Overview of Talk

- Why study was commissioned.
- Aims and objectives.
- Fish screens tested.
- Operational performance.
- Entrainment results and key findings.
- Screening considerations.
- Screening conclusions.
Background to the Study

- Commissioned jointly by Thames Water Utilities Ltd (TWU) and Veolia Ltd, on behalf of Three valleys water Ltd (TVW).

- Environment Agency (EA) concerns about the impacts of operating water abstractions on the freshwater River Thames.
  - identified a possible risk to the sustainability of coarse fish stocks in the River Thames associated with the entrainment of fry into water intakes.
Aims and Objectives of the Study

• To obtain better estimates of the rates of entrainment and levels of impact at each intake.

• To assess the significance of losses by species at the fish population level using Equivalent Adult Value (EAV) methodology, together with a review and analysis of freshwater Thames stock size data.

• To test the efficiency of various Best Practice fish protection solutions in the lowland river context of the Thames.
  – The screening techniques considered were required to be in line with, or an improvement upon, “Best Practice”, as set out in the Environment Agency’s Science Report SC030231 (Turnpenny and O'Keeffe 2005).

• To undertake an options appraisal of potential solutions.

• To produce recommendations.
Study Site Locations
Fish Screening Options

- Johnson’s Passive Wedge-Wire Cylinder (PWWC) screens
  - S-type (stainless 316l) 3 mm, 2 mm and 1 mm slot widths.
  - Each screen was sized to give the same nominal design; 0.15 m/s slot velocity at a flow rate of 25 l/s.
  - Fitted with an air backwash system, that periodically delivers short, high pressure air bursts through the screen (typically 10 bar).
  - Debris carried away by the sweeping flow over the screen.
Fish Screening Options

- **Hydrolox (Series 1800) travelling screen**
  - Screens made from individual UV resistant polymer modules laid in a brick format forming a screen that typically rotates vertically.
  - Screen designed to meet Best Practice 0.15 m/s through slot velocity.
  - Debris is sprayed back into the river and carried away by the sweeping flow.
Fish Screening Options

- **EIMCO Water Technologies (CF100 screen) travelling screen**
  - A central flow pattern travelling screen with 3 mm conical mesh.
  - Screen sized for Best Practice.
  - No carryover of debris possible.
  - Debris return channel integrated.
Fish Screening Options *in-situ*
Results: Screen Operational Performance

- Travelling screens
  - No biofouling was observed on the Hydroloox S1800 or EWT CF100 screen.

  - No screen blockage during leaf fall in autumn on Hydroloox S1800 or EWT CF100 screen.

  - No significant carryover of debris was observed with the Hydroloox screen and any debris collected by the EWT screen was effectively deposited downstream via the screen backwash facility.
Results: Screen Operational Performance

- PWWC Screens
  - Significant biofouling observed during trials; pressure transducers fitted to the screens showed no sustained pressure drops across the screen surfaces. Air backwash could not clear biofouling.
  
  - During autumn leaf fall in 2006 all PWWC screens blocked resulting in reduced abstraction. Air backwash could not clear leaf litter.
Results: Entrainment at Test Site

- Percentage composition of fry entrained (left) compared to percentage EAV entrained (right) at test site during 2007.
Results: Key findings

- Relationship between river velocity and entrainment.

- Diurnal pattern of entrainment. Greatest values between dusk and dawn (22:00 – 05:00).

- Entrainment rates could fluctuate by more than 60% daily.
Results: Entrainment Results at Test Site

- Lowest raw entrainment observed through the Hydroloox screen – 56 fry / ML
- Lowest EAV entrainment observed through the 2mm PWWC screen followed by 3mm PWWC and Hydroloox S1800.
- Highest entrainment observed through EWT CF100 screen.

<table>
<thead>
<tr>
<th>Screen type</th>
<th>Sum of fish / ML</th>
<th>Sum of raw weekly entrainment at $Q_{actual}$</th>
<th>Sum of weekly EAV at $Q_{actual}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWWC 1mm</td>
<td>161</td>
<td>103,142</td>
<td>327</td>
</tr>
<tr>
<td>PWWC 2mm</td>
<td>61</td>
<td>40,166</td>
<td>66</td>
</tr>
<tr>
<td>PWWC 3mm</td>
<td>69</td>
<td>46,890</td>
<td>97</td>
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<tr>
<td>EWT CF100</td>
<td>362</td>
<td>241,738</td>
<td>1168</td>
</tr>
<tr>
<td>Hydroloox 1800</td>
<td>56</td>
<td>37,099</td>
<td>105</td>
</tr>
<tr>
<td>Control / raw</td>
<td>205</td>
<td>131,684</td>
<td>692</td>
</tr>
</tbody>
</table>
Results: Fry Exclusion

- Numbers of fish by size class entrained by each screen and control during spring and summer 2007.
- Data corresponded well with laboratory tests on exclusion.
Results: Potential Fish Savings by Installing Fine Screens at all Sites.

- Five-year average entrainment loss at all water intake points on the lower Thames and potential savings.

<table>
<thead>
<tr>
<th>River Thames Site</th>
<th>Control</th>
<th>PWWC 1mm</th>
<th>PWWC 2mm</th>
<th>PWWC 3mm</th>
<th>EWT CF100</th>
<th>Hydrolox 1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egham</td>
<td>2,414</td>
<td>1,143</td>
<td>231</td>
<td>340</td>
<td>4,077</td>
<td>368</td>
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<tr>
<td>Walton 2</td>
<td>133,859</td>
<td>63,361</td>
<td>12,826</td>
<td>18,843</td>
<td>226,082</td>
<td>20,401</td>
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<td>Datchet</td>
<td>25,114</td>
<td>11,888</td>
<td>2,406</td>
<td>3,535</td>
<td>42,416</td>
<td>3,828</td>
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<tr>
<td>Sunnymead</td>
<td>26,131</td>
<td>12,369</td>
<td>2,504</td>
<td>3,678</td>
<td>44,134</td>
<td>3,983</td>
</tr>
<tr>
<td>Hythe End</td>
<td>41,127</td>
<td>19,467</td>
<td>3,941</td>
<td>5,789</td>
<td>69,462</td>
<td>6,268</td>
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<tr>
<td>Laleham</td>
<td>102,811</td>
<td>48,665</td>
<td>9,851</td>
<td>14,473</td>
<td>173,643</td>
<td>15,669</td>
</tr>
<tr>
<td>Chertsey</td>
<td>3,979</td>
<td>1,883</td>
<td>381</td>
<td>560</td>
<td>6,720</td>
<td>606</td>
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<tr>
<td>Hampton</td>
<td>27,562</td>
<td>13,046</td>
<td>2,641</td>
<td>3,880</td>
<td>46,551</td>
<td>4,201</td>
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<tr>
<td>Total EAV loss</td>
<td>362,997</td>
<td>171,822</td>
<td>34,781</td>
<td>51,099</td>
<td>613,086</td>
<td>55,324</td>
</tr>
</tbody>
</table>

Percentage loss of standing stock:

- 31%
- 17%
- 4%
- 6%
- 43%
- 6%
Key Considerations

• Number of important factors to take into account in the decision of which screen is most suitable for a particular location.
  – Operational performance.
  – Fish entrainment results.

• Also
  – Footprint of screen, operating noise, aesthetics, navigation, civil engineering works, CAPEX / maintenance costs, screening material, operational experience of screens, land take, handling reverse flow etc.
Screening Conclusions

- PWWC screens gave good fish protection despite average sweeping velocities below 0.3m/s during summer months. Operational issues with leaf litter may result in downtime if intake located in low flow environments.

- No significant benefit in using a PWWC slot-width smaller than 3mm.

- Hydroloxx travelling screen (through-flow type) similar fish protection capabilities of PWWC screens with no operational issues and represents a Best Practice technology.
Any Questions?