Potential Health Risks from Pathogens in Alternative Waters

Jatinder Sidhu
Health Risk Assessment of Local Source Waters

Science Forum, 19-20 June 2012
Captured Stormwater

• Alternative water source which can be used to augment non-potable and potable supplies around cities
• Involves collection of runoff from creeks and drains
• Potential health risks from pathogens
• Understanding of loadings and sources of pathogens required for improved health risk assessment
Aims of the study

- to determine the prevalence of pathogens
- to check association between MST and chemical markers of sewage pollution
- to determine if adenovirus numbers vary during the storm event
Sampling Sites
Makerston Street site
## Site Description

<table>
<thead>
<tr>
<th>Site name</th>
<th>Land Use</th>
<th>Potential source of faecal pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitzgibbon drain, Brisbane</td>
<td>Residential</td>
<td>Sewage pipe network, small numbers of horses and cattle</td>
</tr>
<tr>
<td>Hornsby, Sydney</td>
<td>Urban roads/carpark</td>
<td>Sewage pipe network</td>
</tr>
<tr>
<td>Banyan Creek, Melbourne</td>
<td>Residential</td>
<td>Sewage pipe network,</td>
</tr>
<tr>
<td>Smith Street, Melbourne</td>
<td>Commercial</td>
<td>Sewage pipe network, industry</td>
</tr>
<tr>
<td>Makerston Street, Brisbane</td>
<td>City, commercial</td>
<td>Sewage pipe network</td>
</tr>
</tbody>
</table>
Autosamplers

Makerston street  Fitzgibbon drain
Stormwater Sampling

• 20-40L samples collected from 5 sites in Melbourne, Brisbane and Sydney
• Five mL concentrated sample used for detection of MST markers and pathogens
• One L sample used for the capture of Adenovirus
Methodology

• Pathogens
  – Hemoflow HF80S filters
  – PCR detection

• Faecal indicators
  – Membrane filtration
Microorganisms

- Viral Pathogens
  - Adenovirus
- Bacterial Pathogens
  - Campylobacter jejuni
- MST markers
  - Bacteroides HF183
  - *Metahonobrevibacter smithii nifH*
Chemical Markers

• Food
  – Caffeine
  – Acesulfame

• Pharmaceuticals
  – Paracetamol
  – Aspirin
FIB Results

- **E. coli** numbers as 40 to 6560 cfu 100mL\(^{-1}\)
- *Enterococcus* spp. numbers 1930 to 22600 cfu 100mL\(^{-1}\)
- *Enterococcus* spp. numbers tenfold or more higher than *E. coli* across all sites
<table>
<thead>
<tr>
<th>Sites</th>
<th>FIB*</th>
<th>Pathogens</th>
<th>MST markers</th>
<th>Food markers</th>
<th>Pharmaceuticals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>E. coli</td>
<td>Enterococcus</td>
<td>Adenovirus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. jejuni</td>
<td>HF183</td>
<td>nifH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acesulfame</td>
<td>Caffeine</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Paracetamol</td>
<td>Aspirin</td>
</tr>
<tr>
<td>Fitzgibbon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/12/2011</td>
<td>3600</td>
<td>16700</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>3560</td>
<td>11800</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>17/04/2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hornsby</td>
<td>40</td>
<td>1930</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>15/02/2012</td>
<td>100</td>
<td>20900</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>20/02/2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banyan Creek</td>
<td>3400</td>
<td>10200</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>9/11/2011</td>
<td>7200</td>
<td>22600</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6/02/2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smith Street</td>
<td>6560</td>
<td>152000</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>30/09/2011</td>
<td>-</td>
<td>7900</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>28/02/2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Biological and Chemical markers

• Eight samples tested from four sites
• All samples (100%) positive for Adenovirus and HF183
• Five samples (63%) positive for five markers, two positive (25%) for four markers
• Chemical and MST markers confirm presence of sewage contamination
Adenovirus Results

[Graphs showing Adenovirus number L⁻¹ and Water Depth for Makerston St and Fitzgibbon St]
Adenovirus

- Both sites tested positive for Adenovirus
- Makerston Street numbers 148 to 400 pdu L$^{-1}$
- All samples positive during the storm event
- Fitzgibbon drain numbers 0 to 9000 pdu L$^{-1}$
- From Fitzgibbon drain data, higher numbers appear to coincide with peak of event
- Potentially other enteric virus also present
Conclusions

- *Enterococcus* spp. numbers several fold higher than category D (<501 *Enterococci* per 100mL\(^{-1}\)) under Australian guidelines for managing risks in recreational water (NHMRC 2008).
- Adenovirus present in samples from all sites.
- *C. jejuni* detected in 50% of samples from 4 sites tested.
- Wide prevalence of MST and chemical markers suggest sewage contamination of stormwater.
- Some degree of captured stormwater treatment is required prior to non-potable use.
Acknowledgements

Co-authors:
R. Aryal, A. Palmer, W. Ahmed and S. Toze

- Urban Water Security Research Alliance, a scientific collaboration between the Queensland government, CSIRO, The University of Queensland and Griffith University
- Monash University’s Cities as Water Supply Catchments program funded by the National Water Commission, the Victoria Smart Water Fund and a broad range of governmental and industry partners as listed on the program’s website (http://www.watersensitivocities.org.au/programs/cities-as-water-supply-catchments/)
Urban Water Security Research Alliance

THANK YOU!

www.urbanwateralliance.org.au