Final Report
Project R2004
Development of a Framework for the Sustainable Rivers Audit

Appendix 2
Functional Process Zone Conceptual Models of River Function

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Conceptual models of river function have been developed for each of the eight Functional Process Zones (FPZs) in the Murray-Darling Basin identified by Thoms (1998), Thoms *et al.* (2000), Thoms *et al*. (in press) and this study. These models should be interpreted in conjunction with the description of the FPZs, summarising the key geomorphic features of each model, and how they relate spatially to one another.

Cooperative Research Centre
for Freshwater Ecology

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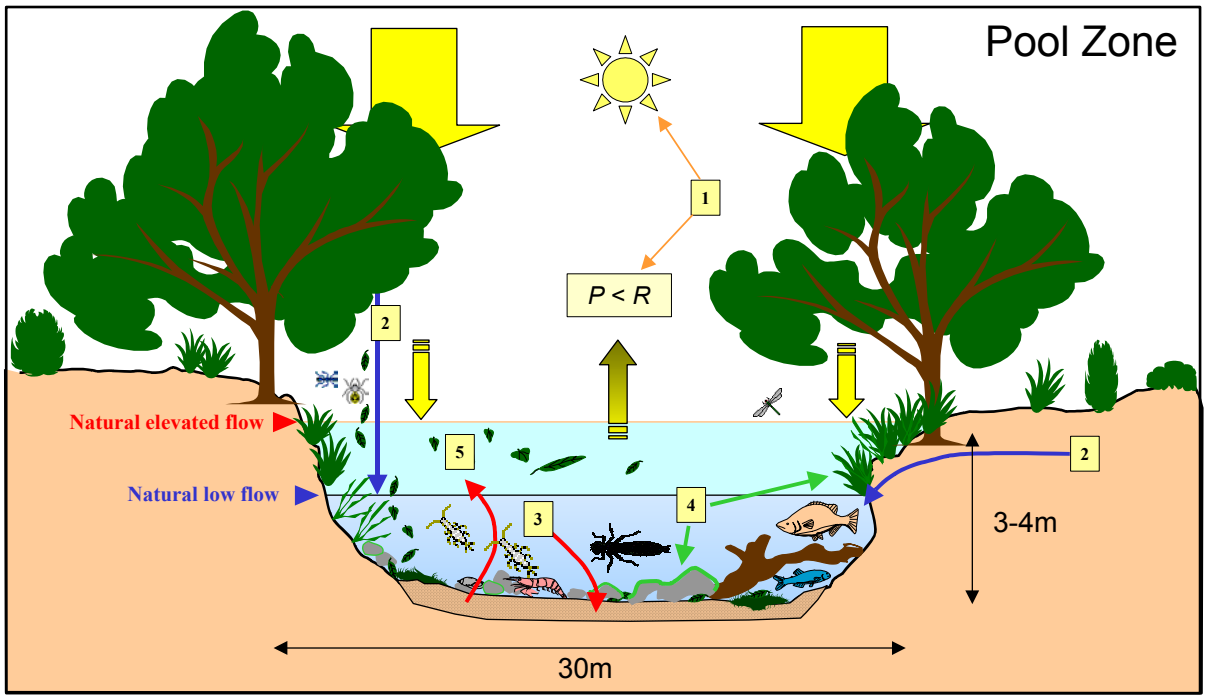
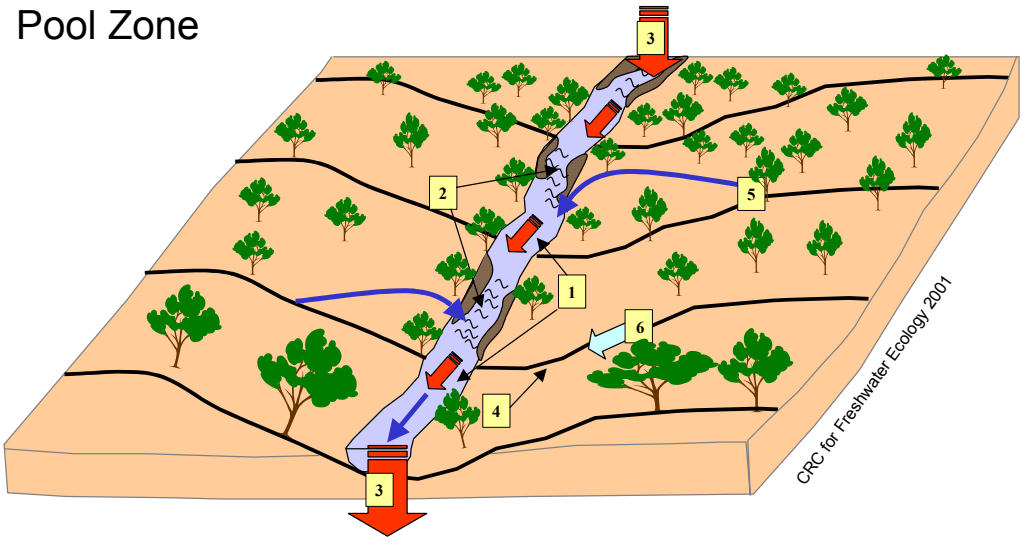
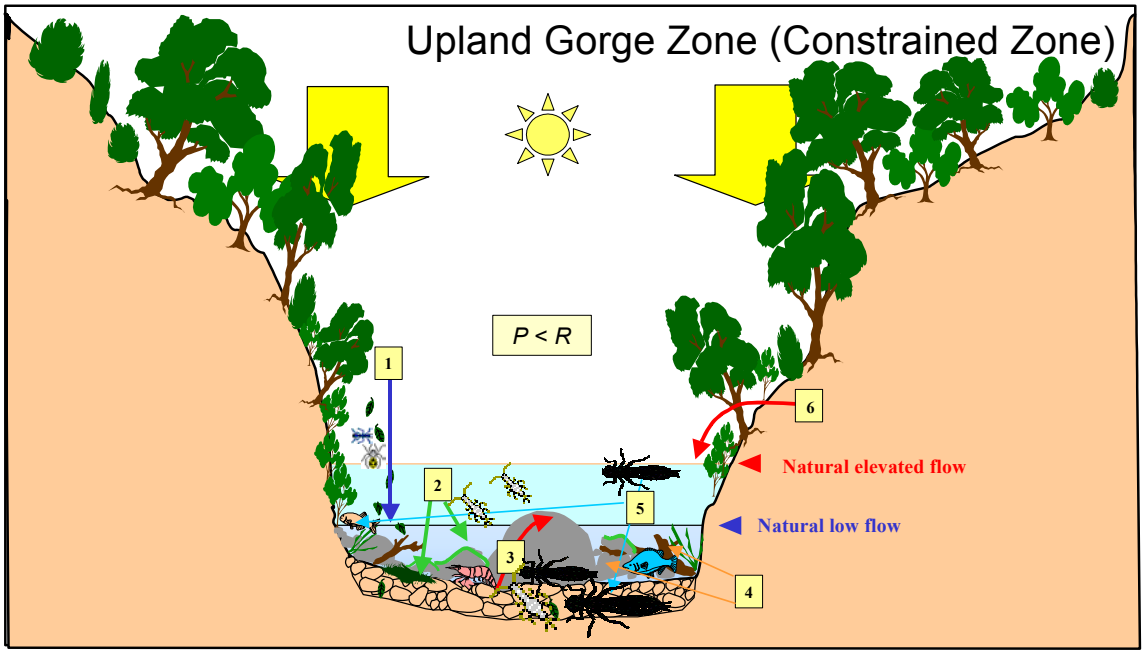


1 Riparian vegetation shades the edges of the stream, keeping the water temperature and P:R ratios down. 2 Riparian and catchment inputs of large debris and CPOM provide important habitat and food resources for invertebrates, fish, frogs. 3 Fine sediment (silt/clay) is deposited from upstream into pool areas in low flow. 4 Primary production (another important food source) is dominated by microalgae (diatoms) with some submerged and emergent macrophytes, which provide habitat. 5 Elevated flow increases pool depth and may result in flushing of detritus, nutrients and fine sediment from pools, but lateral connection is restricted by the valley shape.

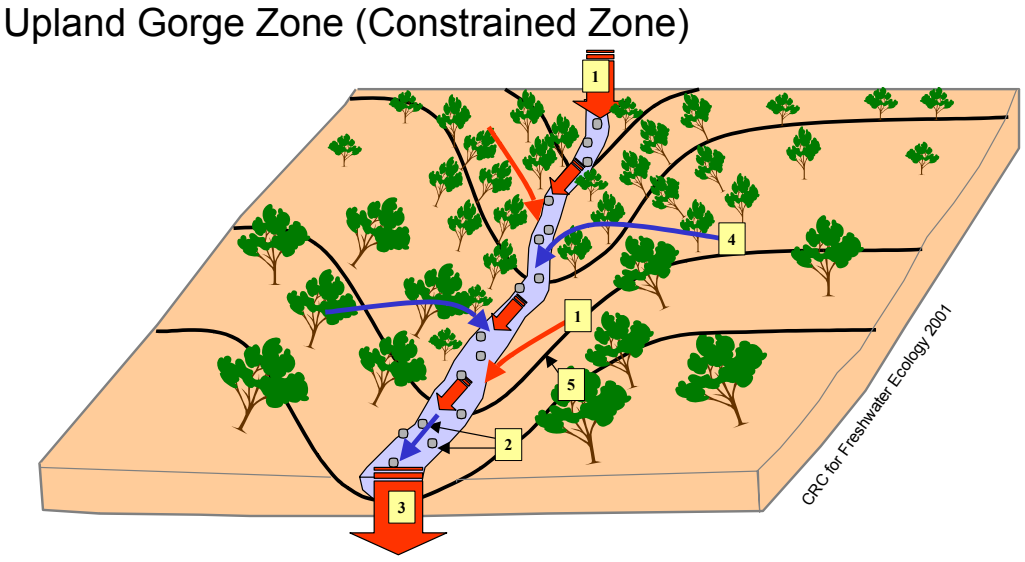


1 Long pools form upstream of short channel constrictions formed by bedrock bars or local gravel deposits that act as riffle areas. 2 Riffle areas are areas of relatively high energy which transport fine sediment and other material from upstream or from pool areas. Fine sediment overlying a bedrock/cobble base in pools may be scoured at bankfull flows, however discharges greater than 50 m/s are required to move coarser material in this zone. 3 The pool zone is a sediment supply area to downstream zones, with most sediment entering the channel from upstream. 4 Lateral connection to the floodplain (usually less than 30m wide) is restricted by the valley morphology. 5 Detritus and nutrients are added to the stream by the surrounding catchment, most of which are transported downstream. 6 The contribution that runnoff makes to the stream is small because of good vegetation cover.

Figures 3.3, 3.4

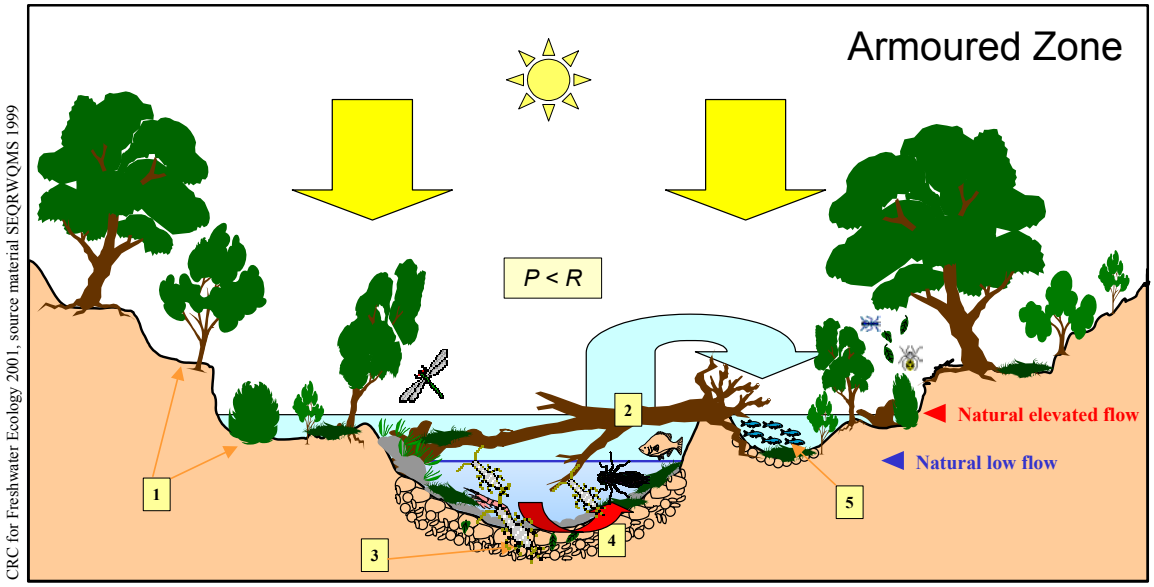


1 Riparian vegetation on the banks is supported by boulder and cobble accumulations, supplying shade, organic debris and terrestrial organisms to the food web. 2 CPOM and algae provide important habitat and food resources for invertebrates, fish, frogs. 3 Elevated flow increases water depth and results in mobilization of cobbles at high flows, flushing of detritus, nutrients, fine sediment and scouring of algae from the substratum. 4 Habitat space for macroinvertebrates, frogs and fish in the substratum is provided by cobble/boulder accumulations and fallen timber. 5 At high flows riparian vegetation is inundated and organisms may seek refuge within the substratum or under vegetation. 6 Sediment and organic matter may enter the channel directly from adjacent valley slopes.

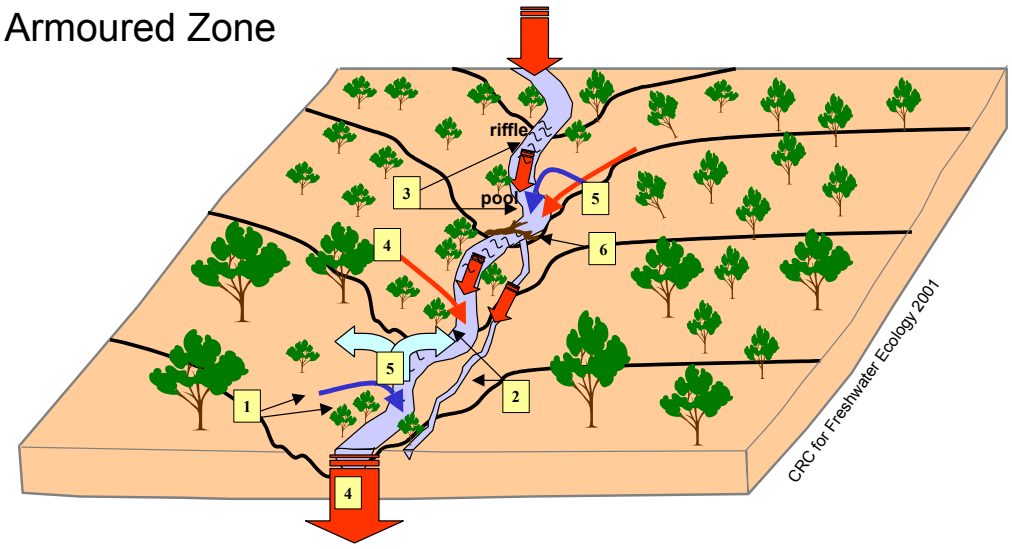


1 Sediments are added directly to the channel from adjacent valley slopes and from upstream. 2 The in-channel environment consists of bedrock, large boulder/cobble accumulations and scour pools. This substrate is important habitat for riparian vegetation, invertebrates, fish and frogs. While boulder accumulations are very stable, cobble accumulations are highly mobile during flood flows. 3 A lack of sediment deposition areas in this zone makes it a sediment source area for downstream zones. 4 Vegetation commonly extends all the way down the valley to the river banks, so inputs of detritus and wood from the riparian zone can also form an important component of the habitat. However, this habitat is regularly scoured away in elevated flows, so retention time of nutrients and organic matter is short. 5 Lateral floodplain connections are again restricted by valley shape.

Figures 3.5, 3.6

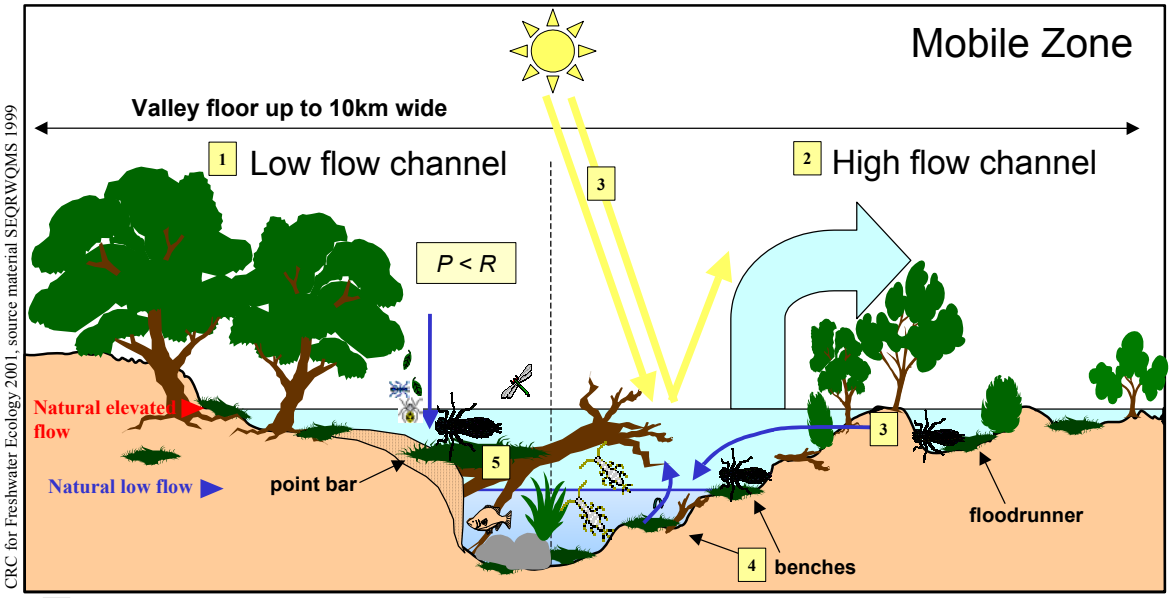


1 Incised floodplains of different ages formed by channel scouring become inundated at high flow, with submerged terrestrial vegetation and organic litter then available as food and habitat. 2 Fallen timber may create debris dams, trapping organic matter of various sizes, also providing food and habitat for invertebrates, fish and frogs. 3 Armoured cobbles and gravels provide a restricted invertebrate habitat within the substratum and trap detritus, however fish spawning is prevented by the armour layer to low flow areas under logs. 4 Sediment, detritus and nutrients are exported downstream when flow is high enough to move the bed surface and/or scour terraces. 5 Small floodrunners are inundated at high flows, increasing available habitat area.

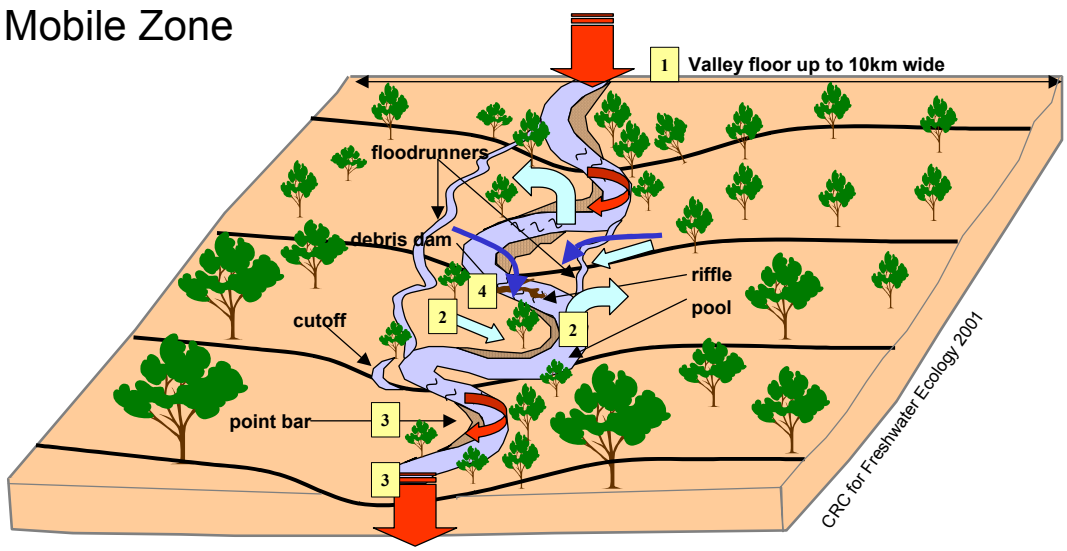


1 The armoured zone is characterised by a series of floodplains of different ages, inset into high level terraces. 2 The channel meanders though the valley, constrained to some extent, but exhibiting some development, such as low level flood runners. 3 The channel has riffle and pool sections, with a gravel substrate heavily armoured by a layer of cobbles. Pools may act as refuges for biota in times of high flow. 4 The armoured zone is a sediment source area, with sediment derived from old floodplains, cutting the channel deeper, and from upstream sources. 5 Nutrients and detritus are stored on floodplain surfaces, and may be washed into the channel in times of high flow. 6 Debris dams may form in riffle areas from fallen timber, trapping organic matter and providing important habitat for fish, invertebrates and frogs. Habitat in the substrate is restricted for some organisms by the armour layer.

Figures 3.7, 3.8

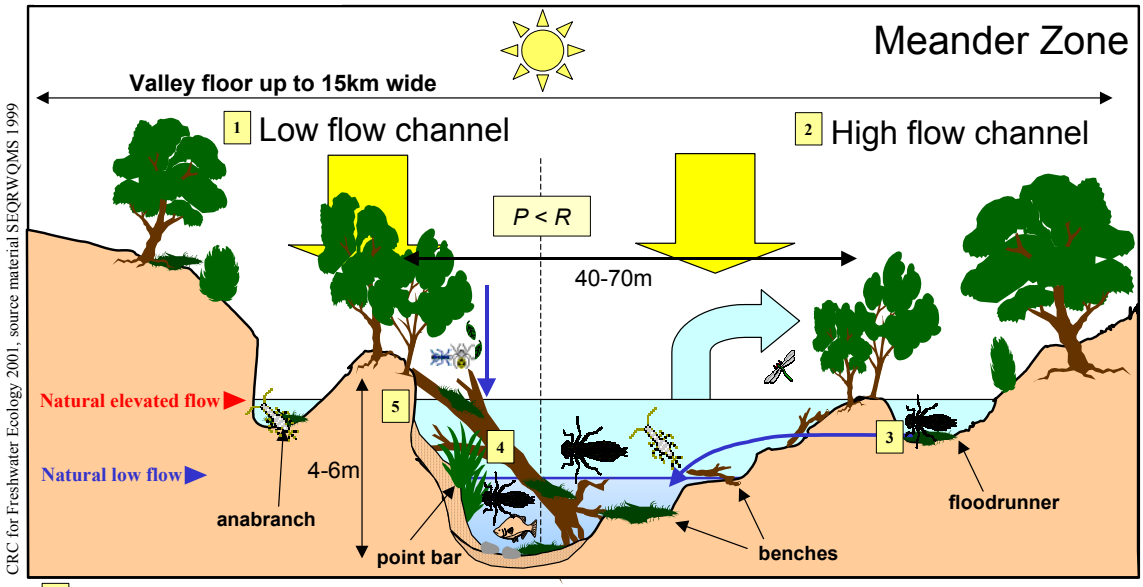


1 In the mobile zone high and low flow channel features are very distinctive. The low flow channel is characterised by large sandy point bars, riffles and large, deep pool sections. In low flow, habitat is provided by cobble/gravel accumulations and riparian vegetation in riffle sections, fallen trees, detritus and emergent vegetation in pool areas. 2 The high flow channel is characterised by in-channel benches, flood runners and complex floodplain features. In high flow, flooding of the terrestrial environment, in channel benches and floodrunners provide habitat in the form of fallen and inundated vegetation and detritus. 3 At high flow detritus, sediments and nutrients are flushed from the channel and the floodplain, which may temporarily increase turbidity and reduce light penetration. 4 Benches are important areas for storage of organic matter, nutrients and sediments and play an important role in in-stream processes. 5 Fallen timber may create debris dams, trapping organic matter of various sizes, also providing food and habitat for invertebrates, fish and frogs.

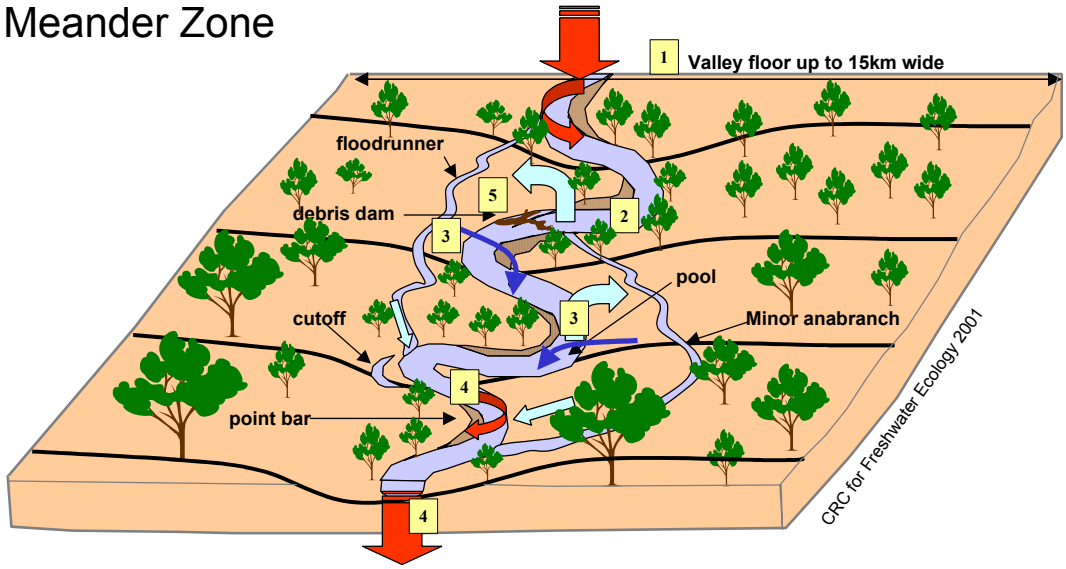


1 The mobile zone has a large valley floor, enabling development of floodplain features such as floodrunners, cutoffs and levees. 2 In high flows, lateral connections to the floodplain are established and nutrients, detritus, etc may be flushed into the main channel from the floodplain and in-channel benches, creating habitat and food resources for invertebrates, fish and frogs. High flows also provide cues for fish migration, spawning and dispersal. 3 The primary function of the mobile zone is transport of sediment and other material, with large storage areas such as point bars in the channel. 4 Detritus may also be stored in debris dams that can form in riffle areas from fallen timber.

Figures 3.9, 3.10

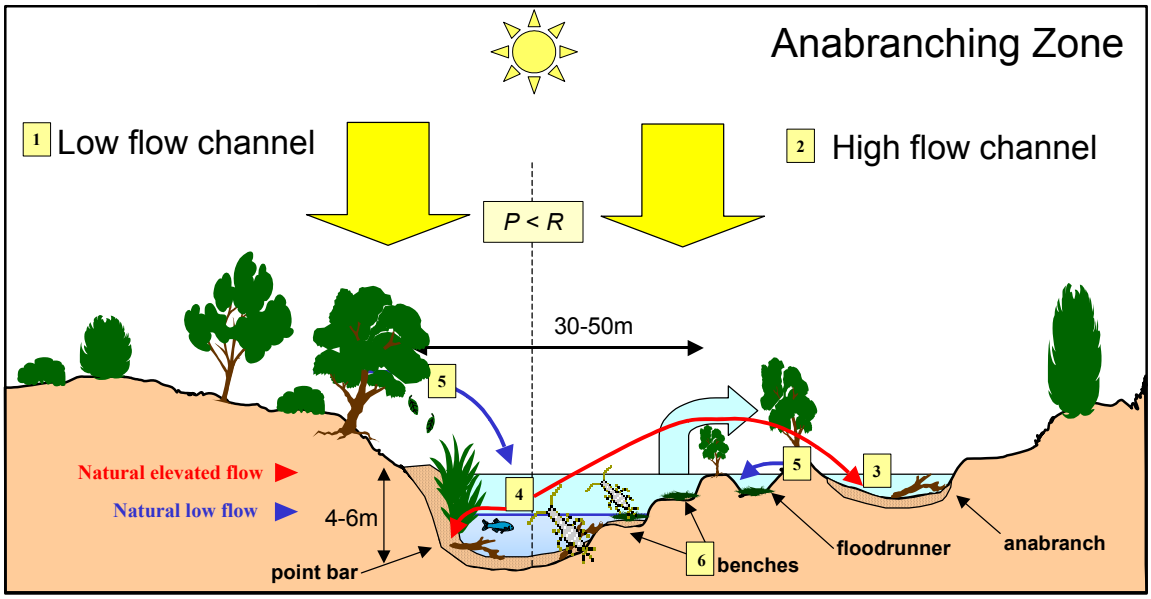


1 Like the mobile zone, the high and low flow channel features of the meander zone are very distinctive. The low flow channel is characterised by sandy point bars, large riffles and large, deep pool sections. In low flow, habitat is provided in riffle areas by gravel/sand accumulations and riparian vegetation in riffle sections, fallen trees and detritus. Pool areas are characteristically sandy/silty with emergent vegetation and wood/detritus providing habitat. 2 The high flow channel is characterised by in-channel benches, diverse flood runners and an extensive floodplain. Flooding of the terrestrial environment, in-channel benches and floodrunners provides habitat in the form of fallen and inundated vegetation and detritus. 3 Inundation of anabranches, floodrunners, in-channel benches and the floodplain also flushes detritus, sediments and nutrients into the main channel. 4 Fallen timber may create debris dams, trapping organic matter of various sizes, also providing food and habitat for invertebrates, fish and frogs. 5 Banks are steeper and more cohesive than in the mobile zone.

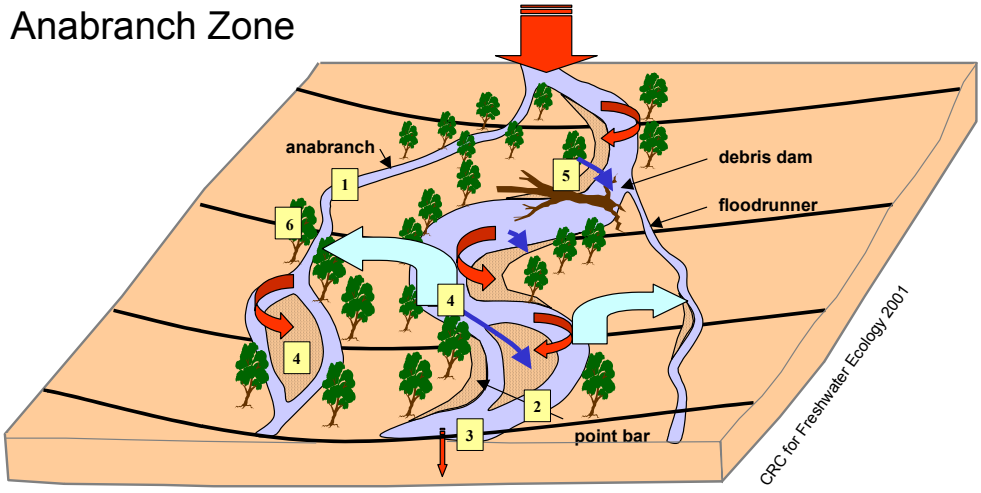


1 The meander zone has a large valley floor, enabling development of floodplain features such as floodrunners, former channels, cutoffs and minor anabranching. 2 The in-channel environment is characterised by bars, benches and pools. 3 In high flows, lateral connections to the floodplain are established and nutrients, detritus, etc may be flushed into the main channel from the floodplain and in-channel benches, creating habitat and food resources for invertebrates, fish and frogs. High flows also provide cues for fish migration, spawning and dispersal. 4 The meander zone is also a sediment transport zone, with large storage areas such as point bars in the channel. Sediment is finer in the meander zone than the mobile zone, with banks steeper and more cohesive (mostly fine sands, silts and clays. 5 As well as benches, detritus may again be stored in debris dams that can form in riffle areas from fallen timber.

Figures 3.11, 3.12

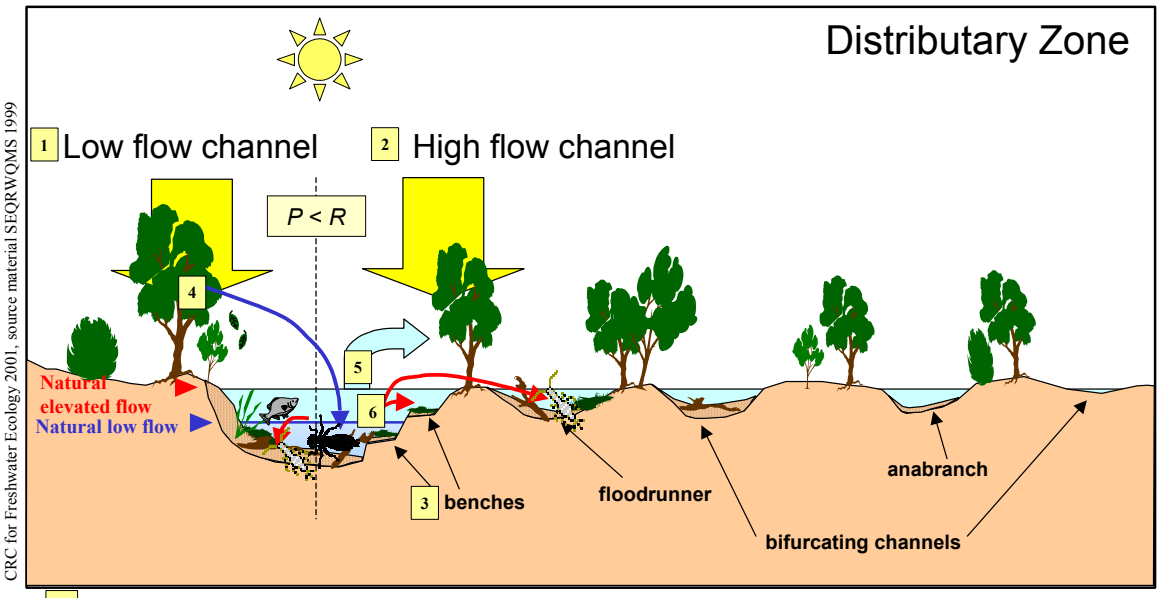


1 At low flow the channel is simple, with most habitat diversity occurring at high flows. The low flow channel has no riffle sections, characterised by large pools and sandy point bars. Substrate is limited to sandy bars, silt/clay areas, with fallen vegetation and emergent macrophytes the only main habitats. 2 The high flow channel is characterised by in-channel benches, diverse flood runners, large anabranches and an extensive floodplain. Woody debris is again the main habitat, with the inundated terrestrial environment also providing habitat at extremely high flow. 3 Anabranch channels are isolated at low flow but may begin to flow at one third to half bankfull discharges. 4 Sediment, nutrients and organics are deposited and stored in the anabranch zone. 5 Invertebrates, fish and frogs rely on riparian vegetation inputs to provide the main habitat. 6 Benches can also be important areas for storage of organic matter, nutrients and sediments.

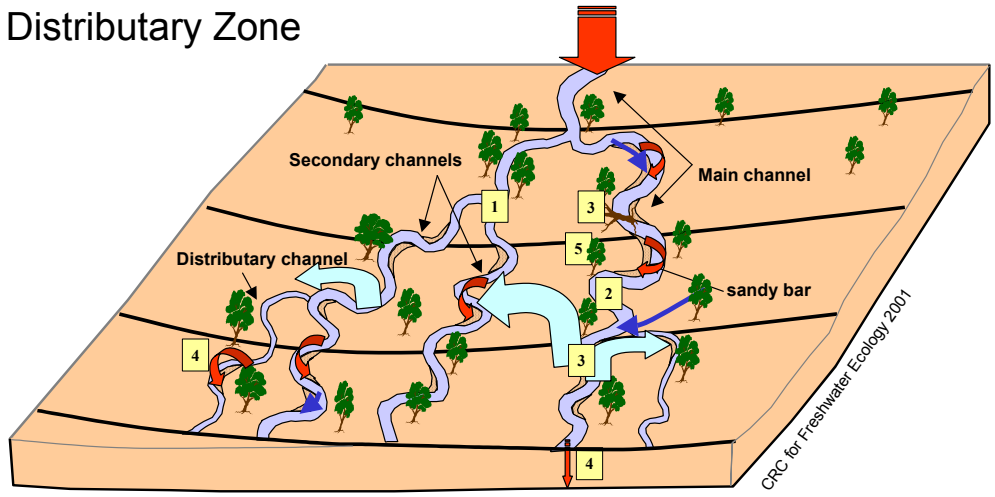


1 The anabranch zone is characterised by a series of channels (anabranches) which flow across a very broad flat fan shaped surface. The river channel in this part of the catchment may be underfit within an old paleochannel system. 2 The low flow channel is simple, with large pools and sandy point bars, but no riffles. Most habitat diversity occurs at high flows, with in-channel benches occurring at different levels, large anabranches, floodrunners and an extensive floodplain. Anabranches are isolated at low flow but begin to flow at one third to half bankfull discharges, therefore bankfull capacities are lower in this zone than in other zones. 3 As the anabranch zone is a sediment storage area there is a net loss of sediment going downstream from this zone. 4 Lateral connection to the floodplain results in storage and high retention of sediments, nutrients and detritus in bars and the floodplain. Banks are highly cohesive (silt/clay). 5 As substrate diversity is restricted to sandy bars and silt/clay areas, organisms rely on fallen riparian vegetation and formation of debris dams to provide habitat. At extremely high flows the terrestrial environment may also provide habitat. 6 Vegetation in this zone is sparse and mainly restricted to the river banks.

Figures 3.13, 3.14

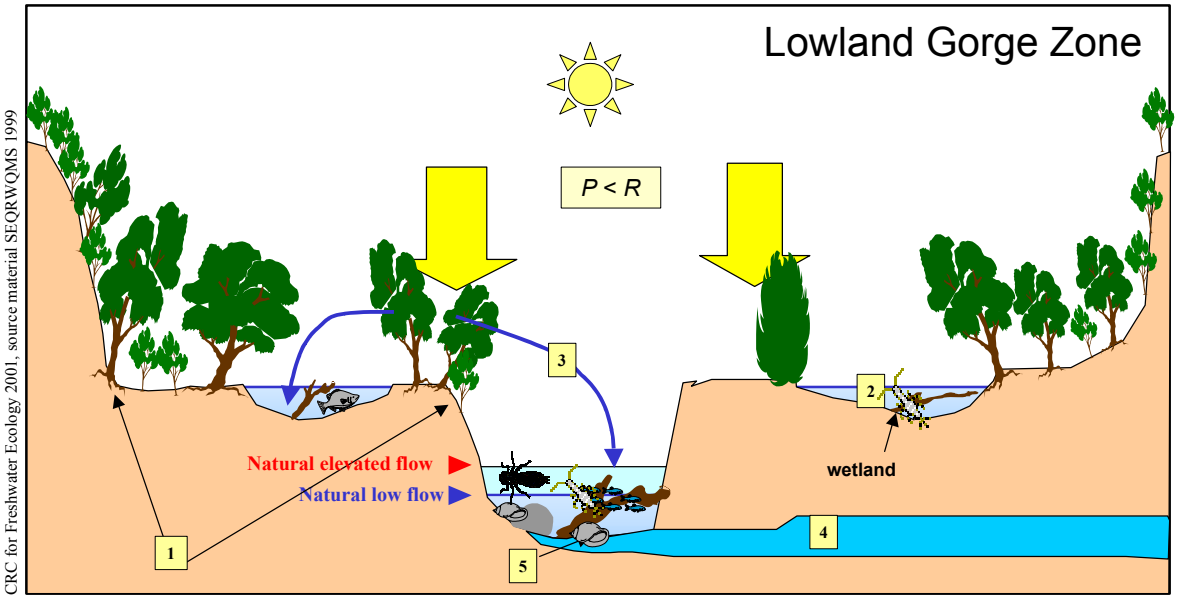


1 The low flow channel is again simple, with more diversity in the high flow channel. At low flow, the channel has deep pools and riffles, with the occasional point bar. The substrate consists of sandy bars and silt/clay areas, with woody debris the main microhabitat. 2 The high flow channel is characterised by in-channel benches at different levels, floodrunners, anabranches and bifurcating channels. The main habitat is again woody debris, with secondary channels and the inundated terrestrial environment providing habitat in very high flow. 3 Benches are important areas for storage of organic matter, nutrients and sediments and play an important role in in-stream processes. 4 Invertebrates, fish and frogs rely on riparian vegetation inputs to provide the main habitat. 5 Flow in the smaller distributary channels is dependent on flow in the main channel. 6 Sediment, nutrients and organic matter are deposited from the main channel and stored in the distributary zone.



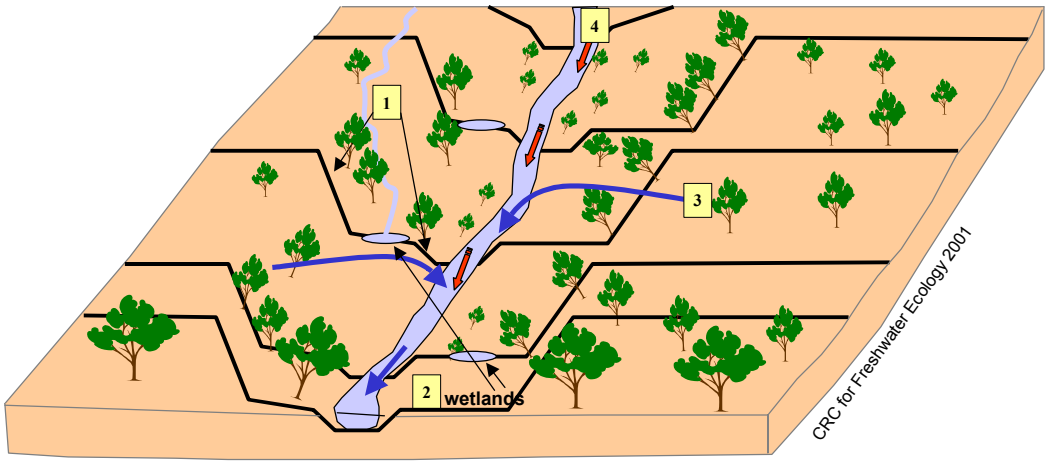
1 The distributary zone is defined by its bifurcating channels (channels that take off from each other). Although secondary channels exist relatively independently of the main channel, flow in the smaller distributary channels is directly related to flow in the main channel. Therefore many distributary channels may have zero flow for long periods. In all channels there is a rapid decrease downstream in bankfull cross sectional area because of evaporation and flood attenuation. 2 Most channels are narrow and featureless, with sandy bars and the occasional deep hole the main features. In the high flow section of the main channel, in-channel benches occur, important for organic matter, nutrient and sediment storage and in-stream processes. 3 At high flows inundation of terrestrial vegetation may form habitat, but the main habitat again is fallen woody debris such as snags and associated finer organic material, as the channel substrate is comprised of sand, silt and clay. 4 The distributary zone is also a sediment storage area, with sediment, nutrients and organics retained in bars, on the floodplain and in smaller channels. 5 Vegetation in this zone is again sparse and mainly restricted to the river banks.

Figures 3.15, 3.16



1 The valley of this zone is constrained, with the channel also constrained within the gorge zone. 2 Wetlands may form on tributary streams adjacent to the channel but are independent of channel flows. 3 Riparian vegetation supplies debris and nutrients to the channel and adjacent wetlands, important habitat and food for invertebrates, fish and frogs. 4 The incised river channel intercepts groundwater flow, therefore in low flow conditions salinity of water increases. 5 Organisms have evolved in varying salinity conditions, with a higher presence of molluscs compared to insects. Higher turbidity may also inhibit phytoplankton, which would normally consume nitrogen, phosphorus and silica nutrients (used by molluscs).

Lowland Gorge Zone



1 The valley of this zone is constrained, with the channel also constrained within the gorge zone. 2 Wetlands may form on tributary streams adjacent to the channel but are independent of channel flows. 3 Riparian vegetation supplies debris and nutrients to the channel and adjacent wetlands, important habitat and food for invertebrates, fish and frogs. 4 Small amounts of sediment may be supplied to the channel from upstream.

Functional Process Zone Characteristics of the Murray-Darling Basin

Headwater Pool Zone

Headwater Pool Zones (Figures 3.1, 3.2) are generally characterised by long pools separated by short channel constrictions. The pools are the dominant morphological feature and form upstream of these channel constrictions. Channel constrictions are often associated with major bedrock bars or substantial localised gravel deposits that extend across the channel and act as riffles. Local river bed slopes increase significantly at these constrictions, representing small areas of relatively high energy, in contrast to the relatively low bed slopes and energies of the pool environment. Overall, bed slopes in the pool zones can be in the order of 0.0001 with corresponding stream powers of 1.5 ωm^{-2}. Stream power is the rate of work (ie. sediment movement) or the energy that is expended in a stream or river.

The river channel planform or configuration of this zone is controlled by valley morphology. The river channel may have a small flanking floodplain (up to 30 m) but this is dependent on the size and configuration of the valley floor trough; as such the size of the valley floor limits floodplain development. Bankfull channel dimensions can be up to 30 m in width, 3 to 4 m deep, with width/depth ratios of 10. Bankfull channel capacities do not generally exceed 30 m^3s^{-1}.

The channel-bed sediment or substratum in these reaches consists of fine silt/clay material overlying a bedrock/cobble base in the pools. However, gravel/cobble or bedrock dominate the short constricted riffle areas. Bankfull flows generally have the competence to entrain the finer bed substratum, but discharges in excess of bankfull capacities are required to initiate motion of coarser material. The river bed in these pool zones may be characterised as being stable with a Relative Bed Stability (RBS) index of between 1 and 2.3 (Jowett 1997).

Habitats of this zone

The major habitats of this zone are:

Functional set: the Headwater Pool Zone of each river system

Functional unit: the main Functional units in the Headwater Pool Zone of each river system are the riffle/chute areas and the large pool areas. Riffle/chutes provide areas of relatively fast flowing, shallow, turbulent water compared with deeper, slower flowing pool regions.

Mesohabitats: The major mesohabitats in the riffle and chute areas relate to the different substratum composition with areas of cobble/gravel and regions of sand. In the pool, mesohabitats appear to be somewhat more diverse with comparable regions

of substratum, combined with emergent and possible submerged aquatic vegetation.

Confined Zone (Constrained)

This is a relatively high energy zone dominated by steep bed slopes S > 0.010 with bankfull channel stream powers in excess of 400 ωm^{-2} (Figures 3.3, 3.4). Generally bedrock chutes, large boulder/cobble accumulations and scour pools dominate the in-channel environment. Boulder materials are relatively immobile, but cobble accumulations are highly mobile during flood flows producing well sorted deposits. Variations on this theme can occur in confined zones where the supply of sediment is finer. For example, the dominant geology in a catchment may consist mainly of sandstones, hence these confined valley sections will be dominated by sand as opposed to boulder/cobble. Because of the 'confined' nature of the valley floor, floodplain development is restricted and may not occur at all. Hence, in these zones sediments are added directly to the channel from adjacent valley slopes. There is a lack of any major sedimentary deposits, and this, together with the high-energy environment, suggests these areas are important sediment source zones for the downstream river system. The river bed is relatively unstable with Relative Bed Stability index of 0.46. Channel planforms are controlled by the structure of the valley.

Habitats of this zone

The major habitats of this zone are:

Functional set: the Confined Zone of a river system

Functional unit: there are few functional units in the Confined Zone of the river system. The main channel itself is the dominant unit with perhaps some differentiation of riffle areas and pool areas within the channel, although not as distinct as in the Pool Zone. Dominant within the channel are large boulder/cobble accumulations some of which provide habitat for riparian vegetation.

Mesohabitats: within the channel unit the major mesohabitats relate to substratum composition with variable accumulations of cobble/gravel providing a complex array of habitat types. The stands of riparian vegetation also provide habitat, both themselves and their associated fallen timber.

Armoured Zone

This is also a high energy zone with high bed slopes of (0.01 to 0.002) and corresponding bankfull stream powers up to 400 ωm^{-2}. A feature of this zone is that the bed sediments are highly armoured. Armouring of bed sediments refers to the development of a surface layer which is coarser than the sediment beneath it. This coarse layer protects the finer materials underneath which are not mobilised until the armour layer is removed. The Armoured Zone is also characterised by a series of floodplains of different ages, inset into high level terraces.

This zone is a sediment source area as evidenced by terrace formations and active lowering of the bed of the modern channel (Figures 3.5, 3.6). The river channel is partially constrained and is mainly controlled by the valley, but there are usually some floodplain formations present. The river channel exhibits a meandering pattern that is superimposed on a larger valley pattern. It is characteristic of a bed load/mixed load channel (Schumm 1988) with high bed slopes, low sinuosities, and large meander arcs and wavelengths. The in-channel environment is dominated by cobble and gravel-size sediments that are extensively armoured and relatively stable (RBS =0.38 to 1.05).

Habitats of this zone

The major habitats of this zone are:

Functional set: the Armoured Zone of a river system

Functional unit: the Armoured Zone marks the beginning of where Functional units begin to be divided into those occurring in the low-flow channel and those within a high-flow channel. Within the low-flow section of the Armoured Zone Functional units are riffle and pool areas within the main channel. Some of the riffle sections are large and support well established stands of riparian vegetation. Pool regions are also large and deep and would provide a substantial refuge area during floods. In the Armoured Zone the high-flow channel is present but not well developed. Functional units in this region of the channel include flat surfaces within the incised channel and the small flood runners.

Mesohabitats: within the low-flow channel the major mesohabitats relate to substratum composition with accumulations of cobble/gravel within the riffles providing a complex array of habitats. The stands of riparian vegetation also provide complex habitat, both themselves and their associated fallen timber, some of which can create large debris dams rich in organic matter of a range of sizes. Within the pool unit of the low-flow channel, mesohabitats include emergent and submerged vegetation. Woody debris can also be present within pools. The high-flow channel generally contains sparse mesohabitats, the most dominant being submerged terrestrial vegetation in times of flood.

Mobile Zone

The Mobile Zone (Figures 3.7, 3.8) is an area characterised by relatively mobile river-bed sediment, large sediment storage areas within the channel and a relatively active channel. The presence of well developed inset floodplain features such as benches, point bar systems, cut offs and levees testify to the relatively active and unrestricted nature of this river-floodplain environment. Valley floor widths of up to 10 km enable floodplain development.

The river channel is freely meandering with an irregular planform; sinuosities up to 1.95. Characteristics of the Mobile Zone are increases in meander wavelengths and meander arcs in comparison to the armoured reach. Stream powers can be up to 20 ωm^{-2}.

The morphology of the in-channel environment is extremely variable with the presence of bars (point and lateral), benches (at various levels) and riffle/pool sequences. These in-channel storage features reflect high rates of sediment transport. River bed sediments typically have a bimodal distribution (median grain size of 64 to 100 mm) and are highly mobile (RBS < 1) with a range of sediment sorting.

In this Functional Process Zone, short lengths of river (<50m), such as large riffles may have armoured bed sediments. This can occur where the valley floor may 'pinch' in or where flow is obstructed by an artificial structure, such as a bridge or road crossing.

Habitats of this zone

The major habitats of this zone are:

Functional set: the Mobile Zone of a river system

Functional unit: the Mobile Zone is probably the most complex reach in terms of functional unit development, with distinct and diverse low- and high-flow channels. Within the low-flow section of the Mobile Zone functional units are again the riffle and pool areas within the main channel. In this reach the riffle sections are large and support well established stands of riparian vegetation. Pool regions are also large and deep. The low-flow channel is also characterised by large sandy point bars. In the Mobile Zone the high-flow channel can be well developed with in-channel benches, diverse flood runners and an extensive floodplain. Functional units in the high-flow channel also include the flat bench surfaces, the small flood runners and complex features of the floodplain itself.

Mesohabitats: Within the low-flow channel the major mesohabitats relate to substratum composition with varying accumulations of cobble/gravel within the riffles providing complex substrate habitats. The stands of riparian vegetation also provide complex habitat, both themselves and their associated fallen timber which, as in the Armoured Zone, create large debris dams. Within the pool functional unit of the low-flow channel, microhabitats include emergent and submergent vegetation. Woody debris can also be present within pools. Mesohabitats within the high-flow channel relate to the terrestrial environment inundated during floods, but snags and fallen woody debris also form a major mesohabitat in this region of the channel.

Meandering Zone

A distinguishing feature of the Meandering Zone is the significant increase in the width of the valley floor (> 5 to 15 km) and the presence of large, well developed floodplain surfaces. The river channel is relatively active and displays a typically meandering style. Sinuosities may range from 1.8 to 2.35 with meander wavelengths up to 700 m. The presence of well developed floodplain features such as flood channels, former channels, avulsions, cut offs and minor anabranching testify to the relatively active and unrestricted nature of the river-floodplain environment in this reach. The river in this zone is typical of a mixed to wash-load channel (Schumm 1988).

The morphology of the in-channel environment is variable with the presence of bars (point and lateral), benches (at various levels) and riffle/pool sequences (Figures 3.9, 3.10). These in-channel sediment storage features reflect the relatively high rates of sediment transport. The river bed sediments typically have a bimodal distribution like those found in the Mobile Zone but are smaller in size (median grain size of < 1 to 64 mm). The appreciable fining of the bed sediment and/or well developed floodplain features are clear characteristics distinguishing between the Meander and Mobile Zones. The bank sediment is also very fine, mostly fine sands, silts and clays. The cohesive nature of the bank sediment contribute to relatively steeper banks in this zone compared to upstream zones. The bankfull channel widths can vary between 40 and 70 m and depths between 4 and 6 m.

Habitats of this zone

The major habitats of this zone are:

Functional set: the Meandering Zone of a river system

Functional unit: the Meandering Zone contains a complex array of functional units with distinct and low- and high-flow channel units. Within the low-flow section of the Meandering Zone, Functional units are the riffle and pool areas within the main channel. In this zone, riffles can be large and support well established stands of riparian vegetation. Pool regions are also large and deep. The low-flow channel is also characterised by large sandy bar systems, both point and lateral bars. In this zone high-flow functional units are developed with in-channel benches, diverse flood runners and an extensive floodplain. Functional units include the flat bench surfaces, the small flood runners and complex features of the floodplain itself.

Mesohabitats: within the low-flow channel the major mesohabitats relate to the substratum composition with accumulations of gravel/sand within the riffles providing complex substrate habitats. The stands of riparian vegetation also provide complex habitat, both themselves and their associated fallen timber which, as in the Armoured and Mobile Zones, can create large debris dams. Within the pool functional unit of the low-flow channel, mesohabitats include the sand/silt-size sediment, emergent vegetation and possibly submerged vegetation. Woody debris can also be present within pools. Mesohabitats within the high-flow channel also relate to the terrestrial environment inundated during floods, but snags and fallen woody debris form a major mesohabitat in this region of the channel.

Anabranching Zone

This Functional Process Zone is characterised by multiple channels, which can be both anabranching or anastomosing, which dissect a generally extensive and well developed floodplain surface (Figures 3.11, 3.12). Anabranch channels break out from the main or ‘parent’ channel, flow across the floodplain to rejoin the main channel at a distance downstream. These anabranch channels begin to flow at approximately one third to half bankfull discharges. Anastomosing channels, rather than breaking out from a main channel, consist of multiple channels all of which are ‘active’ to the same degree during periods of flow. The individual channels are characteristic of a wash-load system

(Schumm 1988), with low bed slopes (<0.00001), high sinuosities (>2.0), low bankfull stream power (<5 ωm^{-2}) and highly cohesive river bank materials (percent weight of silt/clay >25%). The contemporary channel can have sinuosities up to 2.10, and is often contained within a older channel system that has a much larger meander wavelengths (>13 km) and channel dimensions (widths > 800m). The active channel generally has bankfull characteristics of low width/depth ratios, widths of between 30 and 50 m, and depths of 10 to 15 m. The river bed is normally stable with a RBS of 0.98 to 4.85. The effect of multiple channels means that bankfull capacities in this zone are lower in comparison to other zones (50 m^3s^{-1}).

Habitats of this zone

The major habitats of this zone are:

Functional set: the Anabranching Zone of a river system.

Functional unit: the Anabranching Zone is typical of many inland lowland rivers in Australia. In this zone the low-flow channel is relatively simple with most of the habitat diversity occurring at higher-flow levels. Within the low-flow section of the Anabranching Zone, riffles do not exist and the main functional units are the large pools within the main channel. Sections of the low-flow channel may also be characterised by large bar systems, principally point bars. In the Anabranching Zone the high-flow channel is also well developed with in-channel benches occurring at different levels within the channel, diverse flood runners and large anabranches leaving the main channel at different flow heights and an extensive floodplain. Functional units in the high-flow channel include flat bench surfaces, flood runners and anabranches and complex features of the floodplain itself.

Mesohabitats: within the low-flow channel the major mesohabitats relate to substrate composition, but diversity is limited to sandy bars, regions of silt/clay and small areas of bedrock. Woody debris from fallen riparian vegetation is the other major microhabitat of the low-flow channel. Mesohabitats within the high-flow channel are similar to those within the low-flow channel with woody debris dominating. At extremely high flows mesohabitats relate to the terrestrial environment inundated, but snags and fallen woody debris again form a major microhabitat in this region of the channel.

Distributary Zone

The basic feature that defines a Distributary Zone is that it has bifurcating channels — channels that off take from each other (Figures 3.13, 3.14). These secondary channels persist relatively independently of the main channel, the channel from which they off take, for some length far in excess of their width. These distributary channels may or may not rejoin the main channel. Distributary channels that do not rejoin other channels often terminate in lakes or terminate dispersed across floodplains. Daily flows of 1–50 m^3s^{-1} do occur in these channels but for the majority of the channels long periods of zero flow are common. Flow in the smaller distributary channels is related to high flows in the main channel.

In all channels there is a rapid downstream decrease in bankfull cross sectional area. This is attributed to loss of water by evaporation and flood attenuation. The sediment within all channels is comprised of very fine sands, silts and clays. Indeed, the percentage weight of silts and clays can be up to 40 %. Most of the channels are relatively narrow and featureless with occasional deep holes scattered along their length.

Habitats of this zone

The major habitats of this zone are:

Functional set: the Distributary Zone of a river system.

Functional unit: In the Distributary Zone the low-flow channel is relatively simple with most of the habitat diversity occurring within the higher flow channels. Within the low-flow section of the distributary Zone deep pools are common functional units. Sections of the low-flow channel may also have point bars. In the high-flow section of the main channel in-channel benches occur at different levels and these are considered to be important for the in-stream ecological processes. The secondary channels and the extensive floodplain surface through which they flow are the dominant functional unit in this zone. The high-flow channels also contain flat bench surfaces, flood runners and anabranches and a complex array of floodplain features.

Mesohabitats: Within the low-flow channel the major mesohabitats relate to substrate composition, but diversity is limited to sandy bars and regions of silt/clay. Woody debris from fallen riparian vegetation is the other major microhabitat of the low-flow channel. Mesohabitats within the high-flow channel are similar to those within the low-flow channel with woody debris dominating. At high flows mesohabitats relate to the secondary channels and inundated terrestrial environments, but snags and fallen woody debris again form a major mesohabitat in this region of the channel.

Lowland Confined

This Functional Process Zone contains many features similar to the Meandering Zone, but the main channel is confined, hence lateral movement is limited. A distinguishing feature of Lowland Confined Zones is a relatively narrow width of the valley floor (2 to 3 km) and associated floodplain surface (Figures 3.15, 3.16). These sections of river are generally confined within geological structures or paleo-channels. Floodplain features such as minor anabranching and flood channels dominate this zone. The river bed and bank sediments are typically fine sands, silts and clays. The appreciable fining of the bed sediment and/or well developed relatively stable floodplain features are also notable in this zone. The river channel in this zone is predominately a wash load channel (Schumm 1988).

The morphology of the in-channel environment is variable with the presence of large bars (point and lateral) and benches (at various levels); hence large amounts of sediments are stored in this zone. The cohesive nature of the bank sediment contributes to relatively steeper banks in this zone compared to upstream zones. The bankfull channel has widths between 40 and 70 m and depths between 4 and 6 m.

Habitats of this zone

The major habitats of this zone are:

Functional set: the Lowland Confined Zone of a river system

Functional unit: the Lowland Confined Zone contains an array of functional units with distinct low- and high-flow channel units, which include floodplain surfaces. Within the low-flow section of the Lowland Confined Zone, Functional units are deep pool areas within the main channel. These pools can be large and support well established stands of riparian vegetation. In this zone high-flow functional units are developed with diverse bars and in-channel benches and limited floodplain surfaces. Floodplain features include; levees, flood runners and older channels. Functional units include the flat bench surfaces, the small flood runners and features of the floodplain itself.

Mesohabitats: within the low-flow channel the major mesohabitats relate to the substratum composition with accumulations of fine sand, silt and clay within the pools providing relatively homogeneous substrate habitats. Present within the pool functional unit of the low-flow channel are emergent vegetation and possibly submerged vegetation. Woody debris can also be present within pools. Mesohabitats within the high-flow channel also relate to the terrestrial environment inundated during floods, but snags and fallen woody debris form a major mesohabitat in this region of the channel.

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