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RAINGARDENS OR RAINWATER TANKS – COMMUNITY'S WILLINGNESS TO INSTALL AND EFFECTIVENESS IN ACHIEVING REGIONAL CHANGE

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Abstract

Diffuse source pollution is the single biggest threat to urban waterways and bays (Melbourne Water and EPA Victoria, 2009). At-source pollution control has been promoted as an appropriate means to deal with diffuse source pollution and there are a range of recommended measures.

Rainwater tanks and raingardens are two of the more popular treatments recommended. The effectiveness of these treatments has been reviewed and documented by several authors. A lesser known attribute, however, is the community desire to install these treatments.

Melbourne Water has conducted four significant pieces of research that have collected enough data to subsequently test the assumption about the decision to install a raingarden or a rainwater tank. The results indicated that the decision to install a rainwater tank are predominantly about perceived individual benefits, value and flexibility, as opposed to technical performance and downstream impacts. The paper presents results from the following pieces of social research:

- Community segmentation for waterways
- Community segmentation for water
- Qualitative research on barriers and incentives to install a raingarden.
- Little Stringybark Creek

This paper proposes, using a community segmentation model, that the most effective way of treating stormwater is through rainwater tanks for over 95% of the community, with a very small percentage of "Environmental Enthusiasts" still willing to consider raingardens.

The paper draws the following conclusions:

- The community's overwhelming willingness to install rainwater tanks indicates that rainwater tanks should be part of future regional stormwater improvement programs, in addition to raingardens. A caveat to considering how rainwater tanks could also become the focus of future stormwater improvement programs is that the plumbing and operation of tanks need to be optimised to effectively treat stormwater quality and quantity.
- The primary driver of drought (and corresponding water restrictions) has generated a large amount of stormwater disconnections on private lots, and if the drought breaks then these "basic" systems may be reconnected. This implies that there is a need to work with the community to convince them to retain these treatments (perhaps with modifications to reduce flooding risks for example) in place.
- A segmentation model has been useful in understanding the range of value, issues and actions within different sections of the community.

- While Melbourne Water's 10,000 raingardens program appears to be a realistic target, the time to achieve this goal could be challenging and the measure of registrations may not reflect the effectiveness of the program.
- There is an opportunity to engage the 23% of the community that have rainwater tanks only and present the "next generation" of home water solutions in the form of a raingarden to this group. The message of saving water is well engrained in the community's mindset, and the next step could be extending the mindset of this group of people to treating urban stormwater in order to protect waterways.

Rainwater tanks are rarely recognised by the community as a stormwater treatment device. Nonetheless while the driver for installing a rainwater tank is not to improve waterway health, the improvement still occurs. Therefore if the community's willingness to undertake an action that will improve waterways is high, and conversely raingardens are seen as "nice" but not necessary, it seems appropriate to promote tanks as a waterway treatment device.
These findings need to be considered in the design of future stormwater management programs in urban catchments.

1. Introduction

Diffuse source pollution is the single biggest threat to urban waterways and bays (Melbourne Water and EPA Victoria, 2009). At-source pollution control has been promoted as an appropriate means to deal with diffuse source pollution and there are a range of recommended measures.

Rainwater tanks and raingardens are two of the more popular treatments recommended by catchment management and waterway management agencies. The effectiveness of these treatments has been reviewed and documented by several authors. A lesser known attribute, however, is the community desire to install these treatments.

This paper looks at some new research that covers community perceptions and willingness to install these treatments.

The fundamental issue that this paper explores is community willingness and how influential this is in achieving regional changes to water quality and urban flows.

There are two definitions of a raingarden referred to in this paper to distinguish between a scientific/ industry raingarden and the large variety of less formal raingardens installed by the community. An 'industry standard' raingarden includes bioretention systems, above ground and within ground, swales, porous paving, and gravel trenches to name a few. These systems are tested, sized appropriately, deal with high and low flows, and are generally more expensive.

The community definition of a raingarden is referred to as "stormwater disconnection." This type of raingarden is not a tested, scientific approach to treating stormwater, but an opportunistic approach to taking some rainwater from hard surfaces and directing them to existing gardens and are very cheap.

2. Background

The last 15 years in Australia have seen a rapid change in our approach to managing stormwater. Stormwater, both quality and quantity has been recognised as the most significant threat to waterways. Reducing the load of pollutants, the concentration of pollutants and the volume and velocity of stormwater has dominated the research and practitioner focus. This was a departure from the flood dominated era.

Stormwater pollution has been identified as the single biggest threat to Port Phillip Bay (CSIRO, 1996). As our city's population continues to grow, so does the need to manage stormwater effectively. In 2006 the state government committed $20 million to address water quality issues in the Yarra River and throughout the wider Port Phillip and Westernport catchment. From this, Melbourne Water's Lower Yarra and Living Rivers Programs were born, with $10 million committed to its five Lower Yarra Councils, and $10 million to the remaining 33 councils.

The programs focus is to enhance local government relationships through capacity building and stormwater improvement initiatives through development and increased knowledge of effective stormwater management through Water Sensitive Urban Design. Its approach is for long term change and improvements, rather than traditional grants which have proven unsuccessful for more long term change (Morison and Brown, 2007).

Essentially there are two issues that need to be considered in regards to improving the quality and quantity of stormwater and creating a sustainable stormwater system. Firstly is the science of removing pollutants and excess runoff. Second is how that science is translated into practice. The second stage of this process is often overlooked but is extremely important in ultimately achieving improved river health in urban areas.

To review the willingness by community to build raingardens and rainwater tanks Melbourne Water conducted four pieces of social research. In addition to this Melbourne Water was one of several sponsors of a University of Melbourne and Monash University world-first stormwater disconnection program at Little Stringybark Creek. "The Little Stringybark Creek Project is a research program co-ordinated by The University of Melbourne and Monash University. It is putting into practice new approaches to stormwater management,that focus on improving the health of creeks and rivers." (University of Melbourne, 2010).

Melbourne Water's 10,000 Raingardens Program (Melbourne Water, 2010) promotes a new, responsible way of gardening so everybody can create their own water sensitive garden and do their bit to help the environment and protect our rivers and creeks. The "10,000 Raingardens" program's main focus is to raise community awareness and understanding of effective stormwater management at a residential lot, and encourages people to contribute to healthy waterways through voluntary construction of raingardens and similar WSUD treatments at home. The program accompanies and supports other Melbourne Water stormwater quality initiatives, for example the Living Rivers Program. Research that explores the community willingness and benefits of actions at home and their effect on river health is very useful in delivering this program.

3. Research approach

The data and findings in this paper have been drawn from a series of research projects aimed at understanding how different parts of the community engage and act on protecting and improving urban waterways. The research was conducted over a 16 month period. The projects are listed below.

Table 3-1: Stages of research

Project	Objective	Methodology	Date	Sample size
1	Initial segmentation	Quantitative – online	May – November 2009	960
2	Deeper analysis of 2 segments	Qualitative	November 2009	16
3	Willingness to build a raingarden	Qualitative	February - May 2010	32
4	Waterways social research and raingardens presence	Quantitative – online + phone + face to face	May 2010	2516

5	Little Stringybark Ck pilot - catchment wide stormwater disconnection	Economic instruments and education (qualitative social research)	2007 – 2013	1000 properties in catchment (63 interviews)

The approach and findings of each project are outlined separately below followed by an overall discussion and implications.

4. Establishing a segmentation model

In May 2009 Melbourne Water began a major project that has triggered the other research projects that have all contributed to the discussion and findings of this paper.

Approach

The first significant project was undertaken to look at the diversity of how the community relate to their waterways. It was a quantitative study aimed at segmenting the community of Melbourne based on their knowledge, attitudes and behaviours around waterways. A cluster analysis was undertaken on the data to group the respondents with similar characteristics.

Some of the key questions that drove the waterways segmentation model were around the importance of waterways, the willingness to personally do more, and the willingness to learn more. Another important aspect of this stage of the methodology was the application of a behaviour change model, the "Stages of Change" model (Andreasen, 1995). This model describes where segments of the community fit relative to their interest and willingness to act to improve waterway health. It provided a useful starting process to thinking about a behaviour change program for raingardens. For example a behaviour change program would not be applicable to the whole population but only those at a particular point on the behaviour change spectrum. Figure 4-1 outlines the nature of this model.

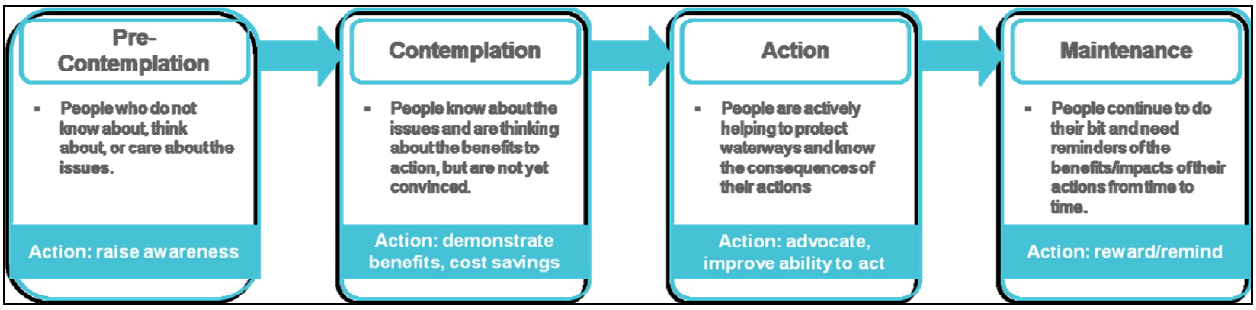

Figure 4-1: Stages of Change - behaviour change model (Andreasen, 1995).

Findings

The segmentation methodology revealed 6 distinct groupings of the community:

- Engaged Environmentalists (22%)
- Passive Environmentalists (17%)
- Moderates (29%)
- Uninformed (20%)
- Disengaged (9%)

- Not interested (3%)

The percentages indicate the approximate size of this segment when considering the greater Melbourne population.

Figure 4-2 shows how these segments can be related to the "Stages of Change" model.

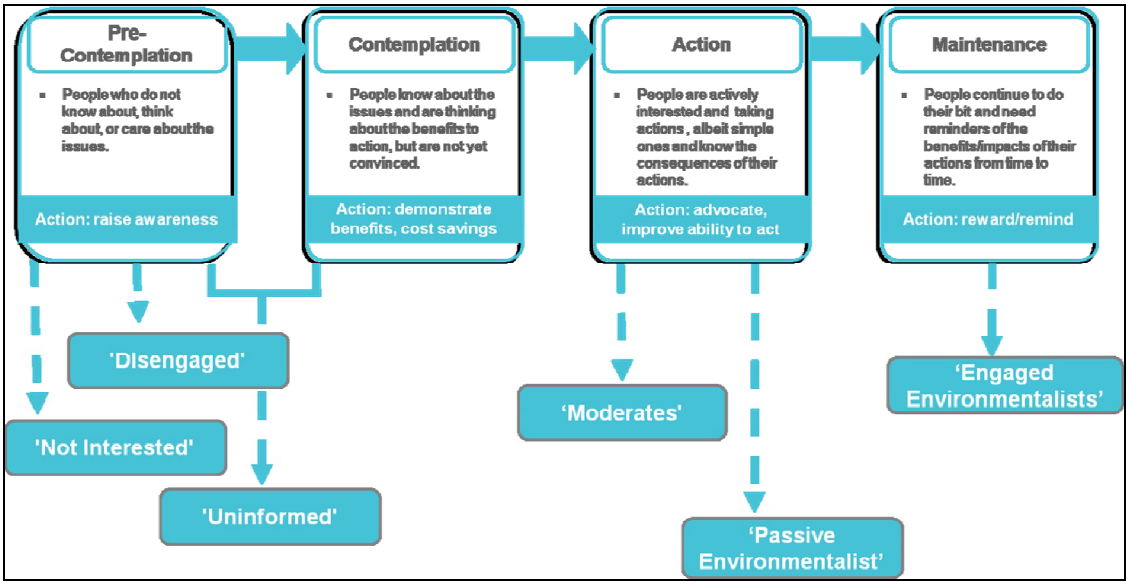

Figure 4-2: Stages of Change model with Waterways segments.

Project 1 has identified that the usual engagement and communications that Melbourne Water have undertaken on waterway issues is basically targeting 22% of the population, the Engaged Environmentalists. It also reveals that there is an interesting gap in the spectrum as the segments are concentrated at the left, and then the right, indicating that as people learn and appreciate their waterways, they move past the contemplation phase relatively quickly.

While most groups were fairly distinct two of the segments seemed quite close together, especially in their level of importance and willingness to act. These were the "Passive Environmentalists" and the "Moderates." These two segments were seen as very important and possible target segments, and also constituted almost half of the Melbourne population. They had similar mean scores to some of the crucial questions of importance of waterways and willingness to take action. Further research on these segments was required to be sure of their characteristics, drivers and overall relationship to waterways. The findings of this further analysis are presented below.

5. Reviewing two community segments

Approach

The second project was to undertake two focus groups to understand specifically the "Passive Environmentalists" and the "Moderates" from the segmentation model described above. This was a traditional focus group approach where groups of people were recruited and asked to provide opinions on the environment and their knowledge, attitudes and behaviours with waterways.

Findings

Project 2 revealed that the two segments in question, the "Passive Environmentalists" and the "Moderates", were wrongly placed on the behaviour change model. This was revealed as it became apparent in the focus groups that the Moderates were actually marking themselves down because they knew more about what could be done to improve waterways. Whereas the "Passive Environmentalists" were indicating that waterways were important but weren't that knowledgeable or committed to taking action.

The segmentation model then resulted in new names and a new order which is seen in Figure 5-1. With the segmentation now more or less established Melbourne Water then began a process to understand how current programs were matched against the segments and how this segmentation could be applied in practice.

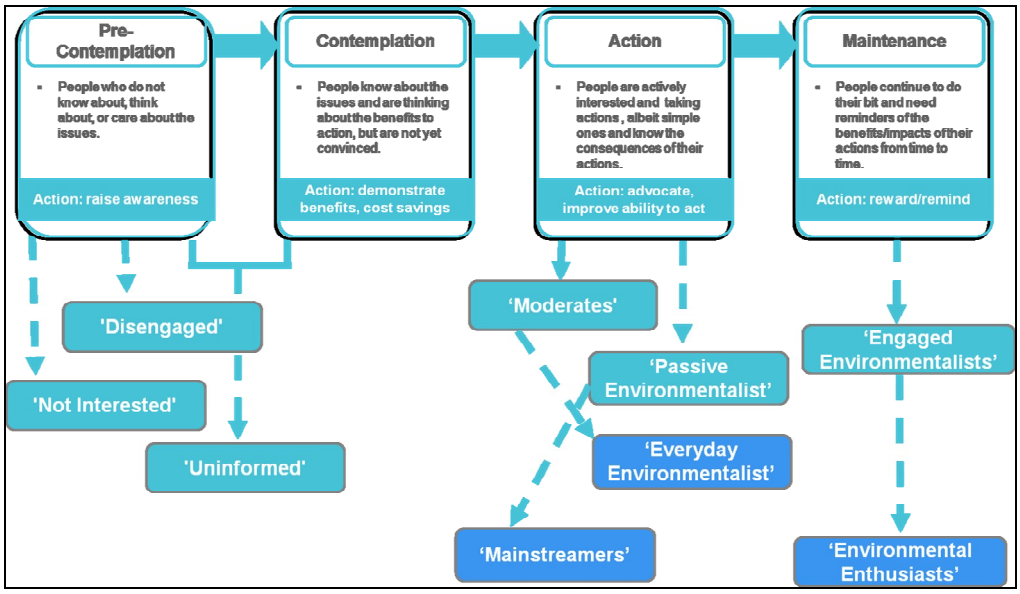

Figure 5-1: Updated Stage of Change model and Waterways segments.

6. Raingardens and the EEs: "Environmental Enthusiasts" and "Everday Environmentalists"

Approach

One of the first programs that Melbourne Water wanted to apply the segmentation model to was the "10,000 Raingardens" program (Melbourne Water, 2010). This program is at the forefront of addressing the existing housing stock of Melbourne that contributes such a large volume of the total pollutant load to Port Phillip Bay and threatens many hundreds of kilometres of waterways.

Project 3 of the research was a qualitative research project undertaken on the two segments; Environmental Enthusiasts and Everyday Environmentalists, and included four focus group discussions of one and half hours with approximately eight in a group. In these sessions, individuals were asked to bring images of their home and include details of their current set up of capturing or diverting stormwater. Rainwater tanks and industry standard raingardens were discussed during these sessions, with a variety of raingarden material presented to the focus groups at each session.

Approximately three months later focus groups participants were individually interviewed to further understand their willingness and barriers to install raingardens and other stormwater treatments on a residential lot.

Findings

In Project 1 of the research there was evidence that Environmental Enthusiasts were very willing to build a raingarden. This stage of the research aimed to test that evidence in a more in-depth manner.

The results from the 4 focus groups revealed that very few people supported the idea of building an industry standard raingarden, were sufficiently convinced that they provided benefits to the community, and were willing to spend up to $1000 to build one. The overwhelming issue was that a raingarden doesn't provide much in the way of benefits to an individual, and even with these environmentally minded segments it was felt that a rainwater tank would be a higher priority for themselves, and that agencies like Melbourne Water should deal with river health issues.

Raingardens are a new concept to many and the two raingarden types (above ground and inground) Melbourne Water is currently promoting, require services from professionals i.e. plumbers for reconnection to stormwater. Limited time for consulting experts and organising professionals is likely to be a key contributing factor for why few individuals are likely to build raingardens or similar stormwater diversions. Limited time may also have been a contributing factor to why fewer individuals opted to partake in the follow-up interviews. There was also little time (three months) between the focus groups sessions and the follow-up interviews and there may also have been an element of guilt for not following through on their interest in constructing a raingarden.

Both the Environmental Enthusiasts and Everyday Environmentalists groups are engaged with their waterways, and are more typically willing to take action and contribute to healthy waterways. However, these focus groups demonstrated that there are limits to this action and how important are the associated benefits of taking action.

It is worth noting that many individuals from both EEs were currently diverting stormwater into rainwater tanks, rather than raingardens. This was seen to be the most popular and appealing solution. Others had actively diverted stormwater directly to existing garden beds, lawns and pools, with the driving factor being water savings rather than stormwater quality and river health outcomes.

A total of eight individuals participated in the follow up interviews with half responding to have since installed some type of diversion to stormwater or expressed interested in installing a type of diversion such as a raingarden. The remaining half signalled a high intention to divert their stormwater during the focus groups but during the follow up interviews it appeared unlikely that they were going to install a raingarden.

Campaigns such as "Target 155", "Every Drop Counts" and current Stage 3 water restrictions have influenced attitudes and behaviours towards water usage across Melbourne. Continued dry periods across south east Australia (Nicholls, 2009) have also driven many to conserve water and reduce water consumption.

Rainwater tanks have been seen to provide flexibility, save water and are generally more understood in comparison with raingardens. Raingardens are a more recent concept, and their purpose and how they fit into the water cycle is still at early stages.

Overall, it appears from the research that even the environmentally minded segments are generally not willing to install industry standard raingardens and do not really see many benefits to the concept.

7. Quantitative analysis of home behaviours and drivers

Approach

The fourth project utilised quantitative methods to look at the presence of raingardens, rainwater tanks, and a range of other behaviours. One of the key needs of the research was to establish a benchmark for the "10,000 Raingardens" program.

Anecdotally it was felt that rainwater tanks are very popular, and that there a lot of people who have disconnected downpipes and directed the runoff onto trees, shrubs or part of their garden and lawn. This quantitative research aimed to establish some real numbers for those situations.

This research, undertaken in the first half of 2010, was part of a larger program of social research being undertaken by Melbourne Water. Data was being collected for a range of projects and issues. It was a good opportunity to not only get an updated dataset on community perceptions of waterways and evaluate the effectiveness of a marketing campaign, but to begin to explore some potential values, indicators and actions.

This research was unique in that it presented an opportunity to collect data across a range of issues (within the broad scope of waterways), across a range of methodologies (phone, online, longitudinal and face-to-face), over a 4-month period and ultimately collecting a sample size that exceeded any other previous research.

The development of the 5 questionnaires used in the "Waterways social research" project used input from an internal working group at Melbourne Water.

The broad range of questions used in this fourth project included questions across the following themes:

- Presence of tanks, raingardens, gardens at home
- Demographics
- Visitation to waterways – how often, for how long, why
- Rating on a range of issues related to liveability (e.g. cost of housing, transport, employment, personal safety, waterways, parks and gardens)
- Importance, satisfaction, willingness and overall rating of waterways
- Values and waterways (e.g. nature v human needs, future generations)
- Priorities of managing waterways
- Awareness of advertising
- Action taken as a result of advertising
- Attendance at Moomba
- Favourite, most interesting activity at Melbourne Water Moomba precinct
- Rating of specific waterway attributes
- Causes of pollution and threats to waterways
- Awareness of current waterways charges and willingness to pay

The data on presence of rainwater tanks and raingardens is the data that is presented in this paper.

The key questions relating to rainwater tanks and raingardens included:

- Which of the following do you have at home? (a list of various options was included)
- What was it that encouraged you to disconnect your downpipe in this way?

Findings

The results of this quantitative study revealed that rainwater tanks and raingardens are very popular in the greater Melbourne region (Figure 7.1). In terms of tanks results reveal 32% of properties in Melbourne have a rainwater tank. This figure is similar to other research pieces (Greenlight Report 2009) and anecdotally it is well known that rainwater tanks are a popular item in a city that has been on water restrictions for over 8 years (Melbourne Water, 2010). The most surprising result however was that 18% of residents have some form of 'raingarden' - stormwater disconnection.

Using an estimate of housing stock (DSE 2010), this equates to approximately 250,000 properties in Melbourne that have disconnected at least one downpipe.

It is important to note that the figures related to the presence of raingardens do not explicitly use the term "raingarden" – but respondents were asked if they had "Downpipes diverted into a garden area to water your garden." Similarly it is not known how large or how effective the rainwater tanks were in terms of effectively treating stormwater. However, the finding that 41% of residents in Melbourne have a tank or a stormwater disconnection is noteworthy.

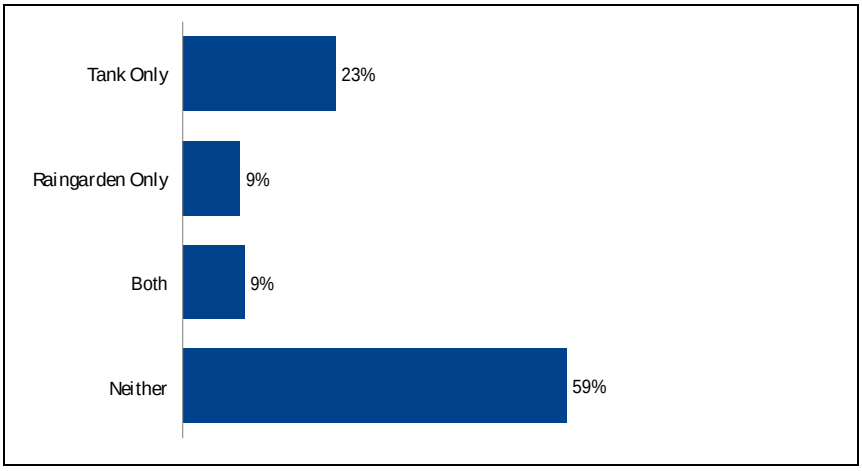

Figure 7-1: Presence of rainwater tanks, raingardens or both (n = 2516).

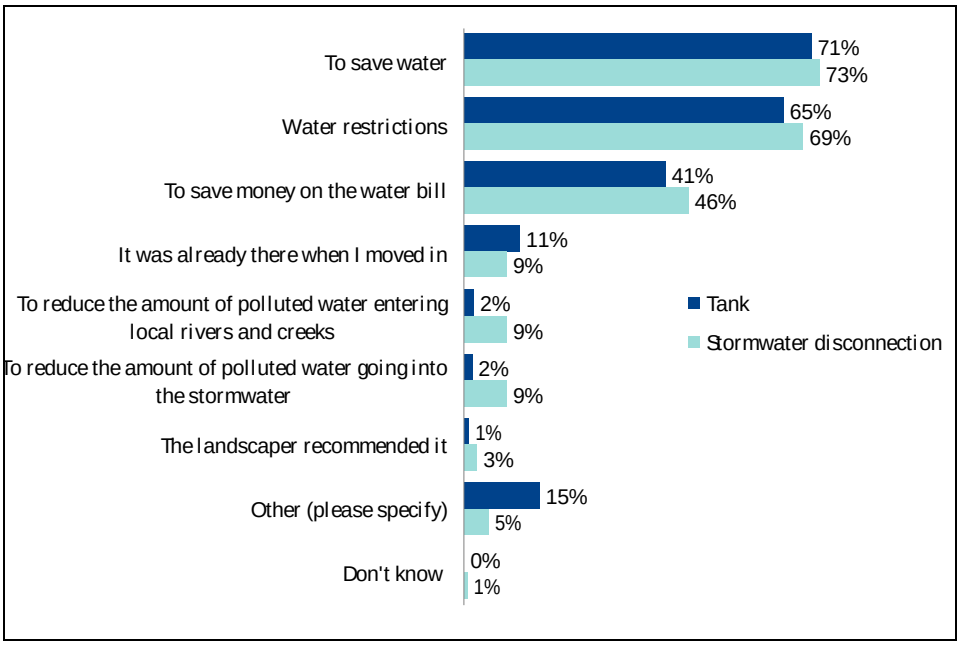

Figure 7-2: Drivers of installing a rainwater tanks and a raingarden (n = 560).

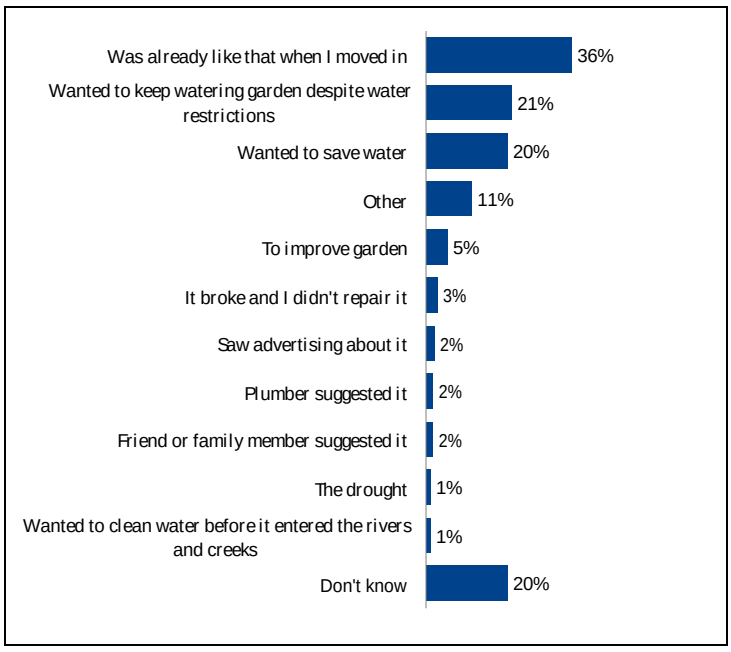

Figure 7-3: Reasons for installing a raingarden (those that only have raingardens) (n = 82).

Unsurprisingly, the main driver to installing a rainwater or stormwater disconnection was saving water and water restrictions. Figure 7-2 is interesting in that there is a very small percentage of people that are taking actions at home with the driver of improving rivers and creeks. This reinforces the finding that there are only small percentage of people that recognise the benefits of tanks and stormwater disconnection and downstream waterways. There is a real risk that if there were no water restrictions and drought that residents would reconnect their downpipes directly to the stormwater system?

The common element of the drivers behind installing a rainwater tank or stormwater disconnection are personal. Avoiding water restrictions, saving money, flexibility to water at any time, are all reasons that indicate the personal benefit is paramount. Conversely in Figure 7-3 there is only 1% of people who have disconnected a stormwater pipe for the purposes of improving the quality of rivers and creeks.

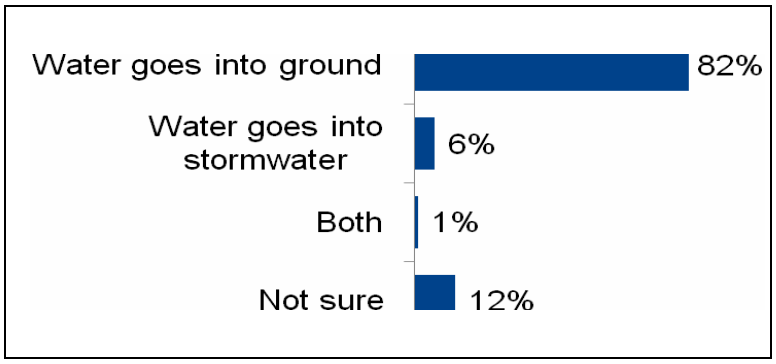

Figure 7-4: Where does water from my roof go flow (n = 81).

Figure 7-4 is another interesting finding which verifies that the community are simply disconnecting their stormwater pipes as opposed to building an industry standard raingarden. Melbourne Water currently recommends that a raingarden is reconnected to the existing stormwater pipe, but that is only occurring for 7% of residents with this setup.

8. Little Stringybark Creek

Approach

Melbourne Water is supporting a pilot 'stormwater disconnection' project in a 450ha urban catchment in the east of Melbourne. The Little Stringybark Creek catchment in the suburb of Mt Evelyn, with around 1000 properties, was chosen because of its restoration potential. The effects of the pilot will be robustly assessed with a before-after, control-impact-reference comparison.

The main aim of the Little Stringybark Creek Project is to test the proposition that ecologically successful restoration of urban streams requires breaking the hydraulic connection between impervious surfaces and streams, through catchment-wide implementation of appropriately designed water sensitive urban design (WSUD) measures.

In addition to the main aim of the project there are several other lines of enquiry that are being explored and outcomes that are expected.

- Refined objectives for urban streams (flow and water quality) that will feed into the next generation of Best Practice Objectives
- Models of the relative efficacy of reach-scale verses catchment-scale restoration measures and a prioritization/decision support tool for stream management actions
- Web based tool for assessing allotment scale WSUD
- Field trials and assessment of Market Based Instruments – including cost comparisons and efficiencies for both allotment scale and streetscape works
- Significant engagement of community and raised awareness of stream health and WSUD
- Monitoring performance of a wide range of infiltration systems (water quality and flow)
- Monitoring of rainwater tanks (usage, energy)
- Simple cost-effective designs for infiltration systems

- Increased capacity of the local municipality to implement WSUD, which will provide insights for working with other urban councils
- Several demonstration sites / open days of various raingarden designs, which will be used to engage not only people in the Shire of Yarra Ranges, but throughout Melbourne
- Policy and planning approaches for long term protection of high value/priority catchments

The project uses a combined incentive-based and education-oriented approach, in order to engage the community and to engender the installation of rainwater tanks and the construction of raingardens on private property. Incentives are being offered via a uniform price auction approach. Residents in the catchment are invited to bid on the payment they require to install a tank and or raingarden. An environmental benefit index has been developed based on stormwater quality and quantity metrics to assess projects in terms of cost/benefit. The methodology of the metric, auction approach and results from "round one" are documented by Fletcher et al 2010a as well as Fletcher et al 2010b..

Essentially, the success of the Little Stringybark Creek project hinges on two key outcomes: the participation of the Mount Evelyn community, whose residents own private land within the Little Stringybark Creek catchment, and the involvement of the Shire of Yarra Ranges, within whose area of jurisdiction the project falls. In this way, the Little Stringybark Creek project is designed with assumptions about human behaviour and decision-making in respect to water management, both at the household-level and that of local government.

Recent social research on the project to date was intended to identify the key factors that have facilitated or hindered community participation in the project. The research used a qualitative methodology, which is primarily concerned with "how the world is viewed, experienced and constructed by social actors" (Smith, 2005, cited in Johnston *et al.* ?: 660). In addition to interviews with residents the research also used ethnographic data, such as field notes from participant observation at site visits, project meetings and community events. Sixty-three interviews were conducted with the residents within the pilot catchment and included a mix of formal and informal interview styles. Target audiences included:

- Applicants who were successful in the first-round of the auction
- Applicants who were unsuccessful in the first-round of the auction
- Residents who have expressed interest in the second-round of the auction
- Residents who have not engaged with the project to date

It was quite difficult to secure interviews with the last group (residents who have not engaged with the project to date) and hence successful first-round applicants were questioned about anyone with whom they had discussed their participation in the project but had not applied.

Additional data from community surveys sent out before and after the first phase of the project also provided useful findings. The surveys questioned residents about water use, rainwater tanks, rain gardens and attitudes towards stormwater management and the Little Stringybark Creek.

Findings

A variety of factors were found to affect overall householder participation in the Little Stringybark Creek project. Some of the positive factors included the economic incentive, the project ethos, institutional identity and the personality of project staff. Factors that were shown to hinder the LSC project process and result in non-participation can be grouped into:

- *the community engagement process* – example - many interviewees said they were suspicious of the initial mail outs about the project
- *complexity* – example - the details required in the application process were quite onerous and confusing to residents

- *Time burden, apathy and livelihoods* – example - interviewees found the bureaucratic nature of the process a burden
- *financial resources, trust and risk* – example - the upfront capital required by residents before receiving funding was off putting and there was a degree of mistrust as to whether payments would be made

Specifically, in relation to the preference by the community for tanks versus raingardens, a number of factors were found to influence their decision.

While some residents were worried about the cosmetic appearance of rainwater tanks, the surveys and interviews demonstrated a much higher knowledge about and interest in rainwater tanks over raingardens. This was demonstrated by the high uptake of tanks (54) versus raingardens (7) in the first round of funding.

All the interviewees who had opted for a rain garden in the first round, or who were not concerned about installing one in the second round, demonstrated a high awareness of the hydrological principles of infiltration, either as a result of a science-oriented higher education and/or a practical farming background.

It was also found that cognitive processes further influence community preferences. For instance, many (%) interviewees observed that rainwater tanks have a direct and tangible benefit for the household. Conversely, most (%) people perceived raingardens to have only a wider, environmental benefit. The desire to possess rainwater tanks was therefore a more significant driver of householder participation than the ownership of a raingarden. Moreover, several interviewees associated raingardens with a negative impact on the household due to their perceived creation of 'soggy' ground, such that a common concern relating to raingardens and infiltration trenches is that they become full of water and then the ground becomes saturated, resulting in flooding to their or their neighbours' property. In this way, a common perception of an infiltration system or raingarden is associated with a negative connotation. Underlying this perception of infiltration systems is householder understanding of hydrological processes.

Confounding the overwhelming preference for tanks over raingardens by the community in round one was the bias of the environmental benefit metric towards tanks. Refinement of the metric to include an infiltration sub-index that mimics the benefits of groundwater recharge and hence baseflows has resulted in much higher environmental benefit scores for raingardens. The combination of tanks which are more effective at reducing volumes and raingardens which are more effective at recharging groundwater results in the best environmental benefit score. Expressions of interest in the second round are already showing a much higher interest in installing raingardens – but are mostly in addition to the installation of a tank – which is still proving the main reason for residents to participate in the program.

In addition to a change in the metric, increased education has proven useful in changing peoples attitudes toward raingardens. For example, several (%) potential second-round applicants described how the demonstration raingarden day had improved their understanding of the function and operation of infiltration systems. They indicated that seeing one had made them more willing to consider including one in their application. This finding further demonstrates how cognitive processes interact with community participation in environmental initiatives and suggests that the education element of the Little Stringybark Creek project is worthwhile and highly relevant to the project staff's efforts to trigger action and to transform behaviour at the household level. As well as the community information sessions, a strategy of regularly featuring articles in diverse local media (for example youtube and local press) about infiltration systems and their relationship to creek health would also maximise community exposure to relevant concepts and increase general awareness and understanding of the issues at hand and the Little Stringybark Creek project as a proposed solution.

9. Limitations of social research

Limitations from the 5 projects are similar to all social research projects, in that there are a range of issues that affect the accuracy of the results. Typically, these include the data collection method; online or phone; the nature of self-reporting, the time of the year and the degree to which other issues in the media are influencing people's considerations of this subject.

10. Conclusions and Implications

The restoration and protection of urban waterways is a complicated mix of technical, social, economic and environmental activities. The consideration of the social components are important in addressing how the existing housing stock and private lots contribute stormwater pollution to receiving waters.

8 key implications can be derived from the findings:

1. The community's overwhelming willingness to install rainwater tanks indicates that rainwater tanks should be part of future regional stormwater improvement programs, in addition to raingardens. In terms of engaging the Mainstreamers , Everyday Environmentalists and Environmental Enthusiasts this research implies that rainwater tanks should be part of that communication. A caveat to considering how rainwater tanks could also become the focus of future stormwater improvement programs is that the plumbing and operation of tanks need to be optimised to effectively treat stormwater quality and quantity.

2. The primary driver of drought (and corresponding water restrictions) has generated a large amount of stormwater disconnections on private lots, and if the drought breaks then these "basic" systems may be reconnected. This implies that there is a need to work with the community to convince them to retain these treatments (perhaps with modifications to reduce flooding risks for example) in place.

3. Consideration needs to be given to how to reduce the gap between the community's view of industry standard raingardens and stormwater disconnections.

4. If raingardens are proven technically as good or better treatments than rainwater tanks to deal with stormwater issues, or are needed in combination with rainwater tanks to effectively treat stormwater, then it will be very hard to overcome the willingness and perceived benefits that the community see in rainwater tanks alone. Regulation may be the only way of ensuring raingardens are built and retained on private lots.

5. There is an opportunity to engage the 23% of the community that have rainwater tanks only and present the "next generation" of home water solutions in the form of a raingarden to this group. The message of saving water is well engrained in the community's mindset, and the next step could be extending the mindset of this group of people to treating urban stormwater in order to protect waterways.

6. Little Stringybark Creek has demonstrated the use of economic incentives that utilise an environmental benefit scoring system combined with education is an effective way of increasing the uptake of various treatment systems.

7. Although an appealing concept to Environmental Enthusiasts and Everyday Environmentalists, industry standard raingardens can appear to be a challenge to retrofit housing with existing gardens. For this reason, industry standard raingardens did not appear to be the first priority when considering other financial expenditures for around the home. While Melbourne Water's

10,000 raingardens program appears to be a realistic target, the time to achieve this goal could be challenging and the measure of registrations may not reflect the effectiveness of the program.

8. The segmentation model has been useful in understanding the range of value, issues and actions within different sections of the community.

Community willingness and perceived benefits have been measured through social research and the innovative on-ground project within the Little Stringybark Creek catchment. The relationship between these factors can be summarised in the following formula:

Regional waterway improvement = f (TP, W, PB)

Where

F = function of
TP = Treatment performance (or the effectiveness of removing stormwater pollutants and stormwater volume)
W = Willingness of the community to adopt behaviour
PB = Perceived benefits of behaviour

This research has suggested that the perceived benefits and willingness to install industry standard raingardens are minimal and that the consideration of rainwater tanks in stormwater improvement programs will produce a better regional outcome.

According to quantitative research, rainwater tanks are far more popular than raingardens. The perceived benefits of rainwater tanks are very closely linked to personal benefits, with some recognition of regional water supply benefits. Rainwater tanks are rarely recognised as a stormwater treatment device, but nonetheless while the driver is not waterway improvement one of the outcomes is waterway improvement. Therefore if the community's willingness to undertake an action that will improve waterways is high, and conversely raingardens are seen as interesting but unnecessary, it seems most appropriate as an interim policy measure to promote tanks as a waterway treatment device.

11. References

Andreasen, A.R., 1995. 'Marketing Social Change: Changing Behaviour to Promote Health, Social Development, and the Environment', San Francisco: Jossey Bass.

Brown, H.L, 2010. Report into the factors that influence community participation in the Little Stringybark Creek project, unpublished report

CSIRO, 1996. Port Phillip Bay Environmental Study.

Department of Sustainability and Environment, 2010. Melbourne 2030 - What is the nature of the housing market? Accessed online at http://www.dse.vic.gov.au/melbourne2030online/content/implementation_plans/04a_about.html

Fletcher, T.D., Walsh, C.J., Bos, D., Nemes, V., Rossrakesh, S., Prosser, T., Hatt, B. & Birch, R. (2010) Restoration of stormwater retention capacity at the allotment-scale through a novel economic instrument. Water Science and Technology, in press.

Fletcher T.D. , Walsh C.J., Bos D., Nemes V.; RossRakesh S., Prosser T., Hatt B. & Birch R., 2010. Restoration of stormwater retention capacity at the allotment-scale through a novel economic instrument.

Proceedings from Novatech 2010 – 7th International Conference: Sustainable technologies and strategies in urban water management.

Melbourne Water and EPA Victoria, 2009. Better Bays and Wetlands. Accessed online at http://www.epa.vic.gov.au/water/coasts/betterbays.asp

Melbourne Water, 2010. History of Melbourne's Water Supply. Accessed online at http://www.melbournewater.com.au/content/water_storages/water_supply/history_of_melbournes_water_supply.asp?bhcp=1

Melbourne Water, 2010. Raingardens.melbournewater.com.au

Morison, P. and Brown, R. 2007. Cooperate or coerce? Intergovernmental approaches to mainstreaming Water Sensitive Urban Design. *Proceedings of the 13th International Rainwater Catchment Systems Conference and the 5th International Water Sensitive Urban Design Conference*, 21-23 August, 2007, Sydney, Australia.

Nicholls N., 2009. Extremes, climate change and disasters. The Centre for Australian Weather and Climate Research's "Modelling Workshop 2009: Modelling & Understanding High Impact Weather."

Smith, S. 2005. Qualitative methods. In The dictionary of human geography. Edited by R. J.Johnston, D. Gregory, G. Pratt and M. Watts. Oxford: Blackwell Publishing Ltd.

University of Melbourne, 2010. Little Stringybark Creek website. http://www.urbanstreams.unimelb.edu.au/