Stream Health Monitoring in the Moreton Bay Region

The first Stream Health Map of the entire local government area

Stream health, biodiversity value
and inventory of aquatic macroinvertebrates

prepared for

Environment and Local Laws
Moreton Bay Regional Council

by Ulrike Nolte
July 2010
The ‘Sapphire Rockmaster’ is a typical resident of rocky headwater streams in the D’Aguilar Range. Damselflies are excellent flyers catching their prey on the wing.

*Diphlebia coerulescens* [Photo © Ulrike Nolte]
1. Executive Summary

This report is to inform Council about the current ‘ecological condition’ of freshwater streams (= stream health) and their biodiversity in the Moreton Bay Region.

On the whole the freshwater streams in the Region are in relatively good condition, and headwater streams include reaches of very high biodiversity value, which are most vulnerable and need to be protected.

1.1 Stream Health

The Stream Health Map presented below is based on data collected at 157 sites along the Region’s freshwater streams. It is the first stream health map for the Moreton Bay Region (Figure 1). Prior to the council amalgamation, stream health was mapped for the Pine Rivers District. This program was subsequently extended, and the first assessment of all major streams (baseline monitoring) in the Caboolture and Redcliffe Districts was completed in June 2010.

This report gives an overview over methods, principal results and recommendations, while all detailed information is available in form of electronic databases and maps.

Principal results include the finding that one third (35.5%) of the Region’s freshwater streams are healthy (Stream Health Class \(a, b, c\)); they need to be protected. Almost half of all streams (45.3%) are moderately to severely disturbed yet still ecologically balanced (SHC \(d\)); here further degradation has to be prevented and stream health should be improved. The remaining 19.2% of the Region’s streams are polluted (SHC \(e, f, g\)) and need repair. These quantitative results are compiled in Table 1, while the spatial pattern of Stream Health Classes is shown in the Stream Health Map (Fig.1).

<table>
<thead>
<tr>
<th>SHC</th>
<th>SH description</th>
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<th>Proportion per SHC [%]</th>
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<tr>
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<td>3.9</td>
<td>protect</td>
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</tr>
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<td>0.0</td>
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<td>Total</td>
<td></td>
<td>893.3 km</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Stream Health Map 2010 for the Moreton Bay Region
1.2 Biological Diversity

Other important results from Stream Health Monitoring are related to the biodiversity our freshwater streams support.

In the Moreton Bay Region 721 species of freshwater macroinvertebrates were recorded. Some of these species are extremely rare and of local significance, while others are quite common. Worth mentioning is a small snail, only 3 mm high, which is known to occur only in the upper reaches of the South and North Pine Rivers. This locally significant species has to be protected and is included in the Natural Resource Management species list for SEQ (DEWHA 2009).

Also noteworthy is the fact that 30 species were collected for the first time, most of them insects. Because they are new to science, specimens were deposited in museum collections, so that they can be formally described and named.

Figure 2. The freshwater snail *Fluvridona anodonta* is only known from the Moreton Bay Region, and from nowhere else in Australia or the world. This species needs to be protected.

[Photo © Ulrike Nolte]

1.3 Recommendations include to

- focus on the protection of healthy headwater streams (Class a and b) and to understand this to be an active management action of highest priority;
- prepare a HEV map (stream reaches of high ecological value = biodiversity value)
- prepare a Target Stream Health Map for the entire MBR (‘Vision 2031’);
- prepare water quality objectives (WQO) for the entire MBR by extending ‘The Stream Health Manual’ to the whole local government area.
- add monitoring sites on Bribie Island;
- add further monitoring sites in the headwaters of the Stanley and Mary Rivers since the baseline monitoring revealed unexpected high nutrient levels in these upper catchments. Sources of excess nutrient input need to be identified so that they can be controlled;
- continue Stream Health Monitoring throughout the MBR on a 5-year basis to keep Council informed on all matters concerning stream health. This enables informed decisions on sustainable stream management.

In putting living ecosystems at the centre of monitoring and management, Stream Health Monitoring works towards a sustainable use of natural assets.

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2. Background Information

The first stream health assessment (baseline monitoring) undertaken in the Redcliffe and Caboolture Districts was conducted from January 2009 to June 2010. Baseline Stream Health Monitoring (SHM) in the Pine Rivers District was completed in 2001, and the current results shown in the Steam Health Map (Fig.1) are based on the second round of monitoring (Nolte 2008).

Stream health is monitored using biological indicators, namely macroinvertebrate communities that live in the streams. Measured on a scale of seven Stream Health Classes (Table 1) the biotic response of freshwater life to environmental impact is assessed. The SHM data, in conjunction with land use data, and data from other components of Council’s Waterways Monitoring Framework (water quality data, riparian condition data) yield the information needed to prepare stream health maps for the Moreton Bay Region (Figure1).

Stream Health Maps summarise and translate complex data sets into easily understandable maps. Because stream health is subject to change, stream health maps should be up-dated every five years. Only then are stream health maps powerful management tools, as they keep Council informed on the current ecological status of the Region’s streams, on changes in space and time, on responses required to manage the streams in a sustainable way, and whether management actions are successful.

The preparation of the Pine Rivers Shire Council’s local water quality guidelines, The Stream Health Manual (Nolte & Loose 2004), would not have been possible without Stream Health Monitoring. The monitoring allowed setting desired and realistically achievable water quality objectives (for the then Pine Rivers Shire). These targets are now embodied in the Queensland Water Quality Guidelines and the Environmental Protection (Water) Policy 2009 (DERM 2009a & b).

It is recommended to identify stream health targets for all major streams in the MBR and extend ‘The Stream Health Manual’ to the the entire local government area.

3. Objectives

The main objectives of stream health monitoring are to

- provide advice to Council in all matters concerning stream health so as to enable informed decisions on sustainable stream management;
- inform strategic planning (e.g. Waterways Overlay Code Map);

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• identify natural assets through:
  o monitoring of the biological diversity of the Region’s freshwater streams
    with the principle objective to identify stream reaches of high biodiversity
    value;
  o identifying healthy, largely unimpacted stream reaches.

• provide information for enquiries of the public

Furthermore, stream health monitoring provides data and information on whether

- the health of the Region's waterways is increasing or decreasing
- certain catchments and their streams are under particular stress
- land development is impacting significantly on our streams (erosion/siltation,
  impact of fertiliser and other pollutants)
- water resources are protected and managed in a sustainable way
- degraded streams are recovering
- healthy waterways of high biodiversity value are adequately protected.

The stream health monitoring also informs about the biodiversity of MBR’s freshwater
streams, providing the data necessary to map HEV stream reaches, in compliance with
State requirements (EPA 2009a).

4. Monitoring Area, Sampling Sites and Time of Monitoring

Stream health was monitored throughout the Moreton Bay Region covering 893 kilo-
meters of freshwater streams so far. A total of 157 stream sites were visited, visually
assessed, and sampled for macroinvertebrates. This represents a very dense monitoring
grid of unparalleled quality in SEQ. On average, the SHM grid equals one monitoring
site every 5.7 stream kilometres. All monitoring sites are mapped in Figure 3.

SHM sites were selected strategically, with a higher number of sites in catchments that
presently are under pressure through development (e.g. Freshwater Creek, Burpengary
Creek) and / or eutrophication (= pollution with organic matter, e.g. Caboolture River).
The number of sites per major catchment is listed in Table 2. Detailed information for
each of the 157 SHM sites is kept in MBRC’s Monitoring Site Atlas (in preparation).
Figure 3. The 157 stream health monitoring (SHM) sites in the Moreton Bay Region. Shown are the main trunks of all major freshwater streams along with catchment boundaries.
Table 2. Major catchments in the Moreton Bay Region, number of Stream Health Monitoring sites per catchment, and year of latest monitoring.

<table>
<thead>
<tr>
<th>Catchments</th>
<th>No. of SHM sites</th>
<th>Last SH Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kedron Brook</td>
<td>3</td>
<td>2008</td>
</tr>
<tr>
<td>Cabbage Tree Creek</td>
<td>3</td>
<td>2008</td>
</tr>
<tr>
<td>South Pine River</td>
<td>35</td>
<td>2005 – 2008</td>
</tr>
<tr>
<td>Freshwater Creek</td>
<td>6</td>
<td>2006 – 2008</td>
</tr>
<tr>
<td>Saltwater Creek</td>
<td>6</td>
<td>2005 – 2007</td>
</tr>
<tr>
<td>Burpengary &amp; Little Burpengary Creeks</td>
<td>12</td>
<td>2009</td>
</tr>
<tr>
<td>Redcliffe Peninsula</td>
<td>4</td>
<td>2009</td>
</tr>
<tr>
<td>Pumicestone Passage</td>
<td>4</td>
<td>2009 – 2010</td>
</tr>
<tr>
<td>Stanley River</td>
<td>20</td>
<td>2009 – 2010</td>
</tr>
<tr>
<td>Mary River</td>
<td>2</td>
<td>2009</td>
</tr>
</tbody>
</table>

Gaps identified: In the headwaters of the Stanley and Mary Rivers some further sites should be assessed (access and water flow permitting), because the baseline monitoring undertaken in 2010 revealed an unexpected high eutrophication level. To be able to improve poor stream health high in these catchments, the source of the excess nutrient input needs to be identified so that it can be controlled. Also, freshwater streams on Bribie Island are yet to be monitored. It is expected that ‘filling the gap’ will add some 6 to 8 sites to the SHM component.

Monitoring frequency: The aim is to sample each SHM site every five years to update the SHM database so as to keep Council informed on current stream health and changes.

Stream health is not static but changing over time, mainly due to changes in land use. Changes can go in either direction, to the worse caused by poorly managed landuse leading to increased sediment and nutrient input – or to the better due to successful stream rehabilitation measures and prudent planning and development.

To monitor each established SHM site every five years on a long-term basis seems to be a balanced approach between the ability to detect changes caused by rehabilitation work and other management actions, and the workload involved in biological SHM. A five-
year-repeat monitoring has proven to work well in other parts of the world where SHM is an established part of stream management (Europe: Directive 2000/60/EC; AQEM 2004; North America: US EPA 2002). Hence the former Pine Rivers Shire Council adopted a five-yearly SHM routine in 2002, and it is recommended to adopt this monitoring frequency for the entire Moreton Bay Region.

Stream monitoring certainly depends on stream discharge, which in turn depends on rainfall. The unpredictable weather pattern in SEQ can hamper a five-year monitoring routine as was experienced during the last drought. The Pine Rivers District, where baseline monitoring was completed in 2001, was due for SH monitoring in 2006. This was delayed, however, until April 2008 when creeks had returned to normal flow conditions (Nolte 2008; see also Table 2).

5. Methods

The method is only briefly outlined because it was described and discussed in detail in earlier reports to Council (e.g. Nolte 2008, AFS 2001).

Field work: At each SHM site all main aquatic habitats are sampled for macroinvertebrates. The kind and number of habitats present differ from site to site, depending on the stream type (upland stream, lowland stream) and on the health or degree of degradation. Generally speaking, the healthier the stream reach the more distinct in-stream habitats are present.

The stream bed is the habitat all sites have in common. It also is the only in-stream habitat that can be sampled in a truly quantitative way. This is done using a corer (85 cm²), which is pushed 5 cm deep into the bottom sediment. The fine net (0.20 mm) attached to the corer collects the sample. Per site 3 corer samples are taken so as to measure the all important macroinvertebrate abundance, which is a key indicator for Stream Health Classes (Nolte & Loose 2004, Haase & Nolte 2008). The corer samples are also analysed for the suit of species and counts per species to obtain data on the dominance structure of the bottom-dwelling community (= benthos) at a site. When there is a good stream flow, additional benthos samples are taken with a Surber sampler (225 cm², 0.25 mm net) to catch larger and fast moving macroinvertebrates so as to complete the list of benthic species.

Other habitats sampled include surface growth on boulders and submerged logs (= aufwuchs), which is gently brushed off a measured area (mostly 5 cm x 10 cm) over a fine net (0.20 mm). The areas are measured – although strictly quantitative sampling is
not possible from such irregular natural surfaces – to keep samples comparable between monitoring sites.

Stands of water plants (= macrophytes), submerged roots from riparian vegetation, and stream bank overhangs are sampled in a purely qualitative way using a standard AusRivAS hand-net (0.25 mm). These samples are analysed for the macroinvertebrate species present and their relative abundance (= dominance structure).

**Sample processing and analyses:** On site, all samples are gently pre-washed through a fine net (0.20 mm) and checked for large animals, which can be identified and counted alive without a microscope (e.g. yabbies, water scorpions, beetles) to be released back into the stream. Then the samples, kept separately according to habitat, are preserved in ethanol to be analysed in the laboratory using a stereo-microscope and, for species identification, a compound microscope. All samples are used to record the stream health indicators listed below.

**Stream Health Indicators:**
- Abundance (= number of animals per square metre stream bottom)
- Species richness (= number of species recorded at the stream site)
- Community composition (= kind of species recorded)
- Presence and number of indicator species per site (e.g. clean water indicator species or pollution indicator species)
- Presence of locally significant species
- Dominance structure (= relative density of individual species)
- Community structure (= relative presence of predators, grazers, detritus feeders, etc; age structure).

**Data evaluation and stream health classification:** The macroinvertebrate data were used to calculate the *Invertebrate Species Index* (ISI) for each stream site. The ISI is a biotic index, numerically measuring stream health by using the abundance recorded per species \( A_i \), the species’ indicator weight \( W_i \) and sensitivity scores \( S_{10i} \) to organic pollution. The equation to calculate the ISI is given below; Details are published in the international scientific journal ‘Ecological Indicators’ (Haase & Nolte 2008).

\[
\text{ISI} = \frac{\sum_{i=1}^{n} S_{10i} \cdot W_i \cdot A_i}{\sum_{i=1}^{n} W_i \cdot A_i}
\]

Calculation of the ‘Invertebrate Species Index’ or ISI to measure stream health at a given stream site (from Haase & Nolte 2008).

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The resulting numerical value of the ISI calculated for a particular stream site lies in the range from 1 to 10 and fits into one of the seven Stream Health Classes (SHC). For details see Council’s *Stream Health Manual* (Nolte & Loose 2004 and Haase & Nolte 2008). SHC range from SHC a (= clean) to SHC g (= excessively polluted).

Each SHC has an assigned colour code (Table 3) so that on-ground findings can be translated into stream health maps, which are valuable management tools.

As can be seen from Table 3, the method MBRC employs to measure and monitor ecological stream condition is more sensitive towards disturbance compared to the generic Queensland Guidelines (DERM 2009), therefore delivering a clearer picture of stream health throughout the Region. The value of the higher resolution power of seven SHC (instead of three Levels) lies in that it assists informed management decisions, such as prioritising stream reaches in need of management and prioritising the implementation of management actions.

**Table 3.** The seven Stream Health Classes (SHC) and specific colour codes used in stream health mapping, along with degree of disturbance through nutrient load, and the corresponding ‘ecosystem condition level’ from the Queensland Water Quality Guidelines 2009 (DERM 2009). The finer differentiation for MBR streams is clear, and this greatly assists management to prioritise streams and action needed.

<table>
<thead>
<tr>
<th>Stream Health Class</th>
<th>Nutrient load</th>
<th>Corresponding Ecosystem condition level as per Qld WQG 2009 / ANZECC 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Clean or traces of load</td>
<td>Level 1</td>
</tr>
<tr>
<td>b</td>
<td>Little loaded</td>
<td>Level 1</td>
</tr>
<tr>
<td>c</td>
<td>Loaded</td>
<td>Level 2</td>
</tr>
<tr>
<td>d</td>
<td>Strongly loaded</td>
<td>Level 2</td>
</tr>
<tr>
<td>e</td>
<td>Polluted</td>
<td>Level 3</td>
</tr>
<tr>
<td>f</td>
<td>Strongly polluted</td>
<td>Level 3</td>
</tr>
<tr>
<td>g</td>
<td>Excessively polluted</td>
<td>Level 3</td>
</tr>
</tbody>
</table>
6. Results

6.1 Stream Health in the Moreton Bay Region

Nearly 900 kilometres of freshwater streams are now assessed in the MBR and Stream Health Classes assigned to the stream reaches. The quantitative distribution of the seven SHC are summarised in Table 4, the spatial distribution is shown on the Stream Health Map (Figure 4).

Table 4. Stream Health Classes (SHC) and their quantitative distribution along 893 km of freshwater streams monitored in the Moreton Bay Region.

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<th>SHC</th>
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<tr>
<td>Total</td>
<td></td>
<td>893.3 km</td>
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</tbody>
</table>
Figure 4. The Stream Health Map 2010 for the Moreton Bay Region. Shown are also the major catchment areas.
Stream Health Class a:

Results: As many as 35 stream kilometres (or 3.9%) were in near-natural, very healthy condition. This is a very positive result. All SHC a streams are headwaters arising in forested, protected catchment areas in National Parks. All of them are located in the coastal range, with a clear cluster in the southern D’Aguilar National Park, in the southwestern part of the MBR (Figure 4). SHC a stream reaches were identified in the headwaters of Cedar, Kobble and Lacey’s Creeks and the North Pine River.

Discussion: Noticeably, in the Caboolture River system not a single stream reach fits in this best category, and in the Stanley River system only one short headwater tributary of Stony Creek was found to be a SHC a stream (Figure 4). These findings reflect the intensive land use – mostly cattle and dairy farming – in largely deforested headwater catchment areas that were turned into pasture since European settlement.

SHC a streams only occur in catchment areas that are almost unimpacted from human activities, which is why these streams (better: stream reaches) are so rare. There are many local governments areas without a single SHC a stream reach. SHC a streams are most valuable and vulnerable natural assets. They are delicately balanced ecosystems highly susceptible to degradation, in particular to nutrient input, which easily can happen well before any structural damage of the creek itself or of its riparian vegetation is visible. Most importantly, once SHC drops from class a it cannot go back to its former state and is forever lost.

Management response: The protection of SHC a streams is of highest priority as these are truly rare natural assets. Ecosystem protection has to be an active management response.

Stream Health Class b:

Results: A total of 58 stream kilometres (or 6.5%) were found to be minimally impacted and only little loaded with bio-nutrients. All SHC b stream reaches are located in well-forested upper catchments.

Discussion: Most of the SHC b reaches where identified in protected catchment areas in the southern D’Aguilar National Park, where they follow downstream of SHC a headwaters as these become slightly impacted (Figure 4). In non-protected catchment areas, the very headwaters arise as SHC b streams – if not as c, d or even stronger impacted waters (see below).

The upper Caboolture River system supports several SHC b reaches – most notably Gregors Creek, which in addition is of remarkably high biodiversity value (more details
It seems that the headwaters benefit from a progressive reduction of grazing in the upper catchments areas (e.g. Ocean View, Campbells Pocket) as this takes cattle out of the creeks. This is seen in the Stanley and Mary River systems, where the land is used for intensive grazing and fruit growing, and where headwater streams are of SHC c, d or even e (Figure 4).

**Management response:** A high priority is to protect SHC b streams. These streams are very healthy, natural assets. Often SHC b reaches are of high biodiversity value. It is prudent to actively protect SHC b stream reaches because good health in the upper reaches is a key factor for achieving (or maintaining) good stream health in the lower stream reaches. It is economically cheaper to protect healthy streams compared to restoring them (if this is possible at all).

**Stream Health Class c:**

**Results:** A total of 224 stream kilometres (or 25.1%) were found to be loaded with bio-nutrients and slightly impacted, though still in good ecological condition.

In the southern part of the MBR, Stream Health Class c reaches are often located in the transition zone of upper and middle catchments, including Cedar, Kobble, Lacey's, Four Mile and One Mile Creeks and the North Pine River. Not so the South Pine River, which is of poor stream health in most upper reaches, arising as SHC c or less healthy streams (Figure 4).

In the middle and northern parts of the MBR, that is the Caboolture and Stanley Rivers and their tributaries, most headwater streams arise as Stream Health Class c streams reflecting the intensive landuse in the uppermost catchment areas (Figure 4).

**Discussion:** Stream Health Class c streams show clear signs of disturbance, mainly through input of bio-nutrient in combination with structural degradation of in-stream habitats (e.g. cattle trampling) and the stream banks (thinning of riparian vegetation). Degradation often is minor or temporary (otherwise the SHC would drop further), so that SHC c reaches can be easily restored (to SHC b), often simply through a riparian buffer zone.

**Management response:** Protect. Provide buffer zone either side of the creek is a high priority to restore stream health back to SHC b. Because most SHC c reaches are located high in the catchments, and because minor impact can often be stopped easily, management action in SHC c reaches usually deliver a very high outcome compared to the money spent.
Stream Health Class d:  
**Results:** Most streams in the MBR were strongly loaded with bio-nutrients and moderately disturbed, amounting to a total of 404 stream kilometres (or 45.3%).

In the Pine Rivers system, Burpengary Creek and Caboolture River system SHC d reaches are located in the middle catchment areas. In the Stanley and Mary Rivers in addition, many headwaters were found to be of SHC d (Figure 4).

**Discussion:** SHC d streams are regarded to be still in a tolerable condition as the stream ecosystem is balanced enough to up-hold a certain degree of ‘ecosystem services’ such as its biological water-purifying capacity.

Stream Health Class d streams often drain rural or rural residential areas. Increased direct nutrient input into the stream and physical disturbance of the stream-bed together with a severe degradation of the riparian zone are the main impacts. Stream health of SHC d streams can easily drop further down to ‘polluted’. This needs to be prevented.

**Management response:** Prevent further degradation. Although SHC d stream reaches are clearly impacted, repair measures are of low priority. It is more important to stabilise the situation because SHC d streams are quite resilient and able to even slightly recuperate once physical disturbance and pollution sources are controlled.

Stream Health Class e:  
**Results:** A total of 164 stream kilometres (or 18.4%) were found to be highly disturbed ecosystems and polluted with biological nutrients.

Most SHC e reaches are located in residential and urban areas, and clusters of polluted stream reaches are located in the eastern part of the Moreton Bay Region (Figure 4). Of serious concern is the finding that several upper stream reaches and even headwater creeks in rural agricultural areas were polluted, all located in the Region’s northern catchments. These include Waraba and Lagoon Creeks near Wamuran, upper Monkeybong and Running Creek in the Stanley River system, and one headwater creek of the Mary River.

**Discussion:** SHC e streams are highly disturbed because often they are deprived of riparian vegetation and some streams even of their natural stream-bed (engineered, remodelled, concrete-lined channels). As a consequence natural in-stream processes are much reduced and the biological water-purifying capacity is destroyed. SHC e reaches often emit a putrid smell and give rise to complaints.
The SHC e headwater creek of the Mary River is alarming. Despite being a structurally intact rainforest creek (complete with cat birds and bower birds!) the stream ecosystems itself is destroyed. The uppermost part of the catchment is used for avocado farming, grazing and large dams in a very destructive way.

**Management response:** SHC e stream reaches need **repair.** Though improvement is certainly desirable, repair of SHC e reaches **in urban areas is of low priority** in the view of limited resources.

**Repair** of the SHC e stream in the **Mary River headwaters** is of **absolute highest priority.** Immediate action should be possible, because (1.) the physical structure of the creek itself is little impacted (mainly siltation) and its riparian zone is good quality rainforest. And (2.) the creek is on a VCA property (Voluntary Conservation Agreement) and the owner would welcome assistance to improve stream health. The key is a better and more sustainable management of the upper catchment area.

**Stream Health Class f:**

**Results:** A total of 7.3 stream kilometres (or 0.8%) were found to be severely polluted. This poor and severely impacted condition was diagnosed for six stream reaches in six different catchment areas, all of them located in old, established urban areas. These are lower Bells Creek and lower Humpybong Creek on the Redcliffe peninsula, upper Freshwater Creek in Kallangur, upper Saltwater Creek (Tributary B) in Dakabin, a tributary in the lower catchment of Little Burpengary Creek in Deception Bay, and lower Lagoon Creek in an mixed urban/light industrial area of Caboolture (Figure 4).

**Discussion:** SHC f streams are severely damaged, sick ecosystems that are beyond recovery without management action. The high amount of bio-nutrients generates a high productivity of aquatic live, including of blue-green algae and other bacteria. SHC e stream reaches not only emit a putrid smell but also pose a hazard to the community (children, pets that may play in the water).

**Management response:** Identify and control the pollution sources. Consider sign posting. **Repair** is of higher priority than for SHC e reaches.

**Stream Health Class g:**

**Results:** No excessively polluted freshwater streams were identified in the MBR.

**Discussion:** Most commonly SHC g reaches are located direct downstream of sewage treatment plant outfalls, suffering from excessive nutrient input and residue chlorine

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used for disinfection. The former triggers a high biological production from just a few pollution hardy species, while the latter further reduces the suite of species able to live under such extreme conditions. SHC $^g$ streams support high macroinvertebrate abundances of up to 90,000 animals per square metre stream bottom, all belonging to just 2 or 3 species (Nolte 1999). As SHC $^g$ streams are often the result of point-polluters, stream health improvement is easy to achieve (as the pollution source is understood) though expensive.

In the MBR most sewage treatment plants discharge into tidal waters, which are not subject to this Stream Health Monitoring. The few STP discharging into freshwater streams performed satisfactorily, with the receiving waters responding with SHC $^d$ (Stanley River, lower South Pine River).

6.2 Biodiversity of freshwater streams in the Moreton Bay Region

Macroinvertebrates (key indicators for stream health): Currently (2010), there are 721 species of macroinvertebrates recorded from freshwater streams in the Morton Bay Region. By far most of the species are insects (608 species; 84%). Crustaceans with 40 species (6%) and molluscs with 32 species (snails and clams: 4%) are also quite common, while the remaining 41 species belong to many different animal groups (flatworms, leeches, water mites, etc., Figure 5). For a list of all species along with their distributional and taxonomic details see the aquatic macroinvertebrates database.

Noteworthy is the fact that 167 species belong to a single family, the Chironomidae or non-biting midges (23% of total, Figure 5), several of which are rare and of high biodiversity value. Chironomids play a key-role in ecosystem processes such as nutrient uptake (water-purifying capacity) and nutrient cycling (many invertebrates, fish and even birds feed on them). Because of their species-richness, chironomids are very good environmental indicators; they include species indicative of near natural conditions as well as species restricted to severely degraded and polluted ecosystems.
Worth mentioning is a small snail (*Fluvilona anodonta*), only 3 mm high, which is known to occur only in the upper reaches of the South and North Pine Rivers, and nowhere else in Australia or the world (Figure 2). This locally significant species needs to be protected, and is included in the Natural Resource Management species list for South East Queensland (DEWHA 2009).

Australia's invertebrate fauna is poorly known and contains a high number of species still undescribed and new to science. Thirty species from streams in the Moreton Bay Region were collected for the first time and are new to science (3 snails, 2 mayflies, 25 midges). Specimens of these species were included in official museum collections so they can be formally described and named.

New findings about habitat requirements and ecological preferences of 199 aquatic macroinvertebrates were published in an international scientific journal (Haase & Nolte 2008) and are mainly based on Council’s database. This aut-ecological information is the foundation of stream health monitoring based on biological indicators as used in the MBR.

Council’s Stream Health Monitoring is pioneering work, which significantly contributes to the knowledge of Queensland's freshwater fauna and biodiversity.
7. Conclusions

On the whole the freshwater streams in the Moreton Bay Region are in comparatively good condition.

The Region is in the outstanding position to have several near-natural streams of Stream Health Class a and SHC b, which are rare natural assets. It is of highest management priority to actively protect these streams from degradation.

Of concern are severely degraded headwaters in the Stanley and Mary River systems. Here an improved management of the adjacent land (catchment) is of high priority.

8. Recommendations

It is recommended to

- focus on the protection of healthy headwater streams (SHC a and b) and to understand this to be an active management action of highest priority;
- prepare a HEV map (stream reaches of high ecological value = biodiversity value)
- prepare a Target Stream Health Map for the entire MBR (‘Vision 2031’);
- prepare water quality objectives (WQO) for the entire MBR by extending ‘The Stream Health Manual’ to the whole local government area.
- add monitoring sites on Bribie Island;
- add further monitoring sites in the headwaters of the Stanley and Mary Rivers since the baseline monitoring revealed unexpected high nutrient levels in these upper catchments. Sources of excess nutrient input need to be identified so that they can be controlled;
- continue Stream Health Monitoring throughout the MBR on a 5-year basis to keep Council informed on all matters concerning stream health. This enables informed decisions on sustainable stream management.
9. References


