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Public Perceptions of Recycled Water: A Survey of Visitors to the London 2012 Olympic Park

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Abstract
The Old Ford Water Recycling Plant, operated by Thames Water, was used to supply non-potable recycled blackwater to some of the venues at the London 2012 Games. In an effort to learn from this experience, Thames Water commissioned a survey of visitors to the Olympic Park during the Games to explore public responses to the water recycling project. Results show a very high level of support for using non-potable recycled blackwater, both in public venues and in homes. Such findings may indicate a growing receptivity towards this technology, and show that Thames Water (and other private water companies) are well placed to encourage and even lead public discussion around the role of water reuse in the future of urban water supplies.

Keywords
Recycled blackwater; public perceptions; London 2012 Games

INTRODUCTION

The importance of understanding public reactions to, and acceptance of, water reuse technology has long been recognised. Lazarova et al. (2013) recently asserted that 'the public's knowledge and understanding of the safety and suitability of recycled water is a key factor to the success of any water reuse programme'. For the reuse of 'blackwater' (i.e. sewage effluent, as distinct from the reuse of 'greywater' or stormwater) the challenge of public acceptance is particularly relevant, and a significant body of research has developed around the subject. Studies have documented instances when support for reuse schemes has been high (e.g. Friedler et al. 2006) as well as instances where public objections have actively hindered a scheme's progress (e.g. Hurlimann & Dolnicar 2010). Some notable trends have been documented – for instance, people are generally less receptive to the idea of using recycled water for uses that involve more personal contact (e.g. drinking or bathing), and even for non-potable uses they can be less supportive of using it within their homes (e.g. Bruvold 1985, 1988; Hills et al. 2002; Robinson et al. 2005; Marks et al. 2006). General disgust (i.e. the 'yuck factor') and concerns over public health risks are often cited as key factors in shaping public responses (Po et al. 2003; Po et al. 2005).

Efforts have been made to develop empirically tested conceptual models that can explain and even predict public reactions to some reuse projects (e.g. Po et al. 2005; Porter et al. 2005; Nancarrow et al. 2007). These models are generally based around theories of planned behaviour, and serve to highlight a range of factors that shape the *intended* actions of respondents – i.e. to use/not use or drink/not drink recycled water – under various scenarios. Each of the three studies noted above offers a slightly different conceptual model, based on similar driving factors, and each claims to have empirical confirmation of a given model's validity. So while such studies undoubtedly provide useful insight into the key drivers of public reactions to reuse projects, and the inter-relationships between those drivers, such discrepancies underscore the underlying complexity and contextual sensitivity of those reactions – this sensitivity was explicitly acknowledged in one of the studies (Nancarrow et al. 2007). Additionally, all three are based in Australia, and are mainly focused on reactions to indirect potable reuse (IPR) schemes or non-potable reuse for irrigation schemes. Therefore, the applicability of such models to understanding public reactions in other countries and to a wider range of reuse schemes remains largely untested and uncertain. Further empirical

evidence is clearly needed to help develop such approaches further.

Alternative water systems, including water reuse schemes, are increasingly becoming features of the Olympic Games in their efforts to become more sustainable events. The Sydney Olympic Park incorporates a Water Reclamation and Management Scheme (WRAMS) which supplies recycled water for a variety of non-potable uses (including toilet flushing, laundry and garden irrigation) and has the capacity to serve a population of 20,000 people (SOPA 2006). Similarly, the Qinghe Reclaimed Water plant supplied 60,000 cubic meters of water per day for landscape irrigation at the Beijing Olympic Park (UNEP 2008). As a result, due to the high profile nature of Olympic events, they are becoming unique forums for raising public awareness of reuse schemes, and for gauging public reactions to them.

Thames Water was the official water utility provider for the 2012 Olympic and Paralympic Games. Together with the Olympic Development Authority, Thames Water constructed and managed a water recycling plant at the Olympic Park, known as the Old Ford Water Recycling Plant (OFWRP). This plant supplied recycled 'blackwater' (sewage) as a non-potable supply to certain venues, to be used for irrigating lawns and gardens, for flushing toilets, and for topping up rainwater harvesting systems. This system was aimed, in part, at helping the London 2012 games to meet key sustainability objectives. The OFWRP is the first of its kind in the U.K., and Thames Water is keen to learn from, and build on, its experience with this emerging technology. As part of its learning objective, Thames Water commissioned a survey of visitors to the London 2012 Olympic Park, to gauge their opinions and responses towards the recycled water system.

The purpose of this paper is to present the results of this survey, and to set those findings in the context of previous work undertaken by Thames Water – for instance, Hills et al. (2002) document a survey of visitors to the Millennium Dome in London (now the O2 Arena), which was designed to gauge their opinions regarding the site's in situ water reuse and non-potable supply system. Comparisons between the Olympic Park survey and such previous studies provide glimpses of a shift in the public dialogue surrounding water reuse in the UK.

METHODS

The survey was administered just outside the Olympic Park site by a team of researchers from Cranfield University. All surveyors were briefed on the background and nature of the water recycling project at the Olympic Park, prior to beginning the survey. The study was conducted during both the Olympic Games (August 2012) and the Paralympic Games (September 2012). The survey included British residents only, and targeted those who were exiting the Park. The latter restriction was to ensure that respondents had had the chance to see information signs in the Park regarding the recycled water scheme. Foreign residents, and those who had not been into the Park, were screened out of the study.

The survey instrument was developed jointly by staff from Thames Water and Cranfield University. It consisted primarily of closed questions, including some that employed Likert-type scales (i.e. where responses were scored from 1 to 5 to gauge the intensity of respondents' support). Respondents were provided with pictorial diagrams illustrating recycled water schemes, in order to assist them in understanding and responding to key questions. Some open-ended questions were also included to provide additional depth and context. Key relevant demographic information was also recorded (e.g. age, gender, postcode, size of household). Each interview took approximately 10 minutes to complete.

A total of 309 surveys were collected during the two Games, all of which were useable in subsequent analysis. The total population from which the sample was drawn (i.e. all British residents who attended an event at the Olympic Park) is estimated to be approximately 3 million people. Therefore, a sample of 309, at a 95% confidence level, provides a confidence interval of ±5.6%. The responses were analysed by a Cranfield University researcher, and the results were subsequently compared with some previous surveys conducted by Thames Water examining public opinions towards different recycled water schemes.

RESULTS

Demographic results showed that respondents were evenly distributed in terms of gender (50% male and 50% female). The age distribution of our sample was fairly consistent with that of the UK population as a whole (as shown in the 2011 census, ONS 2012), with the largest inconsistencies occurring in the 45-59 bracket (which was over-represented in our sample) and the 75+ bracket (which was under-represented in our sample. Postcode data showed that around one third of the sample (33%) was from London and its immediate vicinity. They also showed that a similar proportion of respondents (32%) were likely to be resident within the Thames Water service area.

Respondents were asked whether they had been aware, before taking the survey, that a water recycling scheme was in use at the Olympic Park. The results showed that nearly one third of respondents (31%) had been previously aware of the reuse scheme. However, when asked whether they had seen any information signs about the recycled water scheme within the Olympic Park, relatively few respondents (only 12%) indicated that they had seen the signs. Therefore, prior awareness of the reuse scheme was more likely driven by Thames Water's efforts to publicise the scheme in the lead up to the Games.

The results show a very strong level of receptivity to using dual supply systems that deliver recycled blackwater for non-potable uses. For instance, respondents were asked how supportive they were of using this kind of recycled water in public venues and in their homes. They were asked to rank their level of support on a scale from 1 (completely against) to 5 (completely supportive). The results show that, overall, respondents were extremely supportive of using non-potable recycled blackwater (assuming a dual supply system) – 96% indicated that they were supportive of using it in public venues such as the Olympic Park (with 87% indicating that they were 'completely supportive') and 90% indicated that they were supportive of using it in homes (with 70% indicating that they were 'completely supportive'). These results are summarised in Figures 1 and 2.

A comparison of the levels of support indicated by respondents from different demographic groups (conducted using crosstab analysis) showed that gender had no significant association with responses to these questions. It also showed that respondents with younger children did not express significantly different opinions from the rest of the sample. However, age did have a statistically significant association with responses around use in public areas (Chi-square sig. value of 0.014), and use in homes (Chi-Square sig. value of 0.013). In particular, those in the youngest age category (18-24) were more likely to indicate that they were 'neutral' or 'against' the use of recycled blackwater in public areas and homes (adjusted residual values were 3.7 and 3.1 respectively, with anything above 2 indicating a substantive relationship).

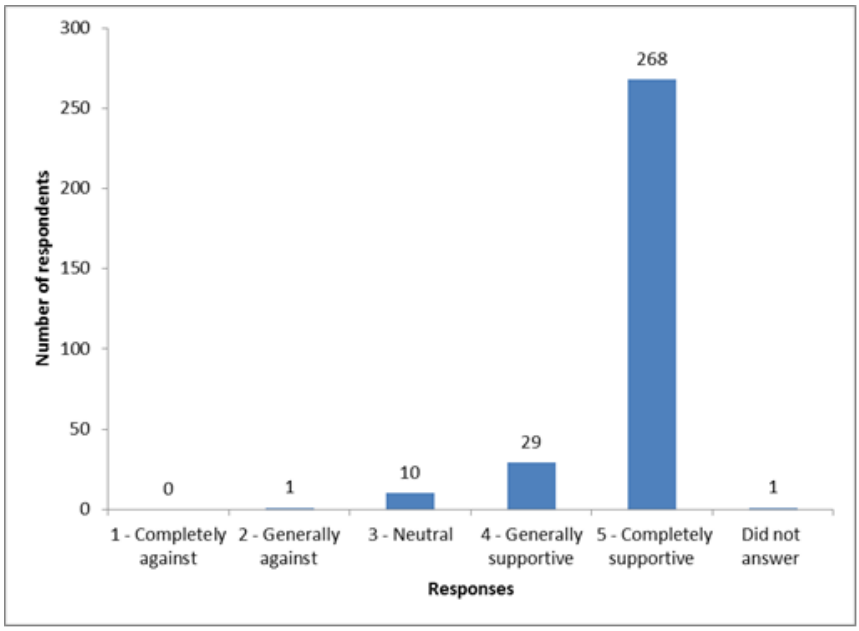

Figure 1 - Respondents' level of support for using recycled blackwater in public venues, via dual supply (n = 309)

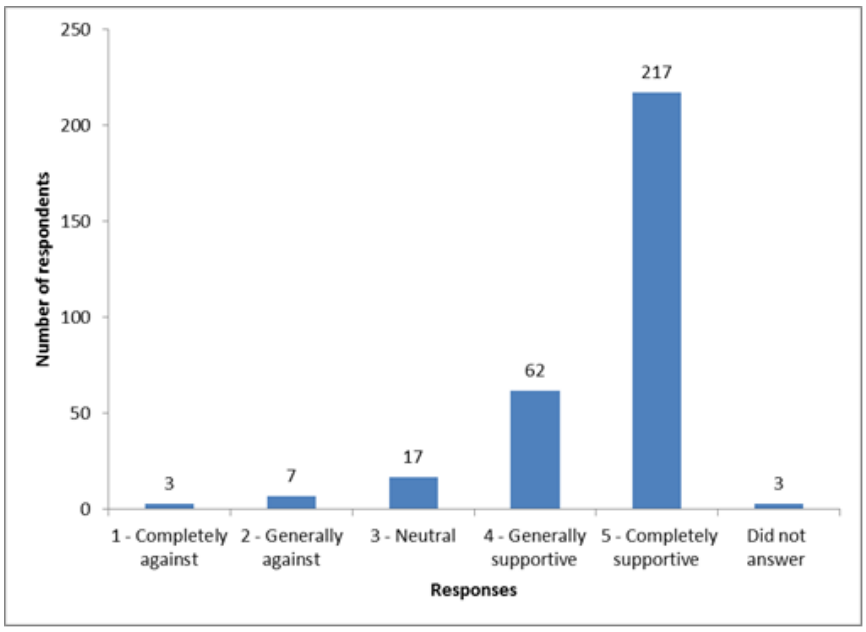

Figure 2 - Respondents' level of support for using recycled blackwater in homes, via dual supply (n = 309)

Additionally, respondents were asked whether the presence of this kind of recycled water system (via a dual supply) would influence their decisions on whether to buy a home, assuming that the home was equal in all other respects to potential alternatives. The results (summarised in Figure 3) show that the vast majority of respondents (95%) claimed that they would not be put off by, and may even welcome, the presence of a dual supply system relying on recycled blackwater. It is worth noting that many of the respondents who indicated that the system 'would not influence' their choice also mentioned that other factors, particularly the price of the house, would be the overriding influence on their purchase choice. Crosstab analysis was again used to compare responses from different demographic groups. It showed that none of the three variables considered – gender, age, and having younger children – had any significant association with willingness to purchase a home with a dual supply scheme using recycled blackwater.

Finally, respondents were asked to indicate which organisation they thought should run a water recycling scheme, assuming it was used to supply non-potable water to homes via dual supply. They were presented with a list of options comprised of: 1) Private water company (e.g. Thames Water); 2) Local council; 3) National government; 4) A non-profit organisation; or 5) Other. The largest proportion of respondents (42%) indicated that they were happy for private water companies to be in charge of such systems. Interestingly, many respondents rationalised their responses by indicating that water companies ought to have the most relevant expertise for administering these systems. The next most common preference was for non-profit organisations (23% of respondents). Once again, crosstab analysis showed that none of the demographic characteristics previously considered (age, gender, young children) had any significant associations with responses to this question. One additional characteristic– whether or not respondents were Thames Water customers – was also considered, but the analysis showed that it, too, had no statistically significant association with responses.

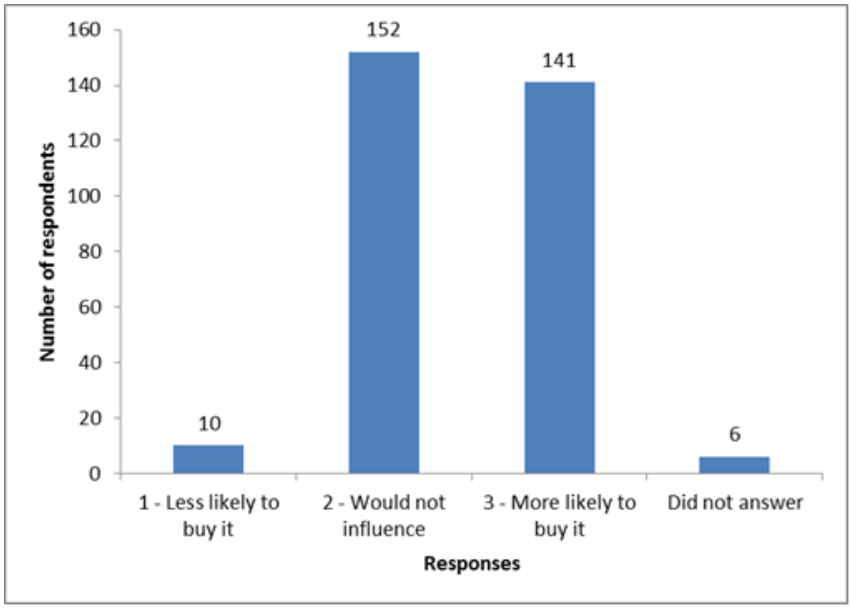

Figure 3 - Whether/how a dual supply system relying on recycled blackwater would influence respondents' decisions on whether to purchase a home (n = 309)

DISCUSSION

In general, when compared with previous studies undertaken by Thames Water, these results seem to show a higher level of support for using non-potable recycled water via dual supply systems. For instance, the Millennium Dome survey reported by Hills et al. (2002) found that 83% of respondents 'strongly agreed' that they were happy for dual supply systems to be used in public areas (compared to 87% 'completely supportive' in this study), while 64% 'strongly agreed' that they were happy for such systems to be used in homes (compared to 70% 'completely supportive' in this study). One important difference between the two studies is that the recycled water system used at the Millennium Dome incorporated stormwater capture to supply non-potable water, whereas the system in place at the Olympic Park relied exclusively on blackwater treatment. Therefore, the fact that support for the reuse scheme appeared somewhat higher at the Olympic Park (despite the fact that blackwater reuse is often more controversial than greywater/stormwater reuse) is encouraging.

Both studies also demonstrate the potential for utilising high-profile events and venues for promoting awareness of alternative water supply schemes. Indeed, for the Olympics and Paralympics in particular, the overall positive atmosphere that those events generated may have contributed to the high levels of support observed in the survey responses. This reinforces the idea that Olympic events can provide unique, positive forums in which to engage the public in discussions around new, more sustainable technologies.

One significant finding from the Millennium Dome survey was that the acceptability of the reclaimed water supply appeared significantly enhanced among those who had seen signs about the system in the washrooms (where the water was used for toilet flushing), and those who had seen the Watercycle exhibit in the venue, which was set up to explain the system (Hills et al. 2002). Likewise, at the Olympic Park, it was hoped that signs in toilets and around the Park would help raise awareness and support for the water recycling scheme. The fact that so few respondents had seen these signs was perhaps an indication that they were not placed well enough to be effective. As the Park moves forward into its legacy and re-development phase, it will be important to revisit how information signs regarding the use of recycled water are placed and/or used.

This study specifically considered whether responses were associated with gender, age, and whether respondents had young children in the home – the latter factor is often thought to make households more sensitive to the perceived health risks associated with recycled water. In general, no associations were found – the sole exception being a slight association between the youngest age category and less supportive responses towards the reuse scheme. Some previous studies have found associations between demographic characteristics and perceptions of reuse, with women (Po et al. 2005) and younger age groups (Porter et al. 2005) sometimes exhibiting significantly more negative and risk averse attitudes towards using water from reuse schemes. However, other studies have found relatively few associations between demographic characteristics and support for a reuse scheme. For instance, Friedler et al. (2006) found no correlation between the level of support for a 'medium contact' reuse scheme and the biographical characteristics of respondents (age, gender, marital status, having young children at home, education level, and income level). In the Millennium Dome survey, Hills et al. (2002) did find that higher-income socio-economic groups were likely to be more supportive of the reuse scheme. This study did not request income information from respondents, but it can be surmised that those who attended Olympic events (and had the financial capacity to purchase tickets) were more likely to be from such higher-income groups, which may help to explain the higher level of support for reuse observed.

As previously mentioned, results from past research has often shown that the level of support for using recycled water decreases with its degree of closeness to, or contact with, respondents. In other words, people are generally less receptive to the idea of using recycled water for uses that involve more personal contact, and can also be less supportive of using it in their homes (e.g. Bruvold 1985, 1988; Hills et al. 2002; Robinson et al. 2005). The results from this survey are somewhat consistent with this trend, in that the average score for use in homes is lower than the average score for use in public venues. However, the level of support for use in homes is still very high. It is important to note that, in this survey, only two uses were specified for the non-potable recycled water – flushing toilets and irrigation of lawns and gardens. Therefore, respondents were not asked to consider uses that involved more personal contact (such as washing clothes, washing dishes, or watering food crops). This may help to explain the higher level of support for use in homes.

The fact that so many respondents were not put off by the idea of purchasing a home that incorporated a dual supply system using recycled blackwater is encouraging, and an important consideration for the Olympic Park as it moves ahead with re-development (particularly residential

re-development). With the evidence from this study, there is perhaps an opportunity to engage with developers to explore how dual supply systems can be incorporated into new housing developments in a cost-effective manner, and how the benefits of such systems can be communicated to potential home buyers. This also highlights a potential avenue for further developing and expanding the application of the behavioural modelling approaches (Po et al. 2005; Porter et al. 2005; Nancarrow et al. 2007) discussed earlier. Such approaches could potentially be used to explore the factors shaping homebuyers' intentions to buy/not buy a property with a dual supply system (vs. intentions to drink/not drink recycled water), which highlights an avenue for further research.

Finally, the fact that so many respondents believed that water companies should manage water recycling schemes, owing to their perceived expertise, provides an interesting contrast to previous work in some ways. For instance, one UK study found that using recycled water from second party or public sources was less acceptable for respondents than the prospect of using recycled water where the source and application are located within their own household (Jeffrey & Jefferson, 2003). This apparent preference for in-situ water recycling schemes was not reflected in this study, since such a large proportion of respondents indicated they were receptive to recycled water being supplied by water companies. For Thames Water and other companies, this is an encouraging finding as it provides a further indication that they are well placed to take the lead in developing this technology and its potential role in the future of water supply systems.

CONCLUSIONS

This study offers some significant insights around the human dimensions of water reuse. The findings are encouraging, in that they may indicate a growing receptivity towards water reuse in the UK, and particularly towards recycled blackwater, as a means of supplying non-potable water for residential use and for use in public venues. The results illustrate that there is considerable potential for recycled water from the OFWRP to remain a key component of water supplies on the Olympic Park site, even for new residential development.

While this study did not consider receptivity to any potable reuse schemes, which are far more likely to raise objections, it does suggest that there may be a growing maturity in the UK's general public dialogue around water reuse, which provides further encouragement for the exploration of all types of reuse technology. The results have also shown that private water companies, such as Thames Water, are well placed to develop such public engagement around this technology. Finally, they showed that the use of water reuse projects at high profile events like the Olympics can provide valuable opportunities both to foster, and to learn from, public discussion and debate.

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