Georges Bay Community Water Quality Monitoring
• Congratulations to the volunteers for a great dataset!
• Thanks to Alison Hugo, NRM North and BODC for the opportunity to work on the data.
• Thanks to Christine Crawford for background on Georges Bay monitoring, and for discussions to come
Water quality in Georges Bay

• Description of the George catchment and factors that have a major influence on water quality
  – Land use upstream of Georges Bay
  – Flow in the George River
  – Marine and tidal influence on Georges Bay

• Summary of previous results from Georges Bay

• Description of the community-based sampling program

• Summary of monitoring results 2007-2011

• Open discussion with volunteers on your experiences, what worked, what didn’t, where to from here.........
Water quality in Georges Bay is influenced by water quality in the catchment, land that drains directly to the Bay and tidal exchange with the Tasman Sea.
Catchment description - land use
River naturalness
River naturalness
River flow, George River

River Flow, George River

Average daily flow (cumecs)

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

2007
2008
2009
2010
River flow, George River

- Largest source of freshwater to Georges Bay
- Typically highest flows in winter
- Record breaking heavy rain and flooding in January, March 2011
Georges Bay

- “Wave dominated estuary”
  - a famous barway
  - long, narrow entrance channel
  - well-developed flood tide delta
  - deep main basin
  - large active riverine deltas.
- Marine influence in Bay from the Tasman Sea, and the East Australian current (warm but nutrient poor) & Southern Ocean (cold but nutrient rich)

Georges Bay

- Water from East Australian Current moves south in summer bringing warm, nutrient poor water into Tasman Sea
- Water from Southern Ocean moves north in autumn and winter, bringing cold, nutrient rich water
Georges Bay Monitoring

- Community–based monitoring plan developed by TAFI (now IMAS).
- Focus on the health of the bay by monitoring local water quality.
- Monthly sampling program, in-situ water column profiles and surface water samples sent to laboratory.
- Regular sampling, didn’t specifically target floods.
- Data collated by Alison Hugo on behalf of volunteers.
Monitoring sites- Georges Bay water quality

**GB1**- Mouth of Georges Bay, entrance to estuary, shallow, flushed with each tide.

**GB2**- Mouth of Moulting Bay, 19m deep, tidal and river (wind) influence.

**GB3***- Southern shore, 19m deep, tidal and small river influence, local land-use.

**GB4**- Beauty Bay, mid-depth 6m, tidal influence, river less pronounced.

**GB5**- George River at Bridge, shallow (~1 m) always fresh.
# What was measured in Georges Bay?

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature*</td>
<td>Normal range, affects biological and chemical processes, species distribution.</td>
</tr>
<tr>
<td>Salinity/conductivity*</td>
<td>Mixing and circulation of fresh and marine waters, affects species distribution, water quality.</td>
</tr>
<tr>
<td>Dissolved oxygen*</td>
<td>Critical to maintaining life and controls much water chemistry, indicates increase in organics.</td>
</tr>
<tr>
<td>Turbidity*</td>
<td>Amount of suspended solids in the water. Natural processes (storms, floods); contaminant sources and loads, light penetration.</td>
</tr>
<tr>
<td>Chlorophyll-a</td>
<td>Photosynthetic pigment, measures biomass of phytoplankton community, microalgal blooms.</td>
</tr>
<tr>
<td>Dissolved nutrients (ammonia, phosphate, nitrate/nitrite)</td>
<td>Nitrogen and phosphorous are essential. “Biologically available” nutrients for uptake by phytoplankton and other organisms.</td>
</tr>
</tbody>
</table>
# Report card for Georges Bay, 2004-05

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Comments</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Normal</td>
<td>1</td>
</tr>
<tr>
<td>Salinity</td>
<td>Normal</td>
<td>1</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Limited data</td>
<td></td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>No data (high oxygen demand at STP outfall)</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>Limited data, mostly within limits</td>
<td></td>
</tr>
<tr>
<td>Chlorophyll-α</td>
<td>No data</td>
<td></td>
</tr>
<tr>
<td>Dissolved nutrients</td>
<td>No phosphate data, few high values</td>
<td>3</td>
</tr>
</tbody>
</table>

(All measured in 2007-2011 monitoring)

1. Excellent
2. Good
3. Satisfactory
4. Poor
5. Degraded
### Report card for Georges Bay, 2004-5

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Comments</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total nutrients</td>
<td>Nitrogen periodically high, Phosphorous</td>
<td>3</td>
</tr>
<tr>
<td>Seagrass area</td>
<td>Stable</td>
<td>1</td>
</tr>
<tr>
<td>Seagrass condition</td>
<td>Limited data, good</td>
<td>2</td>
</tr>
<tr>
<td>Bacteria</td>
<td>High at bridge</td>
<td>2</td>
</tr>
<tr>
<td>Animal kills</td>
<td>Ongoing low levels of oyster mortality</td>
<td>3</td>
</tr>
<tr>
<td>Toxicants</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Algal blooms</td>
<td>Limited data, no toxic blooms</td>
<td></td>
</tr>
</tbody>
</table>

**Rankings:**
1. **Excellent**
2. **Good**
3. **Satisfactory**
4. **Poor**
5. **Degraded**

(Not measured in 2007-2011 monitoring)

"Establishment of an Integrated Water Quality Monitoring Framework for Georges Bay"

Christine Crawford and Camille White

Tasmanian Aquaculture & Fisheries Institute, September 2005
Volunteer monitoring - Water column profiles

- Temperature, dissolved oxygen, salinity measured at surface and every meter down through the water column
  - Basic “physico-chemical” parameters that tell us something about mixing processes in Georges Bay
- Also measured pH and turbidity in surface samples
  - Some information about biological processes, and sources of pollution
2007-2011 Monitoring results

Water column profiles

- Summer GB1 (mouth)
- Summer GB3 (Stieglitz)
Georges Bay Water column profiles

**Summer GB4 (Beauty Bay)**

**Summer GB2 (Humbug Pt)**

**Winter GB4 (Beauty Bay)**

**Winter GB2 (Humbug Pt)**

- Temp
- Salinity
- Oxygen
Surface water quality, GB5

- Temp
- Salinity
- Oxygen
Temperature – seasonal patterns

Marine

George River
Temperature – seasonal patterns

[Graph showing temperature patterns for George River GB5, Marine GB1, and Humbug GB2 over a period from March 2007 to March 2011.]
Turbidity freshwater and marine inputs

- GB1 mouth
- GB5 George River
- TPC

Turbidity

Mar 07  Jun 07  Sep 07  Dec 07  Mar 08  Jun 08  Sep 08  Dec 08  Mar 09  Jun 09  Sep 09  Dec 09  Mar 10  Jun 10  Sep 10  Dec 10
Surface water quality, freshwater GB5

inputs

Turbidity
NTU

Flow
cumecs

Mar 07 | Jun 07 | Sep 07 | Dec 07 | Mar 08 | Jun 08 | Sep 08 | Dec 08 | Mar 09 | Jun 09 | Sep 09 | Dec 09 | Mar 10 | Jun 10 | Sep 10 | Dec 10
(Where did the samples go?)
Dissolved Nutrients 2007-2011

- Nutrients (Nitrogen and Phosphorous) are commonly imported into estuaries via natural processes; they are also introduced as runoff from agriculture and other anthropogenic activities in the catchment.
- Expensive to measure all forms of nutrients (total and dissolved) so often a subset is measured
- Dissolved = biologically available.
Dissolved Nutrients 2007-2011

GB1 Marine influence from Tasman Sea

- Winter influx of nitrate + nitrite from Southern Ocean.
- Slight increase in phosphate.
- Autumn maxima in ammonia.
- Occasional phytoplankton blooms in summer (light, temperature).
Dissolved Nutrients 2007-2011

GB5 Fresh water influence from George River

- Very high catchment loads of nitrate, year round but peaking with higher flows
- Ammonia generally low
- Phosphate low seasonally.
- Chlorophyll low, but peaks in summer and spring (flow, turbidity, nutrients?)
Dissolved Nutrients 2007-2011

GB2 Mixing of fresh and marine waters, high flushing rate

- Site strongly influenced by marine water quality, some dilution from river and run-off (nitrate + nitrite, ammonia, phosphate, chlorophyll-a)
• Important for diatom growth, as their cells are made from silica.
• Diatoms provide a nutritious food source to oysters
• Most silica coming in from the catchment (granite hills and sediments)?
Microscopic wonders in Georges Bay

Have you seen this?
Thanks to Ali Turnbull and TSQAP for data!

- Phytoplankton almost always dominated by diatoms, with occasional “crashes”.
- Diatoms important food source for oysters.
- Phytoplankton dominated by coastal marine species, with occasional Antarctic visitors.
## Summary for Georges Bay, 2007-11

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Comments</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Normal</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Salinity</td>
<td>Normal</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Catchment sources</td>
<td>2 (-)</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>Normal, seasonally low at depth, BOD</td>
<td>2 (-)</td>
</tr>
<tr>
<td>Chlorophyll-α</td>
<td>Peaks in summer, generally in normal range.</td>
<td>3 (-)</td>
</tr>
<tr>
<td>Dissolved nutrients</td>
<td>Nitrate high from catchment, ammonia can be elevated,</td>
<td>3? (3)</td>
</tr>
</tbody>
</table>

(Community based monitoring, “first pass”)

1) Excellent
2) Good
3) Satisfactory
4) Poor
5) Degraded
In closing,

• Community monitoring has provided a comprehensive dataset that fills some important gaps in our knowledge and understanding of Georges Bay.
• High quality dataset that can contribute to setting local management objectives, and water quality targets
• Data from the community monitoring program shows Georges Bay water quality reflects
  – Seasonal changes in coastal water quality (nutrients, temperature)
  – Seasonal changes in quality and quantity of water from the George River (flow, nutrients, turbidity, temperature, salinity)
  – Catchment geology (silicate?)
• Overall water quality reflects base flow conditions, with suggestions that contributions from the catchment are very high during flow events.
• Water quality is Georges Bay is generally good, for the parameters monitored
• Thankyou!
• Questions?
• Feedback on community monitoring program...