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Response to 2002 peer review comments

Appendix A.

No response needed.

Appendix B.

Mass balance calculations can be useful, but have to be applied carefully to this problem because of the importance of oxidation rate to the daily oxygen demand contributed from upstream load. Most of the upstream organic matter is highly decomposed phytoplankton (Kratzer et al. 2003) and only about 40% of the organic nitrogen in the upstream load is live phytoplankton that oxidizes to dissolved ammonia at the measured rate of 0.15 mg N / mg chlorophyll *a* / day (20° C). Because of the relatively low rate of oxidation and small percentage of chlorophyll *a* in the upstream load, the dissolved ammonia load from the RWCF was higher on a daily basis than the dissolved ammonia load produced by oxidation of nitrogenous organic matter from upstream. The relative contribution of both sources to the dissolved ammonia concentration in the DWC varied with residence time, but was strongly influenced by the percentage of chlorophyll *a* in the upstream load. A mass balance model that takes the oxidation rate of the organic matter into consideration was included in the revised report.

I agree with the reviewer that reduction of the dissolved ammonia load from the treatment plant alone would not eliminate the low dissolved oxygen in the DWSC because of the oxygen demand from upstream sources. High chlorophyll *a* concentration at Mossdale in June and October and are probably the primary cause of low dissolved oxygen concentration in the DWSC about 20 days later. In addition, 30% of the variation in total BOD was associated with carbonaceous demand throughout the season. Management alternatives that do not address the decomposition of high phytoplankton biomass in the DWSC will not be adequate.

Appendix C. – David Beasley

No comment necessary.

Appendix D. – Alex Horne

No comment necessary

Appendix E. – Alan Jassby

Item 1.

Chlorophyll *a* load from in situ growth was estimated based on net oxygen production from light and dark bottle incubations in the photic zone. In this technique, net growth rate is estimated from a change in oxygen concentration and is a direct estimate of new carbon production in the photic zone.

It is true that the net carbon produced in the total DWSC water column (photic plus aphotic zone) is far less than that produced in the photic zone alone because of respiration processes in the aphotic zone. However, the purpose of this calculation was to determine the relative amount of new organic matter than would be respired in the aphotic zone. This quantity was the best value for comparison with the upstream load because both sources of chlorophyll *a* caused respiration in the aphotic zone of the DWSC. Additions were made to the text for clarity.

Item 2.

There was no intention to indicate the upstream load was unimportant and changes were made in the text in order to clarify that point. However, the correlation analysis cannot be discounted and is very important. The upstream load of organic nitrogen and TBOD or NBOD in the DWSC were poorly correlated and contrasted sharply with the strong correlation between the RWCF dissolved ammonia load and both TBOD and NBOD in the DWSC. I agree with the reviewer that this correlation is probably not spurious because of the variable nature of the RWCF load.

It is true, there was often a large load of dissolved ammonia from upstream based on Mossdale water quality data. Dissolved ammonia concentration reached as high as 0.42 mg/L at Mossdale in 2001 in our data set. How much of this reached the DWSC is unclear. It is hard to imagine that oxidation processes were not operating in the 12-mile journey to the DWSC between Mossdale and Channel Point.

A simple mass balance model was developed to assess the relative contribution of upstream and RWCF dissolved ammonia load from both direct addition of dissolved ammonia and indirect addition of dissolved ammonia through the oxidation of organic nitrogen. The load calculations assumed there was no loss for each source during transport into the DWSC. The range of potential contributions was developed based on the measured ammonification rate of chlorophyll *a* concentration of 0.19 mg N/ mg chlorophyll *a* /d at 25 °C. If all of the organic nitrogen oxidized at the maximum rate then it took 10 days for the accumulated load of dissolved ammonia plus dissolved ammonia from the oxidation of organic nitrogen from upstream at MD to exceed that from the RWCF dissolved ammonia discharge. In contrast, if only the most reactive organic material, chlorophyll *a*, was oxidized at the measured rate then the RWCF consistently contributed the majority of the ammonia in the DWSC at all residence times from 1 to 25 days. Clearly the RWCF is a major contributor to oxygen demand in the DWSC but as expected the magnitude of its impact varies with a suite of conditions.

I agree that the importance of the RWCF ammonia load does not eliminate the importance of oxygen demand from phytoplankton blooms. The carbonaceous BOD comprised up to 50% of the total BOD and accounted for 30% of the variation in the daily total BOD for both years. This was a significant percentage of the total BOD. In fact, this percentage might have been higher if the impact of the June phytoplankton bloom on low dissolved oxygen concentration in July was included.

A check of the Mossdale NBOD in 2001 indicated NBOD comprised an average of 42%. Most of the total BOD was not NBOD as indicated by the reviewer. This was the result of an inappropriate graphical format. All graphs were revised.

A plot of non-ammonia TKN against NBOD was added for clarity.

Fig. III-10 was revised.

Yes, there was very little correspondence between NBOD and non-ammonia TKN. A graph was added to demonstrate this fact. See above.

Item 3.

There was no evaluation of the algal production rate or environmental variables on the BOD in the correlation analysis. The correlation analysis only explored the potential impact of the concentration of oxygen demanding substances on the variation in oxygen demand. As it turned out, these variables accounted for most of the variance so the analyses didn't go further.

Environmental variables such as water temperature and mechanistic processes are logically important, but were not needed to explain most of the variance. This may be due to the relatively stable water temperature, surface irradiance and turbidity during the study period and the near zero net oxygen production of the phytoplankton. This is a good point and was included in the revised report.

Item 4.

Upstream load is an important contributing factor to oxygen demand in the DWSC. The relative contribution of the upstream load and the RWCF was addressed by development of the mass balance model for ammonia concentration. Both were important and their relative importance was strongly influenced by the oxidation rate of the upstream load. See item 2.

Appendix F.

No responses needed.