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Wimmera Catchment Management Authority

Waterways for Life.

Wimmera River
Reaches 3,4,5 & 6.1
Waterway Action Plan

- Final
- 4 August 2006

action Salinity & Water AUSTRALIA

Victoria The Place To Be

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Glossary

Term	Definition
Aggradation	The process of raising the bed level of a stream through deposition of sediment
Alluvial	Sediment deposited by flowing water, in a riverbed, flood plain, or delta
Bedrock	Exposed solid rock that underlies loose material, such as soil, sand, clay, or gravel
Bedload	Coarse solids transported by flows
Bench	A level elevation of deposited material attached to a stream bank that exists between the streambed and the floodplain
Degradation	A decline or lowering of the condition/quality, of the stream or floodplain
Erosion	Processes, such as weathering, dissolution, abrasion, and transportation, by which material is worn away from a surface
Geomorphology (morphology)	The branch of geology that studies the characteristics and configuration and evolution of rocks, land forms
Headcut	Vertical or near vertical drop in channel elevation greater than 300mm
Hyporheic	The interstitial spaces and voids (habitat) in the bed through which sub surface flows percolate
Incision	Lowering of a waterways bed level through water erosion
Reach	A stream management unit i.e. a segment of a waterway
Riparian	Of, on, or relating to the banks of a natural water course.
Turbidity	Muddiness created by stirring up sediment or having foreign particles suspended in water

Executive Summary

The Wimmera River Waterway Action Plan is one of many such plans being prepared by the Wimmera Catchment Management Authority (Wimmera CMA) as part of a program to identify works and activities across the Wimmera catchments that are needed to manage the stream systems with a view to improving the river health over time. This Plan covers reaches 3, 4, 5 and 6.1 of the Wimmera River, which extends from Eversley through to Joel South.

The Plan focuses on addressing Wimmera CMA's key waterway management responsibilities and priorities as outlined in the Wimmera Waterway Health Strategy (2006). A key output of the plan is the identification and prioritisation of issues and actions that exist within the catchment boundary. Many of these actions will be progressively implemented over the next 5 to10 years.

The plan also provides an accessible form of information and analysis of the key waterway issues which will be of use to not only Wimmera CMA, but also other agencies, community groups and landholders. The Plan's prioritisation of issues and actions for specific waterways will help increase awareness of the catchment's condition amongst landowners and community groups. The Plan will also provide a framework that encourages additional planning and undertaking of works along the River and tributary stream corridors in a coordinated manner.

The Wimmera River in this area is a lowland plain stream that is fed by a number of tributaries rising from the predominantly sedimentary slopes of the Pyrenees ranges. The catchment has undergone widespread clearance since European settlement which triggered a range of degradation processes including stream incision, tunnelling and gullying. These processes are evident in both the mainstem of the Wimmera River and its tributaries. Following settlement, the Wimmera River and its floodplain were subject to widespread clearance and the channel changed from a chain of ponds to that of a continuous channel with some ponds. These changes to the channel also triggered massive erosion responses in the tributaries with the consequence of substantial infill of the channel in the lower reaches. Some of these tributaries are actively eroding today and need rapid intervention to stop further erosion.

The River segments in this study retain a number of high value environmental attributes that are the primary remnants of the former healthy stream system. In particular the River is a refuge for remnant native fish, Platypus and Water Rats which do not occur to any significant degree further downstream. These remnant populations are holding on due to the availability of key pond and run habitats and reasonably low salt levels. These values and attributes are at high risk of being lost through slow loss of the ecosystem and habitats via a range of disturbance activities.

To establish a view on the projected activities to protect and rehabilitate these values for Wimmera CMA, the investigation process undertaken for this study included a review of the relevant previous studies, aerial photography analysis, an information collection process with local contacts and agencies, followed by a detailed field inspection process of many of the problem areas. This investigation process showed that the mainstem segments of the Wimmera River are relatively stable despite some historic disturbances or modifications, but are being severely impacted by tributary inputs. The tributaries show marked indications of disturbances and despite extensive efforts by the former Soil Conservation Authority (SCA) and others, there are still many areas where the bed and banks of waterways are actively eroding and moving laterally at rates that far exceed natural processes.

The major issues for erosion remain within the sedimentary foothill reaches, this generally being associated with either channelisation of streams, a loss of robust and continuous riparian vegetation communities, saline discharges and unfettered access by stock.

The resultant impact on water quality and instream values on the Wimmera River is a marked decline in stream flora and fauna values and increased salt levels and sediments where the tributaries join the mainstem of the River. The impacts of salinity are significant, as are high sediment solids loads that consist of both fine and coarse particulates.

The key issues for Wimmera CMA to tackle in reaches 3, 4, 5 and 6.1 of the Wimmera River and tributaries include:

- The protection and enhancement of areas of higher fauna and flora quality, particularly the pond areas;
- The reconnection of key riparian linkages along the streams;
- The tackling of areas of serious stream erosion in the tributaries through stabilisation and revegetation programs, with particular attention to those streams directly connected to the mainstem;
- The rehabilitation of many former SCA works to secure the function and integrity of those works;
- Degradation of in-stream vegetation, riparian vegetation on stream banks and verges due to impacts of unfettered stock access through co-operative fencing and revegetation programs with land owners;
- The establishment of innovative and improved stock watering arrangements with landowners to lessen the impacts of stock on the riverine environment;
- The study of, protection and enhancement of seasonal wetlands and sediment stores along the tributary streams and in the floodplains for their intrinsic habitat values and water quality management roles;

- The support of interagency programs tackling salinity management and also soil management for the fragile soils systems of the catchment;
- The support of weed management programs along all streams;
- An expanded monitoring program of the water quality and instream fauna across the system to fully define the high values and enable post management adjustment to programs; and
- The support for interagency programs tackling sustainable land use issues.

As the Wimmera River is unregulated at this point, the issue of provision of environmental flows and provision for water supply for stock and domestic uses appears to be intractable without much opportunity for resolution given the existing constraints of an over committed water resource across the catchment. Whilst this is not a waterway management issue there is a need for the matter to be kept in review as part of the wider region flow management process.

A prioritised set of activities for Wimmera CMA to concentrate on have been identified in this report and will be tackled as resources become available.

A lot of successful projects have been undertaken by individuals in conjunction with other agencies in the past and more recently with Wimmera CMA. A number of these works need revisiting and re-establishment, some need maintaining and some need replacing. In many cases there is an urgent need to intervene and undertake new projects to secure and improve the remaining remnant values.

Long term partnerships between Wimmera CMA, other agencies, community groups and landowners are critical to form the tenant of co-operation and engagement needed to ensure that the high remnant values of the Wimmera River are protected and rehabilitated.

1 Introduction

1.1 What is a Waterway Action Plan

A Waterway Action Plan (WAP) is a document that details the condition of a catchment and individual reaches of waterways within that catchment and identifies site-specific actions to promote improved health and stability of these waterways.

The objective of Waterway Action Plans is to identify:

- the existing condition of the riparian zone;
- condition and extent of riparian vegetation (and fencing);
- location of weed infestations;
- bed and bank instabilities;
- the existing condition of instream habitat;
- guide appropriate management; and
- facilitate the implementation of waterway works where required.

The intention of this Waterway Action Plan is to provide the above information in an easily accessible form for users to understand. The Waterway Action Plan sets out both strategic directions and site-specific needs and outlines actions to address key issues associated with specific reaches of waterways. It also sets a framework from which Wimmera CMA is able to prioritise rehabilitation works over the next 5 to10 years. It is important to note that while the Waterway Action Plan defines the needs of specific projects it does not contain detailed project prescriptions or detailed costing estimates. These are additional tasks that will be undertaken at the implementation stage of respective projects.

1.2 Objectives of the Waterway Action Plan

- Progressive reduction in the amount of sediment, suspended solids and turbidity originating and being transported through reaches 3, 4, 5 & 6.1 of the Wimmera River and associated tributaries;
- Protection of the existing floodplains and wetlands for their water quality treatment role and habitat value;
- Rehabilitation of unstable waterways and gullies through tackling bed and bank erosion and rehabilitation of old structures;
- Protect and enhance existing high value riparian areas and improve riparian vegetation condition along the waterways with a key focus of regional biodiversity connection;
- Protect and rehabilitate existing high value and critical instream habitat areas; and
- Support the attainment of the Regional Salinity Management Plan.

It sets out a framework by which Wimmera CMA is able to prioritise rehabilitation works for the next five to ten years.

Wimmera CMA will address the following aims through the development of this Waterway Action Plan:

1) Establish a set of objectives for the management of the stream systems with a view to improving the river health over time;
2) Produce a plan that focuses on key waterway management issues in Wimmera CMA's scope of responsibilities and priorities as outlined in the Wimmera Regional River Health Plan, such that an outline works program for the stream can be identified for the next 5 to 10 years;
3) Provide an accessible form of information and analysis of key waterway issues so that other agencies organisations and community groups are aware of those issues and the plan's prioritisation of works; and
4) Encourage landowners and community groups to be aware of the plan's content, which provides a framework for undertaking additional planning or works along the stream corridors, and addressing their responsibilities in the areas of land management. Waterway Action Plans thus present an opportunity to assist coordination between management authorities and have the potential to promote a shared vision for the waterways between Councils, DPI, DSE, Wimmera CMA the community and other stakeholders.

1.3 Project Scope

The scope of this project is to:

1) Develop a report that documents appropriate management techniques for the Wimmera River (Reaches 3, 4, 5 & 6.1) from Eversley to Joel South to be implemented over the next 5 to 10 years; and

1.4 Key Tasks

The following key tasks have been completed to achieve the above:

- Review of available information including relevant state and regional strategies, reports, aerial photography, longitudinal profiles, water quality information etc;
- Consultation with stakeholders, i.e. department organisations;
- Consultation with the community i.e. landholders;
- Aerial and on-ground inspection of the catchment;
- Division of the catchment into smaller 'sub-catchments' or 'reaches';

- Development of detailed sub-catchment management plans that detail the risks and opportunities within each sub-catchment;
- Prioritisation of management actions;
- Development of detailed sub-catchment maps showing the location of proposed management actions;
- Identification of bed and bank instabilities;
- Identification of pest plant and animal species that may pose a threat to waterway health at a sub reach scale;
- Assessment of the extent and condition of riparian vegetation and fencing at a sub reach scale;
- Identification of high value assets and identification of opportunities to help secure these assets;
- Provision of an indicative budget to undertake management actions; and
- Development of the WAP with a "Landscape" or whole of catchment approach to natural resource management (NRM), giving consideration for other natural resource management (NRM) programs and projects planned or underway within the catchment.

1.5 Catchment Location

Reaches 3, 4, 5 and 6.1 of the Wimmera River are located in Western Victoria, centrally located between Stawell, Ararat and Avoca. The catchment boundary for this study covers an area of approximately 102 km^2, as shown in Figure 1-1 below. Major towns located in the catchment are Eversley and Crowlands.

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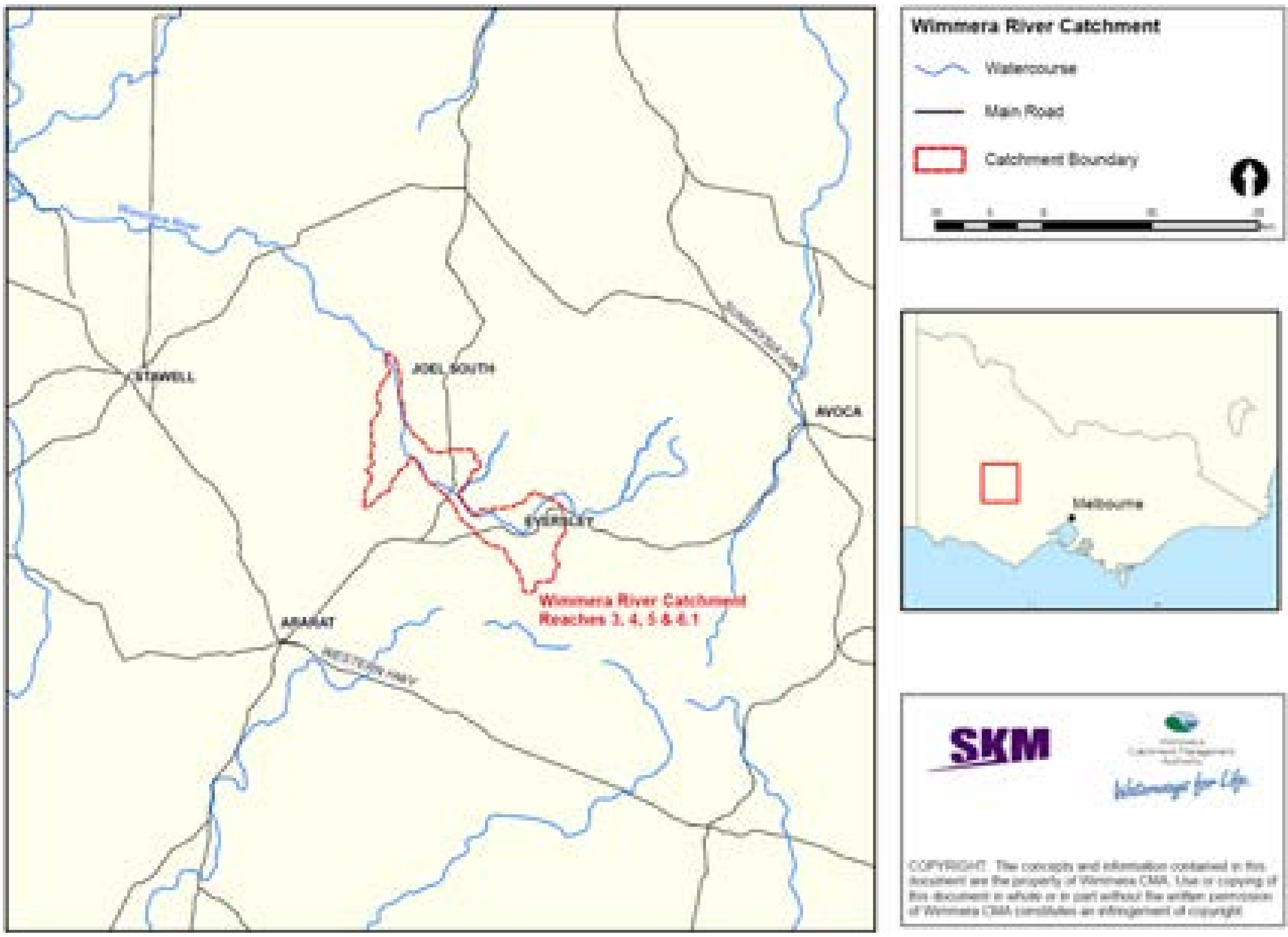

Figure 1-1 Location of the Wimmera River Catchment, Reaches 3, 4, 5, & 6.1

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1.6 Major waterways in the Catchment

The major waterways that enter the Wimmera River along Reaches 3, 4, 5 and 6.1 include:

- Glenlofty Creek;
- Mt. Cole Creek;
- Spring Creek;
- Tuckers Creek;
- Glendhu Creek; and
- Shays Creek

There are also numerous other named and unnamed tributaries throughout the system.

1.7 Relevant Reports and Background Information

Reaches 3, 4, 5 and 6.1 of the Wimmera River is part of the upper Wimmera River catchment. Regional strategies and policies that are relevant to this WAP include:

- Victorian River Health Strategy (2002);
- Wimmera Regional Catchment Strategy (2003);
- Draft Wimmera Waterway Health Strategy (2006);
- Wimmera Water Quality Strategy (2002);
- Wimmera River Geomorphic Investigation (2001); and
- Geomorphic Categorisation and Stream Condition Assessment of the Wimmera River Catchment (2003)

This Waterway Action Plan has been compiled in line with the key management actions, objectives, goals and recommendations set out in these documents.

1.8 Supporting Programs

Wimmera CMA, together with DSE and DPI are the principle authorities responsible for delivering the recommendations of these strategies and policies on a regional basis. Collaborative programs that play a vital role in supporting these objectives include:

- Wimmera Weed Action Plan (2000);
- Wimmera Water Quality Strategy (2002);
- Wimmera Salinity Management Plan (2005);
- Steep Hill Country Management Plan;
- Whole Farm Planning;
- Wimmera Rabbit Management Action Plan (2000);
- Victorian Pest Management Framework (DSE, 2002);

- Pyrenees Shire Planning Schemes;
- Crowlands Landcare Group; and
- Project Platypus

1.9 Management Strategy and Rationale

The management objectives for the Wimmera River are derived from several levels. Firstly there is the State level of policy and broad objectives as set out in the Victorian River Health Strategy (2002). The vision from this document is in the nature of 'a beacon on the hill' - a long term conceptual and aspirational goal that the State's rivers of greatest value to the community will be protected as part of our natural heritage and that the State's rivers will be ecologically healthy, and managed within healthy catchments. This vision is the driver of the activities for the future. The goals include a series of clearly enunciated management approaches including:

- Protecting the rivers that are of highest community value from any decline in condition;
- Maintaining the condition of ecologically healthy rivers;
- Achieving an 'overall improvement' in the environmental condition of the remainder of the State's rivers; and
- Preventing damage from future management activities.

The second level of management objectives are derived from the Draft Wimmera Waterway Health Strategy (2006). This document again contains a number of higher level objectives, but the most pertinent to this study are to:

- Improve the quality of water from the catchments entering the region's waterways;
- Improve in-stream habitat by measures such as fish passage, environmental flow and promotion of efficient water use;
- Rehabilitate waterways through on-ground works that target bed and bank erosion, sedimentation and gully erosion;
- Implement bed stabilisation in the upper Wimmera River;
- Repair and maintain priority structural assets in regional waterways;
- Protect and rehabilitate streamside frontage on the region's waterways while protecting cultural heritage and biodiversity values;
- Promote the adoption of Property Enhancement Grants throughout the region; and
- Increase knowledge and awareness of waterway health issues.

The overarching environmental management objective must be to maintain and where possible rehabilitate the environmental values of the rivers and streams. In the case of the Upper Wimmera

River covered by this study, which is an unregulated stream from a flow point of view, the key activities will relate to the protection and rehabilitation of the instream habitats. This will include the need to respond to the degradation due to ongoing stream erosion arising from historic disturbances and current erosion and the loss of environmental values through uncontrolled stock access.

The management of the issues along the Wimmera will necessarily involve a highly collaborative and partnership approach with the landowners through whose land the River flows, to ensure that mutual goals are achieved. The vexed issue of access for stock to the waterways for watering will need to be particularly tackled by innovative means to satisfy both the need for stock watering,, particularly during droughts, but also ensure that the long term need to protect the high residual values of the waterway including the rehabilitation of the vegetation corridor and the protections of Platypus, Water Rats and native fish populations is met. The impact of the drought has had a marked effect on the Rivers health and the decline of values is evident as a result.

This Waterway Action Plan for the Wimmera River (reaches 3, 4, 5 and 6.1), observes both the high level State wide goals, but also critically takes account of the unique issues of the Wimmera River and recommends an array of actions to address those issues. The approach taken will need to look at the most urgent actions, but also consider the matrix effect of many other issues. It is important to note that the issues within the tributary sub-catchments are equally important, as these have a dramatic impact on the health of the Wimmera River.

2 Catchment Description

2.1 Whole of Catchment Overview

This section provides an overview of the general study area. A more detailed analysis on a reach by reach basis is provided in Sections 4 to 7.

The Wimmera River rises in the Pyrenees Ranges. The Ranges are a mix of sedimentary materials that consist of sandstones, red shale and slates with notable granite intrusions such as Ben Nevis. The foothill slopes consist of weathered colluvium containing cobbles over deeper clays derived from sea transgression during the Miocene period. Streams that intersect these slopes are prone to incision and erosion and are often quite saline. The soil pH is generally acidic, most being mildly or moderately acidic with some being classified as extremely acidic. The catchment is predominantly cleared outside of the few remnant parks and crown land reserves. The main phase of clearing followed after the construction of the Tulkara Railway in 1910 with most of the Grey Box woodland community removed and replaced with perennial pastures or annual crops.

The region has a semi arid climate, with a strong pattern of winter-spring rainfall of between 750 mm around Ben Nevis and down to 400 mm on the lower plains. Except for the occasional summer convection storm event, runoff is predominantly generated in the winter and spring period. Importantly, event flows have a relatively short duration of a few days to a week with base or near base flows being resumed relatively quickly. Base flows for the Wimmera consist of groundwater and spring fed flows derived from sub-catchments with elevated salinity. In longer drought sequences, surface flows in the Wimmera cease but hyporheic flow may continue for longer periods through the sandy substrates. The base flow at the time of this study was very low at a number of locations and tended to be hyporheic in the coarser sediments of the bed at the lower end of the study area and downstream of major sub-catchment junctions.

The upper reaches of the Wimmera River included are characterised by series of floodplains and hard rock valley chokes. Two of these chokes exist near Eversley and Crowlands. These floodplains have been established over a long period of erosion following the formation of the Pyrenees Ranges in the Cambrian and Ordovician Periods. The current floodplain is generally incised in a broader and older alluvial plain, established in the Pleistocene period. The historic flow surface is now observed as a higher terrace within the study area. Sediments along the River are generally harder and more consolidated in the upper floodplains but downstream of Crowlands they are characterised by sandier and less consolidated material.

The river channel has been subjected to a series of changes following settlement in approximately 1840. Prior to that, the river was predominantly an alluvial discontinuous stream with a chain of ponds being the predominant form. Soon after European colonisation of the district a lot of channelisation occurred and many of the old courses enlarged and straightened to allow farming of the more fertile floodplain soils. Today a permanent deep channel exists through the whole study area.

The current riverine habitat is variable with some areas having good values, but many have poor values and disturbed remnants. The aquatic and riparian vegetation is discontinuous and shows the impacts of long-term grazing. The stream has a limited aquatic ecosystem values due to the flow variability, channel disturbances and also impacts of catchment and channel erosion. Notwithstanding this, records of Platypus and some fish are still current and the aged River Red Gums provide a basic vegetative structure along most of the main channel.

2.1.1 Water Quality

Water Quality is one of the key environmental and ecological factors that determine Stream Health. Water quality can be characterised by a range of parameters and include salinity, dissolved oxygen (DO), nutrients, pH and turbidity. With respect to the Wimmera River the key factors that are likely to affect the habitat quality are those of salinity, suspended solids (both coarse and fine) and nutrients. At the time when field inspections were carried out the Wimmera River was at very low flow levels, the result of an extended drought period over some 7-8 years. Large flow events however, were recorded in the area in February 2005 and again in June 2005.

Salinity is often measured by Electro-conductivity (EC) or total dissolved solids (TDS). High TDS levels are usually caused by the presence of potassium, chlorides and sodium. Generally, a high salt content in a riverine environment will result in less fauna and flora species diversity and abundance. Similarly, a higher quality riverine environment is often typified by freshwater environments with low salt levels.

Suspended solids can vary in size from very fine colloidal material to coarse bedload material. The impacts of suspended solids can be severe. Fine suspended sediments can lead to the displacement of species that rely on gills for oxygen transfer and coarser materials can often smother or lead to gross sedimentation of physical habitats, resulting in a decline in habitat quality and abundance. Coarse material is often measured by weight per volume (mg/l) while finer particulates are measured according to turbidity or the clarity of water. High turbidity results in cloudiness, haze, or an absence of clarity in the water. The units of measurement for turbidity are ‘nephelometric turbidity units’ (NTU). ANZECC Guidelines suggest that tubidity levels of greater than 30 NTU reflect a state of degradation

Nutrient levels are often measured by pH. While the pH scale ranges from 0 to 14 the pH of natural waterways tends to hovers between 6.5 and 8.5. Water with a pH of 7 is considered to be neutral, a pH of less that 7 is acidic; and a pH greater than 7 is basic. The major nutrients noted in the catchment were phosphorous and nitrogen. High nutrient levels can result in excessive algal production within waterways leading to deoxygenating and eutrophication which in turn reduces the ecosystem quality and species diversity

Unfortunately, the water quality of the study reaches is not well studied except for records taken at the Eversley gauging station (Site 415 207) in the middle of reach 4. A review of the Eversley records show that salinity varies seasonally with flows. The maximum recorded EC at the site is 2910 us/cm with a 75 percentile of 2440 us/cm and a mean of 1727us/cm. These values exceed the ANZECC Guidelines limits of 1500 us/cm for the protection of aquatic environments, which must not be exceeded for any period of the year (ANZECC 1992). The recorded values at the Eversley gauge are therefore considered to be high and will result in a decline in the diversity of species and number of individuals in the ecosystem. During the field inspections salt levels were observed to increase with downstream distance along the Wimmera River as salt loads were received from the tributaries. It is unfortunate that no records are available for the Joel Joel site (415 215) to confirm this observation. The tributaries such as Glendhu and Shays Creeks were observed to be contributing particularly higher salt loads.

Suspended solids records are available for low flow or base flow periods only and very little data was available for rainfall and run-off events. Typically as a result, turbidities levels are recorded in the lower ranges of 3 – 10 NTU. A single result of 230 NTU has been recorded at the Eversley site. A similar pattern is displayed for coarser sediments with a mean of 15 mg/l and a maximum of 330 mg/l. The mean levels of turbidity and coarse solids indicate generally that erosion products are only likely to be an issue in and after rainfall event conditions and in wet sequences.

From these results we can deduce that the amount of suspended solids being deposited into the Wimmera River are high, particularly in times of major flood events when large amounts of erosion products are swept downstream from the many highly eroding tributaries. It is also apparent that far more quantification of this impact is needed to comprehend the overall loads being transmitted through the system. This is particularly so for the segments of the Wimmera River downstream of the major subcatchments of Glendhu, Shays, Spring and Tuckers Creeks where gross aggradation of sediments has occurred. Importantly the impact of the higher sediment loads was also observed down the mainstem of the Wimmera River but particularly below the key sub-catchments, with noticeable coatings of solids on all the stems of emergent macrophytes well above the waterline. This fine coating of colloidal and fine silts indicates the large loads being transported under event conditions. It is also known that the soils in the sub-catchments have highly slakey and dispersive properties and produce large export loads under event conditions.

With respect to pH, the records show near neutral conditions. Acid soils are known to exist in the catchment but based on the pH records are likely to occur downstream of the monitoring site. However again as the data is skewed to low flows there maybe a misleading trend in the data. Any changes in pH below 6.0 would result in a decline in species diversity, abundance and composition.

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Phosphorus levels recorded at the Eversley site were generally low. In particular the reactive phosphorus levels were well below the ANZECC (1992) guideline level of <0.1mg/l for the protection of aquatic ecosystems. Again no data was available for high flow events so the ability to comment on the transport of Phosphorus from catchment erosion and cropped areas, is limited. It is expected that increases in phosphorus transport would occur in association with the fine clay colloids particles following rainfall events. It should also be noted that in discussion with many farmers during the field trips, many have been unable to afford to apply any significant levels of fertiliser in a broad acre grazing country during the drought due to the high cost. The soils of the catchment also tend to bind and retain the applied phosphorus.

A similar pattern also exists for total nitrogen where the mean levels are generally below the 0.75mg/l set by ANZECC. It was interesting to note that the majority of the nitrogen was in organic form with inorganic nitrogen states being at relatively low levels. This points to a generally mesotrophic condition rather than eutrophication. This is supported by a lack of presence any large populations of algae throughout the reaches during the field inspection. Only a few observations were made of significant algae presence – this being limed to a few populations of the filamentous green algae Spirogyra sp. in some of the larger unshaded ponds below the Mt Cole Creek junction. This level of presence would be regarded as normal. The high levels of organic nitrogen observed at the monitoring site generally indicate the cycling of organic material within the water columns. There are no significant sewage inputs into waterways within the study area which would result in higher levels of nutrients during the winter and spring period. Of concern for nutrient loads was the high degree of uncontrolled stock access to the stream throughout the majority of the catchment.

Dissolved Oxygen did not appear to be a problem at the Eversley monitoring site as the ponds are relatively shallow and receive reasonable wind shear. However a number of deeper ponds were observed along the reaches with some showing signs of lower DO due to the impact of no or very low flows and the presence of organic decay from leaf litter – displaying the grey/tannin colouration. It is unlikely that thermal or salinity stratification would occur in these ponds as they were generally not deep enough for this to happen. Most of the ponds not subject to stock access also had good populations of aquatic macrophytes.

2.1.2 Vegetation

Prior to European settlement, the vegetation of the Wimmera catchment region was a mixture of forests, woodlands, grasslands and seasonal wetlands. Since that time, large areas have been cleared and converted to agriculture such that only fragmented and degraded examples of the fertile plains woodlands and grasslands remain. These are often confined to roadsides and other small areas of public and private land (the former DNRE, 1997).

The condition of remnant vegetation generally reflects the surrounding landuse and the extent of protection from disturbance. The Wimmera River Catchment (Reaches 3, 4, 5 and 6.1) has been previously disturbed by agricultural practices and traverses cleared paddocks and areas of native vegetation. Prior to European settlement, the Wimmera River Catchment would have supported a diverse range of vegetation. The upper hills and lower slopes would have supported dense eucalypt woodland with a diverse understorey and groundcover. On the plains the vegetation would have thinned out to an open woodland as well as grassland and scattered freshwater meadows (WRCLPB, 1997). All reaches and ephemeral tributaries have been modified to varying degrees and most of the riparian zone in the catchment has been highly modified and degraded.

Large scale land clearance associated with land development for agriculture has removed a large majority of the original vegetation cover, and simultaneously many introduced species have been added to the vegetation of the region during this time. Unrestricted livestock within fragile riparian environments has resulted in poor recruitment of native vegetation and has reduced the capacity to cope with natural environmental influences faced by the area such as flash flooding and drought. Consequently, the ecological integrity and environmental condition of the Wimmera River ecosystem varies along its length.

Eleven Ecological Vegetation Classes (EVC) were identified in the study area. Table 2.1-1 below lists the remnant vegetation remaining within the catchment and the reaches in which they occur.

- **Table 2.1-1 -Remaining EVC's of the Wimmera River Catchment (Reach 3,4,5 and 6.1) (DSE, 2005a,b+c)**

Current EVC Remaining in Catchment (DSE, 2005)	Reach	Remaining Character	Location
67 - Alluvial Terraces Herb-rich woodland	3	Mid to upper slopes of the northern sections of catchment, predominately along the higher tributaries of Spring Creek.	Range of slopes and altitudes outside of the riparian zone.
152 - Alluvial Terraces Herb-rich Woodland/ Plains Grassy Woodland Complex	4, 5	Occurs along mainstem, mid to upper slopes of the south-eastern and south-western parts of the catchment.	Intermediate slopes between the plains and more infertile upper slopes.
22 – Grassy Dry Forest	3	Mid to upper slopes of the south-eastern hill slopes.	Range of slopes and altitudes outside of the riparian zone.
23 – Herb-rich Foothill Forest	3	Occurs only on the upper north-western slopes.	Relatively fertile, moderately well drained soils. Easterly and southerly aspects of lower slopes and gullies.
76- Grassy Woodland/ Alluvial Terraces Herb-rich Woodland Mosaic	3, 4, 5, 6.1	Occurs along the mainstem and lower to intermediate tributaries.	Intermediate slopes between the plains and more infertile upper slopes.

20 – Heathy Dry Forest	3	Occurs only in the upper eastern hill slopes.	Shallow rocky skeletal soils
68 – Creekline Grassy Woodland	3, 4, 5	Small, discontinuous remnants along the mainstem and lower to intermediate tributaries.	Drainage lines and adjoining flats
896 – Grassy Woodland/ Heathy Dry Forest Complex	3	Occurs only in the north-eastern lower slopes.	Lower exposed and dry slopes of low to moderate fertility.
175 – Grassy Woodland	3, 5	Small isolated remnant on lower to intermediate slopes.	Intermediate slopes between the plains and more infertile upper slopes.
55 - Plains Grassy Woodland	3, 4, 5	Occurs patchy along the lower to intermediate tributaries south east of Eversley and along the mainstem.	Occupies poorly drained, fertile soils on flat or gently undulating hill slopes on lower elevations.
641 – Riparian Woodland	5, 6.1	Occurs mainly along the mainstem.	Occurs beside permanent streams, typically on narrow alluvial deposits.

The majority of the catchment consists of cleared paddocks which are generally represented by a cover of introduced pasture species, low native species diversity and most of the structural vegetative layers associated with the relevant native vegetation either modified or absent. Vegetation along the floodplain is restricted to mainly scattered River Red Gum interspersed with exotic pasture species.

The riparian vegetation along the main trunk of the Wimmera was continuous in some sections, with the remaining sections having small to large gaps. Table 2.1-1 depicts the general character of the riparian vegetation along Reach 3 of the Wimmera River. River Red Gums formed the dominant canopy species cover along the river, although there was some natural recruitment, the majority of the trees were mature (average height of 25-35m). Understorey vegetation along the river was nominal, with only a few scattered individuals of Black Wattle (*Acacia mearnsii*), Blackwood (*Acacia melanoxyln*) and exotics including Willows (*Salix sp*.), Spiny Rush (*Juncus acutus*) and Tamarisk (*Tamarisk aphylla*).

In-stream vegetation varied from solid bands of vegetation restricted to deeper ponds, to sections which were totally devoid of vegetation cover, which mainly occurred in riffles and runs. Some sections had moderate species diversity with a number of emergent and submergent macrophytes observed throughout the mainstem. Species included, Common Reed (*Phragmites australis*), Cumbungi (*Typha domengensis* and *Typha orientalis*), Rushes (*Juncus sp*.) (including Spiny Rush (*J. acutus*)), Sedges (*Carex sp*.), Water Ribbons (*Triglochin sp*.), Stoneworts (*Characeae sp*.) and Water Milfoil (*Myriophyllum sp*.). Deposition of sand and silt within the main channel has provided suitable conditions for colinisation of emergent aquatic vegetation including Phragmites and Cumbungi.

2-1 – Aerial view of the Wimmera River (Reach 3)

The degradation of riparian environments due to stock access and clearing of vegetation, which has been identified as a primary concern impacting on environmental values present within all of the reaches. This degradation of the riparian zone has resulted in the decoupling of important links and processes between terrestrial and aquatic environments. Riparian vegetation plays an important role in maintaining water quality (temperature), availability of in-stream habitat (woody debris), trophic linkages (terrestrial prey items), protection (flash flooding erosion) and nutrient cycling.

Many sites along the reaches suffer from poor management along the riparian zone and stream fringes. Although some areas of the river remain vegetated, in most areas they confined to thin linear strips in an otherwise cleared landscape. Generally, where the riparian zone does support a native canopy cover, the understorey and groundcover are typically highly modified and degraded as a result of prolonged grazing pressures and weed invasion. Nevertheless, due to commendable landholder efforts, some riparian areas of the river have been fenced to exclude stock and within these enclosures, the regeneration of canopy, understorey and groundcover species is now occurring, demonstrating the benefits of conservation management.

2.1.3 Stream Ecology

The stream ecology of the Upper Wimmera has not been subjected to any systematic and thorough study. Previous studies for the area have included a body of Platypus surveys undertaken for

Project Platypus since 1997 (Serena and Williams) and some limited fish studies work undertaken for the Water Resource Management Plan for the Upper Wimmera and Avoca Rivers (Doeg 2000).

The factors most affecting the quality of the stream ecology are the flow patterns, water quality and the disturbance of the habitats and characteristics arising through land use and stream system changes. The most valuable habitat sections are the residual ponds that the river drops back to in the late spring summer and autumn periods. Many ponds were observed throughout the current study, but unfortunately only a few where stock access is restricted had high quality habitat complexity. These high habitat ponds were distributed across most of the reaches which gives long term hope that a reasonable level of sustainable residual habitats can be maintained and extended along the whole of the upper Wimmera River.

It is interesting to note that Doeg (2000) found it hard to establish an environmental condition rating for the Wimmera River based on the general lack of data and the lack of a historic comparison data set to act as a benchmark. In particular Doeg noted the absence of diatom, algae and quantitative macroinvertebrate data. Not withstanding the general lack of records, Doeg noted that the indicative fish and Platypus populations make the remnant environmental values along the mainstem of the upper Wimmera River in the study reaches environmentally significant.

While Platypus are a highly valued and iconic species to the region, this species is not typically regarded as a classic indicator species as a measure of habitat quality as they are robust and often found in quite degraded habitats. The studies by Williams *et al* (2002 etc), have shown that the platypus population along reaches 3 – 6.1 are breeding, sustaining and dispersing during periods of flow – most likely in late spring. The residual ponds along the mainstem are critical habitats for the survival of this species, as is water quality also. Serena and Williams (1998) note that Platypus abundance seems to decline where annual EC levels exceed 3000. Higher levels of salinity are likely to limit the production of key food species for the Platypus. In this regard the number of animals trapped declined downstream of Crowlands, coincidently with a loss of permanent ponds and increases in salinity. It is also interesting to note that this study identified the lack of large deep permanent ponds downstream of Glendhu Creek junction. It is likely that many of these ponds have been infilled with sediments derived from the Glendhu and Shays Creek catchments. The loss of these ponds is having a negative impact on Platypus populations, thus placing more pressure to maintain platypus habitats in the upper study reaches. Maintaining the health of the upper reaches is significant on a catchment wide basis, as they provide for the potential to convey values in future years if stream health improves.

The latest studies conducted (Serena and Williams, 2006) showed that the population in and around Eversley and Crowlands had declined and it was noted that no animals captured appeared to have been recruited in 2004-2005 breeding season.

It is interesting to note that Williams *et al* (2006) also recorded a number of captures of Water Rat (*Hydromys chrysogaster*) during their surveys along with Eastern Snake Necked Turtle (also known as the Eastern Long Neck Tortoise) and various species of fish. Water Rats were caught at the same capture rate in the 2005-2006 surveys as that in the previous 1997-2002 surveys, indicating a reasonably stable and healthy population.

With respect to fish, there can only be a general description of species found in the study areas as there has been insufficient detailed studies done across both wet and dry seasons to adequately describe the fish resource and its dynamics.

Table 2.1-2 lists the species which have been recorded in the study area and are likely to be found in a more comprehensive survey.

- **Table 2.1-2- Recorded fish species in the study area (Doeg, 2000)**

Common Name	Scientific Name
Mountain Galaxias*	*Galaxias olidus*
Australian Smelt*	*Retropina semoni*
Southern Pygmy Perch*	*Nannoperca australis*
River Blackfish (southern form)*	*Gadopsis marmoratus*
Flat-headed Gudgeon	*Phylipnodon grandiceps*
Western Carp Gudgeon*	*Hypseleotris klunzingeri*
Murray Cod**	*Maccullochelia peelii peelii*
Carp	*Cyprinus carpio*
Eastern Gambusia	*Gambusia holbrooki*
Redfin	*Perca fluviatilis*
Tench	*Tinca tinca*

* Endemic native species

** Introduced native species; all other species are introduced

A range of important food species for Platypus and Water Rat from the Crustacea and Molluscs genus are also likely to be present. Important prey items for these species are listed in Table 2.1-3.

- **Table 2.1-3 - Important prey items for Platypus and Water Rat (Doeg, 2000).**

Common name	Scientific name
Yabby*	*Cherax destructor*
Glenelg Spiny Cray	*Euastacus bispinsus*
Western Cray*	*Geocherax falcat*
Freshwater Shrimp	*Paratya austaliensis*
Pea Mussel*	*Corbicula austalis*
South-eastern River Mussel*	*Velesunio ambiguus*

* Endemic native species; all other species are introduced

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2.1.4 A model of catchment change

During the period of initial settlement of the upper Wimmera, many waterways contained chains of ponds. However, with onset of European-style agriculture, particularly ringbarking and grazing, saw many chains of ponds to be destroyed by channel entrenchment. Changes typically followed the sequence: chain of ponds, discontinuous gully, continuously incised channel, channel containing fixed bar ponds, permanently flowing stream. Since the middle of last century, though, general improvements in farm practices and the application of soil conservation works in some valleys have further increased the diversity of fluvial forms.

Channel initiation by overland flow has been viewed as a threshold phenomenon related to the size of the contributing area and its slope. The relationships between source area and slope have been explored in a number of environments to predict the onset and the stable extent of gully networks. However, once incision occurs, gully heads typically migrate upslope until some threshold of contributing area and/or slope is met. At this point runoff, capable of further incision, cannot be generated and the gully stabilises in its headward extent. Topographic thresholds are also influenced by vegetation. The loss of groundcover and enhanced runoff results in an increase in the erosiveness of flows on the valley floor. The effect of this is to reduce the critical area/slope required for gully initiation and stabilisation.

Much of the channel evolution in the study area, occurred only after valley floor vegetation had been disturbed. However, other factors, such as the strength and hydraulic properties of valley-floor soils, also influence erosion processes. Many soils in the study area have hard-setting A-horizons, and more clayey sodic B-horizons. The B-horizon often has a lower permeability and water is forced laterally and moves as throughflow downslope. If the clays in the B-horizon are dispersive, fine soil particles can be carried in suspension in the throughflow. The transport of clay-sized particles by subsurface water leads to piping, tunnelling and seepage erosion. While the removal of vegetation has increased runoff rates, the characteristics of the underlying soils can have a strong influence on the potential for incision to occur.

An important component of any geomorphic assessment, is an appreciation of the setting in which the processes of erosion and deposition operate. The potential to misinterpret the natural instability that can exist in a catchment, as simply being a result of human impact, or to exaggerate the human impact, has been recognised as a consistent problem in geomorphic studies. Recognition of the different factors that have contributed to the development of the erosional problem, and the role that subsurface and overland flow paths have in driving the erosional processes is important as a precursor to recommending appropriate rehabilitation options.

2.1.5 Flooding

Flooding along the upper Wimmera River is common as the channel capacities are generally small. The morphology of a small channel with generally flat grades and fairly wide confined floodplains means that overbank events onto the floodplain are common. The longitudinal formation of a number of natural valley chokes plus stream perching above the adjacent floodplain and some road and occupation track crossings, results in the floods spilling onto the floodplains readily. Partial alienation of the floodplains has occurred in the lower reaches of the study area where channel incision and enlargement has increased the capacity of the channel above that which existed prior to European settlement. In most cases the current floodplain is well defined and is incised into the prior (Pleistocene period) floodplain.

The largest flood on record in the recent past is on the Wimmera River at Eversley (SI 415207) was in October 1973 with a peak of 15,900 ML/day. This followed a rainfall event of three day duration across most of Victoria. It is interesting to note that these flows are only short lived with floods receding within a few days unless a follow up rainfall event occurs. Higher historic flows are likely to have occurred but the gauging station records do not go back far enough to enable interrogation.

Short term floods can also occur as the result of locally high intensity convectional storms in early to late summer, but the flows from these are generally gone within a matter of hours or a day. These short term events impact heavily on the smaller tributary streams and generally do not impact on the mainstem other than through the transport of large loads of sediment and salt into the Wimmera River.

The only public infrastructure asset that appears to be vulnerable to flooding is the road bridge on the Eversley - Crowlands Road which is an old timber deck on steel beams with timber pylons and abutments. A number of relatively recent repairs are evident. Flooding across the left abutment appears common as the channel capacity is limited. The bridge condition may be impacted on by debris loads from a large flood event and erosion of the eastern (left abutment) could occur. Its condition needs monitoring.

2.2 Management Reaches

To describe the condition, issues and recommended actions along the Wimmera River between Eversley and Joel South, the river has been divided into four primary reaches. The delineation of the catchment into reaches has been based on geomorphic characteristics and behaviour as identified in *Wimmera River Geomorphic Investigation, Sediment Sources Transport and Fate, ID&A, (2002)*. Tributaries connected to these four mainstem reaches have been described as 'sub reaches'.

2.2.1 Reach, sub reach and tributary labelling convention

For the purposes of this report, a numbered labelling convention has been applied that identifies individual reaches, sub-reaches and tributaries throughout the catchment. This convention enables

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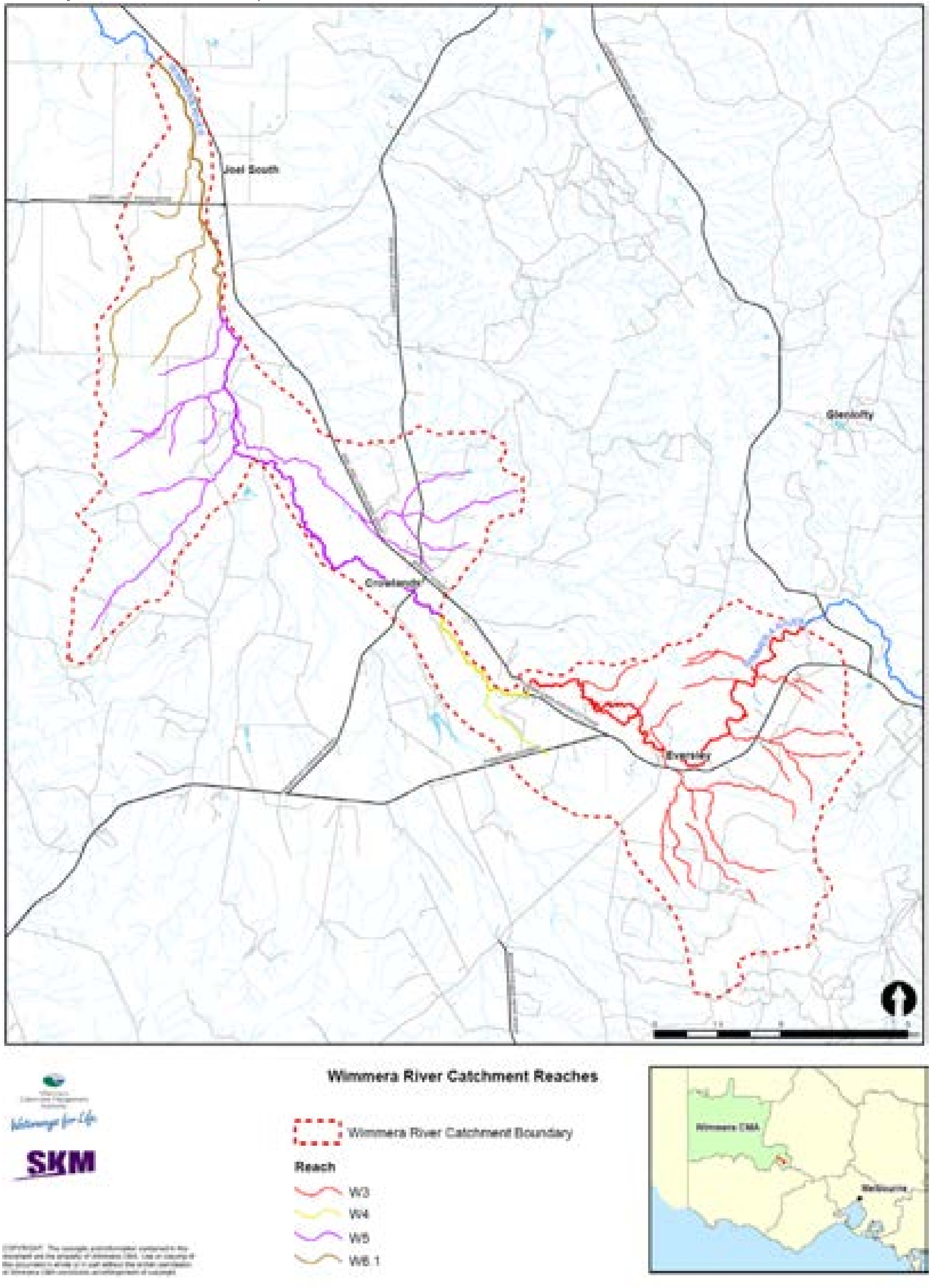
each waterway to have a unique number to help identify waterways within the catchment for the purposes of discussion in this report.

An example of the convention that has been applied is W3. This example refers to Reach 3 of the Wimmera River. Similarly W3/2/4 refers to Reach 3, sub-reach 2, tributary 4. Maps of each of the four reaches of the Wimmera River covered in this study (Reaches 3, 4, 5 and 6.1) are provided at the start of Sections 4 to 7. These maps show all waterways within each of the reaches together with specific numbers allocated.

The location and extent of the four reaches are detailed in Table 2.2-1 below and shown in Figure 2-2overleaf.

- **Table 2.2-1– Reach delineation of the Wimmera River**

Reach #	Reach and Location description	Easting and Northing (GDA 94)
Reach 3	Reach 3 – Wimmera River (Immediately upstream of Glenlofty Creek to Eversley- Crowlands Road)	U/S - 696257 5885197 D/S - 689762 5883675
Reach 4	Reach 4 – Wimmera River (Eversley-Crowlands Road to Spring and Tuckers Creeks)	U/S - 689762 5883675 D/S - 687650 5885542
Reach 5	Reach 5 – Wimmera River (Spring and Tuckers Creeks to Glendhu Creek)	U/S - 687650 5885542 D/S - 682436 5892791
Reach 6.1	Reach 6.1 – Wimmera River (Glendhu Creek to Vances Crossing, Joel South)	U/S - 682436 5892791 D/S - 681011 5898553



■ **Figure 2-2 Geomorphic delineation of the four catchment reaches**

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3 Method for assessing the Catchment

3.1 Information Collection

The following information sources were used to compile the information, which forms the basis of this plan:

- A desktop review of available information and documents;
- A meeting with respective stakeholders was held on 6th February 2006. Stakeholders include (but is not limited to) DSE, DPI, Project Platypus and the Pyrenees Shire Council;
- Community consultation meetings held on the 6th & 7th of April 2006. Advertising means included the distribution of an information sheet via a letterbox drop, advertising in the local paper, and the placement of information sheets at various community centres/locations in the catchment;
- The study team also undertook an aerial inspection of the catchment on the 9th of April 2006; and
- The study team undertook an inspection of the catchment over the period 6th to 17th of April 2006.

3.2 Risk Assessment and Priority Setting

To help prioritise the recommendations made in this project, a risk assessment approach has been used to help rank the relative importance of actions within the catchment of the Activity Plan.

Priority has been established through an assessment of the condition (based on ISC scoring 1-5), then an assessment as to its Consequence (via a Risk/Threat matrix with a score of 1-5) and then an assessment of the urgency or need to intervene quickly or over time with the action (score 1-10). These were multiplied together to get an overall numeric ranking score to determine the priority. This has then been translated into one of five descriptors ranging from Urgent, Very High, High, Moderate through to Low according to the following bands:

Table 3.2-1 Priority ranking scores

Priority	Ranking Score
Urgent	201-250
Very High	151-200
High	101-150
Moderate	51-100
Low	0-50

The priority actions identified in the catchment are shown in Appendix A to Appendix D at the rear of this report.

3.3 Reach Activity Spreadsheets (Summary of Issues and Actions)

Activity spreadsheets have been compiled to document important site specific issues identified in each of the four reaches, refer to Appendix E to Appendix I. The spreadsheets offer an overview of the extent of expenditure required to achieve the vision of this Plan in the next five to ten years. The spreadsheets detail the issues, location, recommended actions, cost estimate and assign a priority to each respective issue. The issues for each reach have been grouped into the following activity headings:

- Habitat (H);
- Stream Stability (S);
- Water Quality (WQ);
- Vegetation (V); and
- Flooding (F).

3.3.1 Issue – Naming convention

Issues have been identified using a naming convention that refers to 1) the Activity Heading, 2) the Issue Number, and 3) the respective Reach/Tributary. For example H/R3/1, refers to a Habitat issue identified in Reach #3, Tributary #1. Similarly, S/R4 refers to a Stability issue identified in Reach 4. The issue number is used to identify specific issues only and is not related to a priority. Priorities are set in the spreadsheets that are attached as Appendices to the report (refer to Section 3.2 above).

3.3.2 Location of issues

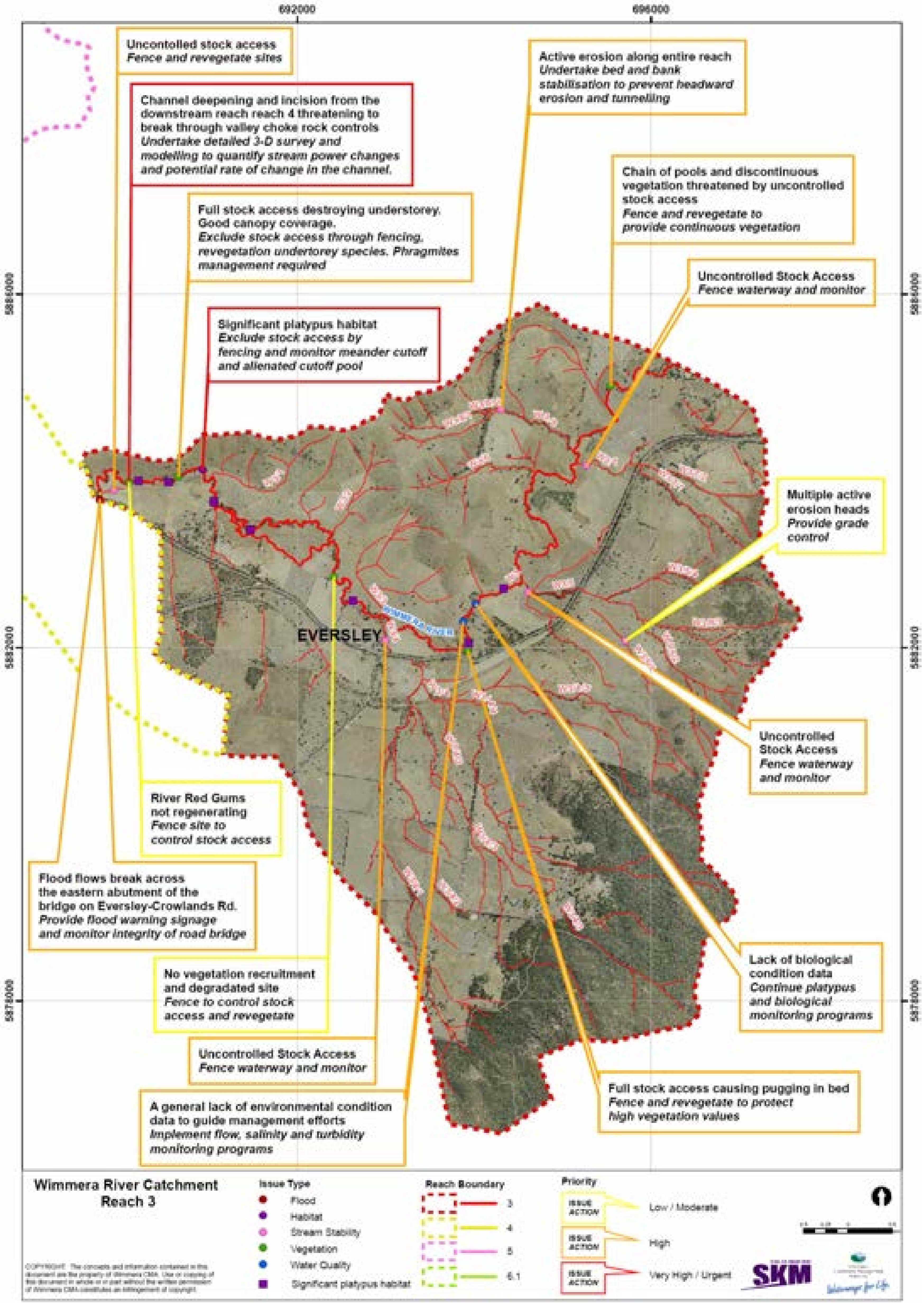
GPS locations have been provided (Easting and Northing) in the MGA datum (GDA94) to help identify site specific locations. Reach maps have also been compiled with an overlying grid to help identify where the respective issues are located. Further, each activity is distinguishable by colour i.e. 'Stability' issues are represented by a different colour to 'Vegetation' issues. Site numbers have also been provided that relate to specific locations where areas of significance have been identified.

3.4 Catchment Analysis by Reach

The next four Sections (Sections 4 to 7) analyse the following four reaches in detail:

- Reach 3 – Wimmera River (Immediately upstream of Glenlofty Creek to Eversley- Crowlands Road)
- Reach 4 – Wimmera River (Eversley-Crowlands Road to Spring and Tuckers Creeks)
- Reach 5 – Wimmera River (Spring and Tuckers Creeks to Glendhu Creek)
- Reach 6.1 – Wimmera River (Glendhu Creek to Vances Crossing, Joel South)

4 Reach 3 – Wimmera River (Immediately upstream of Glenlofty Creek to Eversley- Crowlands Road)



4 Reach 3 – Wimmera River (Immediately upstream of Glenlofty Creek to Eversley-Crowlands Road)

4.1 Location of Reach 3

The upper end of Reach 3 of the Wimmera River is marked by the Landsborough Road bridge (with the Glenlofty Creek junction about 500 m to the west). The lower end the reach extends down to the Eversley-Crowlands Road bridge. This reach includes the site of the Eversley Gauging station.

4.2 Morphological description

This reach covers approximately 13km's of the Wimmera River and has a number of unique features. The channel is characterised by a number of distinct morphologies through the reach. Significant morphological features vary from a partly confined valley with a discontinuous channel and chain of ponds through to a confined valley with a continuous channel with ponds back to a partially confined valley with a discontinuous channel and chain of ponds. On the southern side of the valley there are a number of paleochannels and minor tributaries. An earlier floodplain remains associated with this reach in the form of a higher terrace.

A key feature of the river in this reach is the two distinct valley chokes behind which broad floodplains are formed. The chokes occur where the harder rocky red shale hills compress the floodplain and confine the stream. The first choke provides a control to the upper floodplain through to the Glenlofty Creek junction and the second occurs against the steep rocky hill just upstream of the Eversley-Crowlands Road. These chokes have major impacts on the stream forms upstream. Upstream of the Landsborough Road (Reach 2) the floodplain still exhibits its ephemeral pond formation with many discontinuous channels.

The channel, in the upper end of Reach 3 and the first of the floodplains appears to be the product of drainage activities that were undertaken to allow reliable agricultural development of the floodplain. Some sections are very straight in configuration but the channel generally appears to follow what was probably a pre-existing minor channel which was deepened and interconnected. Many old large meanders, courses and distributary channels are evident across the floodplain.

The contemporary channel is 'U' shaped and is perched above the floodplain in most places. Recent overbank deposition is evidenced by the homogenous 0.5–0.75 m top strata of the floodplain material that has been interpreted as post-settlement alluvium (PSA). Elsewhere, deposition seems to interact closely with the tributary junctions, with pointbar and other sand bank-attached bars evident downstream from confluences. However, the lower Glenlofty Creek and junction show no recent signs of aggradation, which is not surprising given that Glenlofty Creek has retained its chain of ponds formation and displays little sign of gross sediment transport.

Generally, the mainstem may be regarded as stable except for extensive bank disturbance from uncontrolled stock access through the reach. This is exacerbated in places where the waterholes have been deepened by landowners to ensure access to the subsurface flows. It is interesting to note that the position of the River Red Gums in this reach, with the greater majority growing inside the channel margins with virtually none established on the verge, and all appear to be less than 100 years old.

- **Figure 4-1 Broad floodplain at the upper end of reach 3**

- **Figure 4-2 River Red Gums growing inside that channel margins**

The base level of the upper floodplain is controlled by a series of rock bars within a 30 m wide rock gorge downstream of the Eversley gauging station. Tributaries within this floodplain pocket are generally stable with most of the erosion completed. The southern tributaries (W3/4, W3/5 and W3/7) rise on the granitic slopes of the Pyrenees Range and, whilst deeply incised from past erosion activity, they now display a basically stable morphology with many bed rock intersects and reasonable bank stability (banks are generally laid back and grassed). These tributaries are essentially unfenced and any current instability is primarily due to stock access, with no current sediment transport noted. Fencing of these tributaries will be an important response as will post-flood monitoring for any significant change. Some overland flow management actions were also noted in these areas with many check banks constructed; probably by the former SCA in conjunction with the landowners. The integrity of these seems to be good and they are assisting in overland flow management to lessen tunnel and gully erosion.

Tributaries on the north side (W3/1, W3/2, W3/3, W3/6 and W3/8) all rise on the red shale and slate slopes of the local range. These are all ephemeral streams and generally short in length and do not display any significant active erosion. Tributary W3/8 is an exception with active erosion still evident. This tributary has been the subject of past fencing and tree planting works. No substantial bed control work has been performed and hence the channel is still unstable and eroding with both headward and bank erosion; the channel is now deeper than 3 m. A gully plug dam immediately upstream of the mainstem junction is now full of sediment. This stream will need a comprehensive set of actions to attain stability and infill. This works will require multiple bed grade control structures and measures to prevent the head cuts and tunnelling. The adjacent now mature revegetation will need augmentation and the use of sedges to assist with bank and bed controls. On the day that the stream was inspected the creek, a small saline flow was evident indicating intercept of the deeper salt bearing clay substrates.

- **Figure 4-3 The first and most upstream valley choke near the Eversley gauging station**

The second valley choke and upstream floodplain is formed by the parallel hillsides upstream of the Eversley-Crowlands Road bridge where the bed controls are a series of weathered shale bars in the valley floor and channel. This segment is the lower end of Reach 3. The ponds through the choke area are of very high quality having excellent structure and habitat complexity. These are known to be used by Platypus (C. Darbyshire, pers. comm.). Of concern is the change in channel size through the choke over a distance of about 1.8 km, whereby the downstream channel size is four to five times the size of the channel at the upper end of the choke along with significant incision and local steeping of the grade. A series of erosion points were noted through the choke and some of the rock controls appear to have been broken through. It is obvious that the channel deepening and incision from the downstream reach (Reach 4) is in the process of migrating upstream through these rock controls. The sizes of some of the scour ponds at the upper end of the incisions are very large, indicating large energy transitions within the actively eroding portions.

- **Figure 4-4 Excessively large channel capacity upstream of the Eversley-Crowlands Road bridge and immediately downstream of the second valley choke**

We recommend that the choke area is the subject of a detailed survey and hydraulic modelling, under a variety of flows, to quantify the stream power changes and potential rate of change in the channel. It is likely that a number of interventions (grade controls and controlled transitions of larger flows) will be required in this reach to prevent the channel from enlarging further with resultant loss of habitat values. Channel enlargement is also evident under the Eversley-Crowlands Road bridge with the abutment piers recently requiring structural support work.

- **Figure 4-5 Rock bars near the Eversley-Crowlands Road bridge are helping protect the second valley choke**

Upstream of the lower valley choke, the stream sits within a semi-confined floodplain with the higher terrace to the south and the rocky hills to the north. The stream is a discontinuous chain of ponds, with some ponds retaining very high environmental values. The primary channel is basically stable due to its relatively flat grade and interconnection with the floodplain. A number of flood channels and old courses are evident in this segment with a major old course being actively re-engaged on the south bank. Unfortunately most of the stream in this segment has uncontrolled stock access, with subsequent loss of vegetation and erosion of banks. A major initiative will be required to start a rolling program of alternate stock watering and then fencing the highest value elements of the reach. This program will need to extend along the entire waterway.

The small lateral tributaries that enter the stream through the lower part of Reach 3 rise in the steep adjacent hills. Apart from an eroded channel that runs parallel to the Eversley –Crowlands Road most are bedrock controlled and not actively eroding. We did note, however, that some of the rabbit control works such as ripping of burrows may create local slips or erosion points and these need to be monitored.

4.3 Vegetation

Current EVC mapping indicates that vegetation in this reach intersects eight vegetation communities. Table 4.3-1 indicates the specific EVC that have been previously recorded within the study reach and the general vicinity of occurrence.

Creekline Grassy Woodland and Alluvial Terraces Herb-rich Woodland/ Plains Grassy Woodland Complex provides the most relevant EVC to the riparian environment and the re-establishment of a native understorey would be an important step in the improvement of the waterway and initiation of a long-term environmental improvement program.

Overall, the catchment is largely clear of remnant vegetation and is somewhat restricted to the mainstem and on the higher slopes, particularly on the fringes of Mount Ben Nevis and Mount Cole National Park in the south eastern areas of the reach. These areas are generally indicative of limited agricultural activity.

The mainstem is generally characterised by aged River Red Gums over an understorey of scattered Black Wattle and exotic weed and pasture species including Phalaris, Spiny Rush and Gorse. The health of the canopy trees (River Red Gums) vary along the reach, however, a large majority are stressed from the pressures of drought, inappropriate water regimes and uncontrolled grazing.

- **Table 4.3-1 Current Vegetation Attributes (EVC) Reach 3 –Wimmera River).**

Current EVC Remaining in Reach (DSE, 2005)	Occurrence	Location
22 – Grassy Dry Forest	Southern hill slopes	Range of slopes and altitudes outside of the riparian zone.
20 – Heathy Dry Forest	Upper eastern hill slopes	Shallow rocky skeletal soils
23 – Herb-rich Foothill Forest	Small remnants in the north west of the catchment, W/3/6, W3/1	Relatively fertile, moderately well drained soils. Easterly and southerly aspects of lower slopes and gullies.
55 – Plains Grassy Woodland	Scattered remnants along mainstem and ephemeral tributaries south east of Eversley	Occupies poorly drained, fertile soils on flat or gently undulating hill slopes on lower elevations.
68 – Creekline Grassy Woodland	W3/4/1, W3/4/2, W3/4/3	Drainage lines and adjoining flats.
67 - Alluvial Terraces Herb-rich Woodland	South eastern hill slopes W3/4/4	Range of slopes and altitudes outside of the riparian zone.
175 – Grassy Woodland	Upper eastern hill slopes, W3/5/4, W3/6/3	Intermediate slopes between the plains and more infertile upper slopes.
896 – Grassy Woodland/ Heathy Dry Forest Complex	Upper reaches of W3/4 and W3/4/2	Lower exposed and dry slopes of low to moderate fertility.

Although the riparian vegetation was degraded, some areas of the in-stream vegetation represent good species diversity and coverage, particularly in areas north-west of Eversley (Figure 4-6). Dominant aquatic vegetation included small to large stands of Phragmites, pockets of Cumbungi (*Typha domengensis*), Water Ribbons (*Triglochin procerum*) and Common Starwort (*Callitriche stagnalis*). Scattered sedges (*Carex sp*) and rushes (*Juncus sp*.) occasionally fringed the waters edge.

The majority of the streams length has uncontrolled stock access, which has resulted in the loss of native riparian vegetation, both in coverage and diversity. In-stream disturbances including erosion, salinity and sedimentation have accelerated riparian degradation in some areas. The provision of alternative water supplies for stock in conjunction with conservation fencing should be seen as a high priority for this reach and the Wimmera River in general. A revegetation program focussing mainly at the restoration of understorey should shortly follow.

- **Figure 4-6 - Riparian vegetation at the valley choke near Eversley.**

4.4 Habitat

The major instream habitats of the reach include a series of shallow and deep ponds separated by smaller runs of flowing water. While some ponds are a permanent feature of the river, the flowing areas are more variable. These areas would flow deeply during wet sequences, sometimes retaining a small trickle flow through the drier parts of the year, but drying up completely under drought conditions which is the present state. However, subsurface flow below the gravel seams between the ponds also frequently occur throughout the reach.

Small amounts of large woody debris were observed throughout the mainstem, with a number of scattered branch piles, exposed roots and overhanging banks. These areas would provide ideal Platypus habitat. Generally, despite the lack of debris, there appeared to be a reasonable range of instream habitat and instream vegetation. The habitat quality is largely dependant on the water quality in the deeper ponds. If stratification occurs in these ponds, then suitability for fish, amphibians and other water dependant species may be reduced.

Riverine habitat is variable along the reach, and in-channel, bank and riparian vegetation is mainly discontinuous which demonstrates the impact of long term grazing. The mainstem of the reach predominately contains a canopy of aged River Red Gums with limited natural recruitment, other than a few patches in-stream. The lack of natural regeneration is a cause for concern as a large majority of the canopy vegetation along the river is senescing.

The habitat through this reach is variable. As mentioned previously the remnant habitat elements of the well treed channels plus the larger and deeper ponds have very high values, need to be protected and enhanced. As the Upper Wimmera is critical for the maintenance and recolonisation of the rest of the waterway system with recruits for many of the macro fauna such as fish, and mammals such as Platypus and Water Rats its protection is now critical. The slow decline and loss of quality habitats through unrestricted stock access needs to be curtailed. Some areas need to have habitat elements reinserted and others areas need to be revegetated such that large woody debris can be sourced over the next few generations.

The highest value ponds exist within the mid and lower segments of the reach with again the highest values being within and immediately upstream of the second valley choke. Some of these are wonderful examples of what formerly existed and it is a compliment to the current landholder's protective management regime that the values haven't been threatened by excessive grazing access.

4.5 Water Quality

As covered in the main discussion on water quality, this reach has fairly good water quality in periods of low flow where there is limited stock access. Salinity is reasonably low and nutrient issues are not present at a level where concern needs to be expressed. However the decline in quality was very marked in a number of locations at ponds where open stock access was available. Here the ponds could be seen to be turbid and affected by defecation. Bacterial and nutrient levels were high and one instance a blue green bloom of anabaena was observed.

This type of deterioration is threatening to the health of stock as well as to the stream values. The most significant level of protection will arise from the provision of alternate stock water provision and fencing of sensitive areas.

The storm flow quality is very likely to reflect the erosive runoff of skeletal soil systems of the adjoining hills and slopes which generally are only lightly pastured or even subjected to annual cropping. The most likely outcome for the stream is that both suspended solids and turbidity will rise rapidly in storm events as the smaller particulates and colloidal material from the sheet and rill erosion processes are rapidly transported to the mainstem by the relatively steep lateral tributaries.

One of the interesting elements of the current floodplain morphology is that some of these lateral streams enter the floodplain via silt fans or swampy areas rather than defined channels. It may be worthwhile investigating whether these wetland systems could be enhanced to provide more season protection and reduction of suspended solids loads. As an adjunct to this an extension program of water retention techniques on lands and management of the overland flow paths to reduce export of erosion products would be greatly beneficial to the health of the stream system. The observed old SCA programs seemed to be working very well and give an insight as to potential benefits to both land owners and the waterway.

4.6 Flooding

The flooding in this reach is controlled by the valley chokes and extended periods of long duration ponding can be expected in larger events.

The highest recorded flood in recent years at the Eversley Gauge (Stn Number 415207) is 15,900 Ml/day on October 1973. This equates to a peak flow of about 183m^3/sec. This scale of flooding would have serious impact on the channel condition immediately upstream.

The only structural concern with respect to flooding was the Eversley-Crowlands Road bridge at the bottom of the reach where it can be seen that flood flows break across the eastern abutment and then back into the river downstream where the channel capacity is larger. A series of bank scours are observable at this location indicating serious over bank activity.

- **Figure 4-7 - Eversley-Crowlands Road bridge.**

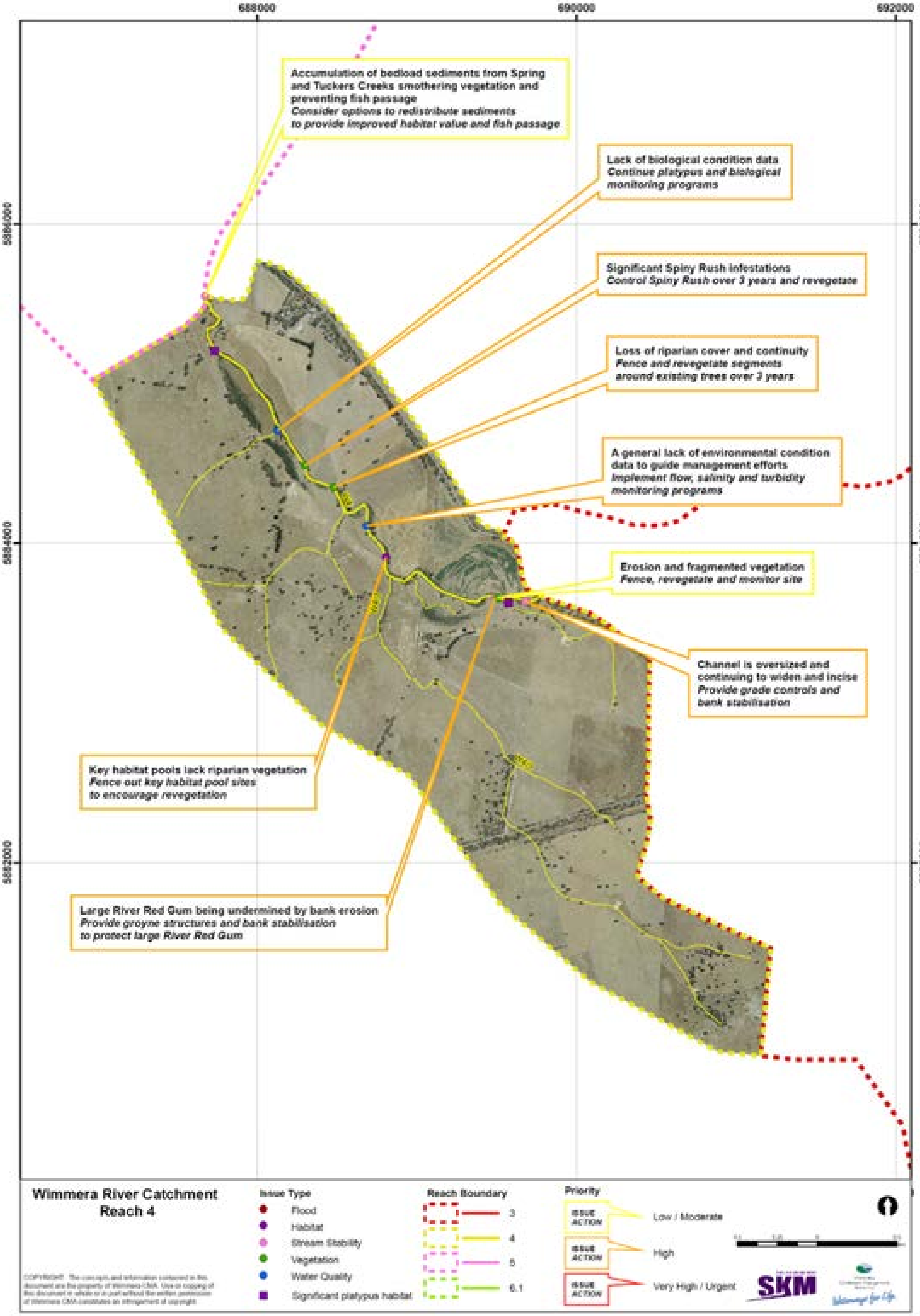
4.7 Threats and Priorities

Table 4.7-1 summarises the major threats that have been identified in Reach 3. For specific details on issues, actions, locations, priorities and cost estimates, refer to Appendix A – Reach 3 Summary of Issues & Actions

- **Table 4.7-1 Major threats to Waterway Health identified in Reach 3**

Threat	Risk
Large channel incision process in valley choke upstream of Eversley-Crowlands Road bridge	Very High
Very high value habitat stream segments and ponds threatened by uncontrolled stock access for watering	Very High
Substantial loss of habitat values and riparian vegetation along Wimmera River mainstem	Very High
Stock access to stream zones in both mainstem and eroding areas of tributaries	Very High
Old SCA stabilisation works in decline on tributary W3/8 due to no maintenance and has the potential to fail	Very High
Small amounts of active erosion in lateral tributary streams with the potential to generate and transport sediment (monitor)	Moderate
Structural integrity of the Eversley-Crowlands Road bridge under flood conditions	High
Loss of key ephemeral swamps and floodplains to mitigate suspended solids and turbidity for tributary inputs	High
Sediment and nutrient transport from catchment due to land use and loss of mitigation systems	Moderate
Salinity production in denuded catchment leading to saline discharge areas and higher salinity	Moderate
A general lack of environmental condition data to guide management efforts	Moderate
Rubbish dumping in eroding tributary near Eversley-Crowlands Roads	Moderate

5 Reach 4 – Wimmera River (Eversley-Crowlands Road to Spring and Tuckers Creeks)



5 Reach 4 – Wimmera River (Eversley-Crowlands Road to Spring and Tuckers Creeks)

5.1 Location of Reach 4

This reach is short extending some 3 km from the Eversley-Crowlands Road to the junction of Spring and Tuckers Creeks, upstream of the Dunneworthy-Crowlands Road.

5.2 Morphological description

Reach 4 is characterised by a large channel that sits in a broad current floodplain with a higher terrace on both sides. Part of the channel has been previously straightened (most likely by State River and water Supply Commission) in the late 1970's after floods reworked the channel at the junction of Spring and Tuckers Creeks. These works were instigated by local land owners as the river level post 1973 was markedly higher. The channel was formerly a chain of ponds with the key control being a valley choke downstream of the Dunneworthy-Crowlands Road. This choke is in Reach 5 and will be described in more detail in that section of the report.

- **Figure 5-1 – Sediment deposition in the Wimmera River at the confluence with Spring & Tuckers Creeks.**

The stream has been modified since European settlement with the creation of a defined channel to interconnect the ponds and drain the floodplain. A number of old courses are visible in the current floodplain with many of these extensively colonised by Spiny Rush (*Juncus acutus*). The tributaries in this reach all enter from the left bank and are generally ephemeral. These have historically eroded into the slope but erosion activity is now slow and episodic. Both W4/1 and W4/2 show signs of past headward erosion with W4/2 being more active. Both streams exhibit relatively saline substrates and there is little vegetation on either bed or banks except for Spiny Rush. W4/2 needs to be monitored for erosion. W4/3 has active multiple head cuts which have been recently treated with car tyres. The same branch is also incised at its junction with the mainstem. The works recently done on the headcuts are unlikely to persist and should be monitored.

- **Figure 5-2 An old course of the Wimmera River can be seen above, with the current and oversized channel located at the right of the picture**

The incision and increased channel capacity at this upper end of the reach, has resulted in the alienation of the floodplain from its channel, particularly the higher north side that is currently used for lucerne cropping. The incision and channel erosion process has also undermined a very old River Red Gum on the left bank and may result in the loss of this magnificent tree. Some older channels were alienated or straightened to allow for the construction of the Tulkara Railway with the former channel on left bank being cut off by the railway embankment on left bank and across the floodplain. The channel is wide and forms in ponds that are fringed with Spiny Rush.

5.3 Vegetation

Current EVC mapping indicates that vegetation in this reach intersects four vegetation communities, including a variety of forest and woodland forms. Table 5.3-1 indicates the specific EVC that have been previously recorded within the study reach and the general vicinity of occurrence.

Creekline Grassy Woodland and Alluvial Terraces Herb-rich Woodland/ Plains Grassy Woodland Complex provides the most relevant EVC to the riparian environment and the re-establishment of a native understorey would be an important step in the improvement of the waterway and initiation of a long-term environmental improvement program.

- **Table 5.3-1 Current Vegetation Attributes (EVC) Reach 4 –Wimmera River).**

Current EVC Remaining in Reach (DSE, 2005)	Occurrence	Location
68 – Creekline Grassy Woodland	Occurs along the majority of the mainstem	Drainage lines and adjoining flats.
896 - Grassy Woodland/ Alluvial Terraces Herb-rich Woodland Mosaic	Occurs on the mainstem and upper reaches of W4/1	Lower exposed and dry slopes of low to moderate fertility.
152 - Alluvial Terraces Herb-rich Woodland/ Plains Grassy Woodland Complex	Occurs on the mainstem	Intermediate slopes between the plains and more infertile upper slopes.
55 – Plains Grassy Woodland	Occurs on the upper reaches of W4/1 only	Occupies poorly drained, fertile soils on flat or gently undulating hill slopes on lower elevations.

Generally, remnant vegetation coverage within the reach is sparse and is mainly limited to a scattered River Red Gum overstorey over an exotic understorey along the mainstem. A large majority of the floodplain vegetation has been cleared for agriculture and is now replaced with exotic pasture species.

The riparian zone is generally characterised by scattered individuals of River Red Gum, Black Wattle (*Acacia mearnsii*), Blackwood (*Acacia melanoxylon*), scattered patches of native grasses particularly Kangaroo Grass (*Themeda australis*) and introduced species such as Gorse, Tamarisk (Figure 5-3) and Spiny Rush.

The River Red Gums are scattered, with their age class generally less than 100 years old indicating that extensive tree removal occurred. Some plantings of about 25 years old were noted, and the successful recruitment of this appeared to be impacted by the salinity of the area. A former saw mill site was located on the banks immediately upstream of the Dunneworthy Road bridge explaining the lack of mature trees within the immediate area.

In-stream vegetation was largely confined to the permanent ponds along the reach, particularly downstream of the old Tulkara Railway where they contain infestations of Phragmites, isolated stands of Cumbungi (mainly *Typha domingensis*), Floating pondweed (*Potamogeton tricarinatus*), isolated patches of Water Ribbons (*Triglochin sp.*) and Swamp Lily (*Ottelia ovalifolia*).

Stock access is generally unrestricted throughout the reach and this is affecting the recruitment of trees. The regeneration of River Red Gum is mainly confined to in-stream, where shallow and moist conditions have favoured germination.

- **Figure 5-3 - Tamarisk (*Tamarisk aphylla*) and Spiny Rush (*Juncus acutus*) can be found throughout Reach 4.**

5.4 Habitat

The habitats in the reach are confined to quite deep languid ponds with little woody debris. Hence these areas would be less preferred by animals as food sources would be reduced. There are few records of fish and or larger mammals with reliance being placed on the Platypus surveys. Williams and Serena (2006) did not detect any animals in this reach in the 2005 trapping study.

No comprehensive fish records exist for the area and the lack of large woody debris jambs indicate a lower likelihood for species such as blackfish. A large carp was observed in one of the ponds as was some Mosquitofish (*Gambusia holbrooki*). The lack of data in this reach makes it hard to make a definitive statement on the quality of the fauna using the reach. However, it is reasonable to say that the habitat complexity and quality declined from that of Reach 3. A significant change in this reach is the lack of large woody debris which has reduced the amount of available habitat for fish and other species.

- **Figure 5-4 – Former Tulkara railway crossing (right) and typical stream characteristics throughout Reach 4.**

5.5 Water Quality

The water quality in this reach is dominated by the occurrence of the saline discharge areas that sees the salinity climb. The EC observed at the time of the field inspections upstream of the junction of Spring and Tuckers Creeks was higher in this reach compared to that of Reach 3.

As in the other reaches the likelihood of elevated suspended solids, especially fine particulates under high flow event conditions is highly likely. This is further compounded by local contributions of both coarse and fine erosion products from the tributaries plus instream erosion in the area around the Eversley-Crowlands Road incision.

5.6 Flooding

Flooding in this reach would be similar to that of reach 3 from a discharge point of view. The flood levels will be controlled by the two restrictions of the Dunneworthy Crowlands Road bridge and the valley choke in reach 5. Flood levels will rapidly climb due to these chokes and the floodplain will be readily engaged in the lower segment.

5.7 Threats and Priorities

Table 5.7-1 summarises the major threats that have been identified in Reach 4. For specific details on issues, actions, locations, priorities and cost estimates, refer to Appendix B.

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- **Table 5.7-1 Major threats to Waterway Health identified in Reach 4**

Threat	Risk
Channel incision and expansion process in upper reach towards Eversley Crowlands bridge upstream of Eversley Crowlands bridge	Very High
High value habitat stream segments and ponds threatened by uncontrolled stock access for watering	Very High
Substantial loss of habitat and riparian vegetation along Wimmera River mainstem	Very High
Stock access to stream zones in both mainstem and eroding areas of tributaries	Very High
Large aged River red gum undermined by incision process and needs protection	High
Small amounts of active erosion in lateral tributary streams with the potential to generate and transport sediment (monitor)	Moderate
Loss of key ephemeral swamps and floodplains to mitigate suspended solids and turbidity for tributary inputs	Moderate
Sediment and nutrient transport from catchment due to land use and loss of mitigation systems	Moderate
Salinity production in denuded catchment leading to saline discharge areas and higher salinity on left bank	Moderate
Habitat complexity declines due to loss of channel characteristics, vegetation and large woody debris	Moderate
Lack of environmental management data to help guide future management initiatives	Moderate

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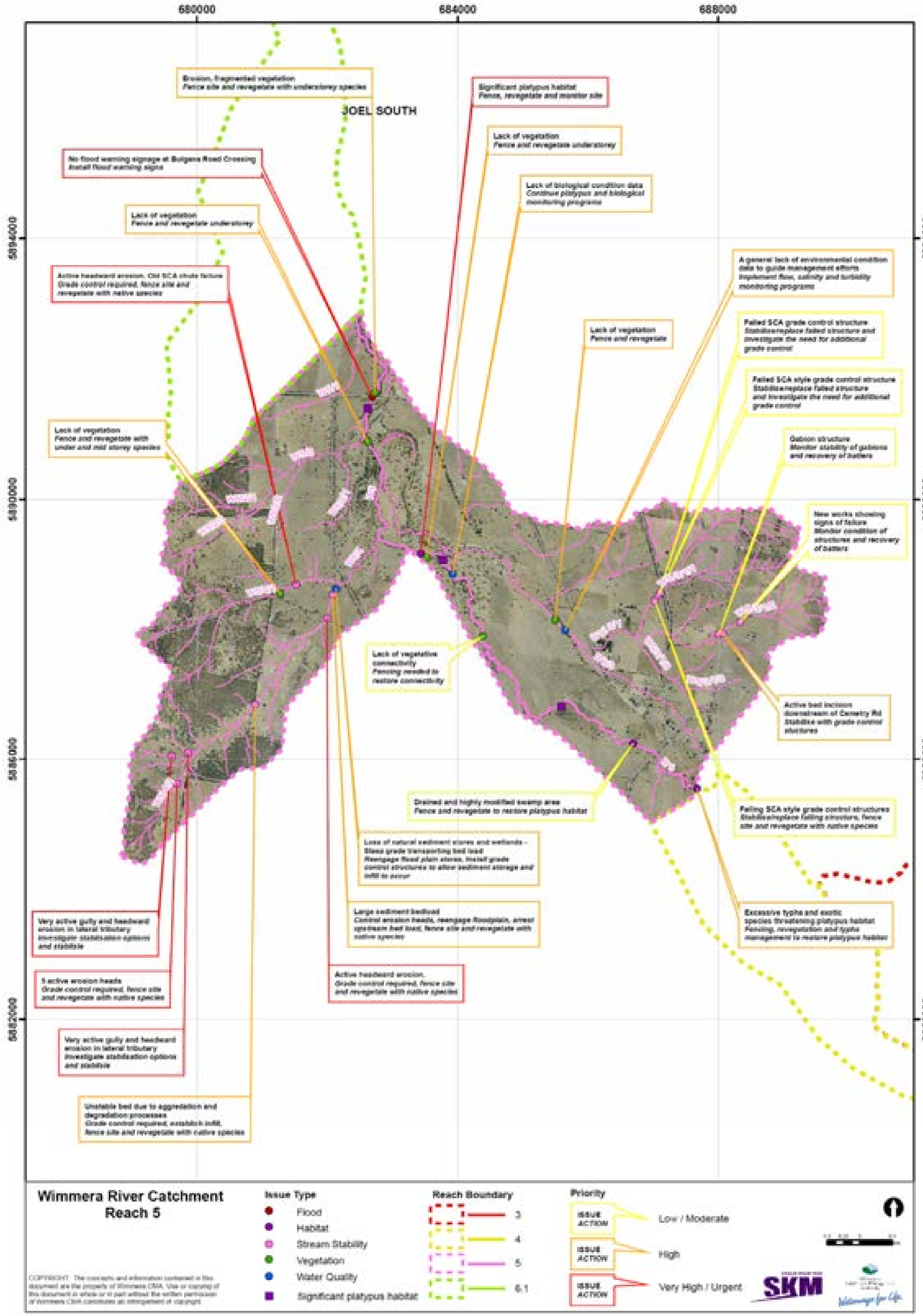
6 Reach 5 – Wimmera River (Spring and Tuckers Creeks to Glendhu Creek)



6 Reach 5 – Wimmera River (Spring and Tuckers Creeks to Glendhu Creek)

6.1 Location of Reach 5

Reach 5 contains some of the highest values on the Upper Wimmera River. The reach extends from the junction of the Spring and Tuckers Creeks though to Glendhu Creek. Mt Cole Creek is a major tributary in this reach that enters on the left bank.

6.2 Morphological description

This reach contains remnants of what once would have had high waterway values and chain of ponds formations. Another floodplain choke occurs in this reach approximately 1.8 km's downstream of the Dunneworthy-Crowlands Road bridge where a rock bar exists in an area where the valley is compressed. The stream channel downstream of the Spring & Tuckers Creek junction has been channelised on a number of occasions to remove the sediment deposits from those catchments. This channelisation is very evident for up to 300 m downstream of the Dunneworthy Road bridge. Currently there are at least three areas where there are obvious deposits now colonised by macrophytes right across the main channel and other areas where the channel is contracted. Here, the mainstem appears to be reverting to its historic form of a chain of ponds. The floodplain displays deeper dark organic clay silt with a more recent PSA layer of light brown yellow silty clay over the top. There are also areas of gravel deposits where these have been transported in from Spring Creek.

- **Figure 6-1 Previous sediment removal site near Dunneworthy-Crowlands Road bridge**

- **Figure 6-2 Coarse bedloads are migrating through the Wimmera system**

Further downstream of Dunneworthy Road bridge the floodplain widens and displays a number of old courses. Interestingly, on the upstream side of the choke there are a number of distinct radial channels leading to the neck of the choke. These are colonised heavily with Spiny Rush indicating both saturation and high salinity. Tree cover along the mainstem is very sparse with most trees only about 30 years old.

On passing through the choke the stream flows in a confined valley and is incised (probably due to the steeper grade and higher stream power). The age of River Red Gums is much older in this segment and the channel appears to be relatively stable for much of the reach. Recent fencing has started to preclude stock access in this area and this will help with the minor bank stability issues. This program should be supported to allow the establishment of bed and bank cover plus establishment of a broad sward of sedges and grasses on the valley floor under the trees.

Towards the lower end of the confined valley segment an obvious increase in channel cross-section becomes apparent with many areas of bank erosion and also bed incision through a series of erosion heads. This is very similar to the activity at the boundary of the choke at the end of Reach 3 / start of Reach 4. Works are needed in this area to slow the rate of change and ensure that the ponds, through the confined valley, are not lost.

The activity of the channel erosion is probably due to impacts of stream straightening over the past 150 years. This interpretation is supported by a rapid increase in channel size through the "Woodlands" property and the presence of numerous alienated old small channels on the floodplain. Examination of the 1870 painting by 'Von Geurard' of the Wimmera River show a number of small multiple channels on the floodplain, instead of the large deep major channel that exists at the site today. One of these smaller channels actually fed the duck pond in front of the Homestead, an impossibility today given the incision process. It is probable that the south channel was actually that of Mt Cole Creek and that the Wimmera River channel was on the northern side of the floodplain. Whilst no records are available it seems probable that some channelisation occurred to link the Wimmera River to the Mt Cole channel to provide more water to the homestead duck pond with this occurring approximately 1.5 km's upstream of the Woodlands Homestead.

The large channel rapidly increases past the incised Mt Cole Creek junction and the stream can be seen to have been channelised through the reach from the Bulgana Road crossing. This channel is relatively stable today due to the landowner's intervention of fencing and revegetation over the last 20 years. Prior to that, all the banks were apparently bare, with bed and bank erosion evident (D Shaw, pers. comm.). Some large woody debris management is evident and this appears to have been reasonably successful. A number of new ponds have formed in the incised channel and some of these have good habitat complexity and value. The age of the River Red Gums is much older along the older courses on the current floodplain with some trees being at least 450 years old or older. An array of macrophytes was evident as was some filamentous green algae.

Erosion around the Bulgana Road crossing has caused deposition within the ponds and subsequent colonisation by Cumbungi and Phragmites. These plants are dominant through this segment to the Glendhu Creek junction where the deposition of bedload has caused the bed to aggrade. This area, although containing ponded water, is densely colonised with Cumbungi and Phragmites with very mature River Red Gums on the banks.

Tributaries join this reach from the north and the southwest. The northern tributary (W5/3) is unnamed and has a number of ephemeral branches, one of which leads to the valley line north of the Crowlands Cemetery (W5/3/2). This waterway has had a number of bed control repair activities using gabion baskets and batter layback works, plus some older SCA works upstream that addressed the large eroded gully system. The more recent works are showing early signs of potential failure and need to be monitored. Downstream of the works area, a number of erosion heads need to be attended to in the adjoining property. The northern branch (W5/3/1) has also been subjected to past works in the SCA era and these have failed with reactivation of erosion obvious, both upstream and downstream of the Landsborough Road. The lower portion of this waterway follows a palaeochannel that is gently graded though the floodplain and joins the Wimmera River in a complex of braided channels about 1.4 km upstream of the Woodlands Homestead. This channel is flat and would have been a series of wetlands prior to clearing. This swampy area is now trapping erosion products from upstream thus protecting the Wimmera River.

- **Figure 6-3 headward erosion on W5/3/1/1 is undermining existing structures**

- **Figure 6-4 Existing concrete drop structure on W5/3/1/2**

The tributaries to the southwest are in very poor condition with extensive active erosion and salinity issues in most segments. The unnamed tributary W5/2 has had past erosion displaying by an incised channel and many bare banks, with some minor areas of instability. Although appearing stable at the time of inspection, this tributary could reactivate readily in a wet sequence due to bare bed and banks and poor vegetation cover, particularly in the foothill zones of W5/2/3 and W5/2/4. The flatter areas downstream of the dam on W5/2 and upstream of Woodlands Road are acting as deposition zones. Many minor tributaries on the western sedimentary foothill slopes show signs of local incision and need to be monitored. Again these are likely to activate in a wet sequence.

The unnamed tributaries W5/4, W5/4/1 and W5/4/2 are major concerns as these display very active bed and bank erosion downstream, upstream and west of Woodlands Road. The sediment from this erosion has little attenuation through the former swampy areas, although these could be readily reengaged to assist with the protection of the high value segments of the Wimmera River. The erosion in W5/4/1 is unabated and is very active following the total failure and undermining of the SCA style concrete chute about 500 m west of Woodlands Road. This failure has reactivated the headward erosion and a substantial amount of eroded material is being transported downstream.

- **Figure 6-5 SCA style concrete chute on W5/4/1 has failed**

The longer W5/4/2 tributary is very serious and the most active of all erosion observed in this Wimmera River study area. High sediment and salt loads are generated by multiple incision and bank erosion processes along the channel. This is compounded by a series of very serious multiple headed gullies at the upper end near the foothill break of slope and further up those slopes. Valiant attempts of tree planting along the verge in the flatter valley areas have been made by some land owners, but little has been done to address the primary channel erosion problem along the whole length of the channel for a distance of nearly 4 km. The level of activity ranks as highly as that of the next valley to the south in the Mt Cole Catchment which has been the subject of recent intervention works.

- **Figure 6-6 Active erosion in W5/4/2 is threatening an upstream dam**

- **Figure 6-7 Flood debris in W5/4/2 suggests that the catchment generates large flows**

This area of stream has deteriorated in the last two years, with the gullies showing significant expansion after the 2004 aerial photography run. The generation of high loads of both coarse bedloads and fine suspended sediments is of high concern for the health of the Wimmera River, particularly given the lack of attenuation in any wetlands. Also of concern is the relatively recent construction of two gully plug dams, both of which can be seen to have overflow erosion problems, creating another potential point of erosion. The salt loads being generated in this catchment are very high and there is a serious infestation of Spiny Rush along most of the stream. Only a few sparse Grey Box and River Red Gums exist along the verge.

- **Figure 6-8 high salt loads and eroding bed and banks in W5/4/2**

- **Figure 6-9 Coarse bedloads are being transported from W5/4/2 into the Wimmera River**

This area will require urgent intervention across the three landholder properties and will require a detailed investigation as to the appropriate responses. The works are likely to involve multiple grade controls, diversion banks and re-entry chutes, reacreation of deposition areas and extensive revegetation.

6.3 Vegetation

Current EVC mapping indicates that vegetation in this reach intersects six vegetation communities, including a variety of woodland forms. Table 6.3-1 indicates the specific EVC that have been previously recorded within the study reach and the general vicinity of occurrence.

Creekline Grassy Woodland and Riparian Woodland provide the most relevant EVC to the riparian environment. The lack of suitable understorey would be the main management focus required within the reach, with the re-establishment of a native understorey an important step in the improvement of the waterway and initiation of a long-term environmental improvement program.

- **Table 6.3-1 Current Vegetation Attributes (EVC) Reach 5 –Wimmera River).**

Current EVC Remaining in Reach (DSE, 2005)	Occurrence	Location
896 - Grassy Woodland/ Alluvial Terraces Herb-rich Woodland Mosaic	Occurring along the mainstem and upper reaches of W5/3 and W5/3/1/3	Lower exposed and dry slopes of low to moderate fertility.
175 – Grassy Woodland	Small pockets occurring along W5/1 and W5/3/1/1	Intermediate slopes between the plains and more infertile upper slopes.
152 - Alluvial Terraces Herb-rich Woodland/ Plains Grassy Woodland Complex	Occurring along the mainstem, W5/3/1/1 and W5/2/4	Intermediate slopes between the plains and more infertile upper slopes.
55 – Plains Grassy Woodland	Occurring along the lower reaches of the mainstem	Occupies poorly drained, fertile soils on flat or gently undulating hill slopes on lower elevations.
68 – Creekline Grassy Woodland	Occurring along the mainstem and small patches along W5/2	Drainage lines and adjoining flats.
641 – Riparian Woodland	Occurring along the mainstem and W5/2/1	Occurs beside permanent streams, typically on narrow alluvial deposits.

Remnant vegetation within the reach is restricted to the mainstem and the western slopes. Significant remnant stands occur on the higher ridges of W5/2/1, W5/2/3, W5/2/4, W5/4/1 and W5/4/2. These stands contain quite healthy Grassy Dry Forest and Alluvial Terraces Herb-rich Woodland communities and are characterised by a mixture of canopy species including Red Stingybark (*Eucalyptus macrorhyncha*), Red Box (*Eucalyptus polyanthemos*), Yellow Box (*Eucalyptus melliodora*) and Bundy (*Eucalyptus goniocalyx*) occurring on the higher ridges and

Grey Box (*Eucalyptus microcarpa*) and Yellow Gum (*Eucalyptus leucoxylon*) occurring in the lower valleys. The remaining areas of the reach are characterised by cleared paddocks and scattered trees over a groundcover of mainly exotic pasture and weed species.

Remnant vegetation along the mainstem north of Bulgana Road is characterised by scattered to a continuous linear band of River Red Gum of varying age classes over a groundcover of mainly exotic pasture and weed species. While on the floodplain, pre-European aged River Red Gums occur as scattered individuals. Some scattered Spreading Wattle (*Acacia paradoxa*), Black Wattle (*Acacia mearnsii*) and Blackwood (*Acacia melanoxylon*) were also observed. Canopy cover increases downstream of the Dunneworthy Road bridge, and recent fencing along the river has promoted some recruitment of River Red Gums. These landholder works should be consolidated by revegetating of the bed and banks with use of a combination of native sedges, rushes and grasses. Revegetation and fencing efforts of the current landholder along this reach have also helped stabilise the banks and have increased habitat values.

The quality of remnant riparian vegetation varies throughout the length of the mainstem. However, some sections of the reach contain some of the highest quality riparian vegetation on the upper sections of the Wimmera River. As with other reaches the recruitment of native vegetation is limited, except for areas that have excluded grazing by fencing and revegetation activities.

In-stream vegetation is largely restricted to the deeper ponds of the mainstem. Patches of Phragmites and clusters of Cumbungi (*Typha sp*.) frequently occur along a number of sections, particularly areas downstream of Bulgana Road. Overall, species diversity is usually low, however a number of the deeper ponds south of Bulgana Road contain decent species diversity (Figure 6-10). Notable species include Floating pondweed (*Potamogeton tricarinatus*), isolated patches of Water Ribbons (*Triglochin sp*.) and Swamp Lily (*Ottelia ovalifolia*). Spiny Rush (*Juncus acuta*) colinsed heavily in some sections downstream of Dunworthy bridge.

The ephemeral tributaries throughout the reach were generally located in a cleared paddock environment coupled with unrestricted stock access. The majority of the tributaries lack vegetation cover both in the riparian zone and within the channel, largely as a result of prolonged grazing and high salinity. Spiny Rush (*Juncus acuta*) frequently occurs as scattered individuals or dense stands in-stream and fringes the bed.

The majority of the mainstem has uncontrolled stock access, which has resulted in the loss of native riparian vegetation, both in coverage and diversity. In-stream disturbances including erosion, salinity and sedimentation have accelerated riparian degradation in some areas. The provision of alternative water supplies for stock in conjunction with fencing reach should be seen as a high priority for this reach and the Wimmera River in general. A revegetation program focussing mainly at the restoration of understorey should shortly follow. Opportunities for revegetation (both in-stream and within riparian zone) and fencing exist in tributaries on the western slopes including W5/2, W5/2/2, W5/2/3, W5/2/4, W5/4, W5/4/1 and W5/4/2. Revegetation in these areas will help stabilise actively eroding heads. These works would facilitate the reconnection of existing forested areas on the higher slopes. Revegetation efforts, initially, would require the use of salt tolerant species on the lower slopes.

- **Figure 6-10 Riparian and in-stream vegetation south of Bulgana Road**

6.4 Habitat

The habitat value in this reach is very high with records of fish and mammals present in the reach. The permanent deep ponds in both the upper and lower segments of this reach are critical to the survival of mammals and fish plus provision of potential recruits for the rest of the system. A breeding female Platypus has been recorded in the ponds at the head of the floodplain choke and it is likely that a nesting burrow is nearby. Other sightings of Platypus are common at the permanent ponds of the reach. Williams and Serena 2006 have recorded capture of Water Rats and tortoises through the reach along with fish by-capture.

The deep ponds show a very high degree of habitat complexity with good morphology, a high degree of large woody debris as substrate and good vegetation cover of both bank and instream, providing a variety of microclimates. A qualitative assessment of the invertebrates showed a reasonable diversity but not that of a low salinity freshwater stream with some of the May Fly and Stone Fly species not evident.

The tributaries show no real habitat values with most being severely degraded.

6.5 Water Quality

The water quality in this reach is a reflection of the upstream catchments plus the impacts of the tributaries. The salinity was qualitatively assessed and an increase in salinity from reach 4 was noted. This is not surprising given the salt inputs from Mt Cole Creek, Spring and Tuckers Creeks and the other tributaries.

Under high flow conditions, the stream would be affected by high levels of turbidity and suspended solids. The liberal coating of sediment high up on the Phragmites and Cumbungi infestations showed that erosion products are a major issue for the reach and likely to affect overall robustness of the stream ecosystem.

6.6 Flooding

Flooding is not a major issue in the reach with no private or public infrastructure or assets under any threat. The upper floodplain levels are controlled by both the natural floodplain choke and the limited cross section of the Dunneworthy Road bridge. These restrictions will locally increase the flood levels. Through the confined valley downstream of the choke the flood is naturally limited and would be out of bank readily. Downstream of the confined valley segment and where the channel is enlarged, the partially confined floodplain will be engaged but not to the degree prior to European settlement.

Flood flows are likely to increase markedly for major events downstream of Mt Cole Creek catchment junction.

The Bulgana Road ford will be readily inundated as the culverts under this are relatively small. Flood warning indicators are placed at the ford approaches. Velocities around the crossing are likely to be relatively high and entry to the ford when flows are 0.5 m above the base should be precluded.

6.7 Threats and Priorities

Table 6.7-1 summarises the major threats that have been identified in Reach 5. For specific details on issues, actions, locations, priorities and cost estimates, refer to Appendix C – Reach 5 Summary of Issues & Actions.

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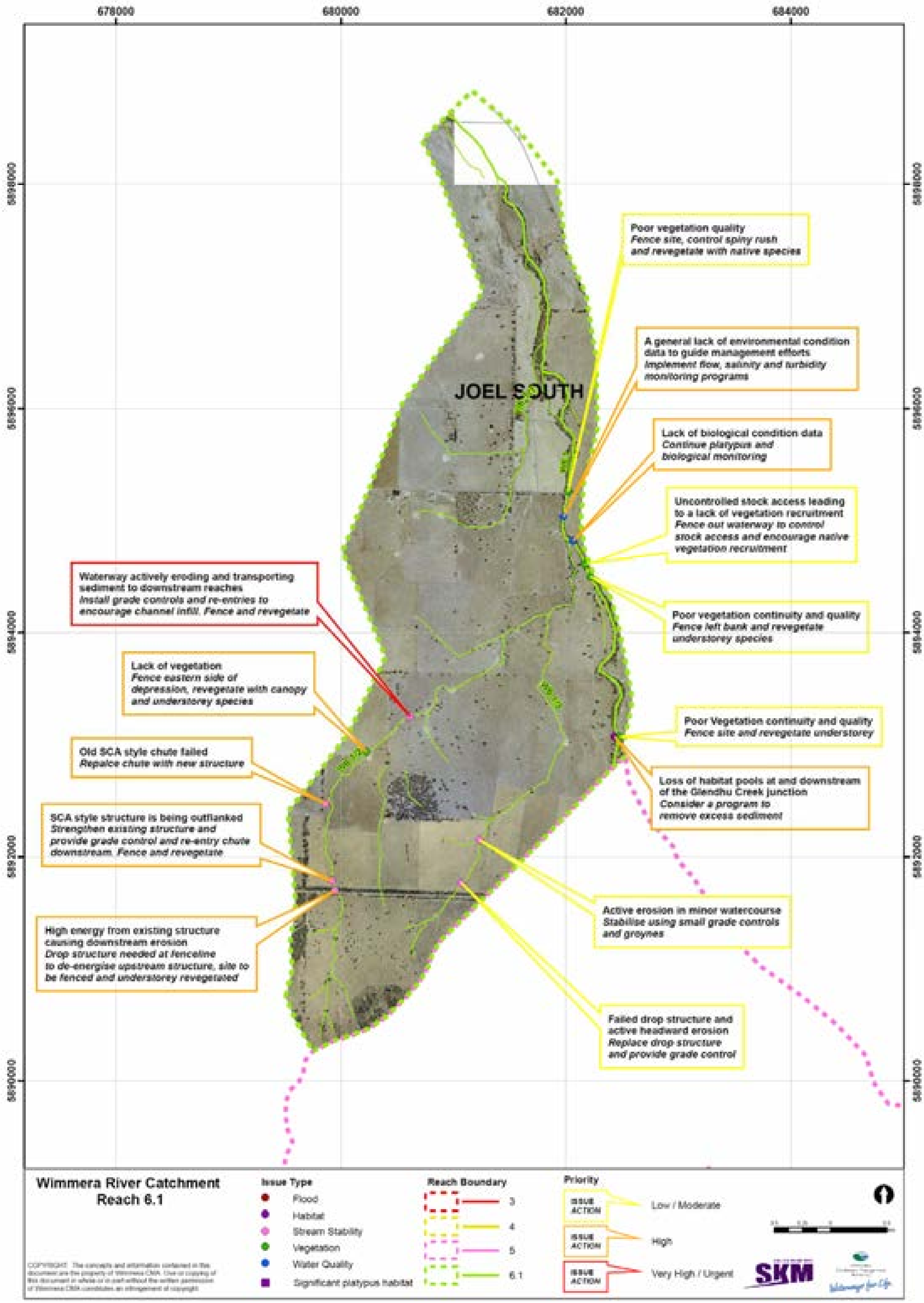
▪ **Table 6.7-1 Major threats to Waterway Health identified in Reach 5**

Threat	Risk
Significant amounts of active erosion in lateral tributary streams with the potential to generate and transport sediment	Urgent
Channel incision and expansion process in lower segment of confined valley needs investigation	Very High
High value habitat stream segments and ponds threatened by uncontrolled stock access for watering in upper segments	Very High
Substantial loss of habitat and riparian vegetation along Wimmera River mainstem in upstream segments	Very High
Habitat complexity declines due to loss of channel characteristics, vegetation and large woody debris in upper segment	High
Increases in salinity and sediments from tributaries	High
Many old stabilisation works need maintenance	High
Loss of key ephemeral swamps and floodplains to mitigate suspended solids and turbidity for tributary inputs	High
Sediment and nutrient transport from catchment due to land use and loss of mitigation systems	High
Salinity production in denuded catchment leading to saline discharge areas and higher salinity on left bank	Moderate
Lack of environmental management data to help guide future management initiatives	Moderate

7 Reach 6.1 – Wimmera River (Glendhu Creek to Vances Crossing, Joel South)



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7 Reach 6.1 – Wimmera River (Glendhu Creek to Vances Crossing, Joel South)

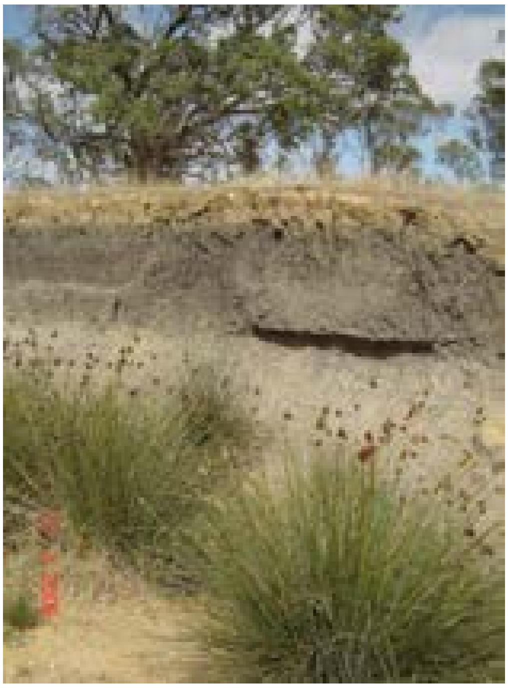
7.1 Location of Reach 6.1

Reach 6.1 of the Wimmera River extends for some 6 km from the junction with Glendhu Creek through to Vance's Crossing in Joel South. The reach includes some minor tributaries that rise on the low rolling sedimentary hills to the west of the river.

7.2 Morphological description

The Wimmera River in this reach is wide and deeply incised within a continuous floodplain. Prior to European settlement, the former morphology of this reach would most likely have been a chain of ponds. The contemporary channel however, is the product of a phase of straightening and channelisation as a result of European settlement. Examination of the 1885 parish plans supports this with many surveyed frontages following the straightened alignments prior to the finalisation of the land selection process. The channel is likely to have eroded at first and then started a filling phase as erosion products from tributaries from adjoining catchments being transported to the Wimmera system (cut and fill). This would have occurred in two phases, the initial extensive land clearance phase of the late 1890's through to the 1920's and also the post WW2 stage that saw extended clearance and cropping across the catchment. Incision of the main channel would have also initiated the erosion within tributaries of the Wimmera River. Many former shallow distributary channels are evident on the current floodplain, although these have also been filled by deposition.

The current floodplain is lower than the former floodplain and consists of very old deposits that are resistive dark silty clays. The upper stratum is some 0.5m thick and consists of post settlement alluvium (PSA) of light coloured fine silty clays and sands (refer to Figure 7-1). This PSA is likely to have been sourced from large exports predominantly from both Shays and Glendhu Creeks, but contributions from other catchments such as Mt Cole Creek would have also impacted.



- **Figure 7-1 Post-settlement alluvium (PSA) layer of brown sands and silt are distinct throughout this reach.**
- **Figure 7-2 Straightened section of the Wimmera River with young River Red Gums and a lack of woody debris.**

The impact of this sediment load on the channel is marked with large overbank drapes plus bed deposits and point bar development. These infill areas are colonised by Phragmites and also a generally young age class of River Red Gums. The River Red Gums appear to be about 40-50 years old indicating that channel disturbances and or the infill process occurred in the wet sequence after WW2. Interestingly, there is generally a very low presence of large woody debris indicating a history of desnagging along the channel.

The sediment load from Glendhu Creek has resulted in a large deposit at the Wimmera River junction. Indeed, deposition of material transported down Glendhu Creek, along with finer material from Shays Creek, can be seen to impact over the whole reach. Few ponds remain along this reach, due to the instream deposition and flow is now often conveyed through the bed material. To counter this, some landowners have dug stock waterholes into the bed of the river. The loss of the deep ponds represents a significant loss of channel diversity and high quality habitats. The deposition process is still quite active and the whole cut and fill process is dynamic and likely to impact on this reach and other downstream areas for a long time.

- **Figure 7-3 Coarse sediments entering the Wimmera River at the junction with Glendhu Creek.**
- **Figure 7-4 Ponds are being infilled with coarse and fine sediments**

The control of stock access would allow vegetation cover to re-establish and slow the current dynamic nature of adjustment processes. Fencing along with provision of alternate watering systems should be investigated. Importantly, however, there is little available data on the channel geometry (or its change over time) and a series of geomorphic monitoring sites should be established to help inform appropriate management responses.

Not withstanding the major right bank tributaries of Glendhu and Shays Creek, there are some minor left bank tributaries arising from the low sedimentary hills to the west.

As expected, some of these tributaries (W6.1/2 and W6.1/3) have reacted to the mainstem incision process and disturbances within their own catchments, with both channel incision and bank erosion occurring. This has historically been responded to by the SCA and the landowners of the day, but as no maintenance or fencing of the areas was conducted the structures have failed with active erosion now evident. W6.1/2 is particularly bad with over 4 km of unstable waterway (refer to Figure 7-5) and significant sediment loads being generated from near Bulgana Road through to the Wimmera River. A comprehensive structural and vegetative response will be needed over 4 km and will involve a range of techniques including multiple grade control structures, diversion banks and re-entry chutes, bank erosion work, re-establishing sediment deposition areas, plus revegetation and fencing.

The same array of responses will be required in W6.1/3 but the scale of response required, is far lower.

- **Figure 7-5 Channel incision and erosion along W6.1/2**

7.3 Vegetation

Current EVC mapping indicates that vegetation in this reach is restricted to two woodland EVC types, further detailed in Table 7.3-1.

Table 7.3-1 details the remnant vegetation currently present in the reach, Riparian Woodland provides the most relevant EVC to the riparian environment and the re-establishment of a native understorey would be an important step in the improvement of the waterway and initiation of a long-term environmental improvement program.

- **Table 7.3-1 Current Vegetation Attributes (EVC) Reach 6.1 –Wimmera River).**

Current EVC Remaining in Reach (DSE, 2005)	Occurrence	Location
641 – Riparian Woodland	Occurring along the majority of the mainstem	Occurs beside permanent streams, typically on narrow alluvial deposits.
896 - Grassy Woodland/ Alluvial Terraces Herb-rich Woodland Mosaic	Occurring in scattered pockets in tributaries W6.1/1, W6.1/2 and W6.1/3	Lower exposed and dry slopes of low to moderate fertility.

Remnant vegetation within reach is largely confined to the mainstem and the edges of Bulgana Road. Apart from a medium sized Grassy Woodland remnant (with a canopy of Yellow Gum and Grey Box) located 500 meters north of Bulgana Road, the majority of the reach is characterised by cleared paddocks and scattered trees over a groundcover of exotic pasture and weed species.

River Red Gums form the dominant canopy cover along the mainstem. These stands are discontinuous, vary in age and are generally without an understorey layer. There is unrestricted stock access throughout the mainstem and its ephemeral tributaries, and this is reflected by a landscape which is largely devoid of remnant vegetation.

In-stream vegetation along the mainstem is largely restricted to the permanent deeper ponds, where large sediment deposits have provided ideal growing conditions for Phragmites and Cumbungi, in which they have colonised many areas (particularly in sections between Joel Forest Vances Crossing Road and one kilometre south of Shea's Flat Road) (Refer to Figure 7-6). Additionally, saline conditions have provided suitable conditions for Spiny Rush to colonise large stretches of the mainstem.

The ephemeral tributaries are largely absent of remnant vegetation and restricted to scattered individuals of River Red Gum and Grey Box. The dominant vegetation along the tributaries was Spiny Rush and exotic salt tolerant pasture species.

Due to the current depleted state of the vegetation within this reach, particularly in the tributaries, revegetation will be a long term process. The removal of stock from the riparian zone and the establishment of canopy species both along the mainstem and tributaries are recommended. Species augmentation along the mainstem should also be undertaken to improve the ecological condition of the reach. The provision of alternative water supplies for stock in conjunction with fencing should be seen as a high priority for this reach and the Wimmera River in general. Revegetation efforts, initially, would require the use of salt tolerant species, particularly along the ephemeral tributaries.

- **Figure 7-6 - Large sediment deposits have provided ideal growing conditions for Phragmites**

7.4 Habitat

The habitat of this reach is severely impacted on by the extensive depositional and cut and fill processes. There are few residual drought ponds at low flows to accommodate the preservation of a broad range of species. Most of the channel is dry and there is little large woody debris. These attributes make it hard for any aquatic species to survive and hence most activity of dispersal and recolonisation will only occur in late spring when flows generally occur.

Overall the habitat is poor for aquatic species, but the vegetation corridor provides for an important roosting and feeding resource in a generally denuded landscape.

7.5 Water Quality

There are no records for water quality in this reach with no data available for the Joel South station. Observations in the field confirm an increase in salinity and also showed that there is a very strong impact arising from high suspended solids and turbidity loads with heavy coatings on the Typha and Phragmites and any other substrate.

High nutrient concentrations can be expected as well with these being associated with the finer silts and colloidal material washed in from the catchments.

As a consequence, the water quality along this reach is likely to be poor.

7.6 Flooding

Flooding in this reach is likely to be extensive although out of channel flooding is unlikely for events less that 1 in 5 year ARI events due to the channel enlargement. No flow gauging data is available for this reach but flood flows are likely to be larger than that of Reach 5 due to the increases in catchment size that includes the Shays and Glendhu Creek sub-catchments.

As with all flooding in the upper part of the Wimmera, floods are likely to be of a short duration for the convectional storms but may be of a longer duration for the typical 3 day winter spring event.

7.7 Threats and Priorities

Table 7.7-1 summarises the major threats that have been identified in Reach 6.1. For specific details on issues, actions, locations, priorities and cost estimates, refer to Appendix D – Reach 6.1 Summary of Issues & Actions.

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Table 7.7-1 Major threats to Waterway Health identified in Reach 6.1

Threat	Risk
Channel cut and infill process needs quantification and investigation	Very High
Habitat complexity declines markedly due to loss of channel characteristics, vegetation and large woody debris	Very High
Stream habitats and ponds threatened by uncontrolled stock access for watering	Very High
Substantial lack of habitat and riparian vegetation along Wimmera River mainstem	Very High
Substantial increases in salinity and sediments from tributaries affecting water quality	High
Active erosion in lateral tributary streams with the potential to generate and transport sediment plus old stabilisation works need maintenance	High
Loss of key ephemeral swamps and floodplains to mitigate suspended solids and turbidity for tributary inputs	High
Sediment and nutrient transport from catchment due to land use and loss of mitigation systems	High
Lack of environmental management data to help guide future management initiatives	Moderate

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