SURVEY OF RIVER FORESHORES IN THE OYSTER HARBOUR CATCHMENT 1997

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1997

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Cover Photo: *Foreshore regeneration along the Boonawarrup Creek. Local farmers Heather (shown in picture) and Mark Adams have fenced the creek, allowing prolific regeneration of trees and shrubs.*

SURVEY OF RIVER FORESHORES IN THE OYSTER HARBOUR CATCHMENT 1997

Report to
Albany Waterways Management Authority

by
APACE Green Skills
and
Dr Luke Pen,
Water and Rivers Commission

WATER AND RIVERS COMMISSION
REPORT SERIES

REPORT NO WRT 17
1997

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APACE Green Skills would like to acknowledge the support of farmers and farm managers in the Oyster Harbour Catchment, without whose cooperation the survey would not have been possible. The Shires of Albany and Plantagenet provided support for the survey.

Three studies provided the foundation on which the current report was based. The first, by Dr Luke Pen, surveyed the condition of the Kalgan River foreshore (Pen, 1994). The second surveyed the condition of the Hay and Denmark River foreshores (APACE Green Skills and Dr Luke Pen, 1995). The third surveyed the condition of foreshores in the Little River catchment (APACE Green Skills, 1996). These surveys were undertaken on behalf of the Albany Waterways and Wilson Inlet Management Authorities, which are now both part of the Water and Rivers Commission.

The on-ground survey work for the project was carried out by Kevin Hopkinson in conjunction with local landholders. Mr Hopkinson also did much of the farmer liaison and preparation of tables for the report as well as taking the photographs. Basil Schur supervised the overall project for APACE Green Skills, and edited and prepared the final report. Other APACE Green Skills staff who assisted in the project included Gerda Vogt, Biddy Myres, Chris Baillie, Louise Duxbury and Sally Haigh. Andrew MacFarlane did the final layout for the report. Craig Chappelle prepared the photographs for publication

Tony Cremin (Agriculture WA), John Beaton and Phil Tasker (Geo Task) produced the maps for the project, entered the survey data onto Geographic Information System (GIS). Mike Taylor, Agriculture Protection (Agriculture WA) provided information on measures to control weeds. A special thanks goes to the staff of Agriculture WA for ongoing support, including Mandy Curnow, Bruce Radys and Dave Weaver.

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HOW TO USE THIS REPORT:

1 **READ THE REPORT** (THE SUMMARY AND SECTIONS 1 THROUGH TO 6), IN PARTICULAR THOSE PARTS RELATING TO YOUR AREA/S OF INTEREST.

2 **USE THE MAP INDEX** (MAP 1.2 ON PAGE 4) TO FIND YOUR APPROXIMATE PROPERTY LOCATION ON THE DETAILED MAP SHEETS. THE RIVER MAPS ARE IN CHAPTER 7.

3 **FIND THE MAP CONTAINING YOUR PROPERTY.** (THIS WILL REQUIRE SEARCHING FOR YOUR LOCATION OR LOT NUMBER, USING LOCAL LANDMARKS).
EACH SUB-SECTION MAP HAS A TABLE FACING IT, WHICH GIVES MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS.

4 **USE THE DETAILED LEGEND FOLD-OUT KEY ON THE INSIDE BACK COVER TO UNDERSTAND THE MAP REFERRING TO YOUR PROPERTY.**

5 **USE THE TABLE AND THE MAP INDEX TO DETERMINE WHAT RECOMMENDATIONS HAVE BEEN MADE FOR YOUR PROPERTY.**

NOTE: THE 'LEFT' AND 'RIGHT' BANKS ARE SEEN AS LOOKING UP RIVER.

Summary

Oyster Harbour, on the south coast of Western Australia and adjacent to the township of Albany, is a regionally significant estuary. Currently it is threatened by eutrophication, due mainly to excessive nutrient input from agricultural areas in the catchment. The catchment area of the Harbour covers 304,000 ha, comprising mainly farmland and Crown land.

The Kalgan and King Rivers are the two major tributaries of Oyster Harbour with the Boonawarrup, Chelgiup, Gaalgegup, Johnston, Moorialup, Napier, Stoney, Takalarup and Takenup creeks and Young River being smaller but significant tributaries of the Kalgan.

The large quantities of nutrients and sediment that each year discharge into Oyster Harbour come principally from diffuse sources feeding these rivers and creeks. These nutrients have caused algal growth which has substantially damaged and reduced seagrass meadows of the harbour. Research has highlighted the importance of streamline fringing vegetation in attenuating nutrient and sediment loss from agricultural areas into waterways.

There is an increasing call from the local rural community for the rivers and other watercourses of the catchment to be fenced. This would protect these large natural bio-filters and reduce erosion of the riverbanks, which occurs when the protective fringing vegetation is lost through livestock grazing and trampling.

To assist with the process of catchment repair, the Albany Waterways Management Authority commissioned APACE Green Skills to carry out a survey to assess the condition of selected foreshores of some of the Oyster Harbour Catchment's tributaries. The survey commenced in February 1997 and concluded in May 1997.

This work graded the condition of sections of foreshore of each river bank into three categories: (A) pristine to slightly disturbed, (B) degraded, (C) erosion prone to eroded, and (D) eroding ditch or weed infested drain; on the basis of weed infestation, soil exposure and erosion. The extent of riverbank fencing and revegetation, and the general quality of the fringing vegetation were also assessed.

Foreshore condition and fencing status were assessed in detail along with fencing and rehabilitation needs and other information and the results were then collated.

In total, 122 kilometres of selected rivers and tributaries were surveyed. Of this length, about 19% of the riparian zone was A grade, 34% B-grade, 30% C-grade and 17% D-grade. Overall, about 204 ha of river valley embankment and foreshore requires revegetation to stabilise the banks, and maintain both aquatic and terrestrial corridors.

In areas where farmland adjoined the selected river and its tributaries, approximately 55% of the foreshore was already fenced. A further 133 km of fencing is required which includes fences that need relocating further away from the main channel.

These tributaries have many points of erosion and subsidence with significant sections of degradation in several tributaries. Deposits of course sediments were observed frequently in the river bed. Fencing has been placed along some of these sections recently, but has not always been placed with sufficient distance from the waterway to provide an effective buffer. To protect riverine fringing vegetation and thereby maintain its bio-filtering and erosion control functions, fencelines need to be located above the river valley and, in the case of steep valley embankments, well above it. In some sections of eroding watercourse or dam spillways, soft-engineering approaches (eg construction of pool and riffle systems) are required. Not withstanding the above, significant sections of the river and tributaries were found to be scenic and contained foreshores of a high quality.

The findings and recommendations of the survey are designed to provide advice and encouragement to landholders and managers to carry out measures which protect and restore river and stream foreshore condition. Farmers who wish to fence rivers, streams or drains on their properties may be eligible for assistance from State and Federal Governments, including from the Albany Waterways Management Authority under waterways rehabilitation programs currently in place for the catchment.

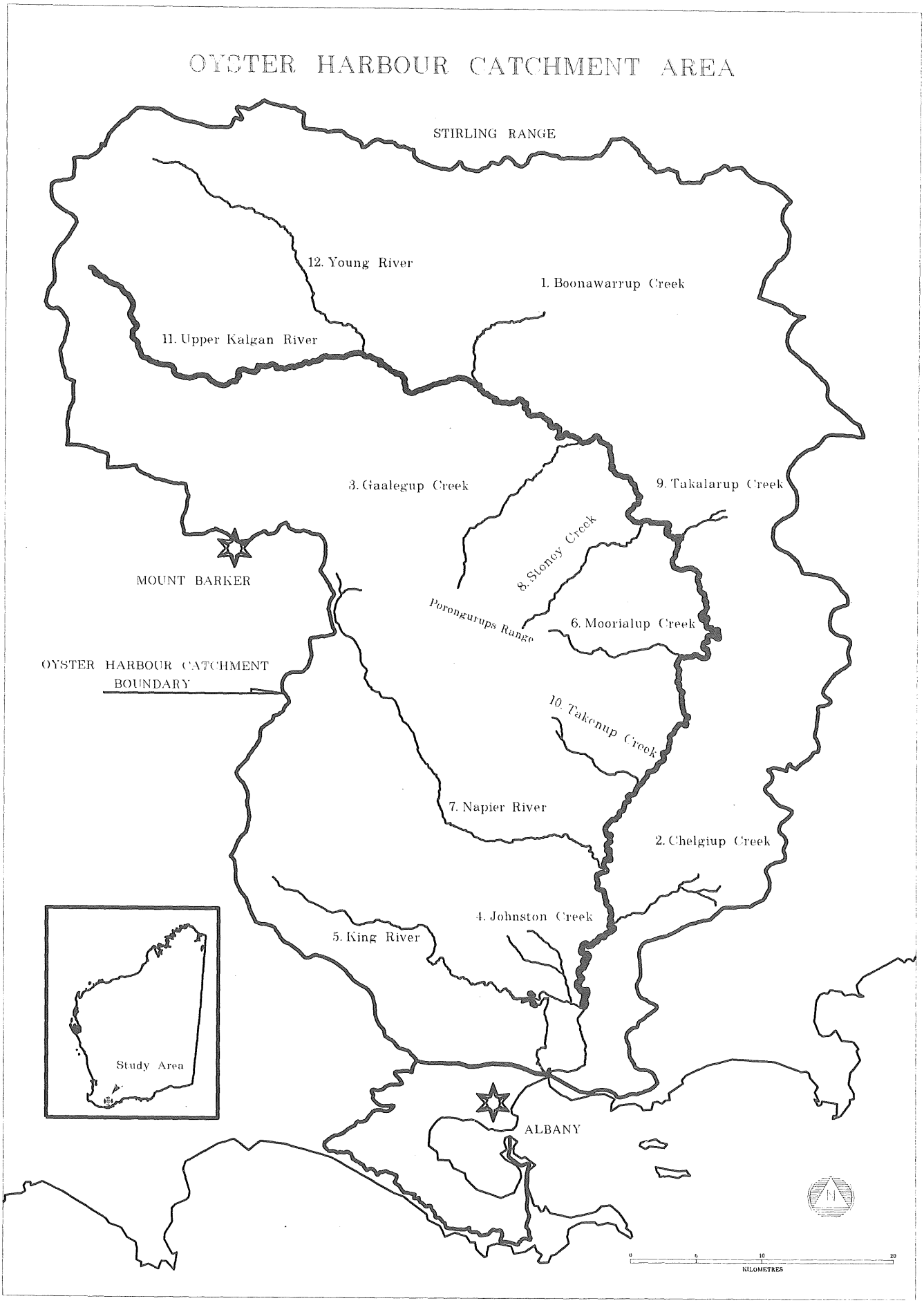
The Oyster Harbour Catchment is extensively used for commercial agriculture. In addition to protection, revegetation and weed management of the fringing vegetation of waterways it is recommended that all agricultural landusers:

- increase the use perennial grasses, shrubs and trees;
- avoid clearing of remnant native vegetation and protect existing remnants;
- obtain environmental management advice and approvals prior to constructing dams or any other structures affecting watercourses;
- investigate alternate stock crossing structures, where problems are occurring;
- assist with construction of pools and riffles and dam overflow structures in certain sections of the catchment where recommended by landcare technicians or other expert advisers;
- be encouraged to form and participate in specific catchment groups, with the aim of formulating a management plan.

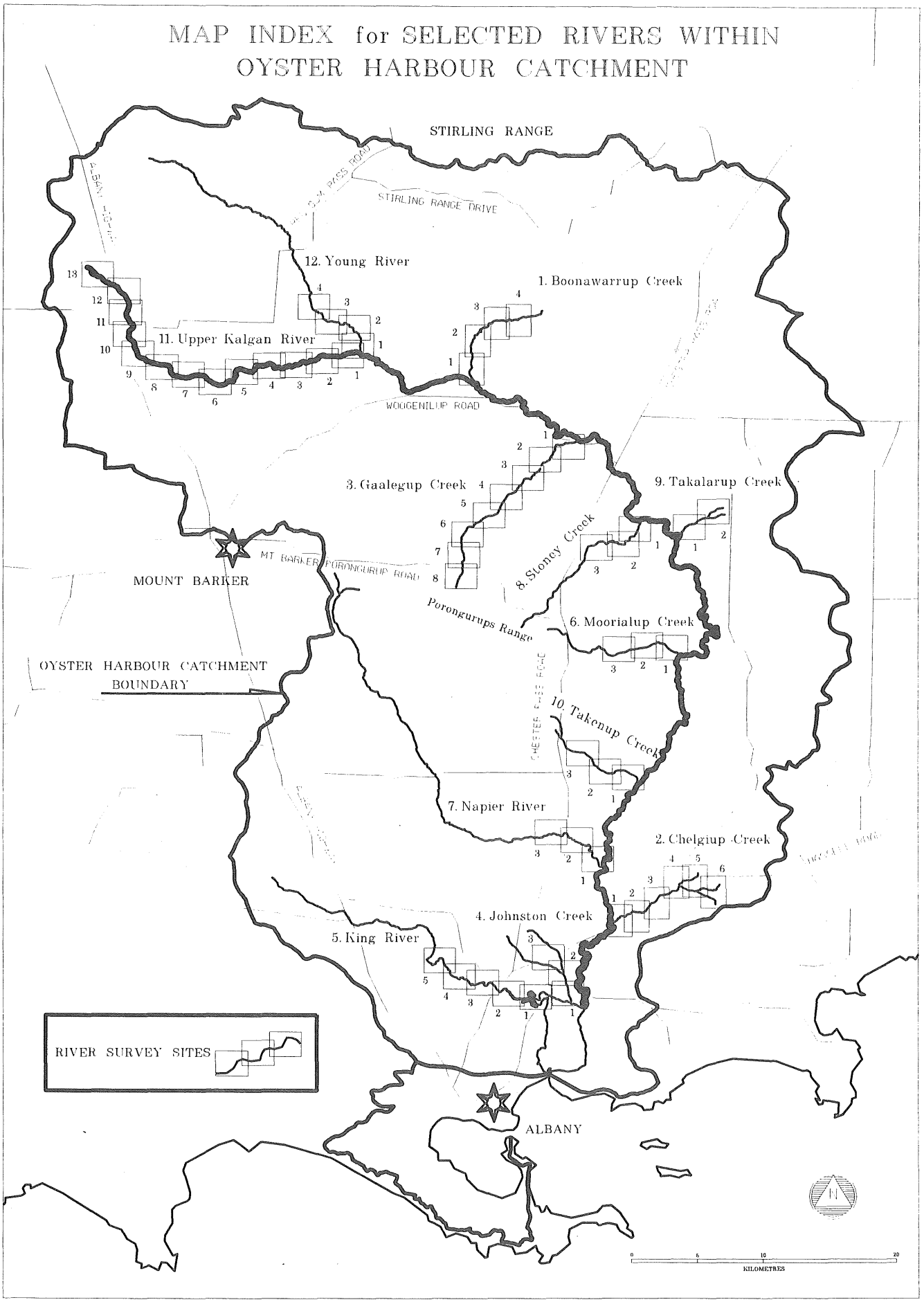
Those landholders with farming enterprises in the Catchment are encouraged by Agriculture Western Australia to minimise nutrient loss to waterways by:

- regular soil testing and use of the appropriate fertiliser recommendations;
- the maintenance of adequate ground cover through stock management;
- the diversification into alternative enterprises on low nutrient retentive sites; and
- the integration of all these measures through whole farm planning.

This report is part of an approach whereby Government agencies and community landcare groups cooperate with all landusers to assist in protecting the health of a much valued south coast estuary and its associated waterways.



Map 1.1 Location Map for the Oyster Harbour Catchment



Map 1.2 Base Map and Map Sheet Index for selected tributaries in the Oyster Harbour Catchment

1. Introduction

1.1 Aims of the study

The aims of the survey were as follows:

1. Survey the condition of selected tributaries in the Oyster Harbour Catchment and its fringing vegetation using the system outlined in Section 3.2;
2. Map points of serious erosion;
3. Map the extent of fencing along the river and tributaries;
4. Provide a general description of the fringing vegetation and landscape;
5. Assess the health of vegetation along the river and tributaries; and
6. Provide a preliminary series of recommendations for rehabilitation work along the foreshores of the river and its tributaries. These recommendations were designed to provide encouragement and advice to landholders and agency managers for future riparian repair work.
7. To provide a 'snap-shot' of river foreshore conditions for selected important tributaries, so that resources for water way management can be appropriately allocated.

1.2 Study area

The study area consists of the land along selected tributaries of the Oyster Harbour Catchment between (see Map 1.2- catchment index map). The area includes the channel embankments, the floodways and floodplains of the river and its tributaries, the valley embankments of the river and tributaries which rise immediately above them and the land use adjacent to the river and its tributaries (see Fig. 2.1 for an explanation of the terms used to describe river valley form).

1.3 Study background

The Kalgan River is the largest tributary of Oyster Harbour, an inlet on the south coast of Western Australia, near Albany (Map 1.1). Studies carried out in 1987 and 1988 by the Environmental Protection Authority revealed that Oyster Harbour was becoming increasingly eutrophic and experiencing large growths of algae which were smothering the seagrass that once dominated the relatively shallow environment of the inlet (EPA, 1990).

The prime cause of eutrophication in Oyster Harbour is the input of nutrients from farmlands into the Harbour via the Kalgan River system (EPA, 1990; SCEP, 1991). In 1988 and 1991, at least 42 and 39 tonnes, respectively, of phosphorus entered Oyster Harbour from the Kalgan River (SCEP, 1991; Prout and Weaver, 1992).

In an effort to control nutrient loss to Oyster Harbour, a catchment management strategy was developed, involving the urban and rural community and government departments. In the general region of the Kalgan River catchment, four Land Conservation District Committees (LCDCs) work at a local level to arrest land degradation and reduce nutrient loss. In order to coordinate catchment management work by the LCDCs within the Oyster Harbour Catchment, the Oyster Harbour Catchment Group (OHCG) was formed. It is supported by Agriculture Western Australia, which investigates and promotes sustainable agricultural systems.

South Coast research has shown that nutrient loss from the catchment reaches maximum levels during high intensity rainfall events in which massive runoff causes widespread erosion in the catchment (SCEP, 1991). Eroded soil from these events is usually richer in nutrients than the original field soil and large quantities are washed into the Oyster Harbour (SCEP, 1991). In most high run-off years, Oyster Harbour turns muddy brown following major storm events.

As the primary source of nutrients entering the Harbour comes from broad acre agriculture, recommendations have been developed that primarily focus on farmers in the catchment area.

Actions recommended by SCEP that landholders can take to minimise nutrient loss to waterways include:

- regular soil testing to determine fertiliser needs;
- increasing the use and acceptance of the PHOSUL-K fertiliser recommendations;
- changing fertiliser application and timing;
- increasing use of deep-rooted plants, perennial grasses, shrubs and trees;
- protecting and rehabilitating stream line vegetation to provide filtering of run off water;

- reducing drainage and promoting on-farm water use;
- increasing water infiltration and soil water storage;
- using soil amendments such as lime;
- protecting wetland areas from stock;
- minimising clearing of remnant bush;
- maintaining adequate ground cover by better stock management;
- using farm planning as a tool for land management;
- diversifying into alternative enterprises where the nutrient retention capacity of soils is low; and
- promoting sound effluent management for intensive animal industries (Prout, 1995).

Agriculture Western Australia has emphasised the need for placement and maintenance of vegetative strips along streams and rivers. Such fringing vegetation acts to prevent erosion, filter out suspended solids during flood events and assimilate nutrients carried in runoff (Weaver *et al.*, 1994; SCEP, 1991; Weaver and Prout, 1993).

Thus among many actions to minimise nutrient loss to waterways, Agriculture Western Australia has emphasised the placement and maintenance of vegetative strips along streams. Such fringing vegetation acts to prevent erosion, filter out suspended solids during flood events and assimilate nutrients carried in runoff (SCEP, 1991; Weaver and Prout, 1993). This led the OHCG to call for the fencing of the Kalgan River in September 1992, as a first step towards managing all major streamlines. In response to this, the Albany Waterways Management Authority, (AWMA) a community based management agency and part of the Water and Rivers Commission, undertook to carry out a survey of the condition of the foreshores of the Kalgan River. Following the positive outcomes of that survey, AWMA commissioned a further survey of the major selected tributaries of the Oyster Harbour Catchment. This report contains the results of this survey.

1.4 Description of the region

The Kalgan River system drains most of the catchment of Oyster Harbour, found in the extreme south west of Australia, just north-east of Albany (see Fig. 1.1). It drains an area of about 2450 km^2 which extends some 75 km inland from the coast. The area is mainly flat to broadly undulating plains, reaching about 200 m ASL, but broken occasionally by minor ridges and by the relatively high Porongurup Range, which reaches 654 m ASL. The larger Stirling Ranges, which reach 1096 m ASL define the northern extent of the catchment (see Fig. 1.1). The plains are developed on marine sediments and the soils are predominantly sandy duplex types with saline sub-soils formed by siltstone.

The climate of the catchment is temperate and mild, with rainfall, beginning at 900 mm at the coast and declining inland to 600 mm, mostly confined to the winter and early spring months. Evaporation is as high as 1400 mm inland, but as little as 50-200 mm on the coast (DPUD, 1991). As with virtually all south-west rivers, the Kalgan exhibits a discharge pattern which reflects the seasonal rainfall: strong flows over the winter/spring period and moderate to negligible flows over the summer/autumn period. Over recent years the magnitude of yearly discharges has varied greatly, and there have even been unseasonal floods, of tropical cyclonic origin, such as the one in January of 1982 (DPUD, 1991).

The catchment of the Kalgan River can be divided into an upper and lower region on the basis of climate and salinity. The upper region, which comprises 83% of the total catchment is relatively dry and prone to salinisation (DPUD, 1991; SCEP, 1991). Consequently, the river water ranges from brackish to saline. The lower Kalgan catchment is wet, with a number of major freshwater tributaries which render the brackish river water from upstream, marginally fresh. The main natural vegetation form of the upper Kalgan catchment is woodland dominated by jarrah, wandoo, marri and yate, while that of the lower Kalgan is forest dominated by jarrah and marri, occasionally with yate and karri (DPUD, 1991).

Most of the Kalgan River catchment has been cleared of its natural vegetation and developed for agriculture, which is mainly cropping and sheep farming in the upper part, and sheep, beef cattle and some dairy farming in the lower part (DPUD, 1991). By 1991 about 66% of the upper Kalgan catchment and 88% of the lower Kalgan catchment had been cleared. The only large areas that retain significant stands of natural vegetation are that portion of the Stirling Range National Park which falls in the catchment and the Porongurup Range National Park.

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1.5. Value of fringing vegetation in catchment management

1.5.1 Stream bank stabilisation and soil conservation

The soils of the natural stream valley support a varied flora of trees, shrubs, sedges and herbs. In turn, the vegetation supports the stream bank and protects it from erosion and subsidence. The vegetation does this in a number of ways. Firstly, fringing vegetation increases stream bank roughness which acts to dissipate the energy of running water, with the effect of reducing the erosive capacity of the stream flow (Troeh *et. al.,* 1980). Secondly, roots and rhizomes bind and reinforce the soil of the embankments. The large roots of trees anchor the embankment in place and the smaller roots and rhizomes of shrubs, sedges and grasses hold the soil firmly in place at the surface of the ground between the large tree roots. In fact, the soil-root matrix can add extra cohesion of the order of ten times that of an unvegetated embankment (Thorne, 1990).

The roots and rhizomes also act to loosen and break up the soil, with the result that a well vegetated bank enables rapid infiltration of rain water (Thorne, 1990; Riding and Carter, 1992). Together with the extraction of the water by the plants themselves, greater hydrological conductivity causes the bank to be drier than a similar unvegetated bank. In wet weather, this means that the vegetated embankment is less likely to become saturated with water, and thus is less prone to mass failure, such as subsidence and toppling caused by the added bulk weight of the water (Thorne, 1990).

Lastly, riparian vegetation is highly resilient, exhibiting quick regeneration and recolonisation following the effects of severe floods. In this way the vegetation helps stabilise the river system against the effects of severe erosion and sedimentation (DeBano and Schmidt, 1990; Wissmar and Swanson, 1990).

1.5.2 Sediment and nutrient retention

Research being carried out in Europe, North America and New Zealand increasingly highlights the important function that riparian zone vegetation has in filtering out sediment and nutrients carried in flowing waters. Work on vegetated buffer strips along waterways or between waterways and agricultural land has shown that vegetation of many forms, including grasslands, sedgelands, woodlands and forests, can filter out and retain substantial amounts of sediment and nutrients (Peterjohn and Correll, 1984; Cooper *et al.*, 1987; Dillaha *et al.*, 1988, 1989; Heede, 1988; Knauer and Mander, 1989; Margette *et al.*, 1989). Dissolved nutrients, especially nitrate, are readily taken up and assimilated by plants (Yates and Sheridan, 1983; Peterjohn and Correll, 1984; Howard-Williams and Downes, 1984; Howard-Williams *et al.*, 1986; Pinay *et al.*, 1990).

By reducing stream flow, riparian vegetation promotes sediment deposition (Thorne, 1990). Sand can be deposited even when water is fast moving and silt will settle out where vegetation causes a marked reduction in flow. However, near-still water, such as that caught in densely vegetated floodplains, is required for the deposition of the very fine clay fractions (Troeh *et al.*, 1980). Over time, substantial stream bank and floodplain accretion can occur in certain areas as a result of sediment deposition, and this can alter hydrological processes (Thorne, 1990). The removal of suspended sediment by vegetation is especially important, as water carrying sediment has a greater momentum and is more abrasive than clean water, and thus has an enhanced capacity to cause erosion (Troeh, 1980).

Much of the nutrients trapped in the vegetation of waterways or in buffer strips is assimilated by the vegetation (Odum, 1990). Generally, the longer the water is held by the vegetation, the greater the uptake of nutrients (Howard-Williams *et al.*, 1986). Of course, the nutrients are eventually released back into the water column when plant material decays, but much of this will once again be assimilated. In this way the riparian system retards the rate of transfer of nutrient particles downstream, in a process known as nutrient spiralling (Pieczynska, 1990; Pinay *et al.*, 1990).

Nitrogen can be removed from riparian systems completely. This occurs via the biochemical process of denitrification, which causes nitrate to be converted to gaseous nitrogen. This process can be the major form of nitrogen removal in certain riparian zones and during particular environmental conditions such as those which occur during and after flooding (Jacobs and Gilliam, 1985; Pinay *et al.*, 1990).

1.5.3 Ecological values

Streamline vegetation not only has natural resource value in its own right, but it also provides a range of habitats for a large variety of plants and animals, particularly species which are restricted to moist or aquatic

environments or species which are restricted to particular rivers or streams. For example, the freshwater streams along the south coast provide one of the few breeding environments for the Pouched Lamprey (*Geotria australis*). Furthermore, as stream systems are linear in form and cover large distances, their vegetation helps to create ecological corridors. These natural corridors, along with unnatural ones such as the vegetated strips along road and rail reserves, enable plant and animal species to move between larger patches of remnant habitat (Hussey *et al.*, 1989).

1.5.4 Recreational and landscape values

Foreshore areas alongside rivers and creeks in the Oyster Harbour Catchment have important recreational and landscape protection values. This is especially the case where such waterways are close to population centres, or sites frequently visited by tourists. For example canoeing is popular from caravan parks situated on the Kalgan and King rivers. In particular foreshore areas along the King River have high value for recreation and landscape amenity. The high recreational value and landscape values of the Kalgan river foreshore has been recognised and a walk way is currently under construction between the upper and lower Kalgan bridges, a project due for completion in 1997. In the future it is expected that recreational uses will increase considerably. A range of appropriately planned recreational developments will need to take place on some of the waterways surveyed in this report in order to accommodate this increase in demand.

1.6 Use of this Report

This report provides a survey the condition of selected tributaries in the Oyster Harbour Catchment and its fringing vegetation. The series of recommendations for rehabilitation work along the foreshores of the river and its tributaries is intended for use by landholders and waterway management agencies. These recommendations were designed to provide encouragement and advice to landholders and agency managers for future riparian repair work.

The report also aims to provide a 'snap-shot' of river foreshore conditions for selected important tributaries, so that overall resources for water way management can be appropriately allocated. The survey aims to provide suitable documentation to support applications for regional resources, as well as providing a means for prioritising fencing and other rehabilitation allocations.

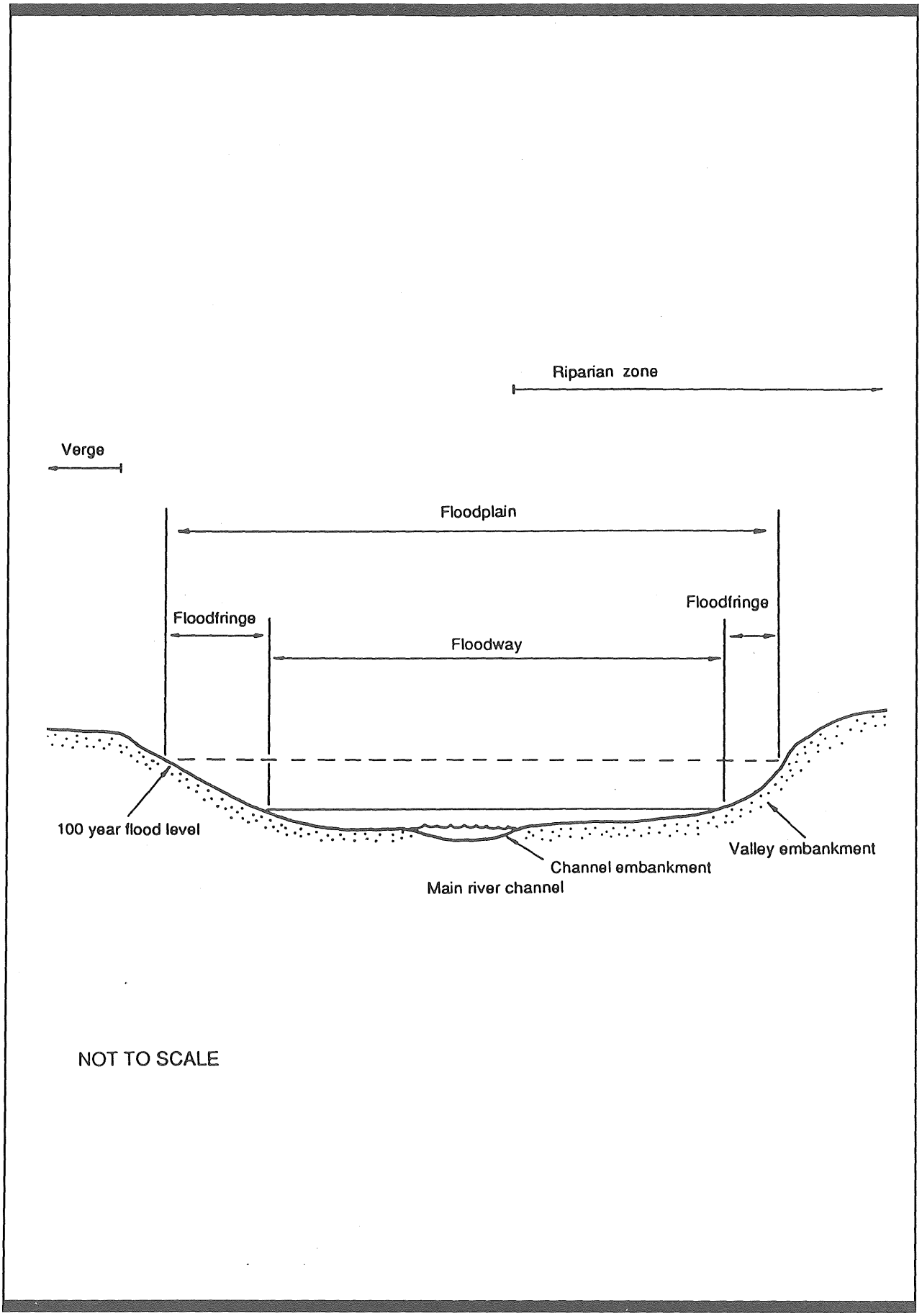
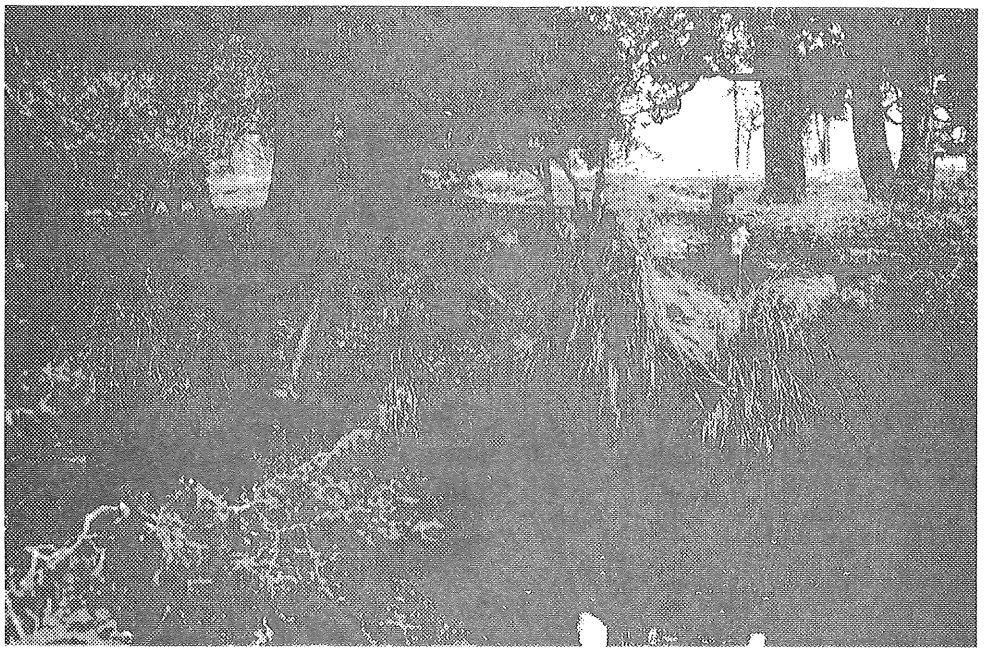
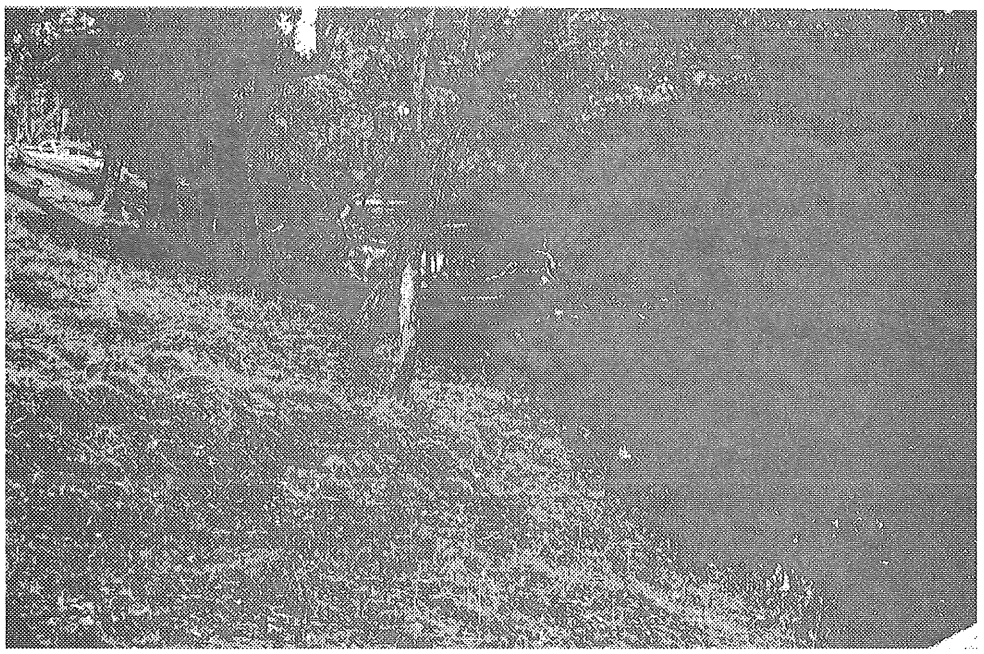


Figure 2.1 - Terms used to describe river valley form.



C3 Grade Foreshore along the King River, showing bank slumping, and the pampas grass. Fencing off the river, careful weed control and revegetation would assist with preventing further erosion.



C1 Grade (left bank) and A2 grade (right bank) along the Napier Creek. Regeneration of remnant vegetation on left bank will not be possible without total exclusion of stock.

C Grade (left bank) and A Grade (right bank) along the Napier Creek, showing logs fallen into the waterway. These snags should not be removed, as they provide aquatic habitat. However, re-alignment at a 40-degree angle to the bank would minimise bank erosion.

2. River Valley Form and the Process of River Degradation

2.1 River form

2.1.1 Cross sectional form

Figure 2.1 illustrates typical river valley form in south-west Western Australia and the nomenclature used to describe it.

A typical south-west river consists of a floodway which resides in a valley. Within the floodway, water generally flows along a central channel, which will wander from one side of the floodway to the other as water moves downstream. Sometimes there are two channels: a primary one, which always carries water, and a higher secondary one, which will carry water in times of flood. It is during these large floods, when the broad channel or floodway of the river is full of water, that the river establishes and maintains its form, including the pools and riffles (see below).

When the floodway is contained within a shallow or steep valley, the embankments on each side will contain the water from even the most severe flooding and, therefore, the extent of the extra flood fringe is minor. Conversely, when there is no obvious valley form, the floodplain (ie. floodway plus flood fringe) may extend over a very wide area.

Fringing vegetation seldom occupies the main channel but where water movement is very slow, due to the frictional effects of floodplain vegetation or stream debris, some aquatic species are able to take root. On the other hand, the channel embankment and the floodway support dense vegetation, which may extend over a broad floodplain or up the river valley embankments. Floodplain and river valley embankments can support their own distinctive plant communities, which are often more open than those of the floodway.

2.1.2 Channels, riffles and deep pools

Length-wise, the typical south-west river can be divided into three distinct zones. These are the long narrow channels which meander along the floodplain, broad shallow riffle zones and deep broad pools. A typical central channel is often no more than a few metres across, while the floodway can be 5 to 20 metres broad. Sometimes the riffle zones consist of open areas where shallow water passes over stones, while in other areas it can be densely vegetated, with shallow water passing between clumps of sedges and tree stems. For example, it is not uncommon for the river floodway to support a completely closed canopy of paperbark trees, where, in the absence of an understorey, the water passes freely between the tree stems.

Deep pools are dotted along the length of rivers and are formed as a result of the movement of water (Marsh and Dozier, 1981). In south-western Australia these pools are as long as 50 to 500 metres or more and are typically 20 to 50 metres across and from 3 to 9 metres deep. Ecologically they are integral to the south-western Australian river ecosystem, nearly always retaining water over the hot dry summer/autumn months when the channel and riffle zones dry up, thus providing refuge habitat in times of drought for many aquatic animals, including birds, turtles, water rats, fish, crayfish, shrimp and mussels.

2.2 River valley degradation: from river to drain

Previous work by Pen (1994) indicates that there is a pattern of degradation which can be used to describe the state of rivers in south-western Western Australia (see Fig. 3.1).

2.2.1 The healthy river valley

In a healthy river valley, native vegetation is dominant. Not only does it provide habitat for a huge range of animals, but it also supports the substratum that sustains it (Thorne, 1990). The large root systems of trees, which may extend as far as 50 metres, become interlaced and tangled to form a mesh or matrix of roots to a depth of two to three metres or more. This matrix of roots and soil, where trees become tied to each other and support each other, is found right along each side of the river and holds the river valley embankments securely in place. The smaller root systems of shrubs and rhizomes of sedges and the tiny root and rhizome systems of herbs, grasses and small sedges hold the soil firmly in place between the large tree roots and, most importantly, form dense masses of roots and rhizomes along the actual river channel.

In this way, the most powerful floods and heaviest rainfall cannot dislodge the soil of the river valley for virtually the entire length of the river. Only rarely does the action of water gain the upper hand and erosion occur. This usually happens at power bends along the river and

would appear, in most cases, to be quickly arrested by the growth of abundant vegetation.

Dense vegetation also serves to retard the rate of flow of floodwaters and to filter out or cause the settling of suspended particles (Thorne, 1990). This action is enhanced by fallen branches which trap leaf litter and cause the formation of obstructions which dam the floodwaters, further reducing their velocity and capacity to erode and carry sediment. In a totally vegetated catchment, floodwaters are held back by the frictional and damming effects of fringing vegetation along hundreds if not thousands of kilometres of streamline and much of the energy required to erode and to carry sediment has been dissipated by the time the waters have reached the estuary.

2.2.2 The degrading river valley

The earliest stage of degradation is the occasional presence of weeds. In near pristine vegetation, weeds are probably brought in by the wind or animals. This type of degradation is merely floristic and poses no threat to the integrity of the river valley, as the native vegetation remains dominant. However, where there are points of physical disturbance, such as along walking and vehicular tracks or where feral pigs or rabbits have turned over the soil, localised exposures of soil and infestations of weeds may occur. In this situation there is a small risk of severe water erosion.

Typically, severe degradation does not begin until livestock regularly enter the river valley to graze. Here they trample the native vegetation, eat out the more palatable species, trample the soil and bring in weed seed. This serves to encourage the establishment of weeds and to discourage the regeneration of native species. The longer the river valley is subject to livestock and the heavier the stocking levels, the quicker the native vegetation is replaced by weeds. The rate of weed invasion is accelerated by an increase in the frequency of fires, which favours species with short life cycles, which are mostly introduced grasses, over species with long life cycles, which are mostly native (Hussey and Wallace, 1993).

Eventually, the native understorey species are replaced entirely by weeds and the native trees begin to die out as the level of regeneration can no longer keep pace with mortality.

2.2.3 The eroding river valley

With continued livestock grazing and trampling and frequent fires, the deep root systems of native shrubs, sedges, grasses and herbs, which once had a firm hold on the soil between the large tree roots, are largely replaced by the shallow root systems of introduced annual grasses and other weeds. These new species do not bind the surface soil as well as the former native species, especially over the late summer/autumn period when most have senesced, and are quite easily dislodged by livestock trampling and surface water flow. Under these conditions, the river valley is prone to severe erosion.

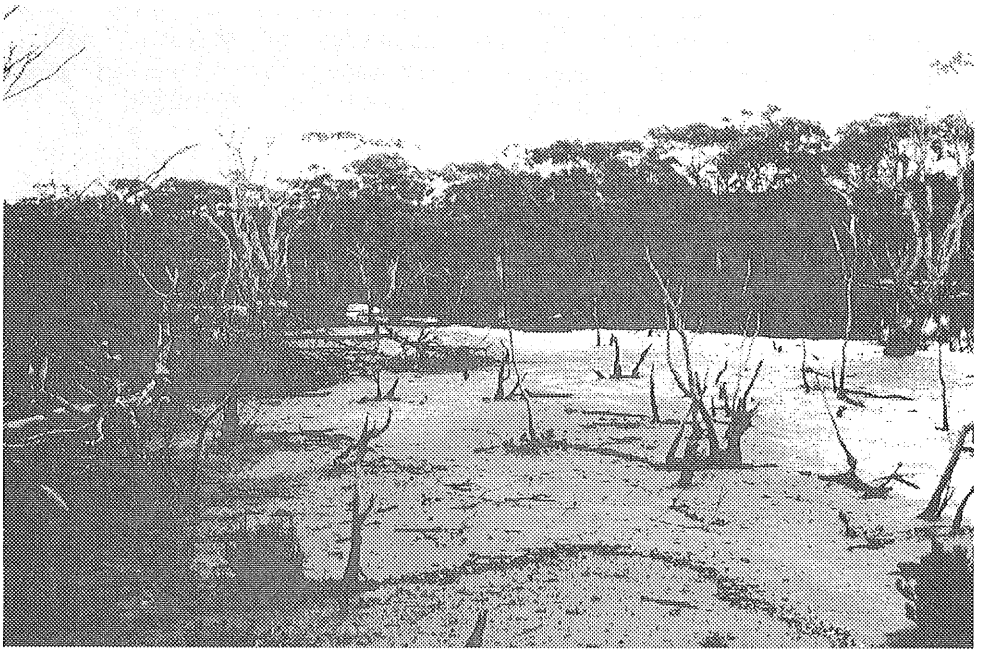
If the thin protection afforded by annual weeds is lost the soil between the large roots of trees and tall shrubs is easily washed away. Up on the valley embankment surface flow from adjacent pastured areas or high flood waters can dig long furrows, exposing tree roots and undermining trees and tall shrubs. Lower down, huge bites can be taken out of the river channel embankment and the valley embankment can be undermined, causing further sections to be undercut beneath the root zone and to collapse into the river. Where this occurs, the remaining part of the embankment can be held in place by tree roots until further undercut, but if trees are not present to support the embankment, parts of the embankment can subside into the river. This would appear to occur in very wet weather where unsupported valley embankments become sodden (Thorne, 1990).

At first, only the most prone areas will exhibit severe erosion, but gradually more and more areas will become eroded, until the river resembles a ditch. Not only will the river valley become increasingly prone to erosion as a result of loss of supporting native fringing vegetation, but as it does so the river can become smoother in parts, and the energy which was once dissipated by the vegetation will become available to erode and to carry sediment. There is also less vegetation to intercept the sediment, and thus prevent it from being washed downstream and ultimately into the estuary.

Ironically, coarse sediment lost from the stream banks can build up in places in the stream bed, which becomes wider and shallower as the material of the eroded embankments fills the floodway. In this situation, high bed sediment loads can have two effects: increased bed roughness can retard stream flow and cause upstream flooding; or conversely, large sediment accumulations can deflect flow into the adjacent stream bank or even onto adjacent land, causing further erosion (Schmidt and DeBano, 1990; Thorne, 1990).

The progressive degradation of riparian vegetation has a compounding effect on the

waterway, as the reservoir of sediment and nutrients filtered out and assimilated by downstream vegetation over many years begins to be released. This factor could be responsible for the sudden discharge of large quantities of sediment and nutrients into estuaries when parts of this reservoir of material are dislodged by severe floods.



Unfenced and salt affected C3 section (left bank) and fenced A2 section (right bank) of the Boonawarrup Creek.

C1 foreshores along the Upper Kalgan valley. Fencing and planting of local trees and shrubs would assist with providing a more effective riparian buffer along this waterway.

Healthy and salt-affected remnant vegetation areas along the Upper Kalgan valley.

3. Materials and Methods

3.1 Vegetation description

Colour aerial photographs at 1:20,000 scale were obtained from Agriculture Western Australia and the Waters and Rivers Commission for the study area, and sketch maps were produced by Watershed Digital Mapping at 1:10,000 scale. The sketch maps were drawn to convey information on property boundaries, river foreshore boundaries, the distribution of vegetation, the river and the land form.

These sketch maps were then taken into the field and annotated with relevant information on landscape, plant communities, weed infestations, foreshore condition, points of severe erosion and fencing status.

The surveys of the selected tributaries in the Oyster Harbour Catchment took place over a eight week period between March and May 1997.

3.2 River foreshore condition assessment

3.2.1 System of assessment

The condition of a section of river foreshore or riparian zone was assessed using a simple system developed by Pen (1994) from observations of river system degradation throughout the south-west of Western Australia . The methods, grades and system of assessment have been summarised in Pen and Scott (1995). The system consists of a number of stages or grades - A, B, C and D - beginning at pristine and running through to completely degraded, following the general process of degradation outlined in Section 2.2. Each grade has three sub-levels which are easy to recognise.

This system is described below.

A-Grade foreshore

A1. Pristine

The river embankments and/or channel are entirely vegetated with native species and there is no evidence of human presence, including livestock damage (Fig 3.1A). This category, if it exists at all, would be found only in the middle of large conservation reserves where the impact of human activities has been negligible.

A2. Near pristine

Native vegetation dominates but introduced weeds are occasionally present in the understorey, though not to the extent that they displace native species. Otherwise there is no human impact. A river valley in this condition is about as good as can be found today (Fig. 3.1A).

A3. Slightly disturbed

Here there are areas of localised human disturbance where the soil may be exposed and weed density is relatively heavy, such as along walking or vehicle tracks (Fig. 3.1A). Otherwise, native plants dominate and would quickly recolonise disturbed areas should human activity decline.

B-Grade foreshore

B1. Degraded - weed infested

In this stage, weeds have become a significant component of the understorey vegetation (Fig. 3.1B). Although native species remain dominant, a few have probably been replaced or are being replaced by weeds.

B2. Degraded - heavily weed infested

In the understorey, weeds are about as abundant as native species (Fig. 3.1B). The regeneration of some tree and large shrub species may have declined.

B3. Degraded - weed dominated

Weeds dominate the understorey, but many native species remain. Some tree and large shrub species may have declined or have disappeared (Fig. 3.1B).

C-Grade foreshore

C1. Erosion prone

While trees remain, possibly with some large shrubs or grass trees, the understorey consists entirely of weeds, mainly annual grasses (Fig. 3.1C). Most of the trees will be of only a few resilient or long-lived species and their regeneration will be mostly negligible. In this state, where the soil is supported by short-lived weeds, a small increase in physical disturbance will expose the soil and render the river valley vulnerable to serious erosion.

C2. Soil exposed

Here, the annual grasses and weeds have been removed through heavy livestock damage and grazing, or as a result of recreational activities. Low level soil erosion has begun, by the action of either wind or water.

C3. Eroded

Soil is being washed away from between tree roots, trees are being undermined and unsupported embankments are subsiding into the river valley.

D-Grade foreshore

D1. Ditch - eroding

Fringing vegetation no longer acts to control erosion. Some trees and shrubs remain and act to retard erosion in certain spots, but all are doomed to be undermined eventually.

D2. Ditch - freely eroding

No significant fringing vegetation remains and erosion is completely out of control (Fig. 3.1D). Undermined and subsided embankments are common, as are large sediment plumes along the river channel.

D3. Drain - weed dominated

The highly eroded river valley has been fenced off, enabling the colonisation of perennial weeds (Fig. 3.1D). The river has become a simple drain, similar, if not identical, to the typical major urban drain.

3.2.2 Application in the field

A section of foreshore would be recognised for assessment on the basis of general homogeneity. For example, a section of foreshore which was fenced off was assessed separately from an adjacent section that was not fenced off and subject to grazing. The floodway and up to 25 metres up the valley embankment were assessed together. The opposite banks of the river were assessed separately and the maps show separate class boundaries for the right and left banks of the river. The right and left banks are the right and left when facing upstream.

The banks of the tributaries were assessed separately and the condition of each bank recorded, along with other relevant management information, such as access for stock, presence of weeds, fencing in place, sites of severe erosion, and areas requiring revegetation.

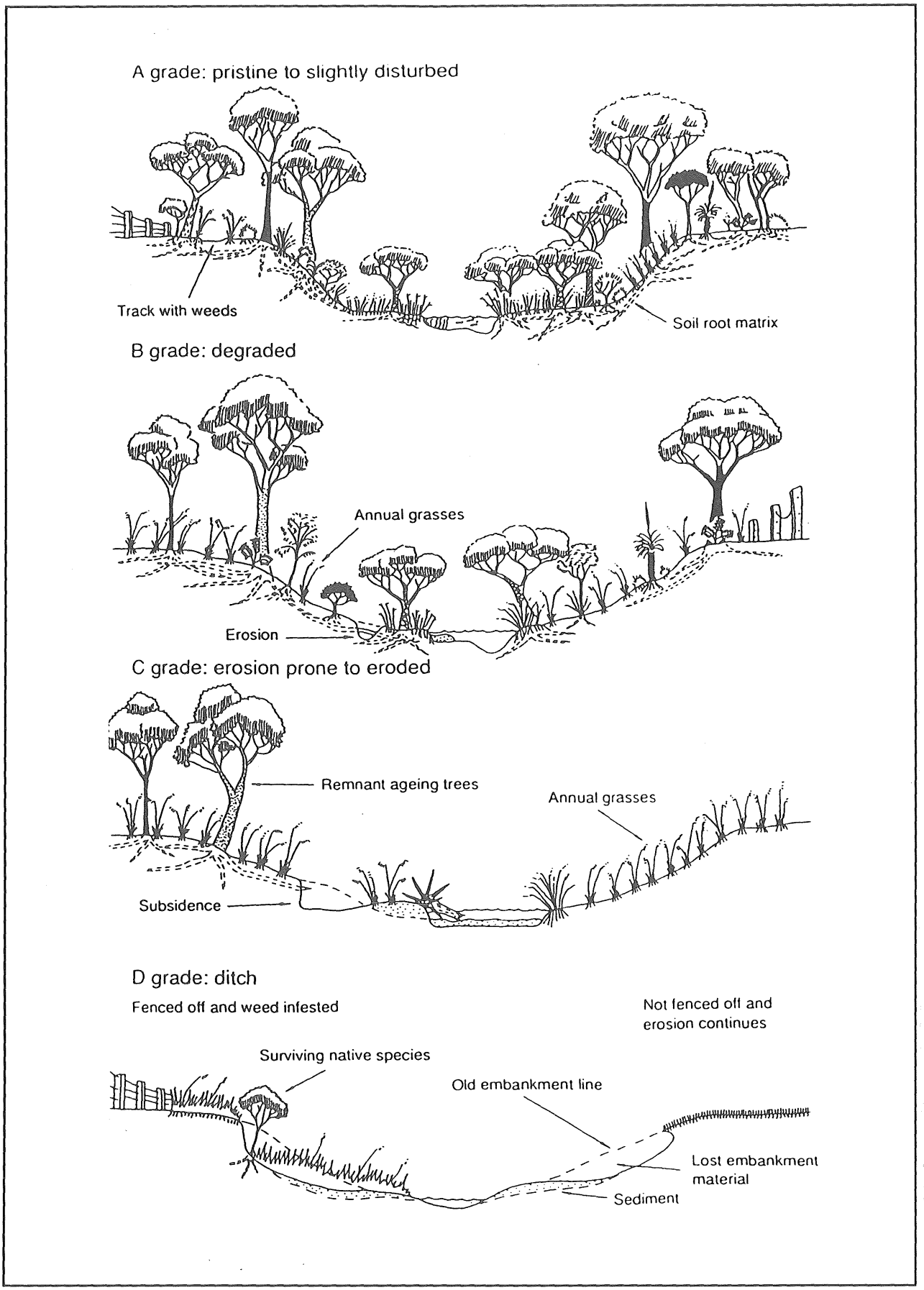
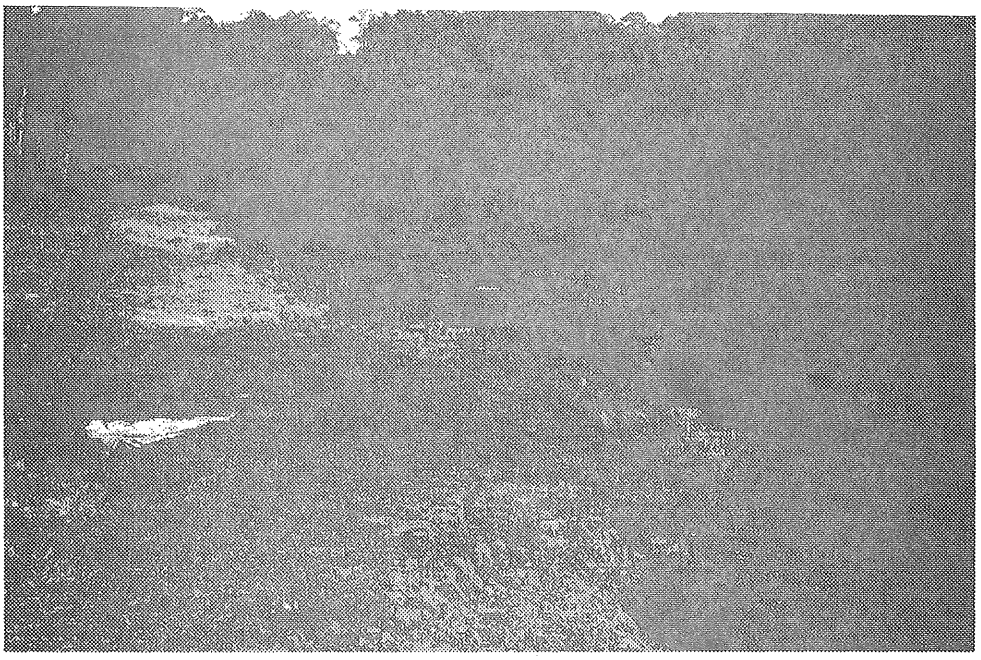
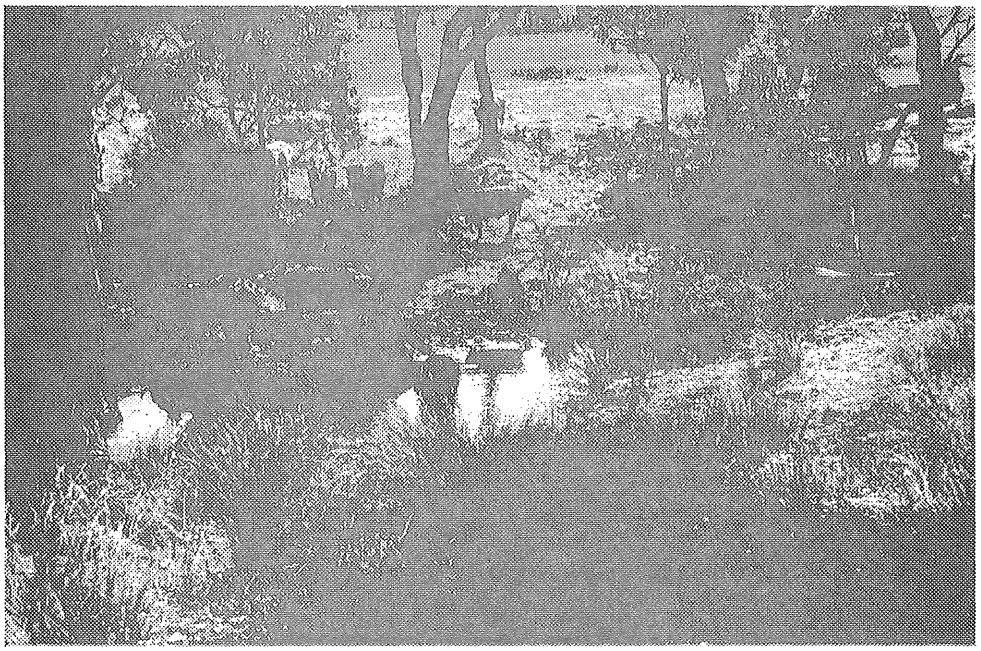


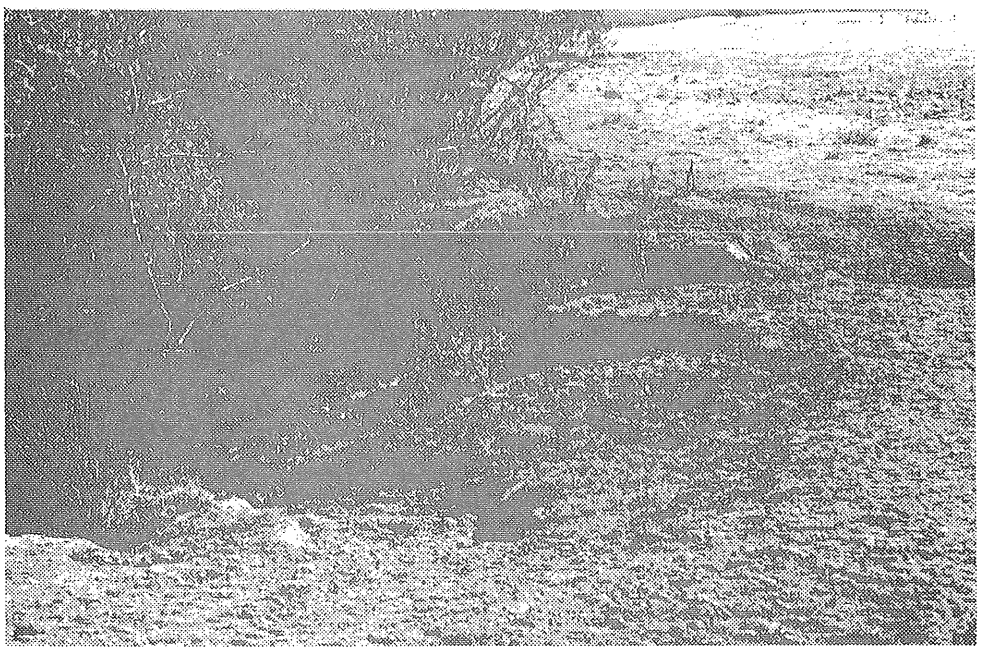
Figure 3.1 - River foreshore condition divided into four stages or grades following the general process of river valley degradation, from pristine river (A) to ditch (D).



C3 Grade (left bank) and B2 Grade (right bank) foreshore along the Chelgiup Creek. Fencing and provision of alternative stock watering point would assist with riparian repair.



C2 Grade foreshores along the Chelgiup Creek with stock access to waterway.



Point source bank erosion on a C2 grade (right bank) along the Johnson Creek, with the weed Taylorina growing along waterway.

4. General Condition of the Foreshores of Selected Tributaries in the Catchment

Table 4.1 provides details of the length of the twelve rivers and tributaries surveyed in this project, the length of surveyed rives and tributaries adjoined to farmland, riparian condition, current fencing on farms, recommended fencing and recommended revegetation on farms in the study area.

A total of 122 km of the twelve selected tributaries were surveyed. A relatively small length of watercourse of some of the surveyed sections falls within public land and has Class A condition foreshores.

The overall on farm watercourse length (both banks) was 221 km. About 55% (or 120km) of the rivers and stream length was already fenced.

Of the total lengths of river and tributaries approximately 19% of the riparian zone was A grade, 34% B grade, 30% C grade and 17% D grade. Approximately 204 ha of river and tributary valley embankment and foreshore was identified as requiring vegetation rehabilitation.

Detailed descriptions of required fencing, vegetation rehabilitation and weed control are provided with maps and tables in Chapter 7.

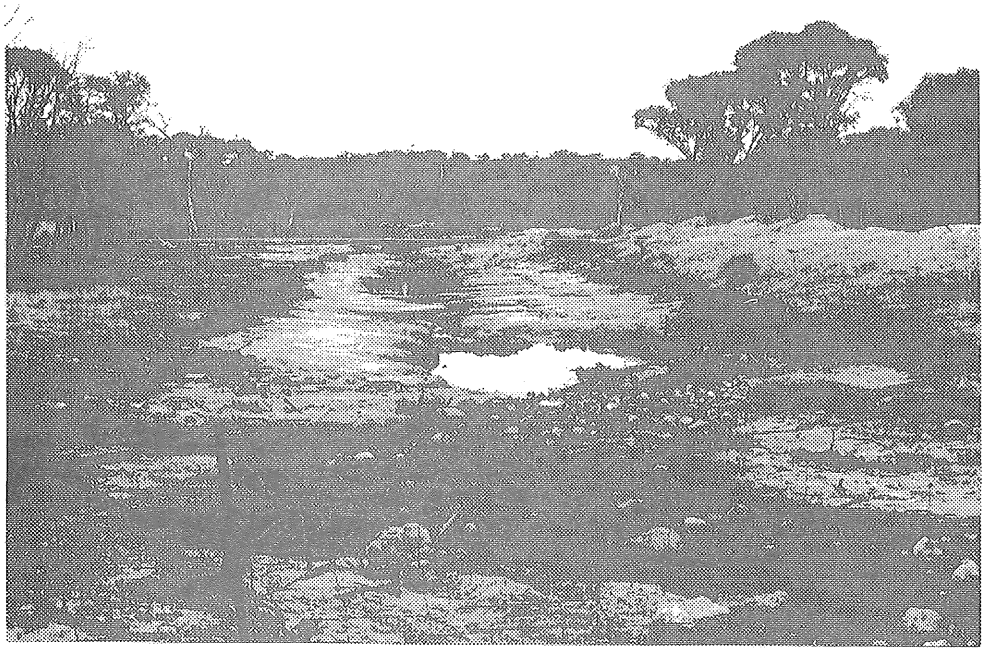
Table 4.1 - General Condition of the foreshores of selected watercourses in the Oyster Harbour Catchment

Note: The on farm watercourse condition is given in brackets.

River	Water-course length surveyed	Farm Water-course length -Both Banks	Foreshore Condition By Percentage (%) ( )=Adjacent to on farm watercourse length				Farm Length Fenced	Farm water-course Fencing Req'd	Vegetation Planting Recommended
	km	km	A	B	C	D	km(%)	km	ha
1. Boonawarrup Creek	9.2	17.2	20 (15)	55 (59)	6 (6)	19 (20)	2.9 (40%)	4.3	10
2. Chelgiup Creek	8.68	16.46	10 (11)	31 (32)	43 (40)	16 (17)	3.9 (24%)	12.56	48.4
3. Gaalgecup Creek	16.7	32.8	12 (10)	42 (43)	32 (33)	13 (14)	17.1 (61%)	11.1	19.4
4. King River	13.43	17.69	25 (13)	36 (42)	39 (45)	Nil	8.7 (44%)	11.2	10.6
5. Johnston Creek	4.52	9.04	Nil	57 (57)	43 (43)	Nil	2.84 (25%)	8.34	6.8
6. Moorialup Creek	6.4	10.05	25 (16)	51 (53)	24 (31)	Nil	11.6 (91%)	1.2	1.2
7. Napier Creek	7.87	11.4	25 (9)	61 (72)	14 (19)	Nil	7.3 (58%)	5.3	4.55
8. Stoney Creek	5.61	11.22	72 (72)	Nil	28 (28)	Nil	11.5 (90%)	1.3	Nil
9. Takalarup Creek	4.15	8.3	Nil	4 (4)	23 (23)	73 (73)	4 (46%)	4.6	8.5
10. Takenup Creek	7.7	14.8	Nil	27 (27)	33 (33)	40 (40)	8.7 (57%)	6.5	4.7
11. Upper Kalgan River	29.3	58.6	13 (13)	34 (34)	45 (45)	8 (8)	33.1 (36%)	58.6	70.8
12. Young River	8.7	13.5	22 (Nil)	9 (12)	32 (41)	37 (47)	8.88 (52%)	8.3	19.1
Total and averages	122.3	221.1	19 (13)	34 (36)	30 (32)	17 (18)	120.5 km (55%)	133.30	204.05

Eroded floodway along the Stoney Creek. Rehabilitation work would involve fencing the area from stock, direct seeding, brushing and planting out seedlings of local species.

Fenced section of the Stoney Creek with natural regeneration coming back. Such areas provide more effective bio-filters, preventing sediment and nutrient loss from farms.



Eroded and excavated section of the Stoney Creek affected by salinisation. D2 Foreshore. Such drainage works can increase sediment and nutrient loss, if vegetation cover is sparse.

5. Major Threats to the Foreshores of Selected Tributaries in the Catchment

Access of livestock into the river valley is a significant cause of soil loss along tributaries in the Oyster Harbour Catchment study area. In some areas, erosion was extensive but moderate, but at watering and crossing points where stock trampling is extreme, erosion is quite severe. This was particularly the case where water draining from adjacent pastures flowed down to the crossing or watering point, causing further erosion. Crossing points which were made at fast flowing sections of the river, where embankments were of the non-cohesive type, also suffered heavy erosion.

5.1 Loss of native riparian vegetation

Along much of the tributaries, the fringing vegetation is in transition from forest, woodland or heath, to grassland. Only in areas where the fringing vegetation is backed by substantial remnant bush, or where it has been fenced off for a long period of time, is the integrity of the riparian vegetation secure. Otherwise the native herbs, sedges, shrubs and trees of the rivers are slowly being replaced by introduced annual and perennial grasses and other weeds.

These introduced grasses and other weeds do not create the deep soil-root matrix required to support the river embankment. In the drier regions, the annual grasses or sparsely distributed tussock grasses, such as veldt grass do not even afford adequate superficial protection against water erosion. This means that many kilometres of the river valleys are becoming increasingly prone to erosion.

Furthermore, introduced species do not provide the full range of habitat requirements for native fauna, while still supporting vermin such as rabbits. Riverine aquatic ecosystems depend on native fringing vegetation to provide shade, shelter, leaf litter and debris, and to stabilise pool embankments and riffle zones.

5.2 Breaks in the ecological corridor

The replacement of native plant communities with grasslands represents breaks in the ecological corridor. Some areas of embankment and floodway are devoid of native vegetation. These breaks not only retard the movements of mammals and birds, but fish are reluctant to move into open sunlit areas of water where they are prone to predation and heat stress (Olsen and Skitmore, 1991).

5.3 Erosion and siltation

From fence to fence, the land given over to the river is often only a few metres wide, which means that undercutting and subsidence can eventually bring the river back to the fenceline and eventually beyond it.

5.4 Major weed invasion

With respect to river management, major weed species are those which cannot be controlled by simply eliminating the disturbance regimes which facilitate the establishment and regeneration of common weeds. Major weeds can become established in relatively undisturbed vegetation and soon proliferate to become dominant species, even replacing the tall native trees in time. Examples of weeds include the giant grasses, pampas grass (*Cortaderia selloana*) and giant reed (*Arundo donax*), the vines and creepers morning glory (*Ipomoea indica*) and dolichos pea (*Dipogon lignosus*), and the climbing shrub blackberry brambles (*Rubus spp.*). These species, and many more, infest large sections of the moist humid river valleys near Perth, Mandurah and Bunbury (Pen, 1992, 1993; Siemon *et al.*, 1993).

Significant sections along the banks of the surveyed tributaries are generally free from major weed invasions. However, some outbreaks of serious weed species occur in riparian bushland. If left unchecked, these plants will spread and dominate the indigenous species.

Pasture plants have replaced native vegetation in many areas. These plants may not be weeds in the agricultural sense, but they do not perform the functions that native vegetation does. Being shallow-rooted, they leave the soil prone to erosion. their low height provides no shade or shelter for native birds, animals or fish.

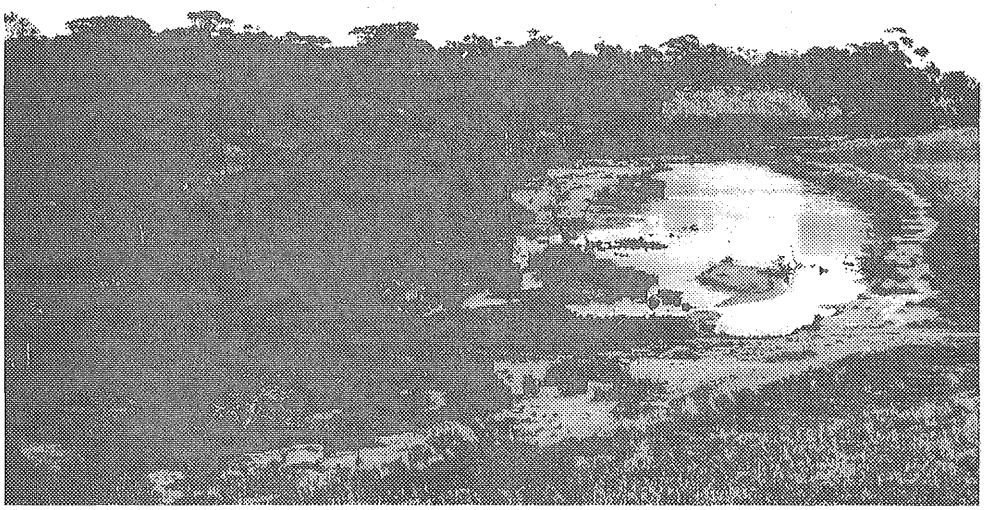
The following weed species were identified in surveying the selected rivers and tributaries in the Oyster Harbour Catchment:

- Blackberry - *Rubus fruticosus*
- Deadly nightshade - *Solanum nigrum*
- Inkweed - *Phytolacca octandra*

- Taylorina - *Psoralea pinnata*
- Watsonia - *Watsonia spp.*
- Bridle Creeper
- Pampas Grass
- Thistle

Chelgiup and Moorialup Creeks were considered the most seriously affected by problem weed invasions. The Johnston Creek, King, Napier Creek and Takenup Creek were also considered to require priority treatment. Boonawarrup Creek, Gaalgecup Creek, Stoney Creek and the Young River were assessed as being relatively free from problem weed invasions at the current time.

Advice on the treatment of foreshore areas for weeds is provided in Section 6.4.1.



Remnant vegetation protected by rock breakaway along the Gaalgecup Creek. C2 Foreshore (right bank) bordering farmland. Fencing and revegetation of a wide riparian belt is recommended.

D2 Foreshore along an actively eroding section of the Takalarup Creek. Soil compaction by stock trampling has reduced pasture cover and increased erosion.

Revegetation work carried out on a degraded section of the Takalarup Creek. Provision of small-scale structures within the waterway (ripple and rock zones) would assist with the rehabilitation of this area.

6. Rehabilitation

6.1 Rivers and Creeks

The foreshores of the Oyster Harbour Catchment's tributaries, which have existing stock grazing as an adjacent land use, should be fenced off to protect the fringing vegetation of the river valleys from the effects of livestock grazing and trampling, and to prevent the slow degradation of riparian vegetation. Further, all foreshores already degraded need vegetation rehabilitation. Protecting and reinstating the vegetation will maximise the natural bio-filtering and energy dissipation function of riparian vegetation, which is needed to remove nutrients and sediment entering the river via tributary creeks and directly from farmland and to prevent foreshore erosion.

It is worth noting that it will not be sufficient to fence and rehabilitate only the foreshores of the main rivers and creeks of the Oyster Harbour Catchment. These represent a minor proportion (<15%) of the waterway length. The remaining minor waterways will continue to deliver nutrients and sediment to the main river channels, which will remove some of this material. The main river channel cannot perform all the necessary buffering to reduce nutrient and sediment loss. Nutrient and sediment loss should thus also be tackled on farms, and on the first and second order streams if the values of Oyster Harbour and the Kalgan River are to be retained and enhanced (Weaver and Prout, 1993).

While fencing off or reinstating vegetation on any of the unprotected parts of the rivers will be beneficial, there are areas which require fencing and/or vegetation rehabilitation more urgently than others. Furthermore, as farmers' funds and subsidies from Government and community groups to construct fences and/or rehabilitate vegetation are limited, it is necessary that these needs are prioritised.

There are four levels of priority (as used in APACE Green Skills and Pen, 1995), which are explained below:

Priority 1- Urgent:

Areas exhibiting severe erosion and/or stock damage which threatens to get worse in the short term.

Priority 1:

Areas showing either limited erosion or the first signs of erosion, or which are prone to erosion due to the absence of fringing vegetation, or areas having infestations of declared weeds (eg. Blackberry).

Priority 2:

Areas which retain substantial fringing vegetation which is becoming progressively degraded by livestock or significant weed infestations (eg. Watsonia).

Priority 3:

Areas which have healthy fringing vegetation or moderately degraded vegetation which are being degraded at a relatively slow rate and are therefore unlikely to become significantly further degraded in the short term.

The following table (Table 6.1) summarises the priority classifications for the 12 selected rivers and creeks in the Oyster Harbour Catchment.

Table 6.1 - Priority Classifications for Tributaries Surveyed.

River	Erosion	Weed Control	Fencing
1. Boonawarrup Creek	1	3	1
2. Chelgiup Creek	2	1-urgent	1
3. Gaalgecup Creek	1	3	1-urgent
4. Johnston * Creek	1-urgent	1	1-urgent
5. King River	1	1	1
6. Moorialup Creek	2	1-urgent	1
7. Napier Creek *	1-urgent	1	1-urgent
8. Stoney Creek	1	3	1
9. Takalarup Creek	1-urgent	3	1
10. Takenup Creek *	1-urgent	1	1
11. Upper Kalgan	1	2	1-urgent
12. Young River *	1-urgent	3	1-urgent

* Denotes rivers considered highest priority for funding for riparian rehabilitation work.

6.2 Placement of fences

Ideally, fences should be placed above the river valley (see Fig. 9.1). Depending on the steepness of the embankment, the fence should be placed 5m to 20m back from the edge of the river valley (Fig. 9.1A). Five metres is sufficient for a shallow valley a couple of metres deep but a broader zone, greater than ten metres, is required for valleys deeper than five metres. The purpose of fencing off the shoulders of the river is to enable trees on the upper part of the embankment and those above the river valley to anchor the embankments to the adjacent, land and thereby prevent subsidence. It should be mentioned that while sections of the tributaries are fenced off, a number of fences are inappropriately placed to provide maximum support against subsidence.

In the case of shallow river valleys, there is little chance that embankments will subside. Nevertheless, fencelines should be located above the river valley (Fig. 6.1B). This is because fences and firebreaks located within the river valley will be damaged and eroded by floodwaters. When they occur, firebreak washouts can be severe and contribute large quantities of sediment to the river system.

If the river valley is particularly broad and floodplains have been cleared for grazing, fencing them off may mean sacrificing good farmland. In this case it is necessary that only those areas that are prone to water erosion or stock damage, such as embankments and secondary river channels which only flow strongly at times of flood, need be fenced off (see Fig. 6.1C). Some of these fencelines will be prone to flood damage, but this can be minimised if fences run, as much as possible, parallel to the direction of floodwaters.

In the flatter and broader valleys it may be acceptable to use fences to control the level of grazing rather than to exclude it altogether. A careful watch would need to be kept to ensure that the grazing is sustainable and is not so heavy to prevent the regeneration of native trees, shrubs and sedges.

6.3 Types of fences

Needless to say, fencing should be appropriate to the livestock being grazed. In some cases this means purchasing expensive materials and much time-consuming effort. But fencing along a river need not be too expensive, especially if electric fences are used. Some farmers have found that a single strand of 'hot' wire nailed from tree to tree is effective in keeping stock out of the river. While this is an excellent idea there are a number difficulties which require attention. Firstly, the nail used to attach the wire will wound the tree and open it to infection and, gradually, the tree will grow around and over the nail. A better idea is to tie the wire to the tree and to loosen the tie as the tree grows.

A problem along tributaries in the study area is that, in many areas, remaining trees suitable for holding hot wires are too close to the main channel to create a useful riparian corridor.

6.4 Vegetation rehabilitation

The general subject of vegetation rehabilitation on cleared land is beyond the scope of this report and the reader is referred to the excellent publications listed in Appendix 2.

6.4.1 Weed management

Mechanical control of weeds, either by grubbing out or slashing will be possible for the small areas of weeds. If the area weeded is too large to be re-colonised by native regeneration, direct-seeding and/or planting of local indigenous species will be necessary. Mulch in the form of brushing sourced from local indigenous plants can be of assistance in holding the ground and preventing weed regrowth.

Chemical control—using the preparation of carefully formulated herbicides, may be necessary in areas where mechanical control is not possible.

Timing is crucial to the successful eradication of weeds. Control work should generally be carried out before seed set. If mature seeds are present, care must be taken not to disperse them into clean areas. Monitoring to assess the need for follow-up weeding is also of utmost importance.

In all weed control work, care should be taken to minimise disturbance. Erosion, and or further weed growth can occur if large areas of weeds are removed without subsequent seeding or planting with suitable species (See Appendix 1 for plant list).

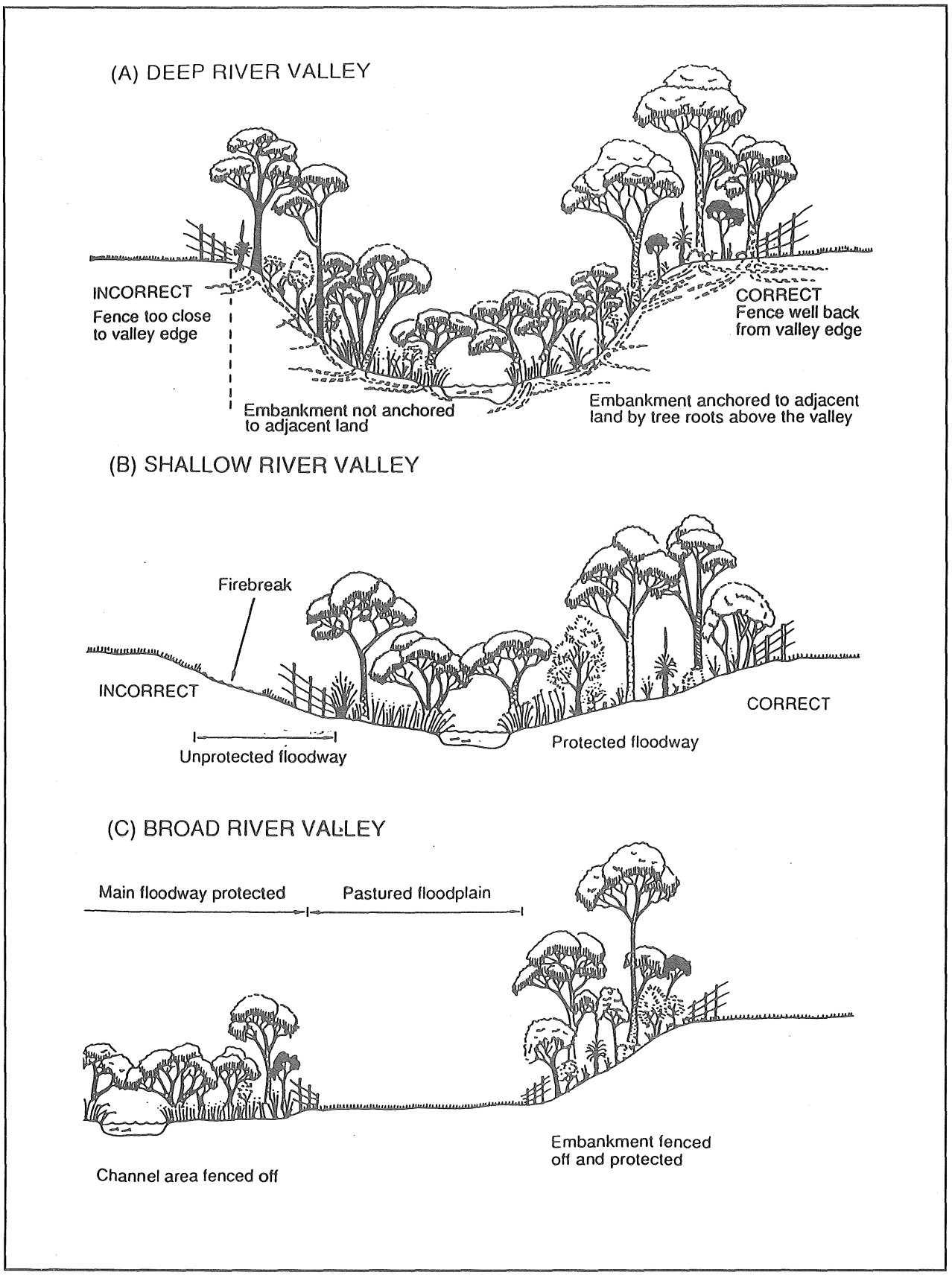


Figure 6.1 - The correct placement of fences in relation to the river valley: (A) the deep river valley, (B) the shallow river valley and (C) the broad river valley with broad floodplain.

6.4.2 Specific weed recommendations for control

The following specific weed recommendations are provided to assist with control of problem weed. Additional advice from Agriculture Western Australia can be obtained when embarking on weed control programs.

Watsonia - Treat by spraying with Roundup Bi-active 360g/l (1 part per 100 of water) or with 2,2- DPA (Dalapon) at 20kg per ha (1kg per 100lt of water spot spray). before flower spike emergence. Dalapon is considered less environmentally damaging than Roundup. Although this formula is designed to be used near wetlands, great care should be exercised to prevent spray drift, which may damage nearby native plants. Isolated plants may be removed by hand. Flower stalks bearing aerial corms or seeds should be cut and bagged and removed from the site. Protect cleanest areas as a priority, and plan the order and priority for tackling larger infestations. Replanting with native plants important if insufficient occur on site.

Blackberry - Blackberry control is most effective if undertaken during the summer months between early December and late March. When using the herbicide Roundup Bi-active or Metsulfuron methyl" (Ally, Brushoff) it is important that no significant rain falls within at least 2 hours of completion of the spraying and that the entire plant is thoroughly wet with the herbicide mixture. Both herbicides are leaf absorbed so any mixture that reaches the ground would be wasted, so spraying should not be overdone.

The action of Brushoff/Ally on Blackberry can be extremely slow, and may not become obvious until the following Spring (September).

Either "Metsulfuron methyl" (Ally, Brushoff) should be applied at a rate of 10g per 100lt of water. As it is a wettable powder it ideally requires premixing before adding into the spray tank. It is also an advantage to continuously agitate the mixture during use. Add a wetting agent such as "Pulse" at 1 part per 400 mixture.

Or Roundup Bi-active 360g/L (1 part per 80 parts of water) should be applied with 1 part "Pulse Penetrant" to 400 parts of mixture.

Small infestations in environmentally sensitive areas can be treated by neatly cutting every cane (within 5cm of the ground) and immediately (within 5 minutes) painting every stump with pure Roundup.

Where blackberry is removed by grubbing, all root material must be removed.

Regrowth might occur one or two seasons after any one of the above controls, and follow-up monitoring is thus required.

Protect cleanest areas as a priority, and plan the order and priority for tackling larger infestations. Replanting with native plants important if insufficient local plants occur on site.

Nightshade - Hand pull small populations, or treat with Roundup Bi-active 360 g/l (at 1:200) from flowering to berry stage.

Pampas Grass - May be difficult to kill with spraying. Treat by spraying with Roundup Bi-active 360g/l (1 part per 100 of water). Best results if treated between early spring and mid summer. For individual plants, lop off top with brush cutter and then remove mechanically.

Taylorina - Removal by hand clearing or selective spraying. Spray with the herbicide "Metsulfuron methyl" (Ally, Brushoff) at a rate of 10g per 100lt of water. Add a wetting agent such as "Pulse" at 1 part per 400 mixture. Wet the entire canopy and trunk with this mixture. Mature trees can be lopped well below the lower branches and painted with "Access" mixed in distillate at a ration of 1 part per 60 distillate. Coppicing will not occur. Seedlings can be removed by hand. Monitor annually for seedlings. Protect cleanest areas as a priority, and plan the order and priority for tackling larger infestations. Replanting with native plants important if insufficient occur on site.

Bridle Creeper - Spray with the herbicide "Metsulfuron methyl" (Ally, Brushoff) at a rate of 10g per 100lt of water. Add a wetting agent such as "Pulse" at 1 part per 400 mixture. Protect cleanest areas as a priority, and plan the order and priority for tackling larger infestations. Replanting with native plants important if insufficient local plants occur on site.

Acacia longifolia - Small plants can be treated with the herbicide "Metsulfuron methyl" (Ally, Brushoff) at a rate of 10g per 100lt of water. Add a wetting agent such as "Pulse" at 1 part per 400 mixture. Large plants can be treated by painting the trucks with "Access" mixed with distillate at a ratio of 1 part Access to 60 parts distillate.

More specific advice on the rehabilitation of cleared areas is beyond the scope of this report and may be obtained from publications such as

'Managing your Bushland' (Hussey and Wallace, 1996) and Bush Regeneration (Buchanan, 1989).

Once waterways are fenced off from stock, weed management problems can arise relatively quickly, particularly if there is insufficient cover of native vegetation on the foreshore. It is vital that landholders who are fencing off waterways from stock, monitor protected areas and plan appropriate means for controlling problem weeds.

6.4.3 Planting along the river valley

Areas of exposed river embankment need to be planted to control erosion. Actual sites of erosion cannot be planted until they are stabilised, as plantings would easily be washed away in the first winter. However, plantings can be carried out just upstream, on cleared non-eroded embankments, to retard flow rates and encourage sedimentation in the former erosion sites, which, in turn, will create sites which can be planted or will be recolonised naturally by plants.

Vegetation rehabilitation requirements along the selected tributaries are given in the tables and maps in Chapter 7.

6.4.4 Minor useful work

There is much useful work that can be done to accelerate regeneration of native riparian vegetation in those B grade areas of the rivers which have recently been fenced off. Tree and shrub seedlings can be protected from rabbit grazing by placing wire cages or old tyres around them, until the plants are large enough to fend for themselves. The cages or tyres can then be moved to other young plants. On a larger scale, small areas can be surrounded by enclosures to reduce grazing by rabbits and small marsupials. This method produces spectacular results on Rottnest Island where Quokka grazing is a major problem. Even clearing or spraying weeds around young plants will encourage growth.

The ground can be prepared below trees and tall shrubs to encourage seed germination and early growth can be encouraged by spraying weeds and by scarifying (shallow ripping) the soil. Deep ripping is not recommended within 20m of trees as it could damage root systems essential for the stability of the embankment and the trees themselves. Scarification has been observed by the authors to produce good results along the Brunswick and Collie rivers. It should not be done in areas subject to swift flood waters, as severe washouts may result.

Even though these suggested activities are on a small scale, taken across the whole river over many years, they will make a very useful contribution to river rehabilitation.

6.5 Stock crossings and watering points

Where properties cross the river, or where farmers own or manage both sides of the river, livestock crossings are required. The heavy livestock trampling associated with crossings often exposes the soil and initiates serious water erosion. However, simple river crossings, if located and managed properly, need not present an erosion hazard to the river banks. For example, a crossing point could be located just downstream of dense riparian vegetation, where flow rates, even during floods, are minimal, or it could be located in a stony area where erosion is not possible.

In areas where the soil is not cohesive and easily washed away, stones can be placed along the track to dissipate energy and buffer the soil against livestock trampling. At the embankments, where the soil is often worn down by livestock, large stones or logs can be placed over small ones to form revetments. Ideally, crossing points should be fenced off when not in use, to prevent livestock access to the river valley.

Because crossings run up and down the river embankments they are prone to erosion by water running off the paddocks and channelling down the tracks. To prevent this, tracks leading down to crossing points should not be aligned with the natural drainage lines of the adjacent paddocks.

6.6 Plant species for rehabilitation

Long term general rehabilitation of parts of the fringing vegetation of the Oyster Harbour tributaries will be necessary to maintain the habitat, bio-filter and ecological corridor functions of the rivers, to combat erosion and preserve the riverine landscape of the region. Lists of native plant species likely to be suitable for the Kalgan River and its tributaries are given in Appendix 1. This Appendix presents information gained from a botanical survey carried out by Dr Luke Pen for the Kalgan river survey.

7. Detailed Description of the Condition and Rehabilitation Needs of the Selected Rivers and Creeks

The twelve selected rivers and creeks have been divided into fifty seven maps. Figure 1.2 shows the map index for the various tributaries of the Kalgan river and the King River. For each map a corresponding table has been developed on which the foreshore condition along with fencing, revegetation needs and erosion and weed control needs are recorded.

The rivers and creeks maps are presented in the following alphabetical order

River/Creek	Maps
Boonawarrup	BOO 1- 4
Chelgiup	CHEL 1-6
Gaalgegup	GAAL 1-8
King River	KING 1-5
Johnston	JOHN 1-3
Moorialup	MOOR 1-3
Napier	NAP 1-3
Stoney	STON 1-3
Takalarup	TAKA 1-2
Takenup	TAK 1-3
Upper Kalgan	UPKAL 1-13
Young	YOU 1-4

Please note the following:

To allow ease of reading from one map to the next, each map has been printed with an overlap. The data and information in the table opposite each map refers only to the area indicated, and does not include the overlap.

Information provided in these Forms and Maps are intended only as advisory recommendations to landholders, catchment groups and agencies. Because of changing land use in the catchment, all recommended fencing is made on the assumption that livestock are being or will be grazed in the area. Obviously this is not always the case, and thus when interpreting the maps and recommendations, landholders need to take into account management and land use practices they have in place for their properties.

Financial assistance may be available for landholders (either as part of catchment groups or as individuals) for watercourse fencing and other waterways rehabilitation work. Landholders are encouraged to contact Agriculture Western Australia or the Albany Waterways Management Authority to check on the availability of such assistance.

Landholders noting any mistake or modification required of any of these maps are encouraged to provide this information in writing to the Albany Waterways Management Authority.

NB Please unfold the Foreshore Survey Map key on the back inside cover of this report when consulting the maps

BOONAWARRUP CREEK SURVEY -BOO1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0km-2.2km

Loc. Numbers of Adjacent Properties-
Left Bank : 1891, 1884.

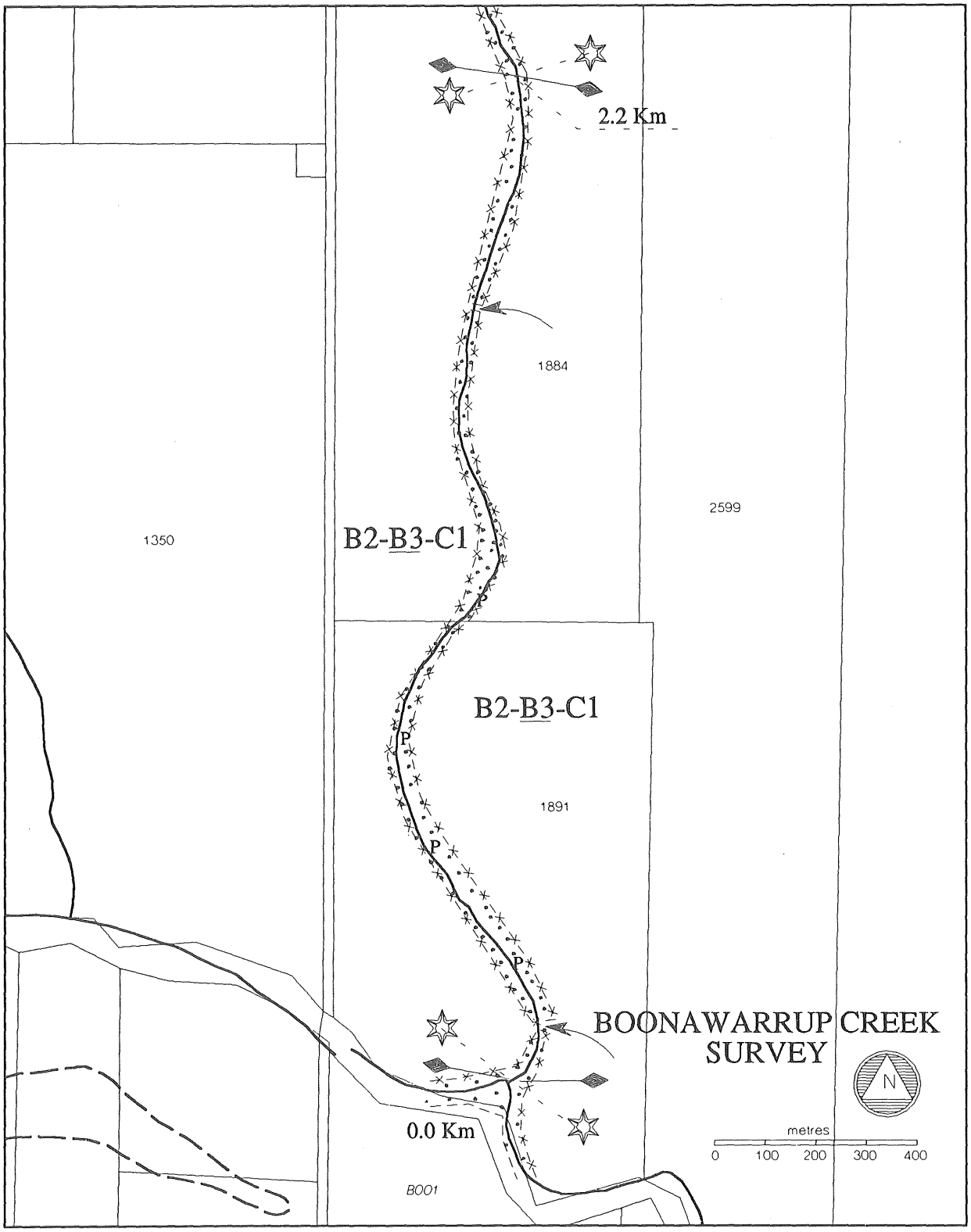
Right Bank : 1891, 1884.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 1/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.2km	2.2km
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	N/A	N/A
Advice on rehabilitation of these sites :		
Other management advice for this section :		


2.2 Km
1884
2599
1350
B2-B3-C1
B2-B3-C1
1891
P
P
P
P
BOONAWARRUP CREEK
SURVEY
N
metres
0 100 200 300 400
0.0 Km
B001

BOONAWARRUP CREEK SURVEY - BOO2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 2.2km-5.6km

Loc. Numbers of Adjacent Properties-
Left Bank : 1633, 4028, 1939, 6141.

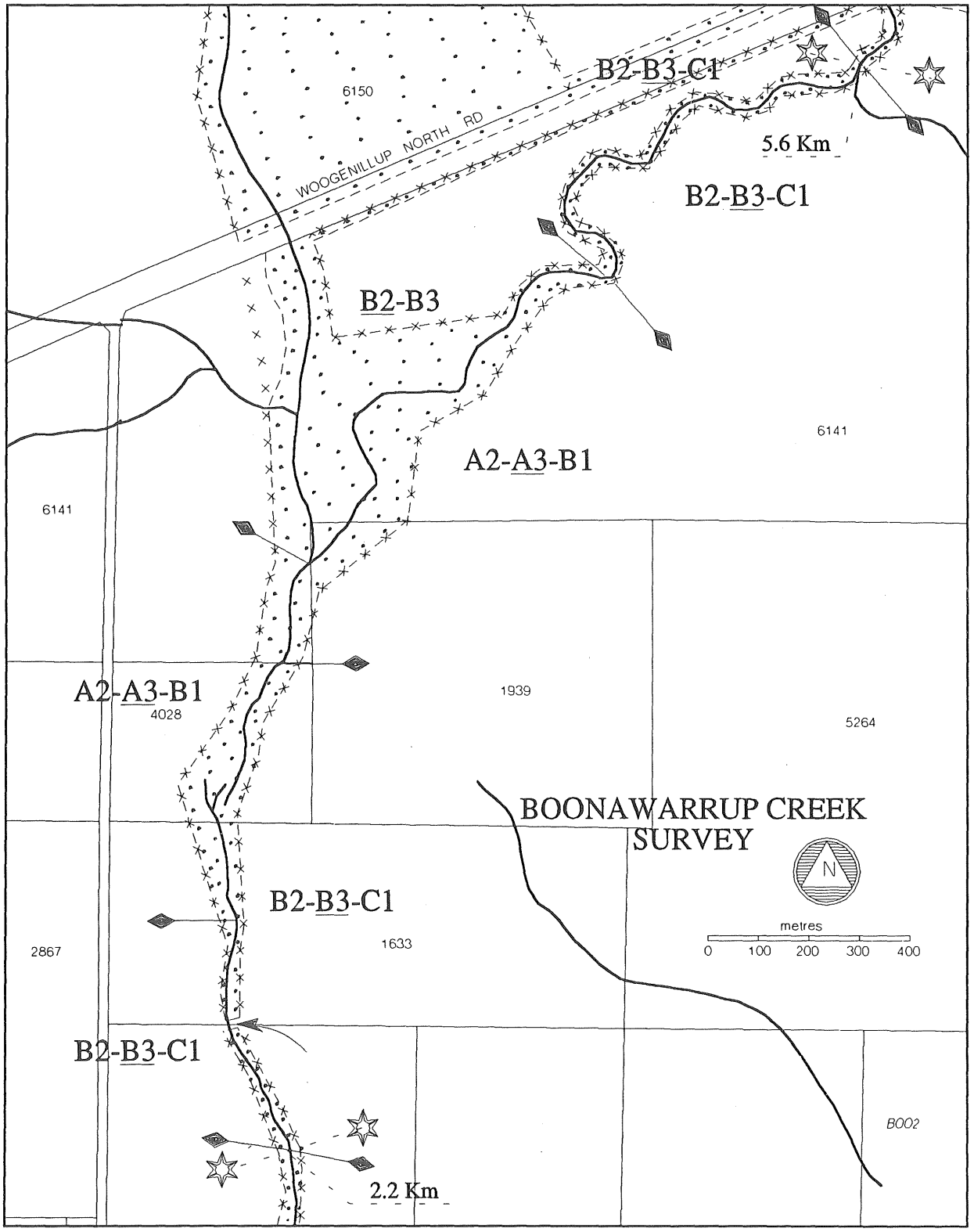
Right Bank : 1633, 4028, 1939, 6141.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 1/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	3.65km	3.4km
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	N/A	N/A
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


B2-B3-C1
6150
WOOGENILLUP NORTH RD
5.6 Km
B2-B3-C1
B2-B3
6141
A2-A3-B1
6141
A2-A3-B1
4028
1939
5264
BOONAWARRUP CREEK
SURVEY
N
B2-B3-C1
metres
0 100 200 300 400
2867
1633
B2-B3-C1
B002
2.2 Km

BOONAWARRUP CREEK SURVEY - BOO3 See Map 1.2 for general location

Distances from River Mouth (km) : 5.6km-7.3km

Loc. Numbers of Adjacent Properties-
Left Bank : 6141, 6142.

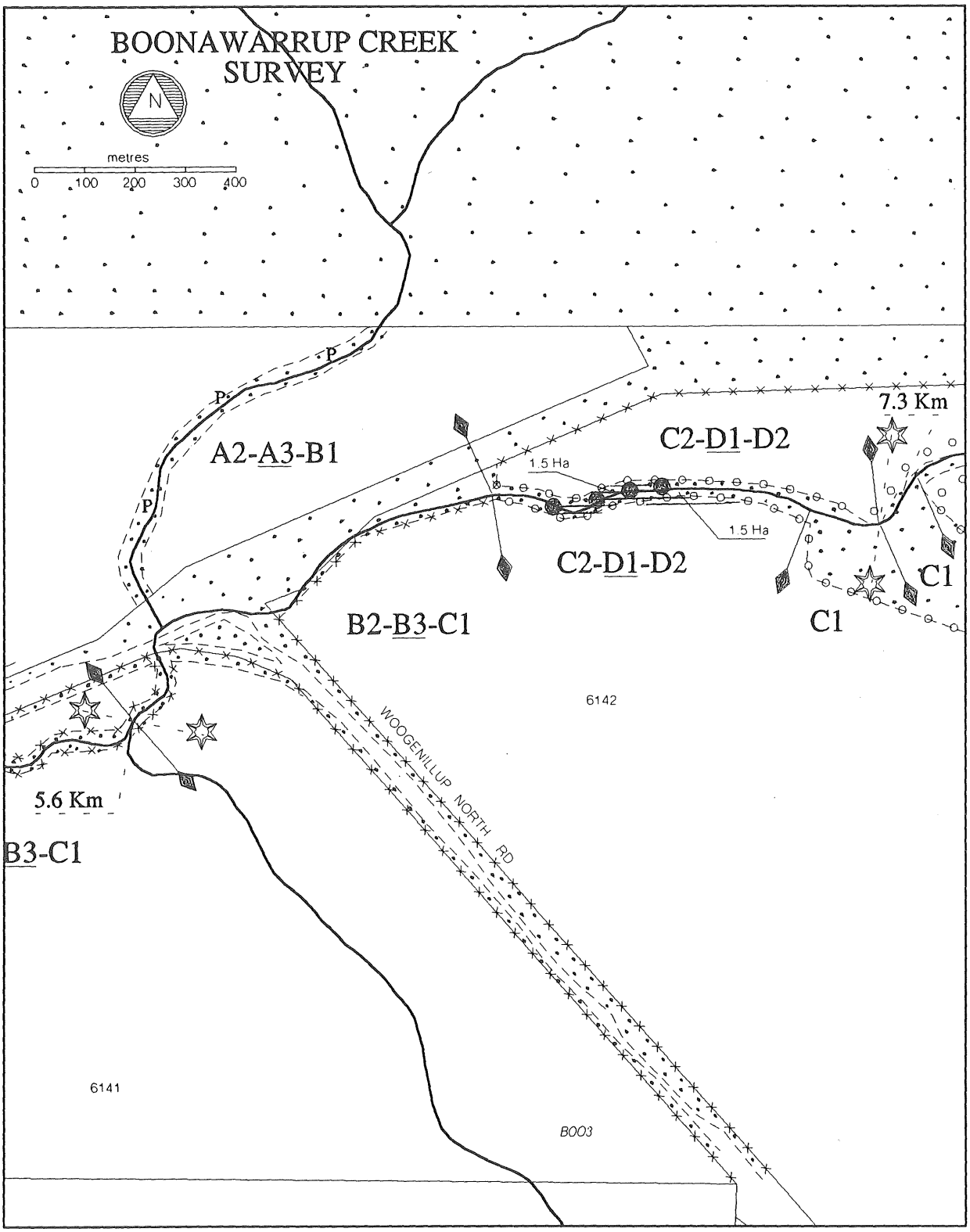
Right Bank : 6141, 6142.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 1/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	750m	750m
Length of Riverbank Fencing Recommended :	950m	1km
Number of Sites showing severe erosion :	4	4
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1-urgent Area (ha) :1.5ha	No. of sites : 1 Priority 1-urgent Area (ha) : 1.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *M.cuticularis, E.occidentalis, E.rudis.* . Rip and mound parallel with river, direct seed samphire and salt bush on bare exposed salty patches.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *M.cuticularis, E.occidentalis, E.rudis.* Rip and mound parallel with river, direct seed samphire and salt bush on bare exposed salty patches.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


BOONAWARRUP CREEK
SURVEY
N
metres
0 100 200 300 400
P
P
P
A2-A3-B1
7.3 Km
C2-D1-D2
1.5 Ha
1.5 Ha
C2-D1-D2
C1
C1
B2-B3-C1
6142
WOOGENILLUP NORTH RD
5.6 Km
B3-C1
6141
BOO3

BOONAWARRUP CREEK SURVEY - BOO4 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 7.3km-9.2km

Loc. Numbers of Adjacent Properties-
Left Bank : 6142

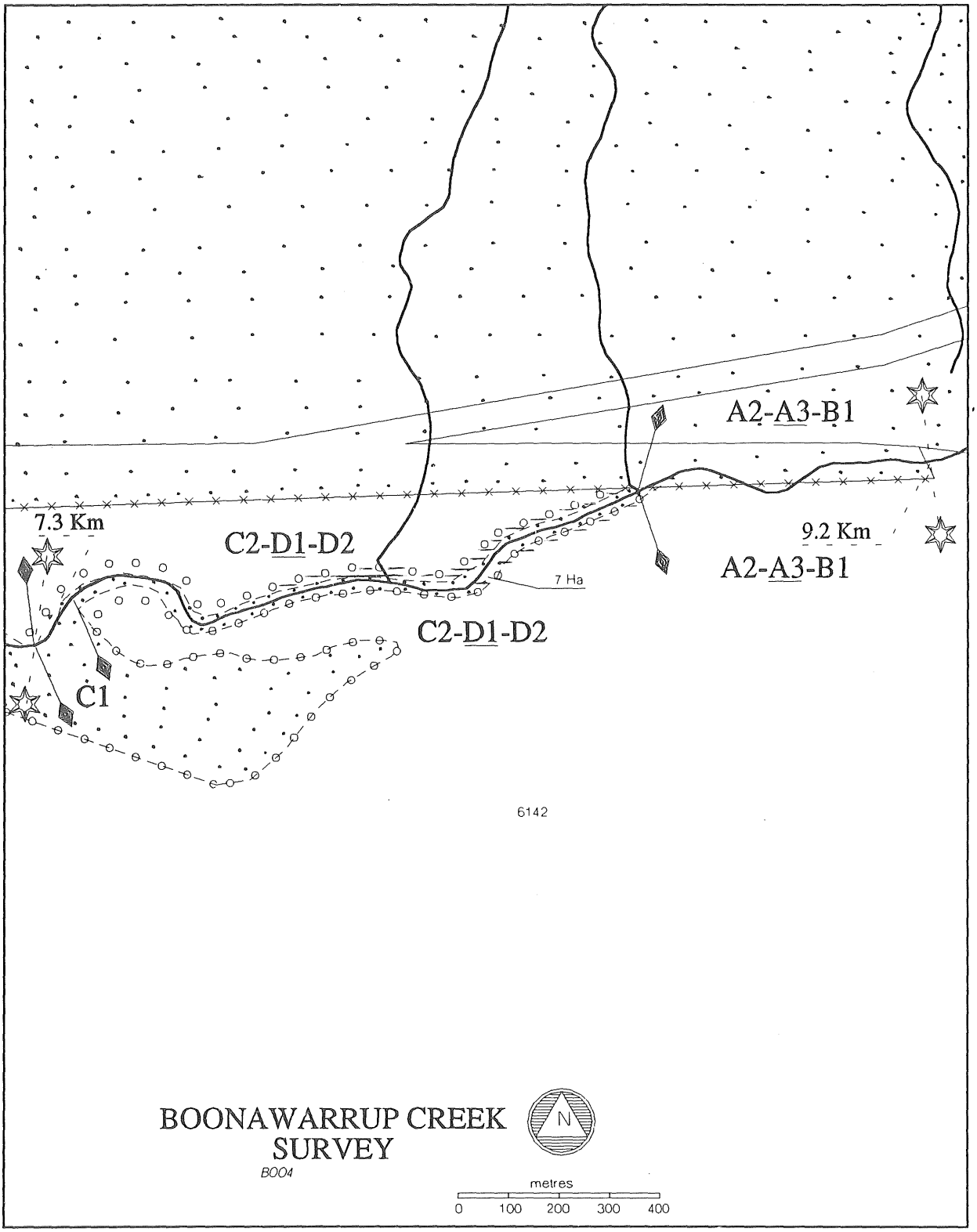
Right Bank : 6142

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 1/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	600m	600m
Length of Riverbank Fencing Recommended :	1.3km	2.8km
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1-urgent Area (ha) : 3.5ha	No. of sites : 1 Priority 1-urgent Area (ha) : 3.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Rip and mound parallel with river, direct seed samphire and salt bush on bare exposed salty patches.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Rip and mound parallel with river, direct seed samphire and salt bush on bare exposed salty patches.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


A2-A3-B1
7.3 Km
C2-D1-D2
9.2 Km
A2-A3-B1
7 Ha
C2-D1-D2
C1
6142
BOONAWARRUP CREEK
SURVEY
B004
N
metres
0
100
200
300
400

CHELGIUP RIVER SURVEY - CHEL1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0-1.45km

Loc. Numbers of Adjacent Properties-
Left Bank : 4762, 215

Right Bank : 4762, 215

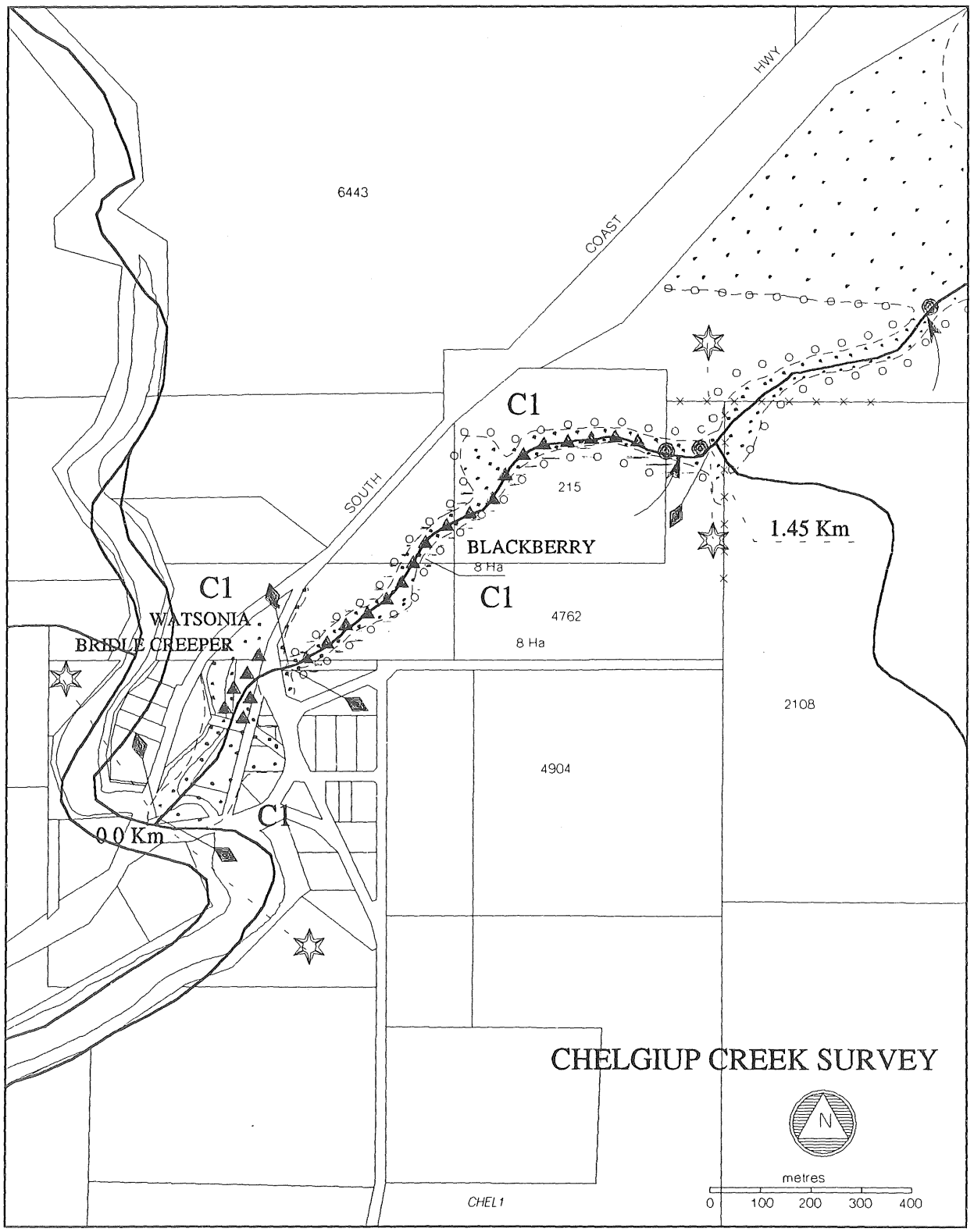
Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	1.04km	1.04km
Number of Sites showing severe erosion :	2	1
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 4ha	No. of sites : 1 Priority 1 Area (ha) : 4ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : M.raphiophylla, A.parviceps, A.flexuosa, C.lanceolata, E.calophylla, A.myrtifolia . Rip and mound where possible, otherwise auger holes and hand plant.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : M.raphiophylla, A.parviceps, A.flexuosa, C.lanceolata, E.calophylla, A.myrtifolia . Rip and mound where possible, otherwise auger holes and hand plant.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Most of left bank.	Most of right bank.
Advice on rehabilitation of these sites :	Treat blackberry, bridle creeper and watsonia.	Treat blackberry, bridle creeper and watsonia.

Other management advice for this section :	Area near private dwellings is fragile due to widespread access. Concentrate creek access to a single area for each dwelling, and rehabilitate the remainder of the bank with covering vegetation. Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.



CHELGIUP RIVER SURVEY - CHEL2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 1.45km-3.19km

Loc. Numbers of Adjacent Properties-
Left Bank : 2108, 6266

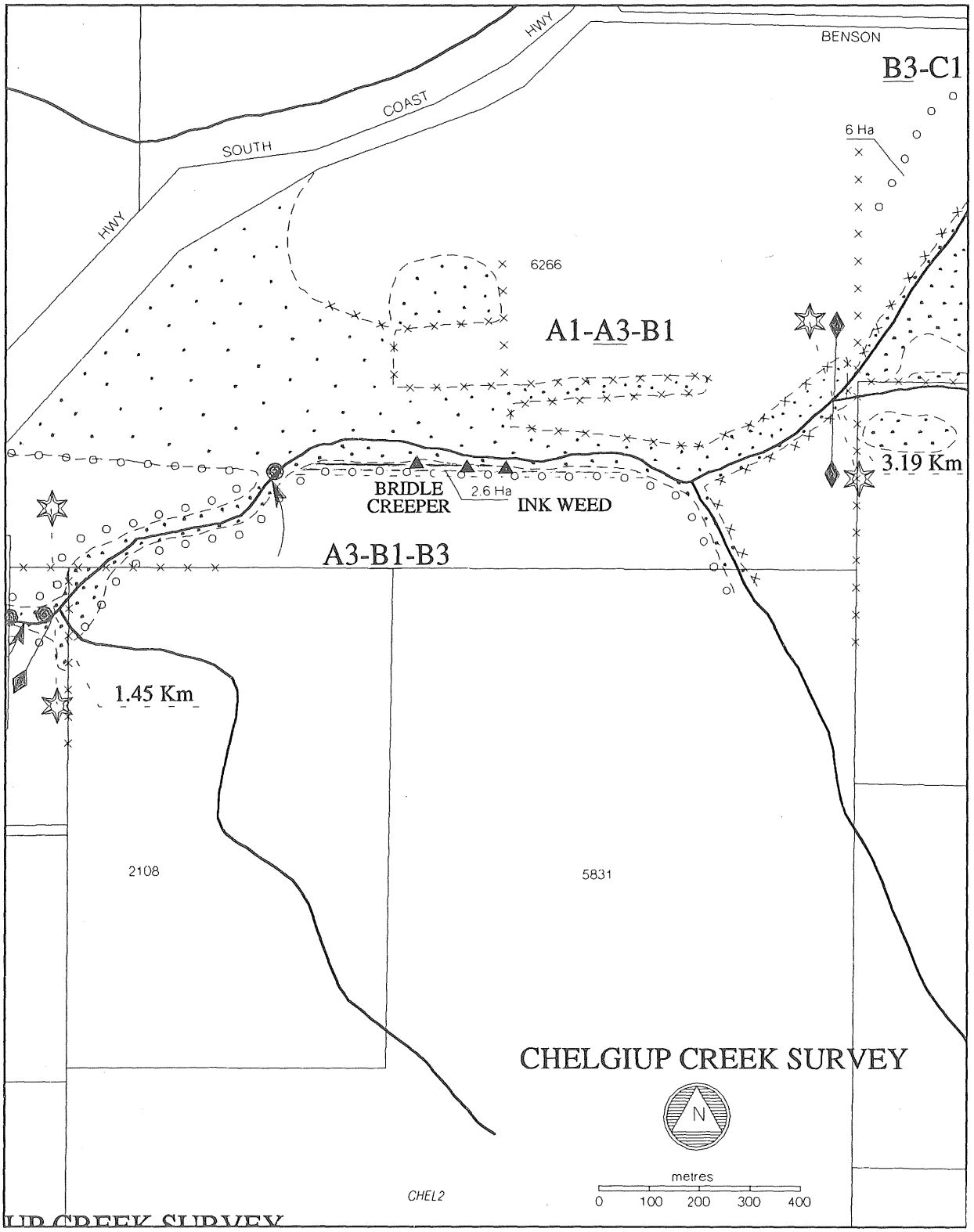
Right Bank : 2108, 6266

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	970m	1.34km
Number of Sites showing severe erosion :	1	1
Advice on remedial measures required for these sites :	Crossing needing rocks to stabilise.	Crossing needing rocks to stabilise.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) : N/A	No. of sites : 1 Priority 1 Area (ha) : 2.6ha
Advice on revegetation species and preparation :	N/A	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.flexuosa, C.lanceolata, A.myrtifolia* . Rip and mound to contour. Some areas of kikuyu need intensive spraying in previous spring and summer.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	3
Advice on rehabilitation of these sites :	N/A	Treat bridle creeper and inkweed.
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.


HWY
BENSON
B3-C1
COAST
SOUTH
HWY
6 Ha
6266
A1-A3-B1
3.19 Km
BRIDLE
CREEPER
2.6 Ha
INK WEED
A3-B1-B3
1.45 Km
2108
5831
CHELGIUP CREEK SURVEY
N
metres
0 100 200 300 400
CHEL2

CHELGIUP CREEK SURVEY - CHEL3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 3.19km-5.34km

Loc. Numbers of Adjacent Properties-
Left Bank : 6266, 3589, 3560

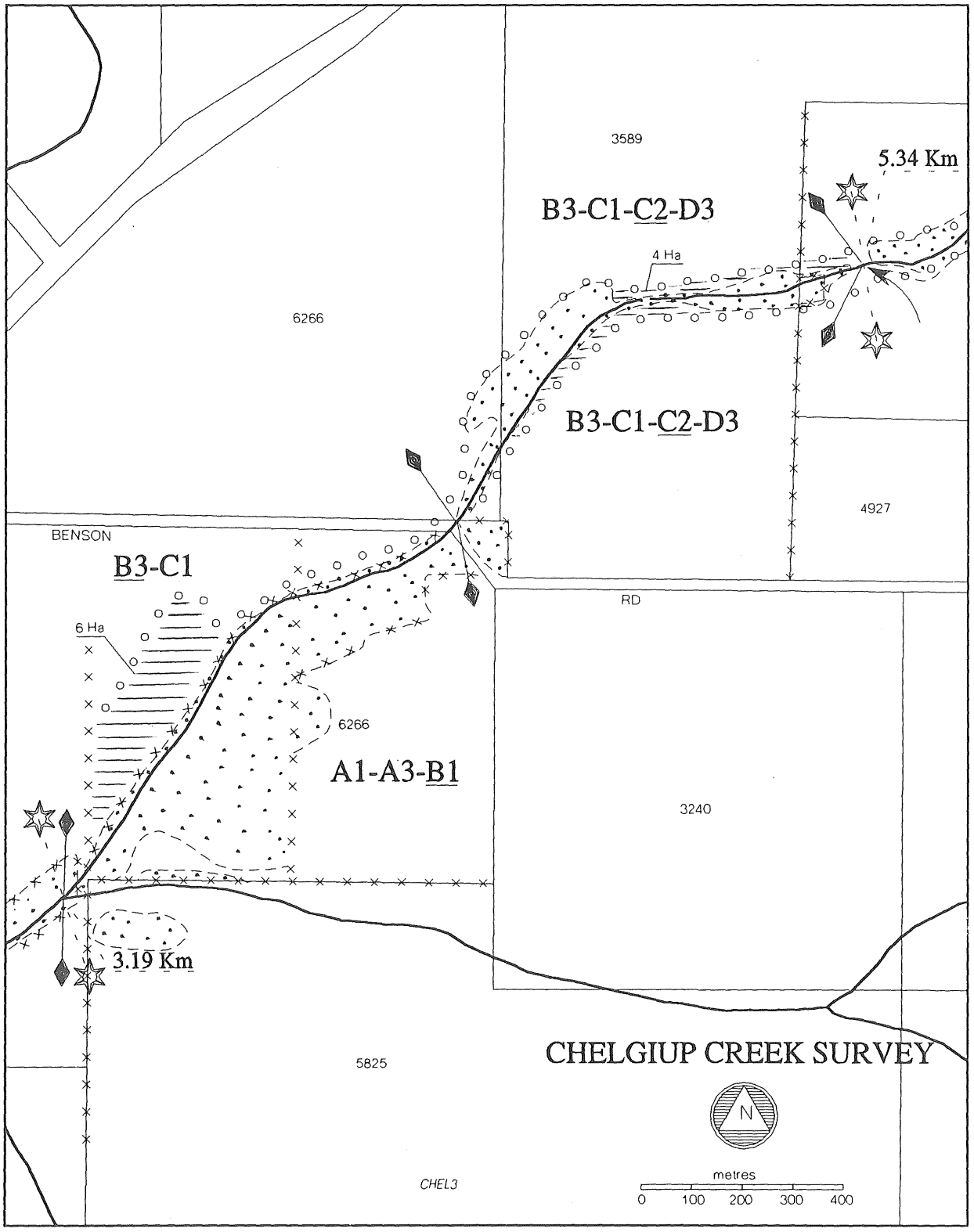
Right Bank : 6266, 3589, 3560

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.12km	1.45km
Length of Riverbank Fencing Recommended :	2.05km	1.2km
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 2 Priority 1 Area (ha) : 8ha	No. of sites : 1 Priority 1 Area (ha) : 2ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linerifolia, A.flexuosa, C.lanceolata, A.myrtifolia* . Rip and mound to contour. Some areas of kikuyu need intensive spraying in previous spring and summer.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linerifolia, A.flexuosa, C.lanceolata, A.myrtifolia* . Rip and mound to contour. Some areas of kikuyu need intensive spraying in previous spring and summer.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.


3589
5.34 Km
B3-C1-C2-D3
4 Ha
6266
B3-C1-C2-D3
4927
BENSON
B3-C1
RD
6 Ha
6266
A1-A3-B1
3240
3.19 Km
5825
CHELGIUP CREEK SURVEY
N
CHEL3
metres
0 100 200 300 400

CHELGIUP CREEK SURVEY - CHEL4 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 5.34km-7.29km

Loc. Numbers of Adjacent Properties-
Left Bank : 3560, 3561, 5823

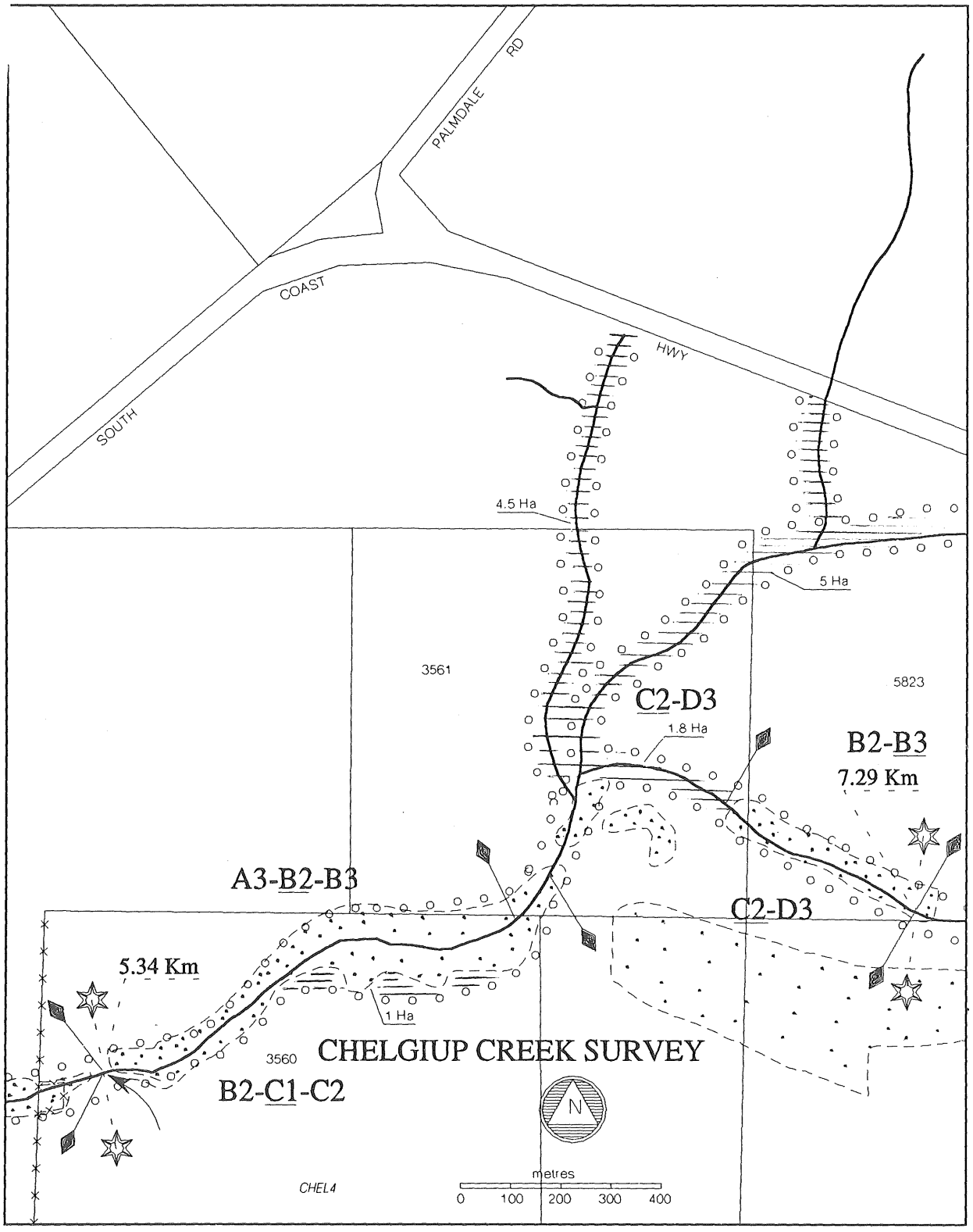
Right Bank : 3560, 3561, 5823

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	1.95km	1.95km
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 0.9ha	No. of sites : 2 Priority 1 Area (ha) : 1.9ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linerifolia, A.flexuosa, C.lanceolata, A.myrtifolia* . Rip and mound to contour. Some areas of kikuyu need intensive spraying in previous spring and summer.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linerifolia, A.flexuosa, C.lanceolata, A.myrtifolia* . Rip and mound to contour. Some areas of kikuyu need intensive spraying in previous spring and summer.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.


PALMDALE RD
COAST
SOUTH
HWY
4.5 Ha
5 Ha
3561
5823
C2-D3
1.8 Ha
B2-B3
7.29 Km
A3-B2-B3
C2-D3
5.34 Km
1 Ha
3560
CHELGIUP CREEK SURVEY
B2-C1-C2
N
CHEL4
metres
0 100 200 300 400

CHELGIUP CREEK SURVEY - CHEL5 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 7.29km-8.68km

Loc. Numbers of Adjacent Properties-
Left Bank : 5823, 6063

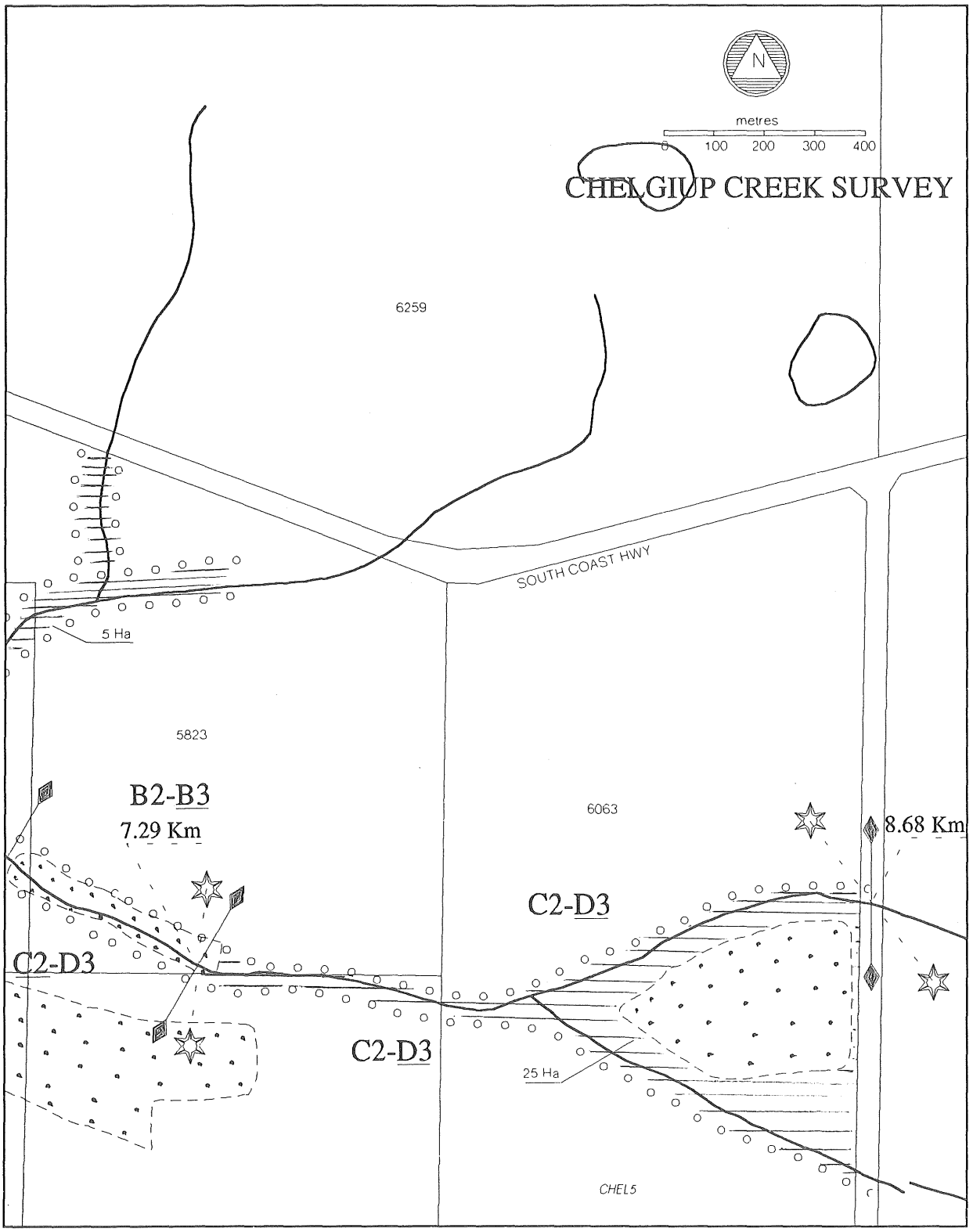
Right Bank : 5823, 6063

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	1.39km	1.39km
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Whole Site-both banks Priority 1 Area (ha) : 25ha	No. of sites : Whole Site-both banks Priority 1 Area (ha) : 25ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linerifolia, A.flexuosa, C.lanceolata, A.myrtifolia* . Rip and mound to contour. Some areas of kikuyu need intensive spraying in previous spring and summer.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linerifolia, A.flexuosa, C.lanceolata, A.myrtifolia* . Rip and mound to contour. Some areas of kikuyu need intensive spraying in previous spring and summer.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.


N
metres
0 100 200 300 400
CHELGIUP CREEK SURVEY
6259
SOUTH COAST HWY
5 Ha
5823
B2-B3
7.29 Km
6063
8.68 Km
C2-D3
C2-D3
C2-D3
25 Ha
CHEL5

GAALGEGUP CREEK SURVEY -GAAL1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0km-2.2km

Loc. Numbers of Adjacent Properties-
Left Bank : 4930, 3456, 6898.

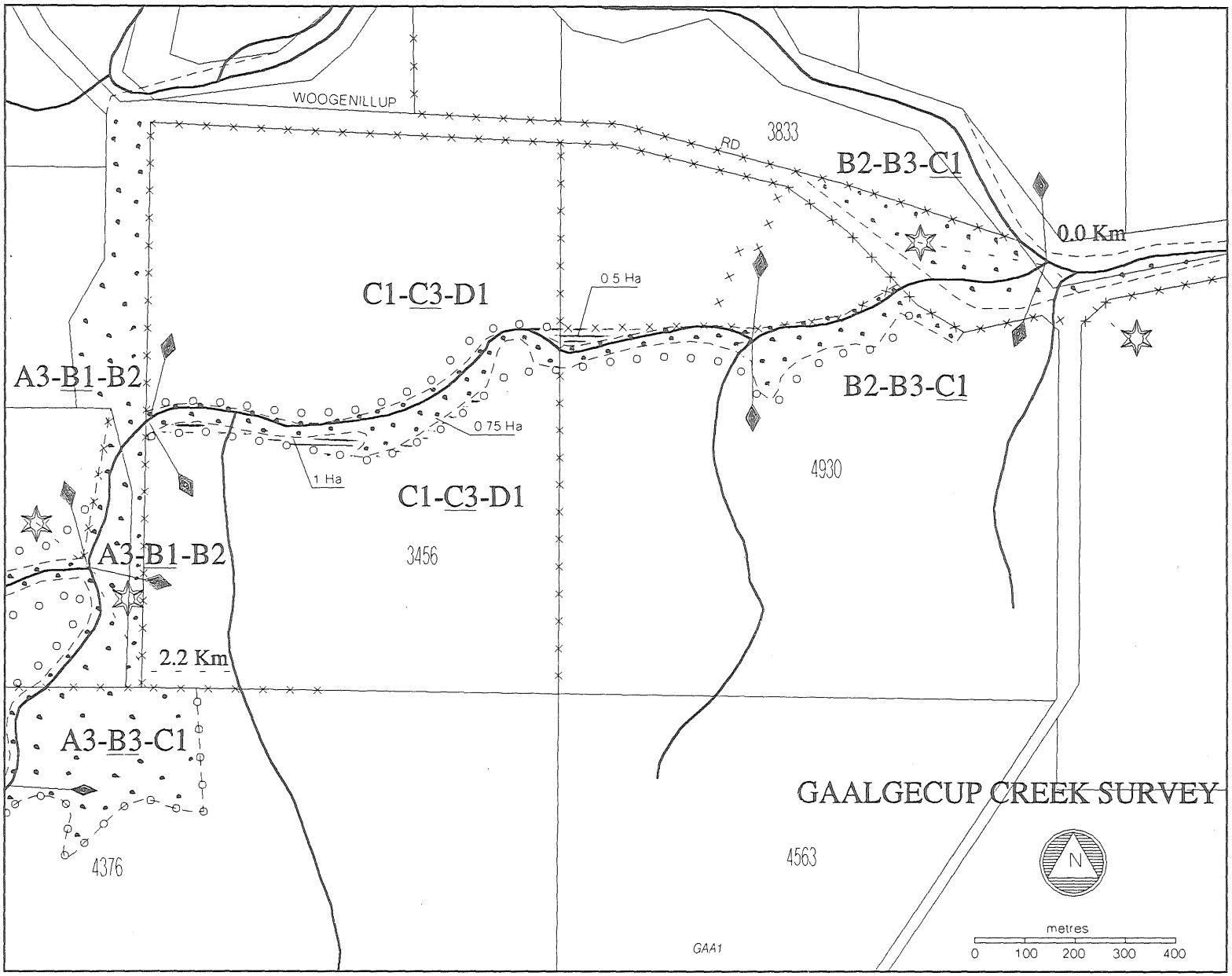
Right Bank : 4930, 3456, 6898.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 8/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	700m	1.3km
Length of Riverbank Fencing Recommended :	1.7km	900m
Number of Sites showing severe erosion :	Most of main river channel is eroded.	Most of main river channel is eroded.
Advice on remedial measures required for these sites :	Exclude stock by fencing, replant/direct seed.	Exclude stock by fencing, replant/direct seed.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 2 Priority Urgent Area (ha) : 1.75ha	No. of sites : 1 Priority Urgent Area (ha) : 0.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.rudis, E.decipiens, E.occidentalis, M.cuticularis,*. Rip and mound parallel with river. Scarify exposed areas and direct seed with samphire sp. and salt bush.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site Species: *E.rudis, E.decipiens, E.occidentalis, M.cuticularis.* Rip and mound parallel with river. Scarify exposed areas and direct seed with samphire sp. and salt bush.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.


WOOGENILLUP
RD
3833
B2-B3-C1
0.0 Km
C1-C3-D1
0.5 Ha
A3-B1-B2
B2-B3-C1
0.75 Ha
1 Ha
4930
C1-C3-D1
3456
A3-B1-B2
2.2 Km
A3-B3-C1
GAALGECUP CREEK SURVEY
4376
4563
N
GAA1
metres
0
100
200
300
400

GAALGEGUP CREEK SURVEY -GAAL2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 2.2km-4.2km

Loc. Numbers of Adjacent Properties-
Left Bank : 6898, 4376, 5238.

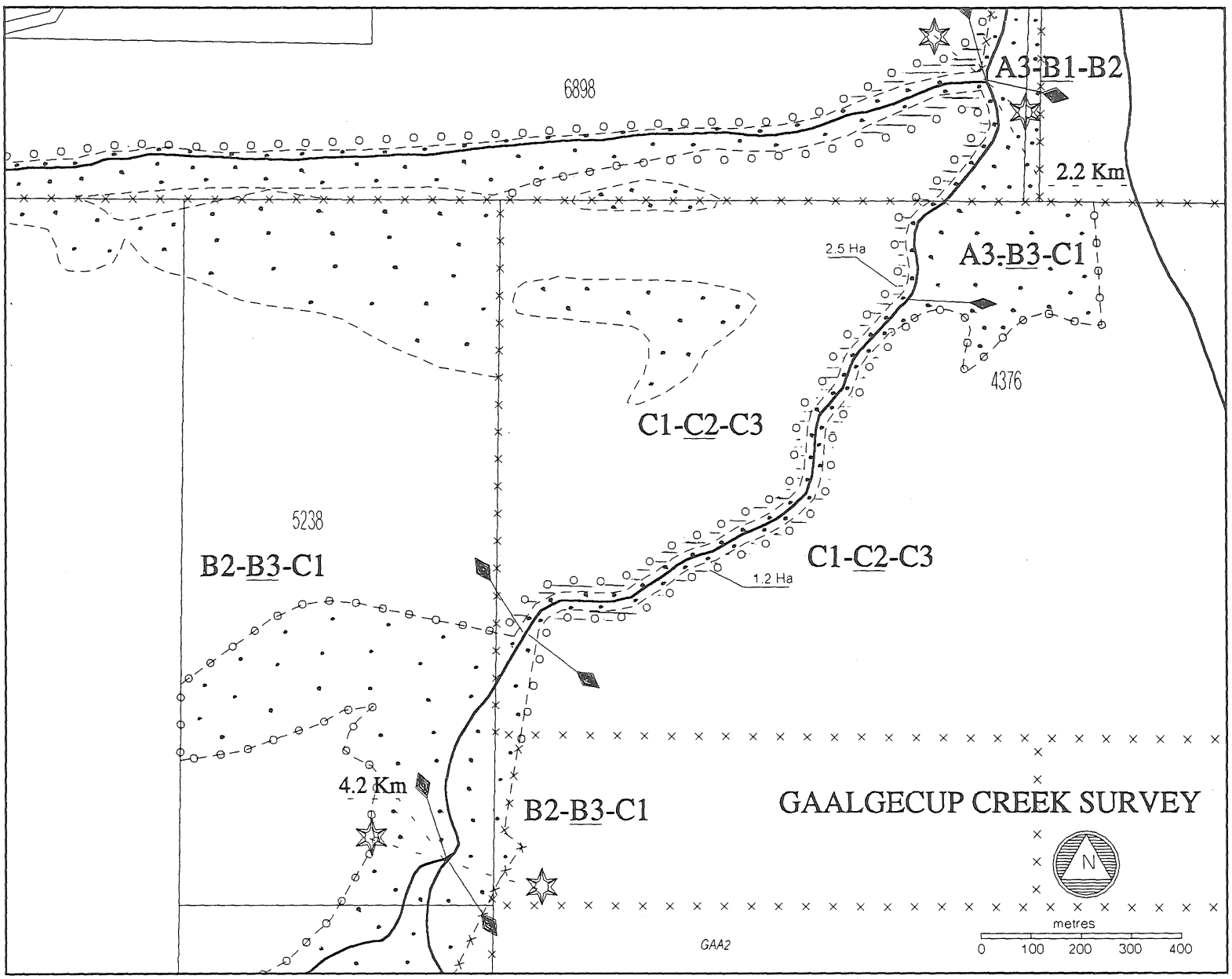
Right Bank : 6898, 4376, 5238.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 8/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	850m	Nil
Length of Riverbank Fencing Recommended :	2km	3km
Number of Sites showing severe erosion :	Most of main river channel is eroded.	Most of main river channel is eroded.
Advice on remedial measures required for these sites :	Exclude stock by fencing, replant/direct seed.	Exclude stock by fencing, replant/direct seed.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority Urgent Area (ha) : 1.2ha	No. of sites : 1 Priority Urgent Area (ha) : 2.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site Species: *E.rudis, E.decipiens, E.occidentalis, M.cuticularis,* rip and mound parallel with river. Scarify exposed areas and direct seed with samphire sp. and salt bush.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site Species: *E.rudis, E.decipiens, E.occidentalis, M.cuticularis,* rip and mound parallel with river. Scarify exposed areas and direct seed with samphire sp. and salt bush.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.


6898
A3-B1-B2
2.2 Km
2.5 Ha
A3-B3-C1
4376
C1-C2-C3
5238
B2-B3-C1
C1-C2-C3
1.2 Ha
4.2 Km
B2-B3-C1
GAALGECUP CREEK SURVEY
N
GAA2
metres
0 100 200 300 400

GAALGEGUP CREEK SURVEY -GAAL3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 4.2km-6.6km

Loc. Numbers of Adjacent Properties-
Left Bank : 5238, 4534, 5239, 5240, 6046.

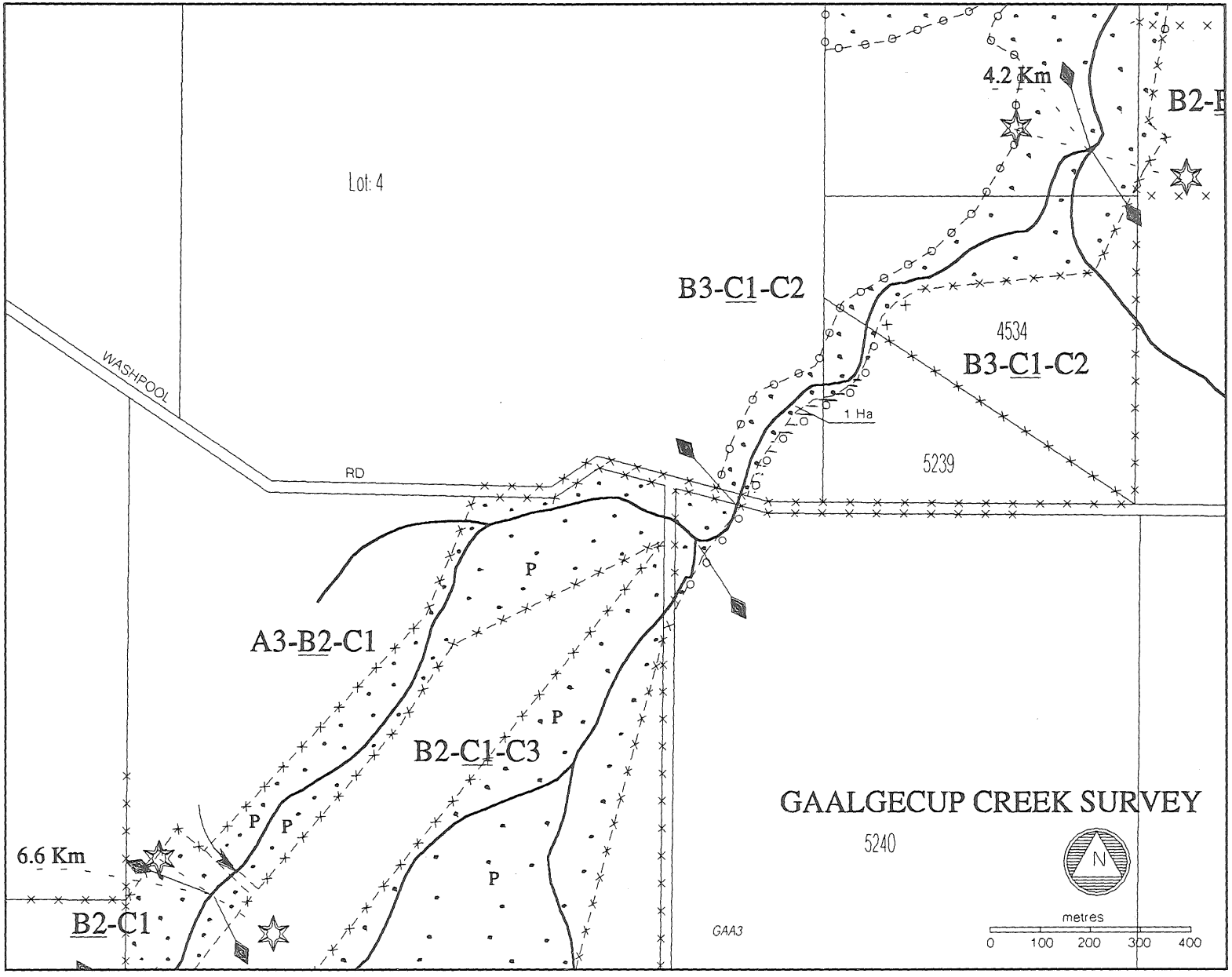
Right Bank : 5238, 4534, 5239, 5240, 6046.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 8/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.7km	1.4km
Length of Riverbank Fencing Recommended :	500m	1km
Number of Sites showing severe erosion :	Most of main river channel is eroded.	Most of main river channel is eroded.
Advice on remedial measures required for these sites :	Exclude stock by fencing, replant/direct seed.	Exclude stock by fencing, replant/direct seed.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority Urgent Area (ha) : 1ha	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site Species: *E.rudis, E.decipiens, E.occidentalis, M.cuticularis, A.saligna,* rip and mound parallel with river. Scarify exposed areas and direct seed with samphire sp. and salt bush.	
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough.	Stabilise stock access to creek, or provide alternative nearby water source such as trough.


4.2 Km
B2-F
Lot: 4
B3-C1-C2
4534
B3-C1-C2
WASHPOOL
RD
1 Ha
5239
A3-B2-C1
P
P
B2-C1-C3
P
P
P
6.6 Km
B2-C1
GAALGECUP CREEK SURVEY
5240
N
GAA3
metres
0
100
200
300
400

GAALGEGUP CREEK SURVEY -GAAL4 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 6.6km-8.7km

Loc. Numbers of Adjacent Properties-
Left Bank : 6046, 4583, 4026, 1150.

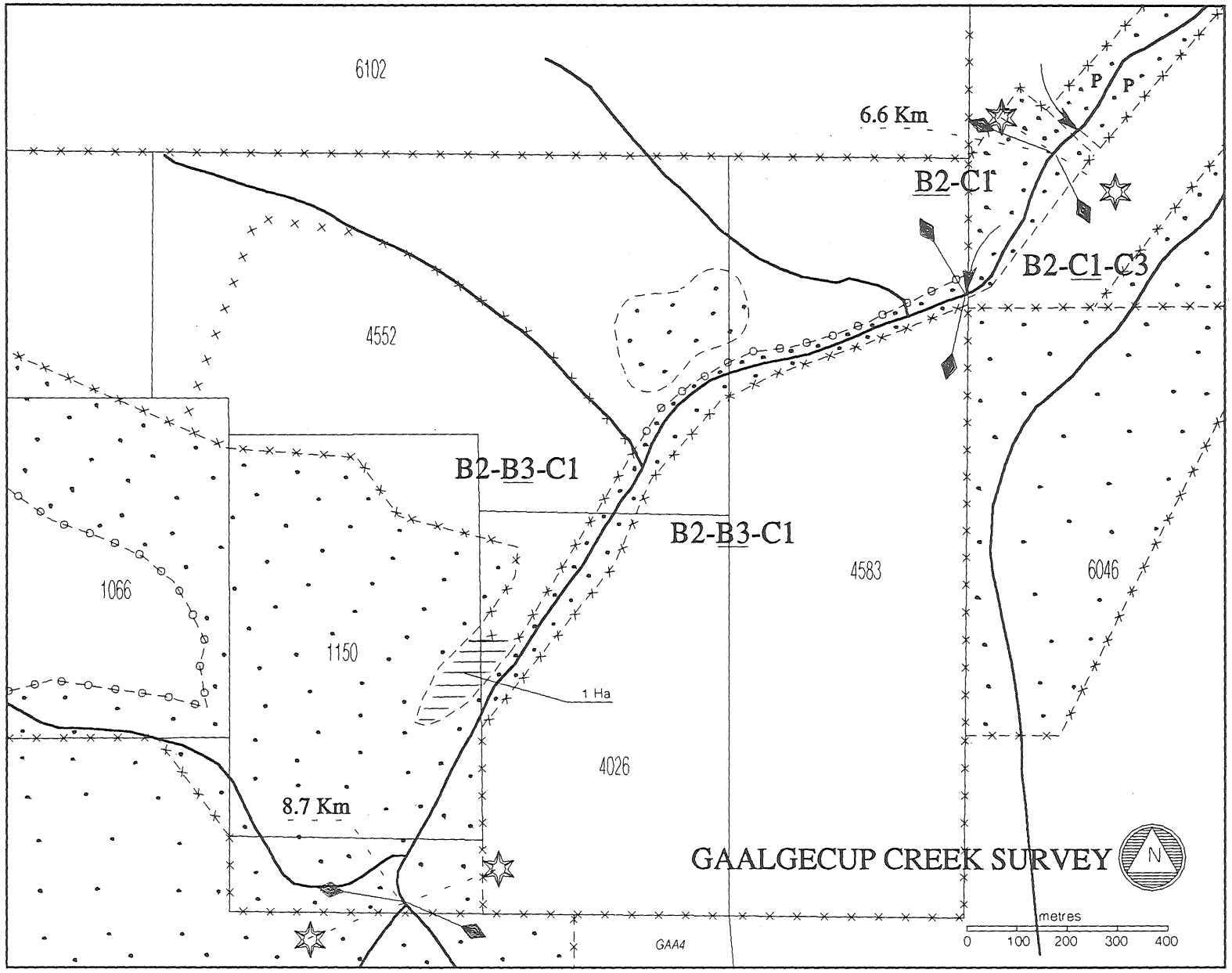
Right Bank : 6046, 4583, 4026, 1150.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 8/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.1km	1.35km
Length of Riverbank Fencing Recommended :	Nil	750m
Number of Sites showing severe erosion :	Most of main river channel is eroded.	Most of main river channel is eroded.
Advice on remedial measures required for these sites :	Exclude stock by fencing, replant/direct seed.	Exclude stock by fencing, replant/direct seed.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : 1 Priority Urgent Area (ha) : 1ha
Advice on revegetation species and preparation :		Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site Species: *E.rudis, E.decipiens, E.occidentalis, M.cuticularis.* Rip and mound parallel with river. Scarify exposed areas and direct seed with samphire sp. and salt bush.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


6102
6.6 Km
P
P
B2-C1
B2-C1-C3
4552
B2-B3-C1
B2-B3-C1
1066
1150
4583
6046
1 Ha
4026
8.7 Km
GAALGECUP CREEK SURVEY
N
GAA4
metres
0
100
200
300
400

GAALGEGUP CREEK SURVEY -GAAL5 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 8.7km-11.2km

Loc. Numbers of Adjacent Properties-
Left Bank : 6889, 5897, 5682

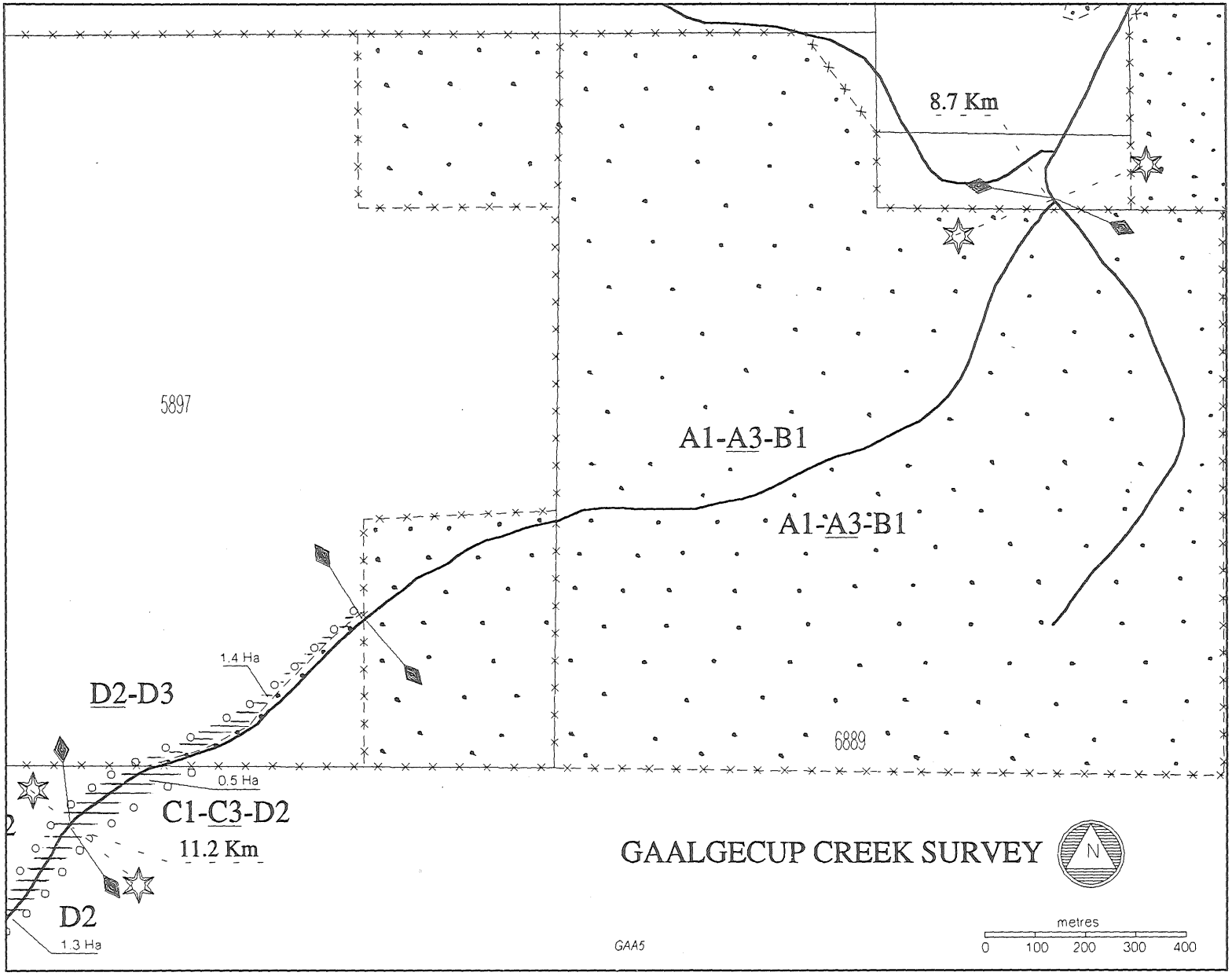
Right Bank : 6889, 5897, 5682

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 9/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	3.4km	2.2km
Length of Riverbank Fencing Recommended :	200m	700m
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority Urgent Area (ha) : 0.5ha	No. of sites : 1 Priority Urgent Area (ha) : 1.4ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia,* rip and mound parallel with river	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia,* rip and mound parallel with river
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


8.7 Km
5897
A1-A3-B1
A1-A3-B1
1.4 Ha
D2-D3
6889
0.5 Ha
C1-C3-D2
11.2 Km
GAALGECUP CREEK SURVEY
N
D2
1.3 Ha
GAA5
metres
0
100
200
300
400

GAALGEGUP CREEK SURVEY -GAAL6 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 11.2km-13.3km

Loc. Numbers of Adjacent Properties-
Left Bank : 5682, 4747, 4923

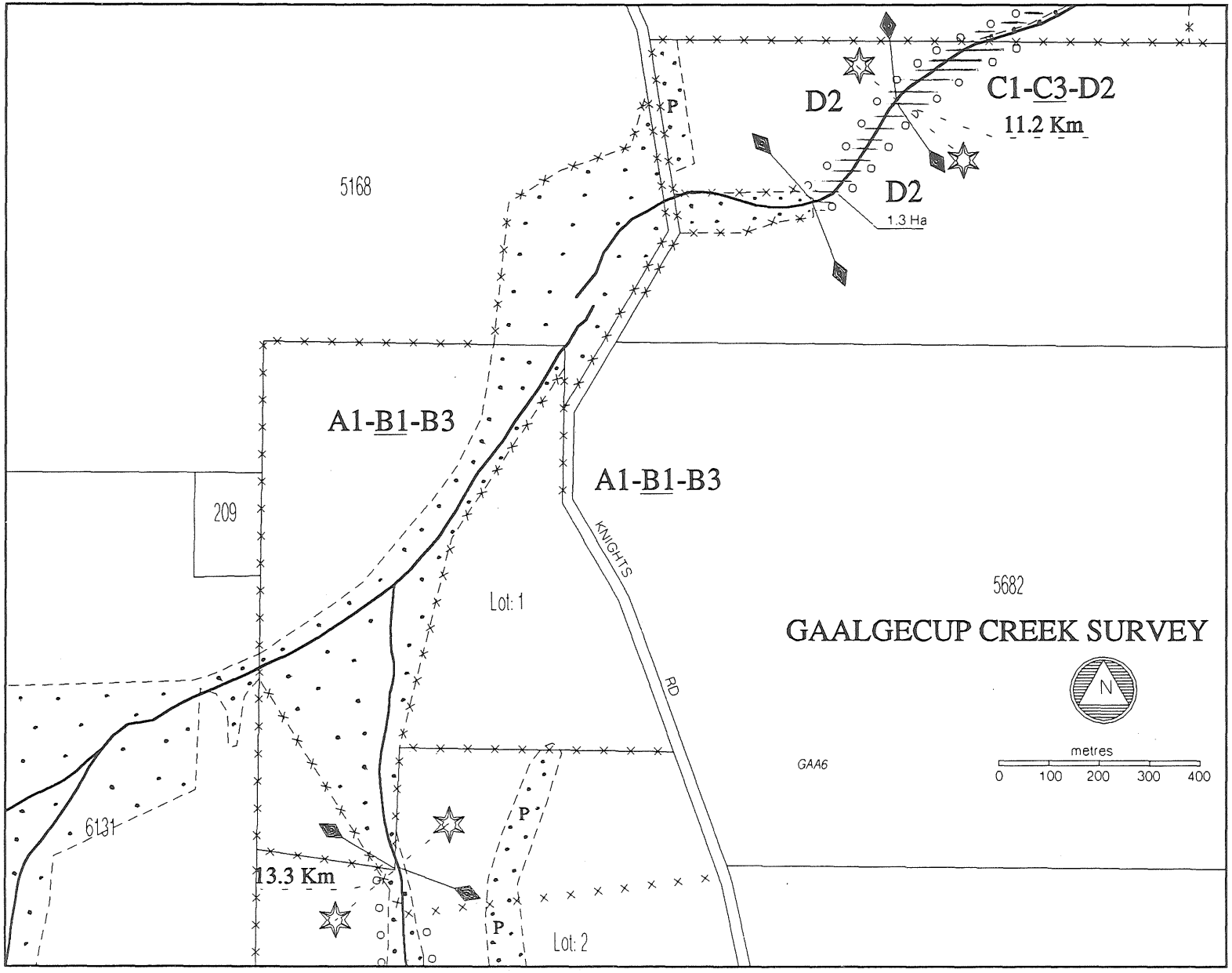
Right Bank : 5682, 4747, 4923

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 9/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.8km	2.1km
Length of Riverbank Fencing Recommended :	250m	250m
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority Urgent Area (ha) : 0.65ha	No. of sites : 1 Priority Urgent Area (ha) : 0.65ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia,* rip and mound parallel with river	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia,* rip and mound parallel with river
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Section of creek has been excavated and forms a straight channel. This section requires some in stream structures such as rock riffle bars to reduce stream bed erosion. Seek expert advise on this.	Section of creek has been excavated and forms a straight channel. This section requires some in stream structures such as rock riffle bars to reduce stream bed erosion. Seek expert advise on this.


5168
P
D2
C1-C3-D2
11.2 Km
D2
1.3 Ha
A1-B1-B3
A1-B1-B3
209
KNIGHTS
RD
5682
Lot: 1
GAALGECUP CREEK SURVEY
N
GAA6
metres
0 100 200 300 400
6131
13.3 Km
P
P
Lot: 2

GAALGEGUP CREEK SURVEY -GAAL7 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 13.3km-15.1km

Loc. Numbers of Adjacent Properties-
Left Bank : 4923, 4909, 4798.

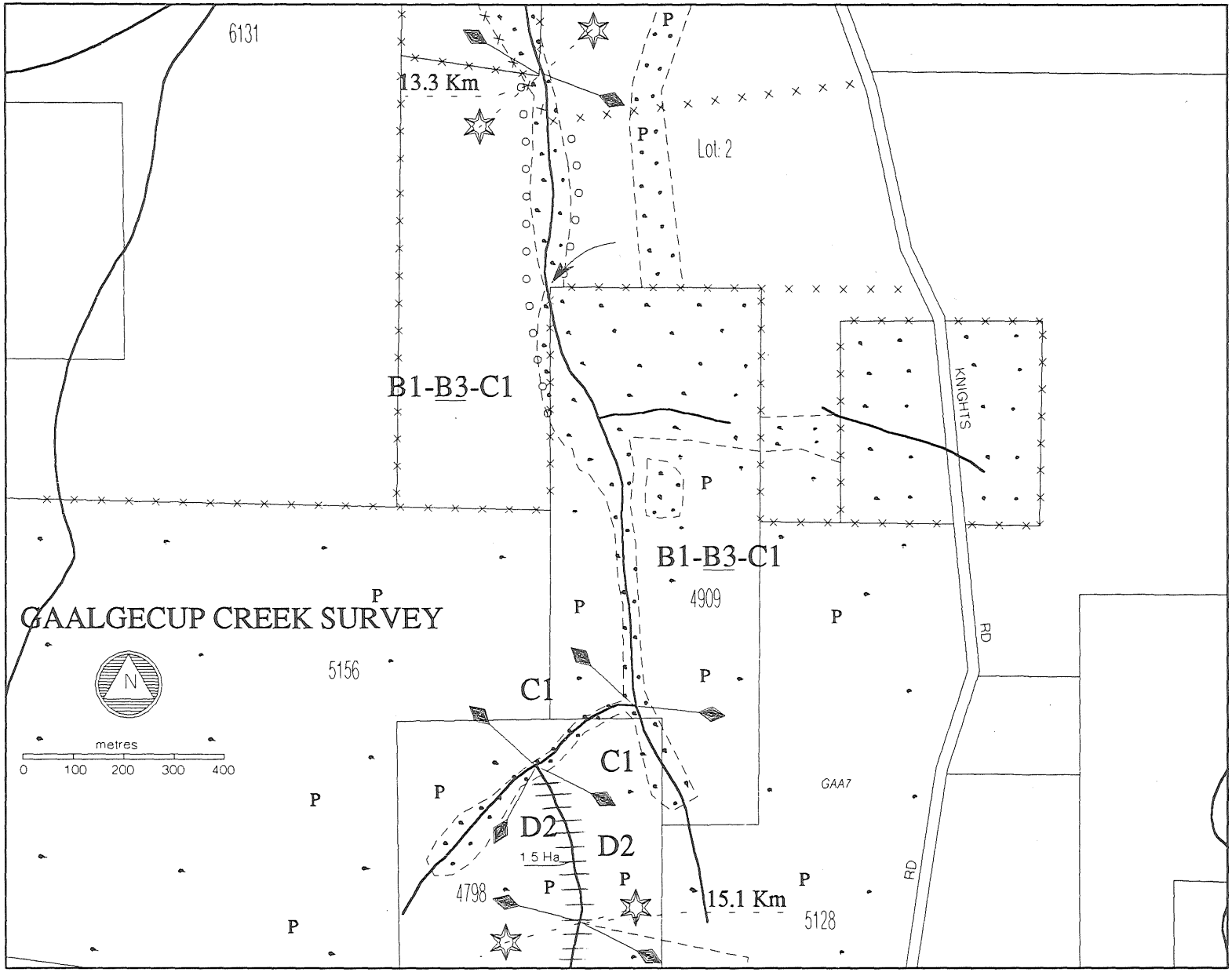
Right Bank : 4923, 4909, 4798.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 9/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	300m	700m
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority Urgent Area (ha) : 1.5ha	No. of sites : 1 Priority Urgent Area (ha) : 1.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.calophylla, E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia*, rip and mound parallel with river	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.calophylla, E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia*, rip and mound parallel with river
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Stabilise stock access to creek, or provide alternative nearby water source such as trough. Most of remaining area is to be planted to blue gums, will not require management.	Stabilise stock access to creek, or provide alternative nearby water source such as trough. Most of remaining area is to be planted to blue gums, will not require management.


6131
13.3 Km
P
Lot: 2
B1-B3-C1
KNIGHTS
B1-B3-C1
4909
GAALGECUP CREEK SURVEY
5156
C1
C1
N
metres
0 100 200 300 400
GAA7
D2
D2
1.5 Ha
4798
15.1 Km
5128
RD
RD

GAALGEGUP CREEK SURVEY -GAAL8 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 15.1km-16.7km

Loc. Numbers of Adjacent Properties-
Left Bank : 4798, 5610, 5227.

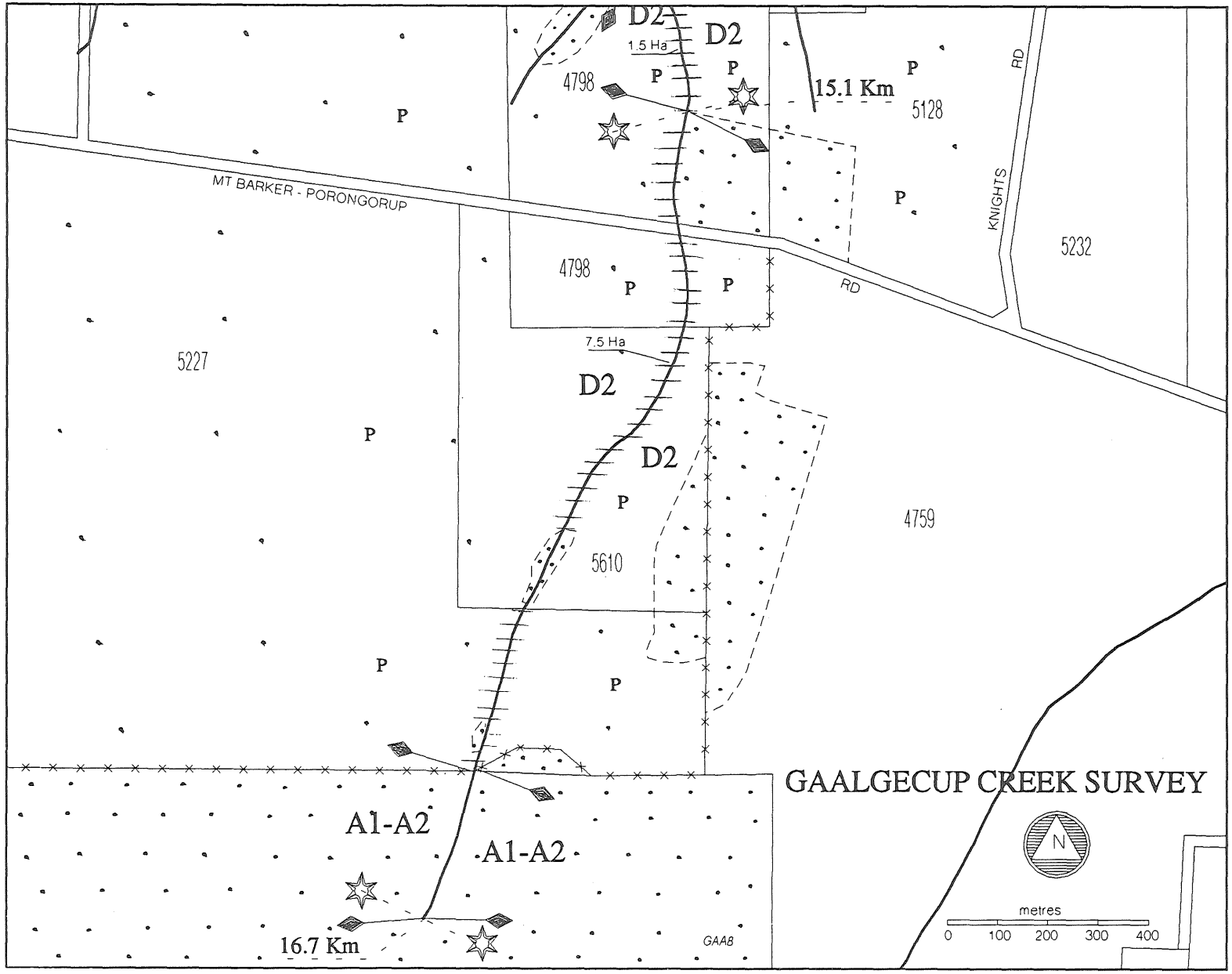
Right Bank : 4798, 5610, 5227.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 9/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Whole site Priority Urgent Area (ha) :7.5ha	No. of sites : Whole site Priority Urgent Area (ha) :7.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.calophylla, E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia,* rip and mound in herring bone fashion, pointing upstream. Consult a local landcare technician in surveying in rip and mound lines.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.calophylla, E.occidentalis, M.cuticularis, Agonis parviceps, A.linearifolia,* rip and mound in herring bone fashion, pointing upstream. Consult a local landcare technician in surveying in rip and mound lines.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Most of area is to be planted to blue gums, will not require management.	Most of area is to be planted to blue gums, will not require management.


D2
D2
1.5 Ha
4798
P
P
15.1 Km
5128
P
RD
KNIGHTS
5232
MT BARKER - PORONGORUP
4798
P
P
RD
7.5 Ha
5227
D2
D2
P
P
4759
5610
P
P
GAALGECUP CREEK SURVEY
A1-A2
A1-A2
N
metres
0 100 200 300 400
16.7 Km
GAA8

JOHNSON CREEK RIVER SURVEY - JOHN 1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0-1.57 km

Loc. Numbers of Adjacent Properties-
Left Bank : 28, 973

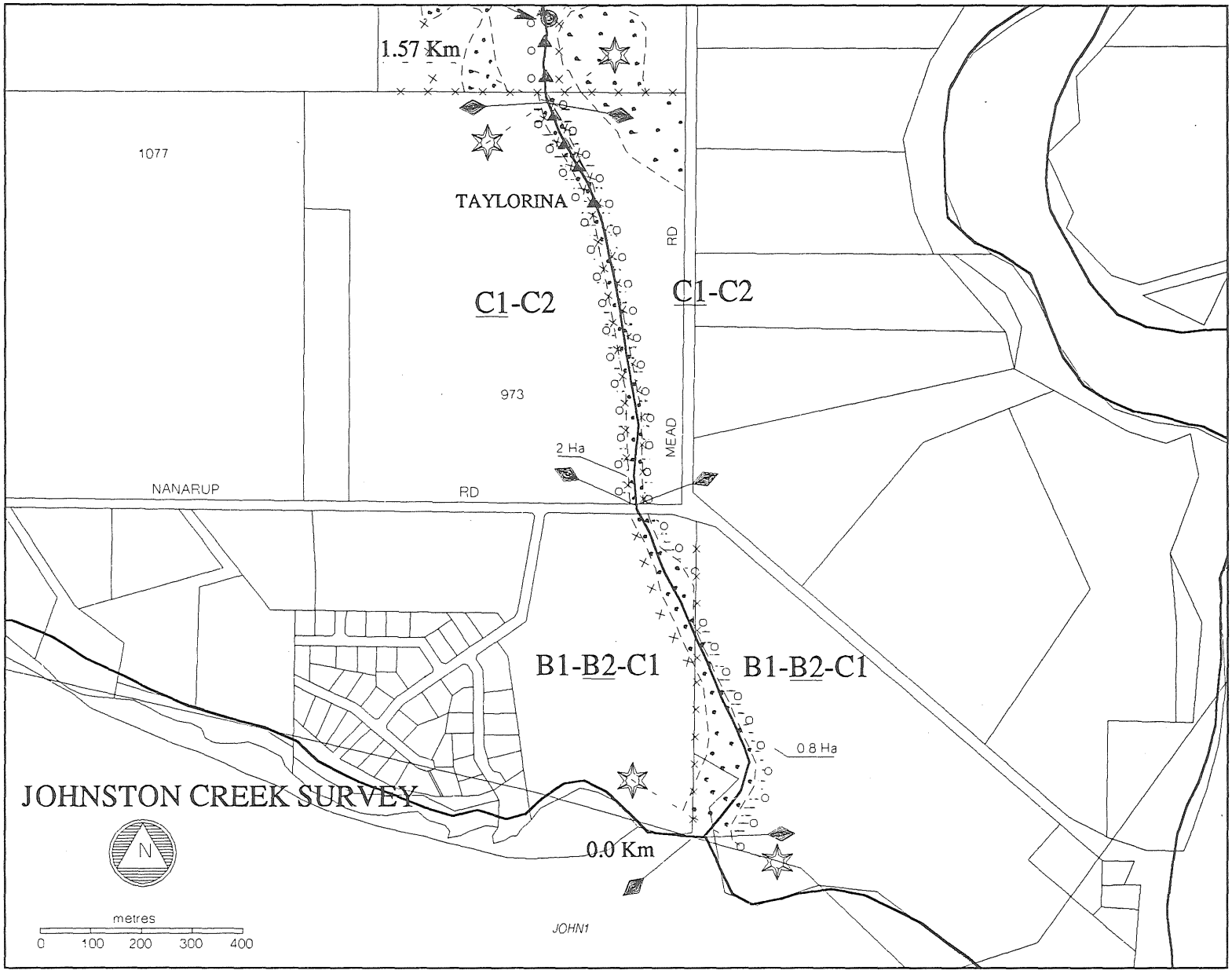
Right Bank : 28, 973

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 2/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.27km	850m
Length of Riverbank Fencing Recommended :	850m	1.57km
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 1ha	No. of sites : 2 Priority 1 Area (ha) : 1.8ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linearifolia.* Treat kikuyu the spring and summer before planting. Area needs ripping and mounding, parallel with creek.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linearifolia. E.marginata, E.calophylla, M.cuticularis* on section closer to estuary. Treat kikuyu the spring and summer before planting. Area needs ripping and mounding, parallel with creek.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	1	1
Advice on rehabilitation of these sites :	Taylorina needs removal by felling and spraying.	Taylorina needs removal by felling and spraying.
Other management advice for this section :		


1.57 Km
1077
TAYLORINA
RD
C1-C2
C1-C2
973
MEAD
2 Ha
NANARUP
RD
B1-B2-C1
B1-B2-C1
0.8 Ha
JOHNSTON CREEK SURVEY
N
0.0 Km
metres
0 100 200 300 400
JOHN1

JOHNSON CREEK RIVER SURVEY - JOHN 2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 1.57 km- 3.37km

Loc. Numbers of Adjacent Properties-
Left Bank : 622, 559

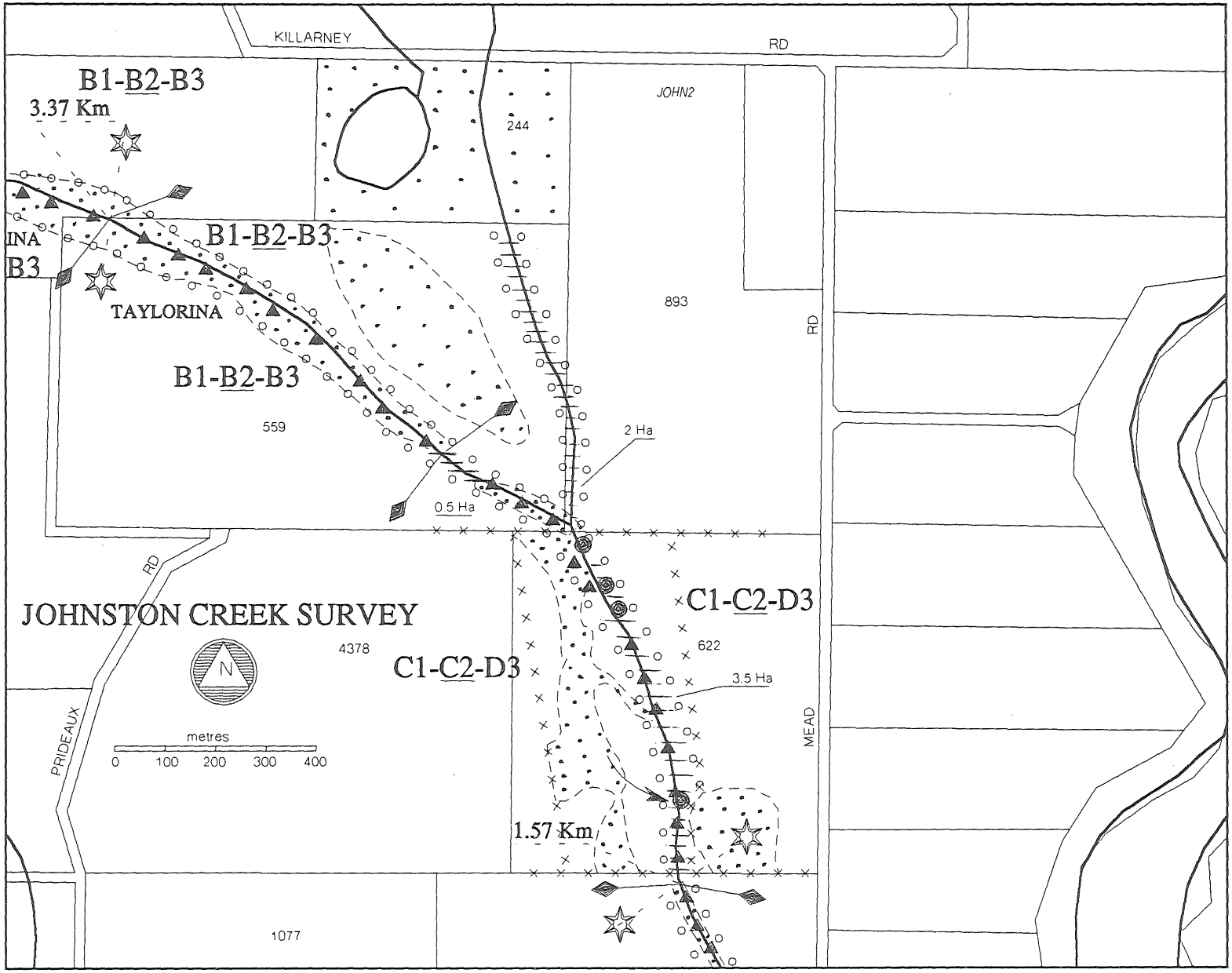
Right Bank : 622, 559

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 2/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	170m
Length of Riverbank Fencing Recommended :	1.8km	1.63km
Number of Sites showing severe erosion :	7	7
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 2 Priority 1-urgent Area (ha) : 2ha	No. of sites : 2 Priority 1-urgent Area (ha) : 4ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linearifolia.* Treat kikuyu the spring and summer before planting. Area needs ripping and mounding, parallel with creek.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.raphiophylla, A.parviceps, A.linearifolia.* Treat kikuyu the spring and summer before planting. Area needs ripping and mounding, parallel with creek.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Entire length.	Entire length.
Advice on rehabilitation of these sites :	Taylorina needs removal by felling and spraying.	Taylorina needs removal by felling and spraying.
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


KILLARNEY
RD
B1-B2-B3
3.37 Km
JOHN2
244
INA
B3
B1-B2-B3
TAYLORINA
893
RD
B1-B2-B3
559
2 Ha
0.5 Ha
RD
JOHNSTON CREEK SURVEY
C1-C2-D3
4378
C1-C2-D3
622
3.5 Ha
N
metres
0 100 200 300 400
PRIDEAUX
MEAD
1.57 Km
1077

JOHNSON CREEK RIVER SURVEY - JOHN 3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 3.37km-4.52km

Loc. Numbers of Adjacent Properties-
Left Bank : 559,706

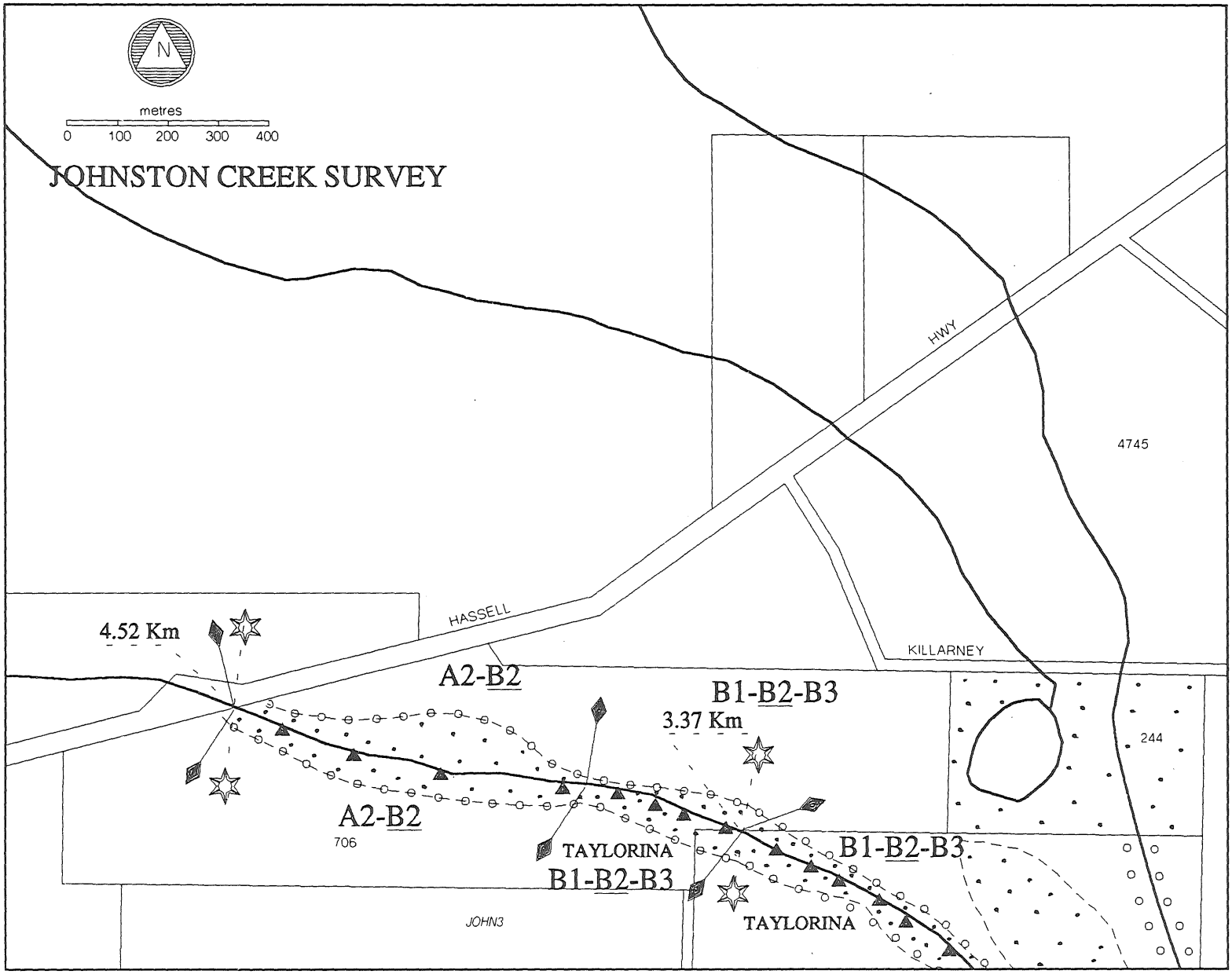
Right Bank : 559, 706

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 2/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	1.15km	1.15km
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	Fence from stock.	Fence from stock.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) : N/A	No. of sites : Nil Priority N/A Area (ha) : N/A
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Entire length.	Entire length.
Advice on rehabilitation of these sites :	Taylorina needs removal by felling and spraying.	Taylorina needs removal by felling and spraying.
Other management advice for this section :	Provide stabilised access points to the creek for crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.

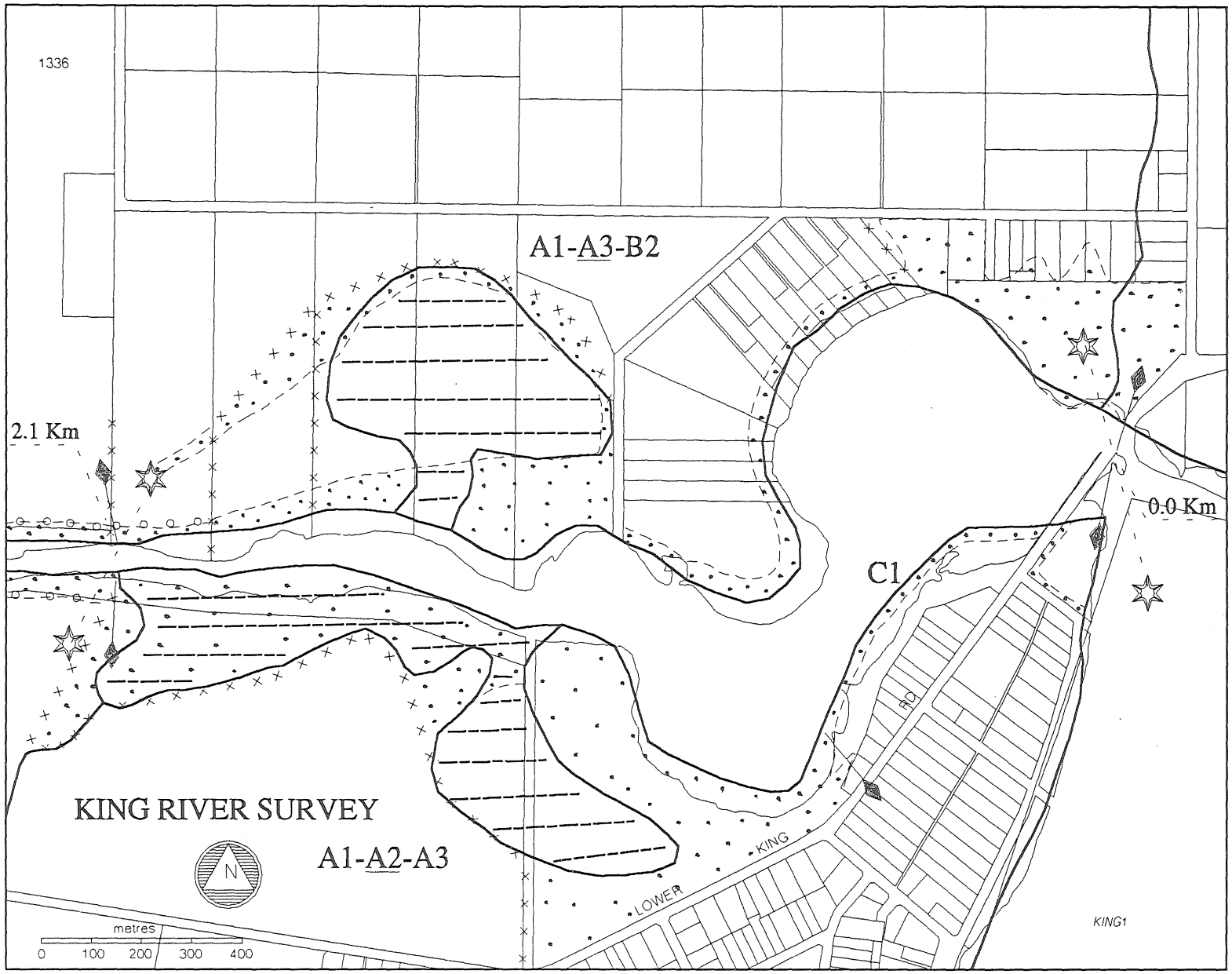

N
metres
0 100 200 300 400
JOHNSTON CREEK SURVEY
HWY
4745
HASSELL
KILLARNEY
4.52 Km
A2-B2
B1-B2-B3
3.37 Km
244
A2-B2
706
TAYLORINA
B1-B2-B3
B1-B2-B3
JOHN3
TAYLORINA

KING RIVER SURVEY - KING 1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) :	0.0 - 2.1
Loc. Numbers of Adjacent Properties- Left Bank :	Crown, Urban, 206.
Right Bank :	Crown, Urban, 1336
Survey Project Officer(s) :	Kevin Hopkinson
Date Surveyed :	21/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.85km	1.5km
Length of Riverbank Fencing Recommended :	Nil	200m
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	Nil	Nil
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Area (ha) : N/A	No. of sites : Nil Area (ha) : N/A
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


1336
A1-A3-B2
2.1 Km
0.0 Km
C1
KING RIVER SURVEY
A1-A2-A3
N
metres
0 100 200 300 400
LOWER KING RD
KING1

KING RIVER SURVEY - KING 2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 2.1 - 4.78

Loc. Numbers of Adjacent Properties-
Left Bank : 206, 729, 482, 401,707.

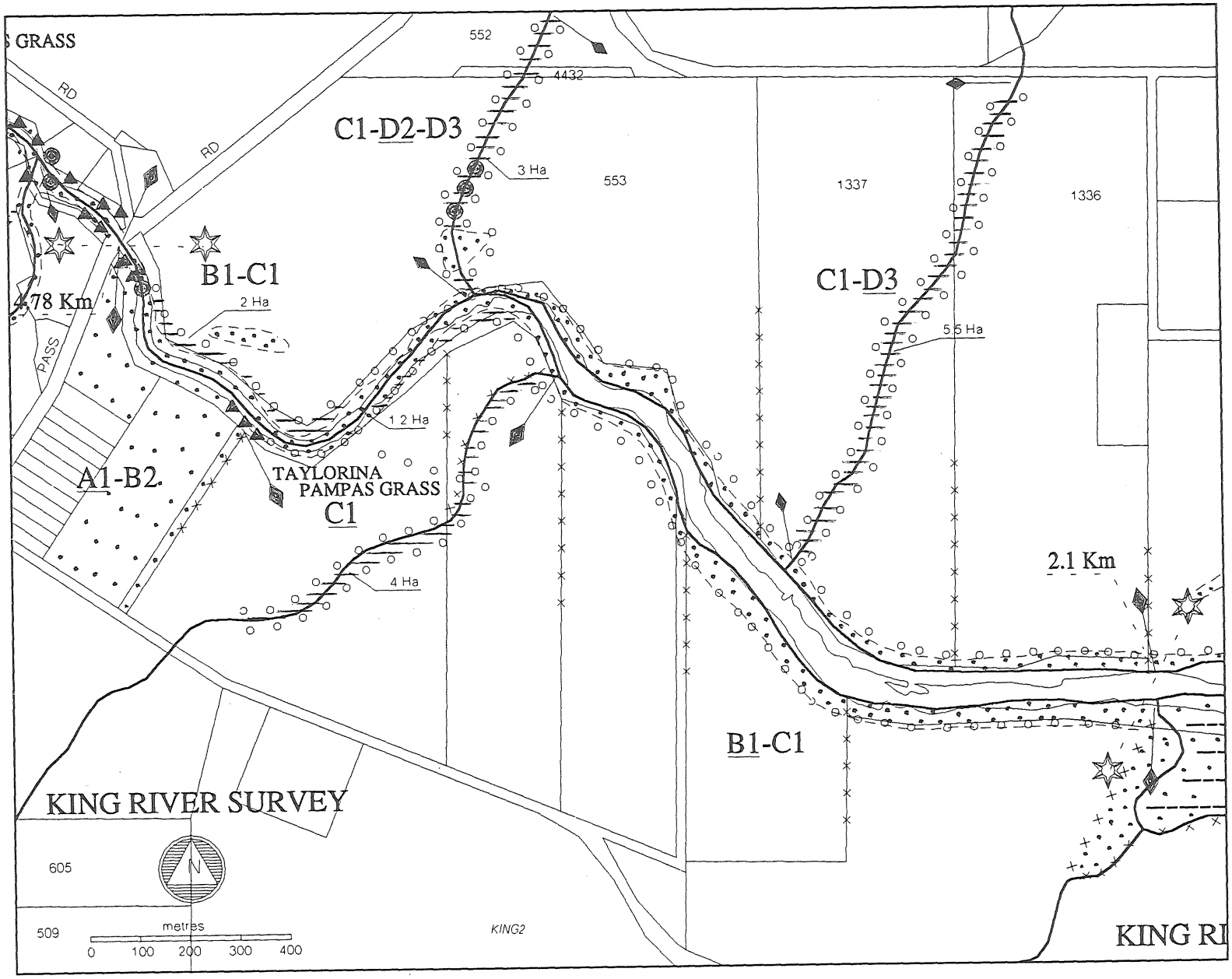
Right Bank : 1336, 1337, 553.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 20/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	100m
Length of Riverbank Fencing Recommended :	2.58km	1.78km
Number of Sites showing severe erosion :	1	3
Advice on remedial measures required for these sites :	Fence, install steps to water	Tributary on Loc 553, with severe erosion, requiring fencing, revegetation.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 2 Priority 3 Area (ha) : 5.2ha	No. of sites : 3 Priority 1-urgent (tributary 553) Priority 2 (trib.1337) Priority 3(riverbank) Area (ha) :10.5ha (includes tributaries)
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *Melaleuca raphiophylla, Agonis parviceps*	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *Melaleuca raphiophylla, Agonis parviceps*
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	3 Priority 1	Nil
Advice on rehabilitation of these sites :	Remove pampas grass and taylorina.	N/A
Other management advice for this section :	Restrict vehicle access to river bank area by closing access track, encourage people to use steps from car park area.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


S GRASS
RD
RD
552
4432
C1-D2-D3
3 Ha
553
1337
1336
B1-C1
2 Ha
4.78 Km
PASS
C1-D3
5.5 Ha
1.2 Ha
A1-B2
TAYLORINA
PAMPAS GRASS
C1
4 Ha
2.1 Km
B1-C1
KING RIVER SURVEY
605
N
509
metres
0 100 200 300 400
KING2
KING RI

KING RIVER SURVEY - KING 3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 4.78 - 7.57

Loc. Numbers of Adjacent Properties-
Left Bank : 245, 940, 892, 796, 964, 439.

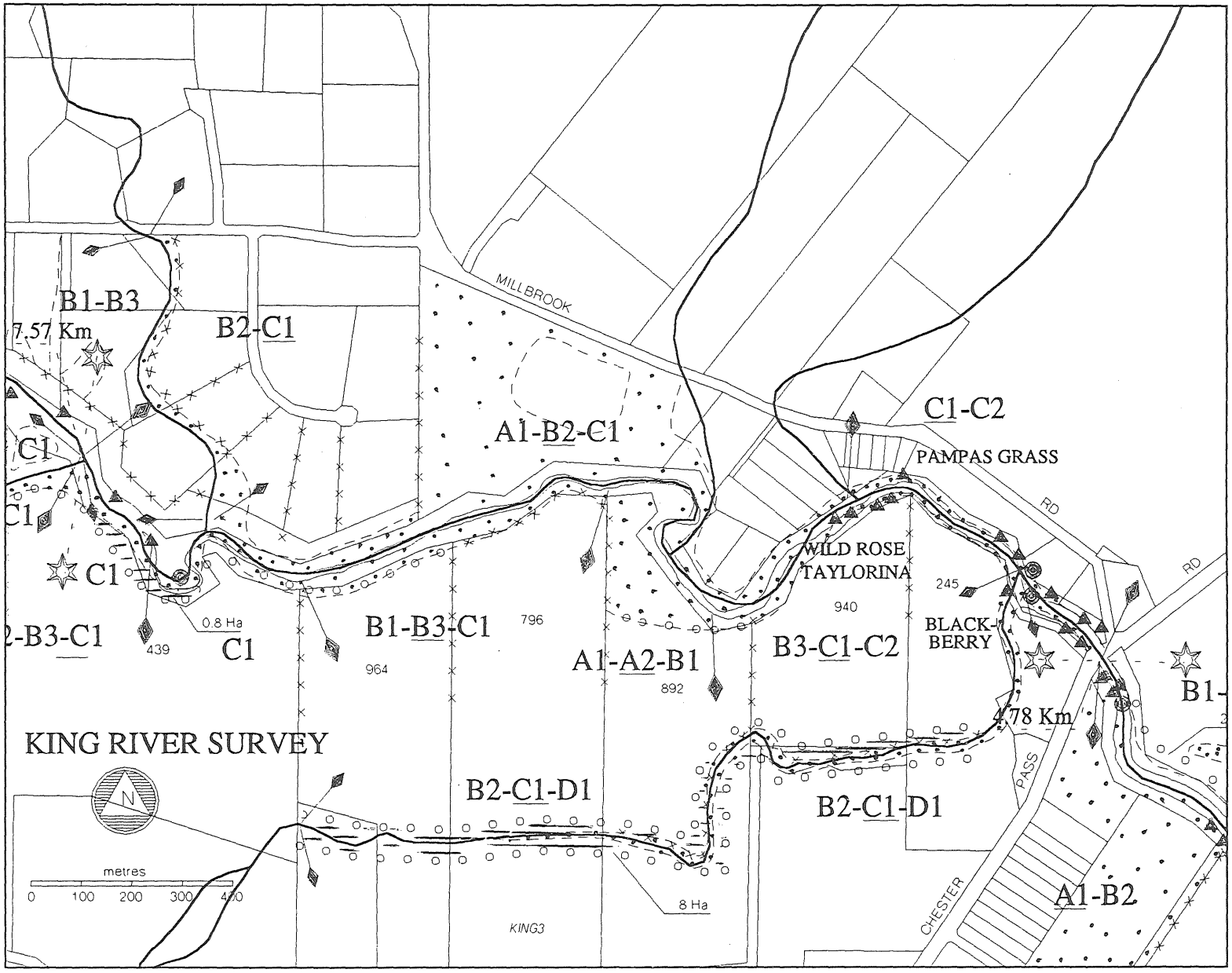
Right Bank : Crown, A18 of 401

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 19/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	350m	330m
Length of Riverbank Fencing Recommended :	1.14km	Nil
Number of Sites showing severe erosion :	2	1
Advice on remedial measures required for these sites :	Fence, revegetate -Loc 439 Fence, install steps-Loc 245	Build steps/jetty
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 2 Priority 1 Area (ha) : 8.8ha	No. of sites : Nil Priority : N/A Area (ha) : N/A
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species for the tributaries: Agonis parviceps, A.linearifolia M, raphiophylla and local reed species. Rip and mound parallel to creek. For main River bank plantings, existing species include: E.calophylla, E.marginata, Callistachys lanceolata, A parviceps, Bosseia lineophylla, Rip and mound parallel to river, also spot spray and plant	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	6 Priority 1	6 Priority 1
Advice on rehabilitation of these sites :	Remove pampas grass, treat for blackberry and taylorina.	As for left bank.
Other management advice for this section :	Care not to expose bank by weed removal.	As for left bank.


B1-B3
7.57 Km
B2-C1
MILLBROOK
A1-B2-C1
C1-C2
PAMPAS GRASS
RD
C1
C1
C1
WILD ROSE
TAYLORINA
940
245
RD
0.8 Ha
439
C1
B1-B3-C1
796
964
A1-A2-B1
892
B3-C1-C2
BLACK-
BERRY
B1-
4.78 Km
KING RIVER SURVEY
B2-C1-D1
B2-C1-D1
PASS
N
metres
0
100
200
300
400
8 Ha
KING3
CHESTER
A1-B2

KING RIVER SURVEY - KING 4 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 7.57 - 9.97

Loc. Numbers of Adjacent Properties-
Left Bank : 439, 515, 618, 615, 619.

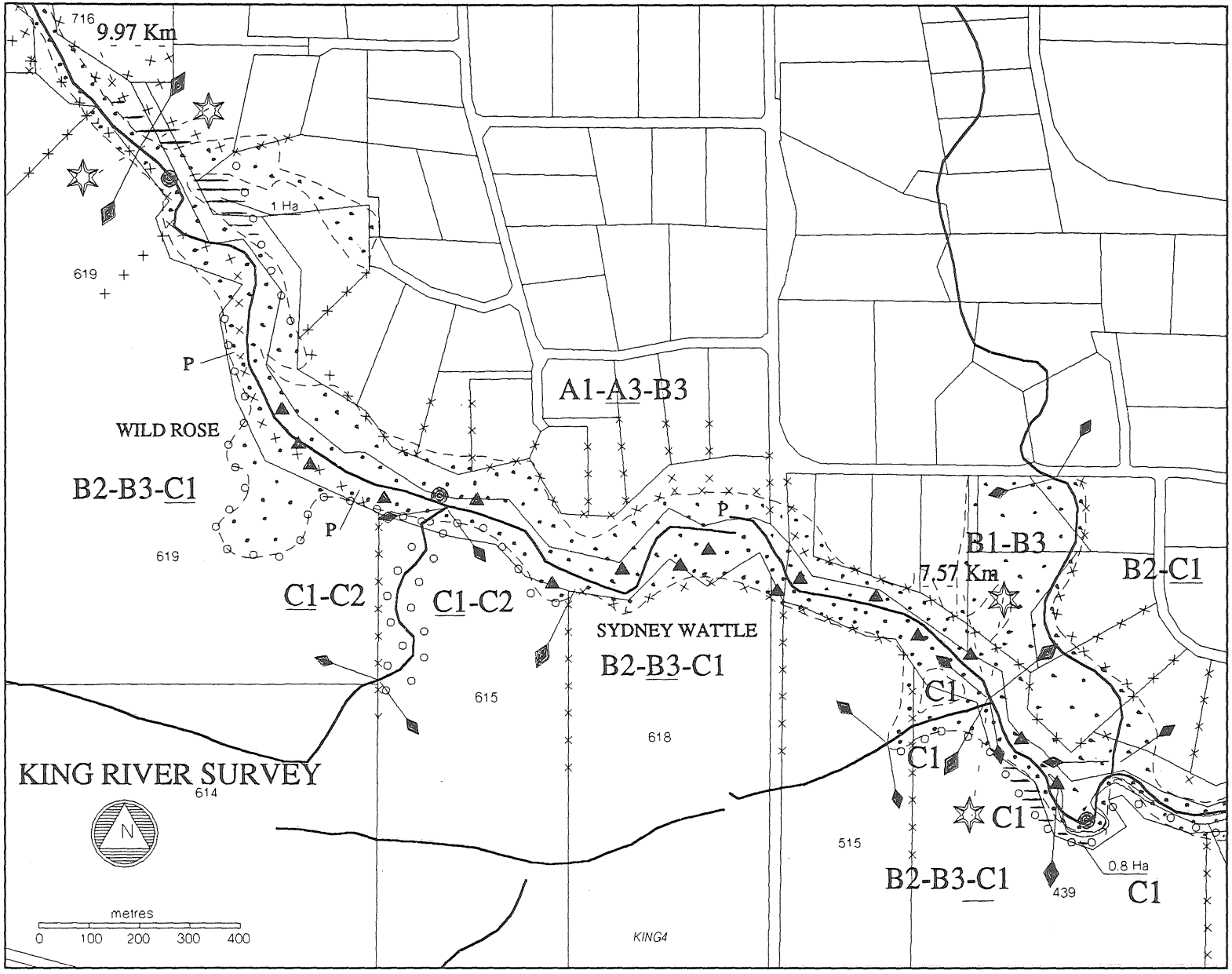
Right Bank : Crown land.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 21/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.67km	2km
Length of Riverbank Fencing Recommended :	1.7km+400m tributary.	Nil
Number of Sites showing severe erosion :	1	1
Advice on remedial measures required for these sites :	Fence from stock, revegetate.	Fence, create pathway for access.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :1 Priority 1 Area (ha) : .08ha	No. of sites : 1 Priority 1 Area (ha) : 1ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing dominant site species: *Agonis parviceps, and M.raphiophylla.* Rip and mound to contour. Consult local landcare technician in surveying rip and mound lines.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing dominant site species: *A.parviceps, A.linearifolia, E.calophylla, E.marginata, Bosseia lineaphylla.* Rip and mound to contour. Consult local landcare technician in surveying rip and mound lines.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	1 Priority 1	Nil
Advice on rehabilitation of these sites :	Remove wild rose on loc 619	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


716
9.97 Km
1 Ha
619
P
A1-A3-B3
WILD ROSE
B2-B3-C1
619
P
P
B1-B3
7.57 Km
B2-C1
C1-C2
C1-C2
SYDNEY WATTLE
B2-B3-C1
615
618
C1
C1
C1
KING RIVER SURVEY
614
N
515
B2-B3-C1
0.8 Ha
439
C1
metres
0 100 200 300 400
KING4

KING RIVER SURVEY - KING 5 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 9.97 - 12.88

Loc. Numbers of Adjacent Properties-
Left Bank : 619, 1019, 746.

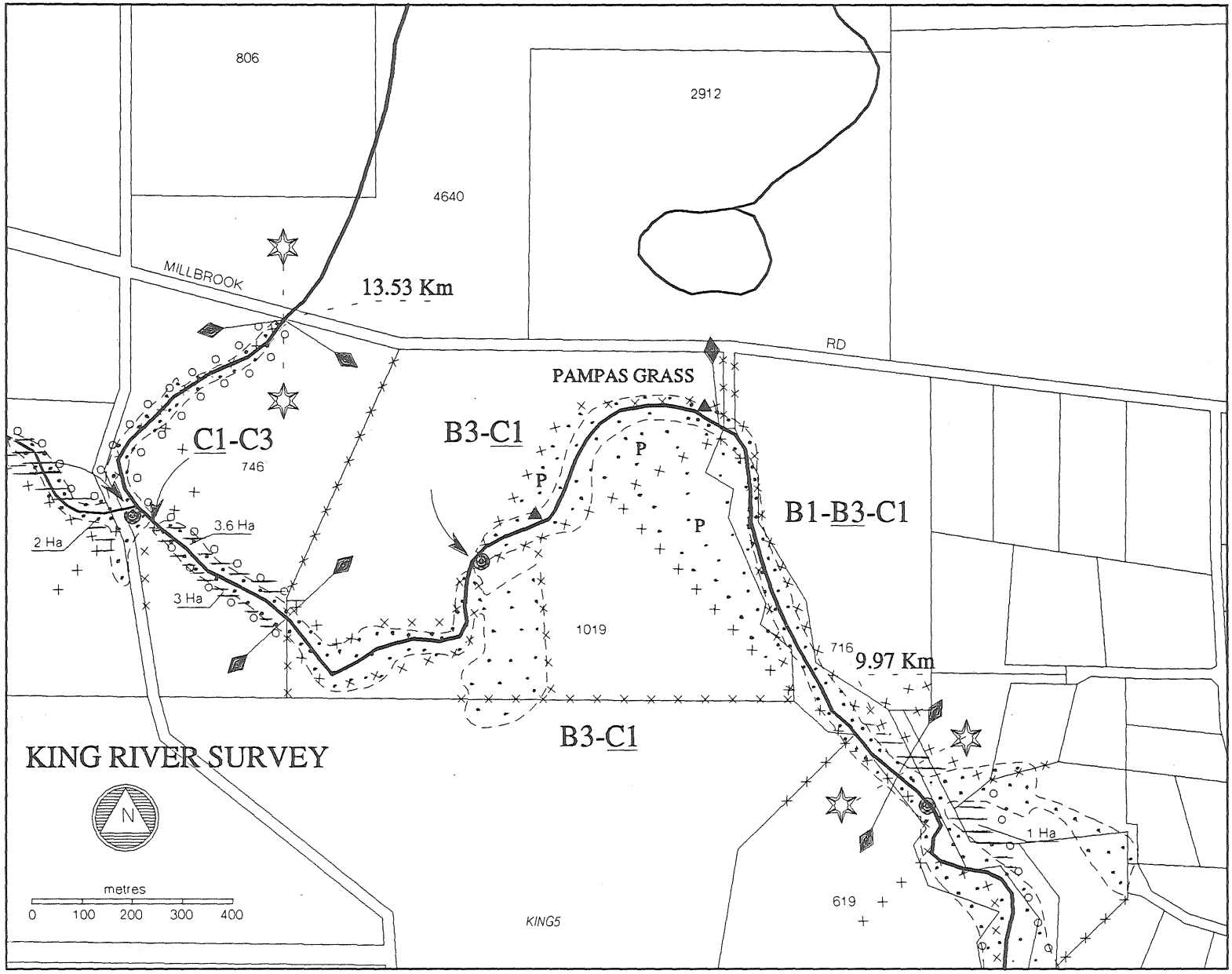
Right Bank : 716, 1019, 746.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 21/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.5km	2.36km
Length of Riverbank Fencing Recommended :	410m+250m tributary	550m
Number of Sites showing severe erosion :	2	3
Advice on remedial measures required for these sites :	Fence from stock, revegetate	Place protective covering ie rocks, logs, along bank at crossing point
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 2 Priority 1-urgent Area (ha) : 5ha	No. of sites :1 Priority 1-urgent Area (ha) : 3.6ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing Flood plain - upper reaches site-species : *M.raphiophylla, A.parviceps. E.calophylla, E.marginata.*	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing Flood plain - upper reaches site-species : *M.raphiophylla, A.parviceps. E.calophylla, E.marginata.*
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	1
Advice on rehabilitation of these sites :	N/A	Remove pampas grass
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


806
2912
4640
MILLBROOK
RD
13.53 Km
PAMPAS GRASS
C1-C3
746
B3-C1
P
P
P
B1-B3-C1
2 Ha
3.6 Ha
3 Ha
1019
716
9.97 Km
B3-C1
KING RIVER SURVEY
N
metres
0 100 200 300 400
1 Ha
619
KING5

MOORIALUP CREEK RIVER SURVEY - MOOR1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0km-2.0km

Loc. Numbers of Adjacent Properties-
Left Bank : 6708, 5976

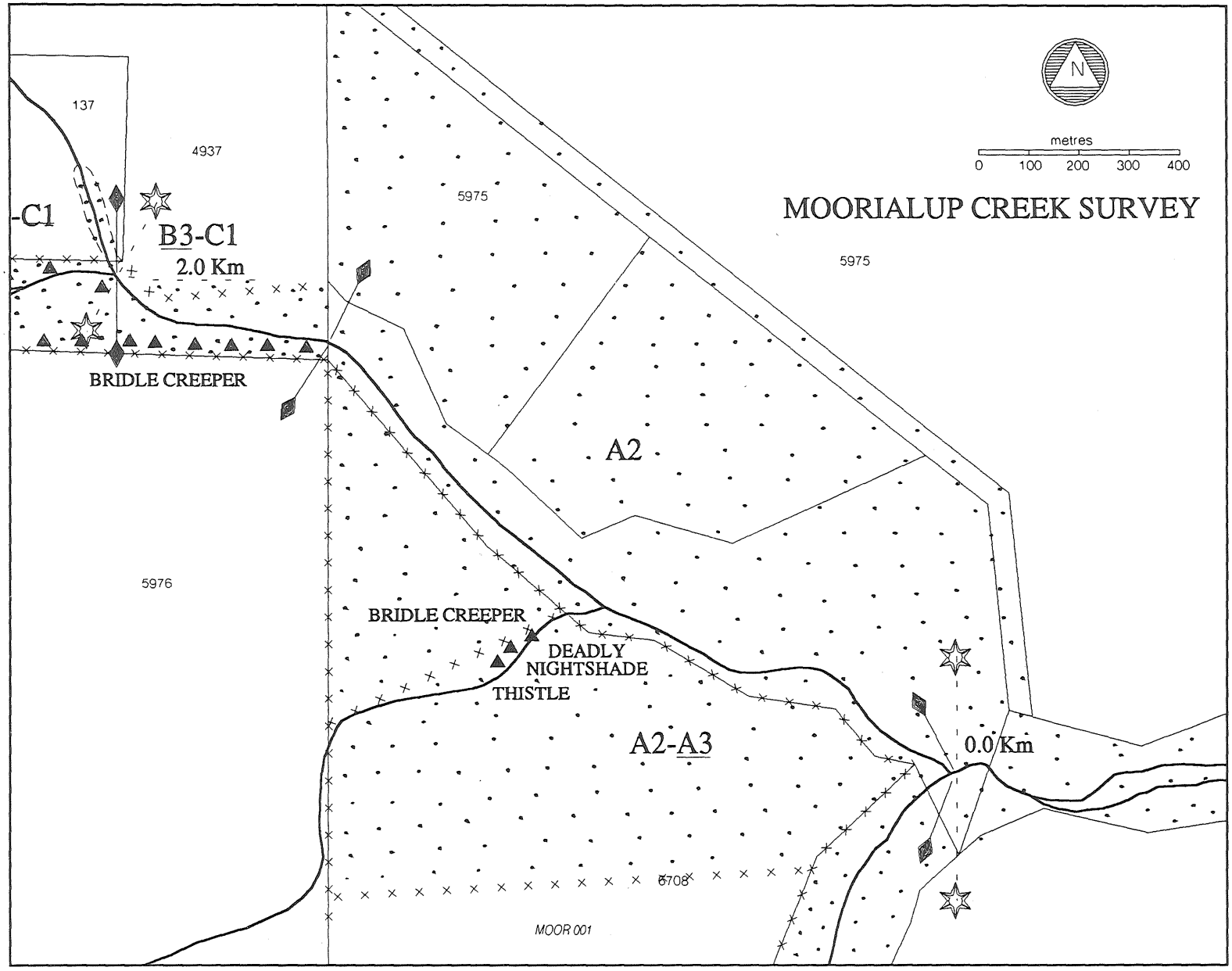
Right Bank : Crown land, 5975, 4937

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 22/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2km	2km
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :Nil Priority N/A Area (ha) : N/A	No. of sites : Nil Priority N/A Area (ha) : N/A
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	3 on Loc 6708, the entire boundary fence for loc 5976 is infested with bridle creeper.	Nil
Advice on rehabilitation of these sites :	Treat for bridle creeper, thistle and deadly nightshade.	N/A
Other management advice for this section :		


MOORIALUP CREEK SURVEY
N
metres
0 100 200 300 400
137
4937
5975
5975
-C1
B3-C1
2.0 Km
BRIDLE CREEPER
A2
5976
BRIDLE CREEPER
DEADLY
NIGHTSHADE
THISTLE
A2-A3
0.0 Km
6708
MOOR 001

MOORIALUP CREEK RIVER SURVEY - MOOR2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 2.0km-4.1km

Loc. Numbers of Adjacent Properties-
Left Bank : 5976

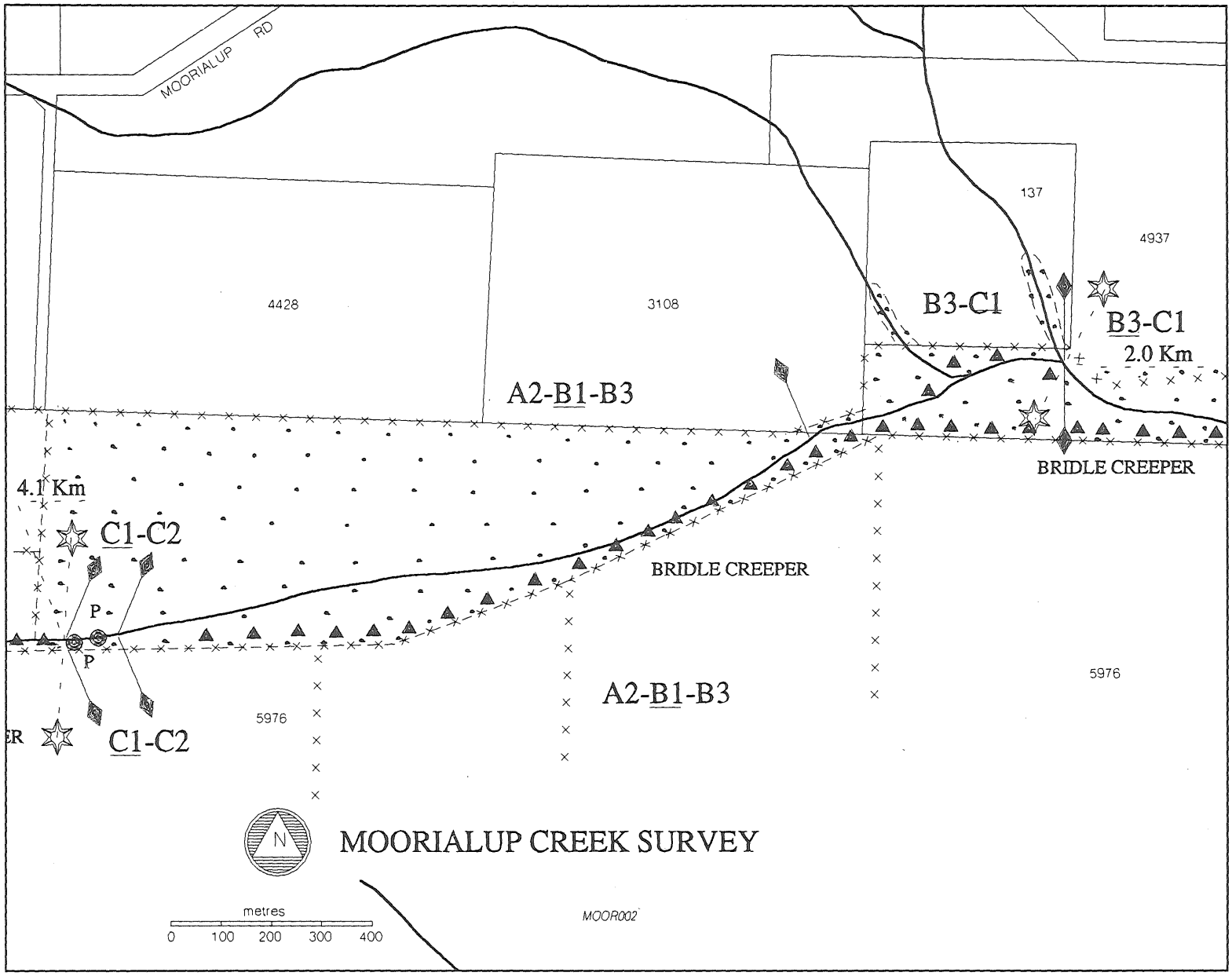
Right Bank : Crown land

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 22/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.1km	2.1km
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :Nil Priority N/A Area (ha) : N/A	No. of sites : Nil Priority N/A Area (ha) : N/A
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	The entire boundary fence for loc 5976 is infested with bridle creeper.	4 in Crown reserve area.
Advice on rehabilitation of these sites :	Treat for bridle creeper, thistle and deadly nightshade.	Treat for bridle creeper.
Other management advice for this section :		


MOORIALUP RD
4428
3108
137
4937
B3-C1
B3-C1
2.0 Km
A2-B1-B3
BRIDLE CREEPER
4.1 Km
C1-C2
BRIDLE CREEPER
P
P
5976
A2-B1-B3
5976
C1-C2
N
MOORIALUP CREEK SURVEY
metres
0 100 200 300 400
MOOR002

MOORIALUP CREEK RIVER SURVEY - MOOR3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 4.1km-6.4km

Loc. Numbers of Adjacent Properties-
Left Bank : 5976,4748

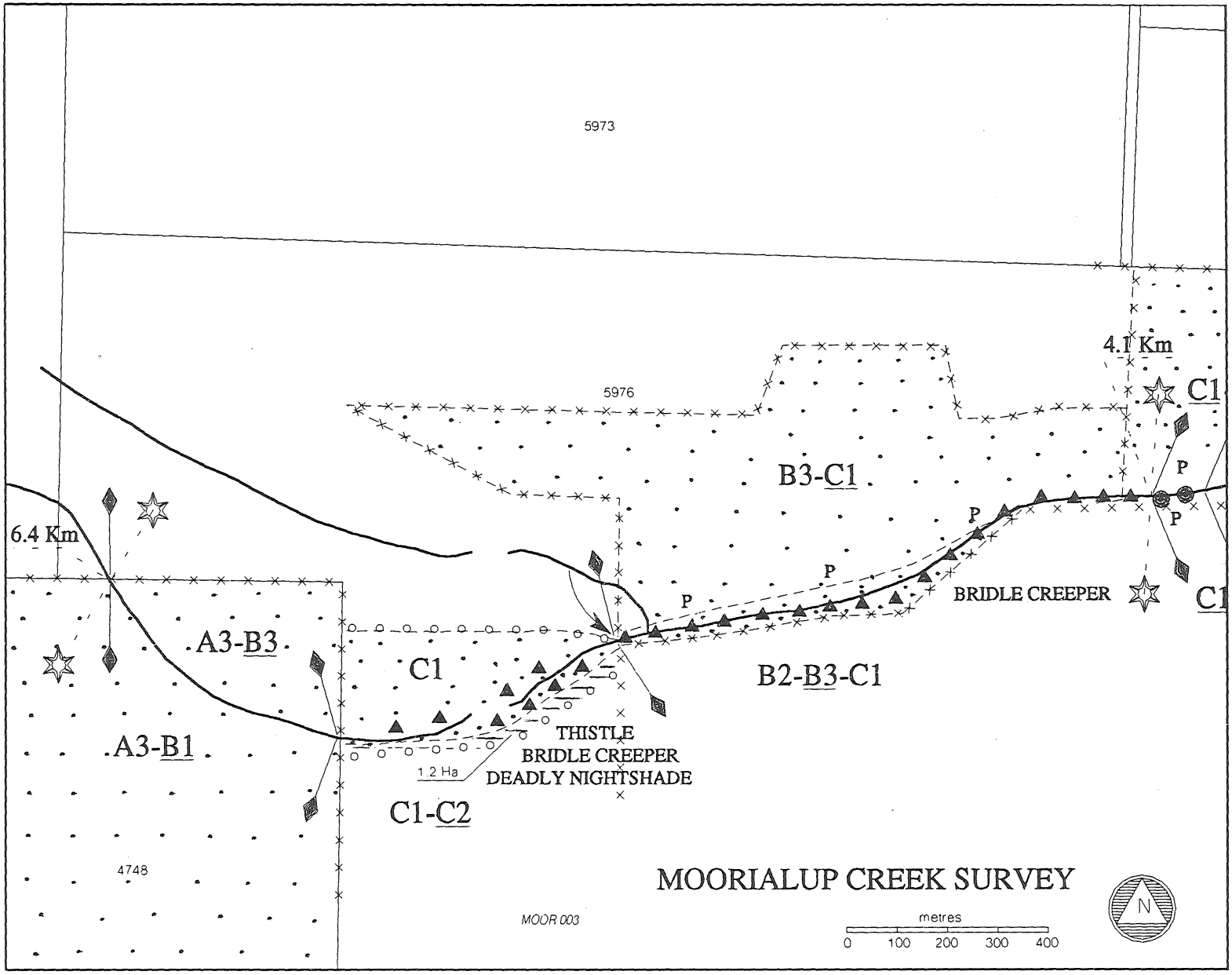
Right Bank : 5976, 4748

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 22/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.8km	1.8km
Length of Riverbank Fencing Recommended :	500m	500m
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :1 Priority 1 Area (ha) : 1.2ha	No. of sites : Nil Priority N/A Area (ha) : N/A
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *A.parviceps, A.linearifolia, M.raphiophylla, E.callophylla.* Rip and mound parallel with creek.	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	The entire boundary fence for loc 5976 is infested with bridle creeper.	Several infestations in unfenced area at west of loc 5976.
Advice on rehabilitation of these sites :	Treat for bridle creeper, thistle and deadly nightshade.	Treat for bridle creeper, thistle and deadly nightshade.
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	


5973
5976
4.1 Km
C1
B3-C1
P
P
P
P
P
BRIDLE CREEPER
C1
6.4 Km
A3-B3
C1
B2-B3-C1
A3-B1
THISTLE
BRIDLE CREEPER
DEADLY NIGHTSHADE
1.2 Ha
C1-C2
4748
MOORIALUP CREEK SURVEY
MOOR 003
metres
0 100 200 300 400
N

NAPIER CREEK SURVEY - NAP 1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0 - 2.14km

Loc. Numbers of Adjacent Properties-
Left Bank : 886, 2349.

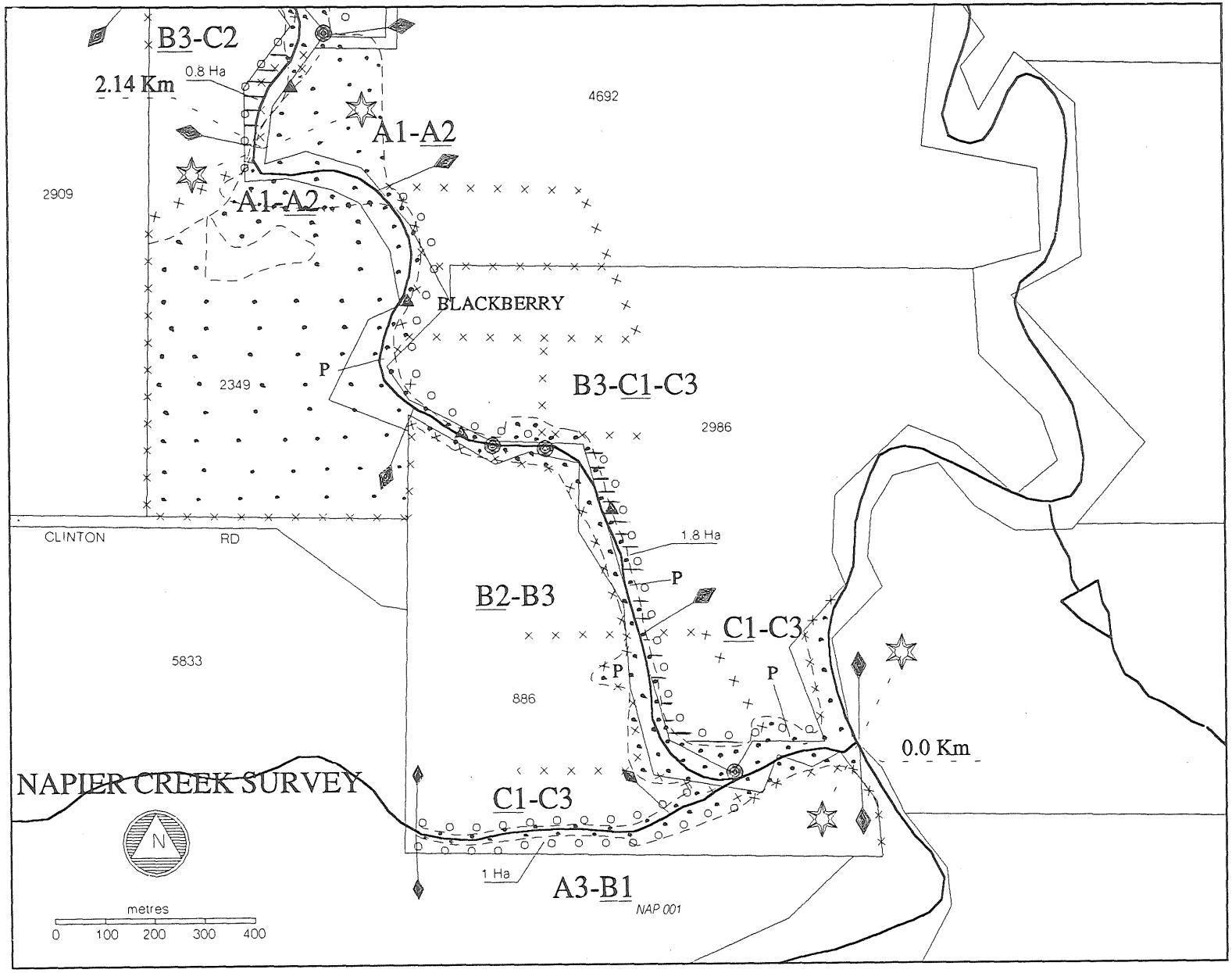
Right Bank : 2986, 4692.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 6/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.14km	1.15km
Length of Riverbank Fencing Recommended :	Nil	700m
Number of Sites showing severe erosion :	Nil	3
Advice on remedial measures required for these sites :	N/A	Fence from stock, place brush along steep gully sides, rocks in gully base, revegetate with natives.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :Nil Priority N/A Area (ha) :	No. of sites : 2 Priority 1 Area (ha) : 1.8ha
Advice on revegetation species and preparation :	Tributary requires revegetating. Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *E.calophylla, E.marginata, M.raphiophylla, Agonis parviceps, A.linearifolia.* Rip and mound parallel with creek line. Consult a local landcare technician in surveying rip and mound lines.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.calophylla, E.marginata, M.raphiophylla, Banksia grandis, Agonis parviceps, A.linearifolia.* Rip and mound parallel with creek line. Consult a local landcare technician in surveying rip and mound lines.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	3
Advice on rehabilitation of these sites :	N/A	Treat blackberry.
Other management advice for this section :		Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps. Do not remove woody snags, drag back to less than 40 degrees to bank to minimise erosion.


B3-C2
2.14 Km
0.8 Ha
4692
A1-A2
2909
A1-A2
BLACKBERRY
P
2349
B3-C1-C3
2986
CLINTON
RD
1.8 Ha
P
B2-B3
C1-C3
5833
P
P
886
0.0 Km
NAPIER CREEK SURVEY
C1-C3
N
1 Ha
A3-B1
NAP 001
metres
0
100
200
300
400

NAPIER CREEK SURVEY - NAPIER 3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 5.09 - 7.87

Loc. Numbers of Adjacent Properties-
Left Bank : 2979, 2197, 2198, 2695.

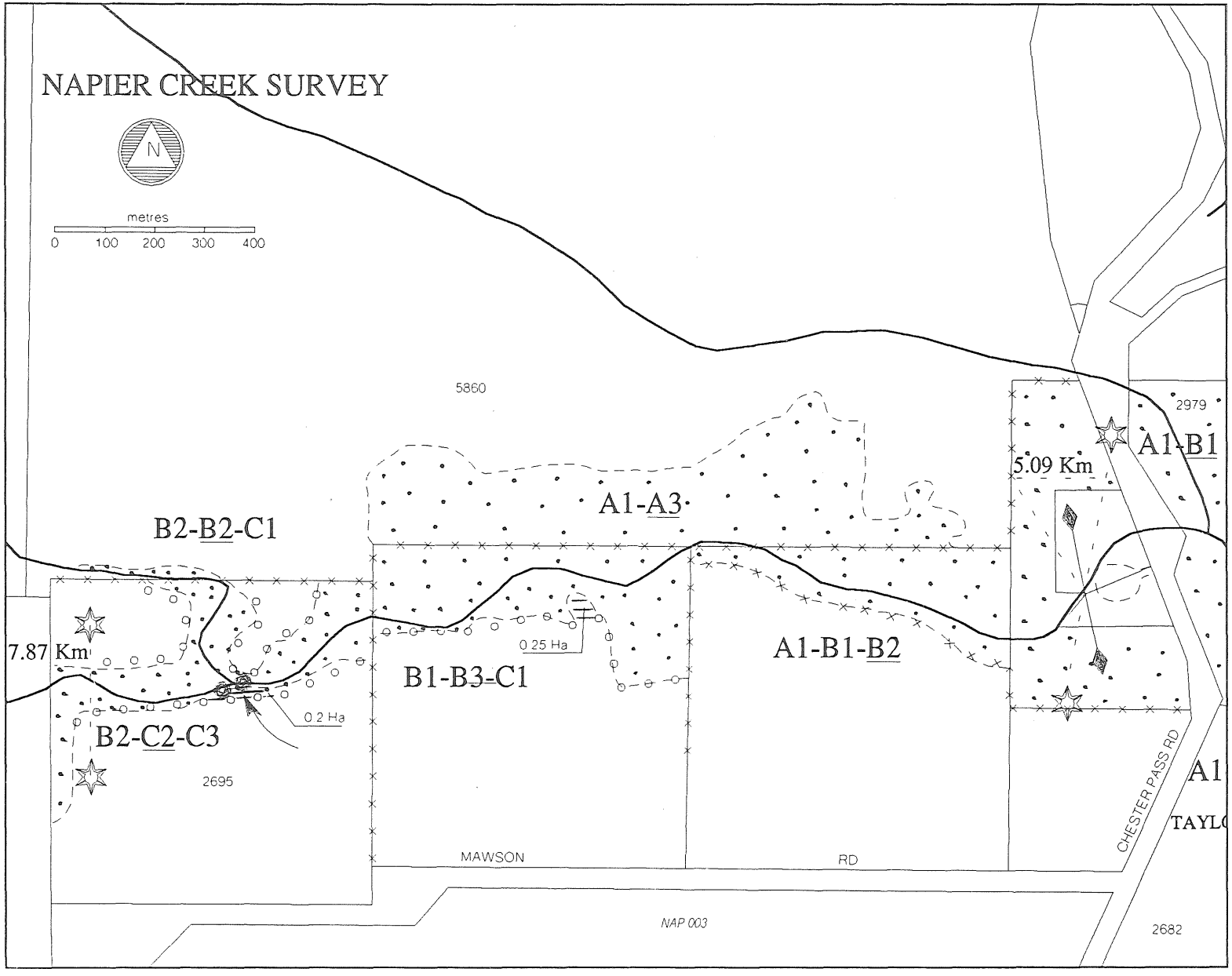
Right Bank : 2979, 2197, 2198, 2695.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 10/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.1km	1.71km
Length of Riverbank Fencing Recommended :	1.37km	880m
Number of Sites showing severe erosion :	4	Nil
Advice on remedial measures required for these sites :	Fence bank to control stock access at crossing. Place rocks in deep gully to slow further erosion. Cover area with brush, and hand plant *Agonis* species.	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 2 Priority 1 -urgent Area (ha) : 0.2ha, 0.25ha	No. of sites : Nil Priority : N/A Area (ha) :
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.calophylla, E.marginata, M.raphiophylla, Banksia grandis, Agonis parviceps, A.linearifolia.* Rip and mound parallel with creek line. Consult a local landcare technician in surveying rip and mound lines.	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


NAPIER CREEK SURVEY
N
metres
0 100 200 300 400
5860
2979
A1-B1
5.09 Km
A1-A3
B2-B2-C1
7.87 Km
0.25 Ha
A1-B1-B2
B1-B3-C1
0.2 Ha
B2-C2-C3
2695
A1
TAYL
CHESTER PASS RD
MAWSON
RD
NAP 003
2682

STONEY CREEK SURVEY - STON 1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0 - 1.83

Loc. Numbers of Adjacent Properties-
Left Bank : 5968

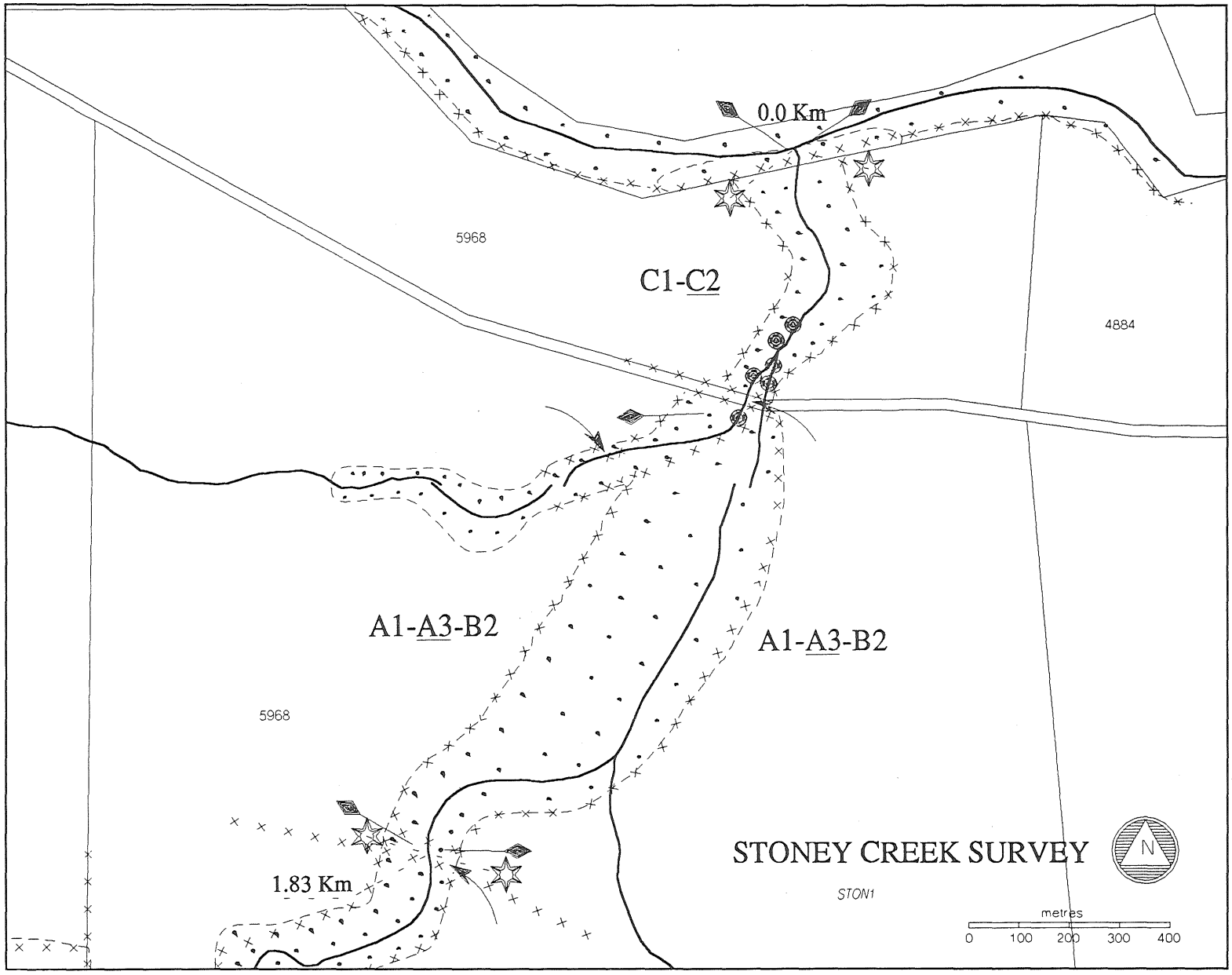
Right Bank : 5968

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 27/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.83 km	1.83 km
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	3	4
Advice on remedial measures required for these sites :	Direct seed area with saltbush. Place rock riffle bars to reduce erosion of stream bed. Seek expert advice on this.	Direct seed area with saltbush. Place rock riffle bars to reduce erosion of stream bed. Seek expert advice on this.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority : N/A Area (ha) :
Advice on revegetation species and preparation :	Area should be lightly scalped, across the flow of the creek, to prepare surface for direct seeding and minimise erosion risk.	Area should be lightly scalped, across the flow of the creek, to prepare surface for direct seeding and minimise erosion risk.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	N/A	N/A
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


0.0 Km
5968
C1-C2
4884
A1-A3-B2
A1-A3-B2
5968
1.83 Km
STONEY CREEK SURVEY
STON1
N
metres
0 100 200 300 400

STONEY CREEK SURVEY - STON 2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 1.83 - 3.96

Loc. Numbers of Adjacent Properties-
Left Bank : 5967, 5968

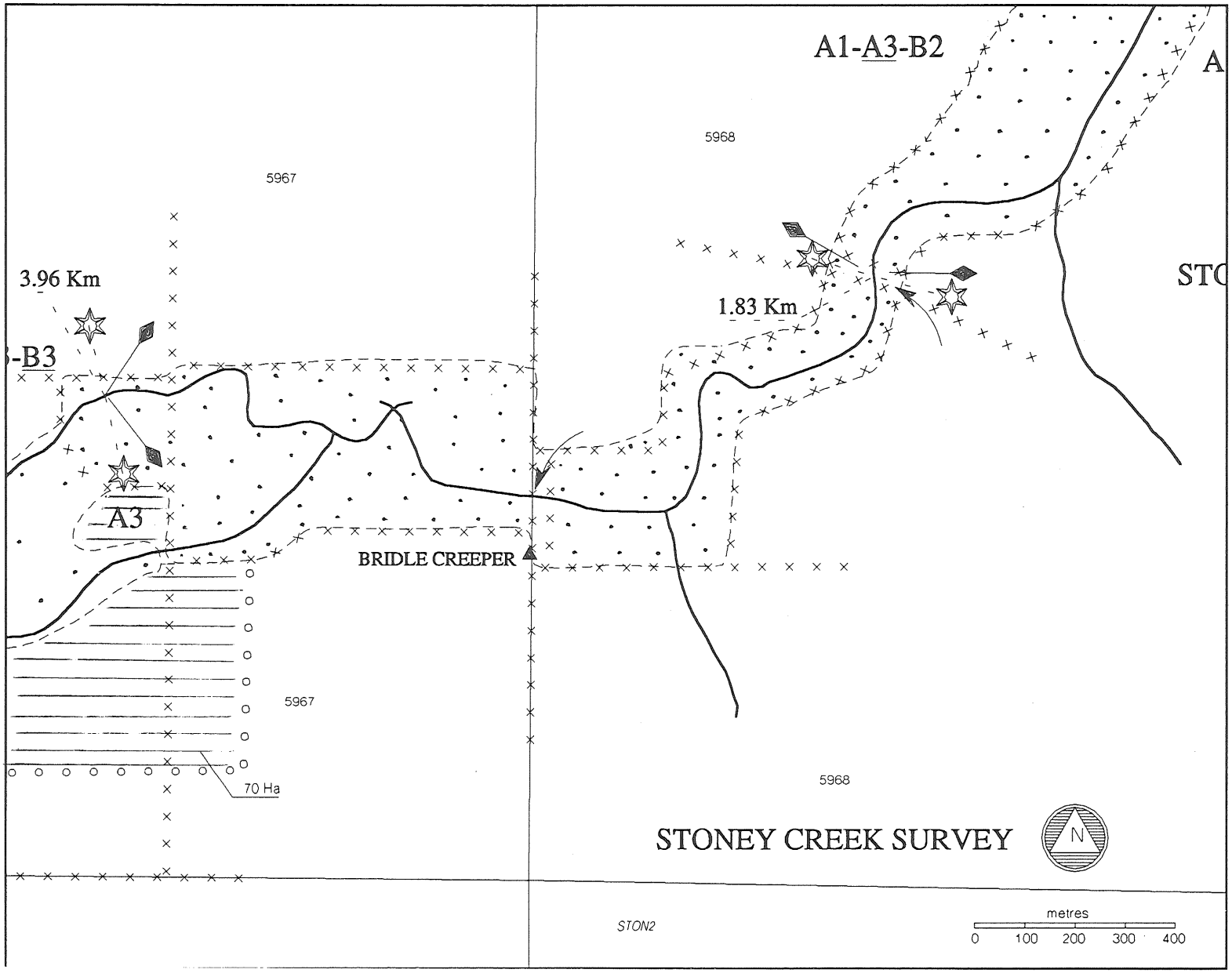
Right Bank : 5967, 5968

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 27/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.13 km	2.13 km
Length of Riverbank Fencing Recommended :	1700m	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 70	No. of sites : Nil Priority : N/A Area (ha) :
Advice on revegetation species and preparation :	Floodplain area difficult to replant. Could direct seed saltbush, then plant amongst saltbush clumps.	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	1	N/A
Advice on rehabilitation of these sites :	Bridle creeper on property boundary needs treating	N/A
Other management advice for this section :		


A1-A3-B2
A
5968
5967
3.96 Km
1.83 Km
STC
-B3
A3
BRIDLE CREEPER
5967
70 Ha
5968
STONEY CREEK SURVEY
N
STON2
metres
0 100 200 300 400

STONEY CREEK SURVEY - STON 3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 3.96 - 5.61

Loc. Numbers of Adjacent Properties-
Left Bank : 5967

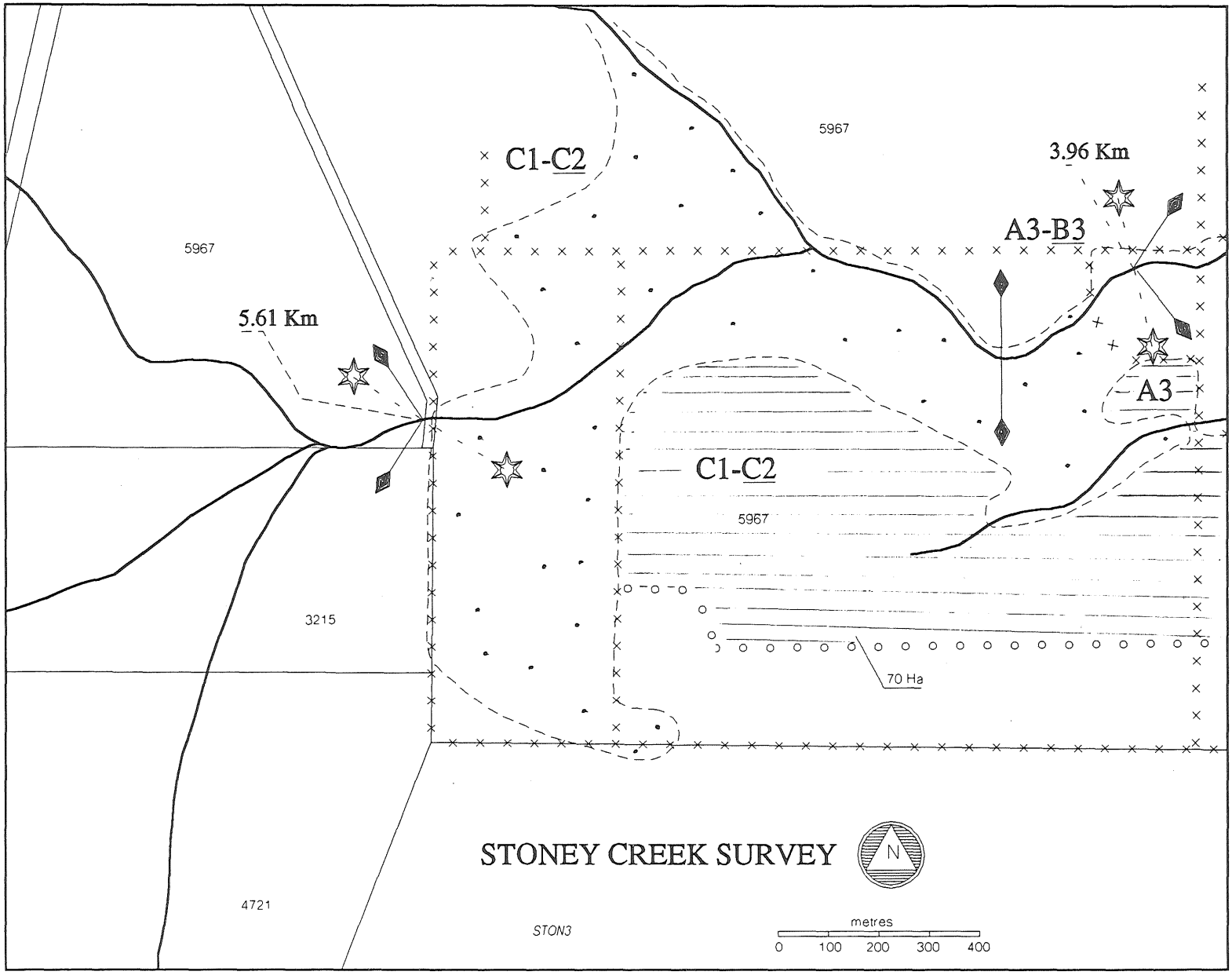
Right Bank : 5967

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 27/3/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	250m	300m
Length of Riverbank Fencing Recommended :	1700m	Nil
Number of Sites showing severe erosion :	Entire floodplain area badly eroded	Entire floodplain area badly eroded
Advice on remedial measures required for these sites :	Exclusion from stock, direct seeding and regeneration.	Exclusion from stock, direct seeding and regeneration.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 70	No. of sites : Nil Priority : N/A Area (ha) :
Advice on revegetation species and preparation :	Floodplain area difficult to replant. Could direct seed saltbush, then plant amongst saltbush clumps. Pasture areas included in new fencing need to be deep ripped, sprayed, and replanted with species such as *E.decipiens, E.occidentalis, A.saligna and M.cuticularis.* and other species from the appropriate section of Appendix 1 of this report.	Floodplain area difficult to replant. Could direct seed saltbush, then plant amongst saltbush clumps. Pasture areas included in new fencing need to be deep ripped, sprayed, and replanted with species such as *E.decipiens, E.occidentalis, A.saligna and M.cuticularis.* and other species from the appropriate section of Appendix 1 of this report.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	N/A	N/A
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Large floodplain area is to be fenced off and excluded from stock, allowing native regeneration.	


C1-C2
5967
3.96 Km
A3-B3
5967
5.61 Km
A3
C1-C2
5967
3215
70 Ha
STONEY CREEK SURVEY
N
4721
STON3
metres
0 100 200 300 400

TAKALARUP CREEK RIVER SURVEY - TAKA1 See Map 1.2 (pg.4) for location

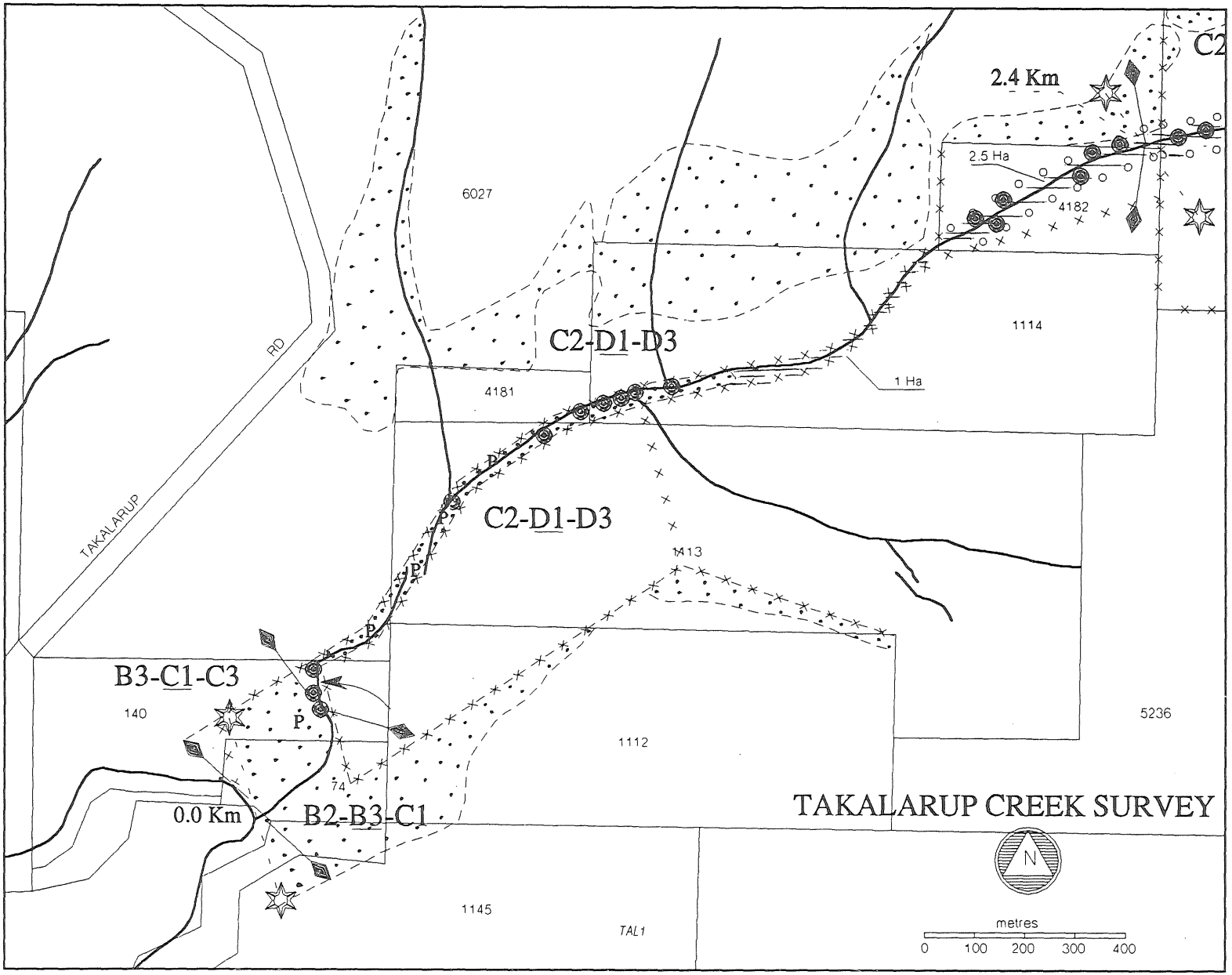
Distances from River Mouth (km) : 0.0km-2.4km

Loc. Numbers of Adjacent Properties-
Left Bank : 74, 140, 6027, 1113, 4181, 1114, 4182.
Right Bank : 74, 140, 6027, 1113, 4181, 1114, 4182.
Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 24/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.9km	1.9km
Length of Riverbank Fencing Recommended :	500m	500m
Number of Sites showing severe erosion :	12	14
Advice on remedial measures required for these sites :	Site is excluded from stock, needs revegetating to stabilise eroded areas.	Site is excluded from stock, needs revegetating to stabilise eroded areas.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :1 Priority 1-urgent Area (ha) :1.25ha	No. of sites :1 Priority 1-urgent Area (ha) :1.25ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.rudis, E.occidentalis, M.cuticularis.* Rip and mound parallel with creek.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.rudis, E.occidentalis, M.cuticularis.* Rip and mound parallel with creek.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


2.4 Km
C2
2.5 Ha
4182
6027
1114
C2-D1-D3
1 Ha
4181
RD
TAKALARUP
C2-D1-D3
1113
B3-C1-C3
140
5236
1112
74
0.0 Km
B2-B3-C1
TAKALARUP CREEK SURVEY
N
1145
TAL1
metres
0 100 200 300 400

TAKALARUP CREEK RIVER SURVEY - TAKA2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 2.4km-4.15km

Loc. Numbers of Adjacent Properties-
Left Bank : 1645, 4184

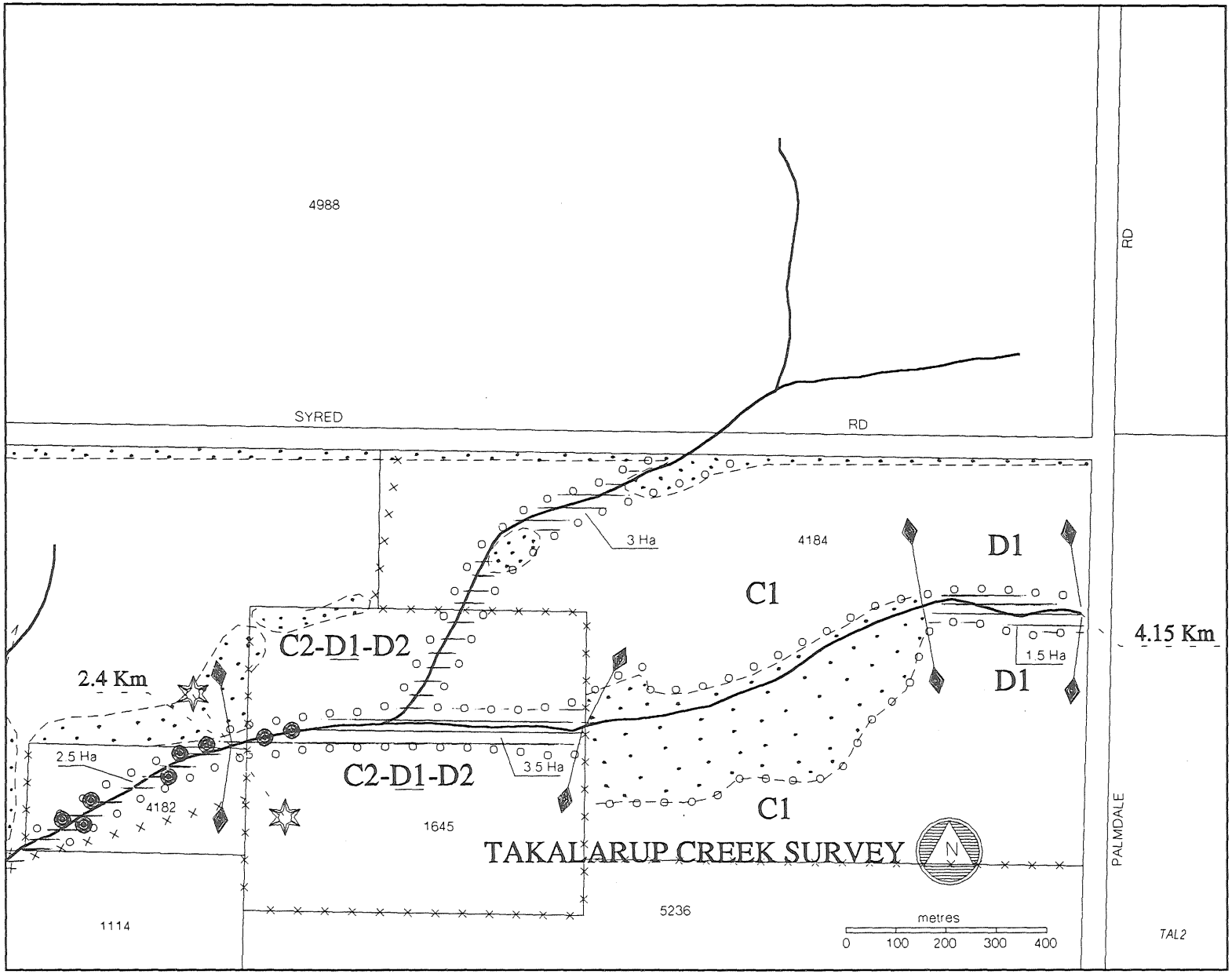
Right Bank : 1645, 4184

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 24/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Nil	Nil
Length of Riverbank Fencing Recommended :	1.75km	1.75km
Number of Sites showing severe erosion :	At least 3	At least 3
Advice on remedial measures required for these sites :	Exclusion of stock by fencing, and revegetating area.	Exclusion of stock by fencing, and revegetating area.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :2 Priority 1-urgent Area (ha) :2.5ha	No. of sites :2 Priority 1-urgent Area (ha) :2.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.rudis, E.occidentalis, M.cuticularis.* Rip and mound parallel with creek.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.rudis, E.occidentalis, M.cuticularis.* Rip and mound parallel with creek.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


4988
SYRED
RD
RD
3 Ha
4184
D1
C1
4.15 Km
C2-D1-D2
2.4 Km
1.5 Ha
D1
2.5 Ha
3.5 Ha
C2-D1-D2
4182
1645
C1
TAKALARUP CREEK SURVEY
N
PALMDALE
1114
5236
metres
0 100 200 300 400
TAL2

TAKENUP CREEK RIVER SURVEY -TAK1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0-2.8km

Loc. Numbers of Adjacent Properties-
Left Bank : 4701, 1846, 5678.

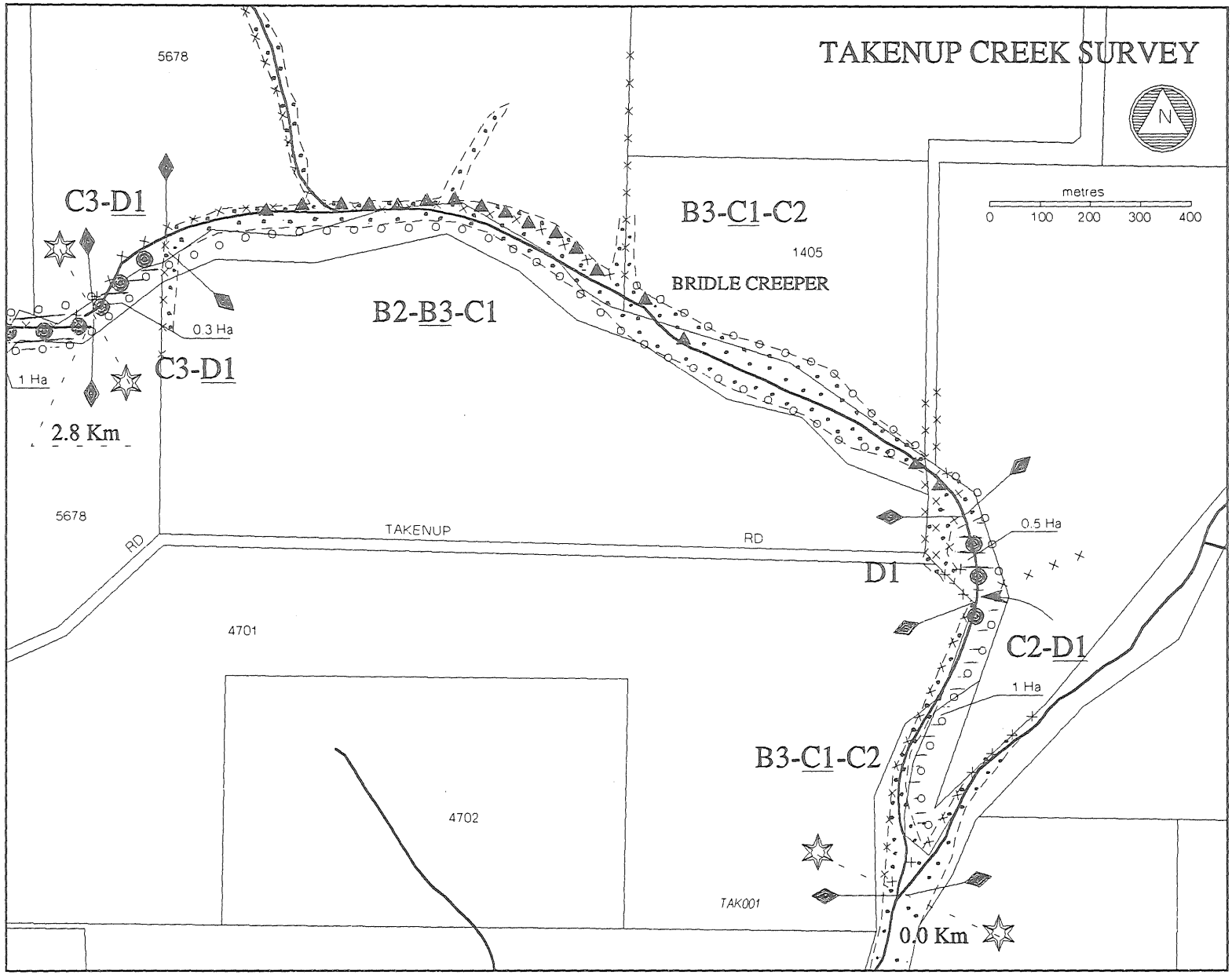
Right Bank : 1931, 1405, 5678.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 18/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	900m	1.2km
Length of Riverbank Fencing Recommended :	1.75km	1.5km
Number of Sites showing severe erosion :	6	7
Advice on remedial measures required for these sites :	Fence area to exclude stock, revegetate exposed bank. Plant above areas of salt intrusion with deep rooted species, and the exposed area planted with salt tolerant plants/grasses	Fence area to exclude stock, revegetate exposed bank. Plant above areas of salt intrusion with deep rooted species, and the exposed area planted with salt tolerant plants/grasses
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites :1 Priority 1-Urgent Area (ha) : 0.3ha	No. of sites :1 Priority 1-Urgent Area (ha) : 1ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.occidentalis, E.rudis, M.raphiophylla, M.cuticularis, Agonis parviceps.* Samphire, saltbush for salt scolds. Rip and mound to contour, consult local landcare technician to survey rip and mound lines. Scarify area for seeding, rake over once seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *E.occidentalis, E.rudis, M.raphiophylla, M.cuticularis, Agonis parviceps.* Samphire, saltbush for salt scolds. Rip and mound to contour, consult local landcare technician to survey rip and mound lines. Scarify area for seeding, rake over once seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Numerous outbreaks of bridle creeper amongst remnant veg.	Numerous outbreaks of bridle creeper amongst remnant veg.
Advice on rehabilitation of these sites :	Treat bridle creeper.	Treat bridle creeper.
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


TAKENUP CREEK SURVEY
N
metres
0 100 200 300 400
5678
C3-D1
B3-C1-C2
1405
BRIDLE CREEPER
B2-B3-C1
0.3 Ha
C3-D1
1 Ha
2.8 Km
5678
TAKENUP RD
RD
0.5 Ha
D1
4701
C2-D1
1 Ha
B3-C1-C2
4702
TAK001
0.0 Km

TAKENUP CREEK RIVER SURVEY - TAK3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 4.9km-7.4km

Loc. Numbers of Adjacent Properties-
Left Bank : 2691, 5101.

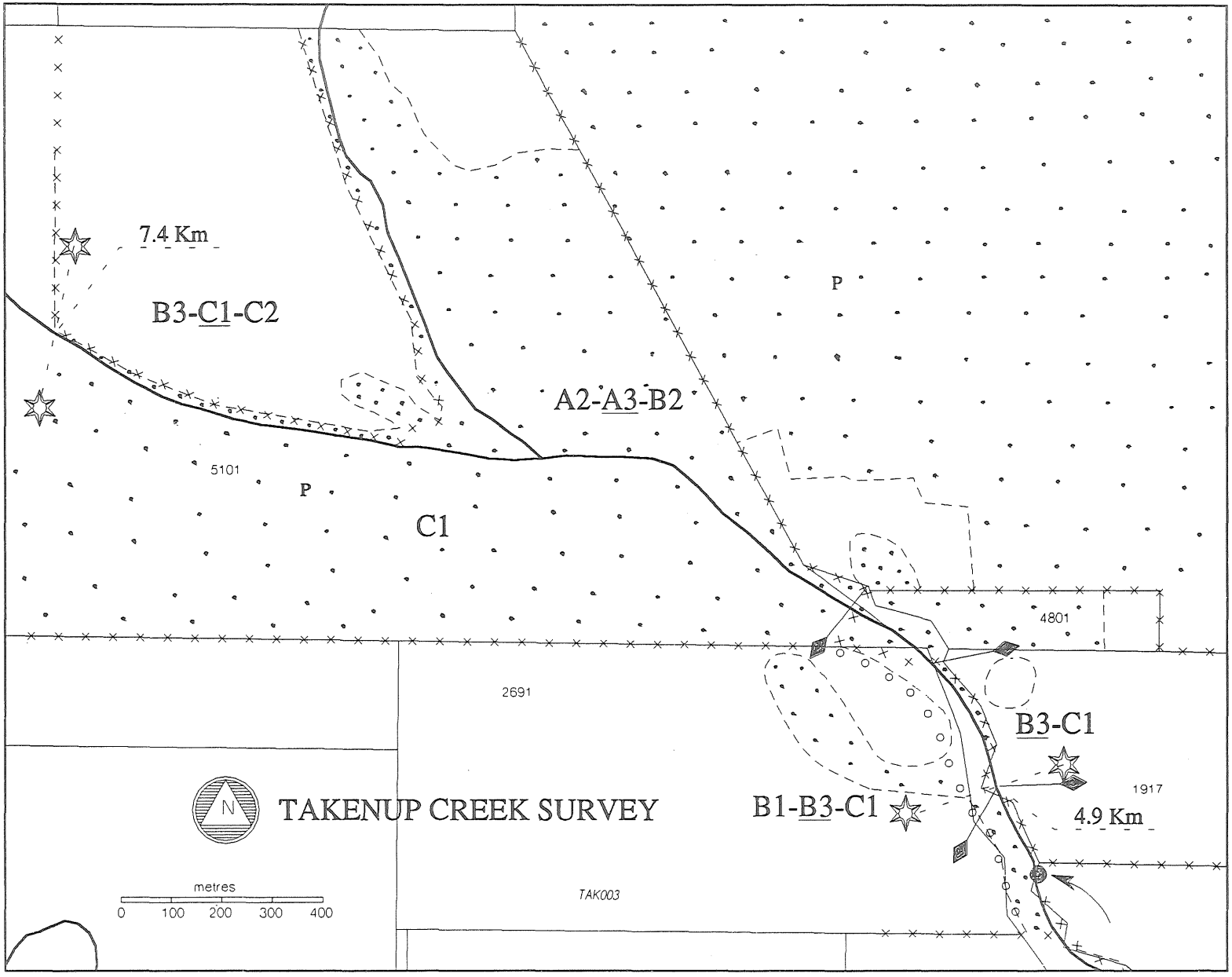
Right Bank : 1917, 4801, 5101.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 18/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.8km	2.5km
Length of Riverbank Fencing Recommended :	450m	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	N/A	N/A
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps. Where crossing streams, or in areas prone to damaging flooding, 'hanging', 'drop' or electric fencing can be used.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps. Where crossing streams, or in areas prone to damaging flooding, 'hanging', 'drop' or electric fencing can be used.


7.4 Km
B3-C1-C2
A2-A3-B2
P
5101
P
C1
4801
2691
B3-C1
1917
4.9 Km
B1-B3-C1
N
TAKENUP CREEK SURVEY
metres
0 100 200 300 400
TAK003

UPPER KALGAN RIVER SURVEY - UPKAL1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0km-2.2km

Loc. Numbers of Adjacent Properties-
Left Bank : 1773

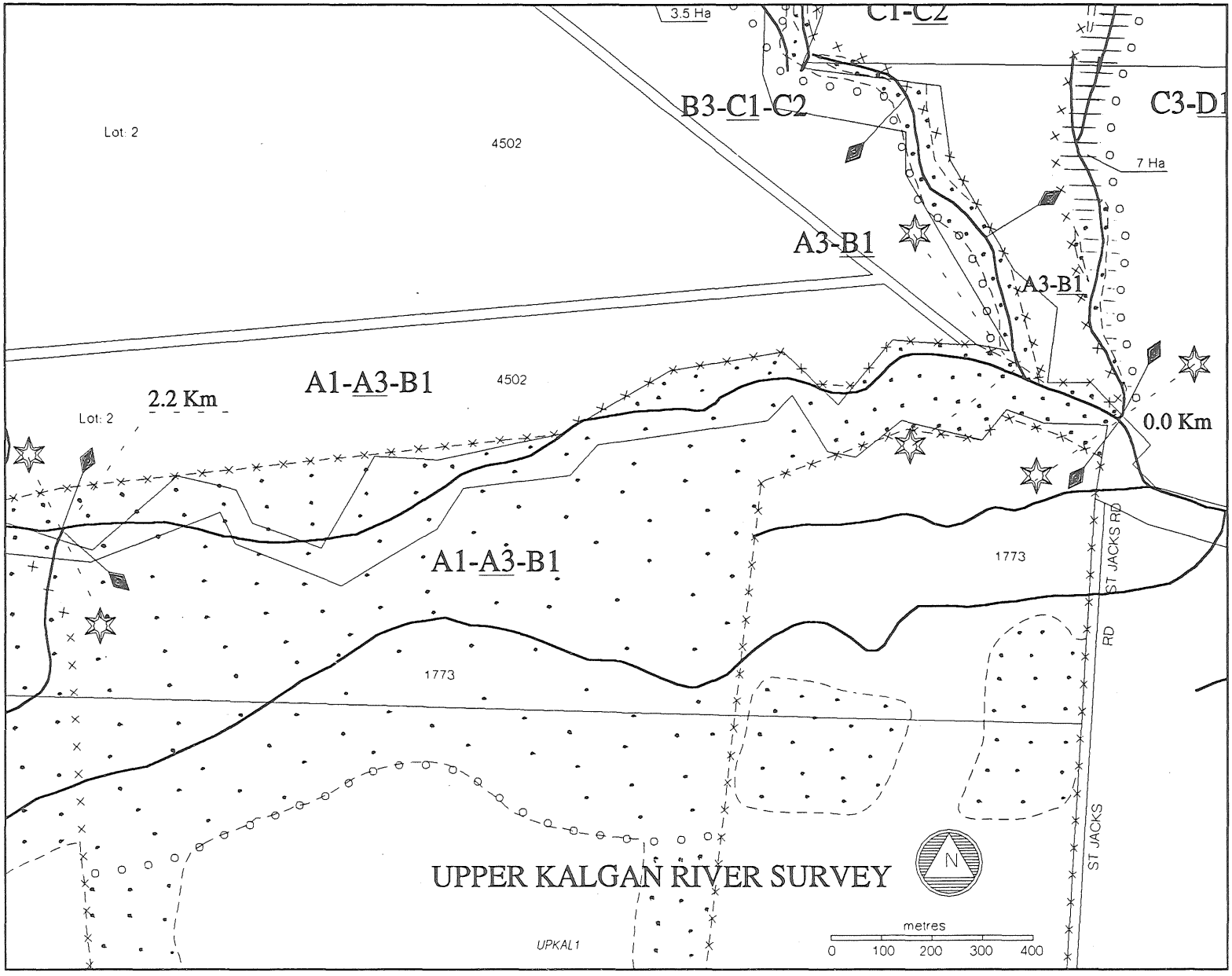
Right Bank : 4502

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.2km	2.2km
Length of Riverbank Fencing Recommended :	1.3km	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


3.5 Ha
C1-C2
B3-C1-C2
C3-D1
Lot: 2
4502
7 Ha
A3-B1
A3-B1
A1-A3-B1
4502
2.2 Km
Lot: 2
0.0 Km
A1-A3-B1
1773
ST JACKS RD
1773
ST JACKS
UPPER KALGAN RIVER SURVEY
N
metres
0 100 200 300 400
UPKAL1

UPPER KALGAN RIVER SURVEY - UPKAL2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 2.2km-4.4km

Loc. Numbers of Adjacent Properties-
Left Bank : 1773, lot2

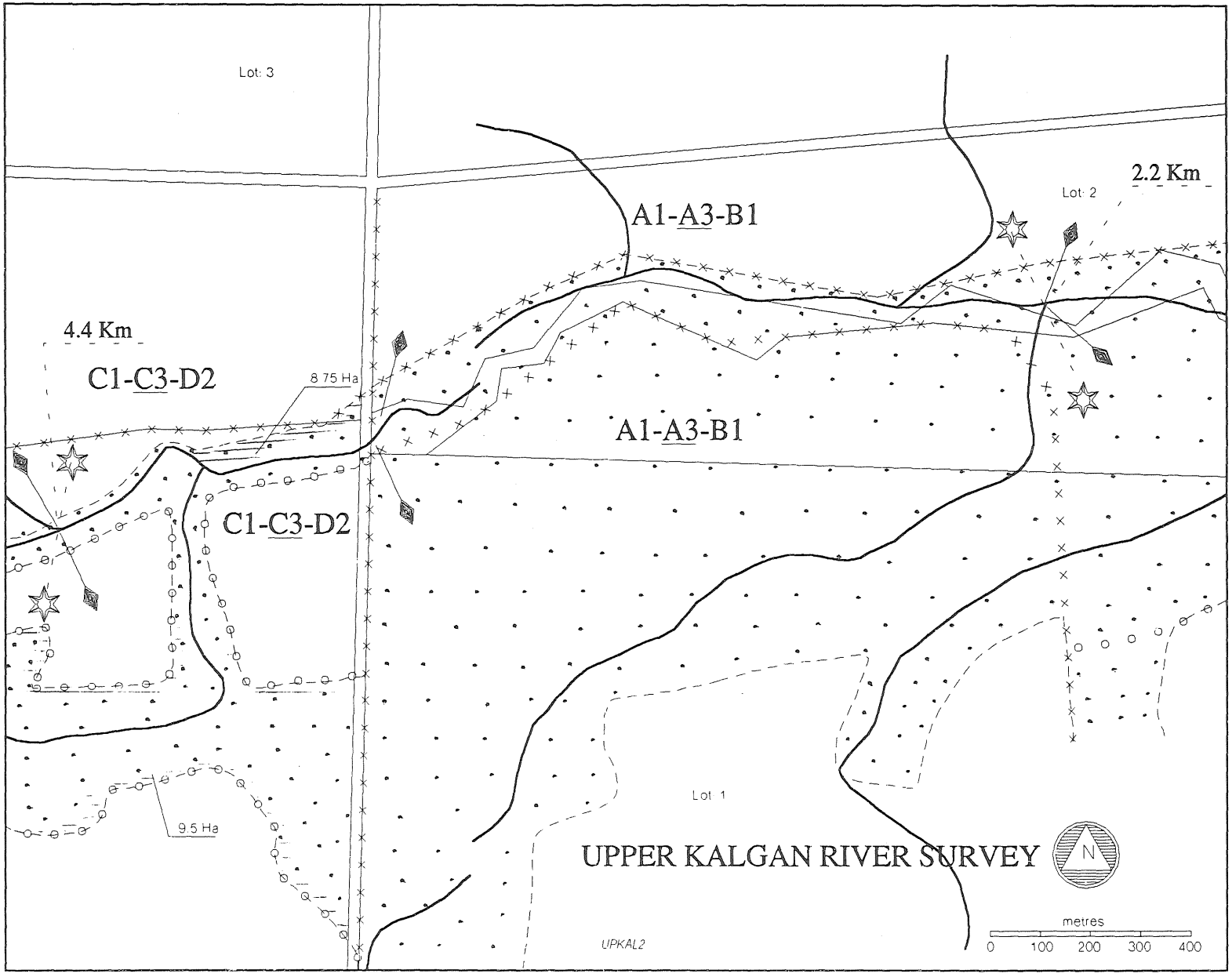
Right Bank : 4502, lot1

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.5km	2.2km
Length of Riverbank Fencing Recommended :	700m	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 9.5ha	No. of sites : 1 Priority 1 Area (ha) : 8.75ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	


Lot: 3
2.2 Km
Lot: 2
A1-A3-B1
4.4 Km
C1-C3-D2
8.75 Ha
A1-A3-B1
C1-C3-D2
Lot: 1
9.5 Ha
UPPER KALGAN RIVER SURVEY
N
metres
0 100 200 300 400
UPKAL2

UPPER KALGAN RIVER SURVEY - UPKAL3 See Map 1.2 (pg.4) for location

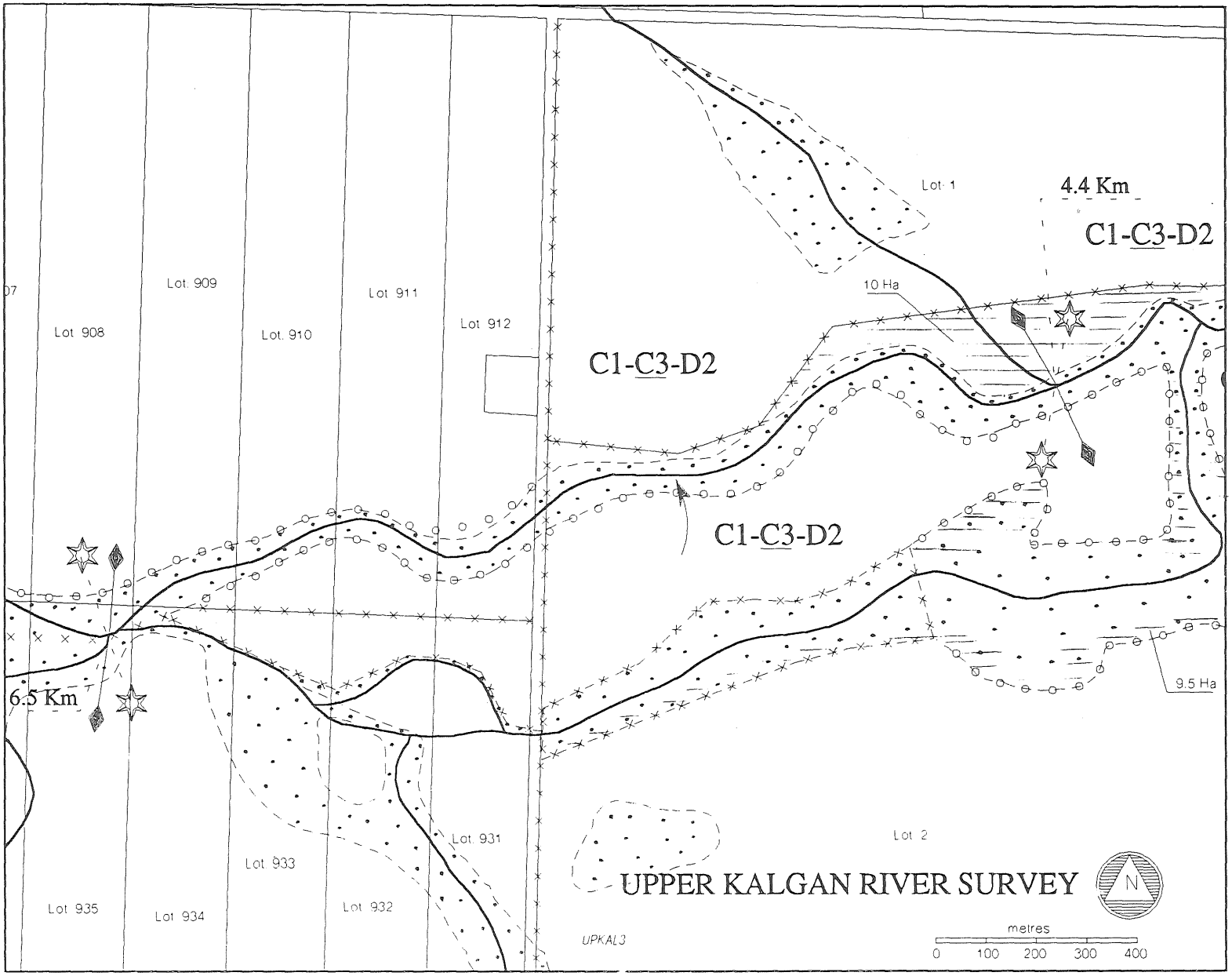
Distances from River Mouth (km) : 4.4km-6.5km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot2, Lot 912, 911, 910, 909, 908,935.
Right Bank : Lot1, Lot 912, 911, 910, 909, 908,935.
Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	150m	1.2km
Length of Riverbank Fencing Recommended :	1.9km	Nil
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : 1 Priority 1 Area (ha) : 10ha
Advice on revegetation species and preparation :		Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	


Lot 1
4.4 Km
C1-C3-D2
10 Ha
Lot 909
Lot 911
Lot 908
Lot 910
Lot 912
C1-C3-D2
C1-C3-D2
6.5 Km
9.5 Ha
Lot 931
Lot 2
Lot 933
Lot 935
Lot 934
Lot 932
UPPER KALGAN RIVER SURVEY
N
UPKAL3
metres
0 100 200 300 400

UPPER KALGAN RIVER SURVEY - UPKAL4 See Map 1.2 (pg.4) for location

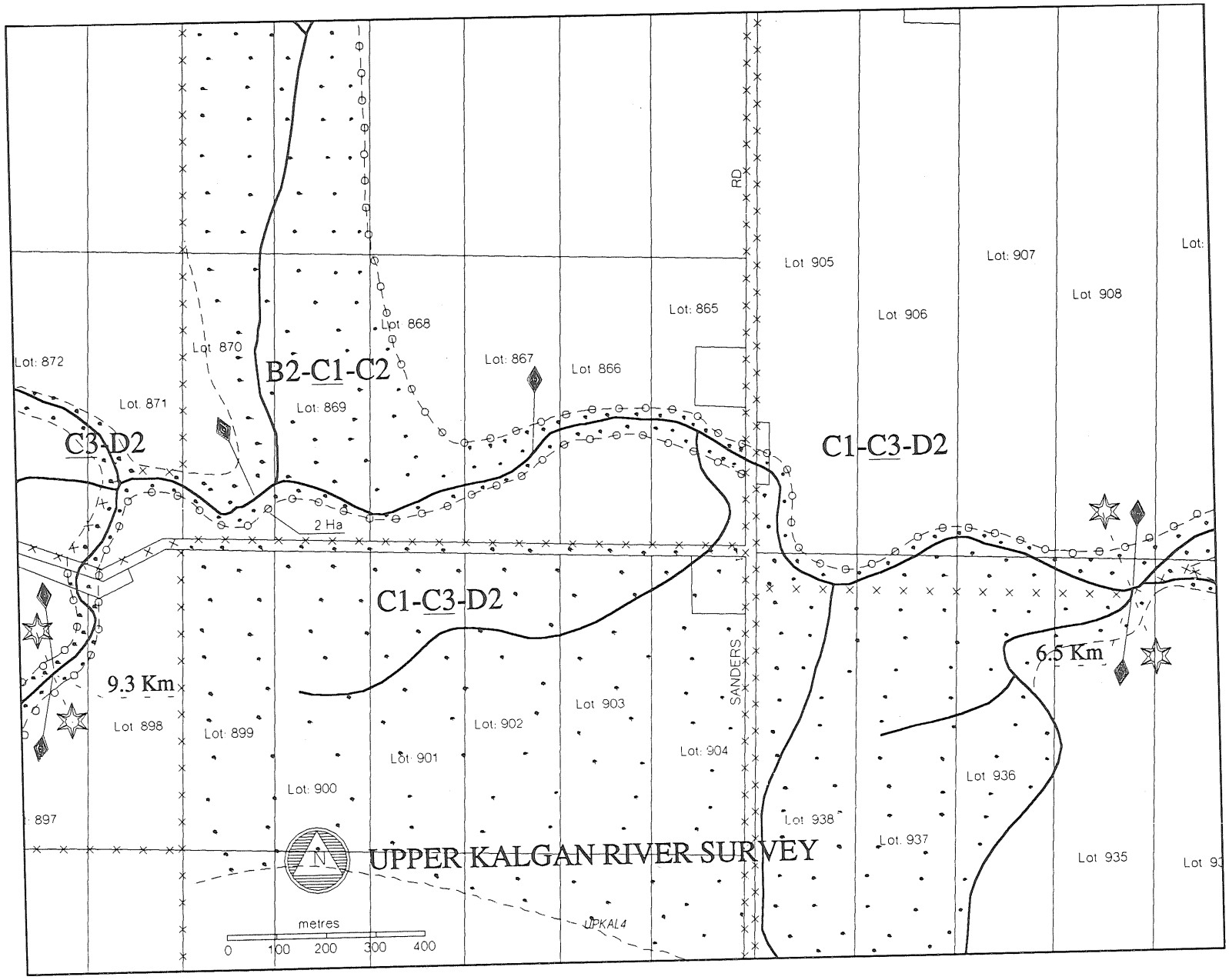
Distances from River Mouth (km) : 6.5km -9.3km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot908,907,906,905,937,938,865,866,867868,869,870,871,898,897.
Right Bank : Lot908,907,906,905,937,938,865,866,867868,869,870,871,898,897.
Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	800m	300m
Length of Riverbank Fencing Recommended :	1.7km	1.5km
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 2ha	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


Lot: 872
Lot. 871
Lot 870
Lot 868
Lot: 869
Lot: 867
Lot 866
Lot: 865
Lot 905
Lot 906
Lot: 907
Lot 908
Lot:
RD
B2-C1-C2
C3-D2
C1-C3-D2
2 Ha
C1-C3-D2
9.3 Km
6.5 Km
SANDERS
Lot 898
Lot: 899
Lot: 900
Lot 901
Lot: 902
Lot 903
Lot: 904
Lot 936
Lot 938
Lot: 937
Lot 935
897
N
UPPER KALGAN RIVER SURVEY
UPKAL4
metres
0 100 200 300 400

UPPER KALGAN RIVER SURVEY - UPKAL5 See Map 1.2 (pg.4) for location

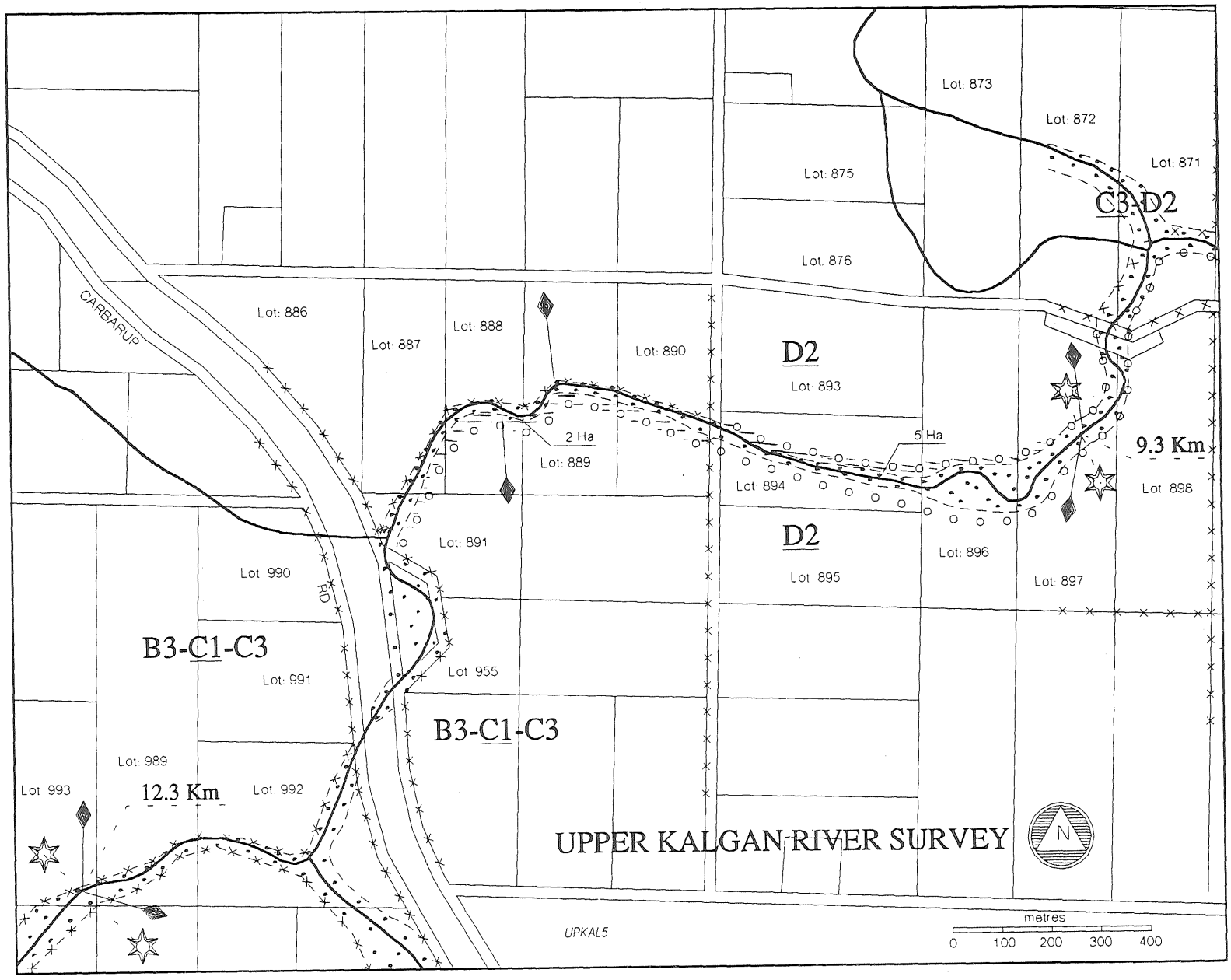
Distances from River Mouth (km) : 9.3km-12.3km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot898,897,896,894,890,889,888,887,891992,989,993.
Right Bank : Lot898,897,896,894,890,889,888,887,891992,989,993.
Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 15/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.2km	2.2km
Length of Riverbank Fencing Recommended :	1.8km	800m
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 2ha	No. of sites : 1 Priority 1 Area (ha) : 5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


Lot: 873
Lot: 872
Lot: 871
Lot: 875
C3-D2
Lot: 876
CARBARUP
Lot: 886
Lot: 887
Lot: 888
Lot: 890
D2
Lot: 893
2 Ha
Lot: 889
5 Ha
9.3 Km
Lot: 894
Lot: 898
Lot: 891
D2
Lot: 896
Lot 990
RD
Lot 895
Lot: 897
B3-C1-C3
Lot: 991
Lot 955
B3-C1-C3
Lot: 989
Lot 993
12.3 Km
Lot: 992
UPPER KALGAN RIVER SURVEY
N
UPKAL5
metres
0 100 200 300 400

UPPER KALGAN RIVER SURVEY - UPKAL6 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 12.3km-14.6km

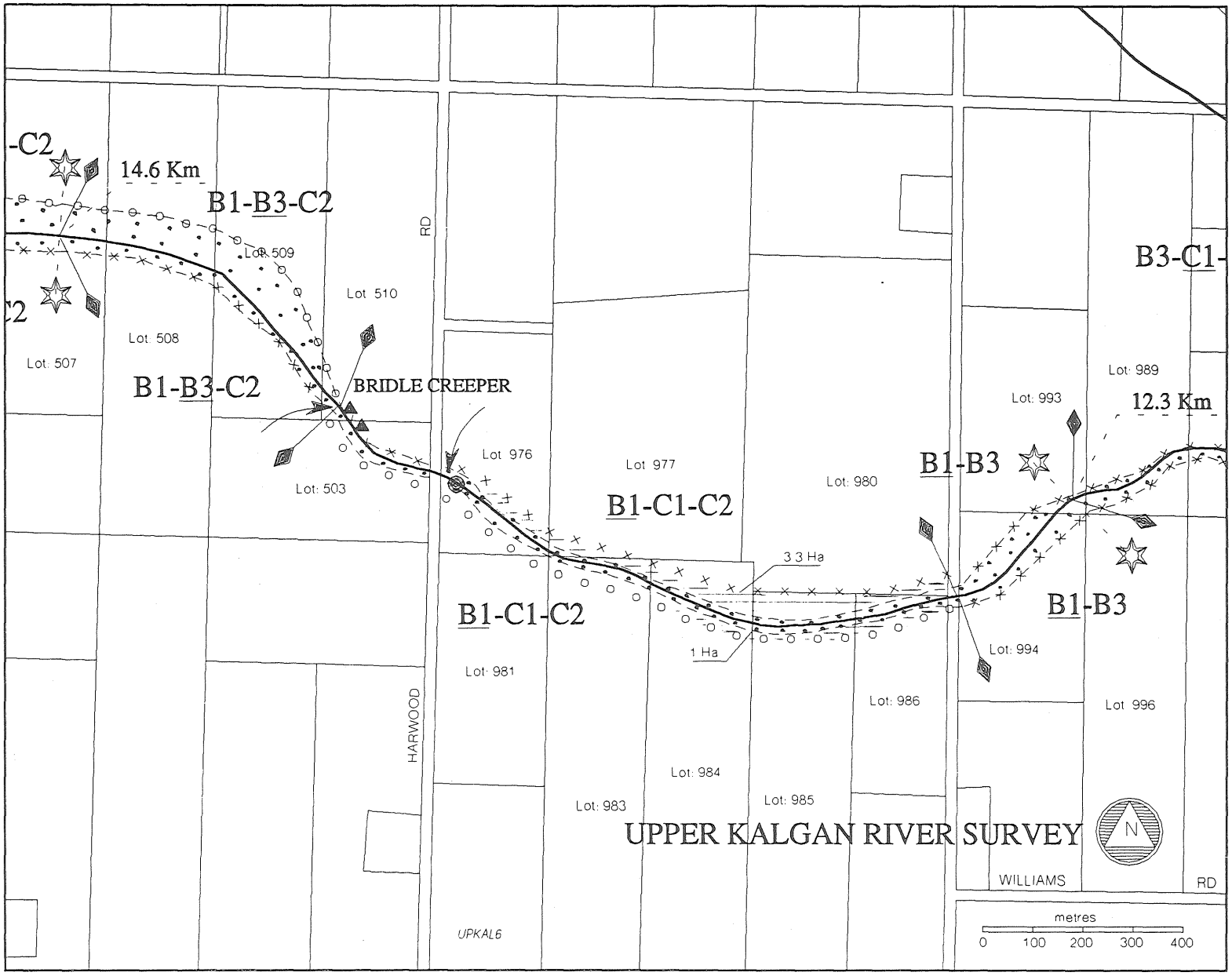
Loc. Numbers of Adjacent Properties-
Left Bank : Lot993,994,986,985,984,983,981,976,503 510,509,508,507.
Right Bank : Lot993,994,986,985,984,983,981,976,503 510,509,508,507.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1km	1.5km
Length of Riverbank Fencing Recommended :	1.4km	800m
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1 Area (ha) : 1ha	No. of sites : 1 Priority 1 Area (ha) : 3.3ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	2
Advice on rehabilitation of these sites :	N/A	Treat bridle creeper.
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


-C2
14.6 Km
B1-B3-C2
Lot: 509
RD
Lot 510
Lot: 508
Lot: 507
B1-B3-C2
BRIDLE CREEPER
Lot 976
Lot 977
Lot: 980
Lot: 503
B1-C1-C2
3.3 Ha
B3-C1-
Lot: 989
Lot: 993
12.3 Km
B1-B3
B1-C1-C2
1 Ha
Lot: 994
B1-B3
Lot: 981
Lot: 986
Lot 996
HARWOOD
Lot: 984
Lot: 983
Lot: 985
UPPER KALGAN RIVER SURVEY
N
WILLIAMS
RD
UPKAL6
metres
0 100 200 300 400

UPPER KALGAN RIVER SURVEY - UPKAL7 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 14.6km-16.7km

Loc. Numbers of Adjacent Properties- Left Bank : Lot507,506,493,475.

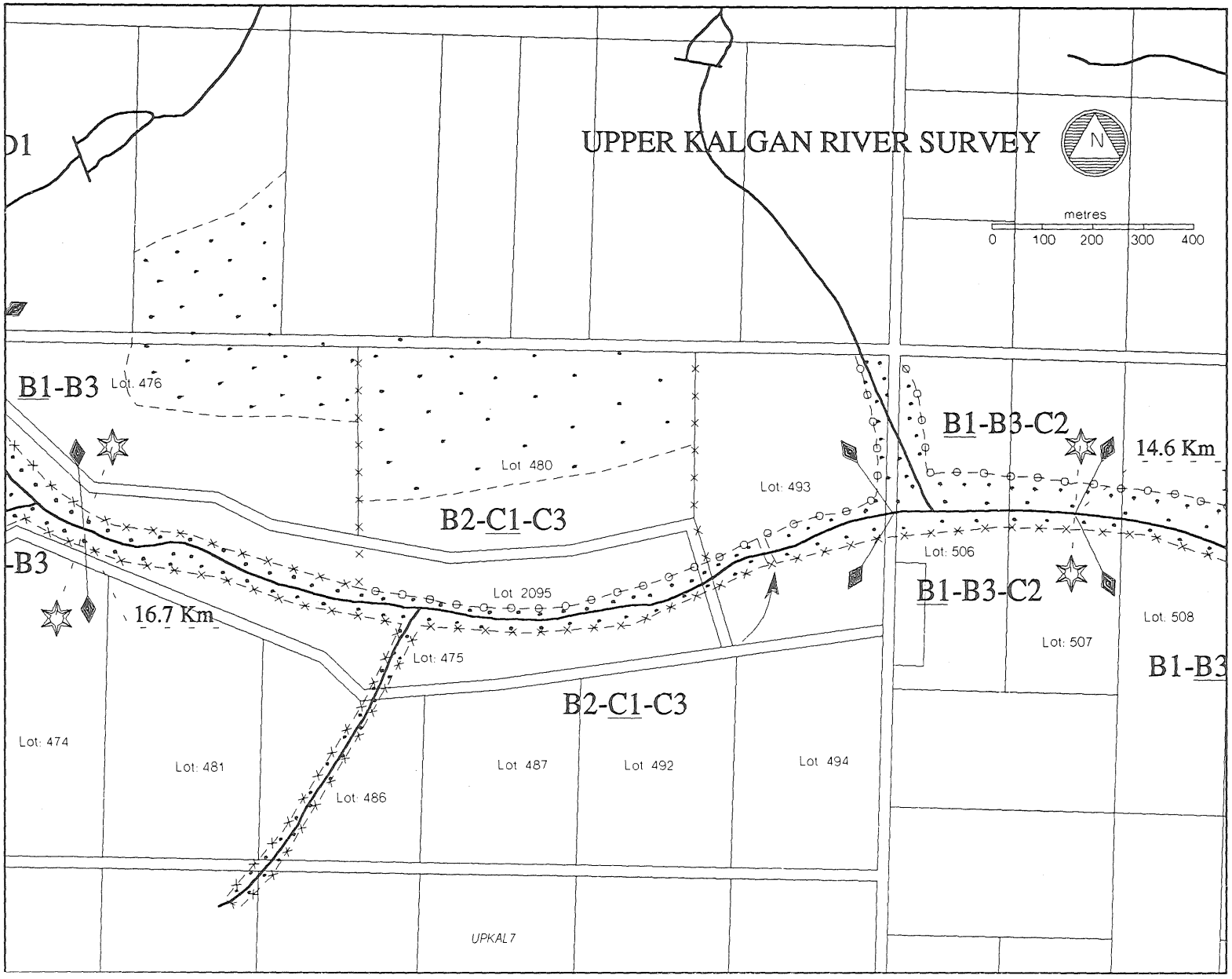
Right Bank : Lot507,506,493,2095.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.1km	700m
Length of Riverbank Fencing Recommended :	Nil	1.4km
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Spot spray and spot plant in exposed areas. Direct seed samphire and salt bush on bare exposed salt patches. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Spot spray and spot plant in exposed areas. Direct seed samphire and salt bush on bare exposed salt patches. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


UPPER KALGAN RIVER SURVEY
N
metres
0 100 200 300 400
B1-B3
Lot. 476
Lot 480
B2-C1-C3
Lot: 493
B1-B3-C2
14.6 Km
Lot: 506
B1-B3-C2
Lot. 508
Lot: 507
B1-B3
Lot 2095
16.7 Km
Lot: 475
B2-C1-C3
Lot: 474
Lot: 481
Lot 487
Lot 492
Lot 494
Lot: 486
UPKAL7

UPPER KALGAN RIVER SURVEY - UPKAL8 See Map 1.2 (pg.4) for location

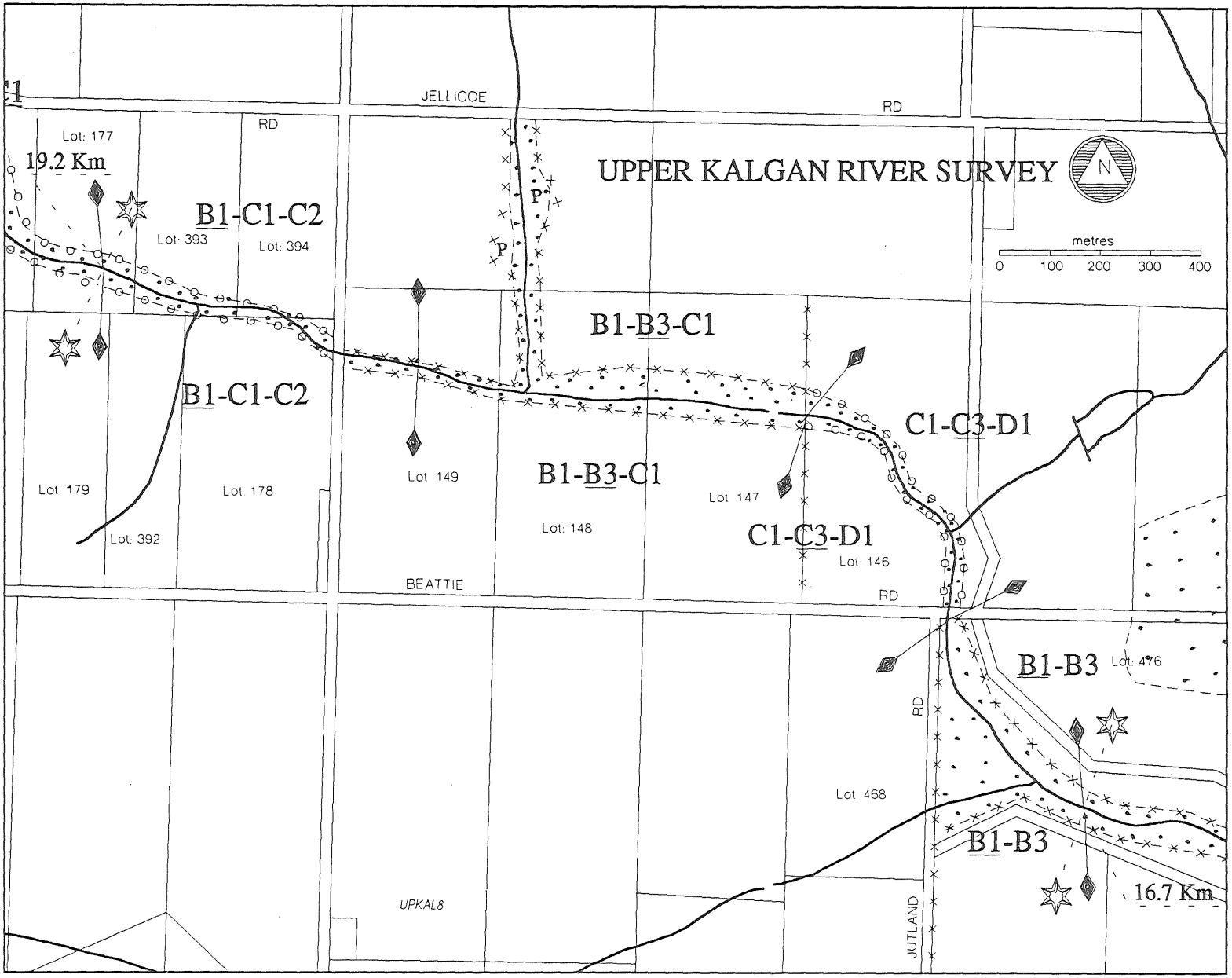
Distances from River Mouth (km) : 16.7km-19.2km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot475,146,147,148,149,178,393,177
Right Bank : Lot475,146,147,148,149,178,393,177
Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.7km	1.4km
Length of Riverbank Fencing Recommended :	1km	1km
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Spot spray and spot plant in exposed areas. Direct seed samphire and salt bush on bare exposed salt patches. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Spot spray and spot plant in exposed areas. Direct seed samphire and salt bush on bare exposed salt patches. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


UPPER KALGAN RIVER SURVEY
N
metres
0 100 200 300 400
JELLICOE RD
Lot: 177
19.2 Km
B1-C1-C2
Lot: 393
Lot: 394
B1-B3-C1
B1-C1-C2
C1-C3-D1
Lot 149
B1-B3-C1
Lot 147
Lot: 179
Lot: 178
Lot: 392
Lot: 148
C1-C3-D1
Lot 146
BEATTIE RD
B1-B3
Lot: 476
RD
Lot 468
B1-B3
16.7 Km
UPKAL8
JUTLAND

UPPER KALGAN RIVER SURVEY - UPKAL9 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 19.2km-21.2km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot177,180,182,184,227,196.

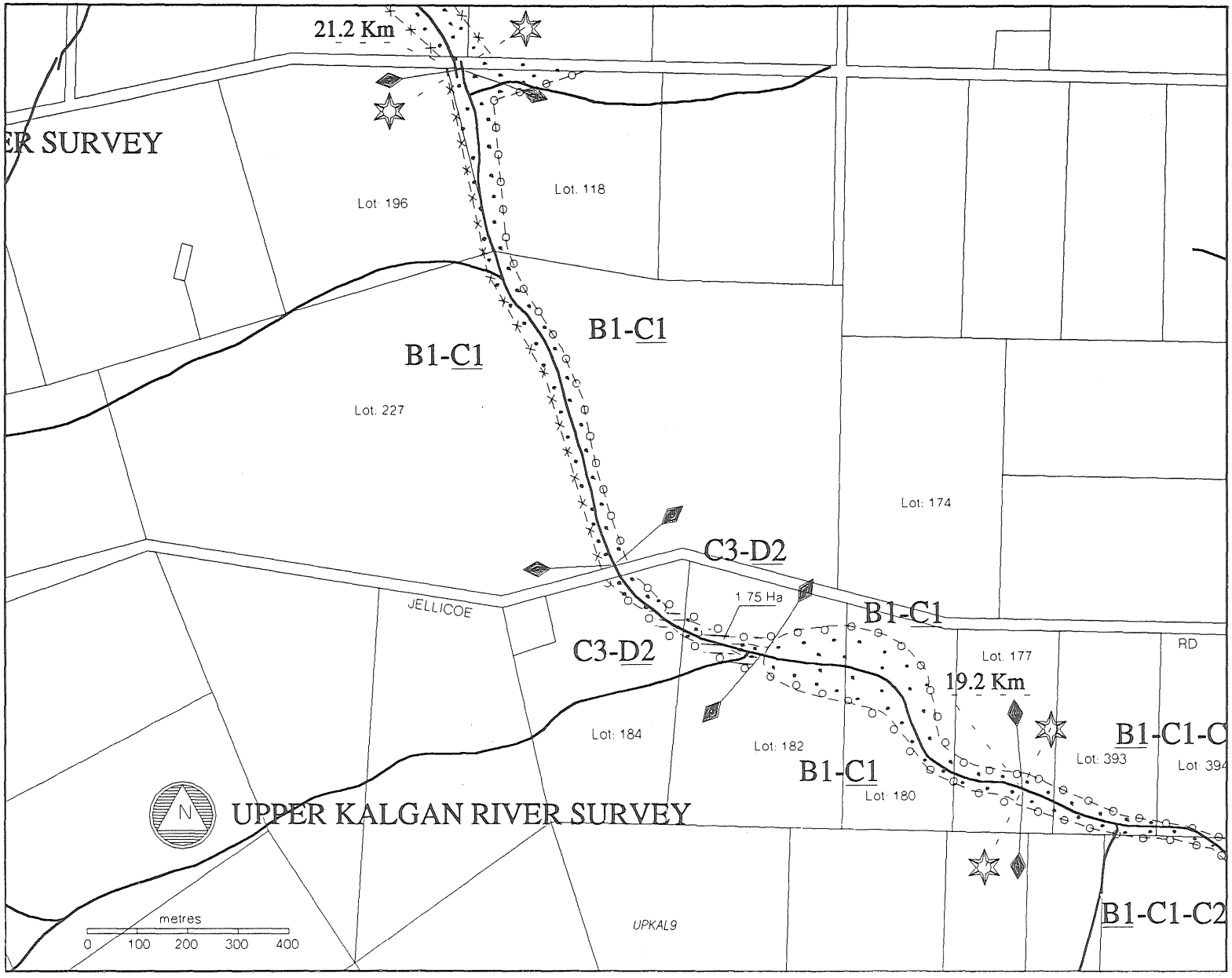
Right Bank : Lot177,180,182,184,227,118.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.1km	Nil
Length of Riverbank Fencing Recommended :	1km	2.1km
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1-urgent Area (ha) :1.75ha	No. of sites : 1 Priority 1-urgent Area (ha) :1.75ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


21.2 Km
ER SURVEY
Lot: 196
Lot: 118
B1-C1
B1-C1
Lot: 227
Lot: 174
C3-D2
JELLICOE
1.75 Ha
B1-C1
C3-D2
Lot: 177
RD
19.2 Km
Lot: 184
Lot: 182
B1-C1-C
Lot: 393
Lot: 394
B1-C1
Lot: 180
UPPER KALGAN RIVER SURVEY
N
metres
0 100 200 300 400
UPKAL9
B1-C1-C2

UPPER KALGAN RIVER SURVEY - UPKAL10 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 21.2km-23.1km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot68,74,69,70,73.

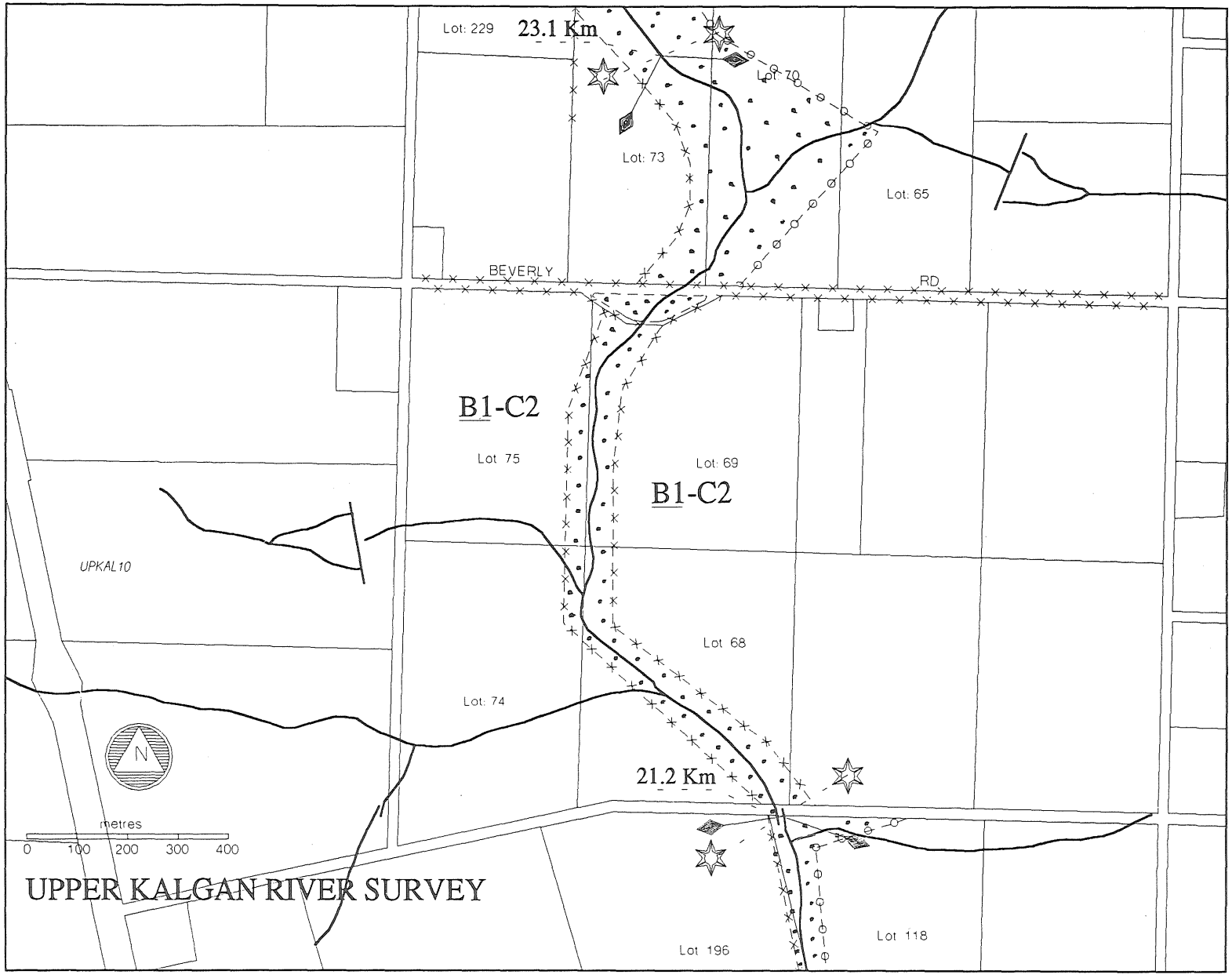
Right Bank : Lot68,74,69,70,73.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.9km	1.1km
Length of Riverbank Fencing Recommended :	Nil	800m
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Spot spray and spot plant in exposed areas. Direct seed samphire and salt bush on bare exposed salt patches. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Spot spray and spot plant in exposed areas. Direct seed samphire and salt bush on bare exposed salt patches. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


Lot: 229
23.1 Km
Lot: 70
Lot: 73
Lot: 65
BEVERLY
RD
B1-C2
Lot 75
Lot: 69
B1-C2
UPKAL10
Lot 68
Lot: 74
N
21.2 Km
metres
0 100 200 300 400
UPPER KALGAN RIVER SURVEY
Lot 196
Lot 118

UPPER KALGAN RIVER SURVEY - UPKAL11 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 23.1km-25km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot73,72,77,78,79.

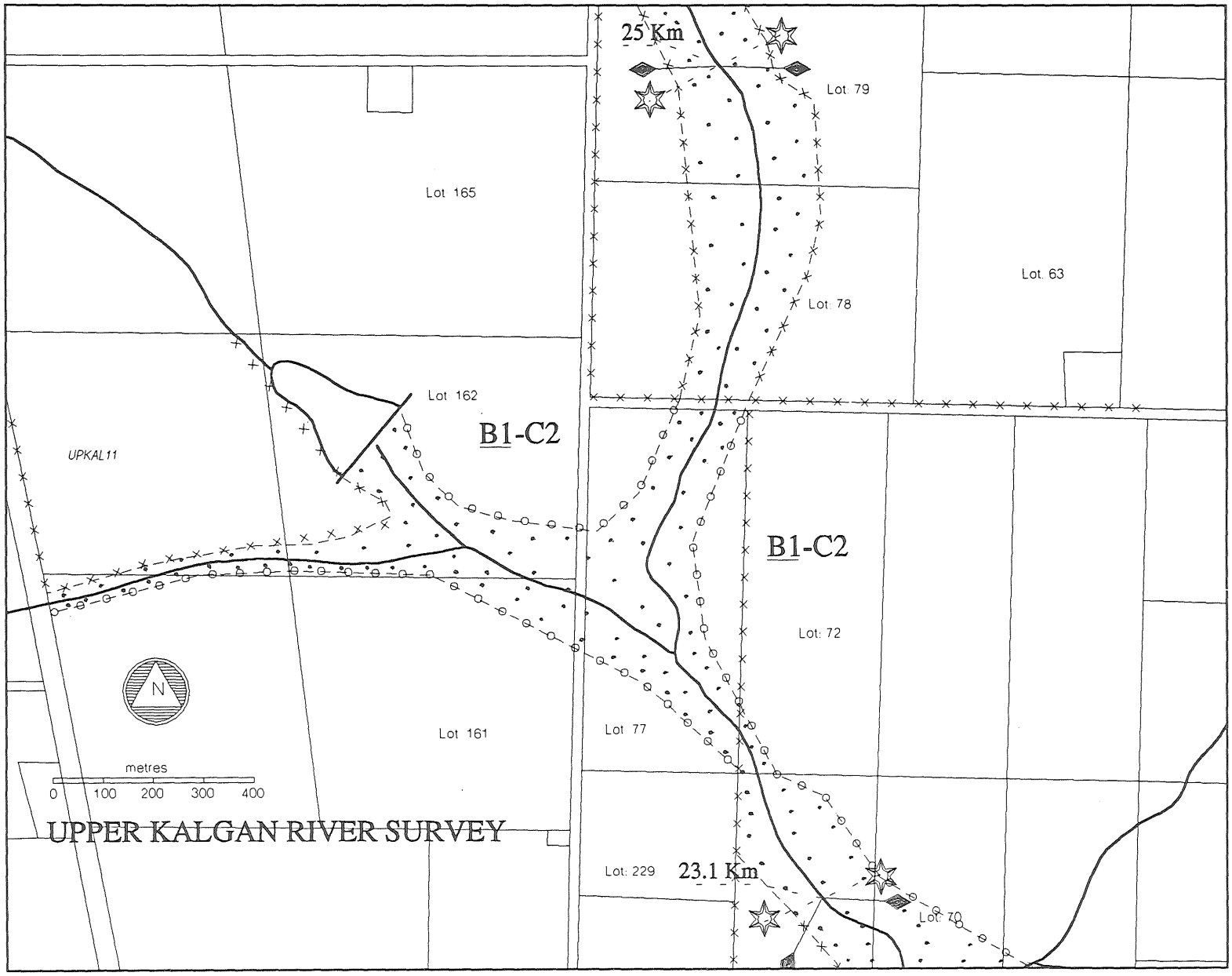
Right Bank : Lot73,72,77,78,79.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	600m	600m
Length of Riverbank Fencing Recommended :	900m	1km
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites : Nil Priority N/A Area (ha) :
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


25 Km
Lot 79
Lot 165
Lot 63
Lot 78
Lot 162
B1-C2
UPKAL11
B1-C2
Lot 72
N
Lot 161
Lot 77
metres
0 100 200 300 400
UPPER KALGAN RIVER SURVEY
Lot 229
23.1 Km
Lot 70

UPPER KALGAN RIVER SURVEY - UPKAL12 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 25km-27.1km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot79,80,166,169,170,171.

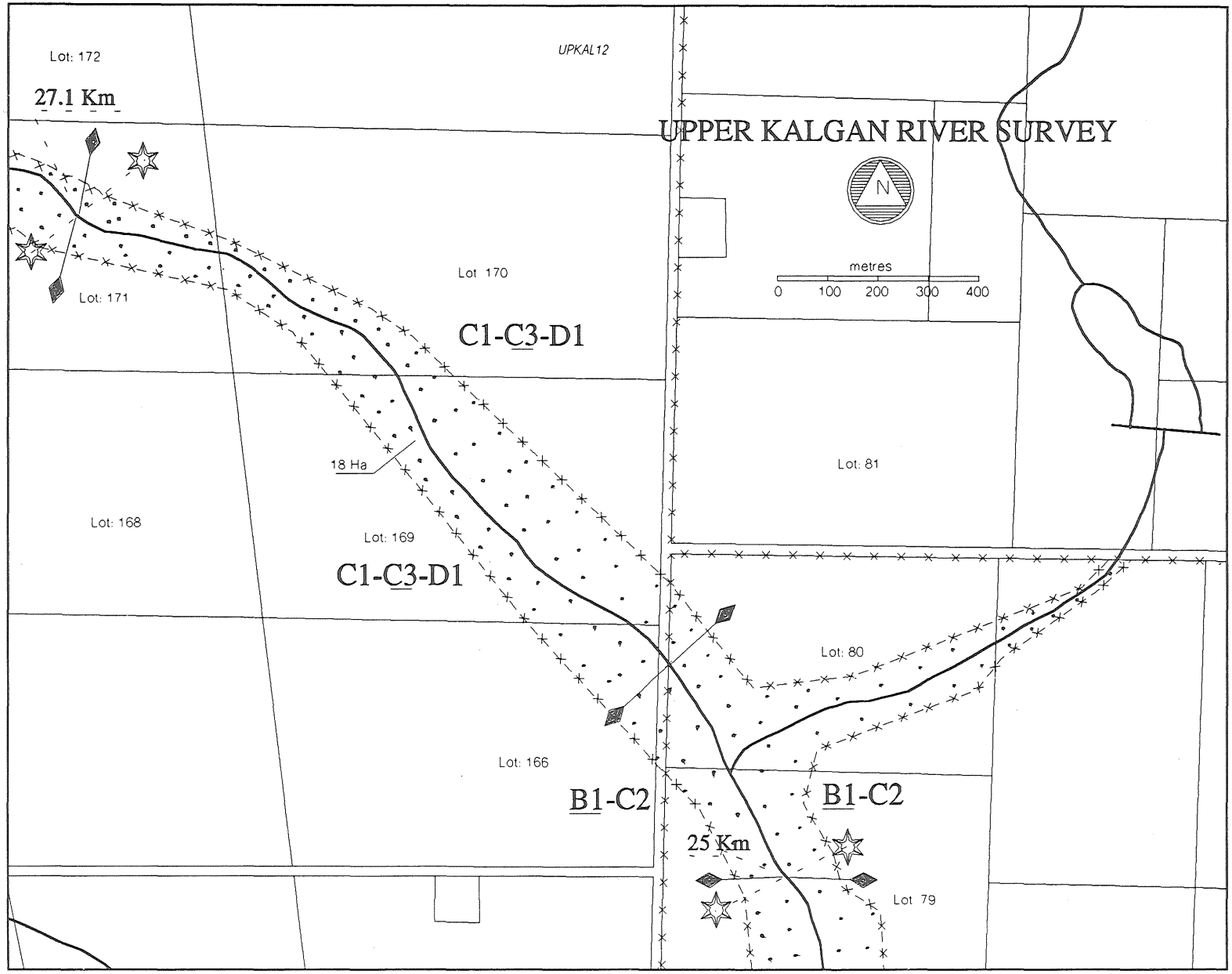
Right Bank : Lot79,80,166,169,170,171.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.1km	2.1km
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1-urgent Area (ha) :18ha	No. of sites : 1 Priority 1-urgent Area (ha) :18ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A


UPPER KALGAN RIVER SURVEY
UPKAL12
Lot: 172
27.1 Km
Lot: 171
Lot 170
C1-C3-D1
18 Ha
Lot: 168
Lot: 169
C1-C3-D1
Lot: 81
Lot: 80
Lot: 166
B1-C2
B1-C2
25 Km
Lot 79
N
metres
0 100 200 300 400

UPPER KALGAN RIVER SURVEY - UPKAL13 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 27.1km-29.3km

Loc. Numbers of Adjacent Properties-
Left Bank : Lot171,172,264,262,132.

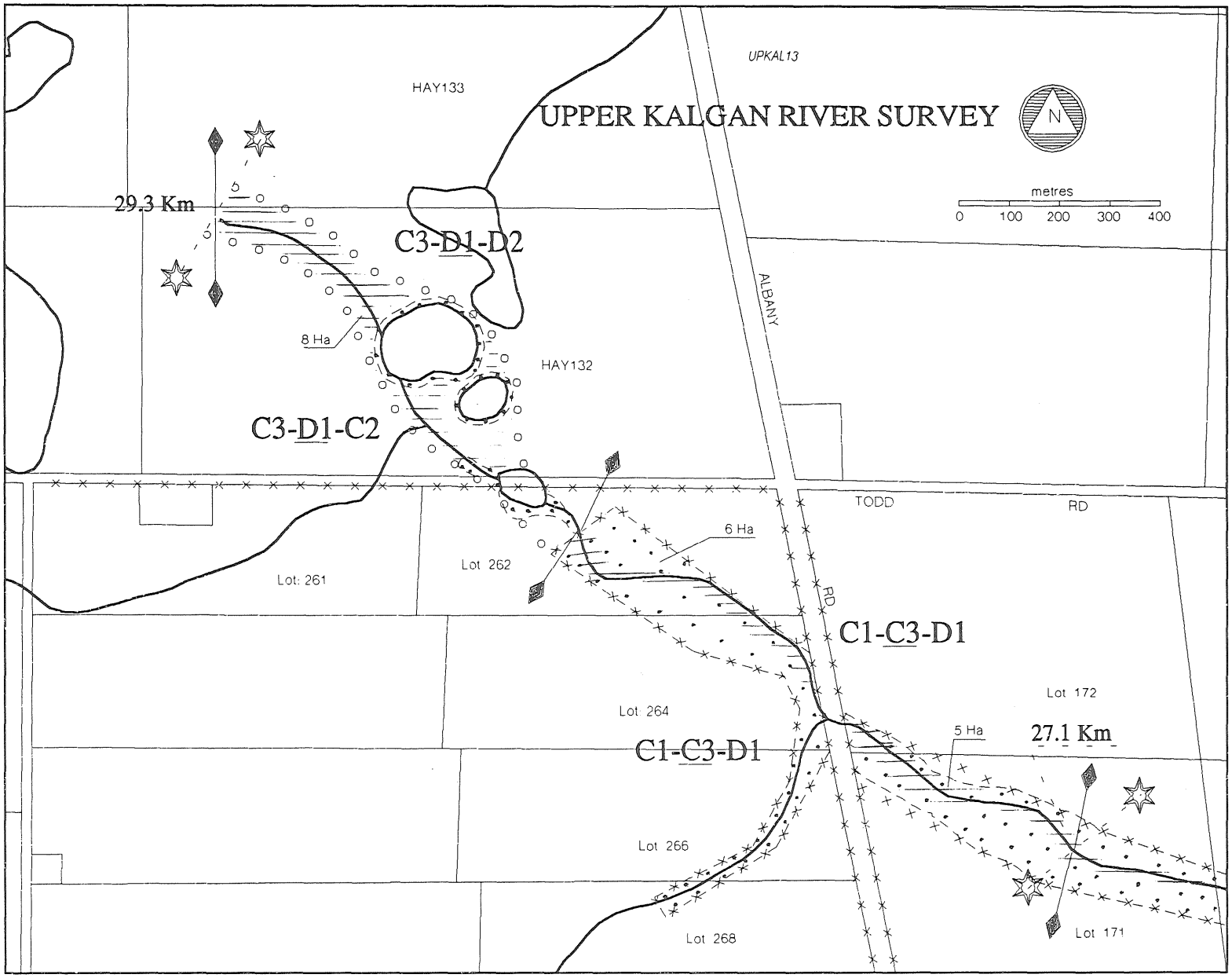
Right Bank : Lot171,172,264,262,132.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 16/5/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.3km	1.1km
Length of Riverbank Fencing Recommended :	1km	950m
Number of Sites showing severe erosion :	Numerous along whole site	Numerous along whole site
Advice on remedial measures required for these sites :	Fence from stock and revegetate.	Fence from stock and revegetate.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 3 Priority 1-urgent Area (ha) :19ha	No. of sites : 3 Priority 1-urgent Area (ha) :19ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species : *M.cuticularis, E.occidentalis, E.rudis.* Direct seed samphire and salt bush on bare exposed salt patches. Area for planting should be ripped and mounded, herring bone fashion pointing towards the direction of flow. Ground for seeding will need to be scarified to break crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


UPKAL13
HAY133
UPPER KALGAN RIVER SURVEY
N
metres
0 100 200 300 400
29.3 Km
C3-D1-D2
8 Ha
HAY132
ALBANY
C3-D1-C2
TODD
RD
6 Ha
Lot: 261
Lot 262
RD
C1-C3-D1
Lot 172
Lot 264
5 Ha
27.1 Km
C1-C3-D1
Lot 266
Lot 268
Lot 171

YOUNG RIVER SURVEY -YOU1 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 0.0km-1.75km

Loc. Numbers of Adjacent Properties-
Left Bank : 4502, 5145.

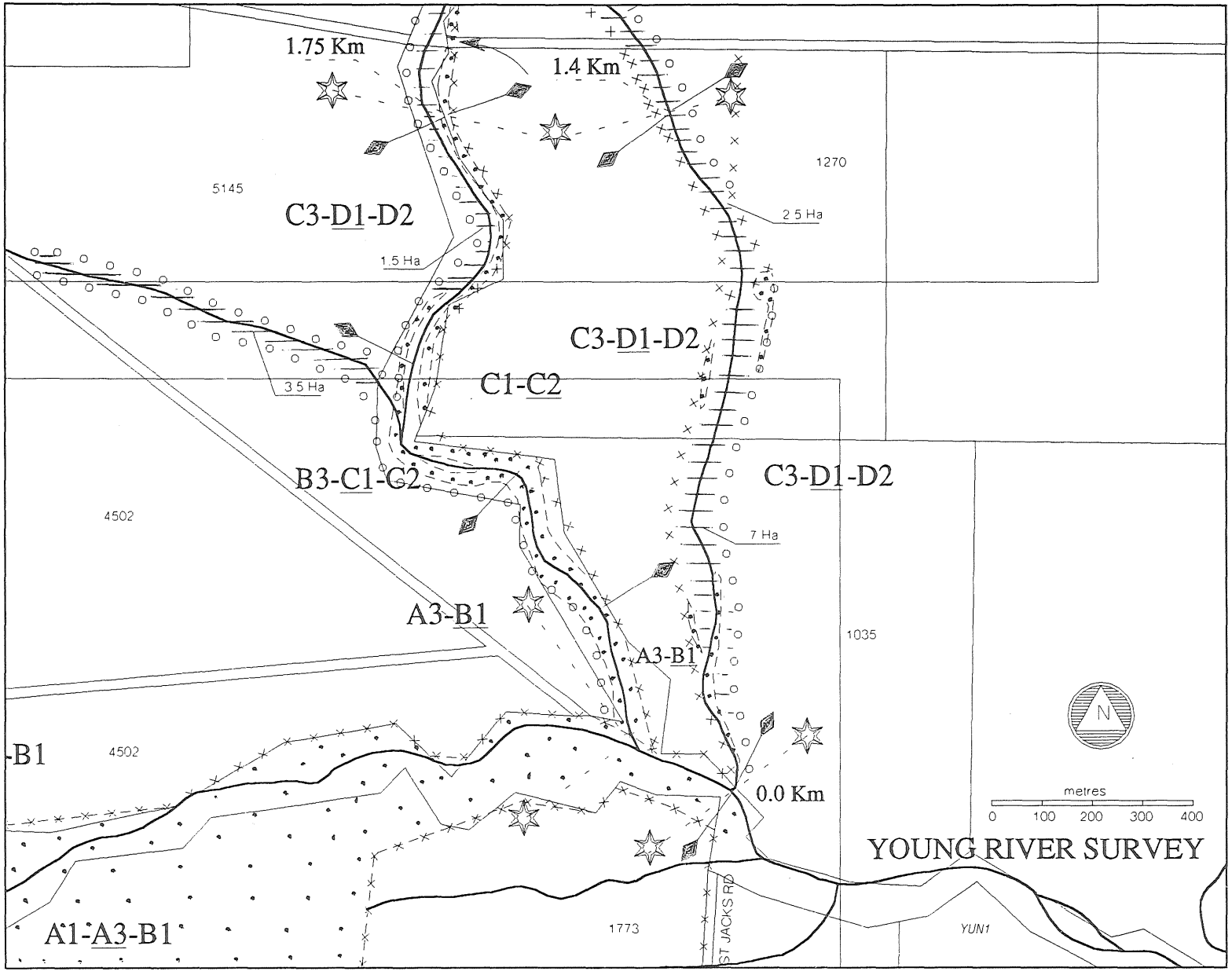
Right Bank : 1035, 1270.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 30/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	Left arm : Nil Right arm : 1.5km	Left arm : 1.5km Right arm : 150m
Length of Riverbank Fencing Recommended :	Left arm : 3km Right arm :Nil	Left arm : Nil Right arm : 1.3km
Number of Sites showing severe erosion :	Most of river flat is eroded	Most of river flat is eroded
Advice on remedial measures required for these sites :	Exclusion of stock, direct seeding of salt tolerants, planting seedlings.	Exclusion of stock, direct seeding of salt tolerants, planting seedlings.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 4 Priority 1-urgent Area (ha) : 8.5ha	No. of sites :2 Priority 1-urgent Area (ha) : 6ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *M.cuticularis, E.occidentalis, E.decipiens.* Rip and mound parallel with river, not in eroded river channel. Direct seed eroded areas with samphire sp. and saltbush. These sites will need scarifying to break up the surface crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *M.cuticularis, E.occidentalis, E.decipiens.* Rip and mound parallel with river, not in eroded river channel. Direct seed eroded areas with samphire sp. and saltbush. These sites will need scarifying to break up the surface crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


1.75 Km
1.4 Km
5145
1270
C3-D1-D2
2.5 Ha
1.5 Ha
C3-D1-D2
C1-C2
3.5 Ha
B3-C1-C2
C3-D1-D2
4502
7 Ha
A3-B1
1035
A3-B1
-B1
4502
0.0 Km
N
metres
0 100 200 300 400
YOUNG RIVER SURVEY
A1-A3-B1
1773
ST JACKS RD
YUN1

YOUNG RIVER SURVEY -YOU2 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 1.75km-3.25km

Loc. Numbers of Adjacent Properties-
Left Bank : 5145.

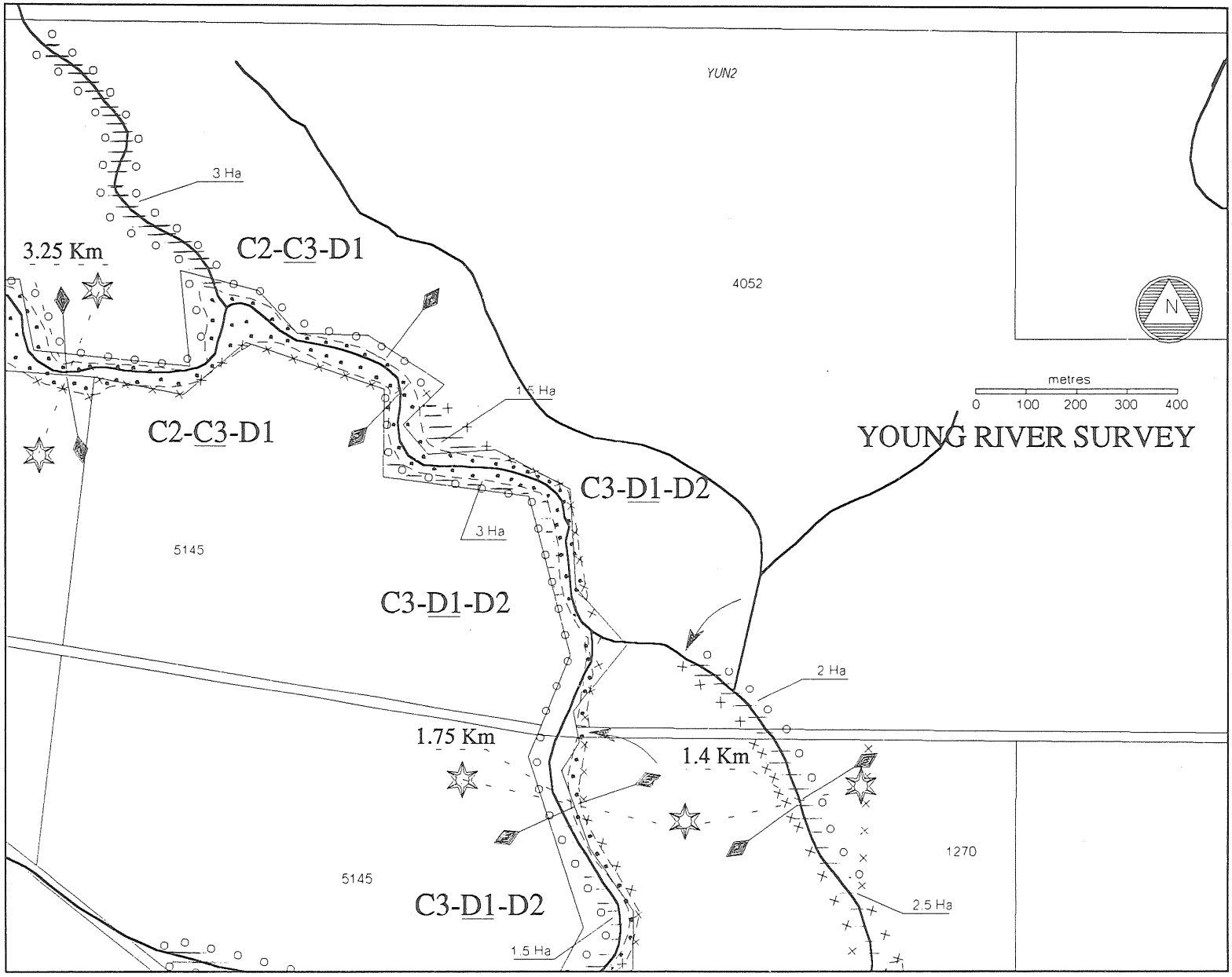
Right Bank : 1270, 4502.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 30/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	800m	1km
Length of Riverbank Fencing Recommended :	1km	2.2km
Number of Sites showing severe erosion :	Most of river flat is eroded	Most of river flat is eroded
Advice on remedial measures required for these sites :	Exclusion of stock, direct seeding of salt tolerants, planting seedlings.	Exclusion of stock, direct seeding of salt tolerants, planting seedlings.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : 1 Priority 1-urgent Area (ha) : 3ha	No. of sites :3 Priority 1-urgent Area (ha) : 6.5ha
Advice on revegetation species and preparation :	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *M.cuticularis, E.occidentalis, E.decipiens.* Rip and mound parallel with river, not in eroded river channel. Direct seed eroded areas with samphire sp. and saltbush. These sites will need scarifying to break up the surface crust, and raked over once the seed has been cast.	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *M.cuticularis, E.occidentalis, E.decipiens.* Rip and mound parallel with river, not in eroded river channel. Direct seed eroded areas with samphire sp. and saltbush. These sites will need scarifying to break up the surface crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


YUN2
3 Ha
3.25 Km
C2-C3-D1
4052
N
metres
0 100 200 300 400
YOUNG RIVER SURVEY
C2-C3-D1
1.5 Ha
C3-D1-D2
3 Ha
5145
C3-D1-D2
2 Ha
1.75 Km
1.4 Km
1270
5145
C3-D1-D2
2.5 Ha
1.5 Ha

YOUNG RIVER SURVEY -YOU3 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 3.25km-5.05km

Loc. Numbers of Adjacent Properties-
Left Bank : 5145, 2844, Crown land.

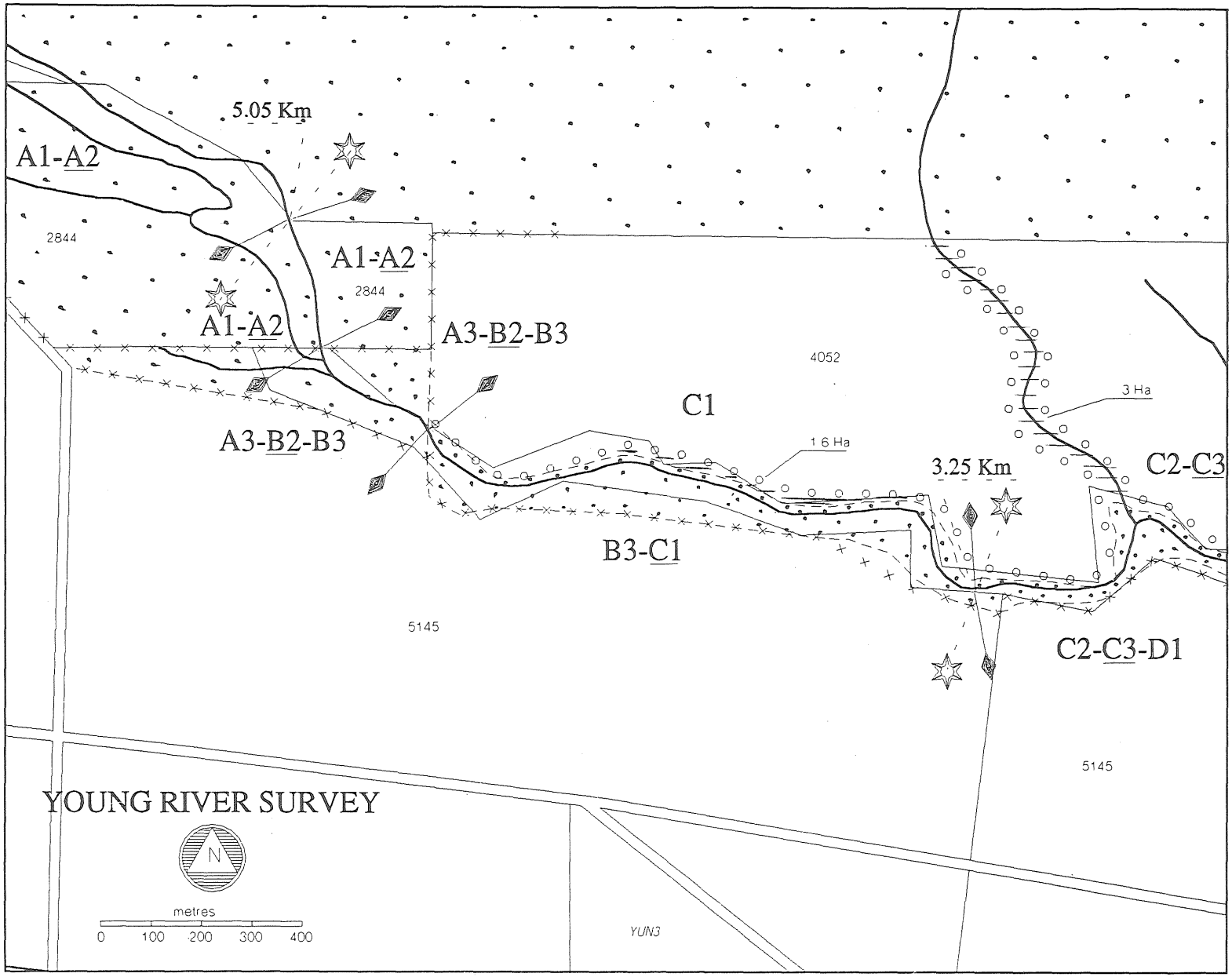
Right Bank : 5145, 2844, Crown land.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 30/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	1.8km	350m
Length of Riverbank Fencing Recommended :	Nil	1.45km
Number of Sites showing severe erosion :	Most of lower river channel is eroded	Most of lower river channel is eroded
Advice on remedial measures required for these sites :	Exclusion of stock.	Exclusion of stock, direct seeding of salt tolerants, planting seedlings.
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites :1 Priority 1-urgent Area (ha) : 1.6ha
Advice on revegetation species and preparation :	N/A	Select revegetation species from appropriate section of Appendix 1 of this report, including the following existing site species: *M.cuticularis, E.occidentalis, E.decipiens.* Rip and mound parallel with river, not in eroded river channel. Direct seed eroded areas with samphire sp. and saltbush. These sites will need scarifying to break up the surface crust, and raked over once the seed has been cast.
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.	Provide stabilised access points to the creek for stock crossing and watering. Ideally provide alternative watering point such as a dam, or pump to a trough utilising solar, wind generated or nose pumps.


5.05 Km
A1-A2
2844
A1-A2
2844
A1-A2
A3-B2-B3
4052
C1
3 Ha
A3-B2-B3
1 6 Ha
3.25 Km
C2-C3
B3-C1
5145
C2-C3-D1
5145
YOUNG RIVER SURVEY
N
metres
0 100 200 300 400
YUN3

YOUNG RIVER SURVEY -YOU4 See Map 1.2 (pg.4) for location

Distances from River Mouth (km) : 5.05km-6.7km

Loc. Numbers of Adjacent Properties-
Left Bank : Crown land.

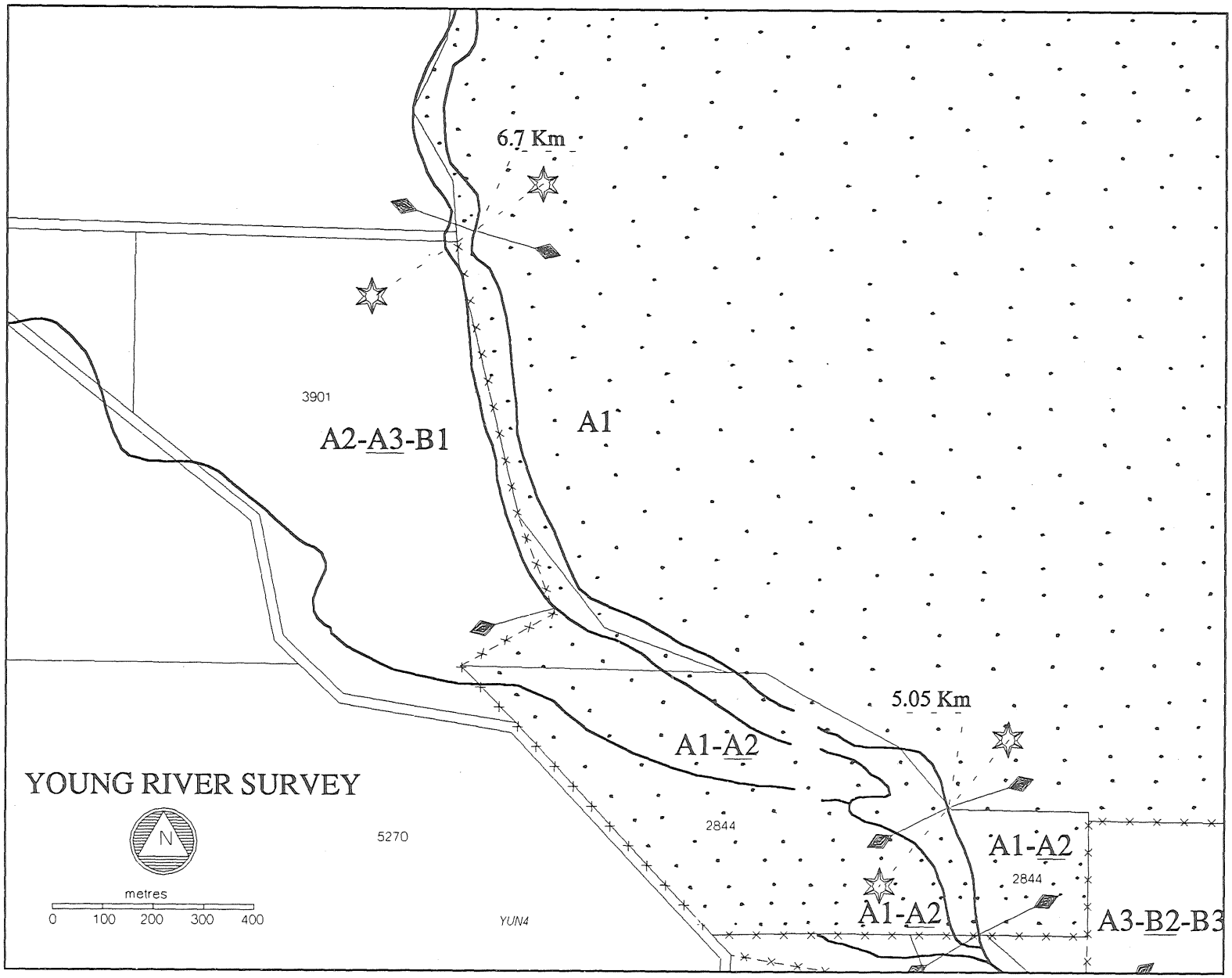
Right Bank : Crown land.

Survey Project Officer(s) : Kevin Hopkinson

Date Surveyed : 30/4/97

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Left Bank	Right Bank
Length of Riverbank Fencing In Place :	2.25km	1.75km
Length of Riverbank Fencing Recommended :	Nil	Nil
Number of Sites showing severe erosion :	Nil	Nil
Advice on remedial measures required for these sites :	N/A	N/A
No. of sites and cumulative approximate area of these sites along riverbank requiring riverbank revegetation work :	No. of sites : Nil Priority N/A Area (ha) :	No. of sites :Nil Priority N/A Area (ha) : Nil
Advice on revegetation species and preparation :	N/A	N/A
Number of other sites requiring rehabilitation work (ie serious weed infestations) :	Nil	Nil
Advice on rehabilitation of these sites :	N/A	N/A
Other management advice for this section :		


6.7 Km
3901
A2-A3-B1
A1
5.05 Km
A1-A2
YOUNG RIVER SURVEY
N
5270
2844
A1-A2
2844
A1-A2
A3-B2-B3
metres
0 100 200 300 400
YUN4

References

APACE Green Skills and Pen, L (1995) The Condition of the Denmark and Hay River Foreshores. A Report prepared for the Wilson Inlet Management Authority. Waterways Commission Report No 60.

APACE Green Skills (1996) Restoring the Health of the Little River: Riparian Survey and Management Recommendations for Repairing the Little River Catchment near Denmark, WA. A report prepared for the Denmark Environment Centre.

CALM (WA Department of Conservation and Land Management) (1992) "South Coast Region Regional Management Plan 1992 - 2002" Management Plan No. 24. WA.

CALM (1994). Forest Management Plan 1994 - 2003.

Collins, P.D.K., Fowlie, W.G. (1981). Denmark and Kent River Basins Water Resources Survey. Engineering Division, Water Resources Branch, Public Works Department, Western Australia.

Cooper, J. R., Gilliam, J. W., Daniels, R. B. and Robarge, W. P. (1987). Riparian areas as filters for agricultural sediment. Soil Science Society of America Journal, 51, 416-420.

DeBano, L. F. and Schmidt, L. J. (1990). Healthy riparian areas as related to watershed stability. In: Erosion Control: Technology in Transition. Proceedings of Conference XXI - International Erosion Control Association, Washington DC, USA.

Denmark Environment Centre (1995), Personal communication.

Dillaha, T. A., Sherrard, J. H., Lee, D., Mostaghimi, S. and Shanholtz, V. O. (1988). Evaluation of vegetative filter strips as a best management practice for feed lots. Journal of Water Pollution Control Federation 60: 1231-1238.

Dillaha, T. A., Sherrard, J. H., Lee, D., Mostaghimi, S. and Lee, D. (1989). Vegetative filter strips for agricultural non point source pollution control. Transactions of the American Society of Agricultural Engineers, 32: 513-519.

DPUD. (1991). Albany Regional Planning Study: Profile. Department of Planning and Urban Development.

Heede, B. H. (1988). The influence of vegetation and its spatial distribution on sediment delivery from selected Arizona forests and woodlands. Erosion control: stay in tune. Proceedings of Conference XIX, Arizona State University.

Howard-Williams, C. and Downes, M. T. (1984). Nutrient removal by streambank vegetation. In: Land treatment of wastes: proceedings of a seminar. Wilcock, R. J. (Ed.) Water and Soil Directorate, Ministry of Works and Development for the National Water and Conservation Authority, Wellington. Water and Soil Miscellaneous Publication No. 70: 409-422.

Howard-Williams, C., Pickmere, S. and Davies, J. (1986). Nutrient retention and processing in New Zealand Streams: the influence of riparian vegetation. New Zealand Agricultural Science 20: 110-114.

Hussey, B. M. J., Hobbs, R. J. and Saunders, D. A. (1989). Guidelines for Bush Corridors. Surrey Beatty & Sons.

Hussey, B. M. J. and Wallace, K. J. (1993). Managing Your Bushland. Department of Conservation and Land Management.

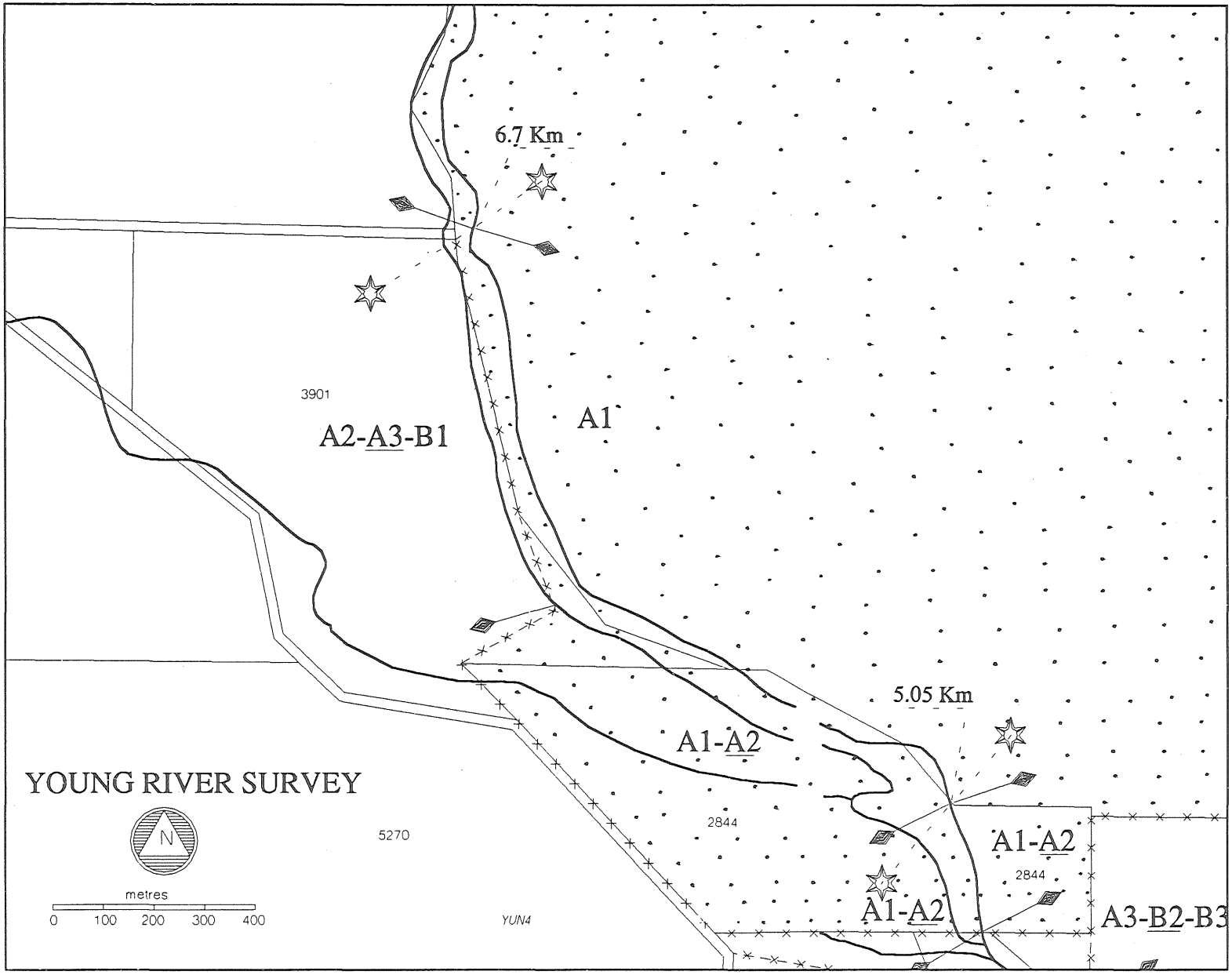
Jacobs, T. C. and Gilliam, J. W. (1985). Riparian losses of nitrate from agricultural drainage waters. Journal of Environmental Quality, 14: 472-478.

Knauer, N. and Mander, U. (1989). Studies on the filtration of differently vegetated buffer strips along inland waters in Schleswig-Holstein 1. Filtration of nitrogen and phosphorus. Zeitschrift-fur-Kulturtecknik-und-Landentwicklung, 30: 365-376.

MacKenzie, A. (1996) Identification of the Main Areas of Erosion and Factors Affecting The Health of The Little River. Report prepared for the Denmark Environment Centre.

Magette, W. L., Brinsfield, R. B., Palmer, R. E. and Wood, J.D. (1989). Nutrient and sediment removal by vegetated filter strips. Transactions of the American Society of Agricultural Engineers, 32: 663-667.

Marsh, W. M. and Dozier, J. (1981). Landscape: An Introduction to Physical Geography John Wiley & Sons, New York.


6.7 Km
3901
A2-A3-B1
A1
5.05 Km
A1-A2
YOUNG RIVER SURVEY
N
5270
2844
A1-A2
2844
A1-A2
A3-B2-B3
metres
0 100 200 300 400
YUN4

References

APACE Green Skills and Pen, L (1995) The Condition of the Denmark and Hay River Foreshores. A Report prepared for the Wilson Inlet Management Authority. Waterways Commission Report No 60.

APACE Green Skills (1996) Restoring the Health of the Little River: Riparian Survey and Management Recommendations for Repairing the Little River Catchment near Denmark, WA. A report prepared for the Denmark Environment Centre.

CALM (WA Department of Conservation and Land Management) (1992) "South Coast Region Regional Management Plan 1992 - 2002" Management Plan No. 24. WA.

CALM (1994). Forest Management Plan 1994 - 2003.

Collins, P.D.K., Fowlie, W.G. (1981). Denmark and Kent River Basins Water Resources Survey. Engineering Division, Water Resources Branch, Public Works Department, Western Australia.

Cooper, J. R., Gilliam, J. W., Daniels, R. B. and Robarge, W. P. (1987). Riparian areas as filters for agricultural sediment. Soil Science Society of America Journal, 51, 416-420.

DeBano, L. F. and Schmidt, L. J. (1990). Healthy riparian areas as related to watershed stability. In: Erosion Control: Technology in Transition. Proceedings of Conference XXI - International Erosion Control Association, Washington DC, USA.

Denmark Environment Centre (1995), Personal communication.

Dillaha, T. A., Sherrard, J. H., Lee, D., Mostaghimi, S. and Shanholtz, V. O. (1988). Evaluation of vegetative filter strips as a best management practice for feed lots. Journal of Water Pollution Control Federation 60: 1231-1238.

Dillaha, T. A., Sherrard, J. H., Lee, D., Mostaghimi, S. and Lee, D. (1989). Vegetative filter strips for agricultural non point source pollution control. Transactions of the American Society of Agricultural Engineers, 32: 513-519.

DPUD. (1991). Albany Regional Planning Study: Profile. Department of Planning and Urban Development.

Heede, B. H. (1988). The influence of vegetation and its spatial distribution on sediment delivery from selected Arizona forests and woodlands. Erosion control: stay in tune. Proceedings of Conference XIX, Arizona State University.

Howard-Williams, C. and Downes, M. T. (1984). Nutrient removal by streambank vegetation. In: Land treatment of wastes: proceedings of a seminar. Wilcock, R. J. (Ed.) Water and Soil Directorate, Ministry of Works and Development for the National Water and Conservation Authority, Wellington. Water and Soil Miscellaneous Publication No. 70: 409-422.

Howard-Williams, C., Pickmere, S. and Davies, J. (1986). Nutrient retention and processing in New Zealand Streams: the influence of riparian vegetation. New Zealand Agricultural Science 20: 110-114.

Hussey, B. M. J., Hobbs, R. J. and Saunders, D. A. (1989). Guidelines for Bush Corridors. Surrey Beatty & Sons.

Hussey, B. M. J. and Wallace, K. J. (1993). Managing Your Bushland. Department of Conservation and Land Management.

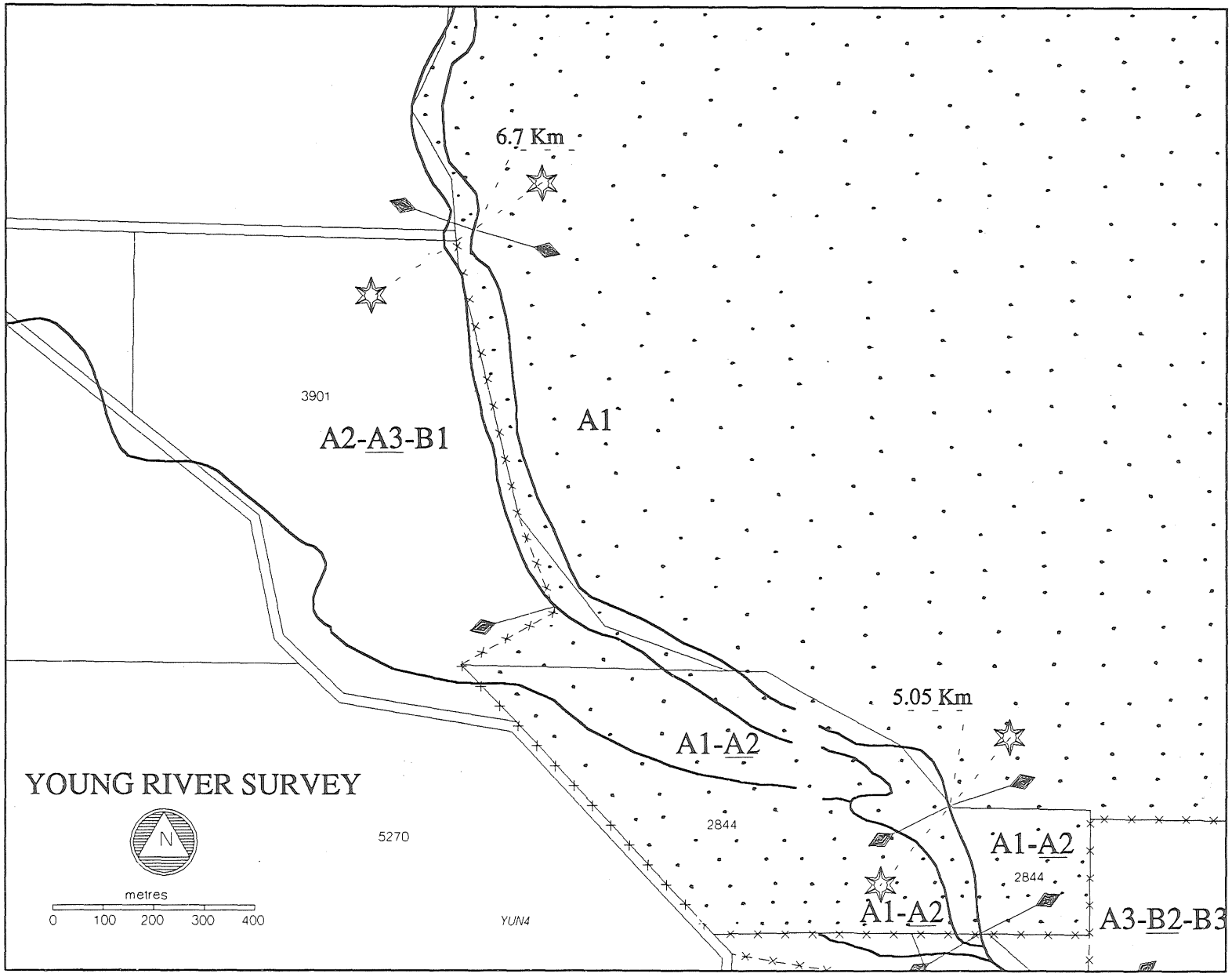
Jacobs, T. C. and Gilliam, J. W. (1985). Riparian losses of nitrate from agricultural drainage waters. Journal of Environmental Quality, 14: 472-478.

Knauer, N. and Mander, U. (1989). Studies on the filtration of differently vegetated buffer strips along inland waters in Schleswig-Holstein 1. Filtration of nitrogen and phosphorus. Zeitschrift-fur-Kulturtecknik-und-Landentwicklung, 30: 365-376.

MacKenzie, A. (1996) Identification of the Main Areas of Erosion and Factors Affecting The Health of The Little River. Report prepared for the Denmark Environment Centre.

Magette, W. L., Brinsfield, R. B., Palmer, R. E. and Wood, J.D. (1989). Nutrient and sediment removal by vegetated filter strips. Transactions of the American Society of Agricultural Engineers, 32: 663-667.

Marsh, W. M. and Dozier, J. (1981). Landscape: An Introduction to Physical Geography John Wiley & Sons, New York.


6.7 Km
3901
A2-A3-B1
A1
5.05 Km
A1-A2
YOUNG RIVER SURVEY
N
2844
5270
A1-A2
2844
A1-A2
A3-B2-B3
metres
0 100 200 300 400
YUN4

References

APACE Green Skills and Pen, L (1995) The Condition of the Denmark and Hay River Foreshores. A Report prepared for the Wilson Inlet Management Authority. Waterways Commission Report No 60.

APACE Green Skills (1996) Restoring the Health of the Little River: Riparian Survey and Management Recommendations for Repairing the Little River Catchment near Denmark, WA. A report prepared for the Denmark Environment Centre.

CALM (WA Department of Conservation and Land Management) (1992) "South Coast Region Regional Management Plan 1992 - 2002" Management Plan No. 24. WA.

CALM (1994). Forest Management Plan 1994 - 2003.

Collins, P.D.K., Fowlie, W.G. (1981). Denmark and Kent River Basins Water Resources Survey. Engineering Division, Water Resources Branch, Public Works Department, Western Australia.

Cooper, J. R., Gilliam, J. W., Daniels, R. B. and Robarge, W. P. (1987). Riparian areas as filters for agricultural sediment. Soil Science Society of America Journal, 51, 416-420.

DeBano, L. F. and Schmidt, L. J. (1990). Healthy riparian areas as related to watershed stability. In: Erosion Control: Technology in Transition. Proceedings of Conference XXI - International Erosion Control Association, Washington DC, USA.

Denmark Environment Centre (1995), Personal communication.

Dillaha, T. A., Sherrard, J. H., Lee, D., Mostaghimi, S. and Shanholtz, V. O. (1988). Evaluation of vegetative filter strips as a best management practice for feed lots. Journal of Water Pollution Control Federation 60: 1231-1238.

Dillaha, T. A., Sherrard, J. H., Lee, D., Mostaghimi, S. and Lee, D. (1989). Vegetative filter strips for agricultural non point source pollution control. Transactions of the American Society of Agricultural Engineers, 32: 513-519.

DPUD. (1991). Albany Regional Planning Study: Profile. Department of Planning and Urban Development.

Heede, B. H. (1988). The influence of vegetation and its spatial distribution on sediment delivery from selected Arizona forests and woodlands. Erosion control: stay in tune. Proceedings of Conference XIX, Arizona State University.

Howard-Williams, C. and Downes, M. T. (1984). Nutrient removal by streambank vegetation. In: Land treatment of wastes: proceedings of a seminar. Wilcock, R. J. (Ed.) Water and Soil Directorate, Ministry of Works and Development for the National Water and Conservation Authority, Wellington. Water and Soil Miscellaneous Publication No. 70: 409-422.

Howard-Williams, C., Pickmere, S. and Davies, J. (1986). Nutrient retention and processing in New Zealand Streams: the influence of riparian vegetation. New Zealand Agricultural Science 20: 110-114.

Hussey, B. M. J., Hobbs, R. J. and Saunders, D. A. (1989). Guidelines for Bush Corridors. Surrey Beatty & Sons.

Hussey, B. M. J. and Wallace, K. J. (1993). Managing Your Bushland. Department of Conservation and Land Management.

Jacobs, T. C. and Gilliam, J. W. (1985). Riparian losses of nitrate from agricultural drainage waters. Journal of Environmental Quality, 14: 472-478.

Knauer, N. and Mander, U. (1989). Studies on the filtration of differently vegetated buffer strips along inland waters in Schleswig-Holstein 1. Filtration of nitrogen and phosphorus. Zeitschrift-fur-Kulturtecknik-und-Landentwicklung, 30: 365-376.

MacKenzie, A. (1996) Identification of the Main Areas of Erosion and Factors Affecting The Health of The Little River. Report prepared for the Denmark Environment Centre.

Magette, W. L., Brinsfield, R. B., Palmer, R. E. and Wood, J.D. (1989). Nutrient and sediment removal by vegetated filter strips. Transactions of the American Society of Agricultural Engineers, 32: 663-667.

Marsh, W. M. and Dozier, J. (1981). Landscape: An Introduction to Physical Geography John Wiley & Sons, New York.

Odum, W. E. (1990). Internal processes influencing the maintenance of ecotones: Do they exist? In: Naiman, R. T. and Decamps, H. (Eds). The Ecology and Management of Aquatic - terrestrial Ecotones. Man and the biosphere Series Vol. 4. UNESCO. The Parthenon Publishing Group, Paris. pp. 91-101.

Olson, G. and Skitmore, E. (1991). State of the rivers of the South West Drainage Division. Western Australian Water Resources Council.

Pen, L. J. (1992). Fringing vegetation of the Lower Collie and Brunswick River 1992. Leschenault Management Authority, Waterways Commission Report No. 37.

Pen, L. J. (1993). Fringing vegetation of the Canning, Southern and Wungong Rivers. Swan River Trust Report No. 7.

Pen, L. J. (1994) Condition of the Foreshore vegetation of the Kalgan River 1992. Albany Waterways Management Authority, Waterways Commission Report.

Pen, L. J. and M. Scott (1995) Stream Foreshore Assessment in Farming Areas. Blackwood Catchment Co-ordinating Group. Western Australia

Peterjohn, W. T. and Correll, D. L. (1984). Nutrient dynamics in an agricultural watershed: observations on the role of a riparian forest. Ecology 65: 1466-1475.

Pieczynska, E. (1990). Lentic aquatic - terrestrial ecotones: their structure, function and importance. In: Naiman, R. T. and Decamps, H. (Eds). The Ecology and Management of Aquatic - terrestrial Ecotones. Man and the biosphere Series Vol. 4. UNESCO. The Parthenon Publishing Group, Paris. pp. 65-89.

Pinay, G., Decamps, H., Chauvet, E. and Fustec, E. (1990). Functions of ecotones in fluvial systems. In: Naiman, R. T. and Decamps, H. (Eds). The Ecology and Management of Aquatic - Terrestrial Ecotones. Man and the biosphere Series Vol. 4. UNESCO. The Parthenon Publishing Group, Paris. pp. 141-169.

Prout, A. L. (1995). The Department of Agriculture approach to nutrient management in Albany Harbours and Wilson Inlet. A Briefing paper presented to the Wilson Inlet Management Authority in April 1995.

Riding, T. and Carter, R. (1992). The importance of the riparian zone in water resource management. Water Resources, Canberra.

SCEP. (1991). Reducing the nutrient load from rural sources to Albany's Harbours. Draft Report. South Coast Estuaries Project Group (SCEPG), Department of Agriculture of Western Australia.

Schmidt, L. J. and DeBano, L. F. (1990). Delayed erosion threats to channel and riparian areas. Erosion Control: Technology in Transition. Proceedings of Conference No. XXI. International Erosion Control Association, February 1990, pp 69-73.

Siemon, N., Davis, G., Hubbard, P. and Duckworth, A. (1993). Fringing vegetation of the Serpentine River in the Shire of Serpentine-Jarrahdale and City of Rockingham. Waterways Commission Report No. 38.

Thorne, C. R. (1990). Effects of vegetation on riverbank erosion and stability. In: Thorne, C. R. (Ed.) Vegetation and Erosion. Jon Wiley & Sons Ltd. pp. 125-143.

Troeh, F. T., Hobbs, J. A. and Donahue, R. L. (1980). Soil and Water Conservation: For Productivity and Environmental Protection. Prentice-Hall, New Jersey.

Weaver, D. M. and Prout, A. L. (1993). Changing farm practice to meet environmental objectives of nutrient loss to Oyster Harbour. Fertiliser Research Vol. 36 Page 177-184 1993.

Weaver, D. M., Pen, L. J. and Reed, A.E.G (1994). Modifying the phosphorus cycle to achieve management objectives in the Oyster Harbour Catchment. WATER Vol 21, 1:28-32.

Wissmar, R. C. and Swanson, F. J. (1990). Landscape disturbances and lotic ecotones. In: Naiman, R. T. and Decamps, H. (Eds). The Ecology and Management of Aquatic - terrestrial Ecotones. Man and the biosphere Series Vol. 4. UNESCO. The Parthenon Publishing Group, Paris. pp. 65-89.

Yates, P. and Sheridan, J. M. (1983). Estimating the effectiveness of vegetated floodplains/wetlands as nitrate-nitrite and orthophosphorus filters. Agricultural Ecosystems and Environment 9:303-314.

Appendices

Appendix 1: List of local plant species for foreshore rehabilitation and revegetation in the Oyster Harbour Catchment.

This Appendix presents information gained from a botanical survey carried out by Dr Luke Pen for this report on the condition of the Kalgan river foreshores

Species/Section Env	1	2	3	4	5	6	7	8	9	10	11	12	13
Tall Trees													
Eucalyptus diversicolor						*							
Medium Trees													
Eucalyptus wandoo													*
Eucalyptus marginata				*		*			*	*			
Corymbia (Eucalyptus) calophylla		*	*	*		*	*		*				
Eucalyptus cornuta			*										
Eucalyptus rudis					*		*	*			*		
Eucalyptus occidentalis					*		*		*				*
Small Trees													
Melaleuca rhaphiophylla					*		*	*			*		
Agonis flexuosa			*										
Agonis juniperina		*											
Melaleuca viminea								*			*	*	*
Melaleuca cuticularis	*											*	
Eucalyptus decipiens										*			*
Hakea oleifolia			*			*							
Banksia seminuda						*			*				
Banksia grandis									*				
Calistachys lanceolata		*			*		*	*					
Casuarina obesa												*	

Appendix 1 (continued)

Small Trees/Large Shrubs	1	2	3	4	5	6	7	8	9	10	11	12	13
Acacia myrtifolia			*			*							
Agonis parviceps			*			*							
Agonis hypericifolia				*		*							
Astartea fascicularis		*			*		*						
Agonis linearifolia		*			*	*							
Melaleuca densa					*								
Leptospermum oligandrum													*
Hakea ruscifolia			*			*							
Hakea prostrata				*		*							
Trimalum floribundum					*			*					
Dondonaea ceratocarpa								*					
Allocasuarina heugeliana													*
Actinostrobus arenarius													*
Shrubs													
Hypocalymma angustifolium			*										
Calothamnus quadrifidus				*						*			
Thrptomene saxicola										*			
Sollya heterophylla			*			*							
Hakea trifurcata		*											
Hakea undulata				*									
Darwinia citriodora			*			*		*		*			
Melaleuca thymoides												*	*
Bossiaea linophylla			*			*			*				
Bossiaea divaricata			*										

Appendix 1 (continued)

Section and Environment	1	2	3	4	5	6	7	8	9	10	11	12	13
Large Sedges													
Gahnia trifidia	*						*					*	
Juncus kraussii	*	*											
Juncus kraussii sub australiensis					*		*	*			*	*	
Lepidosperma effusum		*			*		*	*			*	*	
Lepidosperma tetraquetrum					*		*	*					
Cyathochaeta clandestina				*					*				
Juncus pallidas					*								
Medium Sedges													
Cyathochaeta avenacea			*			*			*				
Baumea juncea		*			*		*	*					
Isolepis nodosa						*	*						
Leptocarpus coangustatus		*			*		*						
Leptocarpus scariosus		*											
Lepidosperma longitudinale		*	*						*				
Small Sedges													
Loxocarya flexuosa			*			*							*
Anarthia laevis											*		
Gahnia ancistrophylla													*
Samphires													
Sarcocornia quinqueflora												*	
Halosarcia lepidosperma												*	
Grasses													
Stipa junceafolia												*	*
Parapholis incurva												*	

Key
1 Saline foreshore, King
2 Freshwater lower foreshore, King, Johnston
3. Moist embankment, King, Johnston
4 Sandy dry embankment, King, Johnston
5. Floodway, Chelgiup, Napier, Takenup
6. Embankment, Chelgiup, Napier, Takenup
7. Floodway, Moorialup
8. Rocky floodway, Moorialup
9. Embankment, Moorialup
10 Rocky embankment , Moorialup
11 Fresh/backish floodway Gaalecup, Stoney, Takalarup, Upper Kalgan, Young
12 Saline floodway Gaalecup, Stoney, Takalarup, Upper Kalgan, Young
13 Embankment Gaalecup, Stoney, Takalarup, Upper Kalgan, Young

Appendix 1 (continued)

Small Trees/Large Shrubs	1	2	3	4	5	6	7	8	9	10	11	12	13
Acacia myrtifolia			*			*							
Agonis parviceps			*			*							
Agonis hypericifolia				*		*							
Astartea fascicularis		*			*		*						
Agonis linearifolia		*			*	*							
Melaleuca densa					*								
Leptospermum oligandrum													*
Hakea ruscifolia			*			*							
Hakea prostrata				*		*							
Trimalum floribundum					*			*					
Dondonaea ceratocarpa								*					
Allocasuarina heugeliana													*
Actinostrobus arenarius													*
Shrubs													
Hypocalymma angustifolium			*										
Calothamnus quadrifidus				*						*			
Thrptomene saxicola										*			
Sollya heterophylla			*			*							
Hakea trifurcata		*											
Hakea undulata				*									
Darwinia citriodora			*			*		*		*			
Melaleuca thymoides												*	*
Bossiaea linophylla			*			*			*				
Bossiaea divaricata			*										

Appendix 1 (continued)

Section and Environment	1	2	3	4	5	6	7	8	9	10	11	12	13
Large Sedges													
Gahnia trifidia	*						*					*	
Juncus kraussii	*	*											
Juncus kraussii sub australiensis					*		*	*			*	*	
Lepidosperma effusum		*			*		*	*			*	*	
Lepidosperma tetraquetrum					*		*	*					
Cyathochaeta clandestina				*					*				
Juncus pallidas					*								
Medium Sedges													
Cyathochaeta avenacea			*			*			*				
Baumea juncea		*			*		*	*					
Isolepis nodosa						*	*						
Leptocarpus coangustatus		*			*		*						
Leptocarpus scariosus		*											
Lepidosperma longitudinale		*	*						*				
Small Sedges													
Loxocarya flexuosa			*			*							*
Anarthia laevis											*		
Gahnia ancistrophylla													*
Samphires													
Sarcocornia quinqueflora												*	
Halosarcia lepidosperma												*	
Grasses													
Stipa junceafolia												*	*
Parapholis incurva												*	

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10 Rocky embankment , Moorialup
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12 Saline floodway Gaalecup, Stoney, Takalarup, Upper Kalgan, Young
13 Embankment Gaalecup, Stoney, Takalarup, Upper Kalgan, Young

Appendix 2: Recommended books and other literature on waterways management and native vegetation rehabilitation

Bradley, J. (1991). *Bringing Back the Bush. The Bradley Method of Bush Regeneration.* Ure Smith Press, NSW.

Buchanan, R. A. (1989). *Bush Regeneration: Recovering Australian Landscapes.* TAFE Student Learning Publications, NSW.

CALM (1987). Nati*ve Seed Collection and Storage.* Information Sheet No. 5, Department of Conservation and Land Management, Perth 1987.

Heinjus, D. (1992). *Farm Tree Planting.* Inkata Press, South Australia.

Hussey, B. M. J. and Wallace, K. J. (1993). *Managing Your Bushland.* Department of Conservation and Land Management.

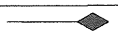
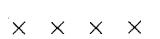
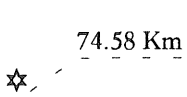
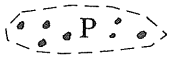
Jones, D. and Elliot, R. (1990). *Pests, Diseases and Ailments of Australian Plants.* Lothian Publishing Company, Melbourne.

Land & Waters Resources Research & Development Corporation. (1996) Fact Sheets on Riparian Management. Nos. 1 - 6 Canberra ACT.

Main Roads Department. *Summary of direct seeding techniques.* Albany division of the Main Roads Department.

Powell, R. (1990). *Leaf and Branch: Trees and Shrubs of Perth.* Department of Conservation and Land Management.

LEGEND - RIVER SURVEY MAPS.

Survey class	Description
A (grade foreshore)	A1. Pristine A2. Near pristine A3. Slightly disturbed
B (grade foreshore)	B1. Degraded - weed infested B2. Degraded - heavily weed infested B3. Degraded - weed dominated
C (grade foreshore)	C1. Erosion prone C2. Soil exposed C3. Eroded
D (grade foreshore)	D1. Ditch - eroding D2. Ditch - freely eroding D3. Drain - weed dominated
Foreshore Condition ie A1-A2-3-B1	(eg mainly A2-3 extending to A1 and B1)
	Class Boundary Symbol
	Existing Fence at time of survey
	Recomended Fencing
	Distance Marker (distance from river mouth)
	Point of Severe Erosion or subsidence
	River Crossing Point
	Serious Weed Infestation and species
	Recomended Area needing rehabilitation / revegetation plus approximate area
	Existing Adjoining Native Vegetation
	Existing Vegetation (Planting)

LEGEND - RIVER SURVEY MAPS.

Survey class	Description
A (grade foreshore)	A1. Pristine A2. Near pristine A3. Slightly disturbed
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Foreshore Condition ie A1-A2-3-B1	(eg mainly A2-3 extending to A1 and B1)
	Class Boundary Symbol
	Existing Fence at time of survey
	Recomended Fencing
	Distance Marker (distance from river mouth)
	Point of Severe Erosion or subsidence
	River Crossing Point
▲ Blackberry	Serious Weed Infestation and species
	Recomended Area needing rehabilitation / revegetation plus approximate area
	Existing Adjoining Native Vegetation
	Existing Vegetation (Planting)