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Comments on Peer Review of the Living Streams Concept
by
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Review findings

This document contains comments by Professor Barry Hart (Director, Water Science Pty Ltd) on the *Peer Review of the Living Streams Concept* by the Australian Rivers Institute (ARI), Griffith University (Hamilton et al., 2022).

Hamilton et al. (2022) were commissioned by the City of Busselton to review the Living Streams concept design for the Lower Vasse River (LVR) developed by Alluvium Consulting (Alluvium 2021a,b). The aim of this concept was to reduce the extent, severity, frequency and duration of cyanobacterial blooms in the LVR between the Butter Factory and upstream to the Busselton Bypass, a length of 3.3 km.

In general, the Hamilton et al. (2022) review supported the three-staged approach recommended by Alluvium: Stage I - removal of sediments extending to different distances upstream; Stage 2 - recirculation of water through one or two modified and/or constructed wetlands; and Stage 3 - construction of in-stream vegetated structures to reduce volume and create wetland habitat within the LVR.

However, they made sensible recommendations regarding the introduction of the three stages, namely:

- That the Stage 1 dredging should be completed in full before Stage 2 is commenced
- That during the dredging consideration should be given to using a flocculant, such as Phoslock®, to offset possible localised effects of the dredging and to contribute to the inactivation of phosphorus in the bottom sediments
- That further work be undertaken to ensure that the proposed wetland enhancement and construction project (Stage 2) will achieve its objectives
- That Stage 3 not be commenced until Stage 2 is completed and further that additional work is undertaken to ensure the benefits of this approach.

I agree with these recommendations with some caveats discussed below. Additionally, I believe the adoption of these recommendations will significantly improve the prospects that this project will be successful.

However, I also make comment in this report and previously (Hart, 2014) that unless the two primary causes of the cyanobacterial blooms in the Lower Vasse River - excessive nutrient inputs from the Vasse catchment and insufficient river flow in summer - are adequately addressed, the potential for blooms in river will always exist despite the restoration efforts discussed by Alluvium and Hamilton et al. (2022).

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Other comments

This section contains my more detailed comments on the Hamilton et al. (2022) review.

Overriding issue

Both Alluvium (2021a,b) and Hamilton et al. (2022) make the point that the fact that cyanobacterial blooms occur in the LVR is primarily because of two factors: the excessive nutrient (nitrogen and phosphorus) input from the Vasse catchment; and inadequate river flow in summer. This point was also made in a review I undertook for the WA Department of Water (now Department of Water and Environmental Regulation) in 2014 (Hart, 2014).

I understand that the bypass from the drain to the LVR has been increased in size, increasing flow in the LVR during winter, but resulting in little additional flow in summer. Thus, the summer flow is still inadequate. Additionally, there seems to have been little progress in reducing nutrient inputs from the agricultural areas of the Vasse catchment.

If these two issues - inadequate flows in summer and nutrient reduction from the catchment - were adequately addressed, I would be more confident that the recommended restoration of the LVR would be successful in the long term.

Sediment removal (Stage 1)

Alluvium (2021 a,b) recommended that the existing organic, nutrient-rich sediment in the LVR be dredged to remove a major source of nutrients (and possibly cyanobacteria) that appears to contribute to algal blooms in the LVR in summer. These sediments have accumulated over many years, largely because of the presence of the weir at the Butter Factory (now removed) and the lack of flow in the LVR to scour the sediments further downstream.

Alluvium recommended two options for sediment removal; from the Butter Factory to the old boat ramp at an estimated cost of $1.046 million; and the whole study reach from the Butter Factory to the Busselton Bypass a distance of 3.3 km at a cost of $2.136 million.

Hamilton et al. (2022) recommended that the whole study reach be dredged with which I agree.

A further three aspects need to be considered regarding the dredging.

Hamilton et al. (2022) further recommended that during the dredging, consideration should be given to using a flocculant, such as Phoslock®, to offset possible localised effects of the dredging and to contribute to the inactivation of phosphorus in the bottom sediments. I am somewhat sceptical regarding this suggestionm. There have been many studies of the application of Phoslock® in the LVR over the past 20 years with mixed success. My view is that further work is required on the need for a flocculant during the dredging operation. Additionally, if the sediments are removed, and they don't build up again, the need for inactivation of sediment phosphorus will not be needed.

Neither Alluvium or Hamilton et al. commented on the situation regarding sediment after the dredging, e.g., will sediment continue to build-up in the future or will the addition flow and removal of the weir be sufficient to flush sediments downstream during the winter months?

The third aspect, which is linked to the above point, is what represent success of the dredging option? Hamilton et al. were strong in their recommendation that sediment removal should be completed, and shown to be successful, before any other stages are commenced. However, they provided no commentary on how the success of the dredging should be assessed. My view is that the success criteria for the dredging should be developed as part of the detailed dredging program.

Application of wetlands (Stage 2)

Hamilton et al. (2022), while generally supporting the use of natural or artificial wetlands to improved water quality, nevertheless felt there was a 'high degree of uncertainty associate with aspects of Stage 2 of the project'. In brief, their concerns were:

- Whether adequate cyanobacterial control will be achieved given that the duration of shading of the algae in the wetland (five days) may be insufficient to offset their ability to grow in the LVR (20 days)
- Whether the succession and density of plants in the wetlands will be adequate to control cyanobacteria via nutrient uptake and reduction of light (shading)
- Whether the on-going costs of pumping LVR water to the wetlands may reduce the cost-benefit of this part of the restoration project.

I agree with these uncertainties and recommend that further work be undertaken on the proposed wetland concept.

In-stream structures (Stage 3)

Hamilton et al. (2022) were also concerned about the proposed Stage 3 involving the construction of in-stream vegetated structures to displace water and create wetland habitat within LVR.

Their concerns were the while the volume of LVR and residence time may be reduced (leaving less time for cyanobacterial growth), there is also the risk that the river would be divided into small areas potentially creating stagnant areas and enhance stratification and better conditions for cyanobacterial growth.

Obviously, more work is needed on this Stage 3 option to prove its effectiveness.

It seems unlikely that the type of interventions considered in Stage 3 (and possibly even Stage 2) would be necessary if the two primary issues - excessive nutrients from the catchment and insufficient river flow in summer - were at least partially addressed.

Causes of cyanobacterial blooms

Hamilton et al. (2022) also provided a very useful critique of Section 2.2 of the Alluvium (2021a) report (Causes of blue-green algae blooms). The various points of clarification on cyanobacterial biology are welcome and should be noted by the City of Busselton in any publicity they issue on this project.

References

Alluvium (2021a). *Living Streams Concept Design for the Lower Vasse River*, Report P4200010_R01 by Alluvium Consulting Australia for City of Busselton, Brisbane.

Alluvium (2021b). *Technical Report. Living Streams Concept Design for the Lower Vasse River*, Report P4200010_R01V02 by Alluvium Consulting Australia for City of Busselton, Brisbane.

Hamilton, D.P., Burford, M.A. and Sheldon, F. (2022). *Peer Review of the Living Streams Concept,* Report by Griffith University for City of Busselton, Brisbane, June 2022, 8 pp.

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