Greywater recycling in Western Australia: Policy, practice & technology

By

Dr. Martin Anda & Ceri Evans
Outline of presentation

Greywater use in WA
Technology & systems
Barriers to increased uptake

Case study: Bridgewater
Water Management
Approval process
Installation of greywater systems
Operation & maintenance issues
Water saving figures

Ongoing greywater research in WA
Introduction

- Greywater reuse in WA
  Slowly being adopted
  Code of practice for greywater reuse in WA

- Need to optimise designs & installations for:
  - Costs
  - Scheme water savings
  - Acceptance
## Greywater technology

<table>
<thead>
<tr>
<th>Greywater Technology</th>
<th>Level of Treatment</th>
<th>End Use Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversion units</td>
<td>Coarse treatment achieved through coarse screening filters, no or limited storage</td>
<td>Sub surface irrigation or dripline trench</td>
</tr>
<tr>
<td>Sedimentation tanks</td>
<td>Primary treatment through sedimentation</td>
<td>As above</td>
</tr>
<tr>
<td>Secondary treatment (mechanical)</td>
<td>Secondary treatment through compact treatment plant, storage required</td>
<td>Sub surface or sub strata or spray irrigation if disinfected</td>
</tr>
<tr>
<td>Secondary units (land based)</td>
<td>Secondary treatment through soil filter, sand filter or constructed wetland</td>
<td>As above</td>
</tr>
<tr>
<td>Advanced units</td>
<td>Tertiary treatment through biological, chemical or physical methods</td>
<td>All forms of irrigation, toilet flushing, washing machine, car washing</td>
</tr>
</tbody>
</table>
Greywater systems approved in WA

Most systems are:
- direct diversion or sedimentation
- coarse or primary treatment
- few advanced systems approved

<table>
<thead>
<tr>
<th>Technology Type</th>
<th>No. of systems approved in WA (Aug 08)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversion systems</td>
<td>8</td>
</tr>
<tr>
<td>Sedimentation tanks</td>
<td>7</td>
</tr>
<tr>
<td>Secondary (mechanical)</td>
<td>2</td>
</tr>
<tr>
<td>Secondary (land based)</td>
<td>0</td>
</tr>
<tr>
<td>Tertiary systems</td>
<td>1 (3 more pending approval)</td>
</tr>
</tbody>
</table>
Barriers to uptake of greywater technology in WA

1. Onerous, lengthy and costly approval process
   - Greywater system approval by DoH
   - Submit application form & fee to local Government authority. Receive ‘Approval to install’.
   - Install greywater system by specialized contractor & plumber
   - Pay fee and receive ‘Permit to Use’ after on-site inspection
   - Apply for $500 rebate

Most complex process of all the states
2. Greywater systems not viable economically:

- Long pay back periods due to low cost of water
- High capital & installation cost of greywater especially advanced treatment units.
- Limited incentive for homeowners

However, defers from building expensive, energy intensive desalination plants
Bridgewater Lifestyle Village

Located 40km South of Perth, city Of Mandurah

Development of 389 houses
Water Management

- On-site greywater recycling – rear yard irrigation
- Rainwater tanks
- Subsurface dripline
- Water efficient appliances
- Water efficient plants
- Waterwise landscapes
Greywater system approval

- Intricate and time consuming
- ‘Approval to install’ application form + site plan required for each home.
- NIMP required
- Trial of 3 x ETT’s & mosquito impact study required – high groundwater table ≤ 500mm
Installation issues

- Miscommunication between 4 involved parties:
  - Plumber, village maintenance team, head office & greywater manufacturer
- No consistency from plumber re: greywater fixtures connected:
  - Some bathroom only
  - Others bathroom & laundry
- Plant death due to insufficient irrigation water
Operation / maintenance issues

- Lack of information & training to homeowners
  - Cleaning of filters
  - Operation of bore back up system

- Increased volumes of greywater overflowed to sewer due to clogged filters

= lost scheme water saving!!

Water usage figures still look very promising.
### Bridgewater Lifestyle Village – preliminary water saving findings

<table>
<thead>
<tr>
<th>Water Source</th>
<th>BWLV (L/p/d)</th>
<th>DWUS (L/p/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-house</td>
<td>171</td>
<td>155</td>
</tr>
<tr>
<td>Blackwater</td>
<td>51</td>
<td>62</td>
</tr>
<tr>
<td>Greywater</td>
<td>106</td>
<td>93</td>
</tr>
<tr>
<td>Hot water</td>
<td>56</td>
<td>-</td>
</tr>
<tr>
<td>Toilet</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Hot kitchen tap</td>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>Cold kitchen tap</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Ex-house</td>
<td>14</td>
<td>211</td>
</tr>
<tr>
<td>Outside tap</td>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>Rainwater tank</td>
<td>1.6</td>
<td>-</td>
</tr>
</tbody>
</table>

Ex-house water usage 14 L/p/d compared to 211 L/p/d from DWUS

## Installation & commissioning

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Units installed</td>
<td>240</td>
</tr>
<tr>
<td>Units decommissioned</td>
<td>10 (as at end June 08)</td>
</tr>
<tr>
<td>Units remaining</td>
<td>100 (approx)</td>
</tr>
<tr>
<td>Units operational *</td>
<td>131 (as at end June 08)</td>
</tr>
<tr>
<td>Units (commissioned) at display home</td>
<td>33 (as at end June 08)</td>
</tr>
</tbody>
</table>

## Approvals to install

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Approvals acquired</td>
<td>240</td>
</tr>
<tr>
<td>Approvals pending **</td>
<td>58 (stage 3)</td>
</tr>
<tr>
<td>Submissions required **</td>
<td>70 (stage 4)</td>
</tr>
</tbody>
</table>

## Permits to use

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits acquired</td>
<td>24</td>
</tr>
<tr>
<td>Permits pending</td>
<td>57</td>
</tr>
</tbody>
</table>

## Rebates $500

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebates acquired</td>
<td>15</td>
</tr>
<tr>
<td>Rebates pending</td>
<td>7</td>
</tr>
</tbody>
</table>

** Submissions remaining | 300 (approximate)

* Does not include display homes

** Currently awaiting on DoH approval for the new GW unit
Ongoing greywater research in WA

- Monitor water flows across a range of household scenarios
- Identify factors which most influence scheme water savings
- What mix of factors maximises water savings?
- Identification of factors that maximise savings NOT a comparison of greywater systems
- Limited previous studies for Perth

WAWA, greywater for irrigation, possible savings of

38% (Water Authority of Western Australia, (1993) What is Wastewater? Wastewater 2030, Perth)
Previous studies

- **ATA Smart Water Greywater Project (2005)**
  - Melbourne
  - 6 houses
  - 0 – 33% savings

- **The Healthy Home (2003)**
  - Queensland
  - 1 house
  - 29-37% savings

- **Melbourne (1995)**
  - 4 houses
  - 21-31% savings
Factors to be studied

1. Volume of greywater generated

- No. of occupants
  - WA Code of practice sizes systems on no. of bedrooms
- Fixtures connected to the system
  - Number of water efficient appliances
- Water use practices of occupants
  - eg: Frequency & duration of showers
2. Greywater systems & technology

- Storage vs non storage systems
- Different treatment levels allowing certain end use applications
- Direct diversion system compared to sedimentation tank
3. End Use Application

- Exterior use (irrigation) or interior use (toilet flushing)
- For irrigation, consider:
  - Soil type
  - System design
  - Vegetation type & water requirements
  - Size of irrigation area
  - Type of irrigation (dripline / dripper / trench / sprinkler)
4. System installation, operation & maintenance

- Level of maintenance required
- Filtration mechanism
  - Filter type (sponge, biomat, strainer, disc)
  - Filter set-up (in-line, dual)
  - No. of filters
- Extent to which maintenance affects efficient running of system
- Volume of greywater overflowing to sewer
5. Homeowner attitudes

How do homeowner attitudes change due to installation of greywater system?
The Case studies

1. Bridgewater (4 houses)
   - 2 bedrooms each
   - 1-2 occupants
   - Bathroom & laundry
   - Diversion system (4 types)
   - Rear garden beds (20m²)
   - Filtration

![Diagram of water flow system]

- Scheme water into house
- Bathroom & laundry
- Filter
- Pump pit
- Overflow to sewer x2
- Re-flux valve
- Dripline to rear garden beds
- Pump, pump & switch
- Bore water backup
- Exterior tap
1. Advanced Wastewater Greyflow 00

2. Land and Water greywater system

3. Advanced Wastewater Greyflow PS

4. Greywater Reuse Systems – Supaflow
2. Hamilton Hill

- Community housing
- 5 houses, 1-4 bedrooms, 1-3 occupants
- Bathroom x5 + laundry x1
- Diversion system + minimal storage
- GRS Waterclear, sedimentation tank & ozone generation
- Irrigation of lawn (109m$^2$) & fruit trees (24m$^2$)

Pump tank with ozone injection

Scheme water into 5 x houses

House 1
Bathroom & Laundry

House 2
Bathroom only

House 3
Bathroom only

House 4
Bathroom only

House 5
Bathroom only

Common room

Exterior taps for houses

Reflux valve
To Water Corp. sewer

Overflow to sewer

Underground sedimentation tank

Biomat filter

Sump pump & float switch

Dripline to lawn

Dripline to fruit trees

External taps used for hand watering of communal areas
3. White Gum Valley

2 bedrooms, 2 adults 2 children
Bathroom & laundry
GRS Watersave + dripper system
Diversion system, sedimentation tank, minimum storage
Fruit trees/garden beds (30m²)

4. Dalglish

4 bedrooms
2 adults 2 children
Shower/bath & laundry
Garden beds (50m²)
AWWS greyflow 00
Diversion system, no storage, filtration

5. Hamilton Hill

4 bedrooms
Diversion, no storage
Garden beds (35m²)

2 adults, 2 children
Bathroom only
Filtration
6. South Fremantle

2 bedrooms, 2 adults
Minimal storage
Bathroom & laundry
GRS Watersave + dripper system
Diversion system, sedimentation tank, min. storage
Waterwise garden beds (30m2)

## Overview of case studies

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Occupants</th>
<th>GW fixtures</th>
<th>Greywater System</th>
<th>Size of irrigation area</th>
<th>Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridgewater</td>
<td>2</td>
<td>Bathroom + Laundry</td>
<td>Diversion No storage</td>
<td>20m²</td>
<td>Garden beds</td>
</tr>
<tr>
<td>Hamilton Hill - Community</td>
<td>1-3</td>
<td>Bathroom + Laundry</td>
<td>Storage Sed. tank</td>
<td>133m²</td>
<td>Lawn &amp; Fruit trees</td>
</tr>
<tr>
<td>White Gum Valley</td>
<td>4</td>
<td>Bathroom + laundry</td>
<td>Storage Sed. tank</td>
<td>30m²</td>
<td>Fruit trees &amp; Garden beds</td>
</tr>
<tr>
<td>Hamilton Hill</td>
<td>4</td>
<td>Bathroom only</td>
<td>Diversion No storage</td>
<td>35m²</td>
<td>Garden beds</td>
</tr>
<tr>
<td>South Fremantle</td>
<td>2</td>
<td>Bathroom + Laundry</td>
<td>Storage Sed. tank</td>
<td>30m²</td>
<td>Waterwise garden beds</td>
</tr>
<tr>
<td>Dalglish</td>
<td>4</td>
<td>Bathroom (exc. basin) + laundry</td>
<td>Diversion No storage</td>
<td>50m²</td>
<td>Garden beds &amp; veggies</td>
</tr>
</tbody>
</table>
Methodology

1. Monitor flows using pulse output water meters & data loggers
   - Scheme water consumption
   - Greywater output to irrigation
   - Exterior taps
   - Volume overflow to sewer

2. Comparison of water bills – pre and post reuse of greywater.
Methodology cont...

- Period of monitoring
  Spring & summer
  Highest irrigation demand

- Possible extension to 1 year
Conclusions

- Fill knowledge gap
  Scheme water savings for all property types?
  Lack of real data

- Development of 5 Star Plan stage 2
  Incorporate most influential factors
  Prioritise water efficiency along side health & environmental concerns

- The importance of careful site specific system design
Thank you
Any Questions?