Response to Discussion Paper on Load Targets for the Port Phillip Bay Environmental Management Plan

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Background

- The Discussion Paper on Load Targets for the Port Phillip Bay Environmental Management Plan prepared by Barry Hart from Water Science and Matt Francey and Karen White from Alluvium provides guidance for setting load reduction targets for the new Port Phillip Bay Environmental Management Plan (EMP), and for upgrading the integrated bay and catchment models.
- The Discussion Paper summarises the current scientific understanding of ecological processes that control water quality in the Bay and the methods used to estimate loads of nitrogen and sediment entering the Bay. The review team consulted with agency staff and scientists with knowledge of the past research, modelling and monitoring in the Bay; and was reviewed and discussed with a range of stakeholders before being finalised.
- The review team has recommended reduction targets for nitrogen and sediment loads that will drive actions to ensure the Bay's current water quality does not deteriorate over the next 10 to 15 years. These targets will also ensure that water quality objectives in the SEPP (Waters of Victoria) continue to be met.

Key points from the review

- The review team reviewed load estimates from the integrated modelling with Source and ELCOM-CAEDYM undertaken by Jacobs and Hydronumerics, and analysis of Melbourne Water's water quality monitoring data undertaken by Tony Ladson. They highlighted the limitations and uncertainties in the catchment modelling and water quality monitoring data for estimating nitrogen and sediment loads. They believe published estimates for loads from waterways have an uncertainty of 30–50%, because of the poor model calibration and underestimation of loads associated with high flow events, sampling error and spatial interpolation.
- For the previous EMP, the baseline load estimate for nitrogen was 7,000 t/y, which comprised 3,600 (±320) t/y from Western Treatment Plant and 3,400 (±650) t/y from waterways and other sources. Despite this level of uncertainty there was a high level of acceptance by stakeholders for the 1000 t/y nitrogen reduction target.
- There is a high level of confidence that the previous EMP's nitrogen reduction target of 500 t/y for Western Treatment Plant was achieved because it can be reconciled against treatment upgrades and verified through robust monitoring of effluent discharges. However, there is a lower level of confidence with regard to whether the 500 t/y reduction from waterways was achieved. This was because there was no process in place to reconcile all of the actions against the reduction target or to monitor or model inflows to the Bay with reasonable certainty.
- To improve confidence in future reporting of achievements it will be necessary to have processes in place to reconcile specific actions against reductions, and to be able to obtain evidence of their effectiveness through a combination of sampling and modelling loads. This will be more challenging for inflows from the catchment than for treatment plants.
- The review highlighted the benefits of setting quantitative targets that can be incorporated into catchment actions. For the Great Barrier Reef, targets are set for active forms of nitrogen (DIN and DON). This approach was not suggested for the Bay, as speciation is currently not supported by the Source loads modelling, and

there is limited data to allow it. The consequences of not having speciation are minor as using total nitrogen is considered more conservative, as the proportion of bioavailable nitrogen as a proportion of total will be lower.

- The inclusion of a sediment target for the EMP provides another driver for catchment management actions to minimise erosion and other mechanisms that contribute suspended solids to waterways and the Bay. It is recognised that the general public are aware of the aesthetic impacts of turbid water and potential links to contaminated water. However, the ecological impacts are less well understood.
- The review highlighted that the current BPEM guidelines for stormwater management are not sufficient to reduce loads, and an approach of no increase in impact would be more appropriate for all urban land development. Similarly the effectiveness and efficiency of approaches and programs for reducing loads from rural lands is not easily quantified.
- The ELCOM-CAEDYM model for the Bay appears to over-estimate primary production as indicated by Chla and comparison with EPA and CAPIM measurements at reference sites. Possible reasons for this include uncertainty in timing and delivery of catchment loads; limited understanding of nitrogen speciation and consumption rates in lower parts of rivers; and limited model pathways for take up of nitrogen. The model assumes take up of nitrogen by phytoplankton, with no pathway for macroalgae (drift algae) or seagrass uptake, or consumption of phytoplankton by zooplankton and fish. Inclusion of these pathways in the model would be reliant on the success of further research and monitoring. The Bay model would also benefit from further calibration and use of a wind field model to simulate local variation in wind patterns. Despite these limitations, the Bay model is considered sufficient for comparative assessment of the impact to water quality from future load scenarios.
- The review team expressed some concern with the accuracy of the 2030 catchment load projections because of the uncertainties associated with the Source model. As an alternative, MUSIC was used to estimate the potential additional flow and loads of TN and TSS from urban consolidation and new greenfield urban areas over the next 10-15 years. The estimates were that in 10-15 years the catchment (not including the WTP) will be contributing an additional average TN load of around 300 t/y and an average TSS load of around 9,000 t/y. These additional loads represent increases of around 15% and 7% respectively over the current loads from urban areas. For comparison, the additional TN load based on MUSIC was estimated at slightly less than the Source estimate, but the TSS load was double that estimated using Source.
- The review team made reference to water balance modelling by GHD, undertaken in 2015 for Melbourne Water that suggested sewage discharges from regional wastewater treatment plants could contribute an additional 200 t/y of TN to local waterways over the next 10-15 years. It is unclear whether this additional load can be mitigated completely. However, for the EMP the assumption will be made that the majority of this additional load can be managed through treatment upgrades or operational changes, and that there will be no significant increase in net loads to waterways.

10 January 2016
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Target recommendations for inclusion in the EMP

- The recommendations from the load targets discussion paper have been considered in the context of developing and communicating the goals of the EMP and the practicalities associated with implementation of the EMP actions. In response we will make the following recommendations in the final EMP, with detail as to how these can be achieved outlined in the accompanying EMP Delivery Plan.
- As recommended, the current baseline for annual loads from waterways within the major catchments (Yarra, Maribyrnong, Werribee and Dandenong) will be considered as ranges. This reflects the uncertainty in estimates and variation in climatic conditions between years.
    - Baseline for total nitrogen (TN) from combined catchments is 1,500-2,200 t/y
    - Baseline for total suspended solids (TSS) from combined catchments is 60,000-70,000 t/y
- To ensure that loads from waterways do not exceed the current baseline range and to mitigate against projected increases in loads from urban and rural sources over the next 10 years, the following targets will be set for waterways:
    - Reduce TN by 300 t/y by 2027 from waterways, which equates to achieving a 30 t/y reduction for each year of the ten-year plan
    - Reduce TSS by 6,000 t/y by 2027 from waterways, which equates to achieving a 600 t/y reduction for each year of the ten-year plan
- As done for the previous EMP the reduction targets for TN and TSS should be split across catchments – 70% from the Yarra and Maribyrnong catchments, with the remainder from Werribee and Dandenong catchments.
- For Western Treatment Plant annual loads of TN should not exceed 3,100 t/y (based on three year rolling average). For other wastewater treatment plants (existing and proposed), there should be no nett increase in the cumulative load of TN to the Bay.
- Progress towards the reduction targets from catchment waterways should be reconciled against individual interventions, and load estimations based on monitoring and modelling.
- For the purposes of setting baselines for loads and reduction targets the current Source model with an allowance of 40% is considered appropriate; however to provide confidence in assessing the achievement of those targets and to refine targets for individual catchments, the model requires significant investment in development and data collection.
- Further development of the Source model would enable assessment of the effectiveness of management interventions. However, as a first step continued investment in monitoring and sampling during high flow events is required to improve load estimations, and to inform decisions on intervention strategies (i.e. are you building infrastructure that allows by-pass during high flow events – critical if 80% of loads occur during these events). Improving the performance of the underlying hydrological model is also required before trying to improve load estimations.
- Given the potential for localised (nearshore) effects of high-flow events during summer, the EMP should define qualitative targets for avoidance of nuisance algal blooms and periods of poor water quality at bayside beaches.
- Investment in upgrading the Source model and ELCOM-CAEDYM model should be undertaken over the initial 2-3 years of the EMP, and potentially done in conjunction with implementation of the Healthy Waterways Strategy. A decision on establishing

in-house capability for Source modelling within Melbourne Water is outside the scope of the EMP.

- The importance of protecting denitrification as a process for removing nitrogen from the Bay should be recognised in the EMP. And there is a need to continue measuring denitrification efficiency at the existing sites. However, if improved monitoring methods are developed there is benefit in obtaining greater spatial and temporal coverage to better understand the potential impacts from catchment and Bay activities. Protection of the denitrification process should be included in the revised SEPP Waters.

- The EMP should support ongoing investment in continued monitoring of waterways (flows and concentrations) and sampling methods to provide greater understanding of loads during high-flow events.

- Annual and five-yearly reporting of loads and progress against targets for load reductions as recommended above will be included in the EMP.

- Development of new stormwater standards for urban land development is out-of-scope for the EMP. However, under draft EMP Action 3.3 it is suggested that the standards be reviewed and improved to reduce loads of nutrients, sediment, litter and other pollutants. Ideally these standards should start from a position of no net increase in loads as opposed to the current standards that result in a residual load increase with new urban development.

- Evaluation of rural land management practices is covered under draft EMP Action 3.3. A decision on whether this should be in the form of a cost-benefit-analysis would require further discussion with stakeholders. However, the EMP recognises the need for continued investment in improved rural land management to reduce loads of nutrients, sediment, litter and other pollutants.

Further comments and responses to the 11 recommendations in the Discussion Paper are provided in Appendix A.

Recommendation	Comment	Response
1. That quantitative annual load target ranges be established for Port Phillip Bay as part of the new EMP, these being: • TN load be 1,500-2,200 t/y for the waterways and 2,200-3,100 t/y for the WTP. • TSS load be 60,000-70,000 t/y for the waterways and 2,400-3,000 t/y for the WTP.	It is better to refer to these target ranges as the current baseline loads. Using ranges allows for natural variation (eg climatic) and uncertainty in estimation methods, and will help in measuring and communicating changes compared with current loads. Referring to a target range can be perceived as requiring a minimum load, which should be maintained. Whereas we want to keep loads at or below the current levels, which appear to be providing suitable water quality in the Bay. Total loads to the Bay, combines discharges from treatment plants, waterways, groundwater and the atmosphere. For management it is more practicable to manage these sources separately, and accordingly have separate targets. Management of forecast increases in sewage at WTP and other wastewater treatment plants should be considered separately to catchment activities (i.e. stormwater management), because these treatment plants are subject to requirements of their EPA operating licenses.	The current baseline for annual loads from waterways within the major catchments (Yarra, Maribyrnong, Werribee and Dandenong) will be considered as ranges. This reflects the uncertainty in estimates and variation in climatic conditions between years. • Baseline for total nitrogen (TN) from catchments will be 1,500-2,200 N t/y • Baseline for total suspended solids (TSS) from catchments will be 60,000-70,000 t/y For Western Treatment Plant annual loads of TN should not exceed 3,100 t/y (based on 3-year rolling average). There is no need to set a target for sediment. For other wastewater treatment plants, there should be no net increase in nitrogen loads to the Bay.
2. That interim load reduction targets for TN (500 t/y) and TSS (9,000 t/y) be adopted for the waterways over the next 10-15 years to ensure the new EMP objective is achieved. Note: it is assumed the WTP will be upgraded as necessary to endure the current TN and TSS load ranges are maintained.	Having a reduction target for nitrogen maintains consistency with the previous EMP and other strategies. The inclusion of a sediment reduction target will have a stronger affinity with the public as it is easier to conceptualise sources of sediment in comparison to sources of nitrogen, which in turn makes it easier to communicate what interventions are required to reduce sediment loads.	To ensure that loads from waterways do not exceed the current baseline range and to mitigate against projected increases in loads over the next 10 years, the following targets will be set for waterways: • Reduce TN by 300 t/y by 2027 (30 t/y for each year of the 10-year plan) • Reduce TSS by 6,000 t/y by 2027 (600 t/y for

	The use of 'interim' load reductions targets suggests that if more accurate load estimation methods reveal that our current estimates of loads are inaccurate it will be appropriate to refine targets in line with the improved numbers. The recommended TN reduction target of 500 t/y includes 200 t/y from regional waste water treatment plants. However, for the EMP the assumption should be made that the 200 t/y will be managed through treatment upgrades or operational changes, and that there will be no net increase in loads to waterways. The recommended reduction target of 9000 t/y for TSS was based on MUSIC. This is significantly higher than if the results from the Source modelling were used to set the target. As such a lesser target, somewhere between the two should be included in the EMP. This can be revised when there is greater certainty in the load estimates. Setting a reduction target over a 10-15 year period represents the uncertainty in the load estimation method and start-up time required for interventions. However, this is undesirable for management as it creates ambiguity in the target and the EMP is a 10-year plan.	each year of the 10-year plan) The above load targets will be required to be met over the 10 year period of the Plan. Progress towards the reduction targets from catchment waterways will be reconciled against individual interventions, and load estimations based on monitoring and modelling of catchment loads. Load reduction targets should be reviewed following upgrade of the catchment models.
3. That further SOURCE modelling be undertaken to more accurately define the current (baseline) loads of TN and TSS contributed via each of the waterways (Yarra, Maribyrnong, Dandenong, Werribee) over the period 2005-2016, and that this take place	The review has highlighted the difficulties associated with the modelling approach for load estimation, and the need to make allowance of some 40% for load targets. It is also understood that to improve the accuracy of the models will require significant investment to improve the model, collect more data for calibration, and allow more time to run the model over longer time periods to obtain	For the purposes of setting baselines for loads and reduction targets the current Source model with an allowance of 40% is considered appropriate; however to provide confidence in assessing the achievement of those targets and to refine targets for individual catchments, the model will require significant investment in development and data

after the current SOURCE model is significantly upgraded.	statistically robust results. Simplification of catchments into the four regions for management purposes does not align with the common understanding of drainage catchments. The Werribee and Dandenong regions have multiple entry points to the Bay from other river systems. They are not based on single catchments, unlike the catchments for the Yarra and Maribyrnong Rivers. This creates confusion when comparing estimates based on monitoring with those from the Source model.	collection. Further development of the Source model will enable assessment of the effectiveness of management interventions. However, as a first step continued investment in monitoring and sampling during high flow events is required to improve load estimations, and to inform decisions on intervention strategies (ie are you building infrastructure that allows by-pass during high flow events – critical if 80% of loads occur during these events). Improving the performance of the underlying hydrological model is also required before trying to improve load estimations.
That seasonally based TN and TSS load target ranges be investigated (focusing particularly on spring and summer) to see if they provide a better link to primary productivity (Chl-a) levels in the Bay than the broader annual TN loads.	The review has highlighted the increased risk from high flow events during warmer periods. However to set seasonally based targets is not practical as current approaches for managing stormwater are not seasonally specific. For waterways managers there is minimal benefit in treating high flow events that occur in winter any differently to ones that occur in summer. Also if high-flow events by-pass treatment processes (pushing the loads downstream), it is likely that the impact of these events will increase as the urban catchment increases in size, and these events occur more frequently in summer. Gaining further understanding of the ecological impact of spring/summer high-flow events on primary production is required to improve the performance of the Bay model. The available information suggests that large proportions of the nutrient loads are being delivered by large runoff	We need to understand the impact of high-flow events, how the impacts vary seasonally, and the time needed for Bay processes to recover. This will inform decisions on intervention strategies, and the investment needed to improve the performance of the model. Given the potential for localised (nearshore) effects of high-flow events during summer, the EMP will define qualitative targets for avoidance of nuisance algal blooms and periods of poor water quality at bayside beaches.

	events – probably larger than the 1/3 month events that are typical captured using WSUD. There may be situations where looking at larger events will need to be considered but this will need to be supported by increased certainty around the drivers of productivity geographically and seasonally within the Bay.	
4. That further Bay modelling be undertaken (following the target setting approach outlined in this report) to better assess the detailed seasonal effects of catchment nitrogen loads on the phytoplankton productivity and biomass (Chl-a) in Port Phillip Bay. This new modelling should investigate better linking of specific catchment loads to the Bay segments they mostly influence, e.g. Yarra-Maribyrnong Rivers to Hobsons Bay; WTP to adjacent Bay region; Dandenong Creek to Bay region off Patterson River. Note: this should only occur after the current Source and ELCOM-CAEDYM models are upgraded.	Jacobs and Hydronumerics noted in their modelling report, that there would be benefit from further calibration of the Bay model with the available data, before attempting to model additional processes. However, to improve the overall model, there should be a focus on process-based data collection, eg measuring biogeochemical processes during high flow events to improve modelling of the Bays resilience. The Bay model would also be improved with more accurate loads data, which would come from improvements to the Source model.	Investment in upgrading the Source model and ELCOM-CAEDYM model will be undertaken over the initial 2-3 years of the EMP, and done in conjunction with implementation of the Healthy Waterways Strategy. It also needs to be integrated with the water quality monitoring programs for the waterways, WTP and the Bay.
5. That consideration be given to establishing: (a) a target (or objective) for denitrification efficiency, and (b) a more extensive monitoring program for denitrification efficiency in Port Phillip Bay.	As identified in the Science Knowledge Synthesis, denitrification continues to be a critical process over much of the Bay, and should continue to be monitored. There is also benefit in developing new techniques for measuring denitrification to provide greater spatial and temporal coverage, and specifically following high-flow events.	The EMP recognises the importance of protecting denitrification as process for removing nitrogen from the Bay, and will continue to measure denitrification efficiency at the existing sites. However, if improved monitoring methods are developed there is benefit in obtaining greater spatial and temporal coverage to better understand the potential impacts from catchment and Bay activities.

		Protection of denitrification has been recommended for inclusion in the revised SEPP Waters.
6. That the waterways monitoring program be upgraded with automated event sampling established in the major waterways, especially in the Yarra River, as soon as possible.	As previously discussed improved accuracy of load estimates is reliant on better monitoring of waterways (flow and concentration), especially during high-flow events.	The EMP will support ongoing investment in continued monitoring of waterways (flows and concentrations) and sampling methods to provide greater understanding of loads during high-flow events.
7. That a program of annual and five-yearly reporting be established along the lines detailed in the report.	The suggested reporting will be reliant on continued monitoring of water quality (nutrients, sediment and pollutants) and flows in waterways, WTP and the Bay. This information will be used to drive the catchment and bay models, which will be used to assess achievement of targets. Assessment of targets will need to be normalised against rainfall and other climate variables.	Annual and five-yearly reporting of loads and progress against targets as recommended will be part of the EMP MERI plan.
8. That the Source catchment model be upgraded so that it is able to provide better links between the effectiveness of controls on urban developments (e.g. BPEM) and end of catchment TN and TSS loads and that consideration be given to establishing in-house capability in Source modelling within Melbourne Water.	As previously discussed improved accuracy of the Source model is reliant on better monitoring of waterways (flow and concentration), especially during high-flow events. There is also need for further research and upgrading of the model to enable assessment of the effectiveness of stormwater management controls at sub-catchment scales. This functionality will be dependent on landuse mapping being able to differentiate between upgraded and traditional stormwater management (currently not available). Establishing in-house Source modelling capability within Melbourne Water would need to be considered as part of a broader resourcing plan for management of waterways.	Investment in upgrading and maintaining the Source model will be undertaken over the initial 2-3 years of the EMP, and done in conjunction with implementation of the Healthy Waterways Strategy. A decision on establishing in-house capability for Source modelling within Melbourne Water is outside the scope of the EMP.

	However, initial estimates are that this may require 0.5 to 1.5 FTE, with additional support for upgrading the functionality of the model.	
9. That consideration be given to developing new guidelines for existing urban areas (infill occurring), recent developments (stormwater treatment to BPEM standards) and new urban greenfield developments (move to a 'no-impact' model).	The EMP focus is on inflows to the Bay, and as such development of new stormwater standards is out-of-scope. However, the EMP recognises that an expanding urban area is going to have a cumulative impact on end-of-valley loads to the Bay. The magnitude of these loads will also increase exponentially with urban growth especially if high-flow events by-pass treatment.	Development of new stormwater standards is out-of-scope for the EMP. However the EMP recognises the need for standards to be reviewed and improved to reduce loads of nutrients, sediment, litter and other pollutants to the Bay. Ideally these standards should start from a position of no net increase in loads of nutrients, sediments, litter and other pollutants. As opposed to the current standards that result in a residual load increase with new urban development. This recommendation is covered by EMP Action 3.3.
10. That consideration be given to undertaking a cost-benefit study of the rural areas in the catchment to identify the most effective management actions to pursue, and then develop a rural land management strategy for the Yarra, Maribyrnong and Werribee catchments.	The EMP focus is on inflows to the Bay, and as such evaluation of rural land management actions is out-of-scope. However, the EMP recognises that rural areas contribute significant loads of nutrients and sediment to the Bay. The existing Source model could be used to support a cost-benefit study, however the results would be improved with an upgraded model.	Evaluation of rural land management practices is covered under draft EMP Action 3.3. A decision on whether this should be in the form of a cost-benefit-analysis would require further discussion with stakeholders. However, the EMP recognises the need for continued investment in improved rural land management to reduce loads of nutrients, sediment, litter and other pollutants.