

Effect of Varying Environmental Objectives for Blackfish on Environmental Flow Recommendations for Steels, Pauls and Dixons Creeks

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For

The Steels, Pauls and Dixons Creek Streamflow Management Plan Committee

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Acronyms/Abbreviations Used in this report:

FLOWS	The “Statewide Method for Determining Environmental Water Requirements”
SEPP	State Environment Protection Policy
SFMP	Streamflow Management Plan
SPDEFTP	The Steels, Pauls and Dixons Creeks Environmental Flows Technical Panel.

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Summary

An assessment was made whether omitting the environmental objective to “Maintain or Restore self-sustaining populations of River blackfish” from the list of objectives assessed in Steels, Pauls and Dixons Creeks would have an influence on environmental flow recommendations in the three creeks. Recommendations had already been made by the Steels, Pauls and Dixons Creeks Environmental Flows Technical Panel in 2003 using the FLOWS method and including the objective for blackfish.

As far as possible, the same processes and criteria used by the Technical Panel were employed in the re-evaluation. However, at some points, it was necessary to assume changes in the logic behind the recommendations.

It is stressed that any suggested variations to the flow recommendations are suggestions of the author of this report, and are not revisions of the recommendations by the Technical Panel. To obtain endorsement from the panel will require re-convening the panel for a more formal review.

Without the objectives for River blackfish, it is suggested that the following environmental flow recommendations in Steels, Pauls and Dixons Creeks could be appropriate.

Steels Creek

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Cease to Divert Flow 2 ML/d						Cease to Divert Flow 15 ML/d					
Low Flow Fresh >15 ML/d						High Flow Fresh >700 ML/d					
						High Flow Fresh >2500 ML/d					

Dixons Creek

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Cease to Divert Flow 2 ML/d						Cease to Divert Flow 5 ML/d					
Low Flow Fresh >5 ML/d						High Flow Fresh >50 ML/d					
						High Flow Fresh >500 ML/d					
						High Flow Fresh >1250 ML/d					

Pauls Creek

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Cease to Divert Flow 2 ML/d						Cease to Divert Flow 8 ML/d					
Low Flow Fresh >8 ML/d						High Flow Fresh >150 ML/d					
						High Flow Fresh >520 ML/d					

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1. Introduction

As part of the process of developing a Streamflow Management Plan (SFMP) for Steels, Pauls and Dixons Creeks, an environmental flow study was conducted (SPDEFTP, 2003a; SPDEFTP, 2003b). The study recommended a number of flows to achieve specified environmental objectives for the three creeks (Table 1.1).

Table 1.1. Environmental Objectives for Steels, Pauls and Dixons Creeks

Environmental Objectives
<ul style="list-style-type: none"> • Maintain or Restore self-sustaining populations of Mountain galaxias, Flatheaded gudgeon and Southern pygmy perch. • Maintain or Restore self-sustaining populations of River blackfish. • Maintain or Restore self-sustaining populations of Common galaxias. • Maintain or Restore natural invertebrate community (O/E Score). • Maintain or Restore in-stream vegetation community. • Rehabilitate Riparian Forest bench and bank vegetation community. • Maintain geomorphic river and channel form.

Environmental flow recommendations based on these objectives contained cease to divert flows for the three creeks of 15 ML/d for Dixons and Pauls Creeks (throughout the year) and Steels Creek (May to October) and 5 ML/d in Steels Creek (November to April).

At a meeting of the Steels, Pauls and Dixons Creeks Streamflow Management Plan Committee on 22 July 2004, concern was expressed as to the likely impact of such recommendations on security of supply. It was suggested that the 15 ML/d cease to divert flow recommendations in particular (representing a relatively high flow the creeks) were primarily driven by the objective to maintain or restore self-sustaining populations of River blackfish.

The opinion was put forward that Steels, Pauls and Dixons Creeks may not have suitable characteristics for a self-sustaining River Blackfish population (particularly the ephemeral nature of the flow and relative lack of in-stream habitat), and that such an objective may be less appropriate in the catchments than other environmental objectives.

This study re-evaluated the environmental flow requirements in the three creeks under the assumption that the environmental objective for River blackfish was not included in the objectives for the catchments.

It should be noted that this re-evaluation has not been conducted by the Steels, Pauls and Dixons Creeks Technical Panel. All opinions are those of the author.

The Panel has not been requested, at this stage, to revise or modify the environmental objectives for the catchments, and revise their recommendations. This study aims to assess what the likely effect of such a revision would be, particularly on the cease to divert recommendations. The results presented here have not been endorsed by the Steels, Pauls and Dixons Creeks Technical Panel.

2. Fish data for Steels, Pauls and Dixons Creeks

The Issues Paper prepared by the Steels, Pauls and Dixons Creeks Technical Panel (SPDEFTP, 2003a) described the fish data available for the catchments (p. 20).

Records of native fish in the three creeks are extremely limited. Prior to the current study, only two ad hoc fish surveys had been conducted in the three creeks, one in Dixons Creek in 1990 and one in Steels Creek in 2000 (DSE Aquatic Fauna Database, unpublished data). These revealed two species of native fish (Short finned eel and Common galaxias) in Steels Creek and one species (Mountain galaxias) in Dixons Creek.

During the field inspection, a small amount of fish sampling was undertaken using a dip net in Steels and Dixons Creeks. This sampling resulted in new records of Southern pygmy perch from each creek and a new record of Flatheaded gudgeon from Dixons Creek. In total, three species of native fish (Southern pygmy perch, Short finned eel, Common galaxias) are therefore known to occur in Steels Creek, and three species (Southern pygmy perch, Mountain galaxias, Flatheaded gudgeon) in Dixons Creek. No records of native fish currently exist for Pauls Creek (DSE Aquatic Fauna Database, unpublished data).

In addition to these recorded species, an anecdotal account of the presence of River blackfish in Dixons Creek was obtained during the field visit. (White, local landholder, pers. comm.). Based on this information, and an assessment of the distribution of River blackfish within the Yarra catchment, it is highly likely that River blackfish occur in Dixons Creek and potentially in Steels and Pauls Creeks.

Whilst the available information suggests a depauperate native fish fauna, it should be recognised that the three creeks have not been surveyed intensively and that other native species may occur, or have occurred in the past, in these systems.

Therefore, the presence of River blackfish in the catchments has been suggested only by anecdotal evidence. However, Steels, Pauls and Dixons Creeks do lie in the broad range of the species within the Yarra River catchment, so the observations are of sufficient validity to infer that the species is present in at least one of the creeks. However, the suitability of the habitats for self-sustaining populations of the species cannot be confirmed or rejected with the current data.

The Issues paper concludes that:

Little data on the presence and distribution of fish species in the study area are available. The status and composition of the current fish fauna of the study area is therefore unclear. (p. 23)

The Technical Panel took the view that River blackfish should be included in the recommendations, despite the lack of hard evidence. This decision can be supported because blackfish is mentioned as a requirement in the State Environment Protection Policy (SEPP) for the Yarra River (State of Victoria, 1999) and is a key species in the Melbourne Water Fish Habitat Activity Strategy (Heron *et al.*, 2002).

However, should the impact of the recommended flows on security of supply be deemed too severe, an argument could be made that removing the objective for blackfish represents a valid compromise, due to the perceived low value of the creeks for the species, and the presence of more secure populations elsewhere in the region.

Removing the objectives for blackfish from the list of objectives assessed does not mean that any populations present would be eliminated. Rather, removing the objective means that flows specifically to maintain or restore the populations with a high degree of certainty would not be provided, and so their survival would simply not be as secure as under the original recommendations.

3. Effects of variation on flow requirements

3.1 Steels Creek

Cease to Divert Flow (Low Flow Season - December to April)

The original 5 ML/d recommended cease to divert flow in Steels Creek over the Low Flow Season (December to April) was based on providing adequate habitat for small bodied fish species and in-stream vegetation in shallow run areas (circled in Figure 3.1). Adequate habitat for blackfish was seen to be provided in the deeper pool areas, irrespective of any cease to divert flow.

Removing the environmental objective for River blackfish would probably mean that different criteria would be used to assess the cease to divert flow. With the deeper pools “set aside” for blackfish, the choice of the Technical Panel was to provide additional habitat for small bodied fish outside the pool areas. Without the objective for blackfish, it is likely that the pools would be seen as adequate habitat for small-bodied fish, and so the criteria used to determine the recommendation would likely be to provide aquatic macroinvertebrate and in-stream plant habitat in the shallow run circled in Figure 3.1.

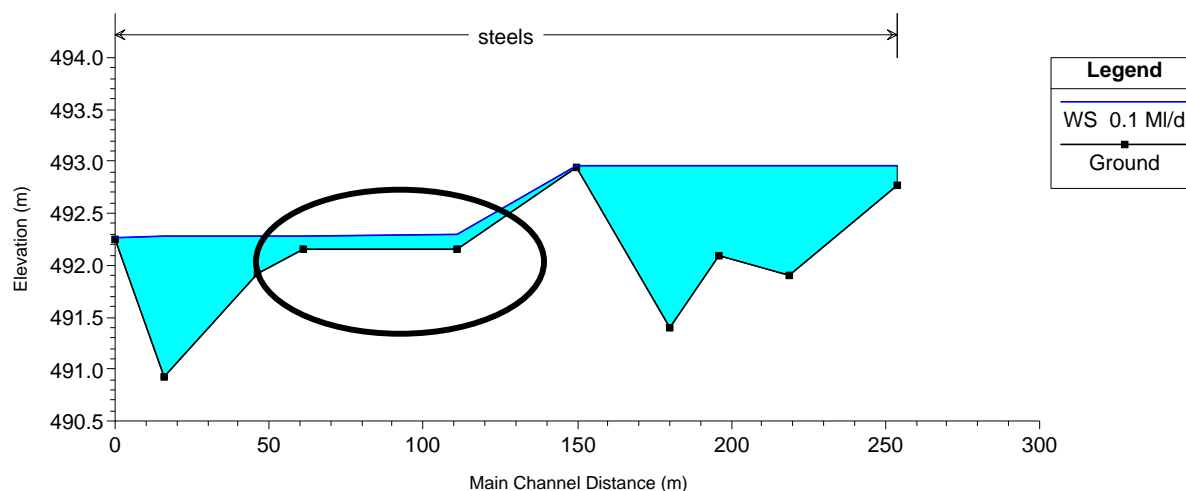


Figure 3.1. Long profile of the Steels Creek site, with area used to determine December to April cease to divert flow (circled).

Therefore, rather than provide adequate areas of the run with depths greater than 0.2 m and shallower than 0.3 m (the hydraulic surrogates for small-bodied fish and in-stream vegetation), the criteria could be changed to depths greater than 0.1 m (for macroinvertebrates) and less than 0.3 m.

Table 3.1 shows the percentage of the wetted width of the low flow channel with depths greater than 0.1 m and shallower than 0.3 m at 4 different flows, using the same transect as in the original recommendations (Figure 3.2).

Table 3.1. Proportion of the low-flow channel in Figure 3.2 with depths >0.1m and <0.3 m.

Flow (ML/d)	% width with depth >0.1 m	% width with depth <0.3 m
15	93	17
10	92	57
5	92	69
2	83	100

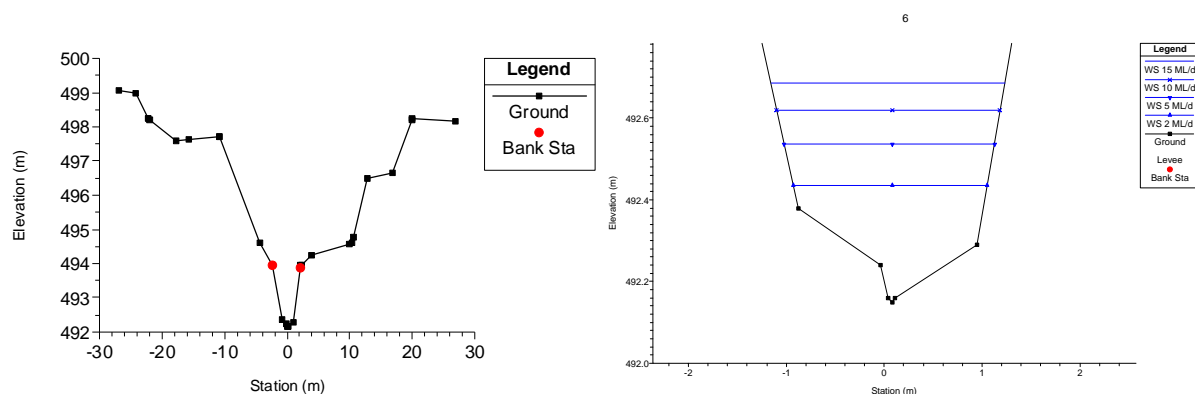


Figure 3.2. Transect in the long run used by the Technical Panel (left) and detail of the low flow channel at 2, 5, 10 and 15 ML/d (right)

While no criterion for selecting an appropriate flow was used by the Technical Panel, it would seem that the depth of water at 2 ML/d would be suitable to meet the revised set of objectives.

This would suggest that the Low Flow Season (December to April) cease to divert flow could be reduced from 5 ML/d to 2 ML/d in Steels Creek if the objective for River blackfish was not included.

The original recommendations extended the period for this cease to divert flow to include November, to allow for “simulation of increases in water temperatures that naturally coincides with reductions in flow in the lead up to the Low Flow Season, thereby creating suitable conditions for blackfish spawning” (p. 15). Without the blackfish objectives, this extension cannot be justified at this point.

Low Flow Freshes (December to April)

The criteria used to determine the original 15 ML/d recommendation for Low Flow Freshes did not include any requirements for River blackfish – it was based on providing localised fish passage for small-bodied fish. The Final Recommendations (SPDEFTP, 2003b) noted that that “River blackfish are unlikely to move significant distances over this period” (p. 13). Removing the environmental objective for River blackfish would therefore have no impact on the recommended 15 ML/d Low Flow Freshes in Steels Creek.

Cease to Divert Flow (Transitional and High Flow Season - May to October)

The May to October cease to divert flow of 15 ML/d was based on providing permanent fish passage for small bodied fish, primarily the migration of Common galaxias to the estuary to breed early in the period, and to allow population mixing of Mountain galaxias, Flatheaded gudgeon and Southern pygmy perch prior to their breeding later in the season. As such, the recommendation was based on the same criterion as the Low Flow Fresh value. The recommended flow would therefore not change if the objectives for blackfish were not included.

The original analysis further showed that a flow of 10 ML/d would not provide adequate fish passage, even for small bodied fish, so an arbitrary reduction in the May to October cease to divert flow, to 10 ML/d or less, would prevent other environmental objectives being met.

An alternative that might be considered by the SFMP Committee could be to restrict the timing of the 15 ML/d cease to divert flow to a period more likely to include the migration and movement patterns of small fish. Regarding Common galaxias, the Issues paper (p. 23) notes that “adequate depths for

fish passage migration are required during the autumn spawning/migration period (corresponding to the Transitional and early High Flow periods)". For Mountain galaxias, the Issues Paper notes that "the main spawning period for Mountain galaxias is between August and September" (p. 22). This means that the period where a cease to divert flow of 15 ML/d could be restricted to the period of, say, May to August¹, returning to 2 ML/d for, say, September to October, without seriously compromising the achievement of the objectives.

Cease to Divert Flow (Transitional Season - November)

The original recommendations allowed for a reduction in the cease to divert flow from 15 ML/d to 5 ML/d in November to increase water temperatures for blackfish breeding. Without the blackfish objectives, there appears to be no reason to recommend the higher cease to divert flow in November. However, to assist in localised fish movement and redistribution of Flatheaded gudgeon (known to spawn in Spring and Summer), the Low Flow Fresh recommendation should be extended to include November.

High Flow Freshes (May to October)

The High Flow Fresh recommendations of 700 ML/d and 2,500 ML/d were based on inundating in-channel benches. While it is noted that these flows would allow localised movement of blackfish, removing the blackfish objective would not have an impact on the recommendation.

Summary

Without the objectives for River blackfish, it is possible that the environmental flow recommendations would be different as in Table 3.2 (note that the table starts in November). However, this is little changed from the original recommendations, apart from the November to April cease to divert flow (reduced from 5 ML/d to 2 ML/d). However, there is a potential to modify the May to October cease to divert flow, restricting it to the May to August period (this would need further advice from a relevant fish expert).

Table 3.2. Potential environmental flow requirements in Steels Creek without the objectives for River blackfish

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Cease to Divert Flow 2 ML/d						Cease to Divert Flow 15 ML/d					
Low Flow Fresh >15 ML/d						High Flow Fresh >700 ML/d					
						High Flow Fresh >2500 ML/d					

¹ Or some other period determined on a year to year basis corresponding to the natural onset of higher flows.

3.2 Dixons Creek

Cease to Divert Flow (Low Flow Season - December to April)

The original Low Flow Season cease to divert flow recommendation of 15 ML/d in Dixons Creek was based, on providing adequate habitat for River blackfish, particularly in the deeper areas of the reach (circled in Figure 3.3). The flow of 15 ML/d was based on providing 60% of the width of the circled transect with depths of greater than 40 cm.

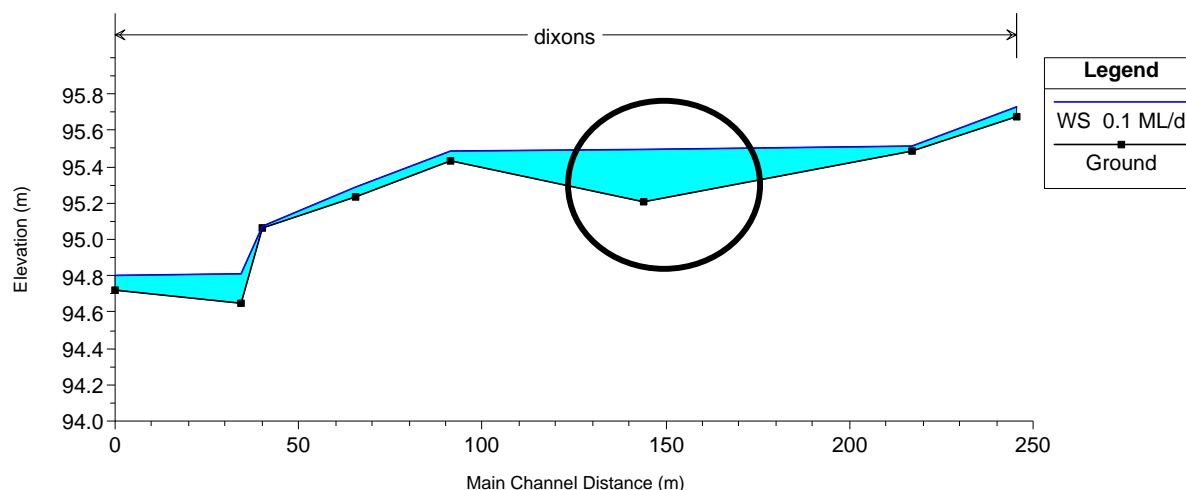


Figure 3.3. Long profile of the Dixons Creek site, with area used to determine December to April cease to divert flow (circled).

Removing the objective for River blackfish would probably change the basis of the recommendation to providing habitat for small bodied fish (depths greater than 0.2 m) in the deeper areas.

The same criteria (providing 60% of the width of the deeper transect with depths greater than 0.2 m) can be provided with a cease to divert flow of 2 ML/d (Table 3.3). This flow would also provide 63% of the wetted width with depths less than 30 cm (suitable for in-stream vegetation).

Table 3.3. Proportion of pool transect with depths greater than 0.2 m.

Flow (ML/d)	Surface water width (m)	Width (m) of depth >0.2 m	% with depth >0.2 m
1	2.74	1.47	53
2	3.09	1.91	62
5	3.58	2.58	72

Thus, removing the requirement for River blackfish objectives to be met could result in a reduction in the December to April cease to divert flow from 15 ML/d to 2 ML/d.

Low Flow Freshes (December to April)

Changing the December to April cease to divert flow from 15 ML/d to 2 ML/d would require the additional inclusion of a Low Flow Fresh for this period. The cease to divert flow of 15 ML/d allowed all the functions of Low Flow Freshes to be met (localised fish passage for small-bodied fish and flushing of the streambed sediments). However, at 2 ML/d, there is inadequate depth for fish passage

at the shallowest points in one of the reaches that were evaluated for fish passage in the original recommendations (circled in Figure 3.4).

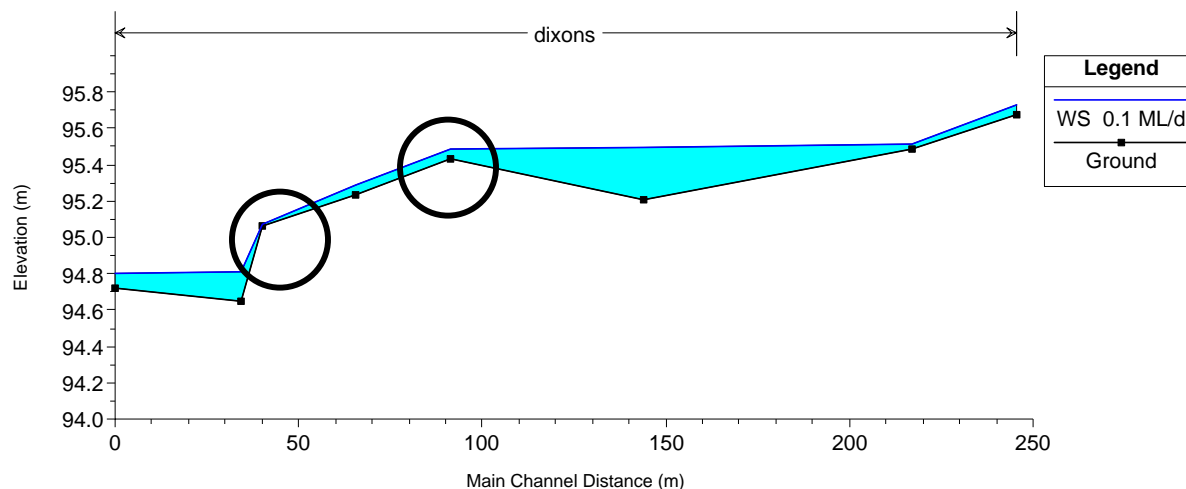


Figure 3.4. Long profile of the Dixons Creek site, with area used to evaluate December to April Low Flow Freshes (circled).

Using these same transects and a criterion that at least 25%² of the width of the channel should have adequate fish passage (depths over 0.12 m), a flow of 5 ML/d provides adequate passage³ (Table 3.4). At 5 ML/d, the average velocity through the shallow sections is between 1.1 and 1.2 m/sec, suitable to allow fish passage.

Table 3.4. Percentage of wetted width with depth greater than 0.12 m in transects circled in Figure 3.4 at 4 different flows.

Flow (ML/d)	% width in transect at 40 m greater than 0.12 m	% width in transect at 91 m greater than 0.12 m
15	54	69
10	63	64
5	50	58
2	0	30

Hence, if the River blackfish objectives were removed from the catchment, a recommendation for Low Flow Freshes of 5 ML/d would need to be added to the recommendations.

Cease to Divert Flow (Transitional and High Flow Season - May to October)

The rationale for the Cease to divert flow over the period between May to October was to allow for permanent small-bodied fish passage through the entire reach. In the original recommendations, the cease to divert flow of 15 ML/d (still needed over this period for blackfish habitat in the deeper pools) provided adequate fish passage. Without the need for blackfish objectives, the cease to divert flow over May to October could be reduced to 5 ML/d, suitable for small-bodied fish passage.

² The criterion used for adequate fish passage in Steels Creek in the original recommendations

³ Flows between 2 and 5 ML/d were not evaluated, due to uncertainty in the modelling between different very low flows. Any selection of flows between 2 and 5 would need to be field validated.

Cease to Divert Flow (Transitional Season - November)

The original recommendations do not specifically mention a justification for November in Dixons Creek. As the same cease to divert flow was recommended for December to April and May to October, it is assumed that this was simply extended to include November. The possible variations noted above suggest that a cease to divert flow in November needs to be considered. Without the blackfish objectives, there appears to be no reason to recommend the higher cease to divert flow in November. However, to assist in localised fish movement and redistribution of Flatheaded gudgeon (known to spawn in Spring and Summer), the Low Flow Fresh recommendation should be extended to include November.

High Flow Freshes (May to October)

The High Flow Fresh recommendations of 50 ML/d, 500 ML/d and 1,250 ML/d were based on inundating in-channel benches. While it is noted that these flows would allow localised movement of blackfish, removing the blackfish objective would not have an impact on the recommendation.

Summary

Without the objectives for River blackfish, it is possible that the environmental flow recommendations would be different in Dixons Creek compared to the original recommendations, as in Table 3.5 (note that the table starts in November). This is substantially different to the original recommendations, with the November to April cease to divert flow reduced from 15 ML/d to 2 ML/d, the May to October cease to divert flow reduced from 15 ML/d to 5 ML/d, and the inclusion of a Low Flow Fresh recommendation.

Table 3.5. Potential environmental flow requirements in Dixons Creek without the objectives for River blackfish

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Cease to Divert Flow 2 ML/d						Cease to Divert Flow 5 ML/d					
Low Flow Fresh >5 ML/d						High Flow Fresh >50 ML/d					
						High Flow Fresh >500 ML/d					
						High Flow Fresh >1250 ML/d					

3.3 Pauls Creek

Cease to Divert Flow (Low Flow Season - December to April)

The Low Flow Season cease to divert flow of 15 ML/d in Pauls Creek was based on providing adequate habitat for macroinvertebrates, small-bodied fish and in-stream vegetation in areas outside the pool located at the downstream end of the reach (circled in Figure 3.5). This pool had a maximum depth of 0.45 m at near zero flows, so it was noted in the final recommendations that the pool “should represent a refuge for River blackfish during low flows” (p. 29).

However, like Steels Creek, if the objectives for River blackfish are not included, it is likely that the pool would be seen as sufficient refuge habitat for small-bodied fish, and the criteria used would be to provide macroinvertebrate and in-stream plant habitat in the shallower areas upstream of the pool.

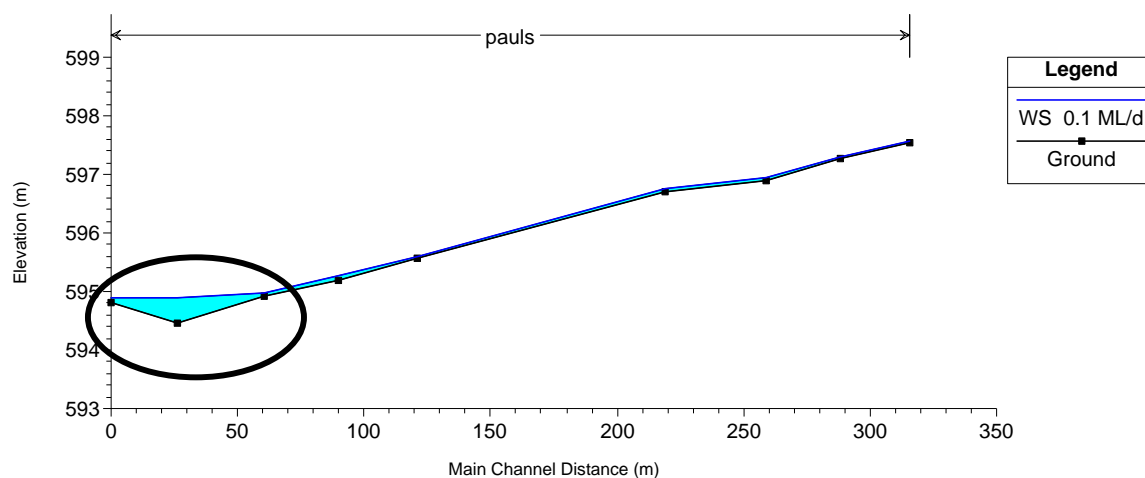


Figure 3.5. Long profile of the Pauls Creek site, with pool at lower end of the reach circled.

Thus, the evaluation criteria used would be depths greater than 0.1 m (for macroinvertebrates) and less than 0.3 m for in-stream vegetation, rather than depths greater than 0.2 m and shallower than 0.3 m (the hydraulic surrogates for small-bodied fish and in-stream vegetation).

The diagram presented in the Final Recommendations (reproduced in Figure 3.6) suggests that at a flow of 5 ML/d, all transects have some water deeper than 0.1 m and all water is less than 0.3 m. At a flow of 2 ML/d, five of the seven transects have some water deeper than 0.1 m and all water is less than 0.3 m. The remaining transects have maximum depths of 8 and 9 cm.

This would suggest that a value of between 2 and 5 ML/d would be a suitable cease to divert flow for the November to April period in Pauls Creek. As the other 2 creeks have December to April cease to divert flows of 2 ML/d, for consistency, a December to April cease to divert flow of 2 ML/d could be reasonably chosen in Pauls Creek.

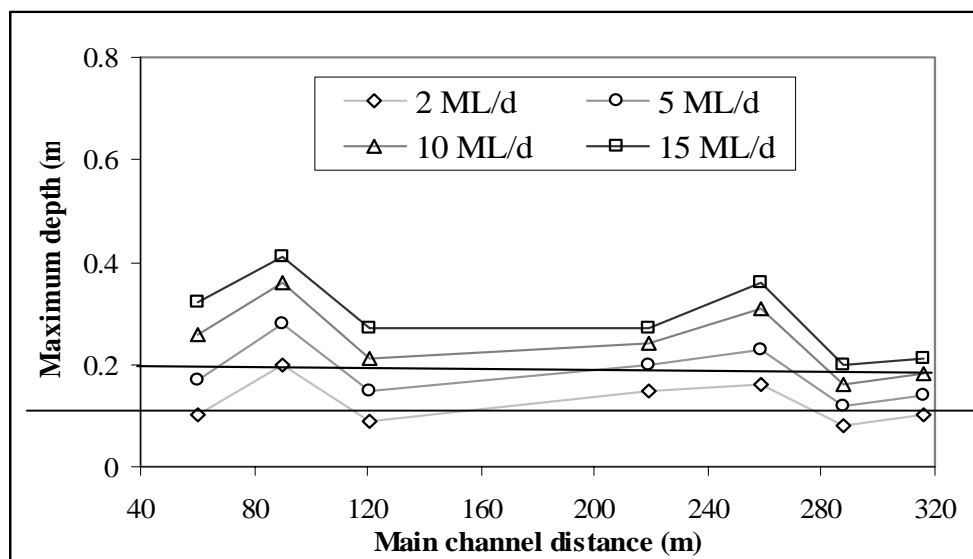


Figure 3.6. Maximum depth at seven transects upstream of the main pool in Figure 3.5 at four different flows.

Low Flow Freshes (December to April)

Changing the December to April cease to divert flow from 15 ML/d to 2 ML/d would require the additional inclusion of a Low Flow Fresh recommendation for this period. The cease to divert flow of 15 ML/d allowed all the functions of Low Flow Freshes to be met (localised fish passage for small-bodied fish and flushing of the streambed sediments). However, at 2 ML/d, there is inadequate depth for fish passage at the shallowest point in the reach (at 290 m in Figure 3.6) where the maximum depth is just 8 cm. At 5 ML/d, the maximum depth in this transect is 0.12 m, just enough to allow fish passage.

However, using the previously identified criterion that at least 25% of the width of the channel should have adequate fish passage (depths over 0.12 m), a suitable flow to provide this is around 8 ML/d (Table 3.4). At 8 ML/d, the average velocity through the shallow sections is around 0.4 m/sec, suitable to allow fish passage.

Table 3.6. Percentage of wetted width with depth greater than 0.12 m in transect at 290 m in Figure 3.4 at 7 different flows.

Flow (ML/d)	% width in transect at 290 m greater than 0.12 m
15	46
10	25
9	25
8	25
7	10
6	10
5	0

Cease to Divert Flow (Transitional and High Flow Season - May to October)

The rationale for the cease to divert flow over the period between May to October was to allow for permanent fish passage through the entire reach. In the original recommendations, the cease to divert flow of 15 ML/d provided adequate fish passage. Without the need for blackfish objectives, the cease

to divert flow over May to October could be reduced to 8 ML/d, suitable for small-bodied fish passage.

Cease to Divert Flow (Transitional Season - November)

The original recommendations do not specifically mention a justification for November in Pauls Creek. As the same cease to divert flow was recommended for December to April and May to October, it is assumed that this was simply extended to include November. The possible variations noted above suggest that a cease to divert flow in November needs to be considered. Without the blackfish objectives, there appears to be no reason to recommend the higher cease to divert flow in November. However, to assist in localised fish movement and redistribution of Flatheaded gudgeon (known to spawn in Spring and Summer), the Low Flow Fresh recommendation should be extended to include November.

High Flow Freshes (May to October)

The High Flow Fresh recommendations of 150 ML/d and 520 ML/d were based on inundating in-channel benches. While it is noted that these flows would allow localised movement of blackfish, removing the blackfish objective would not have an impact on the recommendation.

Summary

Without the objectives for River blackfish, it is possible that the environmental flow recommendations would be different in Pauls Creek compared to the original recommendations, as in Table 3.5 (note that the table starts in November). These are substantially different to the original recommendations, with the November to April cease to divert flow reduced from 15 ML/d to 2 ML/d, the May to October cease to divert flow reduced from 15 ML/d to 8 ML/d, and the inclusion of a Low Flow Fresh recommendation.

Table 3.7. Potential environmental flow requirements in Pauls Creek without the objectives for River blackfish

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Cease to Divert Flow 2 ML/d						Cease to Divert Flow 8 ML/d					
Low Flow Fresh >8 ML/d						High Flow Fresh >150 ML/d					
						High Flow Fresh >520 ML/d					

4. Conclusion

Removing the objective for River blackfish in Steels, Pauls and Dixons Creeks would potentially change the environmental flow recommendations substantially in Dixons and Pauls Creek, reducing the cease to divert flows over the year in both catchments. The recommendations would likely to be unchanged in Steels Creek, apart from a small reduction in the cease to divert flow over the November to May period.

It should be stressed that removing the objectives for blackfish from the list of objectives assessed does not mean that blackfish would not be able to survive in the creeks, or that any populations present would be eliminated. Rather, removing the objective means that flows specifically to maintain or restore the populations with a high degree of certainty would not be provided, and so their survival would simply not be as secure as under the original recommendations.

It is also stressed that any suggested variations to the flow recommendations are those of the author of this report, and should not be seen as revisions of the recommendations by the Technical Panel. To obtain endorsement from the panel will require re-convening the panel for a more formal review.

5. References

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