Department of Sustainability and Environment

# Hollands Creek Demonstration Reach: 2007/08.

# Summary document.

Raymond, S., Lyon J., and Hames, F.

**2008**

Arthur Rylah Institute for Environmental Research

Confidential Client Report

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Arthur Rylah Institute for Environmental Research

# Hollands Creek Demonstration Reach: 2007/08.

# Summary document.

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# Acknowledgements

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# Summary

This report consists of four separate sections. The first of these sections contains a general introduction to the Hollands Creek Demonstration Reach (HCDR), covering the significance of the creek and the general aims of the current project. The second section outlines the detailed monitoring program used to assess the current status of the Hollands Creek Demonstration Reach. Water, stream condition, and an assessment of the fish assemblage are contained within this section. The third section focuses on the community. This section outlines discussion with local groups, government departments, landholders and other interested parties. The final section of the report outlines the rehabilitation works program for the HCDR. This program provides a comprehensive site specific rehabilitation plan. This document is intended to be read in conjunction with the Hollands Creek Demonstration Reach: Background and Recommendations report (DSE, 2007b).

## Key outcomes and findings of the monitoring program

### Fish monitoring

- 95% of fish recorded from lower HCDR sites (sites 1-4)
- Native fish dominate (78%) fish assemblage
- Macquarie perch restricted to site 1
- Macquarie perch – size range (269-382mm, no observed recruitment)
- River blackfish dominant species (62% of total catch)
- European perch account for 83% of introduced fish
- European perch, wide range in fish length indicative of recruitment

### Water quality monitoring

- High turbidity within upstream sites (sites 5, 6 & 7)

### Streamside zone monitoring

- Lower sites in 'moderate to good' condition
- Sites 6 and 7 in 'poor condition'
- Native ground vegetation generally sparse
- Weeds throughout reach

## Key outcomes and findings of the works program

- 7.7 km of fencing completed
- 900 m of willows removed
- Bank protection works commenced
- A detailed site specific works program established
- Prioritisation of the works program

# 1 General introduction

The increasing use of Australian rivers for agricultural and industrial purposes has been a contributing factor in the degradation of river health. Estimates of native fish populations within the MDB indicate that the abundance and distribution of fish species are approximately 10% of pre-European settlement levels (MDBC, 2004a). In an attempt to reverse this trend, the Murray Darling Basin Commission (MDBC) has developed a multi-disciplinary approach to river restoration through the Native Fish Strategy (NFS) (MDBC, 2004a). This approach employs the combined application of strategies targeted to a specific stretch or reach of river referred to as a 'Demonstration Reach'.

The purpose of a 'Demonstration Reach' is to demonstrate to the community the cumulative benefits of rehabilitating in-stream and riparian habitat for improving river health (GBCMA, 2008). Hollands Creek was chosen to demonstrate the cumulative benefits of rehabilitation works to river health (DSE, 2007b). As fish are reported to be a good indicator species of river health, an assessment of fish species, distribution and abundances will be used to assess the effectiveness of the (HCDR) project.

Hollands Creek is of significant ecological importance as it is reported to have the 'most promising population of Macquarie perch in the Broken Catchment' with successful breeding and recruitment of individuals recorded (Pritchard, 2006). Macquarie perch are currently listed as nationally endangered under the Commonwealth EPBC, 1999 and endangered under the 2007 *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE, 2007a). The Hollands Creek Macquarie perch population is restricted to a small stretch of creek in close proximity to the township of Tatong where there is significant habitat characteristics. These characteristics include flowing waters with > 30m overhanging riparian vegetation, branches, emergent vegetation, snags and erosion retaining rock groynes (DSE, 2007b). This 'significant' habitat abuts with farming land upstream of the Swanpool Bridge (beginning of Demonstration reach). The lack of good riparian vegetation above the bridge may account, in part, for the limited range of Macquarie perch. The lack of water flow in the past may also significantly impact on the distribution of Macquarie perch within the Demonstration Reach. Hollands Creek had ceased flowing (above ground) in April, 2008.

The GBCMA (2008) outlined a number of threats and their associated risks to the Hollands Creek Macquarie perch population. Risk analysis was assessed on the probability of a threat causing any impact on the value (Macquarie perch population), beyond current conditions. These threats include; reduced food availability (very high risk), reduced water quality (substantial to high risk), loss of physical habitat (very high risk), insufficient flows (high to very high risk), exotic fish (substantial risk) and barriers to fish migration (low risk).

A number of sites were chosen to assess the impact of rehabilitation works on the local fish community. The choice of sites coincides with regions where works will be undertaken along with comparative sections devoid of works. Sites were monitored for native and introduced fish species, Streamside zone (sub-index), and water quality. This report outlines the base data from monitoring conducted in November, 2007. This data will be used to compare the distribution and abundance of fish within the reach over consecutive years. A comparative analysis of riparian vegetation and water quality will be conducted.

The HCDR is a joint venture between the Goulburn Broken Catchment Management Authority (GBCMA), and the Department of Sustainability and Environment (DSE). This is the first of a series of reports that will be presented on an annual basis. Major works proposed for the ORDR shall be completed by 2010 with minor works ongoing. The monitoring program has been established until 2012 with a view toward future periodic sampling.

The primary aim of this report is to provide a comprehensive database of fish within the Hollands Creek Demonstration Reach. The species, abundance and distribution of fish within the reach will provide information used to measure the effects rehabilitation works have on fish communities, and hence, river health over the next 7 to 10 years.

# 2 Monitoring

## 2.1 Materials and Methods

Hollands Creek is located in north-central Victoria, 35 km south east of Benalla (Figure 1). The Demonstration reach covers approximately 20 river kilometres and commences at the township of Tatong (Swanpool Bridge) upstream to the confluence of Hollands and Spring Creeks. Monitoring sites are outlined in Figure 2. The creek system is dominated by cobbled riffle/run stretches interspersed with deep pebble lined pools. The creek banks consist of rich organic sandy clay loam.

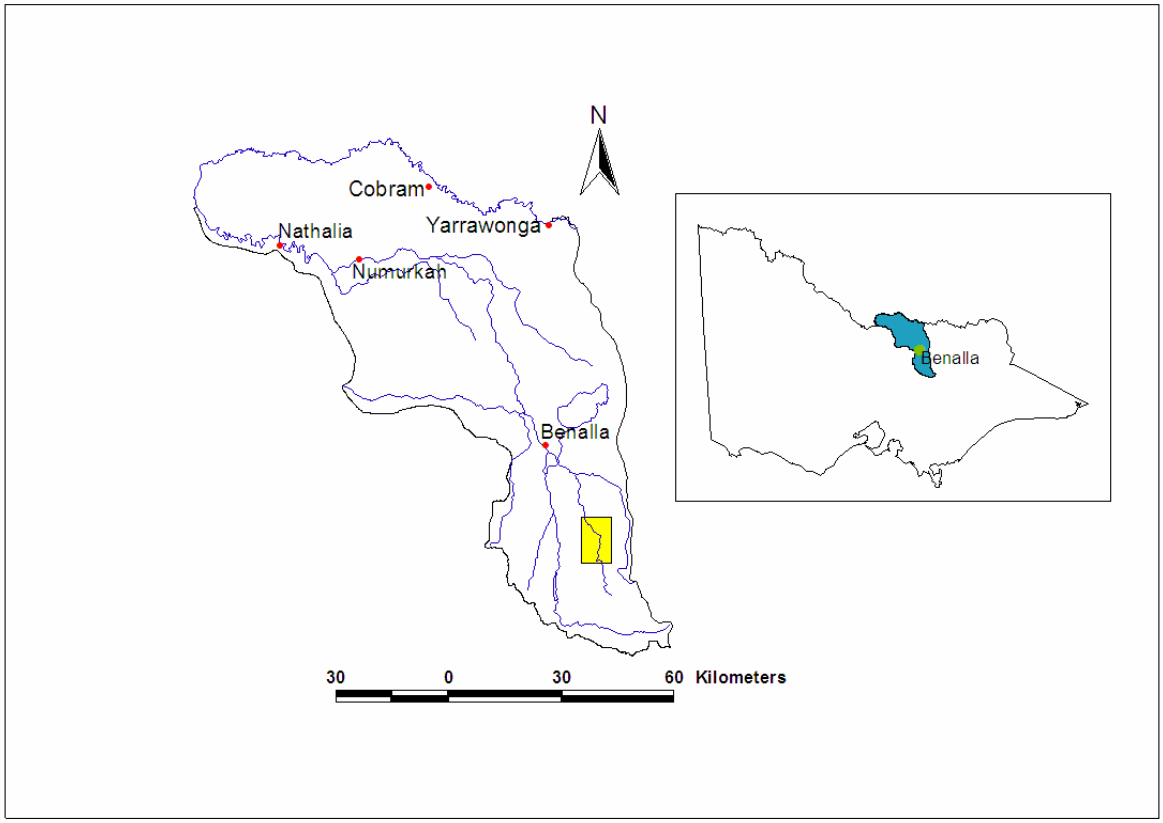


**Figure 1. Location of the Hollands Creek Demonstration Reach**

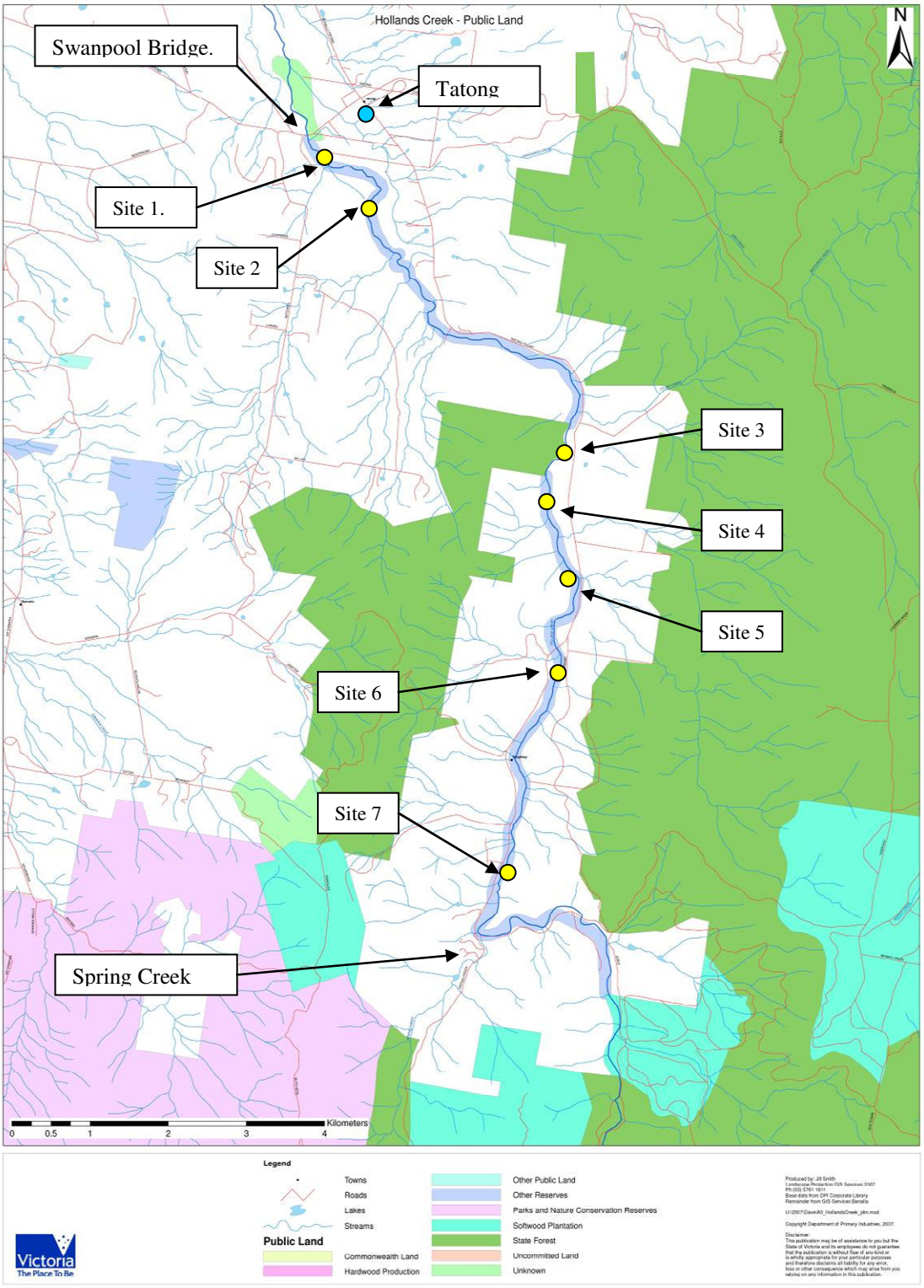


**Figure 2. Monitoring sites for the Hollands Creek Demonstration Reach**

## 2.2 Monitoring

Monitoring of riparian vegetation, water quality and fish populations were carried out. The Index of Stream Condition (ISC) protocols (DSE, 2006) were used to assess temporal changes in riparian vegetation while water quality was recorded using in-stream data loggers and associated measuring equipment. The diversity and abundance of fish were measured at each site using methodology outlined by the Sustainable Rivers Audit (SRA)(MDBC, 2004b). The amalgamation of these monitoring methods provide a means to assess the effect of adaptive management works on fish health within the HCDR. Monitoring data will also provide information used to suggest future site-specific restoration works within the HCDR.

### 2.2.1 Fish monitoring

The monitoring of fish within the HCDR was carried out using electrofishing, bait traps and fyke nets. Electro-fishing was conducted using a Smith Root ® model 12B backpack electro-fisher (set at 300 volts, 60 Hz, pulse DC) following SRA standard protocol (MDBC, 2004b) SRA standard protocol includes eight, 150 second shots for each fish monitoring site. The electro-fishing operator fished in an upstream direction, fishing all accessible habitats with an assistant following the operator to retrieve all stunned fish. Ten, non-baited fish traps were used to capture smaller fish species and/or fry. All fish species were identified to species level, measured to the nearest mm for total length (head-tail fork) and returned to the water. In addition to SRA fishing protocol a number of fyke nets were used to determine the presence of Macquarie perch within pools that were unable to be satisfactorily electro-fished.

## 2.3 Results

### 2.3.1 Water quality

The monitoring data provide baseline information for both current and future analysis. Water quality characteristics measured at each of the seven monitoring are reported in Table 1. These data will be compared with future water quality characteristics to determine any change in water quality with time.

A number of water quality trends are notable within the HCDR sites. With the exception of site 1, dissolved oxygen generally increased with site number; upstream sites had higher dissolved oxygen levels compared with sites lower down in the reach. In contrast, water temperature and conductivity generally decreased with an increase in stream elevation (increasing site numbers). Turbidity was distinctly divided into two categories; low turbidity (sites 1 to 4) and high turbidity (sites 5 to 7). pH was consistent throughout the HCDR sites. pH values remained within the range of 7.0 to 7.8 at the upper sites (sites 2 – 7) and are fairly typical for streams in south-east Auatralia. The most downstream site (site 1) had a slightly elevated pH level of 8.6.

The low turbidity values recorded in this study are typical for upland rivers, which are generally between 2 and 25 NTU (ANZECC, 2000). The downstream end of the HCDR sits at an altitude of 200m and consequently falls within the upland stream category (those streams above 150m altitude, ANZECC, 2000). Sites 5, 6, and 7 are dominated by fast flowing riffle/run sections interspersed by small pools that are prone to drying out under drought conditions. The lower sites (1 to 4) contain deeper pools that may retain water during low/no flow events such as occurred during April, 2008.

**Table 1. Water quality characteristics measured at individual monitoring sites. Samples were taken in November, 2007.**

| Site number | Measured water quality characteristics | | | | |
|---|---|---|---|---|---|
| | Electrical conductivity (uS/cm) | Temperature ($^{o}$C) | Dissolved Oxygen (mg/L) | Turbidity (NTU) | pH |
| 1 | 91.7 | 26.3 | 17.1 | 3.5 | 8.6 |
| 2 | 93.5 | 23.5 | 8.3 | 5.0 | 7.8 |
| 3 | 88.5 | 22.1 | 6.2 | 2.3 | 7.6 |
| 4 | 88.5 | 21.0 | 7.0 | 2.3 | 7.6 |
| 5 | 66.5 | 20.0 | 9.0 | 12.0 | 7.0 |
| 6 | 67.0 | 19.0 | 9.1 | 15.0 | 7.8 |
| 7 | 67.4 | 19.3 | 9.7 | 15.0 | 7.0 |

### 2.3.2 Fish surveys

#### 2.3.2.1 Fish abundance and size

A total of 132 individual fish, of seven species, were caught in the 2007 monitoring program (Table 2 & Figure 3) with a further 25 individuals sighted. Twenty three turtles, 43 yabbies, C*herax destructor,* and one crayfish, *Euastacus armatus*, were also recorded from the HCDR monitoring sites.

The River Blackfish, *Gadopsis marmoratus*, was the most abundant (82 individuals) fish species recorded in the survey, accounting for 62% of the total catch. Redfin and Macquarie perch also significantly contributed to the total number of fish caught, with 24 and 11 individuals, respectively. The remaining fish species contributed to less than 9% of the total fish catch.

Macquarie perch were the largest fish recorded from the HCDR with an average length of 318 mm. The next largest fish were Redfin and River black fish with an average mean length of 129 and 127 mm, respectively. The remaining fish species had a recorded mean length of less than 62 mm.

The River blackfish and Redfin displayed the greatest range in body length, of approximately 200 mm. This indicates that the two populations are made up of a number of age-classes (cohorts). The moderate range in size of Macquarie perch from 270 to 380mm suggests that the population is dominated by breeding individuals from 2 to 4 years of age. The lack of smaller individuals in the population may be problematic for the long-term survival of this species within the HCDR. In contrast, the restricted range in length of Brown trout indicates that non-breeding sub-adults are the sole members of this population.

The gudgeons ranged from 33 to 55 mm while the galaxids observed were from 54 to 67 mm in length. The recorded breeding times (late spring to early summer, [Allen *et al*., 2003]) of the *Hypseleotris* gudgeons and the Mountain galaxias suggests that the individuals caught included adults of breeding size. The young (up to 30 mm in length) of all species are very difficult to detect and capture using electrofishing techniques. The variety in life-history

strategies between fish species may also account for the observed range and size of fish species recorded from the HCDR in 2007.

**Table 2. Total number, mean length and range of fish captured from the 2007 survey of the HCDR.**

| Common name | Scientific name | No. captured | Mean length (mm) | Length range |
|---|---|---|---|---|
| River blackfish | *Gadopsis marmoratus* | **82** | 127 | 23-223 |
| Mountain galaxias | *Galaxias olidus* | **4** | 62 | 54-67 |
| Gambusia | *Gambusia Holbrooki* | **1** | 24 | 24 |
| Gudgeons | *Hypseleotris sp.* | **6** | 42 | 33-55 |
| Macquarie perch | *Macquaria australasica* | **11** | 318 | 269-382 |
| Redfin* | *Perca fluviatilis* | **24** | 129 | 84-282 |
| Brown trout* | *Salmo trutta* | **4** | 60 | 50-71 |

* denotes introduced fish species

#### 2.3.2.2 Distribution of fish

The majority (95 %) of fish captured in the 2007 monitoring program were caught in sites 1 to 4 with the remaining fish consisting of a single River blackfish (site 5), an individual Mountain galaxias (site 7) and 6 Brown trout (sites 6 & 7) all recorded above site 4 (Figure 3). The presence of a 'rock shute' between sites 4 and 5 may act as a barrier to fish passage during times of low/no flow and may consequently prevent fish from moving upstream during these periods.

River blackfish were recorded from sites 1 to 5 and accounted for more than 50 % of the total fish recorded at each of these sites. The blackfish was the only fish recorded from site 5 and was the upper limit of their range in this investigation. More than 20 individual blackfish were caught at sites 1 to 3 with ten individuals collected from site 4 (Figure 4).

The distribution of European perch (redfin) within the HCDR is almost identical to that observed in the river blackfish. While redfin numbers were comparably lower than river blackfish, an average of 8 individuals were recorded from the first 4 sites (Figure 5). No redfin were recorded in the upper regions of the Demonstration Reach.

The five individual Mountain galaxias recorded, covered the greatest range within the HCDR; they were observed in sites, 1, 2, 4 and 7 (Figure 6). This species is widely distributed in streams draining both sides of the divide and are often found in clear pools of small flowing streams around rocks and logs.

The high value species of the HCDR, the Macquarie perch, was only recorded from Site 1 (Figure 7). This is consistent with the findings of Pritchard (2006) who recorded the species from a number of sites below the demonstration reach to the Swanpool Bridge. No individuals were recorded upstream of the bridge in the 2006 fish survey. While all Macquarie perch were recorded from site 1, individuals of this species have previously been caught as far up as site 4 by anglers (pers. Comm., Max Campbell, Tatong Angling Club).

Brown trout were recorded from sites 1, 6, and 7 (Figure 8). The trout were in low numbers compared with the larger native species and were small in size. Trout are voracious predators and have been listed as a species likely to have a negative impact on local native species within Hollands Creek (GBCMA, 2008).

The third of the introduced fish species, *Gambusia holbrooki*, within the HCDR consisted of one individual caught in site 1 (Figure 9). This species is regarded as a pest throughout many regions of Australia where it has had a detrimental impact on local native fish, amphibian and macro invertebrate populations.

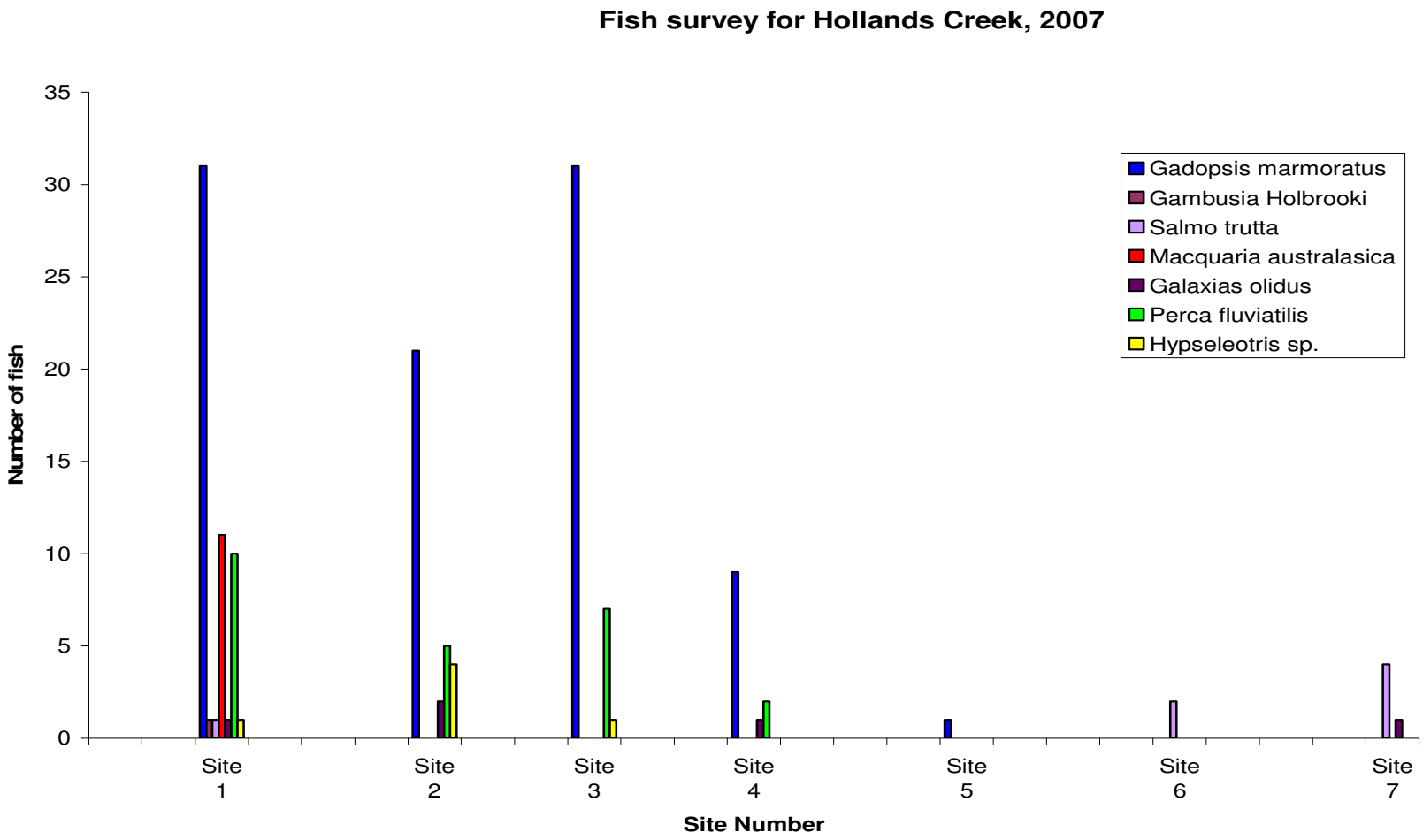


**Figure 3. The total abundance and distribution of fish species recorded from the November 2007 monitoring survey of Hollands Creek Demonstration Reach.**

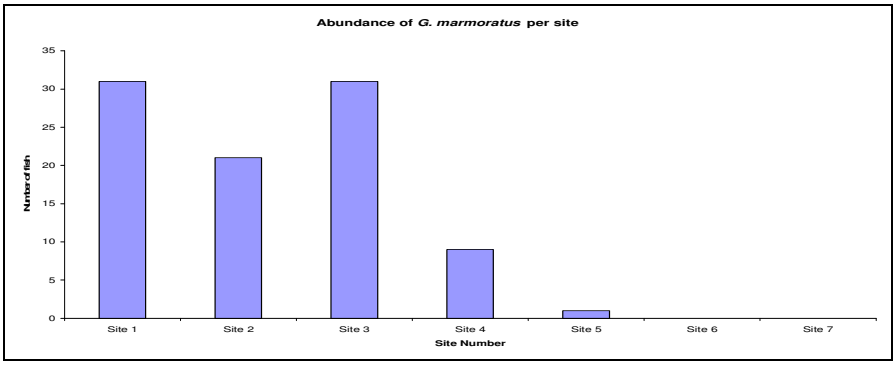


**Figure 4. The abundance and distribution of *Gadopsis marmoratus* (River blackfish) recorded from Hollands Creek Demonstration Reach, 2007.**

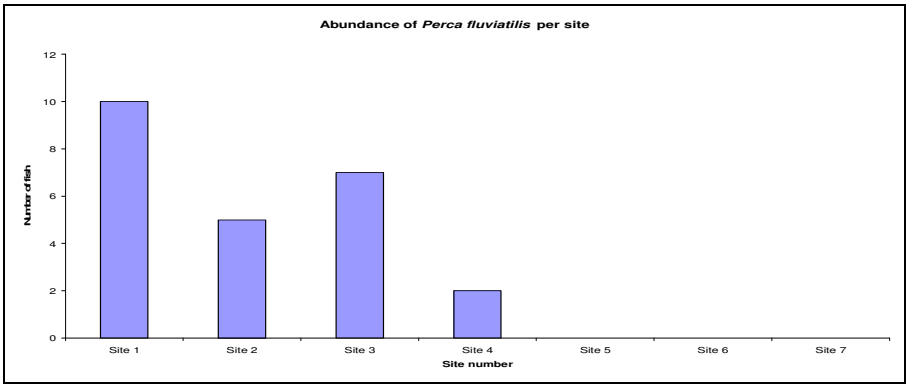


**Figure 5. The abundance and distribution of *Perca fluviatilis* (European perch, redfin) recorded from Hollands Creek Demonstration Reach, 2007.**

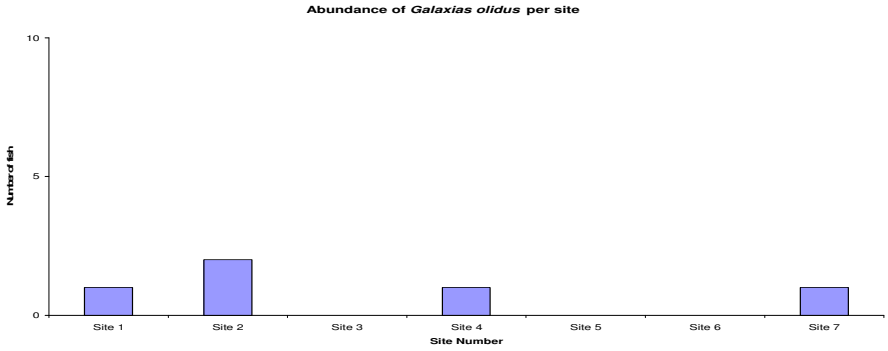


**Figure 6. The abundance and distribution of *Galaxias olidus* (Mountain galaxias) recorded from Hollands Creek Demonstration Reach, 2007.**

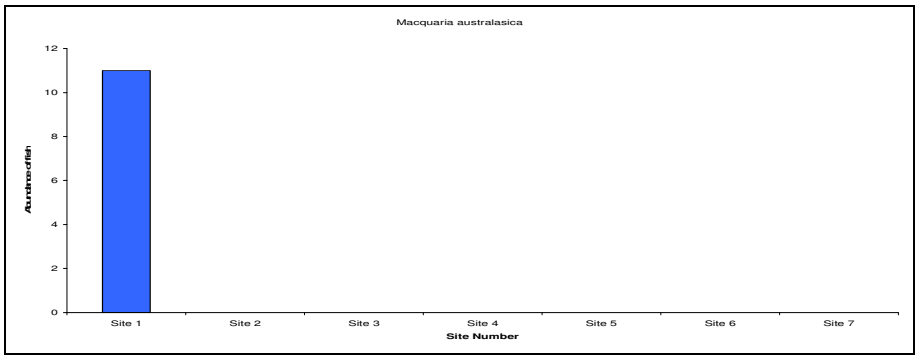


**Figure 7. The abundance and distribution of *Macquaria australasica* (Macquarie perch) recorded from Hollands Creek Demonstration Reach, 2007.**

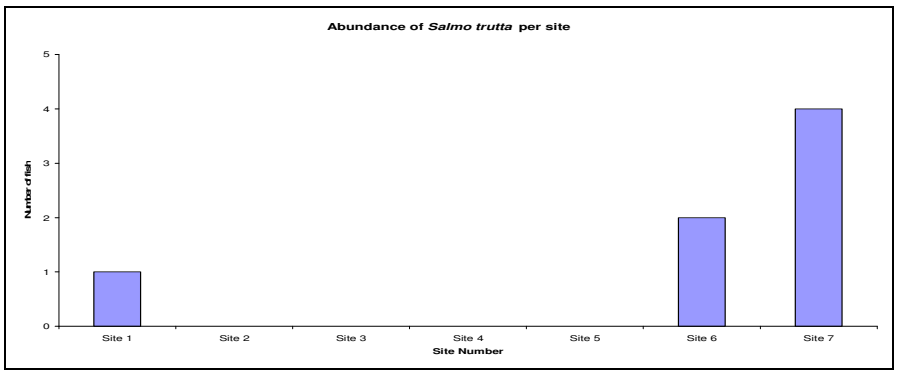


**Figure 8. The abundance and distribution of *Salmo trutta* (Brown trout) recorded from Hollands Creek Demonstration Reach, 2007.**

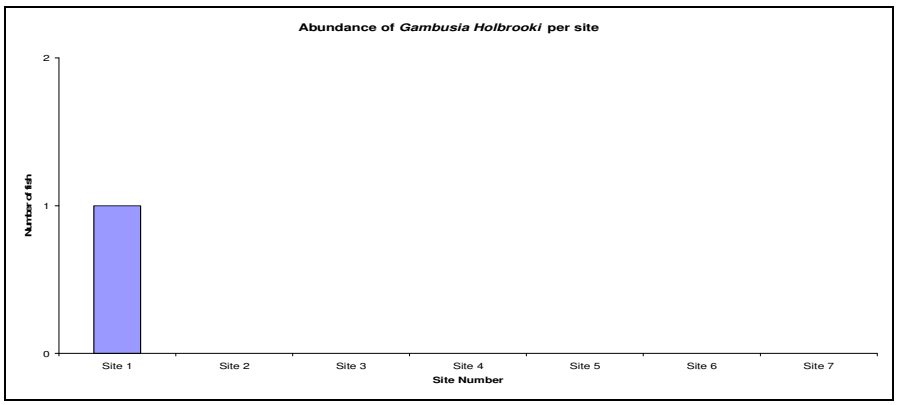


**Figure 9. The abundance and distribution of *Gambusia holbrooki* (Gambusia) recorded from Hollands Creek Demonstration Reach, 2007.**

## 2.4 Stream condition, Habitat hectares and Crown frontage

An assessment of stream condition and surrounding vegetation was carried out on the HCDR by the environmental consulting firm GHD Pty. Ltd. for the GBCMA (GBCMA, 2008). The purpose of this assessment was to determine the present status of the stream and surrounding vegetation at each monitoring site. The three criteria used to assess stream condition and surrounding vegetation assessments of Hollands Creek include; an ISC Streamside zone sub-index score, a Habitat Hectares score and a Crown Frontage score (DSE, 2004; DSE, 2006).

**Streamside zone indicators**

The streamside zone is the land and vegetation next to streams and is also known as the riparian zone. It is the link between streams and the surrounding catchment. The streamside zone plays a number of significant roles for the health of a stream, such as: acting as a filter of inputs to the stream (eg. light, nutrients, sediment); a source of inputs to the stream (eg. logs, twigs, leaves); providing terrestrial habitat; nutrient retention; stabilising the micro-climate; moderating stream water retention through shading; contributing to bank stability; and providing scenery and landscape values. The streamside zone assessment is based on a comparison between the current condition of a site compared with its Ecological Vegetation Class benchmark (EVC). An EVC is a vegetation community that is defined by its plant species and its location in the landscape, and is what it would look like in its long undisturbed condition; it is the reference condition for the vegetation being assessed. The EVC's for Victoria are available at: www.dse.vic.gov.au under the Conservation and Environment link. The calculations and weightings applied to the streamside zone indices are available in the Index of Stream Condition user's manual (DSE, 2006).

The ISC Streamside zone sub-index is given a score between 0 and 10 based on the assessment of a number of indicators. The sub-indices of a component are assigned a rating from 0 (stressed) to 4 (pristine) and weighted according to ISC user's manual (DSE, 2006). Consistent with the ISC protocol, each indicator compares the current condition to its natural condition.

The streamside zone sub-index has nine indicators:

- Width
- Large trees
- Understorey life-forms
- Recruitment
- Longitudinal continuity
- Tree canopy
- Litter
- Logs
- Weeds

**Habitat hectares**

The habitat hectares assessment approach involves assigning a habitat score to a habitat zone that indicates the quality of the vegetation relative to the EVC benchmark. This habitat score can then be multiplied by the area of the habitat zone (in hectares) to determine the quality and quantity of vegetation (in habitat hectares). The habitat hectares scores may range from 0 to 100, with higher scores indicative of increasing quality and quantity of vegetation. The components of the 'habitat score' and their relative weightings are outlined in Appendix A. The components are divided into two groups, reflecting assessments of both 'site condition' and 'landscape context'. Guidelines for the application of the habitat hectares scoring method are provided by the DSE (DSE, 2004). A similar approach to the assessment of Crown frontage was conducted using a GBCMA scoring program (GBCMA, 2008).

The scores in Table 3 (along with their indicators) shall be used, in part, to determine the success of future works programs undertaken by the GBCMA for the HCDR. At present the Streamside zone sub-index scores indicate that sites 1, 2, 3, 5 and 7 are less disturbed than sites 4 and 6 (Table 3). The habitat hectares scores indicate that sites 5, 6 and 7 were comparatively poorer in the quality and quantity of vegetation than sites 1 to 4. The Crown frontage scores suggest that sites 3, 6 and 7 were in poor condition relative to the other sites. An overview of the sites and the assessments conducted indicate that in general the lower sites (1 to 5) are in better condition compared with the higher (upstream) sites (6 & 7), with Site 6 in very poor condition.

**Table 3. A summary of the ISC Streamside zone sub-index score , Habitat Hectares and Crown Frontage scores at each of the seven monitoring sites on Hollands Creek.**

| Site number | ISC Streamside zone sub-index score | Habitat hectares | Crown frontage |
|---|---|---|---|
| | | | |
| 1 | 8.02 | 24 | 26 |
| 2 | 7.97 | 31 | 24 |
| 3 | 7.79 | 29 | 16 |
| 4 | 5.7 | 32 | 25 |
| 5 | 8.68 | 20 | 26 |
| 6 | 3.98 | 16 | 13 |
| 7 | 9.18 | 19 | 15 |

# 3 Community engagement

The Hollands Creek Demonstration Reach has represented an excellent example of a partnership project between government agencies and the community. Initial meetings between representatives from the Arthur Rylah Institute (ARI) and the Goulburn Broken Catchment Management Authority (GBCMA) and various key stakeholders were largely agency-driven. Over time, the community has built a strong sense of ownership for the project and its Community Reference Committee, and taken more responsibility for processes and feedback.

The Hollands Creek Demonstration Reach Community Reference Committee includes several landholders and representatives from the Molyullah-Tatong Landcare group, the Tatong Anglers Club, Tatong village, GB CMA, ARI, the Department of Primary Industries and the Benalla City Council. Monthly meetings are held by the Committee, and members have been actively involved in the development of project plans.

An on-site Field Day on 1st December 2007 attracted 43 people and involved a Taungurung Welcome to Country, presentations from the MDBC Native Fish Strategy State Co-ordinator and Waterwatch, Taungurung storytelling, children's fish-craft activities, an electrofishing demonstration in Hollands Creek, and a shared BBQ lunch (catered by the Tatong Anglers Club) (Plate 1).

Project corflute signs have been developed and distributed to landholders for attaching to their fences or gates (Figure 10). The Committee has developed a promotional sticker featuring Macquarie perch, and worked with the Molyullah-Tatong Landcare group to secure funding to design and create an on-site shelter-sign. Information Sheets have been produced, and a website has been developed within the GB CMA site (http://www.gbcma.vic.gov.au/default.asp?ID=258).

Another Field Site will be held in Spring 2008 to inspect works to date. Presentations on the project and on managed grazing within riparian zones are also planned.


**Figure 10. Corflute signs, Hollands Ck Demonstration Reach project**

*Community Reference Committee Chair Dennis Scott welcomes participants to Field Day Dec 2007*


*Macquarie perch presentation by MDBC NFS Co-ordinator Fern Hames, Field Day December 2007*

*Waterwatch workshop, Field Day December 2007*

*Exploring the catch from the creek, Field Day*

*Waterwatch presentation, Field Day December 2007*

*Electrofishing demonstration by ARI staff, Field Day December 2007.*

Plate 1. Participants at the on site field day.

# 4 Works program for the HCDR

The current project commissioned the development of a works and activities plan for the rehabilitation and protection of sites within the Holland Creek Demonstration Reach. This work involved the creation of a prioritisation and works plan for key sites from Tatong, 500m downstream of Swanpool Road Bridge, and extending upstream for approximately 15km to the confluence with Spring Creek (Figure 2). Prioritisation and recommended works have been based upon preserving and extending habitat continuity and potential range of the end point species, Macquarie Perch.

This report prioritises sub-reaches for rehabilitation and protection based upon a number of key criteria including:

- Proximity to known Macquarie Perch populations;
- Landowner and community involvement;
- Habitat quality and suitability for Macquarie Perch; and
- Potential for restoration.

Hollands Creek has been identified as a high priority reach within the Goulburn Broken Catchment under the GB Regional River Health Strategy (GBCMA, 2005). The presence of a remnant population of the critically endangered Macquarie perch has been identified as a high value asset within the Hollands Creek Catchment. This document outlines targeted management actions within the HCDR in relation to the effects on native fish over a period of at least 7-10 years (DSE, 2007b). The majority of restoration works conducted within the HCDR will take place following the fish survey.

The works and activities plan conducted by the GBCMA (GBCMA, 2008) outlines a draft for the types of works required to improve the status of each monitoring site within the HCDR. These works are listed in Table 4. The planned works are based on a combination of ISC, Habitat Hectares, Crown Frontage, Water quality and past records of the abundance and distribution of Macquarie perch. The GBCMA have produced a very detailed site specific action plan incorporating; timelines, types of works, works/rehabilitation methods, works priorities, and costing for the HCDR project (GBCMA, 2008).

A range of river rehabilitation techniques will be used to improve the health of the HCDR. These techniques include: fencing off stock access to the river, the introduction of in-stream fish habitat (snags), the removal of riparian weeds, promotion of fish passage, re-vegetation of the riparian zone with local native plants and grasses, and improvements in water quality. The benefits of such management works to river health and native fish communities have been well documented (Barrett & Ansell, 2003; Brooks & Lake, 2007). The Goulburn Broken Catchment Management Authority (GBCMA) has commenced rehabilitation works within the reach (Figure 10).

As part of knowledge exchange a web site has been developed for the HCDR. The website provides information on current and previous projects carried out and information on the plants, animals and people that live in, on or around the creek. The goal of this website and its programs is to bring Hollands Creek back to a healthier state for all to enjoy (Appendix B).
See http://www.gbcma.vic.gov.au/hollandscreek/

**Table 4. Recommended actions and site specific works for the rehabilitation of the HCDR.**

| Site number | Recommended action | Specific works |
|---|---|---|
| 1 | Protection | Limited weed management |
| | | Under-story and mid-storey planting |
| | | Restriction of stock access |
| 2 | Protection | Limited weed management |
| | | Under-story and mid-storey planting |
| | | Restriction of stock access |
| 3 | No recommended action | No recommended works |
| 4 | Moderate works | Limited re-vegetation to fill gaps |
| | | Supplement existing planting |
| | | And/or fencing to restrict stock access |
| 5 | Moderate works | Limited re-vegetation to fill gaps |
| | | Supplement existing planting |
| | | And/or fencing to restrict stock access |
| 6 | Large scale works | Extensive weed management |
| | | Extensive fencing |
| | | Re-vegetation of cleared areas |
| 7 | Large scale works | Extensive weed management |
| | | Extensive fencing |
| | | Re-vegetation of cleared areas |

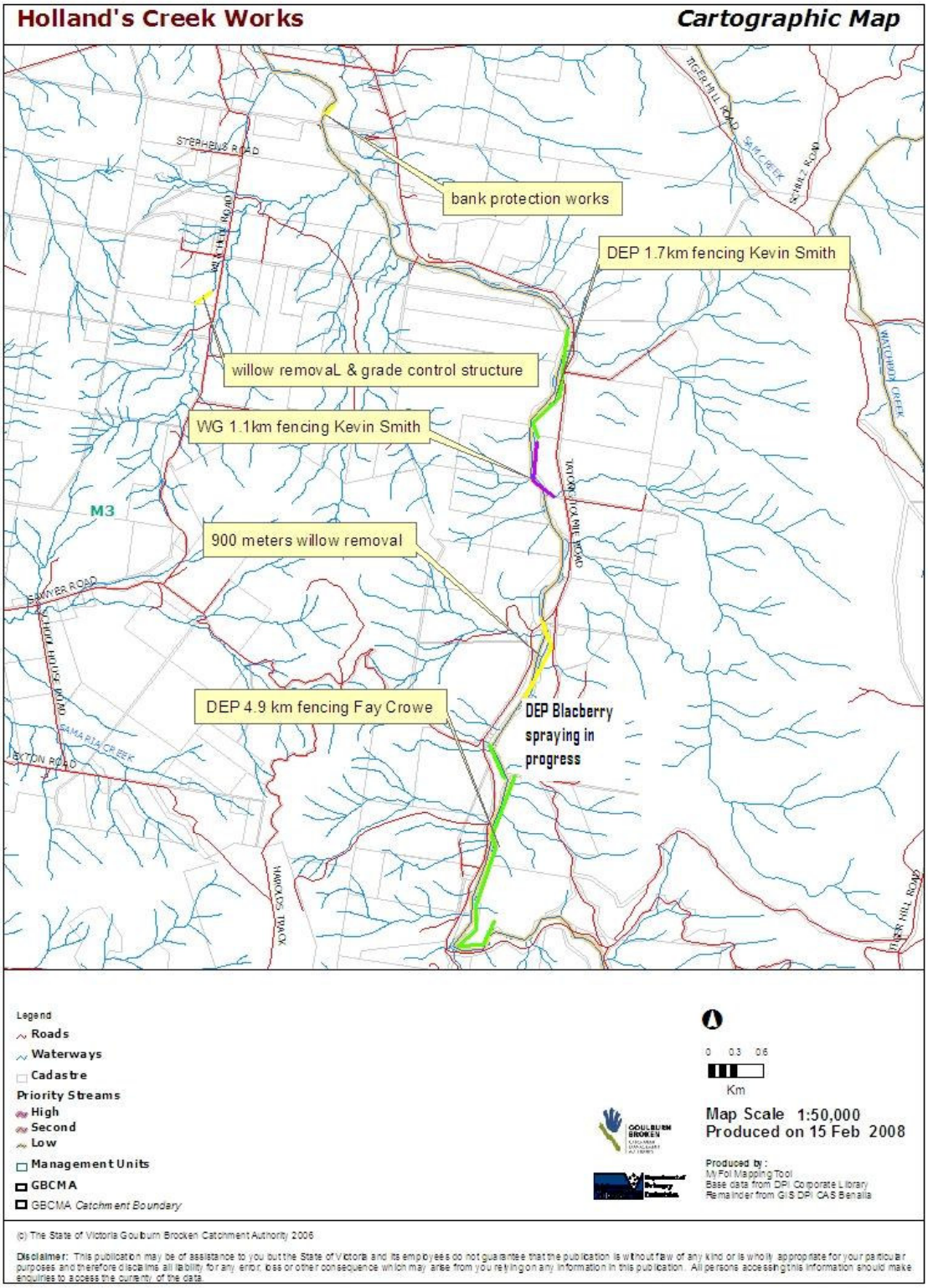


**Figure 11. A summary of the completed works conducted by the GBCMA within the HCDR (Jan 1st – June 1st).**

## General discussion

Four native and three introduced fish species were recorded within the HCDR fish monitoring program, 2007. While the abundance of native fish species dominated the fish assemblage a number of issues arose from the investigation. These issues include; the restricted distribution of Macquarie perch, the lack of small Macquarie perch, the presence of redfin and other exotic fish species, water quality and flow, and the problems associated with previously altered in-stream and riparian characteristics throughout the monitoring sites.

The distribution of the Macquarie perch population within the HCDR is restricted to site 1. This limited distribution may reflect access to suitable habitat including continuous stream side vegetation and the presence of deep pools. The presence of deep pools within the lower half of the HCDR suggests that suitable upstream habitat exists. However, the discontinuous stream side vegetation may influence movement patterns within the Macquarie perch population. The lack of flow observed in April, 2008 may also contribute to the restricted range of the Macquarie perch population.

Pritchard (2006) noted that recruitment in the Macquarie perch population was evident in her investigation incorporating the lower portion of the HCDR. In contrast, the current investigation observed a distinct lack of cohorts (size classes) within the Macquarie perch population. This observation is of considerable concern. The absence of fish smaller than 270 mm may be the result of a number of factors. These factors may include; problems with egg/sperm production, fertilisation, hatching and/or recruitment of individuals. A number of other factors including siltation, predation, pollutants and/or the interruption of spawning cues may have contributed to the lack of smaller Macquarie perch recorded. The factors responsible for the lack of smaller individuals within the Macquarie perch population are not clear. It is clear that the continued inability to recruit smaller individuals will have a detrimental impact on the long-term survival of the critically endangered Macquarie perch population within the HCDR.

The consistent capture of blackfish through the lower half of the demonstration reach and their range in size indicates that the blackfish population may be a viable, self-sustaining fish population. The restricted home-range of river blackfish (within 20 – 30 m, [Allen et al., 2003]) is consistent with the occurance of deeper pools and a larger number of log snags for breeding in the lower half of the demonstration reach.

European perch were also observed to be in considerable numbers throughout the bottom four monitoring sites. The wide range in sizes suggests that this is a self-sustaining population. European perch may pose a significant threat to the Macquarie perch population as well as populations of other native species as they are known hosts of the Epizootic Haematopoietic Necrosis Virus (EHNV). While the virus does not appear to impact negatively on the European perch, native Australian fish are very susceptible to the virus which has been recorded to remove localised fish populations (Whittington *et al*., 1999). European perch also compete with native fish for food and habitat and are known to directly feed on native species. While trout have been recorded to impact on the Macquarie perch population within the reach, their small size (less than 70 mm) lessens this threat at present.

Community engagement has been an ongoing process from the inception of the 'Demonstration Reach' project. To date, local landowners have shown considerable interest and support for the project. Many of the landowners have actively removed weeds and installed off-stream watering points to remove the impact of stock from the creek bed and surrounding areas. The primary aim of community engagement was to gain support from and educate landowners and interested parties in the running of the program. Ultimately, it is expected that community groups shall take over the care of the reach. The significant interest, support and active help from landowners and other local interest groups has led to the current success of the HCDR.

The works program outlined for the HCDR has commenced. The removal of weeds, fencing to restrict stock access, bank protection works, and a comprehensive, site-specific active works plan has been proposed. Works including the introduction of snags, further weed removal and re-vegetation plans are currently being established for the monitoring sites and the reach as a whole. The work plans for the reach will be completed over the following three to four years. It is important to note the ongoing fluidity of the works plan to adapt to suggestions made in the annual DSE Summary document to ensure the long-term success of the project

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# Appendix A.

**Components and weightings of the habitat score**

| | Component | Score |
|---|---|---|
| **'Site Condition'** | Large Trees | 10 |
| | Tree Canopy Cover | 5 |
| | Understorey | 25 |
| | Lack of Weeds | 15 |
| | Recruitment | 10 |
| | Organic Litter | 5 |
| | Logs | 5 |
| **'Landscape Context'** | Patch Size | 10 |
| | Neighbourhood | 10 |
| | Distance to Core Area | 5 |
| | Total | 100 |

(DSE, 2004)

# Appendix B.

## Hollands Creek Demonstration Reach


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**The Hollands Creek**

Hollands Creek has a catchment area of 270km2 which consists of forested hills and farmlands. Substrate composition is of rock in the headwaters associated with sand and mud downstream. Hollands Creek is fed by numerous tributaries including Bog, Stony, Kangaroo, Wild Dog, Spring, Blind and Ryans Creeks. It has mainly riffles/runs and deep pools but in a dry year, it becomes a series of pools.

The headwaters of Holland Creek begin South-east of Tolmie, consisting mostly of straight channel reaching widths of 30 and 45m and depths of 3-4m along the high flow channel. The low flow channel consists of widths of 5 to 10m and depths of approximately 1m. Riparian vegetation is plentiful, with bed material consisting of gravel and pebbles in pools and large cobbles throughout riffles.