ISC Physical Form sub Index

Index of Stream Condition (ISC3)

The ISC Physical Form sub-index has 3 indicators:

1. Artificial Barriers
2. In-stream Large Wood
3. Bank Condition

Artificial Barriers

Artificial Barriers are man-made barriers that can have an impact on the movement and migration of fish in rivers. For the purpose of the ISC, these artificial barriers have been restricted to dams and concrete weirs which have largely been constructed for stream gauges. The scoring or ratings are based on how frequently the barrier has water flowing over the top of it in a 'typical' year and whether the barrier is located on a main-stem section of river or on a tributary (see Table 1). If a barrier has a fish ladder attached, then it is no longer considered an artificial barrier. Reaches are assessed on the barriers that are either in the reach and / or downstream from the reach.

Table 1. Scoring table for Artificial Barriers

Type of barrier	Score
No barriers	5
Upstream of weir not on main-stem	4
Upstream of weir on main-stem	3
Upstream of dam not on main-stem	2
Upstream of dam on main-stem	1

In-stream Large Wood

The amount of In-stream Large Wood (commonly referred to as 'snags') in a reach was determined from aerial photography that was collected from November 2009 to April 2011. All pieces of In-steam Large Wood (with a minimum width of 10 cm and minimum length of 1m) within the channel, were assessed based on the length and complexity of the wood. The complexity is a measure of the number of trunks and branches within the snag.

The reference condition values were determined by selecting a number of reference sections of river for each of the 21 riverine bioregions for Victoria (see Figure 1). Reference sites could not be determined for three bioregions (South West Floodplain, South Central Lowland, and Alps), and estuaries. Therefore, river reaches in these areas could not have an In-stream Large Wood score calculated.

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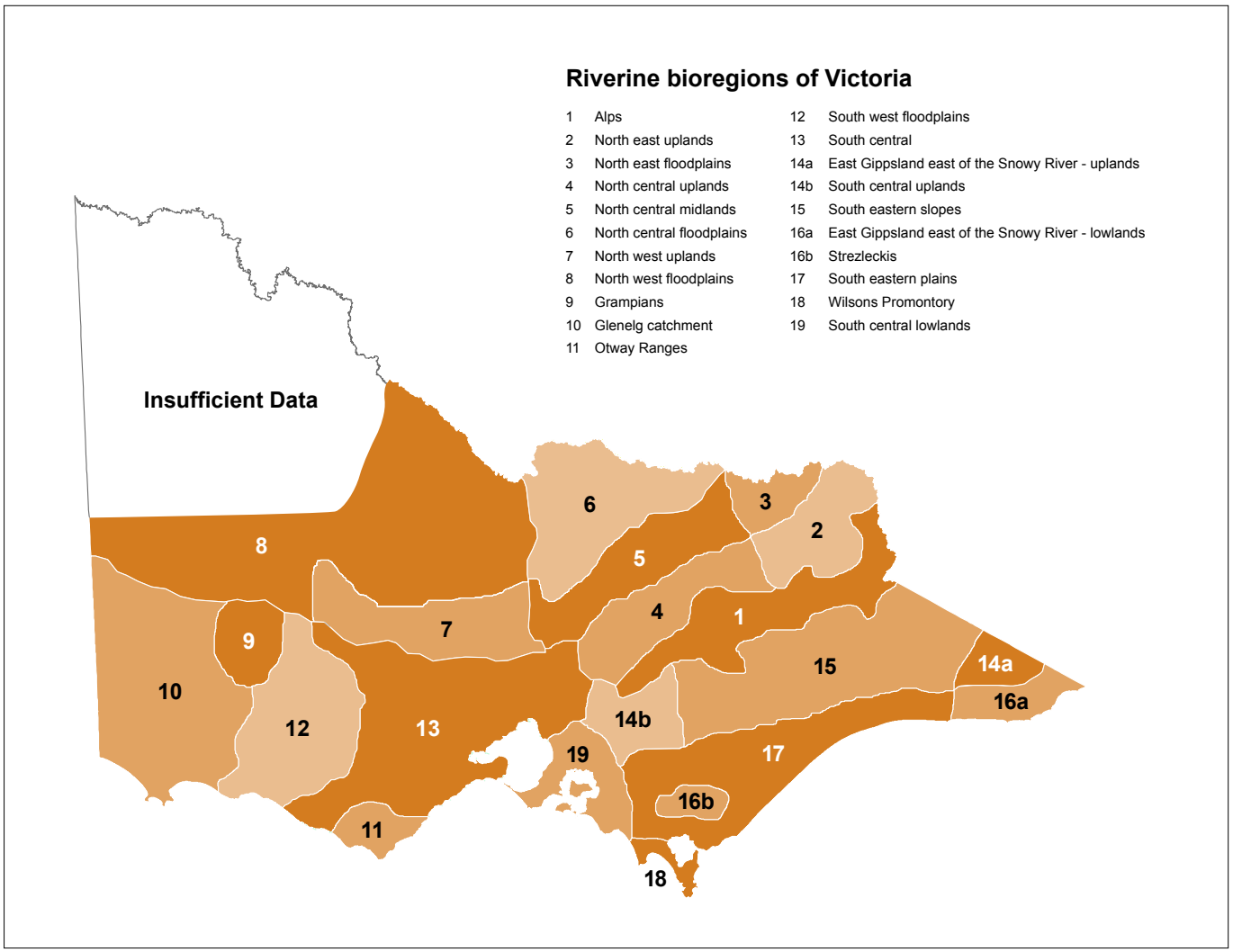
Figure 1. The riverine bioregions for Victoria



As this indicator was assessed from aerial photography, it was not always possible to determine if wood was present in the stream. This was particularly the case in narrow streams (<15m wide) which had extensive amounts of overhanging vegetation (generally greater than 70% of stream length that had overhanging vegetation) and were in largely intact forested catchments. Under these circumstances, near natural levels of In-stream Large Wood would be expected. Therefore, the score derived from the aerial photography has been replaced by a score of 5, indicating a near natural level of In-stream Large Wood (see Table 2).

Table 2. Scoring table for In-stream Large Wood

Percentage difference in proportion of In-stream Large Wood expected	Score
< 11%	5
11 – 40%	4
40 – 60%	3
60 – 80%	2
> 80%	1
No reference available	0

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Bank Condition

The condition of the riverbanks was determined using an observed vs. expected scoring system. As a single survey of the river was produced from the LiDAR data, the rates of riverbank erosion could not be determined. Instead the amount of the riverbank that was likely to be steep was determined. If the riverbank had more steep banks than expected, then this suggests that the river bank was eroding either through widening or incision.

Two main processes were used in the analysis. One of regionalisation of different river types to provide reference conditions and the second to measure the current condition.

The first stage of the regionalisation process was to define the bank face (from the toe of the bank to the bank full) using the LiDAR data.

The second stage was to eliminate streams that were in direct contact with the hillslopes, with no floodplains. These areas, such as gorges, are relatively insensitive to change. As floodplains are relatively flat, a filter of a 7 degree slope was passed over the LiDAR data. Where there were no low slope areas next to the river channel this was determined as having no floodplain. These areas was automatically assigned a score of 5 indicating that these banks were stable.

The third stage was to define different river types, as they are likely to have varying amounts of steep banks. The ISC streams were divided into five different bank sediment size types based on an extrapolation of around 10,000 bed sediment visual estimates. On top of this, the five types were further divided into intermittent and perennial streams, as this was thought likely to influence the degree of steep sections. The silt-clay streams were further divided into those that were above or below 2 m. This is a height that is indicative of mass failures occurring, and these can alter the amount of steep sections in the riverbanks as they may be large and persistent steep areas.

The final stage was to divide streams based on their planform characteristics. Those with a straight planform would likely have different amounts of steepness compared to highly sinuous, or tortuous meanders.

Table 3. Stream bed types and their threshold values

	Stream Bed Type		Plan Form Type *(based on River Angle)*		
			Straight 0-30 degrees	**Curved 31-70 degrees**	**Tortuous >70 degrees**
1	Boulder	% steep bank face	Boulders are not included in the assessment.		
		No. Incised transects			
2	Cobble & Pebble	% steep bank face	15%	20%	20%
		No. Incised transects	-	-	-
3	Gravel	% steep bank face	15%	10%	10%
		No. Incised transects	-	-	-
4	Sand Perennial	% steep bank face	15%	10%	10%
		No. Incised transects	3	2	2
5	Sand Intermittent	% steep bank face	15%	10%	10%
		No. Incised transects	3	2	2
6	Silt-Clay Perennial <2 m height	% steep bank face	20%	20%	20%
		No. Incised transects	2	3	3
7	Silt-Clay Intermittent <2m height	% steep bank face	10%	10%	25%
		No. Incised transects	2	2	3
8	Silt-Clay Perennial >2m height	% steep bank face	40%	40%	40%
		No. Incised transects	4	4	4
9	Silt-Clay Intermittent >2m height	% steep bank face	40%	40%	40%
		No. Incised transects	4	4	4

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Five steps were used to assess current bank condition:

- the slope of the bank face was assessed. Bank faces that had slopes greater than 35 degrees were considered steep, and in some stream types these are highly indicative of erosion.
- For each 100m section of river, the percentage of the bank face which was classified as steep was determined for each bank.
- In each of the 100m sections there were five transects across the stream, spaced at 25m intervals. If the transect crossed an area of steep bank (ie. above 35 degrees) that is >5% of the bank face for the side, on both banks, then it was tagged as 'incised'.
- Each 100m section was then classified as being above or below the erosion threshold for its stream type and sinuosity (see Table 3).
- The final reach score (Table 4) is based on the percentage of steep/ incised 100m sections within the reach.

Table 4. Scoring table for bank condition

% Steep Sections in Reach	Score
< 2%	5
2 – 10%	4
10 – 19%	3
19 – 33%	2
> 33%	1

Calculation of the Physical Form sub-index

The Physical Form sub-index score is a score out of 10 and is calculated by adding the three physical form indicator scores according to the following formula:

Physical Form sub-index = 10/15 (Artificial Barriers score + In-stream Large Wood score + Bank Condition score)

For reaches where an In-stream Large Wood score could not be calculated, the following formula is used:

Physical Form sub-index = Artificial barrier score + Bank Condition score

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