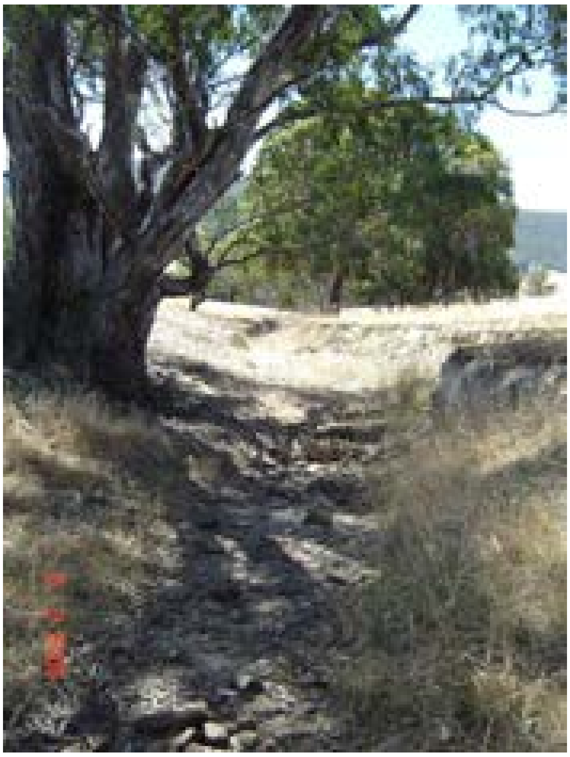
Glenpatrick & Nowhere Creek Waterway Action Plan



- Final
- 4 August 2006

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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 Glenpatrick and Nowhere Creek 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 the streams within the Glenpatrick and Nowhere Creek catchment. The catchment covers an area of 83 km^2 and extends from the Pyrenees State Forest that rise 10 km's north east of the Elmhurst township and extends down to the Wimmera River at Elmhurst.

The Plan focuses on key waterway management responsibilities and priorities as outlined in the Wimmera Waterway Health Strategy (2006). It is focussed on identifying opportunities to improve river health over the next 5 to10 year period.

The plan also provides an accessible form of information and analysis of the key waterway issues so that landholders and agencies can deliver a coordinated and well planed strategic response. It is hoped that this Plan will encourage landowners and community groups to work in partnership with Wimmera CMA and other agencies to implement necessary works along the main creeks and tributary stream corridors.

Glenpatrick and Nowhere Creeks both contain permanent pools in the lower reaches and seasonal ephemeral streams in the mid and upper reaches.

Following European settlement in the region, the Glenpatrick and Nowhere Creek catchment was subjected to significant disturbance, primarily due to gold mining activities and vegetation clearance. This triggered a range of degradation processes including stream incision, tunnelling and gullying. As a result the streams have changed from minor well vegetated channels and or vegetated valleys to what are now moderately unstable and incised channels. The incision and gulley erosion process has occurred in the cleared parts of the catchment. Most of the sediment that has eroded from these waterways has been either transported directly into the Wimmera River or deposited on the floodplains.

The headwaters of both Glenpatrick and Nowhere Creeks originate in the steep hills of the Pyrenees State Forest. The upper reaches of both catchments are in excellent condition with significant quantities of remnant vegetation still remaining. While selective logging and impacts from historic gold mining activities are evident, vegetation and habitat values in the upper reaches are of a high quality.

The middle and foothill regions of the catchment still contain some remnant forest cover, however gold mining activity has resulted in many streams being straightened and/or diverted so the valley floor could be turned over in search of gold. Although some stream erosion has occurred, the largest impact is the loss of native vegetation and the spread of weeds.

Waterways in the lower reaches are generally in poor condition as most of the riparian zone has either been completely cleared of native vegetation or only small discontinuous stands remaining. The effects of uncontrolled stock access to waterways combined with the widespread invasion of weeds and bank erosion is threatening platypus populations and degrading waterway health.

The resultant impact on water quality and instream values in the lower and mid catchment and on the Wimmera River is significant. In particular the impacts of discontinuous and in many cases lack of riparian and instream vegetation is preventing the transfer of ecological values from the healthy upper reaches to the receiving waters of the Wimmera River.

Improved health of the Glenpatrick and Nowhere Creek can be achieved by controlling weeds, controlling stock access to waterways and reinstating native vegetation corridors.

This catchment is unique in the region as it still retains high quality remnant vegetation and high value environmental and ecosystem attributes in the upper catchment. Unfortunately a lack of continuous healthy corridors precludes the effective transfer of these values to and from the Wimmera River.

Whilst the ecosystem values and attributes have declined in the lower reaches, sufficient values still remain to readily improve the health of the streams to a healthy state. A combination of key responses will be required to achieve this including:

- Stabilising stream erosion in the mainstem and tributaries through stabilisation and revegetation programs;
- The reconnection of key riparian linkages along the streams;
- The rehabilitation of former Soil Conservation Style works to secure the function and integrity of those works;
- Control stock access through cooperative 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 for the important water quality treatment role;
- The support and coordination of interagency programs tackling salinity management, soil management and sustainable land uses;
- The support of weed management programs along all streams; and

- Increased monitoring of water quality and instream fauna across the system to better inform management programs

The investigation process undertaken for this study included a review of the relevant previous studies, aerial photography analysis, a information collection process with local landholders and agencies, followed by an on-ground inspection of the entire catchment.

While parts of the catchment are in good condition, a coordinated and cooperative partnership between landholders, Wimmera CMA and other support agencies could quickly improve the overall health of the catchment. This Plan identifies the tasks and efforts required to achieve this goal.

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
- the condition and extent of riparian vegetation (and fencing)
- location of weed infestations
- bed and bank instabilities
- the existing condition of instream habitat, and
- guide appropriate management techniques.

The intention of this Waterway Action Plan is to provide the above information in an easily accessible form for users to understand. The 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 the Wimmera Catchment Management Authority (Wimmera CMA) is able to prioritise rehabilitation works over the next 5 to10 years. It is important to note that while the WAP defines the needs of specific projects and estimated costs of these 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

This plan focuses on key waterway issues for which Wimmera CMA is responsible, namely:

- Progressive reduction in the amount of sediment, suspended solids and turbidity originating from the Glenpatrick and Nowhere Creek catchment;
- 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;
- Protection and enhancement of existing high value riparian areas and to achieve the an improvement of in riparian vegetation condition along the waterways with a key focus of on regional biodiversity connection;
- Protection Protect and rehabilitation of existing high value and critical instream habitat areas; and

- Supporting the attainment of the Regional Salinity Management Plan.
- 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 contents, which provide 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 develop a report and set of maps that documents appropriate management techniques for the Glenpatrick and Nowhere Creek system over the next 5 to 10 years.

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.

- 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
- Prioritisation of management actions
- Development of detailed sub-catchment maps showing the location of proposed management actions
- 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

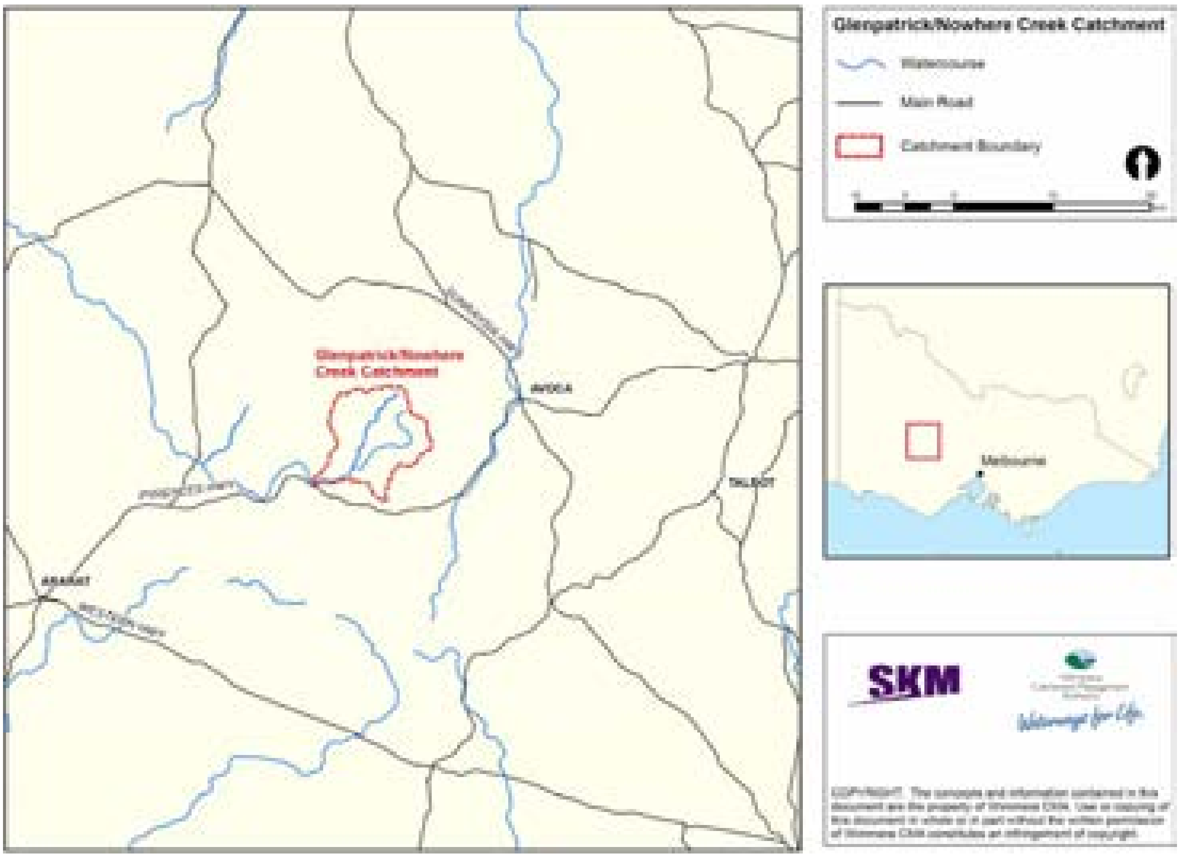
The Glenpatrick and Nowhere Creek catchment is located in Western Victoria and covers an area of approximately 83 km^2, as shown in Figure 0-1 overleaf.. While the historic settlements of Glenpatrick and Glenshee are located within the catchment, the closest major town to the catchment is Elmhurst.

1.6 Major waterways in the Catchment

The major waterways in the Glenpatrick and Nowhere Creek catchment are:

- Glenpatrick Creek;
- Nowhere Creek;
- Spring Creek (an upper tributary of Nowhere Creek).

There are also numerous unnamed tributaries throughout the system.



▪ **Figure 0-1 Location of the Glenpatrick & Nowhere Creek Catchment**

1.7 Relevant Reports and Background Information

The Glenpatrick and Nowhere Creek catchment 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 (2004)
- Draft Wimmera Waterway Health Strategy (2006)
- Wimmera Water Quality Strategy (2002)
- Wimmera River Geomorphic Investigation (2001)
- 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
- Project Platypus

1.9 Management Strategy and Rationale

The management objectives for the Glenpatrick and Nowhere Creeks and their tributaries are derived from several levels. Firstly there is 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 States rivers will be ecologically healthy, managed within healthy catchments. This vision is the driver of the activities for the future. The goals include a series of clearly enunciated management approach 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.
- 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 and its tributaries (such as Glenpatrick and Nowhere Creeks)
- Protect and rehabilitate streamside frontage on the region's waterways while protecting cultural heritage and biodiversity values
- Promote the adoption of the Healthy Waterways Incentive Scheme through out the region
- Increase knowledge and awareness of waterway health issues

The overarching environmental management objective must is be to maintain and where possible rehabilitate the environmental values of the rivers and streams waterways in the catchment. In the case of the Glenpatrick and Nowhere Creeks, the key activities relate to the protection of the high value of the streams. In particular it is recommended that the opportunity be grasped to re-establish a high degree of connectivity between the forested headwaters of the catchments in order to ensure the high organic loads sustain the lower segments of the Wimmera River and provide food for future organism drift and recolonisation. This will require that the stream systems are stable and that key habitat elements and processes are protected and enhanced. It will include the need to respond to the degradation due to on going stream erosion arising from historic disturbances and current erosion and loss of environmental values through uncontrolled stock access.

The management of the issues in the Glenpatrick and Nowhere Creek systems can be relatively easily won over the near to short term with targeted programs, but these will only succeed through the establishment of a highly collaborative and long term partnership approach between agencies and the landowners through whose land the streams flow. This approach will need to respect the mutual goals of waterway and farm management. 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 is provided for, particularly during droughts, but also ensure that the long term need to rehabilitate the waterways including the rehabilitation of the vegetation corridor and the protection of remnant pools and large River Red Gums of the area. The impact of the drought has had a marked effect on the health of both the land system and that of the streams and the decline of values is marked as a result. It is hoped that with the return of more normal rainfall patterns the flows will return to the system.

This Waterway Action Plan for the Glenpatrick and Nowhere Creek systems, considers both the high level State wide goals, but also critically takes account of the unique issues that affect the high value segments of the Glenpatrick and Nowhere Creeks 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. Whilst some good work has been done in the Nowhere and Glenpatrick Creek catchment in the past few years, there is a significant need to revisit the success of those works and ensure that the whole package is addressed over the next 5 – 10 years to ensure that the streams are returned to a protected and sustainable state. The observations in the field showed that some segments in the Glenpatrick and Nowhere Creek system are highly dynamic and could deteriorate in the return of normal wet winters or through a major rainfall event. Without an active and coordinated stream management approach, the streams will decline and result in significant loss of waterway values.

2. Catchment Description

2.1 Whole of Catchment Overview

This section provides an overview of the Glenpatrick and Nowhere Creek catchment generally. A more detailed analysis of the individual reaches within the catchment is provided in Sections 3 to 7.

The Waterways of the Glenpatrick and Nowhere Creek system rise on the steep hills of the Pyrenees Ranges that form the divide between the Wimmera and Avoca Catchments. These hills are comprised of predominantly Cambrian period sandstones, shales, schist and slates with Devonian period intrusions of granite. The ranges form part of an old penne plain that has been eroded over the millions of years exposing the harder rocks with the washed materials forming the alluvium of the valleys. The upper ranges are deeply dissected and covered with a forest of mixed species including Blue Gums. A recent fire in the upper catchment of Glenpatrick Creek has generated a significant regrowth of Blue Gums but little understorey has returned due to the extended dry conditions. Most of the upper catchment is managed as part of State Forest with some logging coups evident.

The streams of the Glenpatrick and Nowhere catchment normally have perennial flows, but the extended drought over the last 8-9 years has meant that the small flows being produced are generally subsurface in the extensive gravel and cobble beds that are part of the extensive alluvial plains. Water is still evident in some of the spring fed pools along the stream and also observed weeping out of the slate and schist seams in the banks.

The upper segments of the stream at the forest edge are very stable but show the unmistakable signs of being subjected to mining activity as part of the gold rush days of the late 1890's through to the early part of the 1900's. Glenpatrick was the largest of the alluvial mining activity with over 10,000 people in the area at its peak (A Pownceby *pers comm.*). Prior to the mining period the streams were relatively small in cross section and well vegetated. The disturbance level through the creeks and valleys was massive, as the diggers sought the fine gold dust and needle gold that the area produced. As a result of this disturbance and a number of very large events the creeks scoured out to the channel sizes that they are today. The area was also pocked with many shafts most of which were bulldozed or filled in by the Mines Department (A Pownceby *pers comm.*). All this added to the levels of disturbance that the stream has been historically subjected. A large sluice dam appears to have been constructed on Spring Creek in the upper Nowhere Creek catchment.

Today, at the upper forest edges, the streams are typically on bed rock with a good cover of vegetation and are producing a large cobble load won from connected slope contact and disturbed valley fill. Once out of the forest the streams are observed to be very steep, large in cross-sectional area and carrying a substantial cobble load. The stream is contained in a confined valley with a flat floor that would be subjected to flooding only in extreme events due to the degree of channel enlargement and incision. The cobble bed tends to embrocate and display a wave pattern longitudinally down the stream where the flow conditions are relatively smooth. Where the stream flows are disturbed by large woody debris or pass around bends, large scour holes have established due to the high stream powers in the transition. The cobble beds are dynamic and are subject to ready disturbance in episodic events. The stream zones downstream of the forest and in the disturbed areas have generally poor vegetation cover with a large suite of weeds evident, particularly Blackberry (*Rubus fruiticosus*) Climbing Groundsel (*Senecio angulatus*), Bridal creeper (*Asparagus asparagoides*), Sweet Briar (*Rosa rubiginosa*), Radiata Pine (*Pinus radiata var. radiata*) and Tagasaste (*Chamaecytisus prolifer*). A poor disconnected remnant of native vegetation exists along the stream, this consisting of several species including Blue Gum (*Eucalyptus globulus var. bicostata*), Mountain Grey Gum (*Eucalyptus cypellocarpa*) and Yellow Box (*Eucalyptus melliodora*).

- **Figure 2-1 Healthy streams in the upper forested catchment areas**

The streams remain confined and as they progress down the valleys towards the lowland plain they store the larger cobble and start to size sort the gravels and fines with a series of wetland areas and stores evident. At the junction of the stream to the plains the alluvium can be seen to be predominantly finer material with layers of gravels and smaller quartz rock. It is evident that there are many lenses down the valleys and some of these carry the spring water that supplies some of the permanent pools. At the time of inspection, after an extended dry period, no flows were observed along any of the waterways, but the permanent pools downstream of the junction of Glenpatrick and Nowhere Creeks were being sustained with relatively freshwater. These would form critical habitat refuges for the Platypus that are known to frequent the area (Williams and Serena 2006). The stream form downstream of the Glenpatrick and Nowhere junction is a continuous channel with some pools. This channel has been subjected to some historic straightening and channelisation lower in the floodplain and is generally unfenced and open to stock access. The channel size decreases as the gradient gets flatter and the floodplain is more engaged and wider, displaying many old courses. The channel through this area is perched with obvious overbank activity and small depositional levees, plus some very important habitat pools. Again vegetation cover is relatively poor and discontinuous.

A stream diversion has taken place in the lower catchment following an old course line with this being directed towards a dam and the overflow making its way across the floodplain in a very small almost indiscernible channel. This man made intervention is fairly old and land use patterns have established around the works. Floods are still likely to follow both courses across the wide flood plain at this point.

- **Figure 2-2 Stream diversion in the lower reach of Glenpatrick Creek**

The impact of the Glenpatrick and Nowhere Creeks on the Wimmera River is far less than that of other catchments due to the retention of the sediment stores in the catchment and the action of the floodplain in mitigating any transported erosion products. The stream system itself has been heavily disturbed and in places unstable and needs intervention to attain stability so as to protect the good elements left. An extensive weed and vegetation management program will be needed along with some large woody debris management to enable the rehabilitation of the waterways. A significant opportunity exists to re-establish the process of reconnection of ecological energetics and recolonisation downstream that will help sustain and improve the ecosystem within the Wimmera River.

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 suspended solids and turbidity. With respect to the Glenpatrick and Nowhere Creek system no recorded data is available to assess the water quality. The key factors that are likely to be of concern are those of salinity, suspended solids (both coarse and fine) and nutrients. At the time of field inspections, the streams were at very low flow levels, likely to be the result of a 7-8 year extended drought period. Large flow events were recorded in the area in February 2005 and 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.

Turbidity is a measure of how cloudy the water is and is affected by suspended solids. 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. For the purposes of this report, discussion on turbidity will limited, and reference will be made to fine, colloidal suspended solids and/or erosion products generally.

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 was unable to be quantified as no recorded data is available. Qualitative assessment of the streams was undertaken by the study team during field inspections.

The low flow water quality of this catchment is a product of the rocky nature and as observed in the remnant spring fed pools generally have a low salt content. Major event flows are likely to be high in suspended solids and turbidity due to the slakey/dispersive soils in the catchment and stream erosion. The levels in these will be high as the soils of the catchment are highly erodible colluvium of weathered red shale and clay material. The streams and tributaries have extensive areas of bare banks due to a combination of low fertility and fairly uncontrolled stock access.

2.1.2 Vegetation

The Glenpatrick and Nowhere Creek catchment retains a healthy cover of native vegetation, some of which is remnant, but containing areas that have regrown since gold mining activities early last century. The native vegetation is dominated by forest structured vegetation with some woodland form present on the valley floor.

Prior to European settlement, the vegetation of the Glenpatrick and Nowhere Creek catchment was a mixture of forests and woodlands. The catchment retains a much greater level of native vegetation coverage than other catchments investigated in the Wimmera region as part of this study.

The condition of remnant vegetation generally reflects the surrounding landuse and the extent of protection from historical disturbance associated with European development of the area. The Glenpatrick and Nowhere Creek Catchment have been previously mined, however, mined areas have naturally regenerated since the conclusion of mining activities. The valley floor has been successively cleared of vegetation for agricultural purposes (grazing), however, the ridge areas of the upper catchment remain well vegetated. All reaches and ephemeral tributaries have been modified to varying degrees and most of the riparian zone in the lower catchment has been highly modified and degraded through clearing, stock access and weed invasion.

Ten Ecological Vegetation Classes (EVCs) were identified in the study area. Figure2-3 lists the remnant vegetation remaining within the catchment and the reaches in which they occur.

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Figure2-3 -Remaining EVCs of the Glenpatrick and Nowhere Creek Catchment (DSE, 2005a,b+c)

Current EVC Remaining in Catchment (DSE, 2005)	Reach	Remaining Character	Location
18 – Riparian Forest	G1, G2	Small linear area flanking the draining line on the valley floor.	Following alluvial terraces associated with drainage lines.
20 – Heathy Dry Forest	N2	Occurs only in the upper eastern hill slopes.	Shallow rocky skeletal soils
22 – Grassy Dry Forest	G1, G2, N1, N2	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	G1, G2, N1, N2	Occurs only on the upper north-western slopes.	Relatively fertile, moderately well drained soils. Easterly and southerly aspects of lower slopes and gullies.
47 – Valley Grassy Forest	G2, N2	Mainly occurs on the upper slopes of the eastern tributaries and the northern valleys of Nowhere Creek and the lower slopes of Glenpatrick Creek (Reach 2).	Fertile well drained colluviums and alluvium on gently undulating lower slopes and valley floors.
67 - Alluvial Terraces Herb-rich woodland	N2	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.
68 – Creekline Grassy Woodland	N1, G1	Mainly occurs along the lower reaches of Glenpatrick and Nowhere Creeks.	Drainage lines and adjoining flats.
70 – Hill Crest Herb-rich Woodland	G1	Upper reaches of Glenpatrick Creek (Reach 1)	Ridgelines and upper slopes of undulating rises and rolling hills at low elevations.
152 – Alluvial Terrace Herb-rich Woodland / Plains Grassy Woodland Complex	N1	Mainly occurs along the mid-slopes of the upper tributaries and valley floor of Glenpatrick Creek (Reach 1) and Nowhere Creek (Reach 1).	Following alluvial terraces associated with drainage lines.
175 – Grassy Woodlands	G1	Upper tributaries of Glenpatrick Creek (Reach 1).	Occurs on sedimentary soils on low rises.

The cleared area of the valley floor is largely made up of exotic pasture species, with narrow bands of riparian vegetation redeveloping along the water courses. This vegetation appears to be at an early stage of natural regeneration largely made up of pioneer species. Dominant canopy species in the lower reaches include River Red Gum (*Eucalyptus camaldulensis*), Yellow Box (*Eucalyptus melliodora*) and scattered individuals of Manna Gum (*Eucalyptus viminalis*). Understorey cover in the lower reaches is generally sparse and restricted scattered individuals of Black Wattle (*Acacia* *mearnsii*), Blackwood (*Acacia melanoxylon*) and exotics including Blackberry (*Rubus fruiticosus*), Gorse (*Ulex europaeus*) and Sweet Briar (*Rosa rubiginosa*).

Remnant vegetation in the higher portions of the catchment consists of a dominant canopy of Blue Gum (*Eucalyptus globulus var globulus*) and Mountain Grey Gum (*Eucalyptus cypellocarpa*) over an understorey of mainly Black Wattle (*Acacia mearnsii*), Blackwood (*Acacia melanoxylon*), Hedge Wattle (*Acacia paradoxa*), Drooping Cassinia (*Cassinia arcuata*), Gorse Bitter Pea (*Daviesia ulcifolia*), Common Rice Flower (*Pimelea humilis*) and Black-anther Flax Lily (*Dianella revoluta*). The ground layer is characteristically made up of exotic pasture and weed species, drought tolerant grasses including Poa Grass (*Poa labillardieri*), Kangaroo Grass (*Themeda australis*) herbs and Bracken (*Pteridium esculentum*).

The riparian vegetation along the mainstem of Glenpatrick and Nowhere Creeks was continuous in some sections in the higher valleys, with the vegetation of the lower reaches present as modified and discontinuous stands of native vegetation present in small patches.

In-stream vegetation was restricted to ephemeral pools in the lower reaches, while the upper reaches were dry and mainly consisted of terrestrial species such as Poa Grass (*Poa labillardieri*) in the bed of the streams. 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*.) Sedges (*Carex sp*.) and Water Milfoil (*Myriophyllum spp*.).

The degradation of riparian environments is primarily 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 isolation of the terrestrial and aquatic environments and the breakdown of the important ecological links and processes that link the two ecosytems. 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.

Although some areas of the river remain well vegetated (particularly in the higher reaches), in most areas vegetation is confined to thin linear strips and the understorey and groundcover are typically highly modified and degraded as a result of prolonged grazing pressures and weed invasion.

2.1.3 Stream Ecology

Little stream ecology data is available for this catchment. Other than an extensive body of work conducted for Project Platypus over a period from 1998 through to 2006 (Serena and Williams 1998; Worley and Serena 2000; Serena and Williams 2002; Williams, Johnston and McQualter 2004 and Williams and Serena 2006), little data is available.

This research showed that when flowing, the Glenpatrick and Nowhere Creek systems provide valuable platypus habitat and have sustained healthy populations through the early part of the drought period. However, as deeper pools have dried up and contracted to a few spring fed pools their numbers have declined rapidly. The loss of these pools may be attributed to both water diversions along these systems and due to the long-term decline in groundwater resources over the drought period. Additionally, the large re-growth areas of juvenile Blue Gums following recent fire in the upper catchment may have also impacted on catchment yields.

The importance of large aged River Red Gums with their overhanging canopy along the floodplain pools are critical elements of the habitat not only for shade, but also for stabilising the steep banks of the pools and providing for resting and breeding burrows. The provision of large woody debris as habitat elements and substrate for invertebrate food sources is also critical.

The loss of the majority of the pools through decline in flows is a significant issue, but as there is little diversion for either irrigation or stock watering, the flow conditions are more likely to be a natural occurrence that cannot be overcome.

If the high values of the Glenpatrick and Nowhere Creeks are to be protected it will be important that the WCMA establish a flow, chemical and biological monitoring program from which management success can be measured.

2.1.4 A model of catchment change

During the period of initial settlement of the upper Wimmera region, most of the waterways contained chains of ponds. However, with the onset of European-style agriculture, gold mining, channel entrenchment, land clearing and grazing, many of the natural stream features were lost. Effects of these wholesale catchment changes include the loss of chain of the once present chain of ponds, discontinuous gullying, incised channels and general stream instability. 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.

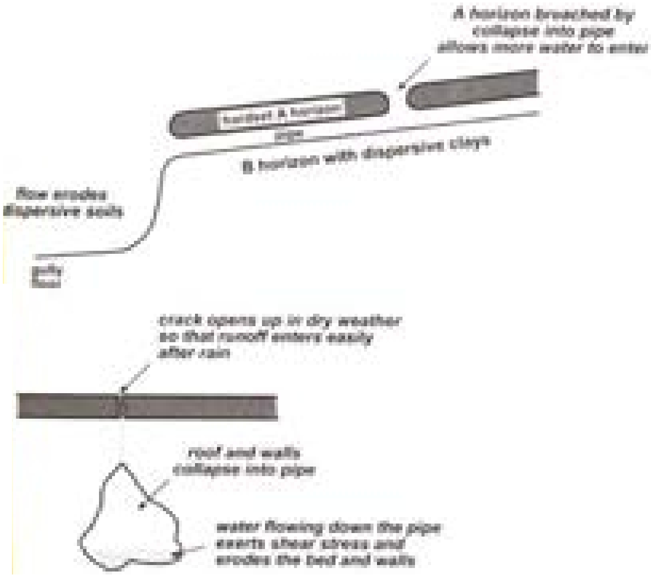
The gullies and broader-scale hillslope erosion that are now apparent in the Glenpatrick and Nowhere Creek catchment are likely to have been initiated in the middle of the Nineteenth Century when valley floor vegetation was cleared for agriculture and for fuel to power gold mining operations along with the introduction of hard-hoofed stock. These changes in landuse have resulted in increased runoff and decreased erosion resistance (Prosser and Slade, 1994). When runoff is concentrated in hillslope hollows, the ability of flows to erode waterways increases, sometimes incising gullies into the valley floor. Once initiated, gullies spread at an exponentially declining rate with much of the networks being formed within the first few decades (Graf, 1977). This model of landscape change has been widely used to explain the occurrence of gully erosion (Prosser and Slade, 1994).

Channel initiation due to by overland flow runoff that has occurred in cleared catchments such as in the mid and lower reaches of the Glepatrick and Nowhere Creek catchment, may be viewed as a threshold phenomenon related to the size of the contributing area and its slope (Horton, 1945). 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 (e.g. Dietrich *et al.*, 1992; Prosser and Abernethy, 1996; Morgan and Mngomezulu, 2003). These studies show that once incision occurs, gully heads migrate upslope until some threshold of contributing area and/or slope is met. In these instances, ongoing runoff is likely to cause further incision until the gully stabilises in its headward extent. This topographic threshold is also influenced by vegetation. The loss of groundcover results in enhanced runoff which leads to an increase in the erosivity of flows on the valley floor. The effect of this is to reduce the critical area/slope required for gully initiation and stabilisation.

The other dimensions of the gully networks to be considered in the Glepatrick and Nowhere catchment are gully width and depth. The gullies will either continue to incise down to bedrock or until some stable gradient is achieved from the baselevel of the downstream drainage network, which in this instance relates to the base level at the Wimmera River (see Schumm *et al.*, 1984). After the gully floor has stabilised the gully walls will tend to lay back under the influence of water and gravity until they are reduced to relatively stable slopes (Crouch, 1987). As gully floor elevation and sidewall slopes stabilise, and the impacts of stock are controlled, vegetation is able to colonise the surfaces, further damping the effects of erosion processes.

Relating gully morphology to erosion process provides a useful field technique to assess gully stability. The further a gully head is from its upstream drainage divide the more potential there is for continued headward extension. The secondary nickpoints that have been observed in many of the gully floors indicate that a change in baselevel has renewed the incision process and that the gullies will continue to deepen until a stable grade is achieved or bedrock is intersected. Deepening gullies will promote sidewall instability and maintain the walls at steep angles. Lower angles on the sidewalls indicate general gully stability. Overtime, with the establishment of vegetation, the gully will begin to infill and begin the process of landscape recovery.

Much of the gully erosion in southeast Australia, and particularly western Victoria occurred after large scale vegetation clearance of the valley occurred (Prosser and Slade, 1994). However, other factors, such as the strength and hydraulic properties of valley-floor soils, also influence erosion processes. Many Australian soils have hard-setting A-horizons, and more clayey sodic B-horizons (Young and Young, 2001). The B-horizon often has a lower permeability. If the clays in the B-horizon are dispersive, as is the case with in the Glepatrick and Nowhere Creek catchment, the fine soil particles will be eroded and carried in suspension to downstream waterways (Figure 2-4). There are also many examples of subsurface flows leading to piping, tunnelling and seepage erosion (Young and Young, 2001). While the removal of vegetation has increased runoff rates, the characteristics of the underlying soils have also had been a major factor in the gully erosion that has occurred.



- **Figure 2-4 - Gullies and seepage flow (from Young and Young, 2001).**

These principles and geomorphic processes, provide an appreciation of the setting in which the processes of erosion and deposition operate within the catchment. The potential to misinterpret the natural instability which 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 (Dollar, 2000). Recognition of the different factors that have contributed to the development of the erosion problem, and the role that subsurface and overland flow paths have in driving the erosion processes is important as a precursor to recommending appropriate rehabilitation options.

In assessing the stability of the waterways within the catchment, it is important to consider the natural characteristics of the area such as the geology, soil types, topography, and type and extent of vegetation cover.

2.1.5 Flooding

Flooding over the catchment is likely to be extensive in the lower reaches where the gradients are flatter and channel capacities limited. Flooding is most likely to occur under a longer duration event with the forested nature of the upper catchment mitigating flashy runoff that may arise in a more intense short duration event.

No public or private assets appear to be under significant flooding threat although some social disruption is likely at a number of road crossings. In particular a safety concern is expressed at the lack of warning on the ford crossing of the Elmhurst-Glenpatrick Road at the forest edge. Velocities at this site are likely to be high and quickly reach an unsafe level once above 300 mm deep. Flooding will also occur at the Nowhere Creek Road, Keams Lane and Moores Lane.

2.2 Management Reaches

To describe the condition, issues and recommended actions in the Glenpatrick and Nowhere Creek catchment, the area has been divided into four primary reaches. The delineation of the catchment into reaches has been based on geomorphic characteristics and behaviour. Tributaries connected to these four mainstem reaches have been described as 'sub reaches'.

2.2.1 Reach, sub reach and tributary labelling convention

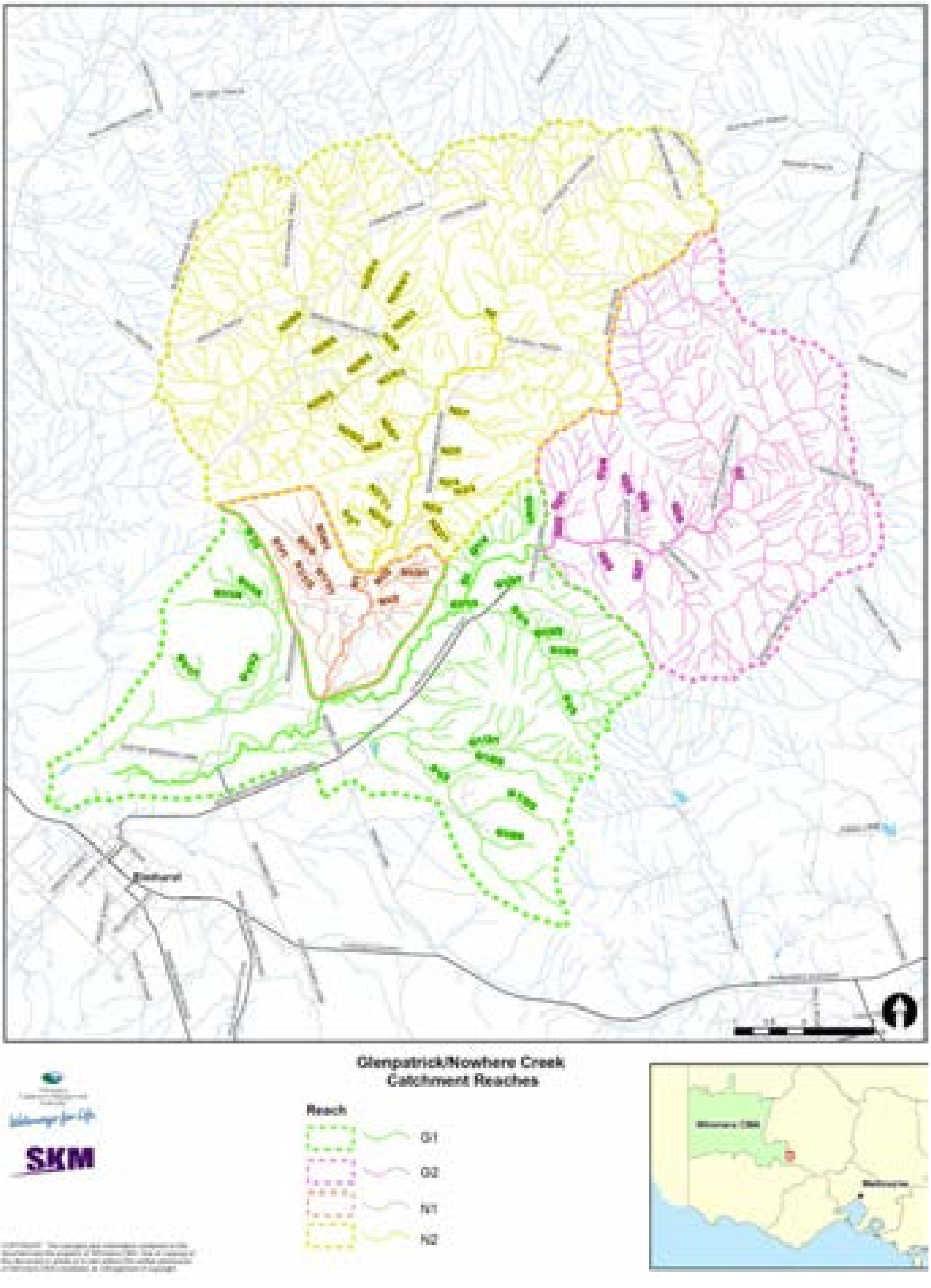
For the purposes of this report, a numbered labelling convention has been applied that identifies individual reaches, sub-reaches and tributaries throughout the catchment. This convention enables each waterway to have a unique number assigned to it to help identify waterways within the catchment for the purposes of discussion.

An example of the convention that has been applied is G1. This example refers to Reach 1 of Glenpatrick Creek. Similarly G1/2/4 refers to Reach 1, sub-reach 2, tributary 4. Maps of each of the four reaches of the catchment covered in this study (Reaches G1, G2, N1 and N2) 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 Figure2-5 below.

- **Figure2-5– Reach delineation of the Glenpatrick and Nowhere Creek Catchment**

Reach #	Reach and Location description	Easting and Northing (GDA 94)
Reach G1	Reach G1 – Glenpatrick Creek (Wimmera River to Van Every Lane)	U/S - 705941 5887349 D/S - 698843 5883717
Reach G2	Reach G2 – Glenpatrick Creek (Van Every Lane to the State Forest)	U/S - 708685 5888521 D/S - 705941 5887349
Reach N1	Reach N1 – Nowhere Creek (Glenpatrick Creek to Break of slope)**Error! Reference source not found.**	U/S - 703361 5887055 D/S - 702757 5885170
Reach N2	Reach N2 – Nowhere Creek (Break of slope to Pyrenees Ranges)	U/S - 705241 5890660 U/S - 703361 5887055



- **Figure 2-6 Geomorphic delineation of the catchment reaches**

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;
- A community consultation meeting held on the 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:

- **Figure 3-1 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 I 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 A to Appendix D. 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 to 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/G1/1, refers to a Habitat issue identified in Reach G1, Tributary #1. Similarly, S/G2 refers to a Stability issue identified in Reach G2. 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 following Sections analyse each of the four reaches (G1, G2, N1 & N2) in detail.

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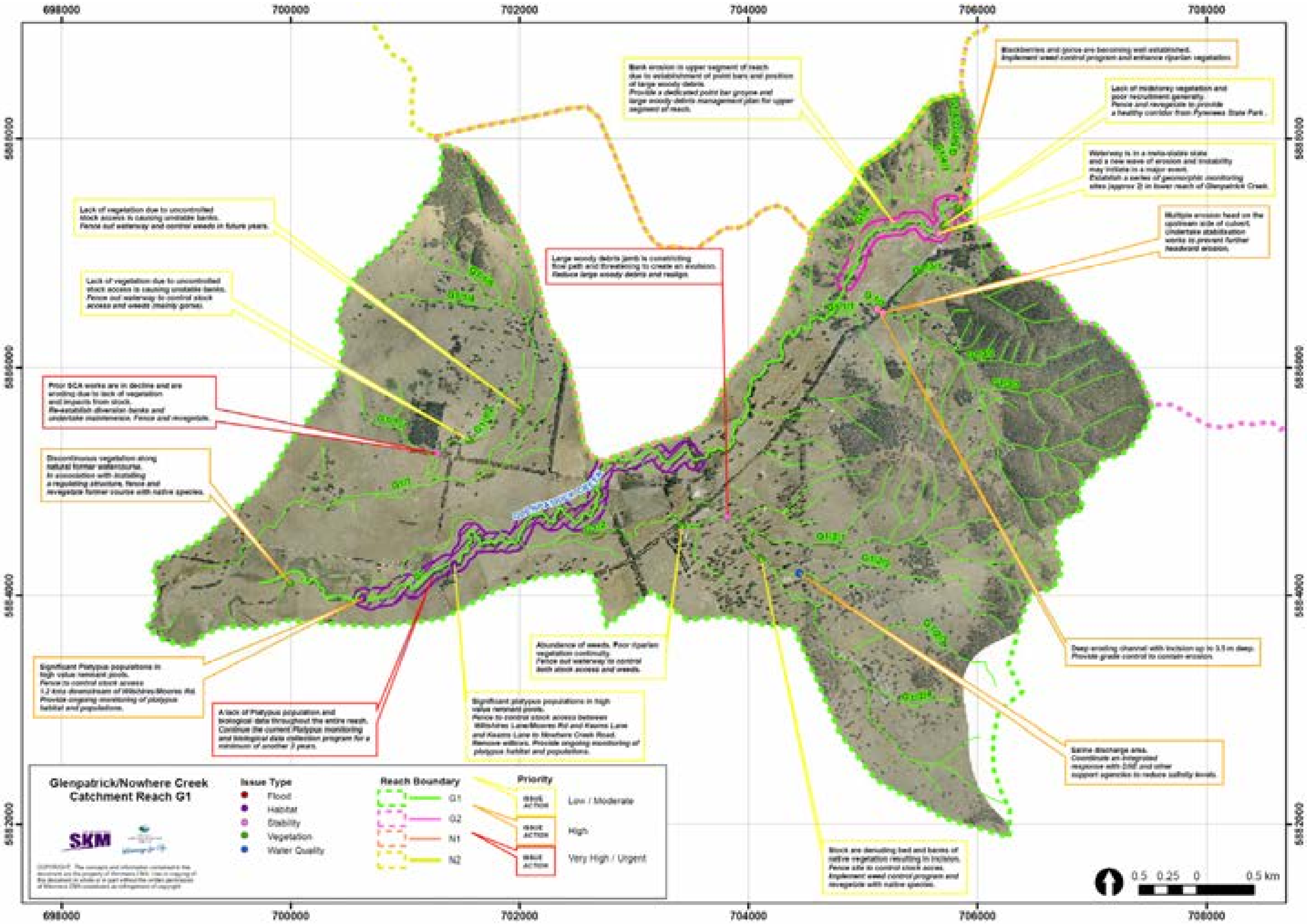
4. Reach G1 – Glenpatrick Creek (Wimmera River to Van Every Lane)



4 Reach G1 Glenpatrick Creek (Wimmera River to Van Every Lane)

4.1 Location of Reach G1

This reach covers most of the floodplain segment of the Glenpatrick Creek from the Wimmera River through to Van Every Lane at the lower end of the Glenpatrick township. It also includes a number of right and left bank tributaries that arise from the granite slopes to the south.

4.2 Morphological description

For discussion purposes this reach has been sub-divided into three segments as follows:

- The lower and flat floodplain segments with wide floodplains downstream of Keams Lane;
- Keams Lane to the confluence of G1/3; and
- Confluence of G1/3 through to Van Every Lane.

The lower segment is of particular interest as it is very well connected with its floodplain the stream channel almost disappearing in some places. This segment is also characterised by old distributary channels in what appears to be a large infilled swamp. It is likely that this process of floodplain and channel infill has taken place since European settlement. A range of drains have been cut to connect to dams, while the mainstem is actually diverted to part of a former stream line that merges with a very small man made channel. It is likely that flood flow events will follow multiple paths across the lower floodplain.

The perched natural channel on the southern edge of the floodplain has been alienated as the invert of the new cut is lower than the natural invert. Current connection to the Wimmera River is not via the main channel but via a small straight drain across the floodplain that joins the Wimmera River some 300 m downstream of the former main channel. This new and straightened main channel has no significant vegetation, is open to stock access and does not provide continuity of stream processes or fish passage. Similarly, the old course is also connected to the realigned and channelised Wimmera River via a man made drain. The lack of a defined natural channel with appropriate environmental attributes is cause for concern and a review of options to create a strong natural stream connection to ensure process continuity should be undertaken.

Upstream of the initial channel diversion point through to Moores Road, the stream is a series of deep pools with mature River Red Gums along the banks. These trees are thin and discontinuous and there is no recruitment as stock have uncontrolled access along the whole stream line. A few willows are also noted in this area. There was no water in the pools at the time of inspection, but when filled they would be important habitat areas. Pools upstream of Moores Road (through to Keams Lane) were full of water, which according to landowners have never been known to dry out as they are fed from deep springs arising from the Nowhere Creek catchment (D. Moore *pers.*

comm.). These pools have an array of good macrophytes and again a discontinuous and thin line of riparian overstorey. Some patches of willows were also noted in this reach. Cattle access is unrestricted and bank damage is occurring. There are multiple flood channels on the floodplain indicating that floods are readily distributed across the area.

Upstream of the junction with Nowhere Creek the stream continues as an enlarged channel with a sand and gravel substrate. Scour holes are evident and, in particular, a large woody debris jamb about 300 m upstream of Nowhere Creek Road is in the process of creating an avulsion. Simple management of the larger pieces of timber and realignment of the rest will resolve this problem.

- **Figure 4-1 Woody debris jamb on G1/2 upstream of Nowhere creek road**

- **Figure 4-2 Instream River Red Gums and cobble creek bed**

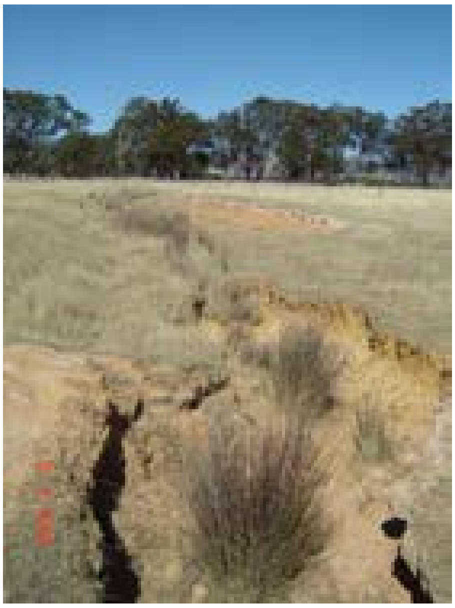
Uncontrolled stock access is denuding and eroding the stream bed and banks through this area. Progressing upstream cobbles are the dominant bed load as bed steepens and the valley becomes more confined. Here, the channel appears to be stable and aggrading except where the channel has some large woody debris or a sharp radius bend that causes the formation of scour holes. A typical unstable bend exists upstream where the combination of a large tree and a sharp bend has activated bank erosion. This is being exacerbated by a strong point bar formation that is directing the flows into the steep bank. Some simple rearrangement of the large woody debris would alleviate this issue. This is repeated several times through this reach.

Compared to downstream, the dimensions of the channel in this segment mean that all but extreme flows are probably disconnected from the floodplain. This means that the streampower in the enlarged and incised channel is likely to be competent to entrain and transport large cobbles at bankfull flow. Whilst the channel appears basically stable at the moment, it should be monitored for future change.

Weediness increases with distance upstream with Blackberries and Gorse becoming prominent. There is only a thin discontinuous riparian vegetation bands and increased bed and bank revegetation is strongly recommended along with fencing to exclude stock.

Tributaries in this section are mainly on the left bank and arise from the granitic and colluvial shale slopes. The gradients are steep and some exhibit the signs of past erosion activity. No large bed loads were obvious, indicating that most of the tributary streams are not actively eroding. However inspection was conducted after an extended dry period of eight years and reactivation of erosion in these generally ephemeral streams is possible. In particular G1/1 and G1/2 appeared to be relatively stable, but have signs of past erosion with incision, scour holes and bare bed and banks due to stock access. There are also some older SCA style works that need to be reviewed for long-term integrity. In particular Tributaries G1/1, G1/1/1 and G1/1/2 have been treated by a series of significant diversion bank and gully plug dam constructions. Whilst these works appear secure there are signs that some repair and or follow up works are needed to address the issues of catchment diversion triggering new or increased stream erosion and the diversion bank system integrity is questionable and open to failure in other areas. Some of the original stream erosion remains untreated and open to uncontrolled stock access and will need attention. G1/2 is fairly stable except for a few instances of minor erosion and to be monitored for increased erosion activity. Again the fencing and revegetation to reduce the impacts of stock access is strongly needed in this tributary.

- **Figure 4-3 Cleared hills are contributing significantly increased runoff volumes**



- **Figure 4-4 SCA style works on G1/2 require maintenance to secure ongoing integrity**

G 1/3 has some erosion problems at the Glenpatrick Road with a large multiple erosion head upstream of the road. Further significant channel erosion exists in the diverted and channelised channel of G1/3/1 with incision up to 3.5 m deep head on the north side of the road. These activities need fairly urgent attention before they advance further and require significant resources to repair.

- **Figure 4-5 erosion head on G1/3**

4.3 Vegetation

The vegetation of the lower catchment of Glenpatrick Creek occurs on the wide valley floor on low rolling hills. The agricultural value of these areas has been exploited over the value of the remnant vegetation in these areas resulting in the wide scale clearing in this area of the catchment.

Remnant vegetation in this reach is largely restricted to the higher sedimentary slopes and valleys which fringe the Pyrenees State Forest on both the southern and northern margins of the catchment, where the higher areas are unsuitable for agricultural activities. The valley floors of the reach are characteristically clear of remnant vegetation in most parts apart from narrow vegetation strips persisting along the mainstem and verges of Elmhurst Glenpatrick Road.

Current EVC mapping indicates that vegetation in this reach includes seven vegetation communities. Figure4-7 indicates the specific EVC that have been previously recorded within the study reach and the general vicinity of occurrence.

The vegetation along the mainstem of Glenpatrick Creek (Reach 1) has a reasonable width of riparian vegetation of approximately 30 metres, although there are some areas of discontinuity along the reach on the lower slopes. The dominant overstorey species of the lower reaches of the mainstem is River Red Gum (*Eucalyptus camaldulensis*) and Yellow Box (*Eucalyptus melliodora*) while Blue Gum (*Eucalyptus globulus var globulus*) dominates the upper reaches. The upper portions of the mainstem contains a rich cover of mid storey and ground layer species, including Black Wattle (*Acacia mearnsii*), Blackwood (*Acacia melanoxylon*) and Tussock Grass (*Poa labillardieri*) all of which frequently occurring in-channel. Large remnant Kangaroo Grass (*Themeda australis*) patches occur in the upper reaches of the mainstem and on G1/3 in areas that receive extra water in the form of run-on.

- **Figure 4-6 Kangaroo Grass (Themeda australis) on G1/3**

As the area receives slightly more rainfall than other catchments within the study area, an increase in weeds such as Blackberry (*Rubus fruiticosus*), Gorse (*Ulex europaeus*), Sweet Briar (*Rosa rubiginosa*), Tagasaste (*Chamaecytisus palmensis*) and Tutsan (*Hypericum androsaemum*) were noted. Generally, the diversity and coverage of weed species increases with distance upstream with Blackberry and Gorse being the most dominate species. Willows (*Salix spp*.) can be found scattered upstream of the initial channel diversion point through to Moores Road.

The tributaries all showed very poor vegetation characteristics with only a few scattered aged River Red Gums existing within the riparian zone. Together with the long drought, stock access to the riparian zone of the tributaries is contributing to further loss of vegetation and stream condition decline.

In-stream vegetation is mainly restricted to the lower parts of the mainstem where small pools contain a good diversity of species, particularly in areas downstream of Keams Lane (Refer to Figure 4-8**Error! Reference source not found.**). Dominant aquatic vegetation included Phragmites (*Phragmites australis*), pockets of Cumbungi (*Typha domengensis*), Small Spike Sedge (*Eleocharis pusilla*), Common Spike Sedge (*Eleocharis acuta*) and Common Water-Milfoil (*Myriophyllum propinquum*).

- **Figure4-7 Current Vegetation Attributes (EVC) Reach G1 – Glenpatrick Creek).**

Current EVC Remaining in Reach (DSE, 2005)	Occurrence	Location
20 – Heathy Dry Forest	Small outcrops, upper eastern hill slopes	Shallow rocky skeletal soils
22 – Grassy Dry Forest	Southern hill slopes	Range of slopes and altitudes outside of the riparian zone.
23 – Herb-rich Foothill Forest	Small remnants in the north west of the catchment.	Relatively fertile, moderately well drained soils. Easterly and southerly aspects of lower slopes and gullies.
68 – Creekline Grassy Woodland	Linear band along main water course.	Alluvial flats of the valley floor in close proximity to the water course.
70 – Hill Crest Herb-rich Woodland	Rocky ridge top.	Shallow rocky skeletal soils
152 – Alluvial Terrace Herb-rich Woodland / Plains Grassy Woodland Complex	Valley floor	Following alluvial terraces associated with drainage lines.
175 – Grassy Woodland	Upper eastern hill slopes	Intermediate slopes between the plains and more infertile upper slopes.

- **Figure 4-8 Riparian vegetation along the lower reach of Glenpatrick Creek.**

The control of stock assess to the riparian zone is a major issue and one which should form the first stage of restoration works. The control and on-going monitoring of widespread exotic species such as Blackberry and Gorse should be a high priority within this reach. Following stock control, the reintroduction of suitable canopy species corresponding to the EVCs is likely to have occurred at the site should also be undertaken.

4.4 Habitat

As discussed through the morphological section, important habitats exist in the deep and permanent pools in the middle reach downstream of Nowhere Creek Road. In particular the few pools that are fed by the permanent springs need to be protected and enhanced with increased plantings weed control and fencing.

These pools have been important Platypus habitat in the past (Williams and Serena 2006) and should continue to provide more permanent critical refuge habitat. Local advice also suggests that River blackfish and Redfin have also been caught in these pools (P Moore *pers comm*.). The ongoing monitoring for Platypus and other biological measures should also be undertaken on a more regular basis.

The cobble sections are fairly depauperate as habitat in the low flow regimes, however under flow conditions will provide important habitat for colonising organisms and drift downstream from the upstream forest sections. The presence of large woody debris in this section is an important element to a healthy stream system.

4.5 Water Quality

The water quality observed in the pools was remarkably fresh and clear. As no data exists for the reach it is hard to comment on the water quality except to say that it will be impaired by high suspended solids an turbidity under event conditions due to the highly erodible soils across the catchment and the generally bare condition of the banks due to stock access.

4.6 Flooding

Flooding will be an issue at the road crossing in this catchment as the channel capacity is likely to be less that the flood flows above a 1 in 5 year ARI event. No private or public assets appear to be under threat. Some private access crossings may be subject to inundation but significant disruption to social movement is unlikely to present for more than a day in any event.

4.7 Threats and Priorities

THREAT	RISK
Need to protect and enhance critical permanent spring fed pools for habitat refuges	Urgent
G1, G1/1 and G1/2 tributary SCA works and upper catchment valley diversion swale in process of failure and could cause significant valley erosion	Very High
G1/3 has large multiple head erosion	Very High
Loss of swamp sections in lower section would result in increased export of erosion products to the Wimmera River	Very High
Reactivation of bed and bank erosion in the mainstem upstream of Nowhere Creek Road due to large woody debris and point bar development	Very High
Uncontrolled stock access to the lower and mid section of the mainstem	Very High
Loss of stream process continuity through to Wimmera through channel changes and diversions at lower end of G1	Very High
Lack of bank and in channel vegetation adding to erosion and decline in stream values	High
Loss of riparian vegetation and uncontrolled stock access to tributary segments of G1/2 and G1/3	High
Need for a dedicated weed and large woody debris management plan along the mainstem of the waterways	High
Salinity and suspended solids export is high from the eroding lands and stream channels	High
Loss of mature trees in the catchment impacts on the long term health of the stream and landscape	High
Need to monitor the morphology of the channel in the upper segment of G1 for changes	Moderate

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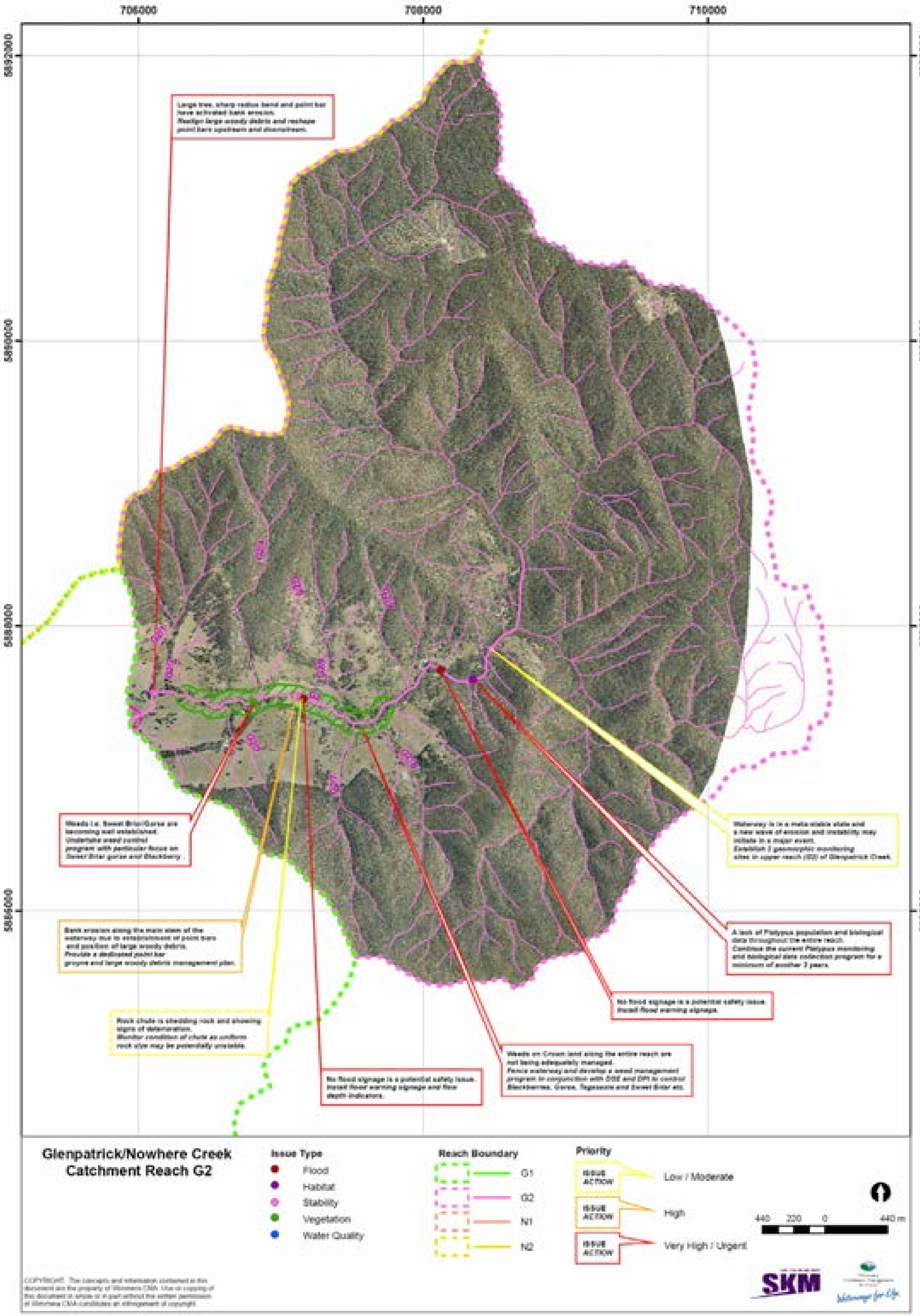
5. Reach G2 – Glenpatrick Creek (Van Every Lane to the State Forest)



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5. Reach G2 Glenpatrick Creek (Van Every Lane to Pyrenees State Forest)

5.1 Location of Reach G2

This reach includes the upper part of Glenpatrick Creek from Van Every Lane up to the state forest boundary though the township area.

- **Figure 5-1 Upper reach of Glenpatrick Creek catchment**

5.2 Morphological description

The upper part of Glenpatrick Creek is very steep and has been subjected to a pattern of disturbance starting with the gold mining period, with channel disruption and total turnover, plus some channel straightening. The disturbed channel eroded badly with a succession of major flood events that saw the channel widen and incise deeply with significant quantities of material transported downstream. In a similar manner to downstream the channel has deepened to the point of alienating the floodplain from all but very large events.

The bed load is dominated by cobbles and shows signs of periodic disturbance with large scour holes and cobble dumps. This occurs particularly where there is a bend with a prominent point bar or large woody debris that directs the high velocity flows into the banks, creating a sharp angled bend. The banks are invariably weak and full of shale and sandstone cobbles. Intersects with colluvial slopes are also prevalent where the stream is over on one side of the valley, thus providing for the ready supply of new cobble loads.

The channel is compounding with a low-flow channel incised into the bed of a larger channel. The inset channel is characterised by a variety of bed forms, particularly cobble bars. In some cases, there is also substantial overbank splays that are now mostly colonised by grasses weeds such as Tagasaste, gorse and blackberries. This colonisation appears to have occurred more recently due to the lack of annual floods during the drought. Stock access is generally uncontrolled or on one side and this can be seen to add to the disturbance levels in the stream. A number of old courses are evident along the stream with these being far smaller than the existing channel. This confirms the anecdotal information that the channel was historically smaller prior to the impacts of mining. There are also signs of land shaping probably due to the Mines Department activity of pushing the old mullock heaps over and filling the numerous shafts that existed in the area.

A road crossing at Akers Lane has had a rock chute and bank armouring installed to stabilise the crossing but it appears that this is failing due to wrong rock sizes and steep tailslopes. Upstream the bed appears to be stable with incision process less active and the bed imbricated. An increased riparian density, albeit weedy, also assists in stabilising the stream. One area near the junction of G2/8 appears to have been used as a cobble and gravel mining area. This may need some stabilisation effort. The incised channel continues up into the forest for about 1km upstream of the last ford crossing on Glenpatrick Road.

- **Figure 5-2 Weeds and mobile cobbles downstream of Akers lane**

- **Figure 5-3 bank erosion due to historic stream straightening of Glenpatrick Creek**

A major issue that gives concern to some landowners is the lack of management of unoccupied Crown lands, particularly with weed control. Some landowners see it unfair and an impossible task to manage controllable weeds on their portion of frontage or land if the upstream areas are not tackled. The mainstem of the Glenpatrick Creek has a wide Crown land reserve along it and some of this is unmanaged and very weedy.

With respect to the tributaries no active erosion was observed in the small ephemeral streams that run off the hillslopes. Whilst incision has occurred in some due the reduced base level in the mainstem, these seem relatively stable at this point of time, but need monitoring after any episodic event for reactivation of erosion potential due to the generally steep gradients.

5.3 Vegetation

The vegetation of the upper south east section of Glenpatrick Creek occurs within the steeper hills of the upper catchment, with the valley floor being contained within the hills on each side.

Current EVC mapping indicates that vegetation in this reach includes four vegetation communities. Figure5-4 indicates the specific EVC that have been previously recorded within the study reach and the general vicinity of occurrence. Riparian Forest provides the most relevant EVC to the riparian environment within the study reach 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.

Although the majority of EVCs previously found within the reach are still present (excluding riparian associations) their distribution is patchy and their abundance minimal. Those remaining should be secured where possible with fencing programs and revegetation undertaken to secure their presence with thought given to linkage and buffering reservations. The riparian landscape requires suitable stock control and revegetation to retain some natural character within these areas.

Generally, remaining remnant vegetation is largely confined to the upper slopes and valleys where agricultural activities have been minimal. Vegetation cover along the mainstem is discontinuous initially along the lower segments of the reach and then becomes continuous in the upper reaches of the mainstem and ephemeral tributaries. The quality, abundance and diversity of these remnants improve in the upper reaches of the mainstem and tributaries. Generally, there is a good coverage and diversity of riparian vegetation along the mainstem, however the encroachment of several weed species such as Blackberry (*Rubus fruiticosus*), Gorse (*Ulex europaeus*), Sweet Briar (*Rosa rubiginosa*) and Tagasaste (*Chamaecytisus palmensis*) have devalued most sites.

The upper slopes retain a good remnant vegetation cover in places, with much of the vegetation having regenerated since the conclusion of mining operations. Many Wattles are found throughout the mainstem, including Black Wattle (*Acacia mearnsii*) and Blackwood (*Acacia melanoxylon*) which is indicative of past disturbances from mining and excavation activities.

The mainstem is generally characterised by a Blue Gum (*Eucalyptus globulus var globulus*) over an understorey of scattered Black Wattle (*Acacia mearnsii*), Blackwood (*Acacia melanoxylon*), Hedge Wattle (*Acacia paradoxa*) and a suite of exotic weed species such as Sweet Brior (*Rosa rubiginosa*), Blackberry (*Rubus fruiticosus*), Gorse (*Ulex europaeus*) and Tagasaste (*Chamaecytisus palmensis*).

Vegetation present along the mainstem of the reach occurs in sizeable patches in a few locations but is discontinuous and narrow where present. The remnant vegetation along the mainstem is a very important wildlife corridor and needs to be secured and rehabilitated to provide connectivity to forested areas in the higher valleys.

- **Figure5-4 Current Vegetation Attributes (EVC) Reach 2 –Glenpatrick Creek).**

Current EVC Remaining in Reach (DSE, 2005)	Occurrence	Location
18 – Riparian Forest	Mainstem	Occurs beside permanent streams, typically on narrow alluvial deposits.
22 – Grassy Dry Forest	Southern hill slopes	Range of slopes and altitudes outside of the riparian zone.
23 – Herb-rich Foothill Forest	Small remnants in the north west of the catchment,	Relatively fertile, moderately well drained soils. Easterly and southerly aspects of lower slopes and gullies.
47 – Valley Grassy Forest	Mid to lower slopes	Occurs on fertile well-drained colluvial or alluvial soils on gently undulating lower slopes and valley floors

Due to the ephemeral nature of this reach, the warterway is dry for most of the year. Therefore, the conditions are not suitable for aquatic species and dryland species such as Poa Grass (*Poa labillardieri*) was often found scattered in the stream bed (Refer to Figure Figure 5-5). Rush (*Juncus spp*) and Sedge (*Carex spp*.) were occasionally observed in the lower reaches of the mainstem.

Although the reach is largely unfenced, there have been minimal impacts from grazing activities, which is indicated by a healthy understorey and groundcover along the majority of the reach. The control, management and on-going monitoring of weed species such as Blackberry, Sweet Briar, Tagasaste and Gorse should be a priority for this reach. A coordinated management regime should be established with the local landholders, DSE and DPI to effectively control these species.

- **Figure 5-5 Blue Gum (*Eucalyptus globulus var globulus*) and native Poa Grass (*Poa labillardieri*) were the dominant species along the mid-sections of Glenpatrick Creek.**

5.4 Habitat

Due to the highly porous nature of the bed, there was no obvious flows above surface with only a few pools evident near the forest where slate and shale intersects were seen to be associated with a spring of freshwater. Anecdotal evidence provided at the community workshops confirmed the decline in the groundwater levels with the water table dropping over the drought period as observed in a number of old open mineshafts.

5.5 Water Quality

The water quality of this section cannot be commented on as no surface flows were observed and there was no data available for the area. A small spring observed near the forest edge emanating from a shale seam from a connected hillslope, was fresh and had a low salinity. Given the geology of the area, this is what can be expected as a low flow quality if and when flows return after the groundwater replenishes.

High flow water quality is likely to be impaired by erosion products from stream erosion and runoff from the lightly vegetated grazing lands, given the soil characteristics of the area.

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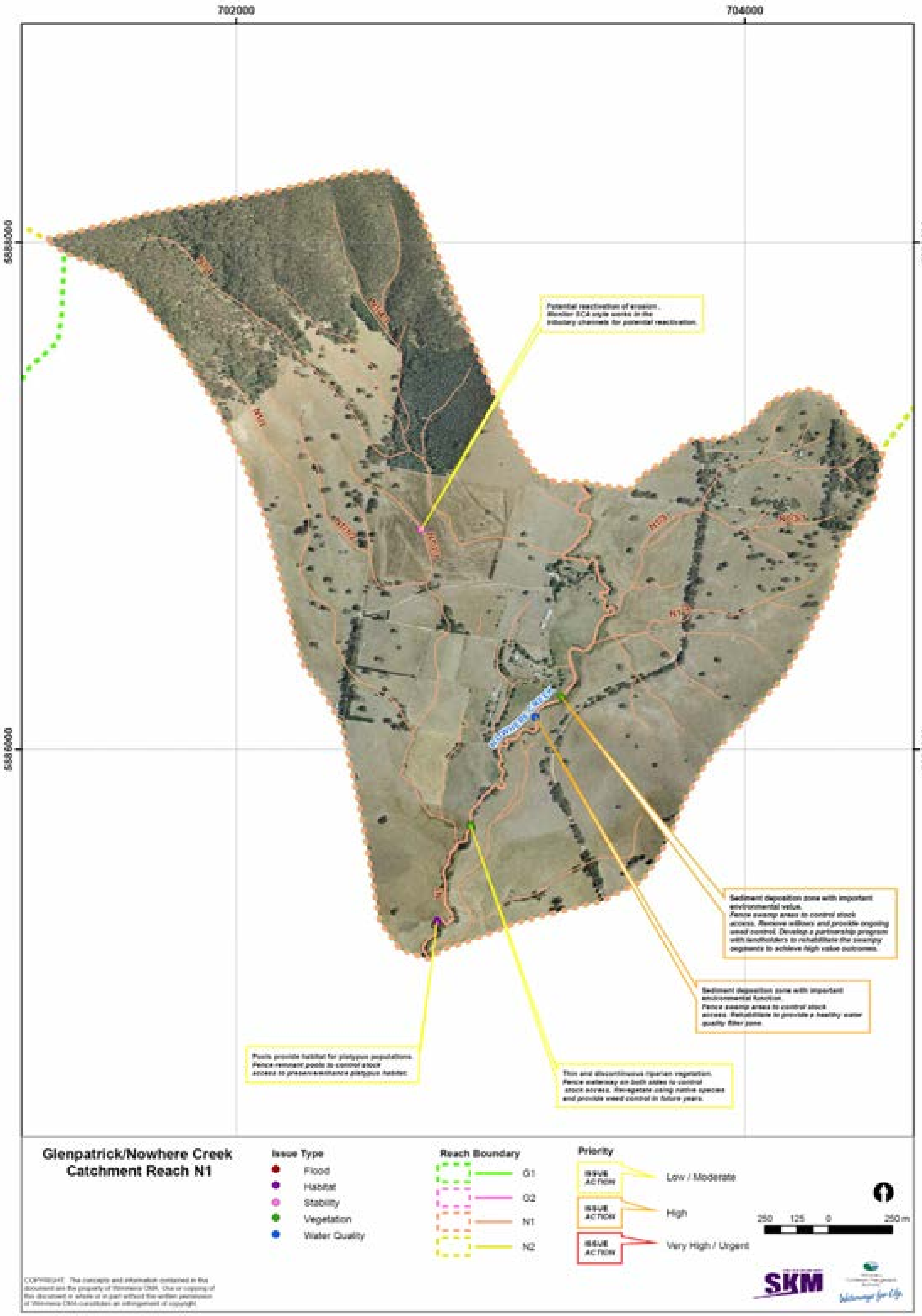
5.6 Flooding

Flooding is not an issue in the area except for the two ford crossings and also potentially where some of the lateral tributaries cross the Glenpatrick Road with only nominal culverts sizes being installed. The ford crossing at both Akers Lane and Glenpatrick Road are both unsafe and need appropriate warning signage and depth indicators as there are no safety barriers on the downstream edge of either crossing. A safety review for these is recommended.

5.7 Threats and Priorities

THREAT	RISK
Strong weed infestations of Gorse, Blackberry and Tagasaste	Very High
Reactivation of bed and bank erosion in the mainstem due to past channelisation, large woody debris and point bar development	Very High
Uncontrolled stock access to many areas of the lower and mid section of the mainstem	Very High
Unsafe ford crossings requiring warning signagae at Akers Lane and Glenpatrick Road	Very High
Lack of bank and in channel vegetation adding to erosion and decline in riparian and stream values	High
Need for a dedicated point bar groyne and large woody debris management plan along the mainstem of the Waterway to slow bank erosion	High
Suspended solids export is high from the eroding tracks lands and stream channels	High
Need to monitor the morphology of the channel in the upper segment of G1 for changes	Moderate

6. Reach N1 – Nowhere Creek (Glenpatrick Creek to Break of slope)



6 Reach N1 Nowhere Creek (Glenpatrick Creek to Break of slope)

6.1 Location of Reach N1

The most downstream of the two Reaches of Nowhere Creek extends from the junction of Glenpatrick Creek to the break of slope which occurs immediately upstream of two significant swamp areas.

6.2 Morphological description

The creek in its lower section immediately upstream of the junction has a small channel that sits in a broad floodplain within a pattern of abandoned courses. The channel is 'U' shaped with signs of overbank deposition and minor silt levees. The channel is stable and has a number of large pool formations that were dry at the time of inspection. The bed material is generally fine material (sands and silts) with only the occasional occurrence of coarser gravels.

There is a thin and discontinuous line of mature River Red Gums along the channel at the lower end but the riparian zone is not fenced. Towards the upper end of the reach, the channel is very small and slightly perched. Here the floodplain appeared to by quite damp with large areas of sedge and rushes dominant across the valley floor. This coincides with the occurrence of multiple old channels and was probably a former sediment deposition area with anastomosing channels and swamp scrub, with the sedges and rushes being the remnant plants of that community. This segment is important in the role it plays in mitigating the transport of erosion products into the downstream and lower gradient areas of Glenpatrick Creek.

- **Figure 6-1 Sediment deposition area at the break of slope on the mainstem of Nowhere Creek (N1)**

- **Figure 6-2 Swamp area on N1 serves an important water quality function.**

The tributaries are all ephemeral and although some show signs of some minor past erosion activity, they are currently stable. Some of these have been subjected to past SCA works with diversion works, gully battering and gully plus dams evident. These appear to be sustainable at the moment but need monitoring particularly given the trend to change farming practices across the region.

6.3 Vegetation

Current EVC mapping indicates that vegetation in this reach includes four vegetation communities. Table 6.3-1indicates 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.

Remnant vegetation within this reach is largely restricted to the upper northern sedimentary valleys in reaches N1/4 and N1/4/1 with vegetation cover having been largely removed from the lower slopes and valley floor for agricultural purposes. These areas are generally characterised by scattered individuals of 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. A Radiata Pine (*Pinus radiata*) plantation exists on the north eastern hill slopes of reach N1/4/1.

- **Table 6.3-1 Current Vegetation Attributes (EVC) N1**

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.
23 – Herb-rich Foothill Forest	Small remnants in the north west of the catchment,	Relatively fertile, moderately well drained soils. Easterly and southerly aspects of lower slopes and gullies.
68 – Creekline Grassy Woodland	Mid sections of the mainstem	Alluvial flats of the valley floor in close proximity to the water course.
152 – Alluvial Terrace Herb-rich Woodland / Plains Grassy Woodland Complex	Upper sections of the mainstem	Following alluvial terraces associated with drainage lines.

The mainstem is generally characterised by aged River Red Gums over an understorey of scattered Black Wattle and exotic weed and pasture species in the lower reaches. 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. Some willows (*Salix spp*.) are located at the confluence of N1/3 and these should be removed carefully and replaced with locally indigenous species such as Grey Box (*Eucalyptus microcarpa*) and Yellow Box (*Eucalyptus melliodora*) with mixture of understorey species such as Black Wattle (*Acacia mearnsii*) and Blackwood (*Acacia melanoxylon*).

A swampland of native Rush *(Juncus spp*.) and Sedge (*Carex spp*.) exists at the confluence of N1/2 which is currently unfenced and currently grazed. This area acts as an important vegetation buffer to enable the filtration of sediments before entering the waterway (refer to Figure 6-2). Additionally, this area would provide an important habitat linkage to the waterway for native fauna. It is recommended that this area is protected by fencing to restrict grazing.

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 the encroachment of weed species have also accelerated riparian degradation in some areas. The provision of alternative water supplies for stock in conjunction with protective fencing on both sides of the waterway should be seen as a high priority for this reach. A revegetation program focussing mainly at the restoration of understorey should shortly follow.

6.4 Habitat

Other than a few dry pools in the lower reach this segment has little habitat value except from the continuity provided from the forest stream processes. The re-establishment of a vegetated stream corridor is required and this will in turn reinforce the critical need to ensure the forested streams are connected through to both Glenpatrick Creek and the Wimmera River to help sustain them.

The pools are important elements and add value in the wetter seasons, but their drying and loss of protection through stock access is a real threat to their role in habitat provision.

The re-engagement and rehabilitation of the swampy segments in the upper reach will be important in its provision of food sources to the rest of the reach as well as protecting the overall system from gross sedimentation. These areas appear to be very boggy and of little productive value to the farming enterprises. Rehabilitation of these areas will need a refined and more detailed investigation and a strong co-operation with the land owners to achieve. The potential for a high quality outcome appears to be within reach given good will and a long-term strategy.

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6.5 Water Quality

No water quality data is available for this section. At the time of inspection all flows were well below the surface and being carried within the gravel and sand lenses in the valley floor. However given the geology and forest cover of the upper catchments it is expected that the low flows will be relatively low in salinity and suspended solids.

High flow quality is likely to reflect the runoff from the cleared erodible terrain, tracks, roads and upstream stream disturbances with high suspended solids and turbidity.

6.6 Flooding

Flooding is not a major threat to any public or private assets in this reach. The out of bank flows will be regular in most wet years and follow natural flood lines in the associated floodplains. Flooding of these areas is not likely to be of long duration as the area is readily drained.

6.7 Threats and Priorities

THREAT	RISK
Need to protect remnant pools and old River Red Gums upstream of the Junction with Glenpatrick Creek	Very High
Reactivation of bed and bank erosion in the mainstem by channelisation through the existing swampy transition area in the upper segment of the reach	Very High
Uncontrolled stock access to many areas of the lower and mid section of the mainstem	Very High
Lack of bank and in channel vegetation adding to erosion and decline in riparian and stream values	High
Suspended solids export is high from the eroding tracks lands and stream channels upstream	High
Need to monitor the past SCA style works in the tributary channels for potential reactivation	Moderate

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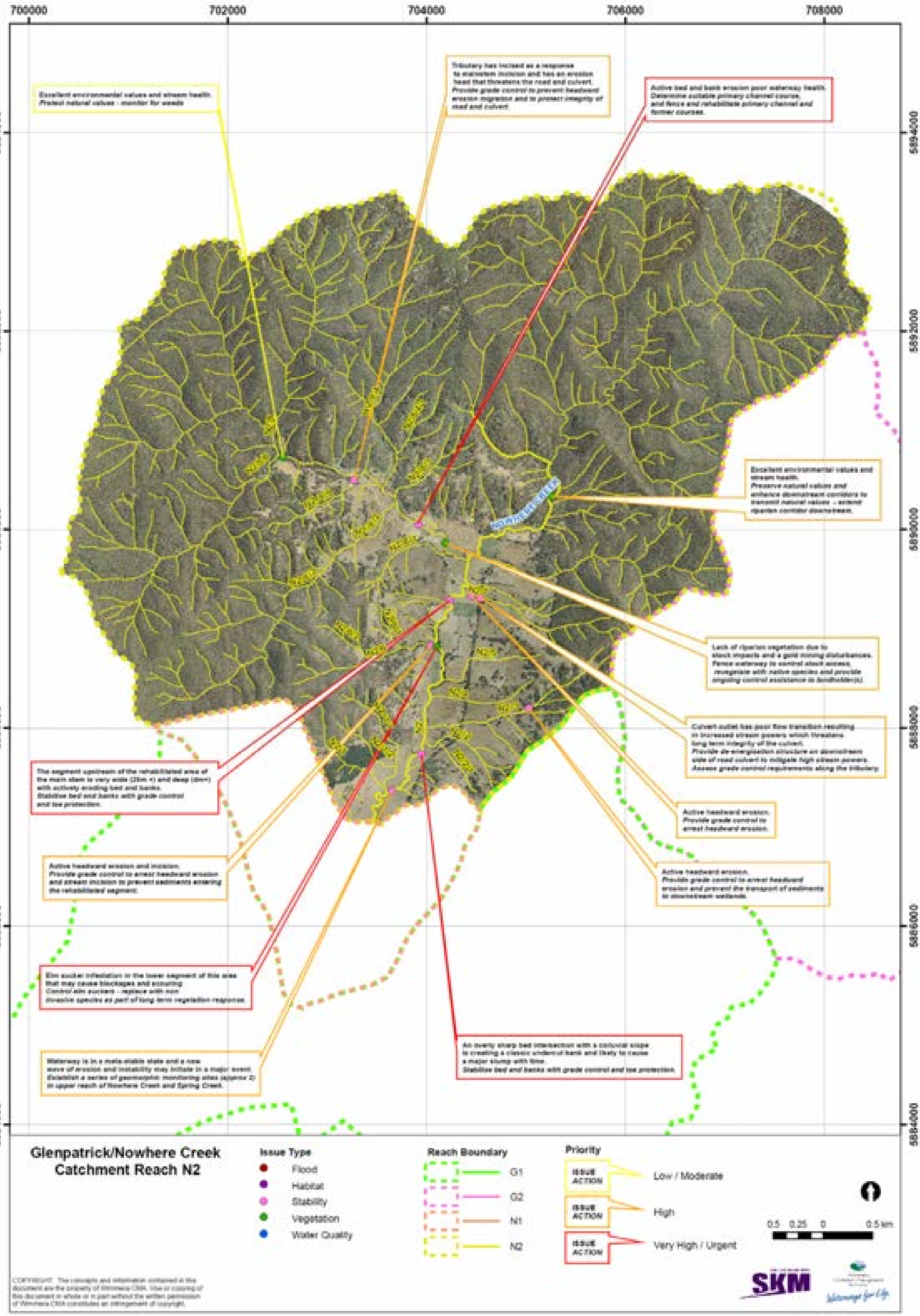
7. Reach N2 – Nowhere Creek (Break of slope to Pyrenees Ranges)



7. Reach N2 Nowhere Creek (Break of slope to Pyrenees Ranges)

7.1 Location of Reach N2

This reach includes both arms of the upper Nowhere Creek system the right bank branch being locally known as 'Spring Creek'. The reach runs from the break of grade north of Reach N1 through to the forest edge on both of the main streams. It includes a number of left and right bank tributaries that rise on the adjacent hillslopes.

7.2 Morphological description

This reach covers the steepening portion of the Nowhere Creek system as it rises up the valley to the forest edge. The lower portion of the reach has only a small channel which sits on what appears to be a cobble fan at the break of slope. The channel is mildly sinuous, small in cross-section and has little overstorey vegetation. A good cover of sedges is evident.

Upstream of this fan, the stream has been channelised, probably following a period of substantial disturbance during the gold mining era. The channel has incised into the alluvium and connected colluvial slopes and whilst some areas are stable others are either active or have the potential to become active under wetter years. The cobble beds of this area can be seen to form prominent bars and benches directing erosive flows into the banks in places. In some places, the bed is undercut and is prone to cantilever failure of the upper portions. Simple insertion of some toe groynes will settle this down.

- **Figure 7-1 Impacts of gold mining have had a significant impact on the catchment**

- **Figure 7-2 Mulloch heaps are prevalent in the forested upstream catchment**

One property owner has undertaken a long-term and personal initiative of stabilisation of the bed and banks with generally outstanding results. The fencing and revegetation through this area is commendable and demonstrates the benefits of this activity as well as that of the landowner's commitment. Not withstanding the good work in this segment there are signs of cobble movement and scour hole appearing in the bed, plus potential problems due to Elm sucker infestation in the lower segment of this area that may cause blockages and scouring. The changes in channel through the rehabilitated area appear natural and may not need intervention, but a watching brief should be maintained.

- **Figure 7-3 Tree planting and effective management has improved stream stability where appropriate techniques have been applied**

Elsewhere the channel is still actively eroding and stock have uncontrolled access leaving the channel with little protective cover on bed, banks or verges. The channel immediately upstream of the rehabilitated area is very wide (>25 m) and deep (~4 m) with actively eroding bed and banks. This appears to coincide with a grade steepening that runs up to Spring Creek Road, but the historic downstream straightening is also a likely contributor with headward erosion a major cause of deepening. The coincidence of this disturbance with the junction of two major subcatchments is also likely to be a factor. Old stream channels are observable on the flat valley floor adjacent to this deep incision given a clue to the fact that the former channels were very shallow. Intervention is required in this area with grade controls and groynes required to arrest further incision and settle the cobble movement. Fencing and revegetation will also be required.

The tributaries in this reach are deeply incised and unstable. N2/3 is very active upstream of Nowhere Creek Road but the sediment load from this is being attenuated by a flat wetland floor downstream. N2/6 has active incision and headward erosion and bed loads can be seen to enter the rehabilitated segment. N2/7 is actively eroding in both bed and bank and is contributing to bed loads in the mainstem. The new road culvert at Nowhere Creek Road on this tributary has a poor flow transition which increases streampower in this area. Erosion is also evident upstream of the road as a result of the culvert invert lowering. Intervention with some grade controls will be required in this reach.

Upstream of Spring Creek Road the channel splits into Nowhere Creek being the left tributary and Spring Creek being the right tributary. Nowhere Creek whilst showing signs of historic channelisation and incision is fairly stable with a cover of grasses and a thin discontinuous line of trees. Landowner fencing is assisting in the maintenance of a stable channel. Further revegetation should be encouraged. The stream in the lower segment of the forest is small and stable having intersected a series of rock bars. There are abundant signs of past gold mining with innumerable mullock heaps and holes in the area.

Spring Creek has been subjected a series of puzzling channelisation and realignment activities. Whilst no information is available to the study team, it appears that either sluice mining activity has occurred or the area has been used as a mine for cobble supply. The straightened channel cuts through a colluvial slope at a depth of nearly 6 m and has widths up 20 m, with the smaller old course well out on left bank. Other old courses indicate that this area has been significantly altered historically, probably for mining. The current condition is poor with active bed and bank erosion and waves of cobbles along the stream. The age class of some Blackwood in the lower portion of this area suggests that some rehabilitation has been attempted in the last 30 years. Some follow up works to establish a stable channel and fence out stock access will assist in stabilising this area.

- **Figure 7-4 Bed & bank erosion as a result of stream straightening and diversion**

The upper forest end of Spring Creek is in very good condition being a small channel with bed rock intersects and a healthy array of groundcovers, midstorey and overstorey. All tributaries appear to be relatively stable with the exception of N2/8/5 which the mainstem of Spring Creek enters from right bank. The lower end of this tributary has incised as a response to mainstem incision and has an erosion head that threatens the road and culvert.

7.3 Vegetation

Current EVC mapping indicates that vegetation in this reach includes five vegetation communities. **Error! Reference source not found.** Table 7.3-1 indicates the specific EVC that have been previously recorded within the study reach and the general vicinity of occurrence.

Valley Grassy Forest 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.

The vegetation of the upper section of Nowhere Creek occurs mainly within the steeper hills of the upper catchment, with the valley floor being contained within the hills on each side. Remnant vegetation is largely restricted to the upper areas of the reach, where land use pressures have been minimal due to the steeper nature of the area. The dominant canopy species in the higher valleys include Blue Gum (*Eucalyptus globulus var globulus*) and Mountain Grey Gum (*Eucalyptus cypellocarpa*). These stands were mainly associated with an understorey of Blackwood (*Acacia melanoxylon*), Black Wattle (*Acacia mearnsii*), Hedge Wattle (*Acacia paradoxa*), Drooping Cassinia (*Cassinia arcuata*), Gorse Bitter-pea (*Daviesia ulicifolia*), Cranberry Heath (*Astroloma humifusum*), Black-anther Flax Lily (*Dianella revoluta s.l.*), Bracken (*Pteridium esculentum*) and Poa (*Poa labillardieri*) (Refer to Figure 7-5).

- **Figure 7-5 Riparian vegetation along the upper reaches of Nowhere Creek.**

Remnant vegetation in the lower valleys is characteristically more scattered as a result of clearing for both agriculture and gold mining. The dominant canopy species occurring in these areas mainly include Red Stringybark (*Eucalyptus macrorhyncha*), Red Box (*Eucalyptus polyanthemos*), Yellow Box (*Eucalyptus melliodora*) and Bundy (*Eucalyptus goniocalyx*). These stands were generally associated with a fabric of Blackwood (*Acacia melanoxylon*), Black Wattle (*Acacia mearnsii*) and woody weeds such as Sweet Briar (*Rosa rubiginosa*) and Gorse (*Ulex europaeus*).

The remaining areas of the reach are characterised by cleared paddocks and scattered trees over a groundcover of mainly exotic pasture and weed species.

- **Table 7.3-1 Current Vegetation Attributes (EVC) Reach N2**

Current EVC Remaining in Reach (DSE, 2005)	Occurrence	Location
20 – Heathy Dry Forest	Upper reaches of Nowhere Creek (Reach 2)	Grows on shallow, rocky skeletal soils on exposed aspects on ridge tops and steep slopes
22 – Grassy Dry Forest	Southern hill slopes	Range of slopes and altitudes outside of the riparian zone.
23 – Herb-rich Foothill Forest	Small remnants in the north west of the catchment,	Relatively fertile, moderately well drained soils. Easterly and southerly aspects of lower slopes and gullies.
47 – Valley Grassy Forest	Along the mainstem and the lower sections of ephemeral tributaries.	Occurs on fertile well-drained colluvial or alluvial soils on gently undulating lower slopes and valley floors
67 – Alluvial Terrace Herb-rich Woodland	Small remnants in the lower reaches of Glenpatrick Creek (Reach 1) and Nowhere Creek (Reach 1&2)	Range of slopes and altitudes outside of the riparian zone.

The mainstem is generally characterised by an overstorey of Blue Gum (*Eucalyptus globulus var globulus*) and scattered aged River Red Gums in the lower reaches over an understorey of scattered Black Wattle (*Acacia mearnsii*), Blackwood (*Acacia melanoxylon*) and exotic weed and pasture species including Sweet Briar (*Rosa rubiginosa*), Gorse (*Ulex europaeus*), Blackberry (*Rubus fruiticosus*) and Phalaris (*Phalaris aquatica*).

The majority of the streams length (particularly the lower reaches) has uncontrolled stock access, which has resulted in the loss of native riparian vegetation, both in coverage and diversity. In-stream disturbances including erosion and weed invasion have accelerated riparian degradation in some areas. An infestation of Elm trees (*Ulmus spp*.) located approximately 150 metres downstream of the N2/1 confluence may cause blockages and scouring in the near future if not appropriately managed.

The scarcity of suitably intact vegetation along the mainstem of the lower slopes is an issue of vegetation management that requires attention. The control of livestock within the riparian zone would help foster greater natural regeneration, thereby promoting the dispersion of native species from the upper catchment to areas down stream. The targeted revegetation of the riparian zone through the re establishment of canopy and mid-storey species would facilitate a greater regeneration capacity for this reach.

The provision of alternative water supplies for stock in conjunction with protective fencing and on-going woody weed control (Sweet Briar and Gorse) should be seen as a high priority for this reach. A revegetation program focussing mainly at the restoration of understorey should shortly follow.

7.4 Habitat

Other than a few dry scour holes in the cobble bed in the lower reach this segment has little habitat value except from the continuity provided from the forest stream processes. The re-establishment of a vegetated stream corridor is required and this will in turn reinforce the critical need to ensure the forested streams are connected through to both Glenpatrick Creek and the Wimmera River to help sustain them.

The pools are important elements and add value in the wetter seasons, but their drying and loss of protection through stock access is a real threat to their role in habitat provision. The re-establishment of a strong riparian corridor is an integral part of this activity

The continued engagement of the cobble fan in the lower reach will be important in its role of mitigating the transport of sediment loads from the actively eroding areas upstream, as well as protecting the overall system from gross sedimentation. These areas appear to be of low productivity and of low productive value to the farming enterprises. Rehabilitation of these areas with revegetation and fencing is needed and will require strong co-operation with the landowners to achieve. The potential for a high quality outcome appears to be within reach given good will and a long-term strategy. The interconnection of this area with that in N1 downstream is high and together forming a critical part of attaining improved stream health through the area.

7.5 Water Quality

No water quality data is available for this reach. At the time of inspection all flows were well below the surface continuing within the gravel and sand lenses in the valley floor. However, given the geology and forest cover of the upper catchments it is expected that the low flows will have relatively low salt concentrations and suspended solids.

Water quality in high flow events is likely to be impaired by erosion products from stream erosion and runoff from the lightly vegetated grazing lands, given the soil characteristics of the area.

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7.6 Flooding

Flooding is not a major threat to any public or private assets in this reach. The out of bank flows will be regular in most wet years for the lower reach whilst almost fully contained within the banks in the deeply incised areas. Some flooding of private crossings may occur on the tributaries, but liability for access is a private matter. The bridge at Spring Creek Road downstream of the junction of Nowhere and Spring Creeks appears to have a relatively high level of flood protection but inundation of this would only be for a matter of a few hours. Flooding of the areas is not likely to be of long duration as the area is readily drained by the steep channels.

7.7 Threats and Priorities

THREAT	RISK
Need to protect and revegetate sediment and cobble fan area at lower end of mainstem reach	Very High
Active of bed and bank erosion in the mainstem downstream of Spring Creek Road and Spring Creek by channelisation leading to disturbed channel and loss of stream process continuity through the reach.	Very High
Uncontrolled stock access to many areas of the mainstem	Very High
Active bed and bank erosion/gullying in lateral tributaries N2/4, N2/6, N2/7and N2/8/5 adding erosion products to mainstem	Very High
Lack of verge bank and in channel vegetation adding to erosion and decline in riparian and stream values	High
Suspended solids export is high from the eroding tracks lands and stream channels upstream	High
Weed infestation along parts of upper catchment tributaries	High
Need to monitor the past landowner works in the mainstem channel for potential reactivation	Moderate

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