# What's in the water?: a survey of recreational users of the Avon-Heathcote Estuary Ihutai



Kite Surfers at the Avon Heathcote Estuary from Windsurfing Reserve on Humphreys Drive (photo credit: Michelle Marquet)

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## **EXECUTIVE SUMMARY**

This report finalises a social research project that investigated, by way of an on-line survey, the perceptions of and attitudes towards water quality held by recreational users of the Avon-Heathcote Estuary Ihutai in Christchurch. The aim of the research was to gain insight into what factors influenced decisions of recreationists to undertake recreational activity in this popular estuarine zone, and the extent to which water quality information provided by the regional council and recreational organisations was utilised. A total of 77 people across a wide range of recreational pursuits completed the survey.

Our research concludes that recreationists of the Avon-Heathcote Estuary Ihutai who responded to our survey are well informed about the sources of microbiological pathogens and the risk of getting sick from ingesting them. There was also a relatively high level of use of information on water quality provided by the regional council and recreation clubs, which indicates a reasonable level of reliance on cognitive (i.e. analytical information processing) thinking in the assessment and perception of the risks. Yet, most interestingly, we found that cognitive thinking was only part of the mix. It is evident that our recreationists draw on a wide and varying range of information sources and that these are woven together to make their own evaluation of water quality health risks and to inform their decision-making on whether or not to recreate.

Drawing on risk analysis theory, we have concluded that affective and social context factors *in combination with* cognitive analysis of scientific information have influenced our respondents attitudes towards and perceptions of water quality risks and their decisions on whether to participate in potentially risky recreational activity.

#### 1. INTRODUCTION

The Avon-Heathcote Estuary Ihutai (the Estuary) is sheltered and shallow, making it an ideal location for a range of recreational activities from swimming to wind surfing to dog walking. However, the water quality of an urban estuarine environment, such as this, can be highly variable and a health risk due to its location at the lower end of populated catchments. There are risks of harmful bacteria and viruses entering the Estuary directly or via their inflowing waters through sources such as broken and leaking sewer pipes, raw sewage discharges, storm water and septic overflows, untreated boat discharges, rural run-off and bird faecal matter (Environment Canterbury, 2011c). The continual flux of freshwater and saline tide flushes microbial contaminants around, out and back into the Estuary. They can become fixed to sediments or be free-roaming (Robertson et al. 2002). Either way, these microbes can, ultimately, lead to human ingestion and result in sickness. Confoundingly, the chances of getting sick are essentially unknown because the amount and the movement of microbial contaminants depends not only on direct inputs but also on the timing of the tides and the strength and direction of the wind.

The chances of getting sick changed dramatically when major damage was caused to sewer pipes around Christchurch after the 2011 series of earthquake events – February 22<sup>nd</sup>, June 13<sup>th</sup> and more recently December 23<sup>rd</sup>. This has resulted in the discharge of almost 8 billion litres of untreated wastewater into the Avon and Heathcote Rivers which drain into the Estuary (Mann, 2011). Indicative of the severity of the damage and the serious ecological implications for the Estuary, after the 22 February event, 12 kilometres of major sewer mains needed to be replaced entirely before sewer overflows into the Estuary could be stopped (Christchurch City Council, 2011). In the meantime, the Estuary, rivers and beaches were closed to recreational activity. The Estuary's closure was referred to by recreationists as a "major blow" and "an absolute tragedy as far as water sports are concerned in Canterbury" (Jocelyn Humphreys, Treasurer of the Pleasant Point Yacht Club in Greenhill, 2011). During this time, reference was made in the media to approximately 2,000 water recreationists having been affected and having to go outside of Christchurch to recreate after the earthquakes (Greenhill, 2011).

The Estuary was officially reopened on November 10<sup>th</sup>, 2011 when it was declared safe for recreational use. This was qualified, however, with Michele Stevenson, a surface water quality scientist with Canterbury's regional council, Environment Canterbury, noting uncertainty about the levels of faecal bacteria in the sediments at the bottom of the rivers and the Estuary and cautioned people about their activities stirring up sediment (Mann, 2011). Both the regional council and the Canterbury District Health Board also warned that all waterways should be avoided for 48 hours after heavy rainfall (Mann, 2011).

The communication of the status of water quality and health warnings is obviously a vital component of any government's duty of care to its citizens. The provision of information on this is intended to ensure the safety of Estuary users from a public health perspective and to assist them to make informed decisions about whether or not to participate in their recreational activity. Environment Canterbury invests considerable resources monitoring the

health of the Estuary and its inflowing rivers and then making information publicly available. The collected information is conveyed to members of the public along a range of communication channels (to be discussed). Given the resources invested and recent earthquake events, the council has been keen to understand how water quality perceptions and attitudes are shaped, and to understand to what extent its monitoring is used for sourcing information. From the perspective of the regional council, understanding these issues can contribute to developing more effective public awareness campaigns and more effective communication strategies.

As this research project sits at the interface of science and policy it reveals the challenge of translating scientific knowledge into action. Drawing on critical risk analysis literature (e.g. Irwin and Wynne, 1996; Wynne, 1995, 1996; Slovic 1987; Slovic et al. 2004), this study seeks to understand what factors are involved in the formulation of risk perceptions and decision-making on matters that are very difficult to know for sure. As such, it provides critical insight into the reliability of the premise that understanding and better informed decisions derive simply from better targeted information.

This report proceeds with seven additional parts. Part 2 sets out the project's aims and objectives. Part 3 explains our on-line survey methodology, its limitations and its success. Part 4, our theoretical framework, summarises a diverse selection of water quality and risk perception studies and critical risk analysis literature which we have used to analyse our survey responses. Part 5 introduces the Estuary, its water quality history, and the impact of Christchurch's recent earthquakes on the Estuary's recreation. We also discuss here how water quality monitoring and communication takes place. Part 6 presents the survey results. This section includes personal observations of the first author. This is followed by participant demographics and recreation characteristics and habits; perceptions of water quality; information sources; awareness and knowledge of the sources of pollution and its effects; health risk perceptions; utilisation of monitoring information and other influential factors in decision making. Part 7, our discussion, analyses the results against the theoretical background. Part 8 draws conclusions and sets out our recommendations.

# 2. STUDY AIMS AND OBJECTIVES

This research was funded by Environment Canterbury and the Avon-Heathcote Estuary Ihutai Trust as part of a summer research scholarship at Lincoln University. The primary purpose of the project was to gain insight into what recreational users of the Estuary know and think about microbiological water quality.

More specifically, the questions for this research sought to gain a snapshot of the following:

- What do recreational users know about microbiological water quality and where does their understanding come from?
- To what extent do users utilise information provided by the regional council and recreation groups?
- What factors influence their decisions about water quality to undertake recreational activity and their utilisation of information about water quality?

Understanding what recreationists know and think about water quality in the Estuary and how official information is used contributes to understanding what factors influence decisions made by recreational users and how they perceive the risks of potentially contaminated water.

### 3. METHODOLOGY

This project was approved by the Lincoln University Human Ethics Committee. It involved an online survey using Qualtrix Software. The survey used a mix of qualitative and quantitative questions to identify the characteristics of the participants and their recreation; to understand how water quality is perceived and what that opinion is based on; to gauge levels of awareness in relation to microbiological contamination and sources; to understand perceptions in relation to the health risks; to find out levels of use and opinions on the regional council's provision of information and, finally, to gain insight into any other factors influencing decisions on whether or not to recreate (Appendix 1).

The survey went 'live' on November 16, 2011 and closed on February 8, 2012. During this time, recreation clubs, community and other organisations were contacted to promote participation in the survey. A research information letter (Appendix 2) was attached to emails sent to these representatives asking if they would be willing to promote the survey on websites, group emails, newsletters and Facebook pages. Overall, a positive response was received and the survey was promoted online by various groups. For example, the windsurfing community shared a link to the survey on a Facebook page, on the New Zealand Wind Surfing website and in a newsletter. Similarly, the New Brighton Project, a community organisation, posted it on their website, Facebook page and gave recommendations for other organisations to contact.

It was anticipated that there would be a bias with the online survey towards those who had an incentive to go to the effort of finding the website and those being internet literate. An important reason for choosing the online method, however, was that we felt it would allow people to respond thoughtfully to the questions in their own environment in their own time and at their own pace. We were concerned that holding people up at the Estuary from participating in their recreational activity could cause frustration and influence responses, thus creating a different bias. We were also concerned that the questionnaire would need to be much shorter if we were to do a face-to-face survey and this would limit the amount of information gathered.

As well as promotion of the survey online, approximately 1,000 flyers (Appendix 3) were delivered to residential houses within close proximity of the Estuary in the suburbs of Sumner, Redcliffs, Moncks Bay, New Brighton and Southshore. The bulk of this was completed in mid December 2011 and to a lesser degree in early January 2012. Some flyers were also placed under the windscreen wipers of cars that were parked at the Mount Pleasant Yacht Club and in the Wind Surfing reserves along Humphries Drive. As a result of delivering flyers, the Star Canterbury made contact and posted a short story in the community newspaper *Pegasus Post* that is circulated in suburbs surrounding the Estuary. The survey closing date was extended to accommodate people who might have seen the article and were interested in participating but unfortunately no additional responses were received.

Given our methodology, it is not possible to calculate a precise response rate but considering that there was a high level of promotion and only 77 people completed the survey, we

considered the response rate to be low. However, it is important to note that the survey time period was during a busy time of year when people were completing tasks before the end of the year and preparing for Christmas. It was also a period when people tend to holiday. Unfortunately, it was also a time period that included more significant earthquakes than had been the case in previous months which may have distracted people. Indeed, part way through the survey period, we noticed that a number of participants were not completing the survey or missing questions. Consequently, the survey was edited to allow for a pop up box that informed participants that they had missed a question when they submitted the survey and a 'progress percentage box' was added which showed how far the participant was through the survey. It was hoped that these tactics would help address the problems identified. Additional to the 77 people who completed the survey, were 16 who partially completed the survey and whose data was also used in this research (although 14 of those did not get past question three).

While these are valid and possible explanations for the low response from the high level of promotion, it illustrates the challenge of relying on the online environment to gather research data. There is no doubt that this has been an instructive exercise. In defence of the online method, we were very pleased with the qualitative data, by way of narrative comments we were able to obtain which, in our opinion, would not have been possible from shorter face-to-face surveys. In any case, given that our analysis was never intended to be statistical, the smaller sample size of responses has not substantially limited our analysis or diminished the importance and value of the insights elicited from our respondents.

In addition to the collection of the survey data, the research also involved general observations by the first author of the Estuary and its surrounding communities. These were made while delivering flyers but also on a near daily basis driving past the Estuary to and from her place of residence in Sumner. The observations provided insight into the recreational activities taking place on and around the Estuary as well as the appearance of the Estuary itself.

Finally, a literature review was conducted to review existing information and studies on water quality perceptions, recreational users and the Estuary in general. This information fed into the introduction and background sections. The following literature review looks more specifically at public perceptions and perceptions of risk, and serves as a theoretical framework to inform the analysis of the research data.

#### 4. THEORETICAL FRAMEWORK

A number of studies maintain that more information is what is required to inform people's understanding of water quality issues (Cochrane et al. 2010; Slovic 1987). For example, Dodson (2007) who carried out a study on the Avon and Heathcote Rivers to identify user perceptions of water quality and whether this matched the health of the rivers as according to scientific modelling recommended that future research examine ways to implement public education systems. Pratap (2011) who examined how water quality information is understood and used by the public and specifically recreational water users, concluded that information primarily needed to be linked to sources that were already used and accessible such as the weather report, on television, online, on the radio or in newspapers. Other studies suggest that the relationship between information, perceptions, attitudes and action is complex and that a much broader set of issues play a role in risk perceptions and behavioural responses. These contrasting perspectives indicate that there is a need for critical reflection on what factors influence people's perceptions of risk and their behaviour.

Aakko (2004, p. 25) argues that "risk communication is more than simply disseminating 'risk' information" and that what is often overlooked is that awareness raising methods typically play out in a one-way address, rather than an engagement with people in an ongoing two-way conversation to decide what is needed or wanted. Meaningful two-way communication is more likely to gain insight into what information is actually most useful for those who use it. An example is information being linked to familiar sources or a clear colour coded system using signs or flags on site as noted by Pratap (2011). Meaningful two-way communication may also provide insight into what is and is not working such as existing signs being poorly placed, not visible, not updated and unclear (Pratap, 2011). Part of an effective communication strategy is evaluation and, as Pratap (2011) observed, few notification systems have undergone evaluation in terms of their effectiveness. While this is an American case study it has parallels in the New Zealand context.

Risk communication, Aakko (2004, p. 26) argues, is about "building trust while deploying an interactive and ongoing communication process in which audience members are active participants". On this basis, meaningful communication, in addition to scientific information, is what helps enable informed decision-making including decisions being made by recreationists on whether or not it is safe to go in the water. In support of this strategy, Fischhoff et al. (1993) argue that effective risk communication can assist people to reduce health risks while Aakko (2004) notes that meaningful communication can help reduce unwarranted fear, anxiety and distrust.

The perception of risk and the role of contextual factors, such as the legitmacy of processes of communication, are important to understand because they shape and influence decision-making processes and, in the context of this project, health risk decisions. Many authors have identified that risk perceptions involve beliefs, attitudes, judgments and feelings (Royal Society, 1992 cited in Harding et al. 2009) and that it is "multi-dimensional and influenced by complex social, political and cultural processes ..." (Bickerstaff, 2004 cited in Harding et al., 2009 p. 246).

Along with these influences, others have been recognised: personality characteristics (Powell, 2007; Barnett & Breakwell, 2001); psychological and institutional factors (Powell, 2007; Harding et al. 2009); experience (Powell, 2007; Botterill & Mazur, 2004; Barnett & Breakwell, 2001; Creyer et al., 2010); probability (Botterill & Mazur, 2004); whether the risk is memorable or not; the perception of costs and benefits, whether the risk is voluntary or not, how familiar the risk is, how dreaded it is, whether it is natural or industrial, catastrophic or incremental and whether there are alternatives (Powell, 2007; Harding et al., 2009; Canter et al., 1993; Fischhoff et al., 1993). Those risks that are perceived to be voluntary, within an individual's control, natural or familiar are thought to be more acceptable risks to take (Fischhoff et al., 1981 cited in Aakko 2004).

In addition, Canter et al. (1993), which reviewed 150 papers and published material on factors affecting public perceptions of water quality risks, identified the following factors: visibility of pollution, personal usage of water, history, education level, age, proximity, familiarity with contaminant and source, trust of local public officials, involvement in decision processes and the level of risk communication efforts. A general lack of trust in water quality information was observed by Pratap (2011) as a barrier to finding water quality information prior to recreation. Clearly, the perception of risk is not simply a matter of receiving information about the risks, understanding and accepting it and acting accordingly.

Included in this long list is a sub-set of factors that have been connected to health risk decisions and which go beyond cognitive processing (i.e. public awareness information) and include feelings and emotions (Fischhoff et al. 1993). Menon et al. (2008) developed a conceptual model which identified five classifications of antecedents that feed into health risk perceptions: individual differences (for example, gender), motivations (for example, risk taking is often the price one will pay to satisfy a need (Powell, 2007)), affective, cognitive and contextual factors (See Appendix 4).

More specifically, Slovic et al. (2004) have developed a framework that centres on the role of *affect* in decision-making. They define affect as the "quality of 'goodness' or 'badness' (1) experienced as a feeling state (with or without consciousness) and (2) demarcating a positive or negative quality of a stimulus" (2004, 312). They categorise affect as being involved in 'risk as feelings' which leads to "fast, instinctive, and intuitive reactions to danger" and "risk as analysis" which refers to our use of "logic, reason and scientific deliberation" in the management of the hazards we face (i.e. cognitive thinking) (2004, p. 311). Our affective responses for example, according to Slovic et al., (2004), would have helped us determine whether it was safe to drink water or approach a dangerous animal in the past. These authors further argue that "as life became more complex and humans gained more control over their environment, analytic tools [such as quantitative risk assessment] were invented to 'boost' the rationality of our experiential thinking" (Slovic et al., 2004, p. 313). On this basis, our experiential system has long been with us but our analytic system has evolved gradually over time (Slovic et al., 2004). The unlikelihood of using a cognitive risk assessment framework for everyday risky encounters is well-captured in Figure 1.

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Figure 1: Cartoon, Street Calculus, by Garry Trudeau (Slovic et al., 2004, p. 312).

Past studies show that visual and olfactory (i.e. smell) influences are strongly linked with perceptions of water quality. A study by Happs (1986), which focused on constructing an understanding of water quality through public perceptions and attitudes, examined the ways in which members of the New Zealand public perceived water appearance and quality at three different sites. It was concluded that people are likely to perceive water quality through visual observation and smell rather than paying attention to measurable factors such as the presence of bacteria. Happs concluded that understanding water quality through public perceptions and attitudes was a complex issue. From our theoretical perspective, these visual and olfactory influences are integral to affective thinking (Damasio 1994 cited in Slovic et al., 2004).

A study by Smith and Davies-Colley (1992), looking at the perception of water clarity and colour in terms of suitability for recreational use, found that the clarity and colour of water can strongly influence water use for recreation. Here, the colour of perceived quality water was blue or green. Similar results were found by Pratap (2011) with perceptions of water quality being described in terms of aesthetics – odours, cleanliness, colour of the water and any other important visible factors such as debris. Similar findings were observed by Nicolson & Mace, 1975; Jensen & McLellan, 2005; House, 1996 and; Dodson, 2007.

Slovic et al., (2004) argue that we need to recognise and appreciate the evolutionary role and involvement of our 'affective' experiential system in the perception of and response to risk. Previous studies on water quality we have identified illustrate the crucial role of affective thinking in people's perception of risk. Importantly, Slovic et al., (2004) also highlight the limitations of our experiential affective thinking. They argue that this system can "occasionally lead us astray" and that this occurs in two ways (p.319). First, deliberate manipulation through marketing and advertising taps into and exploits our experiential system of affect. Second, our experiential system appears to "sensitize us to small changes in our environment" but desensitizes us to large changes (p. 319). The example these authors provide is that we are uniquely attuned to the difference between 0 to 1 deaths but are "less able to appreciate and respond appropriately to larger changes", for example, "between 570 deaths and 670 deaths" (Slovic et al., 2004, p.319).

The role of the media has been identified in a number of studies. Pendleton et al. (2001), for example, found that perceptions of coastal water quality appear to be influenced more by the media and such factors than by coastal education campaigns. This influence of the media has been found in other studies. For example, Happs (1986), too, found that media reports, anecdotes and personal bias were evident in many responses with prior "knowledge". Pratap (2011) found that the internet was the most widely used source for obtaining water quality information followed by television, newspapers or radio with newsletters or brochures being common among members of organised groups and vendors.

Potentially indicative of the manipulation of our experiential mode of thinking by the media is a New Zealand water quality perceptions survey of Rotorua lakes where it was found that respondents who perceived the water quality to be poor were generally unable to identify why. Respondents selected newspaper articles (40%) and television reports (40%) as the two

most common contributors to perceptions of lake water quality. These were followed by personal experience (34%) and word of mouth (20%) (Hooker & Taylor, 2005). It appeared to the researchers that "[t]he message received was simply 'Rotorua lakes have poor water quality'" (Hooker & Taylor, 2005). These findings illustrate the importance of asking people what factors influence and contribute to their perceptions as well as identifying those perceptions.

Clearly, a range of factors influence people's perceptions of risk and their decisions on whether or not to recreate. We have divided these into three context categories, affective, social and cognitive, they are summarised in Table 1.

Affective Context	Social Context	Cognitive Context
<ul> <li>Experience and personal usage</li> <li>Personality characteristics</li> <li>Emotions</li> <li>Psychological</li> <li>Beliefs</li> <li>Judgments</li> <li>Attitudes</li> <li>Feelings</li> <li>Culture</li> <li>Visual observations (clarity, colour, cleanliness, debris, wildlife)</li> <li>Olfactory observations</li> </ul>	<ul> <li>Trust of officials</li> <li>Media and anecdotes</li> <li>Institutional factors</li> <li>Level of <ul> <li>involvement in</li> <li>decision processes</li> </ul> </li> <li>Level of risk <ul> <li>communication</li> <li>efforts</li> </ul> </li> <li>Proximity to risk</li> <li>Politics</li> <li>Demographics</li> </ul>	<ul> <li>Costs and benefits</li> <li>Whether there are alternatives</li> <li>History of risk</li> <li>Certainty of risk</li> <li>Prior knowledge</li> <li>Risk Characteristics: <ul> <li>Probability</li> <li>Voluntariness</li> <li>Familiarity</li> <li>Natural or industrial</li> <li>Memorable or not</li> <li>Dreaded or not</li> <li>Catastrophic or incremental</li> </ul> </li> </ul>

Table 1: Factors influencing perceptions of risk and decision-making identified in the literature.

This framework that has been developed from past studies and the theoretical literature will be used to analyse the results of our survey.

# 5. **BACKGROUND**

#### The Estuary

The Avon-Heathcote Estuary Ihutai is located on the east coast of Christchurch approximately 12 kilometres from the city centre. It is Canterbury's largest semi-enclosed shallow estuary (Environment Canterbury, 2007) and covers an area of approximately 880 hectares (Figure 2) (Owen, 1992). Meandering through the city of Christchurch and its suburbs are the Avon and Heathcote Rivers. These rivers drain into the Estuary from the north and the west, respectively and are spring-fed and relatively slow-moving with a number of tributaries (both natural streams and man-made drains) feeding into them (Stevenson, 2011). The Avon and the Heathcote Rivers, being urban rivers, transport pollutants, waste and effluent from their densely populated catchments into the Estuary, most notably after rain when the run-off from roads, gutters and paths accumulates. The Estuary has a certain level of natural capacity to dilute and assimilate these inputs through the combination of freshwater flows out of the rivers and sea water flows from Pegasus Bay into the Estuary through the tides at the opening. Notably, the tidal influence can extend up the rivers for several kilometres (Estcourt, 1962 and Cameron, 1968 cited in Knox & Kilner, 1973). However, given the high level of contaminated inputs that have gone into the Estuary for prolonged periods of time during various stages of its human history, the Estuary's ecological health has suffered (see Knox & Kilner, 1973; Owen, 1992).



Figure 2: Map of Avon-Heathcote Estuary Ihutai (google maps)

#### **Recreation in the Estuary**

Since the 1800s, the Estuary and its surrounds have had significant recreational, ecological, cultural and historical value for many people of Christchurch. Its value for recreation has been long recognised. Indeed, the Maori name for the mouth of the Avon River – *Otakaro* – translates as a "place for games and sports" (Owen, 1992, p.124).<sup>1</sup> These days, water-based activities include sailing, swimming, wind and kite surfing, kayaking and stand up paddle boarding as well as shore-based activities such as walking, photography, bird watching or cycling. Clearly, the Estuary is of considerable value to a large number of people and has been described as "a well-loved and well-used resource …" (Crawford & Fountain, 2010, p.46).

### The History of the Estuary and its Water Quality

The water quality of the Estuary is a vital element of its recreational value but, given the location of the Estuary and its urban catchments, water quality has been far from consistent. Indeed, by the mid-twentieth century, the Estuary had become a sump for the city's waste (Boyd, 2010). In its early history, the Estuary was important as a food source and a transport route (Boyd, 2010). However, as far back as the 1860s, after John Deans had in 1844 described the water in the Avon River as "clearer than crystal", the smell of the Avon's water had instigated complaints, people were getting sick and water had to be boiled (Deely, 1992 p.110). In 1876 after an epidemic of typhoid, a Drainage Board was formed which established a sewage farm on 18.4 hectares at Bromley in 1883 on the north-west side the Estuary. Hills of sand were flattened and served as a filtering system. Effluent would move across these paddocks of sand before entering the Estuary (Deely, 1992, p.110). Clearly, the human effluent entering the waterway while this system was in operation was poorly 'treated'. There is also a long history of industrial wastes flowing into the Estuary. For example, in 1903 over 4.5 million litres of toxic industrial effluent from woollen mills, glue and metal works and tanneries were entering the Heathcote River (Deely, 1992, p.110) and gradually making their way into the Estuary whereby pollutants would become lodged in its sediments (Knox & Kilner, 1973).

In 1962 the Bromley Sewage Purification Works replaced the sewage farm system. While the new plant stopped the city's poorly treated sewage going into the Estuary, effluent from sources closer to the Estuary continued to be discharged via the sewage farm (Knox & Kilner, 1973, p.20). By 1973, though, Bromley was handling almost all industrial and domestic effluent, which enabled the Estuary to reclaim some of its conservation and recreational values (Knox & Kilner, 1973, p.19-23; Boyd, 2010). There was still doubt, however, over the water quality due to the widespread growth of sea lettuce, *ulva lactuca*, and the decline in fish populations being linked with the discharge of tertiary treated wastewater into the Estuary (Boyd, 2010).

<sup>&</sup>lt;sup>1</sup> Although it is beyond the remit of this report to go into detail, the importance of the Estuary to Maori, their historical links to this place and their occupation in the area can be found in Harris (1992).

In March 2010, the discharge of tertiary treated wastewater into the Estuary ceased upon completion of an ocean outfall pipe. This diversion was a celebrated occurrence as it was hoped it would result in cleaner beaches and a cleaner Estuary (Williams, 2011). Notwithstanding this diversion, though, the usual urban estuary issues remained as there are always risks of microbiological water contamination from various sources such as sewage from broken or leaky pipes, overflows during heavy rainfall and emergency overflows, septic tank leaks, boat discharges; stormwater flows; rural run-off and birds (Environment Canterbury 2011c).

The immersion in or ingestion of water that is contaminated with microbiological bacteria risks contracting gastrointestinal illnesses such as Giardia, Campylobacter and salmonellosis. There is also the possibility of a respiratory illness which can cause cold and flu-like symptoms and the potential for skin, eye and ear infections (Environment Canterbury, 2011). Given these types of illness, the cost of microbiological contamination extends beyond the individual to a potential loss of capacity to work and a drain on public health resources.

It is clear that land-based water pollution and questionable water quality have been enduring issues for the Estuary and its surrounding communities. In the midst of the waxing and waning of water quality for over a Century, substantial experience has been gained by the people of the Estuary's surrounding communities about subtle and not so subtle changes to water quality and the risks of sickness and infection. Notwithstanding the issues, the Estuary has continued to be a popular place for recreation (Crawford & Fountain, 2010) and part and parcel of the Estuary landscape with recreational activities such as yachting, canoeing, swimming, fishing, rowing, shell collecting and many other activities existing and flourishing (Boyd, 2010). A survey during summer in 2006 and 2007 on recreational users of the Estuary found that the most popular activities were walking, dog walking, cycling, wind/kite surfing, and sailing (Greenaway, 2007).

#### The Impact of the Earthquakes

There were high hopes in 2010 that the ocean outfall would, finally, lead to a regeneration of the ecology of the Estuary. What was not anticipated, however, were the Christchurch earthquakes and the consequential dumping of untreated sewage into the waterways which ultimately lead to the Estuary. The 22 February and 13 June 2011 earthquakes in particular, caused significant damage to the sewer system throughout the city with sewer overflows reaching a peak of 85,000 cubic metres a day across 28 different sites (Christchurch City Council, 2011). The amount of untreated wastewater that has been discharged into the Estuary since 4 September 2010 is considerable with a total of approximately 7.8 billion litres (Mann, 2011). This is equivalent to more than 3,100 olympic-sized swimming pools ultimately ending up in the Estuary (Mann, 2011).

Continuing earthquakes and aftershocks have created uncertainty for recreationists. Closed after the September 2010 earthquake until 11 November 2010 when water quality returned to pre-earthquake levels (Environment Canterbury 2010), it was closed again immediately after

the February quakes and did not reopen until 10 November 2011. Notably, this reopening came with provisos to users to be mindful of stirring up sediment, rainfall, more earthquakes and any sewer breakages. The Estuary has been described as "world-renowned" and "a pretty important place for people's free time in the summer months..." (Kitesports Owner, Tim Stockman in Greenhill, 2011), but post-earthquake it was referred to as once more being a "toilet bowl" (Williams, 2011).

#### Water Quality Monitoring and Communication

The regional council, Environment Canterbury, is responsible for sampling water quality. The bacteria *Escherichia coli* (*E. coli*) are used to test for the presence of faecal material and the possibility of other disease-causing organisms in freshwater while enterococci concentrations are measured in marine water (Bolton-Ritchie, 2011). Both are measured in the Estuary by Environment Canterbury to test for microbial water contamination. Environment Canterbury is also responsible for investigating contaminations, informing the Medical Officer of Health (Community and Public Health) and the local council if alert or action levels are reached. The regional council also collates information for the grading of sites (Environment Canterbury, 2011b) and undertakes weekly summer monitoring at 100 popular swimming spots around Canterbury from mid-November to February/March. It publishes its results on a swimming quality map on its website (Figure 3) (Environment Canterbury, 2011b).



Figure 3: The Water Quality Swimming Map (Environment Canterbury, 2011b).

The Regional Council utilises a grading system to calculate contamination levels which is based on the Microbiological Water Quality Guidelines for Marine and Fresh Water Recreational Areas published by the Ministry for the Environment and the Ministry of Health in 2003. A grade of A-D is calculated using water quality data gathered over a number of years and this is combined with a sanitary inspection category which looks at potential contamination risks close to swimming spots (Environment Canterbury 2011b). The result is a 'suitability for recreation' descriptive grading from very poor to very good (Figure 4).

		Microbiological Assessment Category (95th percentile of previous 5 years indicator bacteria data)				
		A	В	С	D	
Susceptibility to faecal influence	≤ 40	41 - 200	201 - 500	> 500	Marine sites (enterococci/100mL)	
		≤ 130	131 - 260	261 - 550	> 550	Freshwater sites (E. coli/100mL)
Sanitary Inspection Category	Very low	Very good	Very good	*	*	* Follow up – unexpected results requiring investigation
	Low	Very good	Good	Fair	*	
	Moderate	*	Good	Fair	Poor	
	High	*	*	Poor	Very poor	
	Very high	*	*	*	Very poor	

Suitability for recreation grades are determined using the following table:

Figure 4: Suitability for recreation (Environment Canterbury 2011b)

There are however, numerous comments on the Environment Canterbury website that qualify the use of the swimming quality map and the grading system in making decisions to recreate (emphasis added):

To keep information up to date, the data are accessed directly from laboratory databases. <u>The information is therefore provisional as it has not been fully checked by all of Environment Canterbury's Quality Assurance Procedures</u>. You are cautioned to consider carefully before using it to make decisions that may concern public health or the conduct of business that may involve monetary or operational consequences.

It is the grading that should primarily be used to determine whether a particular site is suitable for swimming. <u>The weekly data shown in this summer's graphs alone are</u> <u>a less reliable tool to determine whether it is safe to swim at a certain site as</u> <u>contamination levels can vary widely from day-to-day and yesterday's results do not</u> <u>guarantee the water is clean enough today</u>.

All sites are graded at the start of summer each year. <u>The grade does not change</u> <u>during the summer</u>. The grading indicates whether a particular site is in general

suitable for swimming but does not say anything about the suitability at any particular time.

Thus, while the monitoring of water quality takes place, from the perspective of an information-seeker, it does not provide a definitive answer on whether or not to enter the water for recreational purposes.

As already stated, reducing the risk of becoming sick from microbial bacteria from the immersion in water is an important public health issue. Clearly, statutory authorities have a responsibility to keep people informed about the quality of the water for any contact recreation. Communication across multiple channels is an important part of this informative process. For example, to convey the water quality status of the Estuary, Environment Canterbury has a Facebook Page as well as a Canterbury Recreational Water Quality page; a water quality map on their website (Figure 3); a pollution hotline as well as various media releases and publications such as the 'Earthquake affected waterways' accessible from their website.

Communication of water quality is also conducted through recreational clubs' newsletters, websites and Facebook pages; the Christchurch City Council; word of mouth from friends, family and people in shops; newspaper reports both online and in print as well as the websites, newsletters and Facebook pages of community and other organisations. For example, the Canterbury Windsports Association has a tab on their website titled 'water quality' which links directly to the Environment Canterbury water quality swimming map website. Similarly, the Kitesports New Zealand website has a newsletter tab which has comments made on the progress of the Estuary opening; for example:

The Council still has us waiting to get back on our flat water spot in ChCh, but sounds like it's not far off ... kite lessons have started too, Waikuku & our local beaches are the best options for getting people stoked on our awesome sport!

This was again updated upon the official reopening of the Estuary in November 2011 (Kitesports, 2011).

A key organisation involved in the management of the Estuary is the Avon-Heathcote Estuary Ihutai Trust. One of Trust's objectives is particularly relevant to the communication of information (Avon-Heathcote Estuary Ihutai Trust, 2012)

To acquire, publish and use information and knowledge of the Estuary through research and monitoring, public education, contributing to planning, and any other actions that are necessary for the integrated environmental management of the Estuary, its resources and its catchments.

Notwithstanding the considerable communication effort, anecdotal evidence suggests that some recreationists ignore the water quality risk<sup>2</sup> and continue recreating. This could be because they deem the risk of getting sick low, or the joy of the activity outweighs any risk of getting sick or other similar conclusions. This behaviour is explained in the risk analysis literature as people incorporating factors that contextualise official scientific information when making risk decisions.

The apparent, although anecdotal, invocation to factors that contextualise scientific assessments in the perception of risk and consequent behaviour suggests that there are limits to a communication approach which assumes information is accepted, translated and used to make decisions to safeguard health. Hence, this study sought to understand what factors influence people's perceptions of water quality and their consequent decisions on recreation and to gauge the utility of information provided by the regional council and recreational organisations.

 $<sup>^2</sup>$  There is a comment on the Kitesports New Zealand Facebook page that referred to six people kite surfing in the Estuary in October 2011, one month prior to the Estuary being reopened. The first author also saw a number of surfers at Scarborough when the beaches were closed for recreation.

#### 6. **RESULTS**

#### **Personal Observations**

As someone who lives close to the Estuary and drives past almost daily, the first author has her own perceptions of the risks of going in the water which are based on the observations she has made over time, but particularly during this study. When the tide is high and especially when the wind is up, the Estuary appears to be healthy and attractive (see Photo 1) to the point where you can almost forget that close to 8 billion litres of untreated sewage has drained into it since September 2010. Yet, when the Estuary is at low tide and everything is exposed it seems less healthy (see Photo 2). For example, when there is less water you can see sand moulds around Humphreys Drive, a cone on the Estuary floor along the causeway and the general change in the Estuary floor. Although the Estuary has been reopened and recreation abounds, these characteristics serve as a reminder to the first author of the earthquakes and certainly influence her thoughts about recreating in the Estuary. These personal observations are informed by her senses, feelings and intuition.



Photo 1: Estuary looking attractive at High Tide from Mt Pleasant Yacht Club looking west (photo credit: Michelle Marquet)



Photo 2: Estuary sand moulds along Humphreys Drive (photo credit: Michelle Marquet)

#### Participant demographics and recreation characteristics and habits

Survey participants were predominantly between 26 and 60 years old and lived less than five kilometres away from the Estuary. The recreational activities listed were often multiple with many of the participants, for example, walking or cycling as well as participating in other recreational activities. There was a high level of participation in windsurfing, kayaking, sailing, kite surfing and stand up paddle boarding. Other recreational activities were yachting, cycling, swimming, bird watching, taking photos, running, fishing, surfing, skiing and making general observations. Hence, the survey responses reflect a very broad range of recreational activities. The portion of respondents who participated in onshore activities only was low, thus the majority of respondents risked water immersion through their activity. Even for walkers, who often walked with their dog, concern was expressed about the safety of the water for their dog.

Participation in these activities occurred across all seasons but more regularly over the summer months or the windy months (which more or less coincides with summer). Participation in these activities took place predominantly everywhere on and around the Estuary. The frequency of participation in these activities was mixed with 24% participating 2-3 times a month; 22% participating 2-3 times a week; 20% participating less than once a

month and 20% participating once a week. Overall, most respondents participated regularly in their recreational pursuits.

Respondents were asked if their recreational activity was affected by the February 22 earthquake and if so, how. The majority (92%) of participants indicated they were and this was predominantly through having to stop recreating in the Estuary due to reduced water quality and consequential closure of the Estuary. Comments were also made that the earthquake affected recreation through people having to move house, the Yacht Club being destroyed and activities having to be taken up elsewhere. For non-water-based participants, the earthquake resulted in the footpaths and walkways being made unusable, trees being unstable, the reserve closing and the area becoming smelly. For example, respondents noted:

Lost playground(s). Forced a 30 minute drive to find alternative options

I moved from my home in South New Brighton to the west side of the city, and sewage contamination closed the estuary for recreational use.

Polluted and walkways munted.

#### **Perceptions of Water Quality**

Respondents were asked if they were concerned about water quality at the Estuary and why. The majority (89%) of respondents reported being concerned predominantly due to health concerns. There were also concerns expressed in relation to water quality impacts on recreation, continued pollution in general and the health of the Estuary as an ecosystem being poor. Other commonly raised concerns related to wanting the Estuary for children's future; the loss of amenity values; impacts on seafood gathering; and, lastly, concern about the regularity, accuracy and delay of water quality information.

As yachtsmen we invariably stir up sediment and this is concerning at the moment. We have had many people who have had infections from minor scratches and cuts in the past, and the water is far worse at the moment.

The change in the estuary has been visually dramatic since Feb 22, the current knife edge state of the waste water system has me concerned of the potential contamination that can spike through environmental factors outside the testing cycles of Environment Canterbury.

Don't think it's as safe anymore – would worry about my children getting sick – we don't go there anymore.

When your dog refuses to pick up a stick that has landed in the brown foam you know it's bad.

The next series of questions asked respondents to select a descriptive word that, in their opinion, best described the water quality of the Estuary before and after the February earthquakes as well as after the official reopening of the Estuary in November 2011. In summary, the water was perceived as 'reasonable' to 'good' prior to the February earthquake, 'poor' after the earthquake and 'reasonable' to 'poor' post the official reopening of the Estuary (Figure 5). It is important to note that overall, the perception of water quality is at the lower end. This is illustrated in Figure 6.



Figure 5: Proportion of respondents selecting each descriptive word for water quality of the Estuary at different times.



Figure 6: Proportion of responses for perceptions of water quality across all time frames

#### **Information Sources**

The survey participants were asked what source or sources of information on which their opinion on water quality was based. Participants were able to select from their own evaluation, reports from a recreation club, friends, newspaper reports, the regional council or 'other'. The 'own evaluation' category was most commonly selected for each of the time periods, followed by the regional council and then newspapers. Noticeably, after the earthquake, participants based their opinion less on their own evaluation and more on the regional council and newspapers. These results can be seen below in Figure 7.





Details provided in the selection of 'other' sources were:

- Observations or knowledge of sewage being discharged
- Christchurch City Council advice
- Pollution notice
- The Health Board
- Kite shop owners

#### Awareness and knowledge of the sources of pollution and its effects

Survey participants were then asked a series of questions relating to their awareness and knowledge of microbiological water pollution. Overall, respondents were well aware (89%) that urban estuaries have a high incidence of harmful bacteria entering nearby waterways and 97% were aware that bacteria in freshwater can be harmful to one's health if ingested.

The majority of respondents (78%) knew of a range of potential sources of bacteria pollution entering the Estuary. Most commonly cited were: sewage; storm water overflows; duck, bird, dog and wildlife faeces; industrial, urban and rural run off; and failed pipes and drains. Other sources listed were rubbish, chemical dumping, food waste, individuals putting in contaminants, rivers, the sewage plant, and observations of trucks dumping unknown fluids into the Avon River near the Estuary. For example:

Large number of birds in waterways; overflowing sewer pumping stations; runoff from surrounding land/gutters etc

Sewage – the new sea pipeline had improved that until the earthquake. Pollution made by humans from Christchurch and also defecation from the estuary wildlife.

Birds defecating into rivers, human waste being washed in after rain, dog poo, industrial waste being discharged.

There was an almost balanced response to the question of whether it was possible for one's senses (e.g. sight, smell, taste) to detect bacterial pollution with 59% answering no and 41% indicating yes. When asked to explain how, respondents commonly cited visual characteristics such as water discolouration, foaming and froth, visible sewage discharge, algae, debris and muddier or greyer water. This was followed closely by reports of smell.

Estuary water smells like poo and brown foam frequently washes up on the banks and beaches...

You can see the poor water quality in the estuary (you used to be able to see where the treated sewage was mixing with the clean water), you can smell when the water is not good, and it tastes bloody awful!

Common sense really. I have evolved the ability to be hesitant around water that looks nasty in the same way that I stay away from food that has gone off.

Other ways of sensing cited were:

- Taste
- Common sense
- Oily feel to the water

Notably, there were also a number of comments from respondents that reflected uncertainty about using or relying on their senses. Terms such as 'presume' or 'probably' were evident in some comments as well as provisos that what was sensed was not definitive, or not the single determinant, for example:

Smell probably, or sight (algal blooms might give an indication of health), but most pollution wouldn't be detectable.

Sight, and smell are likely indicators, but certainly not definitive, or scientifically measured.

I guess the smellier it is the more likely it is to have bacteria, just a guess though.

# **Health Risk Perceptions**

The next series of questions related to the health risks of the Estuary following its official reopening in November 2011. Respondents were asked whether, in principle, they thought getting sick could be avoided and health warnings ignored. Most (67%) answered no, followed by sometimes (28%) and with only 5% answering yes.

Respondents were asked more specifically whether they thought the water in the Estuary could make them sick. Most (41%) answered sometimes, 35% answered yes, 20% were unsure and only 3% selected no. Respondents were then asked to select from unsure to high, for their assessment of the chances of getting sick. The majority felt the chances were medium to low (see Figure 8).



Figure 8: Respondents assessment of the chances of getting sick from the Estuary.

These responses illustrate that that although the risks are well known, whether they apply to that person on the day remains open.

Almost all (91%) of the respondents answered yes when they were then asked whether they thought a rainfall event should influence decisions about whether or not to enter the water. Respondents were then asked what that opinion was based on and were able to select more than one option. Opinions were based predominantly on own evaluation (70%), followed by the regional council (58%) (see Figure 9).

Other sources given were:

• Christchurch City Council (faxed a warning on water quality, waste water staff)

- District Health Board
- Pollution signs
- Literature
- Technical reports (EOS)
- University study
- Past history



Figure 9: Proportion of responses for sources of information (multiple choices) on opinion of whether a rainfall event should influence decisions to enter the Estuary or not.

#### Utilisation of monitoring information

Just over half (63%) of total survey participants indicated they had used the regional council's website for obtaining information on water quality. Of this, 73% indicated they found it useful and 27% did not. Three main reasons were stated as to why it was thought that the website was not useful. First, it was viewed as not being updated frequently enough. Second, it was considered not to be user-friendly as some respondents indicated they had difficulties finding the information sought, for example:

It [the website] is average. Not easy to find and not clear on dates etc.

Found it hard to get to the site, took too long to find the information we wanted to we gave up.

Third, uncertainty was expressed in relation to measuring methods and dates of measurement. Other general comments were that not enough context was given, that measurements conflict with other reports, and that there was distrust of water and waste employees. Comments were also made by those who did find it useful but still had concerns about the website not being updated frequently enough and possible delays in communication of results.

Eight comments were made in relation to water quality sampling and communication methods in the final question asking for any other comments that may relate to the survey. These comments centred on reliability, accuracy, method and communication of water quality testing. For example:

The best information for me is well published and updated testing results so I can make my own decisions about water health concerns including time and tide that the tests were taken.

Clear communication would be fantastic with dates of testing and also information about what is taken into consideration. If dumping is occurring then it would be good to have this listed so that we know what it is rather than having to assume the worst.

I would love to see some truly independent water tests done on the estuary water at different sites, at different times of year and at different tides. It seems the council only test on the incoming tide which, of course, is only really testing the ocean water.

The first author also made some observations on using the Environment Canterbury website, as a potential recreational user she can relate to some of the comments made above. The swimming water quality map was found easily enough but the information on the map and what it meant was hard to understand. It was not clear what the date or context of the measurement was (i.e. low tide or high tide), or what date it was put up on the website. The swimming water quality map provides measurements of enterococci although both enterococci and *E coli* are measured at the Estuary. A recreationist might expect both measurements to be presented but they are not. A recreationist may also be concerned unnecessarily or have expectations created based on information conveyed on the website, as the first author did when observing a measurement that considerably exceeded the 280 enterococci per 100ml threshold. She was expecting to see warning signs or the distribution of warning information as indicated in Table 2 below (Environment Canterbury, 2011b). On contacting Environment Canterbury, she found that a response occurs only when the initial sample and a resample are above the trigger level; the second sample in this case was not over the trigger level.

Threshold for sea water	Threshold for freshwater	What to do
less than 140 enterococci/100 ml	less than 260 E. coli/100 ml	Surveillance mode: routine sampling
greater than 140 enterococci/100 ml	greater than 260 E. coli/100 ml	Alert mode: increase sampling and look for sources of contamination
greater than 280 enterococci/100 ml	greater than 550 E. coli/100 ml	Action mode: increase sampling, look for sources of contamination and erect warning signs* and inform the public*

\* The local district or city council and Community and Public Health are responsible for signage and informing the public.

 Table 2: Summary of what authorities are required to do when results exceed trigger levels (Environment Canterbury, 2011b).

Obviously, a high first sample provides an indication of transient contamination while a high level at the resample would indicate sustained contamination. Dedicated recreationists have to negotiate these waves of contamination and assess the risks to pursue their activities.

In terms of signage, the majority of users indicated that they saw the signs prohibiting contact with the Estuary (77%) and of this, almost all (93%) followed the instructions. Those who did not follow instructions were either walkers, or those that deemed the signs out of date. For example:

They [the prohibition signs] have become an almost permanent feature, not indicative of the current state of water. Even prior to the quakes, the frequency of sewer overflow events meant that signs were frequently in place and not always retrieved when water quality improved.

I don't think the indications that Estuary has been deemed 'safe' are clear enough – it's all been word of mouth "do you hear the estuary's safe?" or "beaches are off limits again". I haven't seen ANY written information (particularly signage) to indicate whether beaches or estuary are safe, it's all been passed on from talking with people.

The outdated signs were observed by the first author on walks along the Estuary with not only signs being present post the official reopening of the Estuary but also looking really worn – one was seen upside down and facing the wrong way.

Two respondents maintained that they were prepared to take the risk, despite the health risk signs, the first because the risk was deemed low enough and the second because the recreational activity was enjoyed so much. For example:

Seriously addicted to kite boarding and couldn't wait any longer so started kiting early October.

#### Other influential factors in decision-making

On asking survey participants what factors other than information and health warnings would influence their decisions to enter the water, answers were generally specific to the particular activity. For example, the wind for wind and kite surfers or the tide or Estuary floor for yachting. Many responses also indicated that water aesthetics were important, specifically, appearance, smell, colour, clarity and other signs of health such as plant health and wildlife. In addition, a number of people commented that they had been told about pollution or people being sick or other similar information by other people or sources. Comments were:

Colour of the water, what you can see in the water.

Information from the local watersports authorities (such as the kitesurfing shops or lifesaving clubs) would influence my decision. How much the Estuary smells would also impact my decision (if the authorities declared the water safe, but it still smelled horrible, I wouldn't use the estuary for recreational use).

Learning that people actually did get sick from doing so. I can't recall anything about actual health problems from actual people that was attributed to going in the water. Conversely, I see loads of people who have contact repeatedly.

If someone cannot eat the shellfish, why would I swim there?

Survey participants also made comments in relation to the love of recreation as the prevailing factor influencing decisions to recreate or not in the final question asking for any other influencing factors.

Kayaking produces little contact between paddler and water – certainly not immersion – so I am prepared to tolerate a higher degree of pollutants and still paddle, than if I were a swimmer. ... 'Safety' (from illness) is not always my primary concern.

If surf is really good there's nothing that will stop me going out.

Overall, if the conditions are really really good, taking a risk can be worth it!

The last question asked survey participants to make any other comments they thought might help with the project. These comments (31 in total) were quite wide ranging although there were many comments in relation to water quality sampling and communication methods (which have been discussed) as well as an overall desire for the Estuary to be enhanced to reach its full potential along with an appreciation of the ocean outfall.

### 7. **DISCUSSION**

Overall, survey participants were generally well aware of the issue of microbiological water contamination, its sources for the Estuary and the potential it posed as a health risk. This finding is in contrast to the study undertaken by Dodson (2007) who found that a large number of Avon and Heathcote River users were unaware of significant sources of pollution. In general, our recreationists perceptions of the quality of the water in the Estuary were relatively low as a whole. Of course, this deteriorated after the earthquakes and did not return to pre-quake levels after the Estuary was re-opened.

Notwithstanding people's clear understanding of the issue of microbiological bacteria, its potential health risks and knowledge of its sources in the Estuary, when asked specifically whether the Estuary could make them sick, for over 60% of respondents there was ambivalence. This ambivalence is illustrated further when respondents were asked to select from unsure to high their assessment of the chances of getting sick. The majority felt the chances were medium to low (see Figure 8). These responses indicate that while people know the risks in general, they are perceived as either not applying to them or that the risks are sufficiently variable that the chances of getting sick are not that high.

It was noted in the literature that more acceptable risks are those that are voluntary, within the control of the individual, natural and familiar. The health risks of recreating at the Estuary have these characteristics. People can choose to recreate or not in the Estuary, thus the risk is voluntary, and they can choose whether they go to an alternative place. In other words, they have a level of control. Recently, the contamination cause has predominantly been the earthquakes and thus there is a natural aspect to the risks. Also, the Estuary has a history of inconsistent water quality so it is a familiar risk. The health risk of recreating in the Estuary could thus be perceived as a more acceptable risk. This is supported by comments made by a few survey participants that the risk can be worth taking, as well as anecdotal evidence of recreationists going out prior to the official re-opening of the Estuary.

Given this context of the risk for recreationists at the Estuary – voluntary, potentially beneficial and informed by past experience – it is our view that ambivalence about the risk of getting sick is an understandable response given that the chances of getting sick are essentially unknowable at any given time. The amount and the movement of microbes depend not only on direct inputs but also on the timing of the tides and the strength and direction of the wind. The variables are considerable and the permutations influence where and how the waters (and pathogens) mix and move across the Estuary.

Given that it is well known that monitoring is conducted at discrete periods in time, and while monitoring information is available and utilised by many, it is clear that other factors come into play for recreationists to fill the gaps outside these monitoring episodes to make decisions on the day. These intervening assessments would be required to be undertaken by people entering the water if environmental monitoring indicated high levels of contamination as well as those not entering the water if environmental monitoring deemed it safe to do so.

As set out in Part 4, the critical risk analysis literature refers to a wide range of factors that influence perceptions of risk and decision-making (Slovic et al., 2004), and contextualise scientific information (Irwin and Wynne, 1996). The question relating to using one's senses to detect bacterial pollution attracted some interesting results with almost half (41%) of our respondents selecting yes, it is possible, and 48% of respondents commenting on how this would occur. Visual characteristics of the water were described, that is, froth and foam, colour, clarity, discharge, debris, algae and wildlife. In addition, olfactory characteristics such as smell were identified as ways of assessing the risks. Our observation of some hesitation at relying on senses alone to detect water quality pollution reiterates that there is no one single source of information that is utilised – it is a mix of factors that contribute to people's perceptions of risk and their decision-making process.

Table 1 delineated these as affective, social and cognitive context factors. Table 3 (below) illustrates how many of these factors were evident in comments from our survey participants.

Quotes	Influential factors evident in quote
If surf is really good there's nothing that will stop me going out	Personality characteristics (Powell, 2007; Barnett & Breakwell 2001); motivational influence (Powell; 2007), perception of cost and benefits, judgment (Powell 2007; Canter et al.1993; Fischhoff et al 1993; Harding et al. 2009); voluntary risk (Fischhoff et al. 1981 in Aakko, 2004).
Have sailed in the Estuary since 1986 when it really was a sewer. Never have been sick from contact, either I'm tough or the threat isn't as great as science would have us believe	Personal usage, experience (Powell 2007; Botterill & Mazur, 2004; Barnett & Breakwell, 2001; Creyer et al. 2003); history of risk, familiarity of risk, distrust of institution (Powell 2007; Harding et al. 2009; Canter et al. 1993).
Kayaking produces little contact between paddler and water – certainly not immersion – so I am prepared to tolerate a higher degree of pollutants and still paddle, than if I were a swimmer 'Safety' (from illness) is not always my primary concern	Cognitive weighing up (Fischoff et al 1993); perception of costs and benefits (Harding et al. 2009)
Don't think it's as safe anymore – would worry about my children getting sick – we don't go there anymore.	Emotional (affect) (Menon et al. 2008); beliefs and feelings (Harding et al. 2009)
Getting information from the CWA (club) made everyone aware of restrictions, so there was a group-sense that none of should go in.	Social context (Wynne, 1996); word of mouth (Hooker & Taylor, 2005)
Estuary water smells like poo and brown foam frequently washes up on the banks and beaches.	Visual and olfactory influences (affect factors) (Happs, 1986; Smith & Davies-Colley 1992;

The foam does not dissipate until the next high tide.Pratap, 2011; Nicolson & Mace, 1975; Jensen<br/>& McLellan, 2005; House, 1996; Dodson,<br/>2007).

Table 3: Illustration of influential factors through comments made by survey participants

Understanding the extent to which monitoring information from Environment Canterbury and recreation clubs was utilised was addressed through questions asking the source/s on which water quality perceptions and attitudes were based, the source/s of opinion on whether a rainfall event should influence decisions, as well as a question asking whether the regional council website was used for obtaining information and if it was useful.

The regional council was selected second (after one's own evaluation) as the most commonly used source of information on which to base water quality judgments as well as whether a rainfall event should influence decisions on entering the Estuary. The observation that participants based their opinion less on their own evaluation and more on the regional council and newspapers after the earthquake (see Figure 7) was interesting. These findings could indicate the limits of people's intuitive capacities given how unfamiliar recreationists (and everyone) were with earthquake-caused pollution. Given that the Estuary had been closed after the earthquakes and that it was well known how much sewage was going into the Estuary, the risks had increased by orders of magnitude. It was clearly no longer possible to take one's chances and the best option was to rely on the scientific monitoring. However, when the Estuary was re-opened, the status quo appears to have returned and people went back to relying, predominantly, on their own evaluation (see Figure 7).

The finding of relative high use of the regional council for information was in contrast to the literature which found the media to be the commonly used source of information (Pendleton et al. 2001; Happs, 1986; Pratap, 2011; and Hooker & Taylor, 2005). There were, however, many comments in relation to the Environment Canterbury website not being updated frequently enough as well as concern about the information not being easy to find and uncertainty expressed at water quality sampling and communication methods. This last issue came through particularly strongly in other more general questions in the survey. This uncertainty is illustrative of an apparent distrust in officials and came through more explicitly in some comments (see for example the second quote in Table 3, above). Aakko (2004) contends that meaningful risk communication can reduce unwarranted fear, anxiety and distrust. This resonates with the first author in that concern, albeit small, was experienced when using the swimming water quality map and observing an enterococci measurement that exceeded the threshold but not seeing communication of that measurement. It was only with meaningful communication with Environment Canterbury that she was able to find out that action occurs when the sample and re-sample measurements exceed the threshold – which makes sense but would not have otherwise been known. This illustrates the value of engaging with people in a two-way dialogue to, firstly, gauge what information is needed by users and what would be the most useful and, secondly, to reduce unnecessary doubt and uncertainty.

The other point to be made in respect to communication is the use of signs. While the majority of survey respondents (77%) saw the signs, there were a number of comments as

well as observations by the first author that the signs were not effective due to being out of date and looking worn. Pratap (2011) found that colour coded signs on sites that were visible, clear and up-to-date were the second most sought after source of water quality information (so long as the users knew the basis for each colour code).

Given the long history of pollution and recreation in and on the Estuary prior to the advent of scientific monitoring, affective and social context factors would have been indispensible for recreationists in the past to inform their judgements about whether or not to enter the water. The scientific monitoring that is now conducted and conveyed adds to these factors as a valuable source of information. It would appear that the monitoring information has not replaced people's intuitive judgments that are influenced by their senses, experiences and broader social judgments. However, our findings illustrate that these capacities and judgments are perceived to have their limits in the face of unprecedented events.

# 8. CONCLUSIONS

This study has shown that a range of factors influence people's encounters with potentially contaminated water at the Estuary. It is evident that our recreationists draw on a wide and varying range of information sources and intuitions. Their interpretation is influenced by affective factors (e.g. experience, feelings, visual and olfactory observations), social factors (e.g. such as trust of officials, media, anecdotal evidence) and cognitive factors (e.g. costs and benefit weighing up of risk characteristics and the assessment of monitoring measurements). These insights appear to be woven together to make an individual's evaluation of water quality and the health risks 'on the day'.

In general, those surveyed were well informed about water quality, the potential health risks as well as the sources of contaminants. If the survey findings are indicative of the status of the broader set of recreational users at the Estuary, this conclusion has implications for local authorities in terms of how and what information is communicated to particular groups. For example, we found that recreationists wanted more detail on the swimming quality map and measurements to be provided by Environment Canterbury. Our finding of a reasonably high level of water quality literacy amongst our recreationists and their desire to better utilise the information already provided by Environment Canterbury suggests there is potential for fruitful engagement with recreationists and recreation clubs.

To conclude, we make the following recommendations:

- Encourage more two-way dialogue between Environment Canterbury, recreational users and recreation clubs of the Estuary to find out more about what information recreational users need and want and what would be most useful. A database of contacts (such as those who this project has been in communication with) could be useful for direct communication. This dialogue would provide opportunities not only for recreationists to express their views but also for Environment Canterbury to discuss its *modus operandi*, its goals and imperatives for the water quality program.
- Environment Canterbury could consider providing more contextual information on the water quality swimming map such as date, time of day, state of tide and wind when measurements were taken.
- Christchurch City Council could be made aware that pollution signs that are not up to date and clear have little legitimacy and relevance for those needing the information contained on those signs.

Finally, the following observation from the risk analysis literature highlights how our cognitive and affective minds work in tandem. In other words, one cannot do without the other. The findings of this research illustrate this to be the case:

There is wisdom as well as error in public attitudes and perceptions. Lay people sometimes lack certain information about hazards. However, their basic conceptualization of risk is much richer than that of the experts and reflects legitimate concerns that are typically omitted from expert risk assessments. As a result, risk communication and risk management efforts are destined to fail unless they are structured as a two-way process. Each side, expert and public, has something valid to contribute. Each side must respect the insights and intelligence of the other (Slovic, 1987, p. 285).

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#### APPENDICES

#### **Appendix 1: Online Survey**

#### What's in the water?: A survey of recreational users of the Avon-Heathcote Estuary/Ihuta

Q1 You are invited to participate in the project: What's in the water?: A survey of recreational users of the Avon-Heathcote Estuary/Ihutai by completing this electronic questionnaire.

The aim of the project is to take a snapshot of the following:

- What do recreational users (e.g. wind surfers, walkers, shell fish collectors) of the Avon-Heathcote Estuary/Ihutai know about microbiological water pollution;
- What factors influence their decisions about water quality to undertake recreational activity and;
- To what extent do recreationists utilise information provided by sources such as the regional council and recreation clubs.

As a recreational user of the Avon-Heathcote Estuary/Ihutai (the Estuary) over the age of 16 years, participation in this project will involve the completion of this online survey that should not take any longer than 10-15 minutes.

You will not be asked to participate in any follow-up activity and no risks are envisaged from participating in this survey.

Participation is voluntary and you are able to withdraw from the project, including the withdrawal of any information you have provided, by discontinuing with the online survey and closing the web browser. On completing the survey, however, you will be unable to withdraw participation due to the nature of the online survey.

The results of this project will be published in a report and might be published in academic journals. You can be assured of your anonymity - the identity of any participant cannot be known by the researchers and cannot be made public. You can access the results of this project in a research report that will be available in approximately six months time at: http://www.estuary.org.nz/ This research has been funded by the Avon-Heathcote Estuary/Ihutai Trust and Environment Canterbury. The project has been reviewed and approved by the Lincoln University Human Ethics Committee.

The project is being carried out by: Dr Ronlyn Duncan Department of Environmental Management Lincoln University Tel: 325 3838 Ext 8105 or email: Ronlyn.Duncan@lincoln.ac.nz

If you have any concerns about your participation, please do not hesitate to contact her or: Head of Department of Environmental Management, Associate Professor Ton Bührs Tel: 325 38383 Ext 8708 or email: Ton.Buhrs@lincoln.ac.nz

Thank you for your time (please scroll down and click the button, ignore the text box at the bottom) Q2 Please indicate whether you consent to the following:

I consent to participate in the project by completing the following questionnaire. I consent to publication of the results of the project with the understanding that anonymity will be preserved.

If no, please exit the survey by clicking out of the webpage. • Yes (1)

Q3 Are you over the age of 16 years?

- **O** Yes (1)
- **O** No (2)

Q4 What is your age bracket?

- **O** 16-25 (1)
- **O** 26-40 (2)
- **O** 41-60 (3)
- **O** 61-80 (4)
- **O** 80+ (5)

Q5 Within what distance of the Estuary do you live?

- **O** 500 metres (1)
- **O** 1 km (2)
- **O** 5 km (3)
- **O** 10 km (4)
- **O** greater than 10km (5)

Q6 How do you recreate at the Estuary? e.g. do you kayak, fish, windsurf, swim, walk, collect shellfish? State more than one if applicable.

Q7 How often do you participate in your recreational activities at the Estuary?

- **O** Less than Once a Month (1)
- O Once a Month (2)
- $\bigcirc$  2-3 Times a Month (3)
- O Once a Week (4)
- **O** 2-3 Times a Week (5)
- **O** Daily (6)

Q8 Where do you recreate within the Estuary? e.g. eastern, northern, everywhere

Q9 In what season do you recreate? e.g. only in summer, all seasons

Q10 Did the February 22 earthquake interfere with your recreational activity at the Estuary? If yes, in what ways?

- **O** Yes (1) \_\_\_\_\_
- **O** No (2)

Q11 In your opinion, what word best described water quality in the Estuary BEFORE the 22 February earthquake?

- O Excellent (1)
- O Very good (2)
- **O** Good (3)
- O Reasonable (4)
- **O** Poor (5)

Q12 On what source or sources of information is your opinion on the above question based? (Select as many that are relevant)

- $\Box$  Own evaluation (1)
- □ Reports from a recreation club (2)
- Friends (3)
- □ Newspaper reports (4)
- □ Regional Council (5)
- □ Other (6) \_\_\_\_\_

Q13 In your opinion, what word best described water quality in the Estuary AFTER the 22 February earthquake?

- O Excellent (1)
- O Very good (2)
- **O** Good (3)
- O Reasonable (4)
- **O** Poor (5)

Q14 On what source or sources of information is your opinion on the above question based? (Select as many that are relevant)

- $\Box \quad \text{Own evaluation (1)}$
- □ Reports from a recreation club (2)
- Friends (3)
- □ Newspaper reports (4)
- **General Council (5)**
- □ Other (6) \_\_\_\_\_

Q15 Now that the Estuary has reopened for recreation, in your opinion, what word best describes its water quality?

- O Excellent (1)
- O Very good (2)
- **O** Good (3)
- O Reasonable (4)
- **O** Poor (5)

Q16 On what source or sources of information is your opinion on the above question based? (Select as many that are relevant)

- $\Box$  Own evaluation (1)
- □ Reports from a recreation club (2)
- $\Box \quad \text{Friends} (3)$
- □ Newspaper reports (4)
- **Regional Council (5)**
- □ Other (6) \_\_\_\_

Q17 Are you aware that urban estuaries have a high incidence of harmful bacteria entering nearby waterways?

- **O** Yes (1)
- **O** No (2)

Q18 Are you aware that bacteria in freshwater can harm your health if ingested?

- **O** Yes (1)
- **O** No (2)

Q19 Do you think getting sick from bacterial pollution in freshwater can be avoided and therefore health warnings can be ignored?

**O** Yes (1)

**O** No (2)

O Sometimes (3)

Q20 Are you concerned about water quality at the Estuary? Please include why.

- **O** Yes (1) \_\_\_\_\_
- **O** No (2) \_\_\_\_
- O Sometimes (3) \_\_\_\_\_

Q21 Do you know of any potential sources of bacteria pollution entering the Estuary?

**O** Yes (1)

**O** No (2)

Q22 If yes, what pollution sources are you aware of?

\_\_\_\_\_

Q23 Do you think it is possible for your senses (e.g. sight, smell, taste) to detect bacterial pollution?

- **O** Yes (1)
- **O** No (2)

Q24 If yes, describe how:

Q25 Now that the Estuary has reopened, do you think that the water in the Estuary can make you sick?

- **O** Yes (1)
- **O** No (2)
- **O** Sometimes (3)
- O Unsure (4)

Q26 Now that the Estuary has reopened for recreation, in your opinion, at what level are the health risks of entering the water?

- **O** High (1)
- O Medium (2)
- **O** Low (3)
- **O** Unsure (4)

Q27 Do you think a rainfall event should influence decisions about whether or not to enter the water at the Estuary?

- **O** Yes (1)
- O No (2)

Q28 On what source or sources of information is your opinion on the above question based? (Select as many that are relevant)

- Own evaluation (1)
- □ Reports from a recreation club (2)
- Friends (3)
- □ Newspaper reports (4)
- **General Council (5)**
- □ Other (6) \_\_\_\_\_

Q29 If you have obtained information on water quality directly from Environment Canterbury Regional Council website, was it useful for making decisions about whether or not to recreate at the Estuary?

**O** Yes (1)

O No (2)

O Not Applicable (3)

Q30 If this website information was NOT useful, why not?

Q31 Before the Estuary was reopened in early November 2011, did you see signs prohibiting contact with the water?

**O** Yes (1)

**O** No (2)

Q32 If yes, did you follow the instructions?

**O** Yes (1)

O No (2)

O Not applicable (3)

Q33 If you have not followed the sign instructions, why not?

Q34 What factors other than information and health warnings about bacterial pollution might influence your decisions about going in or near the water?

Q35 Please make any other comments which may relate to this survey

#### **Appendix 2: Information Research Letter**

#### TO WHOM IT MAY CONCERN

#### Re: What's in the water? A survey of recreational users of the Avon-Heathcote Estuary/Ihutai

I am writing to request your assistance in encouraging your members to participate in an on-line survey about water quality in the Avon-Heathcote Estuary/Ihutai.

The Avon-Heathcote Estuary/Ihutai Trust and Environment Canterbury have funded a summer research scholarship for Michelle Marquet, a postgraduate student at Lincoln University, to undertake this research.

The aim of the project is to obtain a snapshot of:

- What recreational users of the Avon-Heathcote Estuary/Ihutai know about microbiological water pollution;
- What factors influence their decisions about microbiological water quality to undertake recreational activity and;
- To what extent do these users utilise information on this issue provided by sources such as the regional council and recreation clubs.

It would be greatly appreciated if your organisation could promote the survey, using the attached flyer, on your website if possible, and/or the link to the survey website address, namely, <a href="https://www.lincoln.ac.nz/waterquality">www.lincoln.ac.nz/waterquality</a> in newsletters and/or other general communications to your members.

Participation in the survey is voluntary and should not take any longer than 10-15 minutes. Participation can be withdrawn from the research including any information provided by discontinuing with the survey and closing the web browser. This can be done up to the point when the survey is submitted. At that stage the information is unable to be withdrawn.

The project has been reviewed and approved by the Lincoln University Human Ethics Committee and you may be assured of the anonymity of your members in this investigation. The identity of any participant will not be known to any person. The results of the project will be published and accessible online at: <u>http://www.estuary.org.nz/research/students</u> and could be published in academic journals.

Could you please contact Michelle Marquet by email on <u>Michelle.Marquet@lincolnuni.ac.nz</u> or by phoning 027 3345 228 to advise her if you are willing and able to assist.

If you would like to discuss other aspects of the project, please contact Dr Ronyln Duncan, Department of Environmental Management, tel: 325 3838 ext 8105 or email: ronlyn.duncan@lincoln.ac.nz.

Yours sincerely,

Ronlyn Duncan Lecturer in Water Management 10 December 2011





