10.2.4 Maylands Lakes Restoration

Location:	**Lakes Brearley, Bungana and Brickworks**
Reporting Branch:	**Sustainable Environment**
Responsible Directorate:	**Works and Infrastructure**
Refer:	**Item 12.1.5: OCM 28.04.15** **Item 12.5: OCM 15.11.16** **Item 8.2.2: OCM 22.03.18**

EXECUTIVE SUMMARY

Application:

To allow Council consideration of updated information in relation to the current state of the Maylands Lakes (Brearley, Bungana and Brickworks) and the implications of proposed treatment options.

Key Issues:

- There are poor water quality issues at the Maylands Lakes which are understood to be driven by excessive nutrient loads in the lakes. Nutrient build up in the lakes drives algal blooms.
- Council received a report which identified the drivers of poor water quality and potential management options and resolved to develop a way forward for the project with the Friends of Maylands Lakes (FOML).
- Funding was committed and works completed for Stage 1.
- Preparation for Stage 2 works has identified different site conditions to those previously assumed.
- Differing conditions require a review of the works program and options to ensure that Council is expending funds on the most appropriate options.
- In conjunction with a staged works program, a detailed sampling and modelling program is recommended to better inform Council of the costs and benefits of different treatment options for the lakes.

BACKGROUND

Water quality issues at the Maylands Lakes (Brickworks, Lakes Bungana and Brearley) have led to the occurrence of persistent algal blooms in the lakes and significant local community concern over the issue.

The lakes were designed and built in the late 1990's and the residents who purchased and developed land in the area were of the understanding that the lakes would be able to maintain a high water quality and amenity standard.

The lakes are constructed with a traditional 'pit and pipe' stormwater system. Whilst this approach was contemporary for its time, it is now demonstrated that this often leads to poor water quality outcomes when managing stormwater and wetlands.

The current industry approach for environmental water management is through the use of constructed wetlands (e.g. Eric Singleton Bird Sanctuary) and water sensitive urban design (e.g. raingardens).

In 2016, the City undertook a basic water quality monitoring program. Following completion of the program in 2017, the City engaged an independent environmental engineering company to prepare a management options report. The management options report identified a coordinated

approach of short term and long-term solutions to address the poor water quality and algal blooms at the lakes as follows:

SHORT-TERM MANAGEMENT	LONG-TERM MANAGEMENT
• Revegetation program. • Physical removal of algae (*if blooms still present at the end of 2016 winter period).* • Installation of bat boxes. • Application of Phoslock *(a clay that binds phosphorus).*	• Detailed design and project management. • Dredging of Lake Bungana and Lake Brearley *(including detailed bathymetric survey).* • Installation of solar submersible pumps. • Modification of lake shape. • Community education. • Installation of floating wetlands.
$300K	**$3M**

Additionally, the report indicated the need for a review of the stormwater catchment to find opportunities to install water sensitive urban design features.

The actions are in keeping with contemporary understanding of wetland management. It was also understood, at the time, that it would be prohibitively expensive and not in keeping with the local community values for the lake to be transformed into a constructed wetland. (e.g. Eric Singleton Bird Sanctuary type of wetland)

The FOML worked with officers to consider how the actions identified could be implemented. Whilst the management plan identified $3.3M of works were required to seek improvements in water quality, it was understood at the time that it would be unlikely that this amount of funding would be available over one financial year for restoration works. As such, a staged approach for the works was proposed.

In the 2017-18 financial year, $404,000 was included in the budget and the following works were undertaken:

- Pollutant traps on drains;
- 160m2 floating wetlands;
- Phoslock application;
- Bathymetric and water column surveys; and
- Revegetation.

The 2018-19 budget includes $1M for dredging of the lakes, with a further $125,000 placed in a reserve account for future works.

On confirmation of monies allocated in the 2018-19 budget for the works, officers undertook a detailed sediment sampling program to provide further detail of the quantity and quality of the sediment in the lakes to inform the tender specification and confirm the existing sediment assumptions and understandings. This program included a larger number of sample sites and this further information has identified that the average sediment depth is approximately 5cm across the lakes, as opposed to the 20cm that was identified in the basic sampling program.

The depth and change in understanding is summarised in the tables below:

Table 1.0: Assumed sediment loading in Maylands Lakes (2016)

Brickworks Lake	
Average thickness silt/sediment	10
Volume sediment	200m³
Mass T(N) sediment	0.48
Mass T(P) sediment	0.03C

Lake Bungana	
Average thickness silt/sediment	20cm
Volume sediment	11,168m³
Mass T(N) sediment	27.17T
Mass T(P) sediment	1.96T

Lake Brearly	
Average thickness silt/sediment	20cm
Volume sediment	20,716m³
Mass T(N) sediment	50.32T
Mass T(P) sediment	3.6T

Table 2.0: Actual sediment loading in Maylands Lakes based on more detailed sampling (2018)

Brickworks Lake	
Average thickness silt/sediment	Negligible
Volume sediment	Negligible
Mass T(N) sediment	Negligible
Mass T(P) sediment	Negligible

Lake Bungana	
Average thickness silt/sediment	4.7cm
Volume sediment	2,792m³
Mass T(N) sediment	6.78T
Mass T(P) sediment	0.49T

Lake Brearly	
Average thickness silt/sediment	5.4cm
Volume sediment	5,179m³
Mass T(N) sediment	12.58T
Mass T(P) sediment	0.9T

Whilst less sediment may initially appear beneficial for the project outcomes, officers were concerned that the difference may affect the assumptions made in the nutrient modelling of the lakes and overall effectiveness of dredging; as well as the assumptions made to identify dredging as a priority action of the Maylands Lakes Management Plan.

The sediment sampling also identified some localised spots of contaminated sediment and higher than expected acidity within the sediment. It is considered that these contamination issues can be managed and the majority of the sediment can be treated as a reusable material avoiding disposal costs. It is also noted that the dredging methodology will require a different approach to the original scope.

The different conditions that have been identified through the more extensive sediment sampling study require a review of the works programmed to ensure that Council is expending funds on the most appropriate management options.

CONSULTATION

Officers have met the FOML Management Committee, to discuss the implications of the new information. The members are of the view that whilst they and the wider Maylands community were keen to see the dredging move forward expeditiously, they consider it vitally important that any remedial action is based as far as practicable on empirical data, as well as being supported by effective and efficient management approaches.

ANALYSIS

Poor or declining water quality in lakes and wetlands is a shared problem amongst local governments and at the State level. The industry examples of attempts to restore water bodies for water quality outcomes have been of very mixed success. Whilst there is certainty in building a road, a water body is a dynamic changing system. A recent seminar held by the Western Australian Local Government Authority (WALGA) and Perth Natural Resource Management (NRM) discussed the challenges, costs and limited reliable options available to expeditiously improve water quality. It was noted at this event, that the City presented on one successful case study being the restoration of the Eric Singleton Bird Sanctuary. Presenters at the seminar also presented examples where local governments had implemented actions which resulted in no or even poorer water quality within the lake/wetland system. Discussion was also held in the lack of evidence provided for many ‘quick fix’ products that are promoted by various companies.

The drivers for algal blooms within the lakes are basically from high levels of nitrogen and phosphorus in the water body. These nutrients can be mobilised into the water body by:

- Stormwater entering the lakes from the stormwater drains;
- Nutrient transfer from lake to lake, or from the bore to the lake;
- Nutrients re-released into the water body from sediments on the base of the lakes; and
- Flora and fauna which live at the lakes.

The initial management options were based on the basic water quality monitoring program and a number of assumptions, or theoretical underpinnings. The cost of this monitoring program was significantly less than what is required for a more definitive plan.

Of the $3M of long-term management options identified in the management options report, the FOML and officers recommended dredging as one of the key actions. This was identified as important, as the load of nutrients was thought to be so significant that its removal would be more likely to have a more immediate impact on to the quality of the water.

Now that it is understood that there is less sediment in the lakes, its impact as a dominant system driver for algal blooms may be less than originally thought. Accordingly, this could mean that:

(i) Some of the other management treatments may be more beneficial than dredging;

(ii) Dredging as a single action may see no visual difference in water quality; or

(iii) Water quality may be seen to decrease further after dredging due to an input of nutrients from another source.

Essentially, the focus of the concern is how the City should manage the inherent uncertainty and risks involved in the work. This includes how to balance the uncertainty of a specific water quality outcome at the lake with the substantial increased cost of resources and time that is required to achieve a more informed management approach.

The usual recommended approach to gain a more comprehensive understanding of lake systems such as these is through undertaking an intensive monitoring program to develop a detailed nutrient and hydraulic model for the lakes.

The collection of data and interpreting it into a nutrient and hydraulic model provides a greater understanding of the physical and biological systems within the lakes. This can then be used to understand the effect that different management actions will have on the water quality of the lakes and provide a business case with less uncertainty. This being said, lakes of this type are a living dynamic system and complete certainty of outcomes cannot be provided. A study of this nature for the subject lakes is anticipated to take 14 months to undertake at a cost of $210,000.

The solutions for Maylands Lakes are made more difficult due to their inherent design which accumulates nutrients and their significant size. The lakes are 14 hectares (approximately) in area and up to 7m deep. Comparatively, Eric Singleton Bird Sanctuary is 4 hectares, 1.5m deep and cost $2.9M in capital funding and 4 years of prior investigation to restore.

The challenge for Council is that there is a local community expectation for an expeditious fix for water quality in the Maylands Lakes. At the same time, the change in understanding of the quantity of sediment means that there is uncertainty as to what the visual outcome of any one of the actions identified in the management report will have.

It is noted that there is also a further $2M of actions identified in the original management report, which at this stage, have not been identified in the Long Term Financial Plan.

Based on the changed understanding of the Maylands Lakes systems the following four options have been identified:

Option 1: Dredging of Lake Bungana and develop a more detailed nutrient/hydraulic model of the lakes.

This is the favoured option of officers and the FOML. This approach would involve dredging Lake Bungana as Stage A. In addition, over a 14-month period, the lake would be intensively monitored to understand what changes have occurred and their long-term impact. If there were identified improvements in the lake, then the expectation would be to dredge Lake Brearley in the 2019-20 financial year.

This approach would develop a detailed nutrient and hydraulic balance with the added benefit of data to evidence the effectiveness of dredging.

The approach would also provide an opportunity to learn and improve on the dredging approach for Stage B (Lake Brearley) or reduce the overall expenditure on dredging if the approach does not have the desired impact.

This option would understandably see residents that live adjacent to the lake which is not dredged concerned in the short term. This approach does, however, place the City in a better position to provide a better long-term outlook for the health of the lakes and residents' amenity.

To help reduce the amenity impact of the algal blooms, the City could continue to manually remove algal growth at the south of Lake Brearley ($37,000) and apply a

further application of Phoslock ($100,000). This would need to be considered as part the 2019-20 budget deliberations of the operating cost for the Maylands Lakes.

Option 2: Defer works and develop a detailed nutrient and hydraulic model for the lakes over a 14-month period.

This option would defer all physical works and commence a 14-month program to better understand the environmental systems at the lakes and develop a detailed nutrient and hydraulic study for the lakes. This approach would provide the time, resources and environmental information required to provide a more robust cost benefit analysis of restoration approaches for the short term (1 - 3 years) and long term (10 - 20 years) health of the lakes.

It expected that this approach could lead to significant community concern as it may be seen as further delaying a response to the water quality issues in the lakes.

Should Council wish to progress this option, the cost of developing this model is expected to be $210,000. It is noted that it is possible for the study to identify information which is currently unknown which may require additional investigation.

To help reduce the amenity impact of the algal blooms, the City could continue to manually remove algae at the south of Lake Brearley ($37,000) and apply a further application of Phoslock ($100,000). This would need to be considered as part the 2019-20 budget deliberations of the operating cost for the Maylands Lakes.

Option 3: Continue with the dredging program of both lakes.

This approach assumes that removing nutrients from the lake would be beneficial. It would also provide an environment where the City, in the short term, is seen to be taking action on the quality of water in the lakes.

It is noted, however, that dredging both lakes may result in no visual change in the water quality and algal blooms. In this event, this option could be perceived as not using Council funds appropriately and result in further community concern. If no significant data collection was undertaken; officers could only provide theoretical advice as to why this occurred as opposed to more empirical, specific advice.

The works for the dredging of the lakes have now also changed due to the change in sediment volumes with a different sediment removal and treatment approach required. This is more of a boutique scope of works and the work needs to be market tested to identify their true cost.

It is also identified that dredging in general is a blunt instrument and there will be an initial negative impact to the lake as some sediment is mixed into the water body. This would be managed as best as can be within the scope of the tender.

Option 4: Dredging Stages A and B (if Stage A is successful).

This approach would dredge Lake Bungana as Stage A. Dredging lake Bungana may result in no visual change in the lake water quality and algal blooms. If there was a visual improvement in the lakes, then the expectation would be that the City would continue to dredge Lake Brearley as Stage B.

This approach would provide an opportunity to learn by doing and improve on the dredging approach for Stage B.

Again, with this option, if no significant data collection was undertaken; officers could only provide theoretical advice on the level of success or failure.

Rationale for Dredging Lake Bungana over Brearley in Options 1 and 4.

Dredging either lake may not result in a visual water quality difference. As such, it has been recommended that Stage A be to dredge Lake Bungana first. This lake is the smallest and has the least volume of sediment, which represents the least project risk. If dredging is not effective this approach would represent the least lost opportunity cost. As the dredging scope has changed, this approach comparatively represents the least risk for net increased costs.

Typically, catchment management generally begins restoration works at the top of the catchment (or water flow) and works are progressively implemented downstream. The Brickworks Lakes (and input) have recently been revegetated and using the latter approach Lake Bungana would be the next lake to undertake remediation works.

There is alternatively an argument that Lake Brearley is the worst algae affected lake and dredging works should begin in that lake. This option carries the greatest project risks and uncertainty and is contrary to standard catchment management principles as detailed above.

OPTIONS

The following options are available to Council:

	OPTION	BENEFIT	RISK
1.	Dredging Stage A (Lake Bungana) and develop a more detailed nutrient and hydraulics model for the lakes and Dredging Stage B if successful. ***Estimated Cost:*** *~$710,000 and $137,000 to undertake Phoslock treatment and algae removal. The actual cost of this works can only be confirmed through market testing.*	• Seen as 'something is being done'. • Reduce the opportunity cost if the dredging does not have the desired outcome. • It would be reasonable to argue that there is still value for the health of the wetland in removing sediments from the lake. • Develop a more detailed model which describes the driver of algal blooms in the lakes. • Provide a more reliable costs benefit analysis of undertaking different management approaches.	• That the dredging does not have the desired outcome. • Opportunity cost of using existing monies for dredging one lake as opposed to another management action. • Community concern that dredging is not occurring in both lakes.
2.	Stop works and develop a detailed nutrient and hydraulic model for the lakes over a 14 month period. ***Estimated Cost:*** *$210,000 and $137,000 to undertake Phoslock treatment and algae removal.*	• Develop a more detailed model which describes the drivers of algal blooms in the lakes. • Provide a more reliable cost benefit analysis of undertaking different management approaches.	• Community concern that dredging is not proceeding or is delayed.
3.	Continue with dredging program. ***Estimated Cost:*** *~$1M. The actual cost of this works can only be confirmed through market testing.*	• Seen as 'something is being done'. • It would be reasonable to argue that there is still value for the health of the wetland in removing sediments from the lake.	• That the dredging does not have the desired outcome. • Opportunity cost of using existing monies for dredging two lakes as opposed to another potentially more beneficial management action. • The City will not have a

			detailed model which describes the driver of algal blooms in the lakes.
4.	Dredging Stage A (Lake Bungana) and Dredging Stage B (Lake Brearley) if Stage A is successful. ***Estimated Cost:*** *~$1M dependant if Stage B is complete. The actual cost of this works can only be confirmed through market testing.*	• Seen as 'something is being done'. • Reduced the opportunity cost if the dredging does not have the desired outcome. • It would be reasonable to argue that there is still value for the health of the wetland in removing sediments from the lake.	• That the dredging does not have the desired outcome. • Opportunity cost of using existing monies for dredging one lake as opposed to another potentially more beneficial management action. • The City will not have a detailed model which describes the driver of algal blooms in the lakes.

CONCLUSION

Option 2 would be the preferred officer option if there was a greater buffer between the residential housing and the lake. This approach would provide a more detailed and reliable understanding of the lakes to further inform Council consideration of management options.

As residents live directly adjacent to the lake and it forms the major feature of the residential area, Option 1 is recommended as the preferred option. This option attempts to balance the needs of the local community to see an expeditious action to mitigate the effects of algal blooms at the lakes with the expectation of the community at large to ensure that the City is supporting efficient and effective management approaches and expenditure of ratepayer monies.

This option would provide greater certainty to the community that 'something is happening'; provide greater certainty for future works; is supported by the FOML; and although it is uncertain if there will be a visual improvement in the dredged lake, it would be reasonable to argue that there is still value for the health of the wetland in removing sediments from the lake.

FINANCIAL IMPLICATIONS

The following financial implications are applicable:

Item 1: Maylands Lakes

Asset Category: Other **Source of Funds:** Municipal

LTFP Impacts: There is a further $2M of actions identified in the original management report, which at this stage, have not been identified in the Long Term Financial Plan.

ITEM NO.	CAPITAL / UPFRONT COSTS ($)	ONGOING COSTS ($) ANNUAL		INCOME ($)	ASSET LIFE (YEARS)	WHOLE OF LIFE COSTS ($)	CURRENT BUDGET ($)
		MATERIALS & CONTRACT	STAFFING				
1		$137,000 Phoslock application and manual algae removal		-	10 - 20		1.125M

STRATEGIC LINK

In accordance with the City of Bayswater Strategic Community Plan 2017-2027, the following applies:

Theme: Our Natural Environment

Aspiration: A green and sustainable environment.
Outcome N1: Natural environment and biodiversity which are conserved and protected.

Theme: Our Built Environment
Aspiration: A quality and connected built environment.
Outcome B1: Appealing streetscapes.
Outcome B3: Quality built environment.

COUNCIL POLICY AND LEGISLATIVE IMPLICATIONS

Not applicable.

VOTING REQUIREMENTS

Simple Majority Required

ATTACHMENTS

Not applicable.

COMMITTEE RESOLUTION
(OFFICER'S RECOMMENDATION)

That Council approves the following actions in relation to the restoration of the Maylands Lakes:

1. **Progression of the dredging of Lake Bungana.**
2. **Development of a detailed nutrient and hydraulic model for the Maylands Lakes over a 14-month period.**
3. **Consideration of dredging of Lake Brearley as Stage B in the 2019-20 financial year, dependant on the outcome of the works identified in points 1 and 2 above.**
4. **Communication to affected ratepayers in relation to the reason for the altered program of works in conjunction with the Friends of Maylands Lakes.**

CR CATHERINE EHRHARDT MOVED, CR ELLI PETERSEN-PIK SECONDED
CARRIED UNANIMOUSLY BY EXCEPTION (ENBLOC): 9/0