropriate.

2 Site description

2.1 Location

Newport Waterways is located on the northern foreshore of the Redcliffe Peninsula, in the suburb of Newport, Queensland. The canal waterways and 2.4 km dredged entrance channel provide access to Deception Bay and the wider Moreton Bay. The location and layout of the canal estate is provided in Figure 2-1.

2.2 Canal development

Approval for the construction of the canal estate was obtained in the 1970's under the *Canal Act 1958*. The canal estate was subsequently constructed in stages from the late 1970's through to its current configuration which was completed in 2000 (KBR 2013a). The historic development of the canal estate is summarised in Table 2-1, and the development stages are provided, in plan form, in Appendix A.

Table 2-1 Historic Development of Newport Waterways

Year	Canals added to the estate
1978	Kingfisher, Sandpiper and north Albatross canals
1981	Northern Marina basin, Pelican, Petrel and Cormorant canals
1987	Southern Marina basin, Skua, Curlew, Walkers Creek and south Albatross canals
1988	West Kestrel, Heron, Seagull and north Shearwater canals
1989	East Kestrel, Osprey and Seahawk canals
1990	Gannet, Tern and south Shearwater canals
1991	Sea Eagle, Ibis and Spoonbill canals
1996	Falcon, Hawk, Swan and east Jabiru canals
2000	West Jabiru and Kite canals

Source: KBR 2013a

The canal estate currently comprises approximately 620 waterfront residential properties and a Marina, comprising two marina basins (Northern and Southern marina basins), with a total of approximately 205 berths.

In addition to the current canal estate, the adjacent area to the west of Newport Waterways is planned for future development. This planned development, the *Isles of Newport*, currently incorporates an elevated saline lake, controlled by lock and weir structure, connected to lower Albatross Canal (Civil & Stormwater Design, 2015). The lock will provide access for vessels to lower Albatross Canal and the entrance channel.

Figure 2-1 Newport Waterways Locality Plan

2.2.1 Dredged material placement areas

Periodic maintenance dredging has been undertaken within the canals and entrance channel since 1985. Material dredged from the canals has been placed in one of two land-based facilities, the Section 16 Pond (Albatross Canal Pond) and the Section 19 Pond (Griffith Road Pond). Maintenance dredging campaigns conducted as early as 1992, through to 2000, utilised the Albatross Canal Pond, while subsequent dredging campaigns (2005, 2011, 2013) have utilised the Griffith Road Pond. The Albatross Canal Pond, located on Lot 2 SP175931, was decommissioned following the dredging campaign in 2000 due to the planned future development of this land (KBR 2013a).

The Griffith Road Pond, located on Lot 608 SP145443, has a total pond area of approximately 2.7 ha and volumetric capacity, up to the maximum operating water level of 4.3 m AHD, of approximately 60,000 m^3 (KBR 2011). The total lot area, including the narrow lane down to Walkers Creek Canal, is approximately 4.0 ha, providing very limited area for material drying following dredging.

2.3 Marine environment

The Newport Waterways canal estate is located approximately 1.5 km to the south west of the Scarborough Boat Harbour, in the southern area of Deception Bay. Water levels within the canal estate fluctuate daily as a result of the tidal movement of water within Deception Bay and the wider Moreton Bay. While tidal records for the canal estate are not available, Maritime Safety Queensland (MSQ) publish tidal planes for Scarborough Boat Harbour. These tidal planes have been applied to the Newport Waterways site and are presented in Table 2-2.

Table 2-2 Scarborough Boat Harbour Tidal Planes

Tidal plane	Level (m LAT)	Level (m AHD)
HAT	2.43	1.26
MHWS	1.93	0.76
MHWN	1.58	0.41
AHD	1.17	0.00
MSL	1.11	-0.06
MLWN	0.68	-0.49
MLWS	0.33	-0.84
LAT	0.00	-1.17

Source: MSQ 2016

The canal estate is located adjacent to the Moreton Bay Marine Park. While the canal estate and entrance channel are excised from the Marine Park, they are located directly adjacent to a Habitat Protection Zone (HPZ05). The canal estate is also located near to internationally important RAMSAR wetlands, which are located to the west of the development.

2.4 Maintenance activities

The maintenance activities included in the LTMP and associated Maintenance Model are summarised as follows:

- Maintenance dredging and dredged material disposal, from within:
  - Canal estate
  - Entrance channel
- General maintenance, including:
  - Canal batter maintenance
  - Vegetation removal
  - Litter collection
  - Navigation aids and signage
- Other general and planning activities, including:
  - Water quality monitoring
  - Periodic review and update of the LTMP
  - Dredging design and planning
  - Renewal of environmental approvals

The following sections further discuss these maintenance activities, and are arranged as follows:

- Canal Maintenance Dredging
- Entrance Channel Maintenance Dredging, and;
- Other Maintenance Activities.

3 Canal Maintenance Dredging

3.1 Introduction

The Newport Waterways canals and marina basins experience appreciable siltation. Maintenance dredging is subsequently required in these areas to ensure that their function and amenity is maintained.

This section discusses maintenance dredging within the canals and marina basins, including discussion of historical dredging and material disposal activities, siltation rates, canal depths, dredging and material disposal options, the recommended dredging and material disposal strategy, and environmental approvals. Maintenance dredging within the entrance channel is discussed separately in Section 4.

3.2 Historical activities

Records indicate that maintenance dredging has been undertaken within the canal estate on a periodic basis since 1992. Table 3-1 summarises the dates and dredged areas, based on available records, for past dredging campaigns in the canals, together with maintenance dredging currently planned for 2016. Additionally, Table 3-2 provides a summary of the employed dredged material disposal methodologies, based on available records, for past material disposal.

Table 3-1 Summary of past and planned maintenance dredging campaigns – canals

Year*	Dredged areas	Dredging methodology	Estimated dredged volume (m^3)
†1992	Kingfisher and Lower Albatross canals	Cutter suction dredge to Section 16 Pond	Not known
†2000	Kingfisher, Sandpiper, Pelican, Petrel, Cormorant, Lower Albatross canals, and Northern Marina basin	Cutter suction dredge to Section 16 Pond	Not known
†2005	Sections of Northern and Southern Marina basins, Kingfisher, Jabiru, Albatross, Skua, Curlew, Kestrel, Seagull, Osprey, Seahawk and Shearwater canals.	Small cutter suction dredge to Section 19 Pond	44,000
†2011	Northern Marina basin, Lower Kingfisher, Sandpiper, and Jabiru canals, and Falcon canal.	Small cutter suction dredge to Section 19 Pond	34,000
2013	Southern Marina basin, Kingfisher Canal, Upper Sandpiper, Pelican, Cormorant, Petrel, Skua, Curlew, Mid-Albatross and Lower Walkers Creek canals.	Small cutter suction dredge to Section 19 Pond (38,400m^3) MIDMPA (6,000 m^3)	44,400
‡2016	*Northern Marina basin, Lower Sandpiper, Upper Kestrel, Seahawk, Osprey, Seagull and Heron canals.*	Dredge and disposal to MIDMPA	‡ *27,250*

** Year dredging campaign commenced - inferred from pre-dredge survey dates*

† Source: KBR 2013a – Table 2.3 (p2-4)

‡ Planned 2016/17 maintenance dredging campaign

Table 3-2 Summary of dredged material disposal methodologies - canals

Year*	Dredged material disposal methodology
(1992)	Land reclamation (Retained in Section 16 Pond)
(2000)	Land reclamation (Retained in Section 16 Pond)
2009 (2005)	Approximately 40,000m^3 of material removed from Section 19 Pond and placed as general fill / beneficial re-use in the north-western section of the *Isles of Newport* development area (KBR 2013a).
2012 (2011)	Material removed from Section 19 Pond and placed as general fill / beneficial re-use at an external site (Contractor's site).
2015 (2013)	
†*(2016)*	Dredging and unconfined ocean disposal at MIDMPA

** Year in which material disposal commenced (associated dredging campaign year in brackets)*

† Planned 2016 maintenance dredging campaign

3.3 Siltation

3.3.1 Siltation rates

Siltation rates within the Newport Waterways canal estate have been previously assessed via calibrated hydrodynamic siltation model (calibrated to hydrographic survey datasets) and via direct comparison of hydrographic survey datasets. The results of the previous assessments are documented in KBR (2013). Additional hydrographic survey datasets, collected since the most recent siltation assessment, have facilitated further assessment and updates to the estimated siltation rates. This section summarises BMT's completed assessment and outcomes.

The hydrographic survey datasets made available by MBRC for BMT's assessment are summarised in Table 3-4, together with the known past survey datasets. Based upon the supplied hydrographic survey datasets, assessment of siltation rates between 2009 and 2015 was undertaken. These two surveys were selected as the 'bounds' for the comparison as both surveys were nominated Class A surveys collected by the same entity, in this case the Port of Brisbane Pty Ltd (PBPL).

The broad methodology for the completed assessment is summarised in Table 3-3. The resulting long-term estimated siltation rates for 2009 to 2015 (i.e. G6) are presented in Figure 3-1 and summarised, together with previous estimates, in Table 3-5. Additional discussion of the siltation rates, including causes of the siltation, is provided in the following sections.

Table 3-3 Summary of siltation assessment methodology – 2009 to 2015

Ref.	Survey Grid Calculation	Applicable area
G1	2015 **minus** 2009	All Canals
G2	2011 Pre-dredge **minus** 2011/12 Post-dredge surveys	Dredge areas only
G3	2013 Pre-dredge **minus** 2013/14 Post-dredge surveys	Dredge areas only
G4	2013 Pre-dredge **minus** 2015 Hydrographic survey	Kingfisher canal
G5	Total Estimated Siltation Depth 2009-2015 = G1 + G2 + G3 + G4	All Canals
G6	Estimated Siltation Rate 2009-2015 = G5 / 5.6 years	All Canals

Table 3-4 Summary of hydrographic survey datasets

Date	Survey Description	Surveyor (Survey Plan Ref. No.)	Coverage
01/05/97	Pre-dredge Survey	(Not supplied)	Kingfisher, Sandpiper, Pelican, Petrel & Cormorant canals, North Marina, and lower Albatross Canal
01/03/99	Pre-dredge Survey	(Not supplied)	Kingfisher, Sandpiper, Pelican, Petrel & Cormorant canals, North & South Marinas, and lower Albatross Canal
01/03/00	Post-dredge Survey	(Not supplied)	
01/01/03	General survey	(Not supplied)	North & South Marinas, Skua & Curlew canals, and Lower Albatross canal
01/01/04	General survey - full canal network	(Not supplied)	All Canals
01/09/05	Pre-dredge Survey	(Not supplied)	North & South Marinas, Kingfisher, Jabiru, Albatross, Skua, Curlew, Kestrel, Osprey, Seahawk & Shearwater canals
01/02/06	Post-dredge Survey	(Not supplied)	
*7/08/09 - 08/08/09	Pre-dredge Survey	PBPL (122357)	Full System (Canals & Entrance)
*06/10/11	2011-12 Campaign Pre-dredge Survey	GPS & Hydrographic Services (1158-01 - 04)	All Canals
29/11/11	Investigation Survey	PBPL (126005)	Entrance Channel
*01/12/11	2011-12 Campaign Post-dredge Survey	GPS & Hydrographic Services (not supplied)	Falcon, Northern Marina
*22/02/12	2011-12 Campaign Post-dredge Survey	GPS & Hydrographic Services (1158-10 - 12)	Kingfisher, Jabiru, Sandpiper
*10/09/13	2013-14 Campaign Pre-dredge Survey	PBPL (not supplied)	Southern Marina basin, and Kingfisher, Sandpiper, Pelican, Cormorant, Petrel, Walkers Ck, and Albatross canals.
*06/12/13	Entrance Capital Post-dredge Survey	PBPL (128935)	Entrance Channel
*01/11/13 - 24/02/14	2013-14 Campaign Post-dredge Surveys	GPS & Hydrographic Services (1190-05, 1190-06A, 1190-07, 1190-08A)	Southern Marina, Pelican Cormorant, Petrel, Sandpiper, Albatross, Skua, Walkers Ck, and Curlew canals.
*01/09/14	Beaches Plus 2013-14 Campaign	(Not supplied)	Parts of Kingfisher & Sandpiper
*20/05/15 - 31/08/15[†]	Hydrographic Survey	PBPL (131707)	Full System (Canals & Entrance)

** Survey datasets made available by MBRC*

[†] Partial re-survey completed in 31 August 2015 covering Kingfisher, Sandpiper, Pelican, Cormorant, and Petrel canals (150831_Newport_0.5.pts)

Figure 3-1 Canals - Estimated Siltation Rates 2009 to 2015

Table 3-5 Estimated siltation rates

Canal Area	Estimated Siltation Rates (m^3/a)					§Adopted Average Rate (m^3/a)
	*1997-1999	*2000-2004	*†2004-2009	*2009-2011	2009-2015	
Lower Albatross	3,810	850	240	480	240	230
Upper Albatross	*20*	*10*	760	1,010	860	810
Curlew	–	–	300	220	560	430
Falcon	*390*	*220*	60	370	480	270
Gannet	–	–	10	30	70	40
Hawk	–	–	40	200	300	170
Heron	–	–	30	60	120	70
Ibis	–	–	20	160	100	60
Jabiru	*570*	*220*	630	2,720	2,190	1,410
Kestrel	–	–	220	260	480	350
Kingfisher	*820*	750	480	680	1,110	790
Kite	–	–	30	220	90	60
Northern Marina basin	5,720	1,770	1,790	2,000	1,970	1,880
Osprey	–	–	80	60	100	90
‡Pelican	*360*	*330*	420	490	1,300	860
Sandpiper	*700*	510	340	490	960	650
Sea Eagle	–	–	110	220	180	140
Seagull	–	–	60	110	170	110
Seahawk	–	–	40	30	80	60
Shearwater	–	–	150	350	400	270
Skua	–	–	350	250	590	470
Southern Marina basin	*110*	370	1,340	1,360	1,160	1,250
Spoonbill	–	–	80	180	160	120
Swan	–	–	10	40	70	40
Tern	–	–	50	50	70	60
Walkers Creek	–	–	290	850	1,000	640
Totals	**12,500**	**5,030**	**7,930**	**12,890**	**14,810**	**11,330**

** Source: KBR 2013a – Table 4.2 (p4-8) and Table 4.3 (p4-11)*

Italic numbers indicate partial survey coverage of canal

† 2004-2009 volumes take 2005/06 dredging into account

‡ Cormorant and Petrel canals are combined with Pelican canal

§ Basis for adopted rates is provided in Section 3.3.3.

3.3.2 Causes of siltation

Basic theory

Siltation is the process of suspended fine sediment particles settling out of suspension and being deposited on the bed and banks of channels, rivers, and other areas. The rate of deposition of fine sediment is proportional to the near-bed suspended sediment concentration, the settling velocity of the material, the bed shear stress exerted by flowing water (proportional to current velocity) or waves, and the critical bed shear stress for deposition (bed shear stress above which the deposition rate reduces to zero), as per the following empirical equation (Whitehouse et. al. 2000):

$$\frac{dm}{dt} = -\left(1 - \frac{\tau_0}{\tau_d}\right) C_b w_{50} \qquad \text{for } \tau_0 < \tau_d$$

$$\frac{dm}{dt} = 0 \qquad \text{for } \tau_0 \geq \tau_d$$

Where:

$\frac{dm}{dt}$ *rate of change of mass on the bed per unit area (kg m^{-2} s^{-1})*

τ_0 *applied bed shear-stress exerted by the flowing water (N m^{-2})*

τ_d *critical shear-stress for deposition (N m^{-2})*

C_b *near-bed suspended sediment concentration by mass (kg m^{-3})*

w_{50} *median settling velocity (m s^{-1})*

This empirical equation broadly implies that the siltation rate increases with increasing suspended sediment concentrations and decreasing current velocities. As such, it is expected that siltation rates will be highest in quiescent areas which are near to the source of the suspended sediment (i.e. where the suspended sediment concentrations are highest). When coupled with basic fluid mechanics, the equation also implies that siltation rates will increase following dredging, owing partly to the increase in flow area and subsequent reduction in flow velocities and bed shear stresses.

If the material is not eroded following deposition, the generally loose fine sediments will undergo self-weight consolidation, a process whereby the trapped pore water is gradually expelled from the voids within the soil. This leads to the sediment density increasing as a function of time and depth below the bed level. The increase in density is generally associated with an increase in the strength of the material and an increased resistance to erosion (Whitehouse et. al. 2000). The settled density of fine marine clays can vary appreciably depending upon the depth of deposition and time since deposition (van Rijn 1993).

The average dry density of settled deposits of fine marine clays was previously estimated by KBR for the *Moreton Bay Dredge Material Placement Study* (KBR 2006 p.6-2) and subsequently applied in the Newport Waterways Maintenance Model (KBR 2013a). The estimated *in situ* dry density of approximately 540 kg/m^3 compares relatively well with values published by van Rijn (1993) which indicate dry densities in the range 400-550 kg/m^3 and 550-650 kg/m^3 for 1 year old and 10 year old deposits respectively.

Suspended sediment sources

Previous studies and investigations have assessed the sources of suspended sediments entering the canal estate. These studies have concluded that the vast majority of settled sediments (approx. 95%) originate from Deception Bay, entering via natural tidal exchange, while a minor proportion (approx. 5%) originate from fluvial sources, including various stormwater outlets and Walkers Creek (KBR 2013a).

Temporal variation

Siltation rates will naturally vary with time as a result of the inherent variability in the key controlling factors including the suspended sediment concentrations and tidal velocities. The data presented in Table 3-5 indicates an apparent increase in siltation rates between the 2004-2009 and 2009-2015 assessment periods. Further review of the siltation rates and patterns, residual rainfall trends in the region, ambient suspended sediment concentrations in Deception Bay, and maintenance activities conducted during this time, indicates that the apparent increase may be attributable to a range of factors, including:

- Naturally increased siltation rates in dredged areas following dredging works.
- Potential increases in fluvial sediments as a result of above average rainfall between 2009 and 2013
- Possible increases in suspended sediment concentrations within the canal estate as a result of maintenance works, including maintenance dredging and beach restoration works.
- Lower than average siltation rates during the 2004 to 2009 period as a result of drought conditions (reduced volumes of fluvial sediments).

Review of the siltation rates between the 2004-2009 and 2009-2015 assessment periods shows the largest increases were in areas including Upper-Jabiru, Kingfisher, Pelican (incl. Petrel and Cormorant), and Sandpiper canals, and Walkers Creek. Many of these areas correspond to areas where dredging was undertaken during the 2009-2015 period. Additionally, beach restoration works were completed in Kingfisher, Sandpiper, and Pelican canals during this period.

3.3.3 Future siltation rates

Given the natural variability and complexities in siltation processes, it is not possible to accurately forecast future siltation rates within the canal estate. Therefore, for the purpose of assessing the frequency and volumes of dredging and dredged material disposal campaigns over the specified 50 year planning horizon, the average between the (smaller) 2004-2009 and (larger) 2009-2015 siltation rates has been adopted, as provided in Table 3-5. In determining an appropriate dredging and dredged material disposal strategy, estimated lower and upper-bound siltation rates have also been considered. Table 3-6 summarises the adopted average total siltation rate and estimated lower and upper-bound rates, together with the key survey and model-based estimates for comparison.

The estimated siltation rates from previous calibrated hydrodynamic model simulations have been included in Table 3-6 for general comparison only. These estimated siltation rates represent the

results of numerical model simulations completed for the original LTMP, as opposed to the direct comparison of hydrographic survey datasets.

Table 3-6 Summary of estimated annual siltation rates - canals

Description	Estimated total annual siltation rate (m^3/a)
*2004-2009 - Hydrographic surveys	7,930
2009-2015 - Hydrographic surveys	14,810
*Hydrodynamic siltation model results	13,141
Adopted Average Rate	11,330
Estimated Lower-bound Rate	7,500
Estimated Upper-bound Rate	15,100

** Source: KBR 2013a – Table 4.2 (p4-8) and Table 4.3 (p4-11)*

3.3.4 Isles of Newport development

The current proposal for the *Isles of Newport* development is understood to incorporate an elevated 23.7 ha saline lake (maintained at approximately 1.6 m AHD), controlled by lock and weir structure connected to lower Albatross Canal (Civil & Stormwater Design, 2015), together with a pumped seawater exchange system, which will draw water from upper-Jabiru canal and discharge it into the lake.

The additional water drawn into Jabiru canal for the seawater exchange system has the potential to influence siltation rates in this area of the canal estate. However, assessment of such effects has not been possible as no information regarding the exchange system (including flow rates etc.), or the results of detailed hydrodynamic assessments for the exchange system, have been provided to BMT. As such, the potential influence of the *Isles of Newport* development on siltation rates should be assessed once sufficient information and assessments have been provided by the developer.

3.4 Canal depths

3.4.1 Design bed levels

Maintenance dredging campaigns are conducted to restore canal bed levels to design bed levels to provide a period of immunity against ongoing siltation that may otherwise influence the safe navigation of craft throughout the canal estate. Within the Newport Waterways canal estate, the design bed levels, details of revetment walls, canal batters slopes, canal batter treatments, and canal widths, all vary depending on the stage of the development, with different designs being adopted for various stages and areas within the canal estate. The design bed levels are summarised in Table 3-7.

In order to compare the 2015 surveyed depths against original design bed levels, and to provide a consistent basis for the design of future dredging works, BMT JFA developed a Digital Terrain Model (DTM) of the Newport Waterways canals and entrance channel. This DTM was developed based upon supplied design drawings, and was developed to extend over the waterway areas only

(i.e. between the cadastral boundaries). A depth-coloured plan of the DTM is provided in Appendix A.

3.4.2 Minimum desirable bed levels

Minimum desirable bed levels were established as part of the original Long-term Maintenance Plan and these have been reviewed by BMT. The minimum desirable bed levels, or 'dredging trigger levels', represent a level above the original design bed level, which triggers the need for dredging. The 'dredging trigger levels' have been established on the basis of the original canal design bed levels, the design vessel draughts, and a suitable allowance for under keel clearance at Lowest Astronomical Tide (LAT) (KBR 2013a).

The design vessel draught adopted for the canal estate is 1.5 m, and is based upon guidance provided by the Harbour Master and guidance provided in Table 3.1 of AS 3962-2001 (Guidelines for Design of Marinas) (KBR 2013a). An allowance of 100 mm for under keel clearance at LAT was also previously adopted in most areas of the canal estate, with the exception of the western canals (Jabiru, Falcon, Hawk, Swan, and Kite canals), and the Marina Basins, which included a larger allowance for under keel clearance. The relatively low value of 100 mm was adopted based on the very soft nature of the settled marine clays, together with due consideration for the original canal design levels (KBR 2013a).

BMT have made only minor amendments to the previously adopted design bed levels and dredging trigger levels. These amendments reflected updated design depths and, where appropriate, associated trigger levels, following the provision of additional design drawings and information. The recommended updated values are presented in Table 3-7.

Table 3-7 Adopted design and minimum desirable bed levels

Canal Area	†Original design bed level (m LAT)	Dredging trigger level (minimum desirable bed level) (m LAT)
Lower Albatross	-3.37 to -2.55	*-2.0 (-2.6 to -2.0)
Upper Albatross	*-2.02 to -1.93 (-2.02)	-1.6
Cormorant	-2.02	-1.6
Curlew	-2.02	-1.6
Falcon	-2.43	-2.0
Gannet	*-2.93 (-1.93)	-1.6
Hawk	*-2.23 to -2.43 (-2.43)	*-1.6 (-2.0)
Heron	-1.93	-1.6
Ibis	*-1.93 (-2.02)	-1.6
Jabiru	-2.43	-2.0
Kestrel	-1.93	-1.6
Kingfisher	-1.85	-1.6
Kite	-2.43	-2.0
Northern Marina basin	-3.22 to -2.55	-2.4
Osprey	-1.93	-1.6
Pelican	-2.02	-1.6
Petrel	-2.02	-1.6
Sandpiper	-1.85	-1.6
Sea Eagle	*-1.93 (-2.02)	-1.6
Seagull	-1.93	-1.6
Seahawk	-1.93	-1.6
Shearwater	*-2.93 (-1.93)	-1.6
Skua	-2.02	-1.6
Southern Marina basin	-2.55 to -2.05	-2.0
Spoonbill	*-1.93 (-2.02)	-1.6
Swan	-2.43	*-1.6 (-2.0)
Tern	*-2.93 (-1.93)	-1.6
Walkers Creek	*-2.33 to -2.83 (-2.02)	-1.6

** Updated values (previously adopted values in brackets)*

† Refer to Appendix A for full design DTM

3.5 Dredging and material disposal options

The cost of maintenance dredging and dredged material disposal represents a significant proportion of the total estimated maintenance costs in the Newport Waterways Maintenance Model. As such, the identification and adoption of cost effective options is of key importance in minimising the total long-term costs of maintaining the waterways.

This section presents a discussion of dredging and dredged material disposal options, including the various constraints and results of a completed options assessment. The recommended dredging and material disposal strategy, including alternative options incorporated in the Maintenance Model, is presented in Section 3.6.

3.5.1 Constraints

A number of factors influence and constrain the available dredging and material disposal options available to MBRC. These include:

- Original canal bed levels and trigger depths.
- Estimated average siltation rates, and potential variability.
- Required frequency of dredging.
- Physical constraints within the canal estate, including narrow canals and presence of marine infrastructure.
- Capacity of the Griffith Road Pond (Section 19 Pond) and the limited available handling/drying area.
- Dredged material properties.
- Environmental outcomes and approvals.
- Limited ultimate disposal / re-use options.
- Economic feasibility.
- Overall timeframes for planning, procuring, and executing contracts.

These are broadly discussed in the following sections.

3.5.2 Frequency of dredging

The minimum frequency of dredging required to maintain bed levels below the trigger levels defines the maximum duration between dredging and material disposal campaigns. Based upon the adopted design and trigger levels, and estimated average siltation rates, the minimum required frequency of dredging is one campaign every 2 to 3 years and is generally dictated by the dredging requirements in Kingfisher Canal, which has the least favourable combination of design depth and siltation rate.

3.5.3 Physical constraints

The physical dimensions within the canal estate limit the available dredging methodologies which can be successfully employed to remove accumulated sediments from the canal bed, batters, and

from beneath floating jetties and pontoons. In general, it is considered that conventional small Cutter Suction Dredgers (CSDs) are most effective in dredging within the narrow constraints of the canals, and other methodologies such as Grab Dredgers (GDs) have some limitations, particularly dredging around and beneath jetties and pontoons, and in safely navigating and mooring attendant barges. Notwithstanding, dredging is still possible with both CSDs and GDs, subject to the specific plant and methodologies employed by contractors and subsequent effectiveness in removing material from areas which are difficult to access, and general tolerance control.

3.5.4 Dredged material physical properties

Review of historical sediment sampling and analysis results shows that the material to be dredged during maintenance dredging campaigns principally consists of unconsolidated fine marine clays (KBR 2013a). These sediments present a challenge in terms of drying the material, together with their suitability for beneficial re-use and other ultimate disposal options. The nature of the material also means that large volumetric and mass changes are likely to occur between its *in situ* state, initial placement in land-based ponds, drying, and disposal.

Material mass and volume changes

Estimates of the mass and volumetric properties of dredged fine marine clays were previously completed by KBR (2006 and 2013). These estimates were completed based on a mix of geotechnical test results, including some from the Griffith Road Pond, values provided from PBPL based on their experience, and reference values published in relevant literature, and are provided in Table 3-8 together with mass and volume conversion factors in Table 3-9. No additional geotechnical test results have been made available as part of this study, and therefore BMT have not critically reviewed or updated the previous estimates.

Table 3-8 Material mass and volume properties

Disposal phase	Volume (m^3)	Bulk density (t/m^3)	Solids fraction (t/m^3)	Water fraction (t/m^3)	M.C. (%)
In situ	1.00	1.350	0.537	0.813	152
CSD Dredge	2.96	1.135	0.182	0.953	525
Pond wet	0.89	1.391	0.605	0.786	130
Scraped crust	0.48	1.685	1.089	0.596	50
Spadeable	0.36	1.919	1.476	0.443	30
Pond Crust	0.36	1.920	1.600	0.320	20
Heaped Dry	0.34	1.760	1.600	0.160	10

Source: KBR 2013a and KBR 2006

Table 3-9 Volume and mass conversion factors from *in situ*

Material Location	*Volume conversion factor from *In situ*:	Mass conversion factor from *In situ*:
In situ	1.00	1.00
CSD Dredge	2.95	2.48
Pond wet	0.89	0.91
Pond Crust on Batter	0.36	0.52
Pond Crust in Truck - Bulked	0.44	0.48

** Source: KBR 2013a*

The values in Table 3-8 and Table 3-9 illustrate that the estimated volumes and mass of dredged material reduces appreciably if the material can be dried following initial placement in the Griffith Road Pond (i.e. difference between 'Pond wet' and 'Pond Crust' values).

Drying and suitability for beneficial re-use

Dredged marine clays are difficult and more expensive to handle when wet (i.e. when the moisture content exceeds the Liquid Limit), and it is therefore desirable to dry the material. Based on past dredging and material disposal projects at the site, solar drying of the material in layers not exceeding approximately 0.3m is possible and is estimated to take between seven and fourteen days (weather permitting). However, solar drying of thicker layers is not feasible as a dried surface layer forms (crust), and the significantly reduced permeability of this crust effectively prevents further drying of the underlying material.

Without stabilisation or other treatment, dredged marine clays are generally considered to have poor engineering properties, including California Bearing Ratios (CBRs) of approximately zero (KBR 2013a). This creates additional challenges when considering beneficial re-use of the material.

For a more extensive discussion of the inherent challenges in dewatering, drying, and disposing the dredged material, the reader is referred to Section 4.3 of the *Newport Waterways Maintenance Model Consolidated Maintenance Plan 2013* (KBR 2013a).

3.5.5 Griffith Road Pond

The capacity of the Griffith Road Pond affects the maximum volume of material dredged in any single campaign. The sediment storage capacity of the Griffith Road Pond, following reconfiguration works in 2011, was estimated to be approximately 34,000 m^3 (*in situ* m^3) based upon the surveyed *in situ* dredged volume for the 2011/12 dredging campaign (KBR 2013a). The comparison of pre and post dredge surveys for the subsequent 2013/14 dredging campaign indicates that a total of approximately 38,400 m^3 (*in situ* m^3) was dredged and contained within the Griffith Road Pond. Hence, the sediment storage capacity of the Griffith Road Pond is estimated to be between 34,000 to 38,000 m^3 (*in situ* m^3).

In practice, the storage capacity will depend on a range of operational factors, including the average density of *in situ* sediments, dredging production rates, dredging operational hours and shut-downs, and water quality discharge criteria. As such, it is likely to vary between dredging

campaigns, and adoption of a range between 34,000 to 38,000 m^3 is considered appropriate for informing the long-term dredging strategy.

In addition to the capacity constraints within the Griffith Road Pond, there is also very limited additional area available at the site for drying and handling the dredged material following completion of dredging campaigns. The lack of additional drying area(s) significantly limits the ability to dry the material, via solar drying, within suitable timeframes. Progressive removal of partially dried surface layers of approximately 0.3m thick from the pond's surface is considered feasible, but complete drying of the material (i.e. to approximately 20% MC) would unlikely be possible within reasonable timeframes using this method. As such, without additional land to dry the material at the site, the disposed material will likely have a moisture content in the range 50-130% and subsequently will have a larger volume and total mass than if the material was dried.

3.5.6 Environmental considerations

Environmental regulatory framework

The identification of dredging and material disposal options requires consideration of environmental regulatory constraints, including assessment and approval requirements for different activities. Environmental approvals are currently in place for canal maintenance dredging using a CSD as well as material handling at the Griffith Road Pond. However, there is currently no fixed strategy or approval for the long-term (ultimate) material disposal in place.

The key environmental issues that need to be considered in selecting the disposal strategy are:

- Physio-chemical properties of sediment
- Environmental constraints and approvals at the disposal site.

Consistent with the London Convention, the *National Assessment Guidelines for Dredging 2009* (NAGD) require the adoption of the waste hierarchy for determining acceptable disposal solutions. Ultimately however, the physio-chemical and associated geotechnical properties of sediments determine its suitability for beneficial reuse, recycling, land disposal or unconfined ocean disposal.

Previous sediment sampling and analysis programs have identified Tributyltin (TBT) and some heavy metals (at the marina) and acid sulfate soils as potential contaminants of concern. TBT and chromium concentrations were recorded at levels above the NAGD screening levels in 2010 (KBR 2012) but subsequent sampling in 2013 (KBR 2013b) and 2016 (SMEC 2016) have identified both contaminants at concentrations below the screening levels. Similarly, initial testing of arsenic was high in 2013 but below screening levels in 2016 (SMEC 2016). While potential acid sulfate soils (PASS) occur in the area, the sediments have been found to have appreciable neutralising capacity. As a result, maintenance dredged material has been assessed as suitable for land-based handling and disposal for all past campaigns, and suitable for both unconfined ocean disposal and land-based disposal for the 2016 campaign.

The only current location available for unconfined ocean disposal within Moreton Bay is the Mud Island Dredged Material Placement Area (MIDMPA). It is understood that MBRC have obtained approval to place material from the 2016 dredging campaign within the MIDMPA for ultimate disposal. The MIDMPA is currently used by multiple dredging operators within Moreton Bay,

including the Port of Brisbane Pty Ltd (PBPL), Department of Transport and Main Roads (DTMR) and Redland City Council (RCC), and ongoing studies expect the area to reach capacity before 2050 (KBR 2006) though this is subject to some uncertainty and is dependent upon works undertaken by PBPL/DTMR to expand the life of the facility. As such, the long-term use of the MIDMPA beyond a 30 year planning timeframe is uncertain.

The constraints on the long-term use of the MIDMPA, together with the requirements of the NAGD to consider onshore disposal and beneficial re-use options where possible, necessitate consideration of alternatives to unconfined ocean disposal. Material that has been handled and dewatered at the Griffith Road facility can be placed within landfill or similar sites (with the potential for some minor additional treatment). This will require reliance either on an existing site (e.g. Council-managed landfill site) or the development of a new site (e.g. old mining pits, rehabilitation areas). To the extent that environmental issues associated with the dredged material (e.g. high salt content) can be managed and contained, an onshore placement facility may be feasible from an environmental approvals perspective. A separate environmental feasibility and approvals study would need to be undertaken for any new onshore placement facility in order to allow for receipt of the dredged material.

Water quality guidelines

In addition, consideration needs to be given to the impact of dredging and placement activities upon the water quality objectives (WQOs) of Moreton Bay, as scheduled under the *Environmental Protection (Water) Policy* 2009. These WQOs are set to maintain particular environmental values (EVs), including aquatic ecosystems (e.g. seagrass). WQOs are set based on annual median values. The WQOs for the Newport Waterways canals include a turbidity objective for aquatic ecosystems of <8 NTU. Within Deception Bay the turbidity objective for aquatic ecosystems is <6 NTU.

Previous dredging within the canal estate has exceeded these turbidity levels at times during the dredging campaign (MBRC 2015). However, as the WQO values are based on annual *median* values, dredging activities are not expected to cause any impact to EVs for aquatic ecosystems in either the canals or Deception Bay. In addition, while monitoring is not typically undertaken in Deception Bay during dredging in the canals, KBR (2013a) has previously indicated a likely buffering effect within the canals, limiting turbidity impacts spreading from the canal estate.

3.5.7 Ultimate disposal and beneficial re-use options

There are a limited number of options available for the ultimate disposal and beneficial re-use of the dredged material, owing to the material's inherent properties, together with limited available land or established sites which can receive or store the material.

The *Moreton Bay Dredge Material Placement Study – Stage 2 Report* (KBR 2006) was commissioned by the Queensland Government, in conjunction with the Port of Brisbane, to investigate the future management of material dredged from within Moreton Bay. The study included detailed assessment of the environmental, social and economic issues associated with the options proposed for long-term dredged material disposal, and identification of the most viable

options. The study identified a number of possible disposal options, including those applicable to small boat harbours and canal estates, and included (KBR 2006):

- Continued use of the existing Mud Island DMP area (MIDMPA).
- Filling of old mine sites, including Swanbank and Ipswich coal mines.
- Filling of old gravel extraction pits.
- Opportunistic filling of coastal developments.
- Stabilisation and use as controlled/engineered fill – via mixing with cement or lime.

The study provided an overall recommendation to continue the use of the MIDMPA for the disposal of uncontaminated dredged sediments. However, the study acknowledged that access and location issues dictate that some canals (including Newport Waterways) would require dredging by small Cutter Suction Dredge, and that this material would need to be pumped to a small local pond, subsequently dried, and then trucked to a land based placement area or disused mine.

The following options for disposal or re-use of material dredged from the Newport Waterways canals have been identified:

Disposal:

- MBRC's Caboolture waste management facility (30km)
- Veolia's Ti Tree BioEnergy site (90km)
- Mud Island Dredged Material Placement Area (MIDMPA) (approximately 25km via barge)
- PBPL's Future Port Expansion (FPE) site, Fisherman Islands (approximately 50km)
- Short-term option for redistribution within deep 'holes' within the canal estate (limited capacity)

Rehabilitation and beneficial re-use:

- Potential rehabilitation of existing sand/gravel extraction sites/areas.
- Dried and placed as general fill (non-structural).
- Cement (or lime) stabilisation and re-use as controlled/engineered fill.
- Drying and leeching of salts, mixing with composted green waste, and re-use as garden mulch.

These options are each broadly discussed in the following sections.

MBRC waste management facilities

MBRC have advised that disposal of material at MBRC's Caboolture waste management facility is possible. However, advice provided from MBRC's waste management section has indicated that the salt content in the material is very likely to interfere with methane production from their landfill and it is therefore quite undesirable and costly to dispose of the dredged material at the Caboolture site. Further, initial trials have found that the material becomes quite dusty if used as day-cover, and relatively large areas of land are required to dry the material (J. Purcell, pers. comm., 7 March 2016).

Ti Tree BioEnergy Site

The Ti Tree BioEnergy site, located approximately 90km (by road) from Newport Waterways in Willowbank, is a waste disposal facility located on an existing open-cut coal mine. The site utilises "best practice" bioreactor technology to rapidly stabilise waste while capturing environmentally damaging methane and converting it into electricity (Ti Tree BioEnergy 2009). Initial advice provided by Veolia Environmental Services indicates that much of the material dredged from the canals could be accepted by this site, as either 'Contaminated Soils', or as 'Regulated Waste' (Kimber 2016).

MIDMPA

As noted in Section 3.5.6, the MIDMPA is the only area currently approved for unconfined ocean disposal in Moreton Bay, with the exception of beach nourishment locations near Bribie Island and inactive sites at St Helena Island and Raby Bay. It is designated as a material placement area within the Moreton Bay Marine Park and is managed by PBPL and DTMR. Only material that meets the NAGD requirements for unconfined ocean disposal is allowed to be placed at the site. The MIDMPA is located approximately 25 km by water from Newport Waterways.

There is some uncertainty regarding the long-term capacity of the site, though at current rates the site is expected to reach capacity before 2050 (KBR 2006). Even with actions to expand the longevity of the site, the current MIDMPA has a finite capacity to receive material in the long-term.

PBPL Future Port Expansion

The Future Port Expansion (FPE) site is a land reclamation which will extend the existing port facilities. PBPL have advised that they would consider receipt of the dredged material for use as reclamation material in the FPE (P. Nella, pers. comm. 28/04/2016). However, the FPE site will have a finite life for receiving dredged material, which is currently estimated to reach capacity in approximately 2040.

Redistribution

A potential once-off short-term option for the disposal of dredged material is the dredging and placement (i.e. redistribution) in deep holes within the canal estate. Preliminary assessment of the volumetric capacity of the deeper areas within the canal estate (principally within upper Albatross, Sea Eagle, Spoonbill, Shearwater, and Gannet canals) indicates a volume in the order of 20,000 m^3. Redistribution within the canal estate offers the advantage that the material is not double handled, and would therefore be significantly cheaper than disposal at land-based sites or the MIDMPA. However, the capacity is very limited and placement of material in these areas would require further environmental and engineering studies to protect against environmental impacts and to confirm the likely capacity.

Rehabilitation of existing sand/gravel extraction sites

As identified in the *Moreton Bay Dredge Material Placement Study*, there are likely to be opportunities to place the material for site rehabilitation within disused areas of sand/gravel extraction sites within the region. This would be similar in principal to the relatively recent filling of an existing extraction site along the North Pine River adjacent to the Gympie Arterial Road.

Placement of dredged material would generally comprise sub-aqueous placement, but may extend above existing water levels. Known existing sand or gravel extraction operations in the region include sites in Lawnton, Ningi, Toorbul and Donnybrook.

The key advantage of disposal within existing sand/gravel pits, in addition to the obvious beneficial use of the material, is the likely significantly reduced disposal cost compared with other options. However, each site/pit will have a finite capacity, and therefore new sites will need to be identified as existing ones reach capacity. Given this, it is recommended that MBRC should be continually investigating opportunities for this overall option, and seek to establish contracts with the appropriate entities managing such sites.

Following enquiries made during the current study, it is understood that rehabilitation of a site in Lawnton, most likely adjacent the North Pine River, is planned or currently underway. This potential opportunity should be further investigated.

General fill

Untreated, dried dredged material from the canals has been previously utilised off-site for general fill. In 2009 approximately 40,000m^3 of material was removed from the Griffith Road Pond and placed as general fill in the north-western section of the Isles of Newport development area (KBR 2013a). Further, a total of approximately 65,000 m^3 of material was removed from the Griffith Road Pond following the 2012 and 2014 dredging campaigns, and this material was placed as general fill on the Contractor's own site.

While there is likely to be a limited number of suitable sites for the placement of untreated material, it is considered to represent an economically efficient method as treatment and stabilisation costs are not necessary.

Cement or Lime Stabilisation

Preliminary stabilisation trials, undertaken by a Contractor on material dredged from the Newport Waterways, have indicated that cement stabilisation significantly improves the bearing capacity of the material and can be economically feasible (Geldenhuys 2016). Cement stabilised material could potentially be beneficially re-used for engineered/controlled fill, subject to further testing and assessment (including engineering testing and environmental impact assessment).

BMT are also aware of the Trinity Park project, north of Cairns, in which approximately 300,000m^3 of dredged fine material was successfully treated with lime and used for development fill. Beneficial re-use trials conducted for this project included stabilisation with agricultural lime as well as hydrated lime, and indicated increases in the soaked CBR of the material from approximately 3% (un-stabilised) to 5% and 10% once stabilised with agricultural lime and hydrated lime respectively.

Garden soil

Previous experiments by Kinhill Pty Ltd and PBPL (then Port of Brisbane Corporation) in 1999 have shown that dredged material can be dried and mixed with green waste to produce a soil in which salt tolerant upland plants can grow (KBR 2006). Further, advice from an external consultant has indicated that, subject to confirmation via laboratory scale tests, the material could be treated and subsequently sold as a garden soil which conforms to the requirements of AS 4419 *Soils for*

Landscaping and Garden Use. Such treatment would broadly involve mixing the dried dredged material with a mixture of sand and green waste at a ratio of at least 1:1 (i.e. potentially more sand and green waste required for mixing), followed by addition of soil conditioners, fertilisers, and stabilisers (Blair 2016). The costs associated with treatment would be a function of the final treatment method, cost of the green waste, sand, mixing plant, etc., together with the potential sale price of, and demand for, the end-product.

It may be feasible for MBRC to undertake the treatment of the dredged material at existing waste facilities where green waste is already disposed. It is therefore recommended that MBRC further investigate the technical and economic feasibility of this overall beneficial re-use option.

3.5.8 Economic feasibility

The cost of the various dredging and material disposal options is a key consideration in the overall assessment of the options. In order to compare options, rates have been estimated for the various dredging and material disposal options on the basis of dollars per *in situ* cubic meter. Rates were estimated using a range of sources including quotes, historical rates for past projects, and typical industry rates. Estimated disposal only rates are provided in Table 3-10, and the estimated total combined rate for dredging and material disposal are provided in Table 3-11.

The conversion from 'Raw rates' to 'Per *in situ* $m^{3,}$ rates requires mass and/or volumetric conversions between the disposed sediment mass and volume, and the estimated *in situ* volume. The estimates in Table 3-10 and Table 3-11 assume that the in situ material and disposed material are saturated and have Moisture Contents (MC) of 152% and 130% respectively (i.e. bulk densities of 1.35 t/m^3 and 1.39 t/m^3 respectively). If the material is dried beyond an MC of 130% (i.e. 'Pond wet' material state), the disposal rates may reduce appreciably below the presented rates.

Table 3-10 Estimated disposal only rates

Disposal site/option	Raw rate	Estimated Disposal Only Rate ($ per in situ m^3)
MBRC Caboolture waste management facility	$125/tonne	$155
Ti Tree BioEnergy site	*$43/tonne	$55
Future Port Expansion site	$40/$m^3$	$35
Sand/Gravel Extraction and General fill sites	$10/tonne	$13
Cement stabilisation (excl. site disposal fees)	$10/$m^3$	$9

** Applicable rate if final classification is 'Contaminated Soils'. Rate of $79.70/t applies if classified as 'Regulated Waste'*

Table 3-11 Estimated total dredging and disposal rates

Option	Estimated Dredging & Disposal Rate* ($ per in situ m^3)
Grab dredge - MIDMPA	$80
CSD or Grab Dredge - Redistribution	$35
CSD - GRP - MBRC Caboolture waste management facility	$195
CSD - GRP - Ti Tree BioEnergy site	$125
CSD - GRP - MIDMPA	$80
CSD - GRP - Future Port Expansion site	$75
CSD - GRP - Rehabilitation of extraction sites	$50
CSD - GRP - General fill	$50
CSD - GRP - Cement stabilisation	$65
†CSD - GRP - Garden soil	$75

** Rates exclude contract execution costs (i.e. mobilisation/demobilisation, survey, project management etc.). Applied dredging rate for CSD - $12/$m^3$*

† Preliminary estimate only – includes cost recovery of soil at approx. $18/$m^3$

CSD – GRP – Cutter Suction Dredge to Griffith Road Pond

3.5.9 Overall execution timeframes

The time required to undertake planning and design, tendering, procurement, and contract execution of each dredging program affects the minimum duration between dredging campaigns, and therefore the dredging schedule. The previous dredging and material disposal strategy was based upon a cycle of annual dredging and material disposal. This was adopted largely on the basis of maximising the opportunity for material drying prior to disposal, which subsequently requires lower dredging volumes, and more frequent dredging (KBR 2013a).

Based on MBRC's recent experience in executing the maintenance dredging and material disposal programs, the timeframes to complete the necessary planning and design tasks (including sediment sampling and analysis, dredging design, tender preparation, and EMP updates), together with procurement and the actual dredging and material disposal contract execution, are such that a twelve month turn-around between campaigns is not practically achievable. MBRC have indicated that the minimum practically achievable timeframe between campaigns would be approximately 18 months.

3.5.10 Options assessment

A broad assessment of dredging and dredged material disposal options was completed. The outcomes of the assessment are summarised in Appendix B. The recommended dredging and material disposal strategy was developed following the options assessment, and is presented in the next section.

3.6 Dredging and material disposal strategy

This section presents the recommended dredging and dredged material disposal strategy, together with proposed alternatives incorporated in the Maintenance Model.

3.6.1 Recommended strategy

The recommended dredging and dredged material disposal strategy comprises dredging campaigns every two to three years using a small CSD, with dredged sediment pumped into the Griffith Road Pond, and subsequent beneficial re-use of the material. The key factors leading to the selection of this methodology include:

- Small CSDs can best adapt to the access constraints of Newport Waterways, can dredge under pontoons, have relatively high manoeuvrability, and represents the cheapest dredging method.
- Dredging every two to three years is recommended to meet the expected dredging frequency in canals such as Kingfisher to generally maintain navigable depths, whilst also keeping estimated dredged material volumes for each campaign within the capacity constraints of the Griffith Road Pond.
- The combination of small CSD and beneficial re-use is estimated to represent the cheapest dredging and material disposal option, and is likely to also result in the most favourable environmental outcomes.
- This broad methodology has been successfully employed for all past maintenance dredging campaigns.

A long-term opportunistic fill or beneficial re-use site (or sites) has not yet been secured by MBRC for future dredging and material disposal campaigns. However, as advised by MBRC, it has been assumed that a site (or sites) will be identified, and the necessary agreements established, prior to future dredging and material disposal campaigns.

Based on reviews of the material disposal contracts in 2012 and 2014, it has been assumed in the Maintenance Model that the dredged material is removed from the Griffith Road Pond and disposed at a density corresponding to the ‘Pond wet’ density (i.e. MC 130%). This implies volumetric and mass conversions from *in situ* to disposed material of 0.89 and 0.91 respectively (Ref. Table 3-9, ‘Pond wet’ density). However, in order to minimise the costs for future disposal/beneficial re-use of material from the Griffith Road Pond, opportunities to dry the material beyond the ‘Pond wet’ state (i.e. to reduce its total volume and mass) should be pursued.

Drying of fine grained dredged material is most economically achieved through solar drying (USACE 1987, KBR 2006), and involves construction of drainage channels, to promote drainage and reduce ponding, together with the progressive removal of the dried surface layer or ‘crust’ approximately every seven to fourteen days (weather dependent). If this approach is applied by MBRC, it is estimated that the removed material will have moisture contents in the range 100% to 50% (based upon the information provided in Table 3-8), and therefore a lower volume and mass.

3.6.2 Proposed dredging schedule

A proposed dredging schedule was developed on the basis of the recommended strategy. This proposed schedule was developed in order to inform predicted dredged material volumes applied in the Maintenance Model, together with the dredging areas for the next three dredging campaigns.

The proposed dredging schedule was generated using the existing Excel spreadsheet developed by KBR, with updates to reflect the revised predicted long-term siltation rates, updates to the original design and trigger levels, bed levels and volumes to design as at 2015, and the proposed dredging strategy. The existing spreadsheet tool utilises surveyed levels and volumes, predicted shoaling rates and siltation volumes, and the canal design and dredging trigger levels to estimate the timing and material volumes for future dredging campaigns within the nominated dredging 'zones'. The schedule was developed to cover a period of 20 years and dredging was scheduled to minimise the number of areas where bed levels exceeded the dredging trigger level.

It is important to note that the 'shoaling rates' applied in the tool/schedule correspond with the rate-of-rise in the area of highest siltation within each zone, not the average siltation rate within the zone, as it is the areas of higher siltation which will shoal more rapidly and cause potential impacts to navigation. Also, the 'siltation volumes' represent the average predicted annual siltation volume over the full dredging zone.

The proposed dredging schedule is provided in Appendix C, and a summary of the estimated dredged material volumes and areas for the next three campaigns is provided in Table 3-12 and in Figure 3-2.

Table 3-12 Proposed dredging schedule – Campaigns 1-3

Campaign	Dredging Areas	Estimated Volume (m^3)
1	Northern Marina basin, Lower Sandpiper, Upper Kestrel, Seahawk, Osprey, Seagull and Heron canals.	27,250
2	Southern Marina basin, Lower Kingfisher, Pelican, Upper Sandpiper, Jabiru, Falcon, Upper Albatross, Kestrel, Gannet, and Ibis canals.	32,000
3	Northern Marina basin, Kingfisher, Upper Pelican, Curlew, Skua, Walkers Creek, Upper Albatross, Kestrel, and Spoonbill canals.	29,300

While the proposed volumes and timing are considered appropriate for inclusion in the Maintenance Model (i.e. for the long-term planning of maintenance dredging requirements and costs), the actual timing and material volumes for future dredging campaigns will need to be determined via review and analysis of regularly scheduled hydrographic surveys.

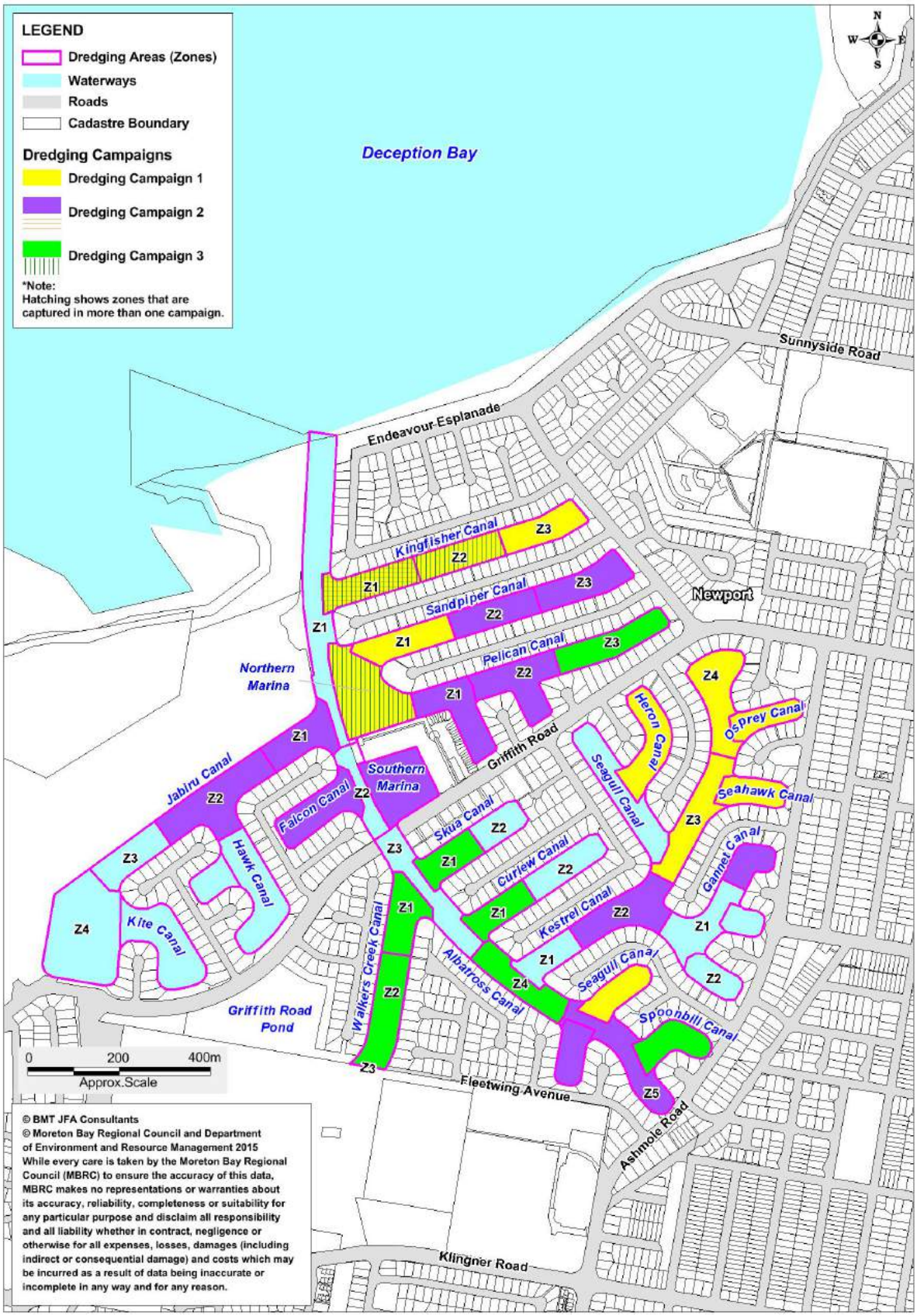

Figure 3-2 Proposed dredging schedule - dredging areas

3.6.3 Alternative options

Two alternative dredging and material disposal options have been included in the Maintenance Model. These options can be selected in the event that the recommended strategy of CSD and beneficial re-use is not available. The alternative options comprise:

- Small CSD, with dredged sediment pumped into the Griffith Road Pond, and subsequent loading into barges and unconfined ocean disposal at MIDMPA.
- Small CSD, with dredged sediment pumped into the Griffith Road Pond, and subsequent loading into trucks and disposal at the Ti Tree BioEnergy site.

These two options, in particular the second, are estimated to have appreciably higher cost rates for dredging and material disposal. However, they have been included in the model to provide alternatives in the event that a more cost effective beneficial re-use option is not available.

3.7 Environmental approvals

3.7.1 Approvals Required

Preferred Option

MBRC currently hold a development permit for dredging and placement activities associated with the Newport Waterways canals: SPDE01220110. This permit provides for the following activities:

- Maintenance dredging up to 80,000m^3/yr to design levels, using a CSD
- Placement of material in the 'Section 19 Pond' (i.e. Griffith Road Pond) with ultimate placement only in approved landfill or other site OR placement of material at MIDMPA.

There is no expiry associated with this approval.

In addition, MBRC holds a marine park permit for placement of up to 210,000m^3/yr at the MIDMPA: MPW2016/MBMP0097. This permit is valid until February 2022.

Based on the recommended strategy, no amendments to this approval are required for dredging activities or for the placement within the Griffith Road Pond. However, additional approvals or government liaison would be required for beneficial re-use activities, depending upon the option employed:

- Use for rehabilitation or fill of an extraction site – environmental approvals required for the site, including a development permit for a material change of use (MCU) and, potentially, an environmental authority to utilise a site for material disposal. **NB** – where the site is already approved, no further approvals are expected to be required.
- Use of dried/treated material – no additional environmental approvals required but, as per Condition G7 of SDPE01220110, permission is required from the Department of Environment and Heritage Protection (DEHP) for placement of material other than at an approved off-site location.

Alternative Options

If material was to be dredged and brought to the MIDMPA for unconfined ocean disposal, no change would be required to the existing dredging permit, SPDE01220110 or marine park permit, MPW2016/MBMP0097. For placement beyond 2022, renewal of the marine parks permit would be required; however, note the constraints on long-term permits as discussed in Section 3.5.6.

No additional approvals are required for ultimate placement of material at an approved landfill site or equivalent (e.g. Ti Tree BioEnergy site).

3.7.2 Planning and Execution Requirements

Preferred Option

As part of each dredging campaign for the Newport Waterways canals, the following actions are required:

- Preparation of a site-based management plan (SBMP) for the works or review and adaption of an existing SBMP, prior to commencement of works
- Sediment testing for acid sulfate soils (ASS) or other contaminants, prior to commencement of works
- Water quality monitoring during dredging.

Depending upon the beneficial re-use options available for each dredging campaign, additional approvals would also need to be sought in parallel. Assessments and testing for these approvals will depend upon the requirements of the relevant approval agencies.

Alternative Options

Before each dredging campaign, testing of material would need to be undertaken to ensure it is suitable for unconfined ocean disposal in accordance with the NAGD.

No further tasks are required for placement at an approved landfill site or equivalent (e.g. Ti Tree BioEnergy site) unless required by the site operator.

3.7.3 Renewals

No renewals are required for existing dredging and placement permits. Any new approvals obtained for beneficial re-use or other options may require renewal.

4 Entrance Channel Maintenance Dredging

4.1 Introduction

The Newport Waterways entrance channel was originally constructed in the late 1970's through the existing shallow areas of southern Deception Bay. The original channel was approximately 1.5 km long, 15 metres wide (at the toe-lines), and had a design depth of -1.85 m LAT. The channel was upgraded via capital dredging in 2012-13, and now has a design length of approximately 2.4 km, width of 30 metres (at the toe-lines), and design depth of -2.4 m LAT. The channel is used by both private and commercial vessels to access the Newport Waterways canal estate.

The channel experiences natural siltation and maintenance dredging is subsequently required to ensure safe navigation. This section discusses maintenance dredging within the entrance channel, including discussion of historical dredging and material disposal activities, siltation rates, design depths, recommended dredging and material disposal strategy, and environmental approvals.

4.2 Historical activities

Available records indicate that maintenance dredging has been undertaken within the entrance channel on a periodic basis since 1985 (KBR 2013a). Additionally, capital dredging for the channel upgrade was completed during 2012 and 2013. Table 4-1 summarises the dates and dredged volumes, based on available records, for past dredging campaigns.

Table 4-1 Summary of past dredging campaigns – entrance channel

Year*	Dredging and material disposal methodology	Estimated dredged volume (m^3)
1985	Maintenance Dredging - Not known	Not known
1992	Maintenance Dredging - Not known	Not known
1999	Maintenance Dredging - Grab dredge and unconfined ocean disposal at MIDMPA	Not known
2007	Maintenance Dredging - Grab dredge and unconfined ocean disposal at MIDMPA	Not known
2012	Capital Dredging - Grab dredge and unconfined ocean disposal at MIDMPA	80,000

** Year dredging campaign commenced*

4.3 Siltation rates

Siltation rates within the original entrance channel have been previously assessed via direct comparison of hydrographic survey datasets. The results of the previous assessments are documented in KBR (2013a) and included an estimated siltation rate, based on comparison of hydrographic survey datasets, of 1,700 m^3/annum for the original channel. An estimated siltation rate of 3,200 m^3/annum for the upgraded channel was also provided, but this estimate was provided prior to the construction of the upgraded channel and was therefore a preliminary forecast of the anticipated siltation rates only. Additional hydrographic survey datasets, collected following

the channel upgrade, have facilitated further assessment and update of the estimated siltation rates. This section summarises BMT's completed assessment and outcomes.

The broad methodology for the completed assessment is summarised in Table 4-2. The resulting estimated siltation rates (i.e. G2) are presented in Figure 4-2 and summarised, together with previous estimates, in Table 4-3. Surveyed bed levels and siltation rates along the entrance channel centreline are also provided in Figure 4-1.

Table 4-2 Summary of siltation assessment methodology – 2013 to 2015

Ref.	Survey Grid Calculation
G1	2015 (20/05/15) **minus** 2013 (06/12/13)
G2	Estimated Siltation Rate 2013-2015 = G1 / 1.45 years

Table 4-3 Entrance Channel - Summary of estimated siltation rates

Description	Estimated annual siltation rate (m^3/a)
*2002-2007 - Hydrographic surveys	*1,700
*2007-2011 - Hydrographic surveys	
†2013-2015 - Hydrographic surveys	†6,500
Adopted Long-term Average Rate	5,000

** Original entrance channel - Source: KBR 2013a (p.5-1)*

† Upgraded entrance channel.

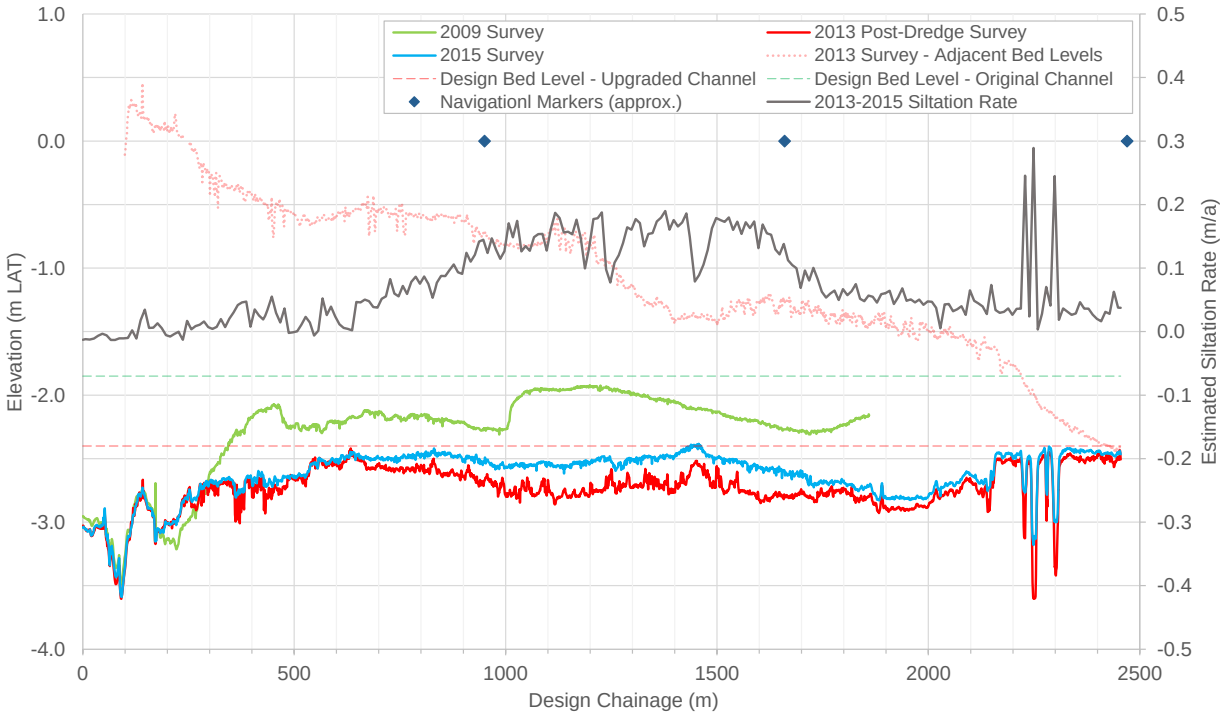

Figure 4-1 Surveyed bed levels and estimated siltation rates - Entrance Channel centreline

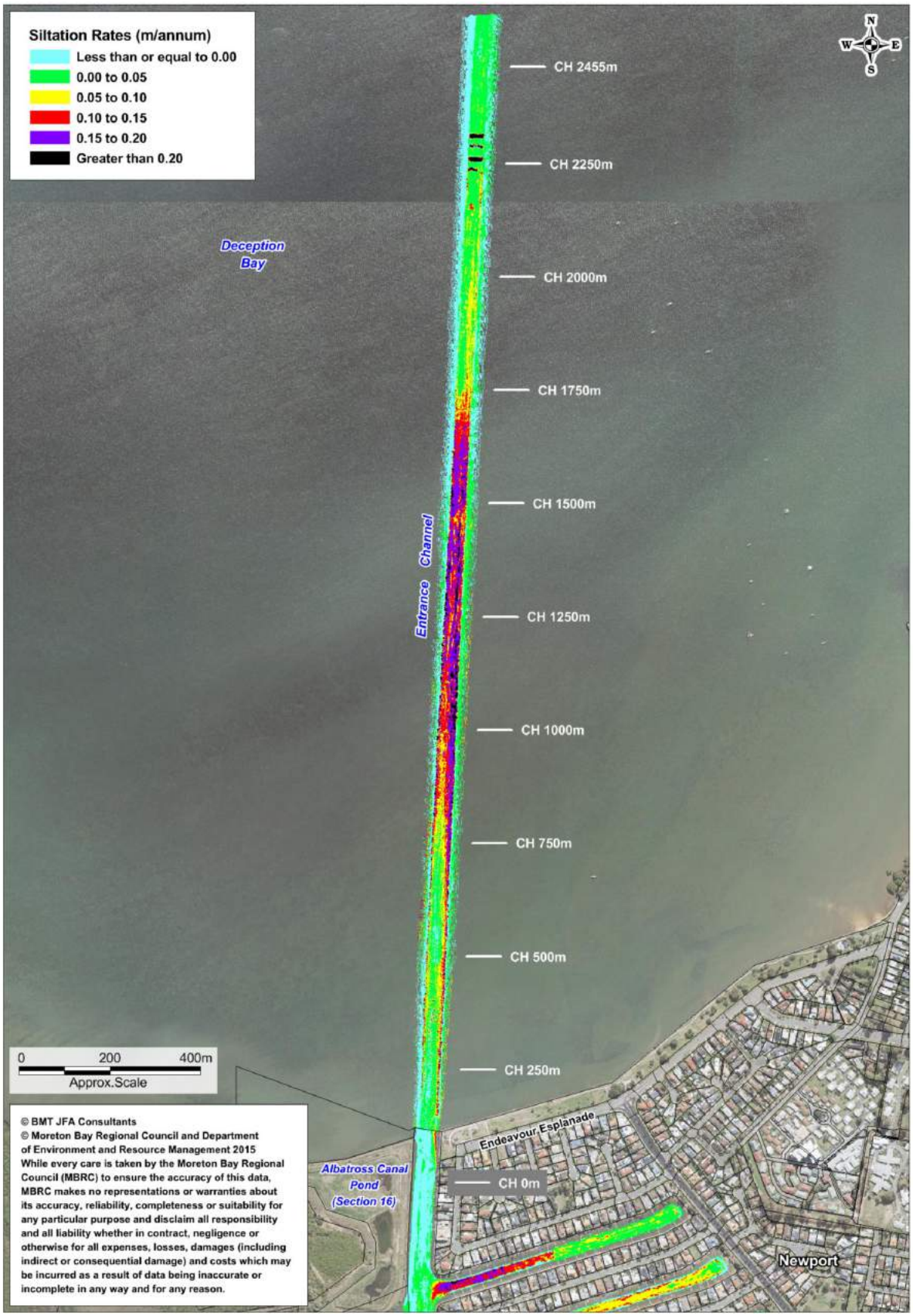

Figure 4-2 Entrance Channel - Estimated Siltation Rates 2013 to 2015

4.3.1 Causes of siltation

Overview

The cause of siltation within the entrance channel is broadly analogous to the canals, being a result of suspended sediments settling out of suspension in the relatively quiescent areas of the channel.

Fine marine sediments are naturally suspended into the water column as a result of wave action and tidal currents within Deception Bay, and the wider Moreton Bay. The deeper depths within the entrance channel, compared with the surrounding tidal and sub-tidal mud flats, result in appreciably reduced wave and current induced bed shear stresses. As outlined in Section 3.3.2, reduced bed shear stresses result in an increased potential siltation rate.

Spatial patterns

The siltation patterns within the entrance channel, based principally on the 2013 to 2015 period (Ref. Figure 4-1and Figure 4-2), are broadly summarised as follows:

- CH 0 to 600 m – Limited siltation
- CH 650 to 1750 m – High siltation
- CH 1750 to 2450 m – Low siltation
- Cross-sectional variation – Generally higher siltation on port (Eastern) side of channel.

The limited siltation rates near to the canal estate entrance (i.e. CH 0 to 650 m) is a result of relatively high ebb and flood tidal velocities in the channel. These tidal current velocities reduce further out in the channel as the tidal 'jet' partially diverts from the channel alignment, heading in a north-north east direction (ebb tide) towards the North Passage of Moreton Bay. This, combined with the relatively shallow surrounding bed levels, results in relatively high siltation within the middle of the channel (i.e. CH 650 to 1750 m). Conversely, the deeper surrounding bed levels in the outer channel (i.e. CH 1750 to 2450 m) result in relatively low siltation rates in this area.

In the areas of relatively high siltation, there is a general pattern of slightly higher siltation on the port (Eastern) side of the channel. This very broadly indicates that a greater proportion of the suspended sediments are transported into the channel from the north-east.

4.3.2 Future siltation rates

Given the natural variability and complexities in siltation processes, it is not possible to accurately forecast future siltation rates within the entrance channel. Therefore, for the purpose of assessing the frequency and volumes of maintenance dredging over the specified 50 year planning horizon, a long-term average siltation rate has been estimated based upon the limited available data since construction of the upgraded channel, together with previously reported estimates.

As provided in Table 4-3, an estimated long-term average siltation rate of 5,000 m^3/annum has been adopted in the Maintenance Model. The basis for this is broadly as follows:

- Previously estimated siltation rate for the upgraded entrance channel of 3,200 m^3/annum (KBR 2013a).

- Estimated siltation rate for the period 2013-2015 of 6,500 m^3/annum.
- Expected enhanced siltation in the period immediately following the capital dredging (i.e. the 2013-15 period).

Given the limited period since construction of the upgraded channel, and associated period of available data, it is strongly recommended that the adopted siltation rate be reassessed following future surveys.

4.4 Channel depths

Maintenance dredging campaigns will be conducted to restore the entrance channel bed levels to the current design level of -2.4 m LAT. A 'dredging trigger level' (i.e. minimum desirable depth) was not previously defined in the original LTMP. Further, the design basis for the upgraded entrance channel has not been provided (this would provide the design vessel, wave height and siltation allowances adopted for the upgraded channel design). It is recommended that the original design basis be used to inform an appropriate dredging 'trigger' level.

Notwithstanding, for the purpose of estimating the frequency and volumes of maintenance dredging over the specified 50 year planning horizon, a minimum desirable depth of -2.0 m LAT has been adopted for the upgraded entrance channel. This broadly allows for the following:

- 1.5 m design vessel draught
- 0.3 m under keel clearance
- 0.4 m design wave height (0.5 x design wave height is applied in determining the required depth)

Under these assumptions, tidally restricted access may apply for vessels with draughts exceeding 1.5 metres.

4.5 Dredging and material disposal strategy

This section presents a summary of dredging and dredged material disposal options for the entrance channel, together with the recommended dredging and material disposal strategy.

4.5.1 Constraints

A number of factors influence and constrain the available dredging and material disposal options available to MBRC. These include:

- Exposed waters and shallow surrounding depths.
- Pumping distances and pond capacities for land-based disposal.
- Environmental outcomes and approvals.
- Economic feasibility.

4.5.2 Physical environment

The entrance channel is located within the shallow exposed waters of southern Deception Bay. This physical environment limits the number of suitable dredging methods, principally due to the relatively narrow channel and shallow surrounding areas.

Typical dredging methodologies, and their limitations in this location, are summarised as follows:

- Cutter Suction Dredge (CSD) discharging to land-based disposal/handling area:
  - Wave action in the exposed waters of Deception Bay will likely necessitate a larger CSD than those used in the canals, and operability may still be affected by waves.
  - The need for anchor lines, while maintaining channel access, may result in reduced operability and potential interruptions to channel access.
  - Pumping distances of up to approximately 4.0 km to the Griffith Road Pond will result in increased costs and likely reduced production rates.
- Trailing Suction Hopper Dredge (TSHD) disposing to MIDMPA:
  - The relatively shallow and narrow entrance channel provides serious restrictions on manoeuvring a TSHD vessel. Subsequently, most TSHD vessels will either not be able to access the channel due to draught restrictions (i.e. shallow depths), or be able to safely navigate within the channel.
  - The relatively long sailing distance to the MIDMPA will result in reduced production rates, and generally increased costs given the small size of TSHD required due to draught limitations.
  - TSHDs are generally less efficient when dredging cohesive materials such as fine marine clays, and are therefore not well suited to maintenance dredging of the entrance channel.
- Grab Dredge (GD) placing in barges for disposal to MIDMPA:
  - GDs are suitable to dredging in moderately exposed waters, and are generally more resilient to wave-action than CSDs.
  - The relatively narrow entrance channel does necessitate that a relatively small grab dredge be used in order to maintain channel access during dredging works, and that anchor lines are placed to minimise potential impacts on channel access.
  - Grab dredging has been successfully employed within the entrance channel for past maintenance dredging campaigns, together with the channel upgrade capital dredging.

4.5.3 Pumping distances and pond capacities

As briefly outlined in Section 4.5.2, long pumping distances are required for a CSD discharging to the Griffith Road Pond. This will require mobilisation and establishment of a very long dredging pipeline, together with the use of at least one booster pump. This will subsequently result in appreciably increased mobilisation and demobilisation costs, and dredging costs.

Additionally, on the basis that MBRC adopt the recommended dredging and material disposal strategy for the canal system, it is anticipated that the Griffith Road Pond will be fully utilised and may not have sufficient capacity to retain dredged material from the entrance channel.

4.5.4 Environmental considerations

The environmental constraints for the entrance channel dredging, as for the canal dredging, are associated with material quality and placement options. In addition, the entrance channel is located within the Moreton Bay Marine Park (MBMP) and adjacent to sediment sensitive seagrass meadows.

Dredged material from the entrance channel has been previously placed at the MIDMPA and has previously been demonstrated to be suitable for unconfined ocean disposal. Dredging in this area is known to generate turbid plumes which could potentially affect nearby seagrass beds and water quality values for Deception Bay. As noted in Section 3.5.6 Water Quality Objectives have been set for Deception Bay in order to maintain Environmental Values, including aquatic ecosystems (e.g. seagrass). Turbid plumes caused by dredging are likely to exceed the turbidity objective associated with these WQOs temporarily but would not cause the annual *median* turbidity levels to change in the Bay. Thus, while there may be potential temporary impacts on seagrass, these will not cause long-lasting impacts. It is added that dredging works in the entrance channel, including potential impacts to water quality, are already subject to approval.

Placement of material at the MIDMPA is approved until 2022. While it is likely approval will continue to be granted in the short-to-medium term, there is uncertainty associated with the availability of the MIDMPA over a long-term planning horizon (see Section 3.5.6). All of MBRC's current permits are linked to the MIDMPA, however, and no other viable offshore dredged material placement area is currently approved. The sediment has not been tested for the purposes of onshore disposal (the key issue being Potential Acid Sulfate soils) but is expected to be of a similar nature to the material from the canals, and therefore potentially suitable for land-based disposal.

4.5.5 Economic feasibility

The cost of the various dredging and material disposal options is a key consideration in the overall assessment of options. In order to compare options, rates have been estimated for potential dredging and material disposal options on the basis of dollars per *in situ* cubic meter. Rates were estimated using a range of sources including quotes, historical rates for past projects, and typical industry rates. The estimated total combined rates for dredging and material disposal are provided in Table 4-4.

The estimated rates in Table 4-4, excluding the Grab dredge to MIDMPA rate, assume that the *in situ* material and disposed material are saturated and have Moisture Contents (MC) of 152% and 130% respectively (i.e. bulk densities of 1.35 t/m^3 and 1.39 t/m^3 respectively). If the material is dried beyond an MC of 130%, the disposal rates may reduce appreciably.

Table 4-4 Entrance Channel - Estimated total dredging and disposal rates

Option	*Estimated Dredging & Disposal Rate ($ per in situ m^3)
Grab dredge - MIDMPA	$60
†CSD - GRP - Future Port Expansion site	$75
†CSD - GRP - Rehabilitation of extraction sites	$70
†CSD - GRP - General fill	$70
†CSD - GRP - Cement stabilisation	$85

** Rates exclude contract execution costs (i.e. mobilisation/demobilisation, survey, project management etc.).*

†Based on preliminary cost estimates only. Applied dredging rate for CSD - $30/$m^3$

4.5.6 Recommended dredging and material disposal strategy

The recommended dredging and material disposal strategy for the entrance channel comprises Grab Dredging and disposal, via barges, to the MIDMPA. The key factors leading to the selection of this methodology include:

- Grab dredging is considered the most suitable dredging methodology for the entrance channel, having been successfully employed within the entrance channel for past maintenance dredging campaigns, together with the channel upgrade capital dredging.
- Placement of dredged material at the MIDMPA alleviates capacity constraints of the Griffith Road Pond and potential disruptions to canal maintenance dredging.
- This option is estimated to be the most cost effective dredging and material disposal option.

In order to inform the Maintenance Model of the timing and material volumes for future maintenance dredging campaigns, a proposed dredging schedule was developed. The developed schedule indicates that maintenance dredging of between 25,000–30,000 m^3 will be required approximately every 5-6 years. This is based on:

- A minimum desirable depth of -2.0 m LAT (including the associated assumptions presented in Section 4.4). Noting that this shall be reviewed by MBRC against the original design basis for the upgraded channel.
- Review and analysis of the limited available hydrographic survey datasets collected since completion of the upgraded channel, and subsequent estimated long-term average siltation rate of 5,000 m^3/annum.

While the adopted volumes and timing are considered appropriate for inclusion in the Maintenance Model (i.e. for the long-term planning of maintenance dredging requirements and costs), the actual timing and material volumes for future dredging campaigns should be determined via review and analysis of regularly scheduled hydrographic surveys.

4.6 Environmental approvals

MBRC currently holds the following permits for dredging and placement activities associated with the Newport Waterways entrance channel:

- SPDC01838011 – Development permit for tidal works (capital and maintenance dredging)
- SPDE01838011 – Development permit for material change of use for an environmentally relevant activity (capital and maintenance dredging, with placement at MIDMPA)
- QS2012/BNT456 – Marine park permit for capital and maintenance dredging and placement at MIDMPA
- 2011DP0373 – Development permit for removing seagrass during capital dredging
- 215/0108071(1) P5855-MOM E5988 – Concurrence approval for dredging

These permits limit dredging to 90,000m^3/yr with a 'Clam Shell Bucket' dredge (i.e. Grab Dredge), with placement at the MIDMPA. The marine park permit (QS2012/BNT456) is due to expire in 2022; none of the other permits have an expiry date.

No additional approvals are required for the recommended dredging and material disposal option.

4.6.1 Planning and Execution Requirements

As part of each dredging campaign for the Newport Waterways entrance channel, the following actions are required:

- Preparation of a site-based management plan (SBMP) for the works or review and adaption of an existing SBMP, prior to commencement of works.
- Preparation of an environmental management plan (EMP) for placement at the MIDMPA or review and adaptation of an existing EMP, prior to commencement of works.
- Sediment testing to ensure material is suitable for unconfined ocean disposal as per the NAGD, prior to commencement of works.
- Water quality monitoring during dredging.

In addition, it is recommended that pre-dredging visual surveys are conducted of the entrance channel to ensure no seagrass has regrown, subject to agency consultation. Any removal of seagrass will require an additional approval (and offsets).

4.6.2 Renewals

QS2012/BNT 456 is due for renewal in 2022. This covers all works in the MBMP, including placement at the MIDMPA. No other renewals are required.

5 Other Maintenance Activities

5.1 Introduction

In addition to maintenance dredging within the canals and entrance channel, MBRC has an ongoing general maintenance program which consists of a number of maintenance activities, including:

- Canal batters and rock wall maintenance
- Vegetation and litter removal
- Maintenance and replacement of signage and navigation aids
- Water quality monitoring

These maintenance activities are each briefly discussed in the following sections.

5.2 Canal batters and rock wall maintenance

The canal batters, extending from the navigation channel to the property boundaries, require periodic maintenance to ensure that their function and amenity is maintained. Additionally, the rock walls which line the entrance to the canals are expected to require periodic maintenance.

5.2.1 Canal batters

The action of boat wakes, stormwater runoff, marine plants, and other factors have the potential to cause erosion and degradation of the canal batters, and maintenance of the batters may subsequently be required. Various canal batter designs are present within Newport Waterways, varying from rock armoured slopes with no concrete revetment wall, to gravel 'beaches' with small concrete revetment walls at the property boundary.

A number of the original canals within Newport Waterways (Kingfisher, Sandpiper, Pelican, Petrel and Cormorant) were constructed with imported sand on top of stiff clay. The action of stormwater runoff, waves, currents and marine activity resulted in the sand eroding from the batters into the canal channels. A capital works program was subsequently undertaken to reconstruct the canal batters, essentially replacing the sand with a 100-200 mm thick layer of 10 mm gravel. This works program was completed in 2015.

Assessment of the frequency and location of future canal batter maintenance activities was not part of BMT's scope. However, the condition of canal batters will be assessed periodically as part of MBRC's regular maintenance inspections, and maintenance activities will subsequently be carried out to address identified issues. In order to inform the Maintenance Model of the timing and estimated costs for canal batter maintenance, MBRC have advised an annual allowance based upon previously completed maintenance works and this figure has been included in the Maintenance Model by BMT.

5.2.2 Rock walls

Rock walls are provided at the entrance to the canal estate, which serve to protect the embankments against the actions of waves and tidal currents. Maintenance of such structures is

typically required following storm events or other significant events which may destabilise the structures. As such, MBRC have advised that a notional annual allowance be included in the Maintenance Model by BMT to account for the future maintenance of the rock walls.

5.3 Vegetation and litter removal

Marine vegetation is removed from canal batters and other areas within the canal estate on an annual basis. Removal of marine vegetation aims to maintain amenity of the canals, whilst also protecting against potential damage to the canal batters and structures caused by vegetation growth. MBRC have advised an annual allowance for vegetation removal based on the cost from previous years and this figure has been included in the Maintenance Model by BMT.

MBRC also collect and dispose of litter from within the canal estate on a regular basis, and have advised an annual allowance for inclusion in the Maintenance Model for this activity based upon the planned frequency of litter collection, and costs from previous years.

5.4 Navigation aids and signage

MBRC are responsible for maintaining navigation aids and signage for the entrance channel and canal estate. Existing navigation aids and signs include four sets of lateral markers (four port and four starboard markers) along the length of the entrance channel, the entrance channel lead markers (two land-based navigation aids), two speed signs located at the canal entrance, signage at the Griffith Road Bridge, and other various signage.

The cost of maintaining and replacing the existing navigation aids and signs within the canals has been estimated based upon historical expenditure records provided by MBRC and an annual allowance has been included in the Maintenance Model. However, the historical costs haven't to-date included maintenance or replacement of the entrance channel navigation aids, which are expected to have an appreciable replacement cost. For the purpose of informing the long-term maintenance costs, it has been assumed that the entrance channel lateral markers will require replacement every 10 years (as specified in the Project Brief), and unit costs will be equivalent to the unit cost for the two new lateral markers installed for the upgraded channel in 2013.

The actual timing for maintenance and replacement of all navigation aids and signs shall be determined on the basis of routine condition inspections.

5.5 Water quality monitoring

MBRC undertake regular water quality monitoring within Newport Waterways, as part of a regional water quality monitoring program. The water quality monitoring is an important activity as it provides an indication of water quality and an early warning system for potential environmental problems within the canals. This in turn helps to protect and maintain the amenity of the canal estate.

A critical review of the existing water quality monitoring program and monitoring results was undertaken in 2015 (by others). Recommended refinements to the existing monitoring program included quarterly sampling in place of monthly, additional analysis parameters, and the preparation of an annual report card (or similar) summarising the monitoring results (FRC

Environmental 2015). MBRC have subsequently advised an estimated annual allowance for a revised monitoring program and this figure has been included in the Maintenance Model by BMT.

5.6 Environmental approvals

Canal batter and rock wall maintenance

Maintenance activities associated with canal batters and rock walls are expected to be 'excluded works'[1] for the purposes of the *Sustainable Planning Act 2009* to the extent these works do not include replacing or rebuilding greater than 20% of the structure. Excluded works do not require environmental approvals.

Vegetation and litter removal

Removal of marine vegetation from structures is considered to be self-assessable to the extent it is reasonably necessary for the maintenance of existing structures. These works are required to comply with the Department of Agriculture and Fisheries (DAF) code for self-assessable development MPO2. This code places the following limitations of maintenance works:

- Clearing limited to the footprint of the structure, an area 1m from this footprint and the associated airspace and substrate.
- Notification must be provided to DAF 5-20 days before commencement of works.
- Signage must be displayed at the works site for the duration of the works.

Where clearing is required to go beyond the area allowed for around a structure, a development permit will be required for the work. This is not expected to be the case for any of the proposed maintenance activities.

Navigation aids and signage

Any works involving interference with markers and aids to navigation should be checked with the Regional Harbour Master (RHM). In particular, under 215/01087(1) P5855-MOM ES988 works involving interference with navigational aids in the Newport Waterways entrance channel are to be referred to the RHM.

Water quality monitoring

No permits are required for water quality monitoring conducted within the canal estate. However, where water quality monitoring occurs within the MBMP, a marine parks permit is required.

5.7 Planning activities

Various design, planning, and support tasks are required in executing a number of the maintenance activities. Additionally, periodic review of the overall LTMP is required in order to ensure that the plan, including key assumptions and rates, remains up-to-date. These planning activities are briefly discussed in the following sections.

[1] See DEHP guideline: https://www.ehp.qld.gov.au/coastal/development/pdf/gl-excluded-works-em2734.pdf

5.7.1 LTMP reviews

It is recommended that the LTMP, including the Maintenance Model, be reviewed and updated every 3-4 years, and that this work includes the following key tasks:

- Detailed assessment and updates to estimated siltation rates.
- Review and update/refinement the overall dredging and dredged material disposal strategy, including review of key sensitive parameters/assumptions.
- Review and update the Dredging Schedule.
- Detailed review of historical expenditure, including executed contract rates and costs.
- Update of the program and rates/costs in the Maintenance Model.

Allowance for periodic review of the LTMP, broadly encompassing these tasks, has been included in the Maintenance Model every 4 years.

5.7.2 Dredging design and planning

Various tasks are required in preparation of and during execution of maintenance dredging works. These include:

- Sediment sampling and analysis – as required by environmental approvals.
- Dredging design and preparation of contract specifications.
- Updates to the existing dredging Environmental Management Plan – as required by environmental approvals.
- Tender inputs and assessment (as required to support MBRC).
- Contract support – including independent verification of dredged volumes.
- Environmental monitoring and reporting – as required by environmental approvals.

Accordingly, allowance for the completion of these tasks has been included in the Maintenance Model for each scheduled dredging campaign.

5.7.3 Approvals

Dredging and disposal activities within the MBMP (i.e. entrance channel dredging and placement at the MIDMPA) require a marine park permit. The current permit for this area is due to expire in 2022. A renewal of this permit will require preparation of an application form but no significant new studies are required. Periodic renewals of a marine park permit are expected every 5-10 years, depending upon the approval period provided by the Department of National Parks, Sport and Racing.

As discussed in Section 3.6, the future of the MIDMPA is uncertain and there is potential that permits to use this area will no longer be provided within the planning period of the LTMP. Where this is the case, alternative onshore or offshore placement options may be required. A study into offshore placement locations, if required, is expected to be led by the Queensland Government, with individual approval applications provided by users (including MBRC) to follow.

No other approvals require periodic renewal.

On this basis, a nominal amount has been included in the Maintenance Model every 10 years to account for the cost of preparing the renewal application, and possibility of additional required studies.

5.8 Potential effects of sea level rise

This sub-section has been prepared to briefly discuss the potential impacts of future sea level rise on MBRC's long term maintenance of the canal estate. Recommended allowances for sea level rise in the project area are first summarised, followed by discussion of the potential effect on navigation (i.e. maintenance dredging) and general maintenance activities.

5.8.1 Sea level rise projections

Recommended allowances for future sea level rise are discussed in the Redcliffe Shoreline Erosion Management Plan (SEMP) (BMT WBM 2009) together with Part 8 of the MBRC Planning Scheme (MBRC 2016). The recommended allowances are for +0.3 m for a 50 year planning horizon (BMT WBM 2009, p.3-21) and +0.8 m by the year 2100 (MBRC 2016, p.3657). The subsequent predicted effect on mean sea levels, taking 2009 as the reference year, are summarised in Table 5-1.

Table 5-1 Predicted sea level rise

Year	Projected Sea Level Rise (m)	Mean Sea Level (mAHD)
2009	0.0	-0.06
2059	*0.3	+0.24
2100	†0.8	+0.74

** Source: BMT WBM 2009*

† Source: MBRC 2016

On the basis of the projected sea level rise, the mean sea level at the site is expected to rise an average of 6 mm/annum between 2009 and 2059, and 10 mm/annum between 2050 and 2100.

5.8.2 Effect on navigation

The potential effect of sea level rise on the full tidal range (i.e. highest and lowest astronomical tides – HAT and LAT), has not been previously assessed and therefore it is difficult to draw conclusions regarding the subsequent effect on navigation within the canal estate. Notwithstanding, assuming a linear shift of the tidal planes with the Mean Sea Level, LAT will rise at the same rates and, on the basis of a static bed level, will act to increase navigable depths. As such, sea level rise has the potential to 'offset' siltation within the canal estate.

However, the net 'offset' is expected to be relatively low over the considered 50 year planning timeframe in the Maintenance Model as most areas experience approximately 25 mm/annum or more of siltation. This is approximately four times the projected rate of sea level rise, and therefore the net effect of sea level rise on navigation and maintenance dredging is expected to be minimal.

Further, navigability is principally a function of LAT, not the Mean Sea Level, and the sea level rise estimates are predictions only and therefore the actual sea level rise will vary from the predictions. As such, additional assessments would be required to confirm the potential effect of sea level rise on navigation and maintenance dredging within the canal estate.

5.8.3 Other maintenance activities

The potential effects of sea level rise on MBRC's general maintenance activities is expected to be limited providing existing infrastructure is not materially affected by the expected marginal increases in water levels. The gradual increase in water levels may limit suitable areas for marine vegetation growth in the longer-term, and therefore may reduce the frequency and duration of this maintenance activity. No discernible difference in the other maintenance activities is expected as a result of sea level rise.

6 Maintenance Costs

6.1 Cost summary

The estimated annual cost of maintenance for the canal estate over a period of 50 years is $1,450,000. This cost represents an annual average amount over a 50 year period in 2016 dollars, where the time value of money and inflation is not taken into account. The breakdown of estimated annual maintenance costs into the key areas of dredging and material disposal, and general maintenance (including planning and administration, navigation aids and signage, and water quality monitoring), for the canals and entrance channel, are summarised as follows:

Entrance channel

- Dredging and material disposal - $350,000 /annum.
- General maintenance - $15,000 /annum.

Canals (including Marina)

- Dredging and material disposal - $950,000 /annum.
- General maintenance - $135,000 /annum.

The maintenance items and associated rates used in estimating the long-term maintenance costs are detailed in the updated Maintenance Model, which is discussed in the following section. The key assumptions in the Maintenance Model are also discussed in Section 6.2.1.

6.2 Maintenance Model

The previous Maintenance Model has been updated and is provided in Appendix D. The Maintenance Model includes details of the adopted cost-rates and their basis, a program of maintenance activities (including predicted dredged volumes over the defined 50 year planning period), estimated annual costs for each identified maintenance item, and summarised maintenance costs.

6.2.1 Key assumptions

A number of assumptions have been made in updating the Maintenance Model, and subsequently in estimating the long-term maintenance costs. The key assumptions which underpin the model are briefly discussed in this section.

The maintenance dredging and dredged material disposal costs are based on the proposed dredging schedule and adopted methodologies presented in Sections 3.6 and 4.5. This includes the outcomes of the completed siltation assessment. Additional key assumptions include:

- Material removed from the Griffith Road Pond has a Moisture Content of 130%, and the volumetric and mass conversions from *in situ* are 0.89 and 0.91 respectively.
- As a conservative approach it has been assumed that, for land-based disposal options, the dredged material will require some treatment for Potential Acid Sulphate Soils (PASS) via addition of lime or cement stabilisation.

- Future dredged material has otherwise been assumed to be uncontaminated and suitable for land-based or unconfined ocean disposal.
- The applied rates for land-based dredged material disposal options include allowance for treatment, loading and haulage, and a disposal charge.
- A long-term opportunistic fill or beneficial re-use site (or sites) will be secured by MBRC, for the use of Contractors, prior to future dredging and material disposal campaigns (Ref. Section 3.6.1)
- As a specific site and strategy has not yet been secured, the applied rate for 'beneficial re-use site' in the Maintenance Model approximately represents an average rate of the specific options presented in Table 3-11.
- Given insufficient available information regarding the *Isles of Newport* development, the impact of this future development on siltation rates has been assumed to be negligible.

The costs for general maintenance activities were largely advised by MBRC. Assumptions in the Maintenance Model include:

- Renewal of the Marine Parks permit (Ref. *QS2012/BNT456*) will be required every ten years, and supplementary studies and assessments will be required to support the renewal application.
- The entrance channel navigation aids (lateral markers) will require replacement approximately every ten years.

6.2.2 Model sensitivity

A specific sensitivity analysis has not been completed on the Maintenance Model. However, based on the calculation methods and assumptions applied in the Model, it is considered that the estimated total long-term maintenance costs are most sensitive to the following parameters and inputs:

- Dredged material volumes – principally the long-term total quantity of material dredged and disposed, which is directly linked to the adopted average long-term siltation rate.
- Dredging technical parameters – specifically the volumetric and mass conversion rates from *in situ* to the material state at disposal, in conjunction with the adopted disposal methodology.
- Dredged material disposal cost rates – including the treatment, loading and haulage, and disposal charge components.

6.2.3 Accuracy of estimate

Inherent uncertainty in the future dredged material volumes, dredging and material disposal methodologies, and various unit cost rates, results in natural uncertainty in the estimated long term maintenance costs. While the original Maintenance Model incorporated a 'Confidence Factor Adjustment' tool to assess the possible range in long-term maintenance costs, BMT have recommended against the application of this existing facility to assess the possible range in cost estimates, owing to the lack of consideration of variability in material volumes and adoption of best practice probabilistic cost estimation methods.

Further, this tool was originally developed and applied as there was previously much greater uncertainty in the unit cost rates for various maintenance activities. The availability of actual costing information for the current LTMP update, via quotes, tendered rates, and expenditure records, has provided a greater degree of certainty in the adopted unit rates, and therefore the overall estimated maintenance costs.

In absence of an appropriate probabilistic cost estimation method, which considers uncertainty in the volumes together with the unit cost rates, and applies best practice methods, it is recommended that MBRC adopt an estimated long-term annual maintenance cost of $1,450,000.

7 Conclusions

BMT JFA Consultants were commissioned by MBRC in late 2015 to review and update the Newport Waterways Long-term Maintenance Plan and associated Maintenance Model. The review and update included review of siltation rates, assessment of dredging and material disposal options, development of a recommended dredging and material disposal strategy, and review and update of maintenance cost rates.

Assessment of siltation rates, encompassing both the canals and entrance channel, was completed via analysis of hydrographic surveys. The completed assessment indicates an average annual siltation rate of approximately 11,330 m^3/annum within the canal estate, and approximately 5,000 m^3/annum within the entrance channel. The rate within the canals corresponds to the approximate average annual rate determined from hydrographic surveys spanning 2004 to 2015. Analysis of limited survey datasets following the upgrade of the entrance channel indicated an average siltation rate of approximately 6,500 m^3/annum between 2013 and 2015. However, an estimated long-term average rate of 5,000 m^3/annum was subsequently adopted based upon the 2013 to 2015 period together with previous estimates.

An assessment of dredging and material disposal options was completed, including consideration of site-based constraints such as the narrow canals, capacity of the Griffith Road Pond, environmental considerations, ultimate disposal and beneficial re-use options, execution timeframes, and the economic feasibility of each option. The subsequent recommended strategy for the canals comprises dredging campaigns every two to three years using a small CSD, with dredged sediment pumped into the Griffith Road Pond, and subsequent beneficial re-use of the material. The recommended strategy for the entrance channel comprises dredging campaigns every 5-6 years using a grab dredge, with disposal (via barges) at the MIDMPA. Both of these options were assessed to be the most cost effective options, and have been successfully employed at the site during previous maintenance dredging campaigns.

The existing Maintenance Model was subsequently updated with revised unit cost rates, dredged material volumes, dredging and material disposal strategies, and maintenance program. A detailed review of historical expenditure records, including review of contracted costs for recent dredging and material disposal contracts, together with obtaining additional cost estimates, was undertaken as part of updating existing, and defining new, unit cost rates in the Model.

The estimated annual cost of maintenance for the canal estate over a period of 50 years, in 2016 dollars where the time value of money and inflation is not taken into account, is $1,450,000. Dredging and material disposal activities represent a significant proportion of the estimated maintenance costs. The breakdown of estimated annual maintenance costs into the areas of dredging and dredged material disposal, and general maintenance are $1,300,000 and $150,000 respectively.

8 Recommendations

BMT recommends that additional work be commissioned by MBRC to provide better definition of the recommended dredged material ultimate disposal methodology (beneficial re-use), together with reduced uncertainty of the estimated long-term maintenance costs. The recommended additional studies and works are summarised below, and are briefly discussed in the subsequent sections.

- Dredged material beneficial use and disposal study.
- Critical review and update of the dredging technical parameters.
- Revision of the uncertainty analysis function within the existing Maintenance Model.

In addition to these, it is also recommended that MBRC investigate options to establish a long-term dredging and material disposal contract, and this is briefly discussed in Section 8.1.4.

8.1.1 Dredged material beneficial use and disposal

The recommended material disposal strategy of beneficial re-use is estimated to represent the most cost effective option. However, the specific details of any necessary material treatment or stabilisation, and final placement site(s) have not yet been determined. Given that the dredged material disposal costs are estimated to represent the single largest component of the total maintenance costs, and there is a large possible range in cost rates for this option, it is strongly recommended that MBRC commission a study to refine this broad option, with an aim of securing all required agreements for beneficial use/disposal of the material and, in doing so, obtaining greater certainty of the associated costs.

The study should consider two primary beneficial re-use options:

- Use as general fill or similar.
- Use for rehabilitation of disused areas of sand/gravel extraction sites or other suitable sites.

Additionally, the study could also consider the potential for treatment and use as garden soil.

Given beneficial use as general fill (either un-treated or cement stabilised) may offer the most economically viable option in the long-term, it is recommended that laboratory tests on the dredged material be undertaken to assess the potential for this use, including:

- Assessment of base engineering and physio-chemical properties
- Trials of material stabilisation using cement and lime

In parallel, it is recommended that MBRC progress the necessary enquiries and investigations to:

- Secure a long-term contract for placement in disused sand/gravel extraction sites as part of a long-term rehabilitation project (or similar); and / or to
- Secure their own specific ultimate dredged material placement site.

It is highlighted that a reliance upon contractors to identify and employ cost effective beneficial re-use strategies may not always yield desirable outcomes, and as such, MBRC should complete

additional investigations and studies in order to secure long-term, cost effective options for land-based disposal of dredged material.

8.1.2 Dredging Technical Parameters

As outlined in Section 6.2.2, the estimated costs for disposal are sensitive to the volumetric and mass conversion rates from *in situ* to the material state at disposal. These parameters are applied in the calculation of the final quantities in the model. Additional site specific data was not made available to enable a critical review of these parameters as part of the current study. Given the sensitivity of the applied quantities in the Maintenance Model to these parameters, it is recommended that further investigations be conducted to provide greater certainty of these parameters and their application to various dredging and disposal methods.

Specific investigation and review of the following parameters is recommended:

- *In situ* material densities
- 'Pond Wet' densities (i.e. settled material from the Section 19 pond)
- Dried material properties (i.e. 'Spadeable' and 'Scraped Crust')
- Appropriate bulking factors.

It is possible that testing of material to determine the material densities could be conducted in conjunction with the beneficial use laboratory testing discussed in Section 8.1.1.

8.1.3 Model uncertainty

Should MBRC wish to adequately understand uncertainty in the estimated long-term maintenance costs, it is recommended that the existing 'Confidence Factor Adjustment' tool within the Maintenance Model be reviewed and updated such that it applies best practice probabilistic cost estimation methods, which consider the inherent uncertainty in the quantities and dredged material parameters as well as the unit cost rates.

8.1.4 Long-term contracts

It is recommended that consideration be given to the establishment of a long-term contract (or contracts) for dredging and material disposal for the canal maintenance dredging. This would likely be established once a long-term land-based beneficial use/disposal sites have been secured (i.e. once the preferred long term dredging and material disposal strategy has been finalised). The benefits of a long-term contract would likely include reduced total contract costs, greater certainty in the timing of dredging campaigns, greater certainty of securing plant and equipment when needed, reduced design and planning costs, reduced procurement effort/costs, and reduced management effort.

Similar long-term contracts have been successfully employed elsewhere in Australia for maintenance dredging programs.

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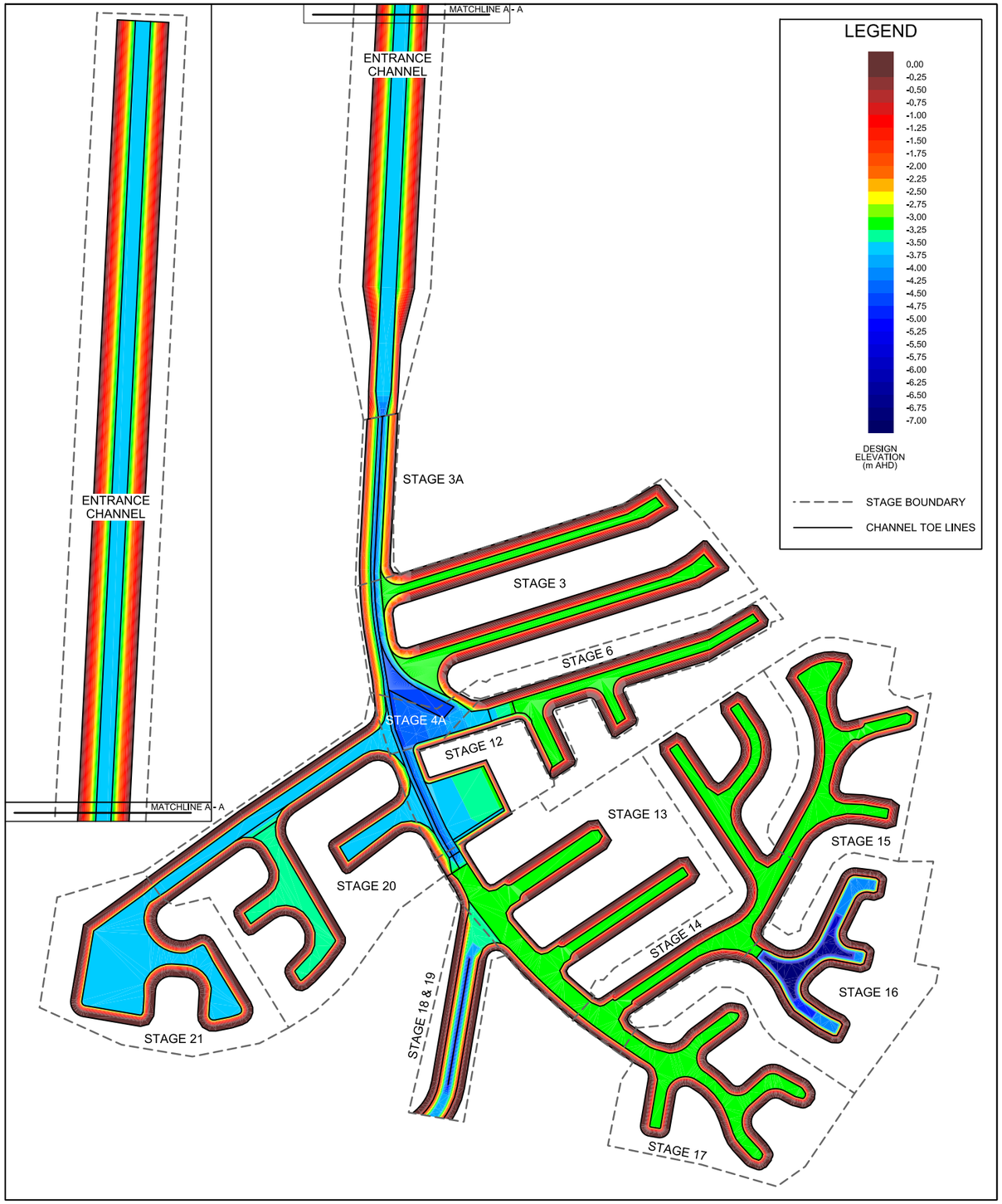
Appendix A Design DTM Plan

NEWPORT WATERWAYS DESIGN DTM



GENERAL NOTES:

THE DESIGN SURFACE MODEL HAS BEEN DEVELOPED BASED ON AVAILABLE DESIGN DRAWINGS SUPPLIED BY MORETON BAY REGIONAL COUNCIL (REFER TABLE 1 BELOW).
THE SUPPLIED DRAWING SET DOES NOT COVER THE FULL CANAL ESTATE AND THEREFORE ASSUMPTIONS HAVE BEEN MADE IN AREAS NOT COVERED BY THE SUPPLIED DRAWINGS (REFER ASSUMPTIONS BELOW).
IN PREPARING THE DESIGN SURFACE MODEL, BMT JFA CONSULTANTS HAVE NOT INDEPENDENTLY VERIFIED THE ACCURACY OF THE DESIGN DRAWINGS OR THE AS-CONSTRUCTED LEVELS.
THE DESIGN SURFACE MODEL DOES NOT INCLUDE THE LOCATION OF SERVICES, INCLUDING UNDERGROUND SERVICES AND DRAINAGE INFRASTRUCTURE.
THIS DRAWING HAS BEEN ISSUED IN CONNECTION WITH THE DIGITAL FILES NOTED IN TABLE 2. A COPY OF THIS DRAWING SHALL ALWAYS BE KEPT WITH THE DIGITAL FILES

TABLE 1 - MBRC SUPPLIED DESIGN DRAWINGS

STAGE	DRAWINGS
3A	3A/E/13A, 3A/E/14A
3 (INCLUDING M1 NORTHERN MARINA)	476-1333-D, 476-1384-C
6	6/E/1A, M1/E/1A
4A (INCLUDING M1 NORTHERN MARINA)	476-1384-C, M1/E/1A
12 (INCLUDING M2 SOUTHERN MARINA)	M2/E/1D, 13/674-017
13	8151-C2, 8151-C3, 8151-C4, 8151-C5
14	9004-C1, 9004-C2, 9004-C3, 9004-C4, 9004-C5
15	9331-C2, 9331-C3, 9331-C4, 9331-C5, 9331-C6
16	89138-C6 D, 89138-C7 E, 89138-C8 E, 89138-C9 F, 89138-C10 E
17	81130-217-2 32 H, 81130-217-5 32 J, 81130-217-7 32 F
18 &19	C101130-318-50 4, C101130-318-51 3, C101130-318-52 3, C101130-318-02 32 C
20	95/2001/20/11 B, 81130-220-2 32 G,81130-220-5 32 D, 81130-220-7 32, 81130-220-8 32 E, 81130-220-10 32
21	C101130-221-2 22 A, FIGURE 1
ENTRANCE CHANNEL EXTENSION	12/497-002 B,12/497-003 B, 12/497-004 A, 12/497-005 A

TABLE 2 - DIGITAL FILE SUMMARY

DATA	FILE
3D DXF FILE (CONTAINING DESIGN STRINGS, TRIANGLES AND GRID)	NEWPORT_CANAL_DESIGN_3D.dxf
0.5m GRIDDED DTM TEXT FILE	NEWPORT_CANAL_DESIGN_POINT5mGRIDDED.txt

ASSUMPTIONS:

IN PREPARING THE DESIGN SURFACE MODEL, A NUMBER OF ASSUMPTIONS HAVE BEEN NECESSARY, MOST COMMONLY AT THE BOUNDARY OF DEVELOPMENT STAGES AND TRANSITIONS BETWEEN AREAS. THESE ASSUMPTIONS ARE BROADLY OUTLINED BELOW:

- WHERE NOTED ON THE PLANS, DEPTHS, GRADIENTS, AND DISTANCES WERE MAINTAINED. WHERE THERE WERE DISCREPANCIES BETWEEN THESE CONSTRAINTS DEPTH AND GRADIENT WERE GENERALLY MAINTAINED IN FAVOUR OF DISTANCE.
- ALL BOUNDARIES NOTED ON THE PLANS WERE ASSUMED TO BE CADASTRAL BOUNDARIES UNLESS NOTED OTHERWISE.
- WHERE THERE WAS NO TRANSITION, OR THE TRANSITION WAS UNCLEAR ON THE PLANS, A CONSTANTANT GRADIENT WAS MAINTAINED BETWEEN KNOWN POINTS.

DATUMS:

HORIZONTAL DATUM - MAP GRID OF AUSTRALIA BASED ON GDA 94, ZONE 56
VERTICAL DATUM - AUSTRALIAN HEIGHT DATUM

DISCLAIMER:

THE DESIGN SURFACE MODEL HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF MORETON BAY REGIONAL COUNCIL AND IS SUBJECT TO AND ISSUED IN CONNECTION WITH THE PROVISIONS OF THE CONTRACT BETWEEN BMT JFA CONSULTANTS AND MORETON BAY REGIONAL COUNCIL. MORETON BAY REGIONAL COUNCIL SHALL, PRIOR TO THE USE OR APPLICATION OF THE DESIGN SURFACE MODEL, CHECK THE MODEL AND CONFIRM THAT ALL ASSUMPTIONS ARE APPROPRIATE. BMT JFA CONSULTANTS ACCEPTS NO LIABILITY OR RESPONSIBILITY WHATSOEVER, INCLUDING CONSEQUENTIAL LOSSES, FOR OR IN RESPECT OF ANY USE OF OR RELIANCE UPON THE DESIGN SURFACE MODEL BY ANY THIRD PARTY.
THE LOCATION OF SERVICES AND DRAINAGE INFRASTRUCTURE, INCLUDING SUBMERGED DRAINAGE OUTLETS,ARE NOT INCLUDED IN THIS PLAN OR THE DIGITAL FILES. LOCATION OF ALL SUCH INFRASTRUCTURE SHALL BE DETERMINED AND CONFIRMED BY MORTON BAY REGIONAL COUNCIL.

REV	DATE	AMENDMENT	DRN	APP
0	15/08/16	ISSUE FOR USE	SM	
A	11/05/16	DRAFT ISSUE	SM	

ORIG SIZE A1 | ARCHIVE J15034-02-01_0.dgn

NOTES

SCALE 1 : 5000
100 0 500
METRES

DATUM
VERTICAL AHD
HORIZONTAL MAP GRID OF AUSTRALIA BASED ON GDA 94, ZONE 56

GDA
BebbCart

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ENGINEER	J.STEWART	11/05/2016
DRAWN	S.MOUCHEMORE	11/05/2016
DRAFTING CHECK	G.BEBBINGTON	11/05/2016
ENGINEERING CHECK	J.STEWART	11/05/2016
APPROVED PROJECT MGR	J.STEWART	11/05/2016

CLIENT: MORETON BAY REGIONAL COUNCIL
PROJECT: LONG TERM MAINTENANCE PLAN
TITLE: NEWPORT WATERWAYS DESIGN DIGITAL TERRAIN MODEL
DRAWING NUMBER: J15034 - 02 - 01
REV: 0

Appendix B Dredging and Material Disposal Options Assessment Summary

Given the number of potential dredging and material disposal options for maintenance dredging within the canal estate, a qualitative options assessment was conducted. The objective of the assessment was to identify the preferred options on the basis of nominated key factors. The nominated key factors included:

- Technical feasibility (inherent within the options identified), including availability
- Regulatory feasibility
- Timing, including frequency and time to commence option
- Economic feasibility, based on cost-rate for dredging, disposal and any necessary capital costs
- Environmental impact.

While these factors were all considered, no quantitative multi-criteria analysis or similar was undertaken. Notwithstanding, differing weights and preferences for each of the factors have been accounted for in the qualitative assessment.

The following sections summarise the completed assessment.

B.1.1 Preliminary List of Options

The identified options for maintenance dredging within the canal estate consist of three basic elements:

(1) Dredging

(2) Handling/interim storage

(3) Ultimate disposal.

The identified options for the canal estate are presented in Table B-1. This table also identifies the timeframe of the option, categorising all options as either short-term (i.e. ~1 year to commence), medium-term (1-5 years to commence) or long-term (>5 years to commence).

Table B-1 Dredging and material disposal options for Newport Waterways canal estate

No.	Dredging	Handling/Interim Storage	Disposal	Timing
1	CSD	Griffith Road Pond	Landfill site	Short
2	CSD	Griffith Road Pond	Other Filling or Rehabilitation site	Short-Medium
3	CSD	Griffith Road Pond	Converted sand/gravel extraction site	Long
4	CSD	Griffith Road Pond	MIDMPA	Short
5	Grab Dredge	-	MIDMPA	Short
6	Grab Dredge	-	Other offshore placement site	Long
7	CSD	Mobile drying/processing plant (in conjunction with Griffith Road Pond for final drying)	Landfill site	Short
8	CSD	Mobile drying/processing plant (in conjunction with Griffith Road Pond for final drying)	Other Filling or Rehabilitation site	Short-Medium
9	CSD	Mobile drying/processing plant (in conjunction with Griffith Road Pond for final drying)	Converted sand/gravel extraction site	Long
10	CSD or Grab Dredge	-	Redistribution within canal estate	Short
11	Grab Dredge	Barge-mounted skips	Landfill or other filling/rehabilitation site	Short
12	CSD	Griffith Road Pond	Beneficial re-use (e.g. construction fill, mulch)	Short-Medium

Of the options in Table B-1, the following were ruled out on the basis of being unfeasible, due to prohibitive cost, lack of availability and/or high regulatory constraint (i.e. highly unlikely to be approved):

- *Option 6: Grab dredging to other offshore placement site*. Current regulatory framework in Queensland makes establishment of a new offshore disposal site unlikely. Existing studies and policy statements prefer the consolidation of unconfined ocean disposal at MIDMPA and do not provide a clear pathway for other sites. Changes in regulatory environment may make this a more viable option in the latter half of the planning period but this is uncertain.
- *Option 10: Redistribution within canal estate*. Redistribution provides a temporary solution but, ultimately, does not have long-term benefits as it does not actually remove the accumulated sediment from the canal system. This option may still be investigated by MBRC as a short-term measure in the future. However, for the purpose of the options assessment, which is focused on long-term options, it has not been considered further.

B.1.2 Options Assessment

The remaining options have been assessed in Table B-2 based on a number of key factors. Where necessary, notes have been made in regards to the weighting of particular factors. The factors considered include timing, environmental impact and economic feasibility. The assessment of timing is based on a balance of the time to commence against the siltation rates, i.e. a measure of

whether the option can be conducted within the timeframe necessary to dredge the canals. Environmental impact considers both environmental effects that could be in breach of existing permits, and general environmental impacts. Economic feasibility considers the cost, including capital cost, associated with each part of the dredging lifecycle.

Each criteria is given a score of **High**, **Medium** or **Low** based on how suitable it is within the context of the criteria. **NB** – in regards to environmental impact, 'High' implies a high score as a result of a likely low environmental impact; 'Low' implies a low score as a result of a likely high environmental impact.

Based on the completed assessment, the preferred options identified for the Newport Waterways canal estate are:

- *Most Preferred*: Dredging with a CSD, handling in Griffith Road Pond, and beneficial re-use of material or disposal for filling/rehabilitation. (Options 12 and 2)
- *Alternative*: Dredging with a CSD, handling in Griffith Road Pond, and disposal at MIDMPA (Option 4)
- *Alternative*: Dredging with CSD, handling in Griffith Road Pond, and disposal at landfill. (Options 1a and 1b)

Beneficial re-use is preferred due to lower costs (with potential gain for beneficial re-use options) and low environmental impact. Placement at the MIDMPA or at a landfill site are suitable alternative options, which were rated lower than the preferred option primarily as a result of the higher costs associated with these options.

Table B-2 Assessment of Newport Waterways canal estate dredging and material disposal options

Option	Time to Commence	Economic Feasibility			Environmental Impact
		Dredging cost	Disposal cost	Capital cost	
1a. CSD to Griffith Road Pond to Landfill Site (dry material)	**High** Immediately available – no additional approvals, site identification or acquisition required	**High** Low cost	**Medium** Medium to high cost	**High** No cost	**High** Activities not expected to cause impacts in excess of project approvals
1b. CSD to Griffith Road Pond to Landfill Site (wet material)	**High** Immediately available – no additional approvals, site identification or acquisition required	**High** Low cost	**Low** High cost	**High** No cost	**High** Activities not expected to cause impacts in excess of project approvals
2. CSD to Griffith Road Pond to Other Filling or Rehabilitation Site	**Medium** Depends upon availability of sites – rehabilitation or other fill sites are typically available, subject to negotiation.	**High** Low cost	**High** Expected to be low cost but site dependent	**High** Expected to be low cost but site dependent	**High** Provides for beneficial use of the material. Environmental management and engineering of external site by others.
3. CSD to Griffith Road Pond to Converted Sand/Gravel Extraction Site	**Low** Depends upon availability of sites – disused or closing extraction sites are likely to require purchase and appreciable development time prior to use	**High** Low cost	**High** Low cost depending on proximity to Newport	**Low** High cost	**High** Provides for beneficial use of the material.
4. CSD to Griffith Road Pond to MIDMPA	**High** Immediately available – no additional approvals, site identification or acquisition required **NB** – this option may not be available long-term, however, due to uncertainty regarding the MIDMPA	**High** Low cost	**Medium** Medium to high cost to transport material	**Medium** Some capital cost likely, but expected to be low to medium	**High** Activities not expected to cause impacts in excess of project approvals
5. Grab Dredge to MIDMPA	**Medium** Amendment of the existing Development Approval (SDPE01220110) to permit this dredging methodology is required. **NB** – this option may not be available long-term, however, due to uncertainty regarding the MIDMPA	**Medium** Low to Medium dredging cost	**Medium** Medium to high cost to transport material	**High** No cost	**High** Activities not expected to cause impacts in excess of project approvals

Dredging and Material Disposal Options Assessment Summary

Option	Time to Commence	Economic Feasibility			Environmental Impact
		Dredging cost	Disposal cost	Capital cost	
~~6. Grab Dredge to Other Offshore Placement Site~~					
7. CSD to Mobile Drying Plant to Landfill Site	**Medium** Expected to be available in the short to medium term – subject to availability of contractors with suitable mechanical de-watering equipment. No additional approvals, site identification or acquisition required	**Medium** Medium dredging cost to account for mobilisation and operation of additional plant	**Medium** Medium to high cost	**Low** High costs for procurement of drying plant	**High** Activities not expected to cause impacts in excess of project approvals
8. CSD to Mobile Drying Plant to Other Filling or Rehabilitation Site	**Medium** Expected to be available in the short to medium term – subject to availability of contractors with suitable mechanical de-watering equipment. No additional approvals, site identification or acquisition required	**Medium** Medium dredging cost to account for mobilisation and operation of additional plant	**High** Expected to be low cost but site dependent	**Low** High costs for procurement of drying plant	**High** Provides for beneficial use of the material. Environmental management and engineering of external site by others.
9. CSD to Mobile Drying Plant to Converted Sand/Gravel Extraction Site	**Low** Depends upon availability of sites – disused or closing extraction sites are likely to require purchase and appreciable development time prior to use	**Medium** Medium dredging cost to account for additional plant	**High** Low cost depending on proximity to Newport	**Low** High cost	**High** Provides for beneficial use of the material.
~~10. Redistribution within Canal Estate~~					
11. Grab Dredge to Skip to Landfill Site	**Medium** Amendment of the existing Development Approval (SDPE01220110) to permit this dredging methodology is required.	**Low** High costs due to relatively low dredging rates	**Low** High costs	**High** No costs	**High** Activities not expected to cause impacts in excess of project approvals
12. CSD to Griffith Road Pond to Beneficial Re-use	**High** (assumes availability of beneficial re-use options)	**High** Low costs	**High** Expected to be low cost but dependent on final option(s)	**High** Expected to be low cost but dependent on final option(s)	**High** Activities not expected to cause environmental impacts; re-use is preferred within waste management hierarchy

Appendix C Proposed Dredging Schedule

Proposed Dredging Schedule

SCHEDULE	Northern Section										
Index	1	21	22	23	25	27	28	29	30	31	32
Canal	Albatross	Kingfisher	Kingfisher	Kingfisher	Northern Marina	Pelican	Pelican	Pelican	Sandpiper	Sandpiper	Sandpiper
Zone	1	1	2	3	1	1	2	3	1	2	3
2015	0	0	0	0	0	0	0	0	0	0	0
2016	-	1	1	1	1	-	-	-	1	-	-
2017	-	-	-	-	-	-	-	-	-	-	-
2018	-	1	-	-	-	1	1	-	-	1	1
2019	-	-	-	-	-	-	-	-	-	-	-
2020	-	1	1	-	1	-	-	1	-	-	-
2021	-	-	-	-	-	-	-	-	-	-	-
2022	1	1	-	-	-	-	-	-	1	1	1
2023	-	-	-	-	-	-	-	-	-	-	-
2024	-	1	1	1	1	1	1	1	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-
2026	-	1	-	-	-	-	-	-	1	1	-
2027	-	-	-	-	-	-	-	-	-	-	-
2028	-	1	1	-	1	-	-	-	-	-	-
2029	-	-	-	-	-	-	-	-	-	-	-
2030	-	1	-	-	-	1	1	-	1	1	1
2031	-	-	-	-	-	-	-	-	-	-	-
2032	-	1	1	1	1	-	-	-	-	-	-
2033	-	-	-	-	-	-	-	-	-	-	-
2034	-	1	-	-	-	-	-	-	1	1	1
2035	-	-	-	-	-	-	-	-	-	-	-
2036	-	1	1	-	1	1	1	1	-	-	-

SCHEDULE	Western Section							Central Section									
Index	10	13	14	15	16	24	42	2	3	8	6	7	38	39	40	44	45
Canal	Hawk	Jabiru	Jabiru	Jabiru	Jabiru	Kite	Swan	Albatross	Albatross	Falcon	Curlew	Curlew	Skua	Skua	Southern Marina	Walkers Creek	Walkers Creek
Zone	1	1	2	3	4	1	1	2	3	1	1	2	1	2	1	1	2
2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	1	1	-	-	-	-	-	-	1	-	-	-	-	1	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1	1
2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2022	-	1	1	1	-	-	-	1	-	1	-	-	-	-	1	-	-
2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2026	1	1	1	-	1	1	1	-	-	1	-	-	-	-	1	-	-
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2028	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1	1
2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	1	1	1	-	-	-	-	-	1	-	1	-	1	1	-	-
2031	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2032	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
2033	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2034	-	1	1	-	1	1	-	-	-	1	1	-	1	-	1	-	-
2035	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2036	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SCHEDULE	South-Eastern Section																		
Index	4	5	17	18	19	20	9	11	12	26	33	34	35	36	37	41	43	46	
Canal	Albatross	Albatross	Kestrel	Kestrel	Kestrel	Kestrel	Gannet	Heron	Ibis	Osprey	Seaeagle	Seagull	Seahawk	Shearwater	Shearwater	Spoonbill	Tern	ENTRANCE	
Zone	4	5	1	2	3	4	1	1	1	1	1	1	1	1	2	1	1	1	Dredge Vols (excl. Entrance)
2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
2016	-	-	-	-	1	1	-	1		1	-	1	1	-	-	-	-	-	35,500
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	1	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	32,000
2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2020	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	29,300
2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2022	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	25,400
2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21,000
2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2026	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,600
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2028	-	-	1	1	1	1	1	1	1	1	1	-	-	-	-	1	-	-	25,500
2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24,500
2031	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2032	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	21,700
2033	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2034	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23,300
2035	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2036	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	16,600
																		Total Vol.	280,400

PREDICTED DREDGE VOLUMES	Albatross 1	Kingfisher 1	Kingfisher 2	Kingfisher 3	Northern Marina 1	Pelican 1	Pelican 2	Pelican 3	Sandpiper 1	Sandpiper 2	Sandpiper 3
Initial Volumes (m^3)	4110	3320	1910	1130	12210	1020	1270	1310	1060	490	670
Est. Annual Siltation Vol (m^3)	100	490	190	110	1880	360	300	200	240	200	210
2015	-	-	-	-	-	-	-	-	-	-	-
2016	-	3,810	2,100	1,240	14,090	-	-	-	1,300	-	-
2017	-	-	-	-	-	-	-	-	-	-	-
2018	-	980	-	-	-	2,100	2,170	-	-	1,090	1,300
2019	-	-	-	-	-	-	-	-	-	-	-
2020	-	980	760	-	7,520	-	-	2,310	-	-	-
2021	-	-	-	-	-	-	-	-	-	-	-
2022	4,810	980	-	-	-	-	-	-	1,440	800	840
2023	-	-	-	-	-	-	-	-	-	-	-
2024	-	980	760	880	7,520	2,160	1,800	800	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-
2026	-	980	-	-	-	-	-	-	960	800	-
2027	-	-	-	-	-	-	-	-	-	-	-
2028	-	980	760	-	7,520	-	-	-	-	-	-
2029	-	-	-	-	-	-	-	-	-	-	-
2030	-	980	-	-	-	2,160	1,800	-	960	800	1,680
2031	-	-	-	-	-	-	-	-	-	-	-
2032	-	980	760	880	7,520	-	-	-	-	-	-
2033	-	-	-	-	-	-	-	-	-	-	-
2034	-	980	-	-	-	-	-	-	960	800	840
2035	-	-	-	-	-	-	-	-	-	-	-
2036	-	980	760	-	7,520	2,160	1,800	2,400	-	-	-

PREDICTED DREDGE VOLUMES	Hawk 1	Jabiru 1	Jabiru 2	Jabiru 3	Jabiru 4	Kite 1	Swan 1	Albatross 2	Albatross 3	Falcon 1	Curlew 1	Curlew 2	Skua 1	Skua 2	Southern Marina 1	Walkers Creek 1	Walkers Creek 2
Initial Volumes (m^3)	1960	2390	4540	1400	310	360	300	1710	590	1830	550	370	330	190	2950	1480	5890
Est. Annual Siltation Vol (m^3)	170	330	530	90	460	60	40	130	310	270	310	120	370	100	1250	340	300
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	3,380	6,130	-	-	-	-	-	-	2,640	-	-	-	-	6,700	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	-	-	-	-	-	2,100	-	2,180	-	-	3,180	7,390
2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2022	-	1,320	2,120	2,030	-	-	-	2,620	-	1,080	-	-	-	-	5,000	-	-
2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-	-	3,380	-	1,240	-	1,480	-	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2026	3,830	1,320	2,120	-	5,370	1,020	740	-	-	1,080	-	-	-	-	5,000	-	-
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2028	-	-	-	-	-	-	-	-	-	-	1,240	-	1,480	-	-	2,720	2,400
2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	1,320	2,120	720	-	-	-	-	-	1,080	-	2,170	-	1,690	5,000	-	-
2031	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2032	-	-	-	-	-	-	-	1,300	2,480	-	-	-	-	-	-	-	-
2033	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2034	-	1,320	2,120	-	3,680	480	-	-	-	1,080	1,860	-	2,220	-	5,000	-	-
2035	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2036	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PREDICTED DREDGE VOLUMES	Albatross 4	Albatross 5	Kestrel 1	Kestrel 2	Kestrel 3	Kestrel 4	Gannet 1	Heron 1	Ibis 1	Osprey 1	Seaeagle 1	Seagull 1	Seahawk 1	Shearwater 1	Shearwater 2	Spoonbill 1	Tern 1	ENTRANCE 1	Totals
Initial Volumes (m^3)	490	600	340	1350	2650	2360	1430	2010	610	1810	100	2360	1270	960	650	140	430	210	**75,210**
Est. Annual Siltation Vol (m^3)	180	320	80	90	110	70	40	70	60	90	140	110	60	210	60	120	60	5000	**11,330**
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
2016	-	-	-	-	2,760	2,430	-	2,080	-	1,900	-	2,470	1,330	-	-	-	-	-	35,500
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	1,560	-	1,620	-	-	1,550	-	790	-	-	-	-	-	-	-	-	-	32,000
2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,210	-
2020	1,390	-	740	-	-	-	-	-	-	-	-	-	-	-	-	740	-	-	29,300
2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2022	-	1,280	-	-	-	-	-	-	-	-	1,080	-	-	-	-	-	-	-	25,400
2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,000	-
2024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21,000
2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2026	1,080	1,280	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25,600
2027	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,000	-
2028	-	-	640	900	1,320	840	400	840	600	1,080	840	-	-	-	-	960	-	-	25,500
2029	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2030	720	1,280	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24,500
2031	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,000	-
2032	-	-	-	-	-	-	-	-	-	-	560	1,760	960	4,530	-	-	-	-	21,700
2033	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2034	720	1,280	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23,300
2035	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,000	-
2036	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	960	-	-	16,600
																			280,400

Appendix D Maintenance Model

NEWPORT WATERWAYS MAINTENANCE MODEL

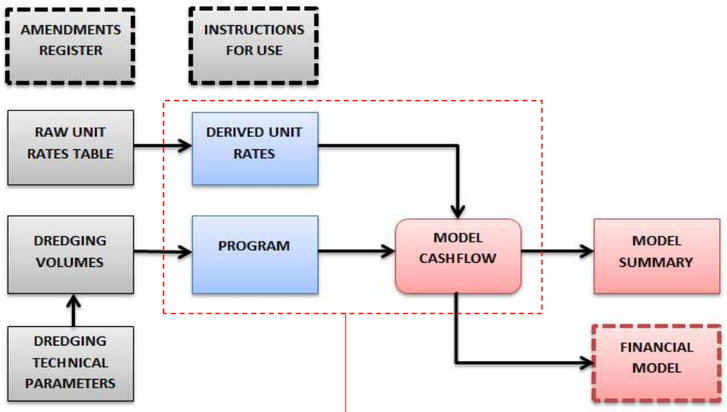
AMENDMENTS REGISTER

DATE	REV No.	BY	DETAILS
04/04/2016	0	BMT JFA	Revised and Updated Maintenance Model - Issued for Use

NEWPORT WATERWAYS MAINTENANCE MODEL

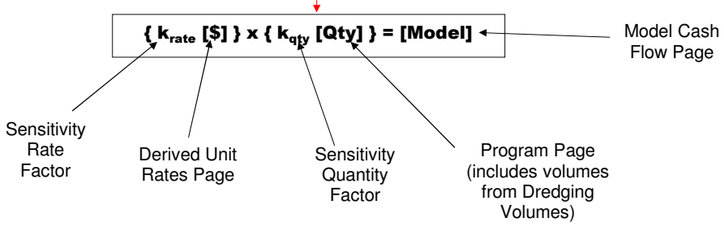
Guidelines on the Use of this Model

Worksheet Data Flow



Note: Worksheet is ordered such that data flows from RIGHT to LEFT. This results in the SUMMARY data being on tabs to the LEFT and INPUT data on tabs to the RIGHT

Governing Equation



Instructions For Use

Prepare the Model and Data Entry

The Spreadsheet is structured so that general input occurs on **RAW UNIT RATES TABLE** and **PROGRAM** pages. Additionally, the **DERIVED UNIT RATES** and **DREDGING VOLUMES** page has adjustable sensitivity factors to model the change of costs and quantities. Otherwise, worksheets show output.

Review **PROGRAM** and **RAW UNIT RATES TABLE** and populate with relevant schedule and costing data respectively. When using the **PROGRAM** worksheet **please note the units** for each item. Only unit-less items may be entered here, as volumes (m^3) are linked to **DREDGING VOLUMES.**

DREDGING TECHNICAL PARAMETERS and **DREDGING VOLUMES** contain information with regards to the major cost item of dredging and spoil disposal. These pages should not be edited without additional geotechnical information, a new dredging schedule, or new spoil disposal systems (except where shown).

Run & Refine Model

The **MODEL CASH FLOW** page is essentially **DERIVED UNIT RATES** x **PROGRAM** (2011-2030), with the addition of subtotals for each section.

The Model may be refined by breaking sections down further or adding new cost items. **This must be done with the care** as data is linked across multiple worksheets to provide relevant output.

Use adjustable sensitivity factor on **DERIVED UNIT RATES** and **DREDGING VOLUMES** pages

Update **AMENDMENTS REGISTER** upon updating model.

Output

MODEL CASH FLOW and **MODEL SUMMARY** pages are output pages, showing a breakdown of costs for given cost items.

It should be noted that all costs shown are 2011 dollars, with no consideration given for inflation

Financial Model Instructions

Instructions for the use of this section are to be written by MBRC as it is developed

Assumptions & Limitations

General

This Maintenance Model has been developed for Moreton Bay Regional Council (MBRC) to assist in the long-term planning and funding of maintenance activities in the Newport Waterways Canal Estate (Newport Waterways). While considerable detail is included within the Maintenance Model, it is highlighted that it has been developed as a broad-scale, long-term planning and costing tool. As such, the Maintenance Model should not be used for the detailed planning and execution of maintenance activities - which will generally require separate planning, design, and execution. Further, the Maintenance Model should be reviewed and updated periodically (notionally every 3-4 years) to ensure that the underlying assumptions and rates remain appropriate.

The Maintenance Model should be read and used in conjunction with the associated Long-Term Maintenance Plan report, which documents the key assumptions and parameters that underpin the Model. Additional comments and instructions are also provided within the Maintenance Model worksheets.

NEWPORT WATERWAYS MAINTENANCE MODEL

MODEL SUMMARY

			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Budget No.	**Component No.**	**ITEM / DESCRIPTON**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
		1. Entrance Channel														
20739	101	**1.1 Dredging & Spoil Disposal**	$ -	$ -	$ -	$ 1,720,000.00	$ -	$ 50,000.00	$ -	$ -	$ 1,720,000.00	$ -	$ -	$ -	$ -	$ 1,720,000.00
20739	102	**1.2 Navigational Aids**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00	$ -	$ -	$ -	$ -	$ -	$ -
20739	104	**1.3 Administration**	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ 4,000.00	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -
		TOTAL	$ -	$ -	$ -	$ 1,755,000.00	$ -	$ 50,000.00	$ 4,000.00	$ 95,000.00	$ 1,720,000.00	$ -	$ -	$ 35,000.00	$ -	$ 1,720,000.00
		2. Residential Canals														
20550	000	**2.1 General Maintenance**	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00
20739	105	**2.2 Dredging**	$ 408,860.56	$ -	$ 504,418.75	$ -	$ 451,587.37	$ -	$ 451,450.39	$ -	$ 328,821.43	$ -	$ 454,165.62	$ -	$ 397,588.24	$ -
20739	107	**2.3 Spoil Disposal**	$ 1,174,338.03	$ -	$ 1,394,075.00	$ -	$ 1,208,683.28	$ -	$ 1,146,177.95	$ -	$ 773,142.86	$ -	$ 1,157,962.50	$ -	$ 1,012,705.88	$ -
20739	106	**2.5 Water Quality Monitoring**	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
20739	104	**2.6 Administration**	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		TOTAL	$ 1,703,798.59	$ 120,600.00	$ 2,019,093.75	$ 120,600.00	$ 1,780,870.65	$ 120,600.00	$ 1,721,828.35	$ 120,600.00	$ 1,222,564.29	$ 120,600.00	$ 1,732,728.12	$ 120,600.00	$ 1,530,894.12	$ 120,600.00
		3. Marina														
20550	000	**3.1 General Maintenance**	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00
20739	105	**3.2 Dredging**	$ 269,389.44	$ -	$ 133,581.25	$ -	$ 155,362.63	$ -	$ 110,649.61	$ -	$ 182,678.57	$ -	$ 110,234.37	$ -	$ 165,661.76	$ -
20739	107	**3.3 Spoil Disposal**	$ 772,661.97	$ -	$ 367,325.00	$ -	$ 419,316.72	$ -	$ 278,822.05	$ -	$ 431,457.14	$ -	$ 278,637.50	$ -	$ 423,894.12	$ -
20739	106	**3.4 Water Quality Monitoring**	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
20739	104	**3.5 Administration**	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		TOTAL	$ 1,055,451.41	$ 13,400.00	$ 514,306.25	$ 13,400.00	$ 588,079.35	$ 13,400.00	$ 403,271.65	$ 13,400.00	$ 627,535.71	$ 13,400.00	$ 402,271.87	$ 13,400.00	$ 602,955.88	$ 13,400.00
		GRAND TOTAL	$ 2,759,250.00	$ 134,000.00	$ 2,533,400.00	$ 1,889,000.00	$ 2,368,950.00	$ 184,000.00	$ 2,129,100.00	$ 229,000.00	$ 3,570,100.00	$ 134,000.00	$ 2,135,000.00	$ 169,000.00	$ 2,133,850.00	$ 1,854,000.00
		ACCUMULATIVE TOTAL	$ 2,759,250.00	$ 2,893,250.00	$ 5,426,650.00	$ 7,315,650.00	$ 9,684,600.00	$ 9,868,600.00	$ 11,997,700.00	$ 12,226,700.00	$ 15,796,800.00	$ 15,930,800.00	$ 18,065,800.00	$ 18,234,800.00	$ 20,368,650.00	$ 22,222,650.00
		RUNNING AVERAGE FROM 2011	$ 2,759,250.00	$ 1,446,625.00	$ 1,808,883.33	$ 1,828,912.50	$ 1,936,920.00	$ 1,644,766.67	$ 1,713,957.14	$ 1,528,337.50	$ 1,755,200.00	$ 1,593,080.00	$ 1,642,345.45	$ 1,519,566.67	$ 1,566,819.23	$ 1,587,332.14

Instructions for Model Summary Worksheet
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NEWPORT WATERWAYS MAINTENANCE MODEL

MODEL SUMMARY

			15	16	17	18	19	20	21	22	23	24	25	26	27
Budget No.	Component No.	ITEM / DESCRIPTON	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
		1. Entrance Channel													
20739	101	1.1 Dredging & Spoil Disposal	$ -	$ 50,000.00	$ -	$ -	$ 1,720,000.00	$ -	$ -	$ -	$ -	$ 1,720,000.00	$ -	$ 50,000.00	$ -
20739	102	1.2 Navigational Aids	$ -	$ -	$ -	$ 60,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
20739	104	1.3 Administration	$ -	$ 35,000.00	$ 4,000.00	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ 4,000.00
		TOTAL	$ -	$ 85,000.00	$ 4,000.00	$ 60,000.00	$ 1,720,000.00	$ 35,000.00	$ -	$ -	$ -	$ 1,755,000.00	$ -	$ 50,000.00	$ 4,000.00
		2. Residential Canals													
20550	000	2.1 General Maintenance	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00
20739	105	2.2 Dredging	$ 439,147.96	$ -	$ 339,982.03	$ -	$ 422,510.09	$ -	$ 252,662.05	$ -	$ 414,078.63	$ -	$ 355,592.95	$ -	$ 414,078.63
20739	107	2.3 Spoil Disposal	$ 1,098,910.20	$ -	$ 809,325.35	$ -	$ 1,033,848.93	$ -	$ 535,583.13	$ -	$ 1,004,168.28	$ -	$ 863,352.42	$ -	$ 1,004,168.28
20739	106	2.5 Water Quality Monitoring	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
20739	104	2.6 Administration	$ -	$ -	$ 3,600.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00
		TOTAL	$ 1,658,658.16	$ 120,600.00	$ 1,273,507.37	$ 120,600.00	$ 1,576,959.01	$ 120,600.00	$ 908,845.18	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,542,446.92
		3. Marina													
20550	000	3.1 General Maintenance	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00
20739	105	3.2 Dredging	$ 112,602.04	$ -	$ 179,567.97	$ -	$ 115,439.91	$ -	$ 208,237.95	$ -	$ 116,971.37	$ -	$ 175,457.05	$ -	$ 116,971.37
20739	107	3.3 Spoil Disposal	$ 279,689.80	$ -	$ 430,074.65	$ -	$ 280,951.07	$ -	$ 442,816.87	$ -	$ 281,631.72	$ -	$ 428,247.58	$ -	$ 281,631.72
20739	106	3.4 Water Quality Monitoring	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
20739	104	3.5 Administration	$ -	$ -	$ 400.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00
		TOTAL	$ 405,691.84	$ 13,400.00	$ 623,442.63	$ 13,400.00	$ 409,790.99	$ 13,400.00	$ 664,454.82	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,403.08
		GRAND TOTAL	$ 2,064,350.00	$ 219,000.00	$ 1,900,950.00	$ 194,000.00	$ 3,706,750.00	$ 169,000.00	$ 1,573,300.00	$ 134,000.00	$ 1,950,850.00	$ 1,889,000.00	$ 1,956,650.00	$ 184,000.00	$ 1,958,850.00
		ACCUMULATIVE TOTAL	$ 24,287,000.00	$ 24,506,000.00	$ 26,406,950.00	$ 26,600,950.00	$ 30,307,700.00	$ 30,476,700.00	$ 32,050,000.00	$ 32,184,000.00	$ 34,134,850.00	$ 36,023,850.00	$ 37,980,500.00	$ 38,164,500.00	$ 40,123,350.00
		RUNNING AVERAGE FROM 2011	$ 1,619,133.33	$ 1,531,625.00	$ 1,553,350.00	$ 1,477,830.56	$ 1,595,142.11	$ 1,523,835.00	$ 1,526,190.48	$ 1,462,909.09	$ 1,484,123.91	$ 1,500,993.75	$ 1,519,220.00	$ 1,467,865.38	$ 1,486,050.00

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NEWPORT WATERWAYS MAINTENANCE MODEL

MODEL SUMMARY

			28	29	30	31	32	33	34	35	36	37	38	39	40
Budget No.	**Component No.**	**ITEM / DESCRIPTON**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
		1. Entrance Channel													
20739	101	**1.1 Dredging & Spoil Disposal**	$ -	$ 1,720,000.00	$ -	$ -	$ -	$ -	$ 1,720,000.00	$ -	$ 50,000.00	$ -	$ -	$ 1,720,000.00	$ -
20739	102	**1.2 Navigational Aids**	$ 60,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00	$ -	$ -
20739	104	**1.3 Administration**	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ 4,000.00	$ -	$ -	$ 35,000.00
		TOTAL	$ 95,000.00	$ 1,720,000.00	$ -	$ -	$ 35,000.00	$ -	$ 1,720,000.00	$ -	$ 85,000.00	$ 4,000.00	$ 60,000.00	$ 1,720,000.00	$ 35,000.00
		2. Residential Canals													
20550	000	**2.1 General Maintenance**	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00
20739	105	**2.2 Dredging**	$ -	$ 355,592.95	$ -	$ 414,078.63	$ -	$ 355,592.95	$ -	$ 414,078.63	$ -	$ 355,592.95	$ -	$ 414,078.63	$ -
20739	107	**2.3 Spoil Disposal**	$ -	$ 863,352.42	$ -	$ 1,004,168.28	$ -	$ 863,352.42	$ -	$ 1,004,168.28	$ -	$ 863,352.42	$ -	$ 1,004,168.28	$ -
20739	106	**2.5 Water Quality Monitoring**	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
20739	104	**2.6 Administration**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -	$ -	$ -
		TOTAL	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,343,145.37	$ 120,600.00	$ 1,538,846.92	$ 120,600.00
		3. Marina													
20550	000	**3.1 General Maintenance**	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00
20739	105	**3.2 Dredging**	$ -	$ 175,457.05	$ -	$ 116,971.37	$ -	$ 175,457.05	$ -	$ 116,971.37	$ -	$ 175,457.05	$ -	$ 116,971.37	$ -
20739	107	**3.3 Spoil Disposal**	$ -	$ 428,247.58	$ -	$ 281,631.72	$ -	$ 428,247.58	$ -	$ 281,631.72	$ -	$ 428,247.58	$ -	$ 281,631.72	$ -
20739	106	**3.4 Water Quality Monitoring**	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
20739	104	**3.5 Administration**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -	$ -	$ -
		TOTAL	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,504.63	$ 13,400.00	$ 412,003.08	$ 13,400.00
		GRAND TOTAL	$ 229,000.00	$ 3,676,650.00	$ 134,000.00	$ 1,950,850.00	$ 169,000.00	$ 1,956,650.00	$ 1,854,000.00	$ 1,950,850.00	$ 219,000.00	$ 1,964,650.00	$ 194,000.00	$ 3,670,850.00	$ 169,000.00
		ACCUMULATIVE TOTAL	$ 40,352,350.00	$ 44,029,000.00	$ 44,163,000.00	$ 46,113,850.00	$ 46,282,850.00	$ 48,239,500.00	$ 50,093,500.00	$ 52,044,350.00	$ 52,263,350.00	$ 54,228,000.00	$ 54,422,000.00	$ 58,092,850.00	$ 58,261,850.00
		RUNNING AVERAGE FROM 2011	$ 1,441,155.36	$ 1,518,241.38	$ 1,472,100.00	$ 1,487,543.55	$ 1,446,339.06	$ 1,461,803.03	$ 1,473,338.24	$ 1,486,981.43	$ 1,451,759.72	$ 1,465,621.62	$ 1,432,157.89	$ 1,489,560.26	$ 1,456,546.25

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NEWPORT WATERWAYS MAINTENANCE MODEL

MODEL SUMMARY

			41	42	43	44	45	46	47	48	49	50
Budget No.	Component No.	ITEM / DESCRIPTON	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
		1. Entrance Channel										
20739	101	1.1 Dredging & Spoil Disposal	$ -	$ -	$ -	$ 1,720,000.00	$ -	$ 50,000.00	$ -	$ -	$ 1,720,000.00	$ -
20739	102	1.2 Navigational Aids	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00	$ -	$ -
20739	104	1.3 Administration	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ 4,000.00	$ 35,000.00	$ -	$ -
		TOTAL	$ -	$ -	$ -	$ 1,755,000.00	$ -	$ 50,000.00	$ 4,000.00	$ 95,000.00	$ 1,720,000.00	$ -
		2. Residential Canals										
20550	000	2.1 General Maintenance	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00	$ 107,100.00
20739	105	2.2 Dredging	$ 355,592.95	$ -	$ 414,078.63	$ -	$ 355,592.95	$ -	$ 414,078.63	$ -	$ 355,592.95	$ -
20739	107	2.3 Spoil Disposal	$ 863,352.42	$ -	$ 1,004,168.28	$ -	$ 863,352.42	$ -	$ 1,004,168.28	$ -	$ 863,352.42	$ -
20739	106	2.5 Water Quality Monitoring	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
20739	104	2.6 Administration	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -	$ -	$ -
		TOTAL	$ 1,339,545.37	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,542,446.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00
		3. Marina										
20550	000	3.1 General Maintenance	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00	$ 11,900.00
20739	105	3.2 Dredging	$ 175,457.05	$ -	$ 116,971.37	$ -	$ 175,457.05	$ -	$ 116,971.37	$ -	$ 175,457.05	$ -
20739	107	3.3 Spoil Disposal	$ 428,247.58	$ -	$ 281,631.72	$ -	$ 428,247.58	$ -	$ 281,631.72	$ -	$ 428,247.58	$ -
20739	106	3.4 Water Quality Monitoring	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
20739	104	3.5 Administration	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -	$ -	$ -
		TOTAL	$ 617,104.63	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,403.08	$ 13,400.00	$ 617,104.63	$ 13,400.00
		GRAND TOTAL	$ 1,956,650.00	$ 134,000.00	$ 1,950,850.00	$ 1,889,000.00	$ 1,956,650.00	$ 184,000.00	$ 1,958,850.00	$ 229,000.00	$ 3,676,650.00	$ 134,000.00
		ACCUMULATIVE TOTAL	$ 60,218,500.00	$ 60,352,500.00	$ 62,303,350.00	$ 64,192,350.00	$ 66,149,000.00	$ 66,333,000.00	$ 68,291,850.00	$ 68,520,850.00	$ 72,197,500.00	$ 72,331,500.00
		RUNNING AVERAGE FROM 2011	$ 1,468,743.90	$ 1,436,964.29	$ 1,448,915.12	$ 1,458,917.05	$ 1,469,977.78	$ 1,442,021.74	$ 1,453,018.09	$ 1,427,517.71	$ 1,473,418.37	$ 1,446,630.00

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TO SIMULATE EFFECTS OF COST VARIATION, USE SENSITIVITY FACTORS ON DERIVED UNIT RATES AND DREDGING VOLUMES PAGES (FOR RATES AND QUANTITIES RESPECTIVELY)

NEWPORT WATERWAYS MAINTENANCE MODEL

MAINTENANCE MODEL CASH FLOW

ITEM / DESCRIPTON	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1. Entrance channel																			
1.1 Dredging and Spoil Disposal																			
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ -	$ -	$ -	$ 100,000.00	$ -	$ -	$ -	$ -	$ 100,000.00	$ -	$ -	$ -	$ -	$ 100,000.00	$ -	$ -	$ -	$ -	$ 100,000.00
Survey	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ 50,000.00
Grab Dredging - Contract Execution Costs - excl. dredging rate and survey	$ -	$ -	$ -	$ 70,000.00	$ -	$ -	$ -	$ -	$ 70,000.00	$ -	$ -	$ -	$ -	$ 70,000.00	$ -	$ -	$ -	$ -	$ 70,000.00
Grab Dredging to barge & haul to MIDMPA - maintenance	$ -	$ -	$ -	$ 1,500,000.00	$ -	$ -	$ -	$ -	$ 1,500,000.00	$ -	$ -	$ -	$ -	$ 1,500,000.00	$ -	$ -	$ -	$ -	$ 1,500,000.00
Supplementary Environmental Monitoring and Approvals Work	$ -	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -
1.2 Navigational Aids	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00	$ -
1.3 Administration																			
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,000.00	$ -	$ -
Review and Update of Maintenance Model	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -
TOTAL	$ -	$ -	$ -	$ 1,755,000.00	$ -	$ 50,000.00	$ 4,000.00	$ 95,000.00	$ 1,720,000.00	$ -	$ -	$ 35,000.00	$ -	$ 1,720,000.00	$ -	$ 85,000.00	$ 4,000.00	$ 60,000.00	$ 1,720,000.00
2. Residential Canals																			
2.1 General Maintenance																			
Litter collection	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
Rock wall maintenance	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00
Navigation Aid and Signage maintenance	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00
Vegetation removal	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00
Routine canal batter maintenance	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00
2.2 Dredging																			
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ 60,281.69	$ -	$ 79,062.50	$ -	$ 74,402.73	$ -	$ 80,314.96	$ -	$ 64,285.71	$ -	$ 80,468.75	$ -	$ 70,588.24	$ -	$ 79,591.84	$ -	$ 65,437.79	$ -	$ 78,540.77
Survey	$ 30,140.85	$ -	$ 39,531.25	$ -	$ 37,201.37	$ -	$ 40,157.48	$ -	$ 32,142.86	$ -	$ 40,234.37	$ -	$ 35,294.12	$ -	$ 39,795.92	$ -	$ 32,718.89	$ -	$ 39,270.39
Contract Execution Costs - excl. dredging rate and survey	$ 72,338.03	$ -	$ 94,875.00	$ -	$ 89,283.28	$ -	$ 96,377.95	$ -	$ 77,142.86	$ -	$ 96,562.50	$ -	$ 84,705.88	$ -	$ 95,510.20	$ -	$ 78,525.35	$ -	$ 94,248.93
Cutter Suction Dredging	$ 246,100.00	$ -	$ 290,950.00	$ -	$ 250,700.00	$ -	$ 234,600.00	$ -	$ 155,250.00	$ -	$ 236,900.00	$ -	$ 207,000.00	$ -	$ 224,250.00	$ -	$ 163,300.00	$ -	$ 210,450.00
2.3 Dredged Material Disposal\Re-use																			
Option A - Dispose at MIDMPA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Option B - Dispose at Beneficial Re-use Site	$ 1,102,000.00	$ -	$ 1,299,200.00	$ -	$ 1,119,400.00	$ -	$ 1,049,800.00	$ -	$ 696,000.00	$ -	$ 1,061,400.00	$ -	$ 928,000.00	$ -	$ 1,003,400.00	$ -	$ 730,800.00	$ -	$ 939,600.00
Option C - Dispose at Alternative Landfill Site	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dredged material disposal - Contract execution costs	$ 72,338.03	$ -	$ 94,875.00	$ -	$ 89,283.28	$ -	$ 96,377.95	$ -	$ 77,142.86	$ -	$ 96,562.50	$ -	$ 84,705.88	$ -	$ 95,510.20	$ -	$ 78,525.35	$ -	$ 94,248.93
2.5 Water Quality Monitoring	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
2.6 Administration																			
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -	$ -
Review and Update of Maintenance Model	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$ 1,703,798.59	$ 120,600.00	$ 2,019,093.75	$ 120,600.00	$ 1,780,870.65	$ 120,600.00	$ 1,721,828.35	$ 120,600.00	$ 1,222,564.29	$ 120,600.00	$ 1,732,728.12	$ 120,600.00	$ 1,530,894.12	$ 120,600.00	$ 1,658,658.16	$ 120,600.00	$ 1,273,507.37	$ 120,600.00	$ 1,576,959.01
3. Marinas																			
3.1 General Maintenance																			
Litter collection	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
Rock wall maintenance	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00
Navigation Aid and Signage maintenance	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Vegetation removal	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00
Routine canal batter maintenance	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00
3.2 Dredging																			
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ 39,718.31	$ -	$ 20,937.50	$ -	$ 25,597.27	$ -	$ 19,685.04	$ -	$ 35,714.29	$ -	$ 19,531.25	$ -	$ 29,411.76	$ -	$ 20,408.16	$ -	$ 34,562.21	$ -	$ 21,459.23
Survey	$ 19,859.15	$ -	$ 10,468.75	$ -	$ 12,798.63	$ -	$ 9,842.52	$ -	$ 17,857.14	$ -	$ 9,765.62	$ -	$ 14,705.88	$ -	$ 10,204.08	$ -	$ 17,281.11	$ -	$ 10,729.61
Contract Execution Costs - excl. dredging rate and survey	$ 47,661.97	$ -	$ 25,125.00	$ -	$ 30,716.72	$ -	$ 23,622.05	$ -	$ 42,857.14	$ -	$ 23,437.50	$ -	$ 35,294.12	$ -	$ 24,489.80	$ -	$ 41,474.65	$ -	$ 25,751.07
Cutter Suction Dredging	$ 162,150.00	$ -	$ 77,050.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00
3.3 Dredged Material Disposal\Re-use																			
Option A - Dispose at MIDMPA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Option B - Dispose at Beneficial Re-use Site	$ 725,000.00	$ -	$ 342,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00
Option C - Dispose at Alternative Landfill Site	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dredged material disposal - Contract execution costs	$ 47,661.97	$ -	$ 25,125.00	$ -	$ 30,716.72	$ -	$ 23,622.05	$ -	$ 42,857.14	$ -	$ 23,437.50	$ -	$ 35,294.12	$ -	$ 24,489.80	$ -	$ 41,474.65	$ -	$ 25,751.07
3.4 Water Quality Monitoring	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
3.5 Administration																			
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -	$ -
Review and Update of Maintenance Model	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$ 1,055,451.41	$ 13,400.00	$ 514,306.25	$ 13,400.00	$ 588,079.35	$ 13,400.00	$ 403,271.65	$ 13,400.00	$ 627,535.71	$ 13,400.00	$ 402,271.87	$ 13,400.00	$ 602,955.88	$ 13,400.00	$ 405,691.84	$ 13,400.00	$ 623,442.63	$ 13,400.00	$ 409,790.99
Grand Total	$ 2,759,250.00	$ 134,000.00	$ 2,533,400.00	$ 1,889,000.00	$ 2,368,950.00	$ 184,000.00	$ 2,129,100.00	$ 229,000.00	$ 3,570,100.00	$ 134,000.00	$ 2,135,000.00	$ 169,000.00	$ 2,133,850.00	$ 1,854,000.00	$ 2,064,350.00	$ 219,000.00	$ 1,900,950.00	$ 194,000.00	$ 3,706,750.00
Cumulative Total	$ 2,759,250.00	$ 2,893,250.00	$ 5,426,650.00	$ 7,315,650.00	$ 9,684,600.00	$ 9,868,600.00	$ 11,997,700.00	$ 12,226,700.00	$ 15,796,800.00	$ 15,930,800.00	$ 18,065,800.00	$ 18,234,800.00	$ 20,368,650.00	$ 22,222,650.00	$ 24,287,000.00	$ 24,506,000.00	$ 26,406,950.00	$ 26,600,950.00	$ 30,307,700.00
Running Average from 2016	$ 2,759,250.00	$ 1,446,625.00	$ 1,808,883.33	$ 1,828,912.50	$ 1,936,920.00	$ 1,644,766.67	$ 1,713,957.14	$ 1,528,337.50	$ 1,755,200.00	$ 1,593,080.00	$ 1,642,345.45	$ 1,519,566.67	$ 1,566,819.23	$ 1,587,332.14	$ 1,619,133.33	$ 1,531,625.00	$ 1,553,350.00	$ 1,477,830.56	$ 1,595,142.11

Instructions for Model Cash Flow Worksheet
DO NOT MODIFY CELL CONTENTS DIRECTLY
MODIFIY UNIT RATES AND PROGRAM SHEETS TO UPDATE DATA.
TO SIMULATE EFFECTS OF COST VARIATION, USE SENSITIVITY FACTORS
ON DERIVED UNIT RATES AND DREDGING VOLUMES PAGES
(FOR RATES AND QUANTITIES RESPECTIVELY)

NEWPORT WATERWAYS MAINTENANCE MODEL

MAINTENANCE MODEL CASH FLOW

ITEM / DESCRIPTON	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
1. Entrance channel																			
1.1 Dredging and Spoil Disposal																			
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ -	$ -	$ -	$ -	$ 100,000.00	$ -	$ -	$ -	$ -	$ 100,000.00	$ -	$ -	$ -	$ -	$ 100,000.00	$ -	$ -	$ -	$ -
Survey	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -
Grab Dredging - Contract Execution Costs - excl. dredging rate and survey	$ -	$ -	$ -	$ -	$ 70,000.00	$ -	$ -	$ -	$ -	$ 70,000.00	$ -	$ -	$ -	$ -	$ 70,000.00	$ -	$ -	$ -	$ -
Grab Dredging to barge & haul to MIDMPA - maintenance	$ -	$ -	$ -	$ -	$ 1,500,000.00	$ -	$ -	$ -	$ -	$ 1,500,000.00	$ -	$ -	$ -	$ -	$ 1,500,000.00	$ -	$ -	$ -	$ -
Supplementary Environmental Monitoring and Approvals Work	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -
1.2 Navigational Aids	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00
1.3 Administration																			
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,000.00	$ -
Review and Update of Maintenance Model	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ 35,000.00	$ -	$ -
TOTAL	$ 35,000.00	$ -	$ -	$ -	$ 1,755,000.00	$ -	$ 50,000.00	$ 4,000.00	$ 95,000.00	$ 1,720,000.00	$ -	$ -	$ 35,000.00	$ -	$ 1,720,000.00	$ -	$ 85,000.00	$ 4,000.00	$ 60,000.00
2. Residential Canals																			
2.1 General Maintenance																			
Litter collection	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
Rock wall maintenance	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00
Navigation Aid and Signage maintenance	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00
Vegetation removal	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00
Routine canal batter maintenance	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00
2.2 Dredging																			
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ -	$ 54,819.28	$ -	$ 77,973.57	$ -	$ 66,960.35	$ -	$ 77,973.57	$ -	$ 66,960.35	$ -	$ 77,973.57	$ -	$ 66,960.35	$ -	$ 77,973.57	$ -	$ 66,960.35	$ -
Survey	$ -	$ 27,409.64	$ -	$ 38,986.78	$ -	$ 33,480.18	$ -	$ 38,986.78	$ -	$ 33,480.18	$ -	$ 38,986.78	$ -	$ 33,480.18	$ -	$ 38,986.78	$ -	$ 33,480.18	$ -
Contract Execution Costs - excl. dredging rate and survey	$ -	$ 65,783.13	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -
Cutter Suction Dredging	$ -	$ 104,650.00	$ -	$ 203,550.00	$ -	$ 174,800.00	$ -	$ 203,550.00	$ -	$ 174,800.00	$ -	$ 203,550.00	$ -	$ 174,800.00	$ -	$ 203,550.00	$ -	$ 174,800.00	$ -
2.3 Dredged Material Disposal\Re-use																			
Option A - Dispose at MIDMPA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Option B - Dispose at Beneficial Re-use Site	$ -	$ 469,800.00	$ -	$ 910,600.00	$ -	$ 783,000.00	$ -	$ 910,600.00	$ -	$ 783,000.00	$ -	$ 910,600.00	$ -	$ 783,000.00	$ -	$ 910,600.00	$ -	$ 783,000.00	$ -
Option C - Dispose at Alternative Landfill Site	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dredged material disposal - Contract execution costs	$ -	$ 65,783.13	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -
2.5 Water Quality Monitoring	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
2.6 Administration																			
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -
Review and Update of Maintenance Model	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$ 120,600.00	$ 908,845.18	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,542,446.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,343,145.37	$ 120,600.00
3. Marinas																			
3.1 General Maintenance																			
Litter collection	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
Rock wall maintenance	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00
Navigation Aid and Signage maintenance	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Vegetation removal	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00
Routine canal batter maintenance	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00
3.2 Dredging																			
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ -	$ 45,180.72	$ -	$ 22,026.43	$ -	$ 33,039.65	$ -	$ 22,026.43	$ -	$ 33,039.65	$ -	$ 22,026.43	$ -	$ 33,039.65	$ -	$ 22,026.43	$ -	$ 33,039.65	$ -
Survey	$ -	$ 22,590.36	$ -	$ 11,013.22	$ -	$ 16,519.82	$ -	$ 11,013.22	$ -	$ 16,519.82	$ -	$ 11,013.22	$ -	$ 16,519.82	$ -	$ 11,013.22	$ -	$ 16,519.82	$ -
Contract Execution Costs - excl. dredging rate and survey	$ -	$ 54,216.87	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -
Cutter Suction Dredging	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -
3.3 Dredged Material Disposal\Re-use																			
Option A - Dispose at MIDMPA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Option B - Dispose at Beneficial Re-use Site	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -
Option C - Dispose at Alternative Landfill Site	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dredged material disposal - Contract execution costs	$ -	$ 54,216.87	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -
3.4 Water Quality Monitoring	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
3.5 Administration																			
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -
Review and Update of Maintenance Model	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$ 13,400.00	$ 664,454.82	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,403.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,504.63	$ 13,400.00
Grand Total	$ 169,000.00	$ 1,573,300.00	$ 134,000.00	$ 1,950,850.00	$ 1,889,000.00	$ 1,956,650.00	$ 184,000.00	$ 1,958,850.00	$ 229,000.00	$ 3,676,650.00	$ 134,000.00	$ 1,950,850.00	$ 169,000.00	$ 1,956,650.00	$ 1,854,000.00	$ 1,950,850.00	$ 219,000.00	$ 1,964,650.00	$ 194,000.00
Cumulative Total	$ 30,476,700.00	$ 32,050,000.00	$ 32,184,000.00	$ 34,134,850.00	$ 36,023,850.00	$ 37,980,500.00	$ 38,164,500.00	$ 40,123,350.00	$ 40,352,350.00	$ 44,029,000.00	$ 44,163,000.00	$ 46,113,850.00	$ 46,282,850.00	$ 48,239,500.00	$ 50,093,500.00	$ 52,044,350.00	$ 52,263,350.00	$ 54,228,000.00	$ 54,422,000.00
Running Average from 2016	$ 1,523,835.00	$ 1,526,190.48	$ 1,462,909.09	$ 1,484,123.91	$ 1,500,993.75	$ 1,519,220.00	$ 1,467,865.38	$ 1,486,050.00	$ 1,441,155.36	$ 1,518,241.38	$ 1,472,100.00	$ 1,487,543.55	$ 1,446,339.06	$ 1,461,803.03	$ 1,473,338.24	$ 1,486,981.43	$ 1,451,759.72	$ 1,465,621.62	$ 1,432,157.89

Instructions for Model Cash Flow Worksheet
DO NOT MODIFY CELL CONTENTS DIRECTLY
MODIFIY UNIT RATES AND PROGRAM SHEETS TO UPDATE DATA.
TO SIMULATE EFFECTS OF COST VARIATION, USE SENSITIVITY FACTORS
ON DERIVED UNIT RATES AND DREDGING VOLUMES PAGES
(FOR RATES AND QUANTITIES RESPECTIVELY)

NEWPORT WATERWAYS MAINTENANCE MODEL

MAINTENANCE MODEL CASH FLOW

ITEM / DESCRIPTON	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
1. Entrance channel												
1.1 Dredging and Spoil Disposal												
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ 100,000.00	$ -	$ -	$ -	$ -	$ 100,000.00	$ -	$ -	$ -	$ -	$ 100,000.00	$ -
Survey	$ 50,000.00	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -	$ 50,000.00	$ -
Grab Dredging - Contract Execution Costs - excl. dredging rate and survey	$ 70,000.00	$ -	$ -	$ -	$ -	$ 70,000.00	$ -	$ -	$ -	$ -	$ 70,000.00	$ -
Grab Dredging to barge & haul to MIDMPA - maintenance	$ 1,500,000.00	$ -	$ -	$ -	$ -	$ 1,500,000.00	$ -	$ -	$ -	$ -	$ 1,500,000.00	$ -
Supplementary Environmental Monitoring and Approvals Work	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000.00	$ -	$ -	$ -	$ -
1.2 Navigational Aids	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000.00	$ -	$ -
1.3 Administration												
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,000.00	$ -	$ -	$ -
Review and Update of Maintenance Model	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -	$ -	$ 35,000.00	$ -	$ -
TOTAL	$ 1,720,000.00	$ 35,000.00	$ -	$ -	$ -	$ 1,755,000.00	$ -	$ 50,000.00	$ 4,000.00	$ 95,000.00	$ 1,720,000.00	$ -
2. Residential Canals												
2.1 General Maintenance												
Litter collection	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
Rock wall maintenance	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00	$ 3,150.00
Navigation Aid and Signage maintenance	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00	$ 450.00
Vegetation removal	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00	$ 54,000.00
Routine canal batter maintenance	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00
2.2 Dredging												
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ 77,973.57	$ -	$ 66,960.35	$ -	$ 77,973.57	$ -	$ 66,960.35	$ -	$ 77,973.57	$ -	$ 66,960.35	$ -
Survey	$ 38,986.78	$ -	$ 33,480.18	$ -	$ 38,986.78	$ -	$ 33,480.18	$ -	$ 38,986.78	$ -	$ 33,480.18	$ -
Contract Execution Costs - excl. dredging rate and survey	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -
Cutter Suction Dredging	$ 203,550.00	$ -	$ 174,800.00	$ -	$ 203,550.00	$ -	$ 174,800.00	$ -	$ 203,550.00	$ -	$ 174,800.00	$ -
2.3 Dredged Material Disposal\Re-use												
Option A - Dispose at MIDMPA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Option B - Dispose at Beneficial Re-use Site	$ 910,600.00	$ -	$ 783,000.00	$ -	$ 910,600.00	$ -	$ 783,000.00	$ -	$ 910,600.00	$ -	$ 783,000.00	$ -
Option C - Dispose at Alternative Landfill Site	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dredged material disposal - Contract execution costs	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -	$ 93,568.28	$ -	$ 80,352.42	$ -
2.5 Water Quality Monitoring	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00	$ 13,500.00
2.6 Administration												
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,600.00	$ -	$ -	$ -
Review and Update of Maintenance Model	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$ 1,538,846.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,538,846.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00	$ 1,542,446.92	$ 120,600.00	$ 1,339,545.37	$ 120,600.00
3. Marinas												
3.1 General Maintenance												
Litter collection	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
Rock wall maintenance	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00	$ 350.00
Navigation Aid and Signage maintenance	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Vegetation removal	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00	$ 6,000.00
Routine canal batter maintenance	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00	$ 4,000.00
3.2 Dredging												
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$ 22,026.43	$ -	$ 33,039.65	$ -	$ 22,026.43	$ -	$ 33,039.65	$ -	$ 22,026.43	$ -	$ 33,039.65	$ -
Survey	$ 11,013.22	$ -	$ 16,519.82	$ -	$ 11,013.22	$ -	$ 16,519.82	$ -	$ 11,013.22	$ -	$ 16,519.82	$ -
Contract Execution Costs - excl. dredging rate and survey	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -
Cutter Suction Dredging	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -	$ 57,500.00	$ -	$ 86,250.00	$ -
3.3 Dredged Material Disposal\Re-use												
Option A - Dispose at MIDMPA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Option B - Dispose at Beneficial Re-use Site	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -	$ 255,200.00	$ -	$ 388,600.00	$ -
Option C - Dispose at Alternative Landfill Site	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dredged material disposal - Contract execution costs	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -	$ 26,431.72	$ -	$ 39,647.58	$ -
3.4 Water Quality Monitoring	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
3.5 Administration												
Approvals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 400.00	$ -	$ -	$ -
Review and Update of Maintenance Model	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$ 412,003.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,003.08	$ 13,400.00	$ 617,104.63	$ 13,400.00	$ 412,403.08	$ 13,400.00	$ 617,104.63	$ 13,400.00
Grand Total	$ 3,670,850.00	$ 169,000.00	$ 1,956,650.00	$ 134,000.00	$ 1,950,850.00	$ 1,889,000.00	$ 1,956,650.00	$ 184,000.00	$ 1,958,850.00	$ 229,000.00	$ 3,676,650.00	$ 134,000.00
Cumulative Total	$ 58,092,850.00	$ 58,261,850.00	$ 60,218,500.00	$ 60,352,500.00	$ 62,303,350.00	$ 64,192,350.00	$ 66,149,000.00	$ 66,333,000.00	$ 68,291,850.00	$ 68,520,850.00	$ 72,197,500.00	$ 72,331,500.00
Running Average from 2016	$ 1,489,560.26	$ 1,456,546.25	$ 1,468,743.90	$ 1,436,964.29	$ 1,448,915.12	$ 1,458,917.05	$ 1,469,977.78	$ 1,442,021.74	$ 1,453,018.09	$ 1,427,517.71	$ 1,473,418.37	$ 1,446,630.00

Instructions for Model Cash Flow Worksheet
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(FOR RATES AND QUANTITIES RESPECTIVELY)

NEWPORT WATERWAYS MAINTENANCE MODEL

MAINTENANCE MODEL PROGRAM (QUANTITIES TIME SERIES)

ITEM / DESCRIPTON	Units	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
1. Entrance channel																															
1.1 Dredging and Spoil Disposal																															
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring	(-)				1					1					1					1					1				1		
Survey	(-)				1					1					1					1					1				1		
Grab Dredging - Contract Execution Costs - excl. dredging rate and survey	(-)				1					1					1					1					1				1		
Grab Dredging to barge & haul to MIDMPA - maintenance	m^3				25,000					25,000					25,000					25,000					25,000				25,000		
Supplementary Environmental Monitoring and Approvals Work	(-)						1										1										1				
1.2 Navigational Aids									1										1										1		
1.3 Administration																															
Approvals	(-)							1										1										1			
Review and Update of Maintenance Model	(-)				1				1				1				1				1				1				1		
2. Residential Canals																															
2.1 General Maintenance																															
Litter collection	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Rock wall maintenance	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Navigation Aid and Signage maintenance	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Vegetation removal	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Routine canal batter maintenance	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2.2 Dredging																															
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring	(-)	0.60	-	0.79	-	0.74	-	0.80	-	0.64	-	0.80	-	0.71	-	0.80	-	0.65	-	0.79	-	0.55	-	0.78	-	0.67	-	0.78	-	0.67	-
Survey	(-)	0.60	-	0.79	-	0.74	-	0.80	-	0.64	-	0.80	-	0.71	-	0.80	-	0.65	-	0.79	-	0.55	-	0.78	-	0.67	-	0.78	-	0.67	-
Contract Execution Costs - excl. dredging rate and survey	(-)	0.60	-	0.79	-	0.74	-	0.80	-	0.64	-	0.80	-	0.71	-	0.80	-	0.65	-	0.79	-	0.55	-	0.78	-	0.67	-	0.78	-	0.67	-
Cutter Suction Dredging	m^3	21,400	-	25,300	-	21,800	-	20,400	-	13,500	-	20,600	-	18,000	-	19,500	-	14,200	-	18,300	-	9,100	-	17,700	-	15,200	-	17,700	-	15,200	-
2.3 Dredged Material Disposal\Re-use																															
☐ Option A — Option A	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
☑ Option B — Option B	m^3	19,000	-	22,400	-	19,300	-	18,100	-	12,000	-	18,300	-	16,000	-	17,300	-	12,600	-	16,200	-	8,100	-	15,700	-	13,500	-	15,700	-	13,500	-
☐ Option C — Option C	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dredged material disposal - Contract execution costs	(-)	0.60	-	0.79	-	0.74	-	0.80	-	0.64	-	0.80	-	0.71	-	0.80	-	0.65	-	0.79	-	0.55	-	0.78	-	0.67	-	0.78	-	0.67	-
2.5 Water Quality Monitoring	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2.6 Administration																															
Approvals	(-)							0.9										0.9										0.9			
Review and Update of Maintenance Model	(-)																														
3. Marinas																															
3.1 General Maintenance																															
Litter collection	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Rock wall maintenance	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Navigation Aid and Signage maintenance	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Vegetation removal	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Routine canal batter maintenance	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3.2 Dredging																															
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring	(-)	0.40	-	0.21	-	0.26	-	0.20	-	0.36	-	0.20	-	0.29	-	0.20	-	0.35	-	0.21	-	0.45	-	0.22	-	0.33	-	0.22	-	0.33	-
Survey	(-)	0.40	-	0.21	-	0.26	-	0.20	-	0.36	-	0.20	-	0.29	-	0.20	-	0.35	-	0.21	-	0.45	-	0.22	-	0.33	-	0.22	-	0.33	-
Contract Execution Costs - excl. dredging rate and survey	(-)	0.40	-	0.21	-	0.26	-	0.20	-	0.36	-	0.20	-	0.29	-	0.20	-	0.35	-	0.21	-	0.45	-	0.22	-	0.33	-	0.22	-	0.33	-
Cutter Suction Dredging	m^3	14,100	-	6,700	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-
3.3 Dredged Material Disposal\Re-use																															
☐ Option A — Option A	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
☑ Option B — Option B	m^3	12,500	-	5,900	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-
☐ Option C — Option C	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dredged material disposal - Contract execution costs	(-)	0.40	-	0.21	-	0.26	-	0.20	-	0.36	-	0.20	-	0.29	-	0.20	-	0.35	-	0.21	-	0.45	-	0.22	-	0.33	-	0.22	-	0.33	-
3.4 Water Quality Monitoring	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3.5 Administration																															
Approvals	(-)							0.1										0.1										0.1			
Review and Update of Maintenance Model	(-)																														

Instructions for Program Worksheet
MODIFY DIMENSIONLESS EVENTS BY INSERTING THE NUMBER OF EVENTS FOR THAT YEAR.
DO NOT MODIFY CELLS IN THIS SPREADSHEET WHICH APPEAR IN BROWN, AS THEY ARE LINKED TO DREDGING VOLUMES WORKPAGES. **MODIFY BLUE CELLS ONLY.**
THIS WORKSHEET IS THEN MULTIPLIED BY THE 'DERIVED UNIT RATES' WORKSHEET TO PRODUCE COSTS FOR EACH ITEM
IN EVENT THAT COSTS ITEMS ARE SHARED BETWEEN SECTIONS/AREAS,
PLACE FRACTION INSTEAD OF 1 FOR DISTRIBUTION OF COSTS

NEWPORT WATERWAYS MAINTENANCE MODEL

MAINTENANCE MODEL PROGRAM (QUANTITIES TIME SERIES)

ITEM / DESCRIPTON	Units	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
1. Entrance channel																					
1.1 Dredging and Spoil Disposal																					
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring	(-)				1					1					1					1	
Survey	(-)				1					1					1					1	
Grab Dredging - Contract Execution Costs - excl. dredging rate and survey	(-)				1					1					1					1	
Grab Dredging to barge & haul to MIDMPA - maintenance	m^3				25,000					25,000					25,000					25,000	
Supplementary Environmental Monitoring and Approvals Work	(-)						1										1				
1.2 Navigational Aids									1										1		
1.3 Administration																					
Approvals	(-)							1										1			
Review and Update of Maintenance Model	(-)		1				1				1				1				1		
2. Residential Canals																					
2.1 General Maintenance																					
Litter collection	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Rock wall maintenance	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Navigation Aid and Signage maintenance	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Vegetation removal	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Routine canal batter maintenance	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2.2 Dredging																					
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring	(-)	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-
Survey	(-)	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-
Contract Execution Costs - excl. dredging rate and survey	(-)	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-
Cutter Suction Dredging	m^3	17,700	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-
2.3 Dredged Material Disposal\Re-use																					
☐ Option A Option A - Dispose at MIDMPA	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
☑ Option B Option B - Dispose at Beneficial Re-use Site	m^3	15,700	-	13,500	-	15,700	-	13,500	-	15,700	-	13,500	-	15,700	-	13,500	-	15,700	-	13,500	-
☐ Option C Option C - Dispose at Alternative Landfill Site	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dredged material disposal - Contract execution costs	(-)	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-
2.5 Water Quality Monitoring	(-)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2.6 Administration																					
Approvals	(-)							0.9										0.9			
Review and Update of Maintenance Model	(-)																				
3. Marinas																					
3.1 General Maintenance																					
Litter collection	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Rock wall maintenance	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Navigation Aid and Signage maintenance	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Vegetation removal	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Routine canal batter maintenance	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3.2 Dredging																					
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring	(-)	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-
Survey	(-)	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-
Contract Execution Costs - excl. dredging rate and survey	(-)	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-
Cutter Suction Dredging	m^3	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-
3.3 Dredged Material Disposal\Re-use																					
☐ Option A Option A - Dispose at MIDMPA	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
☑ Option B Option B - Dispose at Beneficial Re-use Site	m^3	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-
☐ Option C Option C - Dispose at Alternative Landfill Site	m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dredged material disposal - Contract execution costs	(-)	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-	0.22	-	0.33	-
3.4 Water Quality Monitoring	(-)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3.5 Administration																					
Approvals	(-)							0.1										0.1			
Review and Update of Maintenance Model	(-)																				

Instructions for Program Worksheet
MODIFY DIMENSIONLESS EVENTS BY INSERTING THE NUMBER OF EVENTS FOR THAT YEAR
DO NOT MODIFY CELLS IN THIS SPREADSHEET WHICH APPEAR IN BROWN, AS THEY ARE LINKED TO DREDGING VOLUMES WORKPAGES. **MODIFY BLUE CELLS ONLY.**
THIS WORKSHEET IS THEN MULTIPLIED BY THE 'DERIVED UNIT RATES' WORKSHEET TO PRODUCE COSTS FOR EACH ITEM
IN EVENT THAT COSTS ITEMS ARE SHARED BETWEEN SECTIONS/AREAS,
PLACE FRACTION INSTEAD OF 1 FOR DISTRIBUTION OF COSTS

NEWPORT WATERWAYS MAINTENANCE MODEL

MAINTENANCE MODEL DERIVED UNIT RATES

ITEM / DESCRIPTON	Source	Units	RATE	SENSITIVITY: RATE FACTOR	COMMENT
1. Entrance channel					
1.1 Dredging and Spoil Disposal					
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	xxix		$ 100,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxix * (1 + Adopted Confidence Percentage)]
Survey	vii		$ 50,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate vii * (1 + Adopted Confidence Percentage)]
Grab Dredging - Contract Execution Costs - excl. dredging rate and survey	iii		$ 70,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate iii * (1 + Adopted Confidence Percentage)]
Grab Dredging to barge & haul to MIDMPA - maintenance	iv	/m^3	$ 60.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate iv * (1 + Adopted Confidence Percentage)]
Supplementary Environmental Monitoring and Approvals Work	xm		$ 50,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xm * (1 + Adopted Confidence Percentage)]
1.2 Navigational Aids	xmi		$ 60,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate * (1 + Adopted Confidence Percentage)]
1.3 Administration					
Approvals	xxviii		$ 4,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxviii * (1 + Adopted Confidence Percentage)] ; Acquisition of Environmental Approvals for capital dredge
Review and Update of Maintenance Model	xxx		$ 35,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxx * (1 + Adopted Confidence Percentage)]
2. Residential Canals					
2.1 General Maintenance					
Litter collection	xvi		$ 15,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xvi * (1 + Adopted Confidence Percentage)]
Rock wall maintenance	xvii		$ 3,500.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xvii * (1 + Adopted Confidence Percentage)]
Navigation Aid and Signage maintenance	xviii		$ 500.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xviii * (1 + Adopted Confidence Percentage)]
Vegetation removal	xx		$ 60,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xx * (1 + Adopted Confidence Percentage)]
Routine canal batter maintenance	xxi		$ 40,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxi * (1 + Adopted Confidence Percentage)]
2.2 Dredging					
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	xxxiii		$ 100,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxxiii * (1 + Adopted Confidence Percentage)]
Survey	vii		$ 50,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate vii * (1 + Adopted Confidence Percentage)]
Contract Execution Costs - excl. dredging rate and survey	i		$ 120,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate i * (1 + Adopted Confidence Percentage)]
Cutter Suction Dredging	ii	/m^3	$ 11.50	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate ii * (1 + Adopted Confidence Percentage)]
2.3 Dredged Material Disposal\Re-use					
Option A - Dispose at MIDMPA	miii	/m^3	$ 70.00	1	Derived Rate = Sensitivity Rate Factor * Derived Unit Rate miii (below)
Option B - Dispose at Beneficial Re-use Site	miv	/m^3	$ 58.00	1	Derived Rate = Sensitivity Rate Factor * Derived Unit Rate miv (below)
Option C - Dispose at Alternative Landfill Site	mv	/m^3	$ 138.00	1	Derived Rate = Sensitivity Rate Factor * Derived Unit Rate mv (below)
Dredged Material Disposal - Contract Execution Costs	xmviii		$ 120,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xmviii * (1 + Adopted Confidence Percentage)]
2.5 Water Quality Monitoring	xmv		$ 15,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xmv * (1 + Adopted Confidence Percentage)]
2.6 Administration					
Approvals	xxxii		$ 4,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxxii * (1 + Adopted Confidence Percentage)]
Review and Update of Maintenance Model	xxxiv		$ -	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxxv * (1 + Adopted Confidence Percentage)]
3. Marinas					
3.1 General Maintenance					
Litter collection	xxii		$ 15,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxii * (1 + Adopted Confidence Percentage)]
Rock wall maintenance	xxiii		$ 3,500.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxiii * (1 + Adopted Confidence Percentage)]
Navigation Aid and Signage maintenance	xxiv		$ 500.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxiv * (1 + Adopted Confidence Percentage)]
Vegetation removal	xxvi		$ 60,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxvi * (1 + Adopted Confidence Percentage)]
Routine canal batter maintenance	xxvii		$ 40,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxvii * (1 + Adopted Confidence Percentage)]
3.2 Dredging					
Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	xxxvii		$ 100,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxxvii * (1 + Adopted Confidence Percentage)]
Survey	vii		$ 50,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate vii * (1 + Adopted Confidence Percentage)]
Contract Execution Costs - excl. dredging rate and survey	i		$ 120,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate i * (1 + Adopted Confidence Percentage)]
Cutter Suction Dredging	ii	/m^3	$ 11.50	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate ii * (1 + Adopted Confidence Percentage)]
3.3 Dredged Material Disposal\Re-use					
Option A - Dispose at MIDMPA	miii	/m^3	$ 70.00	1	Derived Rate = Sensitivity Rate Factor * Derived Unit Rate miii (below)
Option B - Dispose at Beneficial Re-use Site	miv	/m^3	$ 58.00	1	Derived Rate = Sensitivity Rate Factor * Derived Unit Rate miv (below)
Option C - Dispose at Alternative Landfill Site	mv	/m^3	$ 138.00	1	Derived Rate = Sensitivity Rate Factor * Derived Unit Rate mv (below)
Dredged material disposal - Contract execution costs	xmviii		$ 120,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xmviii * (1 + Adopted Confidence Percentage)]
3.4 Water Quality Monitoring	xmvi		$ 15,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xmvi * (1 + Adopted Confidence Percentage)]
3.5 Administration					
Approvals	xxxvi		$ 4,000.00	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxxvi * (1 + Adopted Confidence Percentage)]
Review and Update of Maintenance Model	xxxviii		$ -	1	Derived Rate = Sensitivity Rate Factor * [Raw Unit Rate xxxviii * (1 + Adopted Confidence Percentage)]

CALCULATED UNIT RATES FOR SPOIL DISPOSAL SYSTEMS

ITEM / DESCRIPTON	Source	Units	RATE	REF NO.	COMMENT
Dredged Material Disposal\Re-use - Option A - Dispose at MIDMPA					
Treat dredged material		$/m^3	$ -		Material treatment N/A
Load to Barges and Dispose at MIDMPA	xi	$/m^3	$ 70.00		Load to Barges and Dispose at MIDMPA
Disposal Cost		$/m^3	$ -		Disposal Cost N/A
		$/m^3	$ 70.00	miii	Rounded total
Dredged Material Disposal\Re-use- Option B - Beneficial Re-use Site					
Treat and load dredged material	ix	$/m^3	$ 13.00		Treat and load dredged material (via 4% cement stabilisation or lime treatment)
Haul to Beneficial Re-use Site	mxiv	$/m^3	$ 30.61		Derived unit rate shown below
Disposal Cost at Beneficial Re-use Site	mxv	$/m^3	$ 13.91		Derived unit rate shown below
		$/m^3	$ 58.00	miv	Rounded total
Dredged Material Disposal\Re-use - Option C - Alternative Landfill Site					
Treat and load dredged material	ix	$/m^3	$ 13.00		Treat and load dredged material (via 4% cement stabilisation or lime treatment)
Haul to Alternative Landfill Site	xii	$/m^3	$ 65.40		Derived unit rate shown below
Dispose at Alternative Landfill Site	mxii	$/m^3	$ 59.83		Derived unit rate shown below
		$/m^3	$ 138.00	mv	Rounded total

CALCULATED UNIT RATES - CONVERSION FOR $/T TO $/M^3

ITEM / DESCRIPTON	Source	Units	RATE	REF NO.	COMMENT
Haul to Alternative Landfill Site	xii,mii	$/m^3	$ 65.40	mxiii	Estimated haulage cost for disposal at Ti Tree Bio Energy site - Willowbank (approx. 85km haulage distance)
Haul to Beneficial Re-use Site	xiii,mii	$/m^3	$ 30.61	mxiv	Estimated haulage cost - assuming approx. 40 km haulage distance
Disposal Cost - MBRC Landfill Site - Assumes 'Pond Wet' bulk density	xiv,mii	$/m^3	$ 173.94	mxi	Rate provided by MBRC Caboolture Waste Management Facility
Disposal Cost - Alternative Landfill Site - Assumes 'Pond Wet' bulk density	xv,mii	$/m^3	$ 59.83	mxii	Quote from Veolia for disposal at Ti Tree Bio Energy site
Disposal Cost - Beneficial Re-use Site - Assumes 'Pond Wet' bulk density	xmx,mii	$/m^3	$ 13.91	mxv	Estimate - notional amount to cover disposal fees at nominated site

MAINTENANCE MODEL DERIVED UNIT RATES
USER MODIFY CELLS IN RED
DO NOT MODIFY RATE CELLS DIRECTLY AS THESE ARE LINKED TO RAW UNIT RATES
COSTS SHOWN ARE UNIT RATES WITH CERTAINTY FACTOR

Instructions for Model Sensitivity Worksheet
1. Use the coloured cells to apply a factor to the adjacent item.
2. Unchanged cells (=1.0) will be displaced as light green, while cells with a factor applied will be displaced as light brown

NEWPORT WATERWAYS MAINTENANCE MODEL

RAW UNIT RATES TABLE

ALL RATES ARE IN 2016 DOLLARS AND EXCLUDE GST

REF NO.	ITEM	UNIT	RATE	CONFIDENCE LEVEL	ORIGIN / REFERENCE / DATE
	Dredging				
i	Cutter Suction Dredging - Contract Execution Costs	$	120,000.00	1	Estimate based on 2013-14 Dredging Campaign
ii	Cutter Suction Dredging - to Griffith Rd (Section 19) Pond	$/m^3	11.50	1	Estimate based on rates for 2011-12 and 2013-14 Dredging Campaigns
iii	Grab Dredging - Contract Execution Costs - excl. dredging rate and survey	$	70,000.00	1	Estimate based on Newport Capital Dredging 2012-13 and Scarborough Entrance Channel Maintenance 2015 Dredging Campaigns
iv	Grab Dredging to barge & haul to MIDMPA - Entrance Channel	$/m^3	60.00	1	Estimate based on Scarborough Entrance Channel 2015 Maintenance Dredging Campaign
vii	Dredge survey	$	50,000.00	1	Estimate based on costs for 2015 full canal estate survey - plus allowance for pre-dredge survey (dredge area only)
	Dredged Material Treatment & Disposal\Re-use				
xmxi	Dredged Material Disposal - Contract Execution Costs	$	120,000.00	3	Estimate based on 2013-14 Material Disposal Campaign
ix	Treat and load dredged material (via 4% cement stabilisation or lime treatment)	$/m^3	13.00	3	Estimate based on information and rates provided by Contractor
xi	Load to Barges and Dispose at MIDMPA	$/m^3	70.00	4	Estimate broadly based on entrance channel maintenance dredging and disposal rate
xiii	Haul to Beneficial Re-use Site	$/tonne	22.00	3	Estimated haulage cost - assuming approx. 40 km haulage distance
xii	Haul to Alternative Landfill Site	$/tonne	47.00	4	Estimated haulage cost for disposal at Ti Tree Bio Energy site - Willowbank (approx. 85km haulage distance)
xiv	Disposal cost at MBRC Caboolture Waste Management Facility	$/tonne	125.00	1	Rate provided by MBRC Caboolture Waste Management Facility
xmx	Disposal cost at Beneficial Re-use Site	$/tonne	10.00	5	Estimate - notional amount to cover disposal fees at nominated site
xv	Disposal cost at Alternative Landfill Site	$/tonne	43.00	1	Quote from Veolia for disposal at Ti Tree Bio Energy site
	Maintenance - Residential Canals				
xvi	Litter Collection - Residential Canals	$/annum	15,000.00	1	MBRC Estimate (Total Rate/Cost) - Apportioned in PROGRAM sheet
xvii	Rock wall maintenance - Residential Canals	$/annum	3,500.00	3	MBRC Estimate based on 2014-15 expenditure (Total Rate/Cost) - Apportioned in PROGRAM sheet
xviii	Navigation Aid and Signage maintenance - Residential Canals	$/annum	500.00	3	Estimate based on Expenditure Records 1999-2012 (Total Rate/Cost) - Apportioned in PROGRAM sheet
xx	Vegetation Removal - Residential Canals	$/annum	60,000.00	2	MBRC Estimate (Total Rate/Cost) - Apportioned in PROGRAM sheet
xxi	Routine canal batter maintenance - Residential Canals	$/annum	40,000.00	3	MBRC Estimate (Total Rate/Cost) - Apportioned in PROGRAM sheet
	Maintenance - Marinas				
xxii	Litter Collection - Marinas	$/annum	15,000.00	1	MBRC Estimate (Total Rate/Cost) - Apportioned in PROGRAM sheet
xxiii	Rock wall maintenance - Marinas	$/annum	3,500.00	3	MBRC Estimate based on 2014-15 expenditure (Total Rate/Cost) - Apportioned in PROGRAM sheet
xxiv	Navigation Aid and Signage maintenance - Marinas	$/annum	500.00	3	Estimate based on Expenditure Records 1999-2012 (Total Rate/Cost) - Apportioned in PROGRAM sheet
xxvi	Vegetation Removal - Marinas	$/annum	60,000.00	2	MBRC Estimate (Total Rate/Cost) - Apportioned in PROGRAM sheet
xxvii	Routine canal batter maintenance - Marinas	$/annum	40,000.00	3	MBRC Estimate (Total Rate/Cost) - Apportioned in PROGRAM sheet
	Administration - Entrance Channel				
xxviii	Approvals - renewal fees	$	4,000.00	3	Estimate based on current renewal fees/costs
xxix	Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$	100,000.00	3	Estimate based on 2013-14 and 2016 (planned) Dredging Campaigns
xxx	Review and Update of Maintenance Model	$	35,000.00	2	Estimate based on 2015-16 review
	Administration - Residential Canals				
xxxii	Approvals - renewal fees	$	4,000.00	3	Estimate based on current renewal fees/costs - Apportioned in PROGRAM sheet
xxxiii	Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$	100,000.00	2	Estimate based on 2013-14 and 2016 (planned) Dredging Campaigns - Apportioned in PROGRAM sheet
xxxiv	Review and Update of Maintenance Model	$			N/A - Rate applied to Entrance Channel
	Administration - Marinas				
xxxvi	Approvals - renewal fees	$	4,000.00	3	Estimate based on current renewal fees/costs - Apportioned in PROGRAM sheet
xxxvii	Dredging Design, Sediment Sampling, Contract Support, Environmental Monitoring.	$	100,000.00	2	Estimate based on 2013-14 and 2016 (planned) Dredging Campaigns - Apportioned in PROGRAM sheet
xxxviii	Review and Update of Maintenance Model	$			N/A - Rate applied to Entrance Channel
	Entrance Channel Misc.				
xm	Supplementary Environmental Monitoring and Approvals Work	$	50,000.00	5	Notional estimate for supplementary work to support renewal of Environmental Approvals/Permits
xmi	Navigational Aids	$	60,000.00	2	Estimate based on cost for new navigation aids installed for upgraded entrance channel, plus allowance for removal of existing. Assumes 4 sets of navigation aids.
	Residential Canals Misc.				
xmv	Water Quality Monitoring	$/annum	15,000.00	2	MBRC Estimate - Apportioned in PROGRAM sheet
	Marinas Misc.				
xmvi	Water Quality Monitoring	$/annum	15,000.00	2	MBRC Estimate - Apportioned in PROGRAM sheet

CONFIDENCE		Optimistic (P10)	Pessimistic (P90)	Adopted Confidence	Indicative Situation
Very High	0	-2%	5%	**0.3%**	Clear, concise scope supported by fixed quotes & labour rates, etc.
High	1	-5%	10%	**0.0%**	Some minor uncertainty exists regarding scope and/or estimate process, etc.
Moderate	2	-10%	20%	**0.0%**	Scope moderately clear, estimate based on mix of quotes & prices from similar jobs.
Low	3	-15%	30%	**0.0%**	Low scope confidence. Estimate based on factoring from other non-identical jobs.
Very Low	4	-20%	40%	**0.0%**	Vague / uncertain scope, prices factored from other similar (not identical) projects.
Order of Magnitude	5	-25%	50%	**0.0%**	Based on the best guess of experienced employees or similar methods.

DEFINITION
Optimistic - P10 = 90% Probability of exceedance
Pessimistic - P90 = 10% Probability of exceedance

CONFIDENCE FACTOR ADJUSTMENT		
Optimistic	‹	**Pessimistic**

Instructions for Raw Unit Rates Table Worksheet
THIS PAGE CONTAINS RAW COSTING DATA
EACH COST ITEM HAS A CONFIDENCE ATTACHED TO ACCOUNT FOR UNCERTAINTY (SEE ABOVE)
"DERIVED UNIT RATES" WORKSHEET CONTAINS OUTPUT BASED ON THIS RAW DATA, INCLUDING THE ERROR ESTIMATE
UNIT RATES MAY BE UPDATED AS NEW DATA BECOMES AVAILABLE, HOWEVER REFERENCE AND DATE TO BE RECORDED.

RAW (NON COSTING) DATA

REF NO.	ITEM	UNIT	VALUE	CONFIDENCE LEVEL	ORIGIN / REFERENCE / DATE
	Other				
mi	Estimated annual accretion volume of Entrance Channel	m^3	5,000	1	Updated Estimate based on Siltation Assessment - Refer Updated Dredging Schedule
mii	Density of Dredged Material - for Disposal Costs	t/m^3	1.39	2	Refer Dredging Technical Parameters - Assumes 'Pond Wet' bulk density

NEWPORT WATERWAYS MAINTENANCE MODEL

ESTIMATED DREDGED MATERIAL VOLUMES

ITEM / DESCRIPTON	Units	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
SENSITIVITY: QUANTITIES FACTOR		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DREDGED MATERIAL VOLUMES (*IN SITU* Density)	(m^3)	**35,500**	**-**	**32,000**	**-**	**29,300**	**-**	**25,400**	**-**	**21,000**	**-**	**25,600**	**-**	**25,500**	**-**	**24,500**	**-**	**21,700**	**-**	**23,300**	**-**	**16,600**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**
Dredging Schedule Mean Siltation Rates																																				
DREDGED MATERIAL VOLUMES - RESIDENTIAL PROPORTION	-	0.60	-	0.79	-	0.74	-	0.80	-	0.64	-	0.80	-	0.71	-	0.80	-	0.65	-	0.79	-	0.55	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78
EXTRA DUE TO																																				
☐ ISLES OF NEWPORT EXPANSION	(m^3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FACTORED DREDGED VOLUMES (*IN SITU* Density)																																				
Total Volume to be Dredged	(m^3)	35,500	-	32,000	-	29,300	-	25,400	-	21,000	-	25,600	-	25,500	-	24,500	-	21,700	-	23,300	-	16,600	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700
Residential Canals Volume to be Dredged	(m^3)	21,400	-	25,300	-	21,800	-	20,400	-	13,500	-	20,600	-	18,000	-	19,500	-	14,200	-	18,300	-	9,100	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700
Marina Volume to be Dredged	(m^3)	14,100	-	6,700	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000
MATERIAL VOLUMES IN GRIFFITH RD SPOIL POND ('Pond Wet' Density)																																				
Total Volume	(m^3)	31,500	-	28,400	-	26,000	-	22,500	-	18,600	-	22,700	-	22,600	-	21,700	-	19,200	-	20,700	-	14,700	-	20,100	-	20,100	-	20,100	-	20,100	-	20,100	-	20,100	-	20,100
Residential Canals Volume	(m^3)	19,000	-	22,400	-	19,300	-	18,100	-	12,000	-	18,300	-	16,000	-	17,300	-	12,600	-	16,200	-	8,100	-	15,700	-	13,500	-	15,700	-	13,500	-	15,700	-	13,500	-	15,700
Marina Volume	(m^3)	12,500	-	5,900	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400
MATERIAL VOLUMES - DRIED AND BULKED ('Pond Crust in Truck - Bulked' Density)																																				
Total Volume	(m^3)	15,400	-	13,900	-	12,800	-	11,100	-	9,200	-	11,200	-	11,100	-	10,700	-	9,500	-	10,200	-	7,300	-	9,900	-	9,900	-	9,900	-	9,900	-	9,900	-	9,900	-	9,900
Residential Canals Volume	(m^3)	9,300	-	11,000	-	9,500	-	8,900	-	5,900	-	9,000	-	7,800	-	8,500	-	6,200	-	8,000	-	4,000	-	7,700	-	6,600	-	7,700	-	6,600	-	7,700	-	6,600	-	7,700
Marina Volume	(m^3)	6,100	-	2,900	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	2,200
Isles of Newport Development: Volume Increase per Year	(%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

DREDGING SCHEDULE INPUTS

Dredging Schedule - Mean Siltation Rates

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Total	(m^3)	35,500	-	32,000	-	29,300	-	25,400	-	21,000	-	25,600	-	25,500	-	24,500	-	21,700	-	23,300	-	16,600	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700

Dredging Schedule - Upper-bound Siltation Rates

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Total	(m^3)	**35,500**	**-**	**36,300**	**-**	**33,600**	**-**	**30,800**	**-**	**25,500**	**-**	**36,300**	**-**	**33,700**	**-**	**33,700**	**-**	**26,900**	**-**	**31,900**	**-**	**21,400**	**-**	**30,200**	**-**	**30,200**	**-**	**30,200**	**-**	**30,200**	**-**	**30,200**	**-**	**30,200**	**-**	**30,200**

Manual - User Defined Volumes

	Units	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Residential Canals	(m^3)	**21,400**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**	**-**	**20,000**
Marinas	(m^3)	**14,100**	**-**	**-**	**-**	**12,500**	**-**	**-**	**-**	**12,500**	**-**	**-**	**-**	**12,500**	**-**	**-**	**-**	**12,500**	**-**	**-**	**-**	**12,500**	**-**	**-**	**-**	**12,500**	**-**	**-**	**-**	**12,500**	**-**	**-**	**-**	**12,500**	**-**	**-**
Total	(m^3)	35,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000

DREDGING VOLUMES - Dredging Schedule - Mean Siltation Rates

Marina Volumes

	Units	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Southern Marina	(m^3)	**-**	**-**	**6,700**	**-**	**-**	**-**	**5,000**	**-**	**-**	**-**	**5,000**	**-**	**-**	**-**	**5,000**	**-**	**-**	**-**	**5,000**	**-**	**-**	**-**	**5,000**	**-**	**-**	**-**	**5,000**	**-**	**-**	**-**	**5,000**	**-**	**-**	**-**	**5,000**
Northern Marina	(m^3)	**14,100**	**-**	**-**	**-**	**7,500**	**-**	**-**	**-**	**7,500**	**-**	**-**	**-**	**7,500**	**-**	**-**	**-**	**7,500**	**-**	**-**	**-**	**7,500**	**-**	**-**	**-**	**7,500**	**-**	**-**	**-**	**7,500**	**-**	**-**	**-**	**7,500**	**-**	**-**
Sum	(m^3)	14,100	-	6,700	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000

Total Volumes

	Units	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Total	(m^3)	**35,500**	**-**	**32,000**	**-**	**29,300**	**-**	**25,400**	**-**	**21,000**	**-**	**25,600**	**-**	**25,500**	**-**	**24,500**	**-**	**21,700**	**-**	**23,300**	**-**	**16,600**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**	**-**	**22,700**
Residential Canals	(m^3)	21,400	-	25,300	-	21,800	-	20,400	-	13,500	-	20,600	-	18,000	-	19,500	-	14,200	-	18,300	-	9,100	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700
Marinas	(m^3)	14,100	-	6,700	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000

Instructions for Dredging Volumes Worksheet
DO NOT MODIFY VOLUMES IN THIS SPREADSHEET WITHOUT NEW DREDGING SCHEDULE ANALYSIS
ONLY MODIFY BLUE CELLS WITH **RED** TEXT

NEWPORT WATERWAYS MAINTENANCE MODEL

ESTIMATED DREDGED MATERIAL VOLUMES

ITEM / DESCRIPTON	Units	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	REFERENCE / COMMENT
SENSITIVITY: QUANTITIES FACTOR		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	User Input.
DREDGED MATERIAL VOLUMES (*IN SITU* Density)	(m^3)	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	Use Drop Down tab in cell A11 to choose between Dredged Material Volume Time Series (s
Dredging Schedule Mean Siltation Rates																	1. Biennial Dredging Campaigns - Mean Siltation Rates
DREDGED MATERIAL VOLUMES - RESIDENTIAL PROPORTION	-	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	0.78	-	0.67	-	2. Biennial Dredging Campaigns - Upper-bound Siltation Rates 3. Manual - User Defined Volumes
EXTRA DUE TO																	
☐ ISLES OF NEWPORT EXPANSION	(m^3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Switch on/off additional volume to account for Isles of Newport Development
FACTORED DREDGED VOLUMES (*IN SITU* Density)																	
Total Volume to be Dredged	(m^3)	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	Estimated In situ Material Volumes Dredged from Newport Waterways
Residential Canals Volume to be Dredged	(m^3)	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	*These Volumes linked to PROGRAM*
Marina Volume to be Dredged	(m^3)	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	*These Volumes linked to PROGRAM*
MATERIAL VOLUMES IN GRIFFITH RD SPOIL POND ('Pond Wet' Density)																	
Total Volume	(m^3)	-	20,100	-	20,100	-	20,100	-	20,100	-	20,100	-	20,100	-	20,100	-	Pond Wet' Volumes in Griffith Rd Spoil Pond following completion of dredging campaigns
Residential Canals Volume	(m^3)	-	13,500	-	15,700	-	13,500	-	15,700	-	13,500	-	15,700	-	13,500	-	*These Volumes linked to PROGRAM*
Marina Volume	(m^3)	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	4,400	-	6,700	-	*These Volumes linked to PROGRAM*
MATERIAL VOLUMES - DRIED AND BULKED ('Pond Crust in Truck - Bulked' Density)																	
Total Volume	(m^3)	-	9,900	-	9,900	-	9,900	-	9,900	-	9,900	-	9,900	-	9,900	-	Dried Dredged Material Volumes
Residential Canals Volume	(m^3)	-	6,600	-	7,700	-	6,600	-	7,700	-	6,600	-	7,700	-	6,600	-	
Marina Volume	(m^3)	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	2,200	-	3,300	-	
Isles of Newport Development: Volume Increase per Year	(%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	User Input - Annual percentage volume from Isles of Newport Development.

DREDGING SCHEDULE INPUTS

Dredging Schedule - Mean Siltation Rates

		2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Total	(m^3)	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-

Dredging Schedule - Mean Siltation Rates - Schedule As Per:
BMT JFA J15034 - NW - Dredging Schedule_Mean Siltation_Biennial_160317.xlsx
(Average dredging volumes adopted from 2037 onwards)

Dredging Schedule - Upper-bound Siltation Rates

		2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Total	(m^3)	-	30,200	-	30,200	-	30,200	-	30,200	-	30,200	-	30,200	-	30,200	-

Dredging Schedule - Upper-bound Siltation Rates - Schedule As Per:
BMT JFA J15034 - NW - Dredging Schedule_Mean Siltation_Biennial_160317.xlsx
But with siltation rates increased to 'Upper-Bound Siltation Rates' from Input Sheet
(Average dredging volumes adopted from 2037 onwards)

Manual - User Defined Volumes

	Units	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	
Residential Canals	(m^3)	-	20,000	-	20,000	-	20,000	-	20,000	-	20,000	-	20,000	-	20,000	-	User input
Marinas	(m^3)	-	12,500	-	-	-	12,500	-	-	-	12,500	-	-	-	12,500	-	User input
Total	(m^3)	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	20,000	-	32,500	-	Resulting total volumes from user input.

DREDGING VOLUMES - Dredging Schedule - Mean Siltation Rates

Marina Volumes

	Units	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Southern Marina	(m^3)	-	-	-	5,000	-	-	-	5,000	-	-	-	5,000	-	-	-
Northern Marina	(m^3)	-	7,500	-	-	-	7,500	-	-	-	7,500	-	-	-	7,500	-
Sum	(m^3)	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-

Volumes from Proposed Dredging Schedule:
BMT JFA J15034 - NW - Dredging Schedule_Mean Siltation_Biennial_160317.xlsx
(Average dredging volumes adopted from 2037 onwards)

Total Volumes

	Units	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	Total	% of Total
Total	(m^3)	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	22,700	-	598,200	
Residential Canals	(m^3)	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	17,700	-	15,200	-	432,400	72%
Marinas	(m^3)	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	5,000	-	7,500	-	165,800	28%

Instructions for Dredging Volumes Worksheet
DO NOT MODIFY VOLUMES IN THIS SPREADSHEET WITHOUT NEW DREDGING SCHEDULE ANALYSIS
ONLY MODIFY BLUE CELLS WITH **RED** TEXT

NEWPORT WATERWAYS MAINTENANCE MODEL

DREDGING VOLUMES - TECHNICAL PARAMETERS TABLE

Volume Conversion Factors - Dredge Spoil			
Spoil Location	**From *In situ* to the following:**	**M.C. %**	**% Air Volume**
Marina (*in situ*)	1.00	152	0.00
C/S Dredge	2.95	525	0.00
Pond wet	0.89	130	0.00
Pond Crust on Batter	0.36	20	7.24
Pond Crust in Truck - Bulked	0.44	10	22.85

Assuming:
Bulking Factor 1.2

Instructions for Technical Parameters Worksheet
DO NOT MODIFY CELL CONTENTS WITHOUT NEW GEOTECHNICAL DATA
BULKING FACTOR APPLIED FOR TRUCKING VOLUMES

SUPPORTING GEOTECHNICAL CALCULATIONS

ρ_{solids} = 2.600 t/m^3 ρ_{water} = 1.025 t/m^3

Location	Total V(m^3)	ρ_{bulk} (t/m^3)	Solids (t/m^3)	Water (t/m^3)	% Solids Mass	% Solids Vol	% Water Vol	% Air Vol	M.C. (%)	Total Mass (t)	Solids Mass (t)
Marina (*In situ)*	***1,000***	***1.350***	0.537	0.813	39.74	20.63	79.37	***0.00***	152	1,350	537
C/S Dredge	2,955	***1.135***	0.182	0.953	16.00	6.98	93.02	***0.00***	525	3,353	537
Pond wet	887	1.391	0.605	0.786	43.48	23.27	76.73	***0.00***	***130***	1,234	537
Spadeable	363	1.919	1.476	0.443	76.92	56.79	43.21	***0.00***	***30***	697	537
Pond Crust	335	***1.920***	1.600	0.320	83.33	61.54	31.22	7.24	***20***	644	537
Heaped Dry	335	1.760	1.600	0.160	90.91	61.54	15.61	22.85	***10***	590	537

Note : Bold and italic is the assumed or known value

BMT JFA Brisbane

Level 8, 200 Creek Street, Brisbane 4000
PO Box 203, Spring Hill QLD 4004
Tel +61 7 3831 6744 Fax +61 7 3832 3627
Email jfa@bmtjfa.com.au
Web http://www.bmtjfaconsultants.com/

BMT JFA Perth

Level 3, 20 Parkland Road, Osborne Park, WA 6017
PO Box 1027, Innaloo WA 6918
Tel +61 8 6163 4914 Fax +61 8 6163 4979
Email jfa@bmtjfa.com.au
Web http://www.bmtjfaconsultants.com/