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Title: **"**Review of winter 'cease-to-take' rules for the Great Forester River WMP area."

SUMMARY: This document reviews information from previous studies and undertakes some additional data analysis to help inform the Working Group about options for the inclusion of winter environmental water provisions (cease-to-take thresholds) in the revised Water Management Plan for the Great Forester River catchment, which is under formal review.

Information reviewed

1. "Ecological flow requirements for the Great Forester River (DPIWE WRA 99/15, 1999)"
2. Winter CTT revisions made by DPIW using 'dry season' reference flows (Report WA 07/07, 2007) "Addendum to Report WRA 99/15 (Ecological Flow Requirements for the Great Forester River)".
3. McKerrows Marsh study outputs and recommendations (DPIWE WAP 05/01, 2005)
4. Water access rules developed for Agrilac's proposed winter water harvesting application for the lower Great Forester River upstream of McKerrows Marsh (DPIPWE internal, 2012).

1. DPIWE Report WRA 99/15 and Addendum Reports WA 07/07 and WRA 99/15

The initial environmental flows study (WRA 99/15, November 1999) that contributed to the formation of the Great Forester WMP utilised the IFIM assessment methodology that DPIWE was using at the time as the best practice approach to deriving environmental flow recommendations for riverine systems in Tasmania. This method used historical monthly median flows (50th percentile flows; 1968 to 1999 gauged flow adjusted to account for irrigation water extraction) as the reference flow (i.e. the flow at which the 'optimum' amount of instream habitat for aquatic organisms is provided). The focus for the analysis was also on months within the irrigation season (December to April inclusive) and no analysis was made

(nor were specific water management rules included in the final WMP) in regards to environmental flow provisions for winter months.

The Great Forster River WMP (adopted in 2003) stipulated a number of additional studies and analyses that DPIPWE was to complete prior to any future review of the Plan. One of these was the development of EWRs for the months outside of the irrigation season. In undertaking this work, DPIPWE recognised the unsuitability of using the median monthly flow statistic as the 'reference flow' and adopted the use of the 20th percentile monthly flow statistic as the new 'reference low flow' for its subsequent environmental flow analyses and the setting of low flow CTT's. This new 'dry season' approach was considered to align more closely with what was being employed nationally in temperate catchments with high levels of irrigated agriculture that experience occasional drought conditions as well as overseas in countries like New Zealand. An additional modification to the approach taken in the Addendum report (WA 07/07, July 2007) was to include analyses excluding brown trout from consideration, since this is an introduced fish species only valued as a recreational fishing resource. The following tables are taken from this report and show the options for new monthly CTTs for all months at both the Prosperity Rd and Old Waterhouse Rd ecological study reaches:

Report WA 07/07 (Table 3). 20th percentile EWRs (ML/day) excluding brown trout for the Great Forester River at Prosperity and Old Waterhouse Roads.

(a) Prosperity Road	Low Risk	Medium Risk	High Risk
January	16.42	16.42 – 12.10	12.10
February	12.96	12.96 – 6.91	6.91
March	12.96	12.96 – 6.91	6.91
April	19.87	19.87 – 14.69	14.69
May	30.24	30.24 – 21.60	21.60
June	45.79	45.79 – 32.83	32.83
July	54.43	54.43 – 47.52	47.52
August	64.80	64.80 – 43.2	43.2
September	55.30	55.30 – 47.52	47.52
October	44.93	44.93 – 33.70	33.70
November	28.51	28.51 – 20.74	20.74
December	20.74	20.74 – 14.69	14.69

River Blackfish and macroinvertebrates are main taxa influencing risk thresholds.

(b) Old Waterhouse Road	Low Risk	Medium Risk	High Risk
January	52.7	52.7 – 30.2	30.2
February	44.1	44.1 – 29.4	29.4
March	44.9	44.9 – 29.4	29.4
April	59.6	59.6 – 31.1	31.1
May	140.8	140.8 – 102.8	102.8
June	198.7	198.7 – 186.6	186.6
July	305.0	305.0 – 203.0	203.0
August	337.8	337.8 – 203.0	203.0
September	309.3	309.3 – 203.0	203.0
October	198.7	198.7 – 185.8	185.8
November	115.8	115.8 – 94.2	94.2
December	62.2	62.2 – 86.4	32.0

Spotted galaxias and macroinvertebrates are main taxa influencing risk thresholds.

Adjusting the figures in the table for Old Waterhouse Rd to align with the streamflow gauging station on the lower Great Forester River (using catchment scaling factors detailed in the Addendum report) the following "Low Risk" monthly flow thresholds were ultimately recommended for consideration during any future Plan review:

Report WA 07/07 (Table 5). Flows at Great Forester 2.5 km Upstream of Forester Rd for management of the Low Risk Environmental Water Requirements (ML/day) assessed using a 20th percentile reference flow and the IFIM method, excluding and including brown trout.

Month	Low Risk (excluding brown trout)	Low Risk (including brown trout)
January	41	52
February	33	42
March	33	42
April	47	62
May	92	97
June	133	145
July	186	202
August	211	225
September	189	205
October	132	144
November	80	87
December	49	64

It is noted that in the Great Forester WMP a 'Managed Minimum Flow' of 30 ML/day is stipulated for the months covering the irrigation season, with total bans on the taking of Surety 5 & 6 water at this flow threshold.

2. McKerrows Marsh studies (Report WAP 05/01)

1. DPIPWE studies in McKerrows Marsh focused on building an understanding of its ecological values and the degree to which surface water flows and groundwater maintained the freshwater dependent values. Surveys of aquatic fauna and flora were undertaken, surface water and local groundwater level data were collected and a computer model constructed to develop a simple water budget for the area around the marsh.
2. Preliminary examination of the hydrology suggested that flows (at the Forester Road gauging station) of between 12-15 cumecs (1035-1295 ML/d) cause flooding of the Marsh area. Flows exceeding 15 cumecs were estimated to occur, on average, about 3 times per year, with 77% occurring in winter and spring (June-November) and only 6% occurring in summer (December-February).
3. The report recommends that the bulk of catchment runoff occurring during early winter is retained in the river for the purpose of groundwater recharge around the marsh and that the first significant inundation event (when inflows exceed 1800 ML/d) be preserved.
4. The study also found that during periods of low inflow, groundwater beneath the marsh is likely to be critical in sustaining the regionally significant blackwood-paperbark swamp forest and water level within the river channel itself. A local groundwater trigger level was recommended to assist with any future rules to manage groundwater extraction in the local area surrounding the Marsh.
5. The report concludes with a recommendation that future monitoring include 3-yearly vegetation mapping, continued monitoring of surface water at the 'Forester Lodge' station and the installation of groundwater monitoring within and/or next to the marsh.

3. WMAB analysis for Agrilac application, internal analysis - December 2012

Following an application in 2012 for a large (20,000 ML) winter water allocation from the Great Forester River catchment by Agrilac Pty Ltd, a hydrological analysis was undertaken by WMAB to assist with the development of options for water extraction from the river upstream of McKerrows Marsh. The analysis used baseflow separated data from gauging station #19201 on the lower Great Forester River (March 1970 – December 2012) to generate monthly baseflow statistics which were then compared with the 'No Risk' 20th percentile cease-to-take levels proposed in the Addendum Report WRA 99/15. This found that monthly mean daily baseflow generally falls below the 20th percentile EWRs during most months, but most particularly during June, July and August. This suggested that during these months, baseflow in the lower river system commonly fails to meet the IFIM-based 20th percentile thresholds and that these monthly values are probably not a reasonable management threshold.

As a result, it was considered more appropriate to use the monthly mean daily baseflow statistics as cease-to-take thresholds for water extraction for the Agrilac application, primarily because this reflects what has actually occurred in the river during recent history. These are set out in the table below (winter take months are bolded):

Month	Mean daily baseflow (ML/d)
Jan	54
Feb	46
Mar	45
Apr	56
May	**69**
Jun	**93**
Jul	**128**
Aug	**170**
Sep	**173**
Oct	**138**
Nov	**96**
Dec	72

From this basis, a number of water access options were investigated with varying rates of potential water extraction (up to a maximum of 200 ML/d) that aimed to minimize the level of hydrologic alteration. These were then considered during the water allocation approval process and the development of license conditions and are not discussed here.

4. Additional analysis for Great Forester River WMP Review

In recent years WMAB has further revised its approach to the development of winter environmental flows under the new Tasmanian Environmental Flows Framework (TEFF; DPIW, 2007). Since there are significant questions about the application of biota specific habitat-flow relationships (which were initially developed specifically to quantify available habitat during dry months) to the winter period, DPIPWE has moved towards a simpler and more defensible approach that takes possible impacts on agricultural users into account. The main objective for winter EWR's under the TEFF is to ensure that WMP's contain water access rules that provide some protection to natural seasonal variations in baseflows and existing patterns of freshes and flood events that are important cues for biological processes such as fish migration, sediment and food transport, and maintenance of channel form and instream habitat condition.

Recently, staff from WMAB have undertaken work in other catchments (i.e. South Esk and Ringarooma catchments) to examine winter cease-to-take thresholds. This work is pointing towards the possible general adoption by DPIPWE of the monthly 10th percentile flow statistic as a balanced solution that provides reasonable periods of access to water for winter-water license holders whilst ensuring that seasonal changes to baseflows are preserved. It should be noted that this is likely to only be applicable where rivers and streams have strongly perennial flow regimes.

Considering the information above, analysis of the historical flow record from the Great Forester River u/s Forester Road (Gauging Station #19201) has been performed to determine flow percentiles during the winter months. Gaps in the record (which encompasses the period 1 March 1970 to 30 September 2017) were filled using transformed flow data from the nearby Ringarooma River at Moorina (Station #30) following correlation analysis. While both flow time series are affected by water use, which is likely to differ between the two catchments, the focus of the analysis is on statistics relating to winter flows, which in both catchments are considered to be relatively close to 'natural'.

The RAP hydrological software package (Marsh et al., 2003) was then used to:

- estimate the flow percentiles equating to the monthly 'Low Risk EWRs (excluding trout)' in Table 5 above,
- derive the monthly 10th percentile flow statistic, and
- calculate monthly median flows for the driest winter on record (2008).

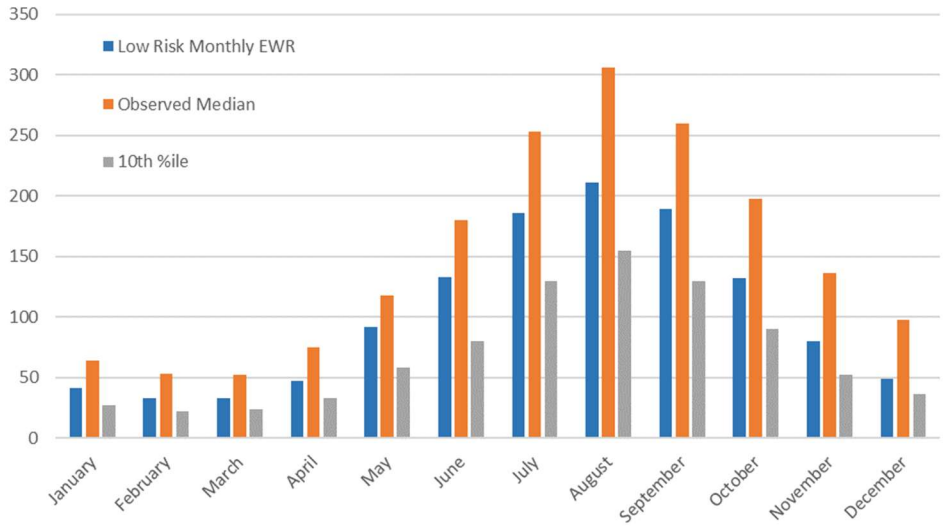
The results of these calculations (table below) shows that the monthly winter 'Low Risk EWR thresholds (excluding brown trout)' equate to between the 19th and the 33rd percentile of historical streamflow. For illustration, the 'Low Risk' EWR for June of 133 ML/d equates to the 30th percentile flow for that month (i.e. observed flow falls below 133 ML/d 30% of the time across the entire 47 years of June flow record).

Month	Low Risk (excl. brown trout) Flow (ML/d)	Percentile	Calculated 10th percentile flow (ML/d)	Driest winter (2008) monthly median flow
May	92	**33**	**58**	**50**
Jun	133	**30**	**80**	**84**
Jul	186	**19**	**130**	**111**
Aug	211	**25**	**155**	**108**
Sep	189	**27**	**130**	**154**
Oct	132	**24**	**90**	**78**
Nov	80	**21**	**52**	**50**

The analysis excludes summer irrigation months (December - April) since it is presumed that the 'Management Minimum Flow' of 30 ML/d stipulated in the existing Plan will remain unchanged.

Recent experience in the South Esk River suggests that cease-to-take thresholds of this magnitude are unnecessarily high and severely restrict access to water by stakeholders with winter water licenses. The monthly 10th percentile flow figures for the lower Great Forester River have therefore been calculated. These are substantially lower than the proposed 'Low Risk (excluding brown trout)' EWR values, greatly improving access for water extractors whilst still preserving the seasonal pattern of change in baseflow in the river (Figure below). For context, the monthly median flow statistic for the driest winter on record (2008) is included in the final column of the table. In several cases, the monthly median for 2008 is very similar to the 10th percentile value, suggesting that under a 10th percentile cease-to-take

access strategy, reasonable access to water might have occurred even in this exceptionally dry winter.



Graph comparing observed monthly median and 10th percentile flow statistics from the Great Forester River upstream of Forester Road SG station along with the monthly 'Low Risk (excluding brown trout) EWR' from the Addendum Report WRA99/15.

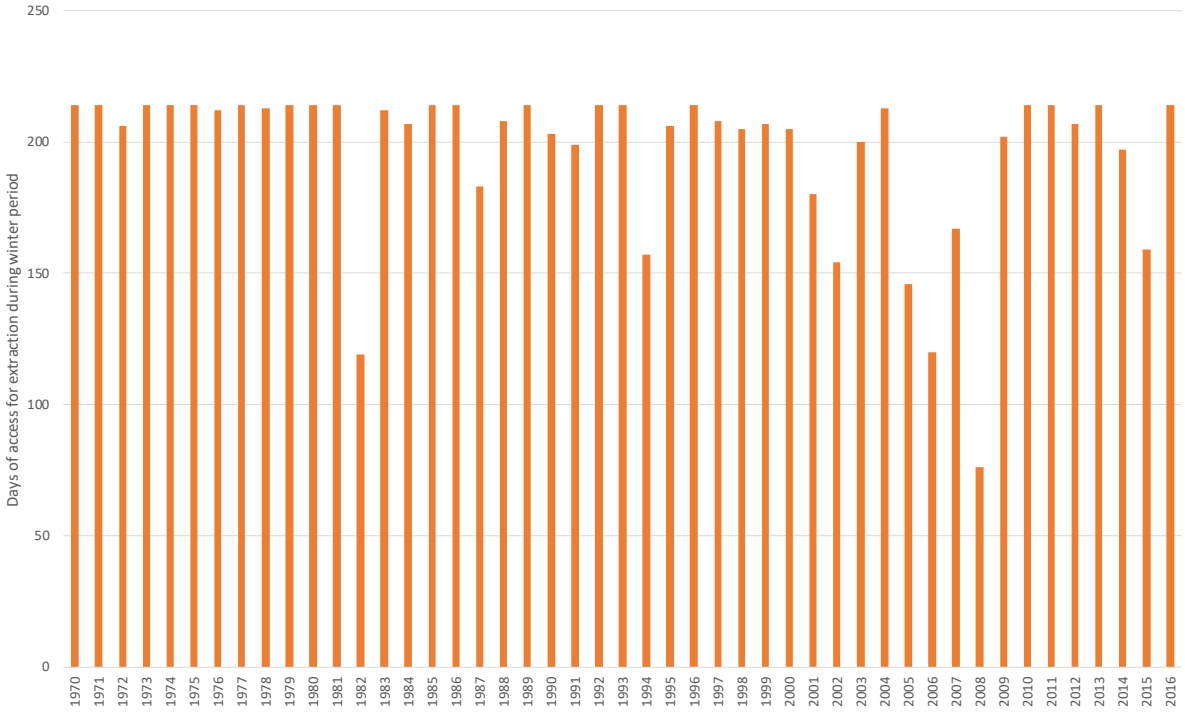
Recommendation:

That for the winter months (May to November) a monthly 10th percentile threshold (tabulated below) be considered for adoption as the winter cease-to-take thresholds in the revised WMP for the Great Forester River. This catchment-wide water access strategy is recommended based on the continued use of gauging station #19201 upstream of Forester Road. If a similar strategy is sought for managing water access in the upper catchment using the Prosperity Road gauging station, further studies will be required since the length of flow record from this station is short and the flow record is also affected by the construction of the Headquarters Road dam.

Month	Recommended monthly winter CTT for revised Plan
May	**58**
Jun	**80**
Jul	**130**
Aug	**155**
Sep	**130**
Oct	**90**
Nov	**52**

A water access analysis has been undertaken using the gauged flow data from the monitoring station upstream of Forester Road and the recommended winter monthly cease-to-take values from the table above. Using a flow record covering the period 1970 to 2016, the following plot shows the annual number of winter days of access for the taking of water. It must be recognised that this analysis utilises actual data (which is affected by historical

winter water extraction) and that during this period the amount of winter water that has been allocated in this catchment has increased.



A number of features are highlighted by this plot:

- during the first half of the period there were very few years when access to winter water extraction would have been subjected to any sort of restrictions.
- between 2000 and 2009 there were substantially more years when access to winter water would have been potentially subject to restrictions. This period is commonly referred to as the Millenium Drought, when much of southeastern Australia experienced reduced water yields and marked reductions in agricultural production.
- across the 46 years of record, there were only 4 years when access to winter water would have been limited to less than 150 days.

References

DPIW (2007) The Tasmanian Environmental Flows Framework - Technical Report. Department of Primary Industries and Water, Hobart, Tasmania, Australia. http://www.stors.tas.gov.au/au-7-0054-00125.

Marsh, N. A., Stewardson, M. J. & Kennard, M. J. (2003) River Analysis Package. Version 3.0.3. Cooperative Research Centre for Catchment Hydrology, Monash University, Melbourne, Victoria, Australia.