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# Guidance for the use of recycled water by industry.

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**VICTORIA  
UNIVERSITY**

**A NEW  
SCHOOL OF  
THOUGHT**

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# Purpose

- Encourage industry to take recycled water
- Support WaterMAPs
- Target large companies and SME's



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# Aims of the Project

- Identify and address key challenges and considerations in industrial use of municipal recycled water
  - *Supply information - booklet*
- Develop a support framework to assist industry in making decision about recycled water
  - User friendly software



# Recycling Water in Industry



- Provides:
  - Water quality guides
  - Specific end uses
  - Case studies
- Very positive feedback

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# Recycling Water in Industry - Potential Risks

- Human/Animal Health
  - Very well covered by legislation/guidelines
  - HACCP
- Brand
  - Marketing can combat to a degree
  - Some areas where you cannot go
- Licensing
- Plant
  - Corrosion, scale, fouling, foaming etc.



# Water Qualities

Use	Min Vic EPA Recycled Water Class	Treatment Level	Notes
Cooling	A	Tertiary	Nitrification
Boiler	A	MF/RO	Demineralization
Wash - Housekeeping	C A	Secondary Tertiary	Significant Controls
Pollution Control	C	Secondary	Ammonia and Phosphate reduction
Quality Control	A	Tertiary	Final rinse may need higher quality



# Water Qualities

Use	Min Vic EPA Recycled Water Class	Treatment Level	Notes
Transport	C	Secondary	Filtration
Separation - Unimetallic	C	Secondary	Filtration, Flotation tests
Separation - Selective	A	Tertiary	Flotation tests
Lubrication - Ambient	A	Tertiary	
Lubrication - High Temperature	A	MF/RO	Demineralization



# Water Qualities

Use	Min Vic EPA Recycled Water Class	Treatment Level	Notes
Fire Control	B	Secondary	Controls
	A	Tertiary	
Irrigation - Restricted	C	Secondary	Controls
	A	Tertiary	
Dust Suppression - Restricted	C	Secondary	Controls
Dust Suppression - Unrestricted	A	Tertiary	



# Water Qualities

Use	Min Vic EPA Recycled Water Class	Treatment Level	Notes
Toilet Flushing	A	Tertiary	Aesthetic improvements
Paper/pulp	A	Tertiary	Colour removal
Textiles	A	Tertiary	Colour removal
Electronics	A	MF/RO	Demineralization



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## Software

- Quicksan tool & Decision Support Framework
- Going out for second trial
- Will be made available through Smart Water soon



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# Approach

- Developed a decision matrix to identify challenges
- Investigated case studies
- Determined rough water qualities



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# Quickscan Tool

- Decision tree – approx 20 questions
  - Availability of recycled water
  - Opportunities for internal recycling
  - Opportunities for demand management
- Identifies if it is worth going to the more detailed Decision Support System



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# Decision Support Framework

- Multi-criteria analysis
- Takes a qualitative approach
- Can give some support to quantitative work, but large amount of variability



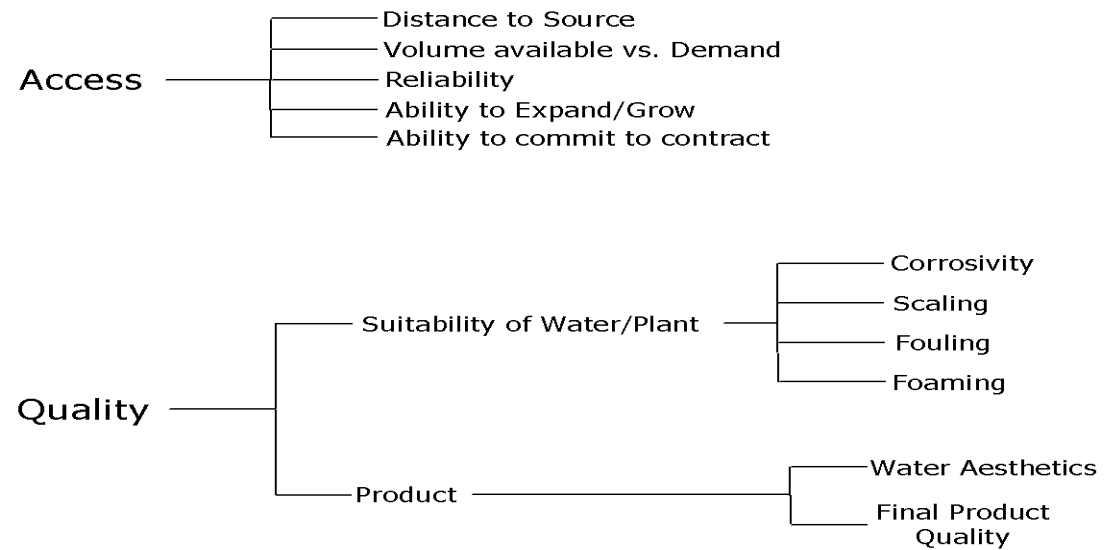
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# Principles

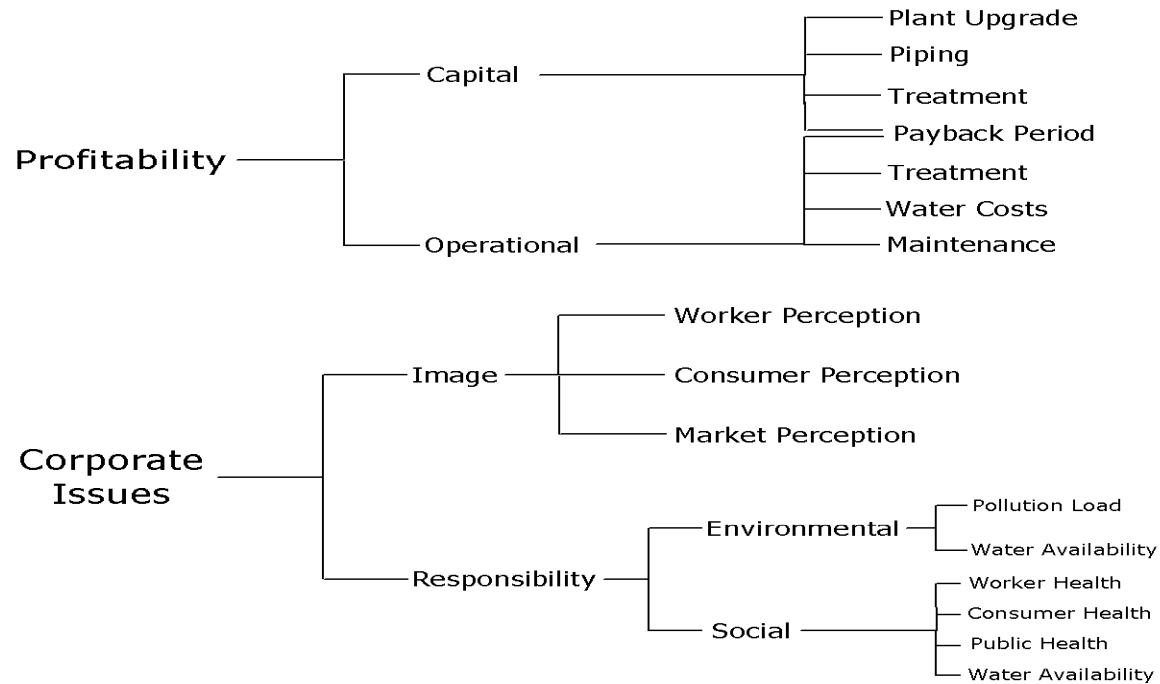
- Developed along business lines
    - Access
    - Quality (Adaptability)
    - Profitability
    - Corporate Issues
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# Criteria



# Criteria



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# Pairwise Comparison

- Compare each criterion at the same level and rank importance
- Nine-point scale:
  - 1 – Equal importance
  - 3 – Moderately important
  - 5 – Strongly important
  - 7 – Very strongly important
  - 9 – Extremely important



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# Scenario

- Medium sized plastics manufacturer in Altona
- Water for boiler feed (1 ML.day<sup>-1</sup>) and cooling (4 ML.day<sup>-1</sup>)
- Industrial water \$1.10 kL<sup>-1</sup>, 10% less for MF/RO quality from Altona STP
- Capital est. \$500,000. Payback in 30 months
- Boiler feed is ion exchanged, cooling water treatment is standard



# Example – Cooling Water

Indicator A	Access																	Indicator B
Distance to Source	9	8	7	6	5	4	3	<del>2</del>	1	2	3	4	5	6	7	8	9	Volume
Distance to Source	9	8	7	6	5	4	3	2	1	2	3	<del>4</del>	5	6	7	8	9	Reliability
Distance to Source	9	8	7	6	5	4	3	2	1	2	3	<del>4</del>	5	6	7	8	9	Expand/Grow
Distance to Source	9	8	7	6	5	4	<del>3</del>	2	1	2	3	4	5	6	7	8	9	Contract
Volume	9	8	7	6	5	4	3	2	1	2	3	4	5	6	<del>7</del>	8	9	Reliability
Volume	9	8	7	6	5	4	3	2	1	2	3	4	5	6	<del>7</del>	8	9	Expand/Grow
Volume	9	8	7	6	5	4	3	2	<del>1</del>	2	3	4	5	6	7	8	9	Contract
Reliability	9	8	7	6	5	4	3	<del>2</del>	1	2	3	4	5	6	7	8	9	Expand/Grow
Reliability	<del>9</del>	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Contract
Expand/Grow	9	8	<del>7</del>	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Contract



# Software

	1 - Very Poor	2 - Poor	3 - Somewhat Poor	4 - Average	5 - Somewhat Good	6 - Good	7 - Excellent
Distance to Source	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volume Available vs Demand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reliability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to Expand/Grow	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to Commit to a Contract	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Corrosivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Scaling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Fouling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Foaming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Water Aesthetics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Final Product Quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upgrade of Plant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Piping	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment (Capital)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Payback Period	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment (Operational)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Water Costs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Production Restrictions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Worker Perceptions	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consumer Perceptions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Market Perceptions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pollution Load	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Environmental Water Availability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Worker Health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consumer Health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public Health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water Availability (Social)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>



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# Assessment

- Seven point qualitative:
  - 1 – Very poor
  - 2 – Poor
  - 3 – Somewhat poor
  - 4 – Average
  - 5 – Somewhat good
  - 6 – Good
  - 7 – Excellent



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# Example – Cooling

- **Corrosivity** 7  
(Significantly less corrosive water due to greater purity)
- **Scaling Potential** 7  
(Significantly lesser problem with scale due to greater purity and lesser calcium content)
- **Fouling Potential** 6  
(Significantly lesser problem with fouling due to lesser presence of nutrients)
- **Foaming Potential** 6  
(Significantly lesser problem with foaming, although some surfactants can pass through RO membrane)
- **Water Aesthetics** 4  
(No significant change to water aesthetics)
- **Final Product Quality** 4  
(No change to final product quality)



# Output

<b>Principle</b>	<b>Score</b>	<b>Weighting (%)</b>
<b>Access</b>	<b>4.90</b>	<b>6.2</b>
<i>Suitability Water/Plant</i>	6.60	
<i>Product Quality</i>	4.00	
<b>Quality</b>	<b>5.95</b>	<b>23.8</b>
<i>Capital</i>	3.37	
<i>Operational</i>	4.99	
<b>Profitability</b>	<b>4.45</b>	<b>46.1</b>
<i>Company Image</i>	3.77	
<i>Corporate Responsibility</i>	5.15	
<b>Corporate Issues</b>	<b>4.81</b>	<b>23.8</b>
<b>Overall</b>	<b>4.92</b>	



# Software

## Altona Site - Cooling Water

Principle	Score	Weighting (%)
<b>Access</b>	<b>4.894</b>	6.17
<i>Suitability Water/Plant</i>	6.6	
<i>Product Quality</i>	4	
<b>Quality</b>	<b>5.95</b>	23.848
<i>Capital</i>	3.946	
<i>Operational</i>	5.026	
<b>Profitability</b>	<b>4.296</b>	46.134
<i>Company Image</i>	3.771	
<i>Corporate Responsibility</i>	5.096	
<b>Corporate Issues</b>	<b>4.765</b>	23.848
<b>Overall</b>	<b>4.839</b>	



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# Conclusions

- **Report finalised** (Smart Water & ISI websites)  
<http://isi.vu.edu.au/sitebuilder/projects/knowledge/asset/files/31/guidancefortheuseofrecycledwaterbyindustry.pdf>
  
- **Software**
  - Currently in 2nd trial phase
  - Initial responses from industry have been positive
  
- Tool will be of use to industry in assessing options for the future



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# Acknowledgements

- Smart Water Fund and Steering Committee
- Trial Users (Alcoa, National Foods, Toyota, Visy, OneSteel)

