Freshwater Streams Monitoring in the Moreton Bay Region

First Annual Report
(October 2011 to September 2012)

prepared for

Environmental Planning & Compliance Department
Moreton Bay Regional Council

by

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1. **Summary**

This is the first annual report for the Freshwater Streams Monitoring program commissioned by Moreton Bay Regional Council in October 2011 (Contract No. MBRC002036). The monitoring program forms an integral part of Council’s *Total Water Cycle Management* (TWCM) planning.

From October 2011 to September 2012, forty monitoring sites were sampled at streams in the South Pine River catchment, along Saltwater and Freshwater Creeks, and some headwater streams in the Caboolture and Stanley River catchments.

A total of 171 stream kilometres were assessed, using aquatic macroinvertebrates as indicators for Stream Health Class (*SHC*) along with chemical water quality data taken by Council officers at the same sites.

1. On the whole, stream health improved considerably since the previous monitoring round (2005 – 2008). Polluted streams (*SHC e*) decreased by 71% from a total of 46.1 km to now 13.3 km, while there was an increase in stream kilometres of *SHC d* (63.7 km to 79.2 km) and *SHC c* (27.4 km to 47.7 km). However, the increase of *SHC d* was also due to degradation of previously healthier streams, including a former *SHC b* reach.

2. The most positive result is that there has been no loss in stream reaches of *SHC a* (3.7 km). This is vital because *SHC a* streams are most valuable assets and therefore of highest protection priority. This is because a degradation of a stream of *SHC a* is irreparable, and would mean an irretrievable loss.

3. Of serious concern is the loss of healthy stream reaches of *SHC b* by over 40% (7.7 km down to 4.5 km) between 2005 and 2011. This is mainly a result of the pollution of upper Cedar Creek in a reach of high biodiversity value. Restoring this reach is of highest management priority.

4. The increase of strongly polluted streams (*SHC f*) by 10% (1.9 km to 2.1 km) needs also to be addressed, but is of lower management priority. Affected is Freshwater Creek North Branch, Kallangur.

5. An additional 20.4 stream km were monitored for the first time (baseline assessment) to find new streams of high biodiversity value (HBV) in the Moreton Bay Region (MBR). Three HBV stream reaches could be identified, including two tributaries to the middle Stanley River and one tributary to Zillman Creek in the headwaters of the Caboolture River.

6. Stream Health Maps are provided showing the current SHC pattern in 2011/12 juxtaposed with the target condition (*Vision 2031*) as well as the two previous Stream Health Maps of 2008 and 2001.

7. For each of the 40 monitoring sites a sampling site sheet was prepared, describing the physical stream setting at the site.

In addition to updating Council’s Stream Health Map, this biological monitoring program is an important contribution to the documentation of the fauna of southeast
Queensland. The work is scientifically based, which is essential to understand the Region’s fragile biodiversity and promote environmental sustainability.

8. Four additional species of high biodiversity value (HBV) were recorded, bringing the total number of freshwater HBV species to as many as 33 in the MBR.

9. Currently there are 711 taxa of freshwater macroinvertebrates documented from the MBR, recorded since stream health monitoring commenced in 1998.

10. Insects are the most abundant and species-rich group, with 604 species recorded so far. Currently almost two-thirds of them bear code-names (369 species) because they are yet to be formally described and named, giving an idea of the dearth of knowledge on Australia’s freshwater fauna. Consequently taxonomic confirmation and verification is a continuous task in the course of this monitoring program, allowing in the past year to replace 33 code-names with scientific names for species recently published.

11. All raw data of macroinvertebrates per stream site are presented.

12. The voucher collection of macroinvertebrates is the scientific validation of the macroinvertebrate data base for the MBR. It is being prepared and curated by Ulrike Nolte since 1998.

13. Fact sheets for six macroinvertebrate species, which include three species of high biodiversity value, are presented as the beginning of a set of 20 such fact sheets to be prepared until March 2014.

The joint field work with Council officers proved to be highly beneficial as it enhances the effectiveness to respond to stream pollution. In all three cases where acute pollution was observed during field work, Council undertook immediate action to identify and control the pollution source. The affected streams were upper Cedar Creek (rural), Freshwater Creek at Kallangur (urban) and Conflagration Creek at Brendale (industrial). In another case of severe siltation, the joint field work resulted in an extensive stream inspection, which instigated the communication with stake holders (North Lakes golf course, Saltwater Creek).

This positive experience from the first year of the program underlines the benefit of the close collaboration between consultant and Council, and highlights the importance of the Stream Health Monitoring Program.
2. Framework

*Stream Health Monitoring* is an integral part of Council’s *Total Water Cycle Management (TWCM)* planning, as it addresses a number of drivers for TWCM, including protection of biodiversity values, environmental values and environmentally sensitive areas, water quality, environmental decline, environmental flow objectives, and impacts of population growth, and changing community values. Stream Health Monitoring is a long-term task, meeting the need to monitor the ecological condition of the Region’s freshwater streams on an ongoing basis.

3. Purpose of this report

This report informs Council about the current pattern of Stream Health Classes (SHC) of most of the South Pine River system, of Saltwater and Freshwater Creeks, and some headwater streams in the Caboolture District. These new results are based on stream sampling between October 2011 and September 2012 and provide data to update Council’s existing Stream Health Map (its data currency at present 2005 to 2008). In addition the report helps to build Council knowledge on the Region’s freshwater fauna in providing fact sheets on macroinvertebrates.

Before presenting the results, the activities undertaken in the past 12 months are briefly listed with reference to the project specifications of the contract (RFT Number MBRC002036).

4. Activities

4.1 Field work

Stream site assessment and macroinvertebrate sampling of 40 stream sites was undertaken, which include 33 established and 7 new monitoring sites. (As per points 2.2, 3.1.1, 3.1.2 and 3.3.2 of contract)

4.2 Laboratory work

4.2.1 Quantitative and taxonomic sample analyses. (*As per points 2.3, 3.1.2, 3.2.1 and 3.2.2 of contract*)

4.2.2 Species identification and Quality Assurance, using all available taxonomic keys, as well as original scientific publications.

For many taxa of aquatic macroinvertebrates, identification literature is yet to be developed and published. Therefore, certain specimens (e.g. some snails, mayflies, caddisflies) had to be sent to taxonomic experts for identification at the Australian Museum in Sydney and the Australian National Insect Collection / CSIRO in Canberra. To give this Quality Assurance a sound foundation, the voucher collection of macroinvertebrates per monitoring site and monitoring date is being continued. (*As per points 2.3, 3.2.2 and 3.3.8 of contract*)
4.3 Fact sheets on macroinvertebrate species

Fact sheets for six macroinvertebrate species from streams in the MBR were prepared. (As per point 3.3.6 of contract)

4.4 Data management, evaluation and Stream Health Classification

4.4.1 Raw data entry as sample analyses progresses. (As per point 3.3.3 of contract)

4.4.2 MAINSTREAM (stream health calculation program) data management is focused on the search and study of newly published scientific literature with the objective to substitute code names of [previously] undescribed macroinvertebrate species with scientific names, validated through the publication of the formal description of a given species. (As per point 3.2.3 of contract)

4.4.3. The Invertebrate Species Index (ISI) has been developed for calculating Stream Health Classes from “real data” (collected on site – as opposed to desk top studies) using MAINSTREAM. The ISI is based on two species-specific metrics of each species collected in a sample, the species score ($S_{10}$) and the indicator weight (W). For most macroinvertebrate species in the region (Southeast Queensland), these metrics are still under development, depending on the availability of data (species occurrence plus related physico-chemical site data). The data collected from October 2011 to September 2012 are still too few to develop $S_{10}$ and W metrics for further species. (Points 3.2.3 and 3.3.7 of contract)

4.4.4 Stream health classes were established for each stream site and the information prepared, which is necessary to update Council’s existing map. (As per points 3.2.3, 3.3.4 and 3.3.5 of contract)

4.5 Reporting

Quarterly progress reports were prepared in January, March and June 2012, followed by this first annual report in September 2012. (As per point 3.2.1 of contract)

4.6 Gaps

Four stream sites sampled at Ocean View in late August and early September 2012 are yet to be analysed; the data will be included in the next report.

4.7 Additional tasks

4.7.1 An additional report on acute pollution of upper Cedar Creek was prepared in November 2011.

4.7.2 Ad hoc inspections of stream reaches with local residents/stakeholders were undertaken: Kingfisher Creek, February 2012 and Saltwater Creek, May 2012.

4.7.3 Advice and photos were provided for a display on freshwater streams in the CREEC Community Centre, June 2012.
5. Methods

Please refer to the ‘Method Manual’ submitted to Council as part of the tender.

6. Results

Results obtained from October 2011 to September 2012 are presented in an order that follows the contract specifications: 3.3. Deliverables.

6.1 Reporting

Three quarterly progress reports, followed by this annual report, have been delivered.

6.2 Sampling site descriptions

are prepared in form of individual site sheets for the 40 stream sites monitored so far. They are presented in the attached folder (2. Deliverable).

6.3 The list of species and their abundance per sampling site

is given in the attached folder (3. Deliverable).

Principal findings from the faunistic data can be summarised as follows:

- A number of species were recorded for the first time in the MBR during last year’s monitoring, most of them insects with longer generation times. It was interesting to find them, though not surprising in view of the long drought that caused most streams to be ephemeral from 2005 to 2008, preventing animals with longer life cycles to develop. Most such first-time-records are caddisfly species, including Pliocaloca ?kleithria, Tamasia ?variegata (family Calocidae), Daternomina sp.1 (Ecnomidae), and Apsilochorema sp.1, Psyllobetina sp.1, and Ulmerochorema sp.1 (Hydrobiosidae) and others.

- Four additional species of high biodiversity value (HBV) were recorded, bringing the total number of freshwater HBV species to 33 in the MBR (see Nolte 2011). The four species are the Australian River Mussel Cucumerunio novaehollandiae (family Hydriidae) (Figure 1), the undescribed caddisfly genus ‘Genus Cal G’ (as in Dean et al. 2004) of the family Calocidae, the caddisfly Aphilo rheithrus sp.1 (family Philorheithridae) and the non-biting midge Podonomopsis evansi (subfamily Aphroteniinae).

Figure 1. The Australian River Mussel is Australia’s largest freshwater mussel with over 200 mm in length. It was recorded in the lower Cedar Creek and South Pine River. For more details refer to the species fact sheet. (Photo: U. Nolte)
• For MBR the number of macroinvertebrate taxa now stands at 711, recorded since stream health monitoring commenced in 1998.

• Insects are the most abundant and species-rich stream animals – with 604 species recorded so far. Their high diversity is the reason why insects are very useful stream health indicators.

• In this stream health monitoring program insects are differentiated to species level, as are snails and mussels (Mollusca, 30 species) and crayfish and shrimps (higher Crustacea, 5 species), because knowledge on these animal groups in Australia allows doing so.

• Other macroinvertebrates are inevitably treated to higher taxonomic levels, such as worms, water fleas, water mites and others (72 taxa). However, their diversity in our streams (species number) is comparatively low and by far out-numbered by insect species.

• Taxonomic knowledge on Australian freshwater insects increased significantly over the last decade. It is, however, still rudimentary as seen from the fact that as many as 61% of insect species collected from the Region’s streams are not yet formally described and therefore bear code-names. Taxonomic work is underway at several universities, museums and other research institutions, so that some 20% of the code-names used are published in identification keys.

  ➢ For the MBR data base this means: Out of a total of 604 insect species, 235 species bear a scientific name and 369 species bear code-names, which include 67 published (semi-formal) code-names.

• This dearth of faunistic knowledge highlights the important contribution this scientifically based stream health monitoring program of MBRC is making to the documentation of southeast Queensland’s fauna. Such work is outstanding and truly pioneering for a local government, and is vital to understanding the Region’s fragile biodiversity and promoting environmental sustainability.

6.4 Stream Health Classes: Current and previous – the change in time.
The 40 stream sites monitored in the past 12 months are listed in Table 1, along with the current Stream Health Class (SHC) and the target SHC per site. Also given is the SHC of previous monitoring rounds (where available). Further below these results are translated into Stream Health Maps (Figures 2 – 13).

Monitoring was focused on streams in the Pine Rivers District, including 9 sites sampled along Cedar Creek, 14 sites in the middle and lower South Pine River system, 5 sites in the Saltwater Creek and 4 sites in the Freshwater Creek systems. Furthermore, headwater streams in the Caboolture and Stanley Rivers were monitored in search for additional HBV stream reaches of high biodiversity value (HBV streams).
In Table 1 selected cells are marked in different colours to highlight principal findings. These are:

- **Eight sites improved**, namely upper and middle reaches of tributaries to the middle and lower South Pine River, and the two northern branches of Saltwater Creek in the Narangba – Dakabin area.

- **Four sites deteriorated**, all of them dramatically. The sites affected are located in upper catchments and all are (or were) sites of high biodiversity value.
  - In case of upper Cedar Creek (Site 15) the alarming change monitored in November 2011, was immediately reported and addressed by Council in that the pollution source was identified with the aim to control it.
  - In case of upper Zillman Creek (Sites 101 and 102) the drop in stream health was readily visible on site in August 2012, compared to the previous monitoring of this stream reach in 2004. Therefore both Sites are marked in Table 1 although the samples have yet to be analysed (Laboratory analysis will reveal whether SHC dropped to d or even further). It was evident that the main cause of eutrophication and disturbance was cattle directly accessing upper Zillman Creek. (Please refer to site sheets for photos).

- **Ten sites are of high biodiversity value** (HBV), including seven sites previously identified to be HBV sites (Nolte 2011) plus three sites that were monitored for the first time and revealed to house HBV species (Sites 190, 226, 230).

- **Sixteen sites are of poorer stream health than the set target.**
  - Ten sites are one SHC away, and
  - 6 sites are two SHC away from the target SHC.
Table 1. List of the 40 stream sites monitored between October 2011 and September 2012: Change of Stream Health Class (SHC) in time and space along with the target SHC for each site.

<table>
<thead>
<tr>
<th>#</th>
<th>Site ID</th>
<th>Site location</th>
<th>2001</th>
<th>2005/06</th>
<th>2011/12</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>Cedar Ck (Majala NP)</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>Cedar Ck (Greene Falls)</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>Cedar Ck (upper) “polluter”</td>
<td>b'</td>
<td>b'</td>
<td>d*</td>
<td>b</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Cedar Ck (Bolwarra Res.)</td>
<td>b'</td>
<td>c'</td>
<td>d*</td>
<td>b</td>
</tr>
<tr>
<td>5</td>
<td>17</td>
<td>Stony Ck (lower)</td>
<td>d</td>
<td>dry</td>
<td>d</td>
<td>c</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>Cedar Ck (Morrison Rd)</td>
<td>c</td>
<td>c</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>7</td>
<td>19</td>
<td>Cedar Ck (Toms Cs)</td>
<td>d</td>
<td>d</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>8</td>
<td>21</td>
<td>Branch Ck (lower) Sth Pine R. system</td>
<td>d</td>
<td>d (almost dry)</td>
<td>c'</td>
<td>c</td>
</tr>
<tr>
<td>9</td>
<td>22</td>
<td>Cedar Ck (Eatons Cs)</td>
<td>d</td>
<td>d'</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>10</td>
<td>23</td>
<td>Bergin Ck (middle)</td>
<td>d</td>
<td>dry</td>
<td>d*</td>
<td>c</td>
</tr>
<tr>
<td>11</td>
<td>24</td>
<td>Wongan Ck (middle)</td>
<td>e</td>
<td>dry</td>
<td>d'</td>
<td>c</td>
</tr>
<tr>
<td>12</td>
<td>25</td>
<td>Wongan Ck (lower)</td>
<td>d</td>
<td>e</td>
<td>d</td>
<td>c</td>
</tr>
<tr>
<td>13</td>
<td>26</td>
<td>Sth Pine R. (Bunya)</td>
<td>d</td>
<td>d</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>14</td>
<td>27</td>
<td>Kingfisher Ck</td>
<td>e</td>
<td>e</td>
<td>d'</td>
<td>d</td>
</tr>
<tr>
<td>15</td>
<td>28</td>
<td>Sth Pine R. (Cashes Cs)</td>
<td>d</td>
<td>d</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>16</td>
<td>29</td>
<td>Sth Pine R. (Leitchs Cs)</td>
<td>n/a</td>
<td>d</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>17</td>
<td>30</td>
<td>Albany Ck (nr border BCC)</td>
<td>d</td>
<td>dry</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>18</td>
<td>31</td>
<td>Conflagration Ck</td>
<td>d</td>
<td>dry</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>19</td>
<td>32</td>
<td>Conflagration Ck</td>
<td>n/a</td>
<td>n/a</td>
<td>f</td>
<td>d</td>
</tr>
<tr>
<td>20</td>
<td>33</td>
<td>Coulthards Ck (lower)</td>
<td>n/a</td>
<td>n/a</td>
<td>e</td>
<td>d</td>
</tr>
<tr>
<td>21</td>
<td>34</td>
<td>Four Mile Ck (middle)</td>
<td>d</td>
<td>d</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>22</td>
<td>35</td>
<td>Four Mile Ck (middle)</td>
<td>e</td>
<td>e</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>23</td>
<td>36</td>
<td>Four Mile Ck (lower)</td>
<td>e</td>
<td>e</td>
<td>e*</td>
<td>d</td>
</tr>
<tr>
<td>24</td>
<td>66</td>
<td>Saltwater Ck, Trib.A North (east to Old Gympie Rd)</td>
<td>f</td>
<td>e</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>25</td>
<td>67</td>
<td>Saltwater Ck, Trib.Narangba (bent Lipscombe Rd)</td>
<td>n/a</td>
<td>e</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>26</td>
<td>69</td>
<td>Saltwater Ck, Trib.B South</td>
<td>e</td>
<td>d</td>
<td>d*</td>
<td>d</td>
</tr>
<tr>
<td>27</td>
<td>70</td>
<td>Saltwater Ck, Trib.C (was upstr. NLakes)</td>
<td>b</td>
<td>c</td>
<td>e</td>
<td>b</td>
</tr>
<tr>
<td>28</td>
<td>71</td>
<td>Saltwater Ck, Trib.C (was dwnstr of NLakes)</td>
<td>b</td>
<td>d</td>
<td>d*</td>
<td>c</td>
</tr>
<tr>
<td>29</td>
<td>72</td>
<td>Freshwater Ck (Sheaves Rd)</td>
<td>f</td>
<td>e</td>
<td>e</td>
<td>d</td>
</tr>
</tbody>
</table>
### Table 1: Stream Site Monitoring Data

<table>
<thead>
<tr>
<th>#</th>
<th>Site ID</th>
<th>Site location</th>
<th>2001</th>
<th>2005/06</th>
<th>2011/12</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>74</td>
<td>Freshwater Ck (shopping centre)</td>
<td>f</td>
<td>f</td>
<td>f</td>
<td>d</td>
</tr>
<tr>
<td>31</td>
<td>76</td>
<td>Black Duck Ck (lower)</td>
<td>d</td>
<td>d</td>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td>32</td>
<td>77</td>
<td>Freshwater Ck (wetland Griffin)</td>
<td>d</td>
<td>d</td>
<td>d</td>
<td>c</td>
</tr>
<tr>
<td>33</td>
<td>101</td>
<td>Zillman Ck (via Dawes Rd)</td>
<td>n/a</td>
<td>c</td>
<td>*</td>
<td>b</td>
</tr>
<tr>
<td>34</td>
<td>102</td>
<td>Zillman Ck (via Dawes Rd)</td>
<td>n/a</td>
<td>c</td>
<td>*</td>
<td>b</td>
</tr>
<tr>
<td>35</td>
<td>190</td>
<td>Trib to Zillman Ck (via Dawes Rd)</td>
<td>n/a</td>
<td>n/a</td>
<td>b</td>
<td>b</td>
</tr>
<tr>
<td>36</td>
<td>191</td>
<td>Zillman Ck (via Miers Rd)</td>
<td>n/a</td>
<td>n/a</td>
<td>*</td>
<td>b</td>
</tr>
<tr>
<td>37</td>
<td>109</td>
<td>Caboolture R Sth (headwaters)</td>
<td>n/a</td>
<td>b</td>
<td>*</td>
<td>b</td>
</tr>
<tr>
<td>38</td>
<td>226</td>
<td>Branch Ck (lower) Stanley R. system</td>
<td>n/a</td>
<td>n/a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>39</td>
<td>230</td>
<td>“Cove Rd Ck” (via Peachester)</td>
<td>n/a</td>
<td>n/a</td>
<td>b</td>
<td>b</td>
</tr>
<tr>
<td>40</td>
<td>231</td>
<td>“Cove Rd Ck” (via Cove Rd)</td>
<td>n/a</td>
<td>n/a</td>
<td>c</td>
<td>b</td>
</tr>
</tbody>
</table>

**Legend of Table 1:**
- a: SHC improved since last monitoring round
- b: SHC deteriorated since last monitoring round
- c: HBV stream site (high biodiversity value)
- d: Current SHC one SHC away from target SHC
- e: Current SHC two SHC away from target SHC
- f: Laboratory analysis yet to be undertaken

### 6.5 Stream Health Map

#### 6.5.1 Stream Health Maps in Time

The updates on the Stream Health Map are presented in form of separate maps for larger sub-catchments to make details better visible (as opposed to a single map of the entire MBR). For all streams the change of SHC in time is given (2011/12; 2005 to 2008; 2001) headed by the Target Stream Health Map (*Vision 2031*).

Cedar Creek is shown in Figures 2 to 5, the middle and lower South Pine River system in Figures 6 to 9, and Saltwater and Freshwater Creeks in Figures 10 - 13. The four stream sites that were assessed for the first time (baseline monitoring) are not shown as maps yet but identified in using Council’s drainage data base IDs (Table 2).

The colour code for the 7 Stream Health Classes (SHC) used in Stream Health Maps is:

- a
- b
- c
- d
- e
- f
- g

For detailed descriptions of the 7 SHC refer to Council’s *Stream Health Manual.*
Figure 2. Stream Health target of Cedar Creek (Vision 2031)

Figure 3. Stream Health of Cedar Creek in 2011

Figure 4. Stream Health of Cedar Creek in 2006

Figure 5. Stream Health of Cedar Creek in 2001 (baseline monitoring)
Principal findings Cedar Creek: Stream health declined along upper Cedar Creek, while it improved along middle and lower Cedar Creek since 2005/06. The headwaters remained very healthy fitting into the best stream health class (SHC) a (Table 1.)

Four stream health maps of Cedar Creek are given in Figures 2 – 5, showing the stream health target, and the change of stream health over the years: in 2011, in 2005/06 and in 2001.

Brief discussion: Overall more reaches of Cedar Creek are now meeting the target SHC as set in Council’s Stream Health Manual.

However, the deterioration of upper Cedar Creek is alarming because the affected reaches are habitats of high biodiversity value (HBV) (see Nolte 2011, pages 22-24) now evidently threatened by eutrophication and siltation.

➢ Part of the problem was addressed in the ad hoc report on evident sewage input into Cedar Creek upstream of Site 15.

➢ The deterioration of Cedar Creek as far down as to the Bolwarra Bushland Environmental Reserve can be attributed in the first place to siltation but also to nutrient input upstream of Site 16. In this context it is noteworthy that over the last few years, land adjacent to Cedar Creek between Site 15 and 16 has been subject to rural residential development. Erosion control on development sites is essential for stream health protection, in particular along HBV stream reaches.

![Figure 6. Stream Health target of the middle and lower South Pine River and tributaries (Vision 2031)](image)
Figure 7. SHC of middle and lower South Pine River system in 2012

Figure 8. SHC of middle and lower South Pine River system in 2006
Principal findings **middle and lower South Pine River system**: Stream health in most tributaries in residential catchment areas improved from SHC e to SHC d (Bergin, Wongan, Kingfisher, Four Mile Creeks).

Albany Creek and the South Pine River itself remained unchanged (SHC d).

The upper reaches of Conflagration Creek (residential) improved from SHC e to SHC d, while the short middle reach between Leitchs Road and South Pine Road (industrial) deteriorated from SHC d to SHC f.

Coulthards Creek was biologically monitored for the first time (baseline assessment), following a recommendation that resulted from chemical monitoring of the stream some years ago, which revealed high levels of ammonium in the water (A.F.S. 2004) and high levels of heavy metals (lead, zinc, nickel) in the sediment (A.F.S. 2005). Biological monitoring resulted in SHC e.

**Brief discussion**: Most streams in residential areas improved, now meeting the target SHC set in Council’s *Stream Health Manual*. However, the industrial landuse in Brendale is harmful for creeks and need to implement better on-site waste management to protect our waterways.
Figure 10. Stream Health target of Saltwater and Freshwater Creeks (Vision 2031)

Figure 11. Stream Health of Saltwater and Freshwater Creeks in 2012
Figure 12. Stream Health of Saltwater and Freshwater Creeks in 2007

Figure 13. Stream Health of Saltwater and Freshwater Creek in 2001 (baseline monitoring)
Principal findings **Saltwater** and **Freshwater Creeks**:

Saltwater Creek is now almost entirely of Stream Health Class d (Figure 11), which is a significant improvement since the last monitoring round in 2007 (Figure 12).

Freshwater Creek, on the other hand, has not changed at all over the past ten years. The northern branches in Kallangur are polluted (SHC e), even including a strongly polluted reach (SHC f) downstream of Old Gympie Road in the area of the shopping centre.

**Brief discussion:**

In the Saltwater Creek system all middle and lower reaches now meet the target SHC set in Council’s *Stream Health Manual*. The upper reaches of Saltwater Creek in the Narangba area and of ‘Tributary A’, however, are one SHC below the target condition of SHC c. The upper reach of ‘Tributary C’ is SHC c, but fails to meet its target SHC b.

In Freshwater Creek, the most polluted reach of SHC f was found to be impacted by a leaking sewer pipe. The damage was immediately reported (May 2012) and the pipe repaired by Unity Water (May 2012), so that hopefully the main pollution source is now controlled. If so, stream health is expected to improve within weeks. It is recommended to establish the ‘after-repair-condition’ through follow-up monitoring.

**6.5.2 Budgeting stream health change in time**

Stream Health Maps show the spatial distribution pattern of Stream Health Classes throughout catchment areas, readily allowing to link landuse with stream health patterns, and to pinpoint areas of management priority. Stream Health Maps are fundamental tools for sustainable and successful stream health management.

For the purpose of simply budgeting the change over the years, it is helpful to add up all stream kilometres of the same SHC and compare their totals between monitoring rounds. This is done in Table 2, where the 171 stream kilometres assessed since October 2011 were grouped according to the 7 SHC.

To keep the information of previous and present monitoring rounds comparable, those streams that were assessed for the first time this year are kept separate. These were mainly healthy streams (Table 2) since they were selected in the search of high biodiversity value streams (see below, under 6.5.3).

The overall result of this budgeting is very positive, because the total stream kilometres of SHC c and SHC d increased considerably, while polluted stream kilometres of SHC e were significantly reduced, by as much as 71% from 46.1 km to now 13.3km (Table 2).
**Table 2.** Totals of stream kilometres per Stream Health Class (SHC). A comparison of present and previous monitoring results to budget the overall change in time.

<table>
<thead>
<tr>
<th>SHC</th>
<th>Previous monitoring 2005-2008</th>
<th>Present monitoring 2011-2012</th>
<th>Δ previous present</th>
<th>Plus additional creeks (2011/12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>3.7</td>
<td>3.7</td>
<td>0</td>
<td>9.9</td>
</tr>
<tr>
<td>b</td>
<td>7.7</td>
<td>4.5</td>
<td>-3.2</td>
<td>6.1</td>
</tr>
<tr>
<td>c</td>
<td>27.4</td>
<td>47.7</td>
<td>+20.3</td>
<td>1.2</td>
</tr>
<tr>
<td>d</td>
<td>63.7</td>
<td>79.2</td>
<td>+15.5</td>
<td>0</td>
</tr>
<tr>
<td>e</td>
<td>46.1</td>
<td>13.3</td>
<td>-32.8</td>
<td>3.2</td>
</tr>
<tr>
<td>f</td>
<td>1.9</td>
<td>2.1</td>
<td>+0.2</td>
<td>0</td>
</tr>
<tr>
<td>g</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total stream km</td>
<td>150.5</td>
<td>150.5</td>
<td>20.4</td>
<td></td>
</tr>
</tbody>
</table>

The most positive result, however, is that there has been no loss in stream kilometres of SHC a. This is significant, because the most healthiest streams of SHC a and SHC b are highly susceptible to degradation and, most importantly, once stream health drops from SHC a it cannot go back to its former state and is an irretrievable net loss.

Of serious concern is the fact that healthy streams of SHC b declined from 7.7 to 4.5 stream kilometres, that is by over 40%, between 2005 and 2011 (mainly due to the pollution of upper Cedar Creek).

The fact that the quantity of strongly polluted streams (SHC f) increased by some 10% (0.2 km, Table 2) needs also to be addressed, but is of lower priority compared to the decline in SHC b streams.

It is of highest management priority to protect streams of SHC a and SHC b.

### 6.5.3 In search of additional HBV streams

Four stream reaches were assessed for the first time in the Caboolture District (baseline monitoring) with the purpose to enhance knowledge on high biodiversity value (HBV) streams in the MBR.

Three sites are located in the Stanley River system and one site in the Caboolture River system. Because these streams have yet to be added to Council’s Stream Health Map, the streams are identified in Table 3 using Council’s Drainage System Waterways ID (DS_WW_ID).
Table 3. Four stream reaches monitored for the first time, along with Council data base identifier (DS_WW_ID), the Stream Health Class (SHC) measured and the respective indication as ecosystems of high biodiversity value (HBV). For details see text.

<table>
<thead>
<tr>
<th>Creek</th>
<th>DS_WW_ID</th>
<th>SHC</th>
<th>HBV reach (yes/no)</th>
<th>Number of HBV species recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tributary to middle Zillman Creek (Site 190) (Caboolture River system)</td>
<td>CAB_01_37483</td>
<td>b</td>
<td>Yes</td>
<td>5 HBV species</td>
</tr>
<tr>
<td>Branch Creek (Site 226) (Stanley River system)</td>
<td>STO_01_08729, STO_01_09748, STO_01_09831, STO_01_10869, STO_01_11889, STO_01_12911, STO_01_13455, STO_01_14480, STO_01_15328, STO_01_15547, STO_01_16570, STO_01_17591</td>
<td>a</td>
<td>Yes</td>
<td>2 HBV species</td>
</tr>
<tr>
<td>upper “Cove Road Creek” (Site 230) (Stanley River system)</td>
<td>STA_29_01575, STA_29_01740, STA_29_02766, STA_29_03404, STA_29_04427, STA_29_05454, STA_29_05686</td>
<td>b</td>
<td>Yes</td>
<td>1 HBV species</td>
</tr>
<tr>
<td>middle to lower “Cove Road Creek” (Site 231) (Stanley River system)</td>
<td>STA_29_00000, STA_29_00527, STA_29_00764, STA_29_01276</td>
<td>c</td>
<td>No</td>
<td>0 HBV species</td>
</tr>
</tbody>
</table>

As many as 5 species of high biodiversity value were recorded in the small unnamed tributary to middle Zillman Creek, which is part of the headwaters of the Caboolture River. The high number of HBV species here is very good news, especially because this finding came quite unexpected in view of the fact that most of the catchment area of the headwaters and middle reaches of Zillman Creek have long been used for cattle grazing, quite severely impacting on stream health (see site sheets for Site 101 and 102).

The small tributary arises on grazing land, but then runs some 500 m through a patch of remnant rainforest before joining Zillman Creek. It is in this rainforest patch where the high number of 5 HBV species was collected, namely the two forest damselflies the
‘Southern Whitetip’ (*Episynlestes albicauda*) and the ‘Bronze Needle’ (*Synlestes weyersii*) (Figure 14), the two caddisflies *Antipodoecia turneri* and *Tasiagma ciliata*, and the ‘Gondwana Midge’ *Aphroteniella filicornis*.

The two HBV species recorded in Branch Creek, which runs entirely through well-forested National Park, are the dragonfly the ‘Conehead Darner’ (*Austroeschna subapicalis*) and the caddisfly *Antipodoecia turneri*.

The unnamed Creek at Cove Road runs most of its course through forestry area near the Glasshouse Mountains. In its middle reach it is home to the forest damselfly ‘Bronze Needle’ (*Synlestes weyersii*), while no HBV species could be found in the creeks lower reach, which is partly cleared and impacted by cattle.

### 6.6 Fact sheets on species of freshwater macroinvertebrates

Fact sheets for six species are presented in the attached folder labelled 6. Deliverable. The six species are listed below, with species 1, 2 and 5 being high biodiversity value (HBV) species.

<table>
<thead>
<tr>
<th>#</th>
<th>Animal group</th>
<th>Common Name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Snail</td>
<td>North Pine Rivers Freshwater Snail</td>
<td><em>Fluvidona anodonta</em></td>
</tr>
<tr>
<td>2</td>
<td>Mussel</td>
<td>Australian River Mussel</td>
<td><em>Cucumerunio novaehollandiae</em></td>
</tr>
<tr>
<td>3</td>
<td>Mussel</td>
<td>Australian Basket Shell</td>
<td><em>Corbicula australis</em></td>
</tr>
<tr>
<td>4</td>
<td>Dragonfly</td>
<td>Blue-spotted Hawker</td>
<td><em>Adversaeschna brevistyla</em></td>
</tr>
<tr>
<td>5</td>
<td>Damselfly</td>
<td>Sapphire Rockmaster</td>
<td><em>Diphlebia coerulescens</em></td>
</tr>
<tr>
<td>6</td>
<td>Water bug</td>
<td>Water scorpion</td>
<td><em>Laccotrephes tristis</em></td>
</tr>
</tbody>
</table>
6.7 Metrics for macroinvertebrate species ($S_{10}$ and $W$)

The species sensitivity score ($S_{10}$) and indicator weight ($W$) for a particular species is derived by using data on a range of environmental variables measured at stream sites where this species was recorded. Nutrient concentrations are part of these environmental variables. The statistical procedures to derive sensitivity scores and indicator weights were described by Haase & Nolte (2008).

As result of the current sampling round, nutrient data of 21 sites are available, which is a rather small sample size to apply statistical analysis. Therefore it was decided to postpone the calculation of $S_{10}$ and $W$ metrics as more water quality data will be available soon. (Until March 2014, metrics for 50 macroinvertebrate species are to be derived to enhance the scope of application of the Invertebrate Species Index (ISI).)

Another important step to advance the ISI is the replacement of preliminary code names used for little known, undescribed macroinvertebrate species.

Describing new species is an on-going process, because just a fraction of all Australian freshwater invertebrates is formally described and hence unambiguously named. Consequently, the search and study of new scientific publications – for the purpose to replace currently used code names in the macroinvertebrate database – is a continuous task that accompanies the data management for the MAINSTREAM calculation program and the ISI.

Over the past year it was possible to replace as many as 33 code names with scientific names due to new publications. Most of these species are mayflies because of the recently published identification key for Baetidae (Webb & Suter 2011) but also include caddisflies, beetles, mosquitoes, midges and others. The list is presented in the attached folder (7. Deliverable).

6.8 Voucher collection of macroinvertebrates

A voucher collection of macroinvertebrates has been prepared and is curated by Ulrike Nolte since 1998. It consists of ethanol-preserved specimens as well as slide-mounted (using Euparal) specimens, and is held at the laboratory in Scarborough, Queensland. Selected material has been included in official museum collections (Australian Museum Sydney, Australian Insect Collection CSIRO, Canberra).

The voucher collection is the scientific validation of the macroinvertebrate data base used for stream health assessment.
7. Benefit from joint field work

The close cooperation with Council officers is highly beneficial for the efficiency of this project.

The abiotic water quality data collected by Council are ideal to advance the Invertebrate Species Index (ISI) because they are taken at the same site where the biological samples are taken. This improves the statistic tests to derive species sensitivity scores ($S_{10}$) and indicator weights ($W$) for further macroinvertebrate species.

Another, perhaps less foreseen benefit from joint field work, site inspections and immediate communication is the resulting effectiveness for tackling stream pollution.

Council could take immediate action to identify and control the pollution source at three polluted stream reaches. And in one case of severe siltation, the joint field work and evolving extensive stream inspection instigated the communication with stakeholders.

The four cases are:

- Upper Cedar Creek (Site 15) impacted by on-site sewage and wastewater management, November 2011.
- Freshwater Creek at Kallangur (Site 74) impacted by broken sewer, May 2012.
- Conflagration Creek at Brendale (site 32) impacted by industrial waste discharge, August 2012.
- Saltwater Creek (Tributary B) at North Lakes (Site 69) impacted by recurring severe siltation at the golf course, originating from upstream residential development, May 2012.

It is a very positive outcome that in all cases where acute pollution was observed during field work, Council undertook immediate steps to improve stream health. This positive experience from the first project year underlines the benefit of the close collaboration between consultant and Council, and highlights the importance of the Stream Health Monitoring Program.
8. References


Haase R. & Nolte U. 2008. The Invertebrate Species Index (ISI) for streams in southeast Queensland, Australia. Ecological Indicators 8: 599-613.

